

As is known, three signals are transmitted in colour television for playing back an image, that is the compatible luminance signal Y and the two colour difference signals (B-Y) and (R-Y). With colour television playback the luminance signal Y is transmitted by amplitude modulation of an image carrier and the two colour difference signals are transmitted by quadrature modulation of a colour carrier.

If a digital signal transmission takes place within a transmission path, then the three analogue signals have to be converted by A/D converters into digital signals. An example of such a digital signal transmission is the so-called timeplex system for transmitting or recording colour television signals, as described in "Fernseh- und Kino-Technik" ("Television and Cinema Technology") 1983, pages 187-195, particularly pages 193-194. With this system all signals are compressed in time for transmission or recording and are expanded again in time after transmission and recording. The A/D conversion and D/A conversion is therefore necessary, because the clocked stores which serve for time compression and time expansion process digital signals. With the timeplex system the time compressed colour difference signal (B-Y) and the time compressed luminance signal Y on the one hand are transmitted or recorded from line to line alternately as are on the other hand the time compressed colour difference signal (R-Y) and the time compressed luminance signal Y.

The signals Y, (B-Y), (R-Y) are independent of each other in amplitude and may not therefore be mixed. Therefore, with A/D conversion there are essentially three separate A/D converters. Because of the different amplitudes of the signals the available modulation range of the converters may not always be fully utilised, so that particularly with small signal amplitudes there is a low signal-to-noise ratio.

The objective underlying the invention is to achieve the best possible utilisation of the modulation range of the converters irrespective of the signal amplitude in each case.

The objective is achieved by the invention described in claim 1. Advantageous further refinements of the invention are described in the dependent claims.

In fact a circuit is known (DE OS 33 05 919), in which the dynamic range of the analogue signal which is to be digitalised is so controlled that the digital signals take in a particular range of values. Thus it is only a question of a known dynamic control in the sense of an automatic amplification control. The step is not undertaken here of intentionally making the amplitude of the signal incorrect on the transmission side in order to utilise the modulation range of the converters irrespective of the signal amplitude or of correcting the incorrect amplitude of

the signal again on the receiving side with the aid of an additionally transmitted control magnitude. Provision is not made there for transmitting a control magnitude and re-establishing the amplitude, nor is it necessary.

The invention is based on the following consideration: If for example a signal has only a small amplitude over a fairly long time interval, then the available modulation range of the converter is not fully utilised. In order to improve both utilisation of the modulation range and the signal-to-noise ratio, the amplitude of the signal is increased, until the modulation range of the converter is utilised and the signal-to-noise ratio during transmission is improved. The transmitted signal is then made essentially incorrect in amplitude. But, due to the characteristic signal transmitted at the same time, this incorrectness of the amplitude may be reset again on the playback side, i.e. after D/A re-conversion. Control of amplification of the signals, before the A/D converter, takes place relatively slowly, e.g. with a time constant of a plurality of lines or several half images.

In a further refinement of the invention in accordance with claims 9-12 the maximum occurring amplitude of the signal is determined in each case during a specific time interval, more particularly a line. A control magnitude which is constant during the time interval is derived therefrom. Said magnitude controls the amplification of the signal, so that the signal takes in the modulation range of the converter irrespective of its original amplitude. Thus a signal portion is individually evaluated in each case and is brought up to the modulation range of the converter by a change in amplification, which is constant during the time interval.

The invention will be described in the following by way of the drawings. In which

Figure 1 shows an example of embodiment of the invention and

Figures 2, 3 show an example of embodiment for the refinement of the invention

The luminance signal is applied to the terminal 1 and has synchronous signal (Y+S) with a maximum amplitude of 1 V, in which by maximum amplitude is meant in the following the signal value from peak to peak. The signal (Y+S) is supplied to the coder 3 by means of the A/D converter 2, which feeds the transmission distance UE. The colour difference signal (B-Y) is applied to the terminal 4 at a maximum amplitude of 1.33 V. This signal is brought by the amplitude adjuster 5 with the divider factor 0.75 to a maximum amplitude of 1 V and supplied to the first input of the switch 6. The signal (R-Y) is applied to the terminal 7 at a maximum amplitude of 1.05 V. This signal is brought in the divider stage 8 with a divider factor 0.95 to a maximum amplitude of 1 V and supplied to the other input of the switch 6. The switch 6 is controlled by the coder 3 through the

half line frequency switching voltage 9 so that alternately from line to line the signal (B-Y) and the signal (R-Y) reach the A/D converter 10 at equal maximum amplitude. The digital output signal of the converter 10 also reaches the coder 3. The decoder 11 lies at the end of the transmission distance D and supplies digital output signals for Y, (B-Y) and (R-Y). The coder 3, the transmission distance UE and the decoder 11, in a video recoder with timeplex recording for example, form time compression during recording, the recording itself and time expansion during playback.

