(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 376 528 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
20.06.2012 Bulletin 2012/25

(21) Application number: **02705372.7**

(22) Date of filing: **20.03.2002**

(51) Int Cl.:
G09G 3/36 *(2006.01)* ***G09G 3/34*** *(2006.01)*
G09G 3/20 *(2006.01)* ***G02F 1/133*** *(2006.01)*

(86) International application number:
PCT/JP2002/002636

(87) International publication number:
WO 2002/077959 (03.10.2002 Gazette 2002/40)

(54) IMAGE DISPLAY AND DISPLAYING METHOD

BILDANZEIGE UND ANZEIGEVERFAHREN

SYSTEME D'AFFICHAGE D'IMAGE ET PROCEDE D'AFFICHAGE

(84) Designated Contracting States:
DE FR GB

(30) Priority: **26.03.2001 JP 2001088162**

(43) Date of publication of application:
02.01.2004 Bulletin 2004/01

(73) Proprietor: **Panasonic Corporation**
Kadoma-shi
Osaka 571-8501 (JP)

(72) Inventors:
- **FUNAMOTO, Taro**
  Mino-shi, Osaka 562-0031 (JP)
- **MACHIDORI, Wataru**
  Amagasaki-shi, Hyogo 661-0953 (JP)
- **ARIMOTO, Katsuyuki**
  Okayama-shi, Okayama 701-1151 (JP)
- **OHTA, Yoshihito**
  Okayama-shi, Okayama 701-0132 (JP)
- **KOBAYASHI, Takahiro**
  Okayama-shi, Okayama 703-8255 (JP)
- **KUMAMOTO, Yasuhiro**
  Neyagawa-shi, Osaka 572-0074 (JP)
- **KARIYA, Tetsuo**
  Ibaraki-shi, Osaka 567-0831 (JP)

(74) Representative: **Gassner, Wolfgang**
Dr. Gassner & Partner
Patentanwälte
Marie-Curie-Strasse 1
91052 Erlangen (DE)

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Description

TECHNICAL FIELD

[0001] The present invention relates to an image display apparatus and method. More particularly, the present invention relates to an image display apparatus and method for displaying an image by driving a passive light modulation device, which modulates light from a light source in a pixel-by-pixel manner based on an electric signal, based on a video signal compressed in the time axis direction.

BACKGROUND ART

[0002] In CRTs used for image display apparatuses, an electron beam strikes a phosphor surface to cause light emission. When measured for a miniscule period of time, each point of the screen is displayed only for an extremely short time by persistence of the phosphor. In CRTs, this point emission is sequentially scanned, to display an image of one frame using the persistence of vision by the eyes. This type of display device is called an impulse type display device.

[0003] In liquid crystal displays, a light modulation device generally called a hold type display device is used. In liquid crystal displays, display data is written in pixels arrayed in a matrix once for each frame using data lines (source lines) and address lines (gate lines). Each pixel holds the display data for the duration of one frame. That is, in liquid crystal displays, the screen is still being constantly displayed even when measured for a period of time smaller than one frame period.

[0004] In such a hold type image display apparatus, there occurs a visual phenomenon where the contour of a moving image is blurred. Taiichiro Kurita, "Picture Quality of Hold Type Display for Moving Images", Technical Report of IEICE, EID99-10 (1999-06) reports why this phenomenon occurs and proposes methods for improving on this problem. From this report, it is found that the display quality of moving images can be greatly improved by shortening the display period in the frame time direction to a half or less of one frame.

[0005] An image display apparatus described in Japanese National Phase PCT Laid-Open Publication No. 08-500915 (hereinafter, simply called the conventional apparatus) is known as an image display apparatus capable of solving the above problem, in which the display period in the frame time direction is shortened to a half or less of one frame as proposed above to thereby provide a liquid crystal display with a feature close to the impulse type display. Hereinafter, this conventional apparatus will be described.

[0006] FIG. 14 illustrates a configuration of the conventional apparatus. The conventional apparatus includes a video signal time compression circuit 101, a PWM modulation pulse generation circuit 102, an inverter 103, a backlight 104, a liquid crystal (LCD) panel 105, an LCD controller 106, a source driver 106 and a gate driver 108. The LCD panel 105, the source driver 107, the gate driver 108, the LCD controller 106 and the backlight 104 are those used for general TFT liquid crystal displays, and therefore detailed descriptions of these components are omitted here.

[0007] FIG. 15 is a timing chart of the operation of the conventional apparatus. Hereinafter, referring to FIG. 15 as necessary, the operation of the conventional apparatus will be described. A video signal is inputted at the time at which the screen is sequentially scanned from the top to the bottom. In a signal timing scheme called VGA, the number of effective scanning lines is 480, the total number of scanning lines is 525, and the vertical synchronizing signal frequency is 60 Hz, in general. Under VGA, the time required from the input of the uppermost line of a screen until the input of the lowermost line of the screen is 480/525/60[s] = 15.2 [ms]. This time length is compressed with the video signal time compression circuit 101.

[0008] FIG. 16 illustrates a configuration of the video signal time compression circuit 101. The video signal time compression circuit 101 includes a dual port RAM 109, a write address control circuit 110, a read address control circuit 111 and a synchronizing signal control circuit 112. The dual port RAM 109 is a random access memory in which a write address/data port and a read address/data port are provided separately to enable independent write and read operations. An input video signal is inputted to the write port of the dual port RAM 109, and written in the dual port RAM 109 according to a write address outputted from the write address control circuit 110. The video signal data written in the dual port RAM 109 is read from the dual port RAM 109 according to a read address outputted from the read address control circuit 111, and outputted therefrom. The synchronizing signal control circuit 112, which receives an input vertical synchronizing signal, an input horizontal synchronizing signal and an input clock, controls the write address control circuit 110 and the read address control circuit 111, and outputs an output horizontal synchronizing signal and an output clock having frequencies increased from those of the inputs.

[0009] The operation of the video signal time compression circuit 101 of FIG. 16 will be described with reference to FIG. 17. The write address outputted from the write address control circuit 110 is counted with the input clock, and is reset with every input vertical synchronizing signal, i.e., every vertical blanking period. The data written to the dual port RAM 109 is the input video signal, each frame of which is stored in the dual port RAM 109. The output clock is generated by changing the input clock to a high-frequency clock by using a PLL synthesizer or the like. The read address is counted with the output clock, and is reset upon completion of read of data of each frame. The count of the read address is then stopped until it is restarted in synchronization with the reset timing of the count of the write address. By the operation described above, each frame of the input video signal is outputted in a time shorter than that required for the input.

[0010] The actual setting of the time required from the input of the uppermost line of a screen until the write of the lowermost line of the screen must be made in consideration of the write capabilities to liquid crystal pixels, such as the ON resistance of TFTs, the wiring resistance of gate lines and source lines, the pixel capacitance and the floating capacitance. The liquid crystal panel that permits the shortest TFT write time among those currently released as products is that of the UXGA resolution (1600 pixels horizontal×1200 pixels vertical). Since 1200/480 = 2.5 considering the number of effective lines, the write time can be compressed by 1 / 2.5 for a panel of the VGA resolution. In other words, in this panel, the time required from the write of the uppermost line of a screen until the write of the lowermost line of the screen can be compressed from 15.2 ms to 6 ms.

[0011] In the liquid crystal panel 105, the liquid crystal is driven with data written in the respective TFT pixels. It is generally known that the response speed of liquid crystal is finite and low. In recent years, however, high-speed response liquid crystal such as optically self-compensated birefringence mode (OCB) liquid crystal has attracted attention. The OCB liquid crystal has exhibited a response time of about 4 ms (falling or rising time) in gray scale images, for example.

[0012] As shown in FIG. 15, for the display data written sequentially from the uppermost line of a screen, the liquid crystal starts responding sequentially from the uppermost line of the screen. Assume that the write time of one frame is 6 ms and the response time of liquid crystal (falling or rising time) is 4 ms, the time required from the write of the uppermost line of the screen until completion of the response of the lowermost line of the screen is 6 + 4 = 10 ms.

[0013] The PWM modulation pulse generation circuit 102 generates a modulation pulse having a width of 6.7 ms synchronizing with the vertical synchronizing signal. FIG. 18 shows the waveform of a lamp current for lighting up a cold-cathode tube as the light source of the backlight 104. The oscillating frequency of the inverter 103 is normally set at about 50 kHz in many cases. It is general practice to intermittently oscillate an inverter according to the waveform shown in FIG. 18, and this is called PWM modulation. In PWM modulation, the brightness of a lamp is controlled by changing the width of a modulation pulse for intermittent ON/OFF control of oscillation. The PWM modulation pulse generation circuit 102 generates the modulation pulse shown in FIG. 15 based on the vertical synchronizing signal. The inverter 103 controlled with this modulation pulse drives the backlight 104, to allow the backlight 104 to emit light for a duration of 6.7 ms. Thus, an image is displayed for only the duration of 6.7 ms in one frame period.

[0014] With the operation described above, the conventional apparatus overcomes the disadvantage of the liquid crystal device as a hold type display device, i.e., the phenomenon where the contour of a moving image is blurred.

[0015] However, in the conventional apparatus, flicker is generated because the backlight blinks at a frequency of 60 Hz in synchronization with the vertical synchronizing signal. This disadvantageously impairs the inherent advantage of liquid crystal displays that little flicker is generated and thus the viewer feels less fatigued when gazing at display details such as text characters.

[0016] The conventional apparatus has another problem in that the effect of improving on the blurring of a moving image decreases and the contour of a moving image is colored in the upper portion of the screen. Hereinafter, the causes of this decrease in the blurring improving effect and the coloring will be described.

[0017] In general, as for the phosphors for the cold-cathode tube fluorescent lamp used as the backlight 104, YOX is used as a read phosphor, LAP as a green phosphor, and BAM (or SCA) as a blue phosphor. FIG. 19 shows examples of persistent response characteristics of the respective phosphors. As seen from the figure, the persistence time of the green phosphor (LAP) is the longest, which is about 6.5 ms. The modulation pulse width shown in FIG. 15 can only be as great as 6.7 ms, considering the limitations of the currently achievable write capabilities to liquid crystal and the response time of liquid crystal as described above, whereas the persistence time of a currently typical fluorescent lamp is about 6.5 ms. This indicates that, during the time of about 6.5 ms shown by A in FIG. 15, the persistence of the backlight remains while an image signal for the next frame is written in the upper portion of the screen. Therefore, in a scene having motion, two frames may appear overlapping with each other, or the blurring of contours may not be improved in the upper portion of the screen. Moreover, the persistence times of the blue phosphor (BAM) and the red phosphor (YOX), which are about 0. 1 ms and about 1.5 ms, respectively, are short compared with that of the green phosphor. Therefore, the overlap of two frames and the blurring of the contour in the upper portion of the screen described above occur only for green, and this results in coloring of the contour in green or magenta. The persistence time of the blue phosphor SCA is substantially the same as that of the blue phosphor BAM.

[0018] Document EP 1 061 499 shows a liquid crystal display which inter alia discriminates whether a current displayed picture is a picture composed mainly of dynamic image or a picture composed mainly of static image. If motion was detected, the brightness of a backlight is increased, if no motion was detected, the brightness of the backlight is lowered. By doing so, the power consumption can be reduced compared to a display wherein the brightness of the backlight is fixed.

[0019] In view of the above, an object of the present invention is to provide an image display apparatus capable of improving on the problem of flicker while improving on motion blurring in a moving image. Another object of the present invention is to provide an image display apparatus capable of minimizing motion blurring and contour coloring that may occur on part of a screen while improving on motion blurring in a moving image.

DISCLOSURE OF THE INVENTION

[0020] The present invention is defined by the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

FIG. 1 is a block diagram of an image display apparatus of a first example.
FIG. 2 is a block diagram of a motion detection circuit 2.
FIG. 3 is a block diagram of a PWM modulation pulse generation circuit 4.
FIG. 4 is a view showing the operation timing in the first example.
FIG. 5 is a block diagram of an image display apparatus of the embodiment of the present invention.
FIG. 6 is a block diagram of a motion detection circuit 22.
FIG. 7 is a view showing the operation timing of a counter decoder 30.
FIG. 8 is a block diagram of a PWM modulation pulse generation circuit 24.
FIG. 9 is a view showing the operation timing in the embodiment.
FIG. 10 is a block diagram of an image display apparatus of the second example of the present invention.
FIG. 11 is a block diagram of a motion detection circuit 38.
FIG. 12 is a view showing the input/output characteristics of a ROM table 42.
FIG. 13 is a view showing the operation timing in the second example.
FIG. 14 is a block diagram of a conventional image display apparatus.
FIG. 15 is a view showing the operation timing of the conventional image display apparatus.
FIG. 16 is a block diagram of a video signal time compression circuit 101.
FIG. 17 is a view showing the operation timing of the video signal time compression circuit 101.
FIG. 18 is a view showing the oscillation waveform of an inverter 103.
FIG. 19 is a view showing the persistent response characteristics of phosphors.

BEST MODE FOR CARRYING OUT THE INVENTION

[0022] Hereinafter, example and the embodiment of the present invention will be described with reference to the accompanying drawings.

(First example)

[0023] FIG. 1 illustrates a configuration of an image display apparatus of the firs example not falling under the scope of the claims. The image display apparatus includes a video signal time compression circuit 101, a motion detection circuit 2, a PWM modulation pulse generation circuit 4, an inverter 103, a backlight 104, a liquid crystal panel 105, an LCD controller 106, a source driver 107 and a gate driver 108. The same components as those of the conventional apparatus shown in FIG. 14 are denoted by the same reference numerals, and the detailed descriptions thereof are omitted here.

[0024] FIG. 2 illustrates a configuration of the motion detection circuit 2. A video signal and a synchronizing signal are supplied to the motion detection circuit 2. The motion detection circuit 2 includes: a frame memory 6 for delaying the video signal by one frame; a subtracter 8 for computing the one-frame difference from the video signal and the output of the frame memory 6; an absolute circuit (ABS) 10 for computing the absolute of the output of the subtracter 8; an accumulator 12 for accumulating the output of the absolute circuit 10 for one frame based on the vertical synchronizing signal; and a comparator 14 for comparing the amount of motion of a display image as the output of the accumulator 12 with a predetermined threshold and outputting the comparison result as a motion detection signal.

[0025] The motion detection circuit 2 calculates the motion amount based on the difference between two continuous frames for each pixel. More specifically, the subtracter 8 outputs the difference between data in one pixel in one frame and data in the same pixel in the immediately previous frame for each pixel, and the absolute circuit 10 outputs the absolute of the difference for each pixel. By this operation, the degree of correlation between the frames is obtained for each pixel. The accumulator 12 accumulates the correlation of each pixel for one frame, to obtain the degree of inter-frame correlation as the average of the entire screen. Whether the display image is an image with large motion (hereinafter, simply called a moving image) or an image with small motion (hereinafter, simply called a still image) is determined depending on whether the output of the accumulator 12 is greater or smaller than a predetermined value. The result is outputted as the motion detection signal. For example, "0" is outputted in the case of a moving image, and "1" is outputted in the case of a still image.

[0026] FIG. 3 illustrates a configuration of the PWM modulation pulse generation circuit 4. The motion detection signal from the motion detection circuit 2 and the vertical synchronizing signal are supplied to the PWM modulation pulse generation circuit 4. The PWM modulation pulse generation circuit 4 includes: a 240 Hz PWM pulse generator 16 for generating a 240 Hz PWM modulation pulse synchronizing with the vertical synchronizing signal; a 60 Hz PWM pulse generator 18 for generating a 60 Hz PWM modulation pulse synchronizing with the vertical synchronizing signal; and a selector 20 for switching between the output of the 240 Hz PWM pulse generator 16 and the output of the 60 Hz PWM pulse generator 18 based on the result of the motion detection by the motion detection circuit 2 and outputting the selected pulse as the modulation pulse.

