TANDBERG television

Part of the Ericsson Group

Active Format Description (AFD)
An Overview

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1 Introduction

This application note describes how AFD is used to enhance the down-conversion process, when converting from 16:9 HD to 4:3 SD.

1.1 Scan formats

HD scans are said to have an aspect ratio of 16:9. This means that the horizontal dimension is (16/9) times the vertical dimension. For HD, the pixels are square, so this leads to the conclusion that there are (16/9) times as many pixels as lines.

SD scans are said to have an aspect ratio of 4:3. This means that the horizontal dimension is (4/3) times the vertical dimension. SD pixels are not square, however, as the screen dimensions are actually (for historical reasons) defined as being 704 x 483. However, although equipment that performs scan conversion must take this into consideration when scaling the picture, the differences are sufficiently small that they can be disregarded in terms of understanding regions of interest.

1.2 Down-conversion to 525-line

This is the process of deriving an SD video signal from an HD video signal. HD video scans are always 16:9 aspect ratio. 525-line SD video feeds, however, are always 4:3. Clearly some form of processing is required in order to derive the 4:3 image from the 16:9 original.

1.3 Down-conversion to 625-line

Down-conversion to 625-line is slightly more complicated, as there are both 4:3 and 16:9 SD formats, leading to more permutations. These, however, will not be considered further in this White Paper.

2 What is "AFD"?

AFD stands for "Active Format Description". It describes the "area of interest" within the scan.

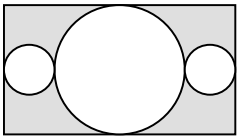
For example:

A 16:9 HD source may not originally have started that way - it might have been up-converted from a 4:3 SD source; in that case, there may be black bars left and right. In that case, the "area of interest" is only the 4:3 section in the center of the 16:9 scan, as we have no desire to protect the black bars.

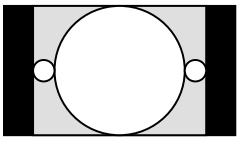
2.1 Diagrams indicating scans & areas of interest

The diagrams of the type shown below are used to describe the "area of interest". Some examples below will help to explain the notation.

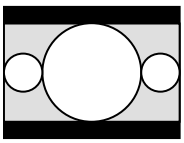
1) 16:9 scan with area of interest being the whole scan. The center circle shows the full height, the outer circles show how far the content of interest extends horizontally. The gray shaded region is active content.



2) 16:9 scan with area of interest being a 4:3 region in the center ("pillar-boxed"). The definitions for the circles and gray area are as above. In addition, the black areas show content that can be discarded (typically because it's black through some previous form of processing). The area of interest is narrower than the full 16:9 scan.



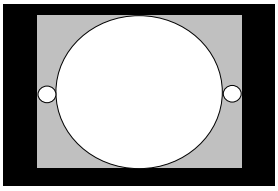
3) 4:3 scan with area of interest being a 16:9 region in the center ("Letter-boxed"). This has a 16:9 area that has been scaled such that none of it has been lost, resulting in black bands top and bottom.



3 The "Postage Stamp" effect

The postage stamp effect can provide significant annoyance to the viewing population, with a significant area of the overall display being black (on all sides). How does this happen?

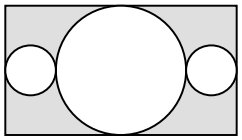
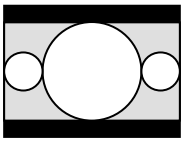
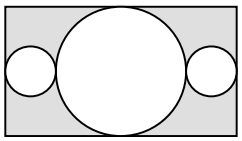
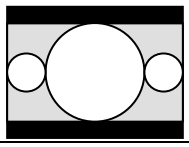
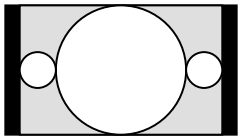
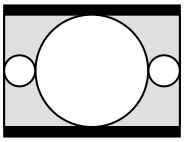
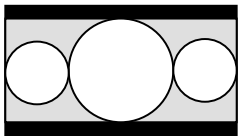
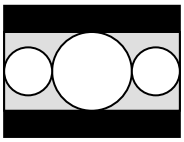
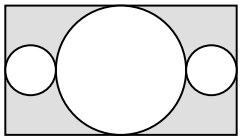
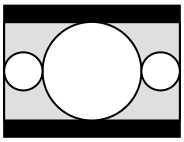
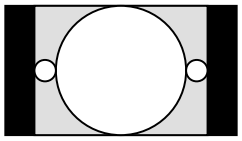
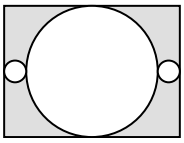
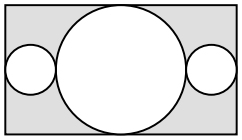
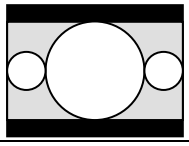
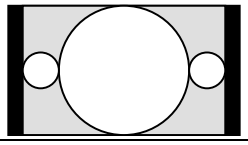
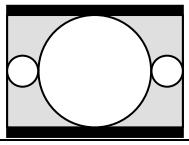
- Start with an SD signal, that is up-converted to HD -> Black bars left and right.
- Take that HD signal and down-convert using letter-boxing -> Adds black bars top and bottom.
- Result -> black bars all the way around!

