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APPLICATION NUMBER: ***90/019,255***
FILING DATE: ***September 20, 2023***

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WO 2007/145637 to Michael Anthony Pugel

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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
21 December 2007 (21.12.2007)

PCT

(10) International Publication Number
WO 2007/145637 A1

(51) International Patent Classification:
H04N 5/44 (2006.01)

(21) International Application Number:
PCT/US2006/023664

(22) International Filing Date: 16 June 2006 (16.06.2006)

(25) Filing Language: English

(26) Publication Language: English

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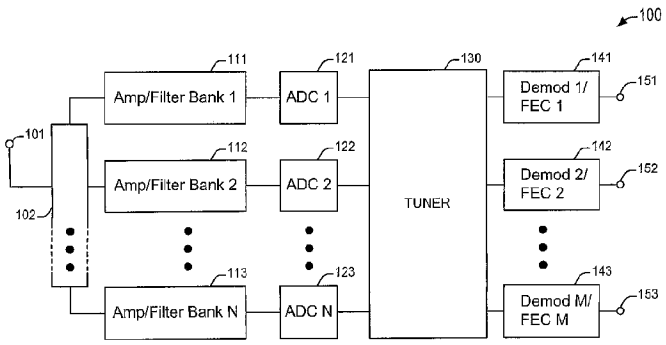
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: MULTICHANNEL DIGITAL CABLE TUNER



(57) Abstract: A method and apparatus is presented for simultaneous reception of a plurality of digital RF channels. Specifically, N amplifier-filter circuits (111, 112, 113) are configured to receive and separate a multichannel analog RF input signal into N analog signals, each including a different frequency band. N analog-to-digital converters (121, 122, 123) are provided, each respectively coupled to one of the N amplifier-filter circuits (111, 112, 113) and configured to receive an analog signal and generate a respective digital signal. A digital tuner (130) is coupled to receive and demultiplex the N digital signals generated by the N analog-to-digital converters (121, 122, 123), thereby recovering M digital RF channels. M demodulation circuits (141, 142, 143) are provided for performing demodulation and forward-error-correction of the M digital RF channels (see FIG. 1). This combination of components permits substantially simultaneous reception of multiple digital cable channels within a single digital receiver circuit suitable for use with conventional cable delivery systems and at a reasonable cost.

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MULTICHANNEL DIGITAL CABLE TUNER

Field of the Invention

[0001] The present invention relates to television communications and, in particular, to an apparatus and method for multi-channel television reception.

Background of the Invention

[0002] In order to accommodate the increasing demands of television consumers, cable television (cable TV or CATV) broadcasters have transformed themselves in recent years to provide digital (as opposed to traditional analog) channels among their broadcast content. Cable TV broadcasters have employed digital technology to, for example, increase the number of offered channels, add per-channel programming information, and provide remote-interaction functionality such as pay-per-view (PPV) movies and sporting events.

[0003] As the benefits of digital cable television have become known, consumer demand has continued to rise, along with demand for increased variety of content. This demand for increased variety has reached the end-user level, where several users within a single household may prefer to enjoy different cable television programs simultaneously. Because digital cable television receivers, or set top boxes (STBs), were previously designed to receive only a single channel at a time, multiple simultaneous channel reception presented a problem for multi-user households.

[0004] Traditional solutions to this problem have included the provision of several receivers or STBs, each located in different rooms of the household. In this way, each television reception device, for example a television set, could be coupled to its own STB, and each user could independently receive and control reception of different cable television programs. These traditional solutions suffered from several disadvantages including increased cost of acquiring a plurality of STBs, increased space requirements for the additional STBs, need for additional household coaxial cable wiring, etc.

[0005] In addition to the above-mentioned disadvantages, traditional solutions lack the flexibility required to keep pace with new developments in consumer demand and diversification of that demand. For example, consumers now demand

support for simultaneous reception and display of multiple television channels on a single television screen (e.g., picture-in-picture (PiP)). In addition, the emergence of personal video recorder (PVR) technology increases the demand for multi-channel reception capability. Many PVR's include the ability to tune one or more channels for viewing, while simultaneously tuning one or more additional channels for recording to a recording medium. The information on the recorded channels is then available for later playback or other processing.

[0006] Along with the ability to simultaneously tune multiple channels it would be advantageous for tuning equipment to include a networking functionality that would allow distribution of received content to various locations, such as various rooms within a residence. It would therefore be desirable to have a distribution network coupled to a multichannel tuner device. Furthermore, it would be advantageous if such a distribution network included a networking device that was integral to a tuner system, thus simplifying setup and maintenance of a network for the redistribution of cable channel content.

[0007] Consumers have begun to demand additional flexibility in the location of reception devices, including handheld personal media devices capable of remotely receiving digital television programs as well as digital music programs, without the increased cost of a plurality of STBs.

Summary of the Invention

[0008] Given consumer demand for increased flexibility and convenience, there is a need for a digital television receiver capable of simultaneously receiving a plurality of channels, designed for delivery of a variety of digital content, and suitable for use with conventional cable television delivery systems.

[0009] The present invention is directed to a method and apparatus for simultaneous reception of a plurality of digital television channels. Specifically, the apparatus of the present invention is directed to a multichannel receiver circuit including a plurality of amplifier-filter circuits configured to receive a multichannel analog RF input signal, the plurality of amplifier-filter circuits including at least a first amplifier-filter circuit configured to generate a first analog signal including a first band of frequencies and a second amplifier-filter circuit configured to generate a second analog signal including a second band of frequencies. A plurality of analog-to-digital

converters is provided, each respectively coupled to one of the plurality of amplifier-filter circuits, the plurality of analog-to-digital converters including at least a first analog-to-digital converter configured to receive the first analog signal and generate a first digital signal and a second analog-to-digital converter configured to receive the second analog signal and generate a second digital signal. A digital tuner is provided, coupled to receive at least the first and second digital signals generated by the plurality of analog-to-digital converters, the digital tuner configured to recover a plurality of digital RF channels.

[0010] In an alternate embodiment, in addition to the above a plurality of demodulator circuits is coupled to the digital tuner, the plurality of demodulator circuits including at least a first demodulator circuit configured to receive and demodulate a first channel of the plurality of digital RF channels and a second demodulator circuit being configured to receive and demodulate a second channel of the plurality of digital RF channels. The plurality of demodulator circuits includes circuitry configured for forward error correction.

[0011] The method of the present invention includes receiving at least one multichannel analog RF input signal; separating the multichannel analog RF input signal into at least two analog signals including a first analog signal including a first band of frequencies and a second analog signal including a second band of frequencies; converting the at least two analog signals into at least two respective digital signals, including converting the first analog signal into a first digital signal and converting the second analog signal into a second digital signal; and demultiplexing the at least two digital signals to recover the plurality of digital RF channels.

[0012] In an alternative embodiment, in addition to the above steps the method includes demodulating the plurality of digital RF channels, including at least demodulating a first digital RF channel and demodulating a second digital RF channel; and forward-error-correcting the plurality of digital RF channels, including at least performing a first forward-error-correction of the first digital RF channel and performing a second forward-error-correction of the second digital RF channel.

[0013] This combination of components, when employed in the configuration of the present invention, permits substantially simultaneous reception of a plurality of digital cable television channels within a single digital receiver circuit. These

advantages can be provided in a form suitable for use with conventional cable television delivery systems and at a reasonable cost.

Brief Description of the Drawings

[0014] In the drawings:

[0015] Fig. 1 is a simplified block diagram illustrating an exemplary multichannel receiver circuit in accordance with the present invention;

[0016] Fig. 2 is a simplified block diagram illustrating a portion of the exemplary multichannel receiver circuit shown in Fig. 1;

[0017] Fig. 3 is a simplified block diagram illustrating another portion of the exemplary multichannel receiver circuit shown in Fig. 1;

[0018] Fig. 4 is a flow diagram illustrating an exemplary method of receiving a plurality of digital RF channels in accordance with an alternate embodiment of the present invention.

Detailed Description

[0019] The following discussion of the method and apparatus directed to a multichannel receiver circuit will help illuminate the features and advantages of the present invention, including its ease of formation using conventional techniques of constructing electronic devices and circuits which are well known in the art.

[0020] In the following discussion, the singular term "signal" and plural term "signals" are used interchangeably and are to be understood as including analog or digital information, at a single frequency or a plurality of frequencies, and may or may not include coding, modulation, sideband information, or other features of signals or waveforms well known in the art. Furthermore, when reference is made to a "receiver," "transmitter," "output," or "input," previous process steps may have been utilized to form signals or waveforms compatible with these features.

[0021] In addition, no particular order is required for the method steps described below, with the exception of those logically requiring the results of prior steps, for example converting of the first and second analog signals into first and second digital signals logically requires the prior generation of first and second analog signals. Otherwise, enumerated steps are provided below in an exemplary order which may

be altered. For instance, the several demodulation steps may be rearranged or performed simultaneously.

[0022] An exemplary embodiment of the invention will now be described with reference to FIG. 1. Although the invention will be described using the environment of reception of cable television signals, it should be apparent that the invention may be used in other types of radio-frequency communications systems as well, including reception of digital television channels via satellite and terrestrial television transmission systems. In contrast to the scheme described above, exemplary embodiments of the present invention provide substantially simultaneous recovery of a plurality of digital RF channels within a single multichannel receiver circuit, thereby reducing cost and increasing system flexibility.

[0023] FIG. 1 shows a simplified block diagram representation of a multichannel receiver circuit generally designated 100 in accordance with an aspect of the present invention. The multichannel receiver circuit 100 includes a plurality of amplifier-filter banks or circuits 111, 112, 113, a plurality of analog-to-digital converters 121, 122, 123, a digital tuner 130, and a plurality of demodulator circuits 141, 142, 143. It should be apparent from FIG. 1 that, although three instances of each plurality are shown, the present invention is not so limited and any number of amplifier-filter circuits, analog-to-digital converters, and/or demodulator circuits may be used in accordance with the present invention. In addition, the number (1 . . . M) of demodulator circuits provided is not necessarily related to the number (1 . . . N) of amplifier-filter circuits and/or analog-to-digital converters provided, and accordingly the present invention should not be so limited.

[0024] In operation, according to one embodiment, a multichannel analog RF input signal received at input coupler 101 is split into a plurality of substantially identical signals at splitter 102. Splitter 102 may include one or more amplifiers, filters, or other components (not shown) which reduce or overcome insertion loss or other adverse effects of the split, as should be apparent to one of ordinary skill in the art. The plurality of amplifier-filter circuits 111, 112, 113 then segregates the multichannel analog input signal into a plurality of separate analog signals of differing frequency ranges, or "bands." Each separate analog signal is then converted from analog to digital form in an analog-to-digital converter 121, 122, 123.

[0025] It should be noted that, in one embodiment of the invention, the splitter 102 is omitted. In this embodiment,the respective inputs of the amplifier/filter banks 111, 112, 113 are mutually directly connected to the input coupler 101. The amplifier/filter banks 111, 112, 113 serve as a demultiplexer to demultiplex the incoming signal received at the input coupler 101. In one embodiment, each amplifier/filter bank has particular characteristics that permit the passage of a specific range of frequencies substantially independent of the frequency selection characteristics of the other amplifier/filter banks. For example, one filter might have a pass-band of about 5 to about 300 MHz, while another filter might have a pass band of about 300 to about 600 MHz.

[0026] In one embodiment, the band break edges would be passed through two amplifier sets, e.g., amplifier/filter banks 111, 112. Thus, for example, the channels present just above a distal 300 MHz would pass through both the the 5 to 300 MHz filter and the 300 to 600 MHz filter. This helps to ensure the continuous coverage of all channel despite non-ideal filter characteristics.

[0027] The converted digital signals are coupled to the digital tuner 130, which demultiplexes the converted digital signals to generate a plurality of digital channel signals. Each digital channel signal is then coupled to a separate demodulator 141, 142, 143, which performs demodulation and forward-error-correction (FEC) operations appropriate for the content of that digital channel. Finally, in one embodiment, the resulting digital channel signals are each coupled to a separate output coupler 151, 152, 153 for further processing including for example MPEG transport processing.

[0028] Each of the plurality of amplifier-filter banks or circuits 111, 112, 113 is configured to process frequencies within a specified band. For example, a first amplifier-filter circuit 111 may be configured to process frequencies from about 5 MHz to about 300 MHz, a second amplifier-filter circuit 112 may be configured for frequencies between about 300 MHz and about 600 MHz, and a third amplifier-filter circuit 113 may be configured for frequencies from about 600 MHz to about 900 MHz. In such an example, the present invention may be used to recover a plurality of digital cable television channels from a multichannel analog RF input signal which includes frequencies ranging from about 5 MHz to about 900 MHz.

[0029] Referring now to FIG. 2, each amplifier-filter circuit 111, 112, 113 includes at least an amplifier 201, 203, 205 and a filter 202, 204, 206, respectively. Each of the amplifiers 201, 203, 205 may be a low-noise amplifier (LNA) or other amplifier suitable for use in analog RF front-end applications.

[0030] Each of the filters 202, 204, 206 may be band-pass filters (BPF) or other devices suitable for passing a range or band of frequencies while simultaneously filtering out or attenuating other frequencies outside the range or band. Each of the amplifier-filter circuits 111, 112, 113 may include one or more additional components (not shown) for accomplishing segregation of the analog input signal as described above.

[0031] In addition, each of the filters 202, 204, 206 may include a gain controlled amplifier. In an exemplary embodiment, each of the filters 202, 204, 206 includes a gain control input that allows adjustment of the respective gain of the filter. The system may thus be configured to allow adjustment of the filters to correspond to a range of possible received signal levels from the system while maintaining desirable signal levels at the inputs of the A/D converters. In one embodiment of the invention, a device is provided for comparing an output of the filter to a set-point value and controlling filter gain in a feedback loop.

[0032] Each amplifier-filter circuit 111, 112, 113 should preferably be physically separate and may be configured to amplify a particular range of frequencies without producing substantial intermodulation distortion effects. Alternatively, the amplifier-filter circuits 111, 112, 113 may be co-located in a single package configured to permit processing of signals within each band separately and independently (e.g., substantially free of intermodulation distortion attributable to simultaneous amplification of a wide range of frequencies). The amplifier-filter circuits 111, 112, 113 should preferably be configured to minimize degradation of one or more signal characteristics particularly susceptible to front end effects, such as noise figure, sensitivity, and dynamic range.

[0033] By employing undersampling techniques, various embodiments of the present invention may be economically implemented. As would be understood by one of ordinary skill in the art, the Nyquist criterion is met as long as the bandwidth of a signal is less than half of the sampling frequency. In one embodiment of the invention, each band has a bandwidth of about 300 MHz. Accordingly, each of the

A/D converters 121, 122, 123 can recover a respective target frequency if operated at a sampling frequency of 600 MHz. In addition, since each of the bands has substantially the same bandwidth, a single 600 MHz clock is sufficient to provide a clock frequency for all of the analog-to-digital converters. Consequently, in one embodiment, a single clock device can provide the requisite clock signal for all of the A/D converters. Moreover, the required frequency is not remarkably high, facilitating design and implementation of the clock device.

[0034] Without the use of undersampling the system would require, for example, a first analog-to-digital converter 121 operating with a sampling frequency of about 600 MHz for processing frequencies in a band from about 5 MHz to about 300 MHz , a second analog-to-digital converter 122 operating with a sampling frequency of about 1.2 GHz for processing frequencies in a band between about 300 MHz and about 600 MHz, a third analog-to-digital converter 123 operating with a sampling frequency of about 1.8 GHz, for processing frequencies in a band from about 600 MHz to about 900 MHz, etc.

[0035] In accordance with an aspect of the invention, each analog-to-digital converter 121, 122, 123 may include a frequency selector 211, 212, 213 for setting the sampling frequency and/or input frequency corresponding to the desired band. For example, a first analog-to-digital converter 121 may include a first frequency selector 211 including a clock input coupler on which a clock signal is transmitted, indicating the desired sampling frequency of the first analog-to-digital converter 121. Other forms of communicating a desired sampling frequency of each of the analog-to-digital converters 121, 122, 123 may be utilized in accordance with the present invention, as would be appreciated by one of ordinary skill in the art.

[0036] Each analog-to-digital converter 121, 122, 123 should have resolution and linearity characteristics sufficient for satisfactorily processing digital television signals and associated signals intended for end users in a conventional cable television broadcast system. For example, each analog-to-digital converter 121, 122, 123 may produce from about 1024 to about 65536 discrete values, corresponding to a resolution of 10 (i.e., $2^{10} = 1024$) to 16 (i.e., $2^{16} = 65536$) bits.

[0037] Referring now to FIG. 3, a digital tuner 130 is provided for processing the digital signals converted by the plurality of analog-to-digital converters 121, 122, 123. The digital tuner 130 may include one or more digital multiplexers or demultiplexers

capable of generating a plurality of digital channel signals from the converted digital band signals. The digital tuner 130 may include a multitude of components configured as is well known in the art to recover a plurality of digital channel signals substantially simultaneously using a plurality of separate digital processors or a single digital processor.

[0038] The digital tuner 130 may include a channel selector 315 to permit selection of one or more particular digital channels desired to be recovered. For example, a selected set of digital cable television channels may be communicated to the digital tuner 130 via the channel selector 315 corresponding to a plurality of pay-per-view selections desired by members of a household; the digital tuner 130 may demultiplex only the digital channel signals corresponding to those digital cable television channels. Alternatively, the digital tuner 130 may be configured to demultiplex and recover all of the available digital channel signals.

[0039] It should be appreciated that the digital tuner 130 in accordance with the present invention is not limited to the above-described operations, but the digital tuner 130 may also perform a variety of other processing operations prior to providing digital channel signals suitable for use in each of the demodulation circuits 141, 142, 143. For example, the digital tuner 130 may perform coding, decoding, scrambling, descrambling, rotating, and/or derotating operations prior to passing the digital channel signals to demodulation circuits 141, 142, 143.

[0040] Each of the demodulation circuits 141, 142, 143 may include one or more demodulators 301, 303, 305 and forward-error-correction (FEC) circuitry 302, 304, 306, respectively. Each of the demodulation circuits 141, 142, 143 may include demodulators 301, 303, 305 configured to perform a particular demodulation function or set of functions corresponding to the type of digital content expected to be found within a corresponding digital channel signal. For example, a first demodulator 301 may be configured to perform quadrature amplitude modulation (QAM) demodulation of digital cable television signals; a second demodulator 303 may be configured to perform quadrature phase shift keying (QPSK) demodulation of digital audio signals; and a third demodulator 305 may be configured to perform vestigial sideband (VSB) demodulation of high-definition television (HDTV) signals. Of course, it should be appreciated that more than one of the plurality of demodulation circuits 141, 142, 143

may be configured to perform similar or identical functions or operations on separate digital channel signals substantially simultaneously.

[0041] Forward-error-correction (FEC) circuits 302, 304, 306 may include one or more components configured for coding or decoding, for example a Reed-Solomon decoder. It should be appreciated that each of the demodulation circuits 141, 142, 143 and/or the digital tuner 130 may include circuitry for providing additional functions, for example adaptive filters for removing multi-path propagation effects, co-channel interference, and other types of radio frequency interference (RFI) well known in the art.

[0042] FIG. 4 shows a flow diagram representation of a method of receiving a plurality of digital RF channels generally designated 400 in accordance with an aspect of the present invention. The method 400 includes a separating step 402, a first converting step 403, a second converting step 404, a demultiplexing step 405, a first demodulating step 406, and a second demodulating step 407.

[0043] The method 400 begins at step 401 and proceeds to step 402 in which a multichannel analog RF input signal is separated into a plurality of analog signals including at least first and second analog signals. The first analog signal includes a first band of frequencies and the second analog signal includes a second band of frequencies. It should be appreciated that the input signal may also be separated into at least a third analog signal including a third band of frequencies, and the first, second, and third bands of frequencies may not necessarily be contiguous.

[0044] In step 403, the first analog signal is converted into a first digital signal using a first analog-to-digital converter. In step 404, the second analog signal is converted into a second digital signal using a second analog-to-digital converter independently of the conversion performed in the first analog-to-digital converter. The first and second analog-to-digital converters may convert different frequency bands from analog to digital form, similar to analog-to-digital converters 121, 122, 123 described above with reference to FIGS. 1 and 2, and each should have a sampling frequency of at least twice the bandwidth of the respective frequency band in accordance with the Shannon-Nyquist sampling theorem. The first and second analog-to-digital converters should perform such conversions with resolution and linearity characteristics sufficient for satisfactorily processing digital television signals

and associated signals intended for end users in a conventional cable television broadcast system.

[0045] In step 405, the first digital signal (converted in the first analog-to-digital converter) and the second digital signal (converted in the second analog-to-digital converter) are demultiplexed to generate a plurality of digital RF channel signals including at least first and second digital RF channel signals. Each of the plurality of digital RF channel signals is typically characterized by a different carrier frequency and a bandwidth or range of frequencies assigned to a particular application or type of content to be carried on that channel. It should be apparent that each digital RF channel signal may in turn carry or provide a plurality of data streams, e.g., audio, video, program information, or interactive content.

[0046] In step 406, the first digital RF channel signal is demodulated and forward-error-corrected. In step 407, the second digital RF channel signal is demodulated and forward-error-corrected. Steps 406 and 407 may be accomplished using demodulation circuits 141, 142, 143 described above with reference to FIGS. 1 and 3. However, the present invention is not so limited and steps 406 and 407 may alternatively be accomplished in any of several other ways known in the art, for example demodulation and forward-error correction steps 406 and 407 may be performed within one or more digital processors temporarily or semi-permanently programmed to perform such operations.

[0047] The method then proceeds to step 407, where it ends until another multichannel analog RF input signal is received from which one or more digital RF channels are desired to be recovered.

[0048] As illustrated in the preceding discussion and accompanying figures, the method and apparatus of the present invention represent an improvement in the state of the art for multichannel digital cable receivers and associated methods. The present invention provides a multichannel receiver circuit and method that accomplishes substantially simultaneous reception of a plurality of digital cable television channels at a reasonable cost. These advantages can be embodied in a single digital receiver circuit capable of recovering a wide variety of digital content, and may be configured for use with conventional cable television delivery systems.

[0049] One of skill in the art will appreciate that the invention, as described above, allows a single device to receive a modulated signal at an input and produce

a plurality of video signals, or other information signals, related to the modulated signal. This plurality of video signals may then be received at respective devices such as, for example, a television display device, a PVR device, a videocassette recorder device, or any other appropriate signal receiving device. These devices may be disposed at respective locations which may or may not be remote from one another. Accordingly, for example, a plurality of television receivers, PVR's, or other devices, may be disposed in respective rooms of a house or multi-unit dwelling, in a respective plurality of offices, or in otherwise separated locations while concurrently receiving signals from a common modulated signal input.

[0050] While the invention has been described in detail in connection with the preferred embodiments known at the time, it should be readily understood that the invention is not limited to such disclosed embodiments. Rather, the invention can be modified to incorporate any number of variations, alterations, substitutions, or equivalent arrangements not heretofore described, but which are commensurate with the spirit and scope of the invention. Accordingly, the invention is not to be seen as limited by the foregoing description, but is only limited by the scope of the appended claims.

CLAIMS

1. An apparatus (100), comprising:

first means for processing (111) an input signal comprising signals in a first frequency band and signals in a second frequency band to produce a first analog signal including signals in the first frequency band and substantially excluding the signals in the second frequency band;

second means for processing (112) the input signal comprising signals in a first frequency band and signals in a second frequency band to produce a second analog signal including signals in the second frequency band and substantially excluding the signals in the first frequency band;

a first analog-to-digital converter (121) for processing the first analog signal to produce a first digital signal representing the signals in the first frequency band;

a second analog-to-digital converter (122) for processing the second analog signal to produce a second digital signal representing the signals in the second frequency band; and

a means for processing (130) the first and second digital signals to simultaneously produce a first output signal representing a first digital channel included in the first frequency band and a second output signal representing a second digital channel included in the second frequency band.

2. The apparatus (100) of claim 1 further comprising a third amplifier-filter circuit (113) configured to process signals within a third frequency band and a third analog-to-digital converter (121) configured generate a third digital signal comprising a representation of said processed signals within said third frequency band.

3. The apparatus (100) of claim 2 wherein said first frequency band includes frequencies from about 5 MHz to about 300 MHz, said second band includes frequencies between about 300 MHz and about 600 MHz, and said third band includes frequencies from about 600 MHz to about 900 MHz.

4. The apparatus (100) of claim 3 wherein said first second and third analog-to-digital converters (121, 122, 123) have sampling frequencies of at least 600 MHz.

5. The apparatus (100) of claim 3 wherein said first second and third analog-to-digital converters (121, 122, 123) are configured for an input frequency of up to about 900 MHz.

6. The apparatus (100) of claim 1 wherein the digital processor (130) includes a frequency selector for selecting a desired sampling frequency.

7. The apparatus (100) of claim 1 wherein each of said first, second, and third analog-to-digital converters (121, 122, 123) have a resolution of at least about 10 bits.

8. The apparatus (100) of claim 1 wherein each of said first, second, and third analog-to-digital converters (121, 122, 123) have a resolution from about 10 to about 16 bits.

9. The apparatus (100) of claim 1 wherein said digital processor (130) is configured to recover substantially all signals with said first and second frequency bands.

10. The apparatus (100) of claim 1 wherein said digital processor (130) is configured to recover a selected set of signals with said first and second frequency bands.

11. The apparatus (100) of claim 10 wherein said digital processor (130) is configured to recover said selected set of signals with said first and second frequency bands substantially simultaneously.

12. The apparatus (100) of claim 1 further comprising a first demodulator circuit (141) coupled to said digital processor (130) and a second demodulator circuit (142) coupled to said digital processor (130).

13. The apparatus (100) of claim 12 wherein said first and second demodulator circuits (141, 142) include circuitry configured for forward error correction (302, 304, 306).

14. The apparatus (100) of claim 12 where said digital processor (130) multiplexes said first, second, and third digital signals, downconverts said multiplexed signal and extracts desired information to be coupled to said first and second demodulator circuits (141, 142).

15. The apparatus (100) of claim 12 where said digital processor (130) downconverts and extracts desired information to be coupled to said first and second demodulator circuits (141, 142) from each of said first, second, and third digital signals individually.

16. The apparatus (100) of claim 1 wherein said apparatus (100) processes frequencies between about 5 MHz and about 900 MHz.

17. The apparatus (100) of claim 1 wherein apparatus (100) processes cable television channels.

18. A method (400) processing signals comprising the steps of:

(a) separating an input signal into a first analog signal and a second analog signal;

(b) digitizing said first analog signal to generate a first digital signal;

(c) digitizing said second analog signal to generate a second digital signal;

(d) downconverting said first digital signal and said second signal; and

(e) extracting desired television program information from said downconverted first digital signal and said second digital signal.

19. The method (400) of claim 18, further comprising the steps of:

(a) demodulating (406, 407) said extracted television program information;

(b) forward-error-correcting (406, 407) said extracted television program information;

20. The method (400) of claim 18 further comprising the steps of:

(a) multiplexing said first digital signal and said second digital signal after said digitizing steps and before said downconverting step.

21. The method (400) of claim 18 further where said downconverting step comprises downconverting each of said first and second set of signals individually.

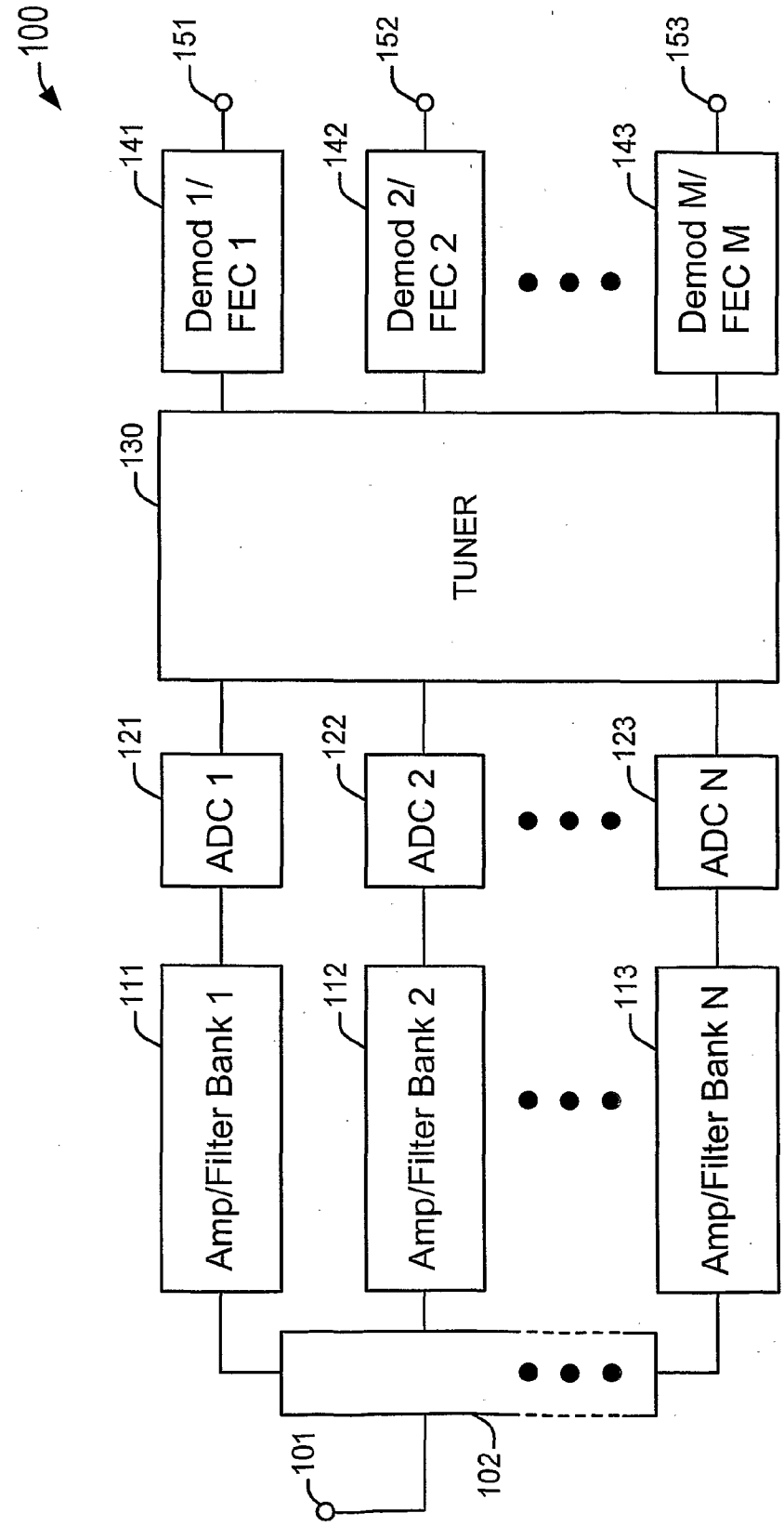

100
151
152
153
141
142
143
Demod 1/ FEC 1
Demod 2/ FEC 2
Demod M/ FEC M
130
TUNER
121
122
123
ADC 1
ADC 2
ADC N
111
112
113
Amp/Filter Bank 1
Amp/Filter Bank 2
Amp/Filter Bank N
101
102

FIG. 1

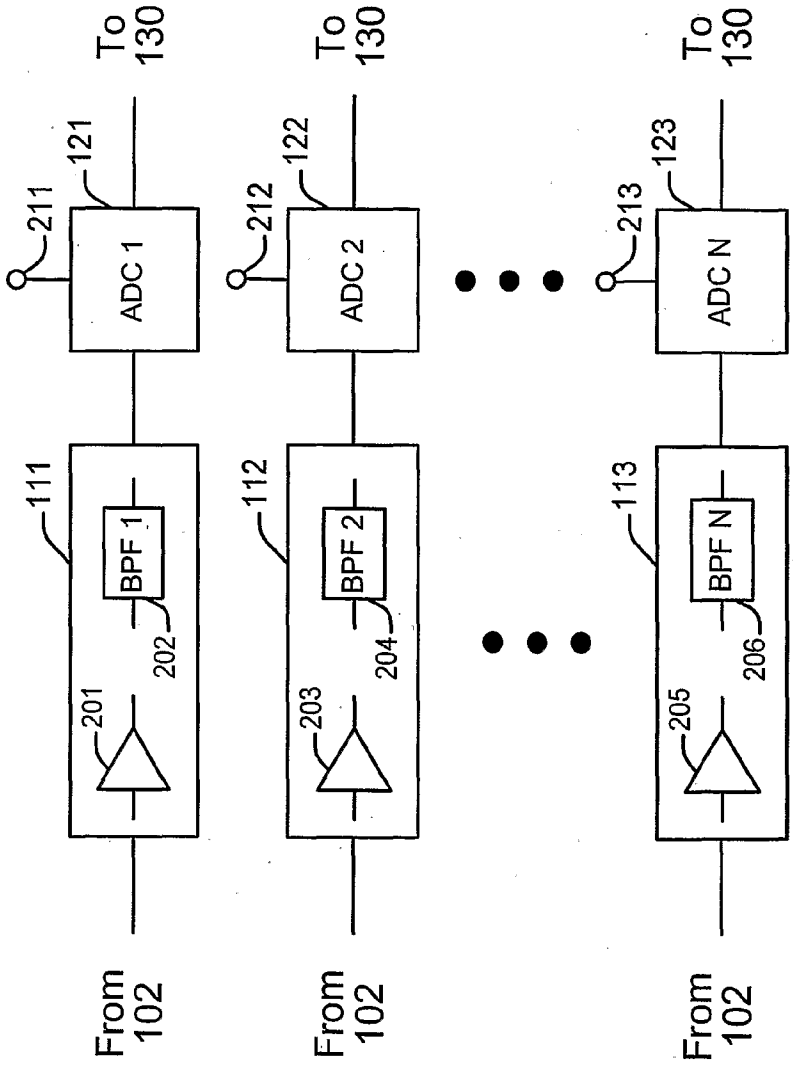

From 102
From 102
From 102
111
112
113
BPF 1
BPF 2
BPF N
202
204
206
201
203
205
ADC 1
ADC 2
ADC N
211
212
213
121
122
123
To 130
To 130
To 130

FIG. 2

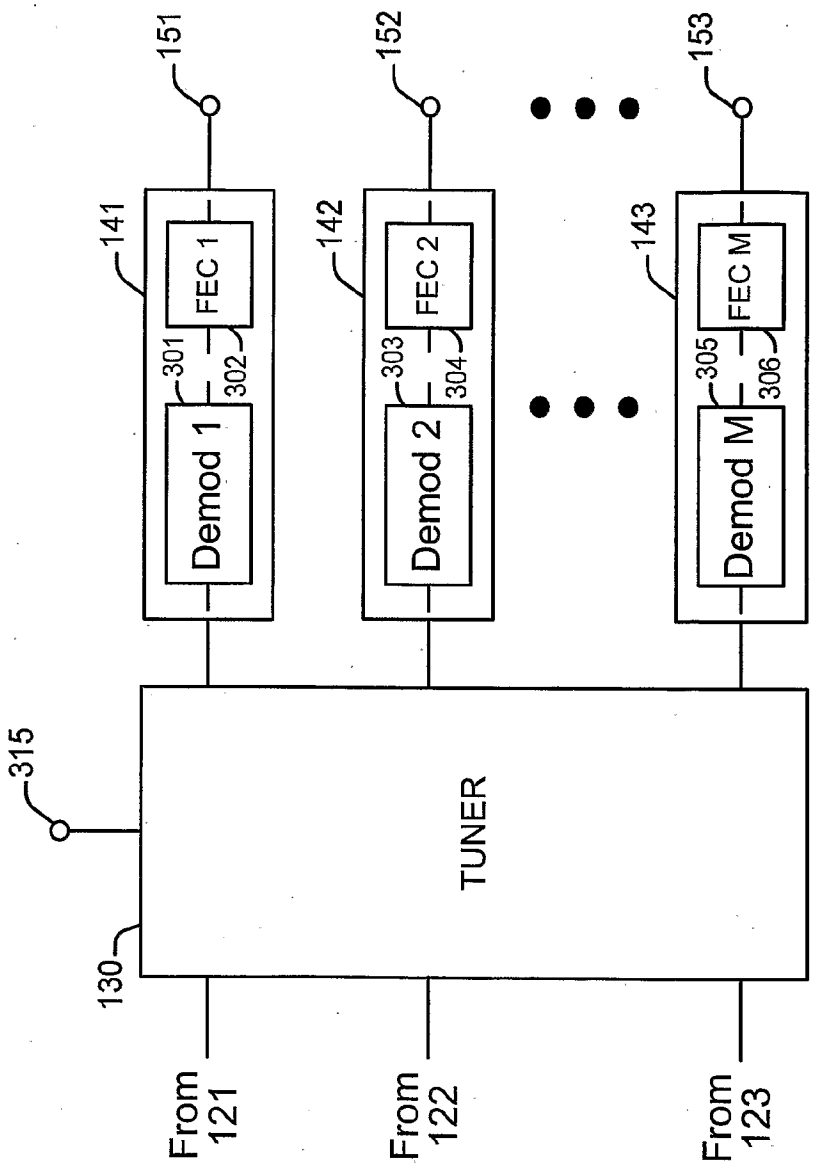

151
152
153
141
142
143
FEC 1
FEC 2
FEC M
301
302
303
304
305
306
Demod 1
Demod 2
Demod M
315
TUNER
130
From 121
From 122
From 123

FIG. 3

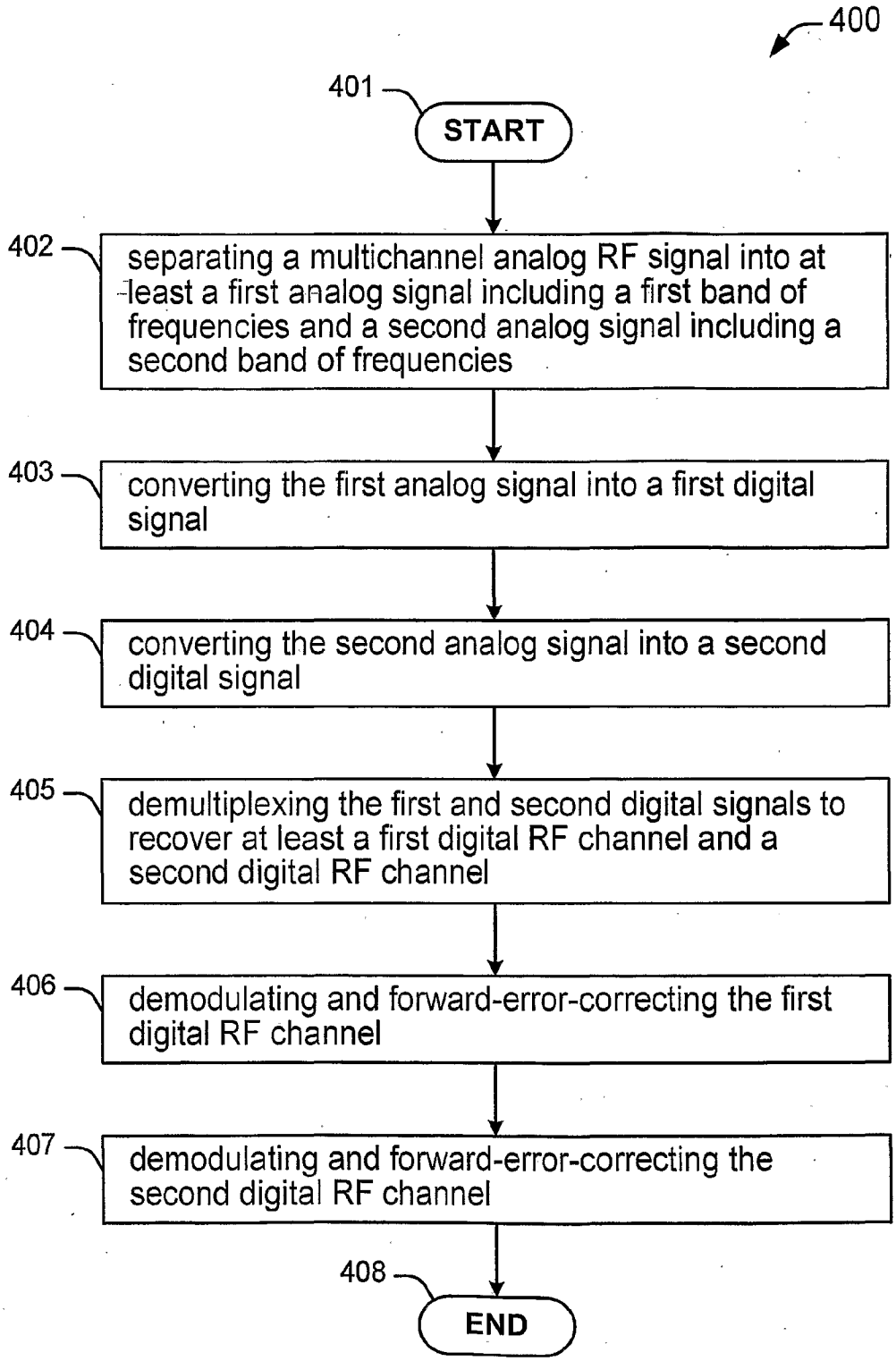

400
401
START
402
separating a multichannel analog RF signal into at least a first analog signal including a first band of frequencies and a second analog signal including a second band of frequencies
403
converting the first analog signal into a first digital signal
404
converting the second analog signal into a second digital signal
405
demultiplexing the first and second digital signals to recover at least a first digital RF channel and a second digital RF channel
406
demodulating and forward-error-correcting the first digital RF channel
407
demodulating and forward-error-correcting the second digital RF channel
408
END

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/023664

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04N5/44

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/204034 A1 (HANRAHAN ROBERT MASON [US]) 14 October 2004 (2004-10-14)	1,2, 9-12,14, 15,17, 18,20,21
Y	the whole document	3-8,13, 16,19
Y	WO 01/20792 A1 (SARNOFF CORP [US]; MALKEMES ROBERT [US]) 22 March 2001 (2001-03-22) page 4, line 19 - page 5, line 27 page 6, line 29 page 8, line 16 - line 22	3-8,16
Y	US 2005/012869 A1 (AKIYAMA TOSHIFUMI [JP]) 20 January 2005 (2005-01-20) figures 4,5	13,19

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 February 2007	26/02/2007

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax (+31–70) 340–3016	Yvonnet, Joel

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/023664

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2005/190777 A1 (HESS KENDAL M [US] ET AL) 1 September 2005 (2005-09-01) figures 6,7	1,18
A	US 5 068 918 A (VERHEIJEN PAULUS A M [NL] ET AL) 26 November 1991 (1991-11-26) column 3, line 20 - line 26	1,18

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2006/023664

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		JP 2005039395 A	10-02-2005
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		JP 3064217 A	19-03-1991
		NL 8901460 A	02-01-1991

Form PCT/ISA/210 (patent family annex) (April 2005)

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
90/019,255	**09/20/2023 02:38:27 PM ET**	**50348.106**

Title of Invention

WIDEBAND TUNER ARCHITECTURE

Application Information

APPLICATION TYPE	Utility / ex parte reexam	PATENT #	9210362
CONFIRMATION #	5785	FILED BY	Krista Myrick
PATENT CENTER #	62831599	AUTHORIZED BY	Raghav Bajaj
CUSTOMER #	23446	FILING DATE	-
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Madhukar Reddy

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
DA / 506990	**E20239J E39175349**	**Krista Myrick**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1812	REQUEST FOR EX PARTE REEXAM-NON-STREAMLINED	12600.00	1	12600.00
			TOTAL AMOUNT:	**$12,600.00**

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National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C.

371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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Exhibit 1012

"RF CMOS Mixer Design and Optimization for Wideband CDMA Application," Li et al., IEEE 2000.

RF CMOS MIXER DESIGN AND OPTIMIZATION FOR WIDEBAND CDMA APPLICATION

Shenggao Li, Jerasimos Zohios, Jung H Choi, Mohammed Ismail

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ABSTRACT

This paper presents the design of a Gilbert downconversion mixer for wideband CDMA application. The mixer is designed using a 0.18um 1.5V/3.3V dual-voltage digital CMOS technology. Design methodology is presented to achieve high linearity and low noise figure. A design flow is introduced targeting the automatic design and optimization for mixers.

I. INTRODUCTION

An important driving force in RF ICs development is the pursuing of single-chip integrated RF CMOS transceivers. Compared with GaAs, Bipolar and BiCMOS, CMOS is the most affordable technology. Most of digital systems such as microprocessor and DSP are designed using CMOS technology. Therefore, full integration of RF transceivers in CMOS technology means the possibility of integrating a whole system such as a cellular phone in a single chip. This can greatly reduce system design cost, system volume, as well as power consumption, all of which are highly desirable in today's portable systems.

Downconversion mixer is one of the important building blocks for RF transceivers in wireless communications. Modern wireless communication standards such as GSM, CDMA, DECT, GPS, as well as the under going Bluetooth, demands high performance RF front ends, which are very often constrained by the achievable power gain, noise figure and linearity of the low noise amplifier (LNA) and downconversion mixers. Particularly, many design challenges exist when these RF blocks and a whole transceiver are to be implemented in CMOS process.

This paper presents the design of a Gilbert cell mixer for the wideband CDMA application at the 2.4 – 2.48 GHz ISM band, targeting the full integration of a direct downconversion transceiver. Section II briefly presents the direct downconversion transceiver and the gilbert cell mixer, followed by the discussion of noise performance estimation in section III. Section IV describes the design procedure, which is part of our goal to seek a systematic flow for mixer design and optimization. Finally, we make our conclusions in section V.

This work was supported in part by TI Fellowship

II. CIRCUIT DESCRIPTION

A. Direct downconversion transceiver

Among different transceiver topologies, the direct downconversion (or homodyne) transceiver stucture as shown in Fig. 1 is a good candidate for fully integrated transceivers, since it eliminates the image rejection filter and IF filters which are bulky but necessary in a conventional heterodyne transceiver. A major drawback that limits the wide application of direct downconversion transceivers is DC offset resulting from LO leakage and self-mixing. Specifically, the LO signal of a mixer can leak to the RF port and is returned by the preceding LNA and the antenna. The returned signal then mixes with the LO signal, generating a DC offset voltage that is often large enough to saturate subsequent stages including VGA, ADC, and etc. Extra design effort is required to alleviate the DC offset problem. In our specific case for the wideband CDMA application in the frequency range of 2.4 – 2.48 GHz, signal is spread over a 32 MHz bandwidth through pesudo random sequences. By adopting differential coding scheme, the DC component in the downconverted signal does not contain useful information at all. The bandpass filters in Fig. 1 after the mixer can then serve to remove the DC offset. The lower high-pass conner frequency of the bandpass filters is around 1 to 2 kHz, which further removes flicker noise generated by the LNA and the mixer. Meanwhile, because useful information is spread over a wide frequency band, the relatively very small high-

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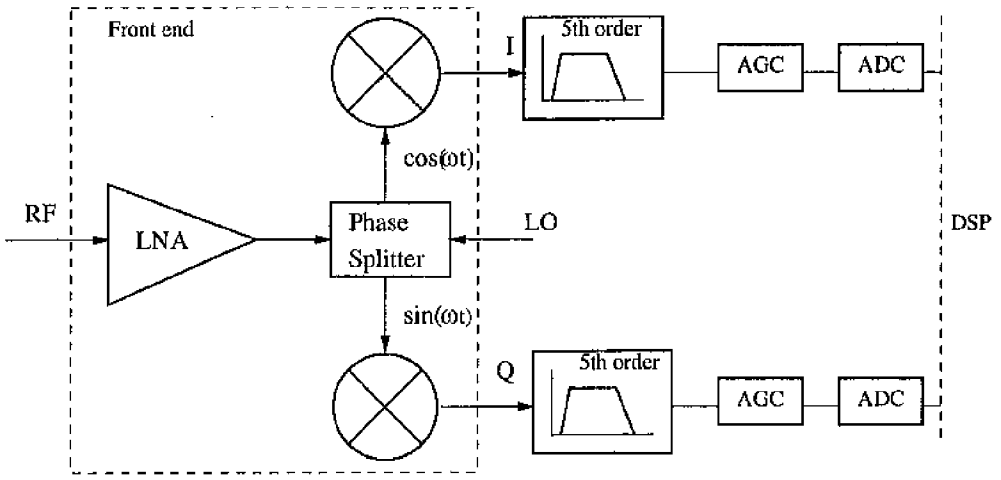


Figure 1: Direct downconversion transceiver

pass conner frequency of the band-pass filter will not seriously degrade system performance.

B. Gilbert mixer

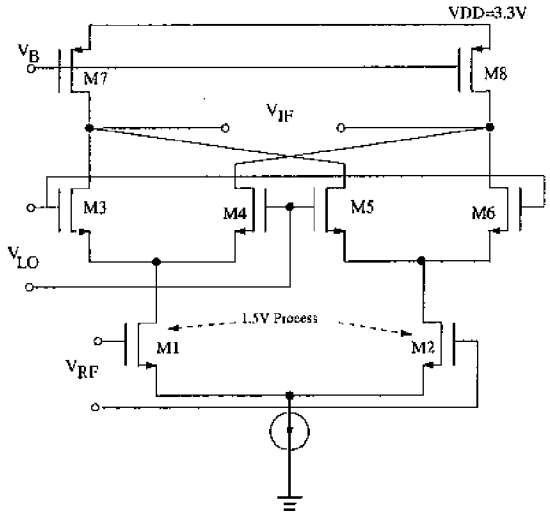


Figure 2: The Gilbert cell

Shown in Fig. 2 is the commonly used Gilbert mixer. Transistors M1-2 form the input transconductors, which convert input RF voltage signal into current signal. Transistors M3-6 are commutating switches, which are turned on and off by the LO signal, accordingly, current signals from the transconductors are delivered to different branches. The net effect of the switching activities is that the RF current signals are multiplyed with the LO signals. Transistors M7-8 serve as active loads. The differential IF output signal is acquisited from these two loads. Fig. 3 demonstrates the downconversion process.

Since the Gilbert mixer is fully differential, any common mode high frequency signals from the LO and RF ports will be substracted at the output. The mixer is expected to have very good RF-to-IF and LO-to-IF isolation performance. In addition, any second order harmonics at the two IF output ports are canceled by the differential output. Note that such quality greatly depends on the switching behavior and transistors working region.

As is well-known, the drain-source current is generally the square of the gate-source voltage for long-channel MOS transistors. The transconductors M1-2 used here hence present nonlinearity when converting input RF voltage signal to current signal. The nonlinearity causes intermodulation. When two signals with close frequencies pass a nonlinear device, the output will contain series of high order harmonics and intermodulation products. Among them, the 2nd and 3rd intermodulation products are of our concern, since they can mix with the LO signal and generate sideproducts which are in the IF frequency band, resulting in signal distortion. Various methods such as source degeneration or translinear loop [2] are used to improve the linearity of the transconductors. We will address this issue later on in this section.

The tail current of the gilbert cell is supplied by a well-known wide-swing current mirror [1] as shown in Fig. 4. The cascaded transistors can provide a nearly constant tail current, while the current of a regular single-stage current mirror will vary over a wide range when its drain source voltage changes. A

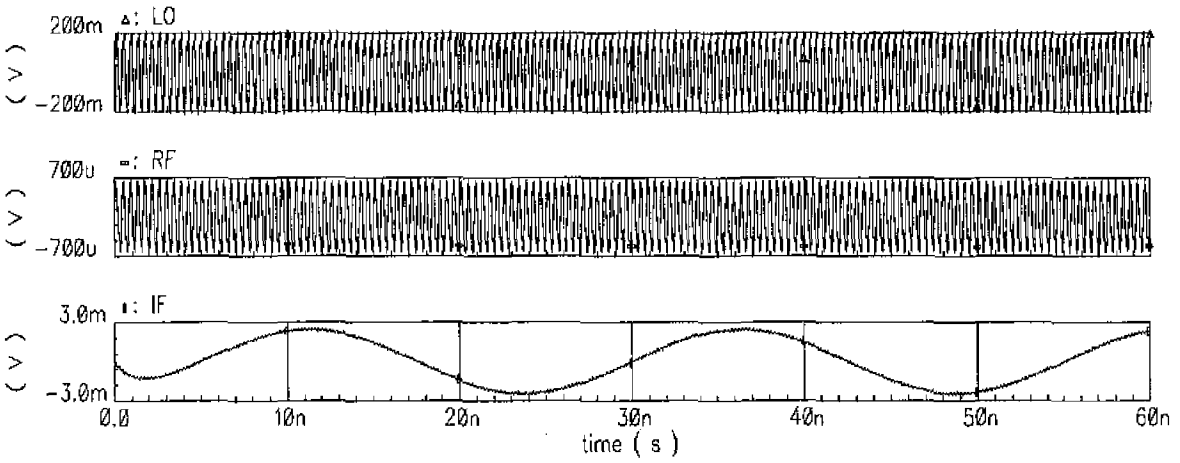


Figure 3: Down mixing with $f_{RF} = 2.4$ G, , $f_{LO} = 2.44$ G

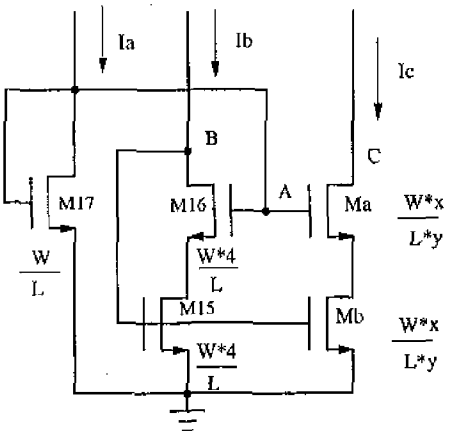


Figure 4: The wide swing current mirror

constant current is desirable because it will simplify the design procedure as will be evidenced in section IV. The wide-swing current mirror is used because its overhead voltage is minimum, namely, the source voltage of the tranconductors M1-2 in Fig. 2 is kept as small as possible. This overhead voltage can be made smaller by using larger transitor aspect ratio (W/L) for the current mirror, since the transistors' effective voltage is reduced with large aspect ratio.

Note that the rail to rail chain now has 5 transistors cascaded, a structure unsuitable for low voltage operation. The CMOS technology used in this design supports dual-voltage, 1.5V and 3.3V respectively, with 0.18 μm minimum length for 1.5V process and 0.34 μm for 3.3V process. We adopt the 3.3V supply voltage. Since the I-V characteristics of CMOS transistors is more linear at short channel length [4], we use the 1.5V process for the two transconductor transistors (M1-2) such that the 0.18 μm minimum channel length can be adopted. The use of minumum channel length for M1-2, does resulting larger flicker noise as clarified in the next section, however, flicker noise is not a serious problem in this application as the bandpass filters after the mixer will suppress it considerably.

III. FIRST-ORDER NOISE ESTIMATION

The design of mixers is a trade-off of many performance specification including conversion gain, noise figure and linearity. Particularly, while conversion gain can be roughly estimated from the conversion gain of the transconductors and the output impedance,

and linearity can be achieved by a few methods as pointed previously, no prior knowledge is available that leads to the satisfactory design of noise figure. In the following discussion we seek to gain some insight about noise performance of mixers.

Noise figure is affected when we scale the sizes of M1-8. The actual noise mechanism of the mixer is hard to describe analytically. We attempt to understand the noise in such a way [3]:

- Baseband noise from M3-8 directly contributes to the output without the need to consider frequency mixing.
- Baseband noise from M1-2 also directly contributes to the output. To understand this, one just needs to notice that M3-M5, and M4-M6 always form a path from M1 or M2 to the IF ports.
- Noise at different band mixes with LO signal and its harmonics and is downconverted to baseband [5].

We further notice that due to the balanced structure of the mixer, noise from the biasing circuitry of M7-8, and from the current mirror that supplies the tail current is canceled out at the differential output.

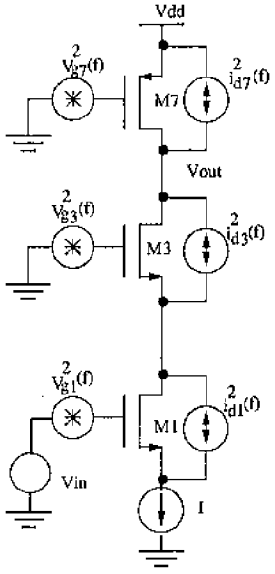


Figure 5: Noise model of the Gilbert cell

To investigate the noise behavior with regard to the transistor geometry, we simplfy the problem and look at only the signal path formed by M1, M3, and M7. The equavalent noise model is illustrated in figure 5. We first assume that all three transistors working in active region (This assumption is true when LO signal are in transtion and can be true when LO amplitude is moderate but still effectively turns on and off the commutating switches.).

Without lengthy derivation, input referred flicker noise is given by

$$\begin{aligned} v_{in,f}^2 &= v_{g1,in}^2 + v_{g3,in}^2 + v_{g7,in}^2 \\ &= v_{g1}^2 + v_{g3}^2 \frac{(\frac{I}{\lambda_n L_1})^2}{g_{m1}^2} + v_{g7}^2 \frac{g_{m7}^2}{g_{m1}^2} \\ &= \frac{K}{W_1 L_1 f} + \frac{K}{W_3 L_3 f} \frac{(\frac{I}{\lambda_n L_1})^2}{2\mu_n C_{ox} \frac{W_1}{L_1} I} \\ &\quad + \frac{K}{W_7 L_7 f} \frac{2\mu_p C_{ox} \frac{W_7}{L_7} I}{2\mu_n C_{ox} \frac{W_1}{L_1} I} \\ &= \frac{K_1}{W_1 L_1 f} + \frac{K_2 I}{W_1 L_1 W_3 L_3 f} + \frac{K_3 L_1}{W_1 L_7^2} \end{aligned} \quad (1)$$

where K_1, K_2, K_3 are process dependent constants.

The input-referred thermal noise is given by

$$\begin{aligned} v_{in,t}^2 &\simeq \frac{i_{d1}^2}{g_{m1}^2} + \frac{i_{d3}^2 r_{ds3}^2}{g_{m1}^2 (r_{ds1} + r_{ds3} + r_{ds7})^2} + \frac{i_{d7}^2 r_{ds7}^2}{g_{m1}^2 r_{ds1}} \\ &\simeq \frac{4kT\frac{2}{3}g_{m1}}{g_{m1}^2} + \frac{4kT\frac{2}{3}g_{m3}}{g_{m1}^2} + \frac{4kT\frac{2}{3}g_{m7}(\frac{\lambda_n L_7}{I})^2}{g_{m1}^2 (\frac{\lambda_n L_1}{I})^2} \\ &= K_4 \frac{\sqrt{L_1}}{\sqrt{W_1 I}} + K_5 \frac{L_1 \sqrt{W_3}}{W_1 \sqrt{L_3 I}} + K_6 \frac{\sqrt{W_7 L_7} L_7}{W_1 L_1 \sqrt{I}} \end{aligned} \quad (2)$$

where K_4, K_5, K_6 are also process dependent constants.

In situation when M3 possiblly works in triode region (M1 and M7 still in active region). Noise terms contributed by M1 and M7 are still valid in equation (1) and (2). However, by first order approximation, the filcker noise of M3 doesnot have much influence on $V_{in,f}^2$ and can be ignored from equation (1). The input referred thermal noise from M3, is now given by the following equation (in the calculation, thermal noise contributed by M3 is simplely that of a resitor of r_{ds3})

$$\begin{aligned} v_{in,t3}^2 &= \frac{I_n^2 r_{ds3}^2}{g_{m1}^2 r_{ds1}^2} \\ &= \frac{\frac{4kT}{\mu C_{ox} \frac{W_3}{L_3} (V_{gs3} - V_t)}}{2\mu C_{ox} \frac{W_1}{L_1} I (\frac{\lambda_n L_1}{I})^2} \\ &= K5 \frac{L_3 I}{W_3 W_1 L_1 (V_{gs3} - V_t)} \end{aligned} \quad (3)$$

These equations give an intuitive feeling of transistor sizing. They are used in the initial design process. As we nomally expect all the transistors M1, M3, M7 work in saturation region, and we also pointed out that flicker noise are handled by the high-pass filtering, equation 2 therefore is of our primary interest. From equation 2 we expect large W_1/L_1, small W_3/L_3 and small $W_7 \cdot L_7$. However, it should be reminded that this model doesnot take 2nd and higher order parasitic effect into consideration, and it is derived from long channel MOS models.

IV. MIXER DESIGN AND OPTIMIZATION

While it is difficult to automate the design flow for the Gilbert mixer, we attempt to systemize the flow in this section.

A current mirror described previously that provides a relatively constant current over a large voltage range is first constructed. Two design parameters are of our concern, the tail current, which directly determines the conversion gain, and the minimum overhead voltage, below which the tail current will vary noticeably. If any factors in one part of the mixer cause the tail current to vary in big magnitude, parameters predetermined for other parts of the mixer will depart from original design considerably, making the design complicated. The tail current is roughly estimated at initial design stage.

The current (allowing a certain range) and the minmum overhead voltage is then utilized to determine the transistor size and DC bias of the transconductor. The goal in this step is to ensure that the transistor works in saturation region, given a certain variation range for its drain voltage. As discuss in previous sections, noise figure, conversion gain, and linearity are all related to the sizes of the transcondutor transistors. Conversion gain and linearity are major consideration initially, but noise figure should be refined later.

The variation range of the drain voltage of the transconductors is determined by taking in account the variation caused by the LO switching activities. It is now time to determine the LO bias voltage and the size of the commutating switches. According to equation 2, the aspect ratio of the switches should be small, while with the predetermined tail current, the aspect ratio is expected to be larger such that the residue gate-source voltage of the switches is small enough. Small residue gate-source voltage requires small LO amplitude to effectively turn on and off the switches, which reduces LO power consumption and makes the

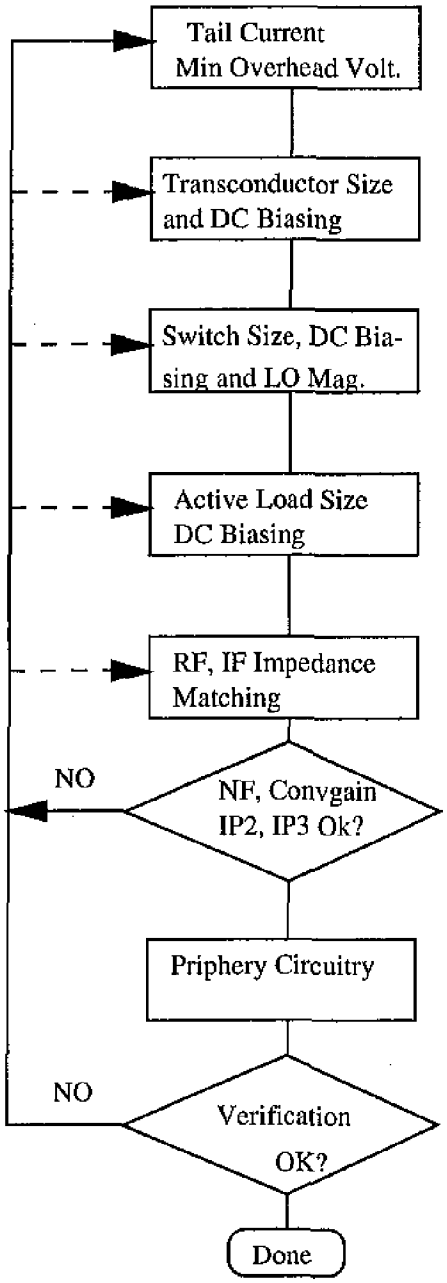


Figure 6: Gilbert cell design flow

switches more ideal. Nonideal switching behavior, that is, the switches are not completely turned on or off, will reduce the conversion gain, and possibly generates more noise. Similar to the transconductors, the switches are designed to work in saturation region, taking the variation of gate source voltage, the variation of the tail current, and the variation of the drain voltage into consideration. Note that the preferred variation range of the drain voltage of the switches is much larger than that of the transconductors, mainly because we want the IF signal to vary over a large voltage range without causing distortion.

Subsequently, the biasing voltage and the transistor sizes of the active loads can be determined. Again, make sure that the active loads operate in saturation region and provide reasonable variation range for the IF signal.

The matching network of the RF port and IF port can now be determined for maximum power transmission. In case noise performance cannot be satisfied, the RF port should be matched for optimal noise figure.

Conversion gain and noise figure, and intermodulation are now obtained. If any of them is not satisfactory, the above procedures are repeated with the adjustment of the tail current and transistor sizes.

These steps form the design flow of the Gilbert cell (Fig. 6). Further peripheral circuitry such as biasing network and common mode feedback is necessary to form a functional mixer, but that will not influence the mixer performance significantly.

As described above, the design procedure of a mixer is particularly time consuming and complicated. While it is hard to automate the whole procedure, each step of the design flow is simply an issue of optimization.

V. CONCLUSIONS

A Gilbert-cell mixer is implemented and will be fabricated in a 0.18 μm dual-voltage (1.5/3.3) CMOS process. A simplified noise analysis model in first order is presented which allows the estimation of noise contribution by each transistors. Dual-voltage process is utilized in the design for better linearity, specifically, short channel length (0.18 μm/1.5V process) is adopted for the transconductors while the mixer operates at 3.3V. A systematic mixer design flow, along with corresponding design considerations, is introduced in an effort to automate the design procedure.

A conversion gain of 12 dB, input referred IP3 of 5 dBm, and noise figure of 11 dB are obtained in simulation.

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Exhibit 1007

Claim Construction Memorandum and Order, *Entropic Communications, LLC v. Charter Communications, LLC*, Case 2:220-cv-00125-JRG, Dkt. 123 (June 26, 2023)

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THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

ENTROPIC COMMUNICATIONS, LLC,	§	
	§	
Plaintiff,	§	
	§	
v.	§	CASE NO. 2:22-CV-00125-JRG
	§	
CHARTER COMMUNICATIONS, INC.,	§	
	§	
Defendant.	§	
	§	
	§	

CLAIM CONSTRUCTION
MEMORANDUM OPINION AND ORDER

Before the Court is the Opening Claim Construction Brief (Dkt. No. 97) filed by Plaintiff Entropic Communications, LLC ("Plaintiff" or "Entropic"). Also before the Court are the Responsive Claim Construction Brief (Dkt. No. 104) filed by Defendant Charter Communications, Inc. ("Defendant" or "Charter") and Plaintiff's reply (Dkt. No. 110). The Court held a hearing on June 13, 2023.

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I. BACKGROUND

Plaintiff alleges infringement of United States Patents No. 8,223,775 ("the '775 Patent"), 8,792,008 ("the '008 Patent"), 9,825,826 ("the '826 Patent"), 8,284,690 ("the '690 Patent"), 9,210,362 ("the '362 Patent"), and 10,135,682 ("the '682 Patent") (collectively, the "patents-in-suit"). (Dkt. 97, Exs. 1–6.)

II. LEGAL PRINCIPLES

It is understood that "[a] claim in a patent provides the metes and bounds of the right which the patent confers on the patentee to exclude others from making, using or selling the protected invention." *Burke, Inc. v. Bruno Indep. Living Aids, Inc.*, 183 F.3d 1334, 1340 (Fed. Cir. 1999). Claim construction is an issue of law for the court to decide. *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 970–71 (Fed. Cir. 1995) (en banc), *aff'd*, 517 U.S. 370 (1996).

"In some cases, however, the district court will need to look beyond the patent's intrinsic evidence and to consult extrinsic evidence in order to understand, for example, the background science or the meaning of a term in the relevant art during the relevant time period." *Teva Pharm. USA, Inc. v. Sandoz, Inc.*, 135 S. Ct. 831, 841 (2015) (citation omitted). "In cases where those subsidiary facts are in dispute, courts will need to make subsidiary factual findings about that extrinsic evidence. These are the 'evidentiary underpinnings' of claim construction that we discussed in *Markman*, and this subsidiary factfinding must be reviewed for clear error on appeal." *Id.* (citing 517 U.S. 370).

To ascertain the meaning of claims, courts look to three primary sources: the claims, the specification, and the prosecution history. *Markman*, 52 F.3d at 979. The specification must contain a written description of the invention that enables one of ordinary skill in the art to make and use the invention. *Id.* A patent's claims must be read in view of the specification, of which

they are a part. *Id.* For claim construction purposes, the description may act as a sort of dictionary, which explains the invention and may define terms used in the claims. *Id.* "One purpose for examining the specification is to determine if the patentee has limited the scope of the claims." *Watts v. XL Sys., Inc.*, 232 F.3d 877, 882 (Fed. Cir. 2000).

Nonetheless, it is the function of the claims, not the specification, to set forth the limits of the patentee's invention. Otherwise, there would be no need for claims. *SRI Int'l v. Matsushita Elec. Corp.*, 775 F.2d 1107, 1121 (Fed. Cir. 1985) (en banc). The patentee is free to be his own lexicographer, but any special definition given to a word must be clearly set forth in the specification. *Intellicall, Inc. v. Phonometrics, Inc.*, 952 F.2d 1384, 1388 (Fed. Cir. 1992). Although the specification may indicate that certain embodiments are preferred, particular embodiments appearing in the specification will not be read into the claims when the claim language is broader than the embodiments. *Electro Med. Sys., S.A. v. Cooper Life Sciences, Inc.*, 34 F.3d 1048, 1054 (Fed. Cir. 1994).

This Court's claim construction analysis is substantially guided by the Federal Circuit's decision in *Phillips v. AWH Corporation*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). In *Phillips*, the court set forth several guideposts that courts should follow when construing claims. In particular, the court reiterated that "the claims of a patent define the invention to which the patentee is entitled the right to exclude." *Id.* at 1312 (quoting *Innova/Pure Water, Inc. v. Safari Water Filtration Sys., Inc.*, 381 F.3d 1111, 1115 (Fed. Cir. 2004)). To that end, the words used in a claim are generally given their ordinary and customary meaning. *Id.* The ordinary and customary meaning of a claim term "is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, i.e., as of the effective filing date of the patent application." *Id.* at 1313. This principle of patent law flows naturally from the recognition that

inventors are usually persons who are skilled in the field of the invention and that patents are addressed to, and intended to be read by, others skilled in the particular art. *Id.*

Despite the importance of claim terms, *Phillips* made clear that "the person of ordinary skill in the art is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification." *Id.* Although the claims themselves may provide guidance as to the meaning of particular terms, those terms are part of "a fully integrated written instrument." *Id.* at 1315 (quoting *Markman*, 52 F.3d at 978). Thus, the *Phillips* court emphasized the specification as being the primary basis for construing the claims. *Id.* at 1314–17. As the Supreme Court stated long ago, "in case of doubt or ambiguity it is proper in all cases to refer back to the descriptive portions of the specification to aid in solving the doubt or in ascertaining the true intent and meaning of the language employed in the claims." *Bates v. Coe*, 98 U.S. 31, 38 (1878). In addressing the role of the specification, the *Phillips* court quoted with approval its earlier observations from *Renishaw PLC v. Marposs Societa' per Azioni*, 158 F.3d 1243, 1250 (Fed. Cir. 1998):

> Ultimately, the interpretation to be given a term can only be determined and confirmed with a full understanding of what the inventors actually invented and intended to envelop with the claim. The construction that stays true to the claim language and most naturally aligns with the patent's description of the invention will be, in the end, the correct construction.

