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(54) **Signal switch device and satellite signal receiver**

(57) A signal switching device for a satellite signal receiver includes a determination module coupled to a set-top box for receiving an instruction signal from the box and outputting a control signal correspondingly, and a switch module coupled to a plurality of signal sources for receiving a first-frequency-band signal, a second-frequency-band signal and a conventional narrowband signal. The switch module outputs either the first-frequency-band signal, the second-frequency-band signal, or the

conventional narrowband signal to the set-top box according to the control signal. The first-frequency-band signal and the second-frequency-band signal are respectively a vertically-polarized wideband signal and a horizontally-polarized wideband signal. The conventional narrowband signal is a vertically-polarized high-frequency signal, a vertically-polarized low-frequency signal, a horizontally-polarized low-frequency signal and a horizontally-polarized high-frequency signal.

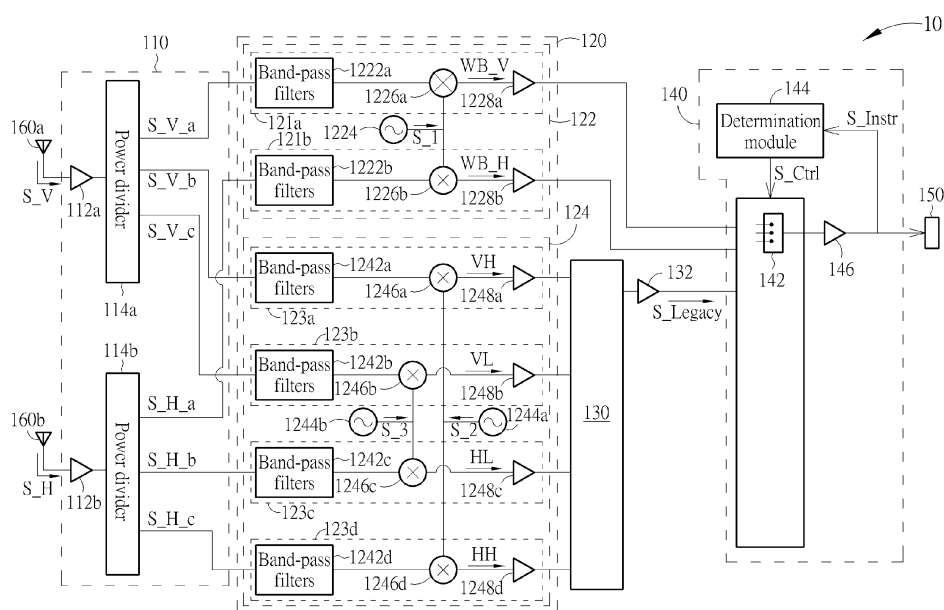


FIG. 1

Description

Field of the Invention

[0001] The present disclosure relates to a signal switching device and a satellite signal receiver, and more particularly, to a signal switching device and a satellite signal receiver able to output a vertically-polarized high-frequency signal, a horizontally-polarized high-frequency signal, a vertically-polarized low-frequency signal, a horizontally-polarized low-frequency signal, a vertically-polarized wideband signal and a horizontally-polarized wideband signal.

Background of the Invention

[0002] Direct broadcast satellite (DBS) has been widely used all over the world. A low-noise block downconverter (LNB), which is a satellite signal receiver disposed in a satellite dish, is configured to receive vertically-polarized and horizontally-polarized radio signals in Ku band (10.7GHz-12.75GHz) and downconvert the radio signals into those at intermediate frequencies (IF). This downconversion allows the radio signals to be carried to users with relatively cheap coaxial cable; in contrast, if the radio signals remain at their original frequencies, it would require an expensive and impractical waveguide line. In a conventional satellite structure, a conventional LNB outputs four-path signals: vertically-polarized low-frequency radio signals (950MHz-1950MHz), horizontally-polarized low-frequency radio signals (950MHz-1950MHz), vertically-polarized high-frequency radio signals (1100MHz-2150MHz) and horizontally-polarized high-frequency radio signals (1100MHz-2150MHz). A multi-switch of the conventional LNB then sends out certain signals of the four-path signals required by a plurality of users. Consequently, there must be four coaxial cables to independently output the four-path signals. On the other hand, the latest frequency specification of a bandwidth of 2.05GHz is introduced into a new type of LNB, which effectively transmits the four-path signals through two cables to reduce the number of the cables and the cost.

[0003] However, the currently used set-top box is not able to receive the four-path signals directly. Namely, when a conventional LNB is changed to a new type of LNB, a user must replace his/her set-top box with a new version one since the set-top box is out of date, which dramatically hinders the development of LNB. Therefore, ensuring a conventional and a new type of set-top box able to share one LNB has benefits for industrial application.

Summary of the Invention

[0004] The present invention aims at providing a signal switching device and a satellite signal receiver, which is capable of outputting a vertically-polarized high-frequency signal, a horizontally-polarized high-frequency signal,

a vertically-polarized low-frequency signal, a horizontally-polarized low-frequency signal, a vertically-polarized wideband signal and a horizontally-polarized wideband signal.

[0005] This is achieved by a signal switching device and a satellite signal receiver according to claims 1 and 8 respectively. The dependent claims pertain to corresponding further developments and improvements.

[0006] As will be seen more clearly from the following detailed description, the claimed signal switching device adapted to a satellite signal receiver is disclosed herein. The signal switching device comprises a determination module coupled to a set-top box and a switch module. The switch module is coupled to a plurality of signal sources to receive a first frequency band signal, a second frequency band signal and a conventional narrowband signal. The determination module is configured to receive an instruction signal from the set-top box and correspondingly output a control signal. The switch module is configured to provide one of the first frequency band signal, the second frequency band signal and the conventional narrowband signal to the set-top box according to the control signal. The first frequency band signal and the second frequency band signal are respectively a vertically-polarized wideband signal and a horizontally-polarized wideband signal, and the conventional narrowband signal is one of a vertically-polarized high-frequency signal, a vertically-polarized low-frequency signal, a horizontally-polarized low-frequency signal and a horizontally-polarized high-frequency signal.

