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FIELD TO FIELD VERTICAL PANNING SYSTEM

Background of the Invention

The invention relates to vertical panning systems which operate properly even under those circumstances in which the number of horizontal lines in successive video fields is unequal, and/or of a length which differs from a standard length.

A wide screen television receiver can be arranged to display television signals in a variety of ways. The receiver can detect signals in letterbox format, and expand the 4 X 3 received signal such that the blank top and bottom bands are cropped and the signal fills a 16 X 9 display area. The receiver can also expand or zoom a non-letterbox signal (e.g., 4 X 3) while cropping active video areas at the top and bottom, to fill the wide screen display. Along with this feature is the additional capability to generate vertical blanking and reset signals for displaying the zoomed source.

A vertical panning circuit controls which part of a vertically overscanned raster will be displayed on the screen. If the vertically overscanned video signal is not in letterbox format, the picture can be zoomed, that is expanded both vertically and horizontally, to simulate a wide screen display format without distorting the displayed portion of the signal. Assuming, by way of example, a change from a 4 X 3 signal to a 16 X 9 display (although other specific ratios are possible), one third of the vertical dimension of the picture is cropped. Many vertical deflection systems are AC coupled, and as a result, pictures are always vertically centered on the display. In the case of a 4:3 picture zoomed for display on a 16:9 display, the top one sixth and bottom one sixth of the picture will always be cropped with an AC coupled vertical deflection system.

The picture content may make it more appropriate to crop more at the top or bottom, while retaining the content at the other. For example, where the action in a picture is at ground level, the viewer might prefer to crop more of the sky. A vertical panning capability enables a choice as to which part of the zoomed picture will be cropped. This can be accomplished by generation of a vertical reset pulse that is delayed by a selectably variable amount from the leading edge of a processed vertical synchronizing pulse based on



the video signal received, referred to as VSYNC. A vertical blanking pulse is likewise generated. The vertical reset pulse is used by the chassis to initiate a vertical retrace, and during the blanking interval defined by the vertical blanking pulse the electron beam is disabled. Since the video output of the wide screen processor is not delayed, a vertical panning feature is created by the appropriate manipulation of vertical blanking and vertical reset pulse delay relative to VSYNC.

One may wish to pan up or down. Panning directions are defined herein in terms of the direction in which the field of view moves over the expanded or zoomed picture. Panning down, for example, will reveal picture content in a lower part of the zoomed picture and will crop picture content from an upper part of the zoomed picture. Panning the video down may also be thought of as scrolling the picture up. Conversely, panning the video up may also be thought of as scrolling the video down. Panning down involves a delay of vertical reset and blanking for each field (of two interleaved fields) by some number of horizontal lines which is less than that of the field. For NTSC, each field is 262.5 lines. Panning up, on the other hand, would require moving the vertical reset and blanking pulses ahead in time relative to VSYNC, which of course is not possible in an AC coupled vertical deflection system if VSYNC is the triggering signal.

Both panning up and panning down may be accomplished by delaying the vertical reset signal by a number of half lines less than or equal to that of one field. For a standard NTSC signal comprising fields having 262.5 lines (i.e., 525 half lines), the panning down delay is between zero and 262.5 half lines. The panning up delay is between 262.5 and 525 half lines. However, this solution still will not accommodate non-standard signals which are produced, for example, in certain modes of VCR playback. Where the non-standard signal is such that the field lengths are not equal, such as pause for a dual azimuth four head VCR, panning up produces an interline flicker with the offset between fields being equal to the difference in the number of lines between successive fields. The respective lines of the successive fields displayed are not aligned. The result



is a very severe artifact which effectively makes the picture unwatchable.

In other VCR modes, the field lengths may be equal, but not of a standard length (i.e., number of horizontal lines). In visual search modes, for example, the field lengths may be equal, but shorter than standard for forward searching and longer than standard for reverse searching. The specific number by which the field line count differs from standard depends on the recording speed and on the search speed, and can be, for example, ± 10 lines. The variation in field line length causes the upward pan delay to pan by too much or too little when operating in the search modes, as compared to operating in the standard mode. In other words, the variation in field line length can cause additional, undesired panning. This occurs because the pan delay is referenced to the previous vertical sync on the assumption that the field length is standard. However, the amount of upward pan obtained is a function of the phase relationship between the vertical reset pulse generated by the pan delay circuit, and the beginning of the next field, i.e., the next VSYNC. Where the number of lines in the field varies, the phase relationship of the vertical reset and the next VSYNC must vary as well.

