

APPARATUS FOR TRANSCODING A TELEVISION SIGNAL

DESCRIPTION

- 5 The present invention relates to an apparatus for converting a television signal according to a first standard, e.g. PAL, to one according to a second standard, e.g. NTSC.
- 10 Different countries of the world each use one of a number of television standards, such as NTSC, PAL and SECAM, for broadcasting. Thus, it is sometimes necessary to convert a signal, broadcast in one country according to one standard, into a signal according to another standard,
- 15 for reception in another country, for example for regions adjacent the border of two such countries.

The respective broadcast standards have different specifications for the synchronizing (sync) signals as well as for the video signals. Thus, when a broadcast

20 signal is converted, the sync signal must also be converted so as to be consistent with the broadcast standard of the converted television broadcast signal.

- 25 The sync signal of a television broadcast signal is a composite sync signal which is produced by combining a horizontal sync signal, a vertical sync signal and an equalizing pulse. The components constituting such a

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5 composite sync signal are differently specified for each broadcast standard. Therefore, to convert the sync signal according to the conversion of the broadcast system, the aforesaid components are converted and combined so as to be consistent with the corresponding broadcast system, to thereby obtain a desired composite sync signal.

10 However, in a conventional sync signal generating apparatus, the sync signal makes no distinction between an odd field or an even field and conversion of the sync signal results in the generation of errors.

15 According to the present invention, there is provided an apparatus for transcoding a television signal comprising: a synchronizing signal generator including a source of a subcarrier frequency signal and logic means to process the subcarrier signal to generate television synchronizing signals, the frequency of the subcarrier
20 frequency signal corresponding to the colour subcarrier frequency of the television standard of the generated synchronizing signals, and comparing means for comparing the odd/even field status of an input television signal and the odd/even field status of the synchronizing signal
25 generator output signal, wherein the synchronizing signal generator is responsive to said comparing means to cause the odd/even field status of the synchronizing signal generator output signal to match the odd/even field

status of said input television signal.

Preferably, the source of a subcarrier frequency signal is responsive to a selection signal to selectively output
5 a signal having a frequency corresponding to the subcarrier frequency of one from a plurality of television standards, e.g. NTSC, PAL-M, PAL-N, PAL and SECAM.

10 Preferably, the logic means includes means for counting cycles of the subcarrier frequency signal to produce horizontal sync pulses, vertical sync pulses and equalizing pulses, means for counting said equalizing pulses to produce odd/even field detection pulses and
15 window signals, and combining means for combining said horizontal sync pulses, said vertical sync pulses and said equalizing pulses in dependence on said window signals to produce a television synchronizing signal.

20 An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figures 1A through 1D are waveform diagrams which show
25 the specifications for the sync signals of different the specifications for the sync signals of different broadcast standards;

Figure 2 is a block diagram of one embodiment of a sync signal generating apparatus according to the present invention; and

5 Figures 3A through 3D are waveform diagrams of the input/output signals of the components shown in Figure 2.

The currently used broadcast television standards include the NTSC standard, the PAL standard, the PAL-N standard,
10 the PAL-M standard and the SECAM standard. The sync signal used in each of the above broadcast

standards has a different specification from those of the other broadcast standards. The components and specifications of the sync signals are represented in the following Table 1.

TABLE 1

BROADCAST SYSTEM COMPONENTS	NTSC & PAL-M	PAL-N	PAL	SECAM	REMARK
1H DURATION	63.5 μ s	64 μ s	64 μ s	64 μ s	b
H _{sync} WIDTH	4.19-5.7 μ s	4.22-5.76 μ s	4.5-4.9 μ s	4.7 $\pm$ 0.3 μ s	a
V-BLANK WIDTH	19-21H	19-25H	18-25H	25H	
PRE-EQ. PULSE DURATION	3H	2.5H	2.5H	2.5H	e
V _{sync} PULSE DURATION	3H	2.5H	2.5H	2.5H	f
POST-EQ. PULSE DURATION	3H	2.5H	2.5H	2.5H	g
EQ. PULSE WIDTH	2.29-2.54 μ s	2.3-2.56 μ s	2.2-2.4 μ s	2.35 $\pm$ 0.1 μ s	c
SERR WIDTH	3.8-5.6 μ s	3.84-5.63 μ s	4.5-4.9 μ s	4.7 $\pm$ 0.3 μ s	d

The waveforms of the respective sync signals according to the specifications of Table 1 are shown in Figures 1A through 1D. Figures 1A and 1B represent an odd