[0027] The PWM modulation pulse generation circuit 4 generates the modulation pulse having a predetermined period based on the motion detection result from the motion detection circuit 2. When the motion detection circuit 2 determines that the display image is a moving image, the selector 20 selects and outputs the modulation pulse from the 60 Hz PWM pulse generator 18. When the motion detection circuit 2 determines that the display image is a still image, the selector 20 selects and outputs the modulation pulse from the 240 Hz PWM pulse generator 16. These outputted modulation pulses have the waveforms shown in FIG. 4. Note that the width and phase of the pulse generated by the 60 Hz PWM pulse generator 18 are the same as those of the modulation pulse used in the conventional apparatus shown in FIG. 15.

[0028] The 240 Hz PWM modulation is not perceived as flicker by the human eyes. Therefore, no flicker is generated during display of a still image.

[0029] The PWM pulse duty is 39% for both the 240 Hz PWM pulse generator 16 and the 60 Hz PWM pulse generator 18. The 240 Hz PWM pulse generator 16 and the 60 Hz PWM pulse generator 18 do not necessarily have the same PWM pulse duty, but preferably do have such because, by having the same PWM pulse duty, the screen luminance is prevented from changing during the switching between a moving image and a still image. Note however that the PWM pulse duty with which the same luminance is obtained may differ a little between the two generators due to the characteristics of the inverter and the cold-cathode tube.

[0030] In this example, the frequency of the modulation pulse during the display of a still image was set at 240 Hz. It is needless to mention that any frequency high enough to make flicker unobtrusive may also be used.

[0031] As described above, in the first example, motion blurring can be improved during display of a moving image, and also flicker can be reduced during display of a still image.

(Embodiment)

[0032] FIG. 5 illustrates a configuration of an image display apparatus of the embodiment, of the present invention. The image display apparatus includes a video signal time compression circuit 101, a motion detection circuit 22, a PWM modulation pulse generation circuit 24, an inverter 103, a backlight 104, a liquid crystal panel 105, an LCD controller 106, a source driver 107 and a gate driver 108. In FIG. 5, the same components as those of the conventional apparatus shown in FIG. 14 are denoted by the same reference numerals, and the descriptions thereof are omitted here.

[0033] FIG. 6 illustrates a configuration of the motion detection circuit 22. The motion detection circuit 22 receives a video signal and a synchronizing signal. The motion detection circuit 22 includes: a frame memory 6; a subtracter 8; an absolute circuit 10; a counter decoder 30 for outputting enable pulses ENABLE_a and ENABLE_b based on the synchronizing signal; an accumulator 26 for accumulating the output of the absolute circuit 10 for each frame only for the time period during which the enable pulse ENABLE_a is true; an accumulator 28 for accumulating the output of the absolute circuit 10 for each frame only for the time period during which the enable pulse ENABLE_b is true; and a comparator 14 for comparing the outputs of the accumulators 26 and 28 and outputting the comparison result as a motion detection signal. In FIG. 6, the same components as those shown in FIG. 2 are denoted by the same reference numerals, and the descriptions thereof are omitted here.

[0034] Referring to FIG. 7, the operation of the counter decoder 30 will be described. The counter decoder 30 generates the enable pulses ENABLE_a and ENABLE_b, which respectively correspond to the upper portion and the lower portion of a screen, based on the vertical synchronizing signal and the horizontal synchronizing signal. The accumulator 26 detects the motion amount based on the video signal for the upper portion of the screen, while the accumulator 28 detects the motion amount based on the video signal for the lower portion of the screen. The comparator 14 compares the motion amount in the upper portion of the screen with the motion amount in the lower portion of the screen based on the outputs of the accumulators 26 and 28, and outputs the result as the motion detection signal.

[0035] FIG. 8 illustrates a configuration of the PWM modulation pulse generation circuit 24. The motion detection signal from the motion detection circuit 22 and the vertical synchronizing signal are supplied to the PWM modulation pulse generation circuit 24. The PWM modulation pulse generation circuit 24 includes: a frame recursive low-pass filter 32 for outputting motion position data based on the motion detection signal; a counter 34 for outputting a pulse obtained by delaying the vertical synchronizing signal by a predetermined time based on the motion position data; and a 60 Hz PWM pulse generator 18 for outputting a modulation pulse synchronizing with the vertical synchronizing signal by being triggered with the output of the counter 34. In FIG. 8, the same components as those in FIG. 3 are denoted by the same reference numerals, and the detailed descriptions thereof are omitted here.

[0036] The PWM modulation pulse generation circuit 24 controls the timing of lighting up of the backlight 104 based on the motion detection signal. More specifically, as shown in FIG. 9, the backlight 104 is lit up with timing similar to that of the conventional apparatus shown in FIG. 15 when the motion is small in the upper portion of the screen. On the contrary, when the motion is small in the lower portion of the screen, the backlight 104 is lit up at a time earlier than that adopted when the motion is small in the upper portion. This control of the lighting-up timing of the backlight 104 is realized by delaying the vertical synchronizing signal in the counter 34 based on the motion detection signal.

[0037] As shown in FIG. 9, the delay in the counter 35 is about 7 ms when the motion is small in the upper portion of the screen, and thus the persistent response of the backlight overlaps with the write into the liquid crystal panel and the response of the liquid crystal in the upper portion of the screen. However, with small motion in the upper portion of the screen, the problem of contour blurring and coloring is reduced. The delay in the counter 35 is about 0 ms when the motion is small in the lower portion of the screen, and thus the persistent response of the backlight overlaps with the response of the liquid crystal in the lower portion of the screen. However, with small motion in the lower portion of the screen, the problem of contour blurring and coloring is reduced.

[0038] In this embodiment, although not requisite, the delay amount in the counter 34 is controlled stepwise in 256-level gray scale in correspondence with the 8-bit motion position data, which is outputted from the frame recursive low-pass filter 32 based on the 1-bit motion detection signal. For example, when the frequency of the horizontal synchronizing signal is 31.5 kHz, the delay amount of the vertical synchronizing signal is controlled stepwise in stages of every 32 μs in the range of 0 ms to 8 ms. The motion position data increases or decreases by one per frame according to the value of the motion detection signal. If the phase of the modulation pulse changes abruptly, the modulation pulse may momentarily become dense or sparse, which may disadvantageously be perceived as a momentary change of luminance. To ensure prevention of this disadvantage, the phase of the modulation pulse is preferably changed gradually as in this embodiment.

[0039] In this embodiment, the scanning was made from the top to the bottom of the screen. It is needless to mention that the present invention is also easily applicable to other ways of scanning, such as scanning from the bottom to the top of the screen.

[0040] As described above, in this embodiment, the lighting-up timing of the backlight is appropriately changed so that the response of the backlight corresponds to the small-motion portion of the display screen. By this operation, occurrence of the problem of blurring and coloring of a moving contour can be suppressed.

[0041] In this embodiment, the motion detection was performed only for two regions, the upper and lower portions of the screen. The number of divided regions of the screen may be increased to enhance the precision of the detection. Moreover, the center portion of the screen may also be detected, and the control range of the delay time in the counter 34 may be widened, to deal with the case that the motion is small in the center portion of the screen.

(Second example)

[0042] FIG. 10 illustrates a configuration of an image display apparatus of the second example. The image display apparatus includes: a gain control circuit 36 for controlling the gain of a video signal based on video signal gain control data; a video signal time compression circuit 101, a motion detection circuit 38 for outputting the video signal gain control data and modulation pulse width control data based on the video signal; a PWM modulation pulse generation circuit 40 for outputting a symptom pulse based on the modulation pulse width control data; an inverter 103: a backlight 104; a liquid crystal panel 105; an LCD controller 106; a source driver 107; and a gate driver 108. In FIG. 10, the same components as those of the conventional apparatus shown in FIG. 14 are denoted by the same reference numerals, and the descriptions thereof are omitted here.

[0043] FIG. 11 illustrates a configuration of the motion detection circuit 38. The video signal and a synchronizing signal are supplied to the motion detection circuit 38. The motion detection circuit 38 includes: a frame memory 6; a subtracter 8; an absolute circuit 10; an accumulator 12; and a ROM table 42 for outputting the video signal gain control data and the modulation pulse width control data based on the output of the accumulator 12. In FIG. 11, the same components as those shown in FIG. 2 are denoted by the same reference numerals, and the descriptions thereof are omitted here.

[0044] The input/output characteristics of the ROM table 42 will be described with reference to FIG. 12. The output of the accumulator 12 is inputted to the ROM table 42 as input data. The output of the accumulator 12 indicates how large the motion of an image is as described above. The ROM table 42 determines the video signal gain control data and the modulation pulse width control data according to the input data and outputs the data as the output data. The relationship between the input data and the output data is as shown in FIG. 12, in which as the value of the input data is greater, that is, as the motion is larger, the modulation pulse width control data is smaller and the video signal gain control data is greater.

[0045] The PWM modulation pulse generation circuit 40 controls the lighting-up of the backlight 104 based on the modulation pulse width control data. More specifically, as shown in FIG. 13, the lighting-up of the backlight 104 is controlled so that as the motion of the display image is larger, the lighting-up time of the backlight including its persistence time overlaps less with the response time of the screen. With this control, it is possible to improve on the problem of contour blurring and coloring generated during display of a large-motion image.

[0046] The luminance will decrease if the modulation pulse width is made small to shorten the lighting-up time of the backlight 104, failing to obtain sufficient brightness. In this example, to compensate for the decrease of the luminance, correction is made so that the video signal gain control data is greater as the modulation pulse width is smaller to thereby increase the luminance level of the video signal. In this correction, the image quality may be degraded due to signal saturation in a white peak portion of the video signal. Moreover, since an actually used liquid crystal panel has the gamma characteristic that is normally about γ=2, it is impossible to perform the correction of the video signal gain for the decrease of the luminance of the backlight precisely for all the levels of gray scale. However, these disadvantages will not cause a serious problem because they are visually less obtrusive on a large-motion screen.

[0047] As shown in FIG. 13, when the motion of the display image is small, the persistent response of the backlight largely overlaps with the write into the liquid crystal panel/response of the liquid crystal in the upper and lower portions of the screen. In this case, however, with small motion of the display image, no contour blurring and coloring is generated. Note that the video signal gain control data is a normal value when the modulation pulse width is large because no reduction in luminance occurs, and thus there will be no degradation of the image quality due to signal saturation in a white peak portion of the video signal.

[0048] As described above, in the second example, the lighting-up of the backlight is controlled so that as the motion of the display image is larger, the lighting-up time of the backlight including its persistence time overlaps less with the response time of the screen. With this control, it is possible to suppress occurrence of the problem of blurring and coloring of a moving contour.

[0049] In the above description, use of a liquid crystal display as the display device was exemplified. The present invention is not limited to this, but is effectively applicable to passive light modulation devices (light bulb type devices), that is, devices of displaying an image by controlling light from a light source, in general. An example of the passive light modulation devices other than the liquid crystal display is a digital micromirror device (DMD) display. Using the DMD display, a higher-quality image display apparatus can be realized.

[0050] In the above description, general phosphors were used as the phosphors for a fluorescent lamp. If a phosphor short in persistence is used, the problem of blurring and coloring of a moving contour can be improved compared with the case of using general phosphors. However, even using the short-persistence phosphor, the problem of generating flicker occurs. In addition, the problem of blurring and coloring of a moving contour occurs in the upper or lower portion of the screen when the total of the write time into the pixels, the response time of liquid crystal and the lighting-up time of the backlight exceeds the vertical period time. Therefore, the examples and the embodiment described above are effective even for the case of using a short-persistence phosphor.

INDUSTRIAL APPLICABILITY

[0051] As described above, the image display apparatus of the present invention can reduce image contour blurring in a moving image, as well as reducing flicker in a still image, during display of a moving image using a light modulation device such as a liquid crystal display. This enables higher-quality image display.

Claims

1. An image display apparatus for displaying an image by driving a passive light modulation device based on a video signal compressed in the time axis direction, the passive modulation device modulating light from a light source in a pixel-by-pixel manner based on an electric signal, the apparatus comprising:

    motion detection means (2, 22) for detecting the amount of motion of a display image based on the video signal;
    modulation pulse generation means (4, 24) for generating modulation pulses different in synchronizing phase according to the detection result from the motion detection means (2, 22);
    light source driving means for enabling the light source to emit light at a timing corresponding to the motion amount by intermittently driving the light source according to the modulation pulses generated by the modulation pulse generation means (4, 24);
    wherein the motion detection means (2, 22) detects the motion amount for each of a plurality of predetermined regions in the entire display area of the light modulation device,
    the image display apparatus further comprises comparison means (14) for comparing the motion amounts for the plurality of predetermined regions detected by the motion detection means (2, 22) with each other, and
    the modulation pulse generation means (4, 24) generates, for the entire display area, the modulation pulses different in synchronizing phase dependent on the comparison result from the comparison means (14).

2. The image display apparatus of claim 1, wherein the plurality of predetermined regions include at least a first predetermined region in which data based on the video signal is written at a time comparatively early in one frame and a second predetermined region in which data based on the video signal is written at a time comparatively late in one frame, and
    the modulation pulse generation means (4, 24) generates a first modulation pulse having a synchronizing phase permitting emission of the light source at a comparatively early time when the motion amount

in the first predetermined region detected by the motion detection means (2, 22) is greater than the motion amount in the second predetermined region, and generates a second modulation pulse having a synchronizing phase permitting emission of the light source at a comparatively late time when the motion amount in the first predetermined region detected by the motion detection means (2, 22) is smaller than the motion amount in the second predetermined region.

3. The image display apparatus of claim 2, wherein the modulation pulse generation means (4, 24) comprises:

count means (34) for delaying a vertical synchronizing signal by a predetermined time according to the comparison result from the comparison means (14); and
pulse output means for outputting a pulse based on the vertical synchronizing signal delayed by the count means (34).

4. The image display apparatus of claim 2, wherein when changing the output pulse with change of the comparison result from the comparison means (14), the modulation pulse generation means (4, 24) sequentially shifts the synchronizing phase of the output pulse stepwise by outputting a modulation pulse in a synchronizing phase somewhere between the synchronizing phase of the first modulation pulse and the synchronizing phase of the second modulation pulse.

5. The image display apparatus of claim 4, wherein the modulation pulse generation means (4, 24) comprises:

frame recursive low-pass filter means for outputting motion position data capable of taking on three or more values based on the comparison result from the comparison means (14);
count means (34) for delaying a vertical synchronizing signal based on the motion position data outputted from the frame recursive low-pass filter means; and
pulse output means for outputting a pulse based on the vertical synchronizing signal delayed by the count means (34).

6. An image display method for displaying an image by driving a passive light modulation device based on a video signal compressed in the time axis direction, the passive modulation device modulating light from a light source in a pixel-by-pixel manner based on an electric signal, the method comprising:

a motion detection step of detecting the amount of motion of a display image based on the video signal;
a modulation pulse generation step of generating modulation pulses different in synchronizing phase according to the detection result in the motion detection step; and
a light source driving step of emitting light from the light source at a timing corresponding to the motion amount by intermittently driving the light source according to the modulation pulses generated in the modulation pulse generation step;
wherein in the motion detection step, the motion amount is detected for each of a plurality of predetermined regions in the entire display area of the light modulation device, and
in the modulation pulse generation step, the modulation pulses different in synchronizing phase are generated for the entire display area, dependent on the motion amount detected in the motion detection step.

