



CONTROL SIGNAL GENERATOR FOR A TELEVISION SYSTEM

This invention relates to television systems and particularly to control signal generators for use in television systems.

5 Integrated circuits are commercially available for processing television signals. For example, the type TA7730 integrated circuit manufactured by Toshiba includes luminance and chrominance signal processing circuitry and provides output signals in component form (i.e., R, G and B signals). Additionally, this integrated circuit also provides a
10 processed luminance output signal which may be used, for example, for providing feedback control of picture parameters.

There are, however, other commercially available integrated circuits that provide luminance and chrominance signal processing but which only provide output signals in RGB component
15 form and which do not provide a processed luminance output signal. An example is the type TDA4580 integrated circuit manufactured by Valvo.

The absence of an output terminal for providing a processed luminance output signal in such integrated circuits is
20 disadvantageous in that it precludes the use of feedback control of luminance signal parameters such as, for example, brightness and contrast. The present invention is directed to solving this problem.

In accordance with a feature of the invention, for use in television systems, of the type referred to above, in which the
25 luminance and chrominance processing sections are incorporated in an integrated circuit and processed luminance information is therefore not readily available, a signal combining circuit is provided for combining color signals produced at output terminals of the integrated circuit to produce a "summed" signal at least
30 approximating the unavailable processed luminance information.

In accordance with another feature of the invention, it is recognized that the "summed" signal will contain pulses corresponding to retrace blanking pulses inserted in the retrace intervals of the color signals and that such pulses will disturb the
35 average and peak-to-peak values of the summed signal.

Accordingly, an amplifier associated with the combining circuit is biased to remove the pulses of the summed signal while retaining substantially the entirety of the summed signal between a



nominal black level and white-going excursions. In this way, a reliable control signal may be derived from the resultant signal by, e.g., an average or peak-to-peak detector.

For a detailed understanding of the present invention,
5 reference should be made to the accompanying drawings in which:

FIGURE 1 shows, partially in block diagram form and partially in schematic form, a television system including a control signal generator constructed in accordance with the invention; and
10 FIGURES 2A and 2B respectively show a graphical representation of a white-stretch gain characteristic and a block diagram of apparatus having a white-stretch transfer function.

In the FIGURES, the same reference numbers have been assigned to the same or similar elements.

15 In the following description, it is assumed that positive-going portions of the luminance signal correspond to white-going portions of a reproduced image.

In the television system shown in FIGURE 1, a composite video provided at an input 142 is separated into two
20 components: a luminance signal provided at an output 144, and a chrominance signal provided at an output 146.

The chrominance signal is processed in a well known manner in processor 148 for producing red, green and blue color difference signals r-Y, b-Y and g-Y. The color difference signals
25 are coupled to a matrix 152. Chrominance processing unit 148 and matrix 152 may be included in an integrated circuit (IC) 154.

The luminance signal is coupled to a white stretch processing unit 136 which also receives the control signal V_{CA} generated by a control signal generator 140 with which the
30 present application is particularly concerned and which will be described in detail below. The output signal of white-stretch processing unit 136 is coupled to a peaking circuit 156 for improving the sharpness of the image. The output signal of peaking circuit 156 is coupled to integrated circuit 154.

35 For luminance signal processing, integrated circuit 154 includes contrast control unit 158 and a brightness control unit 160. User adjustment elements for contrast and brightness are symbolically represented by potentiometers 159 and 161,



respectively, although in modern television systems, they usually include microprocessor controlled digital-to-analog converters. The processed luminance signal is coupled to matrix 152 where it is combined with the color difference signals to produce low level red(r), green(g) and blue(b) color signals. Horizontal and vertical retrace blanking pulses, HB and VB, respectively, generated in a deflection processing section (not shown), are inserted, by matrix 152 in the r,g,b color signals in order to prevent the display of horizontal and vertical retrace lines.

10 The low level r, g, b color signals are amplified by drive amplifiers 164r, 164b, and 164g, to produce R, G, B drive signals suitable for driving respective cathodes of a kinescope 166.

15 In order to prevent spot blooming, as well as display driver and phosphor saturation, due to excessive white-going signal peaks, corresponding, e.g., to characters, a peak detector 168 detects the white-going peaks of a luminance-representative signal, generated within control signal generator 140 as will be explained below, and, in response, generates a control signal for contrast control unit 158. Whenever white-going peaks exceeding a threshold corresponding to spot blooming are detected, the contrast is automatically reduced.

