

Process and device for image signal recording
and/or reproduction

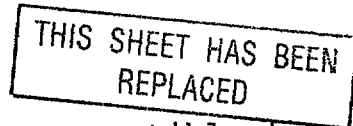
The invention relates to a method and a device for the recording and/or reproduction of image signals.

State of the art

For the compatible introduction of a 16:9 wide screen format into existing television standards (e.g. PAL, SECAM, NTSC) using the format 4:3, the so-called "letter box" process is under discussion. In this process, the 16:9 picture information is represented by black bands at the upper and lower edges of the picture in 4:3 receivers. A vertical transcoding of the 16:9 source signal is necessary for matching the geometrical ratios to the 4:3 receivers, this representing only 431 lines in the visible picture window of the 4:3 receiver. The remaining 144 active lines (575 lines - 431 lines = 144 lines) appear as black bands, each of 72 lines, at the upper and lower edges of the picture in the 4:3 receiver. The description of a process corresponding to this is to be found in "Verbesserungsmöglichkeiten und Entwicklungstendenzen bei PAL", G. Holoch, FKTG lecture, 17.01.1989, Berlin.

Auxiliary items of information can be transmitted in the 144 lines, which appear as black bands in the 4:3 receiver, for providing a format filling presentation without reduced resolution in a 16:9 receiver. These auxiliary items of information may be transmitted in the so-called ultra-black region in accordance with "Die neuen Wege des alten PAL", A. Ziemer, E. Matzel, Funkschau 18/1989. The region between the black level and e.g. half the synchronising pulse height is utilised thereby. Consequently, the incorporated auxiliary signal is not visible on the 4:3 receiver. A method of transmission, which conveys such auxiliary items of information in the form of a vestigial side band modulation of the colour sub-carrier, is specified in PCT/EP91/00397.



Invention

The object of the invention is to provide a compatible image signal recording and/or reproduction system which can record and/or reproduce the image signals together with auxiliary items of information. This object is achieved by the method in accordance with the invention which is defined in claim 1.

Basically, the method in accordance with the invention consists in that, for a process of image signal recording and/or reproduction of image signals including auxiliary items of information that are added to the image signals in accordance with a specified coding scheme, in a recording and/or reproduction device including at least one luminance channel (Y) and at least one chrominance channel (C) wherein the bandwidth of the auxiliary items of information exceeds the bandwidth of a chrominance channel, the auxiliary items of information are distributed and/or processed, for a process of recording and/or reproduction in dependence, on the coding scheme and/or the position in time of the auxiliary items of information such that they can be recorded and/or reproduced using a luminance channel.

Advantageous developments of the method in accordance with the invention are apparent from the dependent claims 2 to 6.

The further object of the invention is to provide a device for the method in accordance with the invention. This object is achieved by the device in accordance with the invention which is defined in claim 7.

Basically, the device in accordance with the invention is provided with means (Fig. 3, S-VHS) for the recording and/or reproduction of image signals having auxiliary items of information that are modulated onto the colour sub-carrier, in particular using a video recorder, including switching means (31, 32; 49) for passing on the demodulated auxiliary items of information to a luminance channel (Y) at periodic intervals during the recording process and/or for passing on, at periodic



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intervals, the auxiliary items of information which have been recorded on a luminance channel (Y) to means for modulating the colour sub-carrier.

Advantageous developments of the device in accordance with the invention are apparent from the dependent claims 8 to 10.

It is also desirable to be able to record the above-mentioned auxiliary items of information (e.g. using the VHS or S-VHS formats) such that the auxiliary items of information can be further processed during reproduction and such that they cannot be lost due to being recorded in conventional video recorders. This would however, be just the case when recording auxiliary items of information modulated on the colour sub-carrier in accordance with PCT/EP91/00397, since video recorders using the VHS or S-VHS principle operate in accordance with the so-called "colour-under" technique. The bandwidth of the auxiliary items of information is thereby reduced in such a way that they can no longer be used.

In general, the full bandwidth of a channel (e.g. 5 MHz for PAL) is needed for the transfer of the auxiliary items of information. This also holds true in like-manner for the recording process. Present day video recorders, which operate in accordance with the S-VHS technique, can in principle record such a bandwidth but then they do expect to receive the wideband luminance signal and the chrominance signal over separate signal leads. In the event of an FBAS signal that is conveyed over only one lead, there is a switch over to the VHS mode which only has a lower recording bandwidth (ca. 3 MHz) at its disposal. In both cases however (S-VHS, VHS), the colour sub-carrier frequency signals are processed using the "colour-under" technique and only have a bandwidth of ca. 600 kHz following a recording. These relationships are described for example in the article "Aus deutschen Landen", Gerhard Welz, Funkschau 20/1989.

