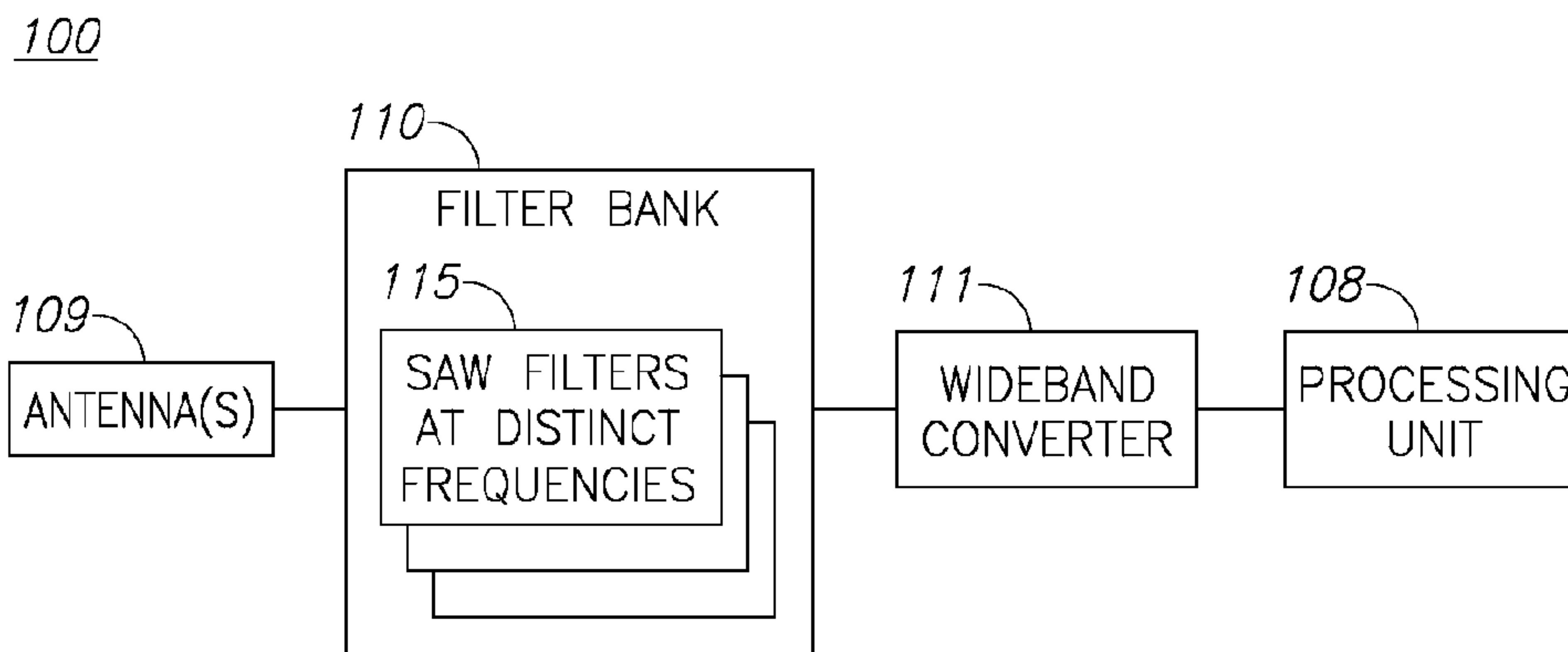




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 (72) Inventeurs/Inventors:  
 SOROKOPUD, BORIS, IL;  
 EDER, YEHUDA, IL;  
 MANOR, YONATAN, IL  
 (73) Propriétaire/Owner:  
 ELBIT SYSTEMS LAND AND C4I LTD., IL  
 (74) Agent: FASKEN MARTINEAU DUMOULIN LLP

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(57) **Abrégé/Abstract:**

Multi-channel communication devices and methods are provided, which employ a filter bank, connected between antenna(s) and wideband converter(s), that comprises many narrowband surface acoustic wave (SAW) filters having respective distinct frequency bands within a bandwidth of the wideband converter(s). For example, devices may be configured as multi-channel receivers with SAW filters replacing current heterodyne circuitry and achieving effective separation of reception channel and effective attenuation of adjacent blocking signals in a compact device. In other examples, devices may be configured as multi-channel transmitters and/or transceivers, possibly having a variable number of channels, to realize compact multi-channel radio.

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[IL/IL]; 5 Hagavish Street, 4250705 Netanya (IL).(72) Inventors: **SOROKOPUD, Boris**; 5/40 Dalya Street,  
1709114 Nazareth Illit (IL). **EDER, Yehuda**; 5 Dror  
Street, 7411105 Nes Ziona (IL). **MANOR, Yonatan**; 16  
Einstein Street, 3460402 Haifa (IL).(74) Agents: **WEILER, Assaf** et al.; Pearl Cohen Zedek Latzer  
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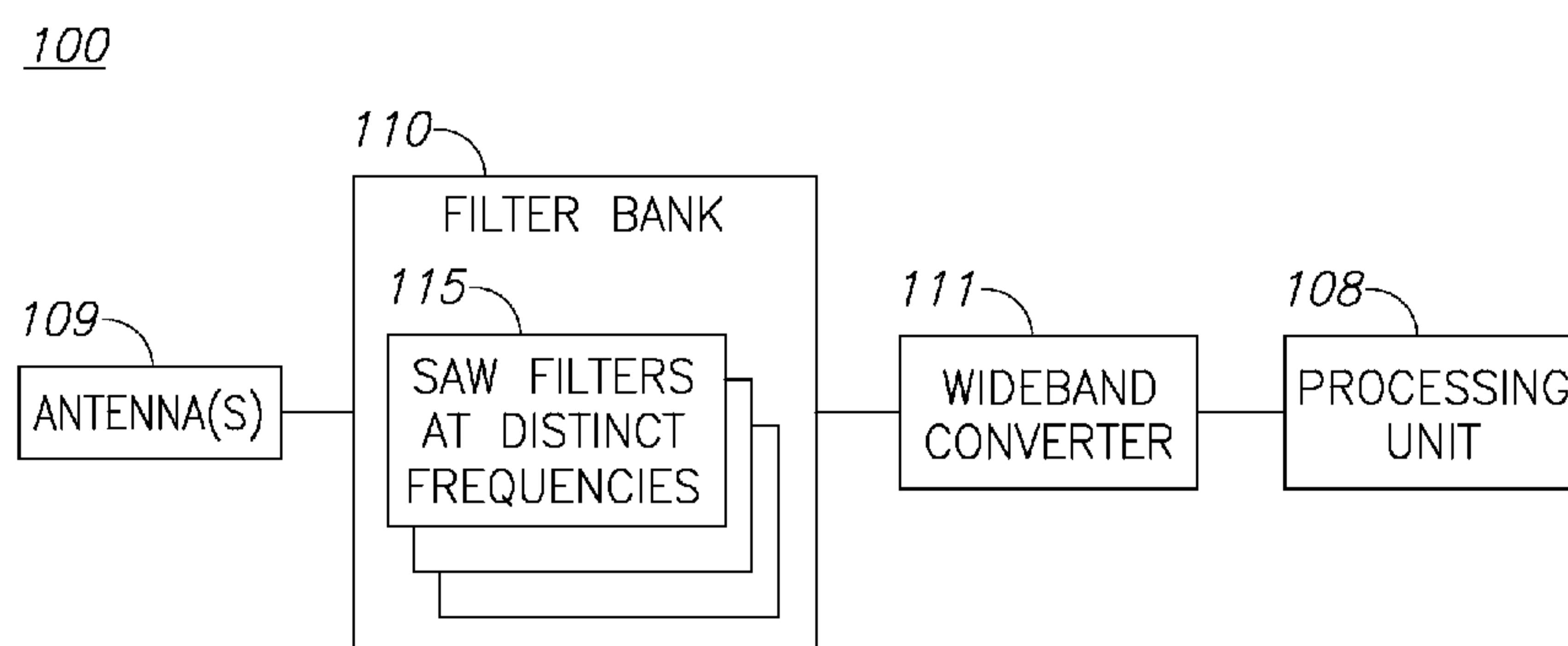


Figure 2A

(57) **Abstract:** Multi-channel communication devices and methods are provided, which employ a filter bank, connected between an antenna(s) and wideband converter(s), that comprises many narrowband surface acoustic wave (SAW) filters having respective distinct frequency bands within a bandwidth of the wideband converter(s). For example, devices may be configured as multi-channel receivers with SAW filters replacing current heterodyne circuitry and achieving effective separation of reception channel and effective attenuation of adjacent blocking signals in a compact device. In other examples, devices may be configured as multi-channel transmitters and/or transceivers, possibly having a variable number of channels, to realize compact multi-channel radio.

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## MULTI-CHANNEL DIGITAL RADIO

## BACKGROUND OF THE INVENTION

## 1. TECHNICAL FIELD

The present invention relates to the field of radio communication, and more particularly, to multi-channel radios.

## 2. DISCUSSION OF RELATED ART

**Figures 1A** and **1B** are high level schematic block diagrams prior art receivers **91** and transmitters **92**, respectively. Receiver **91** (**Figure 1A**) is a super-heterodyne receiver which converts an incoming signal that may have different carrier frequencies into a signal at a predefined intermediate frequency, from which the information modulated into the incoming signal is decoded. Receiver **91**'s bandwidth is illustrated schematically in diagram **60** referring to the VHF and UHF radio regions (very high frequencies, 30-300MHz, and ultra-high frequencies, 300-3000 MHz, respectively) of the electromagnetic spectrum. The signal is received through antenna **91A**, its bandwidth is narrowed (schematically illustrated in diagram **61**) by a Band Pass Filter (BPF) and Digital Control Attenuator (DCA) components and the signal amplified by a low-noise amplifier (LNA) at stage **91C**. Then, at stage **91D**, a frequency mixer is used to modify the carrier frequency into a first intermediate frequency ( $IF_1$ ) by mixing the signal with a frequency generated by a respective synthesizer to yield signal **62** at the intermediate frequency. The signal from stage **91D** is typically transformed again by a stage **91E** into another intermediate frequency ( $IF_2$ ) to remove disturbing frequencies such as mirror frequencies and adjacent frequencies from blocking signals, and yield signal **63** that may then be converted into digital information by Analog to Digital Converter (ADC) **91F**. Stages **91C-91F** represent the de-modulation stage **91B** of a single received channel, the digital information from which is then delivered for further processing (stage **91G**) by field-programmable gate array (FPGA) and digital signal processing (DSP) or microprocessor ( $\mu P$ ).