Summary of the Invention

These and other aspects of the invention are provided in a television apparatus comprising a display for a video signal representing a picture, a measuring circuit, a panning circuit and an adjusting circuit. The video signal has a vertical synchronizing component defining fields of horizontal lines which can have other than a standard number of horizontal lines per field under certain operating conditions. The measuring circuit determines the number of horizontal lines in each field. The panning circuit generates a vertical reset signal which is phase shifted by a selected number of horizontal lines relative to the vertical synchronizing component of the video signal for vertically panning the picture on the video display by the selected number of horizontal lines. The selected number of horizontal lines is adjusted responsive to the measured lengths of the fields to maintain the selected amount of vertical panning even under the certain operating conditions.



The measuring circuit comprises: first and second counters; first and second latches coupled to the first counter; a gating circuit coupled to the first and second latches for selecting which of the first and second latches loads an input from the first counter; and, a first multiplexer responsive to the second counter for selecting an output between the first and second latches. The adjusting circuit comprises: a second multiplexer for selecting as an output between: (a.) successive ones of the selected number of horizontal lines; and, (b.) an algebraic sum of the successive ones of the selected number of horizontal lines and successive ones of the measured lengths, the second multiplexer being responsive to a sign-representative bit of the phase shift; and, a comparator for generating an output signal for initiating the vertical reset signal when the length of a field being measured reaches the output value of the second multiplexer.

Brief Description of the Drawings

FIGURE 1 is a schematic diagram generally illustrating the component parts of a wide screen television apparatus according to the invention.

FIGURE 2 is a combination block and circuit diagram illustrating the deflection circuit shown in FIGURE 1.

FIGURE 3 is a block diagram showing a vertical size control circuit, including a letterbox detector.

FIGURE 4 is a timing diagram illustrating aspects of vertical panning.

FIGURES 5(a) - 5(c) are display format diagrams useful for explaining aspects of vertical panning in connection with FIGURE 4.

FIGURE 6 is a timing diagram illustrating the relationship of vertical sync and vertical reset signals, useful in explaining the operation of the invention.

FIGURE 7 is a circuit diagram illustrating a means for generating a forced vertical reset.

FIGURE 8 is a block diagram of a circuit for monitoring successive field lengths and generating vertical reset and blanking pulses for implementing vertical panning, which are adjusted in accordance with measured field lengths.



FIGURE 9 is a detailed circuit diagram showing an implementation of the counter, latches and multiplexer portion of the circuit according to FIGURE 8.

FIGURE 10 is a detailed circuit diagram showing an
5 implementation of the adder, pan multiplexer and comparator portion of the circuit according to FIGURE 8.

FIGURE 11 is a detailed circuit diagram showing an implementation of a parallel circuit for generating both vertical reset and vertical blanking pulses as indicated by the circuit
10 according to FIGURE 8.

Detailed Description of the Preferred Embodiments

A block diagram for a wide screen television according to the invention is shown in FIGURE 1. The television can be arranged to operate with $2f_H$ non-interlaced horizontal scanning or with
15 conventional horizontal scanning, a non-interlaced version being shown. The television receiver in general comprises a power supply 70, a video signal input section 20, a chassis or TV microprocessor 216 coupled to a one-chip processor 202, a wide screen processor 30, a $1f_H$ to $2f_H$ converter 40, a deflection circuit 50, an RGB
20 interface 60, a YUV to RGB converter 240, kine drivers 242, and display tube arrangement 244, which may be arranged for projection or direct view. The grouping of the various circuits into functional blocks is made for convenience in describing operation of the television, and is not intended to be limiting as to the physical
25 positions and functional coupling of the circuits relative to one another.

The video signal input section 20 can receive, select or display simultaneously a plurality of composite video signals from different sources, e.g., broadcast or cable signals at ANT1 and ANT2,
30 selectable by RF switch 204 for coupling to first tuner 206 and second tuner 208. The output of the first tuner 206 is coupled to one-chip circuit 202, for example industry designated type TA7777, which performs certain tuning, deflection and video control functions. A VIDEO OUT baseband signal from the one-chip 202 is
35 coupled to video switch 200 and to TV1 input of wide screen processor 30. Auxiliary inputs AUX1 and AUX2 are available for



other sources such as video cameras, laser disc players, video tape players, video games, etc., and are selected by video switch 200 for coupling to the SWITCHED VIDEO input to wide screen processor 30. The selected composite video signal (SELECTED COMP OUT) is input
5 to Y/C decoder 210, together with further video sources S1, S2, and responsive to TV microprocessor 216 selects a pair of luminance and chrominance signals (thereafter considered the "main" signal), for coupling to the wide screen processor 30 as Y_M and C_IN. These signals are coupled back to the one-chip 202, for developing color
10 difference signals U_M and V_M, equivalent to R-Y and B-Y signals. These signals are converted to digital form for further processing.

