

(19)



(11)

EP 2 282 301 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

09.02.2011 Bulletin 2011/06

(51) Int Cl.:

G08C 23/04 (2006.01)

(21) Application number: **10155556.3**

(22) Date of filing: **04.03.2010**

(84) Designated Contracting States:

**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL
PT RO SE SI SK SM TR**

Designated Extension States:

AL BA ME RS

(30) Priority: **04.08.2009 JP 2009181393**

(71) Applicant: **Kabushiki Kaisha Toshiba
Tokyo 105-8001 (JP)**

(72) Inventor: **Iwata, Shigeyasu
Tokyo 105-8001 (JP)**

(74) Representative: **Henkel, Feiler & Hänzel
Maximiliansplatz 21
80333 München (DE)**

(54) **Infrared ray receiver and information processor**

(57) According to one embodiment, an infrared ray receiver (215) is provided in an external apparatus (100) with a light emitter (221), and includes a light receiver (102), a receiver (302), a filter (303), and a changer (311). The light receiver (102) receives an infrared signal. The receiver (302) receives a signal indicating whether the external apparatus (100) is active from the external apparatus (100). The filter (303) attenuates a drive frequen-

cy of the infrared signal received by the light receiver (102) for driving the light emitter (221) of the external apparatus (100). The changer (311) changes the attenuation rate of the filter (303) for filtering on the drive frequency based on the signal indicating whether the external apparatus (100) is active.

EP 2 282 301 A2

Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2009-181393, filed Aug. 4, 2009, the entire contents of which are incorporated herein by reference.

BACKGROUND

1. Field

[0002] One embodiment of the invention relates to an infrared ray receiver and an information processor.

2. Description of the Related Art

[0003] An infrared ray remote controller has been used to operate a television (TV) broadcast display apparatus. For example, such an infrared ray remote controller outputs an infrared signal to the infrared ray receiver of the TV broadcast display apparatus to operate the TV broadcast display apparatus. At that time, if ambient light is input to the infrared ray receiver, the TV broadcast display apparatus may malfunction.

[0004] Examples of the ambient light that causes a malfunction include inverter fluorescent light, incandescent light, and sunlight. Japanese Patent Application Publication (KOKAI) No. 2004-56541 discloses a conventional technology in which, to prevent a malfunction due to inverter fluorescent light, noise is detected that is caused by ambient light from the inverter fluorescent light. If the noise exceeds a threshold, the filter characteristic of a bandpass filter (BPS) is changed to improve the resistance to ambient light.

[0005] Apart from the inverter fluorescent light, there are various types of ambient lights that cause a malfunction. For example, if a liquid crystal display (LCD) panel is used for the display screen of the TV broadcast display apparatus, reflected light from the backlight of the LCD panel may enter the receiver of the infrared ray receiving circuit of the TV broadcast display apparatus and thereby cause a malfunction.

[0006] More specifically, the backlight of the LCD panel of the TV broadcast display apparatus is controlled to be driven by turning on/off the inverter at a predetermined frequency. While the receiver of the infrared ray receiving circuit built in the TV broadcast display apparatus is receiving a signal from the remote controller, ambient light from the backlight may change. In this case, the output level of the bandpass filter used in the infrared ray receiving circuit varies, and the TV broadcast display apparatus is likely to malfunction. Besides, when a person stands or an object is placed in front of the TV broadcast display apparatus, if light reflected from the person or the object enters the infrared ray receiving circuit, the TV broadcast display apparatus is likely to malfunction.

[0007] The malfunction may be prevented by, for example, increasing the order of the bandpass filter to suppress the influence of ambient light. However, an increase in the order of the bandpass filter increases the calculation amount, resulting in high power consumption.

[0008] Besides, the conventional technology described above is aimed at the inverter fluorescent light and does not take into account the backlight of the LCD TV broadcast display apparatus. If the conventional technology is applied to ambient light from the backlight, a sensor is required to detect the ambient light, which increases the cost.

[0009] It is therefore an object of the invention to provide an infrared ray receiver and an information processor capable of preventing the malfunction as well as reducing the power consumption.

SUMMARY OF THE INVENTION

[0010] To overcome the problems and achieve the object mentioned above, according to an aspect of the invention, an infrared ray receiver is configured to be provided in an external apparatus with a light emitter, and comprises a light receiver, a receiver, a filter, and a changer. The light receiver is configured to receive an infrared signal. The receiver is configured to receive a signal indicating whether the external apparatus is active from the external apparatus. The filter is configured to attenuate a drive frequency of the infrared signal received by the light receiver for driving the light emitter of the external apparatus. The changer is configured to change the attenuation rate of the filter for filtering on the drive frequency based on the signal indicating whether the external apparatus is active.

[0011] According to another aspect of the invention, an information processor provided with a backlight and capable of switching between active mode and standby mode, comprises an inverter, a light receiver, a filter, a changer, and a controller. The inverter is configured to drive the backlight at a drive frequency. The light receiver is configured to receive an infrared signal. The filter is configured to attenuate the drive frequency of the infrared signal received by the light receiver. The changer is configured to change the attenuation rate of the filter for filtering on the drive frequency based on whether the information processor is in the active mode. The controller is configured to perform control based on a signal the drive frequency of which has been attenuated by the filter at the attenuation rate set by the changer.

[0012] As described above, according to an aspect of the invention, it is possible to prevent the malfunction due to ambient light received with an infrared signal as well as to reduce the power consumption.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0013] A general architecture that implements the var-

ious features of the invention will now be described with reference to the drawings. The drawings and the associated descriptions are provided to illustrate embodiments of the invention and not to limit the scope of the invention.

[0014] FIG. 1 is an exemplary schematic diagram of a television (TV) broadcast display apparatus and an infrared TV remote controller according to a first embodiment of the invention;

FIG. 2 is an exemplary block diagram of a signal processing system of the TV broadcast display apparatus in the first embodiment;

FIG. 3 is an exemplary block diagram of an infrared ray receiving circuit in the first embodiment;

FIG. 4 is an exemplary schematic diagram for explaining how to control a bandpass filter (BPS) by changing the order by an order change module in the first embodiment;

FIG. 5 is an exemplary schematic diagram of waveforms of signals output from respective modules of the infrared ray receiving circuit in the first embodiment;

FIG. 6 is an exemplary flowchart of the process of changing the order of the BPS in the infrared ray receiving circuit in the first embodiment;

FIG. 7 is an exemplary flowchart of the process until a remote control code signal is output in the infrared ray receiving circuit in the first embodiment; and

FIG. 8 is an exemplary block diagram of an infrared ray receiving circuit according to a second embodiment of the invention.

DETAILED DESCRIPTION

[0015] Various embodiments according to the invention will be described hereinafter with reference to the accompanying drawings. In the following, the information processor of the embodiments will be described as, for example, a television (TV) broadcast display apparatus, and the infrared ray receiver of the embodiments will be described as, for example, an infrared ray receiving circuit.

[0016] FIG. 1 is a schematic diagram of a TV broadcast display apparatus 100 and an infrared TV remote controller 150 for operating the TV broadcast display apparatus 100 according to a first embodiment of the invention. As illustrated in FIG. 1, the TV broadcast display apparatus 100 comprises a display surface 101, a light receiver 102, a TV pedestal 103. The TV remote controller 150 outputs an infrared signal. The light receiver 102 of the TV broadcast display apparatus 100 receives the infrared signal. Thus, the TV broadcast display apparatus 100 operates according to the infrared signal output in response to operation performed on the TV remote controller 150.

