

FIELD TYPE DETECTOR FOR VIDEO SIGNAL

This invention is directed to a circuit for distinguishing between the odd and even fields of a composite video signal.

The need to distinguish between odd and even fields arises when an auxiliary image is simultaneously displayed as an overlay to a primary image which typically fills the display area. For example, a picture-in-picture (pix-in-pix) display or the display of a function menu. The overlay and primary fields are asynchronous, making it necessary to distinguish between odd and even field types to assure that the overlay signal is stable with respect to the main field in order to maintain proper interlace and avoid jitter of the auxiliary display.

A known technique of distinguishing between the odd and even fields of a composite video signal includes monitoring the horizontal and vertical blanking signals. The blanking signals are provided by a deflection processor and provide noise immunity. These signals provide time references with respect to the main display which are jitter free because the main display also uses these signals. When the horizontal and vertical deflection signals are used for overlay processing, a problem commonly known as "threshold straddling" frequently arises. Odd and even field type are determined by detecting the phase relationship of the horizontal and vertical blanking signals. A phase exists at which it is impossible to definitely distinguish whether a field should be called even or odd. This is the threshold phase and when the deflection signals are in the vicinity of this phase there is a potential for threshold straddling and vertical jitter of the overlay display can ensue. It is theoretically possible to avoid threshold straddling by careful system design, the addition of an alignment circuit or by maintaining tight system tolerances. However, these methods are both impractical and expensive with today's deflection techniques.

A second technique which is more advantageous and prudent is to design an overlay processor which is immune to threshold straddling. This results in an overlay processor which is less expensive and which can be used in a variety of deflection designs. The invention uses a dual mode field type detector approach to such a design. With the dual mode detector approach,



when the sensed value of the horizontal/vertical phase relationship of the blanking signals is in the vicinity of the threshold value, a switch-over signal is produced and the sensed value of the phase relationship is moved away from the threshold value. A detector which identifies field type in a manner similar to the invention, but which does not sense when the phase relationship is in the vicinity of the threshold value, is described in US Pat. No. 5,025,496.

A system for processing video signal having alternating first and second field types includes a source of composite blanking signals, derived from said video signal and composed of randomly time spaced horizontal and vertical blanking signal components. The difference in the time spacing of the horizontal and vertical components of two consecutive fields is indicative of the field type of the current field. A counter provides a count signal bearing a selected relationship to the number of clock pulses occurring between the negative going transition of the vertical signal component and the positive going transition of the first subsequent pulse of the horizontal signal component. A comparator receives the count signal and a reference count signal and provides a switching signal when the count signal is not greater than the reference count signal. Additional circuitry responds to the switching signal and changes the relationship between said count signal and the number of clock pulses occurring between the negative going transition of the vertical blanking signal component and the positive going transition of the first subsequent pulse of the horizontal blanking signal component so as avoid "threshold straddling".

FIGURE 1 is a block diagram of a preferred embodiment of circuitry for distinguishing between odd and even fields of a composite video signal.

FIGURE 2 shows a composite blanking signal.

FIGURE 1 shows a preferred embodiment of an odd/even field detector including circuitry for avoiding the "threshold straddling" condition at which vertical jitter of the overlay display can occur. A composite blanking signal of the type shown in FIGURE 2 is applied to the up/down "U/D" input terminal of a non-wrapping counter 11. A clock signal with a

frequency of 4 fsc/12 Hz, or approximately 1 Meg Hz, is applied to the clock input terminal of the counter 11. The counter 11 counts clock pulses upwardly toward a maximum saturation count, 31 for example, when the signal applied to the U/D input terminal is relatively positive or downwardly toward a minimum saturation level, 0 for example, when the signal applied to the U/D input terminal is relatively negative. The counter does not wrap around. Thus, when the counter is counting in either direction and reaches a saturation point before it is conditioned to count in the opposite direction, it continues to provide the output signal ordinarily provided at the saturation point until it becomes conditioned to count in the opposite direction.