The second tuner 208 develops baseband video signal TV2, selectable for input to the Y/C decoder together with SWITCHED VIDEO. Switches SW3 and SW4 select these signals Y, C, or external
15 signals Y_EXT and C_EXT corresponding to input S1, considered the auxiliary signal. The main signal path is designated with the suffix "_M" and the auxiliary signal path is designated "_A" in the respective signals. The respective signals can be processed for display alternatively or for display in a picture-in-picture mode via
20 PIP circuit 301.

A composite synchronizing signal COMP SYNC, corresponding to Y_M, is provided by wide screen processor 30 to a sync separator 212, producing horizontal and vertical synchronizing signals H and V, which are input to vertical countdown circuit 214. The vertical
25 countdown circuit develops a VERTICAL RESET signal coupled to the wide screen processor 30. The wide screen processor generates an internal vertical reset output signal IN VERT RST OUT to RGB interface 60, and a switch in the RGB interface selects between the internal vertical reset output signal and the vertical synchronizing
30 component of the external RGB source. The output of this switch is a selected vertical synchronizing component SEL_VERT_SYNC, directed to the deflection circuit 50. Horizontal and vertical synchronizing signals for the auxiliary video signal are developed by a sync separator in the wide screen processor 30.

35 The $1f_H$ to $2f_H$ converter 40 changes interlaced video signals to progressively scanned, non-interlaced signals. Video RAM 420



can be used to store an adjacent field or frame for supplying the lines, or every other line, or lines can be repeated or interpolated, e.g., displaying horizontal lines twice or selecting a line based on detected movement in the picture. The converted video data is

5 supplied to RGB interface 60 as Y_{2f_H} , U_{2f_H} and V_{2f_H} . The RGB interface enables selection of the converted video data or an external RGB video signal, then coupled to the video signal input section. External RGB is deemed to be a wide format display ratio signal adapted for $2f_H$ scanning. The vertical synchronizing
10 component of the main signal is coupled to the RGB interface (as INT VERT RST OUT), for selecting the vertical sync applied to the deflection circuit 50, together with the user's selection of internal or external RGB signals. However, to prevent vertical raster collapse, the RGB interface circuit detects an external synchronizing
15 signal and will override the selection of a non-existent external RGB signal. A microprocessor WSP μP in wide screen processor 30 supplies color and tint controls for external RGB.

A picture-in-picture processor 301, in conjunction with gate array 300 combines the main and auxiliary video signal data to
20 provide a wide variety of display formats which can be selected, for example with a compressed version of an auxiliary signal displayed in the top or bottom margins of a letterbox main display signal, along the lateral sides of a 4 X 3 main display signal, etc. The wide screen microprocessor WSP μP is responsive to the TV

25 microprocessor 216 over a serial bus. The wide screen processor 30 also generates a composite vertical blanking/reset signal, as a three level sandcastle signal. The vertical blanking and reset signals can also be generated as separate signals, as discussed more fully hereinafter, in connection with panning controls. A composite
30 blanking signal is supplied by the video signal input section to the RGB interface.

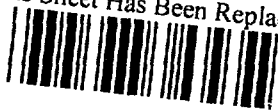
The deflection circuit 50, shown in more detail in FIGURE 2, receives a vertical reset signal from the wide screen processor 30, a selected $2f_H$ horizontal synchronizing signal from the RGB
35 interface 60, and additional control signals from the wide screen processor. The additional control signals relate to horizontal



phasing, vertical size adjustment and east-west pin adjustment. The deflection circuit 50 supplies $2f_H$ flyback pulses to the wide screen processor 30, the $1f_H$ to $2f_H$ converter 40 and the YUV to RGB converter 240.

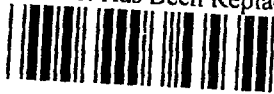
5 The deflection circuit 50 is shown in more detail in FIGURE 2. A circuit 500 is provided for adjusting the vertical size of the raster, in accordance with a desired amount of vertical overscan as necessary for implementing different display formats. As illustrated diagrammatically, a constant current source 502
10 provides a constant quantity of current I_{RAMP} which charges a vertical ramp capacitor 504. A transistor 506 is coupled in parallel with the vertical ramp capacitor, and periodically discharges the capacitor responsive to the vertical reset signal. In the absence of any adjustment, current I_{RAMP} provides the maximum available
15 vertical size for the raster. This might correspond to the extent of vertical overscan needed to fill the wide screen display vertically by expanding a 4 X 3 format letterbox signal source such that the unused top and bottom portions are overscanned. To the extent that less vertical raster size is required, an adjustable current source
20 508 diverts a variable amount of current I_{ADJ} from I_{RAMP} , so that the vertical ramp capacitor 504 charges more slowly and to a smaller peak value. Variable current source 508 is responsive to a vertical size adjust signal, for example in analog form, generated by vertical size control circuit 1030, shown in FIGURE 2. Vertical size
25 adjustment 500 is independent of a manual vertical size adjustment 510, which may be implemented by a potentiometer of back panel adjustment knob. In either event, the vertical deflection coil(s) receive(s) driving current of the proper magnitude. Horizontal deflection is provided by phase adjusting circuit 518, east-west pin
30 correction circuit 514, a $2f_H$ phase locked loop 520 and horizontal output circuit 516.