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field and an even field of a sync signal which is used in the NTSC standard and PAL-M standard. In these broadcast standards, one frame is composed of 525 lines, and the odd field has a time difference of 0.5H from the even field, in which a unit of "H" is the period of one line. Figures 1C and 1D represent an odd field and an even field of a sync signal which is used in the PAL, PAL-N and SECAM standards. In these broadcast standards, one frame is composed of 625 lines, and the odd field has a time difference of 0.5H from the even field. Also, the subcarrier frequencies f_{sc} and the horizontal sync signal frequencies f_H , which are used in the respective broadcast standards, have the following relationships.

$$\text{NTSC :} \quad f_{sc} = \frac{455}{2} f_H = 3.5795 \text{ MHz}$$

$$\text{PAL-M :} \quad f_{sc} = \frac{909}{4} f_H \approx 3.5756 \text{ MHz}$$

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$$\text{PAL-N : } f_{sc} = \left(\frac{917}{4} + \frac{1}{625} \right) f_H = 3.5821 \text{ MHz}$$

$$\text{PAL : } f_{sc} = \left(\frac{1135}{4} + \frac{1}{625} \right) f_H = 4.4336 \text{ MHz}$$

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Referring to Figure 2, signals having frequencies corresponding to those of the subcarriers, which are used in the respective broadcast standards, are input to a broadcast standard selection switch 10. When the received television broadcast signal of a first broadcast standard is converted into that of a second broadcast standard, the subcarrier frequency of the first broadcast standard is selected by the broadcast standard selection switch 10. A control signal for selecting the broadcast standard is supplied to the broadcast standard selection switch 10, a sync signal generator 20 and a window signal generator 30 from a broadcast standard selector 60.

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A subcarrier signal ($4f_{sc}$) which is selectively output from broadcast system selection switch 10 is used as a

clock for the sync signal generator 20 which comprises a counter. The sync signal generator 20 generates an even field horizontal sync signal S1, an odd field horizontal sync signal S2, a vertical sync signal S3 and an equalizing pulse signal S4 which are adapted for the specification of the selected broadcast standard. Figure 3A shows waveforms of these outputs.

The pulse period of the even field horizontal sync signal S1 is determined by the aforementioned relationship between the subcarrier f_{sc} and the horizontal scan frequency f_H . For example, in case of the NTSC standard, the sync signal generator 20 counts the $4f_{sc}$ signal 910 times, resulting in generating of a pulse width of 1H. In case of the PAL standard, the sync signal generator 20 counts the $4f_{sc}$ signal 1,135 times, resulting in generation of a pulse width of 1H. As represented in Table 1, to obtain a pulse width (a) which is the horizontal sync pulse width, the sync signal generator 20 counts the $4f_{sc}$ until a value of

4.19 μsec to 5.7 μsec is reached. Also, the even field horizontal sync signal S1 is delayed by 0.5H.

5 The odd field horizontal sync signal S2 has the same pulse period and horizontal sync width as those of the aforesaid even field horizontal sync signal S1. However, the odd field horizontal sync signal is not delayed.

10 The vertical sync signal S3 has a pulse period of 0.5H. An SERR width (d) should have a value as represented in Table 1 according to the broadcast standard selected. A pulse width (x) corresponds to a value resulting from subtracting the SERR width (d) from the pulse period of
15 0.5H. For example, in case of the NTSC standard, assuming that SERR width (d) is 4.7 μsec being an intermediate value of 3.8 to 5.6 μsec , the pulse width (x) is as follows:

20 $0.5H - 4.7 \mu\text{sec} = 63.5/2 \mu\text{sec} = 27.05\mu\text{sec}$

Thus, the sync signal generator 20 counts clock signal $4f_{sc}$ until reaching $27.05 \mu\text{sec}$. Thereafter, the vertical sync signal S3 is generated by producing a pulse having width (d).

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The equalizing pulse signal S4 has a pulse period of $0.5H$, which should have width (c) as shown in Table 1. The equalizing pulse signal S4 is generated in a way similar to that of the aforesaid vertical sync signal S3. For example, in the case of the NTSC standard, the clock signal $4f_{sc}$ is counted for $2.41 \mu\text{sec}$, being an intermediate value of 2.29 to $2.54 \mu\text{sec}$, thereby constituting a pulse corresponding to the equalizing pulse width (c). Then, the clock signal $4f_{sc}$ is counted for a time resulting from subtracting $2.41 \mu\text{sec}$ from the pulse period of $0.5H$, thereby producing the remaining section of the equalizing pulse signal S4. Since a period of the thus-constituted equalizing pulse signal S4 is $0.5H$, the frequency thereof is double the horizontal scan frequency.