The field type identification signal is provided by elements 11 through 17. The output from the non-wrapping counter 11 is applied to one input terminal of a comparator 12 the other input terminal of which receives a reference signal from a switch 19. During respective line intervals the ratio of relatively positive to relatively negative portions of the composite blanking signal is about 1:6. Thus, during respective line intervals the counter will count downward 6 times more often than upward. There are approximately 60 counts per line interval, hence during respective line intervals the counter will exhibit its lower saturation value. Alternatively, during the vertical blanking interval the blanking signal is relatively positive. When the count into the vertical blanking reaches 30, comparator 12 provides a reset level to the reset terminal of counter 13 and three things occur. Counter 13 is held, set/reset flip-flop 20 is set and switch 19 is changed from a first position (0) to a second position (1). The first position applies a signal representative of 30 to comparator 12 while the second position applies a signal dependent upon the setting of switch 18. With comparator 12 actuated a signal representative of the vertical blanking signal is provided to counter 13. During the vertical blanking interval, the vertical blanking signal is high and counter 13 is in the reset state and remains in this state until the negative going transition of the output signal of comparator 12 occurs.

The set/reset flip-flop 20 provides clocking pulses to latches 15 and 16 from its Q output terminal. The set input



terminal of the set/reset flip-flop 20 is presumed to have precedence over the reset terminal so long as the set input terminal receives a high signal. Accordingly, during the vertical blanking period the set terminal is high and the $\overline{Q}$ output

5 terminal is low and latches 15 and 16 are not clocked. At the end of the vertical blanking period, up/down counter 11 decrements. Assuming the counter saturated $31-1 = 30$ or $31-15 = 16$ counts later, comparator 12 goes low, depending upon the condition of switch 18.

10 At the end of the reset period, up counter 13 begins to count and the set terminal of flip-flop 20 assumes a low value placing the flip-flop in condition to be reset. Latches 15 and 16 can be D-type flip-flops. With a D-type flip-flop, the Q output terminal assumes the value present at the D data input terminal
15 immediately before the application of a pulse transition to the clock input terminal C. When the vertical blanking signal is high, the D input of latch 15 is the same value as the D input signal. Accordingly, when a signal representative of the horizontal blanking signal is received by the reset terminal of flip-flop 20
20 the $\overline{Q}$ output terminal goes high and latches 15 and 16 are conditioned to store the values present at their respective D input terminals. Latch 15 stores the count which occurred between the end of the reset period and the first horizontal pulse. Latch 16 stores the count which occurred between the end of the reset
25 period and the first horizontal pulse of the preceding field. These two counts are compared in comparator 17 to determine whether the field is odd or even.

A signal representative of the horizontal blanking signal is provided by elements 21 to 23. The composite blanking
30 signal is applied to the D-input terminal of a D-type flip-flop 21, the Q output terminal of which is connected to the D-input terminal of another D-type flip-flop 22. An AND gate 23 has input terminals connected to the Q-output terminal of flip-flop 21 and the $\overline{Q}$ output terminal of flip-flop 22. The output terminal of
35 AND gate 23 is connected to the reset input terminal of set/reset flip-flop 20. The Q output signal of flip-flop 21 corresponds to the composite blanking signal. The Q output signal of latch 22 corresponds to the composite blanking signal delayed by one clock



pulse and inverted in polarity. AND gate 23 provides a logic one output value when the Q output of latch 21 and the Q output of latch 22 are logic high values. When the output of AND gate 23 is high, set/reset flip-flop is reset and the Q output goes high to
5 supply a control signal to toggle flip-flop 25 and clock pulses to the clock terminals of latches 15 and 16.

The hysteresis needed to avoid the threshold straddling condition is provided by divider 14, comparator 24, toggle flip-flop 25 and switch 18. Comparator 24 receives a
10 reference count of 2 from a reference source, not shown, and the output from divider 14. Typically, the count signal from divider 14 exceeds the reference count and timing relationship of the horizontal and vertical components is such as to assure accurate identification of the field type. When the threshold straddling
15 condition is approached, the count signal from divider 14 drops lower than the reference count of 2, and the output of comparator 24 toggles flip-flop 25, causing switch 18 to switch. The switching of switch 18 changes the count at which the reset period of counter 13 occurs. This change of count also changes the number
20 of those clock pulses occurring between the negative going transition of the vertical signal component and the positive going transition of the first subsequent pulse of the horizontal signal component which are counted by counter 13, so as to effect a shifting away from the threshold straddling condition.

