

-1-

METHOD AND APPARATUS FOR DISABLING ANTI-COPY
PROTECTION SYSTEM IN VIDEO SIGNALSDISCLOSURE

Background of the Invention

This invention pertains to a video signal encoding /decoding system, but more specifically, to a method and apparatus for restoring to proper video format a video signal which has previously been encoded with anti-copy protection signals. The invention is useful in restoring video signals which are prerecorded on a video recording medium, such as signals recorded on videotape in a video cassette.

U.S. Patent 4,631,603 and copending patent application Serial No. 935,055 disclose copy protection systems for use with video signals. The system disclosed in the '603 patent is finding significant usage with video signals on recorded video cassette tapes. The addition of the copy protection signal(s) to a prerecorded video cassette tape prevents unauthorized copying of the tape and still permits viewing of the program from the original tape. The copy protection systems include unique pseudo-synchronizing pulses and /or positive control signals placed at certain locations in the video signal having the effect of inhibiting proper AGC (automatic gain control) adjustment in a video tape recorder (VCR) during recording. As a result, picture quality of unauthorized copies is significantly deteriorated. However, these anti-copy signals do not affect normal viewing of the original tape.

To explain the copy-protect processes, a typical video signal defines normal viewing fields (e.g., those parts displayed on a television set) and vertical blanking intervals between the fields. Both the viewing fields and the vertical blanking intervals include series of horizontal scan lines carrying picture data and control information that includes for each line, a horizontal synchronizing pulse. The horizontal sync signals are used for horizontally registering successive scan lines. Other synchronizing pulses, e.g. broad pulses and equalizing pulses, normally occur during the vertical blanking interval. These pulses generally are called vertical synchronizing (or sync) pulses because they occur only during the

vertical blanking interval. A television monitor or set, and also the proceeding circuitry associated with VCR recording, uses the vertical sync pulses for vertical roll synchronization and AGC trigger to gain adjustment. Alteration, modification or distortion of these signals can have a deleterious affect on picture quality.

Certain portions of a normal viewing field defined by a video signal typically are not used for defining the actual picture. More specifically, the horizontal scan lines immediately adjacent to those portions of a video signal defining vertical blanking intervals are not used in typical television monitors or sets to define the picture. Therefore those signal portions immediately adjacent to vertical blanking intervals are also available in their entirety for the addition of anti-copy protection signals. Thus, insofar as this invention is concerned, such signal portions are also be considered part of the vertical blanking intervals, and the term "vertical blanking interval" as used herein encompasses the same unless it is clear from the usage that only the actual vertical blanking interval is meant.

The aforementioned copy-protection systems change a normal video signal by adding positive (AGC) and/or pseudo-sync pulses after at least some of the normal sync pulses. By "added" pulses are meant pulses which are incorporated into the video signal to prevent copying, i.e., signals which supplement the normal video signal carrying typical picture data and control information. That is, the term "added" as used herein refers to the type of signal, rather than to the time at which it may be incorporated with the remainder of the video signal. In the arrangement disclosed in U.S. Patent No. 4,631,603, the added pulses appear in the vertical blanking interval so as to interfere with a VCR's vertical synchronizing and/or AGC circuitry.

Under certain circumstances, there is a need to disable the copy protection system to permit recording of copy-protected recordings, such as, for example, during

purposes. U.S. Patent No. 4,695,901 discloses several embodiments of one such system. It is an objective of the present invention to provide an improvement for disabling an anti-copy system.

Summary of the invention

The invention comprises a method and apparatus for narrowing the width and/or attenuating at least some of the pulses, such as added pseudo-sync and/or AGC pulses, by such an amount that the VCR circuitry (VCR sync separator and VCR sampling circuits for AGC, for example) fails to respond. Narrowing is preferably achieved by truncating a portion of each of the pulses or spacing them closer together to attain a high-frequency effect. This method and apparatus takes advantage of the limited bandwidth capacity of VCR circuits which behave similar to a low-pass filter while the wider bandwidth capacity of conventional television circuits continues to respond.