FIGURE 3 illustrates an automatic letterbox detector as part of a vertical size control circuit 1030. The vertical size control circuit comprises a letterbox detector 1032, a vertical display
35 control circuit 1034 and a three-state output device 1036. Alternatively, the vertical blanking and vertical reset pulses can be



transmitted as separate signals. The automatic letterbox detection circuit can automatically implement vertical zoom or expansion, typically by expanding a 4 X 3 format display ratio signal which includes a 16 X 9 format display ratio letterbox of active display area, and unused or matte colored top and bottom border areas. The letterbox detector can locate the active portion of the video by monitoring for a change in luminance between a given video line and a previous line, and controls expansion of the displayed the signal by a variable amount such that the first and last active video lines occupy the top and bottom of the display. Alternatively, the letterbox detector can be arranged to switch between discrete standard display ratios, such as necessary to zoom the 16 X 9 portion of a 4 X 3 signal to fill a 16 X 9 screen. When the output signal VERTICAL SIZE ADJ becomes active in that case, the display is zoomed. The deflection height is increased by 4/3 (see FIGURE 2), which enables the active video portion of the letterbox signal to fill the wide screen display, without image aspect ratio distortion.

The vertical display control circuit 1034 also controls which part of the overscanned raster will be displayed on the screen, a feature referred to as vertical panning. If the vertically overscanned video signal is not in letterbox format, the conventional display format picture can be zoomed, that is expanded, to simulate a wide screen format. In this case, however, the portions of the picture cropped by the 4/3 vertical overscan will contain active video information. It is necessary to vertically crop 1/3 of the picture. In an AC-coupled vertical deflection system, and absent further controls, the top 1/6 and the bottom 1/6 will always be cropped. However, picture content may dictate that more of the top than the bottom of the picture is more appropriately cropped, or vice versa, in order that the more interesting part of the signal is saved, at the expense of a less interesting part. If all the action is at ground level, for example, a viewer might prefer to crop more sky. A vertical panning capacity enables a choice as to which part of the zoomed picture will be shown and which part will be cropped. Vertical panning is explained with reference to FIGURES 4 and 5(a) through 5(c). The three level composite vertical blanking/reset



signal is shown at the top of the timing diagram in FIGURE 4. These signals can be generated separately. The vertical blanking pulse begins when the signal L_COUNT is equal to VRT_BLNK0 and ends when L_COUNT is equal to VRT_BLNK1. The vertical reset pulse
5 starts when L_COUNT is equal to VRT_PHASE. The L_COUNT is the output of a ten bit counter used to keep track of horizontal half lines with respect to the leading edge of VSYNC_MN. VSYNC_MN is the synchronized version of VDRV_MN, the vertical synchronizing component of the main signal provided to the gate array. VRT_BLNK0
10 and VRT_BLNK1 are provided by the microprocessor depending on the vertical panning command. VRT_PHASE programs the relative phase of the VRT_RST output with respect to the rising edge of the vertical synchronizing component in the COMP_SYNC output. The COMP_SYNC output is the output of a J-K flip/flop. The state of the
15 flip/flop is determined by decoding the outputs of L_COUNT and H_COUNT. H_COUNT is the horizontal position counter. The L_COUNT counter is used to segment the COMP_SYNC signal into three segments corresponding to the horizontal synchronizing pulse, the equalization pulse and the vertical synchronizing pulse.

20 A vertical deflection current for "no" overscan (which actually corresponds to a nominal 6% overscan) is shown by dotted lines in FIGURE 4, as is the corresponding vertical blanking signal. The width of the vertical blanking pulse for no overscan is C. The vertical synchronizing pulse is in phase with the vertical reset
25 pulse. A vertical deflection current for the overscan mode is shown by a solid line in FIGURE 4, as is the corresponding vertical blanking pulse, having a pulse width D.

If the bottom overscan A is equal to the top overscan B, the display will be centered as shown in FIGURE 5(a). If the vertical
30 reset pulse is generated so as to lag the vertical synchronizing pulse, the bottom overscan A is less than the top overscan B, resulting in the display shown in FIGURE 5(b), where more of the lower part of the picture is displayed while more of the top is blanked. Conversely, if the vertical reset pulse is generated so as to
35 lead the vertical synchronizing pulse, the bottom overscan A is more than the top overscan B, resulting in the display shown in FIGURE

5(c). More of the upper part of the picture is displayed and more of the bottom is blanked. The relative phase of the vertical synchronizing signal and the vertical reset signal is controllable the microprocessor WSP μ P of the wide screen processor 30, to enable vertical panning during overscan modes of operation. It will be appreciated that the overscanned raster remains vertically centered, or symmetrical, on the picture tube or screen during vertical panning. It is the blanking interval which can be vertically moved, or positioned asymmetrically relative to the raster so as to blank more of the picture at the top than at the bottom, or vice versa.