**CLAIMS:**

1. In a system for processing video signals having alternating first and second field types, said system including a source of composite blanking signals, derived from said video signals and composed of randomly time spaced horizontal blanking and vertical blanking signal components, wherein the difference in the time spacing of said horizontal and vertical blanking components of two consecutive fields is indicative of the field type of the current field, and a source of clock pulses; a field type detector including counter means, responsive to said composite blanking signal and said clock pulses, for providing a count signal related to said time spacing for a current field; and means, responsive to said current field count signal and to a stored count signal related to said time spacing for the field preceding said current field, for providing a field type indication; characterized by:

comparator means, responsive to said current field count signal and to a reference signal for providing a switching signal when said reference signal exceeds said current field count signal; and

means, responsive to said switching signal, for altering the operating mode of said counter means so as to modify the relationship between said count signal and said time spacing.

2. A field type detector in accordance with claim 1 wherein said counter means includes an up/down counter incrementing toward a first saturated count when said composite blanking signal occupies a first level and decrementing toward a second saturated count when said composite blanking signal occupies a second level; additional comparator means, responsive to the count output of said up/down counter, and to a reference count input; and first switching means for alternatively supplying a predetermined high count or a lower count as said reference count input to said additional comparator means, the switching state of said first switching means being responsive to the output of said additional comparator means; said detector being further characterized in that said counter means includes a second counter, responsive to said clock signals, and having a reset



terminal responsive to the output of said additional comparator means, and means for deriving said current field count signal from the output of said second counter; and in that said operating mode altering means includes second switching means for alternatively supplying a predetermined intermediate count or a predetermined low count to an input of said first switching means as said lower count; and means, responsive to said switching signal output of said first-named comparator means, for controlling the switching state of said second switching means.

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FIELD TYPE DETECTOR FOR VIDEO SIGNAL

Abstract

Jitter of an overlay display with respect to the primary display of a television receiver is avoided by providing a field type detector which avoids a threshold straddling condition in field identification. A count signal bearing a first relationship to the number of clock pulses between the negative going transition of a vertical blanking signal and the positive going transition of the first subsequent horizontal blanking pulse is tracked and when the count signal fails to exceed a reference count, the relationship is changed to effectively avoid the threshold straddling condition in field identification apparatus responsive to said count signal.

Fig 1

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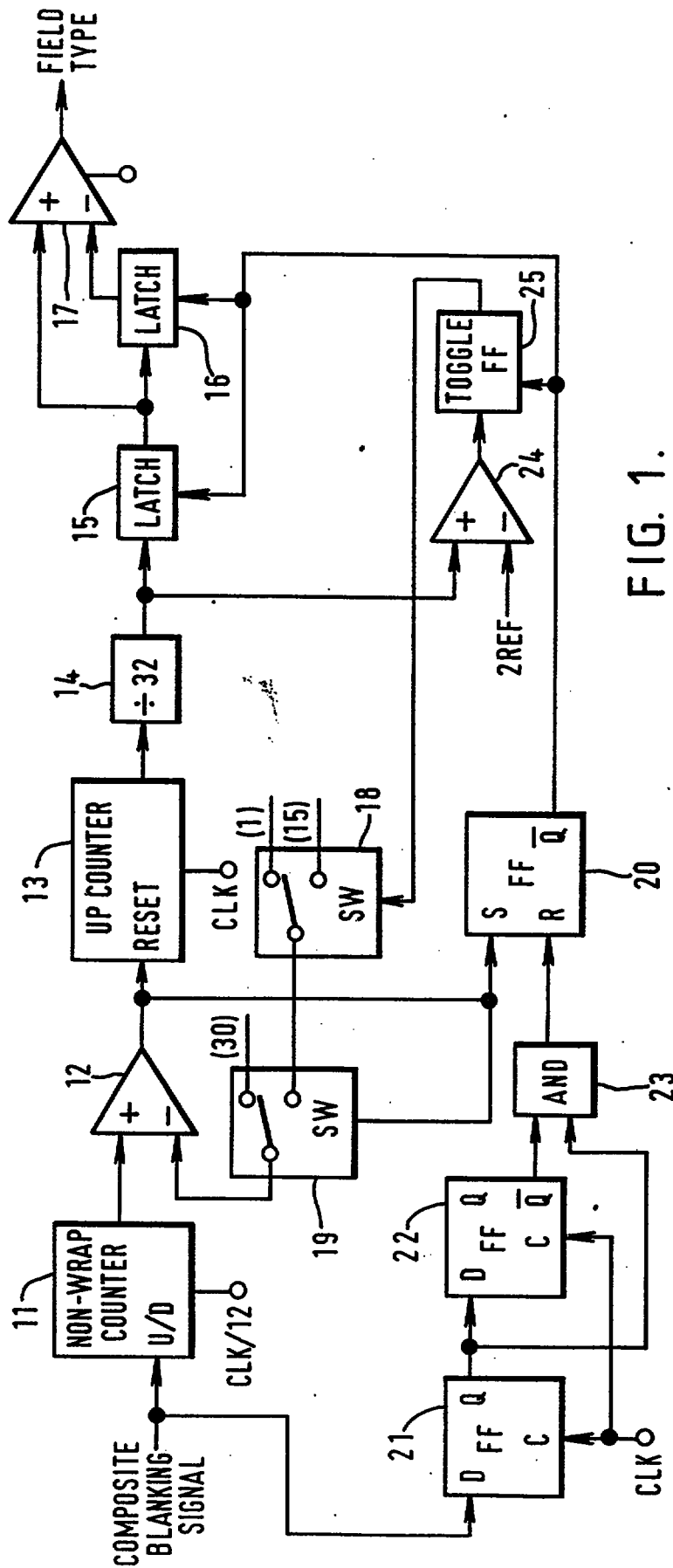