7. The image display method of claim 6, wherein the modulation pulse generation step comprises:

a count step of delaying a vertical synchronizing signal by a predetermined time according to the comparison result in the comparison step; and
a pulse output step of outputting a pulse based on the vertical synchronizing signal delayed in the count step.

8. The image display method of claim 6, wherein in the modulation pulse generation step, when an output pulse is changed with change of the motion amount for each of the plurality of predetermined regions detected in the motion detection step, the synchronizing phase of the output pulse is sequentially shifted stepwise by outputting a modulation pulse in a synchronizing phase somewhere between the synchronizing phase of the first modulation pulse and the synchronizing phase of the second modulation pulse.

Patentansprüche

1. Videowiedergabegerät zum Wiedergeben eines Bilds durch Betreiben einer passiven Lichtmodulationsvorrichtung auf der Grundlage eines in der Zeitachsenrichtung komprimierten Videosignals, wobei die passive Modulationsvorrichtung Licht aus einer Lichtquelle Pixel für Pixel auf der Grundlage eines elektrischen Signals moduliert, wobei das Gerät umfasst:

ein Bewegungserfassungsmittel (2, 22) zum Erfassen der Bewegungsstärke eines Wiedergabebilds auf der Grundlage des Videosignals;

ein Modulationspulserzeugungsmittel (4, 24) zum Erzeugen von Modulationspulsen, welche in einer Synchronisierphase gemäß dem Erfassungsergebnis aus dem Bewegungserfassungsmittel (2, 22) verschieden sind;
ein Lichtquellenbetreibmittel zum Ermöglichen der Lichtquelle Licht mit einem Zeitablauf entsprechend der Bewegungsstärke durch intermittierendes Betreiben der Lichtquelle gemäß den Modulationspulsen, welche durch die Modulationspulserzeugungsmittel (4, 24) erzeugt sind, zu emittieren;
wobei das Bewegungserfassungsmittel (2, 22) die Bewegungsstärke für jeden aus einer Mehrzahl von vorbestimmten Bereichen im gesamten Wiedergabegebiet der Lichtmodulationsvorrichtung erfasst,
das Bildwiedergabegerät weiterhin ein Vergleichsmittel (14) zum miteinander Vergleichen der Bewegungsstärke für die Mehrzahl von vorbestimmten Bereichen, welche durch das Bewegungserfassungsmittel (2, 22) erfasst sind, umfasst, und
das Modulationspulserzeugungsmittel (4, 24) die Modulationspulse, welche in der Synchronisierphase abhängig vom Vergleichsergebnis aus dem Vergleichsmittel (14) verschieden sind, für das gesamte Wiedergabegebiet erzeugt.

2. Bildwiedergabegerät nach Anspruch 1, wobei die Mehrzahl von vorbestimmten Bereichen zumindest einen ersten vorbestimmten Bereich, in welchem Daten auf der Grundlage des Videosignals zu einer vergleichsweise frühen Zeit in einen Rahmen geschrieben werden, und einen zweiten vorbestimmten Bereich enthält, in welchem Daten auf der Grundlage des Videosignals zu einer vergleichsweise späten Zeit in einen Rahmen geschrieben werden, und das Modulationspulserzeugungsmittel (4, 24) einen ersten Modulationspuls erzeugt, welcher eine Synchronisierungsphase aufweist, welche eine Emission aus der Lichtquelle zu einer vergleichsweise frühen Zeit erlaubt, wenn die Bewegungsstärke im ersten vorbestimmten Bereich, welche durch das Bewegungserfassungsmittel (2, 22) erfasst ist, größer als die Bewegungsstärke im zweiten vorbestimmten Bereich ist, und einen zweiten Modulationspuls erzeugt, welcher eine Synchronisierungsphase aufweist, welche eine Emission aus der Lichtquelle zu einer vergleichsweise späten Zeit erlaubt, wenn die Bewegungsstärke im ersten vorbestimmten Bereich, welche durch das Bewegungserfassungsmittel (2, 22) erfasst ist, kleiner als die Bewegungsstärke im zweiten vorbestimmten Bereich ist.

3. Bildwiedergabegerät nach Anspruch 2, wobei das Modulationspulserzeugungsmittel (4, 24) umfasst:

ein Zählmittel (34) zum Verzögern eines vertikalen Synchronisiersignals durch eine vorbestimmten Zeit gemäß dem Vergleichsergebnis aus dem Vergleichsmittel (14); und
ein Pulsausgabemittel zum Ausgeben eines Pulses auf der Grundlage des vertikalen Synchronisiersignals, welches durch das Zählmittel (34) verzögert ist.

4. Bildwiedergabegerät nach Anspruch 2, wobei das Modulationspulserzeugungsmittel (4, 24) beim Ändern des Ausgabepulses mit einer Änderung des Vergleichsergebnisses aus dem Vergleichsmittel (14) die Synchronisierphase des Ausgabepulses nach und nach schrittweise durch Ausgeben eines Modulationspulses in eine Synchronisierphase irgendwo zwischen der Synchronisierphase des ersten Modulationspulses und der Synchronisierphase des zweiten Modulationspulses verschiebt.

5. Bildwiedergabegerät nach Anspruch 4, wobei das Modulationspulserzeugungsmittel (4, 24) umfasst:

ein Rahmenrekursivtiefpassfiltermittel zum Ausgeben von Bewegungspositionsdaten, welche drei oder mehr Werte auf der Grundlage des Vergleichsergebnisses aus dem Vergleichsmittel (14) übernehmen können;
ein Zählmittel (34) zum Verzögern eines vertikalen Synchronisiersignals auf der Grundlage der Bewegungspositionsdaten, welche aus dem Rahmenrekursivtiefpassfiltermittel ausgegeben werden; und
ein Pulsausgabemittel zum Ausgeben eines Pulses auf der Grundlage des vertikalen Synchronisiersignals, welches durch das Zählmittel (34) verzögert ist.

6. Bildwiedergabeverfahren zum Wiedergeben eines Bildes durch Betreiben einer passiven Lichtmodulationsvorrichtung auf der Grundlage eines in der Zeitachsenrichtung komprimierten Videosignals, wobei die passive Modulationsvorrichtung Licht aus einer Lichtquelle Pixel für Pixel auf der Grundlage eines elektrischen Signals moduliert, wobei das Verfahren umfasst:

einen Bewegungserfassungsschritt des Erfassens der Bewegungsstärke eines Wiedergabebilds auf der Grundlage des Videosignals;
einen Modulationspulserzeugungsschritt des Erzeugens von Modulationspulsen, welche in einer Synchronisierphase gemäß dem Erfassungsergebnis im Bewegungserfassungsschritt verschieden sind; und
einen Lichtquellenbetreibschritt des Emittierens von Licht aus der Lichtquelle mit einem Zeitablauf entsprechend der Bewegungsstärke durch

intermittierendes Betreiben der Lichtquelle gemäß den Modulationspulsen, welche im Modulationspulserzeugungsschritt erzeugt sind;
wobei im Bewegungserfassungsschritt die Bewegungsstärke für jeden aus einer Mehrzahl von vorbestimmten Bereichen im gesamten Wiedergabegebiet der Lichtmodulationsvorrichtung erfasst wird, und
wobei im Modulationspulserzeugungsschritt die in der Synchronisierphase verschiedenen Modulationspulse für das gesamte Wiedergabegebiet abhängig von der im Bewegungserfassungsschritt erfassten Bewegungsstärke erzeugt werden.

7. Bildwiedergabeverfahren nach Anspruch 6, wobei der Modulationspulserzeugungsschritt umfasst:

einen Zählschritt des Verzögerns eines vertikalen Synchronisiersignals durch eine vorbestimmte Zeit gemäß dem Vergleichsergebnis im Vergleichsschritt; und
einen Pulsausgabeschritt des Ausgebens eines Pulses auf der Grundlage des im Zählschritt verzögerten vertikalen Synchronsiersignals.

8. Bildwiedergabeverfahren nach Anspruch 6, wobei im Modulationspulserzeugungsschritt, wenn ein Ausgabepuls mit einem Ändern der Bewegungsstärke für jeden aus der Mehrzahl von vorbestimmten Bereichen, welche im Bewegungserfassungsschritt erfasst wird, geändert wird, die Synchronisierphase des Ausgabepulses nach und nach schrittweise durch Ausgeben eines Modulationspulses in eine Synchronisierphase irgendwo zwischen der Synchronisierphase des ersten Modulationspulses und der Synchronisierphase des zweiten Modulationspulses verschoben wird.

Revendications

1. Appareil d'affichage d'images permettant d'afficher une image en commandant un modulateur de lumière passif sur la base d'un signal vidéo comprimé dans la direction de l'axe du temps, le modulateur passif modulant pixel par pixel la lumière provenant d'une source de lumière sur la base d'un signal électrique, l'appareil comprenant :

un moyen de détection de mouvement (2, 22) destiné à détecter la quantité de mouvement d'une image affichée sur la base du signal vidéo :

un moyen de génération d'impulsions de modulation (4, 24) destiné à générer des impulsions de modulation ayant des phases de synchronisation différentes selon le résultat de détection provenant du moyen de détection de mouvement (2, 22) ;
un moyen de commande de source de lumière destiné à permettre à la source de lumière d'émettre de la lumière à un instant correspondant à la quantité de mouvement en commandant de manière intermittente la source de lumière selon les impulsions de modulation générées par le moyen de génération d'impulsions de modulation (4, 24) ;
où le moyen de détection de mouvement (2, 22) détecte la quantité de mouvement pour chacune d'une pluralité de zones prédéterminées dans toute la surface d'affichage du modulateur de lumière,
l'appareil d'affichage d'images comprend en outre un moyen de comparaison (14) destiné à comparer les quantités de mouvement pour la pluralité de zones prédéterminées détectées par le moyen de détection de mouvement (2, 22) entre elles, et
le moyen de génération d'impulsions de modulation (4, 24) génère, pour toute la surface d'affichage, les impulsions de modulation dont les phases de synchronisation sont différentes en fonction du résultat de comparaison délivré par le moyen de comparaison (14).

2. Appareil d'affichage d'images de la revendication 1, dans lequel la pluralité de zones prédéterminées comportent au moins une première zone prédéterminée dans laquelle des données basées sur le signal vidéo sont écrites à un moment relativement précoce dans une trame et une deuxième zone prédéterminée dans laquelle des données basées sur le signal vidéo sont écrites à un moment relativement tardif dans une trame, et
le moyen de génération d'impulsions de modulation (4, 24) génère une première impulsion de modulation ayant une phase de synchronisation permettant l'émission de la source de lumière à un moment relativement précoce lorsque la quantité de mouvement dans la première zone prédéterminée détectée par le moyen de détection de mouvement (2, 22) est supérieure à la quantité de mouvement dans la deuxième zone prédéterminée, et génère une deuxième impulsion de modulation ayant une phase de synchronisation permettant l'émission de la source de lumière à un moment relativement tardif lorsque la quantité de mouvement dans la première zone prédéterminée détectée par le moyen de détection de mouvement (2, 22) est inférieure à la quantité de mouvement dans la deuxième zone prédéterminée.

3. Appareil d'affichage d'images de la revendication 2, dans lequel le moyen de génération d'impulsions de modulation (4, 24) comprend :

un moyen de comptage (34) destiné à retarder un signal de synchronisation verticale par un temps prédéterminé selon le résultat de comparaison provenant du moyen de comparaison (14) ; et
un moyen de sortie d'impulsion destiné à délivrer en sortie une impulsion sur la base du signal de synchronisation verticale retardé par le moyen de comptage (34).

4. Appareil d'affichage d'images de la revendication 2, dans lequel lors du changement de l'impulsion de sortie avec un changement du résultat de comparaison provenant du moyen de comparaison (14), le moyen de génération d'impulsions de modulation (4, 24) décale séquentiellement par palier la phase de synchronisation de l'impulsion de sortie en délivrant en sortie une impulsion de modulation dans une phase de synchronisation qui se situe quelque part entre la phase de synchronisation de la première impulsion de modulation et la phase de synchronisation de la deuxième impulsion de modulation.

5. Appareil d'affichage d'images de la revendication 4, dans lequel le moyen de génération d'impulsions de modulation (4, 24) comprend :

un moyen de filtrage passe-bas récursif de trames destiné à délivrer en sortie des données de position de mouvement pouvant prendre trois valeurs ou plus sur la base du résultat de comparaison provenant du moyen de comparaison (14) ;
un moyen de comptage (34) destiné à retarder un signal de synchronisation verticale sur la base des données de position de mouvement délivrées en sortie à partir du moyen de filtrage passe-bas récursif de trames ; et
un moyen de sortie d'impulsion destiné à délivrer en sortie une impulsion sur la base du signal de synchronisation verticale retardé par le moyen de comptage (34).

6. Procédé d'affichage d'images permettant d'afficher une image en commandant un modulateur de lumière passif sur la base d'un signal vidéo comprimé dans la direction de l'axe du temps, le modulateur passif modulant pixel par pixel la lumière provenant d'une source de lumière sur la base d'un signal électrique, le procédé comprenant :

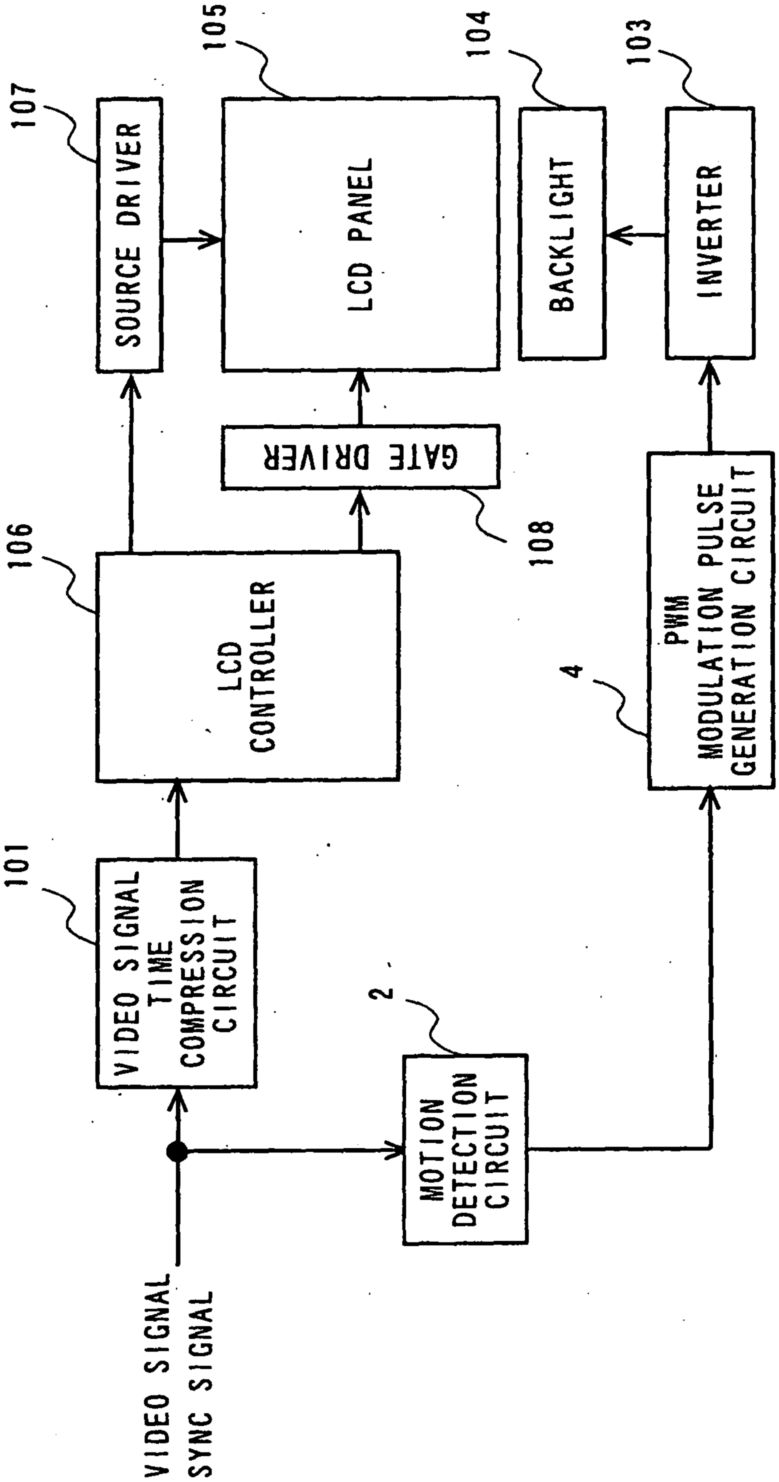
une étape de détection de mouvement qui consiste à détecter la quantité de mouvement d'une image affichée sur la base du signal vidéo ;
une étape de génération d'impulsions de modulation qui consiste à générer des impulsions de modulation ayant des phases de synchronisation différentes selon le résultat de détection dans l'étape de détection de mouvement ; et
une étape de commande de source de lumière qui consiste à émettre de la lumière provenant de la source de lumière à un instant correspondant à la quantité de mouvement en commandant de manière intermittente la source de lumière selon les impulsions de modulation générées dans l'étape de génération d'impulsions de modulation ;
dans lequel, dans l'étape de détection de mouvement, la quantité de mouvement est détectée pour chacune d'une pluralité de zones prédéterminées dans toute la surface d'affichage du modulateur de lumière, et
dans l'étape de génération d'impulsions de modulation, les impulsions de modulation, dont les phases de synchronisation sont différentes, sont générées pour toute la surface d'affichage, en fonction de la quantité de mouvement détectée dans l'étape de détection de mouvement.

