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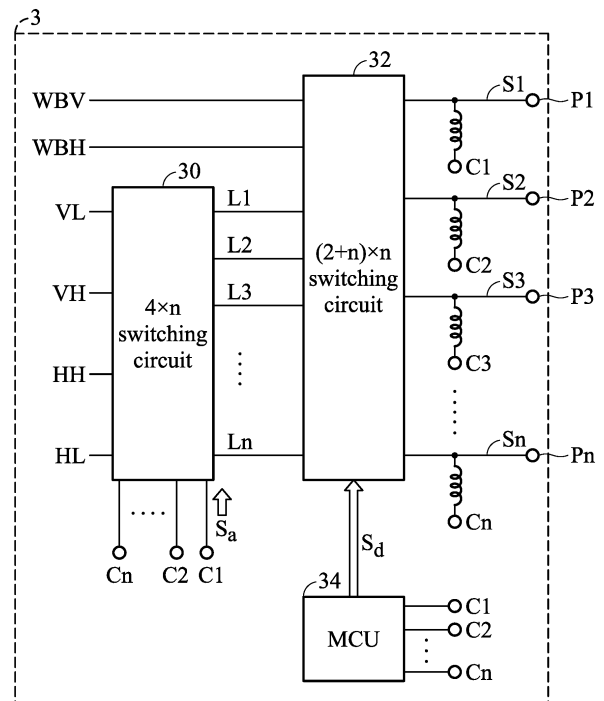
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(54) **SWITCHING DEVICE FOR SATELLITE SIGNALS**

(57) A switching device for satellite signals is disclosed. The switching device includes first and second switching circuits and a controller. The first switching circuit is configured to receive four sets of legacy Low Noise Block converter (LNB) signals and select one of the four sets of LNB signals according to an analog control signal to output a first legacy output signal. The second switching circuit is coupled to the first switching circuit, and includes an output terminal. The second switching circuit receives two sets of wideband LNB signals, and receives a digital switching control signal to select one of the two sets of wideband LNB signals and the first legacy output signal to output a first switching output signal at the output terminal. The controller, coupled to the second switching circuit, is configured to generate the digital switching control signal according to an LNB control signal.



**FIG. 3**

## Description

[0001] This Application claims priority of Taiwan Patent Application No. 104125750, filed on August 7, 2015.

## BACKGROUND OF THE INVENTION

### Field of the Invention

[0002] The present invention relates to direct broadcast satellite, and in particular to the switching device for satellite signals applied to direct broadcast satellites.

### Description of the Related Art

[0003] Global direct broadcast satellite systems are widely applied in receiving TVs and broadcast programs. The development of paid Satellite TV service is mainly the cost reduction of satellite receiving systems (comprising low noise block converter (LNB), Dish Antenna and Set-Top Box), except that innovations are taking place every day in terms of offering a broader coverage area and high-definition television content, resulting in widespread acceptance by users. In addition, the LNB is an important part of the satellite receiving systems.

[0004] Conventional direct broadcast satellite systems are adopted to a legacy LNB or a wideband LNB, and the control methods and outputs of the legacy LNB or wideband LNB are different and cannot be mixed. Users have to use an appropriate legacy LNB or wideband LNB to broadcast legacy or wideband direct broadcast satellite signals.

[0005] As a result, what is needed is for there to be one kind of legacy/wideband LNB including the switching device for the satellite signals so that more than one user may watch different programs simultaneously according to a plurality of outputs of the legacy and wideband LNBs.

## BRIEF SUMMARY OF THE INVENTION

[0006] The object is solved by the features of the independent claims.

[0007] In view of this, a switching device for satellite signals is disclosed. The switching device includes first and second switching circuits and a controller. The first switching circuit is configured to receive four sets of legacy Low Noise Block converter (LNB) signals and select one of the four sets of LNB signals according to an analog control signal to output a first legacy output signal. The second switching circuit is coupled to the first switching circuit, and includes an output terminal. The second switching circuit receives two sets of wideband LNB signals, and receives a digital switching control signal to select one of the two sets of wideband LNB signals and the first legacy output signal to output a first switching output signal at the output terminal. The controller, coupled to the second switching circuit, is configured to generate the digital switching control signal according to an

LNB control signal.

[0008] Preferably, the first switching circuit comprises four sets of first power dividers, wherein each set of first power dividers receives one of the four sets of legacy LNB signals respectively thereby generating an output; and a sub-switching circuit, coupled to the four sets of first power dividers, and selecting one of the outputs of the four sets of first power dividers according to the analog control signal thereby outputting the first legacy LNB output signal.

[0009] Preferably, the second switching circuit comprises two sets of second power dividers, wherein each set of second power dividers receives one of the two sets of wideband LNB signals respectively thereby generating outputs; and a first sub-switching circuit, coupled to the two sets of second power dividers, and selecting one of the outputs of the two sets of second power dividers and the first legacy LNB output signal according to the digital switching control signal thereby outputting the first switching output signal.

[0010] Preferably, the second switching circuit further comprises another output terminal, outputting a second switching output signal; and a second sub-switching circuit, wherein the second sub-switching circuit selects one of the outputs of the two sets of second power dividers and the first legacy LNB output signal according to the digital switching control signal thereby outputting the second switching output signal at the another output terminal.

[0011] Preferably, the controller adapted to generate the digital switching control signal corresponding to a preset setting when the received the LNB control signal is the analog control signal, and the second switching circuit is adapted to select the legacy LNB output signal to serve as the first switching output signal according to the digital switching control signal corresponding to the preset setting.

[0012] Preferably, the controller is adapted to generate the digital switching control signal corresponding to the digital control signal when the controller receives the LNB control signal as a digital control signal, and the second switching circuit is adapted to select one of the two sets of wideband LNB signals to serve as the first switching output signal according to the digital switching control signal corresponding to the digital control signal.

[0013] Preferably, the analog control signal comprises an input voltage and an input tone

[0014] Further, a method for switching of satellite signals is provided, comprising the steps of: receiving four sets of legacy Low Noise Block converter signals, selecting one of the four sets of legacy LNB signals according to an analog control signal, outputting a first legacy LNB output signal at a first switching circuit; receiving two sets of wideband LNB signals and the first legacy LNB output signal at a second switching circuit coupled to the first switching circuit, and generating the digital switching control signal according to an LNB control signal; receiving the digital switching control signal at a second switching

circuit to select one of the first legacy LNB output signal and the two sets of wideband LNB signals; outputting a first switching output signal at an output terminal of the second switching circuit.

**[0015]** Another switching device for satellite signals is disclosed. The switching device comprises a first switching circuit, a second switching circuit, and a controller. The first switching circuit is configured to receive four sets of legacy Low Noise Block converter (LNB) signals and select a plurality of sets of first legacy output signals according to an analog control signal, wherein each set of first legacy output signals is regarded as one of the four sets of LNB signals. The second switching circuit, including a plurality of sets of output terminals, coupled to the first switching circuit, is configured to receive two sets of wideband LNB signals, receive a digital switching control signal to select one of the two sets of wideband LNB signals and a plurality of sets of first legacy output signal to output a set of first switching output signals at the plurality of sets of output terminal. The controller, coupled to the second switching circuit, is configured to generate the digital switching control signal according to an LNB control signal.

**[0016]** Preferably, the first switching circuit comprises four sets of first power dividers, wherein each set of first power dividers is adapted to receive one of the four sets of legacy LNB signals respectively to generate a plurality of outputs; a first sub-switching circuit, coupled to the four sets of first power dividers, selecting four sets of first legacy LNB output signals of the plurality of sets of first legacy LNB output signals from the outputs of the four sets of first power dividers according to the analog control signal; and a second sub-switching circuit, coupled to the four sets of first power dividers, selecting two sets of first legacy LNB output signals of the plurality of sets of first legacy LNB output signals from the four sets of first power dividers according to the analog control signal.