FIG. 1.



FIG. 2.

FIELD TYPE DETECTOR FOR VIDEO SIGNAL

This invention is directed to a circuit for distinguishing between the odd and even fields of a composite video signal.

5 The need to distinguish between odd and even fields arises when an auxiliary image is simultaneously displayed as an overlay to a primary image which typically fills the display area. For example, a picture-in-picture (pix-in-pix) display or the display of a function menu. The overlay and primary fields are asynchronous, making it necessary to distinguish between odd
10 and even field types to assure that the overlay signal is stable with respect to the main field in order to maintain proper interlace and avoid jitter of the auxiliary display.

A known technique of distinguishing between the odd and even fields of a composite video signal includes monitoring
15 the horizontal and vertical blanking signals. The blanking signals are provided by a deflection processor and provide noise immunity. These signals provide time references with respect to the main display which are jitter free because the main display also uses these signals. When the horizontal and vertical
20 deflection signals are used for overlay processing, a problem commonly known as "threshold straddling" frequently arises. Odd and even field type are determined by detecting the phase relationship of the horizontal and vertical blanking signals. A phase exists at which it is impossible to definitely distinguish
25 whether a field should be called even or odd. This is the threshold phase and when the deflection signals are in the vicinity of this phase there is a potential for threshold straddling and vertical jitter of the overlay display can ensue. It is theoretically possible to avoid threshold straddling by careful system design,
30 the addition of an alignment circuit or by maintaining tight system tolerances. However, these methods are both impractical and expensive with today's deflection techniques.

A second technique which is more advantageous and prudent is to design an overlay processor which is immune to
35 threshold straddling. This results in an overlay processor which is less expensive and which can be used in a variety of deflection designs. The invention uses a dual mode field type detector approach to such a design. With the dual mode detector approach,

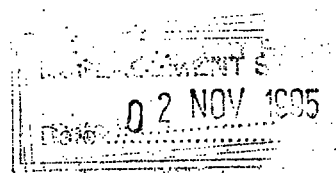
when the sensed value of the horizontal/vertical phase relationship of the blanking signals is in the vicinity of the threshold value, a switch-over signal is produced and the sensed value of the phase relationship is moved away from the threshold value. A detector which identifies field type in a manner similar to the invention, but which does not sense when the phase relationship is in the vicinity of the threshold value, is described in US Pat. No. 5,025,496.