One problem that is encountered when vertical panning is used occurs during special effects modes of VCR playback. It is desired to pan the video up (which can also be thought of as scrolling the displayed image down) by a slight amount (for example four or five lines), the vertical reset pulse is actually delayed from vertical sync by 262.5 lines, less the number of lines of the pan value. In the fast forward mode of a VCR, due to the non-standard nature of the linear tape speed, the number of lines in a field decreases by a number which is dependent on the recording mode (for example, SP or SLP) and the linear tape speed. A nominal number of lines per field contained in fast forward mode of VCR playback (SP mode) could be 253.5 lines. If the desired panning value is down by 5 lines, the delay setting would be for 257.5 lines. However, a new VSYNC occurs every 253.5 lines, resetting the half line counter which would generate vertical reset upon reaching the desired panning delay count. During this mode, a vertical reset will not occur because the half line counter will be repetitively reset without ever reaching the desired value, causing a collapse of the vertical raster and possible tube damage. It is thus necessary to ensure the occurrence of a vertical reset pulse regardless of the phase of VSYNC and the delay setting for vertical reset.

FIGURE 6 shows the timing problems associated with a panning circuit which can occur where field lengths are unequal and/or not of a standard number of lines. The panning "up delay" and the panning "down delay" are shown relative to the leading edge of a vertical sync preceding field 1. The vertical reset pulse for panning down is



shown in broken lines in signal VRST-A, and the vertical reset pulse for panning up is shown in solid lines. Of course it is only possible to pan in one direction at a time.

As shown in FIGURE 6, the panning up delay d1 for field 1 is sufficient to place the generated vertical reset slightly before the next vertical sync, as needed for panning up. However, if field 2 is not the same number of lines as field 1, a delay d2 of the same amount as d1 will place the vertical reset incorrectly. In the example shown, the vertical reset VRST-A in field 2 actually would occur after the vertical sync preceding field 2. Whereas the vertical sync is the point of reference, the line counter which determines the panning delay is normally reset by the vertical sync, and without special provisions, the vertical reset could be lost by the vertical sync continually resetting the delay line counter before the necessary delay interval elapsed.

The correct vertical reset needs to precede the next vertical VSYNC by an unvarying amount, as shown by VRST-B in FIGURE 6. A circuit which forces a vertical reset VRST-B is shown in FIGURE 7. The basic circuit 1100 comprises a plurality of D-type flip/flops 1102, 1104, 1106, 1108 and 1110, a J-K flip/flop 1112 and a counter 1114, as well as a number of AND gates, NOR gates and inverters. The circuit is operated synchronously with a clock signal, which can be synchronized with the video, e.g., at $1024f_H$. The basic operation is as follows. The vertical sync signal is sampled by a signal designated SOL_X_2, which is a one clock wide pulse occurring twice per horizontal line period. Vertical sync has been processed in a way that it is offset from SOL_X_2, for example by 1/16 or 1/8 of a line period. Sampling vertical sync with SOL_X_2 realigns vertical sync with SOL_X_2. The STR_RST signal is a positive going pulse that is 1/2 of a line period long. The leading edge of this pulse signifies the beginning of the desired vertical reset interval. If the number of lines in a field are greater than or equal to the delay setting used to generate the STR_RST signal, the leading edge of STR_RST is used to clear counter 1114, which then counts for the desired vertical reset length and then disables itself. Vertical reset signal VRST is generated by a gate coupled to the



output of counter 1114, and VRST is high (enabling the counter) during the vertical reset pulse. In this implementation, the desired vertical reset length is six half lines, the gate being coupled to the two and four bit counter outputs. Vertical reset lengths of other
5 than six half lines may be selected by using the required counter outputs together with any gates needed to decode the outputs.

For the case where the number of lines in a field is less than the delay setting used to generate the STR_RST signal, the circuit ensures that a vertical reset is produced. On the leading edge of the
10 sampled vertical sync signal, J-K flip/flop 1112 is set. The output of this flip/flop is used as an enable signal for gating through a trigger signal for the vertical reset on the next sampled vertical sync signal VSYNC, namely if J-K flip/flop 1112 has not in the meanwhile been reset by the occurrence of STR_RST. If an STR_RST
15 pulse has not occurred since flip/flop 1112 was set, the leading edge of the next sampled vertical sync signal clears the counter 1114 used to generate the VRST signal. Signal VRST, generated from a gate on the outputs of the counter, then goes high until counter 1114 accumulates the required count of half lines from SOL_X_2. In
20 this manner, it is assured that as long as a VSYNC signal is present, a VRST pulse will be generated of the correct length regardless of the number of lines in a field or the delay setting desired for the STR_RST signal. If a STR_RST pulse does not occur, the leading edge of that signal clears the J-K flip/flop and generates a VRST signal
25 based on the STR_RST pulse.