Prior art multi-channel receivers **91** employ multiple de-modulation stages **91B**, each tuned to receive a different frequency by generating correspondingly different frequencies by the

synthesizers (intermediate frequencies  $IF_1$ ,  $IF_2$  are typically the same for all channels), to yield multiple channels.

Transmitter **92** (Figure **1B**) has a structure that basically corresponds to the structure of receiver **91**. Processing elements **92A** (e.g., DSP,  $\mu$ P, FPGA) generate digital signals which are fed into one or more modulation stage(s) **92B** and are converted by corresponding digital to analog converter(s) **92C**. The analog signal is then mixed at stages **92D**, **92E** with synthesized frequencies to reach the carrier frequency range and then filtered and amplified in stage **92F** (by low pass filter - LPF, driver and power amplifier and harmonic filter) to yield a signal **70** which is broadcasted by antenna **92G**. It is noted that equivalent components in receiver **91** and transmitter **92** were denoted by different numerals in order to streamline their explanation. Clearly, processing stages **91G**, **92A** and antennas **91A**, **92G** may be implemented as single components, respectively, in a transceiver that combines receiver **91** and transmitter **92**.

U.S. Patent Publication No. 20130178179 teaches a subsampling receiver using interstage off-chip RF band pass filter; U.S. Patent Publication No. 2014062614 teaches a switching circuit for selecting a frequency band; Chinese Patent Document No. 101452013 teaches a switch filter array case system for calibration of a spectrum analyzer and a vector signal analyzer; and U.S. Patent No. 3855556 teaches a selectable frequency bandpass filter that modulates an analog signal by applying variable delays on the input signal.

## SUMMARY OF THE INVENTION

The following is a simplified summary providing an initial understanding of the invention. The summary does not necessarily identify key elements nor limit the scope of the invention, but merely serves as an introduction to the following description.

One aspect of the present invention provides a multi-channel communication device comprising, connected between at least one antenna and at least one wideband converter, a filter bank that comprises a plurality of narrowband surface acoustic wave (SAW) filters having respective distinct frequency bands within a bandwidth of the at least one converter.

These, additional, and/or other aspects and/or advantages of the present invention are set forth in the detailed description which follows; possibly inferable from the detailed description; and/or learnable by practice of the present invention.

### BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of embodiments of the invention and to show how the same may be carried into effect, reference will now be made, purely by way of example, to the accompanying drawings in which like numerals designate corresponding elements or sections throughout.

In the accompanying drawings:

**Figures 1A and 1B** are high level schematic block diagrams of prior art receivers and transmitters, respectively.

**Figure 2A** is a high level schematic block diagram of a multi-channel communication device, according to some embodiments of the invention.

**Figure 2B** is a high level schematic block diagram of a multi-channel communication system, according to some embodiments of the invention.

**Figure 3** is a high level schematic block diagram of a multi-channel UHF receiver, according to some embodiments of the invention.

**Figures 4A and 4B** are schematic examples for relating SAW filters frequency bands with bandwidths of the individual communication channels in the multi-channel radio, according to some embodiments of the invention.

**Figure 5** is a high level schematic illustration of phase adaptations that may be carried out between SAW filters in the filter bank, according to some embodiments of the invention.

**Figure 6** is a high level schematic block diagram of a multi-channel UHF transmitter, according to some embodiments of the invention.

**Figure 7** is a high level schematic block diagram of switching in the device, according to some embodiments of the invention.

**Figures 8A** and **8B** are high level schematic block diagrams of transceivers, according to some embodiments of the invention.

**Figure 9** is a high level schematic flowchart of a multi-channel communication method, according to some embodiments of the invention.

#### DETAILED DESCRIPTION OF THE INVENTION

With specific reference now to the drawings in detail, it is stressed that the particulars shown are by way of example and for purposes of illustrative discussion of the preferred embodiments of the present invention only, and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the invention. In this regard, no attempt is made to show structural details of the invention in more detail than is necessary for a fundamental understanding of the invention, the description taken with the drawings making apparent to those skilled in the art how the several forms of the invention may be embodied in practice.

Before at least one embodiment of the invention is explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of the components set forth in the following description or illustrated in the drawings. The invention is applicable to other embodiments that may be practiced or carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein is for the purpose of description and should not be regarded as limiting.

Multi-channel communication devices and methods are provided, which employ a filter bank, connected between antenna(s) and wideband converter(s), that comprises many narrowband surface acoustic wave (SAW) filters having respective distinct frequency bands within a bandwidth of the wideband converter(s). For example, devices may be configured as multi-channel receivers with SAW filters replacing current heterodyne circuitry and achieving effective separation of reception channel and effective attenuation of adjacent blocking signals in a

compact device. In other examples, devices may be configured as multi-channel transmitters and/or multi-channel transceivers, possibly having a variable number of channels, to realize compact multi-channel radio. The disclosed devices and methods may be implemented in handheld or backpack devices, and provide increased battery life.

The SAW frequency-switch filter bank may be used in receivers as a pre-selector with the pass band as the channel band width, for reducing co-location interferences and improving the receiver's selectivity in mobile operated radios and for increasing the dynamic range of the receivers. A filter bank may be used as a front end for single channel receivers and/or multi-channel receivers with very large dynamic ranges. The output of the filter bank module may be connected directly to a wideband ADC (analog to digital conversion), and thus solve ADC dynamic range problems that limit the use of the ADC capabilities in simple receiver architectures with high selectivity performances.

**Figure 2A** is a high level schematic block diagram of a multi-channel communication device **100**, according to some embodiments of the invention. Multi-channel communication device **100** comprises, connected between at least one antenna **109** and at least one wideband converter **111**, a filter bank **110** that comprises a plurality of narrowband surface acoustic wave (SAW) filters **115** having respective distinct frequency bands within a bandwidth of converter(s) **111**, e.g., the frequency coverage may be between 225-512 MHz. Wideband converter **111** may be connected to processing unit(s) **108**. It is noted that in **Figure 2A**, antenna **109** may represent any of antennas **91A**, **92G**, wideband converter **111** may represent any of ADC **91F** and DAC **92C** and processing unit **108** may represent any of processing units **91G**, **92A**.

**Figure 2B** is a high level schematic block diagram of a multi-channel communication system **103**, according to some embodiments of the invention. Communication system **103** may represent a single device having a receiver **101** and a transmitter **102** (termed in such case transceiver **103**), different devices configured as receiver(s) **101** and transmitter(s) **102**, and/or combinations thereof. In certain embodiments, device **100** may be configured as receiver **101**, wideband converter **111** may comprise ADC **91F**, antenna **91A** may be configured to receive radiofrequency (RF) radiation within a specified frequency band that at least partly overlaps the frequency bands of SAW filters **115** and the bandwidth of ADC **91F**, and receiver **101** may be configured to deliver a plurality of reception channels to processing unit **91G**, which correspond

to at least some of the SAW filter frequency bands, converted by ADC **91F**. In certain embodiments, device **100** may be configured as transmitter **102**, wideband converter **111** may comprise DAC **92C**, antenna **92G** may be configured to receive radiofrequency (RF) radiation within a specified frequency band that at least partly overlaps the frequency bands of SAW filters **115** and the bandwidth of DAC **92C**, and transmitter **102** may be configured to modulate signals from processing unit **92A** by DAC **92C** into a plurality of transmission channels which correspond to at least some of the SAW filter frequency bands, and broadcast the transmission channel through antenna **92G**.

In certain embodiments, device **100** may be configured as a transceiver **103**, wherein wideband converter **111** comprises ADC **91F** and DAC **92C** and one or more antenna(s) **91A**, **92G** may be configured to receive and transmit radiofrequency (RF) radiation within a specified frequency band that at least partly overlaps the frequency bands of SAW filters **115** and the bandwidths of ADC **91F** and the DAC **92C**. Transceiver **103** may be configured to deliver to processing unit **91G** multiple reception channels that correspond to at least some of the SAW filter frequency bands and are converted by ADC **91F**, and to deliver from processing unit **92A**, after conversion by DAC **92C**, multiple transmission channels that correspond to at least some of the SAW filter frequency bands for broadcasting by antenna **92G**.

**Figure 3** is a high level schematic block diagram of multi-channel UHF receiver **101**, according to some embodiments of the invention. **Figure 3** exemplifies device **100** configured as receiver **101** in UHF, as a comparison to prior art receiver **91** depicted in **Figure 1A**. In place of the cumbersome set of de-modulation stages **91B**, receiver **101** essentially comprises a set of SAW filters **115** which may be fitted on a small printed board, connected to broadband ADC **91F** that spans the combined frequency band range of SAW filters **115** in filter bank **110**. SAW filters **115** may be configured to provide N reception channels, each of filters **115A-115N** having distinct frequency band **116A-116N**. DCA and LNA **117** may be connected prior to filter bank **110** or after each SAW filter **115** to amplify the signal before or after filtering, respectively. SAW filters **115A-115N** have distinct frequency bands **116A-116N** to provide N distinct reception channels that can be converted to digital signals simultaneously by a single ADC **91F**, or in certain embodiments by two or more ADC's **91F**, depending on specific implementation details (relating e.g., to ease and cost of manufacture). Diagram **120** illustrates schematically three frequency bands **116** (m1, m2, m3) and the received signals **67** after efficient filtering by SAW filters **115**.



The parts of signal **67** which correspond to each of frequency bands **116** (m1, m2, m3) are clearly distinct, and may thus be effectively separated by ADC **91F**.

**Figures 4A** and **4B** are schematic examples for relating SAW filters frequency bands **116A, B** with bandwidths **121A-F** of the individual communication channels in the multi-channel radio, according to some embodiments of the invention. These and similar examples may be used to design and determine the specifications of SAW filters **115** according to given requirements concerning required communication channel bandwidths and inter-channel interference thresholds and/or design and determine the communication channel bandwidths and inter-channel interference thresholds according to specifications of given SAW filters **115** and/or derive an optimization of SAW filters frequency bands **116A, B** and channel bandwidths **121A-F** under given scenarios and requirements. The example in each of **Figures 4A** and **4B** illustrates schematically one SAW filters frequency bands **116A** and **116B** respectively, a central channel **121A** to be filtered by the respective SAW filter, and adjacent channels **121B-F** with their respective attenuation with respect to central channel **121A**, overlapped on the SAW filter transfer function. It is noted that SAW filters **115** provide a narrow channel width of a few MHz and steep channel edges which allow good separation between a large number of channels, e.g., in the UHF region of several hundred MHz.