7. Procédé d'affichage d'images de la revendication 6, dans lequel l'étape de génération d'impulsions de modulation comprend :

une étape de comptage qui consiste à retarder un signal de synchronisation verticale par un temps prédéterminé selon le résultat de comparaison dans l'étape de comparaison ; et
une étape de sortie d'impulsion qui consiste à délivrer en sortie une impulsion sur la base du signal de synchronisation verticale retardé dans l'étape de comptage.

8. Procédé d'affichage d'images de la revendication 6, dans lequel, dans l'étape de génération d'impulsions de modulation, lorsqu'une impulsion de sortie est changée avec un changement de la quantité de mouvement pour chacune de la pluralité de zones prédéterminées détectée dans l'étape de détection de mouvement, la phase de synchronisation de l'impulsion de sortie est séquentiellement décalée par palier en délivrant en sortie une impulsion de modulation dans une phase de synchronisation qui se situe quelque part entre la phase de synchronisation de la première impulsion de modulation et la phase de synchronisation de la deuxième impulsion de modulation.

F I G. 1


VIDEO SIGNAL
SYNC SIGNAL
VIDEO SIGNAL TIME COMPRESSION CIRCUIT
101
LCD CONTROLLER
106
SOURCE DRIVER
107
GATE DRIVER
108
LCD PANEL
105
BACKLIGHT
104
INVERTER
103
MOTION DETECTION CIRCUIT
2
PWM MODULATION PULSE GENERATION CIRCUIT
4

F I G. 2

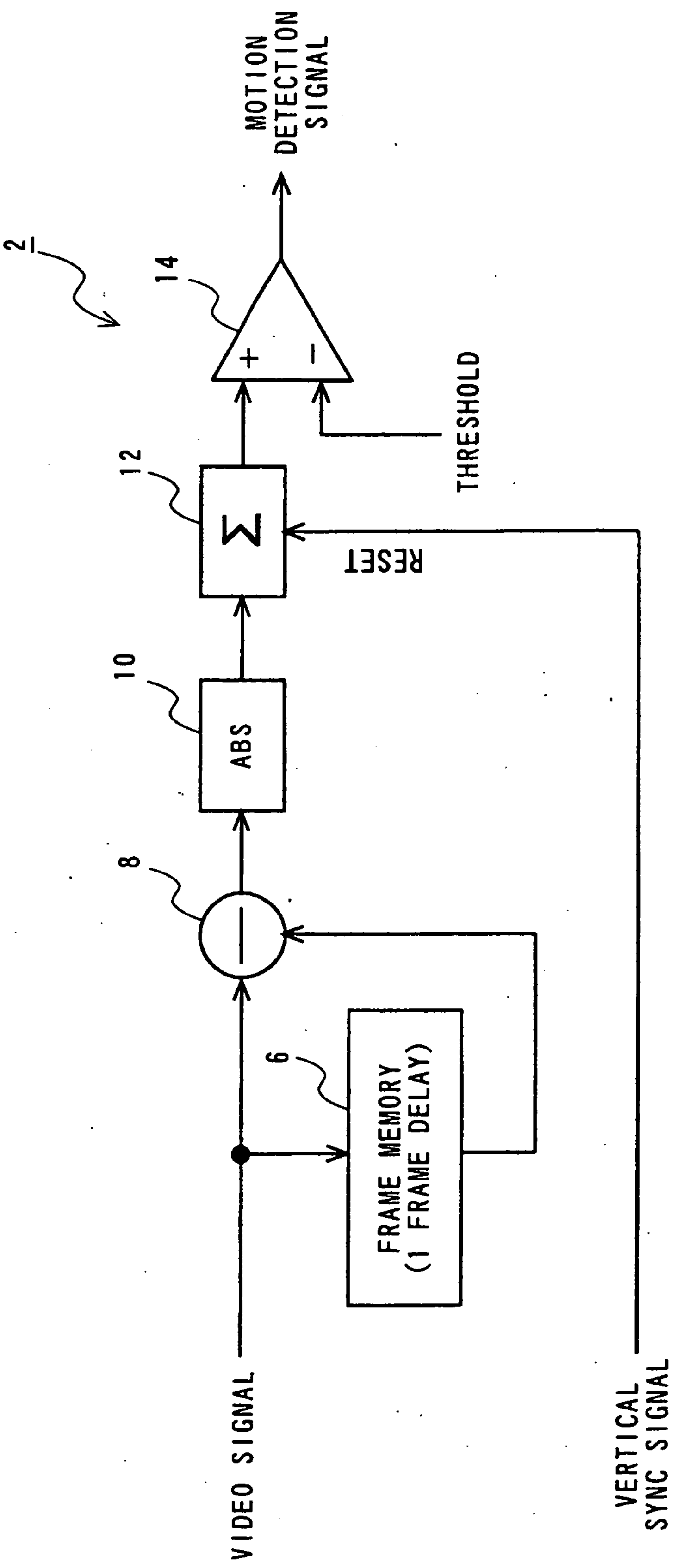
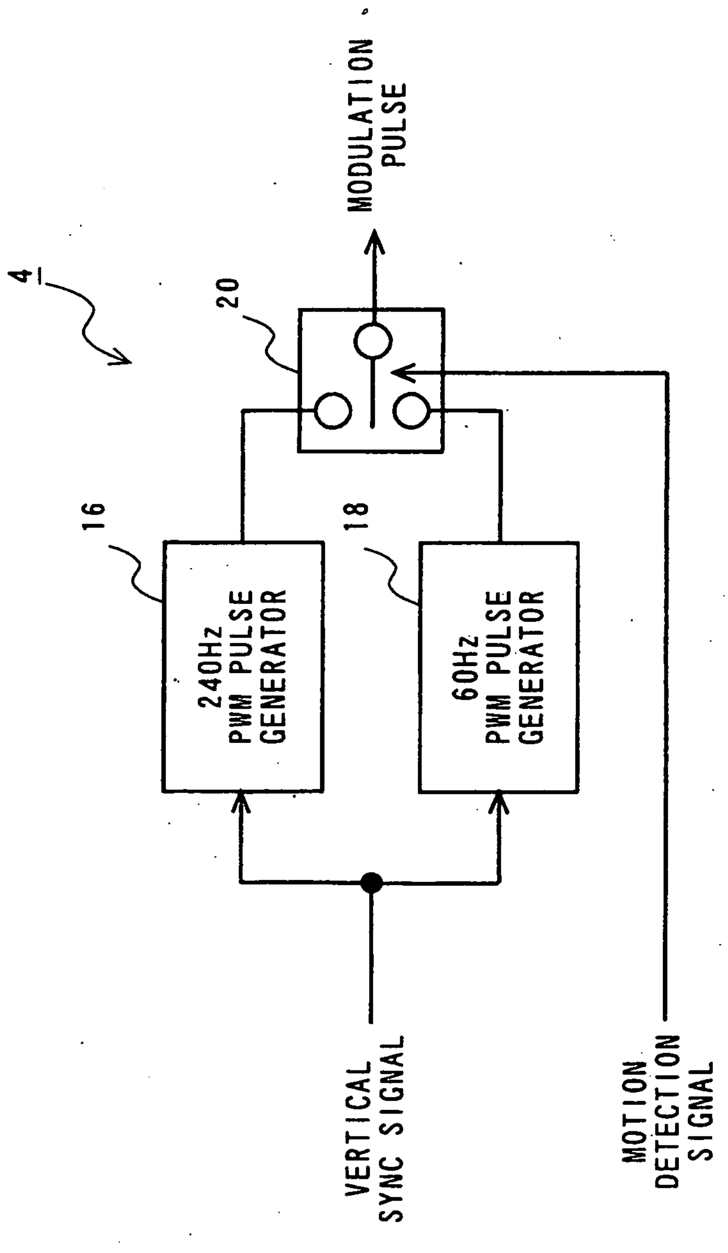
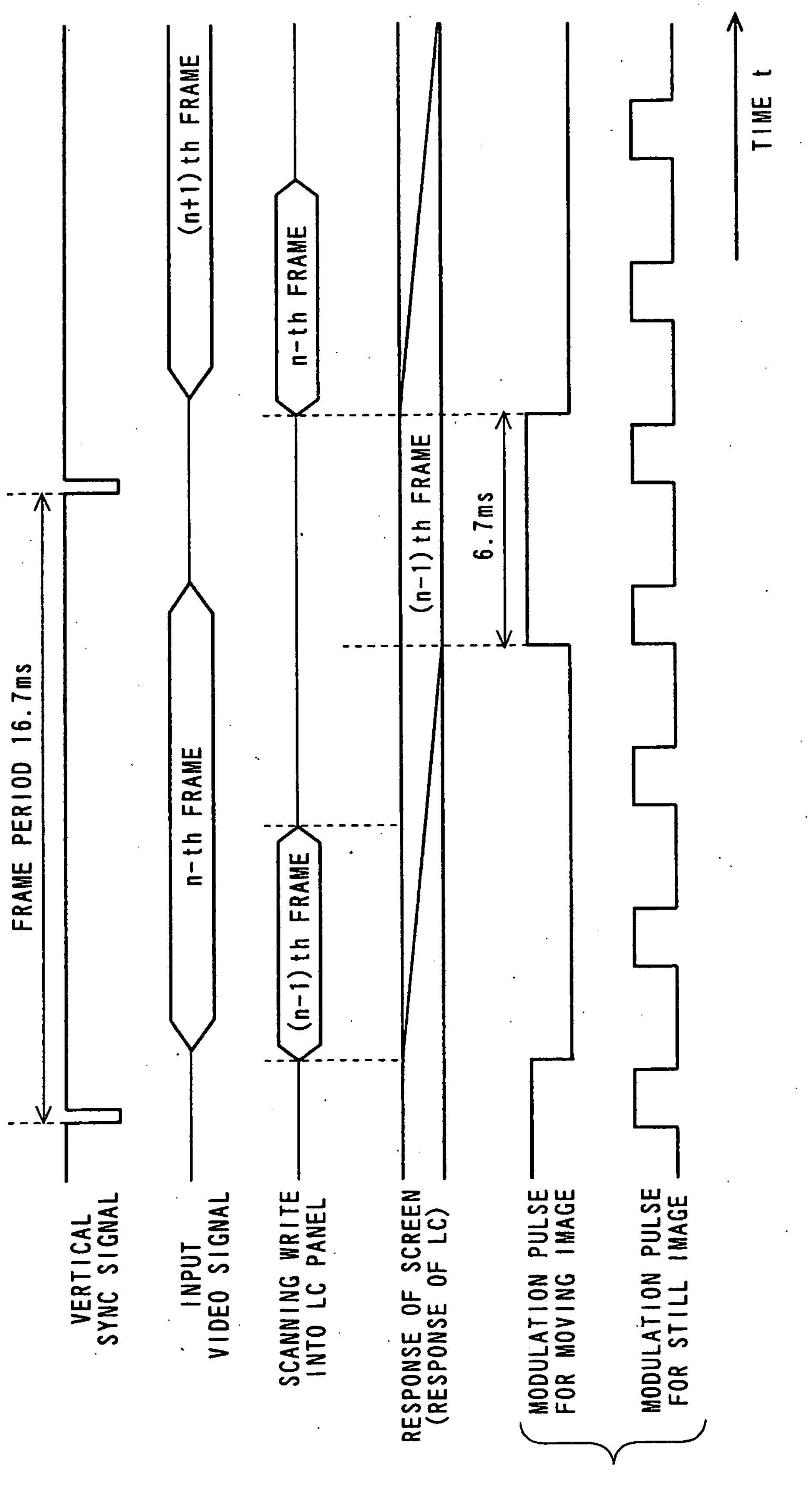

VIDEO SIGNAL
6
FRAME MEMORY (1 FRAME DELAY)
8
10
ABS
12
Σ
RESET
VERTICAL SYNC SIGNAL
14
+
−
THRESHOLD
2
MOTION DETECTION SIGNAL