Referring again to FIGURE 6, both panning up and panning down may be accomplished by delaying the vertical reset signal by an amount less than or equal to one field. For NTSC, panning down is accomplished by counting a delay or zero to 262.5 half lines; and
30 panning up is accomplished by counting a delay between 262.5 and 525 half lines. A problem with this approach is that for nonstandard signals the field lengths may not be equal. One example is the pause mode for a dual azimuth four head VCR. Whereas the field lengths are unequal, counting for greater than one half of a field for panning
35 up (scrolling down) causes the two fields in the frame to become misaligned by a number of lines equal to the difference in the field



lengths. A severe interline flicker thus occurs. What is needed is a circuit which references the panning delay for panning down to the VSYNC at the beginning of the field, and for panning up to the VSYNC which follows the field. This is accomplished according to the invention by coupling a line count signal (for example a half-line count) to a counter and latches which store the total number of lines in each field. The pan up delay for each new field is then calculated from the total number of lines in the previous occurrence of the same field type, less the variable amount of panning which is required by the processor.

Referring to FIGURE 8, the wide screen processor provides vertical reset phase and vertical blanking phase information to the panning delay circuit. The phase information can be, for example, in the form of nine bit two's complement data, representing either a forward delay relative to the most recent vertical sync signal-on the video signal, or a negative "delay" relative to the next vertical sync signal, i.e., a delay of somewhat less than a full field, causing the vertical reset to precede the vertical sync for the next field. Additionally, the wide screen processor provides pulse width information. As shown in FIGURES 8 and 11, the same form of circuit can be provided for generating the vertical reset pulse and the vertical blanking pulse. The processor chooses the pulse width and delay line count for both vertical reset and blanking to complement one another. The delay line count can be, for example, a nine bit half line count, and the pulse width can be six bits (for reset) or eight bits (for blanking). The pulse width can be defined by loading this width data from the processor into a counter, and counting down the counter during the pulse. Alternatively, a comparator can be provided for disabling the pulse when a counter counts up to the required number.

In FIGURE 8, signal SOL_X_2 is a one clock wide pulse occurring twice per horizontal line, and is coupled to ten bit counter 1404. The number of half-lines since the previous occurrence of VSYNC is counted by ten bit counter 1404, and on the leading edge of VSYNC (via a one clock wide pulse VSYNC_E) the count is stored in



latch 1408, one for storing the total number of half-lines in each field.

A toggling circuit comprising one-bit counter 1410 is coupled to VSYNC_E for determining whether the first or second field is the present field. With each occurrence of VSYNC_E, one-bit field counter 1410 changes state, and enables loading of the contents of counter 1404 into latch 1409. VSYNC_E also clears counter 1404 in preparation for the next field.

The one bit counter 1410 controls multiplexer 1414, for applying the contents of one of the two latches 1408 and 1409 to adder 1416. Also coupled to the adder, and to a further multiplexer 1420 is the desired phase data, which can be positive (for panning down) or negative (for panning up). The most significant bit of the phase data (which indicates whether the two's complement word is positive or negative) controls multiplexer 1420. The sign bit of the phase data determines whether the phase data is used directly (if the phase is positive, indicating panning down) or added to the line count for that field (if the phase is negative, indicating panning up).

The output of multiplexer 1420 is coupled to one input of comparator 1424, and the present half line count from counter 1404 is coupled to the other input of comparator 1424. When the half-line count of the present field equals either the pan up delay line count, or the total number of lines in the last occurrence of that field less the number of lines defining the lead between vertical reset and the next VSYNC for panning down, signal STR_RST is generated and applied to force-pulse circuit 1430. The force-pulse circuit is similar to that of FIGURE 6, except the pulse width is provided by the processor rather than being predetermined by gating.

The pulse generation section operable to produce the vertical reset pulse is substantially identical to the pulse generation circuit 1432 operable to produce a vertical blanking pulse, the difference being that the number of bits needed to specify the phase delay (or advance) and the pulse width are different for vertical reset and vertical blanking.

