

The invention relates to an apparatus for the recording and/or reproduction of picture 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. With 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. For matching the geometrical ratios to the 4:3 receivers, a vertical transcoding of the 16:9 source signal is necessary which only represents 431 lines in the visible picture window of the 4:3 receiver. The remaining 144 active lines ($575 \text{ lines} - 431 \text{ lines} = 144 \text{ lines}$) 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 corresponding process 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. This auxiliary information may be transmitted in the so-called ultra-black region in accordance with "Die neuen Wege des alten PAL", A. Ziemerr, E. Matzel, Funkschau 18/1989. Thereby, the region between the black level and e.g. half the synchronisation pulse height is utilised. 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 an apparatus for the recording and/or reproduction of picture signals which can record and/or reproduce picture signals together with auxiliary items of information by using known circuit parts. This object is achieved by the apparatus in accordance with the invention which is defined in claim 1.

Basically, the apparatus in accordance with the invention is provided with an integrated circuit that is arranged prior to a luminance components input and a chrominance components input and that can separate FBAS signals, present at an input, into luminance and chrominance components by means of a signal adaptive filter and a digital chrominance decoder for the colour sub-carrier, wherein this circuit is used in order to digitally demodulate auxiliary items of information modulated onto the colour sub-carrier from FBAS signals in the letter box format present on the input by means of the chrominance decoder and to supply the demodulated auxiliary items of information to the luminance input components input of the apparatus during the lines in the bands of the letter box format.

Advantageous developments of the apparatus in accordance with the invention are apparent from the appendant claims 2 to 8.

An integrated comb filter circuit for the separation of chrominance and luminance is described in the publication "Adaptive Luminanz-Chrominanz-Trennung mit unterschiedlich farbträgerverkoppelten Sampling-Phasen", R. Schweer, M. Plantholt, Fernseh- & Kinotechnik 12/1990.

However, a digital comb filter decoder including this integrated circuit can, with appropriate modifications, likewise be used for the demodulation of auxiliary items of information of FBAS letter box signals as a preliminary to an S-VHS or Hi8 recording. A recording and/or reproduction of all the constituents of such letter box signals with the aid of an S-VHS or Hi8 recorder is thereby possible.

Auxiliary items of information, which were modulated onto a carrier in accordance with PCT/EP91/00397 for compatible transmission in a standard channel, generally occupy the full width of a channel (e.g. 5 MHz for PAL). This then likewise applies for the recording. Present day video recorders, which operate in accordance with the S-VHS or Hi8 technique for example, can of course in principle record such a bandwidth but they do expect to receive the luminance signal and the chrominance signal over separate signal leads.

Thus, in principle, the auxiliary items of information can be recorded in the wide band luminance channel of a recorder of this type. Nevertheless, time base fluctuations, which are associated with the recording, exert a disadvantageous effect during the processing and evaluation of the auxiliary items of information in a corresponding receiver. This problem can be overcome if the auxiliary items of information are demodulated before the recording and are recorded as base band signals.

The above-mentioned integrated comb filter circuit can be used for the demodulation of the auxiliary items of information and the simultaneous splitting of the FBAS signal into a luminance and chrominance component (Y, C) if the sampling of the luminance signals effected in this integrated circuit is carried out with a phase angle corresponding to the modulation of the auxiliary items of information. Advantageously thereby, the phase angle of the sampling clock rate is made available by a phase locked loop circuit (PLL) located in the integrated circuit.

Advantageously, filter means already available in the circuit may be utilised.

The Nyquist filter in accordance with PCT/EP91/00397 which is needed for the demodulation of the auxiliary items of information and which has its Nyquist point at the colour sub-carrier frequency may additionally be integrated if necessary into such a circuit.

Drawings

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

Fig. 1 an S-VHS recorder having a preliminary colour sub-carrier demodulator and change-over switches;

Fig. 2 a known digital comb filter circuit;

Fig. 3 the known digital demodulation of colour sub-carrier modulated colour signals;

Fig. 4 the digital demodulation of colour sub-carrier modulated auxiliary items of information;

Fig. 5 a spectral diagram of the demodulation of auxiliary items of information and the sampling of the main signal.

Embodiments

Fig. 1 shows a device, for the demodulation of colour sub-carrier modulated auxiliary items of information and for the separation into a luminance signal Y and chrominance signal C, which is connected in front of an S-VHS or Hi8 recorder S-VHS. The frequency range located around the colour sub-carrier is filtered out from the incoming FBAS signal by means of a band pass filter 47 and the chrominance signal C is thus obtained. If necessary, the chrominance signal is then supplied to a second delay circuit 48 which undertakes a matching in time to the luminance signal processing 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 that can alter a switch position in dependence on the lines. A chrominance signal representing a chrominance picture content is not present during the letter box lines (switch position 1 or 1'). Advantageously in this case, the third input 1' of the video switching device 49 can be connected to a constant value e.g. earth or the average grey level (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 that the FBAS signal is subjected to a notch filtering. If necessary, the luminance signal is thereafter matched in time to the processing time for the auxiliary items of information in a first delay circuit 46 and then supplied to a second input 2 of the video switching device 49.