FIG. 3

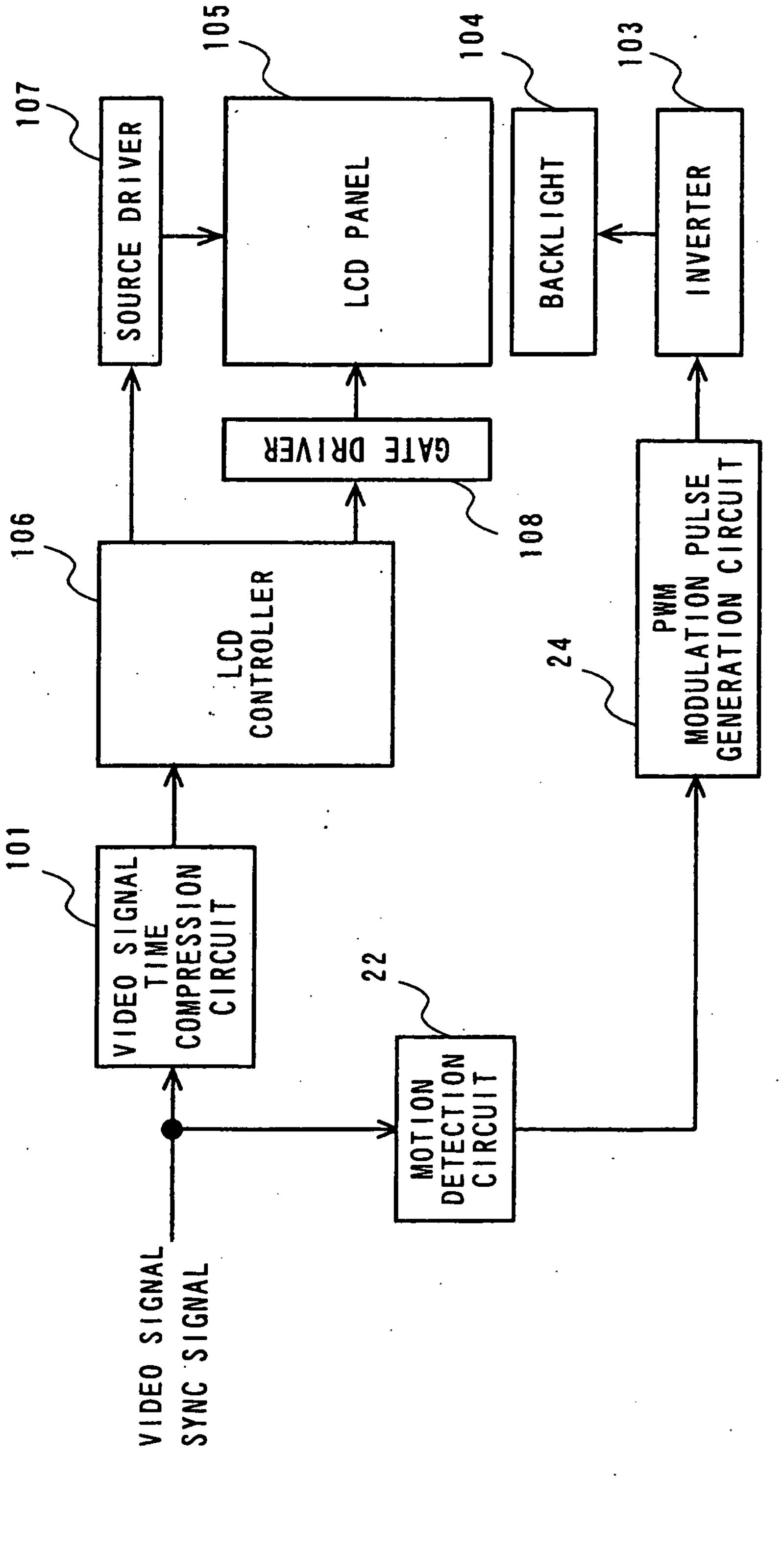

4
20
MODULATION PULSE
16
240Hz PWM PULSE GENERATOR
18
60Hz PWM PULSE GENERATOR
VERTICAL SYNC SIGNAL
MOTION DETECTION SIGNAL

F I G. 4

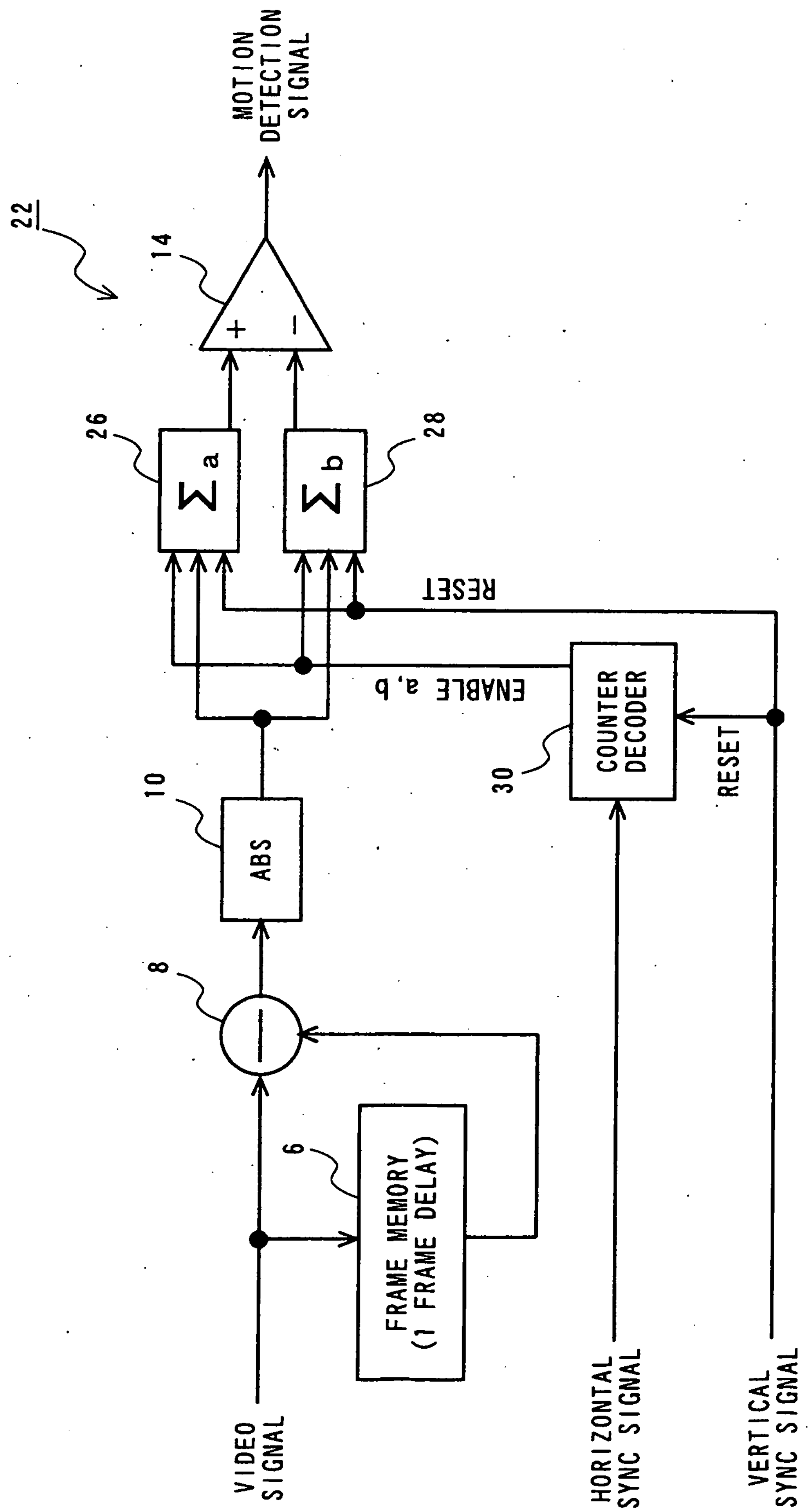


VERTICAL SYNC SIGNAL
FRAME PERIOD 16.7ms
INPUT VIDEO SIGNAL
n-th FRAME
(n+1) th FRAME
SCANNING WRITE INTO LC PANEL
(n-1) th FRAME
n-th FRAME
RESPONSE OF SCREEN (RESPONSE OF LC)
(n-1) th FRAME
6.7ms
MODULATION PULSE FOR MOVING IMAGE
MODULATION PULSE FOR STILL IMAGE
TIME t

F I G. 5


VIDEO SIGNAL
SYNC SIGNAL
VIDEO SIGNAL TIME COMPRESSION CIRCUIT
101
LCD CONTROLLER
106
SOURCE DRIVER
107
LCD PANEL
105
GATE DRIVER
108
BACKLIGHT
104
INVERTER
103
MOTION DETECTION CIRCUIT
22
PWM MODULATION PULSE GENERATION CIRCUIT
24

F I G. 6



MOTION DETECTION SIGNAL
22
14
+
−
26
Σa
28
Σb
RESET
ENABLE a, b
30
COUNTER DECODER
RESET
10
ABS
8
6
FRAME MEMORY (1 FRAME DELAY)
VIDEO SIGNAL
HORIZONTAL SYNC SIGNAL
VERTICAL SYNC SIGNAL

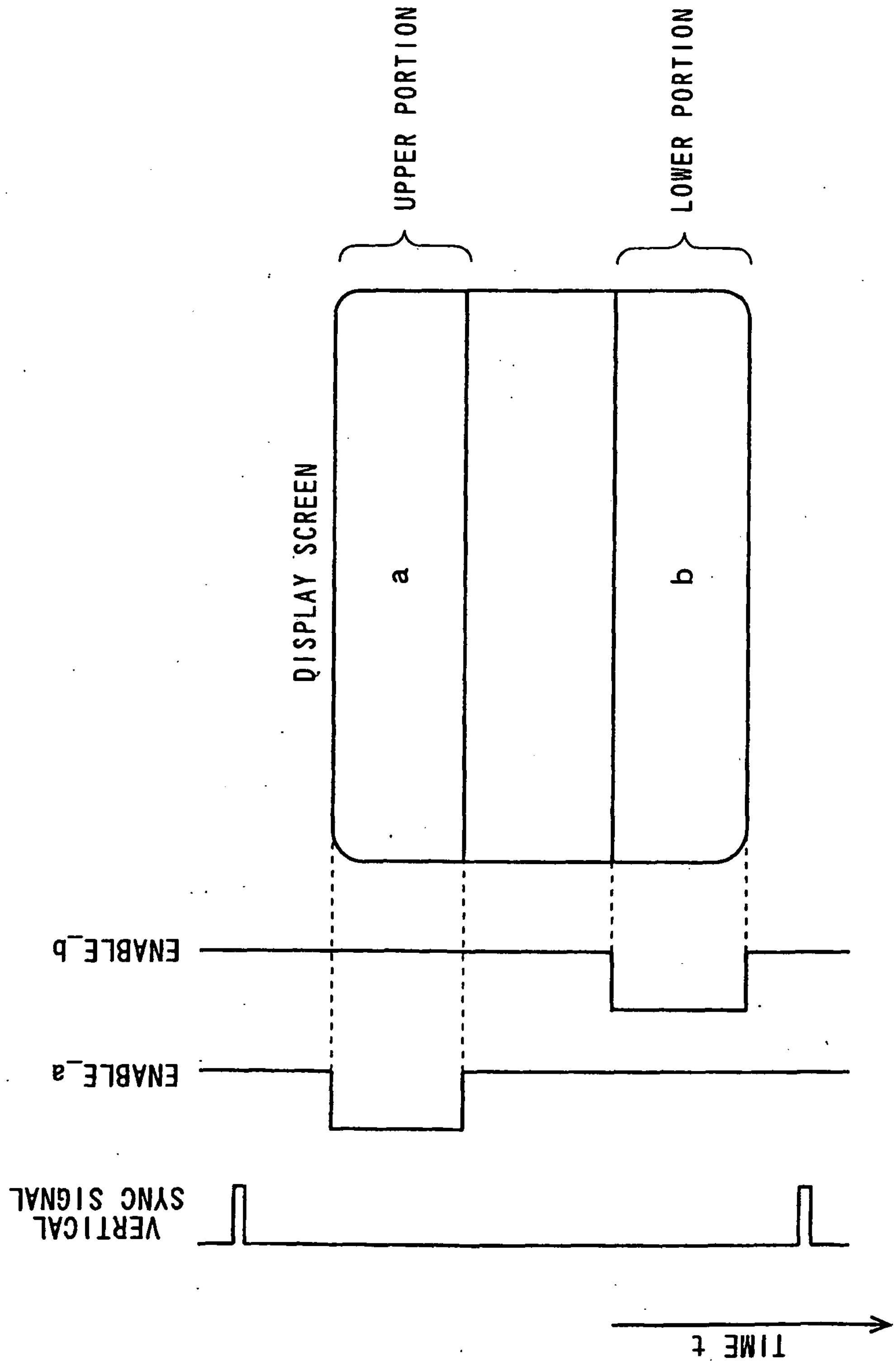
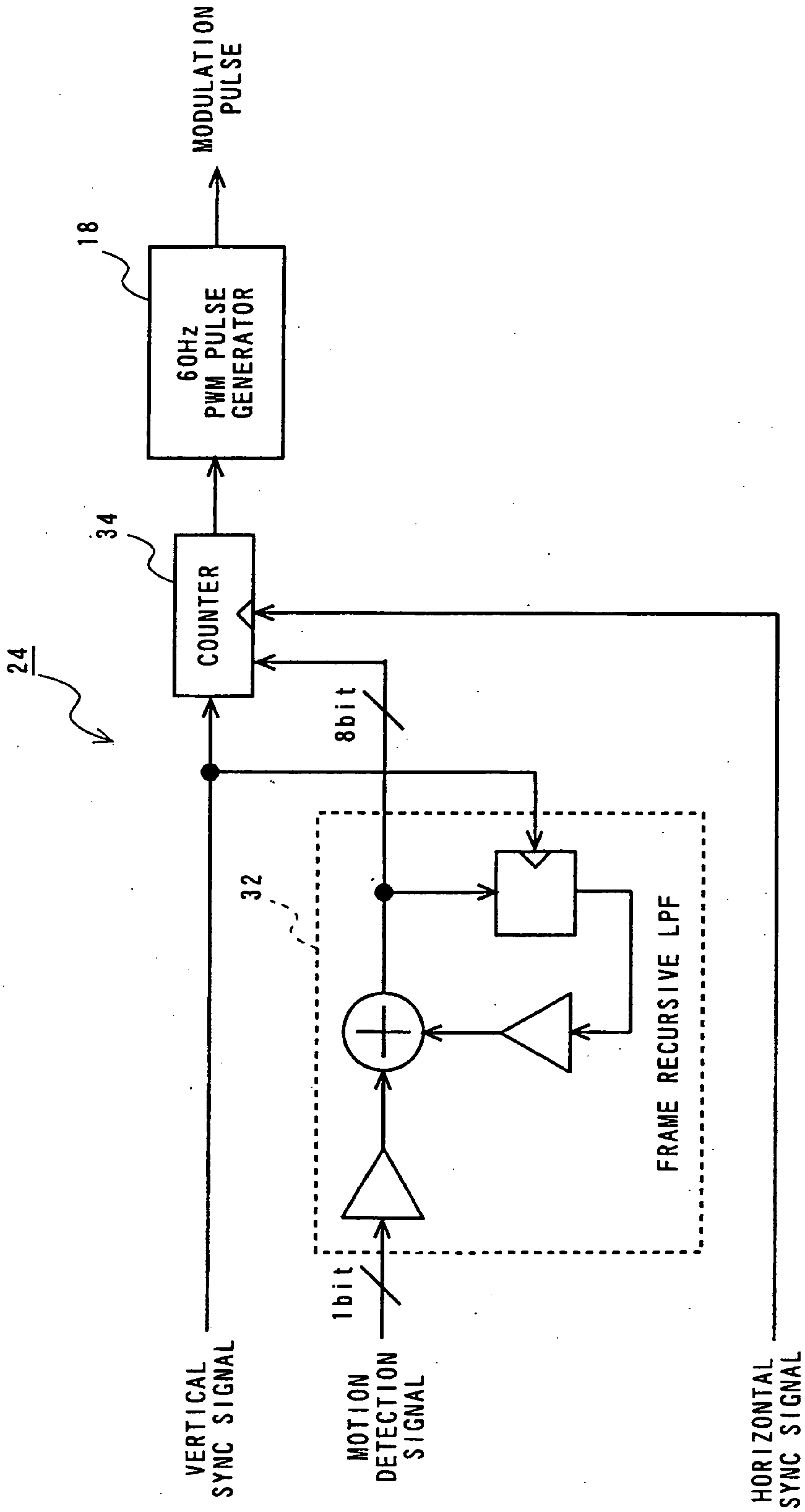
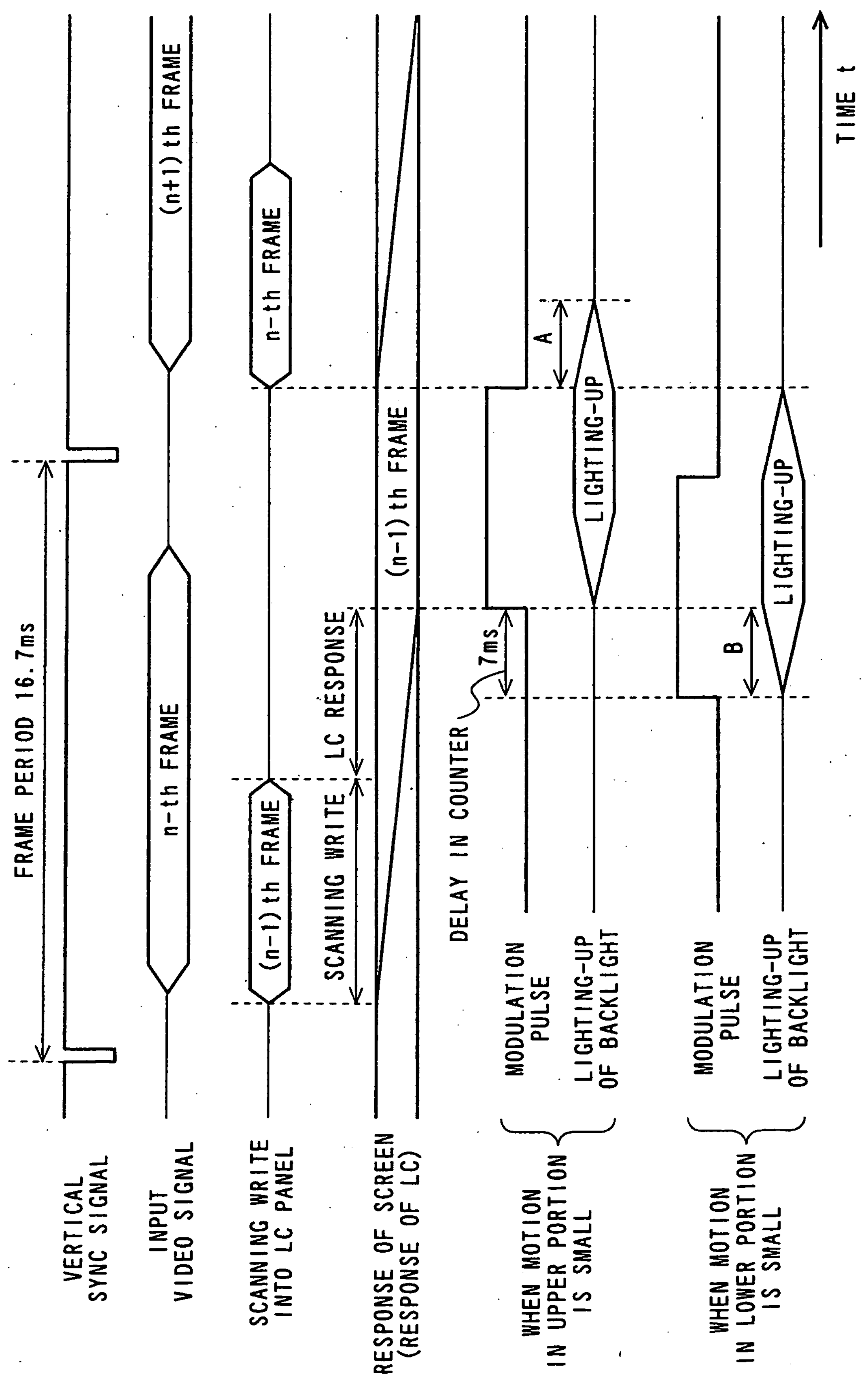