A wide band recording of auxiliary items of information, in particular, of colour sub-carrier frequency auxiliary items of information in accordance with PCT/EP91/00397, can be achieved



by switching between the S-VHS and VHS modes in dependence on the running line number of the FBAS signal being recorded. For example, in the case of 575 active lines of a frame, 72 edge lines at the upper and lower edges of the picture (in toto, $2 \times 72 = 144$ lines per frame) are transmitted on each occasion as "letter box" lines including auxiliary items of information. The video recorder always then records the 72 lines at the upper and lower edges of the picture using the S-VHS mode, whilst the 431 lines of the active image window are recorded using the VHS mode. In principle, this also applies for other selected ratios of lines of the active image window relative to the "letter box" lines. The control of the recording mode is achieved by means of an appropriate switching action in the signal paths. The control signal needed for this can be derived from the synchronising pulses of the FBAS input signal. It is particularly advantageous, if an FBAS signal that is to be recorded on a video recorder (e.g. S-VHS type), is initially separated into luminance and chrominance and if the auxiliary items of information modulated on the colour sub-carrier within the black bands are demodulated accordingly, whereby the auxiliary items of information are supplied to the luminance recording channel during the lines in the black bands. A double switching of e.g. filters during one television image, with the transient phenomena resulting therefrom, is thereby avoided.

Drawings

Embodiments of the invention will be explained with the help of the drawings. The drawings show, in:

Fig. 1 the known recording bandwidths of VHS and S-VHS video recorders;

Fig. 2 the known recording channel of an S-VHS video recorder;

Fig. 3 the recording channel of an S-VHS video recorder and a control device in accordance with the invention;

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Fig. 4 an S-VHS video recorder having a prior connected colour sub-carrier demodulator and switches and

Figs. 5 - 7 an embodiment for a further development of the invention.

Embodiments

Fig. 1 shows the recording bandwidths for the luminance and chrominance signals in a video recorder using the VHS and S-VHS standards, such as are indicated in the above-mentioned article "Aus deutschen Landen".

Fig. 2 shows the recording channel of an S-VHS video recorder (VS 680 VPT by Grundig), such as is indicated in the article "Aus deutschen Landen" and a filter arrangement for recording different source signals. Different filtering processes are executed in the signal path, and thus the respective bandwidths required for VHS and S-VHS recording are achieved, in correspondence with the signal source. The appropriate association is effected by the respective switches 21 and 22.

In the initial attempts to improve the quality of existing television systems (e.g. the introduction of the 16:9 picture aspect ratio), the black bands at the upper and lower edges of the picture in the case of the "letter box" transmission do not in general contain any items of colour information (e.g. in PCT/EP91/00397 or WO90/06655) so that only a luminance channel is needed for recording these auxiliary items of information. However, when recording auxiliary items of information which are modulated onto a colour sub-carrier (such as in e.g. PCT/EP91/00397), these auxiliary items of information would be recorded in the narrow band chrominance channel (Fig. 1) with a heavily restricted bandwidth, and would thus be unusable, unless special measures were taken. For this reason, it is advantageous to use the luminance channel for recording these auxiliary items of information. When recording auxiliary items of information which represent the differences of lines (such as in e.g. WO90/06655), it is likewise advantageous not to use the

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chrominance channel in the lines of the "letter box" bands as otherwise spectral components in the region of the colour sub-carrier will be treated as chrominance signals or will be subjected to a notch filtering process (27, 37) as luminance signals.

Fig. 3 shows the recording channel of an S-VHS video recorder and also a control device. The wideband recording of auxiliary items of information i.e. an S-VHS recording using a 5 MHz low pass filtering process in the luminance channel and e.g. the chrominance channel being switched off, can be achieved when the switches 31 and 32 and a switchable modulator 33 are switched by virtue of an analysis of the synchronising pulses of a "letter box" FBAS signal 34. The switches 31 and 32 correspond thereby to the switches 21 and 22 of Fig. 2. The line synchronising pulse is separated from the FBAS signal 34 in the synchronising pulse stripping stage 35 and is supplied to a line counter with a control signal pulse shaper 36. This control signal then actuates the switches 31 and 32 and the switchable modulator 33 such that recording in the S-VHS standard takes place during certain lines (e.g. in the 2*72 lines at the upper and lower edges of the picture). The modulator 33 has to be switched over at the same time since different frequencies of the FM carrier have to be used for S-VHS and VHS recording (Fig. 1).