[0007] In another aspect of the invention, the claimed satellite signal receiver is disclosed in the detailed description here below. The satellite signal receiver comprises a radio signal receiving module, a radio signal processing module, a front switch module and a signal switching device. The radio signal receiving module is configured to receive a vertically-polarized radio signal and a horizontally-polarized radio signal and output a first radio signal, a second radio signal, a third radio signal, a fourth radio signal, a fifth radio signal and a sixth radio signal. The radio signal processing module is coupled to the radio signal receiving module, and the radio signal processing module comprises a first processing module and a second processing module. The first processing module is configured to convert the first radio signal and the second radio signal into a first frequency band signal and a second frequency band signal. The second processing module is configured to convert the third radio signal, the fourth radio signal, the fifth radio signal and the sixth radio signal into a third frequency band signal, a fourth frequency band signal, a fifth frequency band signal and a sixth frequency band signal. The front switch module is configured to receive the third frequency band signal, the fourth frequency band signal, the fifth frequency band signal and the sixth frequency band signal, and under a command of a set-top box select one of the third frequency band signal, the fourth frequency band signal, the fifth frequency band signal and the sixth frequency

band signal to serve as a conventional narrowband signal. The signal switching device comprises a determination module coupled to the set-top box and a switch module. The determination module is configured to receive an instruction signal from the set-top box and correspondingly output a control signal. The switch module is coupled between the radio signal processing module, the front switch module and the determination module to receive the first frequency band signal, the second frequency band signal and the conventional narrowband signal. The switch module is configured to provide one of the first frequency band signal, the second frequency band signal and the conventional narrowband signal to the set-top box according to the control signal. The first frequency band signal and the second frequency band signal are respectively a vertically-polarized wideband signal and a horizontally-polarized wideband signal. The third frequency band signal, the fourth frequency band signal, the fifth frequency band signal and the sixth frequency band signal are respectively a vertically-polarized high-frequency signal, a vertically-polarized low-frequency signal, a horizontally-polarized low-frequency signal and a horizontally-polarized high-frequency signal.

Brief Description of the Drawings

[0008]

FIG. 1 is a schematic diagram illustrating a satellite signal receiver according to an embodiment of the present invention.

FIG. 2 is a schematic diagram illustrating a satellite signal receiver according to an embodiment of the present invention.

FIG. 3 is a schematic diagram illustrating a signal switching device according to an embodiment of the present invention.

FIG. 4 is a schematic diagram illustrating a satellite signal receiver according to an embodiment of the present invention.

Detailed Description

[0009] FIG. 1 is a schematic diagram illustrating a satellite signal receiver 10 according to an embodiment of the present invention. The satellite signal receiver 10 may be a low-noise block downconverter (LNB) and comprises a radio signal receiving module 110, a radio signal processing module 120, a switch module 130 and a signal switching device 140. The radio signal receiving module 110 may receive a vertically-polarized radio signal S_V and a horizontally-polarized radio signal S_H in Ku band (10.7GHz-12.75GHz) with antennas 160a, 160b and output radio signals S_{V_a} - S_{V_c} and S_{H_a} - S_{H_c}. The radio signal processing module 120 comprises processing modules 122 and 124, which serve as superheterodyne receivers to change frequencies of the radio signals S_{V_a} - S_{V_c} and S_{H_a} - S_{H_c}. The

processing module 122 may lower the frequencies of the radio signals S_{V_a} and S_{H_a} and output a vertically-polarized wideband signal WB_V and a horizontally-polarized wideband signal WB_H of a bandwidth of 2.05GHz. The processing module 124 may lower the frequencies of the radio signals S_{V_b}, S_{V_c}, S_{H_b} and S_{H_c} and output a vertically-polarized high-frequency signal VH, a horizontally-polarized high-frequency signal HH with a frequency range from 1100MHz to 2150MHz and a vertically-polarized low-frequency signal VL, a horizontally-polarized low-frequency signal HL with a frequency range from 950MHz to 1950MHz. The switch module 130 is coupled to the processing module 124 and configured to select one of the vertically-polarized high-frequency signal VH, the vertically-polarized low-frequency signal VL, the horizontally-polarized low-frequency signal HL and the horizontally-polarized high-frequency signal HH to serve as a conventional narrowband signal S_{Legacy}. The signal switching device 140 comprises a switch module 142 and a determination module 144. The determination module 144 receives an instruction signal S_{Instr} from a set-top box (STB) 150 and correspondingly outputs a control signal S_{Ctrl}. The switch module 142 receives the vertically-polarized wideband signal WB_V, the horizontally-polarized wideband signal WB_H and the conventional narrowband signal S_{Legacy} and provides one of the vertically-polarized wideband signal WB_V, the horizontally-polarized wideband signal WB_H and the conventional narrowband signal S_{Legacy} to the set-top box 150 according to the control signal S_{Ctrl}.

[0010] In short, after receiving the vertically-polarized wideband signal WB_V, the horizontally-polarized wideband signal WB_H of a bandwidth of 2.05GHz and the conventional narrowband signal S_{Legacy}, the signal switching device 140 sends one of the vertically-polarized wideband signal WB_V, the horizontally-polarized wideband signal WB_H and the conventional narrowband signal S_{Legacy} to the set-top box 150 according to the instruction signal S_{Instr} provided by the set-top box 150.

[0011] Therefore, whether a conventional set-top box or a new type of set-top box is used, the satellite signal receiver 10 may always switch output signals accurately - namely, outputting the vertically-polarized wideband signal WB_V or the horizontally-polarized wideband signal WB_H of a bandwidth of 2.05GHz to a new type of set-top box, or, outputting the vertically-polarized high-frequency signal VH, the horizontally-polarized high-frequency signal HH with a frequency range from 1100MHz to 2150MHz or the vertically-polarized low-frequency signal VL, the horizontally-polarized low-frequency signal HL with a frequency range from 950MHz to 1950MHz to a conventional set-top box. Therefore, no more extra set-top box is required because of efficient support from the satellite signal receiver 10, and people with set-top boxes of different types may easily share one satellite signal receiver 10. Moreover, a user won't waste money on set-

top boxes even if one's set-top box is out of date and even if the satellite signal receiver 10 is change to another satellite signal receiver 10.

[0012] The satellite signal receiver 10 is an embodiment of the present invention; however, the present invention is not limited thereto, and those skilled in the art might make modifications or alterations accordingly. For example, the instruction signal S_Instr may be a Digital Satellite Equipment Control (DiSEqC) signal. Combined 13V (volts) or 18V direct current (DC) voltage with or without 22kHz tone (i.e., an alternating current AC signal) - i.e., 13V no tone, 13V with superimposed 22 kHz tone, 18V no tone, and 18V with superimposed 22 kHz tone - a DiSEqC signal can provide four different kinds of commands to the determination module 144, such that the determination module 144 correspondingly sends the control signal S_Ctrl to control the switch module 142. The switch module 142 provides one of the vertically-polarized wideband signal WB_V, the horizontally-polarized wideband signal WB_H and the conventional narrowband signal S_Legacy to the set-top box 150 according to the control signal S_Ctrl and enhances output signals with the amplifier 146 of the signal switching device 140.

[0013] On the other hand, as shown in FIG. 1, the radio signal receiving module 110 comprises low-noise amplifiers (LNA) 112a, 112b and power dividers 114a, 114b. The low-noise amplifiers 112a and 112b are respectively coupled to the antennas 160a and 160b in order to amplify the vertically-polarized radio signal S_V and the horizontally-polarized radio signal S_H, which are received from the antennas 160a and 160b, in Ku band. The power divider 114a is coupled to the low-noise amplifier 112a, such that power of the vertically-polarized radio signal S_V is split equally into the radio signals S_V_a - S_V_c; similarly, the power divider 114b is coupled to the low-noise amplifier 112b, such that power of the horizontally-polarized radio signal S_H is split equally into the radio signals S_H_a - S_H_c. In other words, the radio signal receiving module 110 receives the vertically-polarized radio signal S_V and the horizontally-polarized radio signal S_H in Ku band and then outputs the radio signals S_V_a - S_V_c, S_H_a - S_H_c.