For example, SAW filters **115** were designed to provide an attenuation of ca. 50dB between adjacent channels (e.g., **121A, 121B**), ca. 60dB between singly separated channels (e.g., **121A, 121C**) and ca. 100dB between doubly separated channels (e.g., **121A, 121D**). These analog attenuations may be combined with digital attenuations provided by converter **111** (ADC and/or DAC, e.g., 50dB) and other components to provide high level immunity of one channel to adjacent channels, even at large differences of intensity (e.g., up to 100dB, 120dB etc.). Specific required attenuations may be incorporated into the exact design details of device according to the illustrated principles.

Specific SAW filter technologies, e.g., ladder, double mode (DMS) or hybrid SAW filter structures may be selected to provide the best fitting filters. In certain embodiments, ladder structured SAW filters were configured to operate in device **100**.

The shape factor (SF) of the SAW filters provides better selectivity in the receiver, better spectral purity in the transmitter and generally less noise; and also allows using closer antennas in

adjacent devices with less mutual interference due to lower lateral disturbances between channels.

**Figure 5** is a high level schematic illustration of phase adaptations that may be carried out between SAW filters **115** in filter bank **110**, according to some embodiments of the invention. In certain embodiments, interferences between signals in different channels may be reduced by configuring the relative phases between the channels, using phase shifting circuitry comprising switches **122**, phase shifters **124** and inductive and capacitive components **126** in association with SAW filters **115**, e.g., in receiver **101**.

**Figure 6** is a high level schematic block diagram of multi-channel UHF transmitter **102**, according to some embodiments of the invention. **Figure 6** exemplifies device **100** configured as transmitter **102** in UHF, as a comparison to prior art transmitter **92** depicted in **Figure 1B**. In place of the cumbersome set of modulation stages **92B**, transmitter **102** essentially comprises broadband DAC **92C** connected to filter bank **110** of SAW filters **115**, broadband DAC **92C** spanning the combined frequency band range of SAW filters **115** in filter bank **110** and SAW filters **115** possibly fitted on a small printed board. SAW filters **115** may be configured to provide N transmission channels, each of filters **115A-115N** having distinct frequency band **116A-116N**. Signals from processing unit(s) **92A** may be passed through broadband DAC **92C**, amplified and separated to multiple channels in filter bank **110**. The resulting channels may then be amplified and filtered in stage **92F** before being broadcast through antenna **92G**, to yield a much cleaner **107** than prior art signal **70**.

**Figure 7** is a high level schematic block diagram of switching in device **100**, according to some embodiments of the invention. Filter bank **110** with SAW filters 1..N **115** may be used to provide any number of channels 1..K with associated components **117**, e.g., by applying multiple switches **122** to regulate signal flow through SAW filters **115** in filter bank **110**. The number of channels may be modified during operation of device **100**.

**Figures 8A** and **8B** are high level schematic block diagrams of transceivers **103**, according to some embodiments of the invention. **Figures 8A** illustrates a non-limiting example, with a configuration having a single transmission channel and two reception channels (K=2), with corresponding components DAC **92C**, stage **92F** and signal illustrations **107A**, **107B**; and stages **91C**, **117**, ADC **91F** and illustration of two frequency bands **120**, respectively, integrated with a

corresponding switching circuitry scheme. It is emphasized that the illustrated example of one transmission channel and two reception channels is non-limiting, and that the present disclosure includes transceivers with any number of transmission channels and any number of reception channels.

**Figures 8B** illustrates another non-limiting example, in which filters **115** belonging to different channels are separated from each other (spatially in filter bank **110**), to avoid interruptions and cross talk. For example, filters **115A** belonging to a certain set of consecutive channels may be positioned at positions 1, 4, 7 etc. in filter bank **110**, filters **115B** belonging to another set of consecutive channels may be positioned at positions 2, 5, 8 etc. in filter bank **110**, and filters **115C** belonging to yet another set of consecutive channels may be positioned at positions 3, 6, 9 etc. in filter bank **110**, so that adjacent filters **115** in filter bank are well separated with respect to their frequency bands **116**. Separating spectrally-adjacent filters spatially (e.g., into groups **115A**, **115B**, **115C**) enable simultaneous transmission and/or reception at spectrally-adjacent channels without reciprocal interference. A configuration circuitry **123** and duplexer/splitter **122** are used to direct the communication signals to and from respective filters **115**. Any number of transmission sections, reception sections and filter groups may be realized, according to given specifications.

In certain embodiments, the frequency bands of SAW filters **115** may be about 10MHz wide. In certain embodiments, the frequency bands of SAW filters **115** may be about 20MHz wide. In certain embodiments, the bandwidth of converter **111** may comprise several hundred MHz, particularly when device **100** operates in UHF. ADC **91F** and/or DAC **92F** may have bandwidths of several hundred MHz, e.g., 300Mhz, 500MHz, 800Mhz, etc. Such converters are available as ADCs and DACs with wide dynamic ranges. In certain embodiments, combinations of 10MHz wide SAW filters frequency bands and 500MHz wide converters (ADC and/or DAC) provide tens of channels. It is noted that a large number of channels is particularly useful in the UHF and the VHF, in which available spectrum is segmented into disparate section. It is further noted that each channel may be managed by applying customary methods such as different modulations, encryption, time sharing, frequency hopping, etc.

**Figure 9** is a high level schematic flowchart of a multi-channel communication method **200**, according to some embodiments of the invention. Method **200** may comprise using a plurality of

narrowband SAW filters having respective distinct frequency bands associated with at least one wideband converter having a bandwidth that comprises the filters' frequency bands, to yield multi-channel communication (stage **210**).

In certain embodiments, method **200** may comprise receiving RF radiation within a specified frequency band that at least partly overlaps the frequency bands of the SAW filters (stage **220**), filtering the received RF radiation through the SAW filters to yield a plurality of reception channels (stage **230**), and converting the reception channels by the at least one wideband converter, configured as a wideband ADC (stage **240**).

In certain embodiments, method **200** may comprise converting information by the at least one wideband converter, configured as a wideband DAC, into a wideband signal (stage **250**), filtering the converted wideband signal through the SAW filters to yield a plurality of transmission channels (stage **260**), and transmitting the transmission channels as RF radiation (stage **270**).

In certain embodiments, method **200** may comprise, using ADC and DAC as wideband converters, receiving RF radiation within a specified frequency band that at least partly overlaps the frequency bands of the SAW filters (stage **220**), filtering the received RF radiation through the SAW filters to yield a plurality of reception channels (stage **230**), converting the reception channels by the wideband ADC (stage **240**), converting information by the wideband DAC into a wideband signal (stage **250**), filtering the converted wideband signal through the SAW filters to yield a plurality of transmission channels (stage **260**), and transmitting the transmission channels as RF radiation (stage **270**), possibly separating, spatially in the filter bank, the SAW filters belonging to different channels.

Method **200** may be carried out in UHF, with the frequency bands of the SAW filters being within the specified frequency band of the antenna, and may further comprise switching the SAW filters to the corresponding reception channels (stage **232**).

Advantageously, with respect to prior art such as U.S. Patent Publication No. 20130178179, U.S. Patent Publication No. 2014062614, Chinese Patent Document No. 101452013 and U.S. Patent No. 3855556, the current invention provides multichannel transceivers (and/or receivers and/or transmitter) which use the filter bank in association with corresponding wideband converters to implement simultaneous multi-channel digital radio communications at UHF frequencies.

Advantageously, such systems reduce significantly the number of required components with respect to heterodyne-based devices, reduce the power consumption and consequentially increase the battery life for portable devices (e.g., handheld device, backpack devices).

In the above description, an embodiment is an example or implementation of the invention. The various appearances of "one embodiment", "an embodiment", "certain embodiments" or "some embodiments" do not necessarily all refer to the same embodiments.

Although various features of the invention may be described in the context of a single embodiment, the features may also be provided separately or in any suitable combination. Conversely, although the invention may be described herein in the context of separate embodiments for clarity, the invention may also be implemented in a single embodiment.

Certain embodiments of the invention may include features from different embodiments disclosed above, and certain embodiments may incorporate elements from other embodiments disclosed above. The disclosure of elements of the invention in the context of a specific embodiment is not to be taken as limiting their use in the specific embodiment alone.

Furthermore, it is to be understood that the invention can be carried out or practiced in various ways and that the invention can be implemented in certain embodiments other than the ones outlined in the description above.

The invention is not limited to those diagrams or to the corresponding descriptions. For example, flow need not move through each illustrated box or state, or in exactly the same order as illustrated and described.

Meanings of technical and scientific terms used herein are to be commonly understood as by one of ordinary skill in the art to which the invention belongs, unless otherwise defined.

While the invention has been described with respect to a limited number of embodiments, these should not be construed as limitations on the scope of the invention, but rather as exemplifications of some of the preferred embodiments. Other possible variations, modifications, and applications are also within the scope of the invention. Accordingly, the scope of the invention should not be limited by what has thus far been described, but by the appended claims and their legal equivalents.

## CLAIMS

What is claimed is:

1. A compact multi-channel communication device comprising, connected between at least one antenna and at least one wideband converter, a filter bank that comprises a plurality of narrowband surface acoustic wave (SAW) filters having respective distinct frequency bands within a bandwidth of the at least one wideband converter, wherein each of said SAW filter frequency bands comprises a plurality of channels each having respective narrow bandwidth and steep edges for separation therebetween, and wherein each of said SAW filters is configured to provide attenuation between said plurality of channels.
2. The multi-channel communication device of claim 1, configured as a receiver, wherein the at least one wideband converter is an analog to digital converter (ADC), the at least one antenna is configured to receive radiofrequency (RF) radiation within a specified frequency band that at least partly overlaps the frequency bands of the SAW filters and the bandwidth of the ADC, and wherein the receiver is configured to deliver a plurality of reception channels to a processing unit, the reception channels corresponding to at least some of the SAW filter frequency bands and being converted by the ADC.
3. The multi-channel communication device of claim 1, configured as a transmitter, wherein the at least one wideband converter is a digital to analog converter (DAC), the at least one antenna is configured to transmit radiofrequency (RF) radiation within a specified frequency band that at least partly overlaps the frequency bands of the SAW filters and the bandwidth of the DAC, and wherein the transmitter is configured to deliver a plurality of transmission channels from a processing unit, the transmission channels corresponding to at least some of the SAW filter frequency bands and being converted by the DAC.
4. The multi-channel communication device of claim 1, configured as a transceiver, wherein the at least one wideband converter comprises an analog to digital converter (ADC) and a digital to analog converter (DAC), the at least one antenna is configured to receive and transmit radiofrequency (RF) radiation within a specified frequency band that at least partly overlaps the frequency bands of the SAW filters and the bandwidths of ADC and the DAC,

and wherein the transceiver is configured to deliver a plurality of reception channels to a processing unit, the reception channels corresponding to at least some of the SAW filter frequency bands and being converted by the ADC, and to deliver a plurality of transmission channels from the processing unit, the transmission channels corresponding to at least some of the SAW filter frequency bands and being converted by the DAC.