UPPER PORTION
LOWER PORTION
DISPLAY SCREEN
a
b
ENABLE_b
ENABLE_a
VERTICAL
SYNC SIGNAL
TIME t

FIG. 7

FIG. 8


MODULATION PULSE
18
60Hz PWM PULSE GENERATOR
34
COUNTER
24
8bit
32
FRAME RECURSIVE LPF
1bit
VERTICAL SYNC SIGNAL
MOTION DETECTION SIGNAL
HORIZONTAL SYNC SIGNAL

F I G. 9


VERTICAL SYNC SIGNAL
INPUT VIDEO SIGNAL
SCANNING WRITE INTO LC PANEL
RESPONSE OF SCREEN (RESPONSE OF LC)
WHEN MOTION IN UPPER PORTION IS SMALL
WHEN MOTION IN LOWER PORTION IS SMALL
MODULATION PULSE
LIGHTING-UP OF BACKLIGHT
MODULATION PULSE
LIGHTING-UP OF BACKLIGHT
FRAME PERIOD 16.7ms
n-th FRAME
(n+1)th FRAME
(n-1)th FRAME
n-th FRAME
SCANNING WRITE
LC RESPONSE
(n-1)th FRAME
DELAY IN COUNTER
7ms
A
B
LIGHTING-UP
LIGHTING-UP
TIME t

F I G. 10

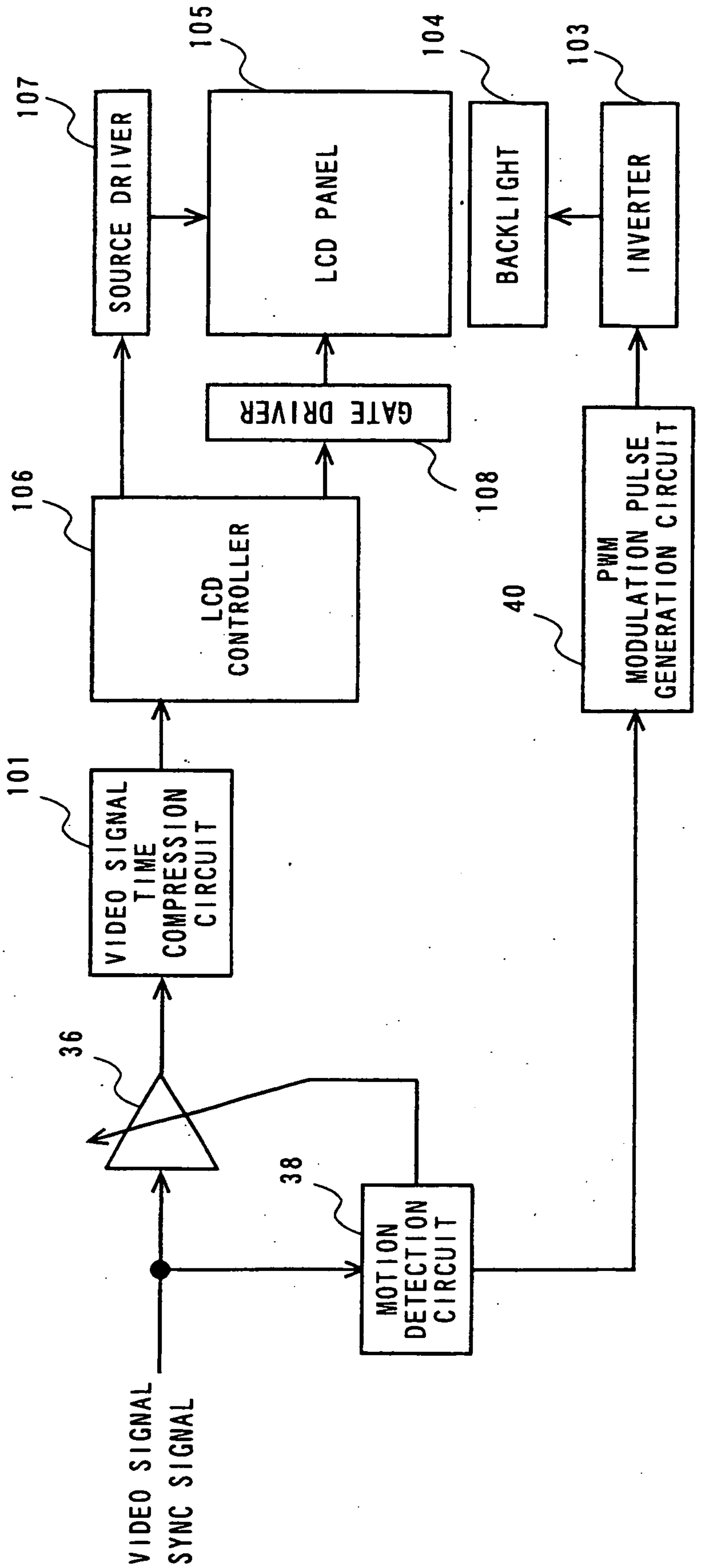

VIDEO SIGNAL
SYNC SIGNAL
36
38
MOTION DETECTION CIRCUIT
101
VIDEO SIGNAL TIME COMPRESSION CIRCUIT
106
LCD CONTROLLER
108
GATE DRIVER
107
SOURCE DRIVER
105
LCD PANEL
104
BACKLIGHT
103
INVERTER
40
PWM MODULATION PULSE GENERATION CIRCUIT

FIG. 11

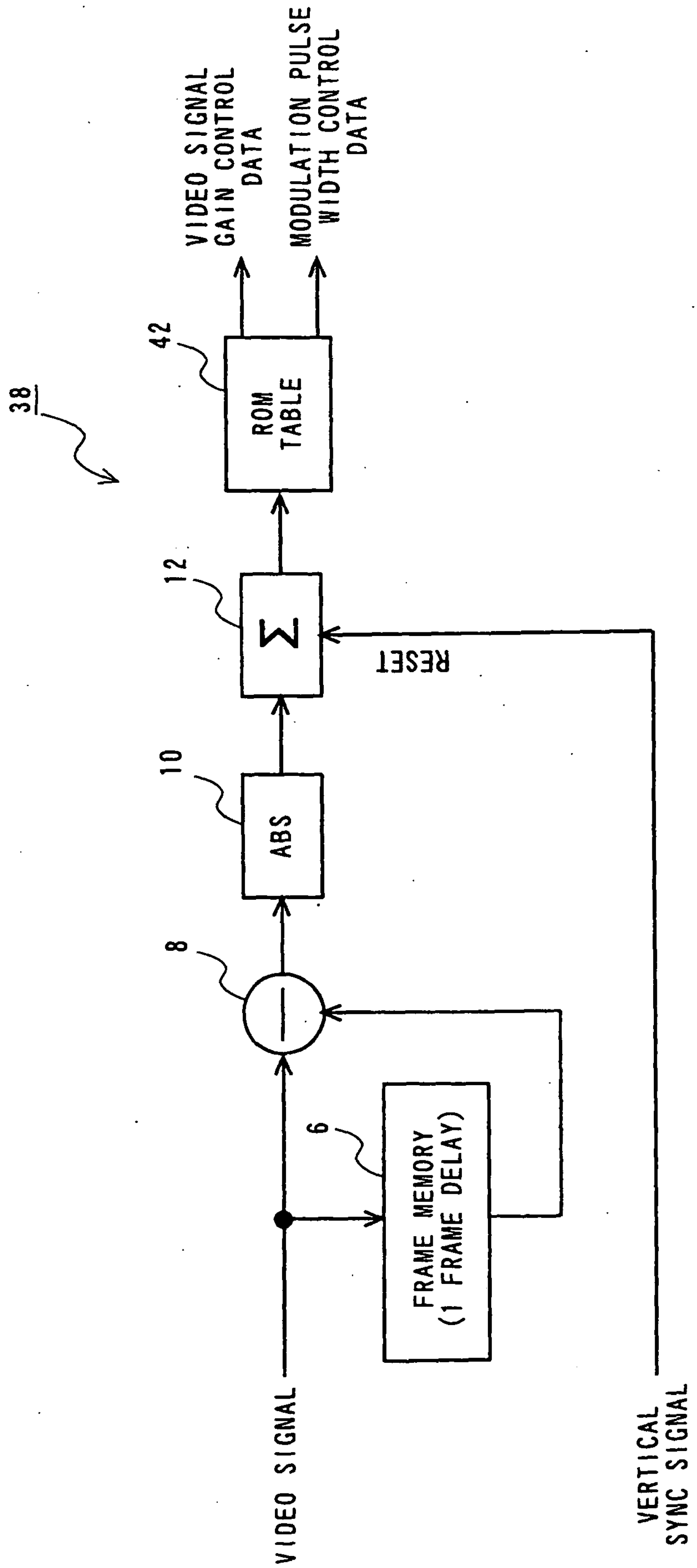

38
VIDEO SIGNAL
FRAME MEMORY (1 FRAME DELAY)
6
8
ABS
10
Σ
12
RESET
ROM TABLE
42
VIDEO SIGNAL GAIN CONTROL DATA
MODULATION PULSE WIDTH CONTROL DATA
VERTICAL SYNC SIGNAL