20 Unfortunately, the automatic contrast control apparatus affects all amplitudes uniformly since contrast control unit 158 has a linear gain transfer function. As a result, mid-range as well as high amplitudes tend to be reduced, resulting in a reduction of the subjective brightness of the image. White-stretch processing unit 136 counteracts this action in the following way.

25 The gain characteristic of white stretch processing unit 136 is graphically represented in FIGURE 2A. The gain characteristic includes a family of non-linear transfer functions having an increased gain (slope) for mid-range and lower level luminance amplitude levels compared with high luminance amplitude levels. The degree of non-linearity increases as an inverse function of the magnitude of a control signal V_C . For the highest magnitude (V_{C1}) of control signal V_C , the gain characteristic collapses to a linear transfer function. For lower magnitudes (e.g., $V_{C2} < V_{C1}$), the transfer functions become more



non-linear. In FIGURE 1, the white-stretch control voltage is identified as V_{CA} because it represents an average signal value, as will be described below.

5 An effective way of providing the transfer function of FIGURE 2A is shown in FIGURE 2B. An input voltage at an input 182 is coupled in parallel to the input of a linear amplifier 184 and to the input of a nonlinear amplifier 186. The output signals of amplifiers 184 and 186 are coupled to a "soft-switch" 188
10 which combines the linear and non-linear output signals in accordance with control voltage V_C to develop a final output signal at 192. The gain characteristic between input 182 and output 192 is that shown in FIGURE 2A.

The implementation of the apparatus shown in block diagram form in FIGURE 2B is shown and described in detail in
15 the concurrently filed application entitled "AMPLIFIER ARRANGEMENT FOR PRODUCING A CONTROLLABLE NON-LINEAR TRANSFER CHARACTERISTIC USEFUL FOR IMPROVING THE CONTRAST OF AN IMAGE", referred to above.

Returning now to FIGURE 1, the control signal
20 (voltage), V_{CA} , for white stretch processing unit 136 is derived in response to the average value of the luminance-representative signal (to be discussed below). When the average image brightness is low, control signal V_{CA} causes the degree of non-linearity of white stretch processing unit 136 to be increased (see
25 FIGURE 2A for V_{C2}). As a result, mid-range amplitudes of the luminance signal are increased relative to high amplitude levels. Since white-going peaks corresponding to small image areas do not significantly affect the average level, an automatic contrast reduction in response to excessive white-going peaks, tending to
30 further reduce mid-range amplitudes, will be compensated for by the white stretch gain increase applied to mid-range amplitudes. In this way, spot blooming, as well as display driver and phosphor saturation, are minimized while providing subjectively sharp, bright images.

35 As earlier noted, for automatic contrast and white stretch control it is desirable to detect the peak and average, respectively, of a signal representing the luminance component of the reproduced image after image characteristics, such as contrast



and brightness, have been adjusted so that the respective control signals will properly reflect the content of the reproduced image. The TA7730 luminance processing IC commercially available from Toshiba provides at an output terminal a luminance-
5 representative signal derived by combining r,g,b color signals which have been subjected to contrast and brightness control. Unfortunately, a luminance or luminance representative signal reflecting contrast and brightness control processing is not provided by other ICs, e.g., such as the TDA4580 available from
10 Valvo, as is indicated with respect to IC 154 in FIGURE 1.

Control signal generator 140 is directed to this problem by combining the r,g,b color signals produced at respective output terminals of IC 154 to produce a signal at least approximately representing processed luminance information.
15 However, the resulting "summed luminance" signal contains pulses corresponding to the high level (e.g., in the range of -100 to -160 IRE) retrace blanking pulses contained in the r,g,b signals which are combined, unlike the summed luminance signal produced by the TA7730 IC, in which r,g,b signals are combined
20 before retrace blanking pulses are added. The pulses contained in a summed luminance signal extend significantly below the black level and will therefore substantially affect the average value (as well as the peak-to-peak value). Accordingly, a control signal derived by detecting the average value of the summed signal
25 would not accurately represent the brightness of the reproduced image. Control signal generator 140 also includes provisions directed to this problem.

Specifically, with respect to control signal generator 140, the r,g,b color signals produced at respective output
30 terminals of IC 154 are summed by means of a resistive combiner comprising resistors 171, 173, 175. The resultant summed signal, produced at the common junction of resistor 171, 173 and 175, is coupled to the base of an emitter-follower amplifier 177. An output signal is developed across a load resistor 179 at the low
35 impedance emitter output of emitter-follower 177.