5. The multi-channel communication device of claim 4, wherein the SAW filters belonging to different channels are spatially separated in the filter bank.
6. The multi-channel communication device of any one of claims 1-5, operable in ultrahigh frequencies (UHF).
7. The multi-channel communication device of claim 6, wherein the frequency bands of the SAW filters are 10MHz wide.
8. The multi-channel communication device of claim 6, wherein the bandwidth of the at least one converter is several hundred MHz.
9. The multi-channel communication device of claim 2, 4 or 5, further comprising a bandpass filter (BPF) between the at least one antenna and the filter bank and a plurality of low-noise amplifiers (LNAs) connected at respective reception channels before the ADC.
10. The multi-channel communication device of claim 9, further comprising switching circuitry configured to connect SAW filters to the corresponding reception channels.
11. The multi-channel communication device of any one of claims 3-5, further comprising amplifiers before and after the filter bank and a harmonic filter between the amplifier that follows the filter bank and the at least one antenna.
12. A multi-channel communication method comprising using a filter bank that comprises a plurality of narrowband SAW filters having respective distinct frequency bands associated with at least one wideband converter having a bandwidth that comprises the filters'

frequency bands, to yield multi-channel communication, wherein each of said SAW filter frequency bands comprises a plurality of channels each having respective narrow bandwidth and steep edges for separation therebetween, and wherein each of said SAW filters is configured to provide attenuation between said plurality of channels.

13. The multi-channel communication method of claim 12, further comprising:

receiving RF radiation within a specified frequency band that at least partly overlaps the frequency bands of the SAW filters,

filtering the received RF radiation through the SAW filters to yield a plurality of reception channels, and

converting the reception channels by the at least one wideband converter, configured as a wideband ADC.

14. The multi-channel communication method of claim 12, further comprising:

converting information by the at least one wideband converter, configured as a wideband DAC, into a wideband signal,

filtering the converted wideband signal through the SAW filters to yield a plurality of transmission channels, and

transmitting the transmission channels as RF radiation.

15. The multi-channel communication method of claim 12, wherein the at least one wideband converter comprises an ADC and a DAC, the method further comprising:

receiving RF radiation within a specified frequency band that at least partly overlaps the frequency bands of the SAW filters,

filtering the received RF radiation through the SAW filters to yield a plurality of reception channels,

converting the reception channels by the ADC,

converting information by the DAC into a wideband signal,

filtering the converted wideband signal through the SAW filters to yield a plurality of transmission channels, and

transmitting the transmission channels as RF radiation.



16. The multi-channel communication method of claim 15, further comprising separating, spatially in the filter bank, the SAW filters belonging to different channels.
17. The multi-channel communication method of any one of claims 12-16, carried out in UHF.
18. The multi-channel communication method of claim 13, 15 or 16, further comprising switching the SAW filters to the corresponding reception channels.