[0017] It is assumed herein that the infrared signal output from the TV remote controller 150 is generally mod-

ulated by pulse phase modulation (PPM). According to the PPM, 1 and 0 are distinguished based on the pulse time interval. The infrared signal output from the TV remote controller 150 contains codes such as power on/off, channel switch, etc. at the time intervals of pulses. Each pulse row is amplitude-modulated by a subcarrier. In the first embodiment, while the frequency of the subcarrier will be described as 38 kHz, it may be any other value.

[0018] The light receiver 102 receives various types of ambient lights other than infrared rays, which may cause a malfunction. Examples of the ambient lights include inverter fluorescent light, incandescent light, and sunlight. Further, the backlight emitted from the display surface 101 may be ambient light. Especially, if a person stands or an object is placed in front of the TV broadcast display apparatus 100, the backlight reflected from the person or the object enters the light receiver 102. Accordingly, the TV broadcast display apparatus 100 is further likely to malfunction. According to the first embodiment, a malfunction due to the backlight is prevented.

[0019] FIG. 2 is a block diagram of a signal processing system of the TV broadcast display apparatus 100 according to the first embodiment.

[0020] A digital terrestrial TV signal received by an antenna 201 for receiving digital terrestrial broadcasting is fed to a tuner 203 for digital terrestrial broadcasting via an input terminal 202.

[0021] The tuner 203 selects a broadcast signal of a desired channel according to a control signal from a controller 213, and outputs the broadcast signal to a demodulator 204.

[0022] The demodulator 204 demodulates the broadcast signal received from the tuner 203 according to a control signal from the controller 213. Thus, the demodulator 204 acquires a transport stream (TS) containing a desired program, and outputs it to a TS decoder 205.

[0023] The TS decoder 205 performs TS decoding on a multiplexed TS signal according to a control signal from the controller 213. The TS decoder 205 also depacketizes digital video and audio signals of the desired program to obtain a packetized elementary stream (PES). The TS decoder 205 then outputs the PES to an STD buffer (not illustrated) in a signal processor 206. In addition, the TS decoder 205 sends section information transmitted via digital broadcasting to a section processor (not illustrated) in the signal processor 206.

[0024] While a user is viewing a TV program, the signal processor 206 selectively performs predetermined digital signal processing on the digital video and audio signals received from the TS decoder 205. Then, the signal processor 206 outputs the video signal to a graphics processor 209 and the audio signal to an audio processor 207.

[0025] The controller 213 comprises a TV microcomputer 231. The TV microcomputer 231 controls the TV broadcast display apparatus 100 according to a remote control code signal output from an infrared ray receiving circuit 215. For example, the TV microcomputer 231 controls the TV broadcast display apparatus 100 to turn on

or pause, to change the channel, to adjust the volume, and the like in response to any operation that can be performed on the TV remote controller 150.

[0026] The controller 213 receives, for example, electronic program guide (EPG) information, program attribute information including program category, video, audio, and closed caption information such as program specific information (PSI) and service information (SI), various types of data for obtaining a program processed by the section processor in the signal processor 206 from the signal processor 206. Each time the controller 213 receives EPG information and attribute information (program category, etc.), the information is stored in a non-volatile memory 232 to update old information. The information stored in the nonvolatile memory 232 is used to display a program guide, to search for a program, and the like.

[0027] From the received information, the controller 213 generates image data to display an EPG or closed captions, and outputs the image data to the graphics processor 209.

[0028] From the section information received from the TS decoder 205, the section processor in the signal processor 206 outputs to the controller 213 various types of data for obtaining a program, EPG information, program attribute information such as program category, closed caption information such as PST and SI, and the like.

[0029] The graphics processor 209 synthesizes the following signals: (1) a digital video signal fed from an AV decoder (not illustrated) in the signal processor 206, (2) an on-screen display (OSD) signal generated by an OSD signal generator 210, (3) image data of data broadcasting, and (4) an EPG/closed caption signal generated by the controller 213. The graphics processor 209 outputs the synthesized signals to a video processor 211.

[0030] In addition, to display a closed-captioned broadcast video or program with closed captions, based on closed caption data under the control of the controller 213, the graphics processor 209 superimposes the closed caption data on the video signal.

[0031] The digital video signal output from the graphics processor 209 is input to the video processor 211. The video processor 211 converts the input digital video signal to an analog video signal in a format displayable on a display module 212. The video processor 211 then outputs the analog video signal to the display module 212 to display the video thereon.

[0032] The display module 212 comprises a backlight 221, an inverter circuit 222, and a liquid crystal display (LCD) panel 223. The LCD panel 223 displays video corresponding to the analog video signal.

[0033] The backlight 221 is a light source located on the rear surface of the LCD panel 223, and illuminates video display on the LCD panel 223 from the rear. The inverter circuit 222 controls the backlight 221 to be driven at a predetermined drive frequency. The modulated light from the backlight 221 is controlled by ON/OFF of the drive frequency.

[0034] The audio processor 207 converts the input digital audio signal to an analog audio signal reproducible by a speaker 208. The audio processor 207 then outputs the analog audio signal to the speaker 208 to reproduce the audio.

[0035] The controller 213 controls the overall operation of the TV broadcast display apparatus 100 including the operation of receiving various types of information or signals as described above. The controller 213 comprises a built-in central processing unit (CPU).

[0036] For example, when the infrared ray receiving circuit 215 receives operation information sent from the TV remote controller 150 or the like via the light receiver 102 such as a photo diode (PD), the TV microcomputer 231 of the controller 213 controls the respective modules according to the operation such as the operation to switch channels.

[0037] The controller 213 is connected to an operation module 214. Thus, the controller 213 can receive operation to control the TV broadcast display apparatus 100 from the operation module 214.

[0038] A description will be given of the infrared ray receiving circuit 215 that prevents a malfunction due to reflected light from the backlight 221 entering the light receiver 102. FIG. 3 is a block diagram of the infrared ray receiving circuit 215.

[0039] As illustrated in FIG. 3, the infrared ray receiving circuit 215 comprises the PD (light receiver) 102, an amplifier 301, a receiver 302, a bandpass filter (BPS) 303, a signal level detector 304, a comparator 305, an integrator 306, a hysteresis comparator 307.

[0040] The PD 102 is a semiconductor diode that receives an infrared signal sent from the TV remote controller 150, and converts the signal to a current. The received infrared signal may be an infrared pulse at a predetermined frequency. The PD 102 also receives ambient light in addition to the infrared signal. Accordingly, it is necessary to suppress the influence of the ambient light.

[0041] The amplifier 301 converts the signal, which has been converted to the current by the PD 102, to a voltage and amplifies the voltage. When intense light enters the PD 102 and output current increases, the amplifier 301 automatically reduces the gain so that the current does not fully exploit the allowable range of the circuit.

[0042] The receiver 302 receives from the TV microcomputer 231 of the TV broadcast display apparatus 100 a control signal indicating that the TV broadcast display apparatus 100 is ON (active) or OFF (shutdown or standby).