[0014] The processing module 122 of the radio signal processing module 120 comprises band-pass filters 1222a, 1222b, a local oscillator (LO) 1224, frequency mixers 1226a, 1226b and amplifiers 1228a, 1228b, which are operated in a way narrated as follows. Briefly, the local oscillator 1224 generates an oscillating signal S_1, which may be at one specific frequency substantially within a range of 9.0GHz to 10.6GHz. Therefore, after the band-pass filter 1222a receives the radio signal S_V_a and removes noises, the frequency mixer 1226a coupled between the band-pass filter 1222a and the local oscillator 1224 mixes the radio signal S_V_a with the oscillating signal S_1 generated by the local oscillator 1224 to down-convert the radio signal S_V_a into the vertically-polarized wideband signal WB_V of a band-

width of 2.05GHz. And the amplifier 1228a amplifies the vertically-polarized wideband signal WB_V. In other words, the band-pass filter 1222a, the frequency mixer 1226a and the amplifier 1228a constitute a frequency mixing device 121a. Similarly, the band-pass filter 1222b, the frequency mixer 1226b and the amplifier 1228b constitute a frequency mixing device 121b - after the band-pass filter 1222b receives the radio signal S_H_a and removes noises, the frequency mixer 1226b coupled between the band-pass filter 1222b and the local oscillator 1224 mixes the radio signal S_H_a with the oscillating signal S_1 generated by the local oscillator 1224 to down-convert the radio signal S_H_a into the horizontally-polarized wideband signal WB_H of a bandwidth of 2.05GHz, and the amplifier 1228b then amplifies the horizontally-polarized wideband signal WB_H. In other words, the processing module 122 receives the radio signals S_V_a and S_H_a in Ku band and then outputs the vertically-polarized wideband signal WB_V and the horizontally-polarized wideband signal WB_H of a bandwidth of 2.05GHz.

[0015] The mechanism of the processing module 124 of the radio signal processing module 120 and the switch module 130 is similar to that in a conventional low-noise block downconverter. Specifically, the processing module 124 comprises band-pass filters 1242a - 1242d, local oscillators 1244a, 1244b, frequency mixers 1246a - 1246d and amplifiers 1248a - 1248d. The band-pass filter 1242a - 1242d, the frequency mixer 1246a - 1246d and the amplifier 1248a - 1248d respectively constitute frequency mixing devices 123a - 123d, which are well-known by those skilled in the art. In brief, the local oscillators 1244a and 1244b respectively generate an oscillating signal S_2 at 10.6GHz and an oscillating signal S_3 at 9.75GHz. The frequency mixer 1246a of the frequency mixing device 123a mixes the radio signal S_V_b with the oscillating signal S_2 to down-convert the radio signal S_V_b into the vertically-polarized high-frequency signal VH with a frequency range from 1100MHz to 2150MHz. Likely, the frequency mixer 1246b of the frequency mixing device 123b mixes the radio signal S_V_c with the oscillating signal S_3 to down-convert the radio signal S_V_c into the vertically-polarized low-frequency signal VL with a frequency range from 950MHz to 1950MHz; the frequency mixer 1246c of the frequency mixing device 123c mixes the radio signal S_H_b with the oscillating signal S_3 to down-convert the radio signal S_H_b into the horizontally-polarized low-frequency signal HL with a frequency range from 950MHz to 1950MHz; the frequency mixer 1246d of the frequency mixing device 123d mixes the radio signal S_H_c with the oscillating signal S_2 to down-convert the radio signal S_H_c into the horizontally-polarized high-frequency signal HH with a frequency range from 1100MHz to 2150MHz. Subsequently, the switch module 130 selects one of the vertically-polarized high-frequency signal VH, the vertically-polarized low-frequency signal VL, the horizontally-polarized low-frequency signal HL and the horizontally-po-

larized high-frequency signal HH received from the processing module 124 to serve as the conventional narrowband signal S_Legacy. The amplifier 132 may boost the strength of the conventional narrowband signal S_Legacy, while the gain of the amplifier 132 depends on different system requirements and the amplifier 132 may be removed in certain circumstances. Accordingly, the processing module 124 may convert the received radio signal S_V_b, S_V_c, S_H_b, S_H_c in Ku band into the vertically-polarized high-frequency signal VH, the horizontally-polarized high-frequency signal HH with a frequency range from 1100MHz to 2150MHz and the vertically-polarized low-frequency signal VL, the horizontally-polarized low-frequency signal HL with a frequency range from 950MHz to 1950MHz. In addition, the switch module 130 may switch between the vertically-polarized high-frequency signal VH, the vertically-polarized low-frequency signal VL, the horizontally-polarized low-frequency signal HL and the horizontally-polarized high-frequency signal HH and then output one of them as the conventional narrowband signal S_Legacy.

[0016] The radio signal receiving module 110, the radio signal processing module 120 are radio frequency front-end circuit and may be further modified according to different design considerations. For example, the power dividers 114a, 114b may be Rat-race power dividers, Wilkinson power dividers, hybrid coupling power dividers and so on. Apart from the aforementioned band-pass filters 1222a, 1222b, 1242a - 1242d, more band-pass filters, high-pass filters or low-pass filters may be added if necessary. FIG. 2 is a schematic diagram illustrating a satellite signal receiver 20 according to an embodiment of the present invention. Since the structure of the satellite signal receiver 20 is the same as that of the satellite signal receiver 10 in FIG. 1, the same numerals and symbols denote the same components in the following description, and the similar parts are not detailed redundantly. As shown in FIG. 2, low-pass filters 1229a, 1229b, 1249a - 1249d are respectively added between the frequency mixer 1226a and the amplifier 1228a, between the frequency mixer 1226b and the amplifier 1228b, between the frequency mixer 1246a and the amplifier 1248a, between the frequency mixer 1246b and the amplifier 1248b, between the frequency mixer 1246c and the amplifier 1248c and between the frequency mixer 1246d and the amplifier 1248d in order to remove noises further. Meanwhile, power dividers 1225, 1245a, 1245b and band-pass filters 1227a, 1227b, 1247a - 1247d are respectively added between the local oscillator 1224 and the frequency mixer 1226a, between the local oscillator 1224 and the frequency mixer 1226b, between the local oscillator 1244a and the frequency mixer 1246a, between the local oscillator 1244b and the frequency mixer 1246b, between the local oscillator 1244b and the frequency mixer 1246c and between the local oscillator 1244a and the frequency mixer 1246d.