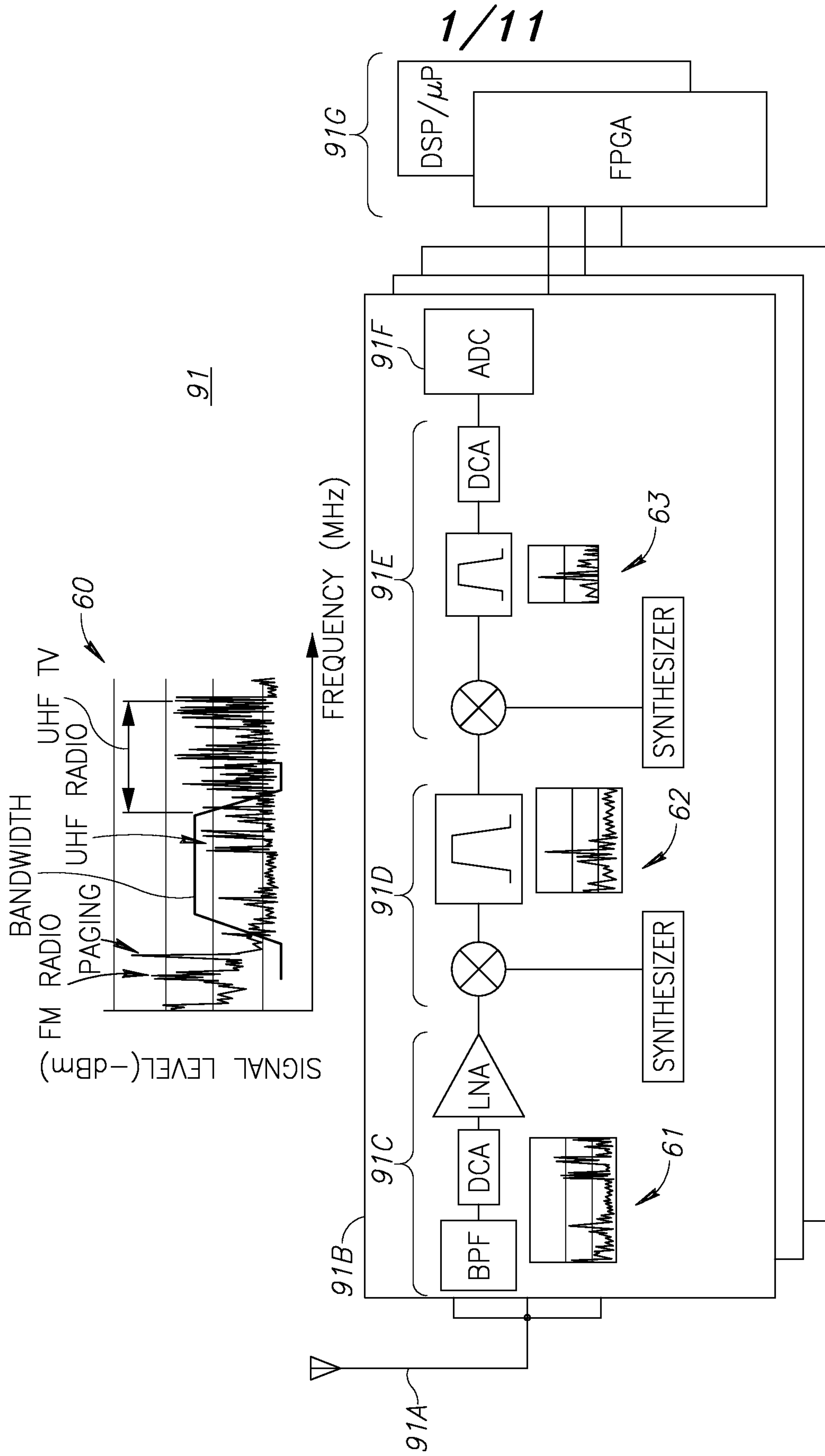


Figure 1A  
PRIOR ART

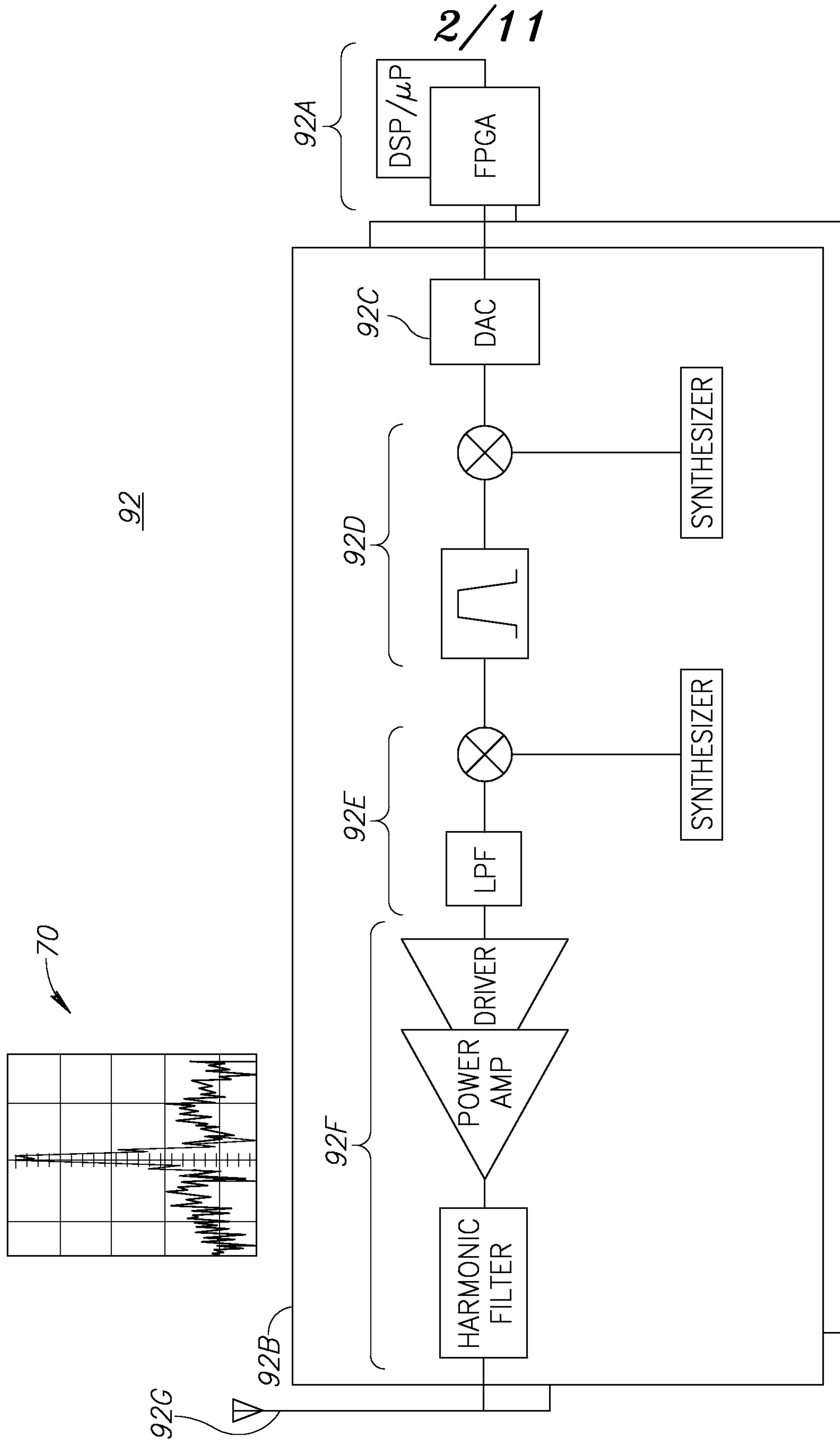


Figure 1B  
PRIOR ART

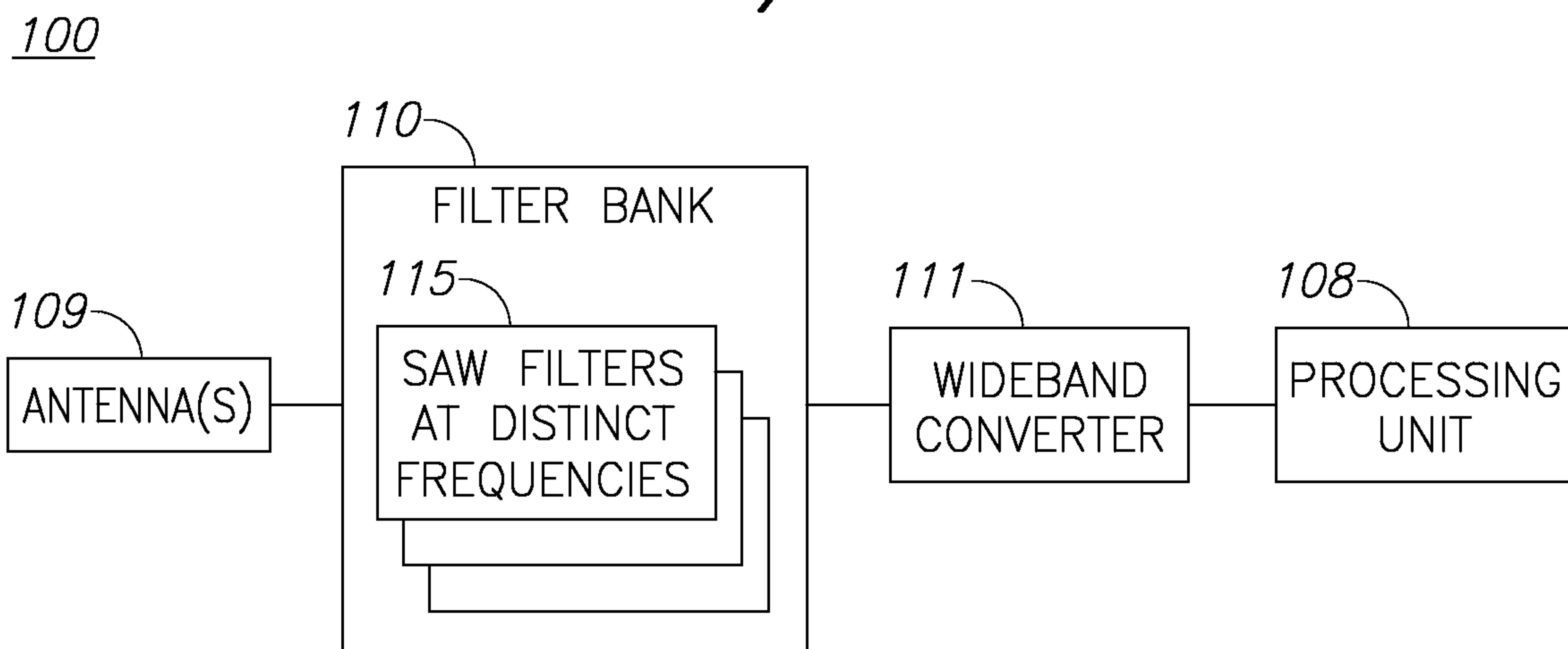


Figure 2A

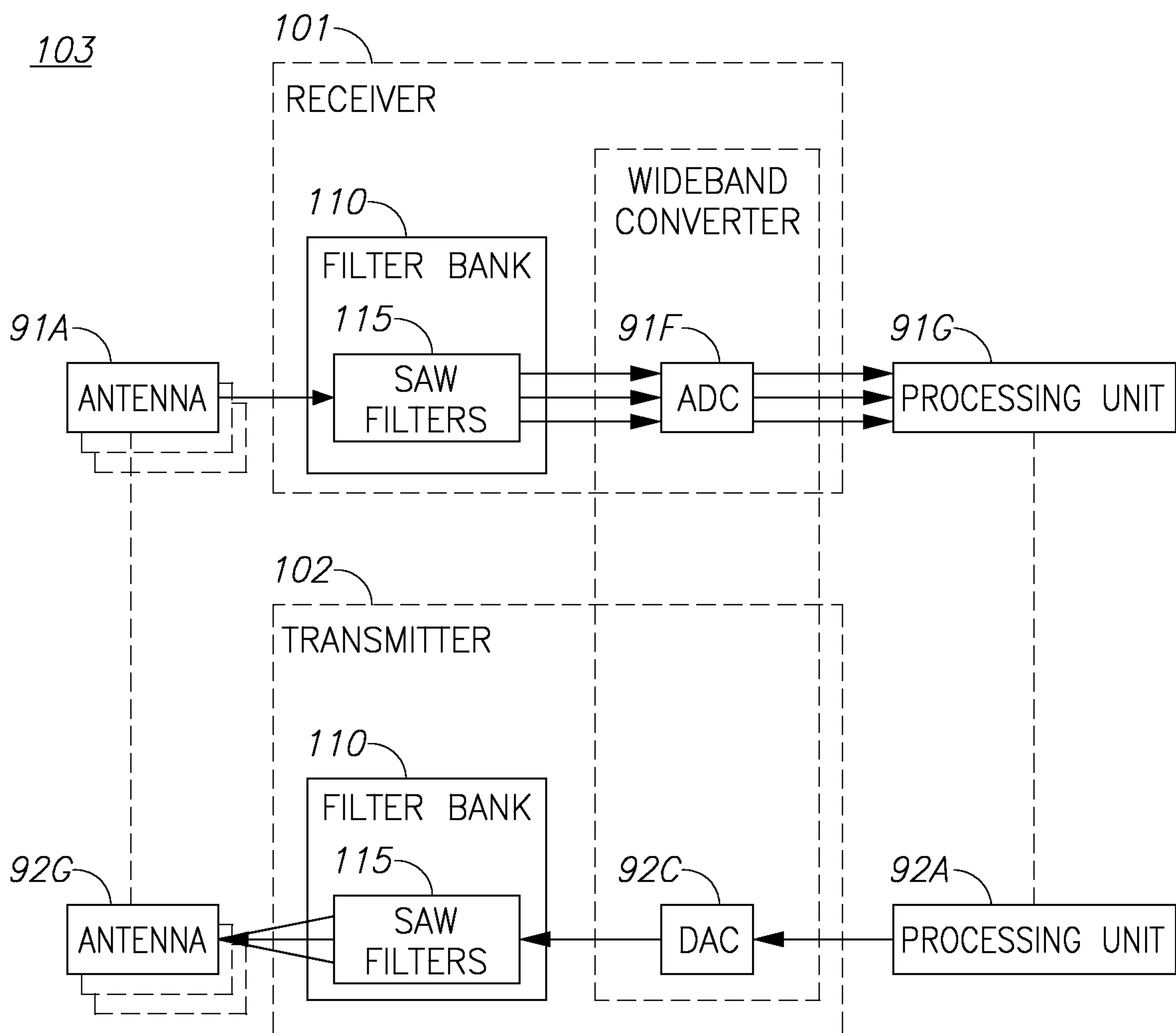


Figure 2B

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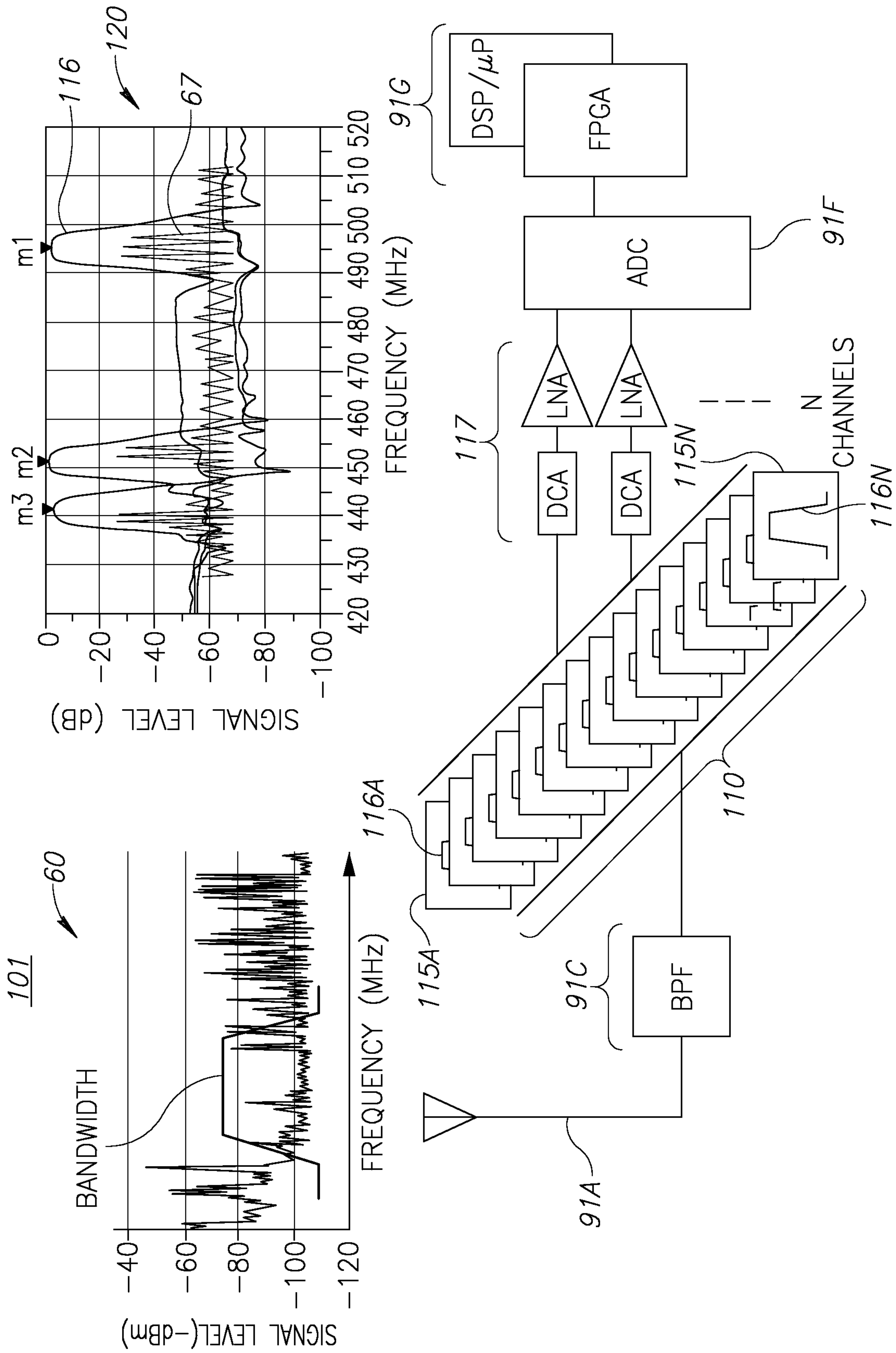