[0043] The BPF 303 comprises an order change module 311. The BPF 303 performs filtering on the signal subjected to the current-voltage conversion by the amplifier 301 using the subcarrier frequency (38 kHz) of the TV remote controller 150 as the center frequency of the pass band. With this, the BPF 303 can extract only signal component of an infrared signal. Accordingly, the drive frequency of the inverter circuit 222 of the TV broadcast

display apparatus 100 attenuates, which eliminates the influence of ambient light.

[0044] The order change module 311 changes the order of the BPF 303. If the order is increased, the BPF 303 becomes more desirable, and thereby ambient light resistance characteristics improve. In this case, however, the processing amount increases, resulting in high power consumption. Therefore, it is desirable that the order be increased when there is incident ambient light and that the order be decreased when there is no incident ambient light.

[0045] The order change module 311 changes the order of the BPF 303 based on whether the TV broadcast display apparatus 100 is ON (active) indicated by a control signal received by the receiver 302. By changing the order, it is possible to change the attenuation rate of the drive frequency at which the inverter circuit 222 drives the backlight 221.

[0046] More specifically, the order change module 311 determines whether the TV broadcast display apparatus 100 is ON based on a control signal received via the receiver 302. If the TV broadcast display apparatus 100 is ON, the order change module 311 changes the order of the BPF 303 to "4". On the other hand, if the TV broadcast display apparatus 100 is OFF, the order change module 311 changes the order of the BPF 303 to "2".

[0047] That is, according to the first embodiment, refracted light from the backlight 221 is likely to enter the light receiver 102 while the TV broadcast display apparatus 100 is ON, and therefore, the order is increased. On the other hand, refracted light from the backlight 221 is not likely to enter the light receiver 102 while the TV broadcast display apparatus 100 is OFF, and therefore, the order is decreased.

[0048] FIG. 4 is a schematic diagram for explaining how to control the BPF 303 by changing the order by the order change module 311. As illustrated in FIG. 4, the order change module 311 changes the order of the BPF 303 to fourth order (Butterworth) to obtain a fourth-order BPF (Butterworth) 401 when the TV broadcast display apparatus 100 is ON. The order change module 311 changes the order of the BPF 303 to second order (Butterworth) to obtain a second-order BPF (Butterworth) 402 when the TV broadcast display apparatus 100 is OFF. As can be seen from FIG. 4, the attenuation of the fourth-order BPF (Butterworth) 401, with the center frequency of the pass band at 38 kHz, is much greater than that of the second-order BPF (Butterworth) 402.

[0049] More specifically, when the TV broadcast display apparatus 100 is ON and displays video on the LCD panel 223, the order change module 311 increases the order of the BPF 303 to improve ambient light resistance characteristics. Thus, it is possible to suppress the influence of ambient light due to the backlight 221 controlled to be driven by the inverter circuit 222. The order change module 311 decreases the order of the BPF 303 when the TV broadcast display apparatus 100 is OFF and does not display video on the LCD panel 223 since there is no

ambient light from the backlight 221 and a malfunction does not occur. In this case, because of the low order, the calculation amount decreases and wasteful power consumption can be avoided.

[0050] Referring back to FIG. 3, the signal level detector 304 integrates a signal output from the BPF 303 and smoothes it.

[0051] The comparator 305 compares a signal output from the BPF 303 and a signal output from the signal level detector 304 to provide timing of charge and discharge for integration.

[0052] The integrator 306 integrates subcarrier components at the timing provided by the comparator 305.

[0053] The hysteresis comparator 307 compares a signal output from the integrator 306 with a threshold to determine whether the signal is equal to or higher than the threshold. The hysteresis comparator 307 generates a logical-level remote control code signal from the comparison result and outputs it. Incidentally, the hysteresis comparator 307 inverts the comparison result to output the remote control code signal. More specifically, when the signal output from the integrator 306 is equal to or higher than the threshold, the hysteresis comparator 307 outputs a signal indicating "OFF". On the other hand, when the signal output from the integrator 306 is less than the threshold, the hysteresis comparator 307 outputs a signal indicating "ON".

[0054] The TV microcomputer 231 controls the TV broadcast display apparatus 100 according to the remote control code signal output from the infrared ray receiving circuit 215.

[0055] A description will be given of waveforms of signals output from the respective modules of the infrared ray receiving circuit 215 according to the first embodiment. FIG. 5 schematically illustrates waveforms of signals output from the respective modules of the infrared ray receiving circuit 215. In the example of FIG. 5, it is assumed that the TV remote controller 150 outputs a signal having a waveform 501.

[0056] After a signal input to the PD 102 is subjected to amplification by the amplifier 301 and filtering by the BPF 303, the BPF 303 outputs an output waveform 502. That is, the BPF 303 attenuates the signal other than 38 kHz components with the order set by the order change module 311 to extract the output waveform 502.

[0057] The signal level detector 304 integrates the output waveform 502 received from the BPF 303 and smooths it, thereby outputting an output waveform 503. The output waveform 503 increases as the output waveform 502 increases, while the output waveform 503 decreases as the output waveform 502 decreases.

[0058] The comparator 305 compares the output waveforms 502 and 503 to provide timing of charge and discharge for integration. The integrator 306 integrates subcarrier components at the timing provided by the comparator 305. As a result, the integrator 306 outputs an output waveform 505.

[0059] When the output waveform 505 becomes equal

to or more than a predetermined first threshold (first threshold of a threshold 504), the hysteresis comparator 307 outputs a remote control code signal 506 indicating "OFF". In this manner, the hysteresis comparator 307 outputs the remote control code signal 506 after inverting the polarity. Then, the threshold 504 changes to a predetermined second threshold. When the output waveform 505 becomes less than the second threshold (second threshold of the threshold 504), the hysteresis comparator 307 outputs the remote control code signal 506 indicating "ON". After that, the threshold 504 is switched between the first and the second thresholds according to the remote control code signal 506. Incidentally, the first and the second thresholds satisfy the relation: first threshold > second threshold, and each are set to an appropriate value in each embodiment.

[0060] The remote control code signal 506 output from the hysteresis comparator 307 is input to the TV microcomputer 231. The TV microcomputer 231 identifies the input code to control the TV broadcast display apparatus 100.

[0061] A description will be given of the process of changing the order of the BPF 303 in the infrared ray receiving circuit 215 of the TV broadcast display apparatus 100 according to the first embodiment. FIG. 6 is a flowchart of the process of changing the order of the BPF 303 in the infrared ray receiving circuit 215.

[0062] As illustrated in FIG. 6, first, the receiver 302 receives a control signal from the TV microcomputer 231 (S601).

[0063] The order change module 311 determines whether the control signal indicates that the TV broadcast display apparatus 100 is ON (S602). Having determined that the TV broadcast display apparatus 100 is ON (Yes at S602), the order change module 311 changes the order of the BPF 303 to the fourth order (S603). Thus, when the TV broadcast display apparatus 100 is ON, i.e., under the condition where reflected light from the backlight 221 is likely to enter the light receiver 102, the fourth-order filtering is applied.