FIG. 12

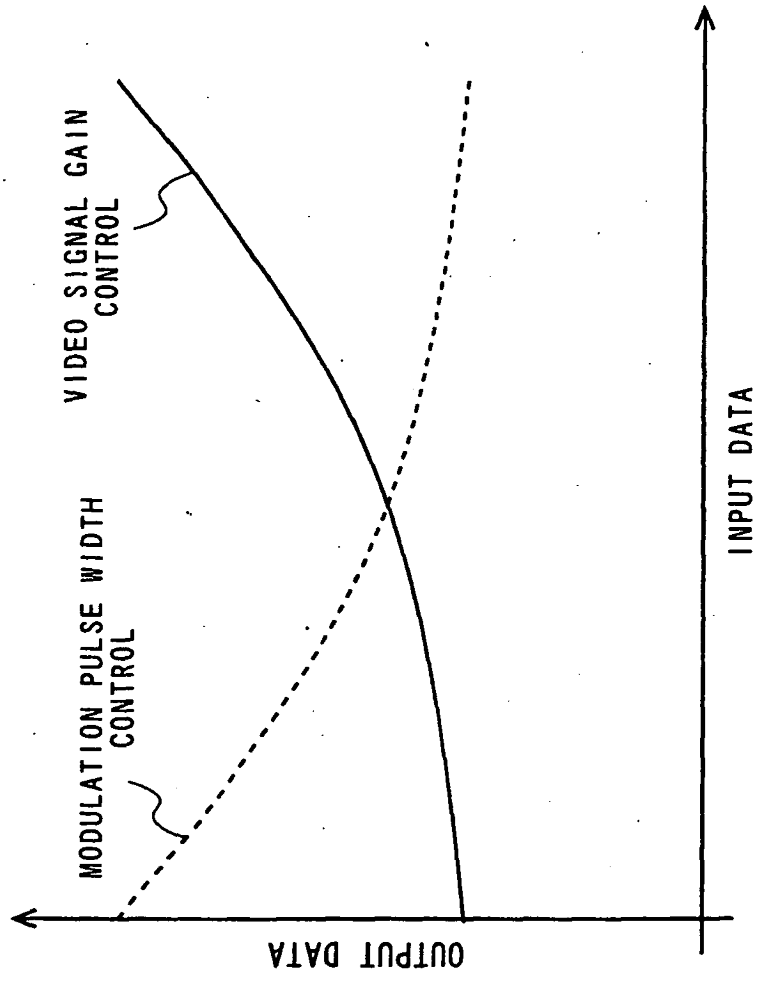

VIDEO SIGNAL GAIN CONTROL
MODULATION PULSE WIDTH CONTROL
OUTPUT DATA
INPUT DATA

FIG. 13

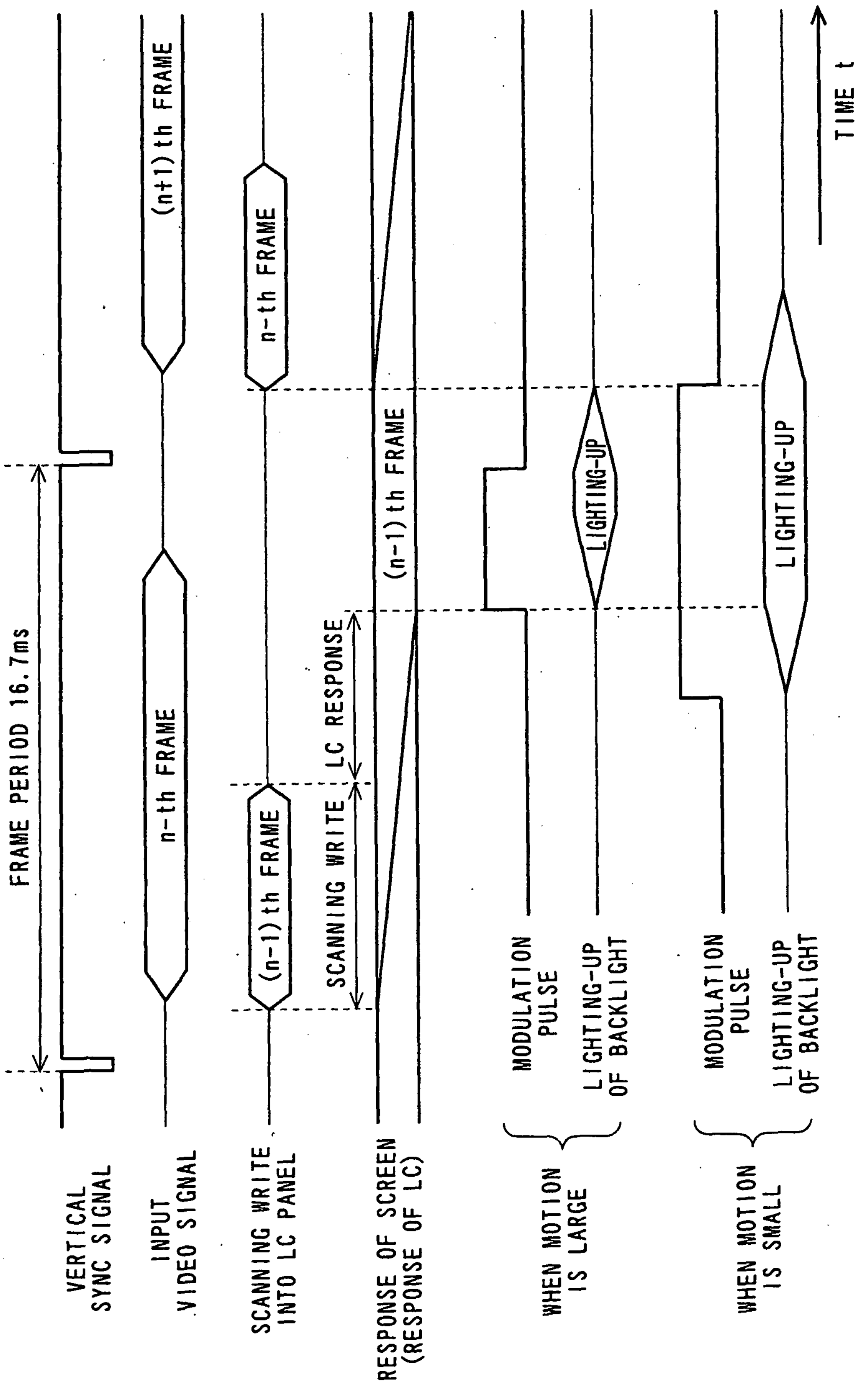
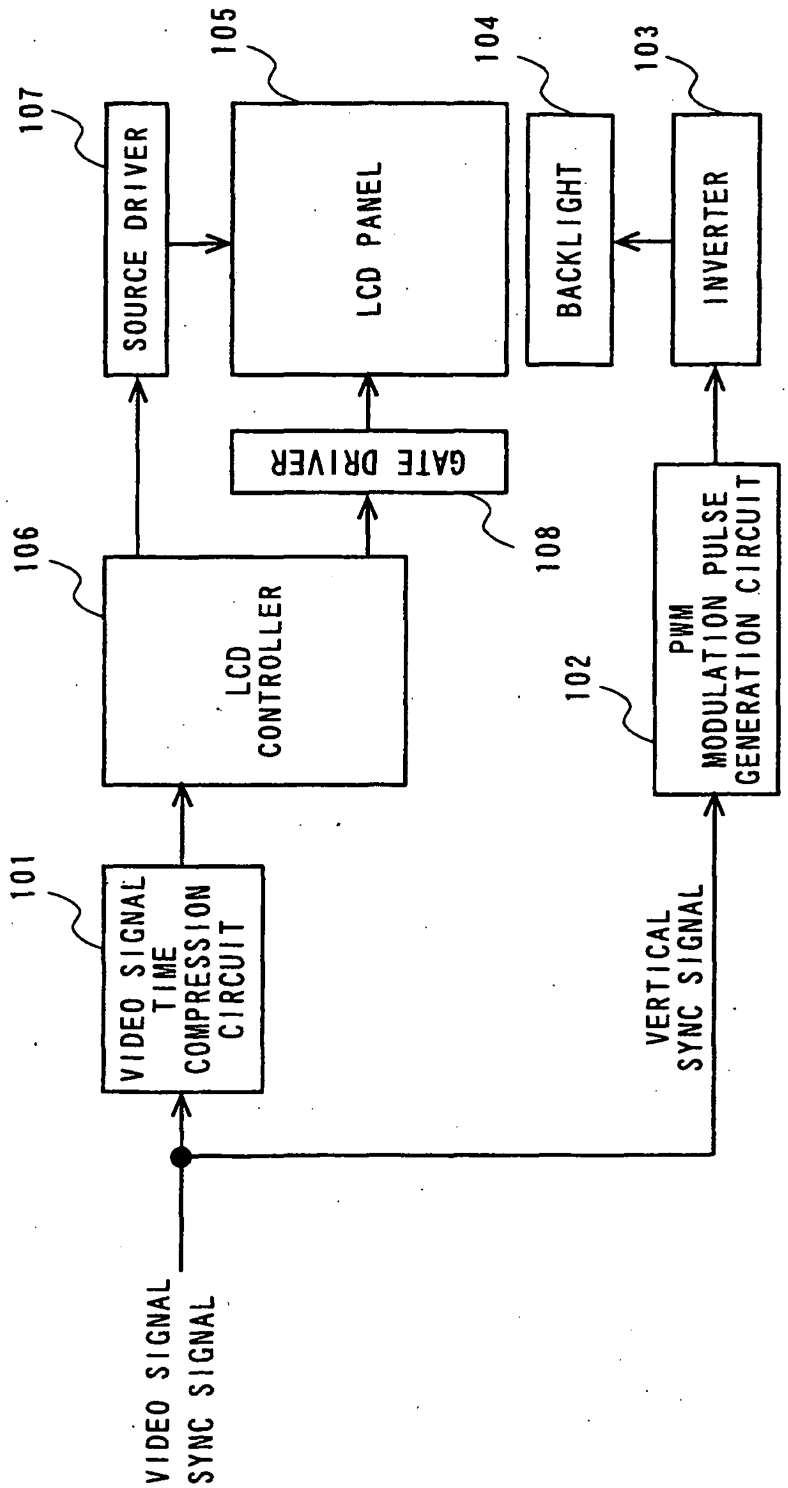

VERTICAL SYNC SIGNAL
INPUT VIDEO SIGNAL
SCANNING WRITE INTO LC PANEL
RESPONSE OF SCREEN (RESPONSE OF LC)
WHEN MOTION IS LARGE
WHEN MOTION IS SMALL
FRAME PERIOD 16.7ms
n-th FRAME
(n+1) th FRAME
(n-1) th FRAME
n-th FRAME
SCANNING WRITE
LC RESPONSE
(n-1) th FRAME
MODULATION PULSE
LIGHTING-UP OF BACKLIGHT
LIGHTING-UP
MODULATION PULSE
LIGHTING-UP OF BACKLIGHT
LIGHTING-UP
TIME t

FIG. 14



VIDEO SIGNAL
SYNC SIGNAL
VIDEO SIGNAL TIME COMPRESSION CIRCUIT
101
LCD CONTROLLER
106
SOURCE DRIVER
107
LCD PANEL
105
GATE DRIVER
108
BACKLIGHT
104
INVERTER
103
PWM MODULATION PULSE GENERATION CIRCUIT
102
VERTICAL SYNC SIGNAL

FIG. 15

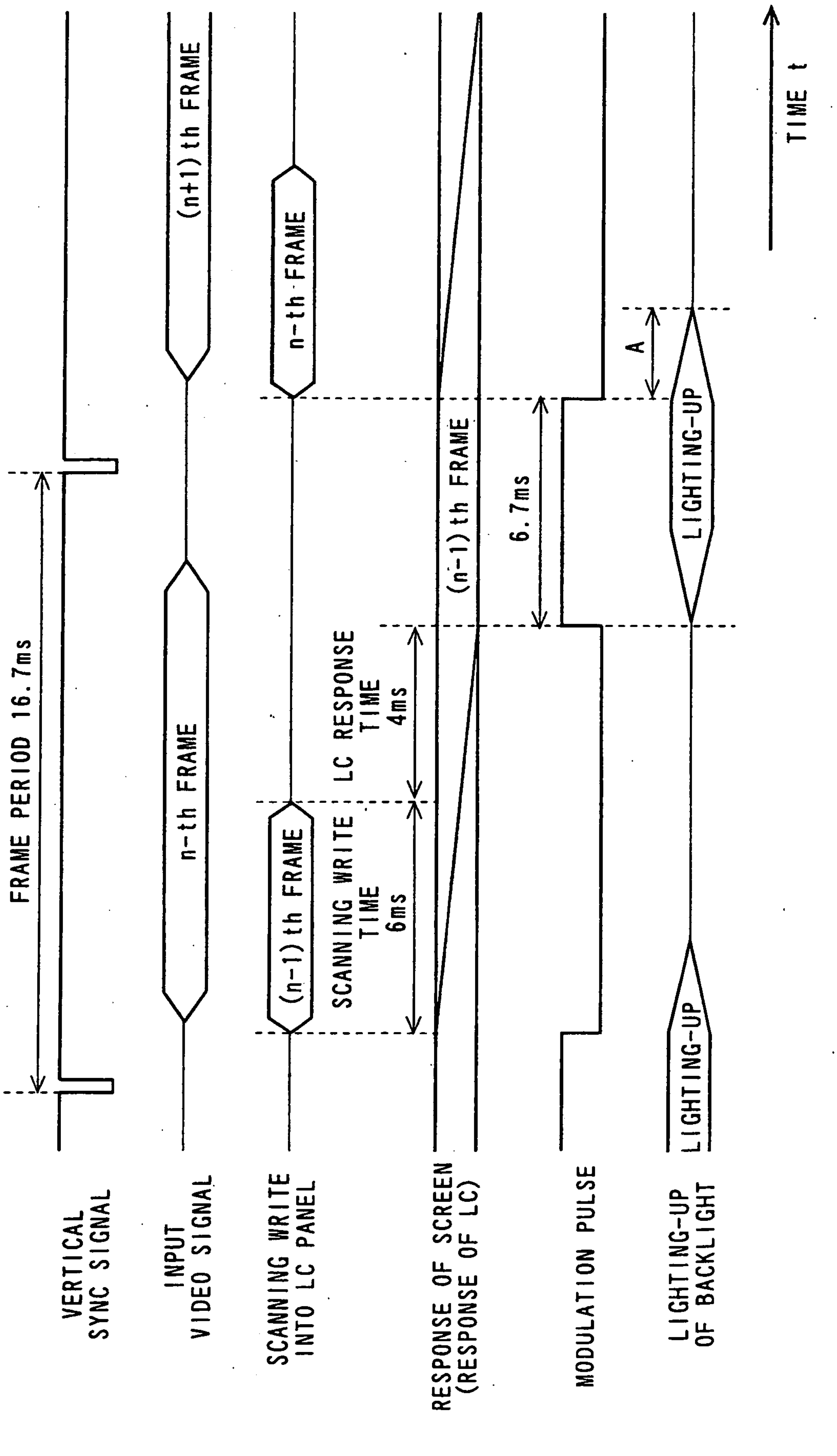
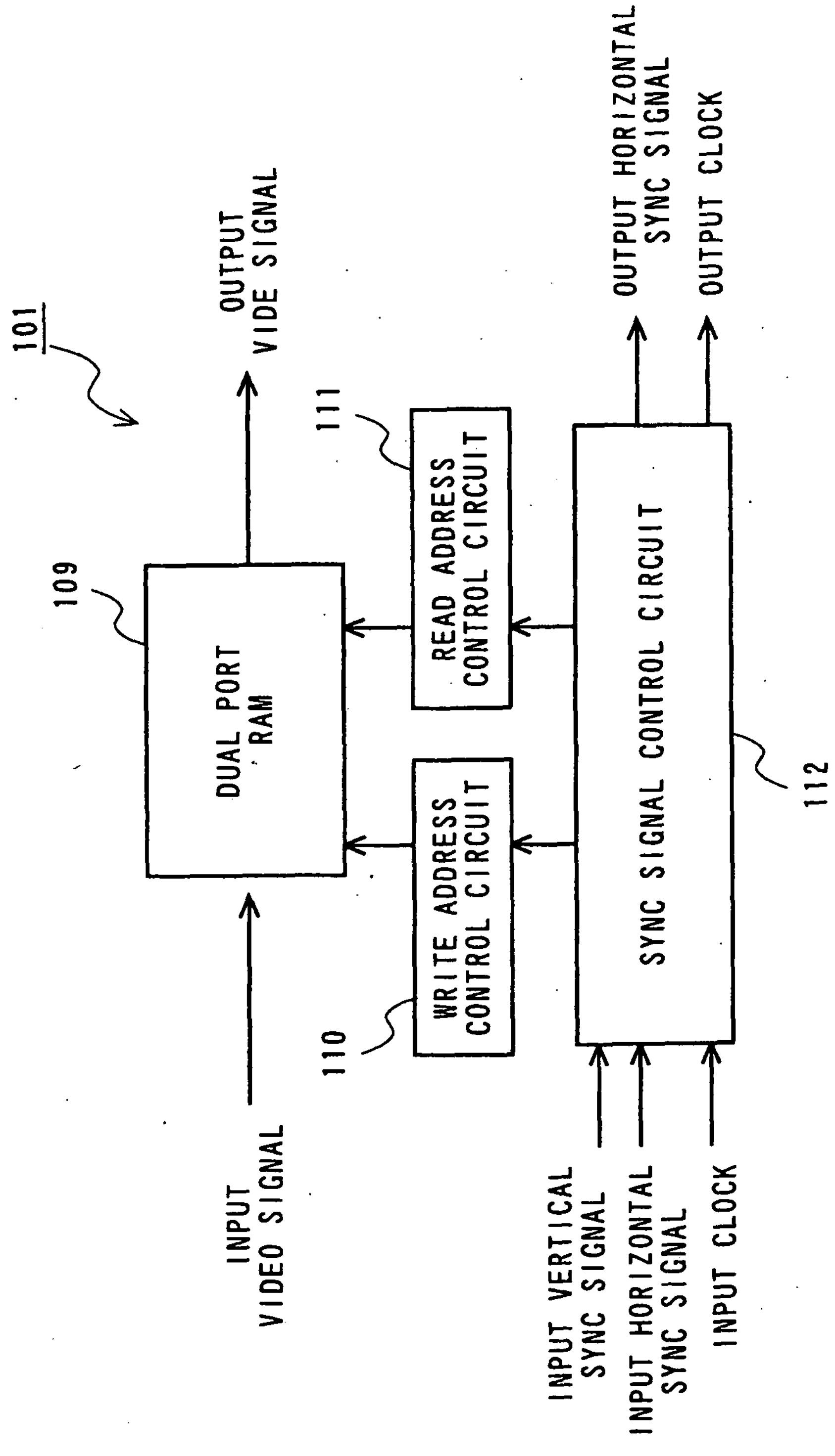