Figure 3

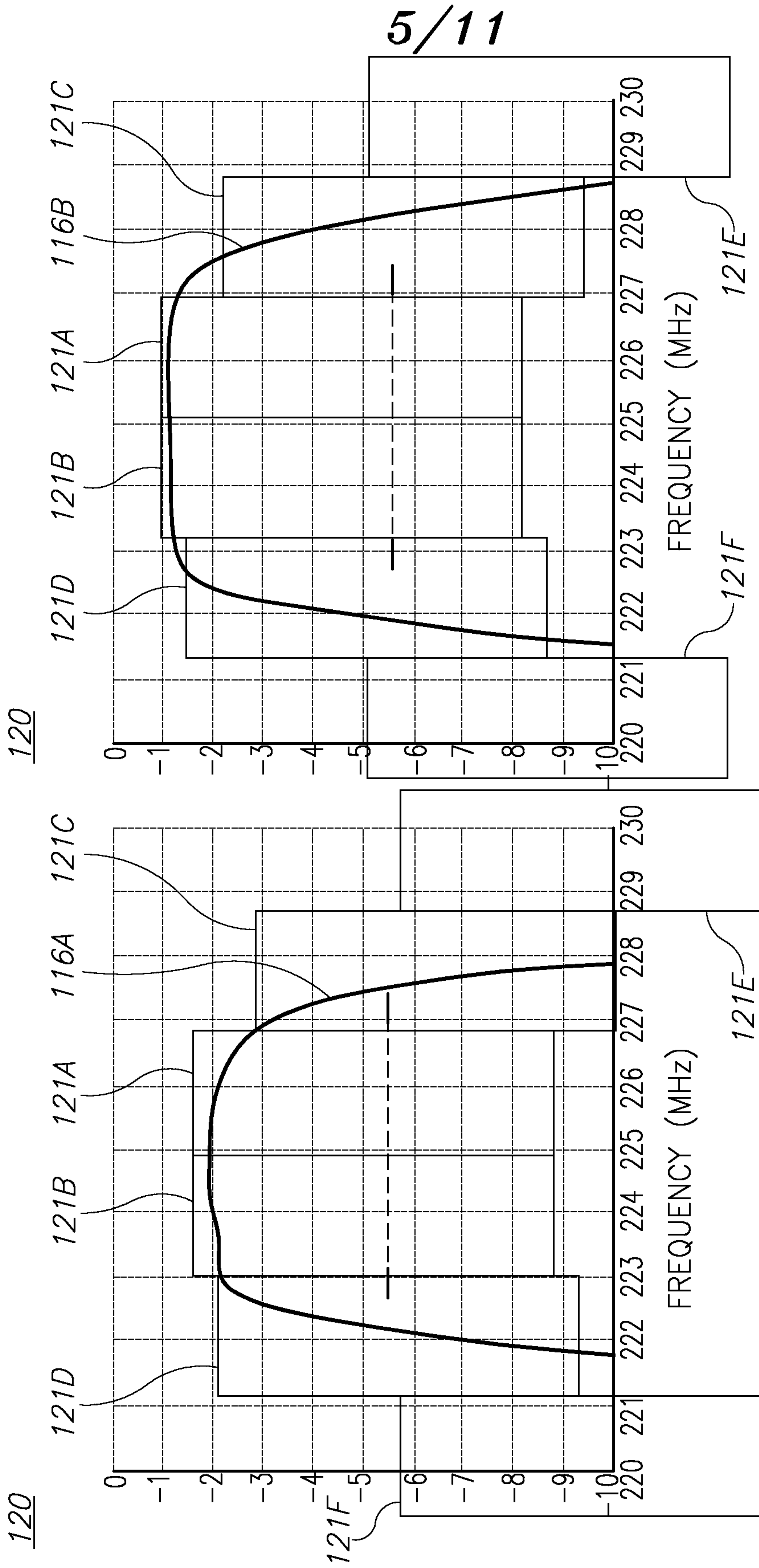


Figure 4B

Figure 4A

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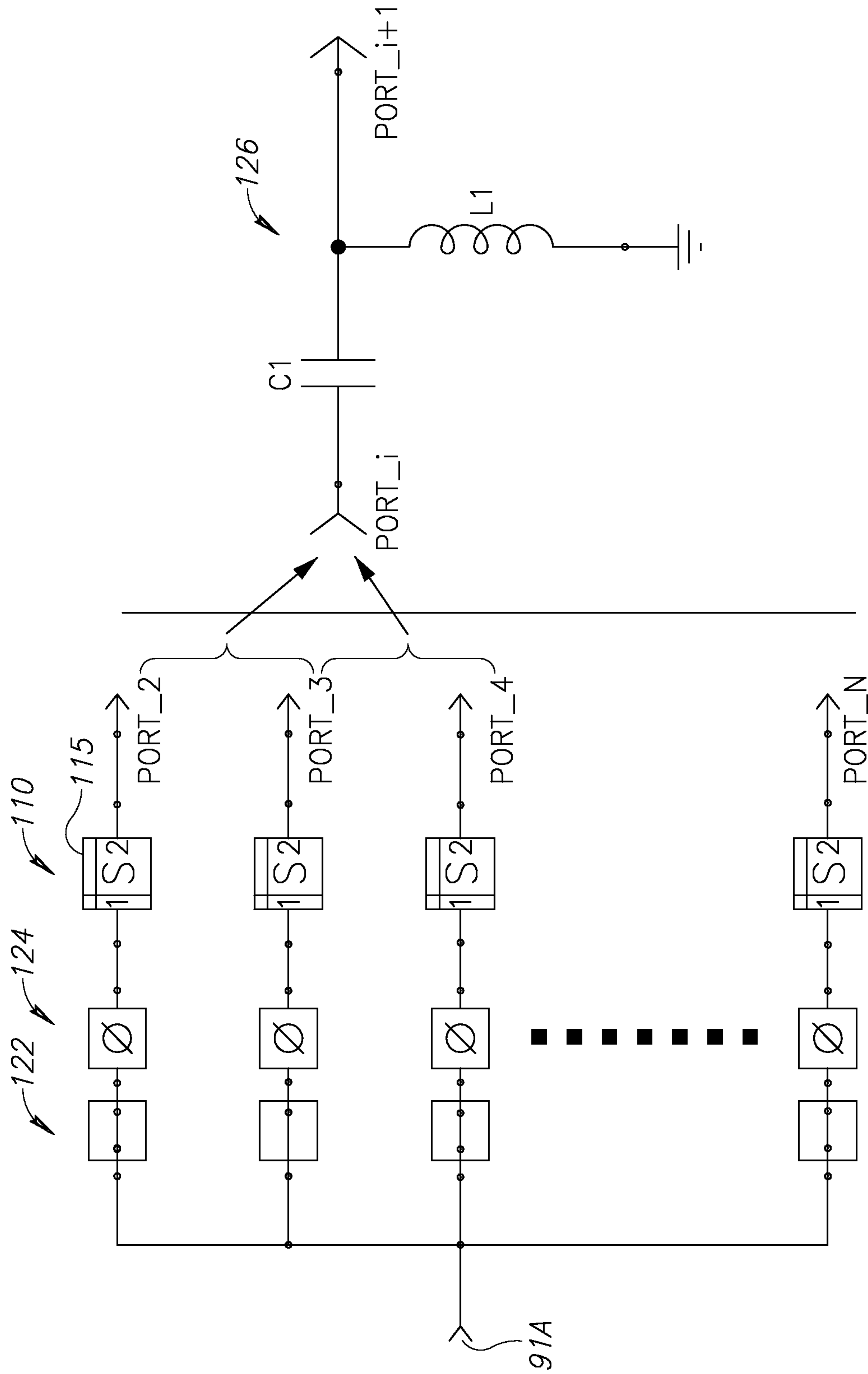