A system for processing video signal having alternating first and second field types includes a source of composite blanking signals, derived from said video signal and composed of randomly time spaced horizontal and vertical blanking signal components. The difference in the time spacing of the horizontal and vertical components of two consecutive fields is indicative of the field type of the current field. A counter provides a count signal bearing a selected relationship to the number of clock pulses occurring between the negative going transition of the vertical signal component and the positive going transition of the first subsequent pulse of the horizontal signal component. A comparator receives the count signal and a reference count signal and provides a switching signal when the count signal is not greater than the reference count signal. Additional circuitry responds to the switching signal and changes the relationship between said count signal and the number of clock pulses occurring between the negative going transition of the vertical blanking signal component and the positive going transition of the first subsequent pulse of the horizontal blanking signal component so as to avoid "threshold straddling".

FIGURE 1 is a block diagram of a preferred embodiment of circuitry for distinguishing between odd and even fields of a composite video signal.

FIGURE 2 shows a composite blanking signal.

FIGURE 1 shows a preferred embodiment of an odd/even field detector including circuitry for avoiding the "threshold straddling" condition at which vertical jitter of the overlay display can occur. A composite blanking signal of the type shown in FIGURE 2 is applied to the up/down "U/D" input terminal of a non-wrapping counter 11. A clock signal with a



frequency of 4 fsc/12 Hz, or approximately 1 Meg Hz, is applied to the clock input terminal of the counter 11. The counter 11 counts clock pulses upwardly toward a maximum saturation count, 31 for example, when the signal applied to the U/D input terminal is relatively positive or downwardly toward a minimum saturation level, 0 for example, when the signal applied to the U/D input terminal is relatively negative. The counter does not wrap around. Thus, when the counter is counting in either direction and reaches a saturation point before it is conditioned to count in the opposite direction, it continues to provide the output signal ordinarily provided at the saturation point until it becomes conditioned to count in the opposite direction.

The field type identification signal is provided by elements 11 through 17. The output from the non-wrapping counter 11 is applied to one input terminal of a comparator 12 the other input terminal of which receives a reference signal from a switch 19. During respective line intervals the ratio of relatively positive to relatively negative portions of the composite blanking signal is about 1:6. Thus, during respective line intervals the counter will count downward 6 times more often than upward. There are approximately 60 counts per line interval, hence during respective line intervals the counter will exhibit its lower saturation value. Alternatively, during the vertical blanking interval the blanking signal is relatively positive. When the count into the vertical blanking reaches 30, comparator 12 provides a reset level to the reset terminal of counter 13 and three things occur. Counter 13 is held, set/reset flip-flop 20 is set and switch 19 is changed from a first position (0) to a second position (1). The first position applies a signal representative of 30 to comparator 12 while the second position applies a signal dependent upon the setting of switch 18. With comparator 12 actuated a signal representative of the vertical blanking signal is provided to counter 13. During the vertical blanking interval, the vertical blanking signal is high and counter 13 is in the reset state and remains in this state until the negative going transition of the output signal of comparator 12 occurs.

The set/reset flip-flop 20 provides clocking pulses to latches 15 and 16 from its Q output terminal. The set input

terminal of the set/reset flip-flop 20 is presumed to have precedence over the reset terminal so long as the set input terminal receives a high signal. Accordingly, during the vertical blanking period the set terminal is high and the $\overline{Q}$ output

- 5 terminal is low and latches 15 and 16 are not clocked. At the end of the vertical blanking period, up/down counter 11 decrements. Assuming the counter saturated $31-1 = 30$ or $31-15 = 16$ counts later, comparator 12 goes low, depending upon the condition of switch 18.
- 10 At the end of the reset period, up counter 13 begins to count and the set terminal of flip-flop 20 assumes a low value placing the flip-flop in condition to be reset. Latches 15 and 16 can be D-type flip-flops. With a D-type flip-flop, the $\overline{Q}$ output terminal assumes the value present at the D data input terminal
- 15 immediately before the application of a pulse transition to the clock input terminal C. When the vertical blanking signal is high, the D input of latch 15 is the same value as the D input signal. Accordingly, when a signal representative of the horizontal blanking signal is received by the reset terminal of flip-flop 20
- 20 the $\overline{Q}$ output terminal goes high and latches 15 and 16 are conditioned to store the values present at their respective D input terminals. Latch 15 stores the count which occurred between the end of the reset period and the first horizontal pulse. Latch 16 stores the count which occurred between the end of the reset
- 25 period and the first horizontal pulse of the preceding field. These two counts are compared in comparator 17 to determine whether the field is odd or even.