[0064] On the other hand, having determined that the TV broadcast display apparatus 100 is OFF (No at S602), the order change module 311 changes the order of the BPF 303 to the second order (S604). Thus, when the TV broadcast display apparatus 100 is OFF or in standby mode, i.e., under the condition where the backlight 221 does not emit light, the second-order filtering is applied.

[0065] By the process described above, the fourth-order filtering is applied while the TV broadcast display apparatus 100 is in use. Accordingly, subcarrier components are extracted with high accuracy, which prevents a malfunction due to ambient light. In addition, the second-order filtering is applied while the TV broadcast display apparatus 100 is not in use, which suppresses power consumption.

[0066] A description will be given of the process until a remote control code signal is output in the infrared ray receiving circuit 215 of the TV broadcast display appa-

ratus 100 according to the first embodiment. FIG. 7 is a flowchart of the process until a remote control code signal is output in the infrared ray receiving circuit 215.

[0067] First, the PD 102 receives an infrared signal output from the TV remote controller 150 and converts it to a current (S701). The amplifier 301 converts the current to a voltage and amplifies the voltage (S702).

[0068] Thereafter, the BPF 303 performs filtering of the order set in the process illustrated in FIG. 6 using the subcarrier frequency as the center frequency of the pass band (S703).

[0069] The signal level detector 304 integrates a signal output from the BPF 303 and smoothes it (S704). Then, the comparator 305 compares a signal output from the BPF 303 and a signal output from the signal level detector 304 to provide timing of charge and discharge (S705).

[0070] The integrator 306 integrates subcarrier components at the timing provided by the comparator 305 (S706).

[0071] The hysteresis comparator 307 compares a signal output from the integrator 306 with a threshold. The hysteresis comparator 307 then generates a remote control code signal from the comparison result and outputs it (S707).

[0072] By the process described above, a remote control code signal is output to the TV microcomputer 231 to control the TV broadcast display apparatus 100.

[0073] In the infrared ray receiving circuit 215 of the first embodiment, when the TV broadcast display apparatus 100 is ON (active), the order of the BPF 303 is set to "4". On the other hand, when the TV broadcast display apparatus 100 is OFF (such as in standby mode), the order of the BPF 303 is set to "2". However, this is by way of example only, and the orders are not limited to the second and the fourth orders. The order of the BPF 303 may be set to any value if the order while the TV broadcast display apparatus 100 is ON is higher than that while the TV broadcast display apparatus 100 is OFF.

[0074] Further, in the first embodiment, while the infrared ray receiving circuit 215 is described by way of example as being provided in the TV broadcast display apparatus 100, it may be provided in other apparatuses. Examples of such apparatuses include information processors with backlight (light emitter) such as, for example, an LCD panel and a PC with backlight.

[0075] As described above, according to the first embodiment, in the infrared ray receiving circuit 215, the BPF 303 extracts subcarrier frequency components. This eliminates drive frequency components that drive the backlight 221. Thus, malfunction can be prevented.

[0076] According to the recent tendency of reducing power consumption, the TV broadcast display apparatus 100 is required to consume less power in standby mode as well. According to the first embodiment, while the TV broadcast display apparatus 100 is in standby mode (i.e., not in use), the power consumption of the infrared ray receiving circuit 215 is suppressed. This reduces the

power consumption of the entire TV broadcast display apparatus 100.

[0077] Moreover, according to the first embodiment, with the above configuration of the infrared ray receiving circuit 215 that receives an infrared signal output from the TV remote controller 150 and outputs a remote control code signal, the ambient light resistance characteristics are improved when the TV broadcast display apparatus 100 is ON. Accordingly, the influence of reflected light from the backlight 221 can be suppressed. Thus, wasteful power consumption can be prevented when the TV broadcast display apparatus 100 is OFF.

[0078] The first embodiment is not limited as described above but is susceptible to various changes and modifications. In the following, such modifications of the first embodiment will be described.

[0079] While the first embodiment employs the BPF 303 that leaves subcarrier frequency components and eliminates drive frequency components to drive the backlight 221, the filter to be used is not limited to a bandpass filter.

[0080] As a modification of the first embodiment, a band elimination filter is used instead of the BPF 303. The band elimination filter of the modification is assumed to eliminate only drive frequency to drive the backlight 221. Otherwise, the modification is similar in configuration to the first embodiment, and the same description will not be repeated.

[0081] The order change module 311 also changes the order of the band elimination filter based on whether the TV broadcast display apparatus 100 is ON.

[0082] According to the modification, if the infrared ray receiving circuit 215 comprises the band elimination filter instead of a bandpass filter, the same effect can be achieved.

[0083] Further, any other filter than a bandpass filter or a band elimination filter may be used if it is capable of eliminating drive frequency to drive the backlight 221 while leaving subcarrier frequency components. For example, a low-pass filter or a high-pass filter may be used.

[0084] While the first embodiment is described above as applying an analog circuit as an infrared ray receiving circuit, according to a second embodiment of the invention, a digital circuit is applied as an infrared ray receiving circuit.

[0085] FIG. 8 is a block diagram of an infrared ray receiving circuit 800 according to the second embodiment. As illustrated in FIG. 8, the infrared ray receiving circuit 800 comprises the PD (light receiver) 102, the amplifier 301, a receiver 801, a low-pass filter (LPS) 802, an analog-to-digital (A/D) converter 803, a BPF 804, a signal level detector 805, a comparator 806, an integrator 807, a hysteresis comparator 808. Constituent elements corresponding to those of the first embodiment will be designated by the same reference numerals, and their description will not be repeated.

[0086] The LPS 802 is an anti-aliasing filter that removes noise or frequency components above the

Nyquist frequency.

[0087] The receiver 801 receives from the TV micro-computer 231 of the TV broadcast display apparatus 100 a control signal indicating that the TV broadcast display apparatus 100 is ON (active) or ON (shutdown or standby). The receiver 801 then outputs the control signal to the A/D converter 803 and the BPF 804.

[0088] The A/D converter 803 comprises a resolution change module 811, and converts an analog signal output from the LPF 802 to a digital signal. The A/D conversion uses sampling frequency twice or more the frequency of the subcarrier signal.

[0089] The resolution change module 811 changes the resolution of the A/D converter 803. If having a higher resolution, the A/D converter 803 can convert an analog signal to a digital signal with higher accuracy. In this case, however, the processing amount increases, resulting in high power consumption. Therefore, it is desirable that the resolution change module 811 reduce the resolution of the A/D converter 803 when such high accuracy is not required. Accordingly, in the second embodiment, the resolution change module 811 reduces the resolution of the A/D converter 803 when there is no ambient light incident to the light receiver 102, i.e., when the TV broadcast display apparatus 100 is OFF.

[0090] That is, the resolution change module 811 changes the resolution of the A/D converter 803 based on whether the TV broadcast display apparatus 100 is ON (active) indicated by a control signal received by the receiver 801.

[0091] More specifically, the resolution change module 811 determines whether the TV broadcast display apparatus 100 is ON based on a control signal received via the receiver 801. If the TV broadcast display apparatus 100 is ON, the resolution change module 811 changes the resolution of the A/D converter 803 to n bits. On the other hand, if the TV broadcast display apparatus 100 is OFF, the resolution change module 811 changes the resolution of the A/D converter 803 to m bits.