Figure 5

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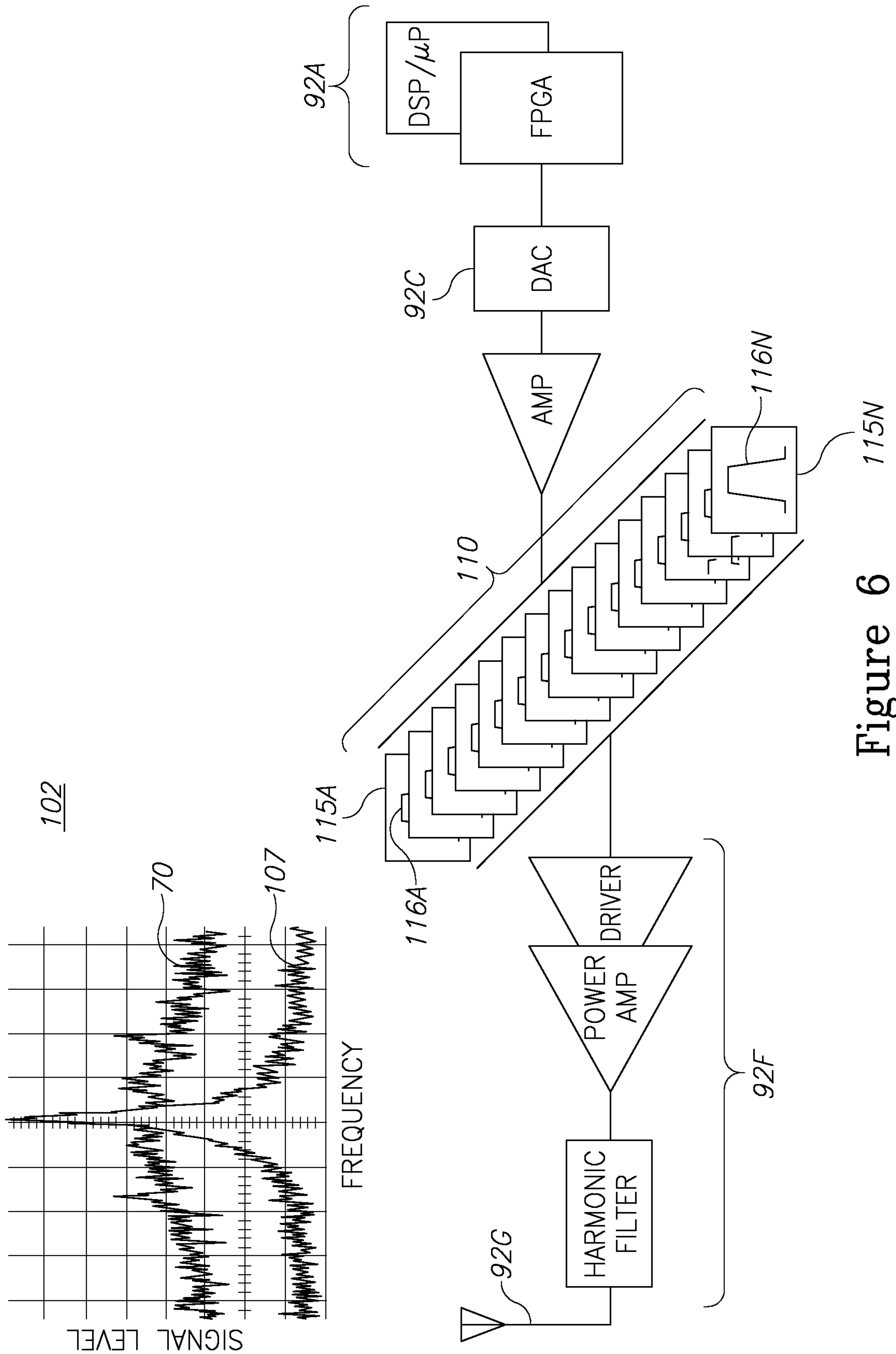