[0017] Besides, the signal switching device 140 is utilized to output one of the vertically-polarized wideband

signal WB_V, the horizontally-polarized wideband signal WB_H and the conventional narrowband signal S_Legacy, and it may be implemented in any form or structure. An example can be seen in FIG. 3. FIG. 3 is a schematic diagram illustrating a signal switching device 340 according to an embodiment of the present invention. The signal switching device 340 may serve as the signal switching device 140 as shown in FIG. 1 and comprises a switch module 342 and a determination module 344. The determination module 344 comprises a chock ch1, an amplitude circuit 3444, a frequency circuit 3442 and a determination unit 3446. The chock ch1 is utilized to pass the instruction signal S_Instr of the set-top box 150 into the amplitude circuit 3444 and the frequency circuit 3442 but attenuate (reduce the amplitude of) signals of higher frequencies. The amplitude circuit 3444 is utilized to extract low-frequency (DC) portions of the instruction signal S_Instr while block high-frequency (AC) portions. In this embodiment, the amplitude circuit 3444 comprises resistors R1, R2 and capacitors C1, C2, which constitutes a low-pass filter to serves as the amplitude circuit 3444; however, the amplitude circuit 3444 may be other low-pass filters such as a Sallen-Key low-pass filter. The frequency circuit 3442 is utilized to extract high-frequency (AC) portions of the instruction signal S_Instr. In this embodiment, the frequency circuit 3442 comprises a bipolar transistor BJT1, a diode D1, resistors R3 - R5 and a capacitor C3, which basically constitutes a common emitter amplifier; nevertheless, the frequency circuit 3442 may be other amplifying circuits such as comprising field-effect transistors (FET). The determination unit 3446 may send the control signals S_Ctrl_a - S_Ctrl_c to the switch module 342 according to signals from the amplitude circuit 3444 and the frequency circuit 3442.

[0018] On the other hand, the switch module 342 comprises switch circuits SW_a - SW_c, a resistor R6 and a capacitor C4. The switch circuits SW_a - SW_c are connected in parallel and coupled to the set-top box 150 through the capacitor C4 in order to block low-frequency (DC) portions/signals. The switch circuits SW_a - SW_c may conduct the vertically-polarized wideband signal WB_V, the horizontally-polarized wideband signal WB_H and the conventional narrowband signal S_Legacy to the set-top box 150 when the control signals S_Ctrl_a - S_Ctrl_c instruct so. Specifically, take the switch circuit SW_a as an example. The vertically-polarized wideband signal WB_V is input into a terminal between a bipolar transistor cascade circuit CAS_a and a diode D2a; hence, when the voltage level of the control signal S_Ctrl_a is low, the bipolar transistor cascade circuit CAS_a outputs low voltage level to turn off diodes D2a, D3a connected in series and the vertically-polarized wideband signal WB_V is blocked. On the other hand, when the voltage level of the control signal S_Ctrl_a is high, the bipolar transistor cascade circuit CAS_a outputs high voltage level to turn on the diodes D2a, D3a and transmits the vertically-polarized wideband signal WB_V to the set-top box 150. Bipolar transistors BJT2a, BJT3a

and resistors R7a, R8a constitute the bipolar transistor cascade circuit CAS_a; however, the bipolar transistor cascade circuit CAS_a may be other kinds of logic circuits. Additionally, the bipolar transistor cascade circuit CAS_a may be connected to a choke ch2a in series so as to prevent the vertically-polarized wideband signal WB_V from flowing into the bipolar transistor cascade circuit CAS_a. Similarly, in the switch circuit SW_b, the horizontally-polarized wideband signal WB_H is input into a terminal between a bipolar transistor cascade circuit CAS_b and a diode D2b so that the voltage level of the control signal S_{Ctrl}_b dominates the flow of the horizontally-polarized wideband signal WB_H. In the switch circuit SW_c, the conventional narrowband signal S_{Legacy} is input into a terminal between a bipolar transistor cascade circuit CAS_c and a diode D2c so that the voltage level of the control signal S_{Ctrl}_c dominates the flow of the conventional narrowband signal S_{Legacy}.

[0019] In the above-mentioned embodiment, the satellite signal receiver 10 and 20 are coupled to one single set-top box 150, and thus only one user uses the service. Nevertheless, multiple set-top boxes are also applicable in the present invention, meaning that lots of users can be well serviced. This can be seen in FIG. 4. FIG. 4 is a schematic diagram illustrating a satellite signal receiver 40 according to an embodiment of the present invention. Since the structure of the satellite signal receiver 40 is the same as that of the satellite signal receiver 10 in FIG. 1, the same numerals and symbols denote the same components in the following description, and the similar parts are not detailed redundantly. As shown in FIG. 4, the satellite signal receiver 40 comprises switch modules 430₁ - 430_n corresponding to set-top boxes 150₁ - 150_n; the signal switching device 440 comprises the switch modules 442₁ - 442_n corresponding to set-top boxes 150₁ - 150_n. The switch modules 430₁ - 430_n respectively select and then output one of the vertically-polarized high-frequency signal VH, the vertically-polarized low-frequency signal VL, the horizontally-polarized low-frequency signal HL and the horizontally-polarized high-frequency signal HH to serve as the conventional narrowband signals S_{Legacy}₁ - S_{Legacy}_n. The determination module 144 receives instruction signals S_{Instr}₁ - S_{Instr}_n from the set-top box 150₁ - 150_n and correspondingly output control signals S_{Ctrl}₁ - S_{Ctrl}_n. The switch modules 442₁ - 442_n respectively select and then send one of the vertically-polarized wideband signal WB_V, the horizontally-polarized wideband signal WB_H and the conventional narrowband signal S_{Legacy}₁ - S_{Legacy}_n to the set-top boxes 150₁ - 150_n.

[0020] As a result, the satellite signal receiver 40 may provide satellite signals in Ku band to a plurality of set-top boxes for a plurality of users. More significantly, whether a conventional set-top box or a new type of set-top box is used, the satellite signal receiver 40 may always switch output signals accurately and send the vertically-polarized wideband signal WB_V or the horizon-

tally-polarized wideband signal WB_H of a bandwidth of 2.05GHz to a new type of set-top box, or send the vertically-polarized high-frequency signal VH, the horizontally-polarized high-frequency signal HH with a frequency range from 1100MHz to 2150MHz or the vertically-polarized low-frequency signal VL, the horizontally-polarized low-frequency signal HL with a frequency range from 950MHz to 1950MHz to a conventional set-top box. Accordingly, people with set-top boxes of different types can easily share one satellite signal receiver 40.

[0021] In the prior art, a conventional set-top box cannot directly receive a vertically-polarized wideband signal or a horizontally-polarized wideband signal, which forces a user to replace the existing set-top box with a new version and hinders the development of low-noise block downconverters. In contrast, whether a conventional set-top box or a new type of set-top box is used, the satellite signal receiver in the present invention can always switch output signals accurately and thus avoid extra cost for set-top boxes.