The video switching device is controlled by a control signal sw_1 which is obtained for example with the help of a not-illustrated synchronisation pulse evaluating stage. The two switches in the video switching device are in the position 2 or 2' during the lines of the main signal. The colour sub-carrier modulated auxiliary items of information from the lines of the letter box bands of the FBAS signal are initially supplied to a Nyquist filter 41 which, in accordance with PCT/EP91/00397, has a -6dB point at the colour sub-carrier frequency and is required for a correct vestigial side band modulation or demodulation. This output signal is then demodulated in a demodulator 42 whereby the colour sub-carrier frequency f_{sc}' is likewise supplied to this demodulator with a suitable phase angle. The colour sub-carrier frequency f_{sc} can be obtained in known manner from the transmitted burst signal. The necessary 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 bands occurring during the demodulation are separated out in a following low pass filter 43. This low pass filter is intended to limit the thus obtained 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 device 49.

Advantageously, by means of this circuit arrangement, which obtains a separate luminance signal Y and chrominance signal C from a letter box FBAS signal, it is achieved that switching processes are not necessary within the pictures during the recording process in the recorder S-VHS. Consequently, possible oscillatory problems in the filters etc are avoided.

If a standard FBAS signal i.e. no letter box signal or a letter box signal having no auxiliary items of information, is present, the two switches in the video switching device 49 advantageously remain respectively in the positions 2 and 2'.

Advantageously, the demodulator 42 can effect an amplification of the auxiliary items of information, in order to compensate the amplitude reduction of the auxiliary items of information due to the vestigial side band transmission and an embedding in the ultra black range, in addition to the actual demodulation. Furthermore, a lifting of the direct voltage level (DC offset) from the ultra black range into e.g. a middle grey level is advantageous for the recording since the recording can then occur in a defined linear modulation range of the recorder and thus distortions can be reduced or avoided. If necessary, this DC offset can be restored before the feeding of the recorded signal into a 16:9 picture reproduction apparatus provided with Y/C inputs.

During the reproduction, the luminance and chrominance signals and the auxiliary items of information undergo a corresponding processing.

The identification of a letter box FBAS signal can be effected by an identification pulse that accompanies the transmission (e.g. during the vertical blanking interval). On the other hand, the fact that the auxiliary items of information are transmitted in the ultra black range i.e. with signal components below the black level, can also be evaluated in a local signal type detector.

Advantageously, the circuit section 21 depicted within the frame can now be realised by the digital comb filter circuit 20 illustrated in Fig. 2 if the colour sub-carrier demodulator 42 is digitally executed.

The luminance - chrominance separation of the input signal FBAS into the output signals Y and C can be directly carried out with this circuit since it has an FBAS input CVBS, a luminance output YOUT and a chrominance output COUT.

The letter box FBAS signal at the input FBAS is supplied via a clamping circuit 202 and a clamping switch 208 to an A/D

converter 21. Alternatively, a chrominance component carried by a carrier can be applied to the clamping switch via an RC stage 203 and the input CIN. The A/D converted FBAS signal is supplied directly to a first filter stage 23 via a first line delay circuit 221 and via a second line delay circuit 222 whose delay times are matched to the instantaneous television standard. The Y components and the C components are low pass filtered in this filter stage. The filtered components arrive in a signal adaptive Y/C comb filter stage 24.

The Y component at its output is supplied to a first D/A converter 281 via a luminance delay circuit 25 and a peaking filter 26.

The C component at its output is supplied to a chrominance decoder 27. This chrominance decoder carries out the demodulation of the colour sub-carrier and in addition it contains an automatic amplitude regulator, a colour tint adjustment for NTSC, a PAL logic, a colour-off switch, a colour signal type identification logic and a PLL control stage which controls the phase angle of the frequency $4 \cdot f_{sc}$ that is four times the colour sub-carrier frequency generated in a clock pulse generator 205. A first quartz 206 is used for the generation of the fourfold PAL- and a second quartz 207 is used for the generation of the fourfold NTSC colour sub-carrier frequency. The chrominance decoder 27 delivers a chrominance signal COUT for further processing in a S-VHS or Hi8 video recorder via a second D/A converter 282, the U component UOUT via a third D/A converter 283 and the V component VOUT in the base band via a fourth D/A converter 284.

Corresponding control signals for the components in the integrated circuit are generated in the control logic 204 from the H synchronisation and V synchronisation pulses present on the inputs HIN and VIN. Various functions of the integrated circuit are controlled or interrogated via the Bus interface circuit 201.

