NBTV colour standard for CD and CD-R

Program of demands:

1. Colour video CD's must be playable as black and white video,
2. Digital processing for play-back must be relatively simple,
3. Only the left CD-channel is used, leaving the right channel free for sound,
4. The video signal must be scalable, i.e. changing the amplitude must not disturb the picture.

A black and white signal derived from R G B

To make processing simple we suggest to make the black and white Luminance signal Y:

Y = 0,5 G + 0,25 R + 0,125 B

This is not too deviative from the CCIR system and is expected to give a quite good colour rendering in black and white. This requires just some byte shifting and two additions.

Note: For pure white (R=1, G=1, B=1) the Y signal becomes 0,875 and not 1,000

Signals encoded

We suggest to encode the signals: **Y R B**, this implies that we need a good working colour-killer to play back black and white discs (otherwise white and grey become green).

Thus the green signal can be regenerated by:

G = 2 Y – 0,5 R – 0,25 B

Just some shifting and subtracting. This can be done in hardware or in a PIC or 80C51 processor.

Binary encoding of Y, R and B

The signals Y, R and B are encoded in 7 bits, unsigned binary, where:

- Y runs from 00 (hex) for black to 6F (hex) for white (because Y goes to 0,875, not to 1),
- R and B run from 00 (hex) for black to 7F (hex) for white, red or blue.
- R and B are combined to one stream of alternating samples of R and B (ARB).
- Colour bandwith becomes about 10 kHz.
- During the sync in the Y signal the R signal is 03 (hex), and the blue signal is 04 (hex).
- This is done to synchronise the ARB-sequence, and to indicate that the signal is in colour.

Bit allocation

We came to two systems:

- system A (CVBS) fullfills requirements 1, 2 and 3, but not 4, used on CD's for distribution,
- system B (Y-C) which fullfills requirements 1, 2 and 4, but not 3, used for processing (editing).

These two systems are quite easily convertable into each other.

Bit allocation system A (CVBS)

The CD-player analogue output should give a more or less standard type of signal. For the club-CD's in black and white this is now:
Samplefrequency = 44100 Hz; CD-code 7F FF gives 2,8 volts, code 80 01 gives -2,8 volts.
Video black = 0 volt (0000 hex), white = 1 volt (2DB6 hex), sync = – 0,42 volt (ECCD hex).

We suggest to use the **most significant 9 bits for Y** in 2's complement (normal for CD)
and the **least significant 7 bits for the ARB signal**.

The Y signal, going from 0000 0000 0000 0000 for black to 0011 0111 1000 0000 for white, this is in hex: 37 80, in decimal: 14208.
Then sync should go to 1110 1000 0000 0000 (in hex: E8 00, in decimal: – 6144)
The video signal now is slightly larger than in the existing club-CD's: 1,214 volt for white and – 0,525 volt for sync. A black and white monitor can easily compensate for this by slightly lowering the contrast control setting.

Bit allocation system B (Y-C)

The Y signal is encoded in the left channel, white, black and sync just like system A. All 14 bits may be used.

The ARB signal is encoded in the right channel from 00 00 for black to 3F FF for white. All 14 bits may be used.

This signal can be faded, but has no sound.
The sync should be restored to the original amplitude when the signal is faded.

Conversion

Both systems can be converted quite easily into each other:

B to A:
- shift right channel 7 bits right,
- copy the 7 least significant bits of right channel to the left channel.

A to B:
- copy left channel to right channel,
- make 9 most significant bits of right channel zero,
- shift bits of right channel 7 positions to the left,
- make 7 least significant bits of left channel zero.

So, if fading is needed:
- first split off the sound into a separate file,
- convert from system A to system B,
- do the fade operations using a normal wave editor,
- do the same operations to the sound file,
- convert back from system B to system A,
- add the sound again from the separate file.