

ON/OFF CONTROL OF A CABLE CONVERTER UNIT**BY A VCR**

The subject application concerns the field of videocassette recorders (VCRs) and apparatus for programming them.

The subject Patent Application is related to copending U.K. Patent Applications GB 2263032A entitled "VCR Control of a Cable Converter Unit" and GB 2263035A entitled "An IR LED Assembly for VCR Control of a Cable Converter Unit".

When a television set owner is a subscriber to a cable television system and also possesses a videocassette recorder (VCR), he may be required to connect to the cable system via a cable decoder box (also called a CATV converter, or a set-top converter). This connection may be required, because in these systems, many cable channels (i.e., the so-called premium channels) are scrambled (i.e., encoded or encrypted) and must be descrambled (i.e., decoded or decrypted) in the cable box. The cable box descrambles the premium channel and converts its RF carrier frequency from its assigned cable channel frequency to a cable box output frequency, normally that of channel 2, 3, 4, or 5 for reception and recording by the VCR, or display by the television receiver. In such an arrangement the viewer may have as many as three remote control units for controlling the video equipment (i.e., one each for a television set, a VCR, and the cable box).

Recently, a programming simplification system known as VCR PLUS™, manufactured by Gemstar Development Corporation, Pasadena, California, has become available. Briefly, the apparatus of the VCR PLUS™ system resembles a standard remote control handunit. The handunit is preprogrammed with the codes for controlling the VCRs and cable control boxes of many manufacturers. The handunit is then programmed by the user with a unique code comprising 1 to 8 digits, which code corresponds to a particular television show broadcast on a given

channel, at a given time and date, and having a given duration. A television show which is broadcast at the most popular viewing time (for example, 7 pm) may have a code which comprises only 1 digit. Conversely, a television show which is broadcast at the least popular viewing time (for example, 3 am) may have a code which comprises the full 8 digits. These codes are printed in the channel guide section of the viewer's local newspaper along with the normal time and channel information. After entering the unique 1 to 8 digit code for a particular television show to be recorded, the user places the handunit in a cradle mounted on his VCR to ensure that the handunit is in the proper orientation for transmitting data to the IR (infrared) receiver of the VCR and to the cable box. At the proper time, the VCR PLUS™ handunit transmits IR codes to the cable box to turn it on and tune it to the desired channel, and to the VCR to turn it on and program it to record the desired television show.

Unfortunately, the stand alone VCR PLUS™ handunit operates in an "open-loop" mode. That is, the VCR PLUS™ handunit has no way of knowing if its commands were actually received by either the VCR or by the cable box because no feedback signal to the VCR PLUS™ handunit exists. This situation causes the following problem. Most cable box IR remote control command formats do not include separate commands for POWER ON and POWER OFF. Rather, it is common practice for cable box manufacturers to program the cable box such that the POWER ON/OFF remote control command is a toggle function. If the command is received while the cable box is "on" then it will turn off. If the command is received while the cable box is "off", then it will turn on. With an "open loop" type of system, such as implemented in the VCR PLUS™ handunit, the controller has no way of knowing if the cable box is "on" or "off". Thus, if the cable box is already "on", the command to turn it "on" in preparation for transmitting it a channel change command will in fact turn the cable box off. As a result, the desired channel change will not be accomplished, and the desired program will not be recorded.

Apparatus in accordance with the subject invention controls a cable box (i.e., the source of its own video input signals), and monitors the television signals received from the cable box, in a "closed loop" manner. By monitoring an appropriate
5 signal the controller of the VCR can detect perturbations of signal level which indicate that the cable box has changed channels. That is the output signal of the cable box remodulated on, for example, the RF carrier frequency of channel 3, will be momentarily lost during the period in which
10 the cable box changes channels. Thus, the subject apparatus can determine if the cable box is "off" or "on" by issuing a channel change command and observing if the cable box responds to the channel change command.

15 In one embodiment of the invention the VCR causes an on-screen display of an error message if it determines that it is unable to control the cable box.

An exemplary embodiment of the invention will now be described,
20 with reference to the following figures:

Figure 1 shows, in block diagram form, a VCR incorporating the subject invention.

25 Figures 2a and 2b are views of a VCR incorporating the invention.

Figure 3 is a flowchart showing a portion of the control program of the controller of Figure 1.