Phillips, 415 F.3d at 1316. Consequently, *Phillips* emphasized the important role the specification plays in the claim construction process.

The prosecution history also continues to play an important role in claim interpretation. Like the specification, the prosecution history helps to demonstrate how the inventor and the United States Patent and Trademark Office ("PTO") understood the patent. *Id.* at 1317. Because the file history, however, "represents an ongoing negotiation between the PTO and the applicant,"

it may lack the clarity of the specification and thus be less useful in claim construction proceedings. *Id.* Nevertheless, the prosecution history is intrinsic evidence that is relevant to the determination of how the inventor understood the invention and whether the inventor limited the invention during prosecution by narrowing the scope of the claims. *Id.*; *see Microsoft Corp. v. Multi-Tech Sys., Inc.*, 357 F.3d 1340, 1350 (Fed. Cir. 2004) (noting that "a patentee's statements during prosecution, whether relied on by the examiner or not, are relevant to claim interpretation").

Phillips rejected any claim construction approach that sacrificed the intrinsic record in favor of extrinsic evidence, such as dictionary definitions or expert testimony. The *en banc* court condemned the suggestion made by *Texas Digital Systems, Inc. v. Telegenix, Inc.*, 308 F.3d 1193 (Fed. Cir. 2002), that a court should discern the ordinary meaning of the claim terms (through dictionaries or otherwise) before resorting to the specification for certain limited purposes. *Phillips*, 415 F.3d at 1319–24. According to *Phillips*, reliance on dictionary definitions at the expense of the specification had the effect of "focus[ing] the inquiry on the abstract meaning of words rather than on the meaning of claim terms within the context of the patent." *Id.* at 1321. *Phillips* emphasized that the patent system is based on the proposition that the claims cover only the invented subject matter. *Id.*

Phillips does not preclude all uses of dictionaries in claim construction proceedings. Instead, the court assigned dictionaries a role subordinate to the intrinsic record. In doing so, the court emphasized that claim construction issues are not resolved by any magic formula. The court did not impose any particular sequence of steps for a court to follow when it considers disputed claim language. *Id.* at 1323–25. Rather, *Phillips* held that a court must attach the appropriate weight to the intrinsic sources offered in support of a proposed claim construction, bearing in mind the general rule that the claims measure the scope of the patent grant.

The Supreme Court of the United States has "read [35 U.S.C.] § 112, ¶ 2 to require that a patent's claims, viewed in light of the specification and prosecution history, inform those skilled in the art about the scope of the invention with reasonable certainty." *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 910, 134 S. Ct. 2120, 2129 (2014). "A determination of claim indefiniteness is a legal conclusion that is drawn from the court's performance of its duty as the construer of patent claims." *Datamize, LLC v. Plumtree Software, Inc.*, 417 F.3d 1342, 1347 (Fed. Cir. 2005) (citations and internal quotation marks omitted), *abrogated on other grounds by Nautilus*, 572 U.S. 898. "Indefiniteness must be proven by clear and convincing evidence." *Sonix Tech. Co. v. Publ'ns Int'l, Ltd.*, 844 F.3d 1370, 1377 (Fed. Cir. 2017).

III. AGREED TERMS

In their April 4, 2023 P.R. 4-3 Joint Claim Construction and Prehearing Statement, the parties submitted the following agreed-upon constructions (Dkt. No. 84, at 1):

Term	Construction
"the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine" ('775 Patent, Claim 18)	Plain and ordinary meaning
"downstream PDU packets" ('775 Patent, Claim 18)	Plain and ordinary meaning
"parameters" ('690 Patent, Claims 1, 9)	Plain and ordinary meaning
"associated with [the] generation and transmission of [a/the] probe" ('690 Patent, Claim 1)	Plain and ordinary meaning
"wideband analog-to-digital converter (ADC) module"	Plain and ordinary meaning

('362 Patent, Claim 1)	

IV. DISPUTED TERMS IN U.S. PATENT NO. 8,223,775

The '775 Patent, titled "Architecture for a Flexible and High-Performance Gateway Cable Modem," issued on July 17, 2012, and bears a filing date of September 30, 2003. The Abstract of the '775 Patent states:

> A cable modem system and architecture. A cable modem engine performs all cable modem functions, and a data networking engine performs all data and home networking functions. The cable modem engine is completely partitioned from the data networking engine. DOCSIS and VoIP functionality is implemented in the cable modem engine. The VoIP functionality may be in accordance with the Packet-Cable specification. The data networking functionality provided by the data networking engine may be in accordance with the CableHome specification.

1. "a data networking engine implemented in a first circuit that includes at least one processor . . ." and "a cable modem engine implemented in a second circuit that includes at least one processor . . ."

"a data networking engine implemented in a first circuit that includes at least one processor . . ." ('775 Patent, Claim 18)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	Indefinite
"a cable modem engine implemented in a second circuit that includes at least one processor . . ." ('775 Patent, Claim 18)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	Indefinite

(Dkt. No. 84, at A-1; Dkt. No. 97, at 6; Dkt. No. 104, at 4; Dkt. No. 115, Ex. A, at 1.)

(a) The Parties' Positions

Plaintiff argues that "data networking" and "cable modem" were well-known phrases at the time of the invention and that the generic word "engine," as modified by the phrases "data networking" and "cable modem," would have been readily understood by a person of ordinary skill in this art. (Dkt. No. 97, at 6–7.) Plaintiff also argues that Defendant's indefiniteness arguments should be rejected because "electrical engineers routinely design subcomponents of consumer electronics, even if the components reside on the same chip," and "[a] POSITA would have no trouble determining where one circuit begins and another ends, because integrating functional blocks on 'a chip' does not render them indistinguishable." (*Id.*, at 8.)

Defendant responds that "[t]here is no disclosure of a DNE or CME implemented in any circuit, much less two circuits which are 'separate' from one another." (Dkt. No. 104, at 5.) Defendant argues that Plaintiff cannot simply chose whatever meaning or "level" of the word "circuit" suits its infringement contentions. (*See id.*, at 6–8.)

Plaintiff replies that the term "circuit" is readily understandable and that the specification discloses separation of functions. (Dkt. No. 110, at 1.)

At the June 13, 2023 hearing, Plaintiff argued that although the functionality of the first circuit and the second circuit must be separate, this does not necessarily require physical separation. Defendant responded that it is *not* arguing that the first circuit and the second circuit must be on separate *chips*, but the problem, Defendant argued, is that this claim uses "circuit" in a subjective way and, as a result, there is no way for a person of skill in the art to know if these limitations are satisfied.

(b) Analysis

Claim 18 of the '775 Patent recites (emphasis added):

18. A cable modem system comprising:

a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment;

a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being *separate* from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media, and the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine, the cable modem engine including a DOCSIS controller and a DOCSIS MAC processor, the DOCSIS MAC processor configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput; and

a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine.

The specification discloses "functional partitioning" and also contrasts the disclosed cable modem system with "current stand-alone cable modem chips":

> Functional Partitioning. Cable modem 100 completely partitions data networking functions . . . from DOCSIS cable modem functionality.
>
> * * *
>
> A chip implementing cable modem system 100 will have only a small incremental hardware cost/functional increase over current stand-alone cable modem chips.

'775 Patent at 4:13–16 & 4:58–60; *see id.* at FIGS. 1 and 2 (illustrating data networking engine ("DNE") 120 and cable modem engine ("CME") 110).

Such disclosure regarding "functionality" is consistent with the technical dictionary cited by Defendant's expert, which defines "circuit" as:

> 1. Any path that can carry electrical current. 2. A combination of electrical components interconnected to perform a particular task. At one level, a computer

> consists of a single circuit; at another, it consists of hundreds of interconnected circuits.

(Dkt. No. 97, Ex. 8, Apr. 4, 2023 Almeroth Decl., App'x C, *Microsoft Computer Dictionary* 99 (5th ed. 2002).)

The specification and this extrinsic evidence are thus consistent with Plaintiff's interpretation that the phrases "first circuit" and "second circuit" are not limited to specific established structures but rather refer to interconnected electrical components that implement the data networking engine functionality and the cable modem engine functionality. *Cf. Linear Tech. Corp. v. Impala Linear Corp.*, 379 F.3d 1311, 1320 (Fed. Cir. 2004) ("when the structure-connoting term 'circuit' is coupled with a description of the circuit's operation, sufficient structural meaning generally will be conveyed to [POSITAs]").

Further, although the claim requires "the second circuit being separate from the first circuit," the "first circuit" and "second circuit" need not be physically separated, such as on separate chips, for example. *Cf. Linear Tech. Corp. v. Int'l Trade Comm'n*, 566 F.3d 1049, 1055 (Fed. Cir. 2009) ("We agree with the Commission's construction of 'second circuit' and 'third circuit,' defining the terms broadly to not require entirely separate and distinct circuits."). This is true even if the disclosed cable modem system 100 is implemented as a "System-on-a-Chip" ("SoC") because even if the SoC is considered to be a single "circuit" (*see* Dkt. No. 97, at 8; *see also* Dkt. No. 104, Ex. 2, May 4, 2023 Kramer dep. at 127:13–22 ("a System on a Chip can be considered an integrated circuit")), this circuit can itself be understood as being composed of multiple circuits. The opinions of Defendant's expert to the contrary are unpersuasive. (*See* Dkt. No. 97, Ex. 8, Apr. 4, 2023 Almeroth Decl. at ¶¶ 64–68.)

Thus, Defendant does not meet its burden to show any lack of reasonable certainty. *Nautilus*, 572 U.S. at 910. The *Dow* and *Teva* cases cited by Defendant do not compel otherwise

because, for example, the present case does not involve different potential methods of measurement. *See Dow Chemical Co. v. Nova Chemicals Corp. (Canada)*, 803 F.3d 620, 631, 634 (Fed. Cir. 2015) (finding indefiniteness as to "a slope of strain hardening coefficient greater than or equal to 1.3"); *see also Teva Pharmaceuticals USA, Inc. v. Sandoz, Inc.*, 789 F.3d 1335, 1338, 1344–45 (Fed. Cir. 2015) (finding indefiniteness as to "a molecular weight of about 5 to 9 kilodaltons").

The Court therefore hereby expressly rejects Defendant's indefiniteness argument. Defendant presents no alternative proposed constructions, and no further construction is necessary.

The Court accordingly hereby construes **"a data networking engine implemented in a first circuit that includes at least one processor . . ."** and **"a cable modem engine implemented in a second circuit that includes at least one processor . . ."** to have their **plain meaning**.

2. "data bus"

"data bus" ('775 Patent, Claim 18)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	Indefinite

(Dkt. No. 84, at A-2; Dkt. No. 97, at 9; Dkt. No. 104, at 8; Dkt. No. 115, Ex. A, at 2.)

(a) The Parties' Positions

Plaintiff argues that the meaning of "data bus" is well known to persons of ordinary skill in the art. (Dkt. No. 97, at 9.)

Defendant responds that, in light of the prosecution history, "the 'data bus' limitation is irreconcilable with the 'completely partitioned' limitation, and claim 18 is therefore indefinite." (Dkt. No. 104, at 8 (citation omitted).)

Plaintiff replies that Defendant's argument is untenable because "[p]rosecution history disclaimers operate to narrow what would otherwise fall within a claim; they do not operate to invalidate claims by eliminating elements textually present." (Dkt. No. 110, at 2.)

At the June 13, 2023 hearing, the parties argued this term together with the above-discussed ". . . in a first circuit . . ." and ". . . in a second circuit . . ." terms.

(b) Analysis

Defendant does not dispute that "data bus" is a well-known term in the relevant art. (*See* Dkt. No. 97, Ex. 10, *The IEEE Standard Dictionary of Electrical and Electronics Terms* 252 (defining "data bus" as "a bus used to communicate data to and from a processing unit or a storage device").)

The parties' dispute pertains not to the term "data bus" in isolation but rather to the accompanying "wherein" clause, which the parties present as a distinct disputed term and which is addressed separately below.

The Court therefore hereby construes **"data bus"** to have its **plain meaning**.

3. "wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine"

"wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine" ('775 Patent, Claim 18)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	The cable modem engine and the data networking engine do not share any connecting circuitry, data paths, or memory devices.

(Dkt. No. 84, at A-4; Dkt. No. 97, at 10; Dkt. No. 104, at 8; Dkt. No. 115, Ex. A, at 2–3.)

(a) The Parties' Positions

Plaintiff argues:

> The disputed claim language explicitly recites that the functions of the DNE [(data networking engine)] and CME [(cable modem engine)] are partitioned. This distinction is key because functions can be partitioned in hardware, software, or both. Functional partitioning is explicitly described in the specification as 'localizing' the cable modem and data networking functions in the separate engines:
>
> * * *
>
> A POSITA would understand that connecting the DNE and CME (e.g., via a data bus) does not eliminate the compartmentalization of their respective functions."

(Dkt. No. 97, at 10 (citations omitted).)

Defendant responds as to this term together with the term "data bus," which is addressed above. (*See* Dkt. No. 104, at 8.) Plaintiff replies likewise. (*See* Dkt. No. 110, at 2–3.)

At the June 13, 2023 hearing, the parties argued this term together with the above-discussed ". . . in a first circuit . . ." and ". . . in a second circuit . . ." terms.

(b) Analysis

Claim 18 of the '775 Patent recites (emphasis added):

> 18. A cable modem system comprising:
>
> a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment;
>
> a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media, and the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine, the cable modem engine including a DOCSIS controller and a DOCSIS MAC processor, the DOCSIS MAC processor configured to process downstream PDU packets and *forward the processed packets directly to the data networking engine* without the involvement of the DOCSIS controller in order to boost downstream throughput; and

> a *data bus* that connects the data networking engine to the cable modem engine, *wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine*.

The specification discloses "localizing" the *functions*:

> Functional Partitioning. Cable modem 100 completely partitions data networking *functions* (advanced bridging/routing, NAT/firewall, VPN, web server and CableHome applications) from DOCSIS cable modem *functionality*. This is accomplished by localizing data networking *functions* in the data networking engine processor and localizing cable modem *functions* in the cable modem engine processor.

'775 Patent at 4:13–19 (emphasis added). Further, the claim itself recites that the cable modem engine "forward[s] the processed packets directly to the data networking engine," thus implying that such communication is not inconsistent with the cable modem engine and the data networking engine being "completely partitioned" from one another. *See id.* at Figs. 1 & 2 (illustrating data path 118 between CME and DNE); *see also id.* at 3:15–17 ("DS PDU packets are forwarded by [the DOCSIS MAC processor] directly to [DNE] 120 along path 118, bypassing controller 116").

The prosecution history cited by Defendant does not compel otherwise. The patentee distinguished the "Brooks" reference (United States Patent Application Publication No. 2001/0039600) as follows:

> [T]he Office Action make the conclusion statement [s*ic*] that "the data networking engine and cable modem engines are represented in Figures 1 and 2 of the [Brooks] reference" . . . . However, Applicant is uncertain how any reasonable interpretation of these Figures can provide correspondence. For example, Figure 2 of [Brooks] discloses only two processors, each of which, therefore, must correspond to the claimed data-networking and cable-modem engines. However, the discussion of Figure 2 makes clear that the cable modem functions are performed by CMAC unit 224 . . . . Therefore, in order for the cable modem engine to contain a processor and perform the CMAC functions as claimed, the cited cable modem engine must include circuitry to connect the processors with the CMAC unit. Because available *connecting circuitry would be shared with the other processor*, Applicant is uncertain how the asserted cable modem engine and home networking engine can be completely partitioned as claimed.

(Dkt. No. 97, Ex. 8, Apr. 4, 2023 Almeroth Decl., App'x G, Apr. 5, 2010 Response to Final Office Action, at 6 (ENTROPIC_CHARTER_0000108) (p. 236 of 290 of Ex. 8) (emphasis added).)

After an advisory action by the examiner, the patentee explained further, distinguishing Brooks as using processors that were not functionally separate:

> The Examiner's apparent designation of the first processor 102 in Brooks '600 as the "data networking engine," and the second processor 104 and the CMAC/CPHY block (114, 118, 224 and 228) as the "cable modem engine," further does not square with the claim 1 feature that "the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine," and the claim 15 feature of "partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VOOP functionality." This is because the CMAC/CPHY block (114, 118, 224 and 228) communicates with both the processors 102 and 104 by sharing the same data paths and sharing the same direct memory access controller. (See peripheral bus 112 – bridge 110 – system bus 108 in Fig. 1 and APB 214 – OMA Controller/ASB-APB Bridge 212 – ASB 210 in Fig. 2, and paragraphs 0034 and 0035).
>
> Further, accepting the Examiner's assertion that first processor 102 handles data networking *functionality*, and considering the description of paragraphs 0025 and 0026 that processor 102 is programmed to implement the desired MAC *functionality* (which would include typical DOCSIS MAC *functionality*), leads to a conclusion that the Brooks '600 processor 102 does not implement a complete partitioning or a completely decoupled arrangement of the data networking engine from the cable modem engine.
>
> Thus, Brooks '600 does not provide the complete partitioning or completely decoupled arrangement of the data networking engine from the cable modem engine that the Examiner apparently asserts it does.

(*Id.*, June 7, 2010 Response to Final Office Action, at 9 (ENTROPIC_CHARTER_0000134) (p. 254 of 290 of Ex. 8) (emphasis added); *see id.*, at 7–9 (ENTROPIC_CHARTER_0000132–34) (pp. 252–54 of 290 of Ex. 8).)

The patentee thus distinguished Brooks as lacking *functional* separation because what the examiner identified as the cable modem engine in Brooks required interaction with the "CMAC unit," and, the patentee argued, such interaction involved circuitry that was shared with what the

examiner identified as the data networking engine in Brooks. (*See id.*) Thus, no relevant disclaimer is apparent, and in particular the patentee did not disclaim having a data bus that connects the data networking engine to the cable modem engine, as recited in above-reproduced Claim 1 of the '775 Patent. *See Omega Eng'g Inc. v. Raytek Corp.*, 334 F.3d 1314, 1324 (Fed. Cir. 2003) ("prosecution disclaimer promotes the public notice function of the intrinsic evidence and protects the public's reliance on *definitive* statements made during prosecution") (emphasis added); *see also id.* at 1325–26 ("for prosecution disclaimer to attach, our precedent requires that the alleged disavowing actions or statements made during prosecution be both *clear and unmistakable*") (emphasis added).

The Court therefore hereby expressly rejects Defendant's proposal that the cable modem engine and the data networking engine cannot share any connecting circuitry, data paths, or memory devices.

The Court accordingly hereby construes **"wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine"** to mean **"wherein the cable modem engine and the data networking engine are not necessarily physically separate but are functionally separate such that the cable modem functions are performed only by the cable modem engine and the home networking functions are performed only by the data networking engine."**

4. "DOCSIS functions"

"DOCSIS functions" ('775 Patent, Claim 19)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	This limitation does not change the scope of claim 18.

(Dkt. No. 84, at A-5; Dkt. No. 97, at 11; Dkt. No. 104, at 8; Dkt. No. 115, Ex. A, at 3.)

(a) The Parties' Positions

Plaintiff argues that Defendant's proposal is contrary to the doctrine of claim differentiation. (Dkt. No. 97, at 12.)

Defendant responds:

> According to claim 19, all DOCSIS functions are localized in the CME. However, as explained . . . above, the specification explains that the sine qua non of a CME is that it 'performs all cable modem functions' including 'the entire DOCSIS cable modem functionality.' Accordingly, claim 19 is redundant and does not further limit the scope of claim 18. Otherwise, the term 'cable modem engine' is indefinite.

(Dkt. No. 104, at 9.)

Plaintiff replies that there is no redundancy because "Claim 18 recites the broader 'cable modem functions,' which does not necessarily have the same scope as 'all *DOCSIS* functions,' referring to the DOCSIS standard." (Dkt. No. 110, at 3.)

At the June 13, 2023 hearing, the parties argued this term together with the above-discussed ". . . in a first circuit . . ." and ". . . in a second circuit . . ." terms.

(b) Analysis

Claim 19 of the '775 Patent depends from Claim 18 and recites:

> 19. A cable modem system as claimed in claim 18, wherein all DOCSIS functions are localized in the cable modem engine.

Plaintiff applies the doctrine of claim differentiation, arguing:

> Claim 18 states that the CME comprises a processor, programmed with software, that when executed causes the CME to perform "cable modem functions other than the home networking functions performed by the [DNE]." Dependent claim 19 increases the burden on the CME—"all DOCSIS functions are localized in the [CME]." Logically, claim 18 does not require that each and every DOCSIS function be executed by the circuitry of the CME, while claim 19 does.

(Dkt. No. 97, at 12.)

As a general matter, "[c]laim differentiation is 'not a hard and fast rule,' but rather a presumption that will be overcome when the specification or prosecution history dictates a contrary construction." *GPNE Corp. v. Apple Inc.*, 830 F.3d 1365, 1371 (Fed. Cir. 2016).

Defendant argues that this limitation set forth in Claim 19 is redundant (and thus does not imply the absence of such a limitation in Claim 18) because Claim 18, read in light of the specification, already requires this limitation. (*See* Dkt. No. 104, at 9.) Defendant argues that "cable modem engine" "is a phrase coined by the inventors" and "[i]f it does not refer to the components of a cable modem that perform all the cable modem functions, then there is no way to know what it is." (*Id.*, at 9.)

Defendant cites disclosure in the Abstract that the CME "performs all cable modem functions" and "implements the entire DOCSIS cable modem functionality." '775 Patent at Abstract & 2:55–56. The Abstract, however, is not limiting, and the portion of the written description cited by Defendant does not purport to limit the entire claimed invention but rather describes a particular embodiment of "cable modem engine 110." *See Phillips*, 415 F.3d at 1323. Further, there is a "presumption that each claim in a patent has a different scope." *Comark Comm'cns, Inc. v. Harris Corp.*, 156 F.3d 1182, 1187 (Fed. Cir. 1998). The contrary opinion of Defendant's expert is unpersuasive. (*See* Dkt. No. 97, Ex. 8, Apr. 4, 2023 Almeroth Decl. at ¶ 36 (citing '775 Patent at 2:15–17 ("In one implementation, the VoIP functionality provided by the

cable modem is in accordance with the PacketCable specification and the data networking functionality provided by the data networking engine is in accordance with the CableHome specification."), 2:23–24 ("Data and home networking functionality is provided by a data networking engine, and DOCSIS and VoIP functionality is provided by a cable modem engine.") & 4:19–21).)

The Court therefore hereby expressly rejects Defendant's attempted reliance on Claim 19 to arrive at a narrow interpretation of "cable modem engine" in Claim 18, and no further construction is necessary as to Claim 19. *See U.S. Surgical Corp. v. Ethicon, Inc.*, 103 F.3d 1554, 1568 (Fed. Cir. 1997) ("Claim construction is a matter of resolution of disputed meanings and technical scope, to clarify and when necessary to explain what the patentee covered by the claims, for use in the determination of infringement. It is not an obligatory exercise in redundancy."); *see also O2 Micro Int'l Ltd. v. Beyond Innovation Tech. Co.*, 521 F.3d 1351, 1362 (Fed. Cir. 2008) ("[D]istrict courts are not (and should not be) required to construe every limitation present in a patent's asserted claims."); *Finjan, Inc. v. Secure Computing Corp.*, 626 F.3d 1197, 1207 (Fed. Cir. 2010) ("Unlike *O2 Micro*, where the court failed to resolve the parties' quarrel, the district court rejected Defendants' construction."); *ActiveVideo Networks, Inc. v. Verizon Commc'ns, Inc.*, 694 F.3d 1312, 1326 (Fed. Cir. 2012); *Summit 6, LLC v. Samsung Elecs. Co., Ltd.*, 802 F.3d 1283, 1291 (Fed. Cir. 2015); *Bayer Healthcare LLC v. Baxalta Inc.*, 989 F.3d 964, 977–79 (Fed. Cir. 2021).

The Court accordingly hereby construes **"DOCSIS functions"** to have its **plain meaning**.

5. "DOCSIS MAC processor" and "DOCSIS controller"

"DOCSIS MAC processor" ('775 Patent, Claim 18)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	The DOCSIS MAC processor as described in the patent specification (*see, e.g.*, '775 Patent at 3:1–20; 4:41–57; *id.* at FIGs. 1 & 2). Otherwise indefinite.
"DOCSIS controller" ('775 Patent, Claim 18)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	The DOCSIS controller as described in the patent specification (*see, e.g.*, '775 Patent at 3:21–48; 4:41–57; *id.* at FIGs. 1 & 2). Otherwise indefinite.

(Dkt. No. 84, at A-6; Dkt. No. 97, at 12; Dkt. No. 115, Ex. A, at 1–2.)

(a) The Parties' Positions

Plaintiff urges that Defendant's proposals would improperly limit these terms to specific exemplary embodiments described in the specification. (Dkt. No. 97, at 12.) Plaintiff also argues that Defendants have already agreed that these are *not* means-plus-function terms governed by 35 U.S.C. § 112, ¶ 6. (*Id.*) Further, Plaintiff submits that "[t]he Federal Circuit and this Court have held that the terms 'processor' and 'controller' denote known classes of structures—generally understood to POSITAs." (*Id.* (citations omitted).)

Defendant responds that "[n]either the phrase 'DOCSIS MAC processor' nor 'DOCSIS controller' has a plain meaning." (Dkt. No. 104, at 9.) Defendant also argues that Plaintiff's proposed construction would either contradict the specification or "make it impossible to distinguish a DOCSIS MAC processor from a DOCSIS controller." (*Id.*, at 9–10.) Defendant

urges that "[t]he only construction of DOCSIS MAC processor and DOCSIS controller that both comports with the specification and provides a basis for distinguishing between the two is a construction whereby each refers to the corresponding device described in the specification." (*Id.*, at 11.)

Plaintiff replies that "the claims themselves describe the functions of the DOCSIS MAC processor and DOCSIS controller," and "Charter has made no argument that the DOCSIS MAC processor and DOCSIS controller should be limited to the specific ARM-based embodiments disclosed in the specification." (Dkt. No. 110, at 3–4.)

At the June 13, 2023 hearing, Defendant submitted that the DOCSIS controller disclosed in the specification performs some MAC functions. Defendant argued that this makes it impossible to distinguish between a "DOCSIS MAC processor" and a "DOCSIS controller," which, in turn, Defendant argued makes it impossible to determine whether an accused instrumentality meets the limitation of "forward[ing] the processed packets directly to the data networking engine without the involvement of the DOCSIS controller."

(b) Analysis

Claim 18 of the '775 Patent recites (emphasis added):

> 18. A cable modem system comprising:
>
> a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment;
>
> a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media, and the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking

> engine, the cable modem engine including a *DOCSIS controller* and a *DOCSIS MAC processor*, the *DOCSIS MAC processor* configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the *DOCSIS controller* in order to boost downstream throughput; and
>
> a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine.

The words "processor" and "controller" refer to known classes of structures in the relevant art, and the parties agree that "DOCSIS" (Data Over Cable Service Interface Specification) and DOCSIS "MAC" (Medium Access Control) have been well-known at all relevant times. (*See, e.g.*, Dkt. No. 97, Ex. 7, Apr. 14, 2023 Kramer Decl. at ¶ 84.)

Defendant proposes to limit these terms to the particular DOCSIS controller and DOCSIS MAC processor disclosed in the specification, but Defendant does not show any definition or disclaimer that would warrant a narrowing of these terms. *See Thorner v. Sony Computer Ent. Am. LLC*, 669 F.3d 1362, 1367 (Fed. Cir. 2012) ("The patentee is free to choose a broad term and expect to obtain the full scope of its plain and ordinary meaning unless the patentee explicitly redefines the term or disavows its full scope.").

Moreover, other claims of the patent-in-suit can be considered. *See Phillips*, 415 F.3d at 1314. Claim 1 recites a "DOCSIS MAC processor" and a "DOCSIS controller," and Claim 12 depends from Claim 1 and recites that "the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor." Because claim terms should be interpreted consistently throughout all of the claims of a particular patent, *id.*, the doctrine of claim differentiation weighs against limiting the "DOCSIS MAC processor" and a "DOCSIS controller" to ARM9TDMI, ARM940, or any other particular specific implementation.

The disclosure in the specification regarding "functional blocks" is also consistent with interpreting these terms broadly rather than limiting them to particular types of processors. *See* '775 Patent at 2:55–3:38; *see also* Dkt. No. 97, Ex. 7, Apr. 14, 2023 Kramer Decl. at ¶¶ 92–93.

Further, Defendant cites disclosure in which the DOCSIS controller is involved with MAC functions (*see* '775 Patent at 3:27–48), but although the claim requires a "DOCSIS MAC processor configured to . . . forward the processed packets directly to the data networking engine without the involvement of the DOCSIS controller," the absence of involvement of the DOCSIS controller in this particular operation does not preclude the DOCSIS controller from being involved with other MAC functions.

Finally, Defendant cites the opinions of its expert that a person of ordinary skill in the art would be unable to distinguish between a "DOCSIS MAC processor" and a "DOCSIS controller," but these opinions are unpersuasive, particularly given that DOCSIS is a well-established standard and that MAC is also a well-known term in the relevant art. (*See* Dkt. No. 97, Ex. 8, Apr. 4, 2023 Almeroth Decl. at ¶¶ 76–77.) Any remaining question regarding distinguishing between a "DOCSIS MAC processor" and a "DOCSIS controller" pertains to factual questions of infringement rather than any legal question for claim construction. *See PPG Indus. v. Guardian Indus. Corp.*, 156 F.3d 1351, 1355 (Fed. Cir. 1998) ("after the court has defined the claim with whatever specificity and precision is warranted by the language of the claim and the evidence bearing on the proper construction, the task of determining whether the construed claim reads on the accused product is for the finder of fact"); *see also Acumed LLC v. Stryker Corp.*, 483 F.3d 800, 806 (Fed. Cir. 2007) ("[t]he resolution of some line-drawing problems . . . is properly left to the trier of fact") (citing *PPG*, 156 F.3d at 1355); *Eon Corp. IP Holdings LLC v. Silver Spring*

Networks, Inc., 815 F.3d 1314, 1318–19 (Fed. Cir. 2016) (citing *PPG*, 156 F.3d at 1355; citing *Acumed*, 483 F.3d at 806).

The Court therefore hereby expressly rejects Defendant's proposed constructions, and no further construction is necessary. *See U.S. Surgical*, 103 F.3d at 1568; *see also O2 Micro*, 521 F.3d at 1362; *Finjan*, 626 F.3d at 1207; *ActiveVideo*, 694 F.3d at 1326; *Summit 6*, 802 F.3d at 1291; *Bayer*, 989 F.3d at 977–79.

The Court accordingly hereby construes **"DOCSIS MAC processor"** and **"DOCSIS controller"** to have their **plain meaning**.

V. DISPUTED TERMS IN U.S. PATENT NO. 9,825,826

The '826 Patent is a continuation of the '008 Patent.

Plaintiff submits: "The '826 and the '008 Patents disclose methods and apparatuses that can be implemented in Customer Premises Equipment (CPE) that enable the CPE to: receive a cable or satellite television signal, digitize said signal, determine a characteristic of the digitized signal, and then report the determined characteristic back to the source of the signal (*i.e.*, the network-based service providers) without interrupting normal customer service." (Dkt. No. 97 at 3.)

The '008 Patent, titled "Method and Apparatus for Spectrum Monitoring," issued on July 29, 2014, and bears an earliest priority date of September 8, 2011. The Abstract of the '008 Patent states:

> A system, such as a satellite reception assembly or customer premises gateway, may comprise an analog-to-digital converter operable to digitize a signal spanning an entire television spectrum (e.g., cable television spectrum or satellite television spectrum) comprising a plurality of television channels. The system may comprise a signal monitor operable to analyze a signal to determine a characteristic of the signal. The system may comprise a data processor operable to process a television channel to recover content carried on the television channel. The system may comprise a channelizer operable to select first and second portions of the signal,

and concurrently output the first portion to the signal monitor and the second portion to the data processor.

6. "network management messages"

"network management messages" ('826 Patent, Claim 1)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	Messages which report on the status of the network based on an analysis of the measured characteristics.

(Dkt. No. 84, at A-8; Dkt. No. 97, at 15; Dkt. No. 104, at 12; Dkt. No. 115, Ex. A, at 5.)

(a) The Parties' Positions

Plaintiff argues that "[t]he Court should construe this term according to its plain and ordinary meaning because 'network management message' is a plain English phrase that means exactly what it says," and "[t]he '826 Patent's specification confirms the phrase is meant to convey all its ordinary possibilities, in disclosing a list of exemplary types/uses of the messages." (Dkt. No. 97, at 15 (citations omitted).)

Defendant responds that Plaintiff attempts to encompass implementations in which the set-top box returns only a measured characteristic and nothing else to the headend, which Defendant argues is inconsistent with the claim requirement that "said measured characteristic is *different than* said network management messages." (Dkt. No. 104, at 12 (emphasis modified).)

Plaintiff replies that Defendant improperly relies on claim language in the parent '008 Patent in an attempt to limit Claim 1 of the continuation '826 Patent. (Dkt. No. 110, at 4.) Plaintiff also argues that Defendant's argument pertains to a question of fact, not claim construction. (*Id.*)

At the June 13, 2023 hearing, Defendant submitted that although Defendant is *not* arguing that the message cannot include the measured characteristic, the message must include something

that is *not* the measured characteristic. As for Plaintiff's interpretation that a *message* conveying just the measured characteristic is "different" than the measured characteristic *itself*, Defendant argued that this would vitiate the claim requirement that "said measured characteristic is different than said network management messages."

(b) Analysis

Claim 1 of the '826 Patent recites (emphasis added):

> 1. A method comprising:
> performing by one or more circuits of a receiver coupled to a television and data service provider headend via a hybrid fiber coaxial (HFC) network:
> receiving, via said HFC network, a signal that carries a plurality of channels, wherein said channels comprise one or both of television channels and data channels;
> digitizing said received signal to generate a digitized signal;
> selecting a first portion of said digitized signal;
> selecting a second portion of said digitized signal;
> processing said selected second portion of said digitized signal to recover information carried in said plurality of channels;
> analyzing said selected first portion of said digitized signal to measure a characteristic of said received signal; and
> controlling the transmission of *network management messages* back to said headend based on said measured characteristic of said received signal, wherein said measured characteristic is different than said *network management messages*.

On one hand, the specification discloses that messages sent to the headend can include measured characteristics:

> The CMTS 114 may process the messages and, in an example embodiment, adjust transmission parameters (e.g., modulation parameters, transmit power, frequency offsets, etc.) and/or perform other maintenance/management based on the received messages.
>
> * * *
>
> Such message may comprise, for example, network status updates indicating whether one or more communication parameters of one or more received television or DOCSIS channels are outside acceptable bounds, and/or *conveying measured/determined characteristics* back to a source of the received signal (e.g., back to a cable headend).

'826 Patent at 3:11–15 & 3:63–4:2 (emphasis added).

On the other hand, the claim here at issue, Claim 1 of the '826 Patent, recites that "said measured characteristic is *different than* said network management messages." Thus, simply sending the measured characteristic to the headend is insufficient to meet this claim limitation. Also of note, this contrasts with the recital in Claim 1 of the related '008 Patent of "report[ing] said determined characteristic to a source of said received signal."

Nonetheless, Defendant's proposal of an "*analysis* of the measured characteristics" lacks sufficient support in the specification. Defendant cites disclosures regarding "analyz[ing]" and whether one or more channels are "outside acceptable bounds":

> The monitoring module 154 may be operable to *analyze* the band C_{J+1} that it receives from the channelizer 102 to *measure/determine characteristics* such as, for example, signal power level vs. frequency, delay vs. frequency, phase shift vs. frequency, type and/or amount of modulation, code rate, interference levels, signal to noise ratio, a transfer function of the channel of [*sic*] over which the signal was received, an impulse response of the channel over which the signal was received, and/or any other characteristic that may help assess characteristics of the channel over which the signal was received, assess characteristics of the transmitter that sent the signal and/or any otherwise be pertinent to performance of the communication system. . . . Additionally or alternatively, the control signal(s) 160 output by the monitoring module 154 may control the transmission of network management/maintenance messages by the device 150. Such message may comprise, for example, network status updates indicating whether one or more communication parameters of one or more received television or DOCSIS channels are *outside acceptable bounds*, and/or conveying *measured/determined* characteristics back to a source of the received signal (e.g., back to a cable headend)[.]

Id. at 3:45–4:2 (emphasis added).

This disclosure regarding "acceptable bounds" relates to a specific feature of a particular embodiment and does not warrant introducing a "status" or "analysis" limitation into the construction of "network management messages." *See Phillips*, 415 F.3d at 1323. Further, this disclosure that "[t]he monitoring module 154 may be operable to analyze the band C_{J+1} that it

receives from the channelizer 102 to measure/determine characteristics" likewise pertains to a particular embodiment and, moreover, this usage of "analyze" merely reflects what is already recited elsewhere in the claim, namely "analyzing said selected first portion of said digitized signal to measure a characteristic of said received signal." Defendant's proposal of construing "network management messages" in terms of an "analysis" would tend to confuse rather than clarify the scope of the claim.

Nonetheless, although the claim already recites "transmission of network management messages back to said headend *based on* said measured characteristic of said received signal," Defendant's proposal of "based on" will assist the finder of fact in understanding that merely sending the measured characteristic is insufficient. *See 01 Communique Laboratory, Inc. v LogMeIn, Inc.*, 687 F.3d 1292, 1296 (Fed. Cir. 2012) ("01 Communique has not cited, and we have not discovered, any authority for the proposition that construction of a particular claim term may not incorporate claim language circumscribing the meaning of the term.").

Finally, Defendant discusses Plaintiff's infringement contentions (*see* Dkt. No. 104, at 12–13), but any remaining dispute pertains to factual questions regarding infringement rather than any legal question for claim construction. *See PPG*, 156 F.3d at 1355; *see also Acumed*, 483 F.3d at 806 (citing *PPG*, 156 F.3d at 1355); *Eon*, 815 F.3d at 1318–19 (citing *PPG*, 156 F.3d at 1355; citing *Acumed*, 483 F.3d at 806).

The Court therefore hereby construes **"network management messages"** to mean **"messages which report on the network based on the measured characteristics."**

VI. DISPUTED TERMS IN U.S. PATENT NO. 8,792,008

7. "operable to"

"operable to" ('008 Patent, Claim 1)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	Configured to

(Dkt. No. 84, at A-8; Dkt. No. 97, at 16; Dkt. No. 104, at 13.)

In their Amended Patent Rule 4-5(d) Joint Claim Construction Chart, the parties agree that "operable to" should be construed to mean "configured to." (Dkt. No. 115, Ex. A, at 3.)

The Court therefore hereby construes **"operable to"** to mean **"configured to."**

8. "digitize a received signal spanning an entire television spectrum comprising a plurality of television channels"

"digitize a received signal spanning an entire television spectrum comprising a plurality of television channels" ('008 Patent, Claim 1)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	The "received signal" contains only television channels.

(Dkt. No. 84, at A-9; Dkt. No. 97, at 16; Dkt. No. 104, at 13; Dkt. No. 115, Ex. A, at 3–4.)

(a) The Parties' Positions

Plaintiff argues that "[t]he plain language of the claim recites '*comprising* a plurality of television channels,' indicating that the 'received signal spanning an entire television spectrum' is *not limited* to only television channels." (Dkt. No. 97, at 16.) Plaintiff also argues that the specification confirms this understanding. (*See id.*, at 17.)

Defendant responds that "'[s]pan' is a plain English word which means the full extent of something from end to end (*e.g.*, 'wing span,' 'life span,' 'span of a bridge')." (Dkt. No. 104, at 14.)

Plaintiff replies that "a television spectrum may contain inside it something in addition to individual television channels," and "[i]t does not cease being a television spectrum if non-video signals are added within the block." (Dkt. No. 110, at 4–5.)

At the June 13, 2023 hearing, Defendant alternatively proposed: "The 'received signal' contains only television channels and data channels which fall between television channels."

(b) Analysis

Claim 1 of the '008 Patent recites (emphasis added):

> 1. A system comprising:
> an analog-to-digital converter operable to *digitize a received signal spanning an entire television spectrum comprising a plurality of television channels*, said digitization resulting in a digitized signal;
> a signal monitor operable to:
> analyze said digitized signal to determine a characteristic of said digitized signal; and
> report said determined characteristic to a source of said received signal;
> a data processor operable to process a television channel to recover content carried on the television channel; and
> a channelizer operable to:
> select a first portion of said digitized signal;
> select a second portion of said digitized signal; and
> concurrently output said first portion of said digitized signal to said signal monitor and said second portion of said digitized signal to said data processor.

As a general matter, "[t]he transitional term 'comprising' . . . is open-ended and does not exclude additional, unrecited elements or method steps." *See Gillette Co. v. Energizer Holdings, Inc.*, 405 F.3d 1367, 1371 (Fed. Cir. 2005).

Defendant submits authority that "[t]he usage 'comprising' means that additional components may be present in the device, but does not change the elements that are stated in the claim." *Outside the Box Innovations, LLC v. Travel Caddy, Inc.*, 695 F.3d 1285, 1305 (Fed. Cir. 2012).

But although the claim language refers to "television spectrum" and refers to the television spectrum comprising television channels, this does *not* preclude non-television channels from being present within that spectrum. In other words, Defendant has not shown that this usage of "comprising" is somehow closed-ended. Also, Defendant's reliance at the June 13, 2023 hearing on a general-purpose dictionary definition of "spanning" as referring to the "extent" of something "between any two limits," even if found relevant, is unpersuasive. *Collins English Dictionary* (30th ed.).

This finding is consistent with disclosures in the specification that the received signal may include data from an IP network or may include DOCSIS channels:

> For downstream traffic, the headend 108 may receive television signals via the antenna 102 and the satellite dish 104, and *may receive data via the IP network 106*. The switch 110 may convey the television signals to the video modulator 112 and the data to the CMTS 114. The video modulator 112 may modulate the received television signals onto a carrier. The CMTS 114 may modulate the received data onto carrier. The splitter/combiner 116 may *combine the outputs* of the video modulator 112 and the CMTS 114 resulting in a frequency division multiplexed (FDM) *signal comprising one or more television channels and/or one or more DOCSIS channels*.
>
> * * *
>
> The RF receive front-end 158 may be operable to process a received RF signal S to generate a digital signal D. The signal S may be the result of *a plurality of television and/or DOCSIS channels* being frequency division multiplexed into a *single signal*. The signal S may occupy a frequency band from F_{lo} to F_{hi}.

'008 Patent at 2:44–54 & 3:12–16 (emphasis added); *see id.* at 4:45–47 ("The data processing module 156 may process one or more of bands C_1–C_J to recover data on one or more channels

(e.g., television and/or DOCSIS channels) . . . .") & 5:60–62 ("Accordingly, for cable television/DOCSIS, the ADC 256 may be operable to digitize the entire cable downstream (e.g., from ~55 MHz to ~1002 MHz).").

Further, Defendant points to the express recital in Claim 1 of the '826 Patent that the received signal comprises "one or both of television and data channels," but this recital in a different independent claim in a different (albeit related) patent does not imply or otherwise justify a narrow interpretation of the disputed term in Claim 1 of the '008 Patent. Further, as Plaintiff argued at the June 13, 2023 hearing, whereas Claim 1 of the '826 Patent allows for there being only data channels, Claim 1 of the '008 Patent requires television channels.

Finally, at the June 13, 2023 hearing, Defendant proposed that "[t]he 'received signal' contains only television channels and data channels which fall between television channels." Defendant thus proposes that a data channel cannot overlap (or be subsumed within) a television channel. As discussed above, Defendant does not demonstrate that the disputed term precludes the presence of data channels within the same spectrum as television channels. The Court therefore rejects Defendant's alternative proposal.

The Court thus hereby expressly rejects Defendant's proposed constructions. No further construction is necessary. *See U.S. Surgical*, 103 F.3d at 1568; *see also O2 Micro*, 521 F.3d at 1362; *Finjan*, 626 F.3d at 1207; *ActiveVideo*, 694 F.3d at 1326; *Summit 6*, 802 F.3d at 1291; *Bayer*, 989 F.3d at 977–79.

The Court accordingly hereby construes **"digitize a received signal spanning an entire television spectrum comprising a plurality of television channels"** to have its **plain meaning**.

9. "signal monitor," "data processor," and "channelizer"

"signal monitor" **"data processor"** **"channelizer"** ('008 Patent, Claim 1)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	Three separate pieces of hardware, configured to perform the functions the claim ascribes to the signal monitor, data processor, and channelizer, respectively.

(Dkt. No. 84, at A-9; Dkt. No. 97, at 17; Dkt. No. 104, at 14; Dkt. No. 115, Ex. A, at 4.)

(a) The Parties' Positions

Plaintiff argues that Defendant's proposal should be rejected because "[n]o phrase [in the claim] even arguably related to separateness is present," and "the specification is clear that these three items do *not* have to be implemented on separate pieces of hardware." (Dkt. No. 97, at 17.)

Defendant responds:

> Entropic contends that there need not be any 'separateness' between the three, and that they can all refer to the same physical device. Entropic provides no support for its contention that this is the 'plain and ordinary meaning' of these terms, or any facts to overcome the presumption that each of these must be a distinct physical component. . . . Nor could Entropic possibly overcome this presumption, as neither the claims nor the specification make any sense unless each of the three is a separate device.

(Dkt. No. 104, at 14–15 (citation omitted).)

Plaintiff replies that Defendant is attempting to argue a question of fact regarding what is separate, as part of claim construction, which Plaintiff submits is improper. (Dkt. No. 110, at 5.) Plaintiff also submits that "[b]y the priority date (2011), it was exceedingly common for a single

SoC [(System on a Chip)] to embody many functional elements, as a POSITA would have been well aware." (*Id.* (footnote omitted).)

At the June 13, 2023 hearing, Defendant argued that these terms refer to three structures that might even be on a single chip but that nonetheless must be physically separate pieces of hardware.

(b) Analysis

Claim 1 of the '008 Patent recites (emphasis added):

> 1. A system comprising:
> an analog-to-digital converter operable to digitize a received signal spanning an entire television spectrum comprising a plurality of television channels, said digitization resulting in a digitized signal;
> a *signal monitor* operable to:
> analyze said digitized signal to determine a characteristic of said digitized signal; and
> report said determined characteristic to a source of said received signal;
> a *data processor* operable to process a television channel to recover content carried on the television channel; and
> a *channelizer* operable to:
> select a first portion of said digitized signal;
> select a second portion of said digitized signal; and
> concurrently output said first portion of said digitized signal to said *signal monitor* and said second portion of said digitized signal to said *data processor*.

As a general matter, "[w]here a claim lists elements separately, 'the clear implication of the claim language' is that those elements are 'distinct component[s]' of the patented invention." *Becton, Dickinson & Co. v. Tyco Healthcare Grp., LP*, 616 F.3d 1249, 1254 (Fed. Cir. 2010); *see Kyocera Senco Indus. Tools Inc. v. Int'l Trade Comm'n*, 22 F.4th 1369, 1382 (Fed. Cir. 2022) (listing components separately in a claim gives rise to "a presumption that those components are distinct").

Defendant does not show, however, that a requirement for "distinct" components, *id.*, necessarily requires separate pieces of hardware. Also, the specification discloses that "[t]he various modules of the subassembly 174," including "the signal monitor 154, data processor 156, and channelizer 152," "may reside in . . . one or more integrated circuits." *See id.* at 4:56–59 & Fig. 1C. Defendant argues that "[w]hat this sentence means is that each individual module can be one or more integrated circuits, not that all of the different modules can be one device" (Dkt. No. 104, at 16), but here, too, the patentee did not express or imply any physical separation.

Finally, at the June 13, 2023 hearing, Defendant emphasized disclosure regarding "[t]he parallel arrangement of the monitoring module 154 and data processing module 156," but this disclosure pertains to a specific embodiment and therefore should not be imported into the claim. *See Phillips*, 415 F.3d at 1323. Also, Defendant does not show that a "parallel arrangement" necessarily implies physically separate structures.

The Court therefore hereby expressly rejects Defendant's proposed construction. No further construction is necessary. *See U.S. Surgical*, 103 F.3d at 1568; *see also O2 Micro*, 521 F.3d at 1362; *Finjan*, 626 F.3d at 1207; *ActiveVideo*, 694 F.3d at 1326; *Summit 6*, 802 F.3d at 1291; *Bayer*, 989 F.3d at 977–79.

The Court accordingly hereby construes **"signal monitor," "data processor,"** and **"channelizer"** to have their **plain meaning**.

VII. DISPUTED TERMS IN U.S. PATENT NO. 8,284,690

The '690 Patent, titled "Receiver Determined Probe," issued on October 9, 2012, and bears an earliest priority date of December 15, 2008. Plaintiff submits that the '690 Patent "relates generally to aiding in the diagnosis of problems with subscriber services." (Dkt. No. 97 at 4.)

The Abstract of the '690 Patent states:

> According to various embodiments of the disclosed method and apparatus, nodes on a network are programmed to generate a probe transmission in response to a request from the node that will be receiving the probe. The receiving node may generate a probe request that specifies a plurality of parameters, such as a modulation profile for the probe; the payload content of the probe; the number of times to transmit the probe; a number of symbols for the payload of the probe; a preamble type for the probe; a cyclic-prefix length for the payload of the probe; a transmit power for the probe; and a transmit power scaling factor for the payload of the probe.

10. "probe" and "physical layer probe"

"probe" ('690 Patent, Claims 1, 7, 8, 9, 11)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	A packet transmitted to a network node which the node compares to a reference packet having a known form in order to determine characteristics of the channel on which the packet was transmitted.
"physical layer probe" ('690 Patent, Claim 9)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	"Physical layer probe" means probe. Otherwise indefinite.

(Dkt. No. 84, at A-10; Dkt. No. 97, at 18; Dkt. No. 104, at 18; Dkt. No. 115, Ex. A, at 7–9 & 11.)

(a) The Parties' Positions

Plaintiff argues that these are different terms and are therefore presumed to have different meanings. (Dkt. No. 97, at 18.) Plaintiff also argues that "Charter's proposed construction imposes on 'probe' a lengthy requirement of a specific function, in clear violation of the rule against importing the specification into the claim." (*Id.* (citation omitted).)

Defendant responds: "Entropic asserts that 'probe' should be construed according to its plain and ordinary meaning, but it does not explain which of the many 'plain meanings' of the word 'probe' applies. Charter's construction, taken from the patent specification, *is* the plain meaning in the context of probes sent between nodes in a network. The DOCSIS specification confirms this." (Dkt. No. 104, at 18.) As for Defendant's proposal of "packet," Defendant submits that "'[p]acket' is in the construction to avoid having the word 'probe' in the construction of 'probe' and because probes *are* packets." (*Id.*)

Plaintiff replies that "Charter grounds its argument to limit 'probe' based on *post-priority, extrinsic* evidence," and "Charter's focus seems to be on the DOCSIS 3.1 cable modems accused of infringement in this case, thereby committing error in construing the claims with reference to the accused devices." (Dkt. No. 110, at 6 (citation omitted).) Also, "with respect to 'physical layer probe,' Charter errs by importing an embodiment into the claims." (*Id.*)

At the June 13, 2023 hearing, Plaintiff alternatively proposed that a "probe" is "a signal used to determine one or more characteristics of a channel." Defendant disagreed with Plaintiff's alternative proposal, but Defendant had no objection to replacing "packet" with "signal" in Defendant's proposed construction.

(b) Analysis

The specification discloses that "probes" are used, for example, to determine characteristics of channels:

> In some instances, probes are sent between nodes of the network in order to allow a receiving node on the network to determine some of the characteristics of the channel between the receiving node and the transmitting node. These probes are typically well defined. Accordingly, the receiving node knows before reception what reference signal was transmitted. By comparing the reference probe with the actual received probe, the receiver can determine some of the characteristics of the channel between the transmitting and receiving node.

* * *

> In various embodiments, these receiver determined probes may be used in a variety of applications. For example, the probes may be used to reach or discover hidden nodes; in networks employing orthogonal frequency division multiple access (OFDMA), the probes may be used for OFDMA subchannel assessment; or in networks accessible by content providers, the probes may be used for off-site network diagnosis.
>
> * * *
>
> In block 204, the requesting node receives the probe generated according to its earlier probe request. The received probe may then be used in further processing in block 205. In one embodiment, the received probe may be used in channel analysis to determine a bitloading table, FEC and other communication parameters for OFDM or OFDMA signals for future transmissions from the probe transmitter. In another embodiment, post reception processing might comprise generating a report from the probe and transmitting this probe report to the requesting node or to a designated entity.

'690 Patent at 1:48–57, 2:20–27 & 6:59–7:11.

Claim 9 of the '690 Patent is limited to a "physical layer probe," and the subsequent recitals of "the probe" in Claim 9 can be readily understood as referring back to the recital of a "physical layer probe" (emphasis added):

> 9. A method comprising:
>
> a) a first node transmitting a probe request to a second node, the probe request specifying a first plurality of probe parameters for *a physical layer probe*, the first plurality of probe parameters comprising a form for *the probe* including a modulation profile for *the probe*;
>
> b) the first node receiving *the probe* from the second node, wherein *the probe* is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node.

The other independent claim of the '690 Patent that recites a "probe" is Claim 1, which recites (emphasis added):

> 1. A method comprising:
>
> a) receiving in a first node, a probe request specifying a first plurality of parameters associated with the generation and transmission of *a probe*, wherein the first plurality of parameters at least specify content payload of *the probe* and a second node;

b) determining a second plurality of parameters associated with generation and transmission of *the probe*;

c) generating *the probe* in accordance with the first plurality of parameters and the second plurality of parameters, wherein *the probe* has a form dictated by the first plurality of parameters; and

d) transmitting *the probe* from the first node to the second node.

Defendant argues that a "probe," even in Claim 1, is necessarily a physical layer signal. In some cases, "[d]ifferent terms or phrases in separate claims may be construed to cover the same subject matter where the written description and prosecution history indicate that such a reading of the terms or phrases is proper." *Nystrom v. TREX Co., Inc.*, 424 F.3d 1136, 1143 (Fed. Cir. 2005). Defendant submits that the patent speaks only of generating physical layer ("PHY") packets. (Dkt. No. 104, at 18 (citing '690 Patent at 3:3–5, 3:40–64 & 5:59).) Defendant also submits authority that "[t]he preference for giving meaning to all terms, however, is not an inflexible rule that supersedes all other principles of claim construction." *SimpleAir, Inc. v. Sony Ericsson Mobile Commc'ns AB*, 820 F.3d 419, 429 (Fed. Cir. 2016) (citation omitted).

Defendant also cites the DOCSIS specification, which states "[a] probe is a wideband physical-layer signal . . . ." (Dkt. No. 104, Ex. 4, *Data-Over-Cable Service Interface Specifications, DOCSIS 3.1*, at 20 & 57 (CHARTER_ENTROPIC00101891 & CHARTER_ENTROPIC00101928).) This statement, however, is not set forth as a broadly applicable definition but rather is set forth as part of a discussion of a specific feature. *See id.*

On balance, using a "physical layer" probe is a specific feature of particular disclosed embodiments that should not be imported into the claims. *See Phillips*, 415 F.3d at 1323. To the extent Defendant maintains that a "probe" must be a "physical layer" probe because no other type of probe is disclosed in the specification, Defendant's argument perhaps may pertain to arguments regarding the enablement or written description requirements but does warrant importing such a limitation into the claims.

Further, the recital of "a probe" in Claim 1 and "a physical layer probe" in Claim 9, as set forth above, weighs at least somewhat further against Defendant's proposal of limiting "probe" to being a "physical layer probe." *See id.* at 1314 (noting that "terms are normally used consistently throughout the patent," and "[o]ther claims of the patent in question, both asserted and unasserted, can also be valuable sources of enlightenment as to the meaning of a claim term").

As for Defendant's proposal of referring to a "packet," Defendant submits that the patent relates to packet-based networks, disclosing for example:

> In the illustrated embodiment, the communications protocol specifies a packet based communications system. In this embodiment, physical layer (PHY) packets comprise preambles and payloads.

'690 Patent at 3:40–44. The specification, however, refers more broadly to a probe "signal." *Id.* at 1:48–57. As noted above, at the June 13, 2023 hearing, Defendant was amenable to replacing "packet" with "signal."

Finally, at the June 13, 2023 hearing, Defendant urged that Plaintiff is attempting to interpret "probe" to encompass *new* information, which Defendant argued is contrary to the specification and the plain meaning of "probe" as referring to a signal that is already known (so that it can be compared to a reference signal). Defendant's argument in this regard is persuasive at least so far as "probe" should be limited to a signal that can be compared to a reference signal having a known form, and this is consistent with the Description of the Related Art portion of the specification. *See* '690 Patent at 1:48–57 (reproduced above).

The Court therefore hereby construes these disputed terms as follows:

Term	Construction
"probe" ('362 Patent, Claim 11)	**"a signal transmitted to a network node that the network node can compare to a reference signal having a known form in order to determine characteristics of the channel on which the signal was transmitted"**
"physical layer probe" ('690 Patent, Claim 9)	**Plain meaning** (apart from the Court's construction of "probe," above)

11. "probe request"

"probe request" ('690 Patent, Claims 1, 7, 8, 9, 11, 15, 16)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	A request sent by a first network node to a second network node which defines the form of a probe to be generated and transmitted by the second network node. The probe request specifies at least the content payload of the probe.

(Dkt. No. 84, at A-11; Dkt. No. 97, at 19; Dkt. No. 104, at 19; Dkt. No. 115, Ex. A, at 7–12.)

(a) The Parties' Positions

Plaintiff argues that "[t]he plain language of the claims confirms that 'probe request' means exactly what it sounds like—a request for a probe." (Dkt. No. 97, at 19.) Plaintiff also argues that Defendant's proposed construction is confusing and incorporates features that are recited elsewhere in the claims. (*Id.*, at 20.)

Defendant responds that "'probe request' could not possibly have had a plain and ordinary meaning in the context of the alleged invention" because "[*t*]*he probe request is the invention*." (Dkt. No. 104, at 19.) Defendant submits that "the specification explains exactly

what this allegedly novel 'probe request' is." (*Id.*) Further, Defendant argues that "to whatever extent the inventor's definition of 'probe request' makes that definition redundant with other claim language, the inventor's definition still governs . . . ." (*Id.*, at 20.)

Plaintiff replies that "well-known components can be used or joined in novel ways," and "[h]ere, 'probe request' means simply a request for a probe," which "must meet certain criteria, but those are defined by the other elements of the claim, not by 'probe request' itself." (Dkt. No. 110, at 7.) Plaintiff also argues that "[Defendant's] resort to lexicography fails because the relied-upon passage is a description, not a definition which meets the high and 'exacting' legal hurdle." (*Id.* (citation omitted).)

At the June 13, 2023 hearing, Plaintiff argues that a "probe request" could specify things other than form, such as transmission power.

(b) Analysis

Claim 1 of the '690 Patent recites (emphasis added):

> 1. A method comprising:
> a) receiving in a first node, a *probe request* specifying a first plurality of parameters associated with the generation and transmission of a probe, wherein the first plurality of parameters at least specify content payload of the probe and a second node;
> b) determining a second plurality of parameters associated with generation and transmission of the probe;
> c) generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters; and
> d) transmitting the probe from the first node to the second node.

The Brief Summary section of the specification states:

> The receiving node may generate a probe request that specifies a plurality of parameters to be used in such a "receiver determined" probe to generate a probe having the "form" specified by these parameters. Accordingly, the probe request specifies a plurality of parameters associated with the generation and transmission of a probe, including the content of a payload of the probe. In one embodiment, the parameters further include: the modulation profile for the probe; the payload

> content of the probe; the number of times to transmit the probe; the number of symbols for the payload of the probe; the preamble type for the probe; the cyclic-prefix length for the payload of the probe; the transmit power for the probe; and the transmit power scaling factor for the payload of the probe. Accordingly, the probe that is transmitted in response to the probe request will have a form dictated by the parameters specified in the probe request.

'690 Patent at 2:3–19.

Contrary to Defendant's suggestion that this disclosure amounts to a definition, no lexicography is apparent. That is, Defendant does not identify any expression of a clear intent by the patentee to set forth a definition for the term "probe request." *See Irdeto Access, Inc. v. EchoStar Satellite Corp.*, 383 F.3d 1295, 1301 (Fed. Cir. 2004) ("It is well-established that the patentee can act as his own lexicographer, so long as he *clearly* states any special definitions of the claim terms in the patent specification or file history.") (emphasis added) (citing *Vitronics*, 90 F.3d at 1582).

Nonetheless, "terms coined by the inventor are best understood by reference to the specification." *Intervet Inc. v. Merial Ltd.*, 617 F.3d 1282, 1287 (Fed. Cir. 2010) (citing *Phillips*, 415 F.3d at 1315). Plaintiff replies that "'probe request' means simply a request for a probe," but Plaintiff does not demonstrate that the term "probe request" has any established meaning in the art. The above-reproduced disclosure explains that, as used in the '690 Patent, a probe request is sent by one network node to another network node and defines the form of a probe to be generated and transmitted.

As for Defendant's proposal that "[t]he probe request specifies at least the content payload of the probe," however, the above-reproduced disclosure refers to the payload but the above-reproduced claim language already specifically recites "the first plurality of parameters at least specify content payload of the probe and a second node," which weighs against including this specific requirement in the construction of "probe request." *See, e.g., Apple, Inc. v. Ameranth,*

Inc., 842 F.3d 1229, 1237 (Fed. Cir. 2016) ("Construing a claim term to include features of that term already recited in the claims would make those expressly recited features redundant.").

The Court therefore hereby construes **"probe request"** to mean **"a request, sent by one network node to another network node, that specifies the form of a probe to be generated and transmitted."**

12. "generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters," "wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node," and "the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe"

"generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters" ('690 Patent, Claim 1) **"wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node"** ('690 Patent, Claim 9) **"the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe"** ('690 Patent, Claim 9)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	Indefinite

(Dkt. No. 84, at A-11–A-12; Dkt. No. 97, at 21; Dkt. No. 104, at 20; Dkt. No. 115, Ex. A, at 7–8 & 10–11.)

(a) The Parties' Positions

Plaintiff argues that these terms are not indefinite because "[a] POSITA would understand there are two sets of parameters—one set which relates to the probe's *form*, and another set relating to any characteristic of the probe." (Dkt. No. 97, at 21.)

Defendant argues that "the claims cover the form of the probe being determined only by the parameters in the probe request," and "[t]his renders the claims indefinite" because "[i]f the parameters determined by the probe transmitter are used to generate the probe, those parameters necessarily contribute to defining the form of the probe," and "it is impossible to imagine a parameter used to generate a probe that does not relate to its form." (Dkt. No. 104, at 21.)

Plaintiff replies that "the probe may be based on additional information, namely 'information that previously existed within the transmitting node.'" (Dkt. No. 110, at 8 (citing '690 Patent at 6:42–45).)

At the June 13, 2023 hearing, Defendant urged that any parameter used to generate something is related to its form. Plaintiff responded that the probe transmitter can define some parameters, such as transmission power, based on information existing within the transmitter.

(b) Analysis

Claim 1 of the '690 Patent recites (emphasis added):

> 1. A method comprising:
>
> a) receiving in a first node, a probe request specifying a first plurality of parameters associated with the generation and transmission of a probe, wherein the first plurality of parameters at least specify content payload of the probe and a second node;
>
> b) determining a second plurality of parameters associated with generation and transmission of the probe;
>
> *c) generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters*; and
>
> d) transmitting the probe from the first node to the second node.

The "generating . . ." limitation thus involves a "first plurality of parameters" that dictates the form of the probe and a "second plurality of parameters" that is *not* recited as dictating the form of the probe. The manner in which "generating the probe" is "in accordance" with the "second plurality of parameters" thus is not recited.

Defendant does not show that this gives rise to any inconsistency. The same is true as to the ". . . is generated . . ." and "parameters" limitations recited in Claim 9 of the '690 Patent. The indefiniteness opinion of Defendant's expert is unpersuasive. (*See* Dkt. No. 104, Ex. 8, Apr. 4, 2023 Almeroth Decl. at ¶ 84.) Moreover, the opinion of Plaintiff's expert is persuasive that the "second plurality of parameters" could, for example, affect a payload portion of a probe without affecting the form of the probe. (Dkt. No. 97, Ex. 7, Apr. 14, 2023 Kramer Decl. at ¶ 138.)

Also, Plaintiff persuasively argued at the June 13, 2023 hearing that the transmitter of a probe could define some non-form parameters, such as transmission power, timing, or destination, "based upon information that previously existed within the transmitting node." *See* '690 Patent at 6:33–45.

Finally, Defendant argues that "the specification says nothing about putting parameters into probe payloads." (Dkt. No. 104, at 22.) This argument perhaps may pertain to arguments regarding enablement or written description, but this does not raise any concern regarding indefiniteness.

The Court therefore hereby expressly rejects Defendant's indefiniteness argument, and Defendant presents no alternative proposed constructions.

The Court accordingly hereby construes these terms to have their **plain meaning**.

VIII. DISPUTED TERMS IN U.S. PATENT NO. 9,210,362

The '362 Patent, titled "Wideband Tuner Architecture," issued on December 8, 2015, and bears an earliest priority date of April 19, 2010. Plaintiff submits that the '362 Patent "relates generally to a receiver system configured to receive a number of channels across a broad radio frequency (RF) spectrum." Dkt. No. 97 at 5.

The Abstract of the '362 Patent states:

> A wideband receiver system comprises a mixer module, a wideband analog-to-digital converter (ADC) module, and digital circuitry. The mixer module is configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels. The wideband ADC module is configured to digitize the swatch [*sic*, swath] of frequencies comprising the plurality of desired television channels and the plurality of undesired television channels. The digital circuitry is configured to select the desired plurality of television channels from the digitized plurality of frequencies, and output the selected plurality of television channels to a demodulator as a digital datastream.

13. "downconverting . . . a plurality of frequencies" and Order of Steps in Claim 11

"downconverting . . . a plurality of frequencies" ('362 Patent, Claim 11)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	Downconverting a plurality of frequencies of an analog radio frequency (RF) signal.
Order of Steps ('362 Patent, Claim 11)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	Claimed steps must be performed in the order recited in the claim.

(Dkt. No. 84, at A-13; Dkt. No. 97, at 22 & 24; Dkt. No. 104, at 24; Dkt. No. 115, Ex. A, at 12–13.)

(a) The Parties' Positions

Plaintiff submits that "[t]here seems to be general agreement that downconverting is well-understood" and that "[t]he process brings 'down' the frequency of a signal, using a 'mixer' or a 'mixing' process." (Dkt. No. 97, at 23.) Plaintiff argues that no order of steps is required because "[t]here is no grammatical or logical reason why digitizing cannot occur before downconverting or *vice versa* since claim 11 states these steps are performed on the same object—the 'plurality of frequencies.'" (Dkt. No. 97, at 25.) Plaintiff also argues that "because the digitizing step does not refer to the output of the 'downconverting' step (but rather its input), the claim itself requires no particular order of those steps." (*Id.*, at 24.) Further, Plaintiff argues that "[v]iewed in light of the differently ordered embodiments disclosed in the specification, Charter's request for an order of the steps limitation is nothing more than a second attempt by Charter to require that the claimed downconverting is done on an analog signal only." (*Id.*, at 25–26.) Finally, Plaintiff argues that there is no basis for limiting the downconverting to only "radio frequency (RF)" signals. (*Id.*)

Defendant responds that "the language of claim 11 itself dictates that the steps be performed in the order written," and "even if the structure of the claim did not mandate the order of the steps (it does), the specification 'directly or implicitly requires' that the claims be performed in order." (Dkt. No. 104, at 24 & 25 (citation omitted).) "Finally," Plaintiff submits, "claim 11 is written to track the order in which the steps are performed in the specification." (*Id.*, at 26.)

Plaintiff replies that "read in light of the specification, the claim envisions digital and/or analog downconversion of desired and undesired channels." (Dkt. No. 110, at 9.)

At the June 13, 2023 hearing, Defendant argued that Plaintiff is attempting to excise the entire invention from the claim because the purported invention is to reduce the need for expensive analog-to-digital converters by downconverting *before* digitizing. *See* '362 Patent at 2:20–27 &

2:45–55. Plaintiff responded that the Defendant's argument is unavailing because the specification also discloses digital downconversion. *See id.* at 5:31–58 & 9:11–34.

(b) Analysis

"As a general rule, '[u]nless the steps of a method [claim] actually recite an order, the steps are not ordinarily construed to require one.'" *Mformation Techs., Inc. v. Research in Motion Ltd.*, 764 F.3d 1392, 1398 (Fed. Cir. 2014) (quoting *Interactive Gift Express, Inc. v. Compuserve, Inc.*, 256 F.3d 1323, 1342 (Fed. Cir. 2001)).

Courts apply a two-part test to determine whether a particular order of steps is required: "First, we look to the claim language to determine if, as a matter of logic or grammar, they must be performed in the order written," and "[i]f not, we next look to the rest of the specification to determine whether *it* directly or implicitly requires such a narrow construction." *Altiris, Inc. v. Symantec Corp.*, 318 F.3d 1363, 1369–70 (Fed. Cir. 2003) (citation omitted).

Claim 11 of the '362 Patent recites (emphasis added):

> 11. A method comprising:
> in a wideband receiver system:
> *downconverting*, by a mixer module of said wideband receiver system, *a plurality of frequencies* that comprises a plurality of desired television channels and a plurality of undesired television channels;
> *digitizing*, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system, *said plurality of frequencies* comprising said plurality of desired television channels and said plurality of undesired television channels;
> *selecting*, by digital circuitry of said wideband receiver system, said plurality of desired television channels from *said digitized plurality of frequencies*; and
> *outputting*, by said digital circuitry of said wideband receiver system, *said selected plurality of television channels* to a demodulator as a digital datastream.

In some cases, "the sequential nature of the claim steps is apparent from the plain meaning of the claim language." *See Mantech Envtl. Corp. v. Hudson Envtl. Servs., Inc.*, 152 F.3d 1368,

1376 (Fed. Cir. 1998); *see also E-Pass Techs., Inc. v. 3Com Corp.*, 473 F.3d 1213, 1222 (Fed. Cir. 2007) ("[B]ecause the language of most of the steps of its method claim refer to the completed results of the prior step, E–Pass must show that all of those steps were performed in order.").

Here, the "downconverting . . ." step and the "digitizing . . ." step both operate on the same "plurality of frequencies," and there is no reference to "completed results of the prior step." *Id.* Rather, the "downconverting . . ." step and the "digitizing . . ." step both refer to the same "plurality of frequencies" without any indication that one of these steps must necessarily be performed before the other. Further, because the "digitizing . . ." step could potentially be performed before the "downconverting . . ." step, the Court rejects Defendant's proposal to limit "downconverting . . . a plurality of frequencies" to downconverting a plurality of frequencies of an *analog* radio frequency (RF) signal.