[0092] In this manner, the A/D converter 803 converts an analog signal to a digital signal with a higher resolution when the TV broadcast display apparatus 100 is ON compared to that when the TV broadcast display apparatus 100 is OFF. With this, while the backlight 221 of the TV broadcast display apparatus 100 is emitting light, the A/D converter 803 has a high resolution, and thus can achieve a high signal-to-noise ratio (SNR). Thus, it is possible to suppress the influence of ambient light.

[0093] On the other hand, the resolution change module 811 reduces the resolution of the A/D converter 803 when the TV broadcast display apparatus 100 is OFF since there is no ambient light from the backlight 221. Thus, wasteful power consumption can be avoided.

[0094] The BPF 804 comprises an order change module 812, and performs filtering on a digital signal subjected to the A/D conversion by the A/D converter 803 using the subcarrier frequency (38 kHz) of the TV remote controller 150 as the center frequency of the pass band. The

BPF 804 is different from the BPF 303 in that the BPF 303 is an analog circuit that performs filtering on an analog signal while the BPF 804 is a digital circuit that performs filtering on a digital signal.

[0095] The order change module 812 changes the order of the BPF 804 based on whether the TV broadcast display apparatus 100 is ON (active) indicated by a control signal received by the receiver 801. The order change module 812 changes the order of the BPF 804 in the same manner as previously described in the first embodiment, and therefore the description will not be repeated.

[0096] As with the BPF 804, the signal level detector 805, the comparator 806, the integrator 807, and the hysteresis comparator 808 are each formed of a digital circuit.

[0097] In an analog circuit, accuracy may be reduced because of variation due to miniaturization. However, according to the second embodiment, the use of the digital circuit results in low manufacturing cost and stable characteristics. Thus, for example, the BPF 804 can improve the accuracy of the cut-off frequency.

[0098] Incidentally, the resolution of the A/D converter 803 is changed in a similar manner as changing the order of the BPF 303 described in the first embodiment, and therefore, the description will not be provided.

[0099] As described above, according to the second embodiment, while the TV broadcast display apparatus 100 is ON, the A/D converter 803 has a high resolution, and thus can achieve a high SNR. This further improves ambient light resistance characteristics, and malfunction can further be prevented.

[0100] The various modules of the systems described herein can be implemented as software applications, hardware and/or software modules, or components on one or more computers, such as servers. While the various modules are illustrated separately, they may share some or all of the same underlying logic or code.

[0101] While certain embodiments of the inventions have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel methods and systems described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the methods and systems described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

Claims

1. An infrared ray receiver (215) configured to be provided in an external apparatus (100) with a light emitter (221), the infrared ray receiver (215) comprising:

a light receiver (102) configured to receive an

infrared signal;

a receiver (302) configured to receive a signal indicating whether the external apparatus (100) is active from the external apparatus (100);

a filter (303) configured to attenuate a drive frequency of the infrared signal received by the light receiver (102), the drive frequency driving the light emitter (221) of the external apparatus (100); and

a changer (311) configured to change an attenuation rate of the filter (303) for filtering on the drive frequency based on the signal indicating whether the external apparatus (100) is active.

2. The infrared ray receiver (215) of Claim 1, wherein the changer (311) is configured to change an order of the filter (303) to a first order when the external apparatus (100) is active, and the changer (311) is configured to change the order of the filter (303) to a second order lower than the first order when the external apparatus (100) is inactive.
3. The infrared ray receiver (215) of Claim 1 or 2, wherein the light receiver (102) is configured to receive the infrared signal of a predetermined frequency, and the filter (303) is a band pass filter configured to use the predetermined frequency as a center frequency of a pass band.
4. The infrared ray receiver (215) of Claim 1 or 2, wherein the filter (303) is a band elimination filter configured to attenuate only the drive frequency.
5. The infrared ray receiver (215) of Claim 1 to 4, further comprising a converter (803) configured to convert an analog signal received by the light receiver (102) to a digital signal with a higher resolution when the external apparatus (100) is active than when the external apparatus (100) is inactive, wherein the filter (804) is configured to perform filtering on the digital signal obtained by the converter (803).
6. The infrared ray receiver (215) of Claim 1 to 4, wherein the external apparatus (100) comprises a backlight as the light emitter (221), and an inverter (222) configured to control the backlight to be driven at the drive frequency.
7. An information processor (100) provided with a backlight (221) and capable of switching between active mode and standby mode, the information processor (100) comprising:

an inverter (222) configured to drive the backlight (221) at a drive frequency;

a light receiver (102) configured to receive an

infrared signal;

a filter (303) configured to attenuate the drive frequency of the infrared signal received by the light receiver (102);

a changer (311) configured to change an attenuation rate of the filter (303) for filtering on the drive frequency based on whether the information processor (100) is in the active mode; and
a controller (231) configured to perform control based on a signal the drive frequency of which has been attenuated by the filter (303) at the attenuation rate set by the changer (311).

8. The information processor (100) of Claim 7, wherein the changer (311) is configured to change an order of the filter (303) to a first order when the information processor (100) is in the active mode, and the changer (311) is configured to change the order of the filter (303) to a second order lower than the first order when the information processor (100) is in the standby mode.
9. The information processor (100) of Claim 7 or 8, wherein
the light receiver (102) is configured to receive the infrared signal of a predetermined frequency, and
the filter (303) is a band pass filter configured to use the predetermined frequency as a center frequency of a pass band.