- A signal representative of the horizontal blanking signal is provided by elements 21 to 23. The composite blanking
- 30 signal is applied to the D-input terminal of a D-type flip-flop 21, the $\overline{Q}$ output terminal of which is connected to the D-input terminal of another D-type flip-flop 22. An AND gate 23 has input terminals connected to the $\overline{Q}$ -output terminal of flip-flop 21 and the $\overline{Q}$ output terminal of flip-flop 22. The output terminal of
- 35 AND gate 23 is connected to the reset input terminal of set/reset flip-flop 20. The $\overline{Q}$ output signal of flip-flop 21 corresponds to the composite blanking signal. The $\overline{Q}$ output signal of latch 22 corresponds to the composite blanking signal delayed by one clock

pulse and inverted in polarity. AND gate 23 provides a logic one output value when the Q output of latch 21 and the $\bar{Q}$ output of latch 22 are logic high values. When the output of AND gate 23 is high, set/reset flip-flop is reset and the $\bar{Q}$ output goes high to
5 supply a control signal to toggle flip-flop 25 and clock pulses to the clock terminals of latches 15 and 16.

The hysteresis needed to avoid the threshold straddling condition is provided by divider 14, comparator 24, toggle flip-flop 25 and switch 18. Comparator 24 receives a
10 reference count of 2 from a reference source, not shown, and the output from divider 14. Typically, the count signal from divider 14 exceeds the reference count and timing relationship of the horizontal and vertical components is such as to assure accurate identification of the field type. When the threshold straddling
15 condition is approached, the count signal from divider 14 drops lower than the reference count of 2, and the output of comparator 24 toggles flip-flop 25, causing switch 18 to switch. The switching of switch 18 changes the count at which the reset period of counter 13 occurs. This change of count also changes the number
20 of those clock pulses occurring between the negative going transition of the vertical signal component and the positive going transition of the first subsequent pulse of the horizontal signal component which are counted by counter 13, so as to effect a shifting away from the threshold straddling condition.

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CLAIMS:

1. In a system for processing video signals having alternating first and second field types, said system including a source of composite blanking signals, derived from said video signals and composed of randomly time spaced horizontal blanking and vertical blanking signal components, wherein the difference in the time spacing of said horizontal and vertical blanking components of two consecutive fields is indicative of the field type of the current field, and a source of clock pulses; a field type detector including counter means, responsive to said composite blanking signal and said clock pulses, for providing a count signal related to said time spacing for a current field; and means, responsive to said current field count signal and to a stored count signal related to said time spacing for the field preceding said current field, for providing a field type indication; characterized by:

comparator means, responsive to said current field count signal and to a reference signal for providing a switching signal when said reference signal exceeds said current field count signal; and

means, responsive to said switching signal, for altering the operating mode of said counter means so as to modify the relationship between said count signal and said time spacing.

2. A field type detector in accordance with claim 1 wherein said counter means includes an up/down counter incrementing toward a first saturated count when said composite blanking signal occupies a first level and decrementing toward a second saturated count when said composite blanking signal occupies a second level; additional comparator means, responsive to the count output of said up/down counter and to a reference count input; and first switching means for alternatively supplying a predetermined high count or a lower count as said reference count input to said additional comparator means, the switching state of said first switching means being responsive to the output of said additional comparator means; said detector being further characterized in that said counter means includes a second counter, responsive to said clock signals, and having a reset



* C L M S *

terminal responsive to the output of said additional comparator means, and means for deriving said current field count signal from the output of said second counter; and in that said operating mode altering means includes second switching means for alternatively supplying a predetermined intermediate count or a predetermined low count to an input of said first switching means as said lower count; and means, responsive to said switching signal output of said first-named comparator means, for controlling the switching state of said second switching means.



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Abstract

Jitter of an overlay display with respect to the primary display of a television receiver is avoided by providing a field type detector which avoids a threshold straddling condition in field identification. A count signal bearing a first relationship to the number of clock pulses between the negative going transition of a vertical blanking signal and the positive going transition of the first subsequent horizontal blanking pulse is tracked and when the count signal fails to exceed a reference count, the relationship is changed to effectively avoid the threshold straddling condition in field identification apparatus responsive to said count signal.

Fig 1