**[0017]** Preferably, the second switching circuit comprises: two sets of second power dividers, wherein each set of second power dividers receives one of the two sets of wideband LNB signals respectively to generate a plurality of outputs; and three sets of third sub-switching circuit, wherein each set of third sub-switching circuits is coupled to the two sets of second power dividers, and adapted to select one of the outputs of the two sets of second power dividers and the plurality of sets of first LNB output signals to output the one of switching output signals according to the digital switching control signal.

**[0018]** Preferably, when the LNB control signal received by the controller is the analog control signal, the controller is adapted to generate the digital switching control signal corresponding to a preset setting, wherein each set of second switching circuits is adapted to select the legacy LNB output signal to serve as the set of switching output signals according to the preset setting, wherein when the LNB control signal received by the controller is a digital control signal, the controller is adapted to generate the digital switching control signal corresponding

to the digital control signal, and the second switching circuit is adapted to select one of the two sets of wideband LNB signals to serve as the set of switching output signals according to the digital switching control signal corresponding to the digital control signal.

**[0019]** Preferably, the analog control signal comprises an input voltage and an input tone.

**[0020]** Further, a method for switching of satellite signals is provided, comprising the steps of: receiving four sets of legacy Low Noise Block converter signals, and selecting a plurality of sets of first legacy LNB output signals from the four sets of legacy LNB signals according to an analog control signal, wherein each set of first legacy LNB output signals is one of the four sets of legacy LNB signals; receiving two sets of wideband LNB signals and the plurality of sets of first legacy LNB output signals at a second switching circuit, generating a digital switching control signal according to an LNB control signal; receiving the digital switching control signal to select one of the two sets of wideband LNB signals and the plurality of sets of first legacy LNB output signals to output a set of first switching output signals at a plurality of sets of output terminals of the second switching circuit.

## BRIEF DESCRIPTION OF THE DRAWINGS

### [0021]

FIG. 1 is a schematic diagram of a direct broadcast satellite system 1 according to an embodiment of the present invention;

FIG. 2 is a block diagram of a legacy/wideband LNB switching device 12 according to an embodiment of the present invention;

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

FIG. 4 is a block diagram of a 4xn switching circuit 30 according to an embodiment of the present invention.

FIG. 5 is a schematic diagram of a (2+n)xn switching circuit 32 according to an embodiment of the present invention.

FIG. 6 is a block diagram of an IF switching device 6 according to an embodiment of the present invention.

## DETAILED DESCRIPTION OF THE INVENTION

**[0022]** The following description is of the best-contemplated operation of carrying out the invention. This description is made for the purpose of illustrating the general principles of the invention and should not be taken in a limiting sense. Certain terms and figures are used throughout the description and following claims to refer to particular components. As one skilled in the art will appreciate, manufacturers may refer to a component by different names. The present invention can be more fully

understood by reading the subsequent detailed description and examples with references made to the accompanying drawings.

**[0023]** FIG. 1 is a schematic diagram of a direct broadcast satellite system 1 according to an embodiment of the present invention. The direct broadcast satellite system 1 comprises a satellite dish antenna 10, a legacy/wideband Low Noise Block converter (LNB) (and Intermediate Frequency (IF)) switching device 12, a wideband set top box (STB) 14, and legacy set top boxes 16a and 16b. The direct broadcast satellite system 1 is applied to a direct broadcast satellite system having the legacy LNB, wideband LNB, or both of them. The direct broadcast satellite system 1 also provides a plurality of outputs of the legacy LNB or wideband LNB. For example, the direct broadcast satellite system 1 comprises the wideband STB 14 and the legacy STBs 16a and 16b simultaneously. After the direct broadcast satellite system 1 receives direct broadcast satellite signals from the satellite dish antenna 10, the legacy/wideband LNB (and IF) switching device 12 provide the direct broadcast satellite signals to the wideband STB 14 deposited in the living room and the legacy STBs 16a and 16b deposited in bedroom and kitchen simultaneously.

**[0024]** Methods of receiving satellite signals for legacy LNB and wideband LNB are the same, but methods of outputting satellite signals for the legacy LNB and wideband LNB are different. The legacy LNB divides the received satellite signals into four parts. In legacy LNB, the control signal send by the user controls the LNB to output which part of the down-conversion signal to the user. The wideband LNB performs a down-conversion on all the receiving signals and outputs the converted result (i.e., down-conversion signals) to STB. The STB does not need to send a control signal to control legacy LNB to output the part of the down-conversion signals. STB demodulates the program the user wants to watch from the received down-conversion signals. The user is required to install a multiplexer at the output terminal of the LNB, so that an LNB provides signals to many users for watching the programs. The legacy STB cannot demodulate the signals send by the wideband LNB, so it is needed to use a new wideband STB. The wideband STB cannot demodulate the signals send by the legacy LNB, so it is needed to use the legacy STB. Thus, it is needed to have a switching device of the wideband/legacy LNB switching device 12 which can switch the device automatically to allow the user to use the wideband and legacy STBs simultaneously before the user updates the STB completely. Consequently, user has no need to replace the wideband/legacy LNB switching device 12 when the user wants to replace the wideband STB.

**[0025]** The present invention provides one kind of the direct broadcast satellite system 1 using legacy/wideband LNB switching device 12. The direct broadcast satellite system 1 switches the outputs of the legacy and wideband LNBs automatically, has a plurality of outputs, and makes more than one user watch different programs

simultaneously according to a plurality of outputs of legacy and wideband LNB.

**[0026]** FIG. 2 is a block diagram of a legacy/wideband LNB switching device 12 according to an embodiment of the present invention. The legacy/wideband LNB switching device 12 comprises antennae 20a and 20b, low noise amplifiers (LNA) 21a and 21b, power dividers 22a and 22b, band pass filters 23a-23f, down converters 24a-24f, an IF switching device 25, and buffers 26a-26f. The wideband/legacy LNB switching device 12 receives one or two antenna signal(s) from satellites (not depicted in the figure) and outputs one to six LNB output signal(s) to the legacy or wideband STB. The wideband/legacy LNB switching device 12 selects six kinds of the input down conversion signals arbitrarily to output signals  $S_{out1}$  to  $S_{out6}$  from output terminals to the legacy STB or wideband STB so that the user connects the desired legacy STB or the desired wideband STB.

**[0027]** The antennae 20a and 20b receive the legacy and wideband signals. The power of the received legacy and wideband signals are amplified by the LNAs 21a and 21b respectively. Each of the amplified legacy signal and wideband signal is divided into three parts by the power dividers 22a and 22b, and then the divided signals are filtered by the band pass filters 23a-23f, and the filtered signals are down-converted to intermediate frequency signals by the down converters 24a-24f. The IF switching device 25 can be used to select appropriate one or more output terminal(s) to output the legacy and wideband LNB signals. The legacy and wideband signals from the IF switching device 25 are send to one or more legacy or wideband STB(s) by the buffers 26a-26f.

**[0028]** Please refer to the outputs of the down converter 24a, wherein the wideband signals WBV and WBH are the down-conversion signals of the wideband LNB, while legacy signals VH, VL, HH, HL are four down-conversion signals divided by the legacy LNB. The main function of the IF switching device 25 is selecting one of the six signals (i.e., the wideband signals WBV and WBH and the legacy signals VL, VH, HH and HL) and outputting the selected one by one of six output terminals. For example, the user selects the top four output terminals to output the legacy signals VH, VL, HH and HL respectively and selects the bottom two output terminals to output the wideband signals WBV and WBH respectively.

**[0029]** FIG. 3 is a schematic diagram of an IF switching device 3 according to an embodiment of the present invention. The IF switching device 3 comprises a  $4 \times n$  switching device 30, a  $(2+n) \times n$  switching circuit 32, and a controller (for example, the microcontroller unit (MCU))34. The IF switching device 3 is regarded as the IF switching device 25 of the legacy/wideband LNB switching device 12 in FIG. 2, and receives the wideband signals WBV and WBH and the legacy signals VL, VH, HH and HL from LNB. Each of output terminals of the IF switching device 3 can selectively output one of the wideband signals WBV and WBH and legacy signals VL, VH, HH and HL as the output signal. Each output signal can

be output to the legacy STB or the wideband STB.