A further possibility consists in basically recording the "letter box" television signals completely in the S-VHS mode. Advantageously, the modulator 33 and the filters in the recording channel (possibly, with the exception of the notch filter 27, 37) would not then need to be switched twice per image. In the case of auxiliary items of information modulated on the colour sub-carrier, merely the auxiliary items of information have to be passed from the chrominance input to the luminance channel during the 2 * 72 lines. In the event that the "letter box" television signal is only present as an FBAS signal, it may initially be split up into a luminance component and into a chrominance component.

The notch filter 27, 37 is advantageously switched off during the recording of the auxiliary items of information.

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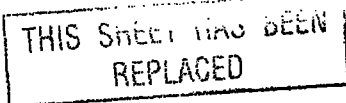
Fig. 4 embodies a circuit arrangement with which a luminance signal Y and a chrominance signal C can be obtained from an incoming FBAS signal. These signals can then be directly recorded by an S-VHS recorder. The circuit arrangement also includes a demodulator 42 with which the auxiliary items of information in accordance with PCT/EP91/00397, or, other auxiliary signals that are modulated for the transmission onto a colour sub-carrier, can be demodulated. The demodulated auxiliary items of information are then present in the form of luminance base band signals Y and can be supplied to the Y input of the S-VHS recorder. In the event that there is no modulation of the carrier by auxiliary signals, such types of signals can be supplied directly to the Y input of the S-VHS recorder. Vis a vis the recording as colour sub-carrier modulated signals, the recording of the signals in the base band has the additional advantage that time base fluctuations caused by the fluctuations in the synchronising process only affect the auxiliary items of information to a lesser extent. The frequency range around the colour sub-carrier is filtered out from the incoming FBAS signal by means of a bandpass filter 47 and hence the chrominance signal is obtained. The chrominance signal is then likewise supplied to a second time delay circuit 48 which makes the necessary time adjustments with respect to the processing of the luminance signal or to the processing time for the auxiliary items of information. This chrominance signal then reaches a fourth input 2' of a video switching device 49 which can alter a switch position in dependence on the lines. There is no chrominance signal representing a chrominance image content present during the letter box lines (switch position 1 or 1'). In this case, the third input 1' of the video switching circuit 49 may advantageously be set at a constant value e.g. earth or average grey (non-coloured). The luminance signal Y can be obtained from the FBAS signal in a separating stage 45, in that either the chrominance signal C is subtracted from the incoming FBAS signal or in that the FBAS signal is subjected to a notch filtering process. The luminance signal Y and the chrominance signal C may also be obtained from the FBAS signal by a comb filtering process that is preferably adaptive to movement. Where

necessary, the luminance signal is thereafter matched in time to the processing time for the auxiliary items of information in a first time delay circuit 46 and supplied to a second input 2 of the video switching circuit 49.

The video switching circuit is controlled by a control signal sw1 which is obtained with the help of the synchronising pulse stripping stage 35 and the control signal pulse shaper 36 for example. The two switches in the video switching circuit are in positions 2 and 2' respectively during the lines of the main signal. The auxiliary items of information from the lines of the letter box bands of the FBAS signal, which are modulated on the colour sub-carrier, are initially supplied to a Nyquist filter 41 which, in accordance with PCT/EP91/00397, has a -6 dB point at the colour sub-carrier frequency and is required for proper vestigial sideband modulation or demodulation. This output signal is then demodulated in a demodulator 42, whereby the colour sub-carrier frequency f_{SC}' is likewise supplied with a certain phase angle (e.g. in correspondence with PCT/EP91/00397) to this demodulator. The colour sub-carrier frequency f_{SC} can be obtained in known manner from the transmitted burst signal. The required phase angle of f_{SC}' , which has to correspond to the modulation phase of the auxiliary items of information, is produced by a phase shifter 44. The unwanted modulation products of the upper side band, which result from the demodulation process, are separated out in a subsequent low pass filter 43. This low pass filter is intended to limit the acquired base band of the auxiliary items of information to frequencies up to the colour sub-carrier frequency. The output signal of the low pass filter is supplied to a first input 1 of the video switching circuit 49.

By using the circuit arrangement described, which extracts a separate luminance signal Y and chrominance signal C from a letter box FBAS signal, one achieves, in advantageous manner, the effect of not needing any switching processes within the images in the course of the recording process in the S-VHS recorder. Possible transient problems occurring in the filters etc are thus avoided.