The digital luminance and synchronous signal at the output of the decoder 11 is transformed by the D/A converter 12 back into the analogue luminance and synchronous signal Y+S, which is available again at a maximum amplitude of 1 V at the terminal 13. The digital output signal of the decoder 11 for the signal train (B-Y), (R-Y) reaches the D/A converter 14, the output of which is connected, alternately from line to line via the switch 15, up to the inputs of the amplitude adjuster 16 with the factor 1.33 and (to the inputs) of the amplitude adjuster 17 with the factor 1.05. This switchover takes place with the half line frequency switching voltage 18 from the decoder 11. The analogue colour difference signal (B-Y) is applied again to the terminal 19 at the original maximum amplitude of 1.33 V as is the colour differences signal (R-Y) to the terminal 20 at the original amplitude of 1.05 V.

The adjusters 8,17 in the path of the (R-Y) signal may be omitted if necessary, since the maximum amplitude of the signal only differs slightly from 1 V.

The colour difference signals from the output of the switch 6 are moreover supplied to the gate 21, which is controlled so as to be passable by the pulse 33 coming from the coder 3 and having the duration of the line sweep time of 52 μ s. The colour difference signal during the line sweep time is rectified by the peak value rectifier 22 and produces at the capacitor 23 the control magnitude U_s with a time constant of approx. 100 ms. This control magnitude U_s controls the amplification of the amplifier 24 in the path of the colour difference signals via the line 34, so that the maximum amplitude of the colour difference signals at the input of the converter 10 takes in the full modulation range of the converter 10 irrespective of the original amplitude.

In the oscillator 25 a colour carrier is produced, from which is gained by the gate 26 through the scanning pulse 35 a colour synchronous signal at the beginning of each line. This colour synchronous signal 35 is modulated in the amplifier 27 in amplitude by the control magnitude U_s and supplied to the transmission path UE. The colour synchronous signal 35 is kept away from the decoder 11 by the gate 32, which is locked during the rear porch and is supplied to the comparator stage 29 by the gate 28, which is connected so as to be passable by the scanning pulse 35. The amplitude is compared there in the comparator stage 29 with a desired value from the desired value generator 30. The said comparator stage delivers a

control magnitude U_s to the comparator 37. The said control magnitude U_s controls the amplification of the amplifier 31 reciprocally with the amplification control of the amplifier 24, such that the colour difference signals again have their correct amplitudes at the input of the switch 15. If for example, due to a slight colour saturation of the image, the colour difference signals (B-Y) and (R-Y) have a low amplitude over a fairly long time interval of several half images, then the amplification of the amplifier 24 is increased by the control magnitude U_s and the amplification of the amplifier 31 is reduced correspondingly by the control magnitude U_s , so that the signals at the terminals 4 and 19 and 7 and 20 respectively again agree in their amplitude.

Figures 2, 3 show an example of embodiment for a change in amplitude, which only acts in each case for one line duration. During the line n from t_1 - t_2 the maximum amplitude of the (B-Y) signal, which is 0.8 V here, is evaluated in the peak value rectifier 22. The modulation range A of ± 1 V would not therefore be fully utilised. In the comparator stage 40, which is fed by a reference voltage stage 41, a control magnitude U_s is gained. This is a measure of the maximum amplitude value occurring during the line n , of the signal B-Y or the difference between this value (0, BV) and the modulation range (1V) of the converter 10. The control magnitude U_s is stored by the store 42 and initially contains its constant value. During the line $n+1$ of t_3 - t_4 the control magnitude U_s appears at the input of the controllable amplifier 24, to which the signal (B-Y) is supplied via the line delay stage 43. The amplifier 24 therefore receives the (B-Y) signal from the line n , and the control magnitude U_s , which is a measure of the maximum amplitude from line n . The control magnitude U_s changes the amplification of the amplifier 24 by the value V so that in the line $n+1$ the signal (B-Y) takes in the full modulation range A . In this way there is a change in the amplification of the amplifier 24 line for line and thus in the amplitude of the signals at the input of the converter 10, in the sense that in each line the maximum amplitude of the signals takes in the modulation range of the converter 10. Therefore there is the shown stepped control magnitude U_{s1} at the input of the amplifier 24, the value of said magnitude being constant in each case during one line duration and being capable of or changing from line to line. At the beginning of a line the control magnitude is cancelled from the preceding line in terms of time and is replaced by the gained control magnitude of the new line. The control magnitude U_{s1} is transmitted as in Fig. 1 by amplitude modulation of the colour synchronous signal 35.