Figure 6



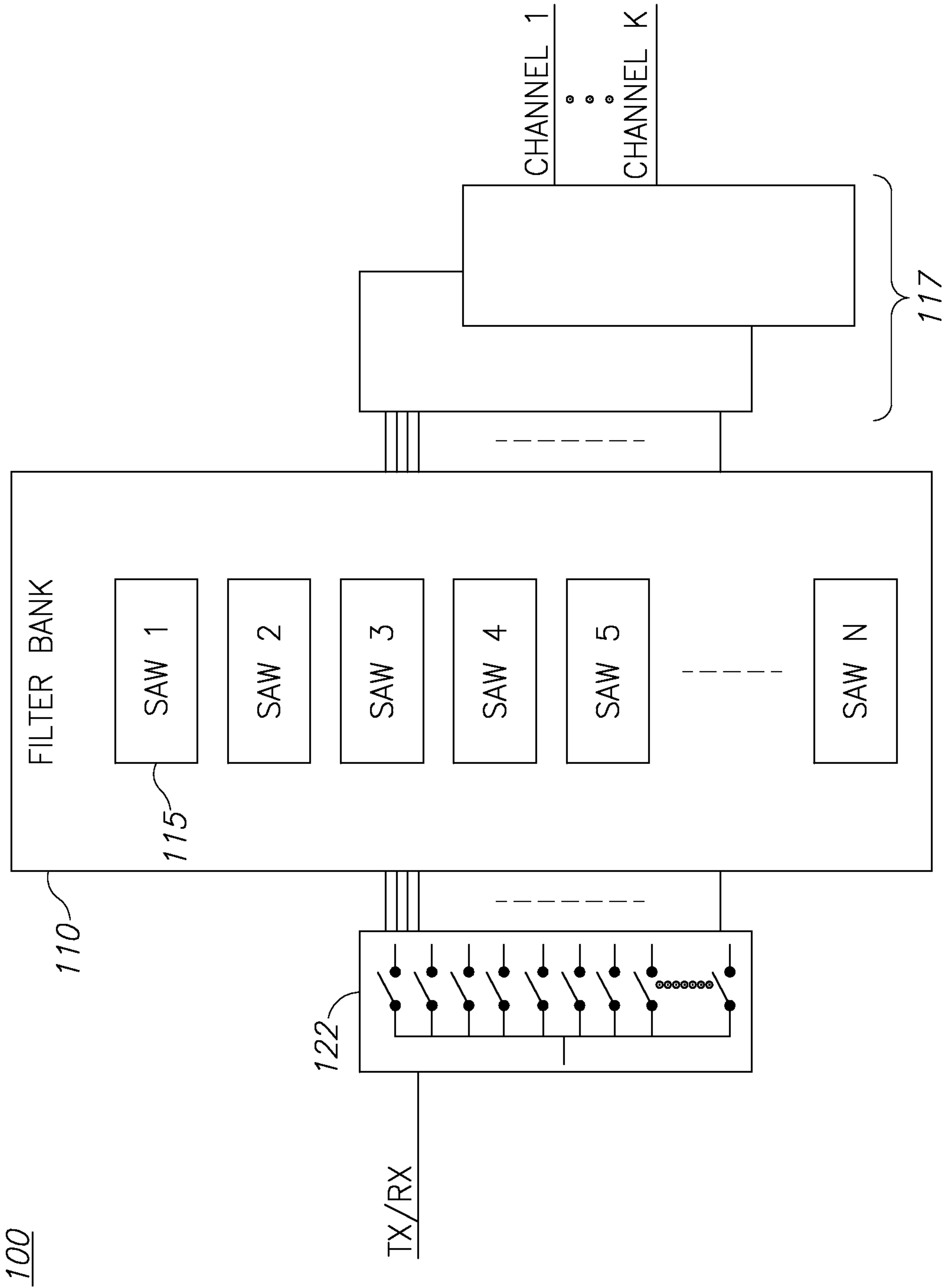


Figure 7

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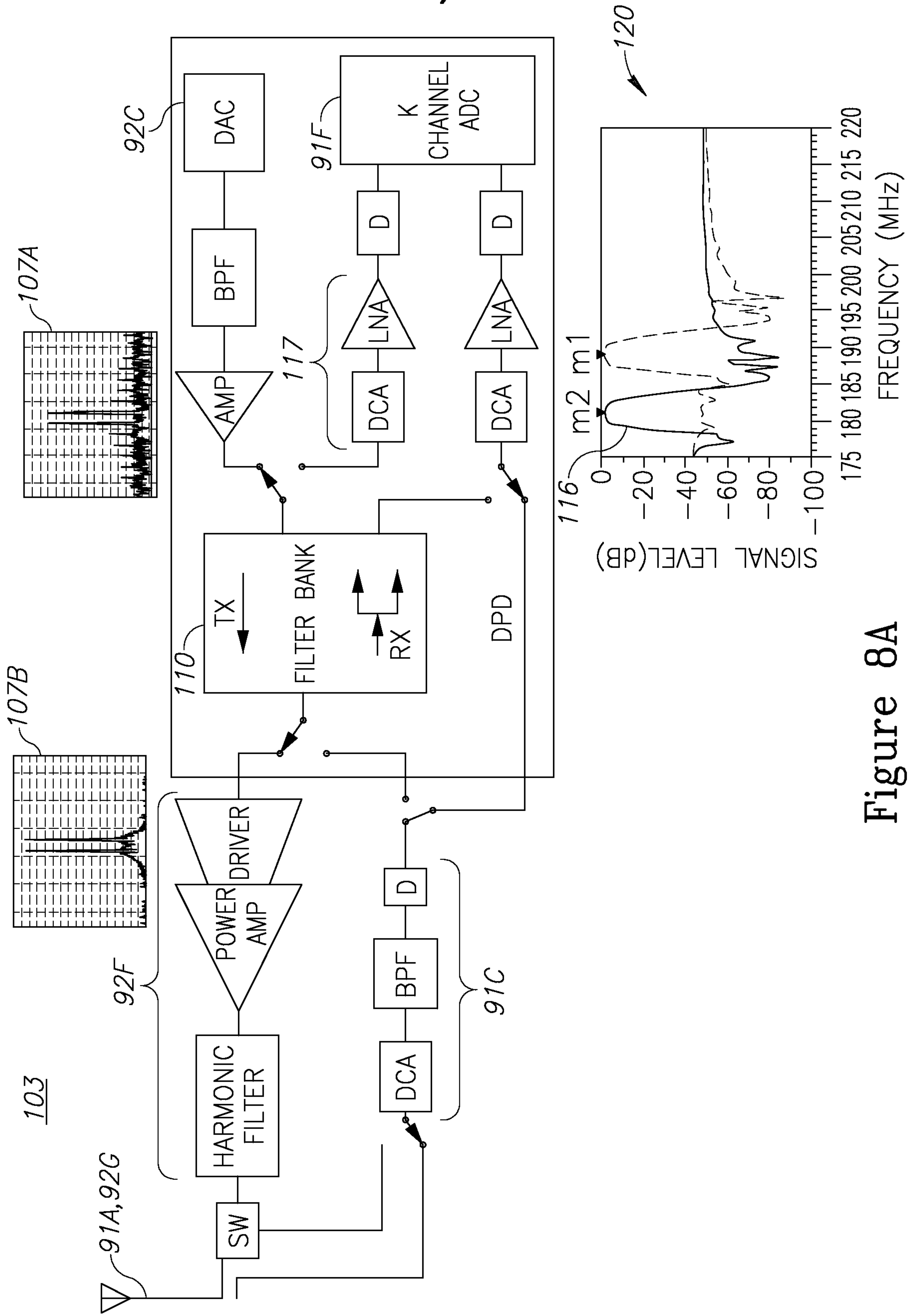
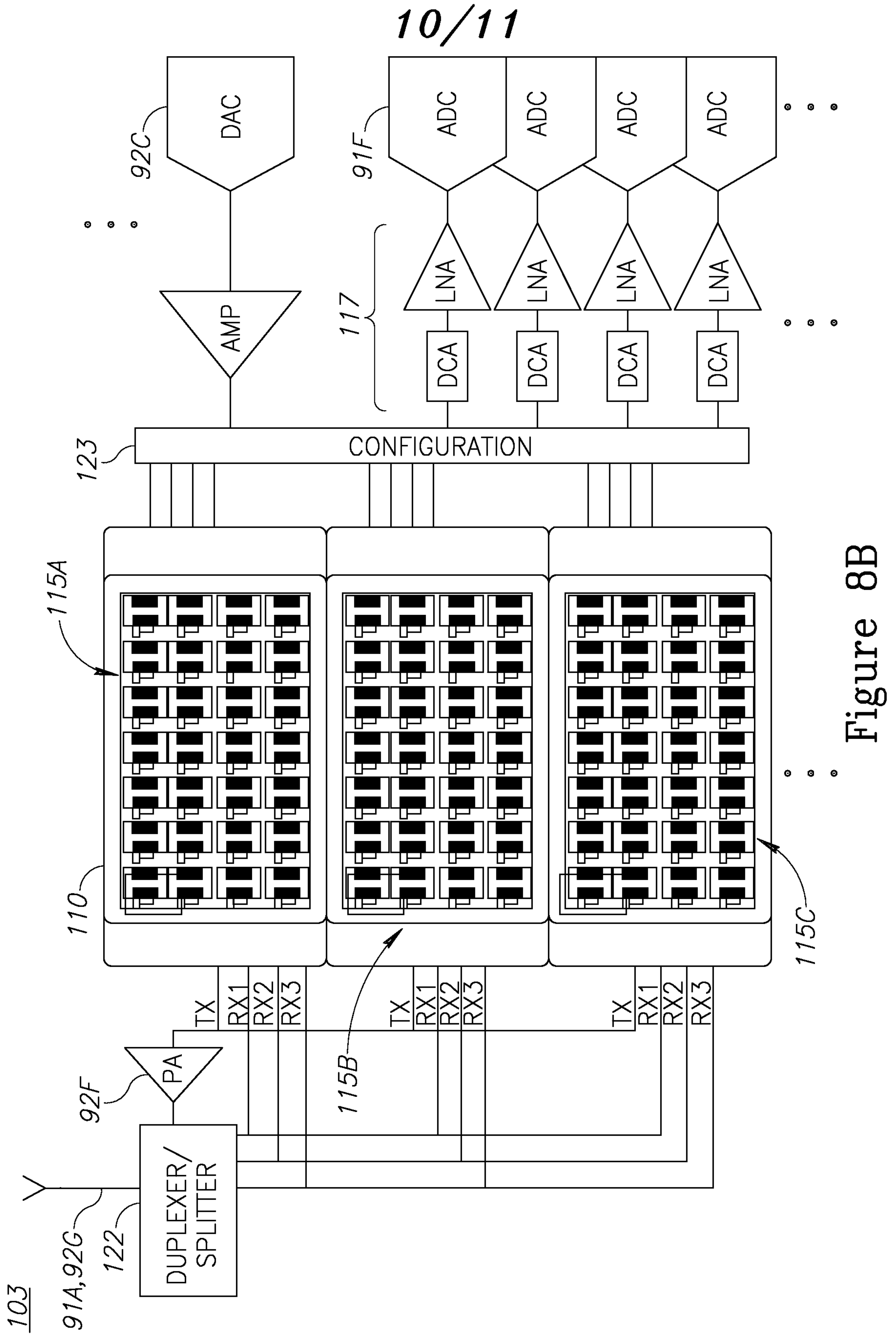
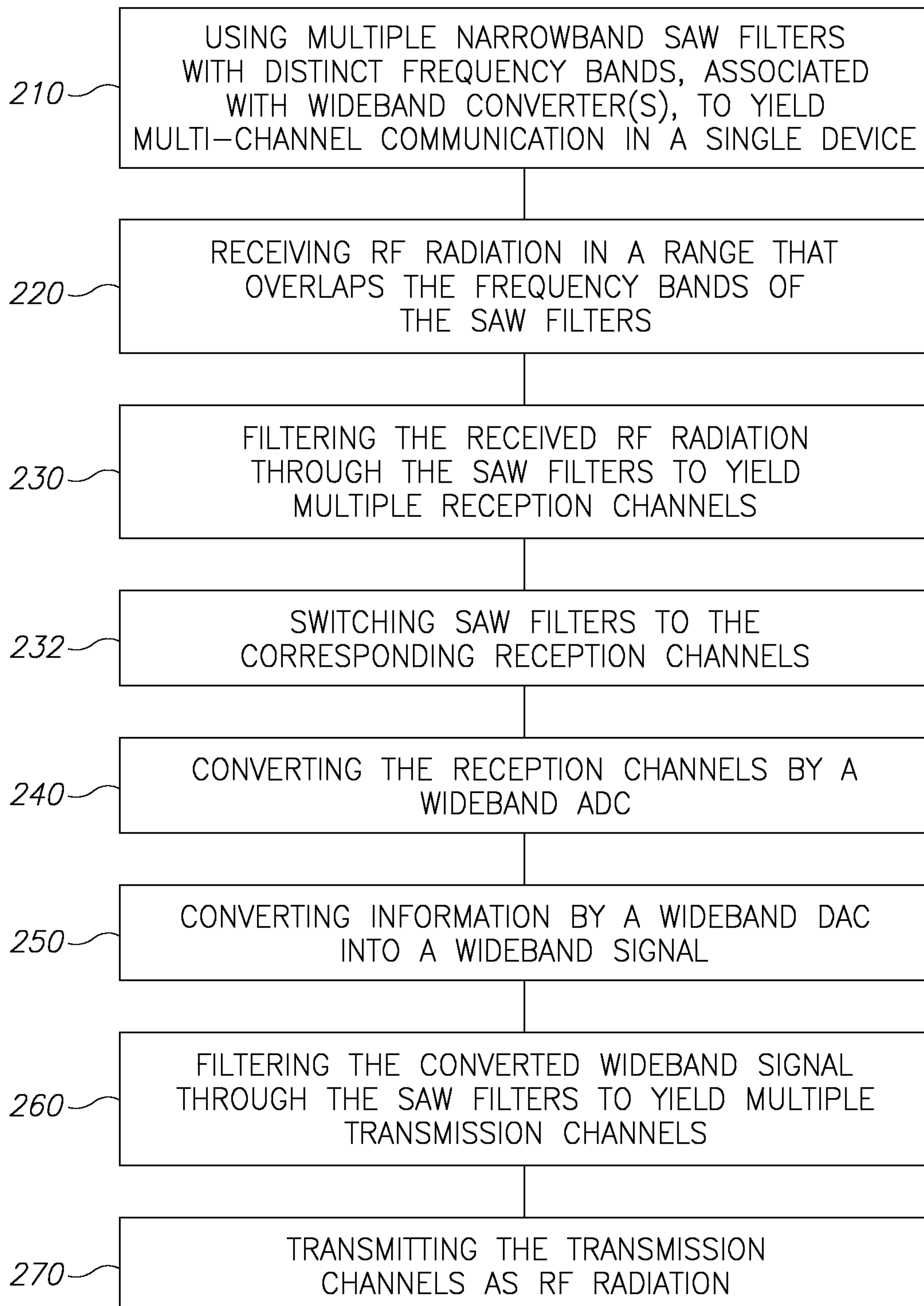
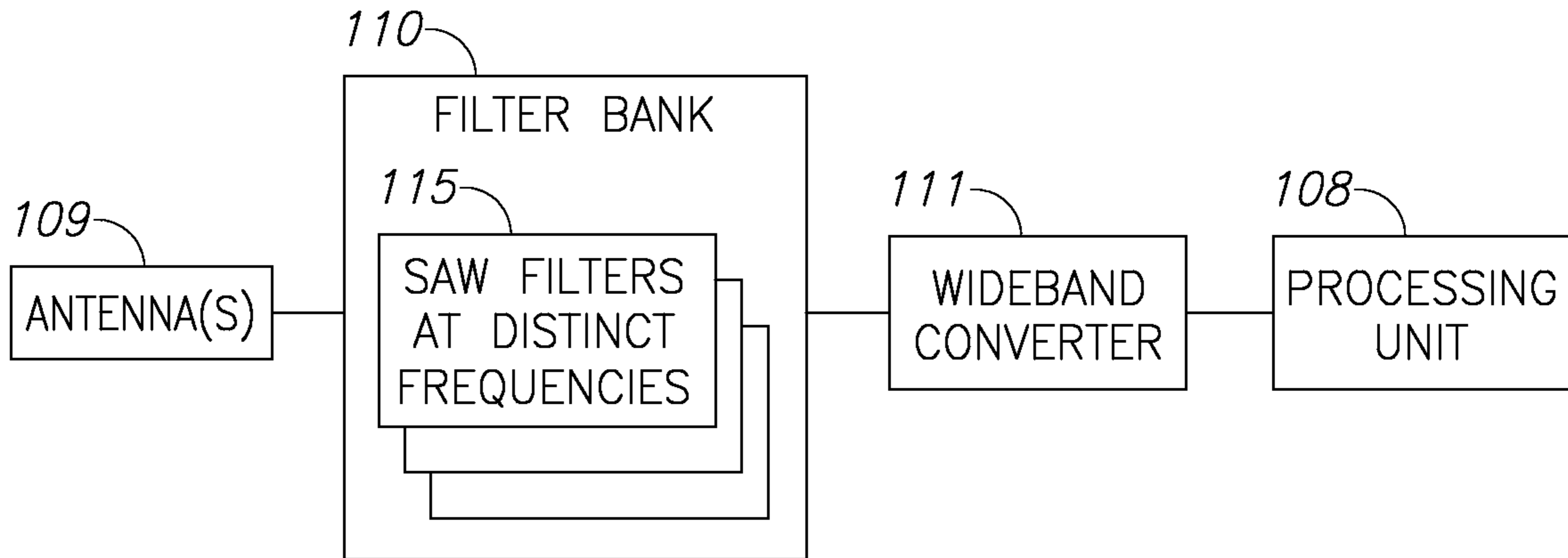


Figure 8A



*11/11*200**Figure 9**

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**Figure 2A**