FIGURES 9 and 10 illustrate a specific embodiment of the invention in detail, and FIGURE 11 illustrates how the vertical reset

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and vertical blanking pulse generation sections can be driven from the same line counting means. The same reference numbers have been used in these drawings to identify the circuit elements discussed with reference to FIGURE 8. The 10 bit half line counter 1404, latches 1408, 1409 and multiplexer 1414 are embodied as shown in FIGURE 8, however, the one bit counter is embodied as a D-type flip/flop 1440, and associated gating so as to form a toggling circuit which changes state at each occurrence of VSYNC_E, for selecting one of the latches 1408, 1409 and one set of inputs to the multiplexer 1414 for presentation on the output.

In FIGURE 10, the adder 1416 is embodied as a series of three four-bit adders in cascade. Either the sum of the vertical phase data and the total line count, or the vertical phase data without modification, are selected by multiplexer 1420 as a function of the sign bit of the phase data and the selected one is coupled to comparator 1424. When the present line count as indicated by counter 1404 equals the required line count, the output of comparator 1424 provides a pulse to pulse-force circuit 1430. The pulse-force circuit includes a circuit 1100 as shown in FIGURE 7 for allowing VSYNC to generate the vertical reset pulse in the event that STR_RST does not occur before a second VSYNC occurs, thereby preventing collapse of the raster.

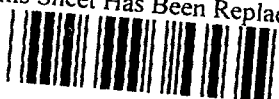
In FIGURE 7, the vertical reset pulse width was determined by gating coupled to the outputs of a pulse width counter, the gating forming a comparator operable to disable the counter and end the reset pulse when the count is reached. In FIGURE 10, the pulse width is variable under control of the processor. The pulse width required can be loaded into a count-down counter for determining the pulse width, or a comparator can be provided for comparing the contents of a counter 1114 to the required pulse width, in which case the circuit could operate substantially as in FIGURE 7.

FIGURE 11 demonstrates a particular embodiment wherein both the vertical reset pulse and the vertical blanking pulse are generated by parallel circuits 1452 coupled to the outputs of a half line counter, latch, multiplexer and adder circuit 1460, as shown more specifically in FIGURES 9 and 10. By varying the panning delay



and respective pulse widths for the vertical reset and blanking in complementary manner, the processor can accomplish accurate panning even in nonstandard modes of operation such as the pause and search modes of VCR playback, wherein the field lengths may be
5 of variable and/or unequal lengths.

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CLAIMS

1. A television apparatus, having means (244) for displaying a video signal representing a picture and having a vertical synchronizing component defining successive vertical scanning intervals which can have other than a standard number of horizontal lines per vertical scanning interval under certain operating conditions, characterized by:

means (1404, 1408, 1409, 1410) for measuring the length of said successive vertical scanning intervals;

means (1430) for generating a vertical reset signal (VRST) which is phase shifted relative to said vertical synchronizing component of said video signal for vertically panning said picture on said video display means by a predetermined amount (RESET PHASE); and,

means (1416, 1420, 1424) for adjusting said phase shift responsive to said measured lengths of said vertical scanning intervals to maintain said predetermined amount (RESET PHASE) of vertical panning even under said certain operating conditions.

2. The apparatus of claim 1, wherein operation of said adjusting means is characterized by:

a first mode of operation for panning said picture down, in which said vertical reset signal (VRST) is generated when the length of a vertical scanning interval being measured reaches a value corresponding to said phase shift (RESET PHASE); and,

a second mode of operation for panning said picture up in which said vertical reset signal (VRST) is generated when the length of a vertical scanning interval being measured reaches a value corresponding to a difference between: (a.) the measured length of a preceding vertical scanning interval having the same field type as said vertical interval being measured; and, (b.) said phase shift (RESET PHASE).

3. The apparatus of claims 1 or 2, characterized in that said adjusted phase shift (output of 1420) is utilized for generating said





phase shifted vertical reset signal (VRST) for a subsequent vertical scanning interval.

4. The apparatus of claim 2, further characterized by means responsive to a sign-bit (MSB) of said phase shift (RESET PHASE) for selecting between said first and second modes of operation, said sign-bit (MSB) having a first polarity for panning down and an opposite polarity for panning up.

5. The apparatus of claim 1, wherein said measuring means is characterized by:

first (1404) and second (1410) counters;

first (1408) and second (1409) latches coupled to said first counter (1404);

means (1405, 1407) coupled to said first and second latches (1408, 1409) for selecting which of said first and second latches (1408, 1409) loads an input from said first counter (1404); and,

a multiplexer (1414) responsive to said second counter (1410) for selecting as an output between said first and second latches (1408, 1409).

6. The apparatus of claims 1 or 5, wherein said adjusting means is characterized by:

a multiplexer (1420) for selecting as an output between:

(a.) successive ones of said phase shifts; and,

(b.) an algebraic sum of said successive ones of said phase shifts and successive ones of said measured lengths,

said multiplexer (1420) being responsive to a sign-representative bit (MSB) of said phase shift (RESET PHASE); and,

a comparator (1424) for generating an output signal (STR_RST) for initiating said vertical reset signal (VRST) when the length of a vertical interval being measured reaches the output value of said multiplexer (1420).