If a standard FBAS signal is present i.e. there is no letter box signal or there is a letter box signal without any auxiliary items of information, the two switches in the video switching circuit 49 advantageously remain in the positions 2 and 2' respectively.

In addition to the actual process of demodulation, the demodulator 42 may also advantageously effect an amplification of the auxiliary items of information in order to compensate for the reduction in amplitude of the auxiliary items of information due to the vestigial side band transmission and the incorporation in the ultra black region, PCT/EP90/01798. Furthermore, a boosting of the dc voltage level (DC offset) from the ultra black region to an average grey level for example, is advantageous to the recording process since the recording then occurs in a defined, linear modulation range of the recorder and hence distortions are avoided or reduced. If necessary, this DC offset can then be reversed before feeding the recorded signal into a 16:9 image reproduction device provided with Y/C inputs.

The luminance and chrominance signals and the auxiliary items of information undergo similar treatment during the reproduction process.

Such recordings can also be edited without any problems due to the recording of the auxiliary items of information in the base band in the luminance channel. In any case, the prerequisite is that the respective auxiliary items of information for each picture of the picture signals be generated or transmitted during this picture.

The principle of the invention can also be utilised in Hi8 video recorders or similar video recorders which record chrominance signals with a reduced bandwidth.

The recognition of a letter box FBAS signal can be effected by means of an identification pulse that is transmitted therewith (e.g. during the vertical blanking interval). On the other hand,



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the fact that the auxiliary items of information ~~are being~~ transmitted, in accordance with PCT/EP90/01798 or WO90/06655, in the so-called ultra black region i.e. with signal components below the black level, can also be determined in a local signal-type detector.

If the auxiliary item of information described, also referred to as a helper signal, having its amplitude in the ultra black region, is to be recorded by a conventional video recorder, then the recording of this helper signal cannot be done directly since conventional video recorders suppress signals in the ultra black region.

In accordance with a further development of the invention, the recording of the helper signal by a conventional video recorder is enabled by means of a circuit included in the recording path of the recorder which displaces the helper signal into the BA [picture blanking] amplitude region. The reproduction path includes a circuit which displaces the helper signal back into the original amplitude region. This development is based on the following consideration.

The locating of the amplitude of the helper signal in the ultra black region is necessary because otherwise visible interference would occur within the black bars at the upper and lower edge of the picture due to the signal. However, this modified location of the amplitude is not necessary during the recording of the signal because the signal is made invisible. Consequently, it is possible to displace the helper signal into the AB amplitude region, which can be recorded by the recorder, for the recording. A substantial advantage thereby is that the actual recording unit does not have to be altered. Just as before, this only receives a signal which it can record like a conventional television signal without any modification.

In Fig. 5, there is present on the terminal a, a signal in accordance with Fig. 7a including the line synchronising pulse Z, the colour synchronising signal B and the helper signal HS which is only transmitted during the first 72 and the last 72

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active lines of a picture. The amplitude range of the helper signal HS is located in the ultra black region between the black level PS and the synchronising floor SB. The signal thus does not include any signal components in the BA region between the black level PS and the white level PW. The effect is thus achieved that black bars having no visible interference are written at the upper and lower edges of the picture during the first and last 72 lines. Here, the helper signal HS has an amplitude of 0.5 V. The BA amplitude amounts to 0.7 V.

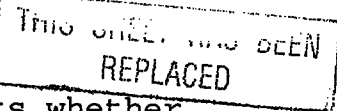
The switch S1 is moved into the position illustrated for recording a signal of this type. The signal in accordance with Fig. 7a reaches the stage 1. The stage 1 causes a dc voltage displacement of the signal HS as is indicated by the arrow 2. The signal HS is thereby displaced up to a level PT within the BA region which is at 0.3 V. In the case of the signal modified in this way in accordance with Figs. 7b, c, the signal HS thus lies in the BA region and consequently can be recorded by the recording unit 3 just like a conventional signal.

During reproduction, the signal in accordance with Figs. 7b, c passes from the terminal c via the switch 2 to the stage 4. The stage 4 displaces the signal in accordance with Figs. 7b, c, as indicated by the arrow 5, back into the original amplitude location in accordance with Fig. 7b which corresponds to the amplitude location in accordance with Fig. 7a. The signal supplied to the terminal a thus reappears on the terminal d. The signal is temporarily converted into the form in accordance with Figs. 7b, c merely for the recording process by the unit 3.