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Referring to Figure 1, radio frequency (RF) signals are applied to an RF input terminal of a tuner assembly 102. Tuner assembly 102 selects a particular RF signal under control of a tuner control unit 104 which applies a tuning control

signal to tuner assembly 102 via a wire 103, and applies bandswitching signals via a control bus 103'. Tuner control unit 104 is controlled by a controller 110. Controller 110, which may be a microprocessor or microcomputer, includes a
5 central processing unit (CPU) 112, a read-only memory (ROM) 114, a random access memory 116, and an external electrically-erasable read only memory (EEPROM) 117. Controller 110 generates a control signal for causing tuner control unit 104 to control tuner 102 to select a particular RF signal, in response
10 to user-entered control signals from a local keyboard 120 and from an infrared (IR) receiver

122. IR receiver 122 receives⁵ and decodes remote control signals transmitted by a remote control unit 125.

Tuner 102 produces a signal at an intermediate frequency (IF) and applies it to a processing unit 130 comprising
5 a video IF (VIF) amplifying stage, an AFT circuit, a video detector, and a sound IF (SIF) amplifying stage. Processing unit 130 produces a first baseband composite video signal (TV), and a sound carrier signal. The sound carrier signal is applied to an audio signal processor unit 135 which includes an audio detector
10 and may include a stereo decoder. Audio signal processor unit 135 produces a first baseband audio signal and applies it to a signal switch unit 137. Second baseband composite video signals and second baseband audio signals may be applied to VIDEO IN and AUDIO IN terminals from an external source.

15 The first and second baseband video signals (TV) are coupled to a video processor unit 155 (having a selection circuit not shown) and is also applied to signal switch unit 137. Video and audio signals are also applied to a tape recorder unit 165 which causes the signals to be recorded onto video tape. Tape
20 recorder unit 165 has a control input and operates under control of a tape recorder unit controller 160, which may be a microprocessor. Tape recorder unit controller 160 is in turn controlled by control signals from controller 110. Under control of controller 110, an on-screen display processor 140 generates
25 character signals, and applies them to a second input of video signal processor 155, for inclusion in the processed video signal. Signal switch unit 137 is controlled by controller 110 via a control input terminal C to select audio and video signals from audio signal processor 135 and video signal processor 155, or
30 from the output terminals of tape recording unit 165 in the playback mode, and to apply the selected signals to a modulator 139 for modulation onto a particular channel frequency carrier, typically that of channel 3 or channel 4. That portion of the circuitry shown in FIGURE 1 which has been described thus far is
35 known from RCA videocassette recorder model VR520.

Unlike the RCA VR520, which has as its main programming feature a TIMER PROGRAM mode of operation, apparatus according to the subject invention may include both a

TIMER PROGRAM programming feature and a VCR PLUS™ programming feature. The control program for the above-mentioned features resides in ROM 114 of controller 110.

Electrically-erasable programmable read only memory (EEPROM) 117 is coupled to controller 110, and serves as a non-volatile storage element for storing autoprogramming channel data, user-entered channel data, and VCR PLUS™ channel mapping data.

An IR LED driver circuit, generally, designated 100, is coupled to controller 110, for providing IR signals to external units, such as a cable box for a cable TV service. IR LED driver circuit comprises a filter capacitor C102, a current-limiting resistor R102, three series-connected IR LEDs (infrared light emitting diodes) D101, D102, and D103, a darlington-connected transistor switch Q101, a base resistor R101, and a speed-up capacitor C101. Controller 110 also controls a visible light LED D104 via an LED driver circuit comprising a resistor R103 and a transistor Q102. Visible light LED D104 serves as an indicator that the TIMER recording function is enabled.

Processing unit 130 also produces an IF AGC signal which is coupled to controller 110 via a wire 131, for detection of variation of the signal strength of signals of currently-tuned channels, the changes being indicative of channel changes. Alternatively, video signal processor 155 produces a valid sync detection signal which is coupled to controller 110 via a wire 151, for detection of valid TV sync, changes in the detection of valid TV sync being indicative of channel changes.

It is herein recognized that it is a clear advantage for the unit which contains the VCR PLUS™ control code (in the subject case, the VCR) for controlling the cable box, to be coupled to the television antenna line, so that the controller can determine whether or not the cable box is actually responding to transmitted IR commands. As noted above, most cable box IR remote control command formats do not include separate commands for POWER ON and POWER OFF. Rather, it is common practice for cable box manufacturers to program the cable box such that the POWER ON/OFF remote control command is a toggle function. Although some cable boxes do include such separate commands, it is felt that a VCR designed to control cable boxes should be able to

control both types of cable boxes. If a "toggle-type" POWER-ON/OFF command is received while the cable box is "on" then it will turn off. If the command is received while the cable box is "off", then it will turn on. With an "open loop" type of system, such as implemented in the VCR PLUS™ handunit, the controller has no way of knowing if the cable box is "on" or "off". Thus, if the cable box is already "on", the command to turn it "on" in preparation for transmitting it a channel change command will in fact turn the cable box off. As a result, the desired channel change will not be accomplished, and the desired program will not be recorded.