**[0030]** Please refer to FIG. 3, a 4xn switching device 30 receives the inputs of the four sets of legacy signals VL, VH, HH and HL and outputs n sets of output signals L1, L2, ..., and Ln to a (2+n)xn switching circuit 32, wherein the output signals L1, L2, ..., Ln are one of the four sets of legacy signals VL, VH, HH and HL and are selected by a legacy control signal Sa. The legacy control signal Sa is a combination of different input voltages and different input tones send by STB, and the legacy control signal Sa is arranged to control which signals the LNB has to output selectively. As a result, the 4xn switching device 30 is similar to the legacy LNB having n inputs, can be connected to n users and is controlled by the legacy control signal Sa (the input voltage and the input tone) to select signal source. N sets of LNB control signals C1, C2, ..., Cn are the input signals from the STB, and each set of control signals may be the analog control signal from the legacy STB or the digital control signal from the wideband STB. The legacy control signal Sa comprises the analog signal, which is send to the legacy LNB respectively, to determine which legacy signal is output by a corresponding output terminal of the 4xn switching device 30. When the LNB control signals C1, C2, ..., Cn are send by the legacy STB, each set of LNB control signals C1, C2, ..., Cn comprises high or low voltage and the tone of 0kHz or 22kHz. For example, the 4xn switching circuit 30 outputs the legacy signal VL at the corresponding terminal, when a legacy LNB coupled to the 4xn switching circuit 30 sends the analog control signal comprising 13V (low voltage) and 0kHz (tone) to the 4xn switching circuit 30. N STB users can use n analog control signals to select the legacy signal outputs at the corresponding output terminals respectively. The output signals L1, L2, ..., Ln of the 4xn switching circuit 30 are output to the (2+n)xn switching circuit 32.

**[0031]** The (2+n)xn switching circuit 32 outputs the wideband signals WBV and WBH or the legacy signals VL, VH, HH and HL selectively according to a switching control signal Sd. The (2+n)xn switching circuit 32 comprises n output terminals P1, P2, ..., Pn ( $n \geq 1$ ), and each of the output terminals P1, P2, ..., Pn outputs an output signal S1, S2, ..., Sn. Each of the output signals S1, S2, ..., Sn is one of the wideband signals WBV and WBH and the legacy signals VL, VH, HH and HL and can be selected by the switching control signal Sd.

**[0032]** The MCU 34 generates the switching control signal Sd according to the LNB control signals C1, C2, ..., Cn generated by the legacy STB and the wideband STBs. Each of the LNB control signals C1, C2, ..., Cn comprises a digital satellite equipment control (DiSEqC) or frequency shift keying (FSK) signal, when the LNB control signals C1, C2, ..., Cn are send by the wideband STB. The (2+n)xn switching circuit 32 receives the switching control signal Sd independently to determine which one of the wideband signal WBV and WBH is send by the corresponding output terminal. In one embodiment, the LNB control signals C1, C2, ..., Cn comprise the DiSEqC sig-

nal and the MCU 34 transforms the LNB control signals C1, C2, ..., Cn to the switching control signal Sd. If the LNB control signals C1, C2, ..., Cn received by the MCU 34 are the digital control signals generated by the wideband STB, the MCU 34 generates the digital switching control signal Sd corresponding the digital control signal, and the (2+n)xn switching circuit 32 selects one of the two sets of wideband LNB signals to serve as a switching output signal (i.e., selects the wideband signal WBV or WBH for outputting by the corresponding output terminal) according to the digital switching control signal Sd corresponding the digital control signal. If the LNB control signals C1, C2, ..., Cn received by the MCU 34 are the analog control signals generated by the legacy STB, the MCU 34 generates the digital switching control signal Sd corresponding a preset setting, and the (2+n)xn switching circuit 32 selects the legacy LNB output signal to serve as a switching output signal according to the digital switching control signal Sd corresponding the preset setting. For example, for the (2+n)xn switching circuit 32, the signal Lx ( $x=1-n$ ) received by the 4xn switching circuit 30 is regarded as an output signal Sx and is output to the output terminal Px directly.

**[0033]** When the specific DiSEqC signal is not send, the configuration of the IF switching device 3 is equivalent to the configuration of the 4xn switching circuit 30 for the legacy STB, the 4xn switching circuit 30 sends the legacy signals VL, VH, HH and HL to the legacy STB through the (2+n)xn switching circuit 32. For the wideband STB, if the specific DiSEqC signal is received by the (2+n)xn switching circuit 32, the (2+n)xn switching circuit 32 can read the specific DiSEqC signal correctly to send the wideband signal of WBV or WBH. As a result, the IF switching device 3 is compatible with simultaneous usage of the legacy and wideband LNBs.

**[0034]** FIG. 4 is a block diagram of a 4xn switching circuit 30 according to an embodiment of the present invention. The 4xn switching circuit 30 comprises 1-z power dividers 40a, 40b, 40c, and 40d and switching ICs 42a, 42b, ..., and 42n. The 4xn switching circuit 30 is the 4xn switching circuit 30 in FIG. 3. As described in FIG. 3, the 4xn switching circuit 30 receives the legacy signals VL, VH, HH, or HL from LNB and selectively output the legacy signals to the (2+n)xn switching circuit 32 according to the control signal Sa.

**[0035]** Each of the switching ICs 42a, 42b, ..., and 42n has four input terminals to receive the legacy signal VL, VH, HH, and HL from the 1-z power dividers 40a, 40b, 40c, and 40d, and n sets of output terminals to output one or more sets of legacy signals VL-1-VL-z, VH-1-VH-z, HH-1-HH-z, and HL-1-HL-z to serve as the output signals L1, L2, ..., and Ln. In some embodiments, the legacy signals VL-1-VL-z, VH-1-VH-z, HH-1-HH-z, and HL-1-HL-z are the duplicate signals of the legacy signals VL, VH, HH, and HL. For example, signals VL-1, VH-1, HH-1, and HL-1 are a set of legacy signals VL, VH, HH, and HL, and signals VL-2, VH-2, HH-2, and HL-2 are another set of legacy signals VL, VH, HH, and HL, and so on. In

some embodiments, the switching IC can be a 4x2 switching IC or a 4x4 switching IC, but it is not limited thereto. The switching IC can be a combination of different 4xx switching ICs (x is an arbitrary value) to obtain n wanted outputs.

**[0036]** The input control signals Sa1, Sa2, ..., and San of the switching ICs 42a, 42b, ..., and 42n can be the analog signals from the legacy STB, but they are not limited thereto. The analog signals generated by the legacy STB comprise legacy input voltages and input tone control signals, and user can control the switching ICs 42a, 42b, ..., and 42n by the control signals send from the legacy STB without needing complicated hardware circuits for transforming the control signals.

**[0037]** FIG. 5 is a schematic diagram of a (2+n)xn switching circuit 32 according to an embodiment of the present invention. The (2+n)xn switching circuit 32 comprises 1-d power dividers 50a and 50b and a (2+e)xe switching IC 52a, a (2+f)xf switching IC 52b, ..., and a (2+g)xg switching IC 52n. The output signals L1~Ln are the legacy signals output from the 4xn switching circuit in FIG. 4. The (2+n)xn switching circuit 32 is the (2+n)xn switching circuit 32 shown in FIG. 3. As described in FIG. 3, the (2+n)xn switching circuit 32 receives the wideband signals WBV and WBH from the LNB and the output signals L1, L2, ..., and Ln, which represent the legacy signals VL, VH, HH and HL, output by the 4xn switching circuit 30 from the LNB. The (2+n)xn switching circuit 32 outputs the wideband signals WBV and WBH or legacy signals VL, VH, HH and HL, selectively.