The "selecting . . ." step, by contrast, refers to "said digitized plurality of frequencies." The "digitizing . . ." step must therefore be performed before the "selecting . . ." step. *Id.*

The "outputting . . ." step refers to "said selected plurality of television channels." The "selecting . . ." step must therefore be performed before the "outputting . . ." step. *Id.*

Finally, Defendant does not persuasively justify limiting the claim to "radio frequency (RF)" signals. Defendant's reliance on the "complex mixer module" 211/221 illustrated in Figure 2 is unavailing. (*See* Dkt. No. 104, at 25–26 (discussing '362 Patent at Fig. 2).) To the extent the specification discloses downconverting radio frequencies, the use of radio frequencies is a particular feature of disclosed embodiments that should not be imported into the claim. *See Phillips*, 415 F.3d at 1323.

The Court therefore hereby construes these disputed terms as follows:

Term	Construction
"downconverting . . . a plurality of frequencies" ('362 Patent, Claim 11)	**Plain meaning**
Order of Steps in Claim 11 of the '362 Patent	**In Claim 11 of the '362 Patent, the "digitizing . . ." step must be performed before the "selecting . . ." step, and the "selecting . . ." step must be performed before the "outputting . . ." step. No other order of steps is required.**

IX. DISPUTED TERMS IN U.S. PATENT NO. 10,135,682

The '682 Patent, titled "Method and System for Service Group Management in a Cable System," issued on November 20, 2018, and bears an earliest priority date of July 23, 2012. Plaintiff submits that the '682 Patent "relates generally to organizing cable modems (CMs) into service groups based on signal-to-noise ratio (SNR) related metrics." (Dkt. No. 97, at 5.)

The Abstract of the '682 Patent states:

> A cable modem termination system (CMTS) may determine, for a plurality of cable modems served by the CMTS, a corresponding plurality of SNR-related metrics. The CMTS may assigning [*sic*] the modems among a plurality of service groups based on the SNR-related metrics. For any one of the modems, the CMTS may configure physical layer communication parameters to be used by the one of the modems based on a SNR-related metric of a service group to which the one of the modems is assigned. The physical layer communication parameters may include one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate. The CMTS and the modems may communicate using orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers, and the physical layer communication parameters may be determined on a per-subcarrier basis.

14. "a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics"

"a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics" ('682 Patent, Claim 1)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	Indefinite

(Dkt. No. 84, at A-14; Dkt. No. 97, at 26; Dkt. No. 104, at 27; Dkt. No. 115, Ex. A, at 14.)

(a) The Parties' Positions

Plaintiff argues that "[a]ny POSITA familiar with hybrid fiber coaxial ('HFC') networks understands what is meant by an SNR profile and SNR-related metrics," and "the adjectives 'worst-case' and 'composite' have plain meanings to a POSITA." (Dkt. No. 97, at 26 (citations omitted).) Plaintiff also argues that "[t]he specification confirms the claim terms are used in accord with a POSITA's expectations." (*Id.*)

Defendant responds that "[t]here is nothing about this limitation that finds any support in the specification." (Dkt. No. 104, at 27.) Defendant argues: "In view of the specification, 'composite SNR-related metric' *cannot* mean a 'composite *best-case* SNR profile.' It can only refer to the 'worst-case.' And the claim is therefore indefinite, as there is no difference between 'composite SNR-related metric' and 'worst-case SNR profile.'" (*Id.*, at 28.)

Plaintiff replies that "Charter's indefiniteness position is a chain of argument ultimately resting on a false equivalence of 'composite SNR-related metric' and 'worst-case SNR profile,'" but "[t]hey are not the same thing." (Dkt. No. 110, at 9.) Plaintiff also submits that "composite metrics based on SNR-related metrics generally (not merely worst-case) are, in fact, disclosed." (*Id.* (citing '682 Patent at 4:40–52).)

At the June 13, 2023 hearing, Defendant argued that Plaintiff does not provide any purported plain meaning for this "composite" term. Defendant submitted that the specification discloses only a "composite worst-case SNR profile." *See* '682 Patent at 4:9–20. Defendant urged that the disputed term is indefinite because the "composite SNR-related metric" cannot be based on the "worst-case SNR profile" if they are both the same thing. Plaintiff responded that "composite" means that something is for more than one cable modem and that a "profile" is something that involves multiple attributes (such as several frequency ranges). Plaintiff concluded that a person of ordinary skill in the art would understand that the term "composite SNR-related metric" relates to multiple cable modems and could be a profile (such as for several different frequency ranges) or could instead be a single composite metric, such as an average.

(b) Analysis

Claim 1 of the '682 Patent recites (emphasis added):

> 1. A method comprising:
>
> determining, by a cable modem termination system (CMTS), for each cable modem served by said CMTS, a *corresponding signal-to-noise ratio (SNR) related metric*;
>
> assigning, by said CMTS, each cable modem among a plurality of service groups based on a respective *corresponding SNR-related metric*;
>
> generating, by said CMTS for each one of said plurality of service groups, *a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics* corresponding to said one of said plurality of service groups;
>
> selecting, by said CMTS, one or more physical layer communication parameter to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and
>
> communicating, by said CMTS, with one or more cable modems corresponding to said one of said plurality of service groups using said selected one or more physical layer communication parameter.

Defendant argues that the specification fails to distinguish between "a composite SNR-related metric" and "a worst-case SNR profile." This argument perhaps may pertain to arguments regarding enablement or written description, but Defendant does not show any lack of reasonable

certainty in the claim language itself. Rather, the claim merely recites a worst-case SNR profile that is based on the SNR-related metrics that correspond to each cable modem, and the composite SNR-related metric, in turn, is based on the worst-case SNR profile. The opinions of Plaintiff's expert are further persuasive in this regard. (*See* Dkt. No. 97, Ex. 7, Apr. 14, 2023 Kramer Decl. at ¶¶ 166 & 168–169; *see, e.g.*, '682 Patent at 4:9–20, 5:7–12 & 5:42–57 & Fig. 2C.) Plaintiff's arguments at the June 13, 2023 hearing (summarized above) are likewise persuasive.

The Court therefore hereby expressly rejects Defendant's indefiniteness argument, and Defendant presents no alternative proposed construction.

The Court accordingly hereby construes **"a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics"** to have its **plain meaning**.

15. "service group[s]"

"service group[s]" ('682 Patent)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	A "service group" is the complete set of downstream and upstream channels within a single CMTS that a single cable modem could potentially receive or transmit on.

(Dkt. No. 84, at A-15; Dkt. No. 97, at 28; Dkt. No. 104, at 28–29; Dkt. No. 115, Ex. A, at 14.)

(a) The Parties' Positions

Plaintiff argues that "[a] 'service group' is a plain English term, and the claim and specification confirm that the groups consist of cable modems (CMs), not *channels*." (Dkt. No. 97, at 28.) "Furthermore," Plaintiff argues, "Charter is attempting to join the upstream and downstream channels without basis in the claim language and contrary to the specification." (*Id.*)

Defendant responds that "[t]he DOCSIS specification itself provides the plain meaning definition of a 'cable modem service group' in the cable television industry (a definition Charter identified in the P.R. 4-3 statement but which Entropic entirely ignores in its brief) . . . ." (Dkt. No. 104, at 29 (citation omitted).)

Plaintiff replies that "[n]othing in the opposition overcomes the central point—the '682 Patent is described in terms of service groups consisting of groups of cable modems (CMs)." (Dkt. No. 110, at 9.) Plaintiff also argues that "whatever DOCSIS might have later said, its use of terms cannot overcome the '682 Patent's usage." (*Id.*, at 10.)

At the June 13, 2023 hearing, the parties submitted this disputed term without oral argument.

(b) Analysis

Claim 1 of the '682 Patent recites (emphasis added):

> 1. A method comprising:
>
> determining, by a cable modem termination system (CMTS), for each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;
>
> assigning, by said CMTS, each cable modem among a plurality of *service groups* based on a respective corresponding SNR-related metric;
>
> generating, by said CMTS for each one of said plurality of *service groups*, a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of *service groups*;
>
> selecting, by said CMTS, one or more physical layer communication parameter to be used for communicating with said one of said plurality of *service groups* based on said composite SNR-related metric; and
>
> communicating, by said CMTS, with one or more cable modems corresponding to said one of said plurality of *service groups* using said selected one or more physical layer communication parameter.

Defendant relies on the following portion of a DOCSIS specification:

> Cable Modem Service Group

> In the HFC plant topology, the complete set of downstream and upstream channels within a single CMTS that a single Cable Modem could potentially receive or transmit on. In most HFC deployments, a CM-SG corresponds to a single Fiber Node. Usually, a CM-SG serves multiple CMs.

(Dkt. No. 104, Ex. 5, *Data-Over-Cable Service Interface Specifications, DOCSIS 3.0*, at 11 (CHARTER_ENTROPIC00101160).)

Because this definition refers to a set of channels that each cable modem can use (rather than a set of cable modems in a system of cable modems), this definition does not inform how the term "service group" is used in the '682 Patent, which refers to grouping cable modems:

> FIGS. 4A and 4B illustrate the network of FIG 1, with different groupings of CMs [(cable modems)] based on one or both of: measured performance metric(s) and location within the HFC network.
>
> * * *
>
> While FIGS. 3A and 3B depict SNR profiles and location as two separate bases on which to assign CMs to service groups, the two may be used in combination.

See '682 Patent at 2:24–27 & 6:39–41.

The Court therefore hereby expressly rejects Defendant's proposed construction. No further construction is necessary, particularly in light of the above-noted context provided by the specification. *See U.S. Surgical*, 103 F.3d at 1568; *see also O2 Micro*, 521 F.3d at 1362; *Finjan*, 626 F.3d at 1207; *ActiveVideo*, 694 F.3d at 1326; *Summit 6*, 802 F.3d at 1291; *Bayer*, 989 F.3d at 977–79.

The Court accordingly hereby construes **"service group[s]"** to have its **plain meaning**.

16. "[communicating with/corresponding to] said one of said plurality of service groups"

"[communicating with/corresponding to] said one of said plurality of service groups" ('682 Patent, Claim 1)	
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	Indefinite

(Dkt. No. 84, at A-16; Dkt. No. 97, at 30; Dkt. No. 104, at 30; Dkt. No. 115, Ex. A, at 14–15.)

(a) The Parties' Positions

Plaintiff argues that "Claim 1 itself of the '682 Patent is clear on how service groups, composed of cable modems, and the CMTS communicate . . . ." (Dkt. No. 97, at 30.) Plaintiff also submits that "[t]he specification has a multitude of references to the communication with the service group by way of, for example, physical layer parameters since the invention could not work without communication." (*Id.* (citations omitted).) "Further," Plaintiff argues, "the terms 'communicating,' 'corresponding,' and 'plurality' each have plain English meanings that are well-understood, and the combination of the terms do not create any ambiguity." (*Id.*)

Defendant responds: "There is no antecedent basis for 'said one of said plurality of service groups,' and there is no way to know which one service group among the 'plurality of service groups' the 'communicating' and 'corresponding' steps should be performed on. The claim is therefore indefinite." (Dkt. No. 104, at 30.)

Plaintiff replies:

> The '682 Patent criticizes the folly of lumping all CMs together in a "lowest common denominator" approach. '682 Patent, 5:50–57. Instead, the '682 Patent groups CMs based on their performance (SNR). For each group, the invention can choose communication parameters based on group performance. The chosen parameters are used to communicate with that group. *E.g., id.* at 5:42–50. This is precisely what the claim does. The "generating" step requires creating a composite metric for each service group. The "selecting step" uses the composite metric for

a particular service group to choose one or more parameter(s) to use with *that* group. The "communicating" step uses the selected parameter(s) to communicate with *that* group.

(Dkt. No. 110, at 10.)

At the June 13, 2023 hearing, the parties submitted this disputed term without oral argument.

(b) Analysis

Claim 1 of the '682 Patent recites (emphasis added):

1. A method comprising:

determining, by a cable modem termination system (CMTS), for each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;

assigning, by said CMTS, each cable modem among *a plurality of service groups* based on a respective corresponding SNR-related metric;

generating, by said CMTS for *each one of said plurality of service groups*, a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to *said one of said plurality of service groups*;

selecting, by said CMTS, one or more physical layer communication parameter to be used for communicating with *said one of said plurality of service groups* based on said composite SNR-related metric; and

communicating, by said CMTS, with one or more cable modems corresponding to *said one of said plurality of service groups* using said selected one or more physical layer communication parameter.

The recital of "a plurality of service groups" provides antecedent basis for "said plurality of service groups."

The parties dispute whether the recital of "*each one of* said plurality of service groups" provides antecedent basis for "*said one of* said plurality of service groups."

At first blush, the recital of "*said one* of said plurality of service groups" appears to fail to specify *which* one of the *plurality* of service groups. This is the opinion of Defendant's expert. (Dkt. No. 97, Ex. 8, Apr. 4, 2023 Almeroth Decl. at ¶ 97 ("there is no way to know which one service group among the 'plurality of service groups' is being referred to").)

A fair reading, however, is that "*said one of* said plurality of service groups" refers back to "each *one of* said plurality of service groups." In other words, the steps that refer to "said one of said plurality of service groups" must be performed for each and every one of the plurality of service groups. This is apparent on the face of the claim and is also consistent with Figure 3A of the '682 Patent referring to determining parameters "*per* service group," and the opinion of Plaintiff's expert is further persuasive. (*See* Dkt. No. 97, Ex. 7, Apr. 14, 2023 Kramer Decl. at ¶¶ 176–77.) The contrary opinion of Defendant's expert is unpersuasive. (Dkt. No. 97, Ex. 8, Apr. 4, 2023 Almeroth Decl. at ¶ 97.)

Indeed, the claim recites only *one* "one of said plurality of service groups," so the reference to "said one" is reasonably clear. Thus, to whatever extent this term is deemed to lack *explicit* antecedent basis, the antecedent basis is *implicit*. *See Energizer Holdings Inc. v. Int'l Trade Comm'n*, 435 F.3d 1366, 1371 (Fed. Cir. 2006) (holding that "an anode gel comprised of zinc as the active anode component" provided implicit antecedent basis for "said zinc anode"); *see also Ex Parte Porter*, 25 U.S.P.Q. 2d (BNA) 1144, 1145 (B.P.A.I. 1992) ("The term 'the controlled fluid' . . . finds reasonable antecedent basis in the previously recited 'controlled stream of fluid . . . .'"); *Fisher-Price, Inc. v. Graco Children's Prods.*, No. 05–1258, 154 F. App'x 903, 909 (Fed. Cir. Nov. 4, 2005) ("[a] claim is not invalid for indefiniteness if its antecedent basis is present by implication") (citations omitted). The burden is on Defendant to show a lack of reasonable certainty, and Defendant has not met that burden. *See Nautilus*, 572 U.S. at 910; *see also Sonix*, 844 F.3d at 1377.

The Court therefore hereby expressly rejects Defendant's indefiniteness argument, and Defendant presents no alternative proposed construction.

The Court accordingly hereby construes **"[communicating with/corresponding to] said one of said plurality of service groups"** to have its **plain meaning**.

X. CONCLUSION

The Court adopts the constructions set forth in this opinion for the disputed terms of the patents-in-suit, and as summarized below.

Disputed Term	The Court's Construction
"a data networking engine implemented in a first circuit that includes at least one processor . . ." ('775 Patent, Claim 18) "a cable modem engine implemented in a second circuit that includes at least one processor . . ." ('775 Patent, Claim 18)	Plain meanings.
"data bus" ('775 Patent, Claim 18)	Plain meaning
"wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine" ('775 Patent, Claim 18)	"wherein the cable modem engine and the data networking engine are not necessarily physically separate but are functionally separate such that the cable modem functions are performed only by the cable modem engine and the home networking functions are performed only by the data networking engine"
"DOCSIS functions" ('775 Patent, Claim 19)	Plain meaning.

"DOCSIS MAC processor" ('775 Patent, Claim 18) "DOCSIS controller" ('775 Patent, Claim 18)	Plain meanings.
"network management messages" ('826 Patent, Claim 1)	"messages which report on the network based on the measured characteristics"
"operable to" ('008 Patent, Claim 1)	"configured to"
"digitize a received signal spanning an entire television spectrum comprising a plurality of television channels" ('008 Patent, Claim 1)	Plain meaning.
"signal monitor" "data processor" "channelizer" ('008 Patent, Claim 1)	Plain meanings.
"probe" ('690 Patent, Claims 1, 7, 8, 9, 11)	"a signal transmitted to a network node that the network node can compare to a reference signal having a known form in order to determine characteristics of the channel on which the signal was transmitted"
"physical layer probe" ('690 Patent, Claim 9)	Plain meaning (apart from the Court's construction of "probe," above).
"probe request" ('690 Patent, Claims 1, 7, 8, 9, 11, 15, 16)	"a request, sent by one network node to another network node, that specifies the form of a probe to be generated and transmitted"

"generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters" ('690 Patent, Claim 1) "wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node" ('690 Patent, Claim 9) "the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe" ('690 Patent, Claim 9)	Plain meanings.
"downconverting . . . a plurality of frequencies" ('362 Patent, Claim 11)	Plain meaning.
Order of Steps ('362 Patent, Claim 11)	In Claim 11 of the '362 Patent, the "digitizing . . ." step must be performed before the "selecting . . ." step, and the "selecting . . ." step must be performed before the "outputting . . ." step. No other order of steps is required.
"a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics" ('682 Patent, Claim 1)	Plain meaning.
"service group[s]" ('682 Patent)	Plain meaning.

"[communicating with/corresponding to] said one of said plurality of service groups" ('682 Patent, Claim 1)	Plain meaning.

The parties are **ORDERED** that they may not refer, directly or indirectly, to each other's claim construction positions in the presence of the jury. Likewise, the parties are **ORDERED** to refrain from mentioning any portion of this opinion, other than the actual definitions adopted by the Court, in the presence of the jury. Any reference to claim construction proceedings is limited to informing the jury of the definitions adopted by the Court.

So ORDERED and SIGNED this 26th day of June, 2023.

RODNEY GILSTRAP
UNITED STATES DISTRICT JUDGE

Exhibit 1001

U.S. Patent No. 9,210,362

Customer No.: 000027683

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Telephone [214] 651.5000
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US009210362B2

(12) **United States Patent**
Reddy et al.

(10) **Patent No.: US 9,210,362 B2**
(45) **Date of Patent: *Dec. 8, 2015**

(54) **WIDEBAND TUNER ARCHITECTURE**

(71) Applicant: **MaxLinear, Inc.**, Carlsbad, CA (US)

(72) Inventors: **Madhukar Reddy**, Carlsbad, CA (US); **Curtis Ling**, Carlsbad, CA (US); **Tim Gallagher**, Carlsbad, CA (US)

(73) Assignee: **MaxLinear, Inc.**, Carlsbad, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **14/614,543**

(22) Filed: **Feb. 5, 2015**

(65) **Prior Publication Data**

US 2015/0156535 A1 Jun. 4, 2015

Related U.S. Application Data

(63) Continuation of application No. 13/962,871, filed on Aug. 8, 2013, which is a continuation of application No. 12/762,900, filed on Apr. 19, 2010, now Pat. No. 8,526,898.

(60) Provisional application No. 61/170,526, filed on Apr. 17, 2009.

(51) **Int. Cl.**

H04B 1/16	(2006.01)
H04N 5/50	(2006.01)
H04B 1/00	(2006.01)

(Continued)

(52) **U.S. Cl.**

CPC ***H04N 5/50*** (2013.01); ***H04B 1/0014*** (2013.01); ***H04N 21/4263*** (2013.01); ***H04N 21/4383*** (2013.01); ***H04N 21/454*** (2013.01); ***H04N 21/6193*** (2013.01)

(58) **Field of Classification Search**

USPC 455/131, 140, 207, 214, 313, 315, 323, 455/324, 325, 334

See application file for complete search history.

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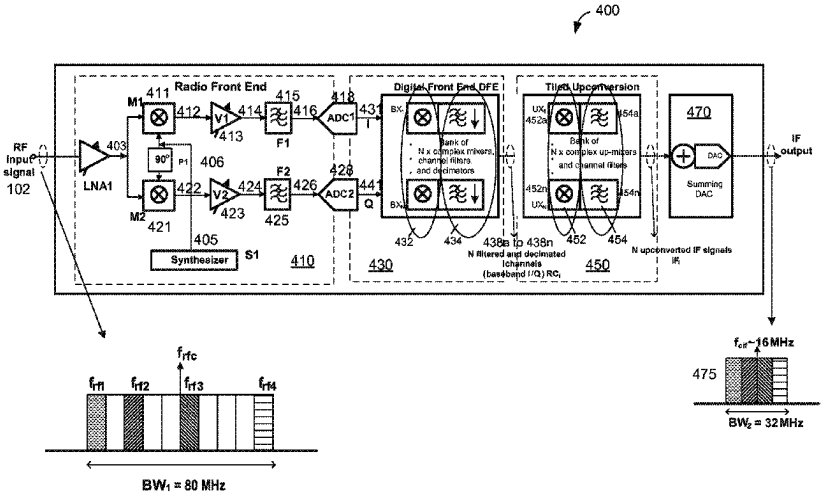
Primary Examiner — Blane J Jackson

(74) *Attorney, Agent, or Firm* — McAndrews, Held & Malloy, Ltd.

(57) **ABSTRACT**

A wideband receiver system comprises a mixer module, a wideband analog-to-digital converter (ADC) module, and digital circuitry. The mixer module is configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels. The wideband ADC module is configured to digitize the swatch of frequencies comprising the plurality of desired television channels and the plurality of undesired television channels. The digital circuitry is configured to select the desired plurality of television channels from the digitized plurality of frequencies, and output the selected plurality of television channels to a demodulator as a digital datastream.

20 Claims, 10 Drawing Sheets



(51) **Int. Cl.**

H04N 21/426	(2011.01)
H04N 21/438	(2011.01)
H04N 21/454	(2011.01)
H04N 21/61	(2011.01)

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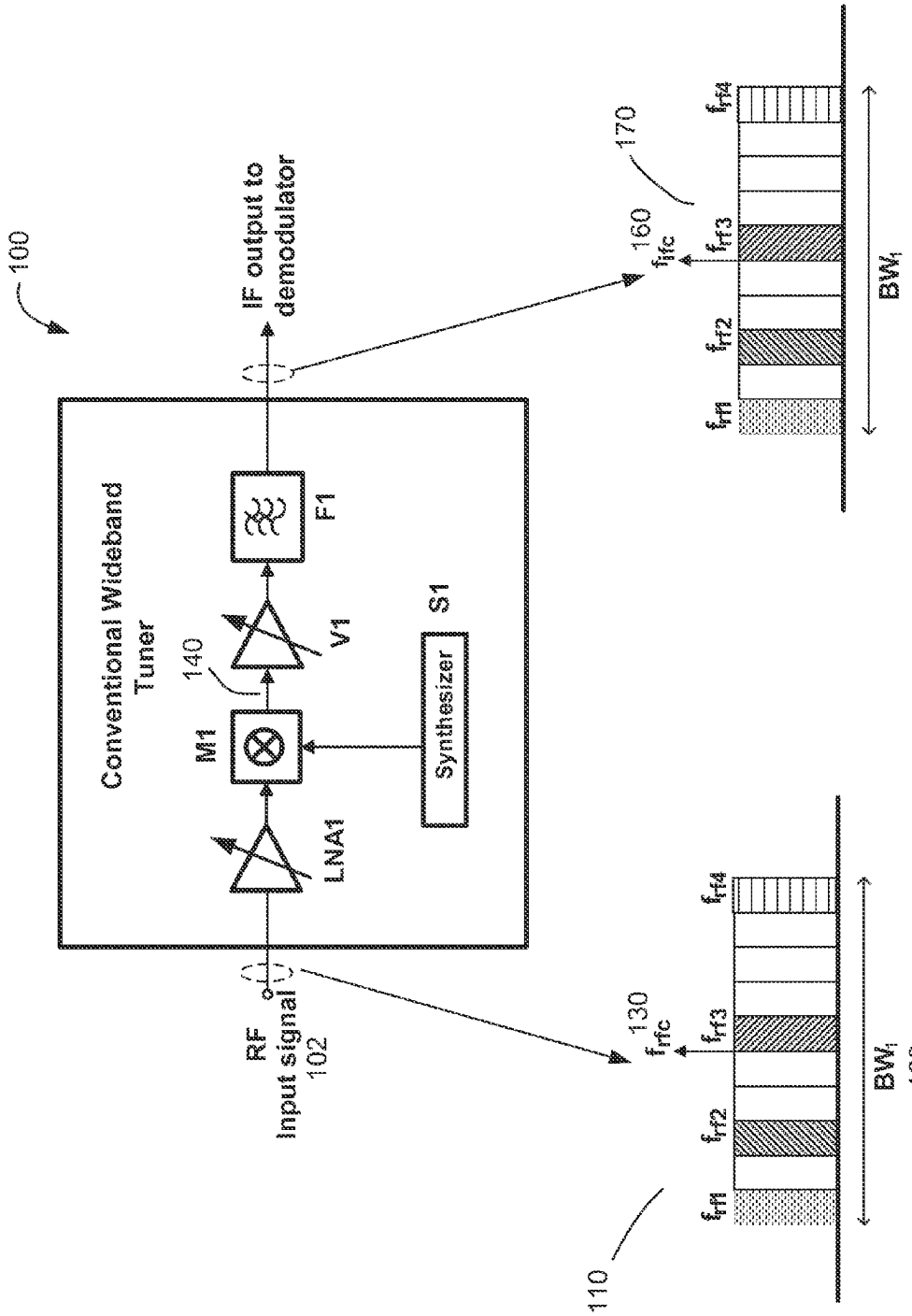


FIG. 1
(Prior Art)

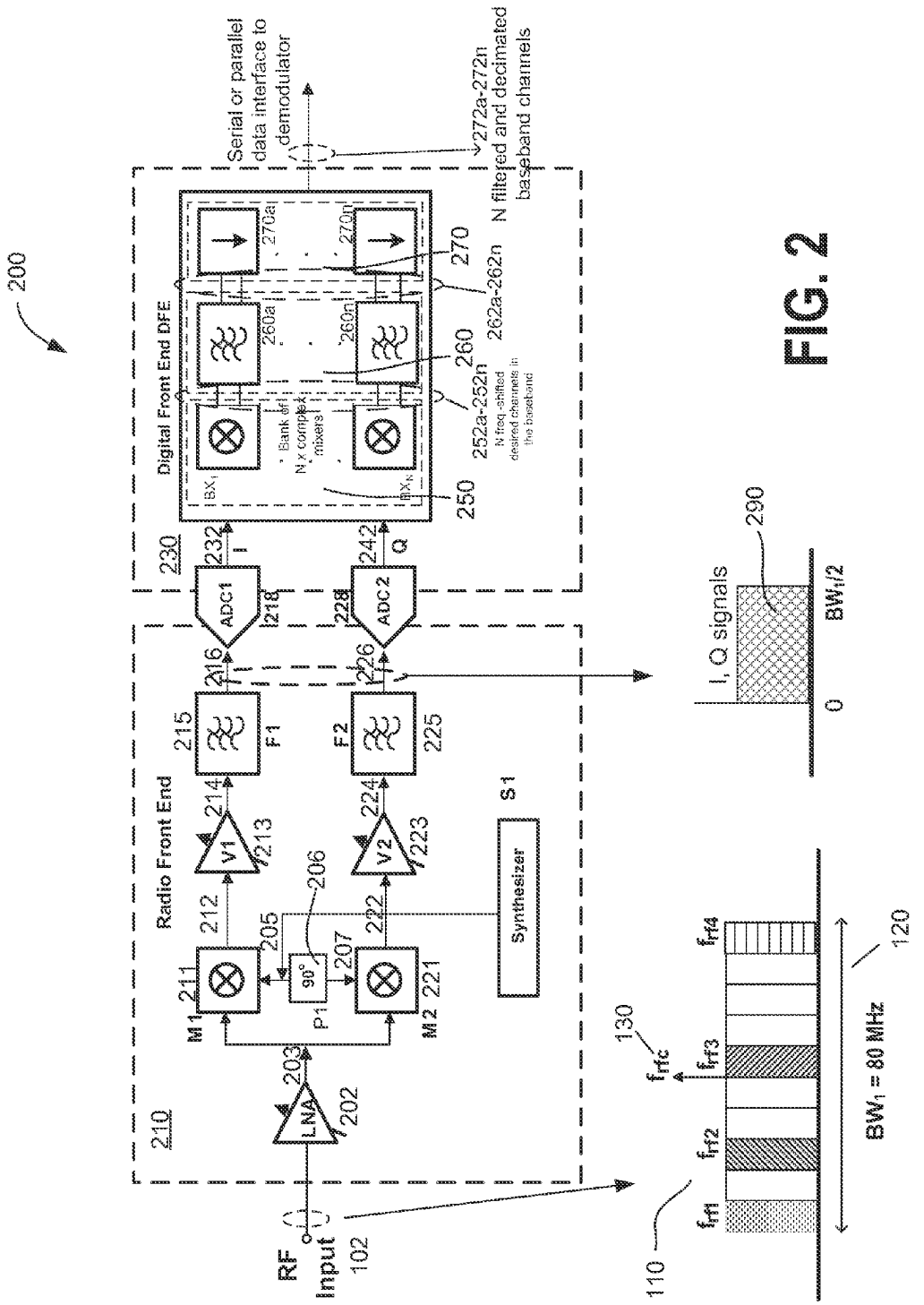

200
Digital Front End DFE
Serial or parallel data interface to demodulator
272a-272n
N filtered and decimated baseband channels
270
262a-262n
260
252a-252n
N freq.-shifted desired channels in the baseband
250
Bank of N x complex mixers
230
232
242
ADC1
ADC2
218
228
216
226
Radio Front End
215
225
F1
F2
214
224
V1
V2
213
223
S1
Synthesizer
206
212
222
205
207
211
221
M1
M2
P1
90°
203
202
LNA
210
RF Input
102
I, Q signals
290
BW1/2
0
130
110
120
BW1 = 80 MHz

FIG. 2

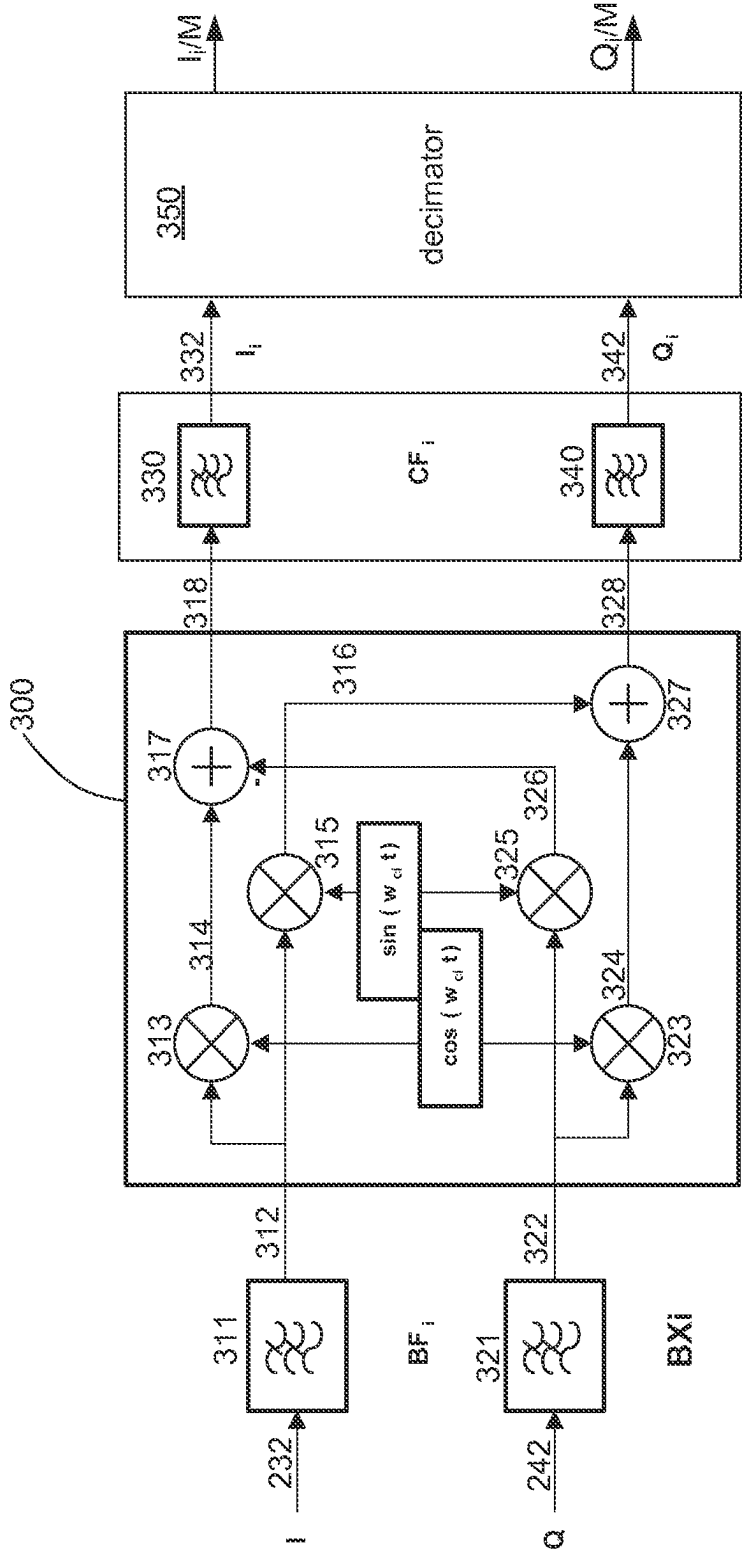

I_i/M
Q_i/M
350
decimator
332
I_i
342
Q_i
330
CF_i
340
318
328
316
300
317
327
326
315
325
sin (w_ct)
314
cos (w_ct)
324
313
323
312
322
311
BF_i
321
BXi
232
242
I
Q

FIG. 3

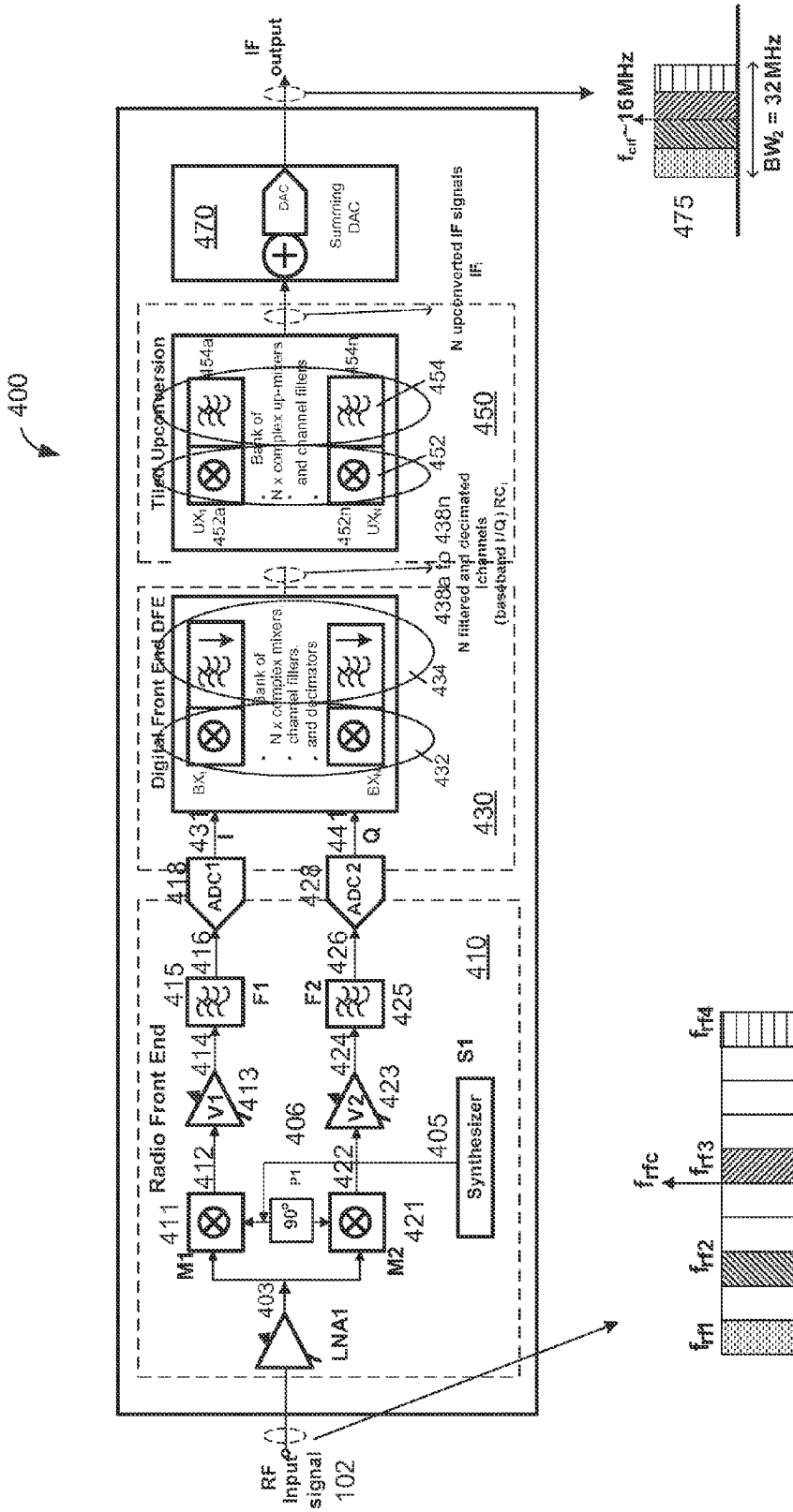

400
RF input signal 102
LNA1
403
M1
M2
411
412
421
422
90°
P1
406
405
Synthesizer
S1
V1
V2
413
423
414
424
415
425
F1
F2
416
426
ADC1
ADC2
418
428
43
44
I
Q
Radio Front End
410
Digital Front End, DFE
430
Bank of
N x complex mixers
channel filters
and decimators
BX1
BX2
432
434
N filtered and decimated
channels
(baseband I/Q) RC1
438a
438n
Tiled Upconversion
450
Bank of
N x complex up-mixers
and channel filters
UX1
UX2
452a
452n
454a
454n
452
454
N upconverted IF signals
IF1
470
DAC
Summing
DAC
IF
output
f_{rf1}
f_{rf2}
f_{rfc}
f_{rf3}
f_{rf4}
BW_1 = 80 MHz
f_{clf} = 16 MHz
BW_2 = 32 MHz
475

FIG. 4

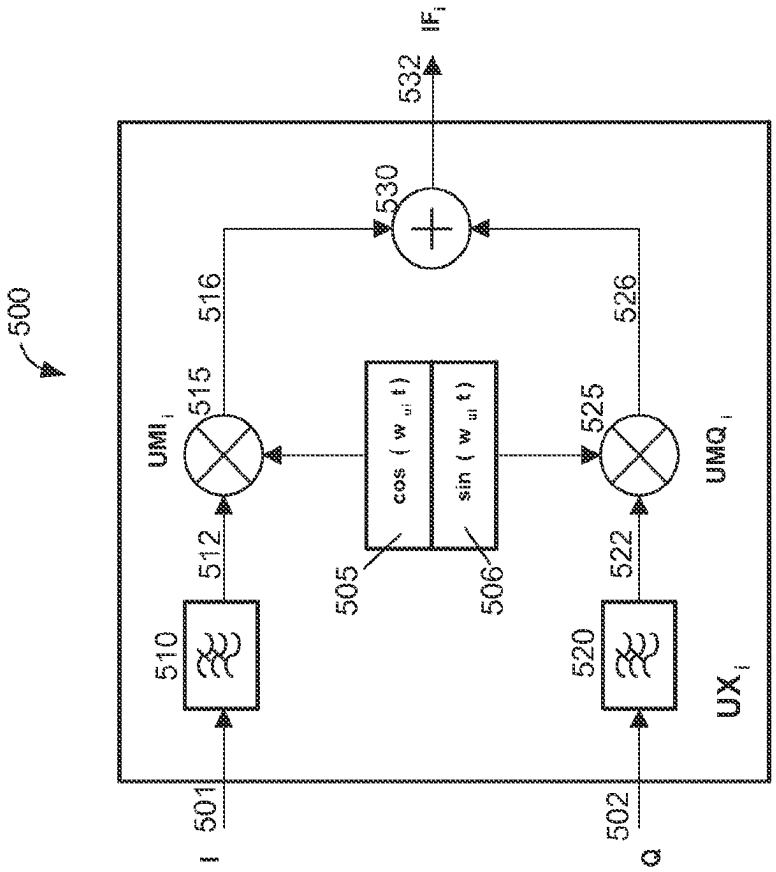

500
532
IF_i
530
516
526
515
525
UMI_i
UMQ_i
cos (w_ui t)
sin (w_ui t)
505
506
512
522
510
520
UX_i
501
502
I
Q

FIG. 5

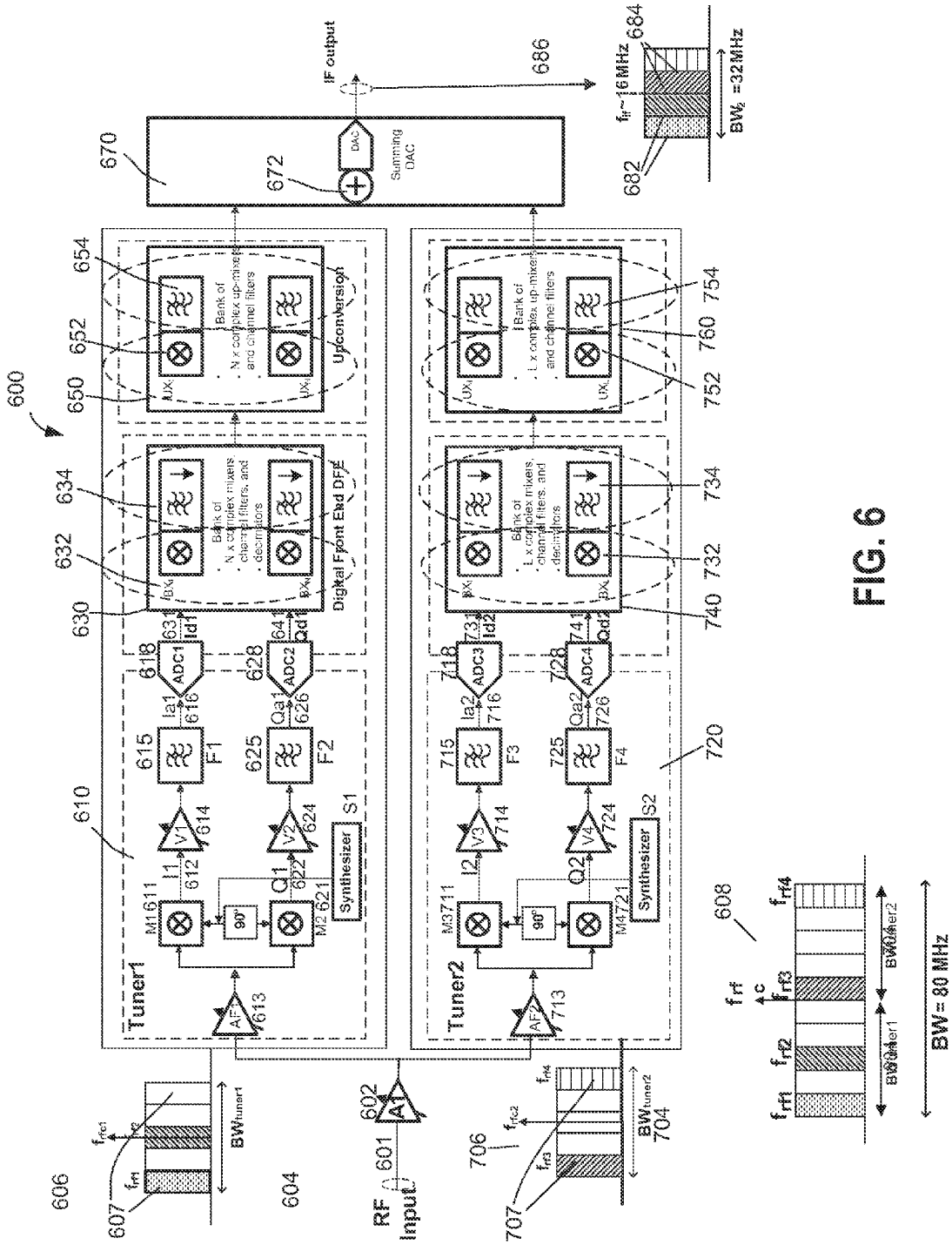

600
610
Tuner1
Tuner2
Digital Front End DFE
Upconversion
Bank of N x complex mixers, channel filters, and decimators
Bank of N x complex up-mixers and channel filters
Bank of L x complex mixers, channel filters, and decimators
Bank of L x complex up-mixers and channel filters
Summing DAC
IF output
RF input
Synthesizer
AF
ADC1
ADC2
ADC3
ADC4
90°
F1
F2
F3
F4
V1
V2
V3
V4
M1611
M2621
M3711
M4721
S1
S2
602
601
604
606
607
608
630
632
634
650
652
654
670
672
686
682
684
704
706
707
720
740
732
734
752
754
760
BW= 80 MHz
BW= 32MHz
fIF~16 MHz

FIG. 6

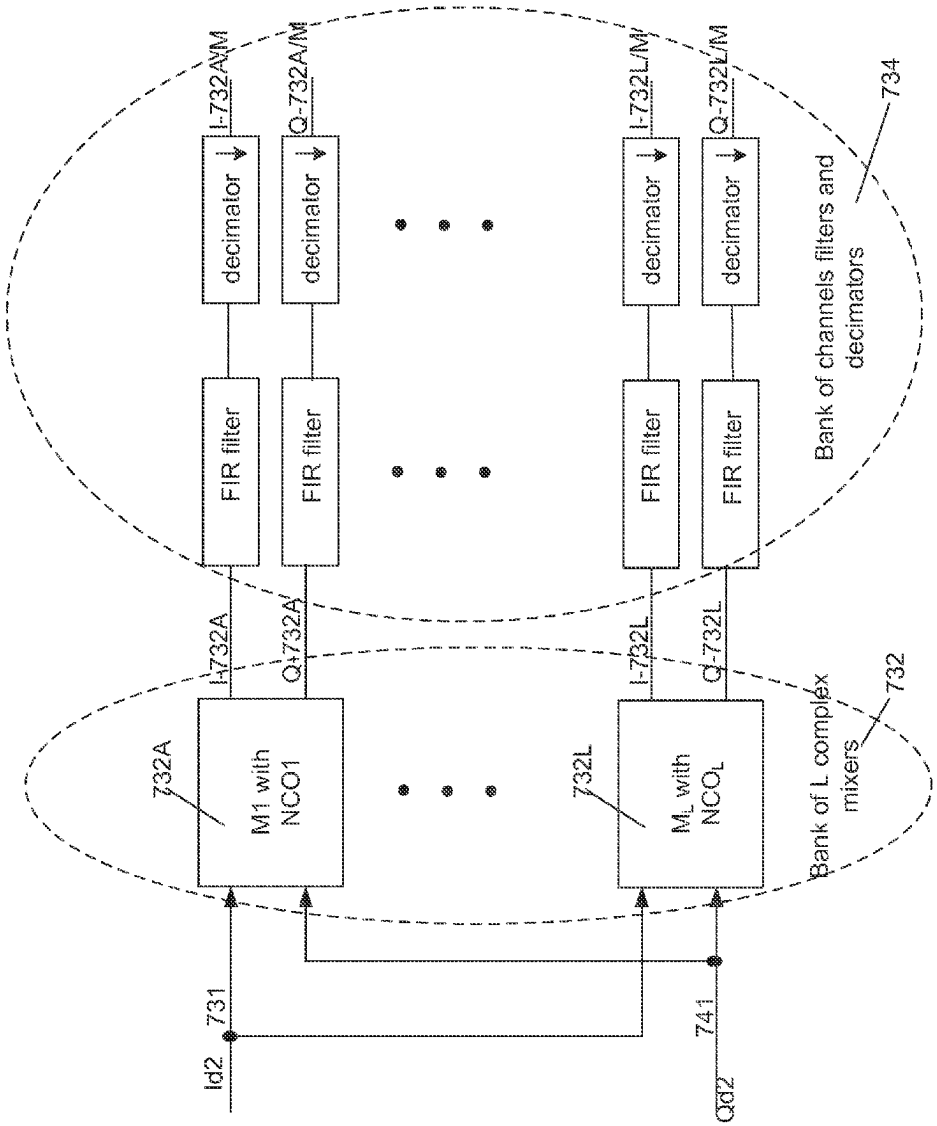

I-732A/M
Q-732A/M
I-732L/M
Q-732L/M
decimator
FIR filter
Bank of channels filters and decimators
734
I-732A
Q-732A
I-732L
Q-732L
732A
M1 with NCO1
732L
ML with NCOL
Bank of L complex mixers
732
731
Id2
741
Qd2

FIG. 7

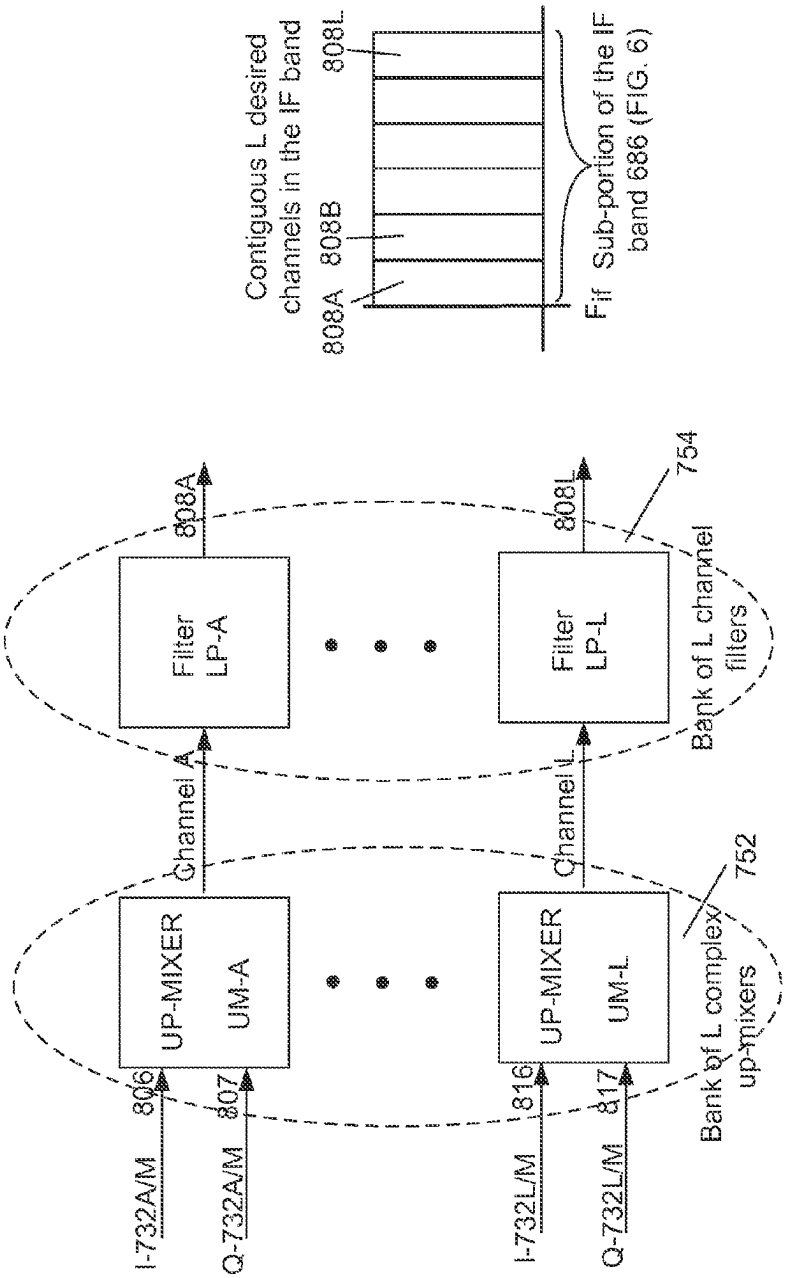

Contiguous L desired channels in the IF band
808A
808B
808L
Fif
Sub-portion of the IF band 686 (FIG. 6)
I-732A/M
Q-732A/M
806
807
UP-MIXER
UM-A
Channel A
808A
Filter LP-A
I-732L/M
Q-732L/M
816
817
UP-MIXER
UM-L
Channel L
808L
Filter LP-L
Bank of L complex up-mixers
752
Bank of L channel filters
754

FIG. 8

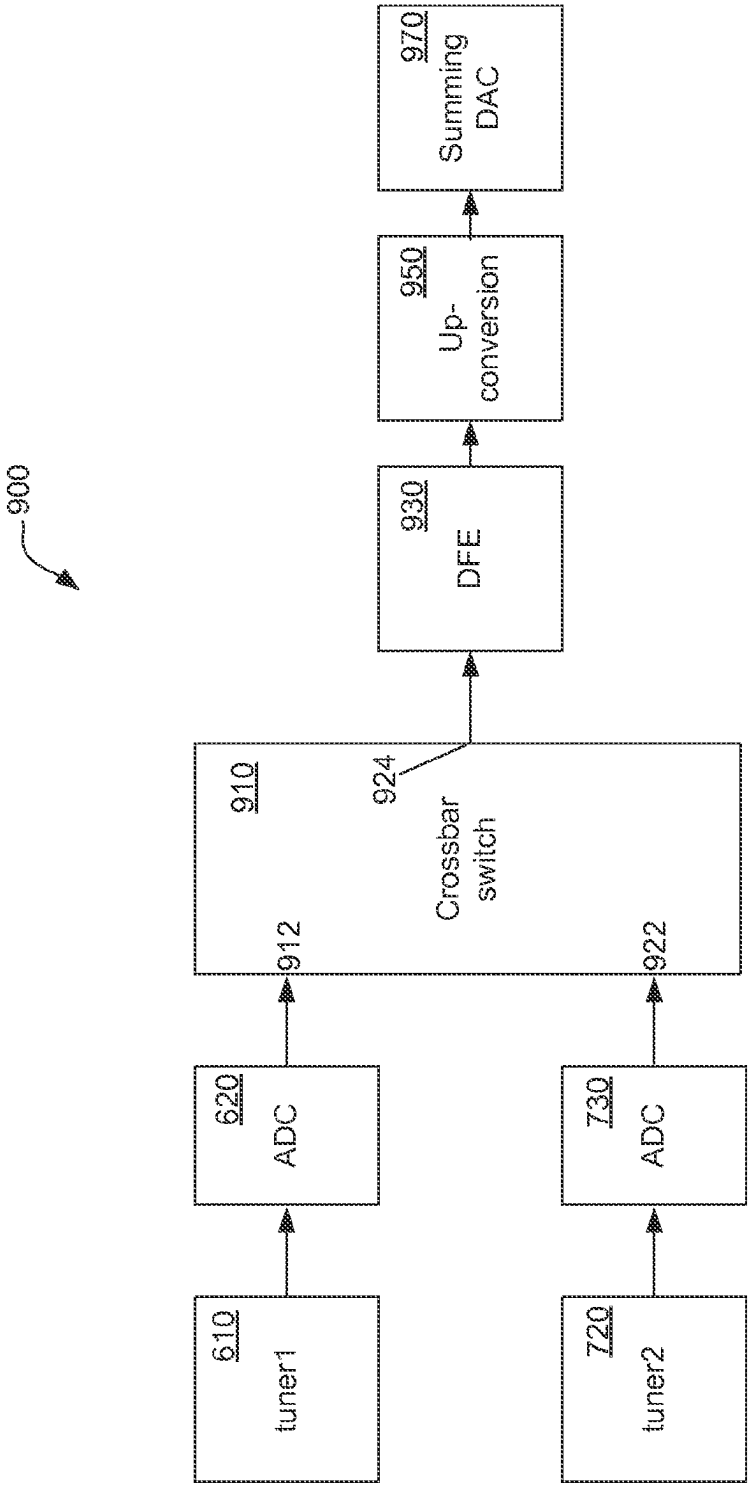

900
610
tuner1
620
ADC
720
tuner2
730
ADC
910
Crossbar switch
912
922
924
930
DFE
950
Up-conversion
970
Summing DAC

FIG. 9

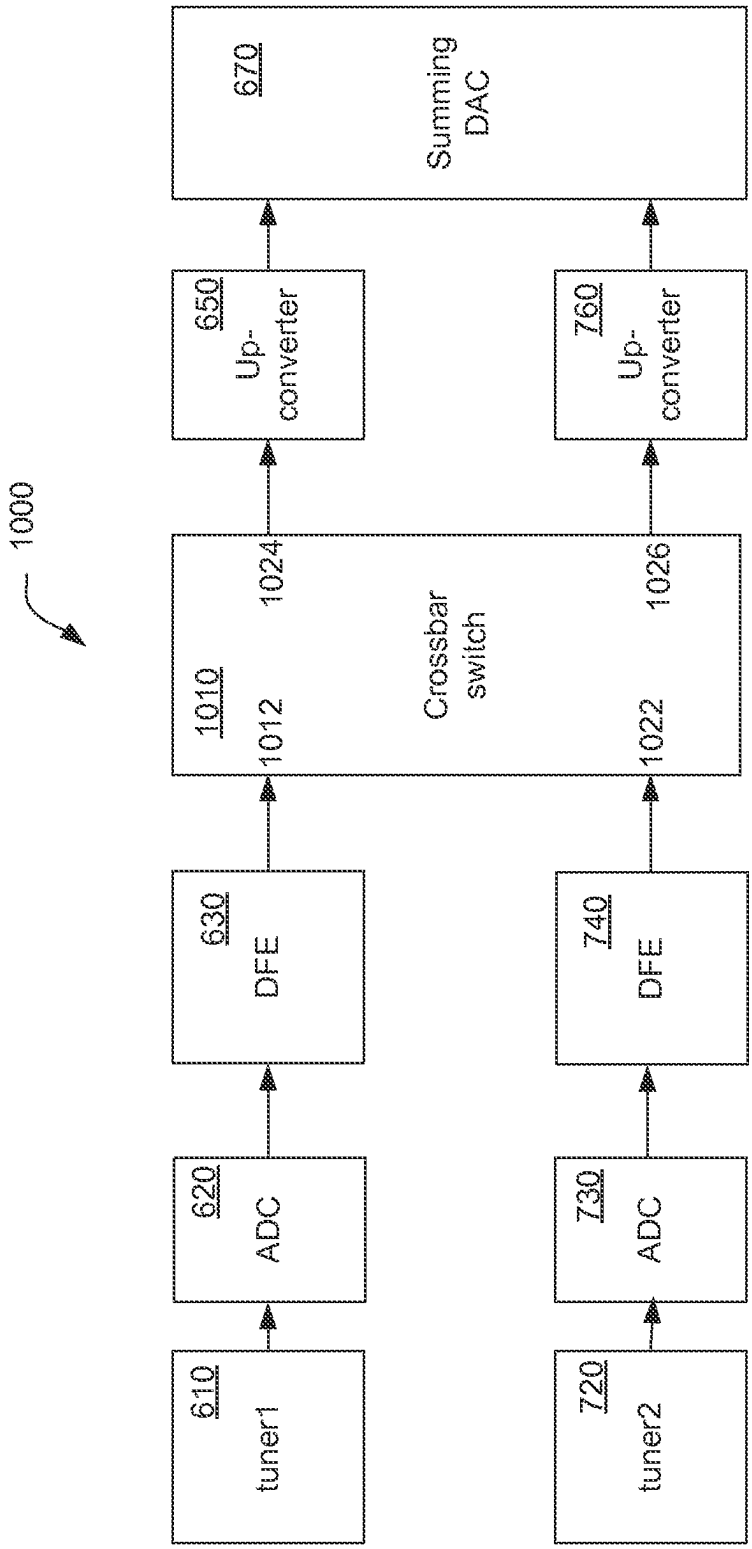

1000
610
tuner1
620
ADC
630
DFE
1010
1012
1024
Crossbar switch
1022
1026
650
Up-converter
670
Summing DAC
720
tuner2
730
ADC
740
DFE
760
Up-converter

FIG. 10

WIDEBAND TUNER ARCHITECTURE

PRIORITY CLAIM

This application is a continuation of U.S. patent application Ser. No. 13/962,871 filed on Aug. 8, 2013, which is a continuation of U.S. patent application Ser. No. 12/762,900 filed on Apr. 19, 2010 (now U.S. Pat. No. 8,526,898), which claims the benefit of priority to U.S. provisional application 61/170,526 filed Apr. 17, 2009. Each of the above referenced documents is hereby incorporated by reference in its entirety.

BACKGROUND

This invention relates to wideband receiver systems and methods having a wideband receiver that is capable of receiving multiple radio frequency channels located in a broad radio frequency spectrum. In particular, the invention relates to wideband receiver systems that are capable of receiving multiple desired television channels that extend over multiple non-contiguous portions of the broad frequency spectrum and grouping them into a contiguous, or substantially-contiguous, frequency spectrum.

Receivers used to down-convert and selectively filter TV channels are referred to as tuners, and tuners designed to concurrently receive several TV channels are referred to as wideband tuners. Existing tuners for these applications down-convert a swath of channels to an intermediate frequency, which are then sent to a demodulator. Because the swath of channels is not contiguous, this swath includes the desired channels as well as undesired channels. The demodulator employs a high-speed data converter to capture this swath of desired and undesired channels in the digital domain and subsequently filters out the desired channels.

In general, television channels broadcasted over the air or over cable networks are distributed across a broad frequency spectrum. That is, the channel frequencies may not be adjacent to each other. In certain applications such as DVR and picture-in-picture, the receiver system may have to concurrently receive several desired channels that may or may not be contiguous. The wideband receiver requirement poses a trade-off to the system to limit either the dynamic range of the wideband tuner or reduce the bandwidth covered by the tuner so that fewer channels may be received and processed by the demodulator.

FIG. **1** shows a conventional wideband tuner **100**. Tuner **100** may be a direct conversion tuner and includes a low noise amplifier LNA1 having an input terminal coupled to a radio frequency (RF) input signal **102** and an output terminal coupled to a mixer M1. The RF signal may include one or more television channels receiving from a cable network via an RF connector or wirelessly via an antenna. The RF input signal may include the VHF and UHF television channels in a terrestrial television broadcasting system or the CATV channels in cable networks. In order to receive all broadcasted channels present in the RF input signal, LNA1 must necessarily have a wide tuning range, high linearity, and low noise. Mixer M1 is coupled to a synthesizer S1 that can generate an oscillator frequency located around the center of the RF signal. Mixer M1 frequency down-converts the received RF input signal to a more convenient intermediate frequency (IF) band. Tuner **100** includes an amplifier V1 having a programmable gain for amplifying the IF signal, which is then band-pass filtered by a filter F1 before outputting to a demodulator.

In general, the RF signal includes multiple desired channels that are located in non-contiguous portions of a radio frequency spectrum. As shown in FIG. **1**, the swath of channels **110** occupies a bandwidth BW1 **120** at an RF center frequency f_{rfc} **130**. Synthesizer S1 may be tuned to a frequency around the center frequency f_{rfc} **130** for mixing channels **110** to an intermediate frequency f_{ifc} **160**, the frequency down-mixed channels **140** are amplified by amplifier V1 and then filtered by F1 to produce a swath of channels **170** centered around frequency f_{ifc} **160**. In an exemplary application shown in FIG. **1**, bandwidth BW1 contains 10 channels. In the case where channels are TV channels that are spaced at either 6 MHz or 8 MHz in most parts of the world, bandwidth BW1 **120** would span from 60-80 MHz, i.e., the down-converted bandwidth at the intermediate frequency would require a bandwidth equal to at least BW1, or at least 80 MHz when such architecture is used. It is noted that in other applications where the desired RF channels are located in the low band such as channels numbers 2 to 6 (VHF in the terrestrial TV broadcast or CATV) and in the high band such as channels numbers 14 to 83 of the UHF TV broadcast or channel numbers 63-158 of the CATV's ultra band, the bandwidth BW1 can be 800 MHz or higher. This wide bandwidth of 800 MHz would require a very expensive digital processing circuitry such as very high-speed analog to digital conversion and high-speed processor in the demodulator.

It is desirable to have wideband receiver systems that can increase the dynamic range without requiring expensive data conversion, filtering and channel selection at the demodulator.

BRIEF SUMMARY

An embodiment of the present invention includes a wideband receiver system that is configured to concurrently receive multiple radio frequency (RF) channels including a number of desired channels that are located in non-contiguous portions of a frequency spectrum and group the desired channels in a contiguous or substantially-contiguous frequency band at an intermediate frequency spectrum, where the term "substantially-contiguous" includes spacing the desired channels close to each other (e.g. as a fraction of the total system bandwidth, or relative to a channel bandwidth) but with a spacing that can be variable to accommodate the needs of overall system. The term "contiguous" heretofore encompasses "substantially-contiguous." The term "spacing" is referred to as the frequency difference between adjacent channels. The system includes a wideband receiver having a complex mixer module for down-shifting the multiple RF channels and transforming them to an in-phase signal and a quadrature signal in the baseband or low intermediate frequency (IF) band. The system further includes a wideband analog-to-digital converter module that digitizes the in-phase and quadrature signals. The digital in-phase and quadrature signals are provided to a digital frontend module that contains a bank of complex mixers that frequency-shift the number of desired channels to a baseband where the desired channels are individually filtered.

The digital frontend module may also include a decimator module that decimates the desired RF channels by a factor M before demodulating them to a digital data stream.

In certain embodiments of the present invention, the wideband receiver system additionally includes an up-converter module having multiple complex up-mixers, each of the complex up-mixers is configured to frequency up-shift each one of the desired RF channels to a sub-portion of an IF spectrum, wherein all sub-portions of the desired channels are adjacent to each another and form a contiguous frequency band in the IF spectrum. The act of frequency shifting the desired channels to the IF spectrum allows the wideband receiver system

to directly interface with commercially available demodulators. Allowing the spacing of the desired channels in the contiguous spectrum to be variable allows a system to optimize placement of these desired channels for the purposes of avoiding sensitive portions of the spectrum which may either be vulnerable to spurious signals and interference; or which may generate interference directly or as a harmonic product, to other systems.

In another embodiment of the present invention, a multi-tuner receiver system having two or more tuners is provided to receive multiple desired RF channels that extend over several non-contiguous sub-portions of a broad frequency spectrum and group them into a contiguous frequency spectrum. The multi-tuner system includes at least a first tuner that processes a first sub-portion of the broad frequency spectrum into a first in-phase signal and a first quadrature signal and a second tuner that processes a second sub-portion of the broad frequency spectrum into a second in-phase signal and a second quadrature signal. The multi-tuner receiver system further includes a first analog-to-digital converter module that digitizes the first in-phase and quadrature signals and a second analog-to-digital converter module that digitizes the second in-phase and quadrature signals. In addition, the multi-tuner system includes a first digital frontend module having a first number of complex mixers corresponding to a first number of the desired RF channels located in the first sub-portion of the broad frequency spectrum and a second digital frontend module having a second number of complex mixers corresponding to a second number of the desired RF channels located in the second sub-portion of the broad frequency spectrum. The first digital frontend module frequency shifts the first number of the desired RF channels to a first plurality of baseband signals and the second digital frontend module frequency shifts the second number of the desired RF channels to a second plurality of baseband signals.

The multi-tuner system further includes a first up-converter module having a plurality of N complex mixers, wherein N is an integer value equal to the number of desired channel. The first up-converter module frequency up-shifts the first plurality of the baseband signals to a first portion of an intermediate frequency. In addition, the multi-tuner system includes a second up-converter module that frequency up-shifts the second plurality of the baseband signals to a second portion of an intermediate frequency. The first and the second portions of the intermediate frequency are non-overlapping and located adjacent to each other to form a contiguous intermediate frequency (IF) band. The multi-tuner system further includes a digital-to-analog converter that converts the contiguous IF band to an analog waveform signal.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic block diagram of a conventional wideband tuner;

FIG. **2** is a schematic block diagram of a wideband receiver system according to an embodiment of the present invention;

FIG. **3** is a simplified circuit diagram of a complex down-mixer according to an embodiment of the present invention;

FIG. **4** is a simplified schematic block diagram of a wide-band receiver system according to another embodiment of the present invention;

FIG. **5** is a simplified circuit diagram of a complex up-mixer according to an embodiment of the present invention;

FIG. **6** is a simplified schematic block diagram of a wide-band multi-tuner receiver system according to an embodiment of the present invention;

FIG. **7** is a block diagram illustrating an exemplary digital front end according to an embodiment of the present invention in more detail;

FIG. **8** is a block diagram illustrating an exemplary tiled up-converter module according to an embodiment of the present invention in more detail;

FIG. **9** is a simplified block diagram of a wideband multi-tuner receiver system **900** according to an embodiment of the present invention; and

FIG. **10** is a simplified block diagram of a wideband multi-tuner receiver system **1000** according to another embodiment of the present invention.

DETAILED DESCRIPTION

FIG. **2** is a schematic block diagram of a wideband receiver system **200** according to an embodiment of the present invention. Wideband receiver system **200** includes a radio front end **210** and a digital front end **230**. Radio front end **210** may be a single very wide-band tuner receiver that captures the desired swath of channels located in non-contiguous portions of the spectrum having a frequency bandwidth BW1 **120**. In this example, the number of available channels in BW1 **120** is assumed to be 10 with each channel occupying an 8 MHz bandwidth for a total of 80 MHz. Radio front end **210** is shown as including a low noise amplifier LNA **202** having an input terminal configured to receive an RF input signal **102**. In the example shown, RF signal **102** includes four desired RF channels having the respective carrier frequency f_{rf1}, f_{rf2}, f_{rf3}, and f_{rf4} that are located in non-contiguous portions of the wide frequency spectrum BW1. It is understood, however, that spectrum BW1 **120** may have any other number of desired frequencies that are not contiguous. LNA **202** has a very low noise figure and very high linearity and a wide tuning range (i.e., very high IIP2 and IIP3 intercept points) to maximize a signal-to-noise-and distortion ratio (SNDR) at the amplifier output. LNA **202** may have a programmable gain to amplify RF signal **102** to adequate voltage levels for mixers M1 **211** and M2 **221**.