VERTICAL SYNC SIGNAL
INPUT VIDEO SIGNAL
SCANNING WRITE INTO LC PANEL
RESPONSE OF SCREEN (RESPONSE OF LC)
MODULATION PULSE
LIGHTING-UP OF BACKLIGHT
FRAME PERIOD 16.7ms
n-th FRAME
(n+1) th FRAME
(n-1) th FRAME
n-th FRAME
SCANNING WRITE TIME 6ms
LC RESPONSE TIME 4ms
(n-1) th FRAME
6.7ms
A
LIGHTING-UP
LIGHTING-UP
TIME t

FIG. 16


101
OUTPUT VIDE SIGNAL
111
OUTPUT HORIZONTAL SYNC SIGNAL
OUTPUT CLOCK
109
DUAL PORT RAM
READ ADDRESS CONTROL CIRCUIT
WRITE ADDRESS CONTROL CIRCUIT
SYNC SIGNAL CONTROL CIRCUIT
112
110
INPUT VIDEO SIGNAL
INPUT VERTICAL SYNC SIGNAL
INPUT HORIZONTAL SYNC SIGNAL
INPUT CLOCK

F I G. 1 7

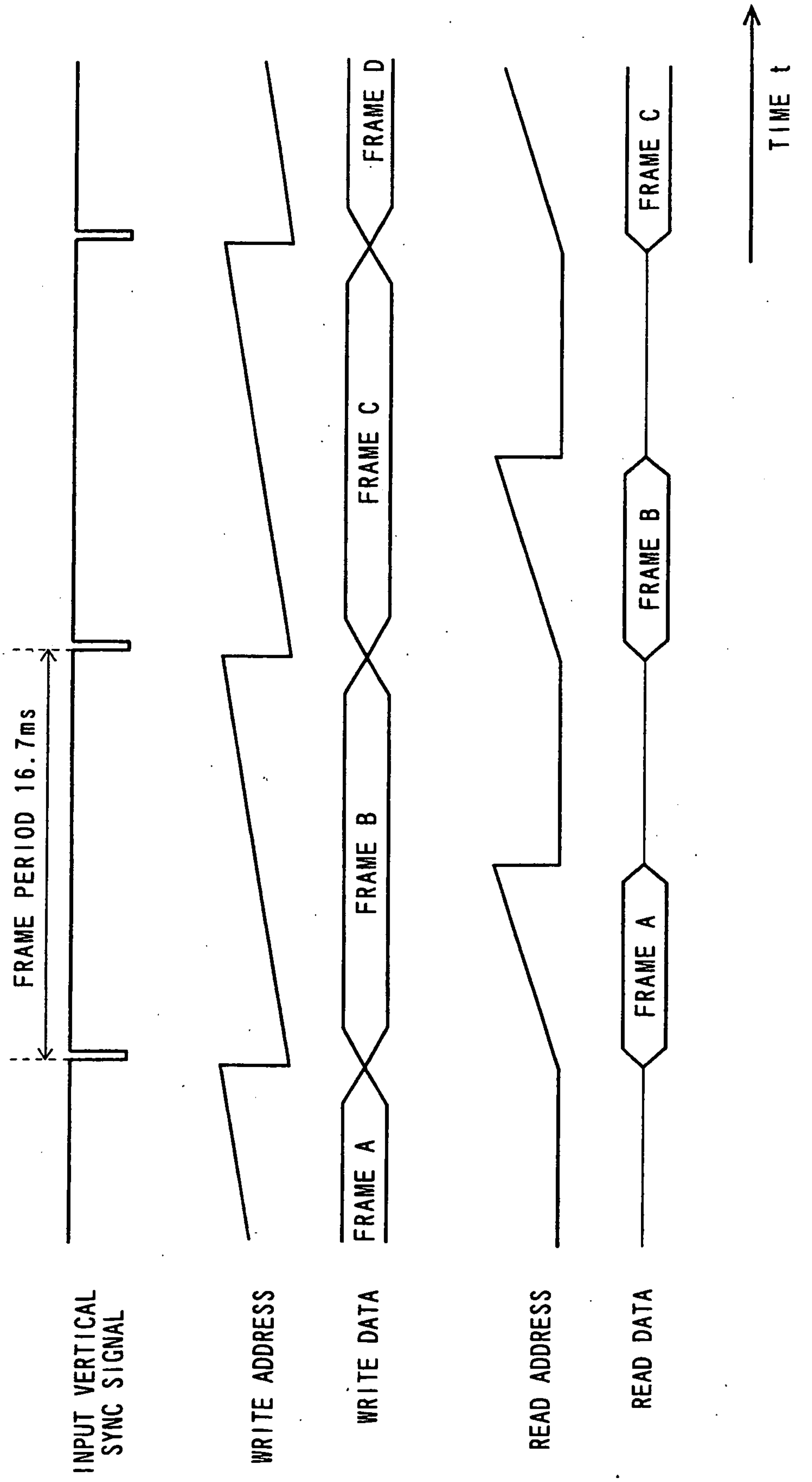

INPUT VERTICAL SYNC SIGNAL
WRITE ADDRESS
WRITE DATA
READ ADDRESS
READ DATA
FRAME PERIOD 16.7ms
FRAME A
FRAME B
FRAME C
FRAME D
FRAME A
FRAME B
FRAME C
TIME t

FIG. 18

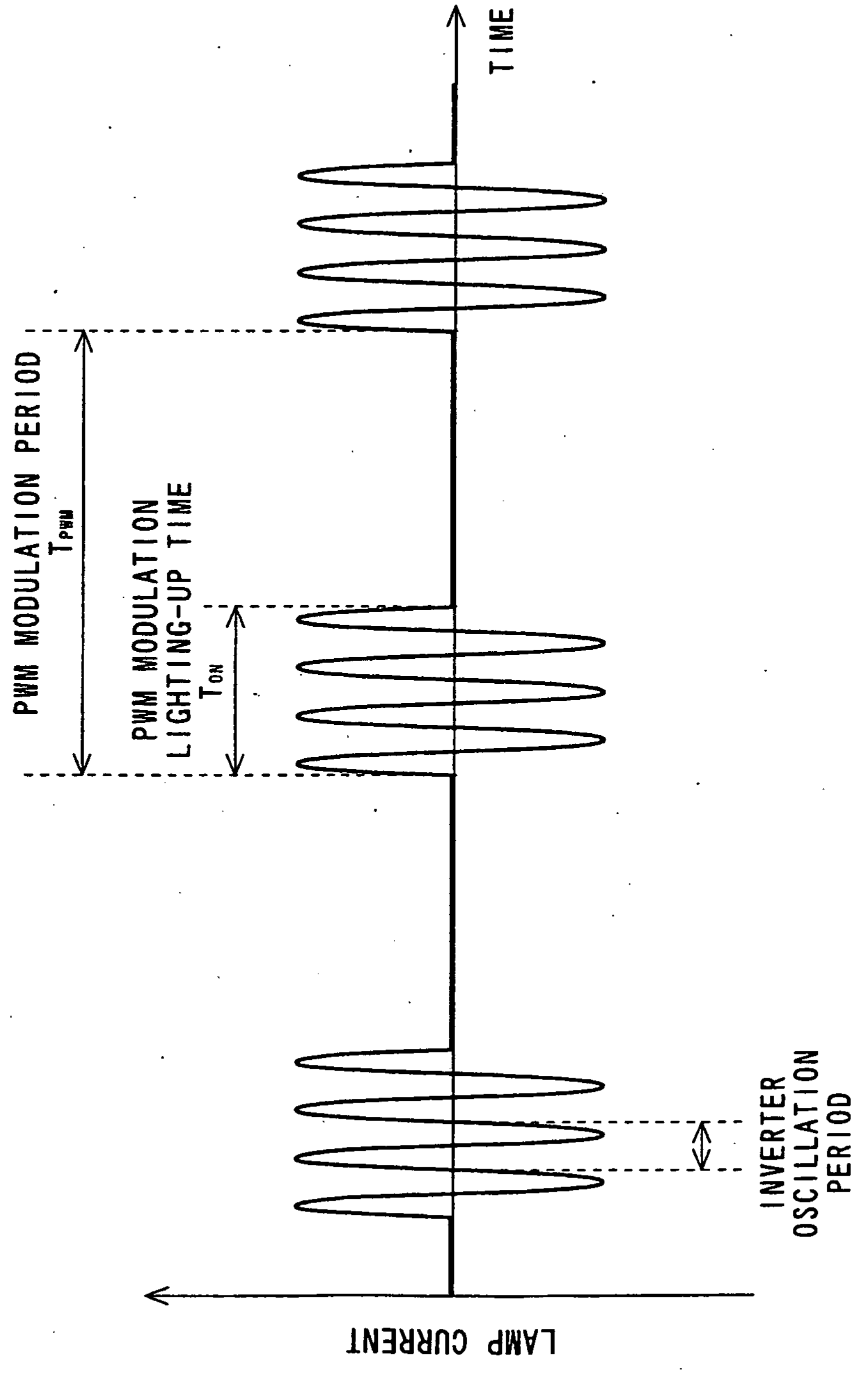
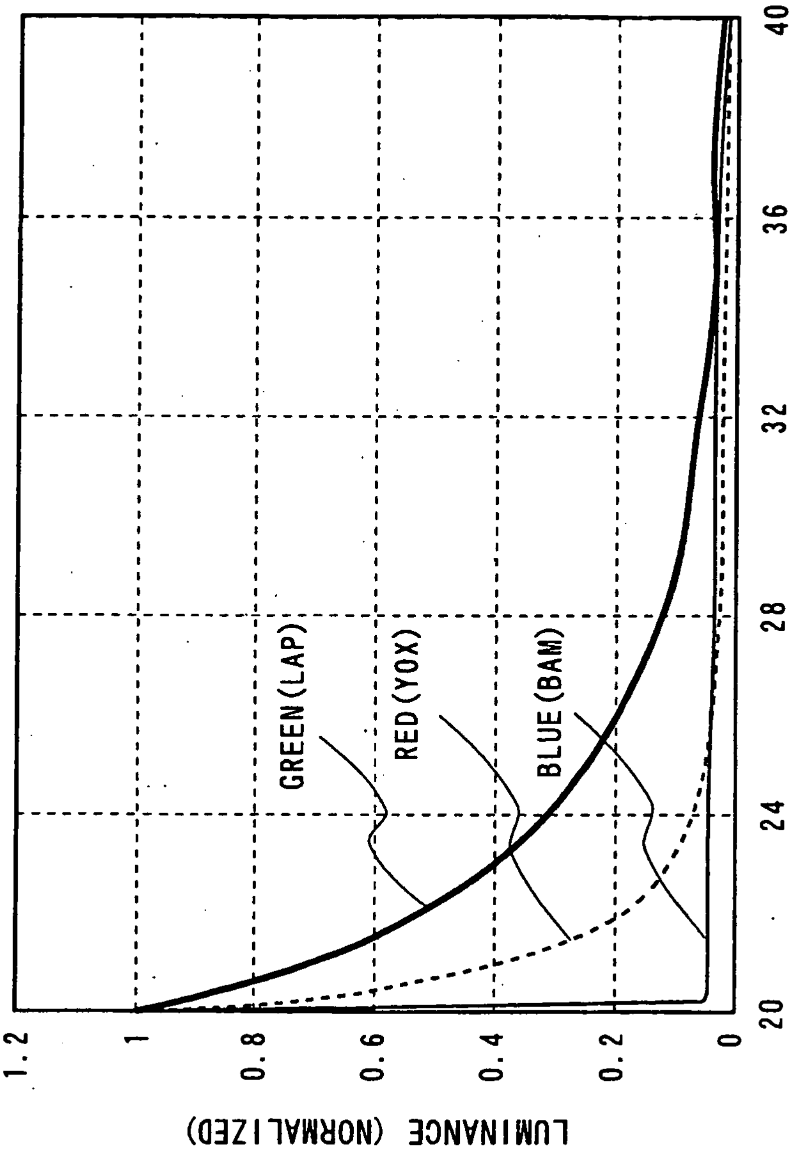

TIME
PWM MODULATION PERIOD
T_{PWM}
PWM MODULATION
LIGHTING-UP TIME
T_{ON}
INVERTER
OSCILLATION
PERIOD
LAMP CURRENT

FIG. 19


GREEN(LAP)
RED(YOX)
BLUE(BAM)
LUMINANCE (NORMALIZED)
TIME[ms]
1.2
1
0.8
0.6
0.4
0.2
0
20
24
28
32
36
40

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 8500915 PCT **[0005]**
- EP 1061499 A **[0018]**

Non-patent literature cited in the description

- **Taiichiro Kurita.** Picture Quality of Hold Type Display for Moving Images. *Technical Report of IEICE, EID99-10,* June 1999 **[0004]**

专利名称(译)	图像显示和显示方法		
公开(公告)号	EP1376528B1	公开(公告)日	2012-06-20
申请号	EP2002705372	申请日	2002-03-20
申请(专利权)人(译)	松下电器产业有限公司.		
当前申请(专利权)人(译)	松下电器产业株式会社		
[标]发明人	FUNAMOTO TARO MACHIDORI WATARU ARIMOTO KATSUYUKI OHTA YOSHIHITO KOBAYASHI TAKAHIRO KUMAMOTO YASUHIRO KARIYA TETSUO		
发明人	FUNAMOTO, TARO MACHIDORI, WATARU ARIMOTO, KATSUYUKI OHTA, YOSHIHITO KOBAYASHI, TAKAHIRO KUMAMOTO, YASUHIRO KARIYA, TETSUO		
IPC分类号	G09G3/36 G09G3/34 G09G3/20 G02F1/133 G02F1/13357		
CPC分类号	G09G3/36 G09G3/3406 G09G2310/08 G09G2320/0247 G09G2320/0261 G09G2320/062 G09G2320/0626 G09G2320/064 G09G2320/0646 G09G2320/0653 G09G2320/066 G09G2320/103 G09G2320/106		
代理机构(译)	GASSNER，WOLFGANG		
优先权	2001088162 2001-03-26 JP		
其他公开文献	EP1376528A1 EP1376528A4		
外部链接	Espacenet		

摘要(译)

一种使用用于显示的背光（104）的液晶显示装置，包括：视频信号时间压缩电路（101），用于在时间轴方向上压缩视频信号并输出时间压缩的视频信号; LCD控制器（106），用于根据时间压缩视频信号驱动液晶面板（105）;源极驱动器（107）和栅极驱动器（108）;运动检测电路（2），用于根据视频信号检测显示图像的运动量; PWM调制脉冲发生电路（4），用于根据来自运动检测电路（2）的检测结果产生频率不同的调制脉冲;以及用于基于调制脉冲点亮背光（104）的逆变器（103），从而能够减少运动图像中的图像轮廓模糊并减少静止图像中的闪烁。

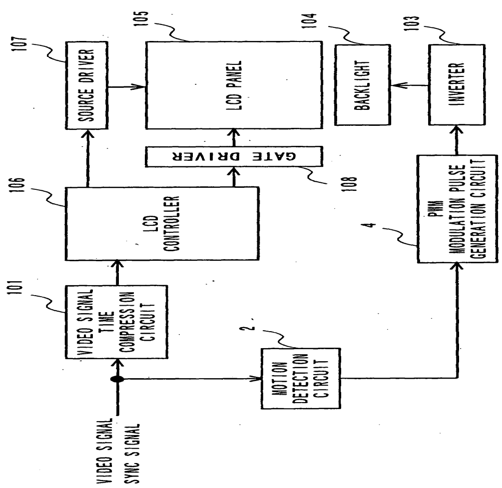

FIG. 1