The digital demodulation of quadrature modulated colour signals, such as are used for example in the PAL and NTSC systems, is illustrated in Fig. 3 and is extended for the use in accordance

with the invention of a digital demodulation of colour sub-carrier modulated auxiliary items of information.

For the digital processing of colour signals carried on a carrier, it is advantageous to tie the sampling frequency of the analogue to digital converter 21 to the corresponding colour sub-carrier frequency f_{SC} . Particular advantages with a view to a simple realisation of processing processes, such as the colour demodulation for example, arise, if the sampling frequency is selected to be equal to four times the colour sub-carrier frequency $4 \cdot f_{SC}$ and a special phase relationship is thereby maintained.

Fig. 3a shows the carrier signals which have a 90° phase displacement due to the quadrature positioning. These carrier signals are modulated by the corresponding colour signal components (not illustrated in Fig. 3). If the sampling phase of the frequency $4 \cdot f_{SC}$ that is four times the colour sub-carrier frequency in Fig. 3b is now so selected that the zero crossings and maxima or minima of the carrier signals are sampled, then, on each occasion, there arise two sampling values per carrier period T_{SC} , which represent these special values. By a selection of such sampling values by means of a switch S, which is clocked at half the sampling frequency ($2 \cdot f_{SC}$), the carrier signals in accordance with Fig. 3c can be separated out.

This process can also be interpreted as sampling at double the colour sub-carrier frequency. Consequently, the spectrum of the colour components carried by a carrier is repeated at odd multiples of the colour sub-carrier frequency as is illustrated in Fig. 3e. The actual demodulation of the carrier frequency colour components, which causes the transfer into the base band, is obtained by a switched weighting of the sampling values by ± 1 in correspondence with Fig. 3d. The colour sub-carrier is thus converted to a dc component and the modulated and sampled colour components can be obtained via the D/A converters 282 - 284.

Since the weighting appears in a sequence corresponding to the colour sub-carrier period T_{SC} , this process can be conceived as modulation with the colour sub-carrier frequency. In the spectral diagram in accordance with Fig. 3f, the spectral components of the sampling in Fig. 3e are displaced by the

colour sub-carrier frequency. One then obtains the wanted colour components in the base band by appropriate low pass filtering.

Fig. 4 shows the sampling of a colour sub-carrier which serves as the modulation carrier for the auxiliary items of information. Fig. 4a illustrates the sampling of the carrier $\cos(\omega_{SC}t)$ at a frequency $4f_{SC}$ that is four times the colour sub-carrier frequency wherein sampling is effected at the extreme values and the zero crossings (0° phase displacement). Fig. 4b illustrates the sampling of the same carrier oscillation with a phase angle of the sampling raster displaced by 45° for example. If one now only takes into consideration every second sampling value, as is also illustrated in Figs. 3b and 3c, one then obtains sampling values which represent a carrier oscillation $\cos(\omega_{SC}t - 45^\circ)$ that is displaced by 45° . This oscillation then demodulates the auxiliary items of information with the correct phase in the manner illustrated in accordance with Figs. 3d and 3f if they have been likewise modulated at the transmitter end by a carrier oscillation $\cos(\omega_{SC}t - 45^\circ)$. The correctly phased demodulation of the auxiliary items of information having an arbitrary modulation phase can be achieved by a corresponding phase displacement of the scanning raster at the receiving end in accordance with Fig. 4b. In general, the phase angle of the transmitter end modulation of the auxiliary items of information is known so that, at the receiving end, the corresponding evaluation of the colour bursts is sufficient in order to produce the required phase angle of the scanning raster by a phase shifter.

In accordance with Fig. 4b, it is sufficient to provide a sampling frequency having twice the frequency of the colour sub-carrier frequency $2f_{SC} = 1/[T_{SC}/2]$ and a corresponding phase angle for the demodulation of the auxiliary items of information.

In accordance with Fig. 3c and Fig. 3e, the effective sampling frequency for the chrominance is likewise only $2f_{SC}$. A sampling in the A/D converter 21 at twice the colour sub-carrier frequency is then sufficient for the luminance chrominance separation and demodulation of the auxiliary items of

information when using the comb filter circuit of Fig. 2. The chrominance signals are band pass filtered in the first filter stage 23 and then correspond to the illustration in accordance with Fig. 3e wherein the illustrated spectra now contain both quadrature components as is necessary for the chrominance recording in the S-VHS mode.