FIG.1

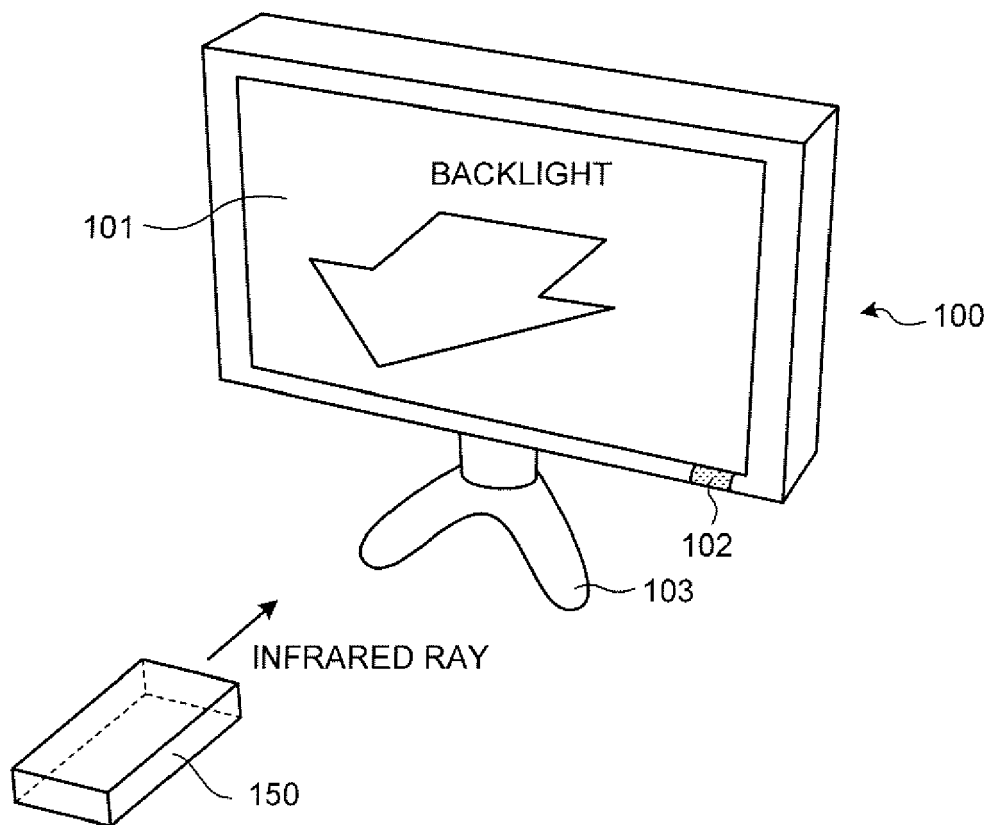


FIG.2

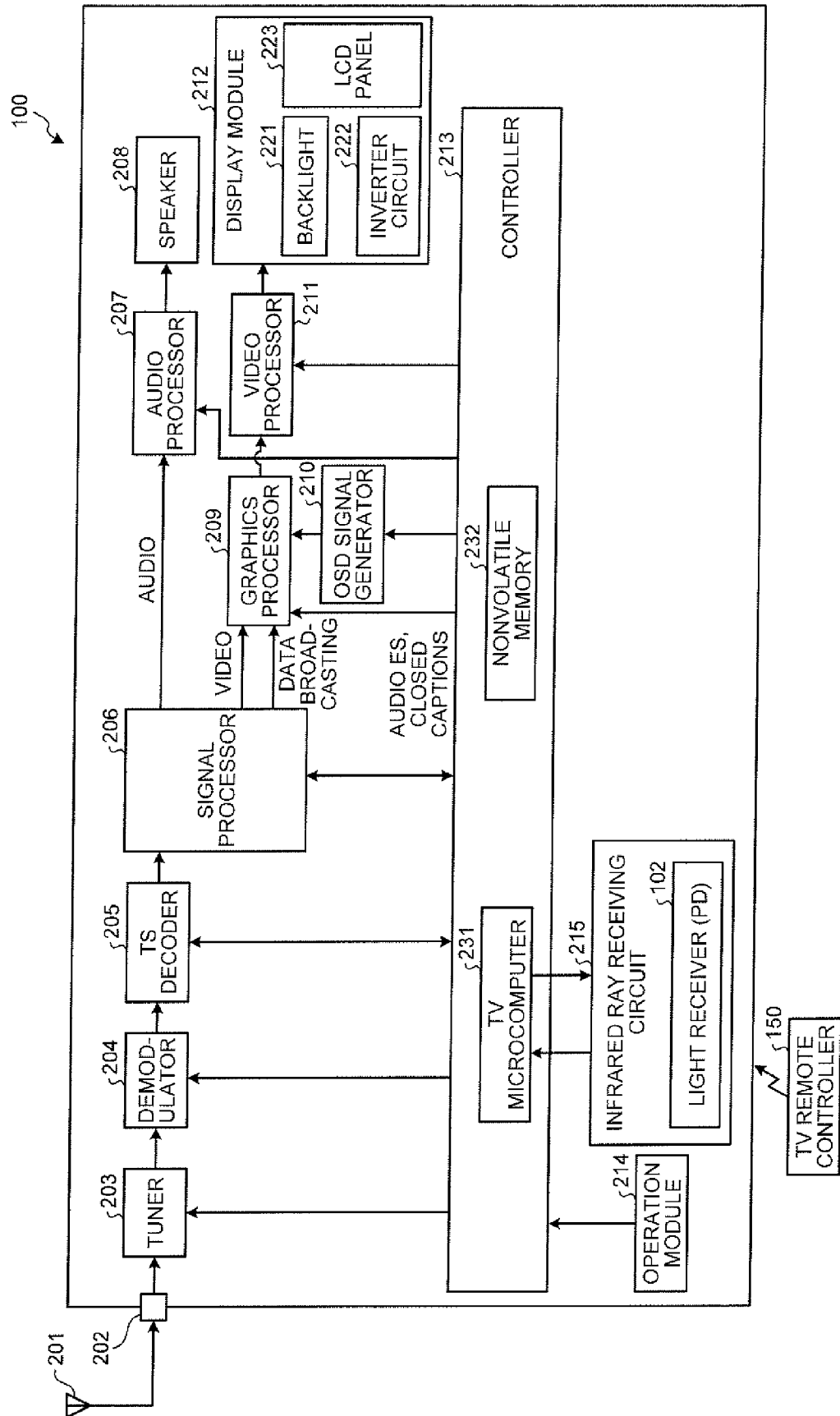


FIG.3

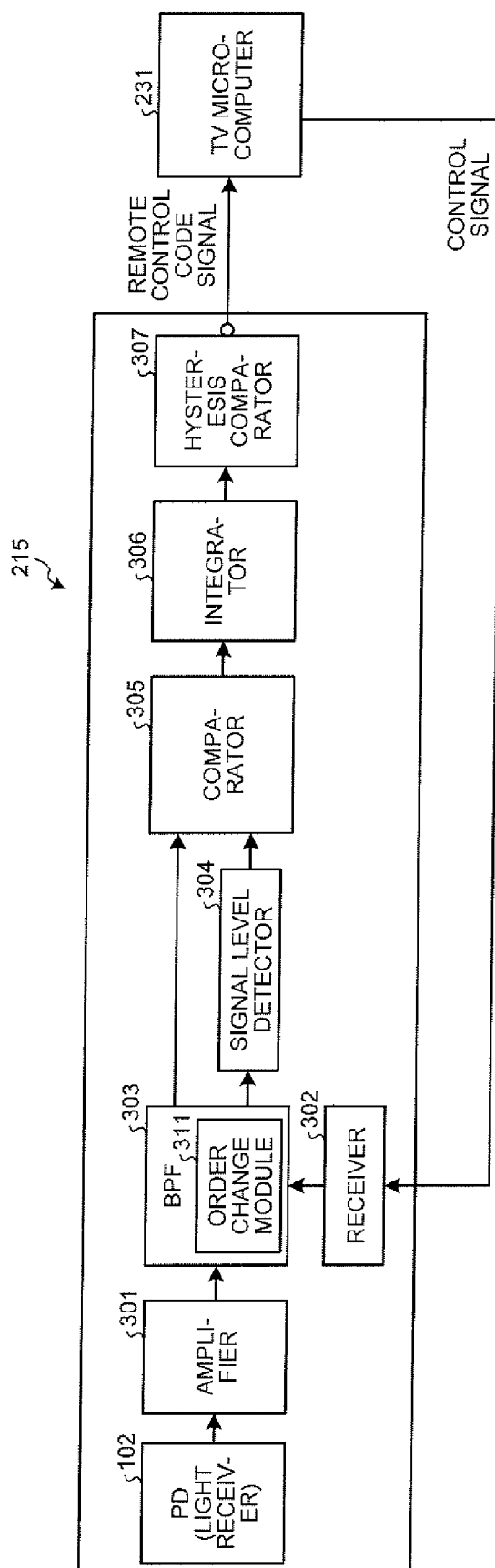


FIG.4