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The sync signals generated by the sync signal generator 20 as described above are supplied to a window signal generator 30, a horizontal sync signal generator 100 and a first multiplexer 40.

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The equalizing pulse signal S4, having a frequency of $2.f_H$, is supplied to the counter 32 of the window signal generator 30 and is used as a clock. The counter 32 counts the pulses of the equalizing pulse signal S4, and generates an even/odd field detection pulse, an equalizing pulse, a window signal for combining the vertical sync pulse, and a video-blanking (V-blanking) signal corresponding to the interval having no video signal in the selected standard.

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Such output signals of the counter 32 are shown in Figure 3B. Even/odd field detection pulse S5 has window pulse width w of $2.5H$ for all the broadcast standards. That is, counter 32 counts clock signal $2.f_H$ for five periods, and generates a pulse, to then maintain a high state of the pulse. Here, an overall period of even/odd field detection pulse S5 is $262.5H$

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in case of the NTSC or PAL-M standards, and $312.5H$ in case of the PAL, SECAM or PAL-N standards. Also, counter 32 generates a $2.5H/3H$ window signal $S6$ for defining the pre-equalizing and post-equalizing pulses, and a $5H/6H$ window signal $S7$ for forming a vertical sync window signal $S10$ in combination with the above window signal $S6$ as represented in Table 1. Here, the window pulse widths w of $2.5H/3H$ window signal $S6$ and $5H/6H$ window signal $S7$ are $2.5H$ and $5H$ in case of the PAL, PAL-N and SECAM standards, and $3H$ and $6H$ in case of the NTSC and PAL-M standards. The $2.5H/3H$ and $5H/6H$ window signal $S6$ and $S7$ are passed through a NAND gate 34 to thereby form the vertical sync window signal $S10$. The vertical sync window signal $S10$ has a window pulse width w of $2.5H$ or $3H$. The window signal generator 30 generates $7.5H/9H$ window signal $S8$ and supplies it to a third multiplexer 50. Accordingly, equalizing and vertical sync signal $S11$, which is formed by the $2.5H/3H$ vertical sync pulse and the $2.5H/3H$ post-equalizing pulse, is selected so as to be included as a part of a composite sync signal $S15$. Also, the counter 32 of the window signal generator 30 counts the clock signal $2.f_H$ to generate the V-blanking signal

S9 representing the interval having no video signal. The pulse width w of the V-blanking signal S9 is 21H in case of the NTSC or PAL-M standards, and 22H in case of the PAL, PAL-N or SECAM standards.

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The vertical sync signal S3 and equalizing pulse S4 output from sync signal generator 20 are supplied to a first multiplexer 40. Also, the vertical sync window signal S10 output from NAND gate 34 is supplied to a selection terminal of a first multiplexer 40. The vertical sync pulse signal S3 is selected and output for the 2.5H or 3H pulse width w of the vertical sync window signal S10, while equalizing pulse signal S4 is selected and output for the 2.5H or 3H pulse width w before and after the vertical sync window signal S10.

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The even field horizontal sync signal S1 and odd field horizontal sync signal S2 output by the sync signal generator 20 are supplied to a second multiplexer 120 of a horizontal sync signal generator 100. An even or odd field horizontal sync signal output from second multiplexer 120 is supplied to a third multiplexer 50 and a counter 131 of odd/even field detector 130.

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Referring to Figure 3C, 5H/6H window signal S7 output from the window signal generator 30 is supplied to a clear terminal CLR of the counter 131, so that counter 131 operates during the high state of the window signal S7. That is, counter 131 counts clock signal S12 during the high state of the clear signal, to supply an output signal S13 thereof to a D-type flip-flop 132. The even/odd field detection pulse S5, output from the window signal generator 30 is supplied to the D-type flip-flop 132 as a clock signal. The D-type flip-flop 132 outputs a signal S13 input thereto on a rising edge of the clock signal S5. Thus, as shown in Figures 3C and 3D, if the input signal S13 is in a high state when the clock signal S5 changes from a low state to a high state, an output signal S14 goes to a high state. Accordingly, it can be seen that the currently generated horizontal sync signal is an odd field horizontal sync signal. Also, if the input signal S13 of the D-type flip-flop 132 is in a low state at a rising edge of the clock signal S5, output signal S14 goes to a low state. Accordingly, it can be seen that the currently generated horizontal sync signal is an even field horizontal sync signal.