After the D/A conversion on the playback side there is a change in the amplification of the amplifier 31 as in Fig. 1, reciprocally with the change in the amplification of the amplifier 24, such that the colour difference signals again have their original amplitude.

If it is assumed that the colour signal hardly changes from line

to line, then the amplitude measurement value of line n may control the colour signal amplitude of line $n+2$.

The circuit in accordance with the invention is particularly important in the timeplex system for the colour difference signals, because they are compressed and expanded in terms of time by a high factor of approximately 5. However, the invention may also be used for the luminance signal Y , in order to modulate the A/D converter 2 fully.

The switch 6 in Fig. 2 may also have an effect on the reference voltage stage 41. This achieves replacement of the maximum amplitude matching stages 5,8 with reference level switching which is line by line.

PATENT CLAIMS

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1. A circuit for the analogue/digital-conversion of a colour television signal which contains in three separate paths (1,4,7) a luminance signal (Y), a first and a second colour difference signal (B-Y, R-Y), wherein the colour difference signals occur alternately from line to line, characterised in that the respective signal applied to an analogue/digital converter (10) is so controlled in amplitude by a control magnitude (Us) derived from the original amplitude of the signal, that the signal irrespective of its original maximum amplitude always takes in almost the full modulation range of the analogue/digital converter (10) and that the control magnitude (Us), transmitted with a control signal over the transmission path (11) by the analogue/digital converter (10) serves for the restoration of the amplitude of the signal to the original value (amplifier 31) after the digital/analogue re-conversion (14).
 2. A circuit according to Claim 1, characterised in that the two colour difference signals are brought to equal maximum amplitudes (1V) and are applied to the same analogue/digital converter (10).
 3. A circuit according to Claim 2, characterised in that the two colour difference signals (B-Y, R-Y) are applied to the inputs of a switch (6) operated at line frequency, by way of amplitude regulators (5,8), the output of which is connected to the input of the analogue/digital converter (10).
 4. A circuit according to Claim 1, characterised in that the luminance signal (Y) including synchronising impulses and the colour difference signals (B-Y, R-Y) have equal maximum amplitudes at the inputs of the analogue/digital converters (2,10).
 5. A circuit according to Claim 4, characterised in that during the digital/analogue re-conversion, the colour difference signal train (B-Y, R-Y) is applied to the input of a digital/analogue converter (14), the output of which is alternately connected by means of a switch (15), actuated at line frequency, to the two colour difference signal paths (19,20).
 6. A circuit according to Claim 5, characterised in that amplitude regulators (16,17) are disposed in the colour difference signal paths (19,20), so dimensioned that the signals regain their original, different maximum amplitudes (1V).
 7. A circuit according to Claim 1, characterised in that the control magnitude (Us) is derived by means of peak value rectification (22) of the signal.
 8. A circuit according to Claim 7, characterised in that a low-pass filter (23) is disposed in the path of the control magnitude (Us) having a time constant of the order of 100 ms.
 9. A circuit according to Claim 1, characterised in that during a defined time interval (t1-t2) the maximum amplitude of

the signal (B-Y) is determined and a control magnitude (Us) derived therefrom, and constant for the duration of the time interval, so controls the amplitude of the signal that the maximum amplitude takes in the modulation range (A) (Figs. 2,3).

10. A circuit according to Claim 9, characterised in that the control magnitude (Us) derived in the time interval (t1-t2) controls the amplitude of the signal delayed by the duration of the (said) time interval in the time interval (t3-t4) following thereafter.

11. A circuit according to Claim 9, characterised in that the time interval is equal to the duration of a line period.

12. A circuit according to Claim 1, characterised in that the control signal (35) is an oscillation transmitted at the beginning of the line, amplitude modulated by the control magnitude.



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