**[0038]** The (2+n)xn switching IC in FIG. 5 has n legacy signals and two wideband signals to serve as input signals. The (2+n)xn switching IC in FIG. 5 also has n sets of outputs. The n sets of outputs can be selected from the wideband signals WBV and WBH or the legacy signals VL, VH, HH and HL.

**[0039]** The 1-d power dividers 50a and 50b receive two sets of wideband signals WBV and WBH and output one or more sets of wideband signals WBV-1-WBV-d, WBH-1-WBH-d. For example, the wideband signals WBV-1-WBV-d are the duplicated signals of the wideband signal WBV, and the wideband signals WBH-1-WBH-d are the duplicated signals of the wideband signal WBH.

**[0040]** The (2+n)xn switching ICs 52a, 52b, ..., and 52n receive the legacy signals and wideband signals from 1-d power dividers 50a and 50d and the 4xn switching circuit, and output n sets of outputs according to the digital DiSEqC signal. Each set of outputs is one set of signals of the received legacy signals and the received wideband signals. The DiSEqC control signal is a digital signal, but it is not limited thereto. The MCU (not shown) receives the DiSEqC control signal from the wideband STB and transforms the DiSEqC control signal to the digital switching control signals Sd1, Sd2, ..., and Sdn. If the (2+n)xn switching ICs 52a, 52b, ..., and 52n are the digital switching ICs, user can control the (2+n)xn switching ICs 52a, 52b, ..., and 52n by the control signals send from the legacy STB without needing complicated hardware cir-

cuits for transforming the control signals. For example, the (2+n)xn switching IC 52a receives two sets of wideband signals WBV-1, and WBV-2 from 1-d power dividers 50a and 50b, receives e sets of legacy signals L1, L2, ..., and Le from the 4xn switching circuit, and selects one or more sets of signals S<sub>11</sub>, S<sub>21</sub>, ..., S<sub>e1</sub>, ..., S<sub>1d</sub>, ..., and S<sub>gd</sub> according to the digital switching control signal Sd1, or Sd2, ..., Sd3.

**[0041]** FIG. 6 is a block diagram of an IF switching device 6 according to another embodiment of the present invention. In this embodiment, n=6, and the IF switching device 6 comprises a 4xn switching circuit 60 and a (2+n)xn switching circuit 62. The 4xn switching circuit 60 comprises power dividers 600a, 600b, ..., and 600d and a 4x4 switching circuit 602a and a 4x2 switching circuit 602b. The (2+n)xn switching circuit 62 comprises power dividers 620a and 620b and 4x2 switching circuits 622a, 622b, and 622c. The IF switching device 6 having six inputs and six outputs can be an IF switching device capability of switching its inputs automatically.

**[0042]** The 4x4 switching circuit 602a and the 4x2 switching circuit 602b are analog control switching ICs, and two of them both receive four sets of legacy signals VL, VH, HH, and HL. The 4x4 switching circuit 602a outputs at most four sets of output signals according to the selection of the analog control signal Sa, and the 4x2 switching circuit 602b outputs at most two sets of output signals according to the selection of the analog control signal Sa. The analog control signals Sa and Sb comprise the combination of high or low voltages and the combination of the tone of 0kHz or 22kHz, generated by the legacy STB (not shown) connected to the IF switching device 6.

**[0043]** The 4x2 switching circuits 622a, 622b, and 622c are digital control switching ICs, and all three of them receive two sets of legacy signals and two sets of wideband signals. The 4x2 switching circuits 622a, 622b, and 622c output at most two sets of output signals according to a digital switching control signal S<sub>MCU</sub>. The digital switching control signal S<sub>MCU</sub> is a DiSEqC signal, and the digital switching control signal S<sub>MCU</sub> is generated by the wideband STB (not shown) connected to the IF switching device 6.

**[0044]** The embodiments of FIG. 1 to FIG. 6 are applied to realize legacy/wideband LNB switching devices. The legacy/wideband LNB switching devices is arranged to switch the outputs of the legacy/wideband LNB, having a plurality of outputs, such that more than one user can watch different programs simultaneously according to a plurality of outputs of the legacy and wideband LNBs.

**[0045]** One skilled in the art will realize that the information and signals may be presented in a variety of different techniques. For example, data, instructions, information, signals, bits, symbols, and chips described in the specification can be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

**[0046]** One skilled in the art will further realize that each

of the logic blocks, modules, processors, actuators, circuits, and algorithm steps in this specification can be implemented by circuit hardware (for example, digital achieve hardware, analog hardware, or any combination thereof which can be implemented by the source code or other related technologies), various forms of the code or design code of instruction (it be called as software or software module here), or any combination thereof. In order to clearly show the compatibility of the aforementioned software and hardware, a variety of illustrated components, blocks, modules, circuits, and steps described in the specification is usually described by its function. The implement of these functions by software or hardware and is related to the particular application and design constraints of the complete system. One skilled in the art can realize the function described in a variety of ways for each particular application, but the decision of the implementation is without departing from the purpose scope of the invention.

[0047] In addition, the various illustrative logical blocks, modules and circuits described in connection with the present disclosure may be implemented or performed with a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array signal (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, electrical components, optical components, mechanical components or any combinations thereof designed to perform the functions described herein, code or program instructions executed in the internal, external, or both of the integrated circuits. A general purpose processor may be a microprocessor, but as an alternative, the processor may be any commercially available processor, controller, microcontroller or state machine. A processor may also be implemented by combination of the calculation devices, for example the combination of DSP and microprocessors, a plurality of microprocessors, one or more microprocessors and the core of DSP, or other combination of various settings.

[0048] One skilled in the art will understand that the present invention discloses a particular order, and that the sequence of the program steps disclosed in the present invention is an example only. One skilled in the art will understand that the particular order or sequence of the program steps disclosed in the present invention can be rearranged in a different order based upon design preferences without departing from the purpose and scope of the present invention. Each sequence of the steps accomplished by the requirement or method of the embodiment in the present invention is just an example, and not limited to the particular order or sequence of the program steps disclosed in the present invention.

[0049] The method of claim or algorithm steps may execute software modules by hardware or processor, or in a combination of both to realize. Software modules (including executable instructions or relative data) and other data may be saved in the data memory, such as RAM

memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, hard disk, floppy disk, discs, or any other machine-readable (such as computer-readable) storage media. Data storage media may be coupled to the machine, such as computers or processors (also called "processors"), and the processors may read and write code from the storage media. Data storage media may be integral to the processor. Processor and storage media may be embedded in an ASIC. The ASIC may be embedded in the user equipment. Or processor and the storage media may be embedded in the form of discrete elements in the user equipment. In addition, the applicable computer program products may comprise computer-readable media, comprising code exposed by one or more exposed books. In some embodiments, the applicable computer program products may comprise packaging materials.

[0050] The embodiments described above are intended to be exemplary. One skilled in the art will recognize that there are numerous alternative components and embodiments that may be substituted for or included in the particular examples described herein and such additions or substitutions still fall within the scope of the invention.

## Claims

1. A switching device for satellite signals, comprising:

a first switching circuit (30), receiving four sets of legacy Low Noise Block converter (LNB) signals (VL, VH, HH, HL), selecting one of the four sets of legacy LNB signals (VL, VH, HH, HL) according to an analog control signal (Sa) thereby outputting a first legacy LNB output signal (L1-Ln);

a second switching circuit (32), coupled to the first switching circuit (30), and comprising an output terminal (P1-Pn), wherein the second switching circuit (32) is adapted to receive two sets of wideband LNB signals (WBH, WBV) and the first legacy LNB output signal (L1-Ln), and to receive a digital switching control signal (sd) to select one of the first legacy LNB output signal (L1-Ln) and the two sets of wideband LNB signals (WBV, WBH) thereby outputting a first switching output signal (S1-Sn) at the output terminal (P1- Pn); and

a controller (34), coupled to the second switching circuit (32), and generating the digital switching control signal (Sd) according to an LNB control signal (C1-Cn).