These and other aspects, features and advantages of the invention will become apparent upon review of the succeeding description taken in connection with the accompanying drawings. The invention is pointed out with particularity by the appended claims.

Brief Description of the Drawings

Fig. 1 is a detailed diagram of an illustrative circuit which alters the frequency characteristics of normal copy-protect signals by narrowing widths of pseudo-sync pulses.

Fig. 2 is a detailed diagram of an illustrative circuit which, in conjunction with the circuit of Fig.1, narrows either the AGC pulses or both AGC and pseudo-sync pulses.

Fig. 3(a) through 3(j) are waveforms for explaining the operation of the circuits of Figs.1 and 2.

Fig. 4(a) through 4(i) are waveforms for describing the effect of altered video signals in VCR circuitry.

Description of Illustrative Embodiments

Copy protection of video signals finds its widest use now in the protection of prerecorded tapes. Copy protection therefore will be described in connection with a for protecting prerecorded tapes of video cassettes.

Circuit diagrams Figs.1 and 2 together with the waveforms of Figs.3 to 4 illustrate alternative embodiments of the invention which inhibit or disable the effect of the copy-protect signals. In the following described embodiments, disabling or reduction in effect of the copy-protect signals is achieved by interposing a means of attenuation during presence of the copy-protect signals, by narrowing the width of the pseudo-sync and/or AGC pulses, or by otherwise increasing their high-frequency contents by, for example, time-compressing the pulses or adding additional narrow pulses between them to increase their effective frequency. Such means can be employed during all or part of the duration of the copy-protect signals. These embodiments are illustrative of any such means which alters, modifies or changes the video signal in a fashion where, because of the relatively slow response time (lowered video bandwidth) or other characteristic of VCR, the copy-protect signals become less effective or are nullified to prevent unauthorized copying.

Fig. 3(a) depict typical prerecorded signals in the blanking interval of a video signal. By way of example, Fig. 3(b) illustrates the results of a first modification wherein the pseudo-sync pulses 16' are narrowed to an extent that the VCR cannot respond to them. Fig.3(i) illustrates the results of a second modification wherein AGC pulses 18' are narrowed. Fig.3(j) illustrates the results of yet a third, modification where both the pseudo-sync pulses 16' and AGC pulses 18' are narrowed. Other variations or modifications, such as attenuation, level shifting, pulse narrowing, pulse extension, signal substitution or removal, or any combination thereof may also be employed to achieve the intended result of enabling copying of video signals having the copy-protect signals.

With the aid of other waveforms shown in Fig. 3 the pulse narrowing circuits of Fig. 1 and 2 are described as illustrative of a circuit for disabling the effects of copy-protect signals. Fig. 1 illustrates a circuit for narrowing pseudo-sync pulses, while Fig. 2 illustrates a circuit for narrowing AGC pulses or both AGC and pseudo-sync pulses. The copy-protect disabling means may include either or both of these circuits.

With reference to the pseudo-sync pulse narrowing, circuits of Fig. 1, a horizontal sync pulse V_H (Fig. 3(C) provided from a sync separation circuit is supplied to a one-shot circuit 100. One-shot 100 extends the duration of the horizontal sync pulses and provides an output pulse accordingly. Resistor 102 and capacitor 104 establish the duration of the output pulse of one-shot circuit 100. The circuit of Fig. 1 also receives a vertical rate sync pulse V_V . Both the extended horizontal sync pulse from one-shot 100 and the vertical rate sync pulse V_V are supplied to the inputs of AND gate (U5) 106, the output of which, shown in Fig. 3(e), controls an analog switch 108. When AND gate 106 is asserted, switch 108 couples video output 110 via buffer 112 to a blanking reference voltage V_{b1} for a time duration so as to narrow the first pseudo-sync pulse as indicated in Fig. 3(b). When AND gate 106 is deasserted, switch 108 couples the video output to the signal emanating from buffer 114. The output of buffer 114 is thereby switched to buffer amplifier 112, which in turn, produces video output at 110 having narrowed AGC pulses.

