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APPLICATION NOTE 3634

Visual Impact of Video Parameters in Video Systems: Part 2—The Effect of Chrominance-to-Luminance Delay

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Abstract: The ultimate measure of video system quality is largely determined by visually looking at the resulting picture. It is, nonetheless, important that engineers have objective measurements for judging video quality. The delay mismatch between chrominance and luminance, the color and brightness ***of the optical signal****, is an important video parameter which is both difficult to gauge and requires measurement by an objective specification. This article, the second in a series of application notes discussing the electrical parameters that affect video systems, will help the designer understand the relationship between the chroma-to-luma delay mismatch, that is the mismatch between the color and brightness* ***of the electrical signal****. Ways to measure those mismatch values and their impact on video picture quality will be discussed.*

Introduction

Designers must pay attention to several important parameters to maintain the quality of an image in processing composite video signals (CVBS). Chrominance and luminance, the color and brightness of the optical signal, are two such parameters. The chroma-to-luma delay mismatch parameter is related to the Group Delay Deviation specification, which defines the electrical delay of different frequency bands throughout the system.

Composite video signals are fundamentally the combination of the chroma (color) and luma (brightness) information. This composite video signal is used to modulate the RF signal distributed as normal broadcast TV, is important for reducing the required transmission bandwidth, and allows a simple, single-wire connection for baseband video.

This article will illustrate the effects of the chroma-to-luma delay mismatch and present ways to measure the mismatch values. This application note is the second in a series of application notes discussing the electrical parameters that affect video systems. We encourage you to review the first article in the series, Visual Impact of Video Parameters in Video Systems: Part 1—Differential Gain and Differential Phase.

Chroma-to-Luma Delay

This parameter specifies the time difference that it takes for the video signal's chroma portion to pass through a system, relative to the time it takes for the luma portion. This time difference, the delay error,

will cause color bleeding, especially at the edges of objects in the picture, and will make the picture look smeared. The 12.5T sine-squared pulse with a 3.58MHz (or 4.43MHz for PAL) modulation is used to test this specification (**Figure 1**). The delay mismatch is measured by analyzing the baseline of this signal. A straight line for the baseline indicates no delay error. If the chroma is leading or trailing the luma, the baseline will no longer be a straight line but will waver. Baseline shape will indicate whether chrominance is leading or lagging luminance (**Figure 2**).

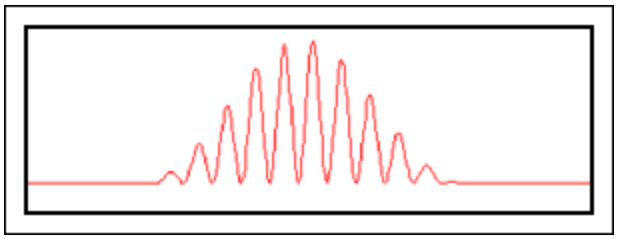

Figure 1. 12.5T test signal.

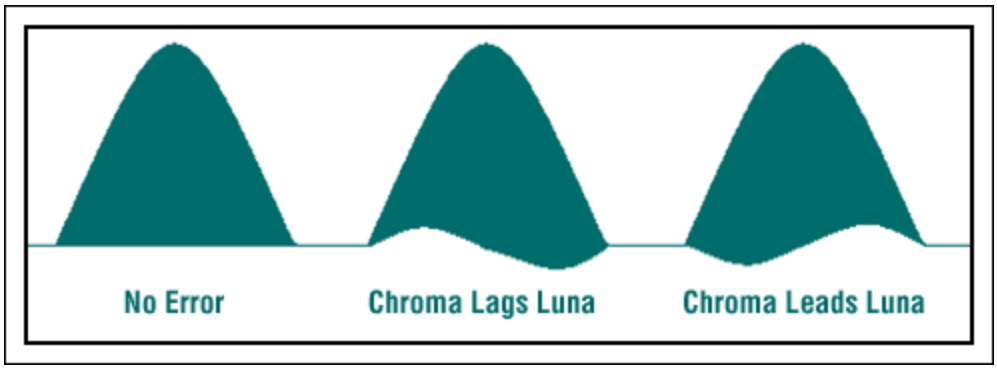

Figure 2. Illustration of the effects of delay mismatch on the modulated 12.5 T pulse. The difference between the chroma trailing luma and leading luma are clearly visible.

Visual Effect of Video System with Large Chroma-to-Luma Delay Error

Figure 3 is the original picture with no chroma-to-luma delay error. **Figure 4** shows the visual effect of the luma-to-chroma delay error. Notice that the picture in Figure 4 looks less sharp; the color bleeding is visible at the edges of the box and the letters. **Figure 5** shows a zoomed-in view to see the effect of the errors more clearly.

Figure 3. Original picture with no chroma-to-luma delay.

Figure 4. The visual effect of luma-to-chroma delay mismatch on the video electrical signal of the same image.

Figure 5. Close-up of the delay mismatch error in Figure 4.

Conclusion

The above example is the result of a 300ns luma-to-chroma delay error. It dramatically illustrates the visual effect of this error on the displayed picture. For most video systems, the delay mismatch error will

be typically less than this. A delay error of less than 20ns will generally result in, and be considered, good quality. Delay mismatch error of more than 20ns will noticeably degrade the picture quality. Therefore, it is critical that video system designers pay close attention to the chroma-to-luma delay mismatch to ensure the vividness and crispness of reproduced pictures.

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