Mixers M1 **211** and M2 **221** may be conventional mixers formed using, for example, differential Gilbert cells. Each of the mixers **211** and **221** multiplies (mixes) an amplified RF signal **203** with a respective first oscillator frequency signal **205** and a second oscillator frequency signal **207** to generate an in-phase signal **212** and a quadrature signal **222** that have a phase shift of 90° degree between them. Mixers **211** and **221** are identical so that the amplitude of the in-phase signal **212** and quadrature signal **222** are the same. The first and second oscillator frequencies **205** and **207** are identical and have a 90° degree phase shift generated through a 90° degree phase shifter P1 **206**. Synthesizer S1 may be a single local oscillator operable to generate the oscillator frequency **205** for converting the receive RF signal **102** to a zero-IF or low-IF band. Synthesizer S1 can be a coarse (large step) phase locked loop. Synthesizer S1 can also be programmable to cover the wide-band frequency of the analog and digital terrestrial broadcast and/or the cable television system. The RF signal **102** may have relatively uniform signal strength in a cable network. However, its signal strength may extend in several orders of magnitude in a terrestrial broadcast system, thus, LNA **202** and/or mixers M1 **211**, M2 **221** are required to have a relatively high dynamic range to handle the large variations in the signal strength.

In-phase signal **212** and quadrature signal **222** are further amplified and filtered by respective amplifiers V1 **213**, V2 **223** and filters F1 **215**, F2 **225** to generate a filtered in-phase signal **216** and a filtered quadrature signal **226**. Filters F1 **215**

and F2 **225** may be passive or active low-pass filters to filter out any unwanted frequency components of the signals **214** and **224** before digitizing them for further processing in digital front end **230**. It is understood that the in-phase path **216** and the quadrature path **226** must have the same amplitude spectrum and maintain a fixed phase relationship, i.e., amplifiers V1 **213**, V2 **223** and filters F1 **215**, F2 **225** must be substantially identical. Because the two paths **216** and **226** are in quadrature, the spectral components from both positive and negative frequencies can be overlaid so that the bandwidth (cutoff frequency) of filters F1 **215** and F2 **225** can be one half of the BW1 bandwidth **120**.

Analog-to-digital converters ADC1 **218** and ADC2 **228** are high-speed (i.e., high sampling rate) converters to maximize the dynamic range. In an exemplary application, radio front end **210** operates as a nominal zero-IF down-mixer so that signals **216** and **226** have a nominal bandwidth **290** equal to one half of the RF signal bandwidth BW1 thanks to the complex down-mixer architecture. In other embodiment, radio front end **210** operates as a low-IF down-mixer so that the nominal bandwidth **290** of signals **216** and **226** is greater than one half of the bandwidth BW1. In practice, the sampling rate of ADC1 **218** and ADC2 **228** is chosen to be higher than the Nyquist sampling requirement, i.e., the filtered analog quadrature signals **216** and **226** may be over-sampled in order to reduce or avoid aliasing of undesired signals into the digitized I and Q signals.

ADC1 **218** generates a digital signal I **232** that is a digital representation of the analog filtered signal **216**; ADC2 **228** generates a digital signal Q **242** that is a digital representation of the analog filtered signal **226**. Digital signals I **232** and Q **242** are then applied to a bank of N complex mixers **250**, wherein N is an integer value corresponding to the number of desired RF channels located in the non-contiguous portions of the frequency spectrum BW1. It is understood that the number N can be any integer value. In one embodiment, N can be equal to the number of all available channels that exist in the licensed frequency spectrum to provide system flexibility. In other embodiments, N can be equal to the number of all receivable channels within a geographic area. In yet another embodiment, N can be an integer value less than the number of receivable channels with the geographic area to reduce system costs. In the exemplary embodiment shown in FIG. **2**, the number of desired channels is 4. That is, each of the 4 complex mixers **250** mixes in-phase and quadrature signals **232** and **242** with an associated frequency to generate a corresponding baseband, which is then individually filtered, decimated and provided to an associated demodulator.

Each of the N complex mixers **250** receives the digital signals I **232** and Q **242** from ADCs **218** and **228** to extract a different one of the desired channels and frequency-shifts the extracted signals to the baseband frequency. Each of the frequency shifted desired channels **252** is filtered by an associated filter module (identified as **260***a* to **260***n*). In an embodiment, each of the filtered signals **260***a* to **260***n* may be sent directly to an associated demodulator (identified as **270***a* to **270***n*) for extracting the original information transmitted in the associated desired channel. In another embodiment, each of the filtered signals **262***a* to **262***n* is further decimated before providing to a demodulator. A path of digital front end **230** is described in more detail below.

FIG. **3** is a simplified circuit diagram of one of the signal paths **272***a* to **272***n* of digital front end **230** shown in FIG. **2** according to an embodiment of the present invention. In an embodiment, digital signal I **232** may be further filtered by a filter **311** to obtain a filtered signal **312**. Similarly, digital signal Q **242** may be further filtered by a filter **321** to obtain a filtered signal **322**. Thus, digital signals **312** and **322** only contain low-frequency components with undesired high-frequency components being eliminated by respective filters **311** and **321**. It is noted that filtered signals **312** and **322** are interposed between the respective ADCs **218**, **228** and the bank of N complex mixers **250**.

Mixer **300**, which represents one of the N complex mixers **250**, includes four multipliers **313**, **315**, **323**, and **325**. Multipliers **313** and **315** multiply the filtered signal **312** with respective $\cos(\omega_{ci}t)$ and $\sin(\omega_{ci}t)$ signals and generate respective products **314** and **316**. Similarly, multipliers **323** and **325** multiply the filtered Q signal **322** with respective $\cos(\omega_{ci}t)$ and $\sin(\omega_{ci}t)$ signals and generate respective products **324** and **326**. An adder **317** sums the products **314** and **326** to generate a frequency-shifted signal I **318**. An adder **327** sums the products **324** and **316** to generate a frequency-shifted signal Q **328**. Basically, complex mixer **300** causes a frequency shift of the filtered components **312** and **322** to respective baseband signals **318** and **328** in the digital domain according to the operation:

$$Y(t)=X(t)*e^{-j\omega_{ci}t} \quad (1)$$

or taken the Fourier transform, we obtain:

$$Y(\omega)=X(\omega-\omega_c) \quad (2)$$

Multipliers **313**, **315**, **323**, and **325** are identical digital multipliers. In an embodiment, a numerically controlled oscillator with quadrature output generates the $\cos(\omega_{ci}t)$ and $\sin(\omega_{ci}t)$ signals. Numerically controlled oscillators (NCO) can be implemented using a phase accumulator and a look-up table. NCOs are known to those of skill in the art and will not be described herein. The frequency ω_{ci} is so chosen that each one of the desired channels embedded in the digital signals I **232** and Q **242** will be downshifted to the baseband. In the given example shown in FIG. **2**, the bank of N complex mixers will have four complex mixers, each one of the N (i.e., four) complex mixers is coupled to an individual NCO having a distinct frequency ω_{ci} so that when mixing the filtered digital I and Q signals **312** and **322** with that frequency, each one of the complex mixers will generate the signals I (**318**) and Q (**328**) of a corresponding one of the desired channels at the baseband.

In an embodiment, baseband signals **318** and **328** are further individually filtered by respective filters **330** and **340** that are identified as one of the filters **260***a-n* in FIG. **2**. Filters **330** and **340** may be band-pass or low-pass filters having a narrow bandwidth equal to the bandwidth of a desired channel. In certain embodiments, filters **330** and **340** can be analog passive or active low-pass or complex band-pass filters such as polyphase filters. In another embodiment, filters **330** and **340** can be digital low-pass filters, such as finite impulse response (FIR) filters to eliminate high frequency components that may be aliased back to the baseband signals Ii (**332**) and Qi (**342**) when decimated by subsequent decimator **350**.

The reduced sampling rate of the N desired baseband channels will be sent as a serial or parallel digital data stream to a demodulator using a serial or parallel data interface according to commonly known methods, as shown in FIG. **2**. This approach provides several advantages over conventional tuner architectures. First, it eliminates the need of expensive data conversion, filtering and channel selection on the demodulator side. Second, it removes undesired channels from the signal path at an early stage, thus relieves the large dynamic range requirement in the demodulator.

FIG. **4** shows a simplified schematic block diagram of a wideband receiver system **400** according to another embodiment of the present invention. Wideband receiver system **400**

includes a radio front end **410**, a digital front end **430**, a tiled up-conversion module **450**, and a summing digital-to-analog converter module DAC **470**. Radio front end **410** includes a low noise amplifier LNA1 that receives an RF input signal **102** and provides an amplified RF signal **403** to mixers M1 **411** and M2 **421**. Mixer M1 **411** is coupled to an oscillator frequency **405** of a synthesizer S1 whereas mixer M2 **421** is coupled with the oscillator frequency **405** via a phase shifter P1 **406** that generates a 90° degree phase-shift to the oscillator frequency **405**. Mixers M1 **411** and M2 **421** generate respective in-phase signal **412** and quadrature signal **422** that are further amplified by respective amplifiers V1 **413** and V2 **423**. The amplified in-phase and quadrature signals **414**, **424** are then filtered by filters F1 **415** and F2 **425** to eliminate undesired frequency components that would be aliased back to the in-phase and quadrature signals when digitally sampled by subsequent analog-to-digital converters ADC1 **418** and ADC2 **428**. Digital signals I **422** and Q **442** at the input of digital front end **430** are digital representations of the filtered analog in-phase and quadrature signals **416**, **426** before the ADCs. Digital front end **430** include a bank of N complex mixers **432** comprising **432***a* to **432***n* identical mixers, where N is an integer value corresponding to the number of the desired channels located in non-contiguous portions of the frequency spectrum. Each of the N complex mixers **432***a* to **432***n* frequency down-converts signals I **432** and Q **442** to an associated baseband. Each of the frequency down-converted I and Q signals are coupled to respective low-pass, band-pass, or decimating filters **434**. In this regard, the radio front end **410** and the digital front end **430** are similar to respective radio front end **210** and digital front end **230** of FIG. **2** that have been described in detail above.

In an alternative embodiment of the present invention, the N filtered and decimated channels **438***a* to **438***n* (where indices a to n correspond to the associated number of desired channels) are not provided to a demodulator for demodulation. Instead, the N filtered and decimated channels **438***a* to **438***n* are further frequency up-converted to an intermediate frequency (IF) spectrum. In order to achieve that, the N filtered and decimated channels are coupled to a tiled up-conversion module **450** that includes a bank of N complex up-mixers, where N is an integer value correspond to the number of desired received channels. The N complex up-mixers include identical digital mixers **452***a* to **452***n* that will be described further in detail below with reference to FIG. **5**. The N up-shifted channels are then filtered by a subsequent bank of channel filters **454** that, in an embodiment, comprises N individual finite impulse response (FIR) filters. The N filtered channels are then digitally combined and converted to the analog domain by a summing digital-to-analog converter module DAC **470**. The N up-shifted channels are adjacent to each other and form a contiguous or substantially-contiguous set of channels **475** in the IF spectrum centered around f_{if} as illustrated in FIG. **4**. In an embodiment, the spectra of the mixed products are spaced in such a way so as to avoid overlap with known frequency bands containing potential or actual interferers. In another embodiment, the spectra of the mixed products are spaced in such a way so as to avoid overlap with frequency bands that might introduce interference to other systems. In general, because the bandwidth BW_2 is substantially lower than BW_1, the IF frequency f_{if} can be set proportionally lower, e.g., typically about 16 MHz to accommodate the spectrum of BW2 of up to 32 MHz (corresponding to the total bandwidth of the four desired channels, each having a bandwidth of 8 MHz in this example).

The up-conversion approach of FIG. **4** provides several advantages over conventional tuner architectures. First, it allows the demodulator to operate the data converter at a lower data rate and with lower resolution (fewer bits) due to the fact that the contiguous channels have a narrower bandwidth. Second, the up-conversion approach provides full compatibility with existing demodulators that require an analog IF signal. Third, it removes undesired channels from the signal path at an early stage, thus relieves the requirement of a high dynamic range requirement of the demodulator's analog-to-digital converter and the demodulator itself.

FIG. **5** shows a simplified exemplary circuit diagram of a complex up-mixer **500** according to an embodiment of the present invention. Up-mixer **500** is one of the N complex up-mixers **452***a* to **452***n* in tiled up-conversion module **450** shown in FIG. **4**. Up-mixer **500** includes filter **510** and **520** configured to eliminate unwanted frequency components present in respective input signals I **501** and Q **502**. Filtered signals **512** and **522** are provided to up-mixers UMI **515** and UMQ **525** that multiply the filtered signals **512** and **522** with respective $\cos(\omega_u t)$ and $\sin(\omega_u t)$. The products **516** and **526** are summed in an adder **530** to generate an IF signal **532** according to the following equation:

$$IF(t)=I(t)*\cos(\omega_u t)+Q(t)*\sin(\omega_u t) \quad (3)$$

Up-mixers UMI **515** and UMQ **525** are identical digital multipliers that multiply the respective filtered signal **512** and **522** with a cosine function **505** and a sine function **506** that can be generated from a NCO using a digital phase accumulator and a look-up table.

As described above, TV channels are grouped into multiple frequency bands in North America. For example, channels 2 through 6 are grouped in VHF-low band (aka band I in Europe), channels 7 through 13 in VHF-high band (band III), and channels 14 through 69 in UHF band (bands IV and V). In order to receive such a wide frequency spectrum, the low noise amplifier and mixer must have very low noise, wide tuning range and high linearity as described above in the wideband receiver systems **200** and **400**. However, a wideband receiver having a single tuner with high sensitivity may have a high power consumption. For certain applications, it may be advantageous to use multiple tuners that are optimized for a given frequency band, such as a dedicated tuner for the low VHF band, another dedicated tuner for the high VHF band and the UHF band, and yet other dedicated tuners for receiving the digital video broadcasting (DVB) via satellite (DVB-S), via cable (DVB-C), or terrestrial digital video broadcasting (DVB-T). The multi-tuner approach may also be advantageously applied to cable networks that carry TV programs on an 88 MHz to 860 MHz according to the Data Over Cable Service Interface Specification (DOCSIS) protocol.

FIG. **6** shows a simplified schematic block diagram of a wideband multi-tuner receiver system **600** according to an embodiment of the present invention. In an embodiment, multi-tuner system **600** includes low noise amplifier A1 **602** for receiving an RF input signal **601**. Amplifier A1 **602** is coupled to at least a tuner1 **610** and a tuner2 **720**. In another embodiment, multi-tuner system **600** may not include amplifier **602** so that RF input signal **601** can be received directly at each tuner **610** and **720**.

Tuner1 **610** includes an amplifying filter AF1 **613** that filters and amplifies a first portion BWtuner1 **604** of a broad frequency spectrum **608** that contains a first plurality of RF channels **606** including desired channels **607** having respective channel frequencies f_{rf1} and f_{rf2}. The first portion of the broad frequency spectrum BWtuner1 **604** is then frequency down-converted to a low-IF or zero-IF in-phase signal I1 **612** and a quadrature signal Q1 **622** through respective mixer M1

611 and M2 621. Signals I1 612 and Q1 622 are further amplified and low-pass filtered before applying to respective analog-to-digital converters ADC1 618 and ADC2 628 that convert analog signals Ia1 616 and Qa1 626 to respective digital in-phase signal Id1 631 and digital quadrature signal Qd1 641. Because tuner1 610 only covers a portion BWtuner1 604 of the entire frequency spectrum 608 having fewer channels, the ADC1 618 and ADC2 628 can be slower-speed analog-to-digital converters with a large number of bits, i.e., large dynamic range.

Digital signals Id1 631 and Qd1 641 are then provided to a digital front end DFE 630 that includes a first bank of N complex mixers 632 and channel and decimating filters 634. The first bank of N complex filters 632 has N identical complex mixers, where N is an integer value equal to the number of desired channels located in the first portion BWtuner1 604 of the broad frequency spectrum 608. In an embodiment, each one of the first bank of N complex mixers includes four digital mixers that multiply digital stream Id1 631 and Qd1 641 with respective digitized cosine function and sine function to generate the sum and difference frequency components, as shown in FIG. 3. The digitized cosine and sine frequency, i.e., the mixer frequency is so chosen so that when mixing signals Id1 631 and Qd1 641 will move them to a baseband or a low-IF band. In an embodiment, channel and decimating filters have similar structures as filters 330 and 340 and demodulator 350 as shown in FIG. 3. That is, channel and decimating filters include digital low-pass filters 330 and 340 that eliminates unwanted high frequency components of the baseband signals I and Q prior to applying them to a decimator 350 (FIG. 3) that reduces the sample frequency without any loss of information since Id1 631 and Qd1 641 are sampled at a much higher frequency by the respective ADC1 618 and ADC2 628.

The decimated desired channels are then provided to an up-converter module 650 that includes a bank of N up-mixers. The bank of N up-mixers includes N identical up-mixers whose structure is shown in FIG. 5. In an embodiment, N is an integer value equal to the number of desired channels present in BWtuner1 604. Each one of the up-mixer frequency-shifts the baseband signals I and Q of each one of the desired channels to an appropriate portion of the intermediate frequency band according to Equation (3). In other words, the bank of N up-mixers is "frequency multiplexing" the desired channels onto a first portion 682 of an IF band 686.

Similarly, tuner2 720 includes an amplifying filter AF2 713 that is configured to receive a second portion BWtuner2 704 of the broad frequency spectrum 608. The second portion 704 contains a second plurality of RF channels 706 including a second number of desired channels. In the exemplary illustration of FIG. 6, the second portion 704 has a frequency bandwidth of BWtuner2 that contains desired channels 707 having respective channel frequencies f_{rf3} and f_{rf4}. Tuner2 720 includes elements such as mixers M3 711, M4 721, amplifiers V3 714, V4 724, filters F3 715, F4 725 and analog-to-digital converters ADC3 731 and ADC4 741 that are substantially the same as the like-named elements of the signal path of tuner1 610. Thus, redundant description is omitted herein.

Digital in-phase signal Id2 731 and digital quadrature signal Qd2 741 are then provided to digital front end 740. Digital front end 740 includes a bank of L complex filters, where L is an integer value equal to the number of desired channels in the second portion BWtuner2 704 of the broad frequency spectrum 608. Each one of the bank of L complex filters is a digital complex mixer configured to transform the signals Id2 731 and Qd2 741 to baseband signals that are further filtered by individual digital low-pass filters such as FIR filters before decimated by a subsequent decimator. The elements of digital front end 740 are substantially similar to those described in digital front end 630. Thus, redundant description is omitted herein.

The decimated baseband I and Q channels are further provided to a subsequent up-conversion module 760 that performs a function substantially similar to that of the up-conversion module 650 already described above. The outputs of up-conversion module 650 and 760 can be tiled to generate a contiguous set of IF frequencies 682, 684 centered at f_{if} 686. In an embodiment, the outputs of up-conversion module 650 and 760 are digitally summed and converted to an analog signal by summing DAC 670. In another embodiment, the up-conversion modules 650 and 760 and the digital summing function 672 can be performed using an inverse discrete Fourier transform or an inverse Fast Fourier transform operation.

The multi-tuner architecture provides the flexibility that multiple commercially available tuners can be used without the need of designing a wideband tuner. For example, a tuner designed for a terrestrial broadcast digital TV can be used together with a tuner dedicated to receiving a cable signal and/or a tuner for receiving a satellite broadcast signal. The multi-tuner receiver system provides an additional advantage that other tuners can be added quickly to the system to accommodate any future applications. Additionally, the multi-tuner architecture allows the use of slower speed (i.e., lower cost) analog-to-digital converters with a larger number of bits for achieving large dynamic range.

FIG. 7 shows a block diagram of an exemplary digital front end of the invention in more detail. In an embodiment, in-phase signal Id2 731 and quadrature signal Qd2 741 at the output of respective ADC converters 718 and 728 are provided to each of the L complex mixers 732 comprising mixers 732A to 732L. A more detailed description of each of L complex mixers is shown in FIG. 3. Mixer 732A multiplies Id2 731 and Qd2 741 with a cosine signal and a sine signal that are generated from an NCO1 and produces an I-732A signal and a Q-732A signal that are further individually filtered by an FIR filter before decimating. The bank of L complex mixers corresponds to the block 732 in FIG. 6; and the set of FIR filters and decimator corresponds to the block 734 in FIG. 6. Each decimated pair of I-732*i*/M in the baseband, where the index "i" is from A to L, is further provided to a subsequent up-mixer for frequency-shifting to an intermediate frequency as shown in FIG. 8.

FIG. 8 shows an exemplary embodiment of a bank of L complex up-mixers according to the present invention. Each decimated pair of complex signals I-732*i*/M and Q-732*i*/M is provided to an associated complex up-mixer, whose frequency is so chosen that when mixing with the pair of complex signals I-732*i*/M and Q-732*i*/M will generate an associated channel at a predetermined sub-portion of the intermediate frequency band 686 (FIG. 6). A more detailed schematic block of one of the L up-mixers is described above together with FIG. 5.

FIG. 9 is a simplified block diagram of a wideband multi-tuner receiver system 900 according to an embodiment of the present invention. In an embodiment, system 900 includes a crossbar switch 910 having at least an input terminal 912 configured to receive signals from an analog-to-digital converter (ADC) 912 and an input terminal 922 configured to receive signals from an ADC 922. Crossbar switch 910 also includes an output terminal 924 that is coupled to a digital front end 930. In an embodiment, input terminals 912 and 922 of crossbar switch 910 have P inputs, where P is an integer value that is equal to the total number of desired channels received by tuner1 610 and tuner2 720. Output terminal 924

of crossbar switch **910** have Q outputs, where Q is an integer value that is equal to the total number of desired channels received by tuned **610** and tuner2 **720**.

In an embodiment, digital front end **930** may include a bank of R complex mixers that frequency shifts the received channels to a baseband. Digital front end **930** may combine digital front end **630** and **740** shown in FIG. **6**. Similarly, a tiled up-conversion module **950** may include up-converter modules **650** and **760** of FIG. **6**.

System **900** further includes a summing DAC that operates similarly as summing DAC **470** and **670** that have been described in detail in relation with respective FIG. **4** and FIG. **6** above. Thus, redundant description is omitted herein.

FIG. **10** is a simplified block diagram of a wideband multi-tuner receiver system **1000** according to another embodiment of the present invention. System **1000** includes at least tuner1 **610** coupled with digital front end **630** through an analog-to-digital converter **620** and tuner2 **720** coupled with digital front end **740** through an analog-to-digital converter **730**. System **1000** further includes a crossbar switch **1010** that is interposed between digital front ends **630**, **740** and up-conversion modules **650**, **760**. Crossbar switch **1010** includes an input terminal **1012** having S inputs coupled with DFE **630** and an input terminal **1022** having T inputs coupled with DFE **740**. In an embodiment, S is an integer value equal to the number of desired channels processed in DFE **630** and T is an integer value equal to the number of desired channels processed in DFE **740**. Crossbar switch **1010** further includes an output terminal **1024** having U outputs coupled with up-converter module **650** and an output terminal **1024** having V outputs coupled with up-converter module **760**. In an embodiment, the total number of the outputs U and V is equal to the sum of the inputs S and T. Thus, crossbar switch **1010** allows the routing of any channel from either DFE **630** or DFE **740** to up-converters **650** or **760**. It is understood that system **1000** is not as flexible as system **900** because DFE **630** and DFE **740** are already pre-assigned to respective tuner1 (**610**) and tuner2 (**720**). However, this pre-assigned arrangement allows a simpler implementation of crossbar switch **1010** that operates at lower speeds.

While several embodiments in accordance with the present invention have been described, it is to be understood that the above description is intended to be illustrative and not restrictive. Many embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention should, therefore, be determined not with reference to the above description, but instead should be determined with reference to the appended claims along with their full scope of equivalents.

What is claimed is:

1. A wideband receiver system comprising:
- a mixer module configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;
- a wideband analog-to-digital converter (ADC) module configured to digitize said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;
- digital circuitry configured to:
  - select said plurality of desired television channels from said digitized plurality of frequencies; and
  - output said selected plurality of television channels to a demodulator as a digital datastream.

2. The wideband receiver system of claim **1**, wherein said output of said digital datastream is via a serial interface.

3. The wideband receiver system of claim **1**, wherein said output of said digital datastream is via a parallel interface.

4. The wideband receiver system of claim **1**, wherein said mixer module comprises a first mixer configured to generate an in-phase signal and a second mixer configured to generate a quadrature signal.

5. The wideband receiver system of claim **1**, wherein said wideband analog-to-digital converter comprises:
- a first ADC configured to generate a digital in-phase signal; and
- a second ADC configured to generate a digital quadrature signal.

6. The wideband receiver system of claim **5**, wherein said digital circuitry comprises a plurality of complex mixers configured to frequency shift said selected plurality of desired television channels.

7. The wideband receiver system of claim **6**, wherein:
- prior to said frequency shift, said selected plurality of desired television channels occupy non-contiguous portions of a frequency spectrum; and
- after said frequency shift, said selected plurality of desired television channels occupy a contiguous frequency spectrum.

8. The wideband receiver system of claim **1**, wherein said digital circuitry comprises a plurality of channel filters configured to perform said selection of said plurality of desired television channels.

9. The wideband receiver system of claim **8**, wherein each one of said plurality of channel filters is a finite impulse response filter.

10. The wideband receiver system of claim **1**, wherein said digital circuitry comprises a decimator circuit configured to decimate one or more of said selected plurality of television channels prior to said output of said selected plurality of desired television channels.

11. A method comprising:
- in a wideband receiver system:
  - downconverting, by a mixer module of said wideband receiver system, a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;
  - digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system, said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;
  - selecting, by digital circuitry of said wideband receiver system, said plurality of desired television channels from said digitized plurality of frequencies; and
  - outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream.

12. The method of claim **11**, comprising outputting, by said digital circuitry of said wideband receiver system, said digital datastream via a serial interface.

13. The method of claim **11**, comprising outputting, by said digital circuitry of said wideband receiver system, said digital datastream via a parallel interface.

14. The method of claim **11**, comprising:
- generating, by a first mixer of said mixer module, an in-phase signal; and
- generating, by a second mixer of said mixer module, a quadrature signal.

15. The method of claim **11**, comprising:
- generating, via a first ADC of said wideband analog-to-digital converter, a digital in-phase signal; and

generating, via a second ADC of said wideband analog-to-digital converter, a digital quadrature signal.

16. The method of claim **15**, comprising frequency shifting said selected plurality of desired television channels via a plurality of complex mixers of said digital circuitry.

17. The method of claim **16**, wherein:

prior to said frequency shifting, said selected plurality of desired television channels occupy non-contiguous portions of a frequency spectrum; and

after said frequency shifting, said selected plurality of desired television channels occupy a contiguous frequency spectrum.

18. The method of claim **11**, wherein said digital circuitry comprises a plurality of channel filters configured to perform said selecting.

19. The method of claim **18**, wherein each one of said plurality of channel filters is a finite impulse response filter.

20. The method of claim **11**, comprising decimating, by said digital circuitry, one or more of said selected plurality of desired television channels prior to said outputting of said selected plurality of television channels.

* * * * *

Exhibit 1006

"Frequency Translation Method for Low Frequency Variable Gain Amplification and Filtering," Mabel Y. Feng, June 2007

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Frequency Translation Method for Low Frequency Variable Gain Amplification and Filtering

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Submitted to the Department of Electrical Engineering and Computer Science

in partial fulfillment of the requirements for the degree of

Masters of Engineering in Electrical Engineering and Computer Science

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

June 2007

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Frequency Translation Method for Low Frequency Variable Gain Amplification and Filtering

by

Mabel Y. Feng

Submitted to the Department of Electrical Engineering and Computer Science
on May 11, 2007, in partial fulfillment of the
requirements for the degree of
Masters of Engineering in Electrical Engineering and Computer Science

Abstract

This thesis discusses an innovative solution to an industry challenge. A frequency translation method is designed to shift low frequency signals to intermediate frequencies in order to utilize higher-frequency components. This solution, appropriate for applications involving 1-10MHz signals, can provide continuously variable gain and filtering at little cost in dynamic performance. The working system converts the low frequency signals up to the 70MHz band to achieve up to 28dB attenuation and 60-86MHz variable filtering. A Single Side Band system has a Signal-to-Noise Ratio (SNR) of 71dB with a 73dB SNR Analog-to-Digital Converter (ADC), 44 dB Output Third-Order Intercept Point (OIP3), and a Noise Figure (NF) of 14dB. Ultrasound and other applications in the 1-10MHz range benefit greatly from this upconversion scheme.

VI-A Company Thesis Supervisor: Richard Reay
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Acknowledgments

This thesis would not have been possible without the advice and assistance of these individuals. First, I had the wonderful opportunity of working with some of the best in Linear Technology's converters group – Richard Reay, Atsushi Kawamoto, and Derek Redmayne. This project idea stemmed from Mr. Redmayne's experienced work in the field. My faculty and thesis advisor Professor Charles Sodini has been a great mentor for my project, encouraging me to endeavor interesting projects during my time in the VI-A program. My VI-A experience at Linear Technology has been an educational experience for me, with special thanks to Sam Nork and Dave Bell who still make a point to check in and make sure we are doing well, even with their busy schedules. There are several more individuals at the company that have made my experience what it is, thank you.

I would also like to thank my family for their support, my friends for their encouragement as I worked through school and at Linear Technology. The lessons I have learned here in the six months in preparing, experimenting, and writing my thesis will go a long way in my life.

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Chapter 1

Introduction

1.1 Problem Statement

Ultrasound, sonar, and medical imaging rely on a method of receiving dispatched signals and properly processing them for image conversion. High-end ultrasound applications require a high dynamic range system for minimal interference and distortion. This would give the higher resolution imaging necessary in high-end image processing. One challenge in ultrasound has been how to implement a truly continuously adjustable gain control in a system with low distortion at the operational frequencies. Designing such a system can be a challenging feat and is not an easily solvable problem for engineers. Hence, if a solution that is simple to both implement and understand can be developed for this industry challenge, then there are many uses for the application. The following section expands the ultrasound background so that the reader may fully understand the scope of the problem at hand.

1.2 Background

1.2.1 Ultrasound

Much of medical imaging is made possible by ultrasound. The images are obtained by emitting an energy beam throughout the body or mass and reconstructing the

reflected energies into an image with analog to digital processing. This is similar to how radar and sonar sweep across an area and study the echoes back at the source. A transducer probe receives the reflected signal energies at different times across the surface structure, allowing the image to be reconstructed based on a signal attenuation versus time relation. Higher frequencies provide higher resolution images but attenuate faster as the signal travels through the body. The image energies are transmitted at frequencies optimized for signal strength and resolution, so ultrasound frequencies typically range from 2-7 MHz [35].

As an energy beam travels through a mass medium such as the human body, the signal strength decreases due to interfering media and noise. The reflected signal is more attenuated if it has traveled a longer distance in the body and through electronic cables. The beam signals can be subsequently amplified before digital conversion. Hence ultrasound systems require at least gain and attenuation control as well as a means of reducing noise degradation.

Current ultrasound applications incorporate time gain compensation (TGC) amplifiers to maintain a strong (and consistent) energy level as the signals are picked up by the transducer. A standard time-independent amplifier provides the same dB gain to every reflected signal, no matter how far away the signal. Hence, the reflected echoes are still of different magnitudes [Figure 1-1(a)]. With a TGC, the gain increases over time to maintain a constant level of signal attenuation in reflected pulses [Figure 1-1(b)].

What has been described so far is the analog domain of ultrasound. There is, however, the digital processing side that converts the analog echoes to digital signals for digital image processing. At the analog-to-digital converter (ADC) interface, high performance systems require low distortion and noise at the input to the ADC before digital processing. It is important to ensure also that the ADC quantization noise is not a significant factor to the overall noise; it sets the bit resolution. Also, interfering signals about the main desired signal (fundamental) can be prominent distortion sources in ultrasound. If the system has poor intermodulation distortion, the ADC will take the additional spurs as signals in the system and the reconstructed

signal will be heavily distorted. Using high dynamic range and high resolution ADCs like Linear Technology's LTC2249 allows designers to meet the high standards of ultrasound imaging.The system block diagram is shown below in Figure 1-2.

In the analog domain dynamic performance can be limited by ADCs and TGC amplifiers. It was established that the ADCs can meet the specifications for high performance so we take a look at the types of TGC or varying gain amplifiers to devise a high-end solution.

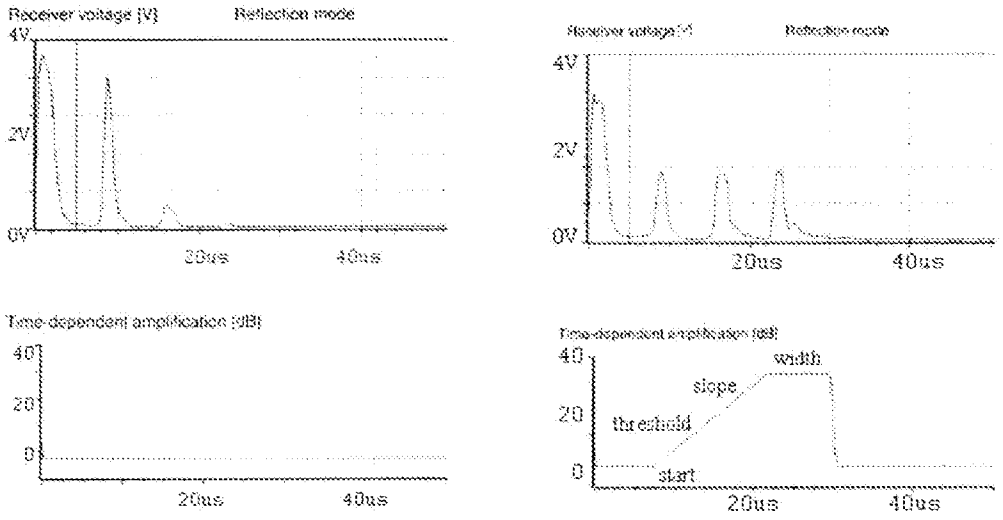


Figure 1-1: Ultrasound Time Gain Compensation. (a) Constant Gain Amplification. (b) TIme Varying Gain Amplification. [36]

1.2.2 The Frequency Spectrum

The challenge at hand is to find variable gain devices that are usable at specific parts on the frequency spectrum. Consider the entire frequency spectrum, from DC up to GHz (radio frequency RF or ultra high frequency). On the low frequency end (DC to 1 MHz), there are several options available for designers. There are discrete programmable step gain amplifiers but for ultrasound, continually adjustable gain amplifiers are more suitable. Instead of adjusting gain in the analog domain, it is also possible to first digitize the low frequency signal with an oversampling ADC and then digitally adjust the gain. Once we progress into the MHz range, we are offered the choice of using Analog Devices' patented XAmp continuous VGAs [23].

However, most adjustable gain amplifiers do not provide the same performance at low frequencies as in higher bandwidths (less than 100MHz).

At intermediate frequencies (IF) and above, continuous variable gain can be realized using PIN (p-intrinsicSi-n structure) diodes. This is a common component found in radio receiver and transmitter paths. PIN diodes are limited on the lower frequency side by two things : physical size and carrier lifetime. A more thorough background on PIN diodes is given in Section 2.4.

In addition to continuous variable gain capabilities, it is important to filter out interfering signals for the best signal processing. High frequency and RF use surface acoustic wave (SAW) filters for their steep filter response, but they are also limited on the low frequency end by size. As in the PIN diodes, a more thorough background on SAW filters is given in Section 2.3. Lower frequency applications would just implement high order filters to achieve as ideal of a filter response as possible. A quality filter in the signal path improves the dynamic performance of the system by preventing out of band noise from getting to the ADC.

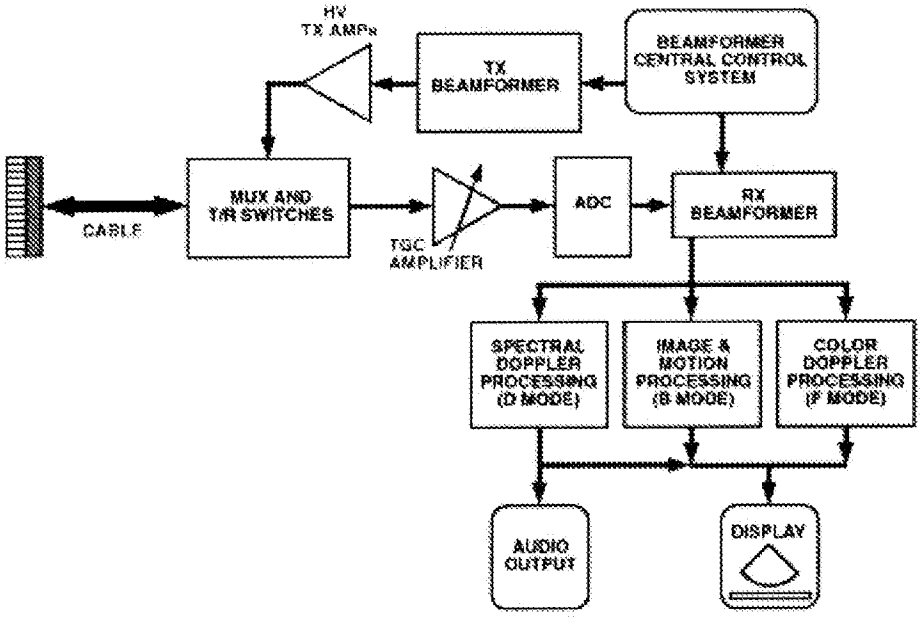


Figure 1-2: Ultrasound System Block Diagram. From [35]

1.3 Proposed Method

The background in the prior section discusses some of the challenges and limitations in low frequency applications. By using frequency translation, one can essentially move the problem to higher frequencies to take advantage of high frequency components. This method can provide continuously variable gain and filtering for ultrasound. The challenge then is to be able to design a system that offers good dynamic performance, on par or better than what low frequency processing can achieve. The thesis explains this method of frequency translation and develops a solution that meets the standards in the ultrasound industry.

1.4 Organization

The thesis is organized as follows: Chapter 2 describes the various components that will be used in the system and also defines the performance figures used. Chapters 3 and 4 discuss design solutions and modifications made to the system. Chapter 5 leads a discussion of the results and how they compare to theoretical expectations of the entire system. Chapter 6 gives a conclusive summary of the merits and drawbacks of this application and suggests future work.

Chapter 2

Building Blocks and Measuring Stick

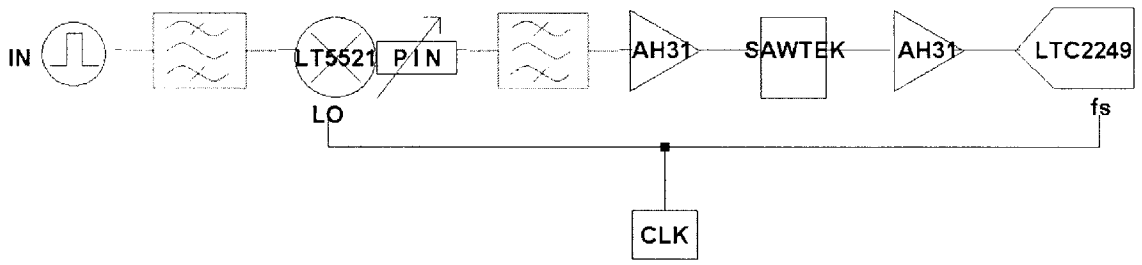


Figure 2-1: Frequency Translation Method General Block Diagram.

The general block diagram of the system is shown in Figure 2-1. This chapter provides background information for the building blocks of the system.

2.1 Frequency Translation

Frequency translation is the process of shifting a signal from one frequency to another, without loss of information in the signal. This is useful in any application that does not care at what frequency the information is transmitted (i.e. the carrier frequency contains no information). In modern communications, frequency translation is used in receivers to downconvert RF to a lower frequency and used in transmitters to upconvert baseband signals to RF.

Modulation is a standard example of frequency translation at work. Essentially, there is information summarized by the function $f(t) = A\cos(\omega_i t)$, and we want to transmit it at a frequency $f_c(t)$. The modulated signal $f_m(t)$ is now of the form $f_m(t) = \cos([\omega_i - \omega_c]t) + \cos([\omega_i + \omega_c]t)$, and is the frequency translated version of the original $f(t)$ signal. The information is preserved because modulation scales the amplitude of the signal but does not distort it. In downconversion, $f_c < f_i$ and in upconversion, $f_c > f_i$.

2.2 Undersampling

In sampling schemes, the choice of sampling frequency determines the quality of the sampled output signal. It makes sense that more samples taken over a period would ensure a better reconstruction of the signal. And, if the signal is not sampled at a fast enough rate, then the conversion will not produce an output that resembles anything like the input. The criterion for proper sampling is the Nyquist theorem (Equation 2.1). The input signal frequency f and the ADC sampling frequency f_s need to satisfy the Nyquist theorem to ensure that no information is lost in sampling:

$$\omega_s \geq 2\omega, \ where\ \omega = 2\pi f\ and\ \omega_s = 2\pi f_s. \tag{2.1}$$

One of the ways to sample signals for analog-to-digital conversion is undersampling. For undersampling, we are concerned more about the input bandwidth rather than the input frequency. Here, the Nyquist theorem is concerned with the comparison between the sampling frequency and the input bandwidth.

It is important to note here the distinction between input signal bandwidth and input signal frequency. In an upconversion scheme, the input of interest has a bandwidth of the low frequency about the local oscillator frequency (i.e. 10MHz about LO=70MHz). The input signal frequency goes up to 80MHz but its bandwidth is 10MHz. Because the input does not have information from DC up to 80MHz, it is appropriate to consider only the 10MHz input bandwidth in Nyquist. Input bandwidths less than the Nyquist frequency ($\frac{f_s}{2}$) are fully recovered. Input bandwidths

greater than the Nyquist frequency will fold back into the baseband (DC to $\frac{f_s}{2}$) region. Therefore, if the input signal bandwidth is limited to one Nyquist zone at any location on the frequency spectrum, foldback of the signal will not cause the signal to fold on top of itself.

If the Nyquist criterion is not met, the ADC can produce an aliased component within the signal bandwidth. This aliased component is an undesired signal that needs to be pushed outside of the signal bandwidth. Figure 2-2 shows the frequency effects of aliasing.

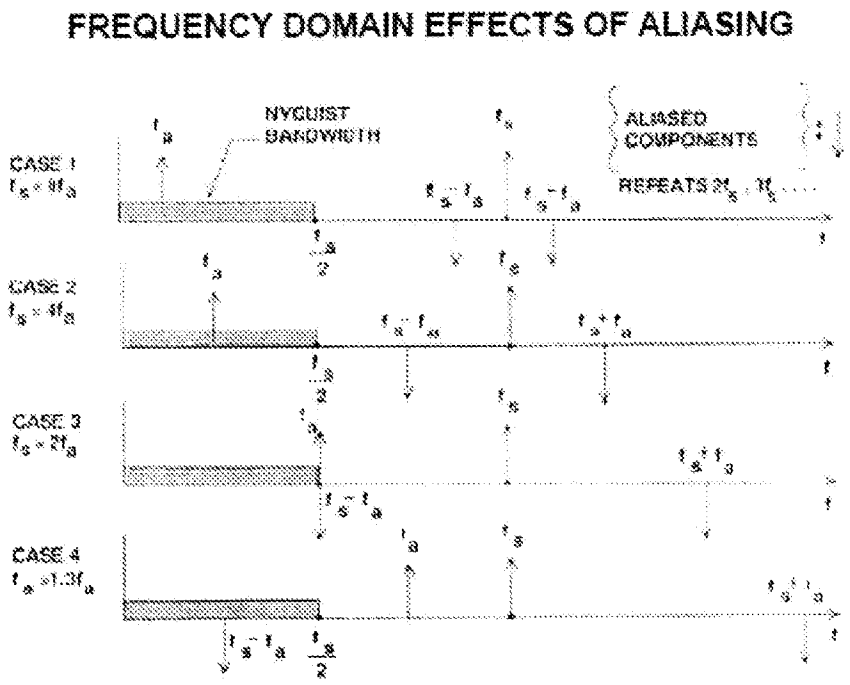


Figure 2-2: Sampling Analog Input Signal f_a at Sampling Rate f_s. For different f_s, the effects of aliasing can be seen in Case 3 when the Nyquist criterion is not met, because the aliased component $(f_s - f_a)$ is at the Nyquist frequency $\frac{f_s}{2}$. From [37].

Undersampled systems allow direct sampling at the IF frequencies as opposed to downconverting the IF signal down to baseband before sampling. Existence of high performance and high sampling rate ADCs (130MSPS or more) allow pre-receiver design to be simplified in cost and design.

Although undersampled systems eliminate the need to sample at the base rate, they tend to exhibit bad noise figures. Due to harmonic folding, every input frequency

harmonic is folded back into the Nyquist zone, which degrades noise performance. Typically, noise performance increases when bandwidth decreases. Another factor that degrades noise is flicker ($1/f$) noise that is introduced with direct-IF sampling receivers. Instead, efforts to improve linearity have to be made, to mitigate the degraded noise performance.

2.3 SAW Filters

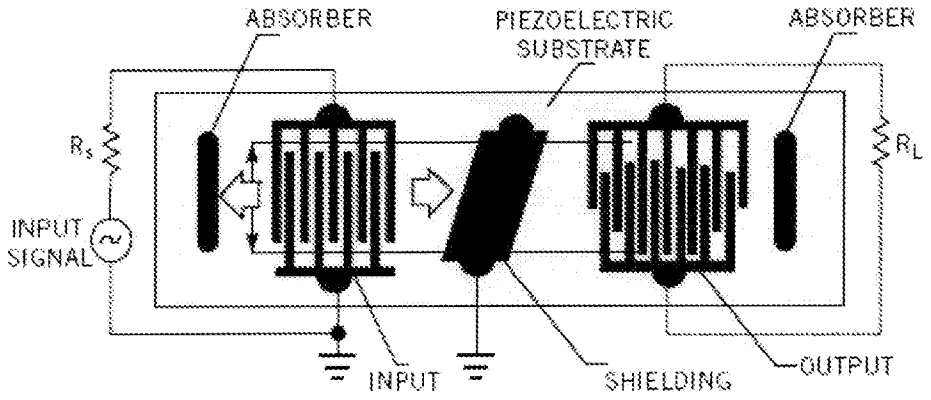


Figure 2-3: Physical Construction of a Typical Surface-Acoustic-Wave (SAW) Filter. [16]

In a surface acoustic wave filter, a mechanical wave travels along the surface of a material with elasticity, and has a decaying amplitude correlated with the depth of the surface [Figure 2-3]. SAW filters use piezoelectric crystals to convert electrical signals to mechanical waves, seen as vibrations. The wave is then delayed as it propagates across the crystal before being converted back to an electric wave. Only waves vibrating at certain (passband) frequencies are converted back into electric waves. SAW filters are ubiquitous in the communications market because they provide significant advantages in not just performance but also cost and size over other types of filters.

SAW filters provide much sharper frequency roll-off than other filters [Figure 2-4]. For example, to achieve the same order response, a passive LC (inductive-capacitive) filter needs to be very high order (possibly 7th-9th order). With their steep stopband

attenuation, the SAW filters are excellent at removing nearby interference, easing the dynamic range parameters of the ADC. This is especially important here because ultrasound signals are often subject to a lot of noise and interference, as discussed before.

In wave propogation, there is an intrinsic delay. If the signal is too low in frequency, the period of the signal becomes greater than this propogation delay, making SAW filters inappropriate for low frequency applications. For higher frequencies, there is a smaller delay so the size of the filters can be physically smaller. Hence SAW filters are better suited for higher frequency applications.

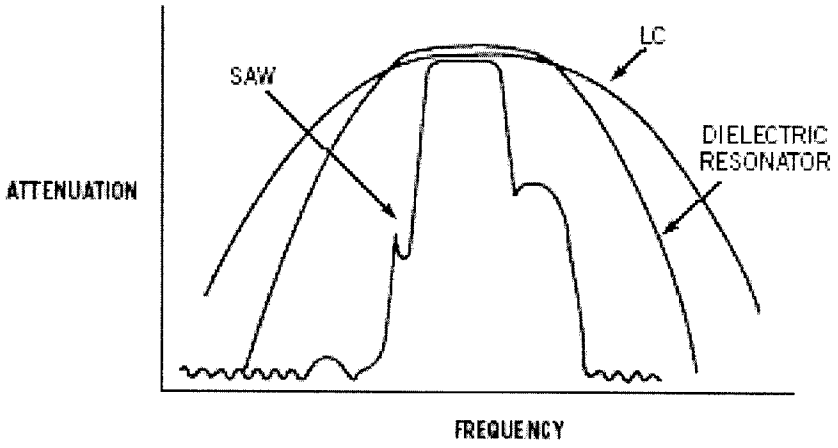


Figure 2-4: Comparison of Different Types of Filters.
SAW filters, seen here provide the sharpest rolloff. [16]

Although SAW filters provide impressive stopband response, they do have a higher insertion loss than passive LC filters. A following low-distortion amplifier can compensate for the gain loss.

The SAW filters used are from SAWTEK : f_c at 70MHz with both 5MHz and 20MHz bandwidths. The insertion loss was 7.25dB and 14.5dB respectively and the group delay variation was 80ns and 65ns respectively [7], [8].

2.4 PIN Diodes

P-Intrinsic-N diodes are often used in high frequency attenuator circuits. These devices are relatively simple devices yet they are excellent for providing continuously adjustable gain with little distortion, cost, and almost ideal linear resistive behavior. Many RF engineers are satisfied with the harmonic distortion and intermodulation distortion performances of available PIN diodes [33]. In addition, the wide range of gain can be achieved at very little DC excitation, which is suitable for low-power applications [28]. To understand the operation of the PIN diode, it is best to start with the well-known 'standard' PN diode and develop the model of the PIN diode from there.

A standard diode has an abrupt PN junction, with the well known I-V characteristic curve and equation $I = I_s(e^{\frac{qV}{kT}} - 1)$, where I_s is the saturation current, q is the charge of an electron, k is Boltzmann's constant, and T is the temperature, in Kelvin. It has a small signal dynamic resistance $r_d = \frac{kT}{qI}$ in forward bias ($V > 0$). We focus only on the forward bias of the diode here.

In the PIN diode, the lightly doped intrinsic region (of width W) inbetween the heavily doped P and N regions affects charge storage and resistive behavior of the device. The resistance of the PIN diode is controlled by a DC current bias I_d. When the PIN diode is forward biased, minority charge carriers are injected into the intrinsic layer (from both P and N doping regions). Therefore, there is charge in the intrinsic layer, which is the basis for the operation of the PIN diode. At frequencies greater than the inverse of the carrier lifetime τ, the intrinsic region charge $Q = I_d\tau$ dominates the resistance of the PIN diode. The carrier lifetime can be thought of as the average time that an injected (minority) carrier survives in the lightly doped intrinsic-region (until recombination in the intrinsic-region or the carrier has traveled a mean distance W to the other heavily doped region).

A simple model of the PIN diode is shown in Figure 2-5(a). The PIN diode has two junctions (P-I and I-N), each modeled as an ideal standard diode. The intrinsic region behaves as variable resistor R_{rf}, controlled by the current bias. The small

signal model of the PIN diode is in Figure 2-5(b). r_d is the small signal resistance found earlier from the I-V curve, and C_d is the capacitance of the junction.

The resistance R_{rf} can be derived using device geometry (W/L_D) and Einstein's relation $(qD = \mu kT)$ and its expression is given by:

$$R_{rf} = (W/L_D)^2 V_{th}/(2I_d) = \frac{W^2}{2\mu I_d \tau_{eff}}, \tag{2.2}$$

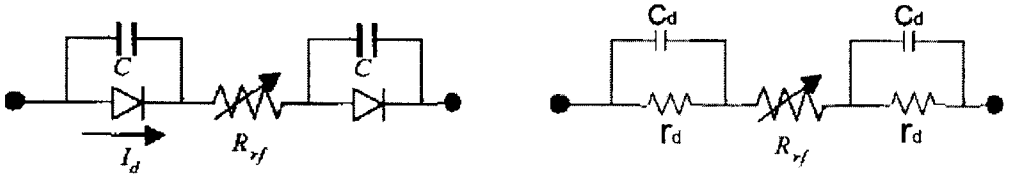
where $V_{th} = kT/q$, μ = mobility, I_d = DC forward current, τ_{eff} = effective carrier lifetime, W = width of intrinsic region, and $L_D = (D\tau_{eff})^{1/2}$, the diffusion length and the ratio $(W/L_D) < 1$. The D in Einstein's relation refers to the ambipolar diffusion constant, $D = 2D_nD_p/(D_n + D_p)$. τ_{eff} is discussed later in this section. With the device geometry less than unity, this approximation is useful for thin-PIN diodes. [32]

With this nonzero R_{rf}, the entire voltage drop across the PIN diode is

$$V_{PIN} = 2V_d + V_{rf} = 2V_d + I_d R_{rf}, \tag{2.3}$$

where V_d is the diode drop across the ideal PN diode and V_{rf} is the voltage drop across the variable resistance. The same I_d runs through the entire PIN diode, so one could add a load line for R_{rf} on-top the I-V curve for the PIN diode. The PIN diode I-V characteristic can be found then by fitting the points to the curve I_d v. V_{PIN}. The plot, in accordance with the model in Figure 2-5(a) is depicted in Figure 2-6.

The total small signal impedance across the entire PIN diode is $Z = 2r_d + R_{rf}$.



(a) Model

(b) Small Signal Circuit

Figure 2-5: (a) Circuit Model of PIN Diode in two parts - two ideal PN diodes with capacitance C across them for reverse-bias operation, and the variable resistance R_{rf}. (b) Small Signal Equivalent Circuit of PIN Diode - r_d and C_d are small signal parameters of a standard diode. [33]

From the equivalent circuit in Figure 2-5(b), we see that Z is actually frequency dependent. At low (down to DC) frequencies, the PIN diode behaves as a standard PN diode. In thin PIN diodes (where the device geometry is less than unity) R_{rf} is less than r_d, so for large currents, $Z \approx 2r_d$. At high frequencies, C_d shorts out r_d and $Z \approx R_{rf}$. The two approximations for Z at low and high frequencies hold for all non-zero values of forward bias current.

The current level affects the linearity of the variable resistor. Ideally, R_{rf} is K/I_d, where K is a constant value that is a function of the parameters in Equation 2.2. In

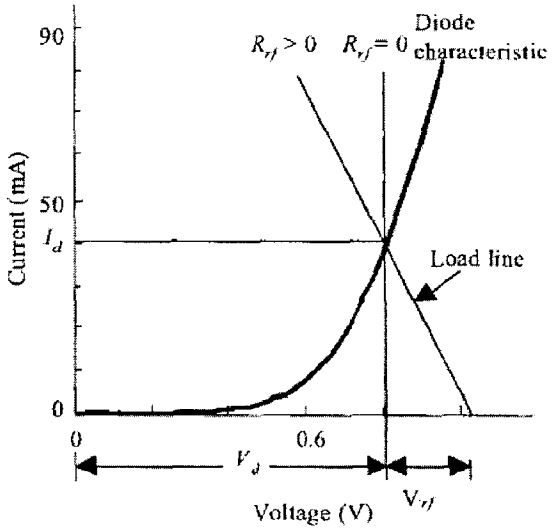


Figure 2-6: I-V Characteristic of PIN Diode, with standard PN I-V curve and load line for non-zero R_{rf} for high frequency operation of the diode. [30]

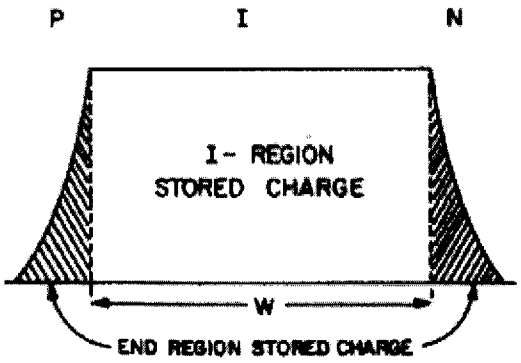


Figure 2-7: Plot of charge stored in a forward biased PIN diode, including end-region and intrinsic-region stored charge. [31]

the high-frequency case where Z is dominated by R_{rf}, increasing the DC bias current does not increase Z linearly. At low levels of bias, $\tau_{eff} \approx \tau$, which is a parameter that can be extracted experimentally and is not a function of bias current itself. Then K is a constant value and $R_{rf}I_d$ product is also constant. At higher levels of bias, there is a greater injection of carriers into the intrinsic region, and a buildup at the end regions occurs, as seen in Figure 2-7. There is a nonlinear increase in recombination rates in the end regions, which lowers the amount of charge stored in the intrinsic region. The effective charge in the intrinsic region is not $Q = I_d\tau$ anymore, but a new $Q_{eff} = I_d\tau_{eff}$ where τ_{eff} lumps the effects in the end regions with the intrinsic-region behavior for an empirical effective carrier lifetime [31].

Oftentimes, the parasitic elements are modeled in the PIN diode equivalent circuit to account for packaging. For example, a parasitic inductance L from packaging may be added in series with R_{rf}, making it a series RL circuit in forward bias. For simplicity, we design the PIN diode into the system without considering the L, because the 70MHz frequency of interest is not near the RF range that PIN diodes are often used.

The PIN diode used was the BAP50-05 from Philips Semiconductors. This double diode package (common cathode) provides a forward resistance up to 600Ω from 10μA to 10mA bias current [14]. Since 70MHz is not quite RF, we redefined R_{rf} to be R_{PIN}. Fitting the datasheet points to the I_d v. V_{PIN} curve, R_{PIN} can be modeled to have an exponential relationship with I_d,

$$R_{PIN} = AI_d^{-K}, \tag{2.4}$$

where A and K are determined by curve fitting the datasheet values of the BAP50-05 PIN diode [14]. A was found to be 14.538 and $K = 0.6862$ in Figure 2-8.

With I_d measurements and extrapolated A and K values from the PIN diode model, the diode resistance was plotted across a range of forward bias current, shown in Figure 2-9.

2.5 Varactor Diodes

Varactor diodes provide a variable capacitance as a reverse bias voltage is applied to the diode junction. If a diode is reverse biased, then there is a region void of carriers, nominally called the depletion region. The reverse-biased diode then is a P-region (plate), depletion region (dielectric), and a N-region (plate), which models a capacitor. The variable capacitance value arises from the change in depletion region in response to the applied voltage. Oftentimes, varactors are used for tuning over a range of frequencies. At higher frequencies, there is a wider tuning range possible for varactors. The varactors used are the Philips BB207 double diode package [15].

2.6 Mixers

Much of the pre-ADC design of this application resemble a standard receiver system where a signal is shifted in frequency then goes through a signal processing chain of various amplifiers and filters before being sampled by the ADC. In the design for the new application, mixers, amplifiers and filters will also be used. Thus design

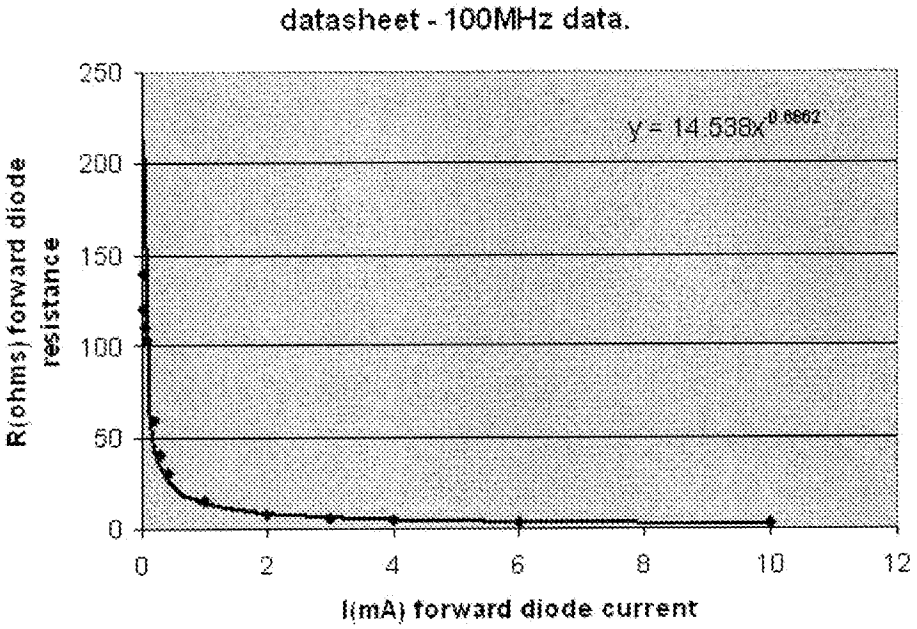


Figure 2-8: Fitted Curve to BAP50-05 Datasheet Values for 100 MHz Data.

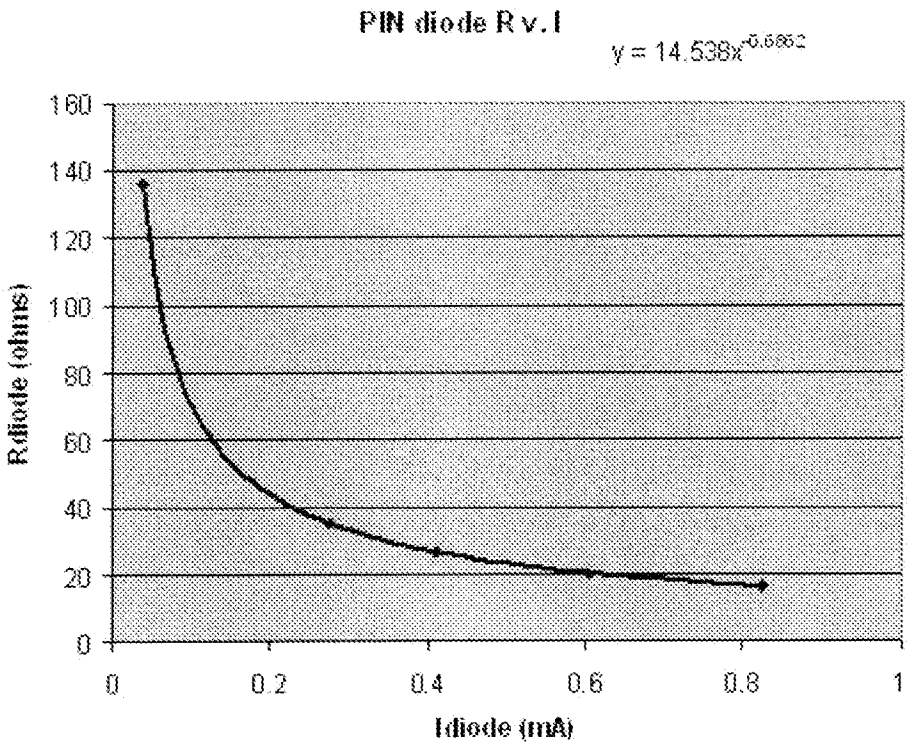


Figure 2-9: Diode Resistance Derived from Datasheet Equation, at $f_c = 70$MHz.

considerations for each of these analog components are important. Here, we look at the mixer design in more detail. In the proposed work, mixers will be used in the low frequency (MHz) domain instead of the RF domain. Their primary function is to perform upconversion like in transmitter systems rather than downcoversion mixers in standard receivers.

The mixer takes an input, often a low noise amplified signal, and translates it to a different frequency. Frequency translation is possible through the linear addition or subtraction of frequencies. The design of the mixer will be extremely important in this thesis because it is here where many considerations of modulation, noise, image rejection, and others must be accounted for in order to translate low-frequency signals to the IF band for further processing.

The mixer takes two signals and multiplies them in the time domain. Mathematically, if the two signals are $A\cos(\omega_1 t)$ and $B\cos(\omega_2 t)$, the product of the two signals is:

$$\frac{AB}{2}[\cos(\omega_1 - \omega_2)t + \cos(\omega_1 + \omega_2)t]. \tag{2.5}$$

The output of the mixer results in two output signals operating at the sum and difference of the two input frequencies. The mixer stage in the receiver is shown diagrammatically in Figure 2-10.

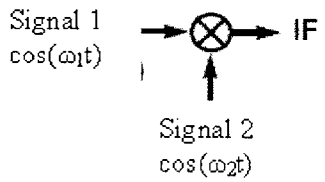


Figure 2-10: Mixer Diagram.

Signal 1 and Signal 2 multiply to produce a frequency shifted output signal in the IF Band. From Equation 2.5, A=B=1.

There are several nonidealities in mixers that need to be considered in design. Noise, linearity, dynamic range and isolation are discussed briefly.

Noise figure characterizes how effective the device is at rejecting noise while maintaining the signal. It is defined as the ratio of input signal-to-noise ratio (SNR) to output IF SNR. It varies across different types of mixers because it is highly dependent on whether or not both output frequencies are desired. If both bands (frequencies) are desirable because they contain useful information, there is twice the signal power. Noise figure improves in this case, which is termed the double-sideband (DSB) case. In the single-sideband (SSB) case where only one of the bands is considered, the noise figure is degraded by 3 dB ($3dB = 10\log(0.5)$). In the case that the mixer has the worst noise figure in the system additional pre-mixer stages may be necessary to improve the noise figure of the system. If SSB is preferred, it is possible that an image rejection filter will be implemented before the mixer to greatly attenuate the image signal before mixing.

Here, linearity and dynamic range are also important in mixer design. Linearity characterizes how the mixer output amplitude (power) varies as the input amplitude (power) changes, at a given frequency. Besides noise figure, gain, and power consid-

erations, the mixer must maintain linear operation with both strong and weak input signals. Distortion, in particular when a weak signal is in presence of a strong interfering signal, must be minimized. This is cruical in the application of ultrasound. Dynamic performance of the system may be dominated by the dynamic performance of the mixer as it is not only the first element in the signal chain but also a challenging element to design.

There are many topologies for mixers, such as square law mixers, multiplier based mixers and double-balanced mixers, to name a few [17]. Since dynamic performance is important, the active double-balanced mixer was selected. Active devices, although they require power, can provide conversion gain instead of loss. A double balanced mixer provides better isolation between the local oscillator and the output port of the mixer. Image reject and I/Q mixers were considered for SSB to properly obtain one sideband. However, these mixers are much more complicated. For this application if good filtering through SAWs can attenuate both the clock and image feedthrough signals, then the more complicated mixers are not necessary.

The mixer used in the thesis is Linear Technology's own LT5521 active double-balanced mixer. It has low distortion, 40dBm clock feedthrough, and an impressive 24.dBm output IP3 at output frequency 1.95GHz. The noise figure is acceptable at 12.5dB. Although designed for high frequencies, it is usable at the intermediate frequencies if it is designed with the proper network. The topology of the LT5521 follows a Gilbert cell mixer, with differential inputs feeding into degenerated common emitters of the differential pairs in the Gilbert topology [17]. The high frequency local oscillator switches between the differential pairs. The open collector differential output has 300Ω resistance across it. Additional information can be found in [2].

2.7 Amplifiers

The test experiment used two low noise AH31 amplifiers, with +16 to +20dB gain over 44MHz to 95MHz. The application circuit is shown in Figure 2-11. The ouput IP3 point is 42dBm at 75MHz and the noise figure is 2.4dB. Both amplifiers were

needed to ensure that the mixer would not be overdriven by a large input power. It is recommended that +20dB gain amplifiers with very low distortion are used in the system. It is also desirable to have a more limiting bandwidth amplifier. A bandwidth less than the Nyquist zone prevents foldback of any noise or distortion from the amplifier.

2.8 Analog-to-Digital Converters (ADCs)

The LTC2249 14-bit 80MSPS analog to digital converter was used for this particular experiment. This six stage pipelined ADC is low power, high resolution, and has 73dB SNR. Refer to [1] for more information.

2.9 Clock Sources

The clock rate of 70MHz is a typical intermediate frequency (IF) and many components such as SAW filters and IF amplifiers are designed with a center frequency of 70MHz, or a multiple of it. Two clocks are required: one for the ADC sampling source and another for the upconversion local oscillator (LO). The design lab owned a 70MHz crystal oscillator. For a clock frequency other than 70MHz, a narrowband tunable helical filter with a standard signal generator can be used as a clock source.

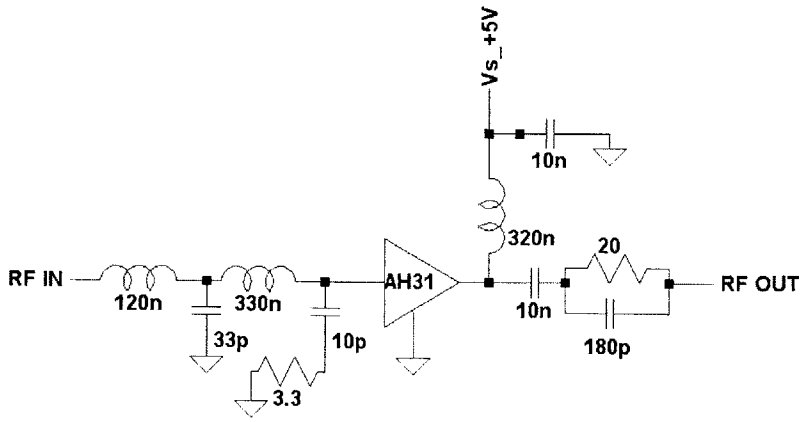


Figure 2-11: AH31 Amplifier Application Circuit.

Chapter 3

Design Modifications

3.1 Setup

In the application setup, there were many design considerations in the system. Some design changes were made after initial setup of the application, done in the Design Lab. Some design modifications were made directly on the demonstration boards while some required construction of a new part. Tools used were laboratory measuring and analyzing tools and programs for design and simulation.

3.2 Simulation

The program used for simulation was Linear Technology's SwitcherCAD SPICE simulator, available online at zero cost. Models of various components and filter designs were constructed in this program, and laboratory results were compared to simulation output.

3.3 Design

The signal chain, shown again in Figure 3-1, starts with a low frequency signal which is translated to a higher frequency using the LT5521 before going through a series of amplifiers, filters, and varying element networks. The end of the signal chain goes

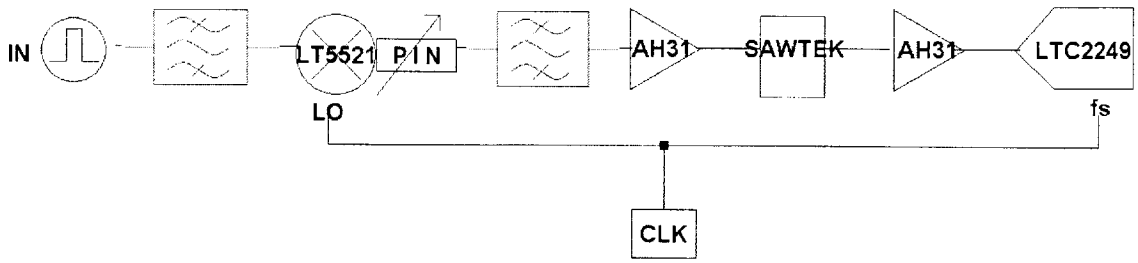


Figure 3-1: Frequency Translation Method General Block Diagram.

into the ADC input and is sampled by a clock source for data conversion.

Design components in the thesis were broken down into four categories: passive filters, mixer, variable gain devices, variable filter devices. Each component design is detailed in its own section, with references back to the complete system design.

3.3.1 Filter Design

The signal is filtered throughout the pre-ADC path in order to present a high quality, undistorted signal at the ADC input. Several types of filters are needed and were investigated for appropriate applications. The filters designed and used in this frequency translation method include: 1MHz – 40MHz cascaded lowpass–highpass elliptic section filter, 70MHz Butterworth wideband bandpass filter, 60 – 86MHz variable bandpass filter.