In contrast, apparatus in accordance with the subject invention controls the POWER ON/OFF function of the cable box (i.e., the source of its own video input signals), and monitors the television signals received from the cable box, in a "closed loop" manner. By monitoring the IF AGC signal on line 131 of FIGURE 1, controller 110 can detect perturbations of the signal level which indicate that the cable box is, in fact, powered-up as indicated by the fact that it can change channels. That is, the output signal of the cable box remodulated on, for example, the RF carrier frequency of channel 3, will be momentarily lost during the period in which the cable box changes channels. Thus, the subject apparatus can determine if the cable box is "off" or "on" by determining if the cable box responds to channel change commands.

It is important to note that even though "off", some cable boxes still produce (i.e., couple through) the television signal of the last selected cable channel. Thus, merely detecting the presence of a television signal is not enough to unambiguously determine that the cable box is indeed "on" (i.e., capable of responding to channel change commands).

It is also recognized that other signals (such as a "Valid Sync Detect" signal or baseband video AGE coupled by line 151 of FIGURE 1) can also be monitored to provide this feedback information as to whether commands transmitted to the cable box have actually been received and executed. Advantageously, if a signal which tracks a characteristic of the baseband video signal (such as Valid Sync Detect or baseband video AGC) is used for

detecting loss of signal during channel change, then the subject invention is applicable to use with cable boxes which produce decoded cable television signals at baseband rather than remodulating them to a particular television channel frequency.

5 The present invention will be further described with reference to FIGURES 2a and 2b, and 3.

FIGURE 2a is a perspective view of a cable box 210 placed VCR 200 having a , In FIGURE 2b, VCR 200 is shown coupled to the RF input via cable box 210. Tuner 102 of FIGURE 10 2b is the same tuner unit 102 previously described with respect to FIGURE 1. It is common practice for cable television services to encode (i.e., scramble) at least their "Premium" channels. FIGURE 2b is a configuration which may be used when some or all of the television channels provided by the cable television service are 15 encoded in some fashion (i.e., a cable box is required for decoding). In such a configuration, the VCR will be set to record all television programs on the cable box output channel (typically, channel 2, 3, or 4). Cable box 210 of FIGURES 2a and 2b includes a window 212 for admitting an IR (infrared) remote control signal 20 for turning the cable box on and off, and for causing the tuner of the cable box to change channels. VCR 200 of FIGURES 2a and 2b includes a window 204 for admitting an IR (infrared) remote control signal for turning the VCR on and off, for causing the tuner 102 of the VCR to change channels, and for controlling the 25 recording and playback of videotapes. VCR 200 also includes a window 214 through which IR signals generated by the VCR are transmitted to external units such as cable box 210. Note from FIGURE 2b that cable box 210 preferably receives IR signals from window 214 of VCR 200 along a rearward directed path 216, and 30 from a "bounce" path 218 in which the IR signals may be reflected from a wall or other object 220. The rearward direction of the IR light provides more assurance that the VCR-generated IR commands will reach the cable box. It is important to note that because the "bounce" IR light path 218 is always longer than the 35 more direct rearward path 216, more IR power is required to ensure remote control signal reception at the cable box. For this reason, two IR LEDs are directed along the longer bounce path. The two generally forward-facing LEDs may also be angled

outward from each other (i.e., along diverging paths) in order to cover more area and increase the chance of reflecting a signal back to the cable box. The "bounce" path is provided for the case in which the user chooses not to place the cable box on top of the VCR.

FIGURE 3, shows a portion of the control program of controller 110 of VCR 200. The routine illustrated in FIGURE 3 ensures that cable box 210 is powered-up, so that it is capable of executing any channel change commands which may be required to record the desired television programs. First, the VCR turns itself on, and tunes its own tuner to the output channel of the cable box. This is automatically done by the software of controller 110 approximately two minutes before the scheduled time of the start of the desired television program. The routine is then entered at step 300 in which the cable channel memory is initialized to channel 2. At step 305, the cable box ON/OFF toggle command is sent to the cable box. As noted above, this action may cause the cable box to turn off if it is already on. At step 310, the stored channel number code, is sent to the cable box. The cable channel number memory is incremented at step 315. At step 320, the newly incremented cable channel number is sent to the cable box. If the cable box is turned on, then there will be a variation in the monitored signal (i.e., such as video AGC), as the cable box changes from one channel to the next higher channel. This variation is looked for in step 325. If no variation is present, then the cable box may be in the off state. In that case, a check is made that the incrementing procedure of step 315 has not yet caused the cable channel number to reach channel 14 (step 330). While a check of only three or four channels might be sufficient to ensure that the cable box is on, checking all of channels 2-13 is easily accomplished with the routine of FIGURE 3, and a count of 14 is a reasonable value at which to terminate the routine, and escape the loop. Therefore, if at step 330, if the cable channel number is less than 14, the program loops back to step 305, and once again issues the POWER ON/OFF toggle command to the cable box. A cable channel number exceeding 13 indicates that the program loop (i.e., 305-330) has been traversed repeatedly with no detectable variation of television signal. In that case, the NO