One shoot circuit 100 also supplies an output to another one-shoot circuit 116 thereby to produce at the output one-shoot 116 a signal indicative of the horizontal line period, e.g., a horizontal active gate. AND gate (U3) 118 produces an active horizontal video gate signal for scan lines 10 through 20 by logically combining the output of one-shoot circuit 116 and the vertical rate signal V_V .

AND gate (U4) 120 produces a signal for controlling a switch 122 that functions in combination with switch 108 to modify or alter the video output signal at output 110. One input of AND gate 120 is the output of AND gate 118 and the other input is coupled to the output of yet another one-shoot circuit 124. One-shoot 124 emits a series of pulses triggered by incoming AGC pulses. Also, one-shoot 124 triggers on the rising edge of the incoming AGC and produces at its output time-extended AGC pulses. These extended pulses are produced by "slicing" the incoming video signal at a certain voltage level to pass only those pulses above a threshold established by a reference voltage V_{b2} . The reference V_{b2} couples the inverting input of differential amplifier 126. Time constant components including resistor 128 and capacitor 130 of one-shot circuit 124 enable it to produce the extended AGC pulses having a duration longer than the

original AGC pulses. As a result, the output of AND gate 120 contains all sliced video pulses during lines 10 through 20 in the vertical blanking interval.

When AND gate 120 is asserted, an AGC reference pulse of a level V_{B} is inserted in the video signal at output 110, as depicted in Fig. 4 (b). When AND gate 120 is deasserted, the video signal passes unchanged to the output 110. In the VCR, the video signal during a portion of the vertical interval becomes "filtered" as depicted in Fig. 4(c).

Fig. 2 illustrates a circuit for narrowing AGC pulses and/or pseudo-sync pulses. For AGC pulse narrowing, the illustrated circuit receives a control signal (Fig. 3(d)) from AND gate 120 (Fig. 1) and generates pulses having a fraction of the width of original AGC pulses. As previously explained, the control signal triggers on the leading edge of each original AGC pulse. Time-constant components, including resistor 142 and capacitor 144, establish the pulse width of one-shot 140 output pulses, as shown in Fig. 3 (f). These pulses trigger additional one-shots 146 and 152. As subsequently described in further detail one-shot 146 produces control pulses which narrows AGC pulses, while one-shot 152 produces control pulses which narrow both AGC and pseudo-sync pulses.

To narrow AGC pulses, the output of one-shot 146 controls switch 158 for selectively coupling either the input video signal or a blanking reference level V_{B} to buffer amplifier 160. Pulse widths (durations) emitted from one-shot 146 are established by resistor 148 and capacitor 150. Exemplary pulses are shown in Fig. 3 (g). The buffer amplifier 160 supplies an output video signal from switch 158 to an output terminal 162, as shown in Fig. 3 (i), which enables copying of input video having embedded copy-protect signals.

To narrow both AGC and pseudo-sync pulses, one-shot 152 produces a control signal which controls switch 164. Fig. 3(h) depicts the output of one-shot 152 in accordance with resistor-capacitor time-delay circuit 154, 156. Switch 164, under control of one-shot 152, couples either input video or a blanking reference level V_M to buffer amplifier 166. Buffer amplifier 166 holds the output from switch 164 for further alteration. Another control signal (Fig. 3 (e)) from AND gate 106 (Fig. 1) controls a switch 168 to effect cascaded control of the video signal from switch 164. The control signal from AND gate 106 narrows the first pseudo-sync pulse of the horizontal line. As a result, the combined effect on the video signal at output 170 via buffer amplifier 172 is a video signal having both AGC pulses and pseudo-sync pulses narrowed, as shown in Fig. 3(j).

As readily understood from the foregoing, a preferred means for disabling the effect of copy-protect signal appearing in a prerecorded medium may comprise any one of or a combination of the subparts previously set forth, depending upon whether it is desired to change either or both of the AGC and pseudo-sync pulses.

