

TELEVISION SYSTEM

The invention concerns a method for the transmission of a video signal according to the preamble of the claim 1.

For introducing a 16:9 broad picture format into existing television standards (for example, PAL, SECAM, NTSC) having the format 4:3 the so-called 'letter box' method is in discussion. With this method the 16:9 information is presented in a compatible way on the 4:3 receiver with black bars at the upper and lower picture edges. For this, to adapt the geometry conditions at the 4:3 receiver a vertical transcoding is needed which presents only 432 active lines in the visible picture area in the 4:3 receiver. The remaining 144 lines of the active 4:3 picture area appear in the 4:3 receiver as black bars of 72 lines each at the upper and lower picture edges. A description of such a method can be found in "Verbesserungsmöglichkeiten und Entwicklungstendenzen bei PAL" (Possible Improvements and Tendencies of Development for PAL); by G. Holoch, lecture FK TG at Jan. 17, 1989, Berlin.

For a full format presentation on a 16:9 receiver, however, additional information of the 16:9 source signal ^{is} are required, i.e., for example, the information of the 144 lines which appear as black bars in the 4:3 receiver. The information of the 144 lines can be transmitted as

additional information in the so-called infrablack range pursuant to A. Ziemer, E. Matzel, "Die neuen Wege des alten PAL" (New Ways of the Old PAL), Funkschau issue No. 18/1989.

For this, the video signal amplitude range between black level and, for example, half the sync pulse amplitude is exploited. Through this the incorporated additional information is not visible in the 4:3 receiver.

Other additional information which can be transmitted in the same manner is described in the DE-A-39 30 964.

With the transmission of additional information in the form described it has become apparent that problems in compatibility may appear through difficulties of synchronization with the ordinary 4:3 receiver. These problems, for example, become manifest as a non-stable vertical synchronization or also as a tearing out of lines of the visible picture window (close to the black bars). These synchronization problems must be attributed to the transmission of low frequent spectral components (direct current part) of the additional information with high energy share.

The invention is based on the task of producing a compatible transmission system which transmits additional information for a 16:9 receiver, in particular with an improved backwards compatibility, to known 4:3 receivers.

This task is solved by the features given in the patent claim 1. Advantageous further developments of the invention are given in the subclaims.

The additional information to be transmitted is modulated using a vestigial sideband modulation upon the color carrier for example, of the PAL system. This low frequency spectral parts and, possibly an available direct

current component with statistically high energy content are shifted to the high frequency color carrier. Thus, the lower energy high frequency parts of the base band information are transmitted in the low frequency range. The modulation process thereby leads to a reflection of the original spectrum of the additional information on the axis of the color carrier frequency.

Moreover, by this method a higher modulation level in the infrablack range can be achieved because known receiver circuits usually operate with a low pass before the sync pulse processing and thus no impairment in synchronization through the high frequency transmission of high energy parts occurs. The higher possible modulation level has an advantageous effect on the signal-to-noise ratio of the additional information.

Below, the invention is further illustrated with the help of the drawings. These show in

Fig.1 a known color television signal,

Fig.2 additional information incorporated in the infrablack area by a known method,

Fig.3 the base band spectral distribution according to the invention,

Fig.4 the transmission characteristic of a known IF filter,

Fig.5 known PAL averaging and demodulation,

Fig.6 compensation of disturbance components with compatible reception.

Fig.1 shows a CSCC signal with sync pulse 11, porch 12, color burst 13, as well as the video signal as such 14.

Fig.2 shows additional information incorporated in the infrablack range of the video signal as has been

described in "Die neuen Wege des alten PAL", A. Ziemer, E. Matzel, Funkschau 18/1989. One can recognize the relatively small amplitude range for the additional information between half the sync pulse amplitude and the black level.

Fig. 3 shows the amplitude frequency response 31 of a PAL transmission channel, the vestigial sideband modulation 32 of the color carrier, as well as the required Nyquist slope 33 with the -6 dB point 34.

Through the modulation of the color carrier with the additional information in the form of a vestigial sideband modulation, the transmission of additional information loaded with a direct voltage part, or with low frequency parts of higher amplitude, is rendered possible in an advantageous way without impairing the synchronization of present standard receivers. Furthermore, the amplitude range for the entire additional information can be markedly increased to a range lying between the sync pulse base line and a level above the black value. This causes an advantageous improvement in the signal-to-noise ratio for the additional information.

The required filtering for forming the vestigial sideband with a Nyquist slope path with respect to the color carrier frequency (i.e. 6dB attenuation with the color carrier frequency) can happen in principle on the transmitter side or the receiver side or even by the combined effect of two filters whereby, for example, two equal filter characteristics are used in the transmitter and in the receiver.

With the last mentioned alternative it is possible to use IF filters (for example TSF 5315, manufactured by Sanyo, built into the IF module IF 2132, manufactured by Thomson-CSF) used today in television receivers and, therewith, to

cause a 3 dB amplitude drop with the color carrier frequency in the receiver (color carrier frequency = 34.47 MHz in IF position).

Fig.4 shows the transmission characteristic of this IF filter with the component specific tolerances.