A 1MHz–40MHz bandpass filter was designed to filter the low frequency signal before upconversion. This filter was comprised of cascaded lowpass and highpass elliptic sections, each 5 poles. The filter design tables were taken from Williams' *Filter Design Handbook* and modified for a 1MHz high pass and 40MHz low pass with stopband attenuation $A_{min} = 40dB$ at a stopband frequency at 70MHz [38]. The high pass filter has a stopband frequency at 800kHz.

The 70MHz bandpass filter is designed with more relaxed requirements, because other components in the signal chain will subsequently filter the passband signal content. The bandpass filter diagram in Figure 3-2 shows the design specifications. In the passband, it is desirable to have as little loss from input to output. The

designed filter has -0.7dB insertion loss. It is also desirable for this bandpass filter to block reflected waves in the passband. The S11 or S22 parameters indicate return loss, so minimal levels of return loss in the passband is desired. A -24dB return loss in the passband is sufficient for the application. The filter performance matches expectations from simulation.

Elliptic sections, although more complicated to design than Butterworth or Chebyshev filters, provide a steeper stopband response and hence greater attenuation in regions outside the passband. These filters are useful for providing a steep attenuation at each of the stopbands. To prevent any interference from input signal harmonics at or around the local oscillator of the mixer, it is advantageous to design an elliptic section filter with a stopband at the particular local oscillator frequency. In the test system, LO=70MHz, so this 1MHz-40MHz filter has a stopband at 70MHz with 55dB attenuation. The schematic is shown in Figure 3-3(a).

The system requires approximately 20dB gain while using lossy SAW filters so two AH31 amplifiers are needed after the mixer and before the ADC to achieve a full scale ADC input. Instead of having the mixer output go straight to one of the amplifiers, it is better to bandpass filter the signal before one of the amplifiers. This ensures second (and higher order) harmonics are not passed through the amplifier, which will cause

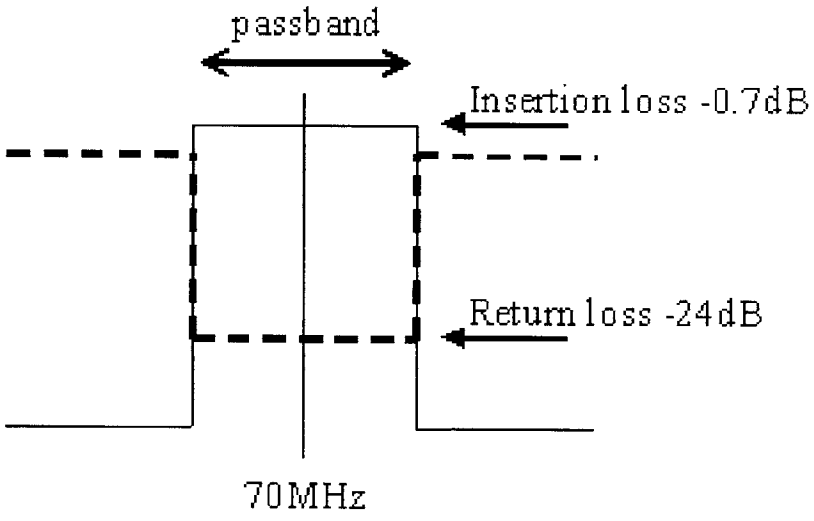
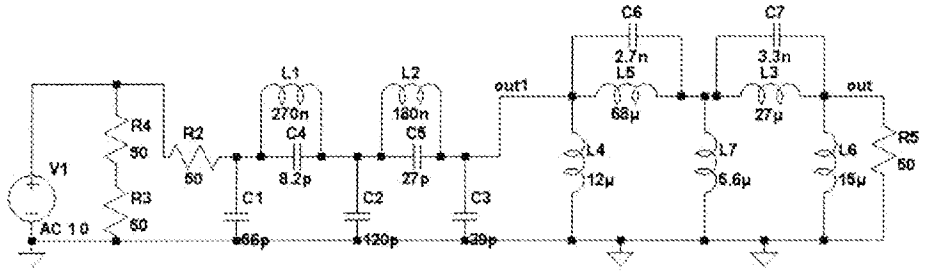
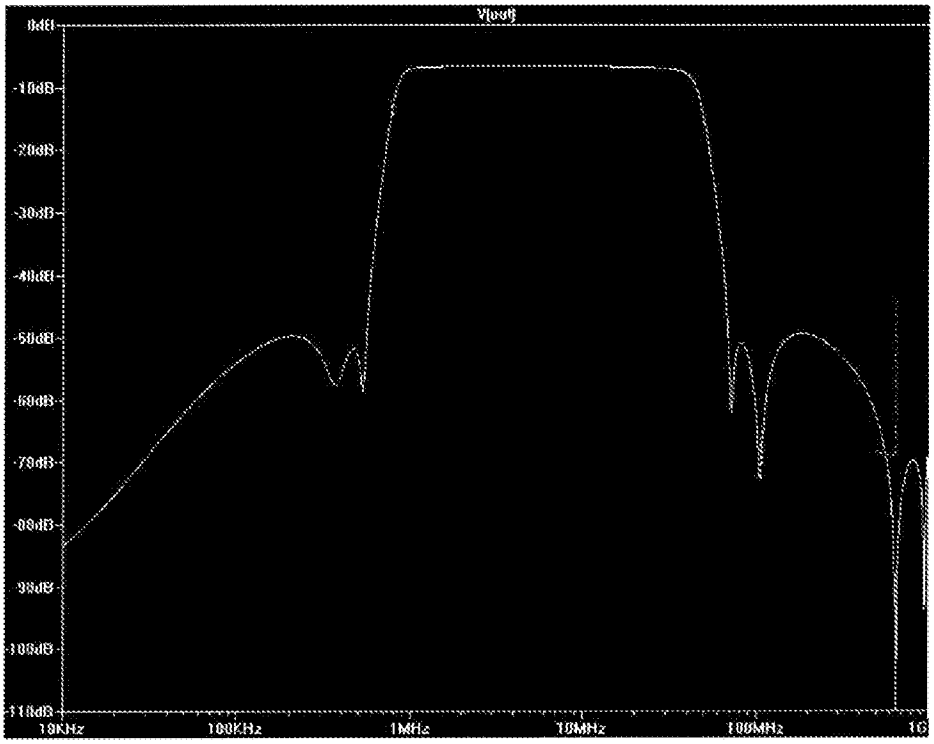


Figure 3-2: Diagram of 70MHz wideband bandpass filter.



(a) Schematic

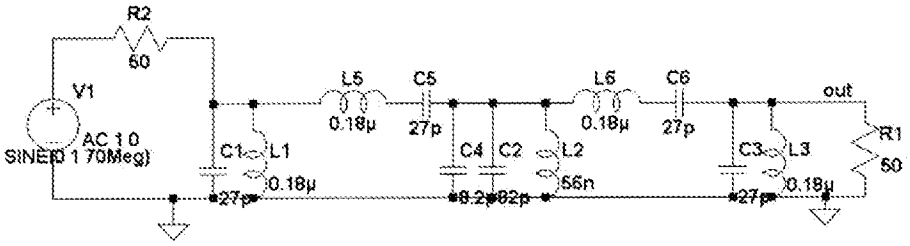


(b) Simulation

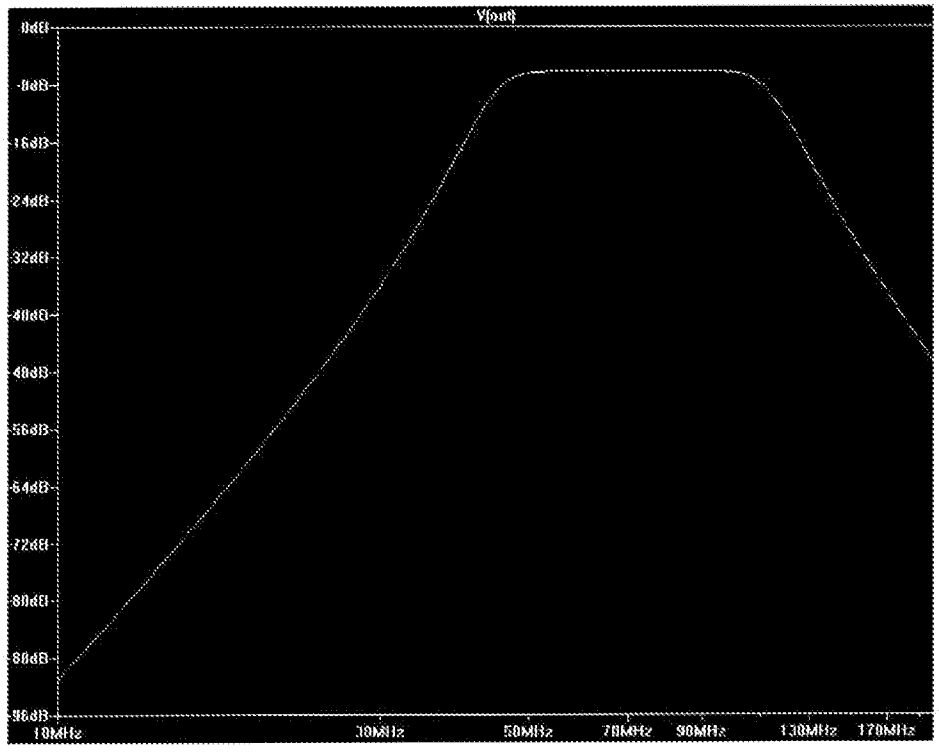
Figure 3-3: Passive Low Frequency Bandpass Filter.

distortion. The filter designed need not have a steep stopband attenuation factor, so elliptic sections are not required. A standard butterworth bandpass filter will suffice.

For a mixing LO frequency of 70MHz, a 40M – 100MHz 5-pole bandpass filter was designed, with -1.3dB insertion loss. The filter attenuates the 140MHz second harmonic by 24dB. The simulation results in Figure 3-4(b) match the design expectations and lab implementation.



(a) Schematic



(b) Simulation

Figure 3-4: Passive Bandpass Filter, $f_c = 70$ MHz

The variable filter, useful in some applications, was designed to provide approximately 20 – 30MHz variation. The discussion of this design is reserved for Section

3.3.4.

3.3.2 Mixer Network Design

The LT5521 was designed for an IF input and an upconversion to RF (GHz) and thus the DC642A demonstration board was configured for such an application. Because this frequency translation is operating at a much lower frequency range, modifications to the demo board circuit must be made to maximize the performance of the mixer.

The existing stock DC642A is shown in Figure 3-5 for $f_{IF} = 250MHz, V_{cc} = 5V$.

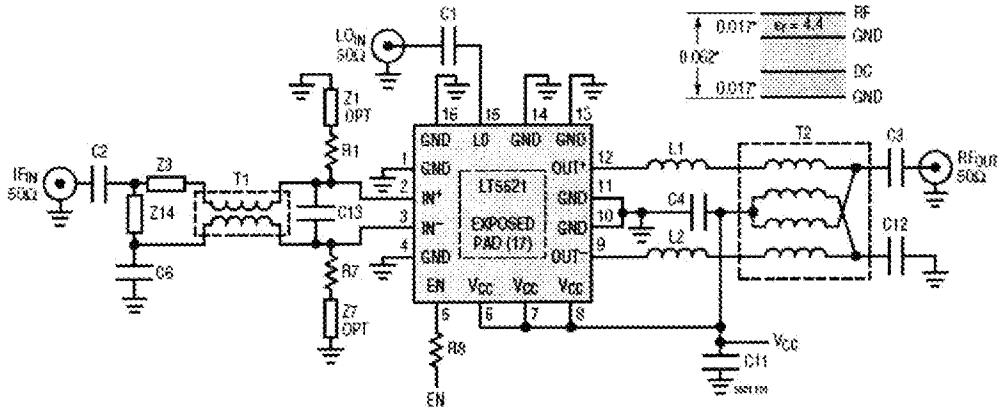


Figure 1. Demonstration Board Schematic

Table 1. Demonstration Board Bill of Materials[1, 2]

REF	f_{IF} = 250MHz, f_{RF} = 1.95GHz f_{LO} = 1.7GHz, V_{CC} = 5V	f_{IF} = 44MHz, f_{RF} = 1.045GHz f_{LO} = 1.001GHz, V_{CC} = 5V	f_{IF} = 250MHz, f_{RF} = 1.95GHz f_{LO} = 1.7GHz, V_{CC} = 3.3V
R1, R7	110Ω, 1%	110Ω, 1%	22.6Ω, 1%
Z14	10pF	120nH	10pF
Z3	0Ω	150pF	0Ω
L1, L2	2.7nH	10nH	2.7nH
T1	M/A-COM MABACT0010[3]	M/A-COM MABACT0010[3]	M/A-COM MABACT0010[3]
T2	M/A-COM ETC1-6-4-2-3	M/A-COM ETC1-6-4-2-3	M/A-COM ETC1-6-4-2-3
C1, C13	6.8pF	27pF	6.8pF
C3	82pF	3.9pF	82pF
C12	82pF	1nF	82pF
C2, C4, C6	1nF	1nF	1nF
C11	1uF	1uF	1uF
Z1, Z7	0Ω	0Ω	100nH
THIS COMPONENT CAN BE REPLACED BY PCB TRACE ON FINAL APPLICATION			
R8	10k	10k	10k

Note 1: Tabulated values are used for characterization measurements.
Note 2: Components shown on the schematic are included for consistency with the demo board. If no value is shown for the component, the site is unpopulated.
Note 3: T1 also M/A-COM ETC1-1-13 and Sprague Goodman GLSW4M202. These alternative transformers have been measured and have similar performance.

Figure 3-5: LT5521 Stock Demonstration Board (DC642A).

To adjust for a 1M – 10MHz input IF frequency, the coupling capacitors C2, C6,

C3 and C12 were changed to 100nF capacitance. L1 and L2 were replaced with wires for minimal resistance. T1 and T2 must be selected for the appropriate impedance matching and frequency. It was suggested[1] T2 be a 4:1 MABAES0054 transmission line transformer, with 5-1000MHz frequency range, -1dB insertion loss [10].

In initial testing of this circuit, it was discovered that there was a considerable DC offset at the output. Since the upconverted signal is sampled at a rate equal to the clock (LO), any clock feedthrough would be interpreted as DC offset. With the stock DC642A, there was offset on the order of 100-150mV from clock feedthrough. This offset is significant and reduces the dynamic range of the signal (there will be considerable clipping on one side of the signal, distorting the final output).

If LO feedthrough is significant, then DSB is not a practical method with this application because the LO frequency will pass through to the ADC. But design modifications can be made to attenuate carrier feedthrough. The bottleneck was found to be in the mixer design. Because the mixer was designed for much higher frequencies, certain transformers provide better isolation and impedance matching than others. But those transformers cannot be used at IF 70MHz when they are optimal in the GHz range. An unbalanced network at the mixer output can kill any quality output-LO isolation the mixer itself may have. So, even if the mixer datasheet isolation figure given at higher frequencies is about the same at the lower IF frequency, the output network design is important to ensure that there is a balanced differential output. Otherwise, local oscillator feedthrough can become significant.

Measuring the LO-output port isolation on Agilent's 8561EC Spectrum Analyzer, the stock board has -48dBm isolation (no signal at the IN port) with LO=70MHz, 0dBm. However, with an input signal at 3.58MHz -19dBm, the mixer output had the desired signals of -19.33dBm at the sum and difference frequencies (73.58MHz and 66.42MHz) and the undesired LO feedthrough of -52dBm. It is attenuated by only 32dBm from the desired output signal. With a post-mixer gain of about 20dB, the LO feedthrough seen would then be -12dB, which is very undesirable in the upconversion scheme.

[1]Suggestion made by Doug Stuetzle, Designer, Linear Technology. July 2006.

The output circuit was redesigned as such: Instead of just one T2 transformer (the 4:1 MABAES0054), a second transformer follows it, shown in Figure 3-6. This output circuit provides a much more balanced network in the desirable IF output frequencies. T1 is a 1:1 ETC1-1-13 M/A-COM balun transformer, 1.1-3000MHz frequency range, -1dB insertion loss. T1's purpose is to properly convert differential to single ended output. The values of the coupling capacitors were increased from 82pF to 100nF. Also, L1 and L2 are used to configure the output to a particular frequency, but they were replaced with wire again (mixer output directly connects to T2).

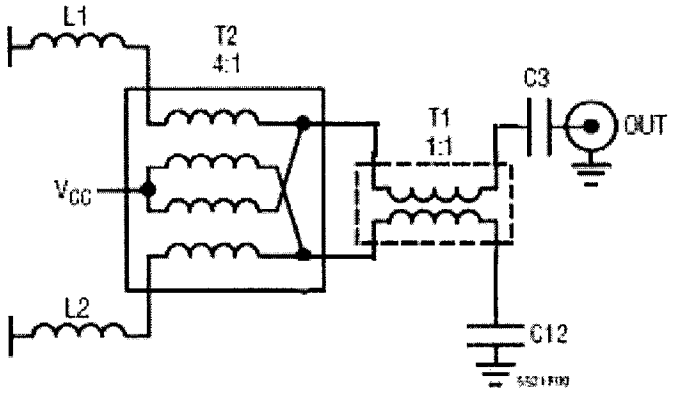


Figure 3-6: Redesigned LT5521 Output Network.

With this design modification, the entire system has a DC offset of -25dB. This is equivalent to 50mV or 400 of 8192 units. This was measured in two ways. The DC level can be measured with the same sample and mixing clock frequency. It can also be measured using PScope with different clocks, offset enough so that they do not a)interfere with each other nor b) lie at the same frequency as the upconverted input signal. The carrier feedthrough was measured to be -25dB in two cases : f_s = 70MHz (ADC clock), LO = 72MHz (mixer); and f_s = 70MHz, LO = 70.5MHz.

However, the spectrum still does not look incredibly clean. There is an elevated noise level about the desired frequency in Figure 3-7. Looking at the input network of the LT5521, it is not matched to at 50Ω output at 70MHz frequency. In fact, it is only 20Ω at 70MHz. This means an impedance transformation must occur through the input network. Thus, a 1:1 balun transformer like the ETC1-1-13 will not be

sufficient. Additionally, baluns at low frequencies (in the 1-10MHz range) do not function as intended, so a flux-coupled transformer is more appropriate. The ETC1-1T is the 1:1 flux-coupled transformer but it is 1:1. A 3:1 flux-coupled WBC3-1TL transformer from Coilcraft works from 0.3-900MHz and a -0.6dB insertion loss. This is the more appropriate choice for the input transformer, to convert the 50Ω line to the 20Ω differential input of the LT5521 mixer.

A quick check was to look at the return loss of the input network before and after impedance matching to a 50Ω transmission line. With the ETC1-1-13 1:1 balun in the input network, the S11 parameter was -3dB. With the WBC3-1TL 3:1 flux-coupled transformer, the S11 parameter was -12dB, a significant improvement over the original setup.

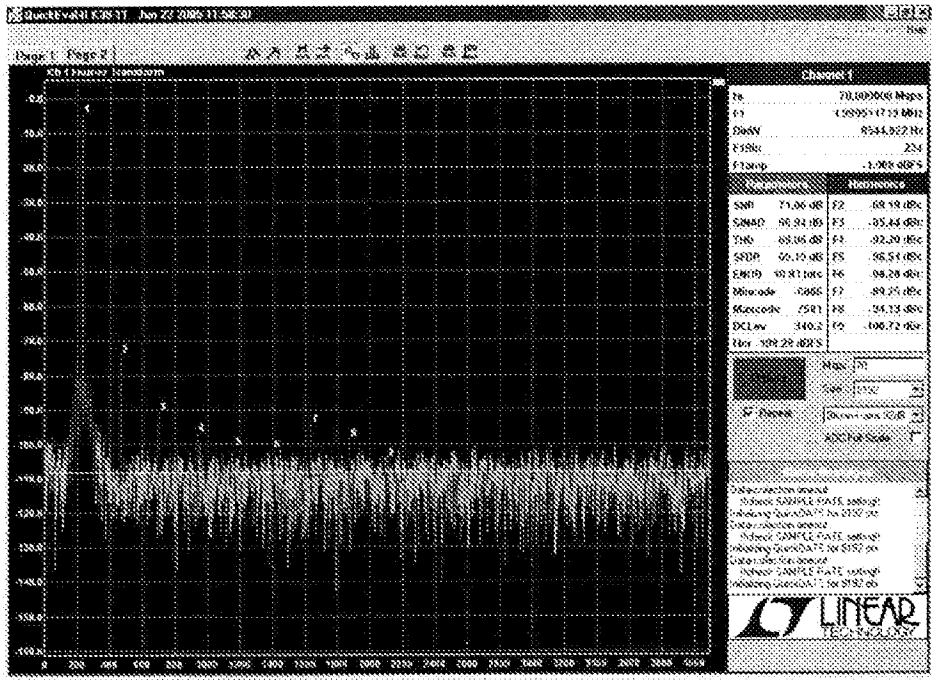
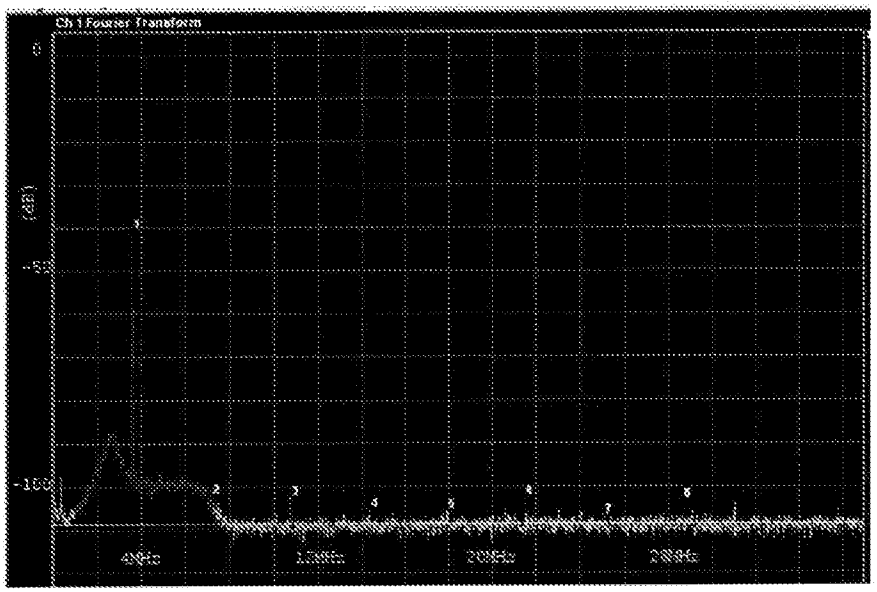


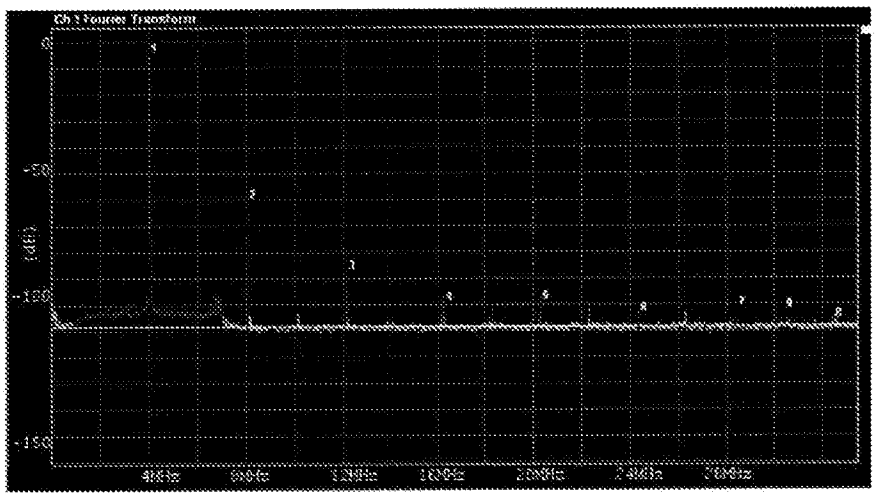
Figure 3-7: Mixer Output – Mismatched Input Impedance.

A comparison can be made between the upconversion scheme with a working modified board and the stock demonstration board, shown in Figure 3-8. The original board is not configured for the specified frequency range and cannot obtain full scale with the same input power level and signal chain as the working board. There is no significant DC level offset because it is attenuated by more than 30dB (expected

fundamental amplitude is full scale at -1dB). The working board can achieve full scale output and a much lower noise floor. The slightly raised noise level about the fundamental frequency is the ADC input bandwidth, limited by the 5MHz SAW filter.



(a) Stock Board



(b) Modified Board

Figure 3-8: Output Improvement with Modified LT5521 Board

3.3.3 Variable Gain Design

The PIN diodes' varying resistance changes the gain of the system. Placing the diodes at the output network of one of the components in the signal chain changes

the output impedance and the overall gain of the system. The mixer output has an internal impedance of 300Ω, so by placing the PIN diode at the output of the mixer, it is possible to achieve an output impedance of $0-300\Omega$. The LT5521 has a differential output, hence the choice of the double diode package (with a common cathode) is very useful here. By placing the two diodes across the differential output, then biasing the cathode of the diodes we can achieve variable mixer output impedance. The PIN diodes are placed right on the legs of the IC package to minimize parasitics on the board like in Figure 3-9.

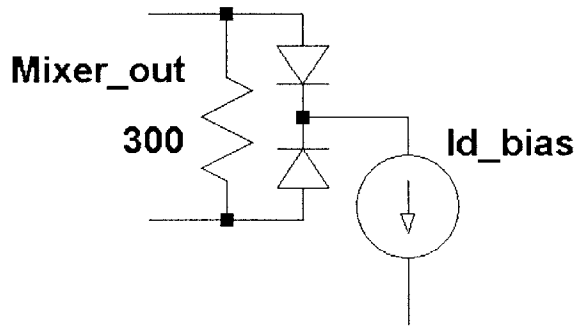


Figure 3-9: PIN Diode Package in System Design.

The anodes of the diodes are biased to the supplies through the center-tapped transmission line T2 transformer. Id_{bias} is determined by a control voltage and resistor $R_b = 180\Omega$. The bias network makes it easy to measure the current through the PIN diodes, using the 180Ω resistor. The voltage drop across the diode is about 0.8V in forward bias, and the voltage drop across R_b can be measured to find Id_{bias}. Each diode receives half the bias current Id_{bias}. The differential impedance of the diode is $2R_{PIN}$, R_{PIN} found in Equation 2.4, and the effective output impedance of the entire mixer network is $\frac{2R_{PIN} \| Z_o}{4}$, where Z_o is the mixer output impedance, and the 4:1 transformer is used. With this variation in mixer output impedance, a range of 27dB attenuation was achieved with a 0-5V bias (see Figure 3-10). The relationship between the overall system attenuation and the effective output impedance is plotted over a 400mV bias range in Figure 3-11.

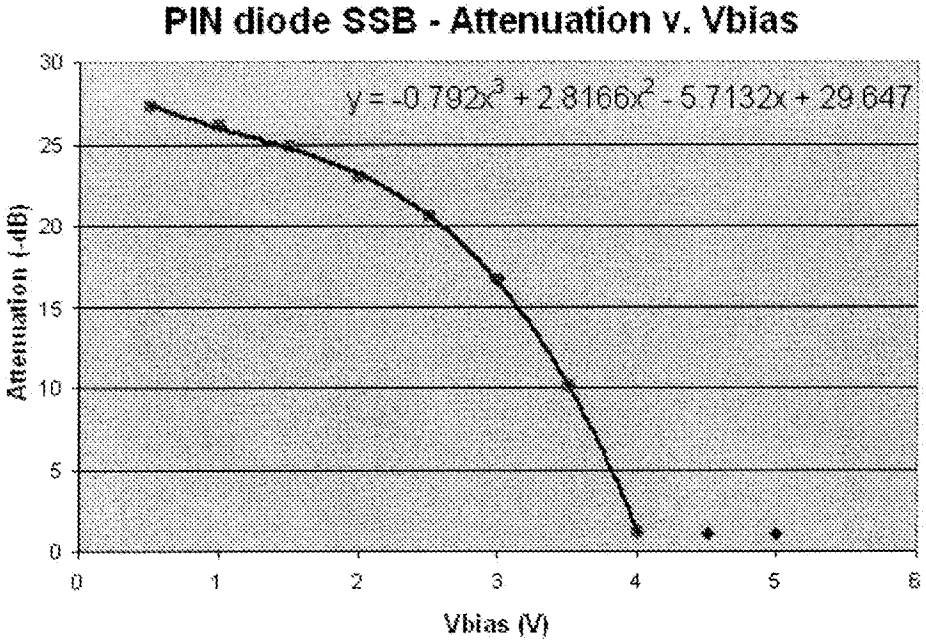


Figure 3-10: System Attenuation v. Bias Voltage on the PIN Diodes.

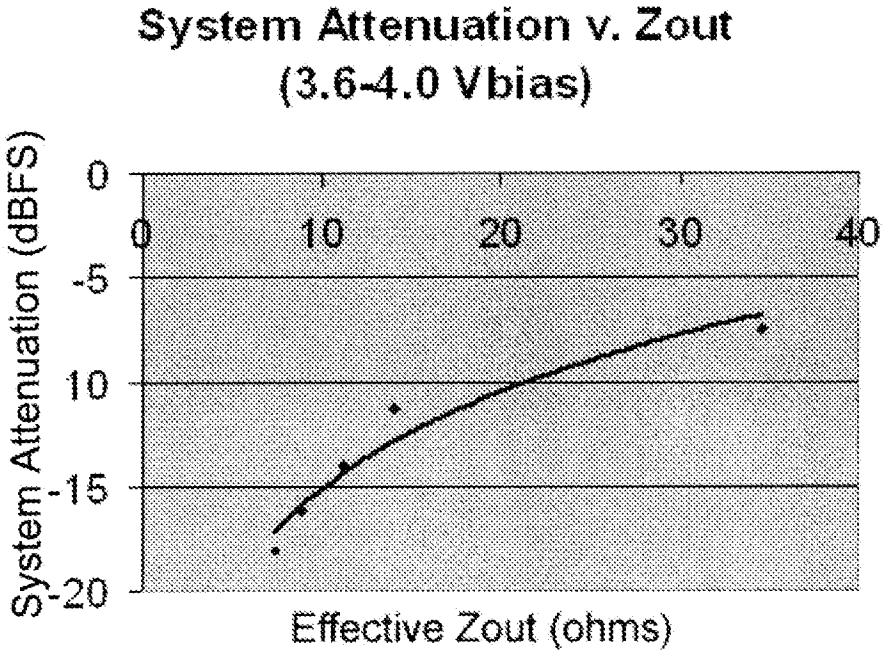


Figure 3-11: Attenuation v. Effective Output Impedance of the System

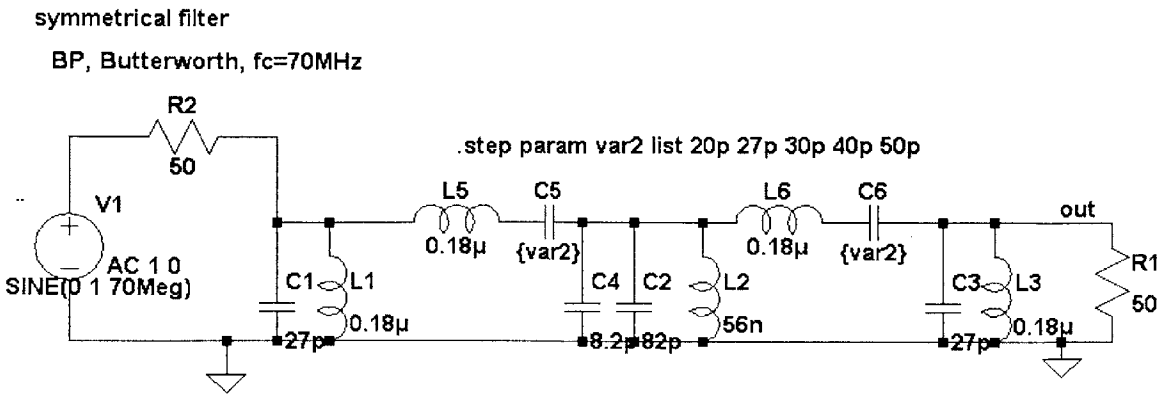
3.3.4 Variable Filter Design

The varactor diodes were fairly simple to design into the system. Each diode acts as a variable capacitor, so placing them in parallel with a capacitor in a filter design will suffice. The diodes can be biased at cathodes with a large resistor and control voltage (much like the PIN diode setup). The challenging part was determining what type of design to actually use. As discussed before, Butterworth and Chebyshev filter designs are easier to design than elliptic section filters. However, a simple test showed that adding varactor diodes into a Butterworth filter was much harder to do than anticipated.

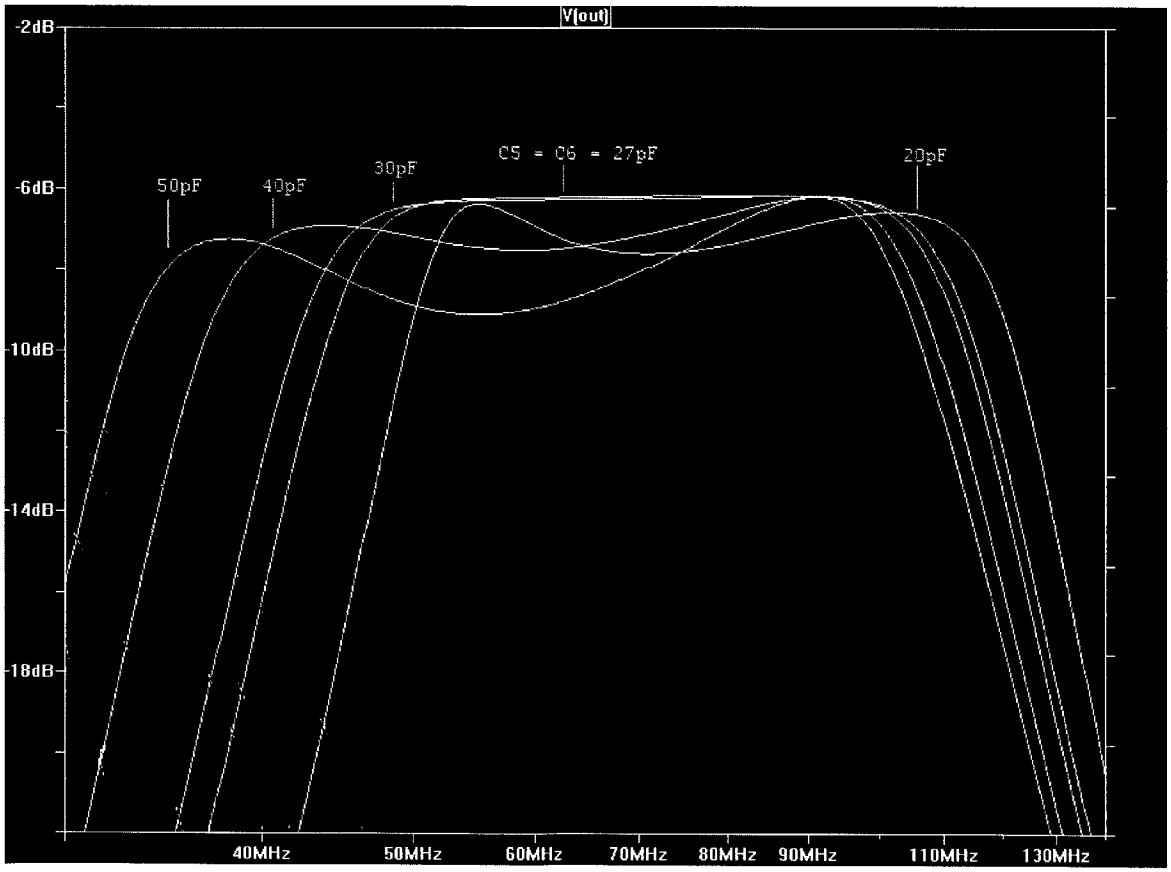
Figure 3-12(a) shows how C5 and C6 values were varied to producing the effects of a varactor diode circuit. To produce the original 70MHz bandpass five-pole butterworth filter, $C5 = C6 = 27pF$. Here, they are varied from 20pF to 50pF. The simulation results in Figure 3-12(b) show an inconsistent filter response across the capacitor range, quite unsatisfactory for a true variable filter. The ideal response is to have the same filter response shifted over a certain frequency range to provide the same performance in the system.

Elliptic sections were considered because their topologies allow for each section to have their own tuning varactor diodes. Construction of these filters with varactor diodes are easy, because the diodes can be just placed on top of each elliptic section. Although this is not a wideband filter, highpass 7-pole and lowpass 5-pole elliptic filters were designed independently, so that the effect of variable filter could be observed independently at each 3dB point. Figure 3-13 shows the two elliptic filters individually with varactor diodes. For the low pass filter $f_{3dB} = 80$MHz and for the high pass filter, $f_{3dB} = 70$MHz. These results show the highpass filter with varactor diodes across one of the elliptic sections. The behavior deviates from the expected response around the 3dB frequency.

Combining the two elliptic section filters as in Figure 3-14(a), and placing varactor diodes on each elliptic section to maintain the same response, produced the bandpass response in Figure 3-14(b). The varactor diodes are modeled in SPICE with the line



(a) Schematic



(b) Simulation

Figure 3-12: Variable Filter Design using Passive LC Bandpass Filter. In (b) the 5 plots correspond to simulations for different capacitor values (C5 and C6 as shown in (a)).

statement :

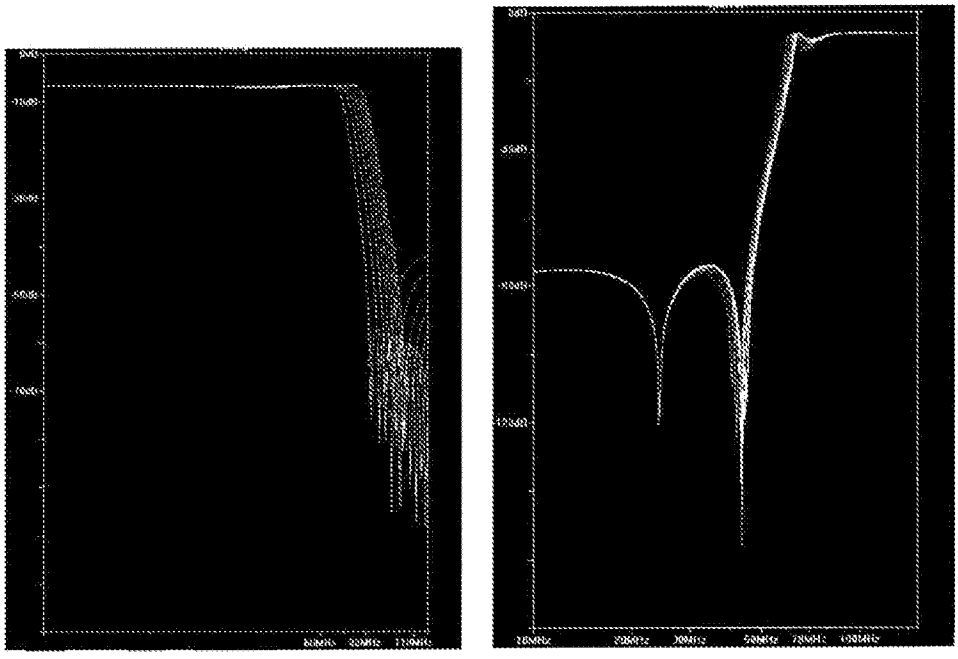
$$.model\ BB207VarCap\ D(R_s = 0.3\ \ C_{jo} = 122.5p\ \ M = 0.81153\ \ V_j = 1.4881$$
$$\text{mfg} = \text{Philips}\quad \text{type} = \text{Varactor})$$

The V2 voltage source is stepped from 1 to 10V, with 3-10V being the suitable operating range in the actual system setup. Each section has additional capacitance from the BB207 package and they are all stepped by the V2 voltage source.

The resultant elliptic section bandpass filter in Figure 3-14(b) shows consistent filter response across 60 to 85MHz. There is less than 0.2dB ripple in the passband across the filter range.

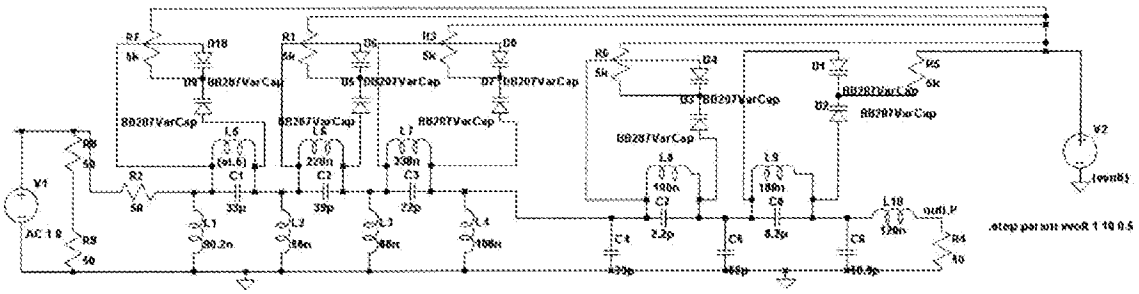
Figure 3-14(c) is the actual filter response of the design constructed on a copper clad board, with 50Ω transmission line. The measurement was made by the Network Analyzer. There is a greater change in passband insertion loss, but the filter response is similar to expected results.

The system achieved 60 to 86MHz variable filtering across a 10V bias range of the varactor diodes. From the network analyzer, the constructed elliptic bandpass filter

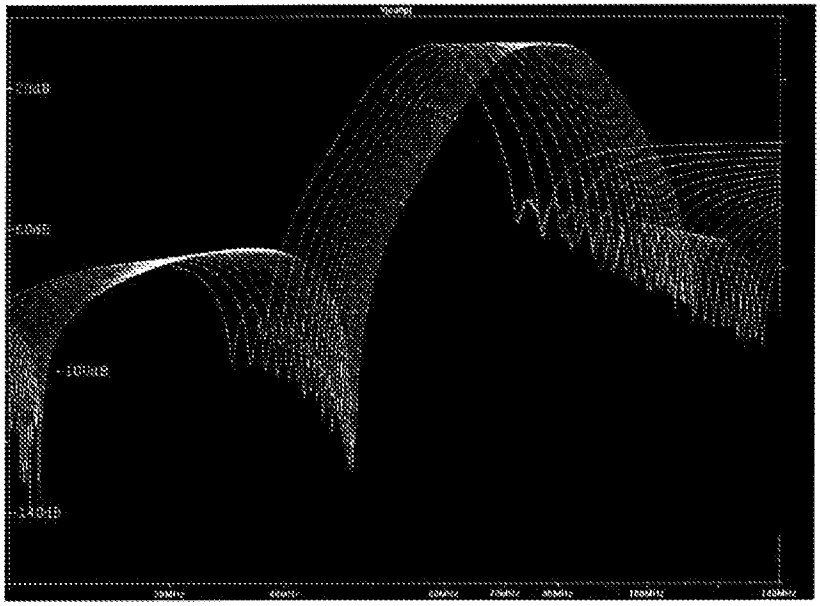


(a) Elliptic Low Pass Filter (b) Elliptic High Pass Filter

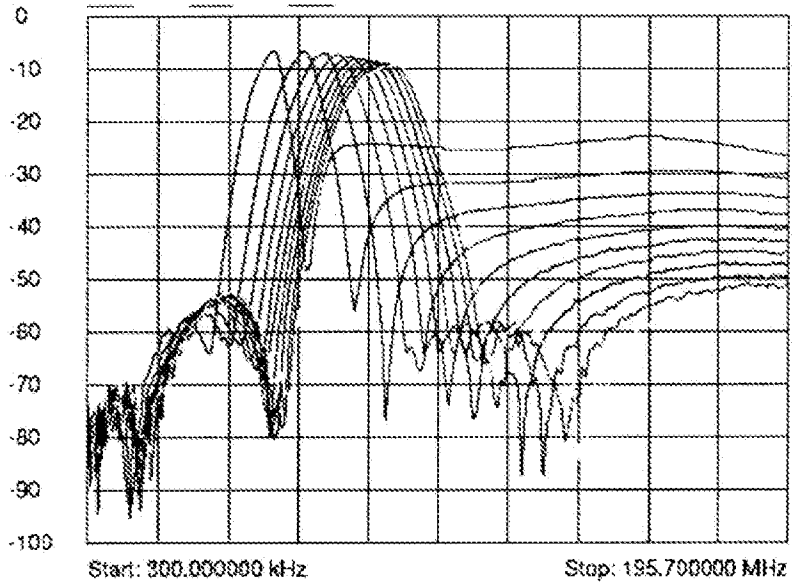
Figure 3-13: Simulation of Elliptic Filters with Varactor Diodes



(a) Schematic



(b) Simulation



(c) Network Plot

Figure 3-14: Elliptic Bandpass Variable Filter

has characteristics shown in Table 3.3.4.

Voltage Bias (V)	Center Freq (MHz)	S22 (-dB)
0	51.87	26
1	60.66	16
2	65.88	13
3	70	11.3
4	73.6	10.4
5	76.31	9.5
6	78.64	9
7	80.535	8.5
8	82.236	8
9	84.4	7.8
10	86.2	7.5

Table 3.1: Variable Filter Characteristics

The entire upconversion scheme with the varactor diodes biased at 2.8V, a 70MHz clock, and 2MHz input has 69dBFS SNR. As expected, adding variable filtering did not compromise the dynamic performance of the system.

3.3.5 Design Conclusion

Each component design was unique and challenging in its own respects, with novel techniques used to ensure practical implementation. Besides designing actual circuit networks, construction of the filters and setup of the system (it is after all heavily application based) are very important. I was able to design filters that work close to expected results from simulation, and achieve an improvement in results from mixer design. It became clear that filter and mixer design are two limiting components of such a frequency translation scheme. However, other application issues arise, as the next section highlights in the presentation and interpretation of results.

Chapter 4

Applications Setup

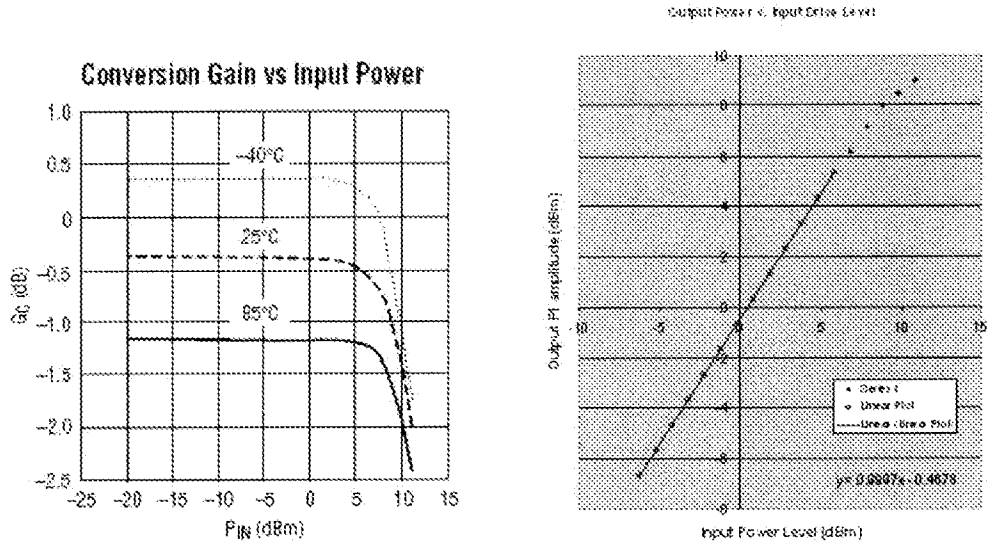
The setup for the application system was carried out in the Design Laboratory of Linear Technology in Milpitas, California under the supervision of one of the senior application engineers. Standard lab equipment was used and all components were either samples from the company or designed myself. The proprietary program PScope developed at Linear Technology was used to process the digitized signal with an 8192-point FFT and Blackman-Harris windowing function. Equipment used included signal generators from Hewlett Packard (model 8644B, 100kHz - 3.2MHz frequency range), a network analyzer from Hewlett Packard (model 8753C, 300kHz-6GHz frequency range), and a spectrum analyzer from Agilent (model 8561EC, 30Hz-6.5GHz frequency range).

This section describes some applications setup issues encountered in designing the frequency translation system. Most are standard high frequency issues not usually seen by ultrasound customers but are everyday issues for radio designers. Signal overdrive, reflected waves, impedance matching, single side-band, and double side-band are discussed here.

4.1 Signal Input Limitations

The signal level into the mixer cannot be too high. If overdriven, the mixer outputs a distorted signal compared to the lower frequency input, rather than a pure frequency-

shifted signal. For linearity, it is best to keep the input range less than 5dBm for the LT5521 [2]. A simple experiment verified datasheet specifications. Figure 4-1(a) shows that the gain falls drastically at $P_{in} > 5dBm$. The mixer input was driven from -24dBm to above 10.8dBm but the region of interest (-5 to +10 dBm) is plotted here in Figure 4-1(b). Up to 5dBm, the output fundamental amplitude and input power level have a linear relation, slope of 1 and gain approximately -0.5dBm (the intercept). Above 5dBm, the mixer reaches saturation because the points fall from the linear extrapolation, indicating that the mixer is now overdriven.



(a) Datasheet Figure, IN=250MHz and LO=1.7GHz. [2]

(b) LT5521, IN=4MHz and LO=70MHz

Figure 4-1: LT5521 Output v. Input Power

Thus, there is a minimum amount of gain required to bring the mixer output to full scale for the ADC. With a minimum 5dBm mixer input, -0.4 mixer conversion gain[1], and required +10dBm analog ADC input produces -1dBFS fullscale output, the minimum gain post-mixer is 4.67dB. The PScope plot in Figure 4-2 shows the distorted output due to an overdriven mixer. Using just one AH31 amplifier, one SAW filter (narrowband 5MHz bandwidth) and proper attenuator pads, the post-mixer gain was about 4-5dB, which is barely enough. There is significant distortion from the harmonics.

[1]Measured with Agilent 8561EC Spectrum Analyzer, with the modified LT5521 network design.

4.2 Clock Jitter

Clock jitter is a slight variation in the period of the signal, due to noise in the oscillatory system. Statistically, the period can be modeled as having a Gaussian distribution[25]. The jitter induces error in the output voltage proportional to jitter magnitude and input slew rate[26]. At higher frequencies and therefore higher slew rates, the effect of jitter is more pronounced. Since this application shifts a signal to higher frequency, clock jitter issues may arise.

With two clocks - one for the frequency translation and one for the ADC sampling, the jitter from the clocks can create an elevated noise floor or induce close in-phase noise about the fundamental signal. These effects degrade the dynamic range and the SNR of the system.

Since the upconversion will shift the signal to the IF range, which is in the range of sampling frequencies for the LTC2249, it proved advantageous to sample and shift

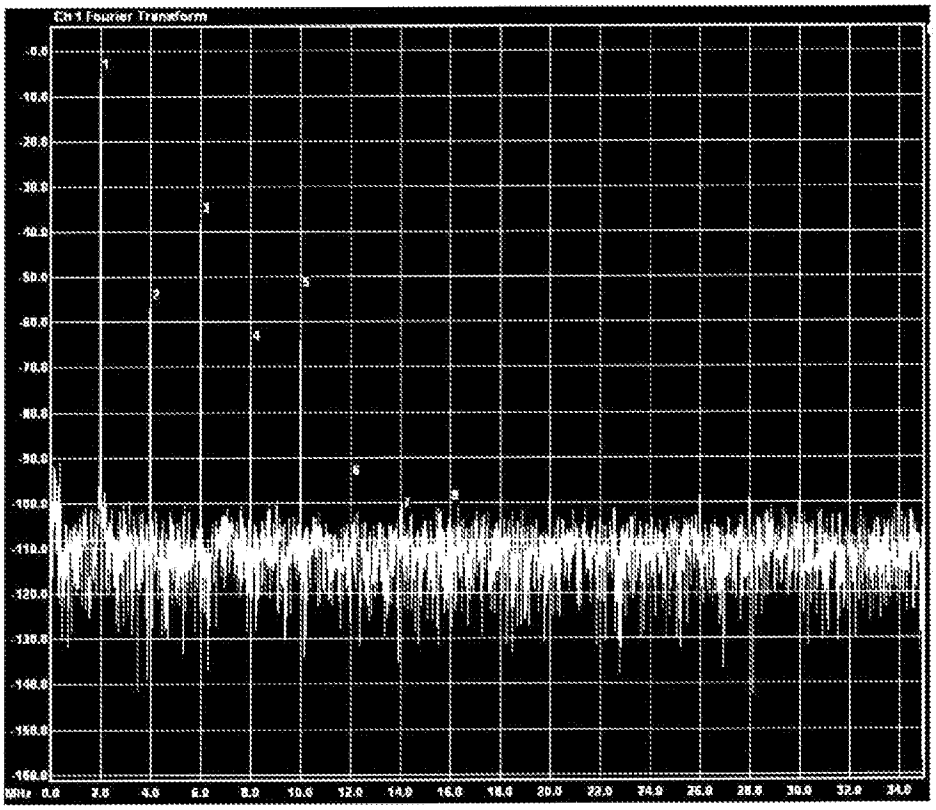


Figure 4-2: Input Overdrive System.

with the same clock source. Any oscillator fluctuation (in time or frequency) will at least be from the same source. The only difference between the two clock signals is the relative phase difference seen at the ADC, since one clock signal is at the front of the signal chain, and one clock signal samples the ADC. Jitter and random phase fluctuations should be cancelled out using the same clock source. Using the same frequency for LO and f_s in the upconversion scheme will make carrier feedthrough look as a DC offset, eliminating it from the AC spectrum.

Figure 4-3 illustrates the effects of two 70MHz clock sources used for f_s and LO, with a 2MHz input into the system. The noise floor is elevated considerably due to oscillator phase noise.

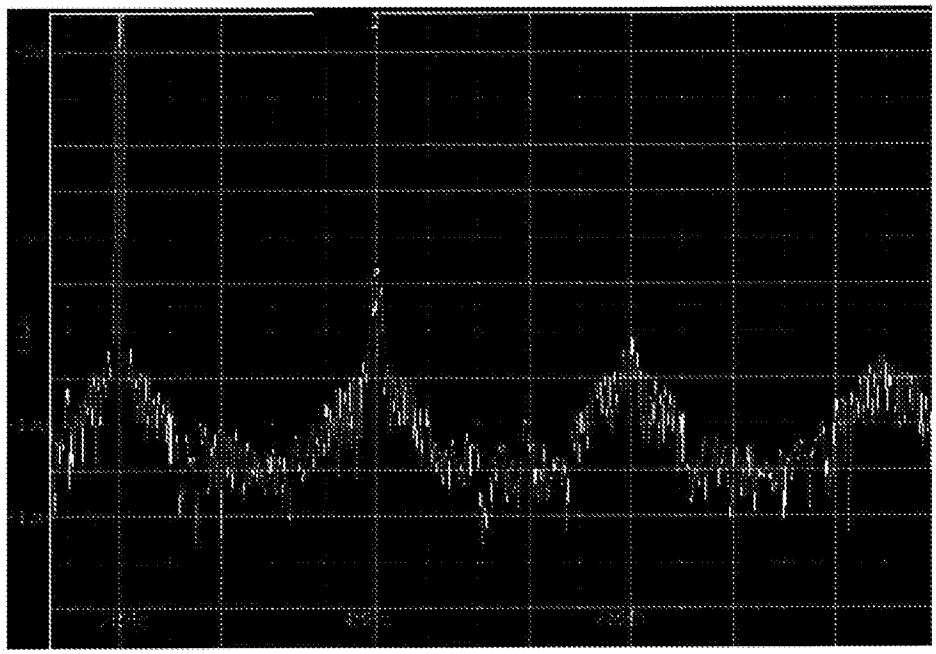


Figure 4-3: Separate Clock Sources for ADC and Mixer.

The work presented here assumes the same clock source unless otherwise indicated.

4.3 Reflected Waves

In higher frequency applications, reflections can affect the system output quality. The measurements used to determine the quality of the system in minimizing reflections are the S parameters, namely the S11 and S22 return loss parameters. Thus, it is

important to look at these parameters of each device in the signal chain. The AH31 amplifiers report S11 = S22 = -25dB and the LC bandpass filter has S11 = S22 = -16dB, which indicate there is sufficient attenuation of reflected waves. However, the SAWTEK filters do not have good S11 and S22 parameters. The data in the Figures 4-4, 4-5, and Tables 4.1 and 4.2 are from published online data from the vendor[2]. In the 5MHz bandwidth SAW, the S22 parameter in the passband is only 7-10dB attenuation. In the 20MHz bandwidth SAW, the S11 and S22 parameters are poor at about 3-5dB attenuation.

In a cascade system as in the presented application, reflected waves can compound on one another, adding undesirable signal level to the output and distorting the digitized signal. These reflections will degrade the SINAD and SFDR figures. In the case that the reflected wave is at the same frequency and phase as the incoming wave, a standing wave forms.

It was advantageous in the setup to place attenuator pads in between stages where reflections can degrade the output. Thus the mixer output, SAW input, and SAW output were all buffered by attenuator pads of 1dB to 5dB.

Freq (MHz)	S11 (dB)	S21 (dB)	S22 (dB)
65	-1.398	-58.811	-1.017
66	-2.784	-27.081	-1.299
67	-6.806	-11.631	-3.674
68	-10.530	-7.585	-7.310
69	-15.131	-7.002	-7.533
70	-16.826	-7.053	-8.945
71	-15.049	-7.036	-9.584
72	-8.065	-7.508	-8.192
73	-5.467	-13.597	-4.261

Table 4.1: SAWTEK 854660 S Parameters

[2]http://www.triquint.com/prodserv/types/filters/if/std_70mhz_family.cfm

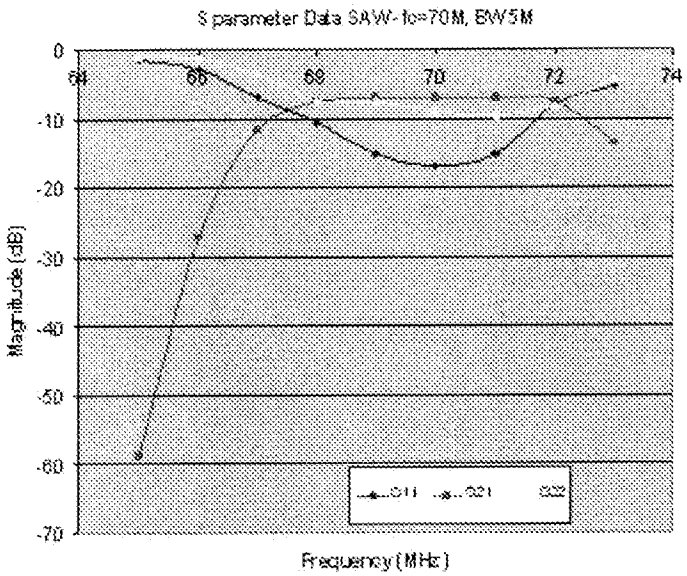


Figure 4-4: S parameter Data from SAW Filter Part 854660.

Freq (MHz)	S11 (dB)	S21 (dB)	S22 (dB)
60	-3.327	-15.791	-3.102
61	-3.728	-14.334	-3.363
62	-3.669	-14.176	-3.317
63	-3.614	-14.161	-3.323
64	-3.834	-14.237	-3.424
65	-4.095	-14.069	-3.625
66	-4.138	-14.040	-3.669
67	-3.945	-14.008	-3.581
68	-4.156	-13.991	-3.664
69	-4.302	-13.998	-3.834
70	-4.418	-14.061	-3.959
71	-4.112	-14.094	-3.757
72	-4.088	-14.051	-3.630
73	-4.428	-14.123	-3.863
74	-4.556	-14.052	-4.057
75	-4.268	-13.984	-3.796
76	-4.155	-14.040	-3.658
77	-4.256	-14.126	-3.710
78	-4.732	-13.837	-4.247
79	-4.570	-13.954	-4.181
80	-3.531	-16.773	-3.181

Table 4.2: SAWTEK 854670 S Parameters

4.4 Single Sideband v. Double Sideband

Mixers translate frequencies to signals at the sum and difference of the two input frequencies (IN and LO). One of these frequencies is the desired sideband, the other is the image sideband. In some cases the sidebands contain different information, but in most cases the desired and image sidebands represent identical information [17]. Thus only one band is necessary, and the signal is filtered as a single sideband (SSB). If both sidebands are needed, double sideband (DSB) filtering is necessary in the signal chain.

SSB and DSB offer different advantages. SSB filters are much more narrowband (they need only be half the bandwidth of a DSB filter) and can be more complex to design. SSB filters can be designed to filter out the mixer carrier frequency, making the system insensitive to LO feedthrough. As discovered in Chapter 4, the local oscillator feedthrough can be a limiting factor in system performance. Feedthrough contributes to a DC offset if the same clock source is used for sampling and upconversion. In DSB, the carrier frequency appears at the output so LO feedthrough becomes a factor. Mixer design, mainly port isolation and balanced network, is cru-

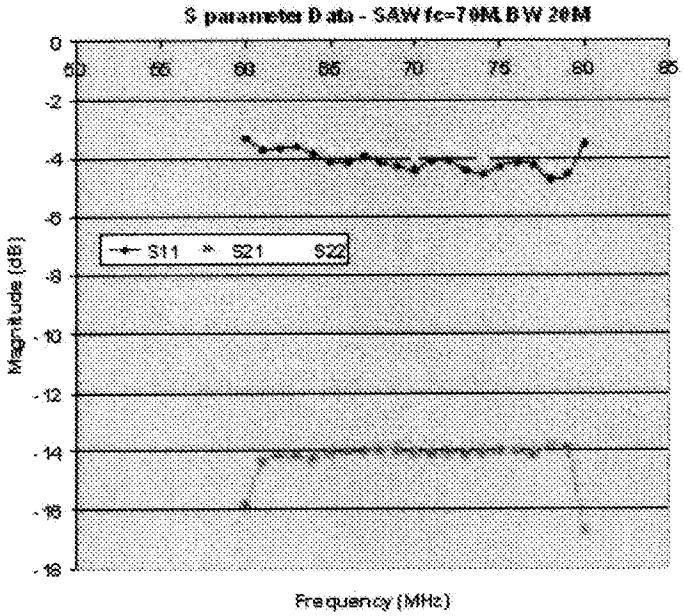


Figure 4-5: S parameter Data from SAW Filter Part 854670.

cial in DSB. Given the same input level in the system, the DSB setup should have a higher SNR and a better noise figure (NF). In DSB, there is twice as much signal, and a $\sqrt{2}$ increase in noise. Noise is measured in RMS and hence does not double like the signal level. A 2x increase is a 6dB gain and a $\sqrt{2}$ increase is a 3dB gain. Thus, the SNR increases by 3dB. With a higher SNR, the noise floor is lower and therefore the noise figure should improve with DSB. These metrics for dynamic performance will be presented in the following section and values for SSB and DSB will both be shown.

4.4.1 Phase Delay Offset

Another difference in SSB and DSB is how they are affected by a timing delay. In DSB, there are two sidebands to consider in the frequency spectrum, which means the time version of this is a signal (i.e. $\cos([\omega_i+\omega_c]t)$) that is modulated by the second (i.e. $\cos([\omega_i-\omega_c]t)$) frequency. Because of the modulation, phase delay becomes significant in sampling time. The system has two clocks traveling different signal path lengths the sampling clock directly to the ADC and the upconversion clock that has to travel the entire signal chain from mixer through amplifiers and filters all the way to the ADC input. Therefore it is important, when looking at double sideband, to ensure that the timing is such that the ADC clock is sampling at the peaks of the modulated analog input signal. Otherwise, it is possible to be sampling near the zero-crossing of the signal. The ADC would falsely output as a very low level signal even if the system is working properly, except for the timing of the clocks.

A SSB scenario has just one sideband, which is the transform of a sinusoid. When the signal is sampled, phase offset is trivial because the signal is not being modulated by another frequency[3].

Thus in the application setup, the length of the signal chain was adjusted so that proper DSB sampling could take place. This involved exchanging BNC cables of different lengths in the middle of the chain. Either the ADC sampling clock could

[3]This of course assumes that interfering signals are heavily attenuated in the signal, otherwise they are a source for modulation.

be delayed, or the signal chain can be lengthened so that the clock would sample at the next peak maxima. In a more realistic applications setting, this can be more of a nuisance than anything, so SSB may be heavily preferred over DSB. With SSB timing delay becomes a nonissue.

4.5 System Gain

Without variable components, the net system gain ranges from 15 to 23 dB. The measured gains of each component in the signal chain is listed in Table 4.3.

Part	Gain or Insertion Loss (dB)	Bandwidth
Input filters (TTE)	-3.4	Narrowband bandpass, input-frequency dependent
Butterworth Bandpass filter	-1.3	Fc=70MHz, BW=30MHz
SAW (1)	-7.25	Fc=70MHz, BW=5MHz
SAW (2)	-14.5	Fc=70MHz, BW=20MHz
AH31 (1)	+18.5	BW 44-90MHz
AH31 (2)	+19.1	BW 44-90MHz

Table 4.3: Gain and Bandwidth Values for Each Component

Throughout the system, the attenuator pads used to reduce reflections and standing waves, described in Section 4.3, sum to 6dB. Using the narrowband SAW(1) the system gain is 23dB. With the wideband SAW(2) the system gain is 15.8dB[4].

With the wideband 20MHz SAW filter care must be taken, as described in Section 4.1, not to just overdrive the system to achieve full scale. A step attenuator can be used to compensate for the 7dB difference in the insertion loss of the two SAW filters. From Section 4.4, the narrowband SAW(1) can be used for SSB filtering and the wider SAW(2) can be used for DSB filtering. To ensure consistency in testing, the same input level is configured for both tests. That level is set with the signal chain for DSB to achieve full scale output. Since the narrowband SAW(2) has a lower insertion loss,

[4]The gain of the system is defined from the filtered input, so the insertion loss of the filter is accounted for in the input level, not in the system gain. The filter is a test setup requirement, but in a real system, it is assumed that the input is well-filtered and a relatively clean signal.

a step attenuator can be used to lower the gain in the SSB chain to achieve full scale output while maintaining the same input power.

One thing to take note here is that adding PIN diodes in the system only decreases the system gain. They cannot increase the gain of the system because of the way they are implemented into the system design. PIN diodes are acting virtually as shunting resistors with increasing current bias. The maximum gain achievable for this upconversion scheme is with either no PIN diodes or reverse-biased PIN diodes.

Chapter 5

Dynamic Performance Results

The heart of this application is looking at the dynamic performance of the entire system. If the system can achieve high dynamic range without requiring the absolute top of the line components, this indicates the robustness of the application. The current application setup allows customers to determine the gain blocks of the system based on the components available at hand, the upconverting frequency, the sampling rate, and allows design room for sharp filtering for improved dynamic range. The dynamic figures of interest are Signal-to-Noise Ratio (SNR), Signal-to-Noise-and-Distortion Ratio (SINAD), Spurious-Free-Dynamic-Range (SFDR) of the entire signal chain (and ADC) as well as harmonic distortion, noise figure (NF), and output third-order intercept point (IP3).

5.1 SNR, SINAD, SFDR

The SNR of the system was generally found to be about 69-71dBFS. Different bandwidth SAW filters provided slightly varying figures, clearly the narrowband 5MHz SAW produced a higher SNR. Also, the SSB and DSB setup provided different SNR values, as anticipated in the discussion in Section 5.3. It was expected that the DSB SNR would be 3dB higher, it was found to be 1-2dB higher in most setups. Given the realistic setup on the lab bench, this is as expected. The dominant harmonics tend to be the second and third harmonics, but SINAD is typically about 62dBc and SFDR

63dBc. The system SNR comes close to the ADC LTC2249 SNR of 73dBFS, the upper limit of the expected system SNR. This suggests the method to be a low noise application, as observed with a 108dB noise floor with an 8192-point FFT. However, the SINAD and SFDR figures indicate that there is distortion in the system setup. The narrowband 5MHz SAW filter keeps higher order harmonics out, so the source of distortion lies in the components in the signal chain. Most likely the distortion arises from the mixer or amplifiers rather than the filters.

Tests were performed to look at the effects of the mixer distortion and amplifier distortion separately. In Figure 5-1 Test 1 has an IF input at 70MHz, processed through the signal chain and sampled by a 74MHz clock. Test 1 has a SNR of 69.2dBc and SINAD 67.2dBc at full scale output. Test 2 has a low frequency 4MHz input, mixed up to 74MHz, processed through the same signal chain and sampled by the same 74MHz clock. Test 2 has a SNR of 67.6dBc, and SINAD 64.8dBc.



Figure 5-1: System Distortion With and Without Mixer.
Test 1: IF input, without mixer. Test 2: LF input, with mixer.

Looking at this test, it was interesting to note that the mixer did not actually degrade the SNR or SINAD by more than a few dB. The mixer definitely contributes some noise and distortion into the signal chain, but does not seem to be the dominant factor. Therefore, the attention was shifted to the AH31 amplifiers.

If the AH31 amplifiers have poor distortion, the second AH31 which is right at the ADC input, will have the most pronounced effect at the output. The previous amplifier in the chain is followed by a narrowband SAW filter, which bandwidth limits the amplifier output.

In Figure 5-1 Test 1 has a filter in between the amplifier and ADC input network. If the order of the two parts were swapped, would the distortion change?

In Figure 5-2, a comparison was made between the order of a LC bandpass filter and AH31 amplifier in the input signal chain to the ADC. Test 1 with a cascade

of AH31-bandpass filter provides SNR = 70dBc and SINAD = 67dBc. Test 2 gives SNR=70dBc and SINAD=55dBc! Therefore, there is a large level of distortion of the AH31 when placed right before the ADC. The AH31 was designed for a bandwidth of 45MHz to 90MHz. This is greater than the Nyquist bandwidth of 35MHz, suggesting that the distortion folds back into the Nyquist zone.

The AH31 amplifiers were selected as off-the-shelf sufficient amplifiers. They are cheap and have fairly low distortion. From the two tests, it is simple to see that placing a filter after the AH31 and before the ADC will improve the SINAD and SFDR values. As long as the AH31 distortion does not affect the more realistic intermodulation test, these amplifiers are still useful components for this application.

5.1.1 SSB v. DSB

Let us compare now the difference between the figures for DSB and SSB. Comparing the two schemes is challenging, because it is hard to determine what the most equal test between the two is. The main difference in the DSB and SSB is the ease of filtering achievable. So most applications of DSB have a wider range filter than SSB. However that changes the signal gain of the post-mixer chain because the two options available are the 5MHz SAW (for SSB) and 20MHz SAW (for DSB). The other factor to consider when looking at SNR and SINAD values is the input power level. With DSB allowing both sidebands for twice the input level than in SSB, it is easy to overdrive the input in DSB. Setting the system up as described in Section 4.4 allows for a fair comparison of SSB and DSB filtering, with equal input levels an an attenuator to adjust post-mixer gain.