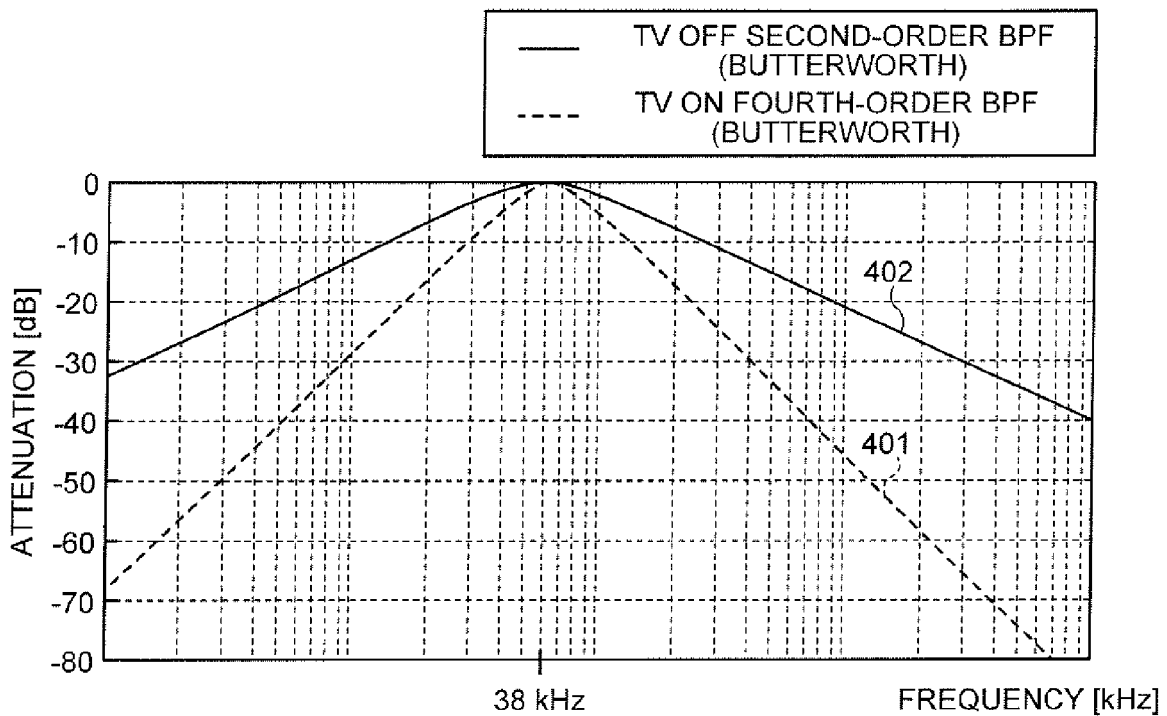


FIG.5

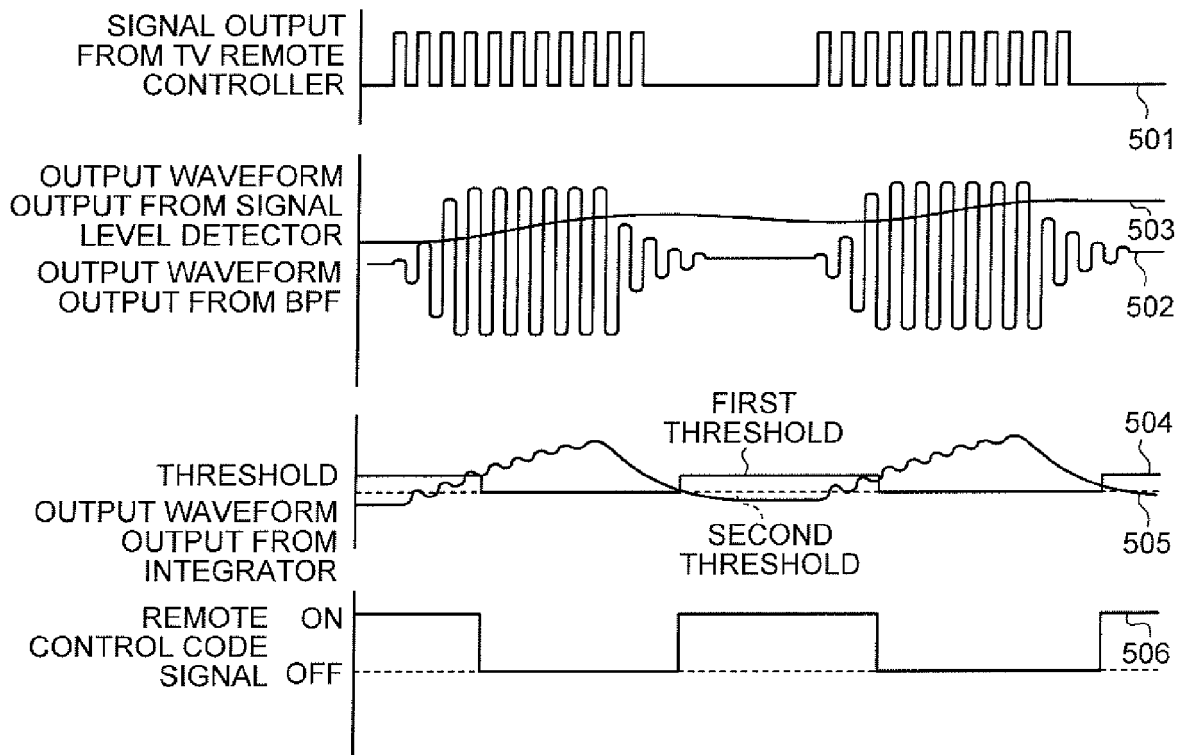


FIG.6

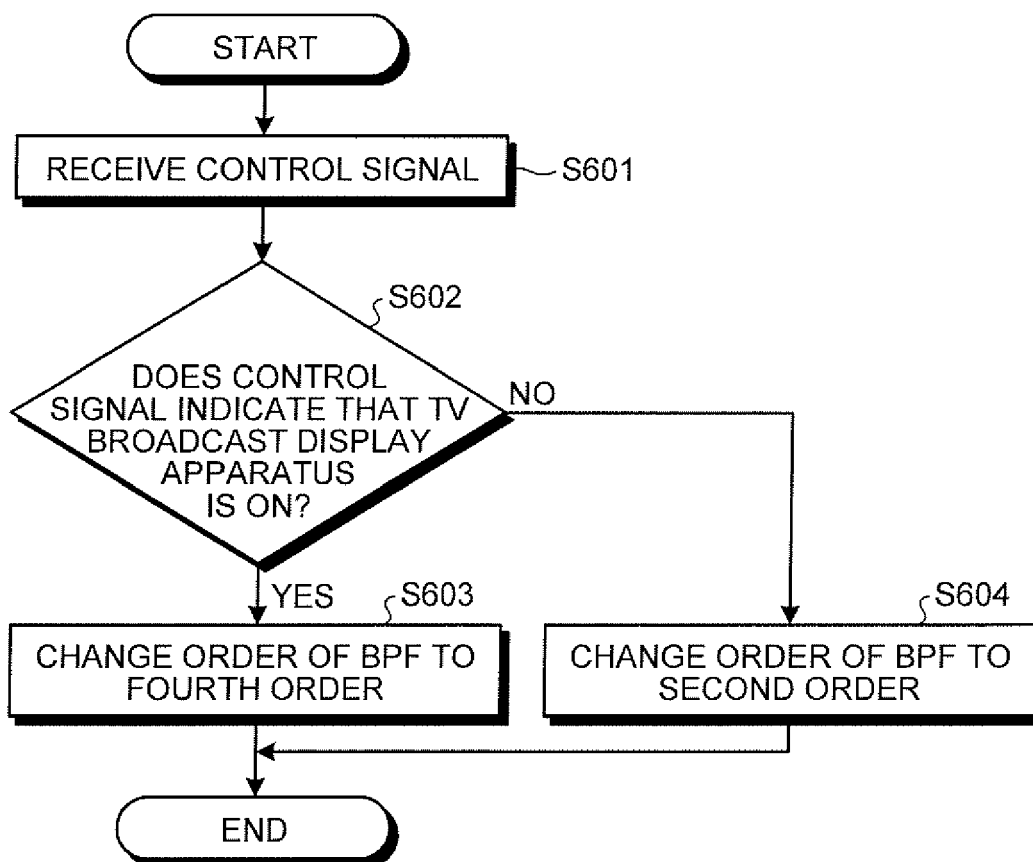


FIG.7

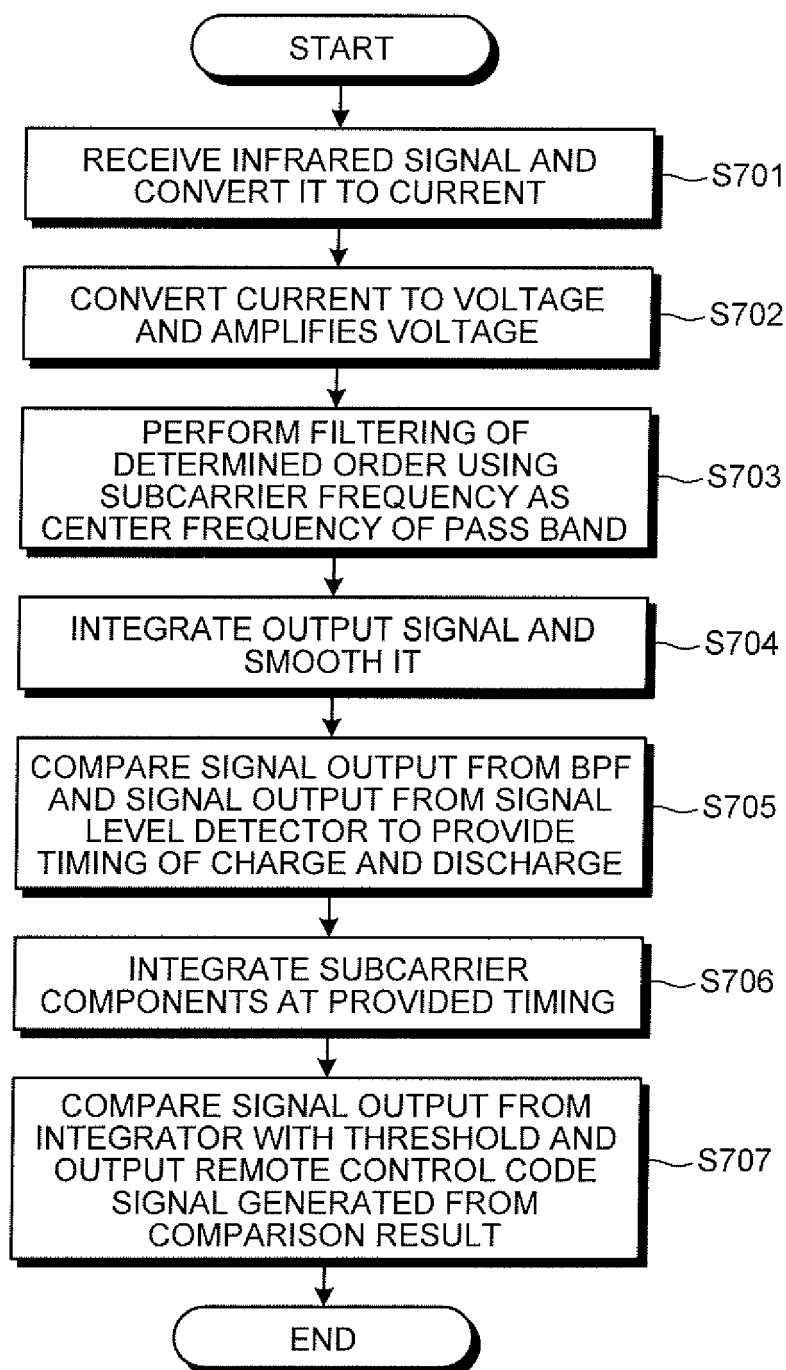