The even or odd field signal S14 is fed back to a comparator 110. The comparator 110 comprises an exclusive-OR gate 111 and a J-K flip-flop 112, and compares an even/odd field signal S_i of an

5 externally-supplied horizontal sync signal with the even/odd field signal S14 supplied from even/odd field detector 130. This feedback and comparison procedure exists for making a sync signal of a field match the even or odd field status of the externally-supplied

10 horizontal sync signal. Comparator 110 compares the fed back even/odd field signal S14 with the externally-supplied even/odd field signal S_i , to thereby supply a selection signal S16 according to the result to the second multiplexer 120. Then, the second

15 multiplexer 120 selectively outputs according to the selection signal S16 the even field horizontal sync signal S1 or the odd field horizontal sync signal S2 which are input to respective input terminals. That is, when the two even/odd field signals input to

20 comparator 110 are identical to each other, second multiplexer 120 maintains the current output as it is without any conversion since the field of the currently

output horizontal sync signal is the same as that of the externally-supplied horizontal sync signal. However, when the two even/odd field signals input to the comparator 110 are different from each other, second multiplexer 120 varies the output signal since the field of the currently output horizontal sync signal is different from that of the externally-supplied horizontal sync signal. The comparator 110 for generating such a selection signal S16 comprises an exclusive-OR gate 111 for receiving the feedback even/odd field signal S14 and the externally-supplied even/odd field signal Si, and outputting a low signal when the two input signals are identical to each other whilst outputting a high signal when the two signals are different from each other, and a J-K flip-flop 112 for receiving the output signal S17 of the exclusive-OR gate 111 as its J and K inputs and receiving the vertical sync window signal S10 as a clock signal, and for maintaining the current output signal as it is if the J and K input signal S17 is low, while varying the output signal if the J and K input signal is high, when the clock signal changes state.

An even or odd field horizontal sync signal S12 output from the second multiplexer 120 and selected by the selection signal S16 is supplied to an input terminal IN1 of the third multiplexer 50. The equalizing and vertical sync signal S11 output from the first multiplexer 40 is supplied to the other input terminal IN2 of third multiplexer 50. The 7.5H/9H window signal S8, output by the window signal generator 30 is supplied to a selection terminal SEL of the third multiplexer 50. The third multiplexer 50 outputs equalizing and vertical sync signal S11 when selection signal S8 is low, while the former outputs horizontal sync signal S12 when selection signal S8 becomes high. By doing so, a composite sync signal S15 is formed.

As described above, in a sync signal generating apparatus according to the present invention, mutual conversion of the sync signal is possible for every broadcast system, and an odd field or an even field with respect to an externally supplied sync signal is identified to generate a horizontal sync signal being consistent with the field of the externally supplied

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horizontaly sync signal, to thereby obtain more accurate synchronization.



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Claims

1. An apparatus for transcoding a television signal comprising:
 - 5 a synchronizing signal generator including a source of a subcarrier frequency signal and logic means to process the subcarrier signal to generate television synchronizing signals, the frequency of the subcarrier frequency signal corresponding to the colour subcarrier
 - 10 frequency of the television standard of the generated synchronizing signals, and
 - comparing means for comparing the odd/even field status of an input television signal and the odd/even field status of the synchronizing signal generator output
 - 15 signal,
 - wherein the synchronizing signal generator is responsive to said comparing means to cause the odd/even field status of the synchronizing signal generator output signal to match the odd/even field status of said input
 - 20 television signal.
2. An apparatus according to claim 1, wherein the source of a subcarrier frequency signal is responsive to a selection signal to selectively output a signal having
- 25 a frequency corresponding to the subcarrier frequency of one from a plurality of television standards.
3. An apparatus according to claim 1 or 2, wherein the



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logic means includes means for counting cycles of the subcarrier frequency signal to produce horizontal sync pulses, vertical sync pulses and equalizing pulses, means for counting said equalizing to produce odd/even field
5 detection pulses and window signals including a vertical sync window signal, and combining means for combining said horizontal sync pulses, said vertical sync pulses and said equalizing pulses in dependence on said window signals to produce a television synchronizing signal.

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4. An apparatus according to claim 2, including a selection switch for producing said selection signal.

5. An apparatus according to claim 3, wherein the
15 comparing means comprises an exclusive-OR gate coupled to receive an odd/even field signal derived from said input signal with an odd/even field signal indicative of the odd/even field status of the synchronizing signal generator output signal, and a J-K flip-flop having its
20 J and K inputs coupled to the output of the exclusive-OR gate and being clocked by the vertical sync window signal.

6. An apparatus for transcoding a television signal
25 substantially as hereinbefore described with reference to the accompanying drawings.