2. The switching device as claimed in claim 1, wherein the first switching circuit (30) comprises:

four sets of first power dividers (40a-40d), wherein each set of first power dividers receives

- one of the four sets of legacy LNB signals (VL, VH, HH, HL) respectively thereby generating an output; and  
a sub-switching circuit (42a-42n), coupled to the four sets of first power dividers (40a-40d), and selecting one of the outputs of the four sets of first power dividers (40a-40d) according to the analog control signal (Sa) thereby outputting the first legacy LNB output signal (L1- Ln).
3. The switching device as claimed in claim 1 or 2, wherein the second switching circuit (32) comprises:
- two sets of second power dividers (50a-50b), wherein each set of second power dividers (50a-50b) receives one of the two sets of wideband LNB signals (WBV, WBH) respectively thereby generating outputs; and  
a first sub-switching circuit (52a-52n), coupled to the two sets of second power dividers (50a-50b), and selecting one of the outputs of the two sets of second power dividers (50a-50b) and the first legacy LNB output signal (L1-Ln) according to the digital switching control signal (Sd) thereby outputting the first switching output signal (S1-Sn).
4. The switching device as claimed in claim 3, wherein the second switching circuit (32) further comprises:
- another output terminal, outputting a second switching output signal; and a second sub-switching circuit, wherein the second sub-switching circuit selects one of the outputs of the two sets of second power dividers and the first legacy LNB output signal according to the digital switching control signal (Sd) thereby outputting the second switching output signal at the another output terminal.
5. The switching device as claimed in any one of the preceding claims, wherein the controller (34) adapted to generate the digital switching control signal (Sd) corresponding to a preset setting when the received the LNB control signal (C1-Cn) is the analog control signal (Sa), and the second switching circuit (32) is adapted to select the legacy LNB output signal (L1-Ln) to serve as the first switching output signal (S1-Sn) according to the digital switching control signal (Sd) corresponding to the preset setting.
6. The switching device as claimed in any one of the preceding claims, wherein the controller (34) is adapted to generate the digital switching control signal (Sd) corresponding to the digital control signal when the controller receives the LNB control signal (C1-Cn) as a digital control signal, and the second switching circuit (32) is adapted to select one of the
- two sets of wideband LNB signals (WBV, WBH) to serve as the first switching output signal (S1-Sn) according to the digital switching control signal (sd) corresponding to the digital control signal.
7. The switching device as claimed any one of the preceding claims, wherein the analog control signal (Sa) comprises an input voltage and an input tone.
8. Method for switching of satellite signals, comprising the steps of:
- receiving four sets of legacy Low Noise Block converter (LNB) signals (VL, VH, HH, HL), selecting one of the four sets of legacy LNB signals (VL, VH, HH, HL) according to an analog control signal (Sa)  
outputting a first legacy LNB output signal (L1-Ln) at a first switching circuit (30);  
receiving two sets of wideband LNB signals (WBH, WBV) and the first legacy LNB output signal (L1-Ln) at a second switching circuit (32) coupled to the first switching circuit (30), and generating the digital switching control signal (Sd) according to an LNB control signal (C1-Cn);  
receiving the digital switching control signal (sd) at a second switching circuit (32) to select one of the first legacy LNB output signal (L1-Ln) and the two sets of wideband LNB signals (WBV, WBH)  
outputting a first switching output signal (S1-Sn) at an output terminal (P1- Pn) of the second switching circuit (32).
9. A switching device for satellite signals, comprising:
- a first switching circuit (60), receiving four sets of legacy Low Noise Block converter (LNB) signals (VL, VH, HH, HL), and selecting a plurality of sets of first legacy LNB output signals (L1-L6) from the four sets of legacy LNB signals (VL, VH, HH, HL) according to an analog control signal (Sa), wherein each set of first legacy LNB output signals (L1-L6) is one of the four sets of legacy LNB signals (VL, VH, HH, HL);  
a second switching circuit (62), comprising a plurality of sets of output terminals (Port1-Port6), and coupled to the first switching circuit (60), wherein the second switching circuit (62) is adapted to receive two sets of wideband LNB signals (WBV, WBH) and the plurality of sets of first legacy LNB output signals (L1-L6), and is adapted to receive a digital switching control signal (S<sub>MCU</sub>) to select one of the two sets of wideband LNB signals (WBV, WBH) and the plurality of sets of first legacy LNB output signals (L1-L6) to output a set of first switching output signals at the plurality of sets of output terminals (Port1-

Port6); and  
 a controller (34), coupled to the second switching circuit (62), and generating the digital switching control signal ( $S_{MCU}$ ) according to an LNB control signal (C1-Cn).

10. The switching device as claimed in claim 9, wherein the first switching circuit (60) comprises:

four sets of first power dividers (600a-600d), wherein each set of first power dividers (600a-600d) is adapted to receive one of the four sets of legacy LNB signals (VL, VH, HH, HL) respectively to generate a plurality of outputs (VL1, VL2, VH1, VH2, HH1, HH2, HL1, HL2);  
 a first sub-switching circuit (602a), coupled to the four sets of first power dividers (600a-600d), selecting four sets of first legacy LNB output signals (L1-L4) of the plurality of sets of first legacy LNB output signals from the outputs of the four sets of first power dividers (600a-600d) according to the analog control signal (Sa); and  
 a second sub-switching circuit (602b), coupled to the four sets of first power dividers (600a-600d), selecting two sets of first legacy LNB output signals (L5, L6) of the plurality of sets of first legacy LNB output signals from the four sets of first power dividers (600a-600d) according to the analog control signal (Sa).

11. The switching device as claimed in claim 9 or 10, wherein the second switching circuit (62) comprises:

two sets of second power dividers (620a, 620b), wherein each set of second power dividers (620a, 620b) receives one of the two sets of wideband LNB signals (WBV, WBH) respectively to generate a plurality of outputs; and  
 three sets of third sub-switching circuit (622a-622c), wherein each set of third sub-switching circuit is coupled to the two sets of second power dividers (620a, 620b), and adapted to select one of the outputs of the two sets of second power dividers (620a-620b) and the plurality of sets of first LNB output signals (L1-L6) to output the one of switching output signals according to the digital switching control signal (Sd).

12. The switching device as claimed in any one of the claims 9-11, wherein when the LNB control signal (C1-Cn) received by the controller (34) is the analog control signal (Sa), the controller (34) is adapted to generate the digital switching control signal (Sd) corresponding to a preset setting, wherein each set of second switching circuits (62) is adapted to select the legacy LNB output signal (L1-L6) to serve as the set of switching output signals according to the preset setting, wherein when the LNB control signal (C1-

Cn) received by the controller (34) is a digital control signal, the controller is adapted to generate the digital switching control signal (Sd) corresponding to the digital control signal, and the second switching circuit (62) is adapted to select one of the two sets of wideband LNB signals (WBV, WBH) to serve as the set of switching output signals according to the digital switching control signal (Sd) corresponding to the digital control signal.

13. The switching device as claimed in any one of the claims 9-12, wherein the analog control signal (Sa) comprises an input voltage and an input tone.

14. Method for switching of satellite signals, comprising the steps of:

receiving four sets of legacy Low Noise Block converter (LNB) signals (VL, VH, HH, HL), and selecting a plurality of sets of first legacy LNB output signals (L1-L6) from the four sets of legacy LNB signals (VL, VH, HH, HL) according to an analog control signal (Sa), wherein each set of first legacy LNB output signals (L1-L6) is one of the four sets of legacy LNB signals (VL, VH, HH, HL);  
 receiving two sets of wideband LNB signals (WBV, WBH) and the plurality of sets of first legacy LNB output signals (L1-L6) at a second switching circuit (62),  
 generating a digital switching control signal ( $S_{MCU}$ ) according to an LNB control signal (C1-Cn);  
 receiving the digital switching control signal ( $S_{MCU}$ ) to select one of the two sets of wideband LNB signals (WBV, WBH) and the plurality of sets of first legacy LNB output signals (L1-L6) to output a set of first switching output signals at a plurality of sets of output terminals (Port1-Port6) of the second switching circuit (62).