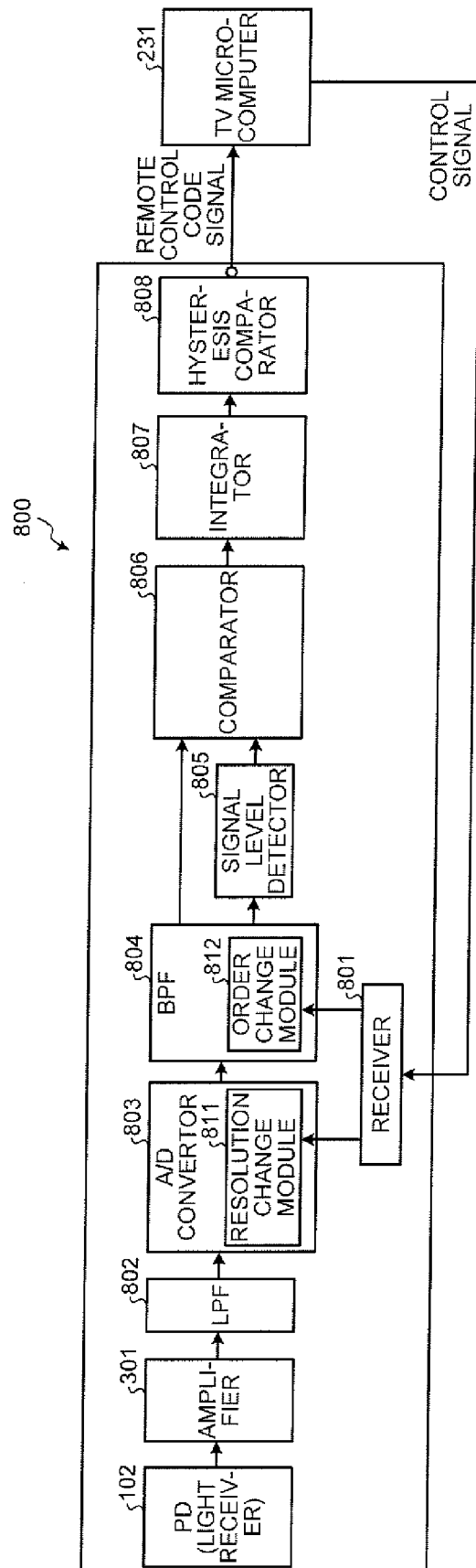


FIG.8



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2009181393 A [0001]
- JP 2004056541 A [0004]