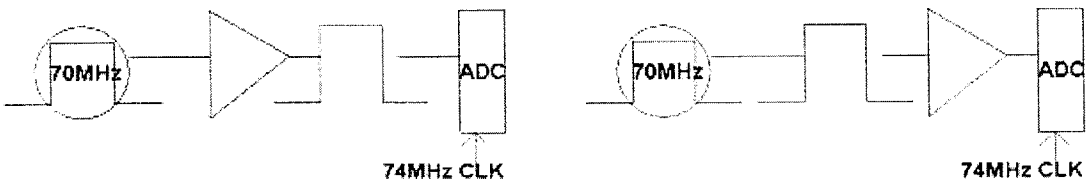


Figure 5-2: ADC Input Distortion. Having the amplifier output post-filtered improves the dynamic results.

The expected difference between SSB and DSB SNR is 3dB, as discussed previously. In the setups discussed, it was very hard to achieve a comparison where the DSB SNR is actually close to 3dB higher. The results of a DSB v. SSB test are depicted in Table 5.1:

Parameter	SSB	DSB
f_s	74MHz	70MHz
Input f	4MHz	4MHz
SAW, f_c=70MHz	5MHz BW	20MHz BW
SNR (with F1=-1dBFS)	66.7dBc	69.7dBc

Table 5.1: Double Side Band and Single Side Band Results.

5.1.2 PIN Diode Dynamic Performance

Now the attention focuses on the dynamic performance of the upconversion scheme with the PIN diodes. After all, the purpose of upconversion is to provide variable gain and filtering. It is important to measure the dynamic performance of the system with the PIN diodes in place.

With the same input level, the output amplitude dropped from full scale -1dBFS to -24dBFS at a 1V bias voltage on the PIN diodes (refer to Table 5.2). This verifies the amplitude has about 25dB gain range. The S11 parameter of the mixer with PIN diodes shows the effect of the varying output impedance matched to the 50Ω transmission line. The measurements were made with the network analyzer with 50Ω matching. In essence, the PIN diodes lower the 50Ω impedance, so that the attenuation observed at the output is due to impedance mismatch.

It is desirable to see that the SNR, SINAD, and SFDR values do not change considerably with the addition of the variable PIN diodes. In the shunt resistor configuration of the PIN diodes, it is possible that some distortion may arise. However, a comparison of SNR and SINAD values in a system with and without PIN diodes showed no change in SNR and less than 1dB change in SINAD, indicating that the distortion from PIN diodes is almost negligible.

In Ultrasound, it is possible that the gain must be adjusted depending on the input level to achieve full scale. Full scale output is desirable. To mimic the application, the PIN diodes were biased at 0.5V intervals across the gain range, and the input level was adjusted accordingly to achieve full scale at the ADC. The SFDR and SINAD values stayed consistent at 73dBFS. The SNR dropped 4dB when the PIN diode became forward biased.

5.2 Noise Figure (NF)

To validate this application of frequency translation, it is important to verify that the noise figure is acceptable. Because a mixer (which usually has a relatively poor noise figure) is in the system chain, the noise figure is not expected to be as good as a single chip VGA. Two methods of noise figure calculations were done, first with Friss' equation and second with the SNR and Gain calculation.

We are looking at noise figure, seen at the input of the system. A cascade system has an overall noise figure determined by the equation :

$$NF = F1 + \sum_{i \neq 1} \frac{F_i - 1}{\prod_{j<i} G_j}, \; where \tag{5.1}$$

F1 = First stage noise figure,

$F_i = i^{th}$ stage noise figure, and $G_j = j^{th}$ stage noise figure.

V_{bias}V	Attenuation (dB)	Return Loss S11 (dB)
5.0	-1	-18.2
4.5	-1	-13.4
4.0	-1	-2.77
3.5	-1.2	-1.83
3.0	-11	-1.41
2.5	-18	-1.30
2.0	-21.3	-1.17
1.5	-23.2	negl.
1.0	-24.47	negl.

Table 5.2: PIN Diode Attenuation and Return Loss.

As seen in Equation 5.1 the first component in the system contributes the most to the noise figure when we assume the system provides overall gain not attenuation. Here, the first component, the mixer, with the worst noise figure is expected to degrade the noise figure the most.

The table shows the noise figures and gains of each component in the system, as specified by their datasheets.

Stage	Gain (dB)	Noise (dB)
Mixer LT5521	-0.5	12.5
Bandpass Filter	-1.3	1.3
Amplifier AH31	+18.5	2.4
Amplifier AH31	+19.1	2.4
SAW filter, 5MHz	-7.5	Negligible
SAW filter, 20MHz	-14.5	Negligible

Table 5.3: Individual Stage Gain and Noise Figures.

Single sideband setup gives NF=13.02 dBFS. Double sideband setup gives NF=13.34dBFS. The difference arises from using different SAW filters for SSB And DSB.

From PScope, the noise figure can be extracted from the gain and SNR values. The relationship is shown in Figure 5-3.

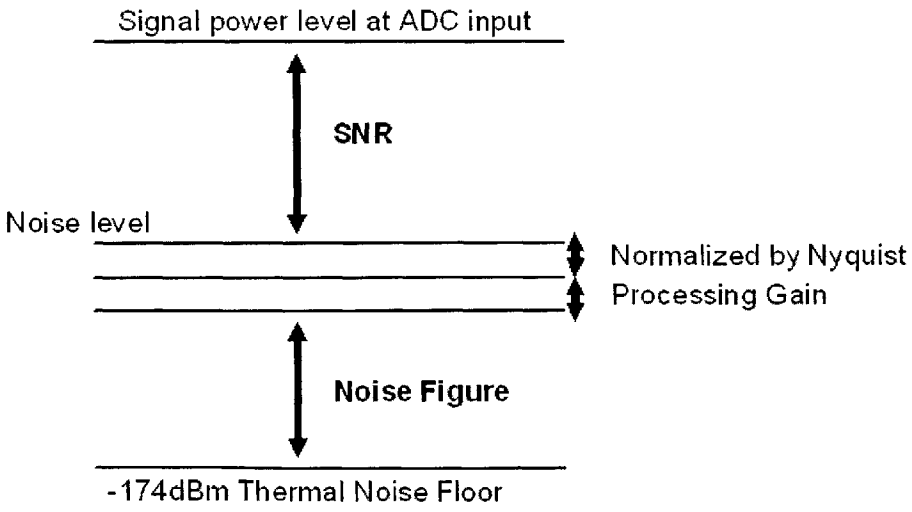


Figure 5-3: Noise Figure.

The equation is as such for a system with filter bandwidth $B < \frac{f_s}{2}$ (Nyquist):

$$NF_{out}(dB) = S_{out} - SNR - NTH - 10\log\frac{f_s}{2} - 10\log\frac{\frac{f_s}{2}}{BW} \tag{5.2}$$

$$NF_{in}(dB) = NF_{out} - Gain. \tag{5.3}$$

S_{out} = signal power level.

NTH = Thermal noise floor.

Processing Gain is $10\log\frac{\frac{f_s}{2}}{BW}$.

Nyquist Normalization is $10\log\frac{f_s}{2}$.

Essentially, the noise floor of the system is calculated, given the SNR and the output signal level. The normalization to Nyquist limits the spectrum to the Nyquist zone, or $\frac{f_s}{2}$. The processing gain scales the noise figure to the bandwidth of interest by further limiting the system to the input bandwidth, when it is less than Nyquist. In a system where the signal is bandlimited to be within Nyquist but has no additional filtering, the processing gain term is not needed. Then the difference between the noise level and the ideal -174dBm noise floor derived from ktB is the calculated noise figure of the system.

For single sideband 4MHz input upconverted to and sampled at 74MHz, the SNR was calculated to be 70dBFS, with a gain of 15. The ADC input was measured at 9.4dBm (ideally 10dBm, but slight loss to input transformer network). The noise figure at the output was 29dB, at the input (NF_{out} - Gain) was 14dB. This is comparable to the 13dB found by the cascaded gain system. The system used the 5MHz bandwidth SAW to allow for single sideband filtering, and thus the processing gain was $10\log\frac{\frac{74M}{2}}{5M}$.

5.2.1 Sources of Noise

From the equation, it is easy to see that the first component, the mixer, should be the dominant factor in the noise figure calculations. To verify whether or not this is true in the system, the mixer was replaced by a signal-generator IF frequency signal (at

the upconverted frequency). To minimize noise from the generator, a step attenuator was used, followed by a narrowband filter to block harmonics. The SNR increased by 5dB, therefore the noise figure improved by 5dB. In the Friss equation with the mixer taken out of the signal chain, the noise figure drops to 6.4dB in a single sideband system (including a -6dB loss from the step attenuator). It is important to note that the mixer plays a significant role in degrading the noise figure of the overall system. Although the amplifiers contribute noise to the system, they are very far down the signal chain. Looking at the equation, the noise figure of each component is divided by the preceding gain. Hence the overall input-referred noise figure is dominated by the mixer.

5.3 Intermodulation Test (IMD)

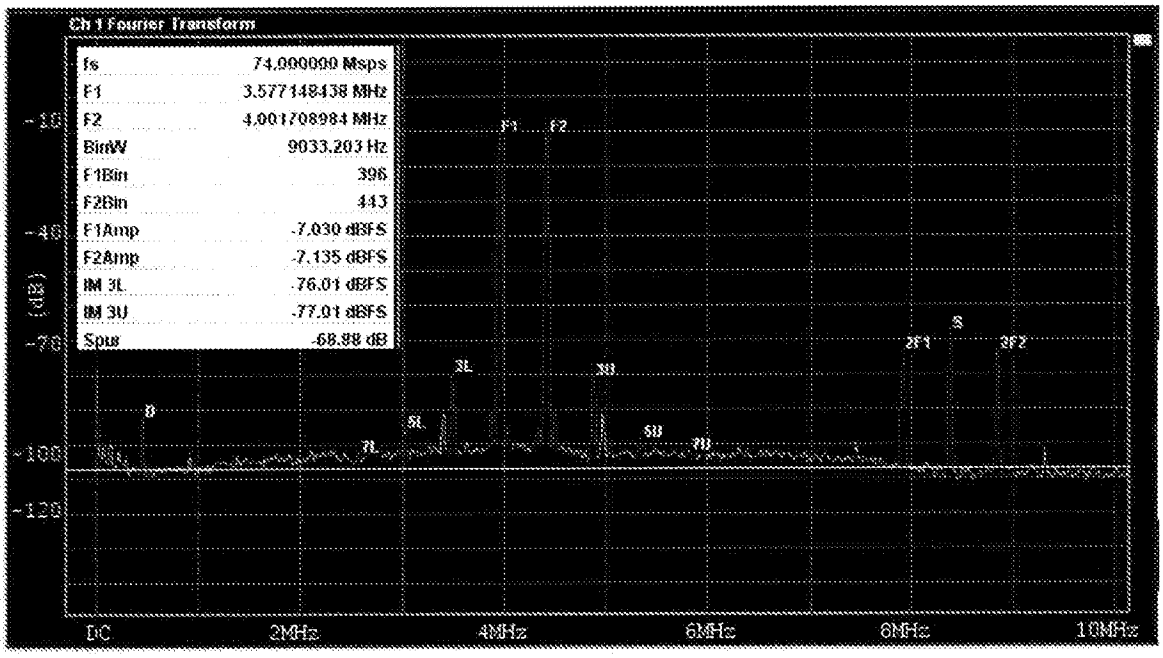


Figure 5-4: Intermodulation Test
Input signals $f_{in1} = 3.58MHz$ *and* $f_{in2} = 4MHz$, Sampling frequency 74MHz.

One of the more realistic methods of characterizing the system is to perform an intermodulation distortion test (IMD). By combining two close-in-frequency signals at the input of the system, this test shows how good the system is at rejecting interfering

signals. This measurement is extremely important in the case of ultrasound, because interfering signals arise close in frequency to the signal and require a high dynamic performing system to process the signal accurately. With a 3.58MHz and 4MHz signal in the ultrasound range, mixed up by a 74MHz clock and sampled with the same clock, 77dB was achieved for attenuation of the third order intermod signal, results in Figure 5-4. The third order IMD is a convenient measurement because it requires just two test signals, and can be set up so that the third order products are within the passband.

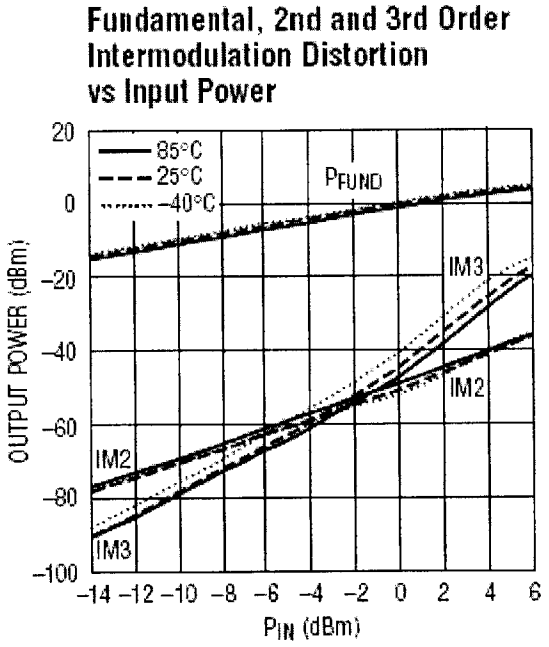


Figure 5-5: LT5521 Mixer Linearity. From Datasheet.

For linearity of the system, it is important to look at how the output fundamental and third order products change in response to input power levels. The LT5521 mixer has high linearity, given by Figure 5-5. The third order IMD gives the hypothetical OIP3 (output third order intercept point) of the system. This value gives the output power at which the third intermod signal equals the fundamental signal level. For every dB change in the fundamental, the third IMD changes by 3dB. It is hypothetical because the system would be saturated before the OIP3 point can be reached. Sweeping the input power of the system (both input signal levels were

stepped synchronously), the output F1 and IM3 amplitudes were plotted in Figure 5-6. Here, the linear portions of the plots were fitted to a line and the intersection of the two extrapolated lines gives the OIP3 point. In this test, OIP3 was found to be 44.2dBFS.

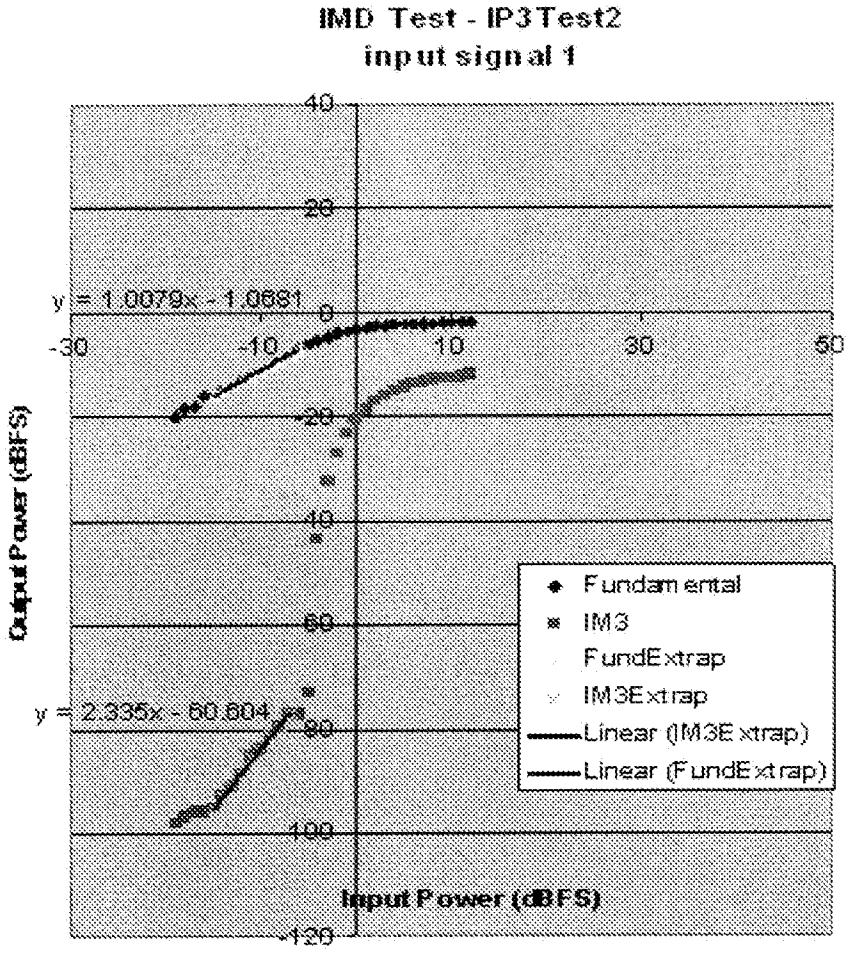


Figure 5-6: IP3 Extrapolation from Intermodulation Test.

Where is the IMD coming from?

The IMD test is performed routinely on mixers, so the LT5521 datasheet specs for +24dBFS IP3 point. This is of course, under a specific set of test parameters, but this value was used as the basic benchmark value. With a gain of 20dB post-mixer, the IP3 level is 44dBFS, which matches the extrapolated OIP3 value.

If the IP3 point and the intermodulation distortion is truly limited by the mixer, then a measurement of the IP3 of the system without the mixer would indicate such.

As in the single tone distortion test, the mixer was taken out of the equation. Two helically-filtered signals (from the signal generator) at 71MHz and 72MHz were inputs to the pre-ADC IF signal chain. The IMD test was carried out with these input signals. The results of this test showed slight improvement in IM3 values (77-80dBFS) and an IP3 improvement to 48dB. This seems to indciate that the mixer degrades the IP3 by 3dB.

However, it is highly possible that the IP3 improvement was masked by the IP3 value of the AH31 amplifier at the end of the signal chain (before the ADC). The typical datasheet OIP3 value for the AH31 is +42dBm, measured with two tones at 10dBm output power separated by 1MHz [9]. The measurements taken are already slightly higher than the typical value for the AH31. Because of the +20dB gain following the mixer, it is possible that the IP3 value of 48dB without the mixer does not really show how much the mixer actually degrades the IP3 value. In this application, it seems that the amplifier is partially responsible for limiting the IP3 value of the system. Fortunately, the system has good intermodulation distortion and attenuation of intermod products. The mixer and the amplifier both contribute to IP3 and intermod products, but the overall application is sufficient for ultrasound requirements.

Chapter 6

Conclusion

6.1 Summary

After a careful analysis of the frequency translation system designed for continuously variable gain and filtering, the performance was found to be desirable and definitely a possibility for the future of high-end ultrasound applications. With a continuous gain range up to 25dB and a 25MHz range of filtering capabilities, the upconversion scheme is palatable for ultrasound. This application is fairly straightforward to put together, and results of over 70dBFS SNR, more than 75dBFS IM3, and 44dB IP3 were achieved.

6.2 Future Work

The integration of the upconversion scheme into a working ultrasound application is challenging as is. However extensions of this thesis work can incorporate more design considerations into the application system. The following highlights possible future work.

There is no limitation in terms of sample rate and clock speed. It is possible to upconvert to a frequency higher than 70MHz, and continue sampling with the same clock source. The upper limit lies in the ADCs, with Linear's parts sampling at or more than 250MSPS.

One of the performance-limiting parts was the LT5521 mixer. Although a great part at high frequencies, it has drawbacks at 70MHz. Naturally, upconversion to higher frequencies can improve the mixer noise and distortion performance. If 70MHz is the desired translation frequency, it is possible to redesign the Gilbert-cell based mixer to improve its dynamic performance.

PIN diodes provide more than 25dB attenuation range across a bias voltage of 5V. However, the gain drops in a third-order polynomial form. It is possible to program the system to provide linear-in-dB gain control using PIN diodes to improve the user interface with the system.

There is also the option of making a module for this product. The idea of making a module out of this entire application system was discussed extensively throughout my thesis work. There are advantages and disadvantages to doing it. In the setup I have configured for my thesis work, there is sensitivity to noise and oscillation. Laying it out on a board or module will eliminate much of the ancilliary issues. However, it is important to consider the time and cost of such a project. The intended market, primarily the high-end ultrasound consumers, may not include the rapidly expanding medical ultrasound industry. In this case, it may not be economically viable to invest resources for fabricating the module. Additional market research should be done to better understand the demand for such integrated boards and/or modules for the upconversion scheme.

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Exhibit 1005

U.S. Patent No. 8,224,274 to Ramon Gomez et al.

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US008224274B2

(12) **United States Patent**
Gomez et al.

(10) **Patent No.: US 8,224,274 B2**
(45) **Date of Patent: Jul. 17, 2012**

(54) **SCALABLE ARCHITECTURE FOR SATELLITE CHANNEL SWITCH**

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(73) Assignee: **Broadcom Corporation**, Irvine, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 627 days.

(21) Appl. No.: **12/337,046**

(22) Filed: **Dec. 17, 2008**

(65) **Prior Publication Data**

US 2009/0168924 A1 Jul. 2, 2009

Related U.S. Application Data

(60) Provisional application No. 61/006,186, filed on Dec. 28, 2007.

(51) **Int. Cl.**
H03M 1/12 (2006.01)

(52) **U.S. Cl.** **455/179.1**; 341/155

(58) **Field of Classification Search** 455/179.1, 455/130, 188.1, 139; 341/144, 155
See application file for complete search history.

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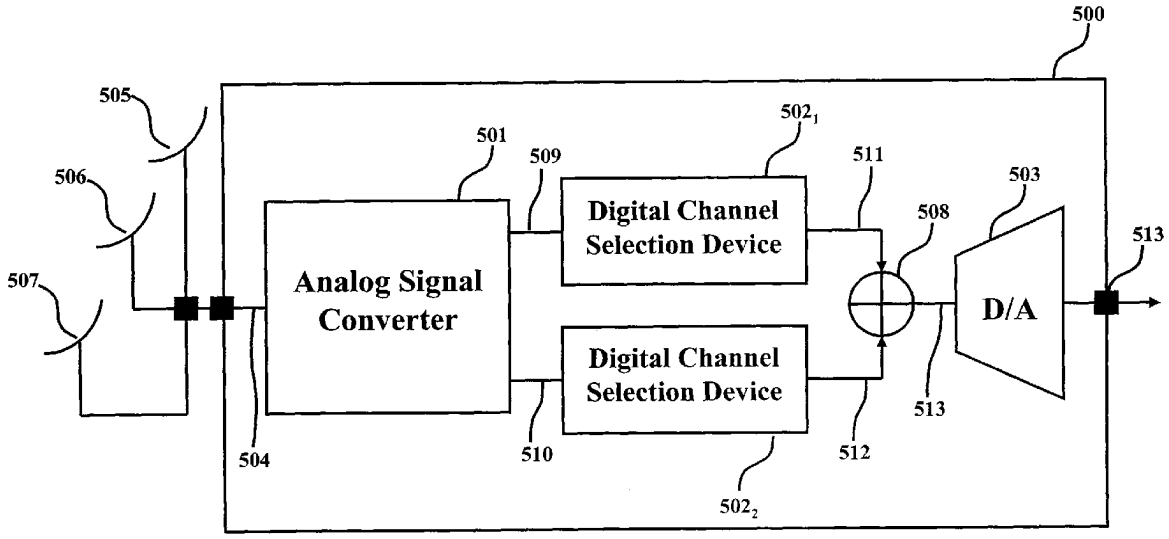
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Primary Examiner — Peguy Jean Pierre
(74) *Attorney, Agent, or Firm* — Sterne, Kessler, Goldstein & Fox P.L.L.C.

(57) **ABSTRACT**

A frequency translation module for a broadband multi-channel communication system may include an analog signal converter, a digital channel selection device, and a digital-to-analog (D/A) converter. The analog signal converter is configured to receive a plurality of analog signals, to select analog signals residing in a predefined frequency band, and to convert each of the selected analog signals into a digital signal. The digital channel selection device is configured to process digital signals corresponding to the selected analog signals and to generate a composite output of digital signals representative of the selected analog signals. The D/A converter is configured to translate the composite output to an analog signal output decodable by a receiver. Further, the frequency translation module may include a mixer configured to upconvert the analog signal output to a frequency decodable by the receiver.

22 Claims, 17 Drawing Sheets



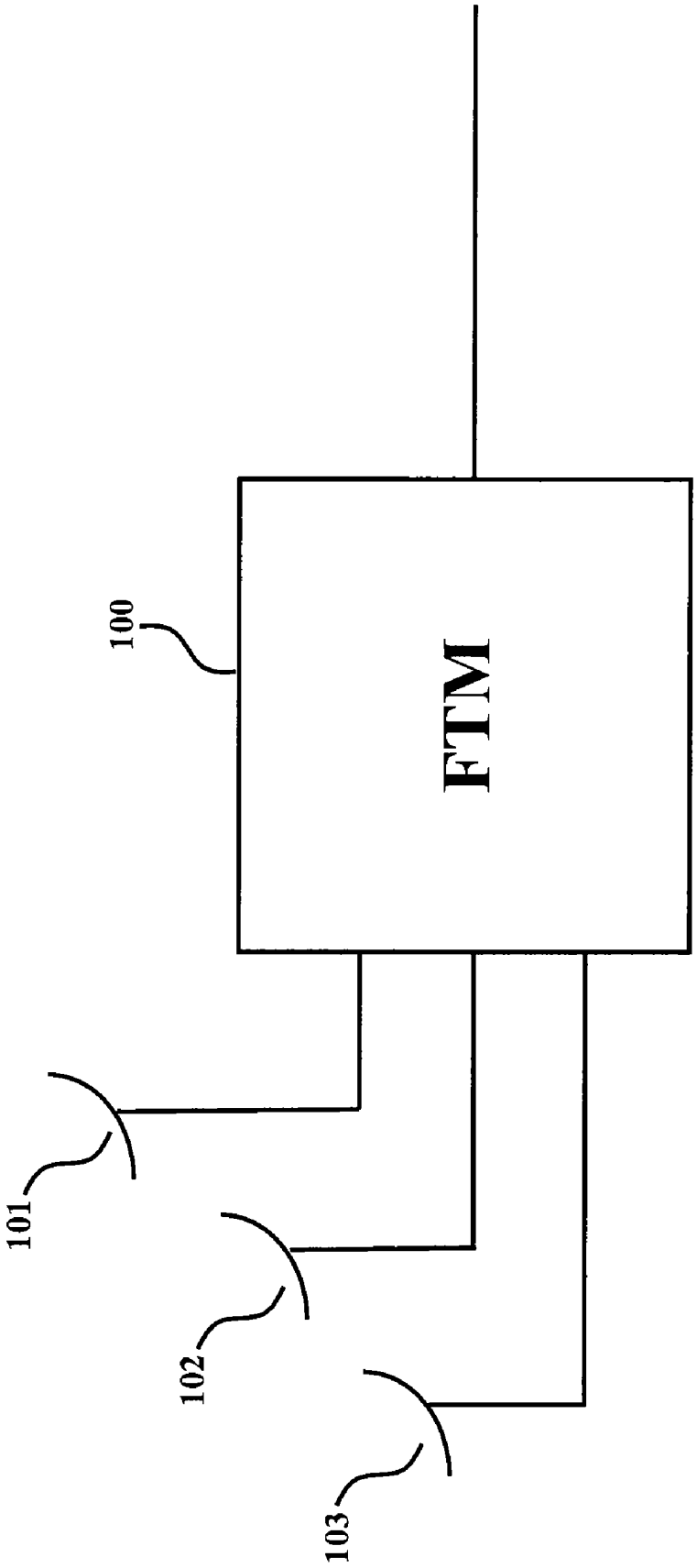


Figure 1

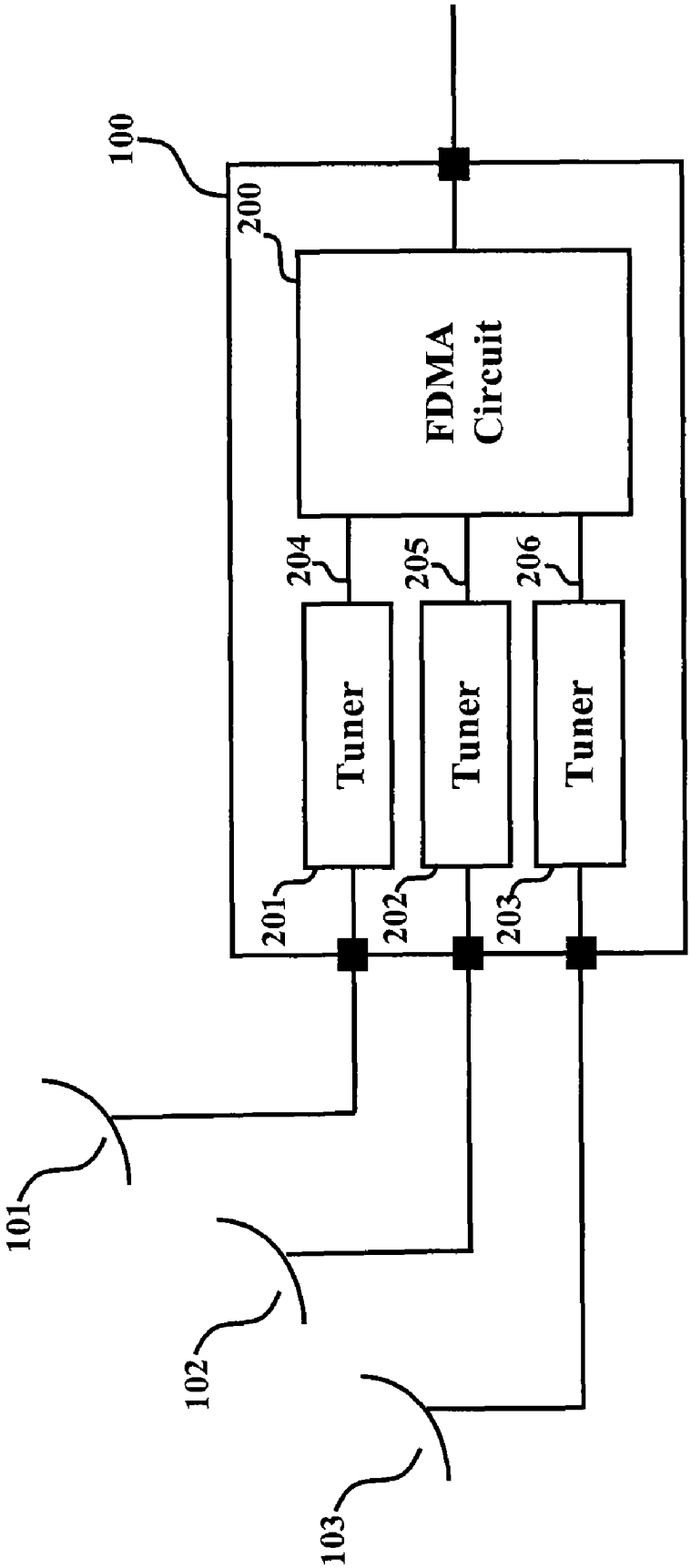

100
200
FDMA Circuit
204
205
206
Tuner
Tuner
Tuner
201
202
203
101
102
103

Figure 2

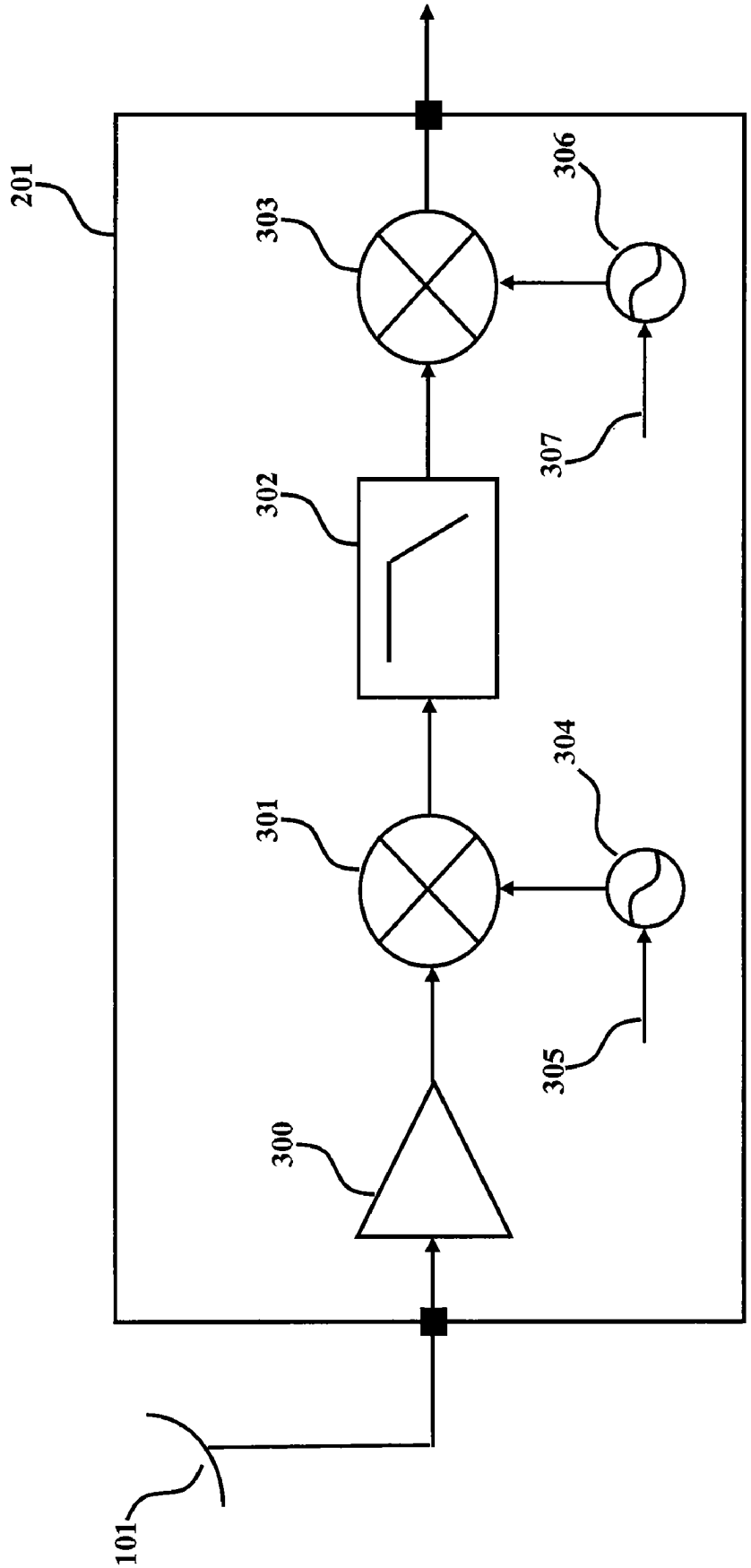


Figure 3

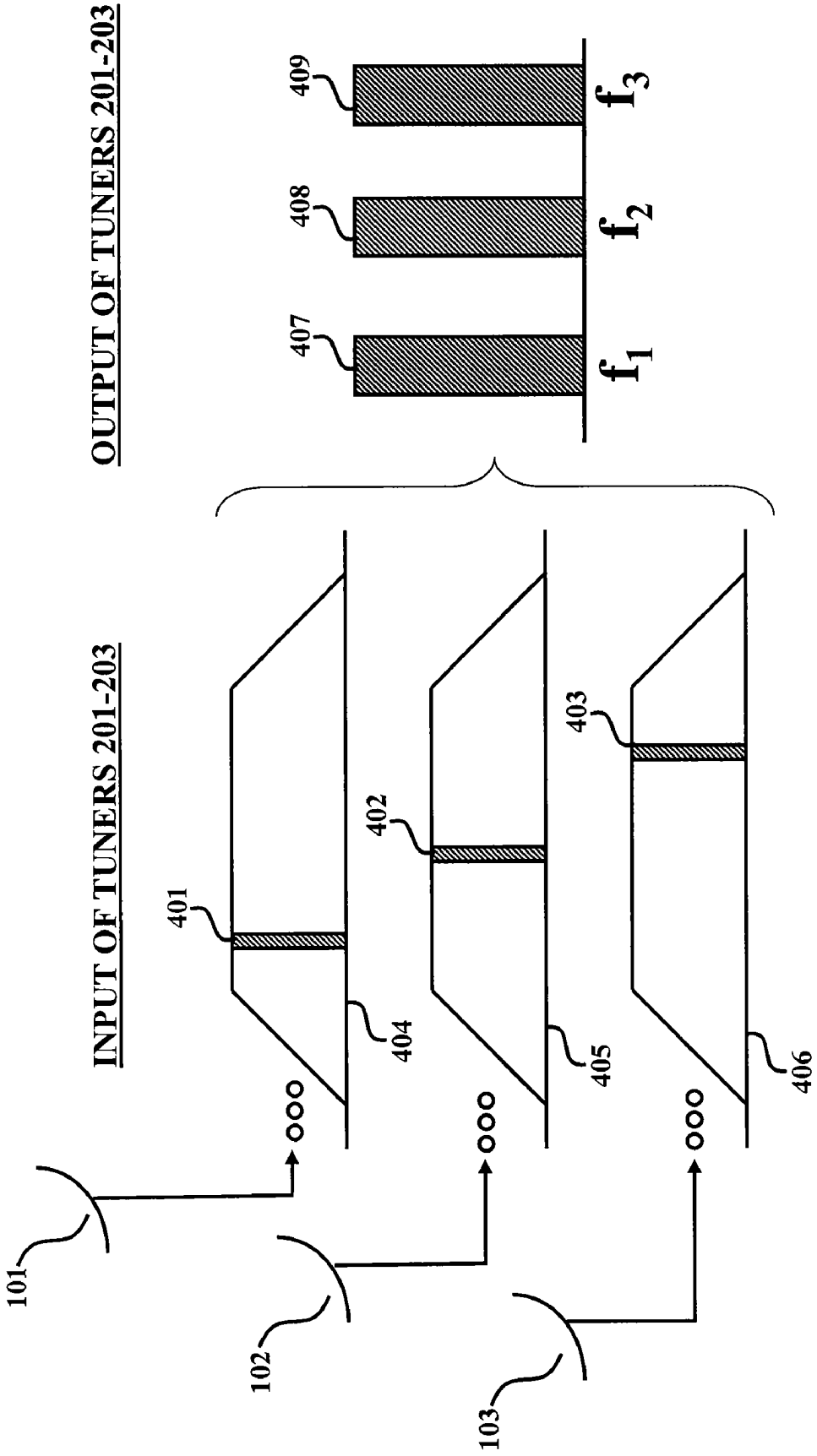

OUTPUT OF TUNERS 201-203
409
408
407
f_3
f_2
f_1
INPUT OF TUNERS 201-203
401
402
403
404
405
406
101
102
103

Figure 4

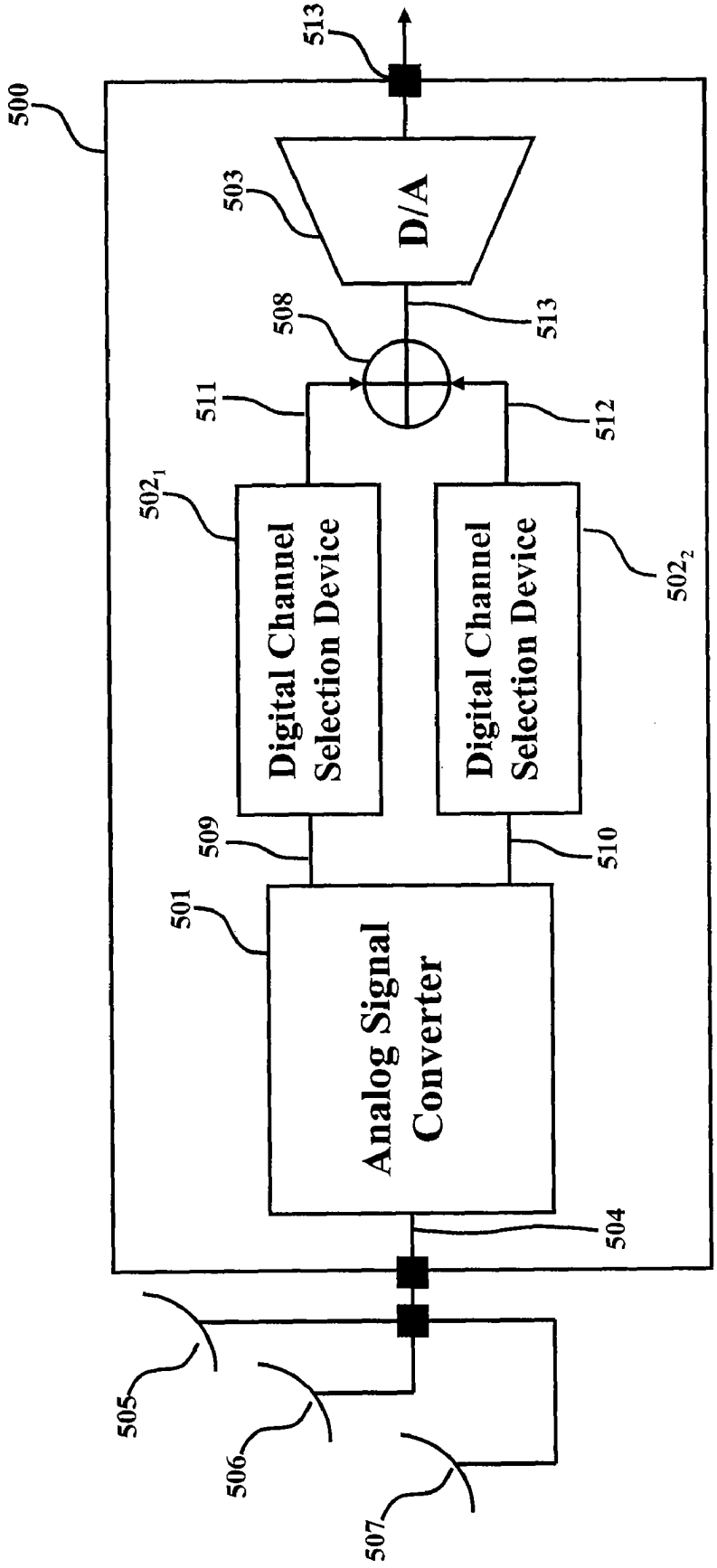

500
513
503
D/A
508
513
511
512
502_1
Digital Channel Selection Device
Digital Channel Selection Device
502_2
509
510
501
Analog Signal Converter
504
505
506
507

Figure 5

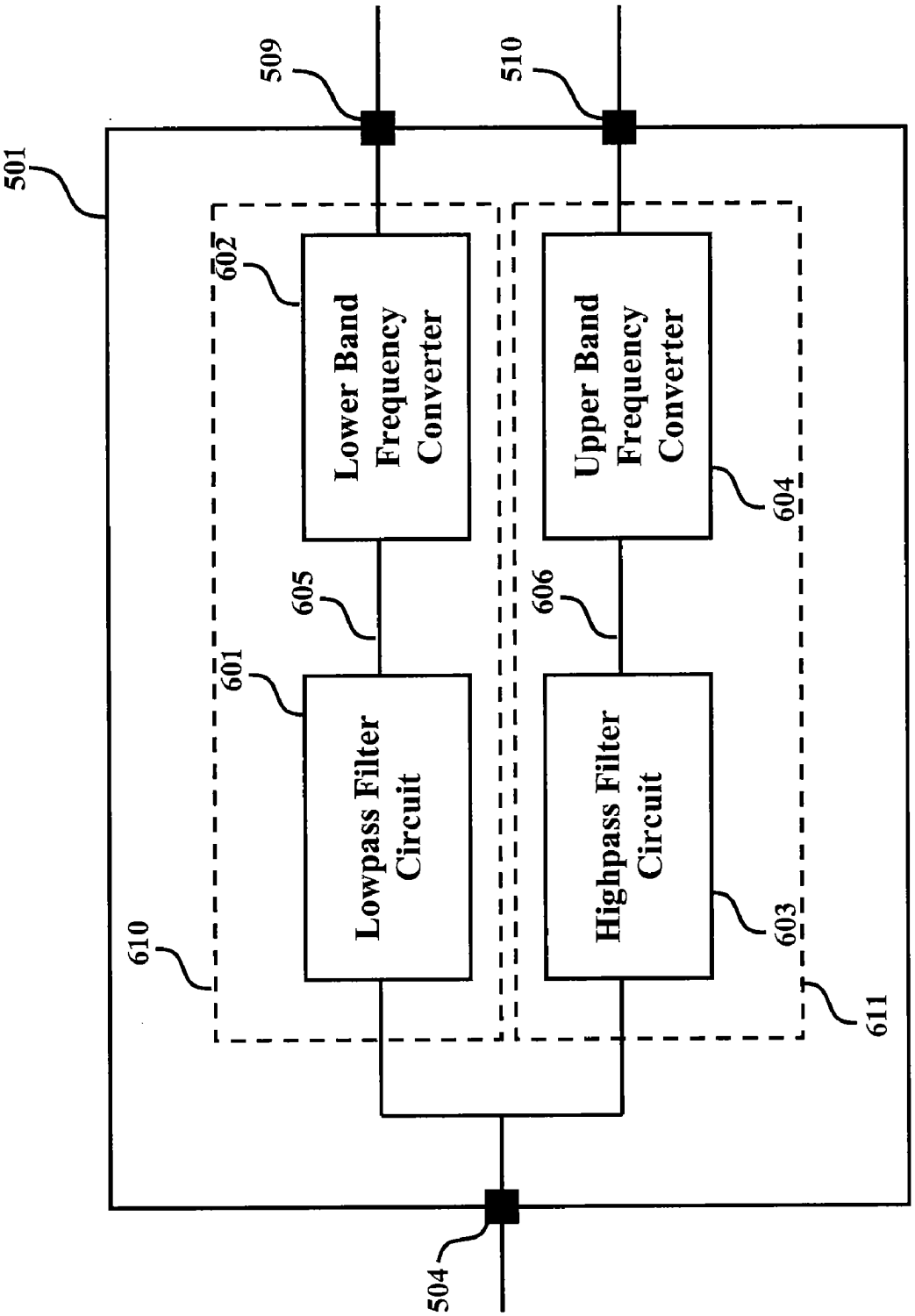

509
510
501
602
Lower Band Frequency Converter
Upper Band Frequency Converter
604
605
606
601
Lowpass Filter Circuit
Highpass Filter Circuit
603
610
611
504

Figure 6

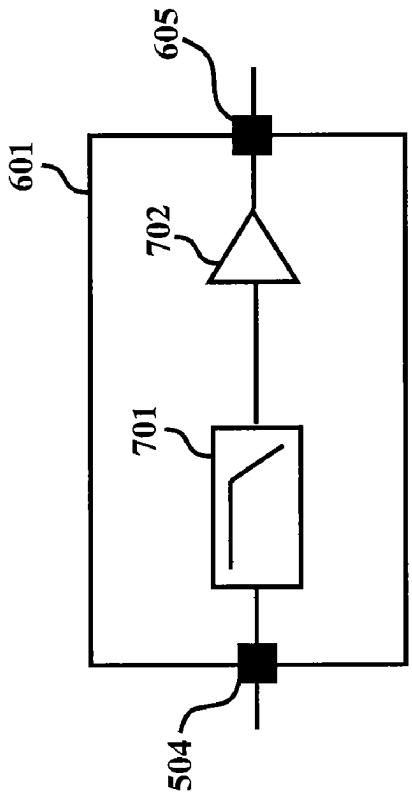


Figure 7

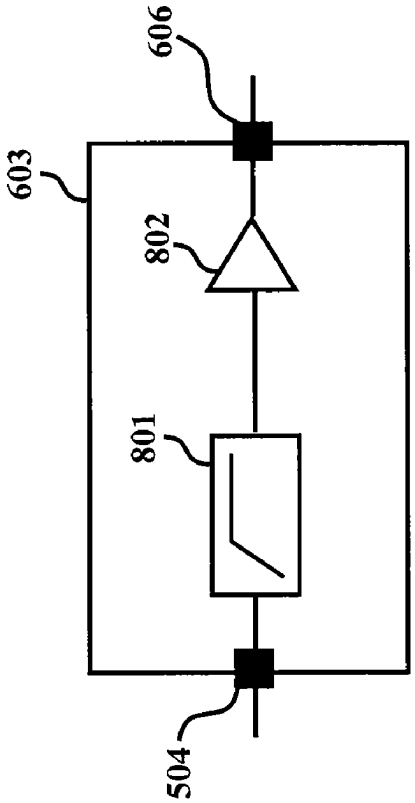


Figure 8

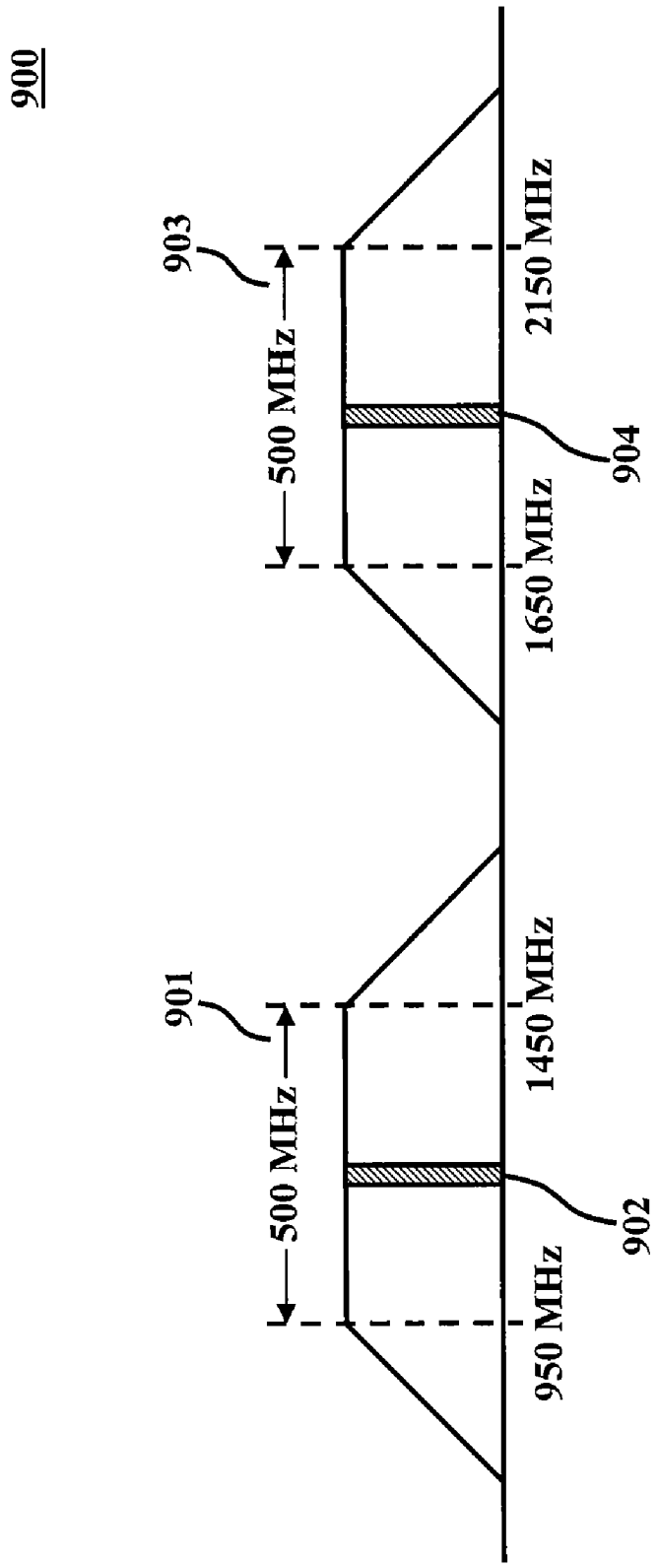

900
903
500 MHz
2150 MHz
904
1650 MHz
UPPER SIDEBAND
901
500 MHz
1450 MHz
902
950 MHz
LOWER SIDEBAND

Figure 9

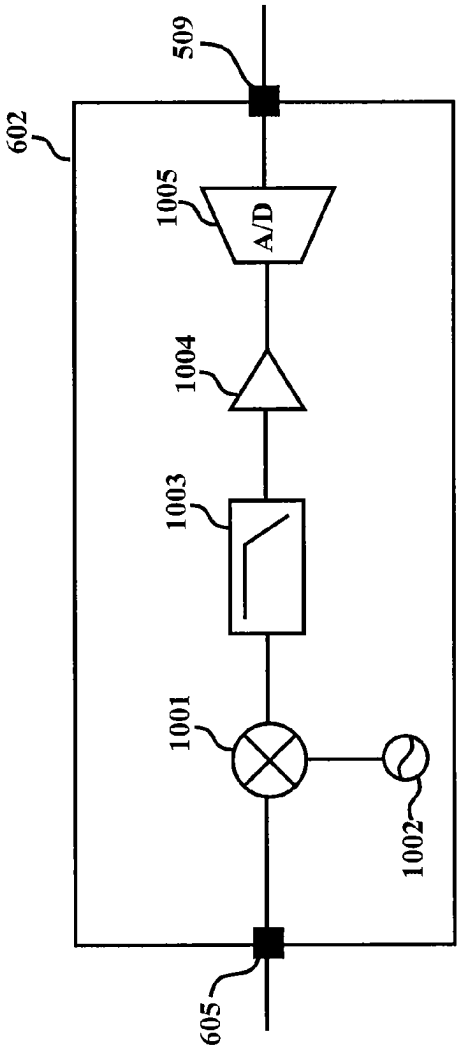


Figure 10

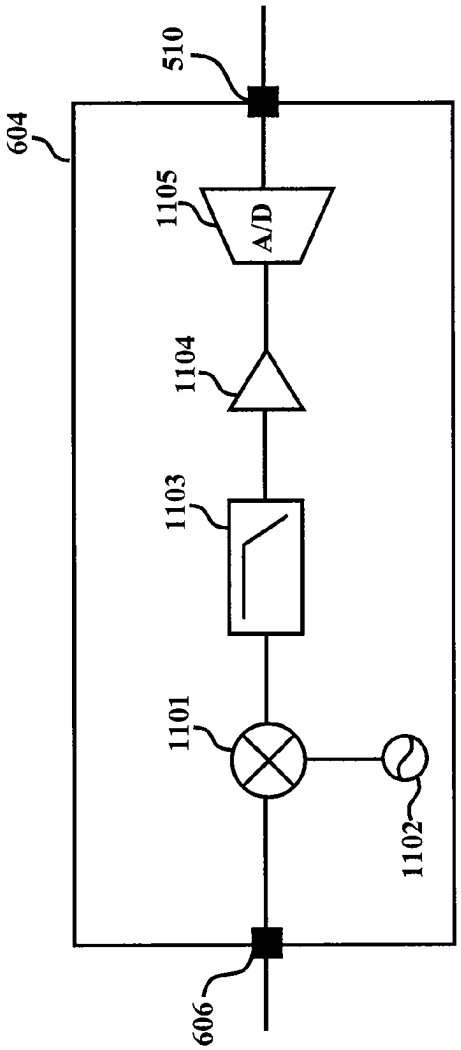


Figure 11

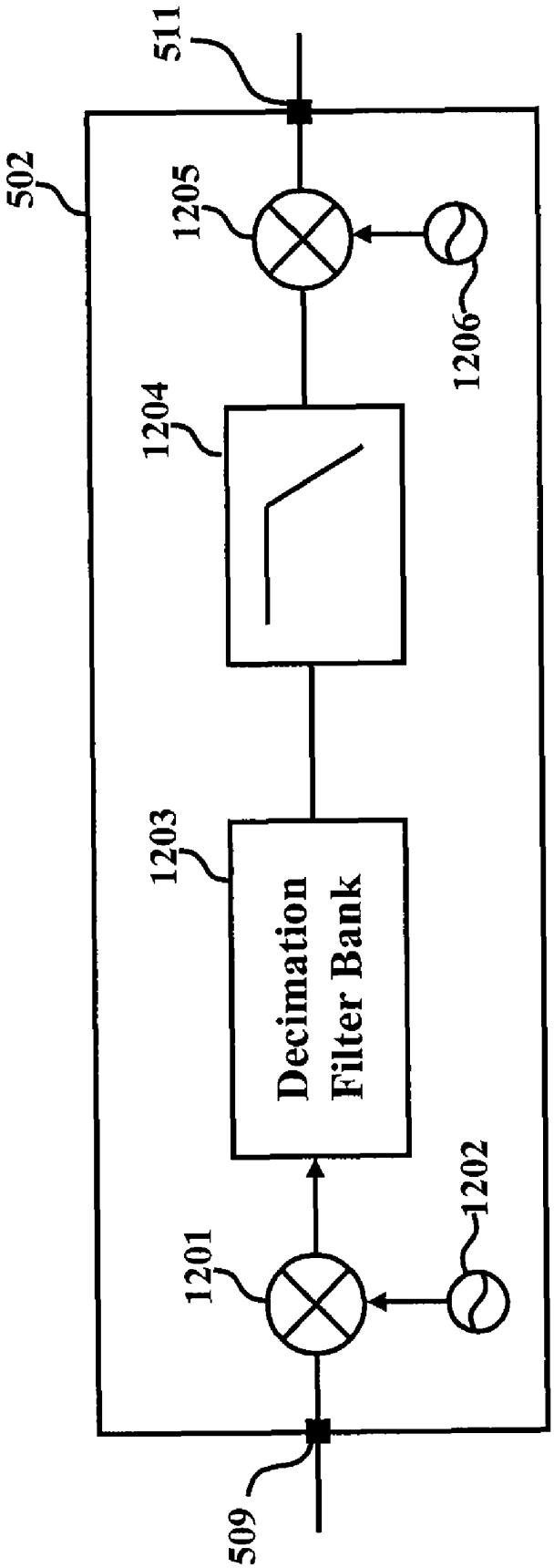

511
502
1205
1206
1204
1203
Decimation
Filter Bank
1202
1201
509

Figure 12

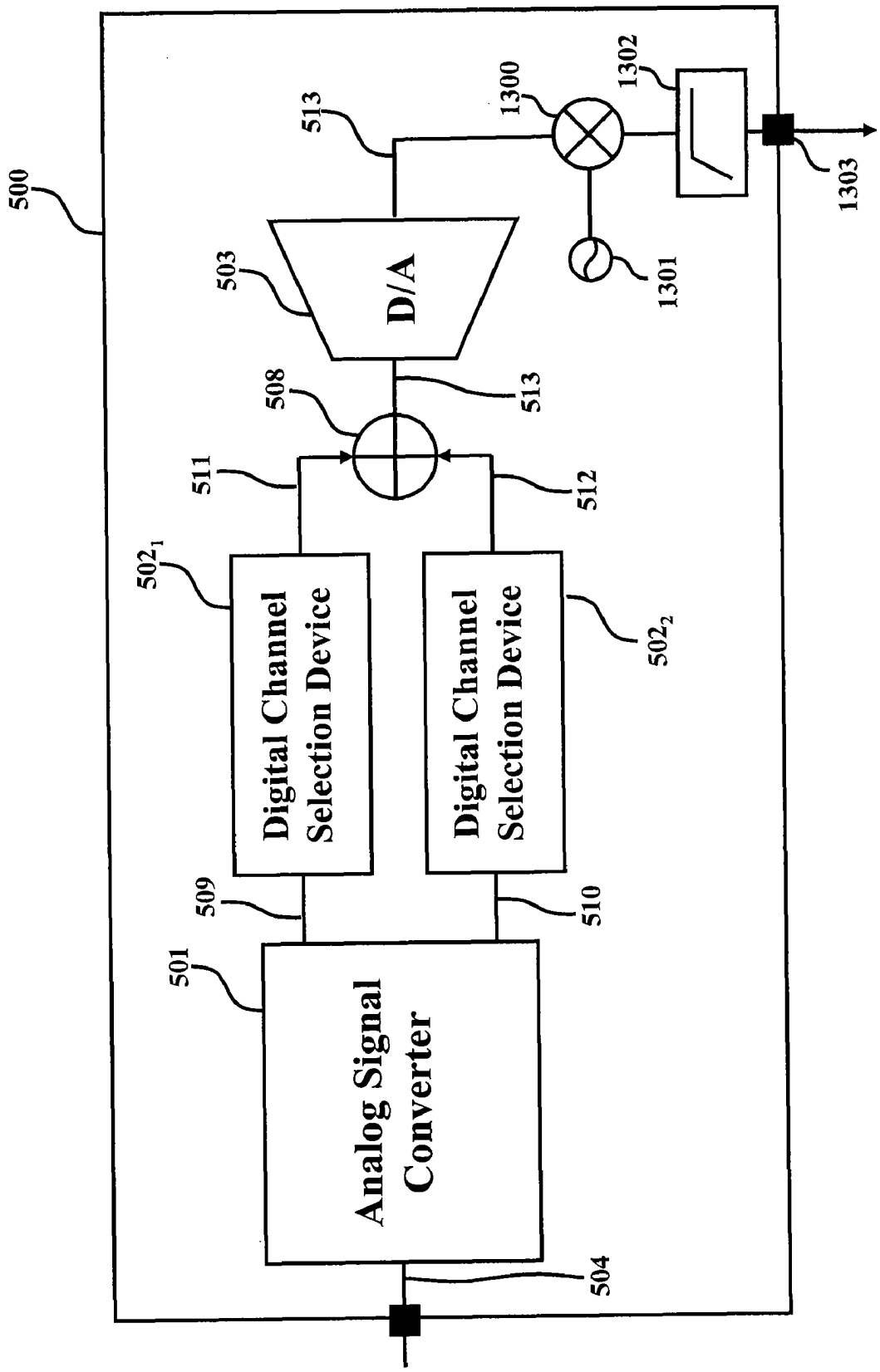

500
513
1300
1302
1303
1301
503
D/A
508
513
511
512
502_1
Digital Channel Selection Device
502_2
Digital Channel Selection Device
509
510
501
Analog Signal Converter
504

Figure 13

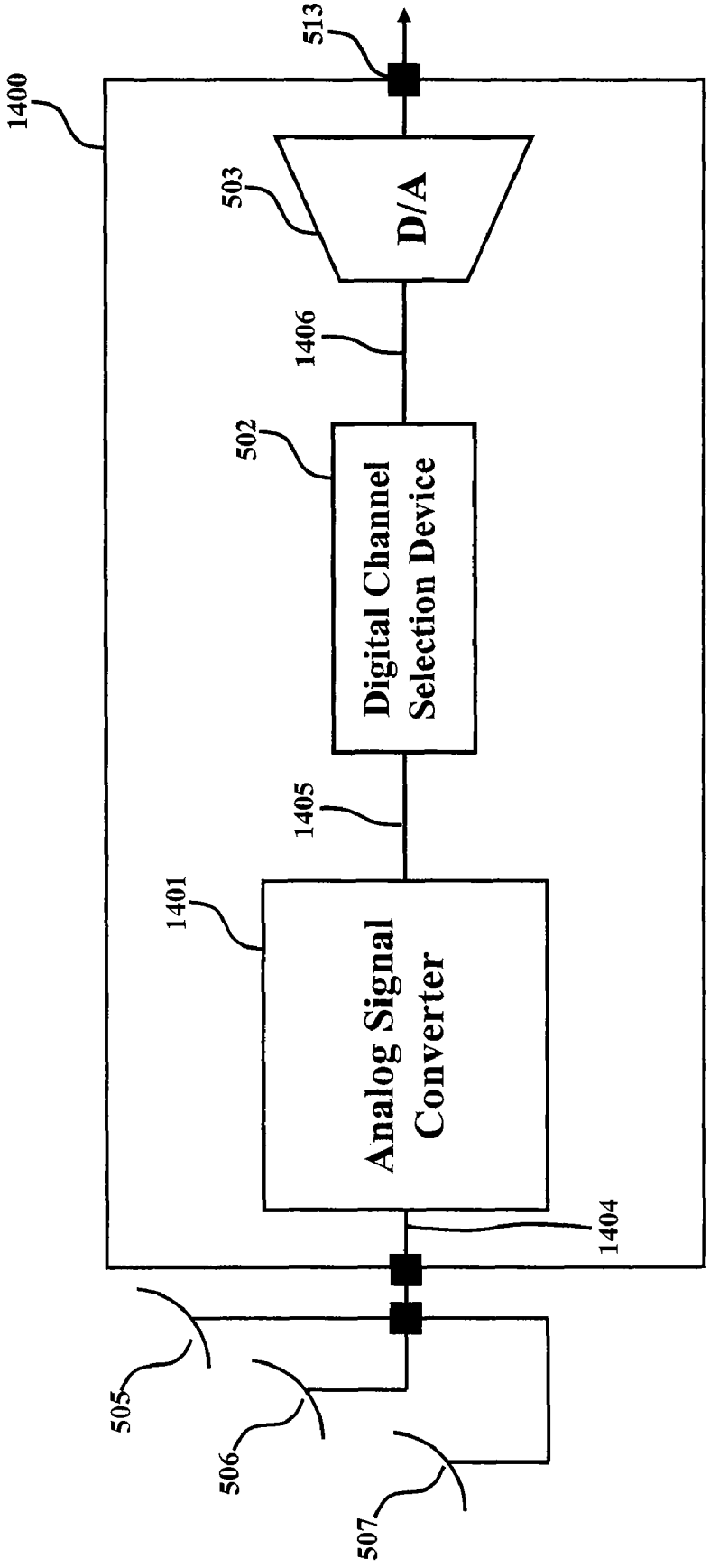

1400
513
503
D/A
1406
502
Digital Channel Selection Device
1405
1401
Analog Signal Converter
1404
505
506
507

Figure 14

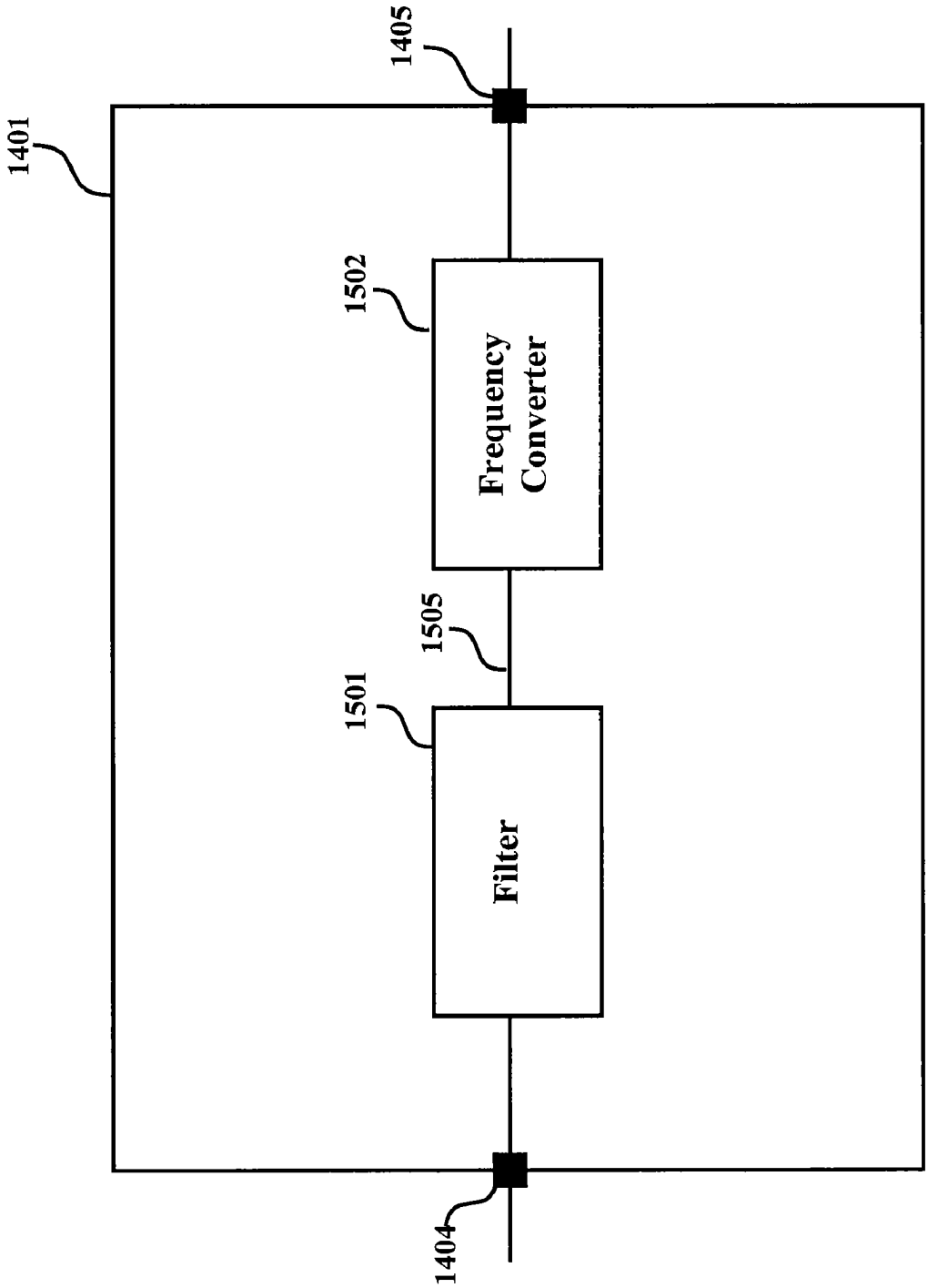


Figure 15

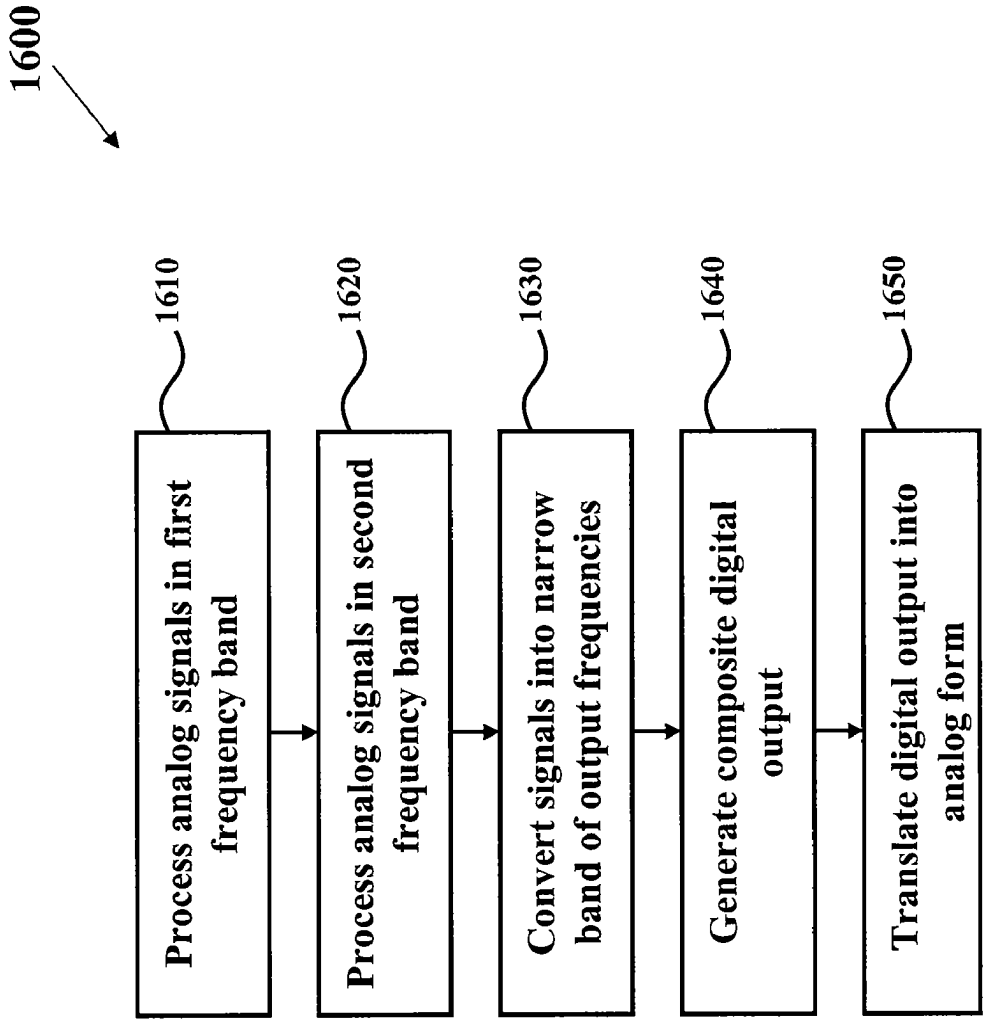

1600
1610
Process analog signals in first frequency band
1620
Process analog signals in second frequency band
1630
Convert signals into narrow band of output frequencies
1640
Generate composite digital output
1650
Translate digital output into analog form