path is taken from step 330 to step 335, at which a TIMER LED (light emitting diode) on the VCR front panel is flashed repeatedly, and a "fail" message is displayed on the screen of a television receiver which may be connected to the VCR. The program is then
5 exited by turning off the VCR at step 340.

Returning to step 325, if a variation in the television signal were detected, the YES path is taken to step 345, at which the cable box is controlled to tune to the proper channel for recording the desired program. At step 350, the VCR begins to
10 record the desired program at the proper time, and ends the recording at the proper time at step 360. It is herein recognized that most television program recording takes place when the user is not at home. Therefore, when the recording is over, the POWER ON/OFF toggle command is once again sent to the cable box to shut
15 it off.(step 360). The VCR then shuts itself off at step 340.

Although the VCR PLUS™ system is referred to in the subject specification, it is herein recognized that the subject invention does not require the use of the VCR PLUS™ system and is extremely useful with standard timer recording.



Claims

1. A videocassette recorder, comprising:
 - a radio frequency (RF) signal input terminal, for receiving a particular RF signal from a controllable external source of RF signals having a first tuner being capable of tuning to a plurality of channels:
 - said videocassette recorder further including,
 - a second tuner coupled to said RF signal input terminal for receiving said particular RF signal, said second tuner tuning said particular RF signal in response to a control signal;
 - a controller for generating said control signal for causing said second tuner to tune said particular RF signal;
 - a data entry unit, coupled to said controller, for entering data in response to operation by a user;
 - a transmitter coupled to said controller for transmitting a remote control signal for controlling said controllable external source of said RF signals; and
 - a detector for detecting an active television signal, said detector being coupled to said second tuner for receiving a signal derived from said particular RF signal, and in response to the detection of a predetermined characteristic of said particular RF signal generates a signal indicative of an active television signal and applies said indicative signal to said controller, said indicative signal exhibiting a variation when said first tuner is tuned from channel to channel;
 - said controller in response to data entered by said user generates said remote control signal and applies said remote control signal to said remote control signal transmitter;
 - said controller causing transmission of a first remote control signal for causing said external source of said RF signals to change between one of a powered state and an unpowered state;
 - said controller thereafter causing transmission of a second remote control signal for causing said external source of said RF signals to change channels and thereafter monitors said indicative signal for said variation of said indicative



signal;

said controller determining that said external source of said RF signals is in a powered state upon detecting said variation, and determining that said external source of said RF signals is in an unpowered state upon failing to detect said variation.

2. The videocassette recorder of claim 1, wherein said transmitter is an IR LED assembly, and said remote control signal is an IR signal.

3. The videocassette recorder of claim 1 or 2, wherein said detector is an automatic gain control (AGC) circuit, and said signal indicative of an active television signal is an AGC signal.

4. The videocassette recorder of claim 1 or 2, wherein said detector is a valid television synchronizing signal detection circuit, and said signal indicative of an active television signal is a signal indicative of the detection of a valid television synchronizing signal.

5. The videocassette recorder of any preceding claim, further comprising:
an on-screen display circuit for displaying on-screen messages on a display screen of a television set;

said controller causing said on-screen display circuit to produce a message indicative of failure in response to said determination that said external source of said RF signals is in said unpowered state.

6. The videocassette recorder of any preceding claim, further comprising:
a timer indicator for displaying a timer indication;

said controller causing said timer indicator means to flash as an indication of failure in response to said determination that said external source of said RF signals is in said unpowered state.



7. The videocassette recorder of any preceding claim, further comprising:
a baseband video signal input terminal, for receiving a baseband video signal from an external source of video signals, said external source of video signals having a tuner capable of tuning a plurality of channels, said external source of video signals providing a video signal derived from a selected one of said channels as said baseband signal;

said transmitter being coupled to said controller for transmitting a remote control signal for controlling said external source of said video signals; and

said detector being coupled to said baseband video signal input terminal for receiving said baseband video signal, and in response to the detection of a predetermined characteristic of said baseband video signal generates a signal indicative of an active television signal and applies said indicative signal to said control means, said indicative signal exhibiting a variation when said tuner of said external source of video signals is tuned from channel to channel.