Fig. 4 illustrates the relationship among original copy-protect input signals of Fig. 4 (a), various selected disabling means, and typical VCR circuitry. For example, upon narrowing pseudo-sync pulses as shown by Fig. 4 (b), the low-pass filtering effect of the VCR transfers a waveform illustrated in Fig. 4 (c) wherein only the original sync pulse is seen, and added AGC pulses and pseudo sync pulses have disappeared. Upon narrowing AGC pulses as indicated in Fig. 4 (d), the low-pass filtering effect of the VCR transfers a waveform as illustrated in Fig. 4 (e) wherein the positive AGC pulses no longer affect AGC gain control. Upon narrowing both AGC and pseudo-sync pulses as indicated in Fig. 4 (f), the low-pass filtering

effect of the VCR transfers a waveform as illustrated in Fig. 4 (g).

As previously indicated, any means which defeats or disables the copy-protect signals based upon the low-pass filtering effect, reduced sensitivity, or other characteristic of a typical VCR suffices to achieve the task set out by the invention. Figs. 4 (h) and 4 (i) show, for example, a means of increasing the effective frequency of pulses appearing in the vertical blanking interval. In this example, AGC and pseudo-sync pulses were narrowed, multiplied, and time-compressed so as to increase their frequency as shown in Fig. 4 (h). Since the VCR circuitry cannot respond quickly, the net effect due to low-pass filtering is the waveform depicted in Fig. 4 (i). Further, means which attenuates the copy-protect signals during a detected portion in the vertical blanking interval by such a level to render them ineffective also achieves the task set out by the invention.



CLAIMS

1. A method for disabling the effects of copy-protect signals added to blanking intervals of a video signal having normal sync pulses, said copy-protect signals including at least one added AGC pulse, said method comprising the steps of:

detecting said blanking interval of said video signal;

identifying the position of said at least one added AGC pulse; and

generating altered video signals in response to said detecting and identifying steps in a manner so as alter the copy-protect signals to reduce their effectiveness in copy-protection;

wherein said copy-protect signals inhibit copying by a video cassette recorder and wherein said developing step comprises altering, reproducing or regenerating said copy-protect signals in a manner where internal characteristics of said video cassette recorder inherently nullify the effects of said copy-protect signals; and

wherein said developing step comprises increasing a frequency of said copy-protect signals beyond an effective bandwidth of a video cassette recorder.

2. A method for reducing effects of copy-protect signals in blanking intervals of a video signal, said copy-protect signals including at least one added



- 10 -

pulse and each blanking interval including at least one sync pulse preceding said added pulse, said method comprising the steps of:

receiving an input video signal;

detecting said at least one sync pulse;

generating copy-protect disabling signals which increase a frequency of said copy protect signals beyond an effective bandwidth of a video cassette recorder, in accordance with said detecting step; and

providing an output video signal including a composite of said input video signal and said disabling signals.

3. A method as recited in claim 1 or 2 wherein said generating step comprises increasing an effective frequency of said copy-protect signals by narrowing widths of the pulses of said copy-protect signals.
4. A method as recited in claim 1 or 2 wherein said generating step comprises increasing an effective frequency by effectively time-compressing said copy-protect signals.
5. A method as recited in any one of the preceding claims whereas said blanking interval is a vertical blanking interval following a normal viewing field.
6. A method as recited in any one of the preceding claims wherein said video signal is a pre-recorded video signal on a video cassette tape.
7. A method as recited in claim 1 wherein said generating step comprises attenuating said copy-protect signals beyond a range of signal sensitivity of said video cassette recorder.



- 11 -

8. A method for reducing the effect of copy-protect signals in a blanking interval of a video signal wherein said copy-protect signals include at least one added AGC pulse, and said blanking interval includes at least one normal sync pulse, said method comprising the steps of:

receiving an input video signal from said recording medium;

detecting the normal sync signal and identifying the location of said copy-protect signals on the basis of the detected normal sync signal;

generating copy-protect disabling signals which increase a frequency of said copy-protect signals beyond an effective bandwidth of a video cassette recorder in accordance with said detecting step; and

transmitting an output video signal comprising a composite of said input video signal and said disabling signals.