The usual helper signal HS does not fully occupy the BA amplitude region. In order to improve the signal to noise ratio, it is expedient, in addition to the displacement of the signal, to boost the amplitude of the signal HS enough for it to occupy approximately the whole of the BA region. The amplifier 6 in Fig. 5 is provided for this purpose. During reproduction, this increase in amplitude is reversed by the amplifier 7 so that the signal on the terminal d again has the original amplitude.

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Preferably, there is provided a circuit which detects whether the first or last 72 lines do not include a signal in the BA region. If a circuit of this type including amplitude detectors and counters detects the lack of signal components in the BA region over this time period, then a switching voltage is produced. This switching voltage switches the switches S1, S2 in Fig. 5 into the position illustrated. The switches S1, S2 are in the upper position for a signal that does not include the helper signal described, since the modification in accordance with Fig. 7 is not then necessary. The signal HS is modulated for example onto a PAL colour sub-carrier using amplitude modulation which has the constant phase of the modulation axis +V i.e. without any PAL switching. This modulation axis V corresponds to the colour difference signal R-Y in the case of PAL.

Fig. 6 shows a variant for a so-called component recorder which records the signals Y, R-Y, B-Y separately. In this case, the conversion by the stage 1 and the amplifier 6, as well as the reverse conversion by the stage 4 and the amplifier 7, is only effective for the Y signal since the colour difference signals do not contain the helper signal. Since Y is recorded as a base band signal, the helper signal does not take the form of a modulated carrier. Consequently, there is additionally provided the modulator 8 which converts the helper signal as a Y component in the base band back into a carrier signal in accordance with Fig. 7.

The recorder in accordance with Fig. 5 is a 1 inch B- or C-recorder for example. The recorder 3 in accordance with Fig. 6 is a broadcast component recorder of the Betacam or M2 type for example. The displacement described of the signal HS during the recording and during the reproduction processes preferably begins shortly after the ending of the colour synchronising signal B and ends shortly before the beginning of the next line synchronising pulse Z. This is necessary since the synchronising signals including the colour synchronising signal must not be displaced in amplitude in the manner described.

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P a t e n t c l a i m s

1. Process (method) for for image (picture) signal recording and/or reproduction on a recording and/or reproducing device with at least one luminance (Y) and at least one chrominance channel (C) for picture signals with additional information which have been added to the picture signals in accordance with a coding rule whereby the band width of the additional information exceeds the band width of a chrominance channel, c h a r a c t - e r i z e d i n t h a t for a recording and/or reproduction as a function of the coding rule and/or the temporal position of the additional information, the additional information is distributed and/or processed in such a way it can be recorded and/or reproduced utilizing a luminance channel.
2. Process according to claim 1, c h a r a c t e r - i z e d i n t h a t prior to the recording on the picture recording and/or reproducing device luminance and chrominance components of the picture signals are separated and additional information modulated on to a carrier is demodulated, particularly demodulated and amplified, and/or that after a reproduction from the picture recording and/or reproducing device luminance and chrominance components of the picture signals are combined and additional information is modulated on to a carrier.
3. Process according to claim 1 or 2, c h a r a c t - e r i z e d i n t h a t the additional information is modulated on to a color subcarrier (f_{sc}) of the picture signals.
4. Process according to one or several of claims 1

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through 3, characterized in that the distribution and/or processing of the signals to be recorded and/or reproduced happens by means of periodical switching-over.

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5. Process according to claim 4, characterized in that the points in time for the switching-over are derived (35) from sync pulses of the picture signals (FBAS) and/or from an identification contained in the picture signals (FBAS).
6. Process according to claim 4 or 5, characterized in that the points in time for the switching-over are derived from the position of lines of the picture signals in which the additional information occupies an ultrablack region.
7. Device for a process according to one or several of claims 1 through 6, provided with means (S-VHS) for the recording and/or reproduction of picture signals with additional information modulated on to the color subcarrier, in particular a video recorder, with switching-over means (31, 32, 49) for handing on (transmitting) demodulated additional information in periodical intervals to a luminance channel (Y) on recording and/or for handing on additional information recorded on a luminance channel (Y) in periodical intervals to means for color subcarrier modulation.
8. Device according to claim 7, characterized in that a notch filter (37, 45) for suppressing the chrominance components of the picture signals is by-passed at the time of recording of the additional information.
9. Device for a process according to one or several of



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claims 1 through 6, characterized in that the recording path contains a circuit (1) which displaces the additional information (HS) into the picture signal amplitude range, and the reproduction path contains a circuit (4) which shifts the additional information (HS) back into the original amplitude range.

10. Device according to claim 9, characterized in that the recording path contains an amplifier (6) which elevates the amplitude range of the additional information (HS) to approximately the entire picture signal range.



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