A resistor 181 coupled between a supply voltage source (V_{CC}) and the emitter of emitter follower 177 raises the conduction threshold of emitter-follower 177 so that substantially



the entirety of the white-going summed signal above the black level is provided at the emitter output, but the pulses, corresponding to the retrace blanking pulses of the r,g,b, color signals, are removed. Thus, due to the increased bias applied to the emitter, the detected average value and the resultant white-stretch control signal, V_{CA} , are relatively reliable representations of the average luminance component of the reproduced image.

While resistors 171, 173 and 175 can be proportioned according to the well known luminance matrix equation to accurately produce a luminance signal, a ratio of 1:1:1 has been found to be very satisfactory in practice for providing a processed luminance-representative component suitable for white-stretch processing control. Also in this regard, it is noted that because a black image corresponds to a complete lack of color information, it is possible to set the conduction threshold of transistor 177 to correspond to the nominal black level independently of the resistor ratio. Brightness adjustments have not been found to significantly affect the accuracy of setting the black threshold of transistor 177 in this manner.

While the discussion so far has been with reference to an arrangement in which all three color signals are summed to produce a luminance representative signal, it is also possible to use two color signals or even one color signal, as long as the blanking-related pulses are removed. This is because, on a statistical basis, the average of any color signal is close enough to the average of the luminance component so as to be adequate in a particular white-stretch processing control application. If one color signal is utilized, the green color signal is preferred because it most closely relates to the luminance information contained in an image.

The average value of the summed output signal is developed by an average detector 183, which may simply comprise an R-C low pass filter. The value of the white peaks of the summed output signal are detected by peak detector 168. A suitable peak detector, which is capable of responding to very sharp peaks, is disclosed in U.S. patent application serial number 380,697 entitled "Peak Detector With Feedback", filed on July 14,



1989 in the name of G.A. Whitledge and assigned to the same assignee as that of the present application.

While there has been illustrated and described what is at present considered to be a preferred embodiment of the present invention, it will be appreciated that changes and
5 modifications may occur to those skilled in the art. For example, while the invention has been described with reference to an IC in which contrast and brightness are controlled by controlling the amplitude and DC content of the luminance signal, contrast and
10 brightness may be controlled by individually controlling the amplitude and DC content of the color signals. This is the case in the TA7730 and TDA4580 ICs referred to above. In addition, while an emitter-follower amplifier is used in the exemplary embodiment, a different type of amplifier or any other type of
15 clipping arrangement for which a conduction threshold can be set may be employed to remove the retrace-blanking related pulses. It is intended that the following claims cover all of such and other modifications which fall within the scope of the present invention.

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CLAIMS:



1. A control signal generator for a television system including a video signal source (154) having at least one output providing a color video signal having a trace portion and having a blanking portion including blanking pulses;

characterized by

a pulse removing circuit (177,179,181) coupled to said video signal source for removing said blanking pulses from said blanking portion of said color video signal to produce a resultant video signal; and

a detector (168 or 183) coupled to said pulse removing circuit for detecting a given parameter of said resultant video signal and providing a control signal representative of said given parameter.

2. A control signal generator as recited in Claim 1 wherein said video signal source provides a plurality of said color video signals, said generator being further characterized by:

a summing circuit (171,173,175) coupled to said source for summing said plurality of color video signals to produce a summed video signal; and

said pulse removing circuit being coupled to said source via said summing circuit

3. A control signal generator as recited in Claim 2 wherein said signal source comprises an integrated circuit for processing luminance and chrominance components of a television signal and further characterized in that said control signal is coupled to an additional processing means (159 or 161) for providing feedback control of selected characteristics of said color video signals.

4. A control signal generator as recited in Claim 3 characterized in that said additional processing means comprises at least one of a contrast control means (159), a brightness control means (161) and a controllable non-linear amplifier (136).



5. A control signal generator as recited in Claim 2 characterized in that said detector comprises at least one of a peak detector (168) and an average detector (183).

6. A control signal generator as recited in Claim 2 characterized in that said summing circuit comprises a resistive network (171,173,175).

7. A control signal generator as recited in Claim 2 characterized in that said pulse removing circuit comprises an emitter follower (177) having an input to which said summed video signal is applied and having an output to which a source of bias (181) is applied.

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