[0022] To sum up, since the signal switching device of the present invention automatically switches to send correct signals in a specific frequency band for a conventional set-top box and correct signals in another specific frequency band for a new type of set-top box according to instruction signals of the set-top boxes, the satellite signal receiver in the present invention can always switch output signals accurately whether a conventional set-top box or a new type of set-top box is used. Consequently, no more extra set-top box is required because of efficient support from the satellite signal receiver in the present invention, and people with set-top boxes of different types can easily share one satellite signal receiver. Moreover, a user won't waste money on set-top boxes even if one's set-top box is out of date and even if a satellite signal receiver is changed to another satellite signal receiver.

Claims

1. A signal switching device (140, 340, 440), adapted to a satellite signal receiver (10, 20, 40), **characterized by** the signal switching device (140, 340, 440) comprising:

a determination module (144, 344) coupled to a set-top box (150, 150₁ - 150_n), wherein the determination module (144, 344) is configured to receive an instruction signal (S_{Instr}, S_{Instr}₁ - S_{Instr}_n) from the set-top box (150, 150₁ - 150_n) and to correspondingly output a control signal (S_{Ctrl}, S_{Ctrl}_a - S_{Ctrl}_c, S_{Ctrl}₁ - S_{Ctrl}_n); and
a switch module (142, 342, 442₁ - 442_n) coupled to a plurality of signal sources to receive a first frequency band signal (WB_V), a second frequency band signal (WB_H) and a conventional narrowband signal (S_{Legacy},

- S_Legacy_1 - S_Legacy_n), wherein the switch module (142, 342, 442_1 - 442_n) is configured to provide one of the first frequency band signal (WB_V), the second frequency band signal (WB_H) and the conventional narrowband signal (S_Legacy, S_Legacy_1 - S_Legacy_n) to the set-top box (150, 150_1 - 150_n) according to the control signal (S_Ctrl, S_Ctrl_a - S_Ctrl_c, S_Ctrl_1 - S_Ctrl_n);
 wherein the first frequency band signal (WB_V) and the second frequency band signal (WB_H) are respectively a vertically-polarized wideband signal (WB_V) and a horizontally-polarized wideband signal (WB_H), and the conventional narrowband signal (S_Legacy, S_Legacy_1 - S_Legacy_n) is one of a vertically-polarized high-frequency signal (VH), a vertically-polarized low-frequency signal (VL), a horizontally-polarized low-frequency signal (HL) and a horizontally-polarized high-frequency signal (HH).
2. The signal switching device (140, 340, 440) of claim 1, **characterized in that** the determination module (144, 344) comprises:
- an amplitude circuit (3444) configured to extract a direct current (DC) portion of the instruction signal (S_Instr, S_Instr_1 - S_Instr_n);
 a frequency circuit (3442) configured to extract an alternating current (AC) portion of the instruction signal (S_Instr, S_Instr_1 - S_Instr_n); and
 a determination unit (3446) coupled between the amplitude circuit (3444) and the frequency circuit (3442), wherein the determination unit (3446) is configured to provide the control signal (S_Ctrl, S_Ctrl_a - S_Ctrl_c, S_Ctrl_1 - S_Ctrl_n) to the switch module (142, 342, 442_1 - 442_n) according to the direct current (DC) portion and the alternating current (AC) portion.
3. The signal switching device (140, 340, 440) of claim 1, **characterized in that** the switch module (142, 342, 442_1 - 442_n) comprises:
- a first switch circuit (SW_a) coupled between the determination module (144, 344) and the set-top box (150, 150_1 - 150_n), wherein the first switch circuit (SW_a) is configured to provide the first frequency band signal (WB_V) to the set-top box (150, 150_1 - 150_n) when the control signal (S_Ctrl, S_Ctrl_a, S_Ctrl_1 - S_Ctrl_n) is a first control signal;
 a second switch circuit (SW_b) coupled between the determination module (144, 344) and the set-top box (150, 150_1 - 150_n), wherein the second switch circuit (SW_b) is configured to provide the second frequency band signal (WB_H) to the set-top box (150, 150_1 - 150_n) when the control signal (S_Ctrl, S_Ctrl_b, S_Ctrl_1 - S_Ctrl_n) is a second control signal;
 and
 a third switch circuit (SW_c) coupled between the determination module (144, 344) and the set-top box (150, 150_1 - 150_n), wherein the third switch circuit (SW_c) is configured to provide the conventional narrowband signal (S_Legacy, S_Legacy_1 - S_Legacy_n) to the set-top box (150, 150_1 - 150_n) when the control signal (S_Ctrl, S_Ctrl_c, S_Ctrl_1 - S_Ctrl_n) is a third control signal.
4. The signal switching device (140, 340, 440) of any of claims 1 to 3, **characterized in that** the satellite signal receiver (10, 20, 40) is a low-noise block down-converter (LNB), and the instruction signal (S_Instr, S_Instr_1 - S_Instr_n) is a Digital Satellite Equipment Control (DiSEqC) signal.
5. The signal switching device (140, 340, 440) of any of claims 1 to 4, **characterized in that** a bandwidth of the first frequency band signal (WB_V) and a bandwidth of the second frequency band signal (WB_H) are respectively greater than a bandwidth of the conventional narrowband signal (S_Legacy, S_Legacy_1 - S_Legacy_n).
6. The signal switching device (140, 340, 440) of any of claims 1 to 5, **characterized in that** a bandwidth of the first frequency band signal (WB_V) and a bandwidth of the second frequency band signal (WB_H) are respectively greater than 2GHz.
7. The signal switching device (140, 340, 440) of any of claims 1 to 6, **characterized in that** a frequency range of the vertically-polarized low-frequency signal (VL) and a frequency range of the horizontally-polarized low-frequency signal (HL) are substantially from 950MHz to 1950MHz, and a frequency range of the vertically-polarized high-frequency signal (VH) and a frequency range of the horizontally-polarized high-frequency signal (HH) are substantially from 1100MHz to 2150MHz.
8. A satellite signal receiver (10, 20, 40), **characterized by** the satellite signal receiver (10, 20, 40) comprising:
- a radio signal receiving module (110) configured to receive a vertically-polarized radio signal (S_V) and a horizontally-polarized radio signal (S_H) and to output a first radio signal (S_V_a), a second radio signal (S_H_a), a third radio signal (S_V_b), a fourth radio signal (S_V_c), a fifth radio signal (S_H_b) and a sixth radio signal (S_H_c);
 a radio signal processing module (120), coupled

to the radio signal receiving module (110), the radio signal processing module (120) comprising:

a first processing module (122) configured to convert the first radio signal (S_V_a) and the second radio signal (S_H_a) into a first frequency band signal (WB_V) and a second frequency band signal (WB_H); and
a second processing module (124) configured to convert the third radio signal (S_V_b), the fourth radio signal (S_V_c), the fifth radio signal (S_H_b) and the sixth radio signal (S_H_c) into a third frequency band signal (VH), a fourth frequency band signal (VL), a fifth frequency band signal (HL) and a sixth frequency band signal (HH);

a front switch module (130, 430_1 - 430_n) configured to receive the third frequency band signal (VH), the fourth frequency band signal (VL), the fifth frequency band signal (HL) and the sixth frequency band signal (HH) and to select under a command of a set-top box (150, 150_1 - 150_n) one of the third frequency band signal (VH), the fourth frequency band signal (VL), the fifth frequency band signal (HL) and the sixth frequency band signal (HH) to serve as a conventional narrowband signal (S_Legacy, S_Legacy_1 - S_Legacy_n); and
a signal switching device (140, 340, 440) according to any of claims 1-7.