9. A method for reducing the effect of copy-protect signals in a vertical blanking interval of a video signal wherein said copy-protect signals include at least one pseudo-sync pulse and an added AGC pulse, and said blanking interval includes at least one normal vertical sync pulse, said method comprising the steps of:

receiving an input video signal from said recording medium;

detecting the vertical sync signal and identifying the location of said copy-protect signals on the basis of the detected vertical sync signal;

generating copy-protect disabling signals which increase a frequency of said copy-protect signals beyond an effective bandwidth of a video cassette recorder in accordance with said detecting step; and



- 12 -

transmitting an output video signal in accordance with a representation of said input video signal and said disabling signals.

10. An apparatus for disabling the effects of copy-protect signals in a video signal, said copy-protect signals including at least one added AGC pulse, said apparatus comprising:

receiving means for receiving an input signal representative of said video signal;

detecting means connected with said receiving means for detecting said copy-protect signals;

signal disabling means responsive to said detection means for generating disabling signals; and

output means for transmitting an output video signal in accordance with a representation of said input video signal and said disabling signals;

wherein said disabling means includes means for increasing an effective frequency of said copy-protect signals.

11. An apparatus for disabling the effects of copy-protect signals contained in vertical blanking intervals of a video signal, said copy-protect signals including at least one added pseudo-sync signal and one added AGC pulse, said apparatus comprising:

receiving means for receiving an input signal representative of said video signal from said recording medium;



- 13 -

detection means connected with said receiving means for detecting said vertical blanking interval which includes said copy-protect signals;

signal disabling means responsive to said detection means for generating disabling signals during the occurrence of at least a portion of said copy-protect signals; and

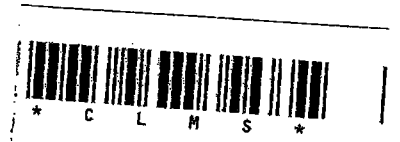
output means for transmitting an output video signal in accordance with a representation of said input video signal and said disabling signals;

wherein said detection means comprises a sync separator for separating the vertical blanking interval from the remaining video signal, said disabling means comprises means for increasing an effective frequency of said copy-protect signals thereby to produce altered signals, and said output means includes means for transmitting the altered signals and a representation of the input video signal.

12. An apparatus as recited in claim 10 wherein said detection means comprises a sync separator for separating the vertical blanking interval from the remaining video signal, said disabling means comprises means for attenuating at least a portion of said copy-protect signals thereby to produce attenuated copy-protect signals, and said output means includes means for transmitting the attenuated copy-protect signals and a representation of the input video signal thereby to transmit an output video signal having disabled copy-protect signals.

13. An apparatus for reducing the effects of copy-protect signals in a video signal, said copy-protect signals including at least one added pulse, said apparatus comprising:

a video input terminal receiving an input signal representative of said video signal;



a sync separator having an input terminal connected to said video input terminal and having an output terminal, thereby providing at said output terminal a signal indicating a blanking interval of said video signal;

disabling circuitry having an input terminal connected to said output terminal of said sync separator, and having an output terminal, providing at said output terminal of said disabling circuitry altered copy-protect signals having an increased effective frequency; and

a video output terminal connected to said output terminal of said disabling circuitry and to said video input terminal, thereby providing a composite of said input video signal and said altered copy-protect signals.

14. An apparatus as recited in claim 13 wherein said disabling circuitry increases an effective frequency of said copy-protect signals by narrowing widths of the pulses of said copy-protect signals.
15. An apparatus as recited in claim 13 wherein said disabling circuitry increases an effective frequency by effectively time-compressing said copy-protect signals.
16. An apparatus as recited in claim 13 wherein said blanking interval is a vertical blanking interval following a normal viewing field.
17. An apparatus as recited in claim 13 wherein said video signal is a pre-recorded video signal on a video cassette tape.