Figure 16

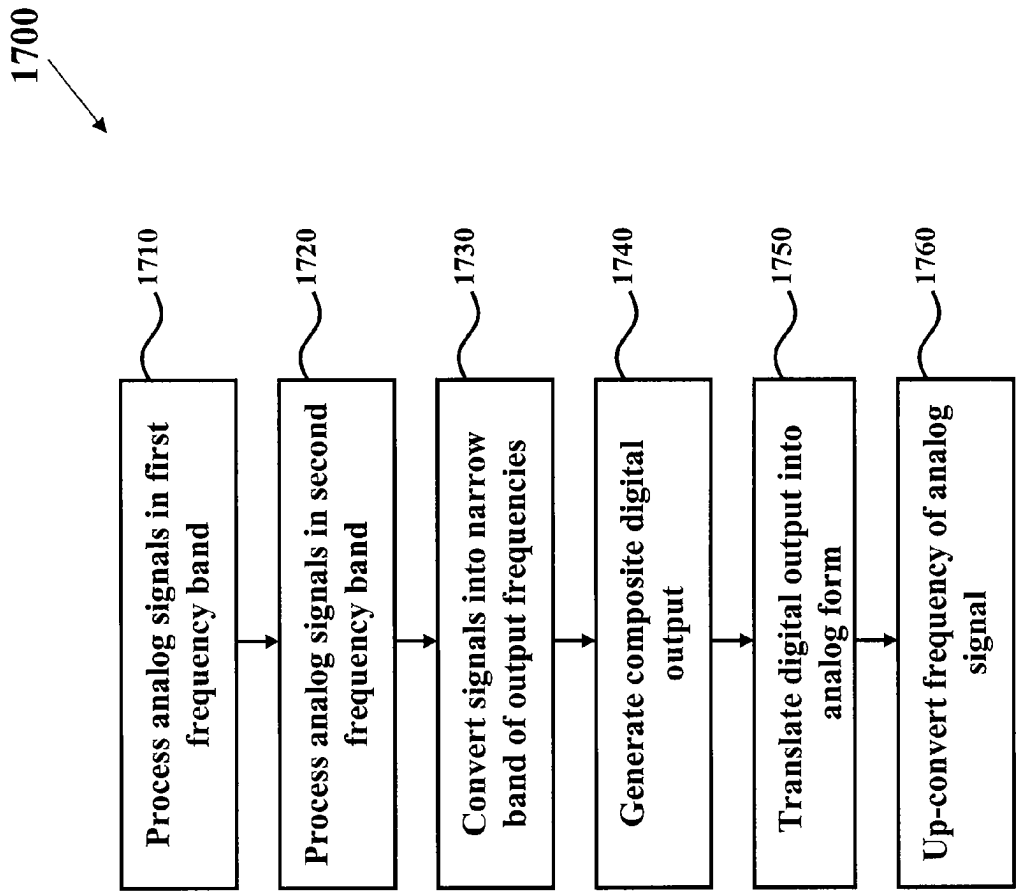

1700
1710
Process analog signals in first frequency band
1720
Process analog signals in second frequency band
1730
Convert signals into narrow band of output frequencies
1740
Generate composite digital output
1750
Translate digital output into analog form
1760
Up-convert frequency of analog signal

Figure 17

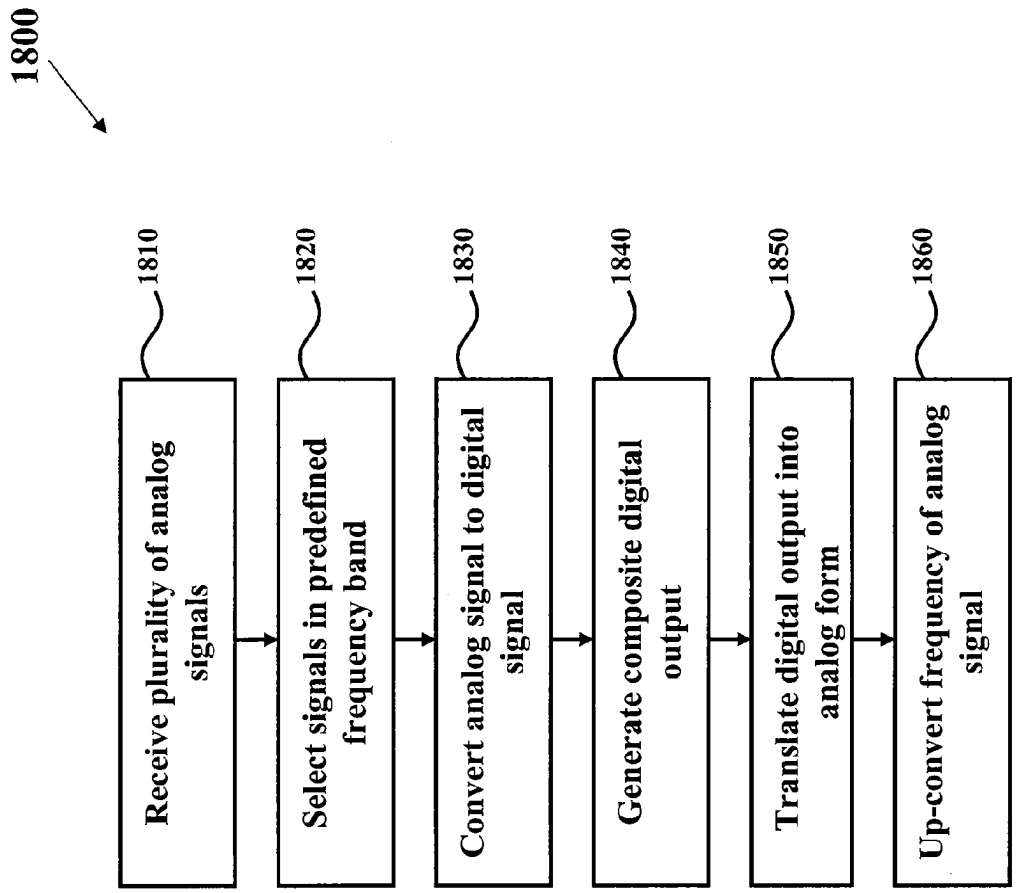

1800
1810
Receive plurality of analog signals
1820
Select signals in predefined frequency band
1830
Convert analog signal to digital signal
1840
Generate composite digital output
1850
Translate digital output into analog form
1860
Up-convert frequency of analog signal

Figure 18

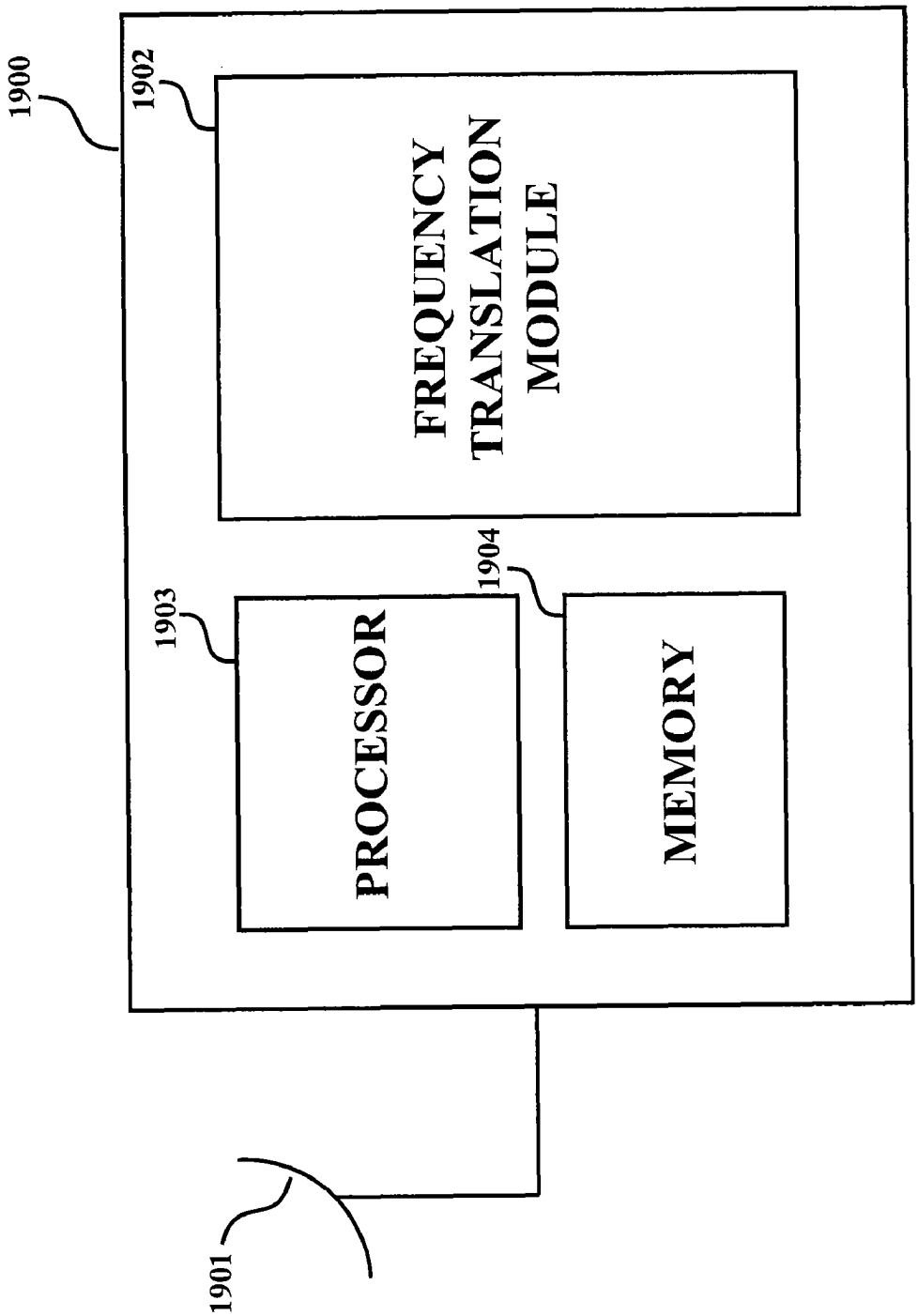

1900
1902
FREQUENCY TRANSLATION MODULE
1903
PROCESSOR
1904
MEMORY
1901

Figure 19

SCALABLE ARCHITECTURE FOR SATELLITE CHANNEL SWITCH

CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Application No. 61/006,186 (BP 6605; SKGF Ref. No. 2875.1940000), filed Dec. 28, 2007, titled "Scalable Architecture for Satellite Channel Switch," which is incorporated herein by reference in its entirety.

BACKGROUND

1. Field

The present invention generally relates to the field of channel switches in a multi-channel communication system. More specifically, the present invention relates to processing one or more input channels to a frequency translation module through a scalable switch architecture.

2. Background

A growing portion of television programming is broadcast directly to home receivers via satellite. Satellite television provides a wide array of programming and is broadcasted from various orbital positions in space. Satellite antennas receive signals from these specific orbital locations. Integrated receiver decoders (IRD) decode the signals received by the antenna signals and pass them to a television for viewing. Oftentimes, households subscribe to additional satellite programs, such as high-definition and specialized programming, where multiple antennas may be required to receive broadcasts from satellites in different orbital locations. The broadcast signal from each satellite may contain a number of distinct bands based on, for example, frequency and polarization. Alternatively, a single antenna (e.g., satellite dish) may be used to receive broadcast signals from the different satellites.

A frequency translation module (FTM) enables a user to selectively switch the signals received from each satellite antenna and deliver these signals to an IRD located within a household. Conventional FTMs contain one or more tuners, where each tuner is coupled to one satellite antenna. The tuner selects and down-converts a desired channel from the satellite signal to an intermediate frequency (IF) signal or a baseband signal, which is suitable for processing and display on a television or computer monitor.

Conventional approaches to the design of tuners employ analog components, such as fixed-frequency filters, mixers, and local oscillators. Consequently, FTMs require extensive hardware, including at least one oscillator and one mixer for each tuner, making the module costly and too large for some applications. Furthermore, as the channel capacity of a FTM grows, the module consumes more power due to the increase in analog components.

What is needed is a method or apparatus for implementing a scalable switch architecture for a FTM that minimizes circuit area and power consumption.

SUMMARY

In order to reduce circuit area and power consumption as the capacity of FTMs grow, digital frequency converters and filters, which are compact in modern integrated circuit technology and consume less power than their analog counterparts, may be used to implement a scalable FTM architecture. In an embodiment of the present invention, a frequency translation module for a broadband multi-channel communication system may include the following: an analog signal converter configured to receive a plurality of analog signals, to select analog signals residing in a predefined frequency band, and to convert each of the selected analog signals into a digital signal; a digital channel selection device configured to process digital signals corresponding to the selected analog signals and to generate a composite output of digital signals representative of the selected analog signals; and, a digital-to-analog (D/A) converter configured to translate the composite output to an analog signal output decodable by a receiver. The frequency translation module may also include a mixer configured to upconvert the analog signal output to a frequency decodable by the receiver.

In another embodiment, a method of switching channels on a broadband multi-channel communication system with a scalable switch architecture may include the following steps: (1) receiving a plurality of analog signals; (2) selecting analog signals whose frequency resides in a predefined frequency band of the communication system; (3) converting each of the selected analog signals into a digital signal; (4) processing the digital signal, corresponding to each of the selected analog signals, into a composite output of digital signals; and, (5) translating the composite output to an analog signal output decodable by a receiver. The method may further include upconverting the analog signal output to a frequency decodable by the receiver.

In another embodiment, a system for switching channels on a broadband multi-channel communication system with a scalable switch architecture may include an antenna, a FTM, a processor, and a memory. The FTM may receive signals through the antenna. Further, the processor may control the operation of the FTM. The memory is in communication with the processor and may store processing instructions. These processing instructions may include directing the processor to perform the following functions: receive a plurality of analog signals; select analog signals whose frequency resides in a predefined frequency band of the communication system; convert each of the selected analog signals into a digital signal; process the digital signal, corresponding to each of the select analog signals, into a composite output of digital signals; and, translate the composite output to an analog signal output decodable by a receiver. The processing instruction may also include directing the processor to upconvert the analog signal output to a frequency decodable by the receiver.

Further embodiments, features, and advantages of the present invention, as well as the structure and operation of the various embodiments are described in detail below with reference to accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings in which:

FIG. **1** illustrates a conventional frequency translation module.

FIG. **2** illustrates a configuration of components in a conventional frequency translation module.

FIG. **3** illustrates a tuner circuit used in a conventional frequency translation module.

FIG. **4** illustrates a processing of signals through a tuner and frequency division multiple access circuit in a conventional frequency translation module.

FIG. **5** illustrates one embodiment of a frequency translation module for a broadband multi-channel communication system.

FIG. **6** illustrates one embodiment of an analog signal converter.

FIG. **7** illustrates one embodiment of a lowpass filter circuit.

FIG. **8** illustrates one embodiment of a highpass filter circuit.

FIG. **9** illustrates a two sideband communication system with a lower sideband and an upper sideband frequency spectrum.

FIG. **10** illustrates one embodiment of a lower band frequency converter.

FIG. **11** illustrates one embodiment of an upper band frequency converter.

FIG. **12** illustrates one embodiment of a digital channel selection device.

FIG. **13** illustrates another embodiment of a frequency translation module for a broadband multi-channel communication system.

FIG. **14** illustrates another embodiment of a frequency translation module for a broadband multi-channel communication system.

FIG. **15** illustrates another embodiment of an analog signal converter.

FIG. **16** illustrates one embodiment of a method of switching channels on a broadband multi-channel communication system with a scalable switch architecture.

FIG. **17** illustrates another embodiment of a method of switching channels on a broadband multi-channel communication system with a scalable switch architecture.

FIG. **18** illustrates yet another embodiment of a method of switching channels on a broadband multi-channel communication system with a scalable switch architecture.

FIG. **19** illustrates one embodiment of a system for switching channels on a broadband multi-channel communication system with a scalable switch architecture.

DETAILED DESCRIPTION

FIG. **1** illustrates frequency translation module (FTM) **100** with three signal inputs. In one embodiment, each signal input may be coupled to a satellite antenna **101-103**, each receiving a signal from a different orbital location and satellite broadcast. For example, antenna **101** may receive a signal from a satellite source in one orbital location that broadcasts one set of high-definition channels, antenna **102** may receive a signal from a satellite source in another orbital location that broadcasts another set of high-definition channels, and antenna **103** may receive a signal from a satellite source in another orbital location that broadcasts other specialized programming. Alternatively, FTM **100** may receive its inputs from a single antenna with multiple outputs, where each output corresponds to, for example, a different satellite transmission frequency, polarization, or location. Further, each signal input of FTM **100** may also be derived from a cable television (CATV) system or an off-air antenna. However, these mentioned communication broadcast sources are not meant to limit the invention.

FIG. **2** illustrates a configuration of components in FTM **100**. FTM **100** translates each signal input into a channel of interest through a tuner **201-203** and a frequency division multiple access (FDMA) circuit **200**. Each tuner **201-203** is coupled to an antenna **101-103**. Further, an output of each tuner **201-203** is coupled to FDMA circuit **200**. For satellite broadcasts, tuners **201-203** each down-convert a radio frequency (RF) input to a baseband signal. In one embodiment, the RF input signal may be an analog television signal having a plurality of television channels that occupy a particular frequency spectrum. FDMA circuit **200** translates each output from tuners **201-203** into a particular frequency band that can be decoded by an integrated receiver decoder (IRD).

As illustrated in FIG. **3**, tuner **201** includes an amplifier **300**, mixers **301** and **303**, a lowpass filter **302**, and phase lock loops (PLLs) **304** and **306**. Tuner **201** performs a dual frequency conversion to select and down-convert a desired or selected channel from a RF input signal **101**. In doing so, amplifier **300** receives and amplifies RF input signal **101**, which contains a plurality of television channels. Mixer **301** receives RF input signal **101** from amplifier **300** and also receives a local oscillator (LO) signal from PLL **304**. For direct conversion, the frequency of PLL **304** is tuned to the frequency of the desired channel in RF input signal **101** so that it is down-converted to baseband, for further processing. For example, if the desired channel in RF input signal **101** is at 100 MHz, then PLL **304** is tuned to 100 MHz, so that mixer **301** down-converts the desired channel in RF signal **101** to DC.

In television and cable tuners, PLL **304** can be controlled by a control signal **305** so to tune the frequency of the LO signal produced by PLL **304**, and thereby control the channel selection that is down-converted to baseband by mixer **301**. Control signals for tuner control are well known to those skilled in the relevant art.

Lowpass filter **302** filters the output of mixer **301** to remove unwanted spurious energy that is above baseband. In another embodiment of tuner **201**, image rejection techniques may be implemented to reduce undesired signals at the output of mixer **301**. For example, a Hartley circuit architecture or Weaver circuit architecture may be incorporated in the design of tuner **201** to further suppress image signals. Image rejection techniques are known to those skilled in the relevant art.

Mixer **303** receives the output of lowpass filter **302** and also receives a LO signal from PLL **306**. Mixer **303** up-converts the output of lowpass filter **302** to generate a RF signal containing the channel of interest. Typically, the frequency of PLL **306** is tuned to a frequency within a frequency bandwidth that may be decoded by the IRD. The specific frequencies mentioned in the description of tuner **201**, and throughout this application, are given for example purposes only and are not meant to be limiting. Those skilled in the relevant art will recognize other frequency applications for tuner **201** based on the discussion given herein. These other frequency applications are within the scope and spirit of the present invention.

In returning to FIG. **2**, antennas **101-103** may receive signals in different frequency spectrums (e.g., antenna **101** may receive high-definition signals in one frequency spectrum, tuner **102** may receive specialized programming in another frequency spectrum, and so forth). Exemplary frequency spectrums **404-406** are illustrated in FIG. **4**, where each frequency spectrum **404-406** contains a channel of interest (e.g., channels **401**, **402**, and **403**). Tuners **201-203** process channels **401-403** to generate outputs **407-409** within the same frequency spectrum using the frequency conversion process described above with respect to FIG. **3**.

FDMA circuit **200** receives each output **407-409** and further processes each signal into a composite signal within a given frequency bandwidth that can be decoded by the IRD. The IRD decodes these signals and separates them into viewer channels, which are then passed to a television or computer monitor for viewing by a user. FDMA circuits and IRDs are known to those skilled in the relevant art.

The FTM architecture described above may be adequate for applications with a small number of FTM input sources, but the architecture does not scale well when there are many

input channel sources. That is, as FTMs grow in capacity, the number of analog components also grows as a result of the number of tuners required for each signal input. For example, for a six-channel FTM, six tuners are required to process each input channel signal; likewise, for a nine-channel FTM, nine tuners are required to process each input channel signal; and, so forth. Many external discrete components may be necessary for signal filtering, which results in an increase in circuit area.

In addition to circuit area, power consumption also increases as a result of growth in FTM capacity. In certain communication system designs, such as mobile or portable applications, circuit area constraints and power consumption requirements may limit the number of channels in a FTM. For example, the analog components in tuner **201** may consume over **1** watt of power. As FTM **100** grows in channel capacity, the number of tuners increases and, consequently, power consumption increases as well. By using digital frequency converters and filters, which are compact in modern integrated circuit technology and consume less power than their analog counterparts, a scalable FTM architecture may be implemented.

FIG. **5** illustrates a FTM **500** according to one embodiment of the present invention. For explanation purposes, FTM **500** operates in a satellite system that broadcasts signals within two frequency bands (e.g., a lower sideband of 950-1450 MHz and an upper sideband of 1650-2150 MHz). Based on the description herein, a person skilled in the relevant art will recognize that FTM **500** can be designed for a communication system that broadcasts signals in one or more frequency bands.

FTM **500** employs an analog signal converter **501** to convert input signals from analog domain to digital domain. Subsequently, digital channel selection devices $\mathbf{502}_1$ and $\mathbf{502}_2$ process the digital information through a series of frequency converters and filters to produce a digital stream of data. The digital stream of data contains one or more channels of interest in both a lower and upper frequency band of the satellite system. Finally, a digital summer **508** and a digital-to-analog (D/A) converter **503** transform the digital data to an analog format, such that an IRD can decode the resulting signals and separate them into viewer channels. The channels are then passed to a television or computer monitor for viewing by the user.

Unlike the conventional FTM architecture described above with respect to FTM **100**, FTM **500** is a scalable architecture in which analog signal converter **501** can be used for two or more input channel sources (e.g., antennas **505-507**) without growth in size or complexity. For instance, as noted above with respect to FTM **100**, a six-channel FTM would require six tuners and, accordingly, a nine-channel FTM would require nine tuners. Both the number of analog components and power consumption grow proportionately with the number of channels in the conventional design of FTM **100**.

On the other hand, the number of analog components and power consumption do not grow proportionately with an increase in the number of input channel sources in FTM **500**. The number of analog components in analog signal converter **501** remains the same regardless of the number of input channel sources received by FTM **500**. The number of digital components may grow as a result of the increase in input channel sources. However, the power consumption from the increase in digital components in FTM **500** will typically be far less than the power consumption from an increase in analog components in the conventional design of FTM **100**

In referring to FIG. **5**, a signal input **504** to FTM **500** may be coupled to one or more broadcast sources. In one embodiment, signal input **504** may be coupled to three satellite antennas **505-507**, each receiving a signal from a different orbital location. In another embodiment, signal input **504** may be coupled to a single antenna with multiple outputs, where each output corresponds to, for example, a different transmission frequency, polarization, or location. Further, signal input **504** of FTM **500** may also be coupled to other broadcast sources, such as a CATV system or off-air antennas. However, these communication broadcast sources are not meant to limit the invention.

Analog signal converter **501** translates RF signals from antennas **505-507** into digital format. FIG. **6** illustrates one embodiment of analog signal converter **501**, which includes two signal converters **610** and **611**. In one embodiment, signal converter **610** includes a lowpass filter circuit **601** and a lower band frequency converter **602**. In another embodiment, lowpass filter circuit **601** can be replaced with a bandpass filter configured to filter out frequencies residing in a lower frequency band (e.g., lower sideband 950-1450 MHz). In one embodiment, signal converter **611** includes a highpass filter circuit **603** and an upper band frequency converter **604**. In another embodiment, highpass filter circuit **603** can be replaced with a bandpass filter configured to filter out frequencies residing in an upper frequency band (e.g., upper sideband 1650-2150 MHz). FIG. **7** illustrates one embodiment of lowpass filter circuit **601**, which includes a lowpass filter **701** and an amplifier **702**. Further, FIG. **8** illustrates one embodiment of highpass filter circuit **603**, which includes a highpass filter **801** and an amplifier **802**.

As mentioned above, a communication system with two frequency bands will be discussed to facilitate in the explanation of FTM **500**. For example, FIG. **9** illustrates a communication system **900** that broadcasts RF signals in two frequency bands—a lower sideband **901** and an upper sideband **903**—that each has a bandwidth of 500 MHz. In this communication system, lowpass and highpass filter circuits **601** and **603** filter one or more FTM input signals into either lower sideband **901** or upper sideband **903** frequency spectrum. For instance, if antennas **505** and **506** receive RF signals between 950 MHz and 1.45 GHz and antenna **507** receives a RF signal between 1.65 GHz and 2.15 GHz, then lowpass filter circuit **601** selectively passes the RF signals from antennas **505** and **506** and suppresses the higher RF signal from antenna **507**. Conversely, highpass filter circuit **603** selectively passes the RF signal from antenna **507** and suppresses the lower RF signals from antennas **505** and **506**. Amplifier **702** in lowpass filter circuit **601** receives and amplifies the signal from lowpass filter **701**. Likewise, amplifier **802** in highpass filter circuit **603** receives and amplifies the signal from highpass filter **801**.

The specific frequency bands mentioned in the description of the communication system above, and throughout this application, are given for example purposes only and are not meant to be limiting. Those skilled in the relevant art will recognize that other frequency bands and communication system applications based on the discussion given herein. The other communication systems are within the scope and spirit of the present invention.

Lower band frequency converter **602** receives the amplified signal from lowpass filter circuit **601**. As illustrated in FIG. **10**, lower band frequency converter **602** includes a mixer **1001**, a PLL **1002**, a lowpass filter **1003**, an amplifier **1004**, and an analog-to-digital (A/D) converter **1005**. Mixer **1001** receives the RF input signal from low pass filter circuit **601** and also receives a LO signal from PLL **1002**. In reference to the communication system illustrated in FIG. **9**, the frequency of PLL **1002** may be tuned to a frequency **902** sub-

stantially in the center of lower sideband **901**. For example, if lower sideband **901** has a frequency range between 950 MHz and 1.45 GHz, then PLL **1002** may be tuned to 1.2 GHz.

In tuning PLL **1002** to a frequency **902** substantially in the center of lower sideband **901**, one or more RF signals residing in lower sideband **601** may be down-converted to an alternate frequency. For example, in reference to FIG. **5**, FTM **500** may be coupled to three satellite antennas **505-507** broadcasting television channels in a frequency range residing in lower sideband **901**. After the RF signals received from each satellite antenna **505-507** are filtered by lowpass filter circuit **601**, mixer **1001** down-converts these signals to another frequency.

Lowpass filter **1003** filters the output of mixer **1001** to remove unwanted spurious energy that is above baseband. Similar to the description with respect to FIG. **3**, in another embodiment of lower band frequency converter **602**, image rejection techniques may be implemented to reduce undesired signals at the output of mixer **1001**. For example, a Hartley circuit architecture or Weaver circuit architecture may be implemented to further suppress image rejection. Image rejection techniques are known to those skilled in the relevant art

In FIG. **10**, amplifier **1004** receives the output of lowpass filter **1003** and amplifies the RF signal. A/D converter **1005** samples the RF signal to translate the analog signal into a digital format. The digital data is then processed by digital channel selection device **502** to filter unwanted noise and to increase the resolution of the digital signal. An example of A/D converter **1005** is a sigma-delta A/D converter and flash A/D converter. Alternatively, other types of A/D converters may be used.

FIG. **11** illustrates an embodiment of upper band frequency converter **604**, which includes a mixer **1101**, a PLL **1102**, a lowpass filter **1103**, an amplifier **1104**, and an A/D converter **1105**. Mixer **1101** receives the RF input signal from highpass filter circuit **603** and also receives a LO signal from PLL **1102**. In reference to the communication system illustrated in FIG. **9**, the frequency of PLL **1102** may be tuned to a frequency **904** substantially in the center of upper sideband **903**. For example, if upper sideband **903** has a frequency range between 1.65 GHz and 2.15 GHz, then PLL **1102** may be tuned to 1.9 GHz.

In tuning PLL **1102** to a frequency **904** substantially in the center of upper sideband **903**, RF signals residing in upper sideband **903** may be down-converted to an alternate frequency. For example, in reference to FIG. **5**, FTM **500** may be coupled to three satellite antennas **505-507** broadcasting television channels in a frequency range residing in upper sideband **903**. After RF signals from each satellite antenna **505-507** are filtered by highpass filter circuit **603**, mixer **1101** down-converts the signals to another frequency. Lowpass filter **1103**, amplifier **1104**, and A/D converter **1105** function in a similar manner to that described in FIG. **10**.

An output of lower band frequency converter **602** is coupled to a digital channel selection device $\mathbf{502}_1$. Likewise, an output of upper band frequency converter **604** is coupled to a digital channel selection device $\mathbf{502}_2$. Digital channel selection devices $\mathbf{502}_1$ and $\mathbf{502}_2$ reduce the sampling rate from the digital outputs of A/D converters **1005** and **1105**, filter unwanted noise signals, and increase the resolution of the digital output. As illustrated in FIG. **12**, digital channel selection device **502** includes mixers **1201** and **1205**, PLLs **1202** and **1206**, a decimation filter bank **1203**, and a lowpass filter **1204**.

Mixer **1201** receives digital data from A/D converters **1005** and **1105** at a particular sampling rate. The frequency of PLL **1202** is tuned to a frequency that reduces the data rate to a more useful value for processing by decimation filter bank **1203**. An example of PLL **1202** is a direct digital frequency synthesis (DDFS) device. A DDFS device may be a phase accumulator that generates a digitized waveform. DDFS devices are known to those skilled in the relevant art. Alternatively, other types of PLLs may be used.

Decimation filter bank **1203** receives the output of mixer **1201**. Decimation filter bank **1203** is designed to downsample, or decimate, the output of mixer **1201** and to filter the digital signal such that a proper frequency response and signal-to-noise ratio are achieved. For example, in referring to the communication system illustrated in FIG. **9**, antenna **505** may receive a RF signal with a frequency of 1.3 GHz, which resides in lower sideband **901**. Lowpass filter circuit **601** selectively passes the 1.3 GHz signal to lower band frequency converter **602**. As described with respect to FIG. **10**, PLL **1002** may be tuned to a frequency **902** substantially in the center of lower sideband **901**. In FIG. **9**, this center frequency is approximately 1.1 GHz. The output of mixer **1001** contains the sum and difference of its two frequency inputs (i.e., input frequencies, 1.3 and 1.1 GHz), to produce an output signal with frequencies of 0.2 GHz and 2.4 GHz. Lowpass filter **1003** filters-out the frequency summation output of mixer **1001** (i.e., 1.3 GHz+1.1 GHz=2.4 GHz), leaving a signal with a frequency of the difference of the two input frequencies (i.e., 1.3 GHz−1.1 GHz=0.2 GHz) at the output of lowpass filter **1003**. The intermediate frequency output of lowpass filter **1003** is then processed into a digital signal through amplifier **1004** and A/D converter **1005**. The frequency of the digital signal at the output of A/D converter **1005** is then converted to another intermediate frequency. Highpass filter circuit **603** and upper band frequency converter **604** process RF signals that reside in upper sideband **903** in a similar manner to that described above.

Decimation filter bank **1203** receives the output of mixer **1201** and processes the digital data into a narrow band of output frequencies. This narrow band of frequencies contains the channels of interest. Decimation filters are known to those skilled in the relevant art.

Lowpass filter **1204** filters the output of decimation filter bank **1203** to remove unwanted spurious energy that is above baseband. Further, mixer **1205** receives the output of lowpass filter **1204** and also receives a LO signal from PLL **1206**. Mixer **1205** up-converts the frequency of the digital signal output of lowpass filter **1204** to an alternate frequency. The up-converted frequency may be in a frequency bandwidth that may be decoded by the IRD. PLL **1206** functions in a similar manner to that described with respect to PLL **1202**. A person skilled in the relevant art will appreciate that for a given set of frequencies within lower sideband **901**, lower band frequency converter **602** may output a narrow band of frequencies containing a channel of interest from this band of frequencies; likewise, upper band frequency converter **604** may also output a narrow band of frequencies containing a channel of interest from frequencies in upper sideband **903**.

In returning to FIG. **5**, digital summer **508** sums the outputs of digital channel selection devices $\mathbf{502}_1$ and $\mathbf{502}_2$. Digital summer **508** produces a composite digital representation of a reduced bandwidth signal containing channels of interest from among a full spectrum of RF signals received by antennas **505-507**. D/A converter **503** receives the output from digital summer **508** and translates the digital output into an analog signal that may be decoded by an IRD. The IRD decodes the RF signals and separates them into viewer channels, which are then passed to a television or computer moni-

tor for viewing by a user. Digital summer devices and D/A converters are known to those skilled in the relevant art.

In view of the discussion above with respect to FIGS. **5-12**, as the number of input channel sources received by FTM **500** increase, the architecture of FTM **500** not only occupies a smaller circuit footprint than conventional FTM **100**, but also consumes less power than FTM **100**. Specifically, as the number of input channel sources grows, analog converter **501** in FTM **500** does not increase in size or complexity, whereas FTM **100** would require an additional tuner for each additional input channel source. Even though the number of digital circuits may grow in FTM **500** as a result of an increase in input channel sources, integrated digital circuits typically consume far less circuit area than analog components in tuner designs. Further, since FTM **100** would require an additional tuner for each additional input channel source, each additional tuner in FTM **100** would typically consume far more power than digital circuits used in the signal processing in FTM **500**.

FIG. **13** illustrates another embodiment of FTM **500**, where a mixer **1300**, a PLL **1301**, and a lowpass filter **1302** are coupled to an output **513** of D/A converter **503**. Mixer **1300** may be used to up-convert the output of D/A converter **508** to a RF signal containing the channel of interest. The frequency of PLL **1301** may be tuned to a frequency within a frequency bandwidth that may be decoded by an IRD. Highpass filter **1302** filters the output of mixer **1300** to remove unwanted spurious energy that is above baseband. The IRD decodes the signals at an output **1303** of highpass filter **1302** and separates them into viewer channels, which are then passed to a television or computer monitor for viewing by a user. IRDs are known to those skilled in the relevant art.

FIG. **14** illustrates a FTM **1400** according to an embodiment of the present invention. FTM **1400** includes an analog signal converter **1401**, digital channel selection device **502**, and D/A converter **503**. Digital channel selection device **502** and D/A converter **503** function in the same manner as described above with respect to FIG. **5**.

FIG. **15** illustrates an embodiment of analog signal converter **1401**. Analog signal converter **1401** includes a filter **1501** and a frequency converter **1502**. Analog signal converter **1401** functions in a similar manner as signal converters **610** and **611** described above with respect to FIG. **6**. However, unlike the processing of signals residing in the lower and upper frequency bands by signal converters **610** and **611**, respectively, analog signal converter **1401** processes signals residing in both the lower and upper frequency bands (e.g., a frequency spectrum compatible with a broadband communication system in which FTM **1400** is implemented). A person skilled in the relevant art will recognize, based on the description herein, that analog signal converter **1401** can process signals in communication systems with broadcasts in one or more frequency bands.

Filter **1501** selectively passes RF signals from antennas **505-507** to frequency converter **1502**. In one embodiment, filter **1501** may be a bandpass filter configured to filter out signals residing in a predefined frequency band such as, for example, 950-2150 MHz. In an embodiment, the predefined frequency band can be an entire frequency spectrum compatible with a broadband communication system in which FTM **1400** is implemented or a sub-set of the frequency spectrum. Similar to amplifiers **702** and **802** in FIGS. **7** and **8**, respectively, an output signal of the bandpass filter may be amplified before being passed to frequency converter **1502** according to an embodiment of the present invention. In another embodiment, filter **1501** can be a lowpass or a highpass filter.

Frequency converter **1502** functions in a similar manner as lower band frequency converter **602** and upper band frequency converter **604** in FIGS. **10** and **11**, respectively. In particular, frequency converter **1502** receives a filtered signal from filter **1501**, processes the filtered signal through a mixer, filters the signal from an output of the mixer to remove unwanted spurious energy above baseband, amplifies the resulting filtered signal, and samples the amplified signal to translate the analog signal into a digital format. The mixer in frequency converter **1502** receives a LO signal from a PLL, where in one embodiment, the frequency of the PLL may be tuned to a frequency substantially in the center of a predefined frequency band. For instance, if FTM **1400** operates in a satellite system that broadcasts signals between 950-2150 MHz, then the PLL may be tuned to 1.55 GHz.

Further, in an embodiment of FTM **1400**, a mixer, a PLL, and a lowpass filter can be coupled to an output of D/A converter **503**. The configuration and operation of the mixer, PLL, and lowpass filter are similar to that of mixer **1300**, PLL **1301**, and lowpass filter **1302** of FIG. **13**.

FIG. **16** illustrates one embodiment of a method **1600** to switch channels on a broadband multi-channel communication system with a scalable switch architecture. Method **1600** may occur using, for example, FTM **500**. In step **1610**, an analog signal whose frequency resides in a first frequency band of the communication system is processed. In step **1620**, an analog signal whose frequency resides in a second frequency band of the communication system is processed. The first frequency band may correlate to a lower sideband frequency spectrum and the second frequency band may correlate to an upper sideband frequency spectrum in a two frequency sideband communication system. An example of a communication system with two frequency sidebands is illustrated in FIG. **9**.

In returning to FIG. **16**, step **1630** converts the processed analog signals, from the first and second frequency bands, into a narrow band of digital output frequencies. For example, digital channel selection device **502** may be used to perform step **1630**. In turning to step **1640**, a composite digital output from the narrow band of digital output frequencies is generated. Digital summer **508** in FIG. **5** may be used to perform this step. In step **1650**, the digital signals resulting from step **1640** are translated into analog form such that a receiver may decode the signals. D/A converter **503** in FIG. **5** may be used to perform step **1650**.

FIG. **17** illustrates another embodiment of a method **1700** to switch channels on a broadband multi-channel communication system with a scalable switch architecture. Steps **1710-1740** perform in a similar manner to steps **1610-1640** in FIG. **16**. Step **1750** translates the digital signals resulting from step **1740** into analog form. In step **1760**, the resulting analog signals from step **1750** are up-converted to a frequency within a frequency bandwidth that may be decoded by a receiver. Mixer **1300**, PLL **1301**, and highpass filter **1302** in FIG. **13** may be used to up-convert the frequency of the analog signal such that a receiver may decode the analog signal.

FIG. **18** illustrates yet another embodiment of a method **1800** to switch channels of a broadband multi-channel communication system with a scalable switch architecture. In step **1810**, a plurality of analog signals is received by a frequency translation module. FTM **1400** can be used, for example, to receive the plurality of analog signals, where the plurality of analog signals can be received from different satellite orbital locations, polarizations, and satellite transmission frequencies. In an embodiment, the plurality of analog signals reside in a frequency spectrum compatible with the broadband multi-channel communication system (e.g., 950-2150 MHz).

In step **1820**, analog signals whose frequencies reside in a predefined frequency band of the communication system are selected. In an embodiment, the analog signals can be selected using a bandpass filter. In another embodiment, the analog signal can be selected using a lowpass filter. The analog signal can also be selected using a highpass filter according to yet another embodiment of the present invention.

In step **1830**, each of the selected analog signals from step **820** are converted into a digital signal. A/D converter **1005** or A/D converter **1105** of FIGS. **10** and **11**, respectively, can be used, for example, to convert the selected analog signals into a digital format.

In step **1840**, a composite digital output is generated from the converted digital signals in step **830**. For example, digital channel selection device **502** may be used to perform step **1840**.

Step **1850** translates the composite digital output into an analog signal output decodable by a receiver. Further, step **1860** upconverts the analog signal output to a frequency decodable by the receiver.

FIG. **19** illustrates one embodiment of a system **1900** for switching channels on a broadband multi-channel communication system with a scalable switch architecture. System **1900** includes an antenna **1901**, a FTM **1902**, a processor **1903**, and a memory **1904**. The representative signal processing functions described herein can be implemented in hardware, software, or some combination thereof. For instance, the signal processing functions can be implemented using computer processors, computer logic, application specific circuits (ASICs), digital signal processors, etc., as will be understood by those skilled in the arts based on the discussion given herein. Accordingly, any processor that performs the signal processing functions described herein is within the scope and spirit of the present invention.

Further, the signal processing functions described herein could be embodied by computer program instructions that are executed by a computer processor or any one of the hardware devices listed above. The computer program instructions cause the processor to perform the signal processing functions described herein. The computer program instructions (e.g., software) can be stored in a computer usable medium, computer program medium, or any storage medium that can be accessed by a computer or processor. Such media include a memory device such as a RAM or ROM, or other type of computer storage medium such as a computer disk or CD ROM, or the equivalent. Accordingly, any computer storage medium having computer program code that cause a processor to perform the signal processing functions described herein are within the scope and spirit of the present invention.

In reference to FIG. **19**, FTM **1902** is coupled to antenna **1901** and receives signals through antenna **1901**. Processor **1903** is coupled to FTM **1902** and controls the operation of FTM **1902**. Memory **1904** is in communication with processor **1903** and stores processing instructions. In one embodiment of the present invention, these processing instructions direct processor **1903** to perform the procedures of method **1800**. Specifically, the processing instructions direct processor **1903** to perform the following: (1) receive a plurality of analog signals; (2) filter out analog signals whose frequency resides in a predefined frequency band of the communication system; (3) convert each of the filtered analog signals into a digital signal; (4) process the digital signal, corresponding to each of the filtered analog signals, into a composite output of digital signals; and, (5) translate the composite output to an analog signal output decodable by a receiver. The processing instructions can also direct processor **1903** to upconvert the analog signal output to a frequency decodable by the receiver.

In one embodiment, the processing direction for directing processor **1903** to convert each of the filtered analog signals may include filtering the analog signal with a filter (e.g., a lowpass filter, highpass filter, and a bandpass filter), mixing the filtered analog signal with a local oscillator (LO) signal with a predefined LO frequency, and digitizing the mixed analog signal with an analog-to-digital (A/D) converter. Further, in one embodiment, the processing direction for directing processor **1903** to mix the filtered analog signal may include mixing the filtered analog signal with a LO signal with a frequency substantially in the center of the predefined frequency band.

In another embodiment of the present invention, the processing instructions stored in memory **1904** direct processor **1903** to perform the procedures of method **1600**. In yet another embodiment of the present invention, the processing instructions stored in memory **1904** direct processor **1904** to perform the procedures of method **1700**.

In one embodiment, the processing direction for directing the processor to process the analog signal residing in the first frequency band may include tuning a mixer's local oscillator input to a frequency substantially in the center of the first frequency band. Similarly, in one embodiment, the processing direction for directing the processor to process the analog signal residing in the second frequency band may include tuning a mixer's local oscillator input to a frequency substantially in the center of the second frequency band. Further, in one embodiment, the processing direction for directing the processor to convert the analog signals may include processing digital signals through a series of digital up-conversion, digital down-conversion, and filtering of the digital signals.

The foregoing description of the specific embodiments will so fully reveal the general nature of the invention that others can, by applying knowledge within the skill of the relevant art, readily modify and/or adapt for various applications such specific embodiments, without undue experimentation, without departing from the general concept of the present invention. Therefore, such adaptations and modifications are intended to be within the meaning and range of equivalents of the disclosed embodiments, based on the teaching and guidance presented herein. It is to be understood that the phraseology or terminology herein is for the purpose of description and not of limitation, such that the terminology or phraseology of the present specification is to be interpreted by the skilled artisan in light of the teachings and guidance. Accordingly, the breadth and scope of the present invention should not be limited by any of the above-described exemplary embodiments, but should be defined only in accordance with the following claims and their equivalents.

What is claimed is:

1. A frequency translation module for a broadband multi-channel communication system, comprising:

an analog signal converter configured to receive a plurality of analog signals, to select analog signals associated with a predefined frequency band to produce selected analog signals, and to convert each of the selected analog signals into respective digital signals;

a digital channel selection device configured to process the respective digital signals corresponding to the selected analog signals to generate a composite output of digital signals representative of the selected analog signals, wherein the digital channel selection device includes a plurality of mixers, a plurality of phase lock loop circuits, a decimation filter bank, and a filter; and

a digital-to-analog (D/A) converter configured to translate the composite output to an analog signal output decodable by a receiver.

2. The frequency translation module of claim **1**, further comprising an antenna configured to receive the plurality of analog signals, wherein the antenna includes a plurality of outputs, each output corresponding to at least one of a different satellite transmission frequency, polarization, and satellite orbital location.

3. The frequency translation module of claim **1**, further comprising a plurality of antennas, wherein each antenna is configured to receive a satellite signal from a different orbital location.

4. The frequency translation module of claim **1**, further comprising a mixer configured to upconvert the analog signal output to a frequency decodable by the receiver.

5. The frequency translation module of claim **1**, wherein the plurality of analog signals are associated with a frequency spectrum compatible with the broadband multi-channel communication system.

6. The frequency translation module of claim **1**, wherein the analog signal converter comprises a filter, a mixer, and an analog-to-digital (A/D) converter configured to process at least one of the selected analog signals whose frequency is associated with the predefined frequency band.

7. The frequency translation module of claim **6**, wherein the filter comprises a bandpass filter.

8. The frequency translation module of claim **6**, wherein a frequency of a local oscillator (LO) input of the mixer correlates to a frequency substantially in the center of the predefined frequency band.

9. The frequency translation module of claim **1**, wherein the decimation filter bank is configured to down-sample a digital output of a mixer to generate a second digital signal and to filter the second digital signal to achieve a predefined frequency response and signal-to-noise ratio.

10. A method of switching channels on a broadband multi-channel communication system with a scalable switch architecture, comprising:

receiving a plurality of analog signals;

selecting, from the plurality of analog signals, analog signals having frequencies associated with a predefined frequency band of the communication system as selected analog signals;

converting each of the selected analog signals into respective digital signals;

combining the respective digital signals, corresponding to each of the selected analog signals, to generate a composite output of digital signals, wherein combining the respective digital signals includes,

down-sampling a digital signal from the respective digital signals to generate a down-sampled digital signal, and

filtering the down-sampled digital signal to achieve a predefined frequency response and signal-to-noise ratio; and

converting the composite output to an analog signal output decodable by a receiver.

11. The method of claim **10**, further comprising:

upconverting the analog signal output to a frequency decodable by the receiver.

12. The method of claim **10**, wherein receiving the plurality of analog signals comprises receiving a plurality of satellite broadcasts from at least one of a plurality of orbital locations, a plurality of polarizations, and a plurality of satellite transmission frequencies.

13. The method of claim **10**, wherein selecting signals comprises selecting signals that are associated with a frequency spectrum compatible with the broadband multi-channel communication system.

14. The method of claim **10**, wherein converting each of the filtered analog signals comprises:

filtering the analog signal into a filtered analog signal with at least one of a lowpass filter, highpass filter, and a bandpass filter;

mixing the filtered analog signal with a local oscillator (LO) signal having a predefined LO frequency to generate a mixed analog signal;

digitizing the mixed analog signal using an analog-to-digital (A/D) converter.

15. The method of claim **14**, wherein mixing the filtered analog signal comprises mixing the filtered analog signal with a LO signal having a frequency substantially in the center of the predefined frequency band.

16. The method of claim **10**, wherein processing the digital signal comprises generating a narrow band of output frequencies that contain channels of interest through a series of digital up-conversion, digital down-conversion, and filtering of the digital signal.

17. A system for switching channels on a broadband multi-channel communication system with a scalable switch architecture, comprising:

an antenna;

a frequency translation module coupled to the antenna, wherein the frequency translation module is configured to receive signals through the antenna;

a processor coupled to the frequency translation module, wherein the processor is configured to control the operation of the frequency translation module; and

a memory in communication with the processor, the memory configured to store a plurality of processing instructions for directing the processor to:

receive a plurality of analog signals;

select, from the plurality of analog signals, analog signals having frequencies associated with a predefined frequency band of the communication system, resulting in selected analog signals;

convert each of the selected analog signals into respective digital signals;

combine the respective digital signals, corresponding to each of the selected analog signals, to generate a composite output of digital signals, wherein to combine the respective digital signals the processor is further instructed to

down-sample a digital signal from the respective digital signals to generate and down-sampled digital signal, and

filter the down-sampled digital signal to achieve a predefined frequency response and signal-to-noise ratio; and

translate the composite output to an analog signal output decodable by a receiver.

18. The system of claim **17**, wherein the memory is configured to store a plurality of processing instructions for directing the processor to upconvert the analog signal output to a frequency decodable by the receiver.

19. The system of claim **17**, wherein the instructions for directing the processor to convert each of the filtered analog signals comprise instructions for directing the processor to

filter the analog signal to generate a filtered analog signal using at least one of a lowpass filter, highpass filter, and a bandpass filter;

mix the filtered analog signal with a local oscillator (LO) signal having a predefined LO frequency to generate a mixed analog signal; and

digitize the mixed analog signal with an analog-to-digital (A/D) converter.

20. The system of claim **19**, wherein the instructions for directing the processor to mix the filtered analog signal comprise instructions for directing the processor to mix the filtered analog signal with a LO signal having a frequency substantially in the center of the predefined frequency band.

21. The system of claim **17**, wherein the instructions for directing the processor to process the respective digital signals comprise instructions for directing the processor to generate a narrow band of output frequencies that contain channels of interest through a series of operations including digital up-conversion, digital down-conversion, and filtering on the respective digital signals.

22. A frequency translation module for a broadband multi-channel communication system, comprising:

an analog signal converter configured to select analog signals associated with a predefined frequency band to produce selected analog signals, and to convert each of the selected analog signals into respective digital signals;

a digital channel selection device configured to process the respective digital signals corresponding to the selected analog signals to generate a composite output of digital signals representative of the selected analog signals, wherein the digital channel selection device comprises a decimation filter bank configured to

down-sample a digital signal from the respective digital signals to generate a down-sampled digital signal, and

filter the down-sampled digital signal to achieve a predefined frequency response and signal-to-noise ratio; and

a digital-to-analog (D/A) converter configured to translate the composite output to an analog signal.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 8,224,274 B2
APPLICATION NO. : 12/337046
DATED : July 17, 2012
INVENTOR(S) : Ramon Gomez

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

At column 14, line 51, please replace "generate and down-sampled" with --generate a down-sampled--.

Signed and Sealed this
Twenty-fifth Day of September, 2012

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent of: Madhukar Reddy *et al.*	§	REQUEST FOR *Ex Parte* REEXAMINATION
U.S. Patent No. 9,210,362	§	
Filed: February 5, 2015	§	Attorney Docket No.: 50348.106
Issued: December 8, 2015	§	Customer No.: 27683
Title: WIDEBAND TUNER ARCHITECTURE	§	Real Party in Interest: Unified Patents, LLC

REQUESTER'S POWER OF ATTORNEY PURSUANT TO 37 CFR 1.510(f)

Pursuant to 37 CFR 1.510(f) Requester, **Unified Patents, LLC**, hereby appoints the Practitioner(s) associated with **Customer Number 27683**, as its attorney(s) to prosecute and to transact all business in the United States Patent and Trademark Office in connection with the above-identified request for *Ex Parte* Reexamination. Please recognize the correspondence address (including any electronic mail address) associated with **Customer Number 27683** for the above-identified *Ex Parte* Reexamination proceeding number to be the address associated with the appointed counsel(s).

The undersigned is authorized to sign this Power of Attorney on behalf of the Requester.

Executed on 9/18/2023.

Unified Patents, LLC

By: Jonathan Stroud

Printed Name: Jonathan Stroud

Title: General Consel

Exhibit 1002

File History of U.S. Patent No. 9,210,362

Customer No.: 000027683

Haynes and Boone, LLP
IP Section
2323 Victory Avenue, Suite 700
Dallas, Texas 75219
Telephone [214] 651.5000
Fax [214] 200.0853

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Texas on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:22-cv-125	4/27/2022	Eastern District of Texas

PLAINTIFF	DEFENDANT
ENTROPIC COMMUNICATIONS, LLC	CHARTER COMMUNICATIONS, INC., ET AL

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	8,223,775	7/17/2012	Entropic Communications, LLC
2	8,284,690	10/9/2012	Entropic Communications, LLC
3	8,792,008	7/29/2014	Entropic Communications, LLC
4	9,210,362	12/8/2015	Entropic Communications, LLC
5	9,825,826	11/21/2017	Entropic Communications, LLC

In the above---entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above---entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1---Upon initiation of action, mail this copy to Director Copy 3---Upon termination of action, mail this copy to Director
Copy 2---Upon filing document adding patent(s), mail this copy to Director Copy 4---Case file copy

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

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☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:22-cv-125	4/27/2022	Eastern District of Texas

PLAINTIFF	DEFENDANT
ENTROPIC COMMUNICATIONS, LLC	CHARTER COMMUNICATIONS, INC., ET AL

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	10,135,682	11/20/2018	Entropic Communications, LLC
2			
3			
4			
5			

In the above---entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above---entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1---Upon initiation of action, mail this copy to Director Copy 3---Upon termination of action, mail this copy to Director
Copy 2---Upon filing document adding patent(s), mail this copy to Director Copy 4---Case file copy

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/614,543	02/05/2015	Madhukar Reddy	28427US04

CONFIRMATION NO. 5785

POA ACCEPTANCE LETTER

23446
MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

OC000000125764692

Date Mailed: 05/24/2021

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 05/18/2021.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/sibrahim/

PTO/AIA/80 (07-17)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no person is required to respond to a collection of information unless it displays a valid OMB control number

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

[X] Practitioners associated with Customer Number: 23,446

OR

[ ] Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

[X] The address associated with Customer Number: 23,446

OR

[ ]

Firm or individual name		
Address		
City	State	Zip
Country		
Telephone	Email	

Assignee name and address: ENTROPIC COMMUNICATIONS, LLC
1345 AVENUE OF THE AMERICAS, 46TH FLOOR
NEW YORK, NY 10105

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of the practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee.

Signature /Andrea L. Gothing/	Date 2021-05-04
Name Andrea L. Gothing	Telephone 415-830-0613
Title Licensing Officer and Authorized Signatory, Entropic Communications, LLC	

This collection of information is required by 37 CFR 1.31, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public, which is to update (and by the USPTO to process) the file of a patent or reexamination proceeding. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 18 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	42754953
Application Number:	14614543
International Application Number:	
Confirmation Number:	5785
Title of Invention:	WIDEBAND TUNER ARCHITECTURE
First Named Inventor/Applicant Name:	Madhukar Reddy
Customer Number:	23446
Filer:	Ronald H. Spuhler/Deborah Wilson
Filer Authorized By:	Ronald H. Spuhler
Attorney Docket Number:	28427US04
Receipt Date:	18-MAY-2021
Filing Date:	05-FEB-2015
Time Stamp:	16:21:16
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Assignee showing of ownership per 37 CFR 3.73	28427US04_373c_Statement_AIA-96.pdf	120583 b06b63dd21b75ce08cdcdf221fb3c1091eef2781	no	3

Warnings:

Information:					
2	Power of Attorney	Entropic-POA_General_Assignee_EntropicCommunications_ALG.pdf	487892 51444e06ae84b241bfc127dc47c5d6c646944dd7	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	608475	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: ENTROPIC COMMUNICATIONS, LLC

Application No./Patent No.: 14/614,543 Filed/Issue Date: 2015-02-05

Titled: WIDEBAND TUNER ARCHITECTURE

ENTROPIC COMMUNICATIONS, LLC, a limited liability company

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: Curtis Ling, Madhukar Reddy, Tim Gallagher To: MAXLINEAR, INC.

   The document was recorded in the United States Patent and Trademark Office at
   Reel 031851, Frame 0086, or for which a copy thereof is attached.

2. From: MAXLINEAR, INC. To: ENTROPIC COMMUNICATIONS, LLC

   The document was recorded in the United States Patent and Trademark Office at
   Reel 055898, Frame 0230, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Ronald H. Spuhler/	2021-05-18
Signature	Date
Ronald H. Spuhler	52245
Printed or Typed Name	Title or Registration Number

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY.DOCKET NO./TITLE	REQUEST ID
14/614,543	02/05/2015	MaxLinear, Inc.	28427US04	85006

Acknowledgement of Loss of Entitlement to Entity Status Discount

The entity status change request below filed through Private PAIR on 04/03/2019 has been accepted.

CERTIFICATIONS:

Change of Entity Status:

X Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be notification of loss of entitlement to small or micro entity status, as applicable.

This portion must be completed by the signatory or signatories making the entity status change in accordance with 37 CFR 1.4(d)(4).

Signature:	/Christopher C. Winslade/
Name:	/Christopher C. Winslade/
Registration Number:	36308

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/614,543	12/08/2015	9210362	28427US04	5785

23446 7590 11/18/2015

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Madhukar Reddy, Carlsbad, CA;
MaxLinear, Inc., Carlsbad, CA;
Curtis Ling, Carlsbad, CA;
Tim Gallagher, Carlsbad, CA;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/614,543	02/05/2015	Madhukar Reddy	28427US04	5785

23446 7590 11/06/2015

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

EXAMINER
JACKSON, BLANE J

ART UNIT	PAPER NUMBER
2649	

NOTIFICATION DATE	DELIVERY MODE
11/06/2015	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

mhmpto@mcandrews-ip.com

Response to Rule 312 Communication	Application No.	Applicant(s)
	14/614,543	REDDY ET AL.
	Examiner	Art Unit
	BLANE J. JACKSON	2649

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address –

1. ☒ The amendment filed on *26 October 2015* under 37 CFR 1.312 has been considered, and has been:

a) ☒ entered.

b) ☐ entered as directed to matters of form not affecting the scope of the invention.

c) ☐ disapproved because the amendment was filed after the payment of the issue fee.
Any amendment filed after the date the issue fee is paid must be accompanied by a petition under 37 CFR 1.313(c)(1) and the required fee to withdraw the application from issue.

d) ☐ disapproved. See explanation below.

e) ☐ entered in part. See explanation below.

/BLANE J JACKSON/
Primary Examiner, Art Unit 2649

OK TO ENTER: /B.J./

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
(Attorney Docket No. 28427US04)

In the Application of:	
	Madhukar Reddy
Serial No.:	14/614,543
Filed:	Feb 5, 2015
Title:	WIDEBAND TUNER ARCHITECTURE
Confirmation No.:	5785
Customer No.:	23446

AMENDMENT UNDER 37 C.F.R. § 1.312

This paper is submitted concurrently with the issue fee and responds to the Notice of Allowance mailed Oct 5, 2015 in the above-identified application. Applicant respectfully requests entry of the following remarks in the record and entry of the following claim amendments pursuant to 37 C.F.R. § 1.312.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

23446 7590 10/05/2015
MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission via EFS
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

Chad M. Gilles	(Depositor's name)
/Chad M. Gilles/	(Signature)
October 26, 2015	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/614,543	02/05/2015	Madhukar Reddy	28427US04	5785

TITLE OF INVENTION: WIDEBAND TUNER ARCHITECTURE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0	$0	$480	01/05/2016

EXAMINER	ART UNIT	CLASS-SUBCLASS
JACKSON, BLANE J	2649	455-207000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 McAndrews, Held & Malloy, Ltd.
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE	(B) RESIDENCE: (CITY and STATE OR COUNTRY)
MaxLinear, Inc.	Carlsbad, CA

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
- ☒ Issue Fee
- ☐ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ☐ A check is enclosed.
- ☒ Payment by credit card. Form PTO-2038 is attached.
- ☒ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number 13-0017 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ☐ Applicant certifying micro entity status. See 37 CFR 1.29
- ☐ Applicant asserting small entity status. See 37 CFR 1.27
- ☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Chad M. Gilles/ Date October 26, 2015

Typed or printed name Chad M. Gilles Registration No. 60,590

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
(Attorney Docket No. 28427US04)

In the Application of:	
	Madhukar Reddy
Serial No.:	14/614,543
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Title:	WIDEBAND TUNER ARCHITECTURE
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AMENDMENT UNDER 37 C.F.R. § 1.312

This paper is submitted concurrently with the issue fee and responds to the Notice of Allowance mailed Oct 5, 2015 in the above-identified application. Applicant respectfully requests entry of the following remarks in the record and entry of the following claim amendments pursuant to 37 C.F.R. § 1.312.

LISTING OF CLAIMS

1. (Original) A wideband receiver system comprising:

a mixer module configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;

a wideband analog-to-digital converter (ADC) module configured to digitize said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;

digital circuitry configured to:

select said plurality of desired television channels from said digitized plurality of frequencies; and

output said selected plurality of television channels to a demodulator as a digital datastream.

2. (Original) The wideband receiver system of claim 1, wherein said output of said digital datastream is via a serial interface.

3. (Original) The wideband receiver system of claim 1, wherein said output of said digital datastream is via a parallel interface.

4. (Original) The wideband receiver system of claim 1, wherein said mixer module comprises a first mixer configured to generate an in-phase signal and a second mixer configured to generate a quadrature signal.

5. (Currently Amended) The wideband receiver system of claim 1, wherein said [[a]] wideband analog-to-digital converter comprises:

a first ADC configured to generate a digital in-phase signal; and

a second ADC configured to generate a digital quadrature signal.

6. (Currently Amended) The wideband receiver system of claim 5, wherein said digital circuitry comprises a plurality of complex mixers configured to frequency shift said selected plurality of desired television channels.

7. (Currently Amended) The wideband receiver system f claim 6, wherein:

prior to said frequency shift, said selected plurality of desired television channels occupy non-contiguous portions of a frequency spectrum; and

after said frequency shift, said selected plurality of desired television channels occupy a contiguous frequency spectrum.

8. (Original) The wideband receiver system of claim 1, wherein said digital circuitry comprises a plurality of channel filters configured to perform said selection of said plurality of desired television channels.

9. (Original) The wideband receiver system of claim 8, wherein each one of said plurality of channel filters is a finite impulse response filter.

10. (Currently Amended) The wideband receiver system of claim 1, wherein said digital circuitry comprises a decimator circuit configured to decimate one or more of said selected plurality of television channels prior to said output of said selected plurality of desired television channels.

11. (Original) A method comprising:

in a wideband receiver system:

downconverting, by a mixer module of said wideband receiver system, a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;

digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system, said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;

selecting, by digital circuitry of said wideband receiver system, said plurality of desired television channels from said digitized plurality of frequencies; and

outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream.

12. (Original) The method of claim 11, comprising outputting, by said digital circuitry of said wideband receiver system, said digital datastream via a serial interface.

13. (Original) The method of claim 11, comprising outputting, by said digital circuitry of said wideband receiver system, said digital datastream via a parallel interface.

14. (Original) The method of claim 11, comprising:

generating, by a first mixer of said mixer module, an in-phase signal; and

generating, by a second mixer of said mixer module, a quadrature signal.

15. (Original) The method of claim 11, comprising:

generating, via a first ADC of said wideband analog-to-digital converter, a digital in-phase signal; and

generating, via a second ADC of said wideband analog-to-digital converter, a digital quadrature signal.

16. (Currently Amended) The method of claim 15, comprising frequency shifting said selected plurality of desired television channels via a plurality of complex mixers of said digital circuitry.

17. (Currently Amended) The method of claim 16, wherein:

prior to said frequency shifting, said selected plurality of desired television channels occupy non-contiguous portions of a frequency spectrum; and

after said frequency shifting, said selected plurality of desired television channels occupy a contiguous frequency spectrum.

18. (Original) The method of claim 11, wherein said digital circuitry comprises a plurality of channel filters configured to perform said selecting.

19. (Original) The method of claim 18, wherein each one of said plurality of channel filters is a finite impulse response filter.

20. (Currently Amended) The method of claim 11, comprising decimating, by said digital circuitry, one or more of said selected plurality of desired television channels prior to said outputting of said selected plurality of television channels.

REMARKS

In the Notice of Allowance, claims 1–20 were allowed. The Applicant thanks the Examiner for positive consideration of the claims. By this correspondence, claims 5–7, 10, 16–17, and 20 amended. The Applicant does not believe the above claim amendments should have any impact on the allowability of the claim since the amendments merely clarify the antecedent basis for certain claim terms.

Regarding the Examiner's reasons for allowance, the Applicant does not agree or disagree with the specific reasons for allowance set forth by the Examiner in the Notice of Allowance, and respectfully asserts that the allowability of the claims is based upon the features of the claims and the totality of the record. Applicant reserves the right to traverse the Examiner's stated reasons and/or to argue other reasons to support allowance of the claims, should the need arise in the future.

Respectfully submitted,

Dated: Oct 26, 2015

By: /Chad M. Gilles/
Chad M. Gilles
Reg. No. 60,590

McAndrews, Held & Malloy, Ltd.
500 West Madison Street - Ste. 3400
Chicago, Illinois 60661
(312) 775-8000

Electronic Patent Application Fee Transmittal

Application Number:	14614543
Filing Date:	05-Feb-2015
Title of Invention:	WIDEBAND TUNER ARCHITECTURE
First Named Inventor/Applicant Name:	Madhukar Reddy
Filer:	Chad M. Gilles/Laura Foley
Attorney Docket Number:	28427US04

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl Issue Fee	1501	1	960	960

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**960**

Electronic Acknowledgement Receipt

EFS ID:	23883899
Application Number:	14614543
International Application Number:	
Confirmation Number:	5785
Title of Invention:	WIDEBAND TUNER ARCHITECTURE
First Named Inventor/Applicant Name:	Madhukar Reddy
Customer Number:	23446
Filer:	Chad M. Gilles/Laura Foley
Filer Authorized By:	Chad M. Gilles
Attorney Docket Number:	28427US04
Receipt Date:	26-OCT-2015
Filing Date:	05-FEB-2015
Time Stamp:	09:14:04
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$960
RAM confirmation Number	7721
Deposit Account	130017
Authorized User	GILLES, CHAD

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	28427US04_issue_fee_transmittal.pdf	1064924 ae7ffcd07015577c7c1970a81843a8c92bbe4ee6	no	1
Warnings:					
Information:					
2		28427US04_312_amendment_.pdf	39944 45b3b82582d702ca749852f609ba1701b5af7a99	yes	6

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Amendment after Notice of Allowance (Rule 312)	1	1
Claims	2	5
Applicant Arguments/Remarks Made in an Amendment	6	6

Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30577 4ade398e6af89b19e63491f3604c21aeddcfefa7	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1135445		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
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www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

23446 7590 10/05/2015

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

EXAMINER
JACKSON, BLANE J

ART UNIT	PAPER NUMBER
2649	

DATE MAILED: 10/05/2015

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/614,543	02/05/2015	Madhukar Reddy	28427US04	5785

TITLE OF INVENTION: WIDEBAND TUNER ARCHITECTURE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0	$0	$480	01/05/2016

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
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23446 7590 10/05/2015
MCANDREWS HELD & MALLOY, LTD
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SUITE 3400
CHICAGO, IL 60661

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Certificate of Mailing or Transmission
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(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/614,543	02/05/2015	Madhukar Reddy	28427US04	5785

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EXAMINER	ART UNIT	CLASS-SUBCLASS
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1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
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2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
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5. **Change in Entity Status** (from status indicated above)
- ❑ Applicant certifying micro entity status. See 37 CFR 1.29
  NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ❑ Applicant asserting small entity status. See 37 CFR 1.27
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NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

UNITED STATES PATENT AND TRADEMARK OFFICE

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United States Patent and Trademark Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/614,543	02/05/2015	Madhukar Reddy	28427US04	5785

23446 7590 10/05/2015

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

EXAMINER	
JACKSON, BLANE J	

ART UNIT	PAPER NUMBER
2649	

DATE MAILED: 10/05/2015

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 14/614,543	Applicant(s) REDDY ET AL.	
	Examiner BLANE J. JACKSON	Art Unit 2649	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *the RCE filed 11 September 2015*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *1-20*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov .
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☐ Examiner's Amendment/Comment
6. ☒ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

DETAILED ACTION

The present application is being examined under the pre-AIA first to invent provisions.

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after allowance or after an Office action under *Ex Parte Quayle*, 25 USPQ 74, 453 O.G. 213 (Comm'r Pat. 1935). Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, prosecution in this application has been reopened pursuant to 37 CFR 1.114. Applicant's submission filed on 11 September 2015 has been entered.

Information Disclosure Statement

The Information Disclosure Statement filed 11 September 2015 is made of record.