7. The apparatus of claim 1, characterized in that successive numbers of said vertical scanning intervals define interlaced video fields.

8. The apparatus of claim 1, further further characterized by an AC coupled vertical deflection system (50) for vertical scanning.

9. The apparatus of claim 1, characterized in that said video display means (244) comprises a wide screen video display unit having a horizontal to vertical aspect ratio greater than 4:3.

10. A television apparatus, having means (244) for displaying a video signal representing a picture and having a vertical synchronizing component defining fields of horizontal lines which can have other than a standard number of said horizontal lines per field under certain operating conditions, characterized by:

means (1404, 1408, 1409, 1410) for measuring the number of horizontal lines in each of said fields;

panning means (1430) for initiating a vertical reset signal (VRST) shifted relative to said vertical synchronizing component of said video signal by a selected number of horizontal lines (RESET PHASE) for vertically panning said picture on said video display means; and,

means (1416, 1420, 1424) for adjusting said selected number of horizontal lines responsive to said measured lengths of said fields to maintain said vertical panning by said selected number of horizontal lines even under said certain operating conditions.

11. The apparatus of claims 10, wherein operation of said adjusting means is characterized by:

a first mode of operation for panning said picture down, in which said vertical reset signal (VRST) is generated when the length of a field being measured reaches a value corresponding to said selected number of horizontal lines (RESET PHASE); and,

a second mode of operation for panning said picture up in which said vertical reset signal (VRST) is generated when the length





of a field being measured reaches a value corresponding to a difference between: (a.) the measured length of a preceding vertical scanning interval having the same field type as said vertical interval being measured; and, (b.) said selected number of horizontal lines (RESET PHASE).

12. The apparatus of claims 10 or 11, characterized in that said adjusted number (output of 1420) of horizontal lines is utilized for generating said vertical reset (VRST) signal for a subsequent field.

13. The apparatus of claim 11, further characterized by means responsive to a sign-bit of (MSB) said phase shift (RESET PHASE) for selecting between said first and second modes of operation, said sign-bit (MSB) having a first polarity for panning down and an opposite polarity for panning up.

14. The apparatus of claim 10, wherein said measuring means is characterized by:

first (1404) and second (1410) counters;

first (1408) and second (1409) latches coupled to said first counter (1404);

means (1405, 1407) coupled to said first and second latches (1408, 1409) for selecting which of said first and second latches (1408, 1409) loads an input from said first counter (1404); and,

a multiplexer (1414) responsive to said second counter (1410) for selecting an output between said first and second latches (1408, 1409).

15. The apparatus of claims 10 or 14, wherein said adjusting means is characterized by:

a multiplexer (1420) for selecting as an output between:

(a.) successive ones of said selected number of horizontal lines; and,





(b.) an algebraic sum of said successive ones of said selected number of horizontal lines and successive ones of said measured lengths,

said multiplexer (1420) being responsive to a sign-representative bit (MSB) of said phase shift RESET PHASE); and,

a comparator (1424) for generating an output signal (STR_RST) for initiating said vertical reset signal (VRST) when the length of a field being measured reaches the output value of said multiplexer (1420).

16. The apparatus of claim 10, further characterized by an AC coupled vertical deflection system (50) for vertical scanning.

17. The apparatus of claim 10, characterized in that said video display means (244) comprises a wide screen video display unit having a horizontal to vertical aspect ratio greater than 4:3.

18. A television apparatus, having:
means (244) for displaying a video signal representing a picture; and, means (1430) for generating a vertical reset signal (VRST) which is phase shifted (RESET PHASE) relative to said vertical synchronizing component of said video signal for vertically panning said picture on said video display means, characterized by:
means (1416, 1420, 1424) for adjusting said phase shift (RESET PHASE) in accordance with variable lengths of scanning intervals of said video signal.

19. The apparatus of claim 18, further characterized by means (1404, 1405, 1407, 1408, 1409, 1410, 1414) for measuring the lengths of said scanning intervals.

20. The apparatus of claims 18 or 19, wherein operation of said adjusting means is characterized by:
a first mode of operation for panning said picture down, in which said vertical reset signal (VRST) is generated when the length

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of a scanning interval reaches a value corresponding to said phase shift (RESET PHASE); and,

a second mode of operation for panning said picture up in which said vertical reset signal (VRST) is generated when the length of a scanning interval reaches a value corresponding to a difference between: (a.) the length of a preceding scanning interval having the same field type as said scanning interval being measured; and, (b.) said phase shift (RESET PHASE).

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