9. The satellite signal receiver (10, 20, 40) of claim 8, **characterized in that** a frequency range of the first radio signal (S_V_a), a frequency range of the second radio signal (S_H_a), a frequency range of the third radio signal (S_V_b), a frequency range of the fourth radio signal (S_V_c), a frequency range of the fifth radio signal (S_H_b) and a frequency range of the sixth radio signal (S_H_c) are substantially from 10.7GHz to 12.75GHz.

10. The satellite signal receiver (10, 20, 40) of claim 8 or 9, **characterized in that** the radio signal receiving module (110) comprises:

a first power divider (114a) configured to divide the vertically-polarized radio signal (S_V) into the first radio signal (S_V_a), the third radio signal (S_V_b) and the fourth radio signal (S_V_c); and
a second power divider (114b) configured to divide the horizontally-polarized radio signal (S_H) into the second radio signal (S_H_a), the fifth radio signal (S_H_b) and the sixth radio signal (S_H_c).

11. The satellite signal receiver (10, 20, 40) of claim 10, **characterized in that** the first power divider (114a) or the second power divider (114b) is a Rat-race power divider, a Wilkinson power divider or a hybrid coupling the power divider.

12. The satellite signal receiver (10, 20, 40) of any of claims 8-11 **characterized in that** the first radio signal (S_V_a), the third radio signal (S_V_b) and the fourth radio signal (S_V_c) are equal in power, and the second radio signal (S_H_a), the fifth radio signal (S_H_b) and the sixth radio signal (S_H_c) are equal in power.

13. The satellite signal receiver (10, 20, 40) of any of claims 8-12, **characterized in that** the first processing module (122) comprises:

a first oscillating signal generator (1224) configured to generate a first oscillating signal (S_1), wherein a frequency of the first oscillating signal (S_1) is substantially within a range of 9.0GHz to 10.6GHz;

a first frequency mixing device (121a) comprising:

a first filter (1222a) configured to receive the first radio signal (S_V_a) and remove noises; and

a first frequency mixer (1226a) coupled between the first oscillating signal generator (1224) and the first filter (1222a), wherein the first frequency mixer (1226a) is configured to mix the first radio signal (S_V_a) with the first oscillating signal (S_1) and output the first frequency band signal (WB_V); and

a second frequency mixing device (121b) comprising:

a second filter (1222b) configured to receive the second radio signal (S_H_a) and remove noises; and

a second frequency mixer (1226b) coupled between the first oscillating signal generator (1224) and the second filter (1222b), wherein the second frequency mixer (1226b) is configured to mix the second radio signal (S_H_a) with the first oscillating signal (S_1) and output the second frequency band signal (WB_H).

14. The satellite signal receiver (10, 20, 40) of any of claims 8-13, **characterized in that** the second processing module (124) comprises:

a second oscillating signal generator (1244a)

configured to generate a second oscillating signal (S_2), wherein a frequency of the second oscillating signal (S_2) is 10.6GHz;
 a third oscillating signal generator (1244b) configured to generate a third oscillating signal (S_3), wherein a frequency of the third oscillating signal (S_3) is 9.75GHz;
 a third frequency mixing device (123a) comprising:

a third filter (1242a) configured to receive the third radio signal (S_V_b) and remove noises; and
 a third frequency mixer (1246a) coupled between the second oscillating signal generator (1244a) and the third filter (1242a), wherein the third frequency mixer (1246a) is configured to mix the third radio signal (S_V_b) with the second oscillating signal (S_2) and output the third frequency band signal (VH);

a fourth frequency mixing device (123b) comprising:

a fourth filter (1242b) configured to receive the fourth radio signal (S_V_c) and remove noises; and
 a fourth frequency mixer (1246b) coupled between the third oscillating signal generator (1244b) and the fourth filter (1242b), wherein the fourth frequency mixer (1246b) is configured to mix the fourth radio signal (S_V_c) with the third oscillating signal (S_3) and output the fourth frequency band signal (VL);

a fifth frequency mixing device (123c) comprising:

a fifth filter (1242c) configured to receive the fifth radio signal (S_H_b) and remove noises; and
 a fifth frequency mixer (1246c) coupled between the third oscillating signal generator (1244b) and the fifth filter (1242c), wherein the fifth frequency mixer (1246c) is configured to mix the fifth radio signal (S_H_b) with the third oscillating signal (S_3) and output the fifth frequency band signal (HL);
 and

a sixth frequency mixing device (123d) comprising:

a sixth filter (1242d) configured to receive the sixth radio signal (S_H_c) and remove noises; and

a sixth frequency mixer (1246d) coupled between the second oscillating signal generator (1244a) and the sixth filter (1242d), wherein the sixth frequency mixer (1246d) is configured to mix the sixth radio signal (S_H_c) with the second oscillating signal (S_2) and output the sixth frequency band signal (HH).

