Annex 5
ENHANCING THE LUMINOSITY OF THE SCOPE SCREEN THROUGH THE ANAMORPHOSIS OF THE IMAGE IN THE PROJECTOR CHIPS

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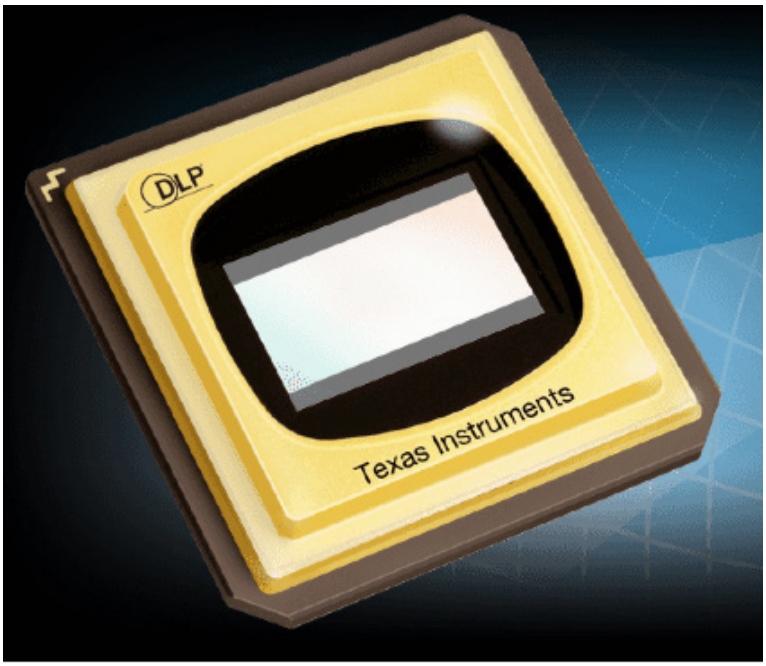
Prior technical note: The Texas Instruments 4K chips inside the projectors have an approximate format of 1.90:1. Let's see how this ratio is calculated based on the chip's pixels. In a 4K chip, we have a grid 4,096 pixels long and 2,160 pixels high, a total of 8.85 million pixels. Dividing the length of the chip, 4,096 pixels, by the height, 2,160, we get this result, 1.90 (1.8963, to be precise). Every projector has three of these chips, one for each of the three basic colours that it will eventually project onto the screen: red, green and blue (RGB).

These chips are technologically astounding. Each one is a grid comprising 8.85 million tiny micro-mirrors, one for each of the pixels that they will project at the screen. Each of these adjustable micro-mirrors sends a perfectly modulated amount of light at the screen, or deflects this light so that it does not reach the screen. This modulation of the luminosity is achieved through the precise orientation of each micro-mirror. Therefore, each of the pixels projected on the screen is, in fact, the simultaneous combination of the light reflected by three different micro-mirrors, each located in a different chip inside the projector. After reflecting in these micro-mirrors, the light goes through three different filters, each of a specific colour, and is projected onto the screen. This combination occurs for each of the 8.85 million pixels of every 4K frame projected. Magic.

However, the Scope format is usually achieved by "cropping" the Scope format inside each of these chips. Similar to what happens when a Scope movie is shown on a television screen, we see two black strips, one at the top of the frame and the other at the bottom. After cropping in this way inside each of the chips, we obtain the cropped 2.39:1 format within the 1.90:1 chip format.

It is important to recognize that the projector's engine is designed to always illuminate 100% of the chip's micro-mirrors. Inside each chip, the micro-mirrors that receive the instruction "black on screen" (equivalent to an unilluminated pixel) deflect the light received so that it does not reach the screen, aiming it instead at a heat dissipator inside the projector. In the case of the Scope format, this occurs for all the pixels located under these cropped black strips. All this light is wasted, sent straight to the dissipator. Therefore, in the case of the traditional Scope projection, in which these two strips are cropped inside the chip, we make use of the whole width of the chip -4,096 pixels in the 4K -, but we only take advantage of the proportional height of Scope – which, in 4K, will be 1,740 pixels (of a total potential chip height of 2,160 pixels).

Figure 46. Scope format 2.39:1 inside the 1.90:1 Chip format.



As a result, we lose the light that would have been reflected onto the screen by the micro-mirrors in these two black strips, equivalent to 19.3% of the total light. In other words, we only make use of the light from 7.14 million micro-mirrors, rather than from the entire 8.85 million available. Practically all the cinemas in the world use this procedure to project Scope movies.

However, we can make use of all the light from the chip. The current standard DCI projectors allow us to compress the Scope image horizontally inside the chip. To take 100% advantage of the chip, we can horizontally compress the Scope image by 25% (remember that the chip format is 1.90, and that 1.90 * 1.25 = 2,375, practically the Scope format). This compression does not entail any technical complication, as the pre-existing functionalities on DCI projectors enable us to do it (Digital projectors have this functionality thanks to history because, in analogue cinema, Scope movies were always made anamorphic). To project the compressed image, we simply have to decompress it using an additional secondary anamorphic lens in front of the primary Flat lens. This enables us to make use of 100% of the light from the chip. The proposed combination is identical to the classic analogue configuration of “Prime + Anamorphic”, traditionally used for 35 mm Scope movies (although they used to be decompressed by far more than 25%). Even though very few cinemas “complicate their lives” with this option, it is advisable to do so when the screens we need are very big and it is crucial and difficult to achieve the necessary luminosity with a single projector. As we have seen in this explanation, with this functionality, we will improve the luminosity of any of our projectors by 19.3% in all the Scope movies.