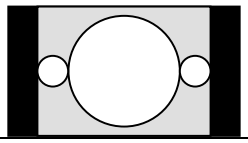
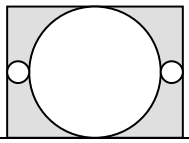
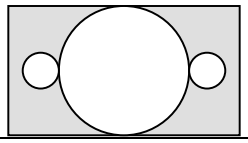
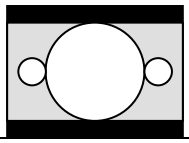
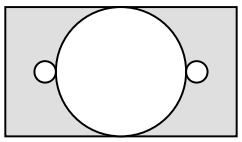
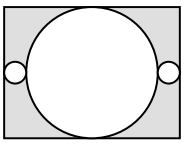
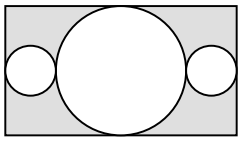
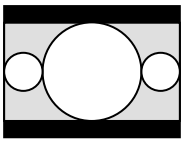


4 AFD codes and how they help

AFD codes are 4-bit values that allow the down-conversion to intelligently switch between letter-box and center cut-out.

4.1 Table of AFD codes

Input Active_format			4:3 output format and resizing method	
Value	**Description**	**Input illustration**	**Output illustration**	**Resizing Method**
0000 - 0001	Reserved (Treat as "As the coded frame"			Letter-box 16:9 into 4:3 scan
0010	box 16:9 (top) (not really applicable for 16:9)			Letter-box 16:9 into 4:3 scan
0011	box 14:9 (top) (not really applicable for 16:9)			Letter-box 14:9 area into 4:3 scan
0100	box > 16:9 (centre)			Letter-box 16:9 into 4:3 scan
0101 - 0111	Reserved	n/a	n/a	Undefined (Will be treated as "As the coded frame")
1000	As the coded frame			Letter-box 16:9 into 4:3 scan
1001	4:3 (centre)			Centre cut-out 4:3 from 16:9
1010	16:9 (centre)			Letter-box 16:9 into 4:3 scan
1011	14:9 (centre)			Letter-box 14:9 active area into 4:3 scan
1100	Reserved	n/a	n/a	Undefined (Will be treated as "As the coded frame")

Input Active_format			4:3 output format and resizing method	
Value	**Description**	**Input illustration**	**Output illustration**	**Resizing Method**
1101	4:3 (with shoot & protect 14:9 centre)			Centre cut-out 4:3 from 16:9
1110	16:9 (with shoot & protect 14:9 centre)			Letter-box 16:9 into 4:3 scan
1111	16:9 (with shoot & protect 4:3 centre)			Centre cut-out 4:3 from 16:9
AFD not present	Default to "As the coded frame"			Letter-box 16:9 into 4:3 scan

5 Colorimetry

Colorimetry is not strictly related to AFD usage, but applies whenever conversions between HD and SD occur. Two different sets of colorimetry are used:

- HD uses ITU-R BT.709 colorimetry
- NTSC SD uses SMPTE-170M colorimetry (further different formats are used for PAL)

Whenever there is conversion from HD to/from SD, it is necessary to take into account that the color space is different, and that appropriate color correction takes place during the conversion.