Fig. 5 depicts a spectral diagram of the demodulation or sampling of auxiliary items of information and main signals. The demodulation of spectrally randomly formed auxiliary items of information is illustrated in Fig. 5a. The auxiliary information is modulated by the colour sub-carrier for the transmission and, after Nyquist filtering at the receiver end, has a Nyquist slope with reference to the colour sub-carrier. Due to the demodulation, these slope regions complement one another, in the vicinity of the frequency 0 and over a width which corresponds to the slope width, to a constant waveform in the spectrum. The filtering F1 in the chrominance decoder 27, which is required after the demodulation, reduces the spectrum down to the colour sub-carrier frequency f_{sc} . If a sampling at twice the colour sub-carrier frequency is applied to the main signal spectrum, which extends for example up to the channel edge f_c (5 MHz), there results the diagram illustrated in Fig. 5b. Here, it is assumed that the Nyquist filter 41 located in the input of the circuit in accordance with Fig. 1 is also active during the lines of the main signal and is not short circuited by a switch. The low pass filtering having the limit frequency f_c that is required after the sampling is indicated by the filter F2.

In principle, a post filtering in accordance with filter F1 during the letter box lines and a post filtering in accordance with filter F2 during the main signal lines can now be effected by periodically switching over sets of filter co-efficients. However, the overlapping region or the loss of resolution is so small that advantageously only one type of filter having a limit frequency f_{grenz} lying between f_{sc} and f_c has to be used.

It is equally possible to integrate the Nyquist filter 41 into the circuit of Fig. 2 and to place it for a digital realisation

after the sampling in the A/D converter 21. For the realisation of the Nyquist flank region, a sampling frequency $>2*f_{sc}$, for example a sampling frequency of $4*f_{sc}$, is then necessary. The demodulation of the auxiliary items of information then occurs in the manner illustrated in Fig. 4 by utilisation of each second sampling value.

For the processing of standard signals i.e. signals not having auxiliary items of information, the demodulation can be switched off by a marking pulse which is transmitted for example during the vertical blanking interval for identifying FBAS signals with/without auxiliary items of information.

For the recording of auxiliary items of information, which were demodulated in accordance with the invention with the help of the modified inserted comb filter circuit, it is expedient to raise the direct voltage level (dc value) to an average grey value before the recording. The recording channel is thereby driven in the most linear region. This function too can be undertaken by the integrated circuit.

Before the reproduction of the recording, the complete demodulation process can be reversed by appropriate modulation and renewed transfer of the modulated auxiliary items of information into the ultra black region.

The circuit described for the demodulation of auxiliary items of information and simultaneous luminance chrominance separation can be installed as an adaptor or be an integral assembly of equipments for two channel recording of Y and C, for example, S-VHS or Hi8 recorders.



Claims

1. Apparatus for the recording and/or reproduction of picture signals which is provided with a circuit part (20, 21) that is arranged prior to a luminance components input (Y) and a chrominance components input (C) and that can separate FBAS signals present at its input (FBAS) into luminance and chrominance components by means of a signal adaptive filter (24) and a digital chrominance decoder (27) for the colour sub-carrier, wherein this circuit part (20, 21) is used in order to digitally demodulate auxiliary items of information modulated onto the colour sub-carrier from FBAS signals in the letter box format present on the input (FBAS) by means of the chrominance decoder (27) and to supply the demodulated auxiliary items of information to the luminance components input (Y) of the apparatus during the lines in the bands of the letter box format.
2. Apparatus in accordance with Claim 1, characterised in that, the FBAS signal present on the input (FBAS) is sampled in the circuit part (20, 21) at four times the frequency of the colour sub-carrier.
3. Apparatus in accordance with Claim 1 or 2, characterised in that, the colour sub-carrier having the auxiliary items of information is sampled in the chrominance decoder (27) at twice the frequency of the colour sub-carrier whereby a colour sub-carrier oscillation is generated whose sampling phase angle corresponds to the modulation phase of this colour sub-carrier oscillation at the transmitter end.
4. Apparatus in accordance with one or more of the Claims 1 to 3, characterised in that, the sampling phases in the chrominance decoder (27) are derived from the colour burst and are made available by means of a PLL control stage.
5. Apparatus in accordance with one or more of the Claims 1 to 4, characterised in that, the integrated circuit (20, 21) contains a Nyquist filter (41) having a -6 dB point lying at the

) colour sub-carrier and with which the auxiliary items of information modulated onto the colour sub-carrier are filtered.

6. Apparatus in accordance with Claim 5, characterised in that, the luminance signal components of the FBAS signals in the lines not pertaining to the bands of the letter box format are filtered by the Nyquist filter (41) before the sampling in the A/D converter (21).

7. Apparatus in accordance with one or more of the Claims 1 to 6, characterised in that, the chrominance decoder (27) additionally effects an amplitude boost.

8. Apparatus in accordance with one or more of the Claims 1 to 7, characterised in that, the demodulated auxiliary items of information have their direct voltage levels increased in the circuit part (20, 21) during the recording.

9. Apparatus in accordance with one or more of the Claims 1 to 8 which incorporates a video recorder, in particular an S-VHS or Hi8 video recorder.