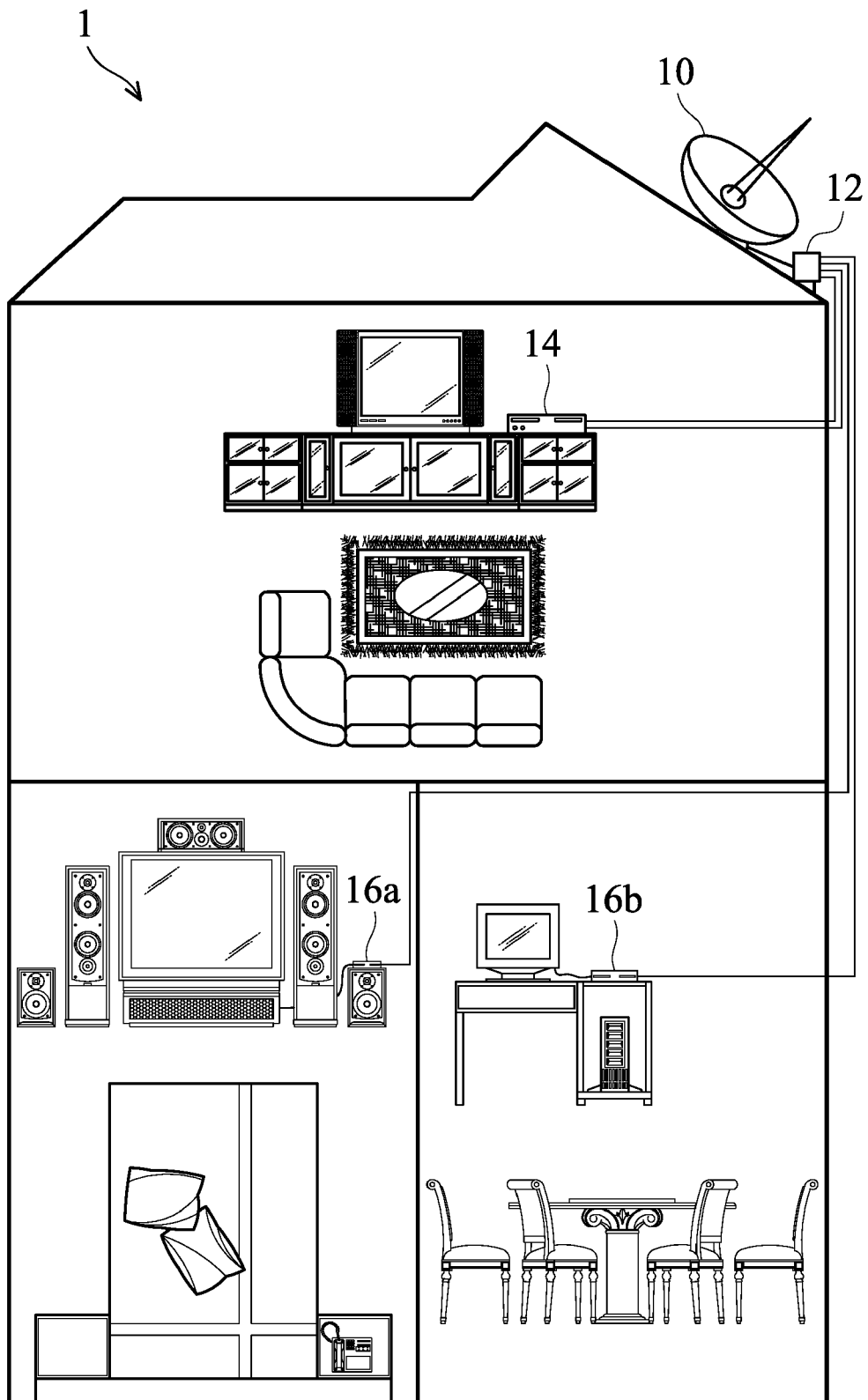


FIG. 1

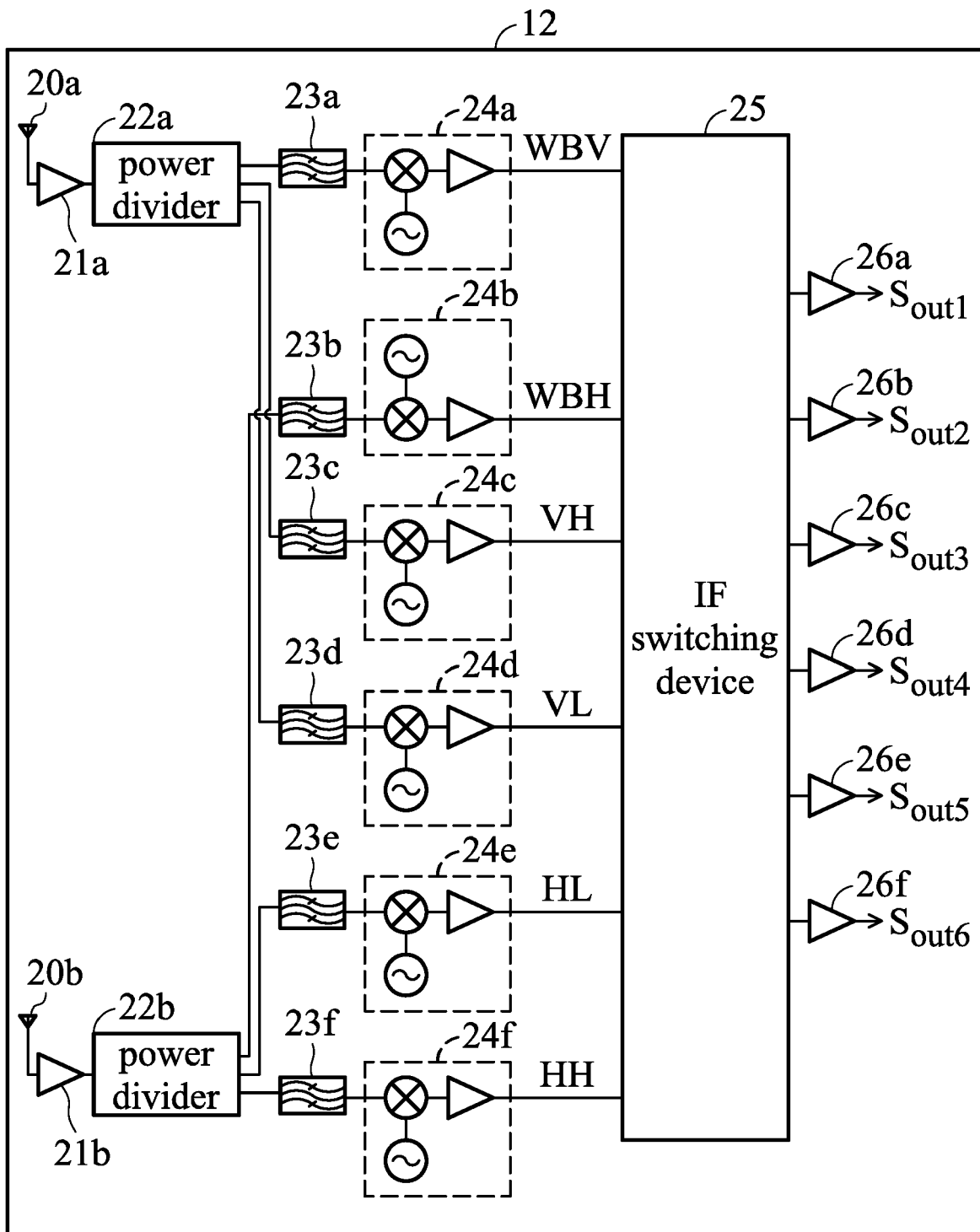


FIG. 2

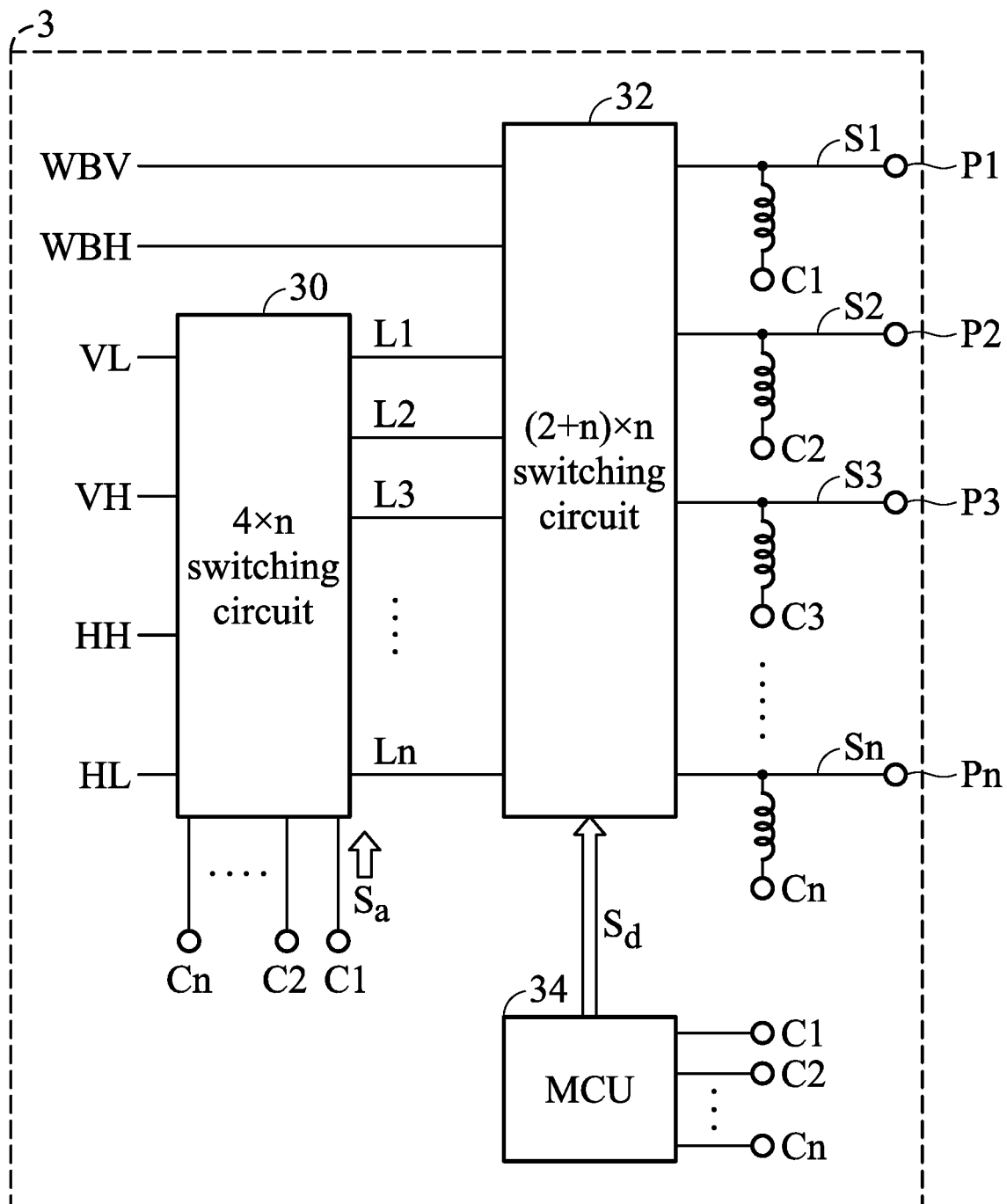


FIG. 3

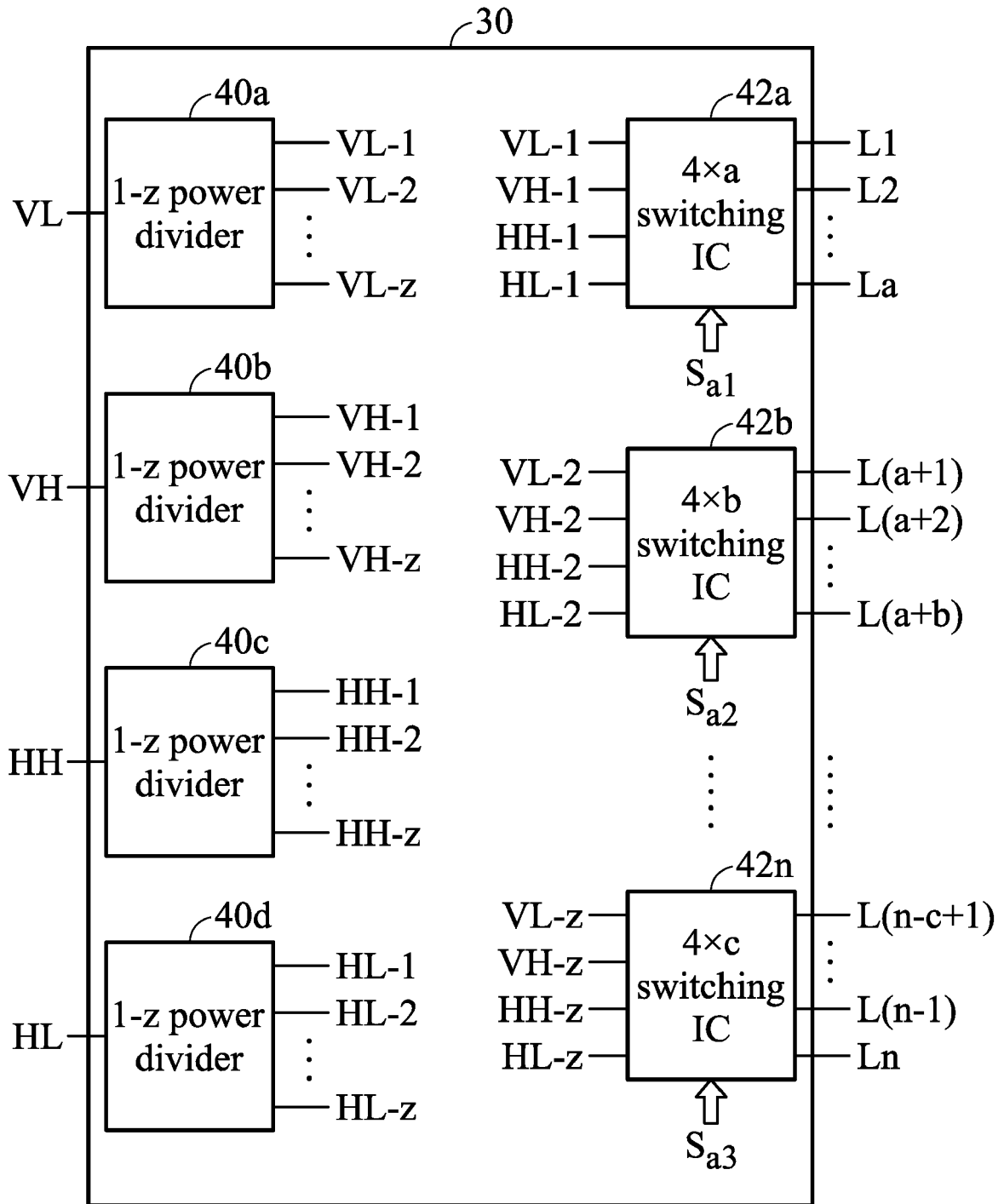


FIG. 4

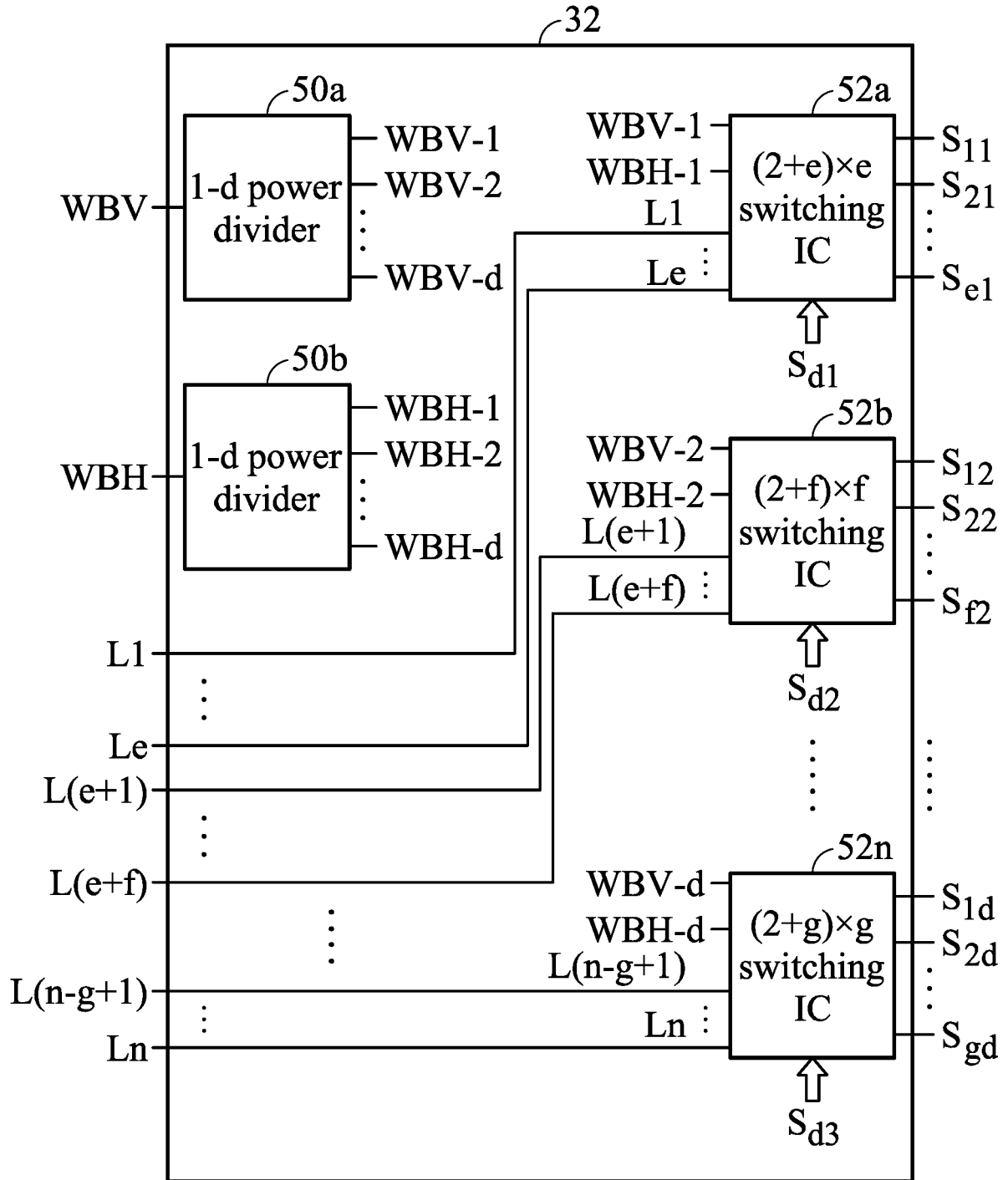


FIG. 5

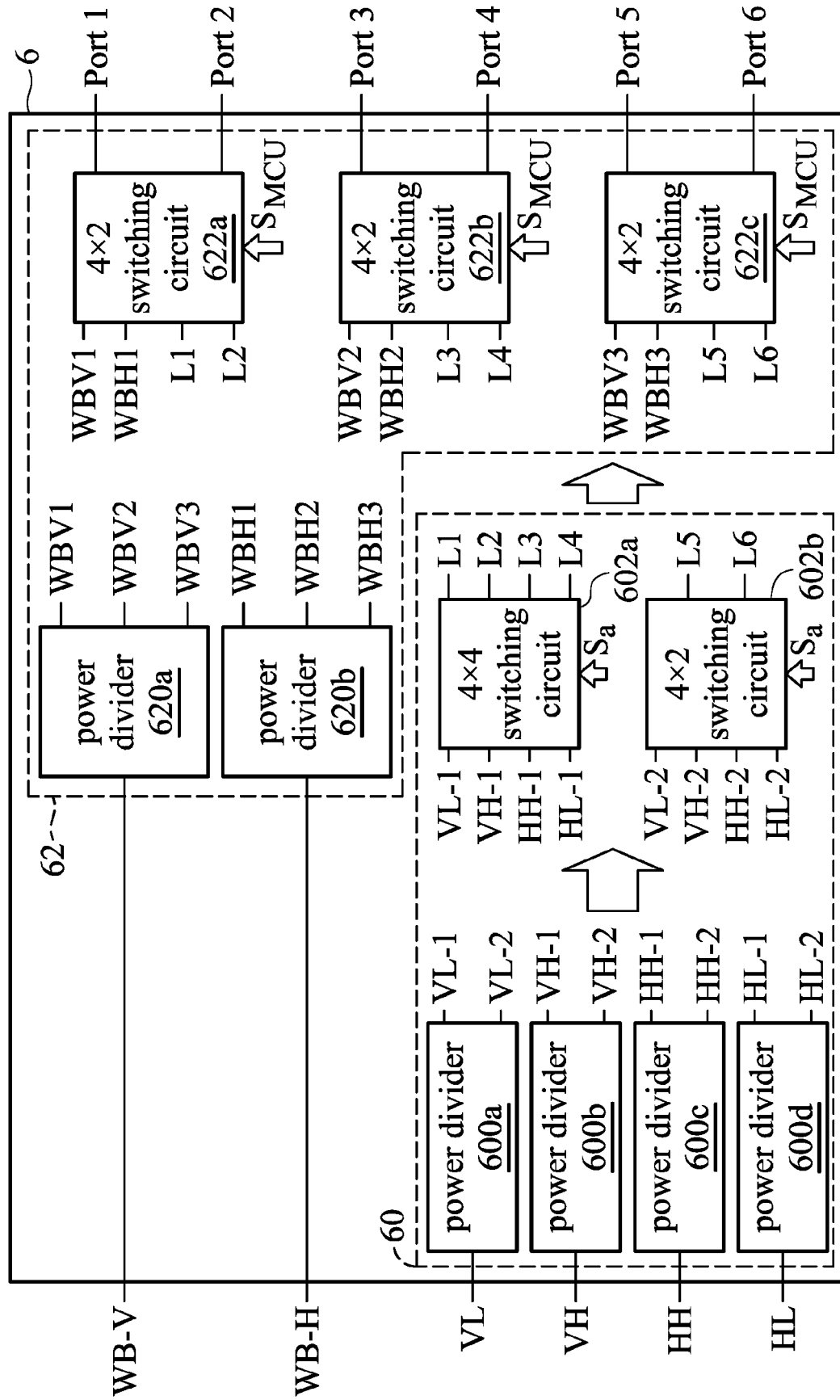


FIG. 6



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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                |                                                      |                                         |
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| Place of search<br>The Hague                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                | Date of completion of the search<br>22 December 2016 | Examiner<br>Van Hoorick, Jan            |
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