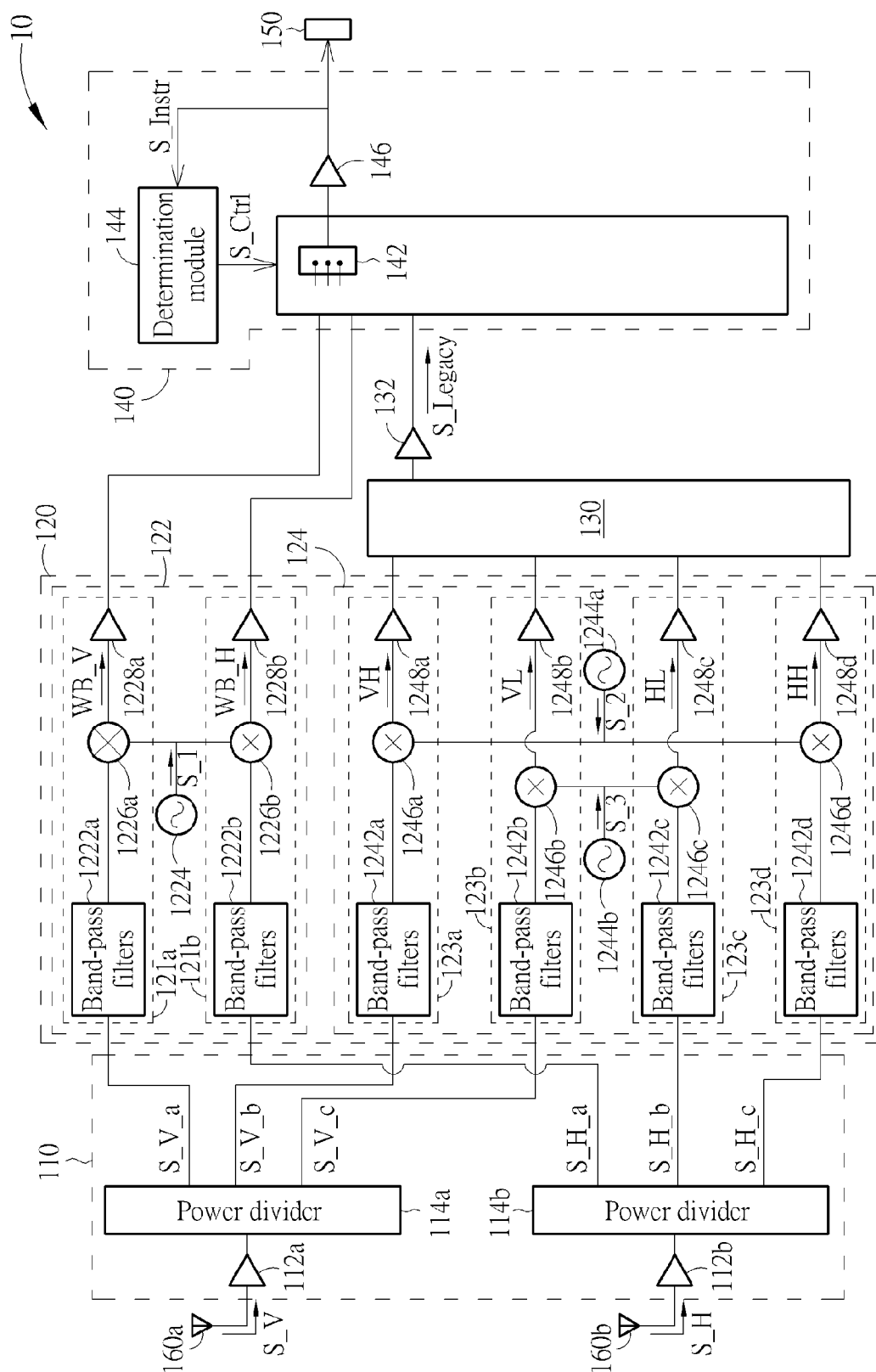


FIG. 1

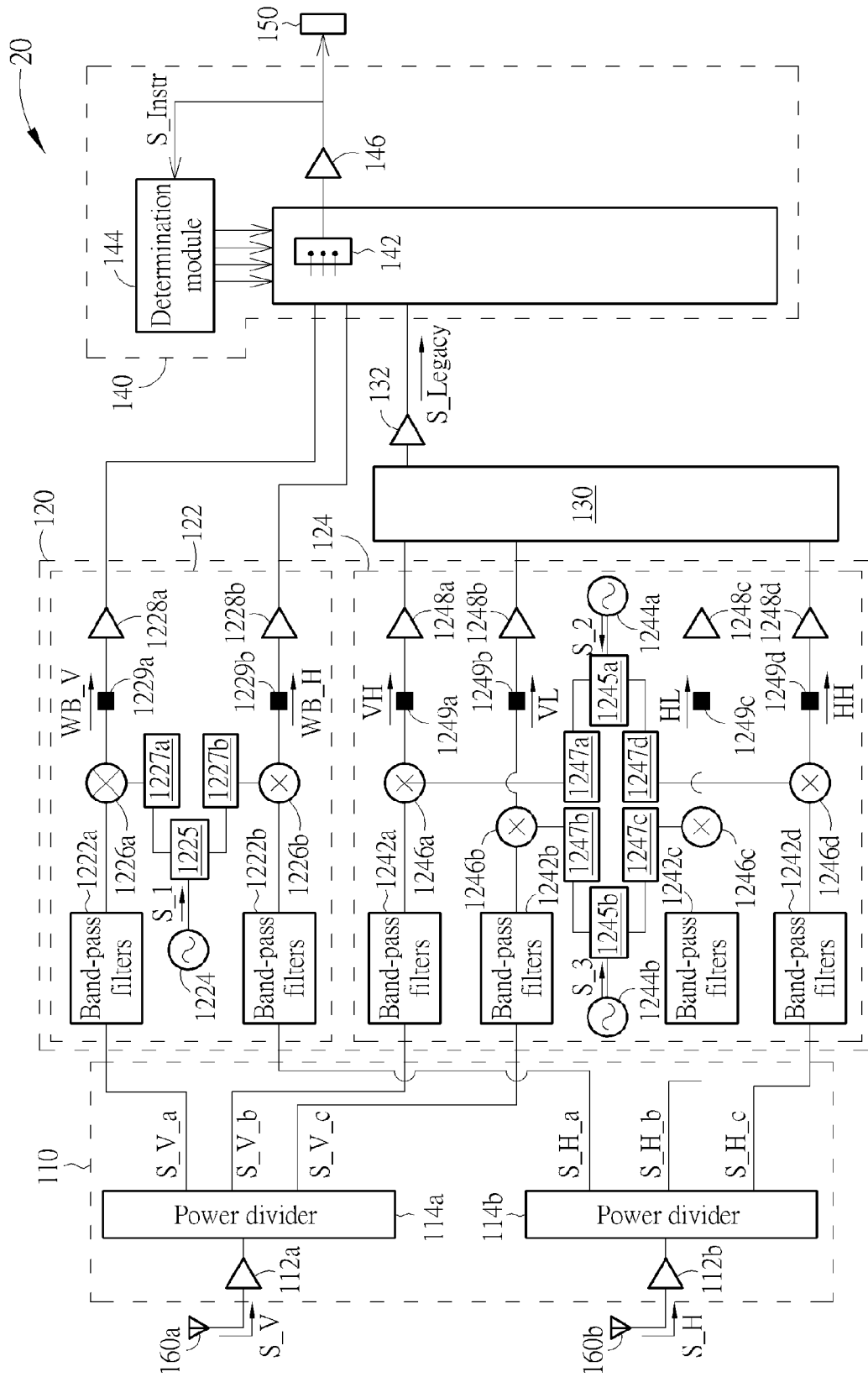


FIG. 2

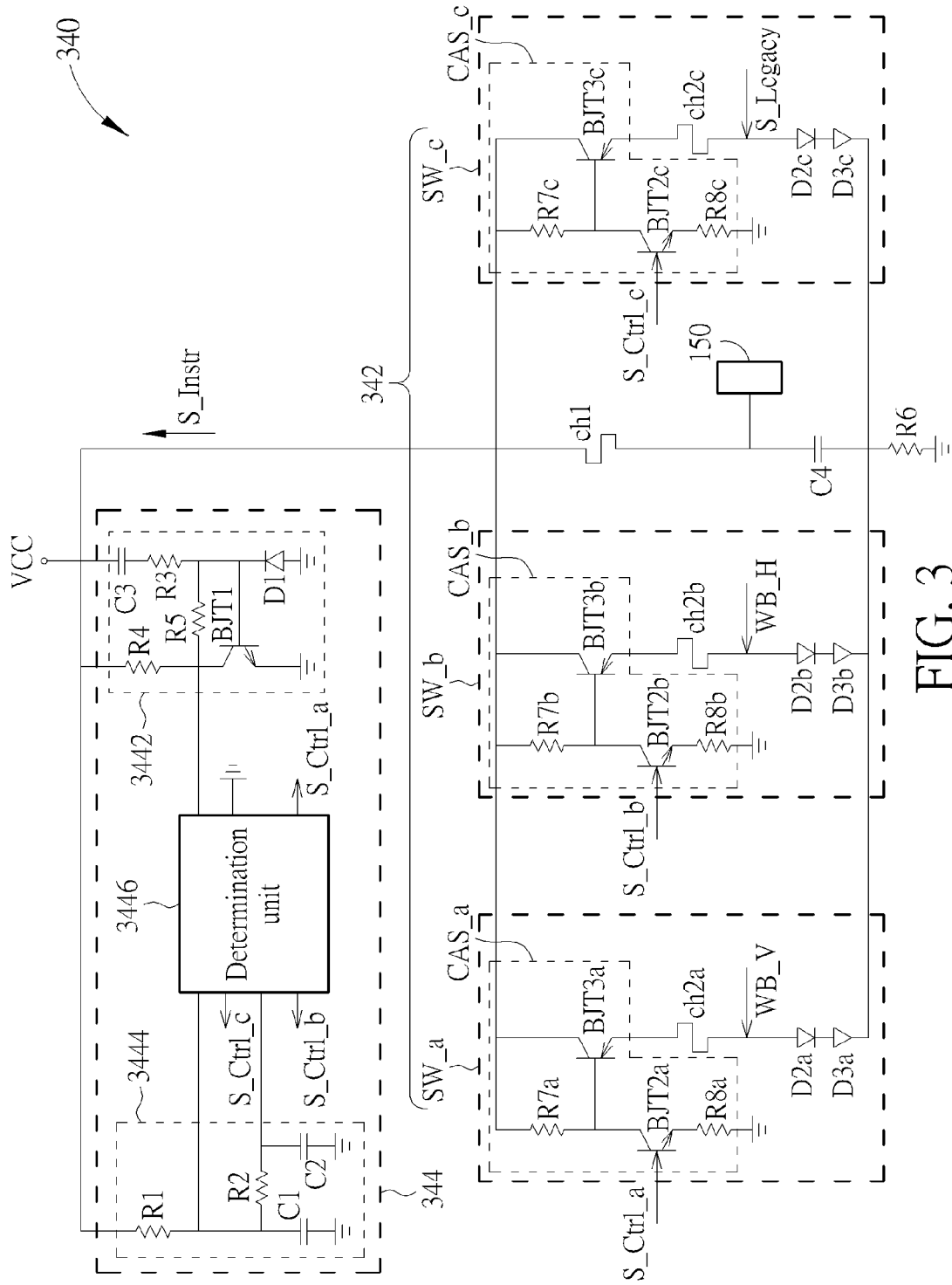


FIG. 3

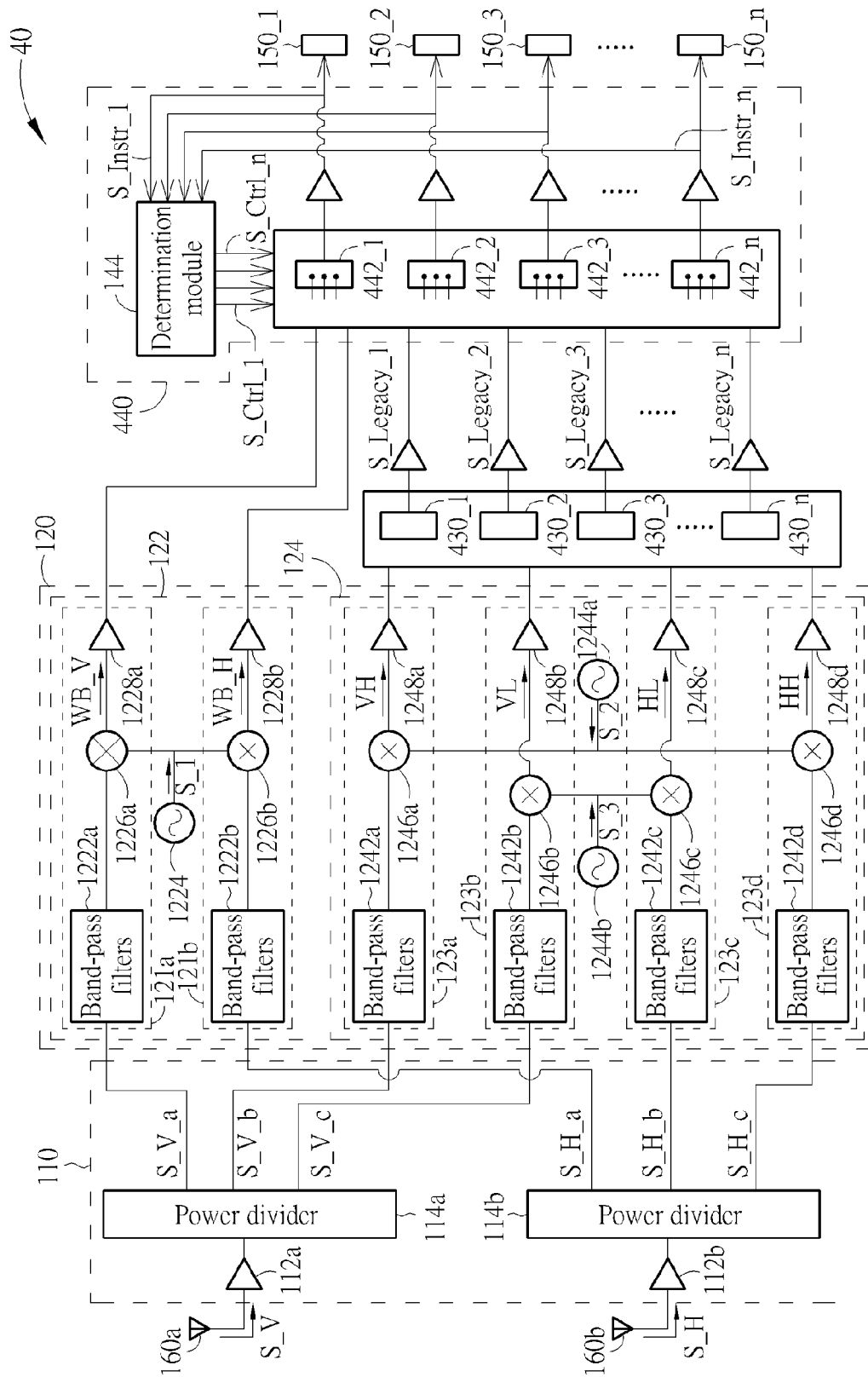


FIG. 4



EUROPEAN SEARCH REPORT

Application Number
EP 14 16 9240

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			H04H
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 13 May 2015	Examiner Iovescu, Vladimir
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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