On the transmitter side, also, filtering should be carried out leading to a further 3 dB amplitude drop at the color carrier frequency. This filtering for the additional information is then advantageously also performed in the IF position using a similar filtering means. This results in the advantage that no other than the prior used IF characteristic need be used for applying invention using vestigial sideband modulation, at least in the receiver.

In DE-A-39 30 964 it is stated that the additional information consists of signal parts which from the line interlace signal transmitted form a signal through post-processing on the receiver side which is presented full format as a progressively scanned picture with 432 lines of active picture contents and in an aspect ratio of 16:9.

The method according to the invention can be applied for the transmission of such additional information.

The additional information is generated on the transmitter side line per line for the 432 lines to be presented at the receiver. The result is 432 additional information portions for the transmission of which only 144 lines (two times 72 lines edge bars) are available.

The necessary reduction by the factor three ($432 / 144$) can be attained using a time multiplex technique in that each of the 432 additional information portions is compressed in

time by the factor three. This way the additional information of three lines each can be time sequentially transmitted per transmission line available. A corresponding increase in band width by the same factor, i.e. three, results from the time compression. For this reason the base band source bandwidth of the additional information may only be one third of the transmission bandwidth. For a PAL video signal there results a maximum bandwidth of approximately $5 \text{ MHz} / 3 = 1.67 \text{ MHz}$.

With the application of the invention-type method the additional information is modulated upon the color carrier in the form of a vestigial sideband modulation. The maximum bandwidth for the additional information resulting herefrom is $4.43 \text{ MHz} / 3 = 1.48 \text{ MHz}$. A minimal limitation of the bandwidth of approximately 11 per cent occurs for the benefit of the above described advantages of the modulation method.

When using the method according to the invention on the PAL standard, the compatible reception can be influenced advantageously by the choice of a specific phase position of the PAL color carrier as modulation frequency (4.43 MHz). This is because the visibility of the disturbances caused by the transmitted additional information is reduced in the edge strips. Standard PAL receivers contain a so-called PAL averaging circuit for suppressing phase errors, to which are connected the actual PAL demodulation with the UV demodulators. Fig.5 shows circuit with PAL averaging, consisting of a running time member 51, a summing stage 52 and a subtraction stage 53. Connected to the summing stage 52 is the U demodulator 54 and the subtraction stage 53 of the V demodulator 55.

If, for example, the positive phase of the capital V carrier is chosen as the phase of the modulation carrier for transmission of the additional information in all lines (i.e. no alternating line PAL switching of the V carrier), then at the output of the summing stage 52 there appears, from the color carrier vector VF_n of actual line N and previous line N-, as resultant a vector with the value $2 \cdot VF$ (Fig.6a), which is passed to the U demodulation. Since the modulation functions

are orthogonal to one another (90° shift between the U and V carrier), the U demodulator 55 delivers from the $2*VF$ vector the value 0 and a component with twice the color carrier frequency, which is suppressed by a low pass filter arranged in the single pass of the U component in known PAL receivers.

The subtraction stage 53 already delivers at the input of the V modulator 55 the value 0 (Fig.6b).

There is thus advantageously a tendency for possible interference patterns to arise, with compatible reception, through the additional information, if the latter does not vary substantially from line to line.

A similar result occurs if the negative V carrier phase is chosen as the modulation phase. In Fig.6a, the summing stage 52 then delivers the vector $-2*VF$, which is then further demodulated with the U carrier and has as a result the value 0.



CLAIMS

1. Method for the transmission of a video signal in a first standard for compatible reception on a receiver for the first standard or on a receiver of a second standard, particularly for the transmission of a video signal (14) according to the so-called letter-box method, with additional information, particularly in the infrablack range (21) of the video signal (14), wherein the additional information is located in particular in the picture sections of the video signal (14) which lie - when reproduced by the receiver of the first standard - outside the picture area for the second standard, characterised in that the additional information is modulated upon a color carrier (4,43) (Fig.3) wherein a vestigial sideband modulation is attained by means of filtering means (Fig.4) and wherein the low frequency parts of the additional information, including a possible direct voltage part, are transmitted in the color carrier higher frequency range (32) and directly beneath the color carrier (4,43).
2. Method according to claim 1, characterised in that the additional information modulated on the color carrier (Fig.3) is level controlled in such a way that the modulation signal additionally has an amplitude range beyond the black level (12) of the video signal.
3. Method according to claim 1 and/or 2, characterised in that a demodulation of the additional information is attained by means of synchronization with the color burst (13).
4. Method according to one or more of claims 1 to 3, characterised in that means in the transmitter and/or receiver for the second standard cause a Nyquist slope (33) with respect to the color carrier frequency.
5. Method according to claim 4, characterised in that the means comprise an IF filter in the receiver of the second standard.



6. Method according to one or more of claims 1 to 5, characterised in that the additional information is compressed in time in the transmitter, in particular by the factor three.
7. Method according to claim 6, characterised in that the additional information is expanded in time in the receiver of the second standard, in particular by a factor three.
8. Method according to one or more of claims 1 to 7 characterised in that the additional information is modulated on the color carrier with constant phase in alternate lines.
9. Method according to one of claims 1 to 8 characterised in that the additional information transmitted is used in a 16:9 picture aspect ratio receiver to form a 16:9 ratio image for display.