PROPOSED STANDARD

For Field-Sequential 3D Television - The Field Polarity for Storing 3D (Stereoscopic) Left and Right Images in the Even and Odd Fields of the NTSC and PAL Video Standards

INTRODUCTION:

NTSC and PAL can both be used for the recording and playback of stereoscopic 3D video by storing the left and right views in the even and odd fields of the video signal. This is commonly known as “field-sequential 3D video” or occasionally “alternate-field 3D video”. Unfortunately the choice of which image (left or right) to store in which field (even or odd) is arbitrary - although a defacto standard has emerged.
This proposed standard seeks to formalize the image/field polarity for the recording of field-sequential 3D video in the NTSC and PAL standards.

DEFINITION OF FIELDS:

For both NTSC and PAL, the odd field (field 1) has its horizontal sync pulses in phase with the leading edge of the vertical sync pulse at the beginning of that field. The even field (field 2) has its horizontal sync pulses offset by 1/2H from the leading edge of the vertical sync pulse at the beginning of that field.

BACKGROUND:

It is worth noting that LM1881 datasheet states:
> For a composite video signal that is interlaced, one of the two fields that make up each video frame or
> picture must have a half horizontal scale line period at the end of the vertical scan - i.e. At the bottom
> of the picture. This is called the “odd field” or “field 1”. The “even field” or “field 2” has a complete
> scan line at the end of the field..

NTSC does have the half line at the end of field 1, _BUT_ this doesn’t apply to PAL. PAL has a half line at the end of field 2 (see Figure 1). This difference is because NTSC has a 9 line vertical interval (3 groups of 6 (1/2H) equalization pulses) whereas PAL only has a 7.5 line vertical interval (3 groups of 5 (1/2H) equalization pulses) therefore the position of half line is different between standards.
THEREFORE this is not a good way of defining the fields...

In contrast, the Gennum GS1881 datasheet states:
> For odd fields the first broad vertical sync pulse is coincident with the start of horizontal, while for even
> fields the first broad vertical sync pulse starts in the middle of a horizontal line.

This is a more general definition and agrees with the timing diagrams for both PAL and NTSC (Figure 1).

DEFINITION OF 3D POLARITY:

The right image is to be stored in the odd field (field 1) and the left image is stored in the even field (field 2).
Note that this rule applies to both PAL and NTSC.

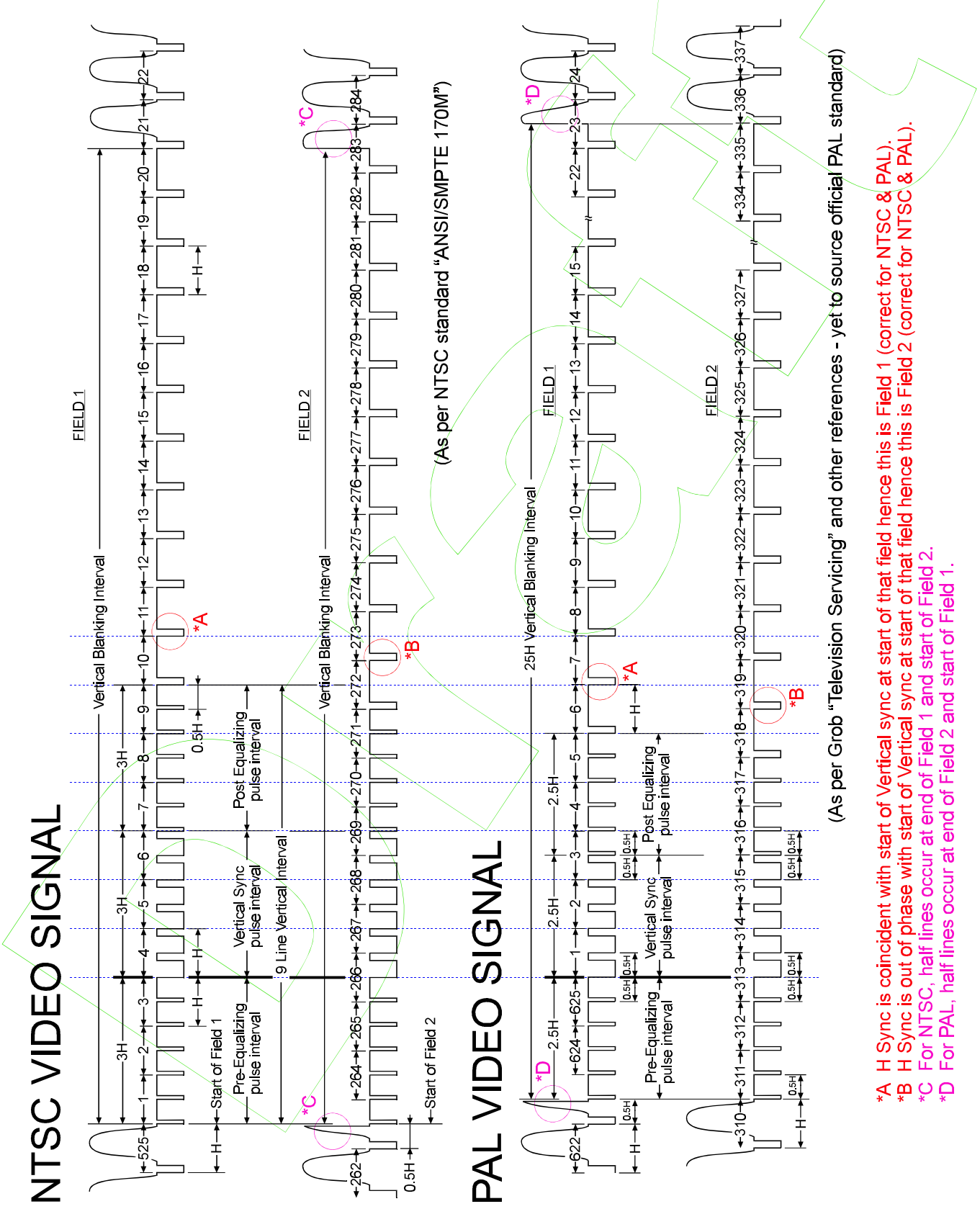
BACKGROUND:

This definition was decided based on the testing of a wide range of commercially available 3D video tapes:
Organisations known to use this polarity: 3DTV, VREX, 3D-Video Inc, Ray3D, Curtin University, + ???
Organisations known to use opposite polarity: Toshiba camcorders, + ???
The field/image polarity most commonly in use was used for this proposed standard.

IN SUMMARY:

Right Image = odd field = field 1 (Hsync aligned with leading edge of Vsync at the beginning of that field)
Left Image = even field = field 2 (Hsync offset by 1/2H with leading edge of Vsync at the beginning of that field)

Figure 1: NTSC and PAL timing diagrams showing vertical interval and field definitions



*A H Sync is coincident with start of Vertical sync at start of that field hence this is Field 1 (correct for NTSC & PAL).
*B H Sync is out of phase with start of Vertical sync at start of that field hence this is Field 2 (correct for NTSC & PAL).
*C For NTSC, half lines occur at end of Field 1 and start of Field 2.
*D For PAL, half lines occur at end of Field 2 and start of Field 1.

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HOW TO DETERMINE THE 3D POLARITY OF A 3D VIDEO SIGNAL:

USING BASIC PRINCIPLES:

Equipment: CRT-based Video Monitor, Dual-Trace Analog Cathode-Ray-Oscilloscope (CRO) with Video Triggering, Liquid Crystal Shutter (LCS) Glasses and Driver Box, 3D Video Source.
Procedure:
(a) Connect 3D Video signal to video monitor and channel 1 of CRO.
(b) Adjust CRO to dual trace mode (second channel no input), set trigger to channel 1 Vsync, and adjust timebase such that full width of screen is approximately 30-50us (less than one field). (In this mode the CRO will hopefully only display half of the fields on the channel 1 display - channel 2 is just being used to gate out half of the fields).
(c) Observe 3D video signal on Video Monitor through LCS glasses and confirm whether 3D image is correct (case A) or pseudo (case B).
(d) Observe the CRO display through the LCS glasses and confirm that only one eye sees the displayed video signal - if both eyes can see in full the displayed video signal, the either the CRO being used is unsuitable or the CRO hasn't been configured correctly. NB: both eyes may be able to see the vertical interval because of LCS switching timing, the slew rate of the LCS, or CRO phosphor persistence.
(e) Take note whether the field being displayed is seen by the left eye (case C) or the right eye (case D).
(f) Expand the display (by adjusting the timebase control) such that detail in the vertical interval can be seen (ensure that the field being displayed does not change) and using the timing diagrams shown in Figure 1 (for NTSC or PAL) determine whether the field is the odd field (case E) or the even field (case F). (Probably the easiest way of identifying the correct field is to count the number of post-equalization pulses: 6 for NTSC odd field, 5 for NTSC even field, 5 for PAL odd field, 4 for PAL even field).
The following case combinations indicate correct* 3D polarity: ACF, ADE, BCE, BDF.
The following case combinations indicate incorrect* 3D polarity: ACE, ADF, BCF, BDE.
(* with respect to this standard)

USING CALIBRATED EQUIPMENT:

If a calibrated LCS glasses driver box was used to view a 3D video sequence, the correct or incorrect 3D polarity could be observed by noting the polarity of the viewed video and the position of the polarity switch on the driver box (if present). A register of equipment which conforms with this standard may be kept at the www.stereoscopic.org website (to be decided).

REFERENCES:

* NTSC Standard: "ANSI/SMPTE 170M - 1994" - "SMPTE Standard for Television - Composite Analog Video Signal - NTSC for Studio Applications"
* PAL Standard: (yet to source)

This document represents intermediate workings for the development of a recommended standard for field-sequential 3D video.
The contents are still in draft form (version 0.2) and will be discussed at the Standards Forum at the January 2000 "Stereoscopic Displays and Applications" Conference.
For more information see: http://www.stereoscopic.org/standard

Andrew Woods
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