Allowable Subject Matter

Claims 1-20 are allowed. The following is a statement of reasons for the indication of allowable subject matter: the Information Disclosure Statement filed with the RCE on 11 September 2015 did not present prior art that comprises the inventive claimed subject matter.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to BLANE J. JACKSON whose telephone number is (571)272-7890. The examiner can normally be reached on Monday through Friday, 8:30 AM-5:30 PM, EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward Urban can be reached on (571) 272-7899. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/BLANE J JACKSON/
Primary Examiner, Art Unit 2649

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	2	"6992855".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/09/16 11:35
L2	3	"7095454".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/09/16 11:36
L3	3	"7167694".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/09/16 11:37
L4	2	"7362178".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/09/16 11:40
L5	2	"7373125".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/09/16 11:41
L6	2	"7421259".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/09/16 11:44
L7	3	"8285240".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/09/16 11:45
L8	2	"8374568".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/09/16 12:01
L9	2	"8374569".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/09/16 12:02
L10	2	"8374570".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/09/16 12:02
L11	4	"8526898".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/09/16 12:03
L12	2	"8577319".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/09/16 12:03
L13	3	"8666350".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/09/16 12:04
L14	7	"8909187".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/09/16 12:05
L15	3	"9059672".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/09/16 12:05
L16	4	"20070042742"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/09/16 12:06
L17	42	Reddy-Madhukar.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/09/16 12:07
S1	7	"6906498".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/09/16 09:24

9/16/2015 12:08:42 PM

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14614543	REDDY ET AL.
	Examiner	**Art Unit**
	BLANE J JACKSON	2649

CPC						
Symbol					**Type**	**Version**
H04N		5	/	50	F	2013-01-01
H04B		1	/	0014	I	2013-01-01
H04N		21	/	4263	I	2013-01-01
H04N		21	/	4383	I	2013-01-01
H04N		21	/	454	I	2013-01-01
H04N		21	/	6193	I	2013-01-01
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CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
			/					
			/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	20	
/BLANE J JACKSON/ Primary Examiner.Art Unit 2649	09/16/15	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	4

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14614543	REDDY ET AL.
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	BLANE J JACKSON	2649

US ORIGINAL CLASSIFICATION		INTERNATIONAL CLASSIFICATION										
CLASS	SUBCLASS	CLAIMED					NON-CLAIMED					
455	207	H	0	4	B	1 / 16 (2006.01.01)						

CROSS REFERENCE(S)					
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
455	214				

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	20	
/BLANE J JACKSON/ Primary Examiner.Art Unit 2649	09/16/15	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	4

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14614543	REDDY ET AL.
	Examiner	**Art Unit**
	BLANE J JACKSON	2649

☒ **Claims renumbered in the same order as presented by applicant** ☐ **CPA** ☐ **T.D.** ☐ **R.1.47**

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	17	17												
2	2	18	18												
3	3	19	19												
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12	12														
13	13														
14	14														
15	15														
16	16														

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 20	
/BLANE J JACKSON/ Primary Examiner.Art Unit 2649 (Primary Examiner)	09/16/15 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 4

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14614543	REDDY ET AL.
	Examiner	Art Unit
	BLANE J JACKSON	2649

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner
H04B 1/16	05/08/15	BJJ

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
455	131, 140, 207, 214, 313, 315, 323, 324, 325, 334	05/08/15	BJJ

SEARCH NOTES		
Search Notes	Date	Examiner
Review of IDS; review of prior art and similar application 14/617,973 to FAOM	05/08/15	BJJ
update search; review of TD to issue	07/30/15	BJJ
The IDS filed with the RCE was reviewed to issue	09/16/15	BJJ

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
	no interference listed class/ subclass or symbol/ group	09/16/15	BJJ

PTO/SB/08a (01-10)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	14614543
Filing Date	2015-02-05
First Named Inventor	Madhukar Reddy
Art Unit	2649
Examiner Name	JACKSON, Blane J.
Attorney Docket Number	28427US04

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/B.J./	1	6906498		2005-06-14	Breuch et al.	
/B.J./	2	6992855		2006-01-31	Ehrlich	
/B.J./	3	7095454		2006-08-22	Waight et al.	
/B.J./	4	7167694		2007-01-23	Khoini-Poorfard et al.	
/B.J./	5	7362178		2008-04-22	Montemayor et al.	
/B.J./	6	7373125		2008-05-13	Godambe et al.	
/B.J./	7	7421259		2008-09-02	Gomez et al.	
/B.J./	8	8285240		2012-10-09	Seendripu et al.	

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	First Named Inventor	Madhukar Reddy
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/B.J./	9	8374568		2013-02-12	Seendripu et al.	
/B.J./	10	8374569		2013-02-12	Seendripu et al.	
/B.J./	11	8374570		2013-02-12	Seendripu et al.	
/B.J./	12	8526898		2013-09-03	Reddy et al.	
/B.J./	13	8577319		2013-11-05	Ling et al.	
/B.J./	14	8666350		2014-03-04	Vauhkonen	
/B.J./	15	8909187		2014-12-09	Seendripu et al.	
/B.J./	16	9059672		2015-06-16	Ling et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/B.J./	1	20050040909	A1	2005-02-24	Waight et al.	

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	Filing Date	2015-02-05
	First Named Inventor	Madhukar Reddy
	Art Unit	2649
	Examiner Name	JACKSON, Blane J.
	Attorney Docket Number	28427US04

/B.J./	2	20070042742	A1	2007-02-22	Kim et al.		

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	1							☐

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
/B.J./	1	JEFFREY A. WELDON, et al. "A 1.75-GHz Highly Integrated Narrow-Band CMOS Transmitter With Harmonic-Rejection Mixers, IEEE Journal of Solid-State Circuits, December 2001, pages: 2003-2015, Vol. 36, No. 12, Seattle, Washington.	☐

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EXAMINER SIGNATURE

Examiner Signature	/Blane Jackson/	Date Considered	09/16/2015

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14614543 14614543 - GAU: 2649
	Filing Date	2015-02-05
	First Named Inventor	Madhukar Reddy
	Art Unit	2649
	Examiner Name	JACKSON, Blane J.
	Attorney Docket Number	28427US04

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Chad M. Gilles/	Date (YYYY-MM-DD)	2015-09-11
Name/Print	Chad M. Gilles	Registration Number	60590

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

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PTO/SB/30EFS (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	14614543	Filing Date	2015-02-05	Docket Number (if applicable)	28427US04	Art Unit	2649
First Named Inventor	Madhukar Reddy			Examiner Name	JACKSON, Blane J.		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
- ☐ Other _____

☒ Enclosed

- ☐ Amendment/Reply
- ☒ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

☒ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 130017

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

☐ Applicant Signature

PTO/SB/30EFS (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Signature of Registered U.S. Patent Practitioner			
Signature	/Chad M. Gilles/	Date (YYYY-MM-DD)	2015-09-11
Name	Chad M. Gilles	Registration Number	60590

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	14614543
Filing Date	2015-02-05
First Named Inventor	Madhukar Reddy
Art Unit	2649
Examiner Name	JACKSON, Blane J.
Attorney Docket Number	28427US04

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6906498		2005-06-14	Breuch et al.	
	2	6992855		2006-01-31	Ehrlich	
	3	7095454		2006-08-22	Waight et al.	
	4	7167694		2007-01-23	Khoini-Poorfard et al.	
	5	7362178		2008-04-22	Montemayor et al.	
	6	7373125		2008-05-13	Godambe et al.	
	7	7421259		2008-09-02	Gomez et al.	
	8	8285240		2012-10-09	Seendripu et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14614543
	Filing Date	2015-02-05
	First Named Inventor	Madhukar Reddy
	Art Unit	2649
	Examiner Name	JACKSON, Blane J.
	Attorney Docket Number	28427US04

	9	8374568		2013-02-12	Seendripu et al.	
	10	8374569		2013-02-12	Seendripu et al.	
	11	8374570		2013-02-12	Seendripu et al.	
	12	8526898		2013-09-03	Reddy et al.	
	13	8577319		2013-11-05	Ling et al.	
	14	8666350		2014-03-04	Vauhkonen	
	15	8909187		2014-12-09	Seendripu et al.	
	16	9059672		2015-06-16	Ling et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20050040909	A1	2005-02-24	Waight et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14614543
	Filing Date	2015-02-05
	First Named Inventor	Madhukar Reddy
	Art Unit	2649
	Examiner Name	JACKSON, Blane J.
	Attorney Docket Number	28427US04

	2	20070042742	A1	2007-02-22	Kim et al.		

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	JEFFREY A. WELDON, et al. "A 1.75-GHz Highly Integrated Narrow-Band CMOS Transmitter With Harmonic-Rejection Mixers, IEEE Journal of Solid-State Circuits, December 2001, pages: 2003-2015, Vol. 36, No. 12, Seattle, Washington.	☐

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14614543
	Filing Date	2015-02-05
	First Named Inventor	Madhukar Reddy
	Art Unit	2649
	Examiner Name	JACKSON, Blane J.
	Attorney Docket Number	28427US04

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Chad M. Gilles/	Date (YYYY-MM-DD)	2015-09-11
Name/Print	Chad M. Gilles	Registration Number	60590

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	14614543
Filing Date:	05-Feb-2015
Title of Invention:	WIDEBAND TUNER ARCHITECTURE
First Named Inventor/Applicant Name:	Madhukar Reddy
Filer:	Chad M. Gilles/Julia Villarreal
Attorney Docket Number:	28427US04

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Request for Continued Examination	2801	1	600	600
		Total in USD ($)		**600**

Electronic Acknowledgement Receipt

EFS ID:	23473533
Application Number:	14614543
International Application Number:	
Confirmation Number:	5785
Title of Invention:	WIDEBAND TUNER ARCHITECTURE
First Named Inventor/Applicant Name:	Madhukar Reddy
Customer Number:	23446
Filer:	Chad M. Gilles/Julia Villarreal
Filer Authorized By:	Chad M. Gilles
Attorney Docket Number:	28427US04
Receipt Date:	11-SEP-2015
Filing Date:	05-FEB-2015
Time Stamp:	18:38:44
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$600
RAM confirmation Number	5709
Deposit Account	130017
Authorized User	GILLES, CHAD

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request for Continued Examination (RCE)	28427US04_Request_for_Continued_Examination_sb30.pdf	697607 bde283d5d6b32b9da5d830d33f6aceade3351584	no	3
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	28427US04_IDS__sb08a_EFS-WEB.pdf	613115 06650c3fde3f01c5ad52cfc3493817e7c6a3d92a	no	5
Warnings:					
Information:					
3	Non Patent Literature	NPL1_Weldon_Article.pdf	1970159 93b8c9066e2cd9443818c07aaf7824194c53cc58	no	14
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	30544 6b43f86ab2f28e16a4f3d9f093260c55218fd43c	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	3311425		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

23446 7590 08/07/2015

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

EXAMINER
JACKSON, BLANE J

ART UNIT	PAPER NUMBER
2649	

DATE MAILED: 08/07/2015

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/614,543	02/05/2015	Madhukar Reddy	28427US04	5785

TITLE OF INVENTION: WIDEBAND TUNER ARCHITECTURE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0	$0	$480	11/09/2015

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

23446 7590 08/07/2015
MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/614,543	02/05/2015	Madhukar Reddy	28427US04	5785

TITLE OF INVENTION: WIDEBAND TUNER ARCHITECTURE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0	$0	$480	11/09/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
JACKSON, BLANE J	2649	348-731000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
- ❑ Payment by credit card. Form PTO-2038 is attached.
- ❑ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ❑ Applicant certifying micro entity status. See 37 CFR 1.29 — NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ❑ Applicant asserting small entity status. See 37 CFR 1.27 — NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
- ❑ Applicant changing to regular undiscounted fee status. — NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/614,543	02/05/2015	Madhukar Reddy	28427US04	5785

23446 7590 08/07/2015

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

EXAMINER	
JACKSON, BLANE J	

ART UNIT	PAPER NUMBER
2649	

DATE MAILED: 08/07/2015

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 14/614,543	Applicant(s) REDDY ET AL.	
	Examiner BLANE J. JACKSON	Art Unit 2649	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *the TD filed 15 May 2015*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *1-20*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov .
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☐ Examiner's Amendment/Comment
6. ☒ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

DETAILED ACTION

The present application is being examined under the pre-AIA first to invent provisions.

Terminal Disclaimer

The terminal disclaimer filed on 15 May 2015 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of US 8,526,898 has been reviewed and is accepted. The terminal disclaimer has been recorded.

Allowable Subject Matter

Claims 1-20 are allowed. The following is a statement of reasons for the indication of allowable subject matter: the prior art made of record teach a wideband receiver system but do not also teach digital circuitry configured to select a plurality of desired television channels from the digitized plurality of frequencies and output said plurality of television channels to a demodulator as a digital datastream.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to BLANE J. JACKSON whose telephone number is (571)272-7890. The examiner can normally be reached on Monday through Friday, 8:30 AM-5:30 PM, EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward Urban can be reached on (571) 272-7899. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/BLANE J JACKSON/
Primary Examiner, Art Unit 2649

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	4	"8526898".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/07/30 10:23
L2	41	Reddy-Madhukar.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/07/30 11:18

7/ 30/ 2015 11:20:12 AM

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14614543	REDDY ET AL.
	Examiner	**Art Unit**
	BLANE J JACKSON	2649

CPC								
Symbol							**Type**	**Version**
H04N		21	/	4263			F	2013-01-01
H04B		1	/	0014			I	2013-01-01
H04N		5	/	50			I	2013-01-01
H04N		21	/	4383			I	2013-01-01
H04N		21	/	454			I	2013-01-01
H04N		21	/	6193			I	2013-01-01
			/					
			/					
			/					
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			/					

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
			/					
			/					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/BLANE J JACKSON/ Primary Examiner.Art Unit 2649	07/30/15	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	4

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14614543	REDDY ET AL.
	Examiner	**Art Unit**
	BLANE J JACKSON	2649

US ORIGINAL CLASSIFICATION		INTERNATIONAL CLASSIFICATION	
CLASS	SUBCLASS	CLAIMED	NON-CLAIMED
455	207	H 0 4 B 1 / 16 (2006.01.01)	

CROSS REFERENCE(S)					
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
455	214				

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	20	
/BLANE J JACKSON/ Primary Examiner.Art Unit 2649	07/30/15	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	4

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14614543	REDDY ET AL.
	Examiner	**Art Unit**
	BLANE J JACKSON	2649

☒ **Claims renumbered in the same order as presented by applicant** ☐ **CPA** ☐ **T.D.** ☐ **R.1.47**

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	17	17												
2	2	18	18												
3	3	19	19												
4	4	20	20												
5	5														
6	6														
7	7														
8	8														
9	9														
10	10														
11	11														
12	12														
13	13														
14	14														
15	15														
16	16														

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 20	
/BLANE J JACKSON/ Primary Examiner.Art Unit 2649 (Primary Examiner)	07/30/15 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 4

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14614543	REDDY ET AL.
	Examiner	Art Unit
	BLANE J JACKSON	2649

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner
H04B 1/16	05/08/15	BJJ

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
455	131, 140, 207, 214, 313, 315, 323, 324, 325, 334	05/08/15	BJJ

SEARCH NOTES		
Search Notes	Date	Examiner
Review of IDS; review of prior art and similar application 14/617,973 to FAOM	05/08/15	BJJ
update search; review of TD to issue	07/30/15	BJJ

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
	no interference listed class/ subclass or symbol/ group	07/30/15	BJJ

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/614,543	02/05/2015	Madhukar Reddy	28427US04

CONFIRMATION NO. 5785

23446
MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

PUBLICATION NOTICE



Title:WIDEBAND TUNER ARCHITECTURE

Publication No.US-2015-0156535-A1
Publication Date:06/04/2015

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently http://pair.uspto.gov/. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
(Attorney Docket No. 28427US04)

In the Application of:	
	Madhukar Reddy et al.
Serial No.:	14/614,543
Filed:	February 5, 2015
Title:	WIDEBAND TUNER ARCHITECTURE
Examiner:	JACKSON, Blane J.
Art Unit:	2649
Confirmation No.:	5785
Customer No.:	23446

RESPONSE UNDER 37 C.F.R. § 1.111

This paper responds to the non-final office action mailed May 14, 2015 ("Office Action") in the above-identified application ("Instant Application"). The only rejections outstanding are obviousness type double patenting rejections, which are obviated by the e-terminal disclaimer submitted herewith.

A Notice of Allowance is courteously solicited.

Respectfully submitted,

Date: May 15, 2015

/Chad M. Gilles/
Chad M. Gilles
Registration No. 60,590
Representative for Applicant

McAndrews, Held & Malloy, Ltd.
500 West Madison Street, 34th Floor
Chicago, Illinois 60661
(312) 775-8000

Electronic Acknowledgement Receipt

EFS ID:	22358195
Application Number:	14614543
International Application Number:	
Confirmation Number:	5785
Title of Invention:	WIDEBAND TUNER ARCHITECTURE
First Named Inventor/Applicant Name:	Madhukar Reddy
Customer Number:	23446
Filer:	Chad M. Gilles/Laura Foley
Filer Authorized By:	Chad M. Gilles
Attorney Docket Number:	28427US04
Receipt Date:	15-MAY-2015
Filing Date:	05-FEB-2015
Time Stamp:	12:49:50
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment/Req. Reconsideration-After Non-Final Reject	28427US04_OA_14MAY2015_Response_with_eterminal_discl.pdf	14297 9cf5a11c2b5cc6e9fbc3a864f6af2505b4e2ba0a	no	1

Warnings:	
Information:	

Total Files Size (in bytes):	14297

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc Code: DIST.E.FILE Document Description: Electronic Terminal Disclaimer - Filed	PTO/SB/26 U.S. Patent and Trademark Office Department of Commerce

Electronic Petition Request	**TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT**
Application Number	14614543
Filing Date	05-Feb-2015
First Named Inventor	Madhukar Reddy
Attorney Docket Number	28427US04
Title of Invention	WIDEBAND TUNER ARCHITECTURE

☒ Filing of terminal disclaimer does not obviate requirement for response under 37 CFR 1.111 to outstanding Office Action

☒ This electronic Terminal Disclaimer is not being used for a Joint Research Agreement.

Owner	Percent Interest
MaxLinear, Inc.	100%

The owner(s) with percent interest listed above in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of prior patent number(s)

8526898

as the term of said prior patent is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the prior patent, "as the term of said prior patent is presently shortened by any terminal disclaimer," in the event that said prior patent later:
- expires for failure to pay a maintenance fee;
- is held unenforceable;
- is found invalid by a court of competent jurisdiction;
- is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
- has all claims canceled by a reexamination certificate;
- is reissued; or
- is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

◉ Terminal disclaimer fee under 37 CFR 1.20(d) is included with Electronic Terminal Disclaimer request.

○	I certify, in accordance with 37 CFR 1.4(d)(4), that the terminal disclaimer fee under 37 CFR 1.20(d) required for this terminal disclaimer has already been paid in the above-identified application.

Applicant claims the following fee status:

◉ Small Entity

○ Micro Entity

○ Regular Undiscounted

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES

I certify, in accordance with 37 CFR 1.4(d)(4) that I am:

◉ An attorney or agent registered to practice before the Patent and Trademark Office who is of record in this application

Registration Number 60590

○ A sole inventor

○ A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application

○ A joint inventor; all of whom are signing this request

Signature	/Chad M. Gilles/
Name	Chad M. Gilles

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

Electronic Patent Application Fee Transmittal

Application Number:	14614543
Filing Date:	05-Feb-2015
Title of Invention:	WIDEBAND TUNER ARCHITECTURE
First Named Inventor/Applicant Name:	Madhukar Reddy
Filer:	Chad M. Gilles/Laura Foley
Attorney Docket Number:	28427US04

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Statutory or Terminal Disclaimer	1814	1	160	160
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**160**

Doc Code: DISQ.E.FILE
Document Description: Electronic Terminal Disclaimer – Approved

Application No.: 14614543

Filing Date: 05-Feb-2015

Applicant/Patent under Reexamination: Reddy et al.

Electronic Terminal Disclaimer filed on May 15, 2015

☒ APPROVED

This patent is subject to a terminal disclaimer

☐ DISAPPROVED

Approved/Disapproved by: Electronic Terminal Disclaimer automatically approved by EFS-Web

U.S. Patent and Trademark Office

Electronic Acknowledgement Receipt

EFS ID:	22358248
Application Number:	14614543
International Application Number:	
Confirmation Number:	5785
Title of Invention:	WIDEBAND TUNER ARCHITECTURE
First Named Inventor/Applicant Name:	Madhukar Reddy
Customer Number:	23446
Filer:	Chad M. Gilles/Laura Foley
Filer Authorized By:	Chad M. Gilles
Attorney Docket Number:	28427US04
Receipt Date:	15-MAY-2015
Filing Date:	05-FEB-2015
Time Stamp:	12:54:06
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$160
RAM confirmation Number	9069
Deposit Account	130017
Authorized User	GILLES, CHAD

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Electronic Terminal Disclaimer-Filed	eTerminal-Disclaimer.pdf	33450 a5bab44ea054ea04a04a5edbb4fb6047012 1287b	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30276 1c2b7f4c2e62ae5e1dbaae9f5c94a098caf7 7eb7	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	63726		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/614,543	02/05/2015	Madhukar Reddy	28427US04	5785

23446 7590 05/14/2015
MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

EXAMINER
JACKSON, BLANE J

ART UNIT	PAPER NUMBER
2649	

NOTIFICATION DATE	DELIVERY MODE
05/14/2015	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

mhmpto@mcandrews-ip.com

Office Action Summary	Application No. 14/614,543	Applicant(s) REDDY ET AL.	
	Examiner BLANE J. JACKSON	Art Unit 2649	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 May 2015*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *1-20* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-20* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *02 May 2015* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

DETAILED ACTION

The present application is being examined under the pre-AIA first to invent provisions.

Information Disclosure Statement

The Information Disclosure Statement filed 10 February 2015 is made of record.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the claims at issue are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory

double patenting ground provided the reference application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO internet Web site contains terminal disclaimer forms which may be used. Please visit http://www.uspto.gov/forms/. The filing date of the application will determine what form should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to http://www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

Claims 1-20 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-27 of U.S. Patent No. 8,526,898. Although the claims at issue are not identical, they are not patentably distinct from each other because the instant application comprises claims which are broad in scope and with the same or fewer claim elements than the claims of the parent patent.

Conclusion

With respect to the preceding rejection, the claims as filed comprise potentially allowable subject matter.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to BLANE J. JACKSON whose telephone number is

(571)272-7890. The examiner can normally be reached on Monday through Friday, 8:30 AM-5:30 PM, EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward Urban can be reached on (571) 272-7899. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/BLANE J JACKSON/
Primary Examiner, Art Unit 2649

Notice of References Cited	Application/Control No. 14/614,543	Applicant(s)/Patent Under Reexamination REDDY ET AL.	
	Examiner BLANE J. JACKSON	Art Unit 2649	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-8,526,898	09-2013	Reddy et al.	455/207
*	B	US-7,599,673	10-2009	Maxim et al.	455/179.1
*	C	US-5,280,636	01-1994	Kelley et al.	455/131
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
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Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	14614543
Filing Date	2015-02-05
First Named Inventor	Madhukar Reddy
Art Unit	
Examiner Name	
Attorney Docket Number	28427US04

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/B.J./	1	8300681	B2	2012-10-30	Petrovic et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/B.J./	1	20070111661	A1	2007-05-17	Bargroff et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
/B.J./	1	2087623	EP	A2	2009-08-12	RF Magic Inc.		☐

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

Receipt date: 02/10/2015	Application Number	14614543 14614543 - GAU: 2649
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2015-02-05
	First Named Inventor	Madhukar Reddy
	Art Unit	
	Examiner Name	
	Attorney Docket Number	28427US04

	1		☐

If you wish to add additional non-patent literature document citation information please click the Add button **Add**

EXAMINER SIGNATURE

Examiner Signature	/Blane Jackson/	Date Considered	05/08/2015

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

Receipt date: 02/10/2015	Application Number	14614543	14614543 - GAU: 2649
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2015-02-05	
	First Named Inventor	Madhukar Reddy	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	28427US04	

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Chad M. Gilles/	Date (YYYY-MM-DD)	2015-02-10
Name/Print	Chad M. Gilles	Registration Number	60590

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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BIB DATA SHEET

CONFIRMATION NO. 5785

SERIAL NUMBER	FILING or 371(c) DATE RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
14/614,543	02/05/2015	348	2649	28427US04

APPLICANTS

MaxLinear, Inc., Carlsbad, CA, Assignee (with 37 CFR 1.172 Interest);

INVENTORS

Madhukar Reddy, Carlsbad, CA;
Curtis Ling, Carlsbad, CA;
Tim Gallagher, Carlsbad, CA;

**** CONTINUING DATA ***************************

This application is a CON of 13/962,871 08/08/2013
which is a CON of 12/762,900 04/19/2010 PAT 8526898
which claims benefit of 61/170,526 04/17/2009

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED **** ** SMALL ENTITY **
02/19/2015

Foreign Priority claimed ☐ Yes ☑ No 35 USC 119(a-d) conditions met ☐ Yes ☑ No Verified and Acknowledged /BLANE J JACKSON/ Examiner's Signature	☐ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		CA	10	20	2

ADDRESS

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661
UNITED STATES

TITLE

WIDEBAND TUNER ARCHITECTURE

FILING FEE RECEIVED		
730	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14614543	REDDY ET AL.
	Examiner	Art Unit
	BLANE J JACKSON	2649

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner
H04B 1/16	05/08/15	BJJ

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
455	131, 140, 207, 214, 313, 315, 323, 324, 325, 334	05/08/15	BJJ

SEARCH NOTES		
Search Notes	Date	Examiner
Review of IDS; review of prior art and similar application 14/617,973 to FAOM	05/08/15	BJJ

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14614543	REDDY ET AL.
	Examiner	Art Unit
	BLANE J JACKSON	2649

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	05/08/2015								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								
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	12	✓								
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	14	✓								
	15	✓								
	16	✓								
	17	✓								
	18	✓								
	19	✓								
	20	✓								

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	15	"8300681".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/05/08 17:41
L2	4	"20070111661"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/05/08 17:42
L3	34	"2087623"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/05/08 17:42
L4	7	Reddy-Madhukar.in. and wideband adj3 receiver	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/05/08 17:44

5/8/2015 5:45:04 PM

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500 WEST MADISON STREET
SUITE 3400
CHICAGO IL 60661

MAILED
MAR 05 2015
OFFICE OF PETITIONS

Dec Code: TRACK1.GRANT

Decision Granting Request for Prioritized Examination (Track I or After RCE)	Application No.: 14/614,543

1. THE REQUEST FILED February 05, 2015 IS **GRANTED.**

The above-identified application has met the requirements for prioritized examination

A. ☒ for an original nonprovisional application (Track I).
B. ☐ for an application undergoing continued examination (RCE).

2. **The above-identified application will undergo prioritized examination.** The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:

A. filing a **petition for extension of time** to extend the time period for filing a reply;
B. filing an **amendment to amend the application to contain more than four independent claims, more than thirty total claims**, or a multiple dependent claim;
C. filing a **request for continued examination**;
D. filing a notice of appeal;
E. filing a request for suspension of action;
F. mailing of a notice of allowance;
G. mailing of a final Office action;
H. completion of examination as defined in 37 CFR 41.102; or
I. abandonment of the application.

Telephone inquiries with regard to this decision should be directed to **Michelle R. Eason** at (571) 272-4231. In his/her absence, calls may be directed to Brian W. Brown at (571) 272-5338.

/Michelle R. Eason/
(*Signature*)

Paralegal Specialist, Office of Petitions
(Title)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
Attorney Docket No. 28427US04

In the Application of:	
Madhukar Reddy, et al.	
Serial No.:	14/614,543
Filed:	February 5, 2015
Title:	WIDEBAND TUNER ARCHITECTURE
Group Art Unit:	2631
Confirmation No.:	5785
Customer No.:	23446

PRELIMINARY AMENDMENT

Applicant submits this Preliminary Amendment in connection with the above-identified continuation application ("Instant Application").

I. CONTENTS OF THIS CORRESPONDENCE

Amendments to the specification begin on page 2.

Amendments to the Specification:

A. Please replace paragraph [0001] with the following amended paragraph:

[0001] This application is a continuation of U.S. patent application 13/962,871 filed on August 08, 2013, which is a continuation of U.S. patent application 12/762,900 filed on April ~~14~~ 19, 2010 (now U.S. Patent 8,526,898), which claims the benefit of priority to U.S. provisional application 61/170,526 filed April 17, 2009, now expired. Each of the above referenced documents is hereby incorporated by reference in its entirety.

The Commissioner is hereby authorized to charge any fees required by this submission including any extra claims fees, to the deposit account of McAndrews, Held & Malloy, Ltd., Account No. 13-0017.

Respectfully submitted,

Date: February 26, 2015

/Chad M. Gilles /
Chad M. Gilles
Reg. No. 60,590

McAndrews, Held & Malloy, Ltd.
500 W. Madison Street - Suite 3400
Chicago, Illinois 60661
(312)-775-8000

Electronic Acknowledgement Receipt

EFS ID:	21606260
Application Number:	14614543
International Application Number:	
Confirmation Number:	5785
Title of Invention:	WIDEBAND TUNER ARCHITECTURE
First Named Inventor/Applicant Name:	Madhukar Reddy
Customer Number:	23446
Filer:	Chad M. Gilles/Laura Foley
Filer Authorized By:	Chad M. Gilles
Attorney Docket Number:	28427US04
Receipt Date:	26-FEB-2015
Filing Date:	05-FEB-2015
Time Stamp:	12:07:55
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		28427US04_Prelim_Amendment.pdf	21005 2c047aef2d2022c9ba4f22e22ff9479042bf50cc	yes	2

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Preliminary Amendment	1	1
	Specification	2	2
Warnings:			
Information:			
	Total Files Size (in bytes):	21005	

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
14/614,543	02/05/2015	2631	730	28427US04	20	2

CONFIRMATION NO. 5785

23446
MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

FILING RECEIPT

OC00000073501362

Date Mailed: 02/25/2015

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Madhukar Reddy, Carlsbad, CA;
Curtis Ling, Carlsbad, CA;
Tim Gallagher, Carlsbad, CA;

Applicant(s)

MaxLinear, Inc., Carlsbad, CA

Power of Attorney: The patent practitioners associated with Customer Number 23446

Domestic Priority data as claimed by applicant

This application is a CON of 13/962,871 08/08/2013
which is a CON of 12/762,900 04/19/2010 PAT 8526898
which claims benefit of 61/170,526 04/17/2009

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access - A proper **Authorization to Permit Access to Application by Participating Offices** (PTO/SB/39 or its equivalent) has been received by the USPTO.

If Required, Foreign Filing License Granted: 02/19/2015
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/614,543**
Projected Publication Date: 06/04/2015

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****
Title

WIDEBAND TUNER ARCHITECTURE

Preliminary Class

375

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

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LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 14/614,543

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	70		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	300		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	360		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*	x 40 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*	x 210 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	730		TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	14614543
Filing Date	2015-02-05
First Named Inventor	Madhukar Reddy
Art Unit	
Examiner Name	
Attorney Docket Number	28427US04

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	8300681	B2	2012-10-30	Petrovic et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20070111661	A1	2007-05-17	Bargroff et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2087623	EP	A2	2009-08-12	RF Magic Inc.		☐

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14614543
	Filing Date	2015-02-05
	First Named Inventor	Madhukar Reddy
	Art Unit	
	Examiner Name	
	Attorney Docket Number	28427US04

	1		☐

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14614543
	Filing Date	2015-02-05
	First Named Inventor	Madhukar Reddy
	Art Unit	
	Examiner Name	
	Attorney Docket Number	28427US04

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Chad M. Gilles/	Date (YYYY-MM-DD)	2015-02-10
Name/Print	Chad M. Gilles	Registration Number	60590

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The information provided by you in this form will be subject to the following routine uses:

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

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Espacenet

Bibliographic data: EP2087623 (A2) — 2009-08-12

SATELLITE SIGNAL FREQUENCY TRANSLATION AND STACKING

Inventor(s): PETROVIC BRANISLAV [US]; HANCOCK DALE [US]; GOLDBLATT JEREMY [US]; BARGROFF KEITH [US] ± (PETROVIC, BRANISLAV, ; HANCOCK, DALE, ; GOLDBLATT, JEREMY, ; BARGROFF, KEITH)

Applicant(s): R F MAGIC INC [US] ± (R.F. MAGIC INC, ; RF MAGIC, INC)

Classification: **- international:** ***H03J1/00; H04B1/28; H04H40/90***
- cooperative: **H04B1/28; H04H40/90**

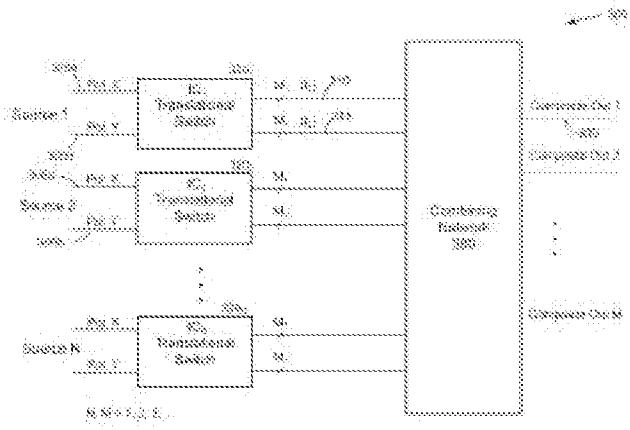
Application number: EP20070870121 20071231

Priority number(s): WO2007US89192 20071231 ; US20060864352P 20061103 ; US20070885814P 20070119 ; US20070886933P 20070128

Also published as: EP2087623 (B1) US2008112385 (A1) US2012099623 (A1) US8892026 (B2) WO2008064371 (A2) more

Abstract not available for EP2087623 (A2)
Abstract of corresponding document: US2008112385 (A1)

Circuits, systems, and methods for assembling a composite signal include a frequency translation circuit coupled to receive an input signal and operable to generate a plurality of frequency-translated versions of the input signal at a respective plurality of different frequencies, the plurality of frequency-translated input signals defining a group of frequency translated signals. The plurality of frequency translated signals may each be processed to provide a composite signal.



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

(11) Veröffentlichungsnummer:
(11) Publication number: **EP 2 087 623 A0**
(11) Numéro de publication:

Internationale Anmeldung veröffentlicht durch die Weltorganisation für geistiges Eigentum unter der Nummer:

WO 2008/064371 (Art. 153(3) EPÜ).

International application published by the World Intellectual Property Organization under number:

WO 2008/064371 (Art. 153(3) EPC).

Demande internationale publiée par l'Organisation Mondiale de la Propriété Intellectuelle sous le numéro:

WO 2008/064371 (art. 153(3) CBE).

Electronic Acknowledgement Receipt

EFS ID:	21447138
Application Number:	14614543
International Application Number:	
Confirmation Number:	5785
Title of Invention:	WIDEBAND TUNER ARCHITECTURE
First Named Inventor/Applicant Name:	Madhukar Reddy
Customer Number:	23446
Filer:	Chad M. Gilles/Laura Foley
Filer Authorized By:	Chad M. Gilles
Attorney Docket Number:	28427US04
Receipt Date:	10-FEB-2015
Filing Date:	
Time Stamp:	09:58:59
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	28427US04_IDS__sb08a_EFS-WEB.pdf	612298 bd13fe91bf17a2e635f435e0e2221e015aeb7033	no	4

Warnings:	
Information:	

2	Foreign Reference	EP2087623A2.pdf	112213 112c7af198fa095a19b1da28e1827b7e61c79aef	no	2

Warnings:	
Information:	
Total Files Size (in bytes):	724511

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If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc Code: TRACK1.REQ
Document Description: TrackOne Request

PTO/AIA/424 (04-14)

CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION UNDER 37 CFR 1.102(e) (Page 1 of 1)

First Named Inventor:	Madhukar Reddy	Nonprovisional Application Number (if known):	
Title of Invention:	WIDEBAND TUNER ARCHITECTURE		

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.

1. The processing fee set forth in 37 CFR 1.17(i)(1) and the prioritized examination fee set forth in 37 CFR 1.17(c) have been filed with the request. The publication fee requirement is met because that fee, set forth in 37 CFR 1.18(d), is currently $0. The basic filing fee, search fee, and examination fee are filed with the request or have been already been paid. I understand that any required excess claims fees or application size fee must be paid for the application.

2. I understand that the application may not contain, or be amended to contain, more than four independent claims, more than thirty total claims, or any multiple dependent claims, and that any request for an extension of time will cause an outstanding Track I request to be dismissed.

3. The applicable box is checked below:

I. ☑ Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)

i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.

---OR---

(b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.

ii. An executed inventor's oath or declaration under 37 CFR 1.63 or 37 CFR 1.64 for each inventor, **or** the application data sheet meeting the conditions specified in 37 CFR 1.53(f)(3)(i) is filed with the application.

II. ☐ Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)

i. A request for continued examination has been filed with, or prior to, this form.
ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

Signature /Chad M. Gilles/	Date February 5, 2015
Name (Print/Typed) Chad M. Gilles	Practitioner Registration Number 60,590

Note: *This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required.**

☑ *Total of 1 forms are submitted.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	28427US04
	Application Number	
Title of Invention	WIDEBAND TUNER ARCHITECTURE	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Madhukar		Reddy	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Carlsbad	State/Province	CA	Country of Residence i	US

Mailing Address of Inventor:

Address 1	2051 Palomar Airport Rd.		
Address 2	Ste. 100		
City	Carlsbad	State/Province	CA
Postal Code	92011	Country i	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Curtis		Ling	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Carlsbad	State/Province	CA	Country of Residence i	US

Mailing Address of Inventor:

Address 1	2051 Palomar Airport Rd.		
Address 2	Ste. 100		
City	Carlsbad	State/Province	CA
Postal Code	92011	Country i	US

Inventor 3 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Tim		Gallagher	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

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Title of Invention	WIDEBAND TUNER ARCHITECTURE	

City	Carlsbad	State/Province	CA	Country of Residence i	US

Mailing Address of Inventor:

Address 1	2051 Palomar Airport Rd.		
Address 2	Ste. 100		
City	Carlsbad	State/Province	CA
Postal Code	92011	Country i	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	23446		
Email Address	mhmpto@mcandrews-ip.com	Add Email	Remove Email

Application Information:

Title of the Invention	WIDEBAND TUNER ARCHITECTURE		
Attorney Docket Number	28427US04	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	10	Suggested Figure for Publication (if any)	

Filing By Reference :

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country i

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	28427US04
	Application Number	
Title of Invention	WIDEBAND TUNER ARCHITECTURE	

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	(•) Customer Number	( ) US Patent Practitioner	( ) Limited Recognition (37 CFR 11.9)
Customer Number	23446		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the application number blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation of	13962871	2013-08-08

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13962871	Continuation of	12762900	2010-04-19	8526898	2013-09-03

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
12762900	Claims benefit of provisional	61170526	2009-04-17

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) [i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country [i]	Filing Date (YYYY-MM-DD)	Access Code [i] (if applicable)

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	28427US04
	Application Number	
Title of Invention	WIDEBAND TUNER ARCHITECTURE	

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Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Authorization to Permit Access:

☒ Authorization to Permit Access to the Instant Application by the Participating Offices

If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date o f filing this Authorization.

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	28427US04
	Application Number	
Title of Invention	WIDEBAND TUNER ARCHITECTURE	

Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

(•) Assignee	( ) Legal Representative under 35 U.S.C. 117	( ) Joint Inventor
( ) Person to whom the inventor is obligated to assign.	( ) Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor :

If the Applicant is an Organization check here. [X]

Organization Name	MaxLinear, Inc.

Mailing Address Information For Applicant:

Address 1	2051 Palomar Airport Rd.		
Address 2	Ste. 100		
City	Carlsbad	**State/Province**	CA
Country i	US	Postal Code	92011
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not subsitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication . An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. [ ]

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	28427US04
	Application Number	
Title of Invention	WIDEBAND TUNER ARCHITECTURE	

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Remove

Signature:

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Signature	/Chad M. Gilles/			Date (YYYY-MM-DD)	2015-02-05
First Name	Chad	Last Name	Gilles	Registration Number	60590

Additional Signature may be generated within this form by selecting the Add button. Add

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent C o o p eration Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

WIDEBAND TUNER ARCHITECTURE

PRIORITY CLAIM

[0001] This application is a continuation of U.S. patent application 13/962,871 filed on August 08, 2013, which is a continuation of U.S. patent application 12/762,900 filed on April 14, 2010 (now U.S. Patent 8,526,898), which claims the benefit of priority to U.S. provisional application 61/170,526 filed April 17, 2009, now expired. Each of the above referenced documents is hereby incorporated by reference in its entirety.

BACKGROUND

[0002] This invention relates to wideband receiver systems and methods having a wideband receiver that is capable of receiving multiple radio frequency channels located in a broad radio frequency spectrum. In particular, the invention relates to wideband receiver systems that are capable of receiving multiple desired television channels that extend over multiple non-contiguous portions of the broad frequency spectrum and grouping them into a contiguous, or substantially-contiguous, frequency spectrum.

[0003] Receivers used to down-convert and selectively filter TV channels are referred to as tuners, and tuners designed to concurrently receive several TV channels are referred to as wideband tuners. Existing tuners for these applications down-convert a swath of channels to an intermediate frequency, which are then sent to a demodulator. Because the swath of channels is not contiguous, this swath includes the desired channels as well as undesired channels. The demodulator employs a high-speed data converter to capture this swath of desired and undesired channels in the digital domain and subsequently filters out the desired channels.

[0004] In general, television channels broadcasted over the air or over cable networks are distributed across a broad frequency spectrum. That is, the channel frequencies may not be adjacent to each other. In certain applications such as DVR and

picture-in-picture, the receiver system may have to concurrently receive several desired channels that may or may not be contiguous. The wideband receiver requirement poses a trade-off to the system to limit either the dynamic range of the wideband tuner or reduce the bandwidth covered by the tuner so that fewer channels may be received and processed by the demodulator.

[0005] FIG. 1 shows a conventional wideband tuner 100. Tuner 100 may be a direct conversion tuner and includes a low noise amplifier LNA1 having an input terminal coupled to a radio frequency (RF) input signal 102 and an output terminal coupled to a mixer M1. The RF signal may include one or more television channels receiving from a cable network via an RF connector or wirelessly via an antenna. The RF input signal may include the VHF and UHF television channels in a terrestrial television broadcasting system or the CATV channels in cable networks. In order to receive all broadcasted channels present in the RF input signal, LNA1 must necessarily have a wide tuning range, high linearity, and low noise. Mixer M1 is coupled to a synthesizer S1 that can generate an oscillator frequency located around the center of the RF signal. Mixer M1 frequency down-converts the received RF input signal to a more convenient intermediate frequency (IF) band. Tuner 100 includes an amplifier V1 having a programmable gain for amplifying the IF signal, which is then band-pass filtered by a filter F1 before outputting to a demodulator.

[0006] In general, the RF signal includes multiple desired channels that are located in non-contiguous portions of a radio frequency spectrum. As shown in FIG. 1, the swath of channels 110 occupies a bandwidth BW1 120 at an RF center frequency f_{rfc} 130. Synthesizer S1 may be tuned to a frequency around the center frequency f_{rfc} 130 for mixing channels 110 to an intermediate frequency f_{ifc} 160, the frequency down-mixed channels 140 are amplified by amplifier V1 and then filtered by F1 to produce a swath of channels 170 centered around frequency f_{ifc} 160. In an exemplary application shown in

FIG. 1, bandwidth BW1 contains 10 channels. In the case where channels are TV channels that are spaced at either 6 MHz or 8 MHz in most parts of the world, bandwidth BW1 120 would span from 60-80 MHz, i.e., the down-converted bandwidth at the intermediate frequency would require a bandwidth equal to at least BW1, or at least 80 MHz when such architecture is used. It is noted that in other applications where the desired RF channels are located in the low band such as channels numbers 2 to 6 (VHF in the terrestrial TV broadcast or CATV) and in the high band such as channels numbers 14 to 83 of the UHF TV broadcast or channel numbers 63-158 of the CATV's ultra band, the bandwidth BW1 can be 800 MHz or higher. This wide bandwidth of 800 MHz would require a very expensive digital processing circuitry such as very high-speed analog to digital conversion and high-speed processor in the demodulator.

[0007] It is desirable to have wideband receiver systems that can increase the dynamic range without requiring expensive data conversion, filtering and channel selection at the demodulator.

BRIEF SUMMARY

[0008] An embodiment of the present invention includes a wideband receiver system that is configured to concurrently receive multiple radio frequency (RF) channels including a number of desired channels that are located in non-contiguous portions of a frequency spectrum and group the desired channels in a contiguous or substantially-contiguous frequency band at an intermediate frequency spectrum, where the term "substantially-contiguous" includes spacing the desired channels close to each other (e.g. as a fraction of the total system bandwidth, or relative to a channel bandwidth) but with a spacing that can be variable to accommodate the needs of overall system. The term "contiguous" heretofore encompasses "substantially-contiguous." The term "spacing" is referred to as the frequency difference between adjacent channels. The system includes a wideband receiver having a complex mixer module for down-shifting the multiple RF channels and transforming them to an in-phase signal and a quadrature signal in the baseband or low intermediate frequency (IF) band. The system further includes a wideband analog-to-digital converter module that digitizes the in-phase and quadrature signals. The digital in-phase and quadrature signals are provided to a digital frontend module that contains a bank of complex mixers that frequency-shift the number of desired channels to a baseband where the desired channels are individually filtered.

[0009] The digital frontend module may also include a decimator module that decimates the desired RF channels by a factor M before demodulating them to a digital data stream.

[0010] In certain embodiments of the present invention, the wideband receiver system additionally includes an up-converter module having multiple complex up-mixers, each of the complex up-mixers is configured to frequency up-shift each one of the desired RF channels to a sub-portion of an IF spectrum, wherein all sub-portions of the desired channels are adjacent to each another and form a contiguous frequency band in the IF

spectrum. The act of frequency shifting the desired channels to the IF spectrum allows the wideband receiver system to directly interface with commercially available demodulators. Allowing the spacing of the desired channels in the contiguous spectrum to be variable allows a system to optimize placement of these desired channels for the purposes of avoiding sensitive portions of the spectrum which may either be vulnerable to spurious signals and interference; or which may generate interference directly or as a harmonic product, to other systems.

[0011] In another embodiment of the present invention, a multi-tuner receiver system having two or more tuners is provided to receive multiple desired RF channels that extend over several non-contiguous sub-portions of a broad frequency spectrum and group them into a contiguous frequency spectrum. The multi-tuner system includes at least a first tuner that processes a first sub-portion of the broad frequency spectrum into a first in-phase signal and a first quadrature signal and a second tuner that processes a second sub-portion of the broad frequency spectrum into a second in-phase signal and a second quadrature signal. The multi-tuner receiver system further includes a first analog-to-digital converter module that digitizes the first in-phase and quadrature signals and a second analog-to-digital converter module that digitizes the second in-phase and quadrature signals. In addition, the multi-tuner system includes a first digital frontend module having a first number of complex mixers corresponding to a first number of the desired RF channels located in the first sub-portion of the broad frequency spectrum and a second digital frontend module having a second number of complex mixers corresponding to a second number of the desired RF channels located in the second sub-portion of the broad frequency spectrum. The first digital frontend module frequency shifts the first number of the desired RF channels to a first plurality of baseband signals and the second digital frontend module frequency shifts the second number of the desired RF channels to a second plurality of baseband signals.

[0012] The multi-tuner system further includes a first up-converter module having a plurality of N complex mixers, wherein N is an integer value equal to the number of desired channel. The first up-converter module frequency up-shifts the first plurality of the baseband signals to a first portion of an intermediate frequency. In addition, the multi-tuner system includes a second up-converter module that frequency up-shifts the second plurality of the baseband signals to a second portion of an intermediate frequency. The first and the second portions of the intermediate frequency are non-overlapping and located adjacent to each other to form a contiguous intermediate frequency (IF) band. The multi-tuner system further includes a digital-to-analog converter that converts the contiguous IF band to an analog waveform signal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. 1 is a schematic block diagram of a conventional wideband tuner;

[0014] FIG. 2 is a schematic block diagram of a wideband receiver system according to an embodiment of the present invention;

[0015] FIG. 3 is a simplified circuit diagram of a complex down-mixer according to an embodiment of the present invention;

[0016] FIG. 4 is a simplified schematic block diagram of a wideband receiver system according to another embodiment of the present invention;

[0017] FIG. 5 is a simplified circuit diagram of a complex up-mixer according to an embodiment of the present invention;

[0018] FIG. 6 is a simplified schematic block diagram of a wideband multi-tuner receiver system according to an embodiment of the present invention;

[0019] FIG. 7 is a block diagram illustrating an exemplary digital front end according to an embodiment of the present invention in more detail;

[0020] FIG. 8 is a block diagram illustrating an exemplary tiled up-converter module according to an embodiment of the present invention in more detail;

[0021] FIG. 9 is a simplified block diagram of a wideband multi-tuner receiver system 900 according to an embodiment of the present invention; and

[0022] FIG. 10 is a simplified block diagram of a wideband multi-tuner receiver system 1000 according to another embodiment of the present invention.

DETAILED DESCRIPTION

[0023] FIG. 2 is a schematic block diagram of a wideband receiver system 200 according to an embodiment of the present invention. Wideband receiver system 200 includes a radio front end 210 and a digital front end 230. Radio front end 210 may be a single very wide-band tuner receiver that captures the desired swath of channels located in non-contiguous portions of the spectrum having a frequency bandwidth BW1 120. In this example, the number of available channels in BW1 120 is assumed to be 10 with each channel occupying an 8 MHz bandwidth for a total of 80 MHz. Radio front end 210 is shown as including a low noise amplifier LNA 202 having an input terminal configured to receive an RF input signal 102. In the example shown, RF signal 102 includes four desired RF channels having the respective carrier frequency f_{rf1}, f_{rf2}, f_{rf3}, and f_{rf4} that are located in non-contiguous portions of the wide frequency spectrum BW1. It is understood, however, that spectrum BW1 120 may have any other number of desired frequencies that are not contiguous. LNA 202 has a very low noise figure and very high linearity and a wide tuning range (i.e., very high IIP2 and IIP3 intercept points) to maximize a signal-to-noise-and distortion ratio (SNDR) at the amplifier output. LNA 202 may have a programmable gain to amplify RF signal 102 to adequate voltage levels for mixers M1 211 and M2 221.

[0024] Mixers M1 211 and M2 221 may be conventional mixers formed using, for example, differential Gilbert cells. Each of the mixers 211 and 221 multiplies (mixes) an amplified RF signal 203 with a respective first oscillator frequency signal 205 and a second oscillator frequency signal 207 to generate an in-phase signal 212 and a quadrature signal 222 that have a phase shift of 90° degree between them. Mixers 211 and 221 are identical so that the amplitude of the in-phase signal 212 and quadrature signal 222 are the same. The first and second oscillator frequencies 205 and 207 are identical and have a 90° degree phase shift generated through a 90° degree phase shifter P1 206. Synthesizer S1 may be a single local oscillator operable to generate the oscillator

frequency 205 for converting the receive RF signal 102 to a zero-IF or low-IF band. Synthesizer S1 can be a coarse (large step) phase locked loop. Synthesizer S1 can also be programmable to cover the wideband frequency of the analog and digital terrestrial broadcast and/or the cable television system. The RF signal 102 may have relatively uniform signal strength in a cable network. However, its signal strength may extend in several orders of magnitude in a terrestrial broadcast system, thus, LNA 202 and/or mixers M1 211, M2 221 are required to have a relatively high dynamic range to handle the large variations in the signal strength.

[0025] In-phase signal 212 and quadrature signal 222 are further amplified and filtered by respective amplifiers V1 213, V2 223 and filters F1 215, F2 225 to generate a filtered in-phase signal 216 and a filtered quadrature signal 226. Filters F1 215 and F2 225 may be passive or active low-pass filters to filter out any unwanted frequency components of the signals 214 and 224 before digitizing them for further processing in digital front end 230. It is understood that the in-phase path 216 and the quadrature path 226 must have the same amplitude spectrum and maintain a fixed phase relationship, i.e., amplifiers V1 213, V2 223 and filters F1 215, F2 225 must be substantially identical. Because the two paths 216 and 226 are in quadrature, the spectral components from both positive and negative frequencies can be overlaid so that the bandwidth (cutoff frequency) of filters F1 215 and F2 225 can be one half of the BW1 bandwidth 120.

[0026] Analog-to-digital converters ADC1 218 and ADC2 228 are high-speed (i.e., high sampling rate) converters to maximize the dynamic range. In an exemplary application, radio front end 210 operates as a nominal zero-IF down-mixer so that signals 216 and 226 have a nominal bandwidth 290 equal to one half of the RF signal bandwidth BW1 thanks to the complex down-mixer architecture. In other embodiment, radio front end 210 operates as a low-IF down-mixer so that the nominal bandwidth 290 of signals 216 and 226 is greater than one half of the bandwidth BW1. In practice, the sampling rate

of ADC1 218 and ADC2 228 is chosen to be higher than the Nyquist sampling requirement, i.e., the filtered analog quadrature signals 216 and 226 may be over-sampled in order to reduce or avoid aliasing of undesired signals into the digitized I and Q signals.

[0027] ADC1 218 generates a digital signal I 232 that is a digital representation of the analog filtered signal 216; ADC2 228 generates a digital signal Q 242 that is a digital representation of the analog filtered signal 226. Digital signals I 232 and Q 242 are then applied to a bank of N complex mixers 250, wherein N is an integer value corresponding to the number of desired RF channels located in the non-contiguous portions of the frequency spectrum BW1. It is understood that the number N can be any integer value. In one embodiment, N can be equal to the number of all available channels that exist in the licensed frequency spectrum to provide system flexibility. In other embodiments, N can be equal to the number of all receivable channels within a geographic area. In yet another embodiment, N can be an integer value less than the number of receivable channels with the geographic area to reduce system costs. In the exemplary embodiment shown in FIG. 2, the number of desired channels is 4. That is, each of the 4 complex mixers 250 mixes in-phase and quadrature signals 232 and 242 with an associated frequency to generate a corresponding baseband, which is then individually filtered, decimated and provided to an associated demodulator.

[0028] Each of the N complex mixers 250 receives the digital signals I 232 and Q 242 from ADCs 218 and 228 to extract a different one of the desired channels and frequency-shifts the extracted signals to the baseband frequency. Each of the frequency shifted desired channels 252 is filtered by an associated filter module (identified as 260a to 260n). In an embodiment, each of the filtered signals 260a to 260n may be sent directly to an associated demodulator (identified as 270a to 270n) for extracting the original information transmitted in the associated desired channel. In another embodiment, each

of the filtered signals 262a to 262n is further decimated before providing to a demodulator. A path of digital front end 230 is described in more detail below.

[0029] FIG. 3 is a simplified circuit diagram of one of the signal paths 272a to 272n of digital front end 230 shown in FIG. 2 according to an embodiment of the present invention. In an embodiment, digital signal I 232 may be further filtered by a filter 311 to obtain a filtered signal 312. Similarly, digital signal Q 242 may be further filtered by a filter 321 to obtain a filtered signal 322. Thus, digital signals 312 and 322 only contain low-frequency components with undesired high-frequency components being eliminated by respective filters 311 and 321. It is noted that filtered signals 312 and 322 are interposed between the respective ADCs 218, 228 and the bank of N complex mixers 250.

[0030] Mixer 300, which represents one of the N complex mixers 250, includes four multipliers 313, 315, 323, and 325. Multipliers 313 and 315 multiply the filtered signal 312 with respective $\cos(\omega_{ci}t)$ and $\sin(\omega_{ci}t)$ signals and generate respective products 314 and 316. Similarly, multipliers 323 and 325 multiply the filtered Q signal 322 with respective $\cos(\omega_{ci}t)$ and $\sin(\omega_{ci}t)$ signals and generate respective products 324 and 326. An adder 317 sums the products 314 and 326 to generate a frequency-shifted signal I 318. An adder 327 sums the products 324 and 316 to generate a frequency-shifted signal Q 328. Basically, complex mixer 300 causes a frequency shift of the filtered components 312 and 322 to respective baseband signals 318 and 328 in the digital domain according to the operation:

$$Y(t) = X(t) * e^{-j\omega_c t} \quad (1)$$

or taken the Fourier transform, we obtain:

$$Y(\omega)=X(\omega-\omega_c) \quad (2)$$

[0031] Multipliers 313, 315, 323, and 325 are identical digital multipliers. In an embodiment, a numerically controlled oscillator with quadrature output generates the $\cos(\omega_{ci}t)$ and $\sin(\omega_{ci}t)$ signals. Numerically controlled oscillators (NCO) can be implemented using a phase accumulator and a look-up table. NCOs are known to those of skill in the art and will not be described herein. The frequency ω_{ci} is so chosen that each one of the desired channels embedded in the digital signals I 232 and Q 242 will be downshifted to the baseband. In the given example shown in FIG. 2, the bank of N complex mixers will have four complex mixers, each one of the N (i.e., four) complex mixers is coupled to an individual NCO having a distinct frequency ω_{ci} so that when mixing the filtered digital I and Q signals 312 and 322 with that frequency, each one of the complex mixers will generate the signals I (318) and Q (328) of a corresponding one of the desired channels at the baseband.

[0032] In an embodiment, baseband signals 318 and 328 are further individually filtered by respective filters 330 and 340 that are identified as one of the filters 260a-n in FIG. 2. Filters 330 and 340 may be band-pass or low-pass filters having a narrow bandwidth equal to the bandwidth of a desired channel. In certain embodiments, filters 330 and 340 can be analog passive or active low-pass or complex band-pass filters such as polyphase filters. In another embodiment, filters 330 and 340 can be digital low-pass filters, such as finite impulse response (FIR) filters to eliminate high frequency components that may be aliased back to the baseband signals Ii (332) and Qi (342) when decimated by subsequent decimator 350.

[0033] The reduced sampling rate of the N desired baseband channels will be sent as a serial or parallel digital data stream to a demodulator using a serial or parallel data interface according to commonly known methods, as shown in FIG. 2. This approach provides several advantages over conventional tuner architectures. First, it eliminates the need of expensive data conversion, filtering and channel selection on the demodulator

side. Second, it removes undesired channels from the signal path at an early stage, thus relieves the large dynamic range requirement in the demodulator.

[0034] FIG. 4 shows a simplified schematic block diagram of a wideband receiver system 400 according to another embodiment of the present invention. Wideband receiver system 400 includes a radio front end 410, a digital front end 430, a tiled up-conversion module 450, and a summing digital-to-analog converter module DAC 470. Radio front end 410 includes a low noise amplifier LNA1 that receives an RF input signal 102 and provides an amplified RF signal 403 to mixers M1 411 and M2 421. Mixer M1 411 is coupled to an oscillator frequency 405 of a synthesizer S1 whereas mixer M2 421 is coupled with the oscillator frequency 405 via a phase shifter P1 406 that generates a 90° degree phase-shift to the oscillator frequency 405. Mixers M1 411 and M2 421 generate respective in-phase signal 412 and quadrature signal 422 that are further amplified by respective amplifiers V1 413 and V2 423. The amplified in-phase and quadrature signals 414, 424 are then filtered by filters F1 415 and F2 425 to eliminate undesired frequency components that would be aliased back to the in-phase and quadrature signals when digitally sampled by subsequent analog-to-digital converters ADC1 418 and ADC2 428. Digital signals I 422 and Q 442 at the input of digital front end 430 are digital representations of the filtered analog in-phase and quadrature signals 416, 426 before the ADCs. Digital front end 430 include a bank of N complex mixers 432 comprising 432a to 432n identical mixers, where N is an integer value corresponding to the number of the desired channels located in non-contiguous portions of the frequency spectrum. Each of the N complex mixers 432a to 432n frequency down-converts signals I 432 and Q 442 to an associated baseband. Each of the frequency down-converted I and Q signals are coupled to respective low-pass, band-pass, or decimating filters 434. In this regard, the radio front end 410 and the digital front end 430 are similar to respective radio front end 210 and digital front end 230 of FIG. 2 that have been described in detail above.

[0035] In an alternative embodiment of the present invention, the N filtered and decimated channels 438a to 438n (where indices a to n correspond to the associated number of desired channels) are not provided to a demodulator for demodulation. Instead, the N filtered and decimated channels 438a to 438n are further frequency up-converted to an intermediate frequency (IF) spectrum. In order to achieve that, the N filtered and decimated channels are coupled to a tiled up-conversion module 450 that includes a bank of N complex up-mixers, where N is an integer value correspond to the number of desired received channels. The N complex up-mixers include identical digital mixers 452a to 452n that will be described further in detail below with reference to FIG. 5. The N up-shifted channels are then filtered by a subsequent bank of channel filters 454 that, in an embodiment, comprises N individual finite impulse response (FIR) filters. The N filtered channels are then digitally combined and converted to the analog domain by a summing digital-to-analog converter module DAC 470. The N up-shifted channels are adjacent to each other and form a contiguous or substantially-contiguous set of channels 475 in the IF spectrum centered around f_{if} as illustrated in FIG. 4. In an embodiment, the spectra of the mixed products are spaced in such a way so as to avoid overlap with known frequency bands containing potential or actual interferers. In another embodiment, the spectra of the mixed products are spaced in such a way so as to avoid overlap with frequency bands that might introduce interference to other systems. In general, because the bandwidth BW_2 is substantially lower than BW_1, the IF frequency f_{if} can be set proportionally lower, e.g., typically about 16 MHz to accommodate the spectrum of BW2 of up to 32 MHz (corresponding to the total bandwidth of the four desired channels, each having a bandwidth of 8 MHz in this example).

[0036] The up-conversion approach of FIG. 4 provides several advantages over conventional tuner architectures. First, it allows the demodulator to operate the data converter at a lower data rate and with lower resolution (fewer bits) due to the fact that the contiguous channels have a narrower bandwidth. Second, the up-conversion approach

provides full compatibility with existing demodulators that require an analog IF signal. Third, it removes undesired channels from the signal path at an early stage, thus relieves the requirement of a high dynamic range requirement of the demodulator's analog-to-digital converter and the demodulator itself.

[0037] FIG. 5 shows a simplified exemplary circuit diagram of a complex up-mixer 500 according to an embodiment of the present invention. Up-mixer 500 is one of the N complex up-mixers 452a to 452n in tiled up-conversion module 450 shown in FIG. 4. Up-mixer 500 includes filter 510 and 520 configured to eliminate unwanted frequency components present in respective input signals I 501 and Q 502. Filtered signals 512 and 522 are provided to up-mixers UMI 515 and UMQ 525 that multiply the filtered signals 512 and 522 with respective $\cos(\omega_u t)$ and $\sin(\omega_u t)$. The products 516 and 526 are summed in an adder 530 to generate an IF signal 532 according to the following equation:

$$IF(t)=I(t)*\cos(\omega_u t)+Q(t)*\sin(\omega_u t) \qquad (3)$$

[0038] Up-mixers UMI 515 and UMQ 525 are identical digital multipliers that multiply the respective filtered signal 512 and 522 with a cosine function 505 and a sine function 506 that can be generated from a NCO using a digital phase accumulator and a look-up table.

[0039] As described above, TV channels are grouped into multiple frequency bands in North America. For example, channels 2 through 6 are grouped in VHF-low band (aka band I in Europe), channels 7 through 13 in VHF-high band (band III), and channels 14 through 69 in UHF band (bands IV and V). In order to receive such a wide frequency spectrum, the low noise amplifier and mixer must have very low noise, wide tuning range and high linearity as described above in the wideband receiver systems 200 and 400. However, a wideband receiver having a single tuner with high sensitivity may have a high power consumption. For certain applications, it may be advantageous to use multiple tuners that are optimized for a given frequency band, such as a dedicated tuner

for the low VHF band, another dedicated tuner for the high VHF band and the UHF band, and yet other dedicated tuners for receiving the digital video broadcasting (DVB) via satellite (DVB-S), via cable (DVB-C), or terrestrial digital video broadcasting (DVB-T). The multi-tuner approach may also be advantageously applied to cable networks that carry TV programs on an 88 MHz to 860 MHz according to the Data Over Cable Service Interface Specification (DOCSIS) protocol.

[0040] FIG. 6 shows a simplified schematic block diagram of a wideband multi-tuner receiver system 600 according to an embodiment of the present invention. In an embodiment, multi-tuner system 600 includes low noise amplifier A1 602 for receiving an RF input signal 601. Amplifier A1 602 is coupled to at least a tuner1 610 and a tuner2 720. In another embodiment, multi-tuner system 600 may not include amplifier 602 so that RF input signal 601 can be received directly at each tuner 610 and 720.

[0041] Tuner1 610 includes an amplifying filter AF1 613 that filters and amplifies a first portion BWtuner1 604 of a broad frequency spectrum 608 that contains a first plurality of RF channels 606 including desired channels 607 having respective channel frequencies f_{rf1} and f_{rf2}. The first portion of the broad frequency spectrum BWtuner1 604 is then frequency down-converted to a low-IF or zero-IF in-phase signal I1 612 and a quadrature signal Q1 622 through respective mixer M1 611 and M2 621. Signals I1 612 and Q1 622 are further amplified and low-pass filtered before applying to respective analog-to-digital converters ADC1 618 and ADC2 628 that convert analog signals Ia1 616 and Qa1 626 to respective digital in-phase signal Id1 631 and digital quadrature signal Qd1 641. Because tuner1 610 only covers a portion BWtuner1 604 of the entire frequency spectrum 608 having fewer channels, the ADC1 618 and ADC2 628 can be slower-speed analog-to-digital converters with a large number of bits, i.e., large dynamic range.

[0042] Digital signals Id1 631 and Qd1 641 are then provided to a digital front end DFE 630 that includes a first bank of N complex mixers 632 and channel and decimating filters 634. The first bank of N complex filters 632 has N identical complex mixers, where N is an integer value equal to the number of desired channels located in the first portion BWtuner1 604 of the broad frequency spectrum 608. In an embodiment, each one of the first bank of N complex mixers includes four digital mixers that multiply digital stream Id1 631 and Qd1 641 with respective digitized cosine function and sine function to generate the sum and difference frequency components, as shown in FIG. 3. The digitized cosine and sine frequency, i.e., the mixer frequency is so chosen so that when mixing signals Id1 631 and Qd1 641 will move them to a baseband or a low-IF band. In an embodiment, channel and decimating filters have similar structures as filters 330 and 340 and demodulator 350 as shown in FIG. 3. That is, channel and decimating filters include digital low-pass filters 330 and 340 that eliminates unwanted high frequency components of the baseband signals I and Q prior to applying them to a decimator 350 (FIG. 3) that reduces the sample frequency without any loss of information since Id1 631 and Qd1 641 are sampled at a much higher frequency by the respective ADC1 618 and ADC2 628.

[0043] The decimated desired channels are then provided to an up-converter module 650 that includes a bank of N up-mixers. The bank of N up-mixers includes N identical up-mixers whose structure is shown in FIG. 5. In an embodiment, N is an integer value equal to the number of desired channels present in BWtuner1 604. Each one of the up-mixer frequency-shifts the baseband signals I and Q of each one of the desired channels to an appropriate portion of the intermediate frequency band according to Equation (3). In other words, the bank of N up-mixers is “frequency multiplexing” the desired channels onto a first portion 682 of an IF band 686.

[0044] Similarly, tuner2 720 includes an amplifying filter AF2 713 that is configured to receive a second portion BWtuner2 704 of the broad frequency spectrum 608. The second portion 704 contains a second plurality of RF channels 706 including a second number of desired channels. In the exemplary illustration of FIG. 6, the second portion 704 has a frequency bandwidth of BWtuner2 that contains desired channels 707 having respective channel frequencies f_{rf3} and f_{rf4}. Tuner2 720 includes elements such as mixers M3 711, M4 721, amplifiers V3 714, V4 724, filters F3 715, F4 725 and analog-to-digital converters ADC3 731 and ADC4 741 that are substantially the same as the like-named elements of the signal path of tuner1 610. Thus, redundant description is omitted herein.

[0045] Digital in-phase signal Id2 731 and digital quadrature signal Qd2 741 are then provided to digital front end 740. Digital front end 740 includes a bank of L complex filters, where L is an integer value equal to the number of desired channels in the second portion BWtuner2 704 of the broad frequency spectrum 608. Each one of the bank of L complex filters is a digital complex mixer configured to transform the signals Id2 731 and Qd2 741 to baseband signals that are further filtered by individual digital low-pass filters such as FIR filters before decimated by a subsequent decimator. The elements of digital front end 740 are substantially similar to those described in digital front end 630. Thus, redundant description is omitted herein.

[0046] The decimated baseband I and Q channels are further provided to a subsequent up-conversion module 760 that performs a function substantially similar to that of the up-conversion module 650 already described above. The outputs of up-conversion module 650 and 760 can be tiled to generate a contiguous set of IF frequencies 682, 684 centered at f_{if} 686. In an embodiment, the outputs of up-conversion module 650 and 760 are digitally summed and converted to an analog signal by summing DAC 670. In another embodiment, the up-conversion modules 650 and 760 and the

digital summing function 672 can be performed using an inverse discrete Fourier transform or an inverse Fast Fourier transform operation.

[0047] The multi-tuner architecture provides the flexibility that multiple commercially available tuners can be used without the need of designing a wideband tuner. For example, a tuner designed for a terrestrial broadcast digital TV can be used together with a tuner dedicated to receiving a cable signal and/or a tuner for receiving a satellite broadcast signal. The multi-tuner receiver system provides an additional advantage that other tuners can be added quickly to the system to accommodate any future applications. Additionally, the multi-tuner architecture allows the use of slower speed (i.e., lower cost) analog-to-digital converters with a larger number of bits for achieving large dynamic range.

[0048] FIG. 7 shows a block diagram of an exemplary digital front end of the invention in more detail. In an embodiment, in-phase signal Id2 731 and quadrature signal Qd2 741 at the output of respective ADC converters 718 and 728 are provided to each of the L complex mixers 732 comprising mixers 732A to 732L. A more detailed description of each of L complex mixers is shown in FIG. 3. Mixer 732A multiplies Id2 731 and Qd2 741 with a cosine signal and a sine signal that are generated from an NCO1 and produces an I-732A signal and a Q-732A signal that are further individually filtered by an FIR filter before decimating. The bank of L complex mixers corresponds to the block 732 in FIG. 6; and the set of FIR filters and decimator corresponds to the block 734 in FIG. 6. Each decimated pair of I-732i/M in the baseband, where the index "i" is from A to L, is further provided to a subsequent up-mixer for frequency-shifting to an intermediate frequency as shown in FIG. 8.

[0049] FIG. 8 shows an exemplary embodiment of a bank of L complex up-mixers according to the present invention. Each decimated pair of complex signals I-732i/M and Q-732i/M is provided to an associated complex up-mixer, whose frequency is so chosen

that when mixing with the pair of complex signals I-732i/M and Q-732i/M will generate an associated channel at a predetermined sub-portion of the intermediate frequency band 686 (FIG. 6). A more detailed schematic block of one of the L up-mixers is described above together with FIG. 5.

[0050] FIG. 9 is a simplified block diagram of a wideband multi-tuner receiver system 900 according to an embodiment of the present invention. In an embodiment, system 900 includes a crossbar switch 910 having at least an input terminal 912 configured to receive signals from an analog-to-digital converter (ADC) 912 and an input terminal 922 configured to receive signals from an ADC 922. Crossbar switch 910 also includes an output terminal 924 that is coupled to a digital front end 930. In an embodiment, input terminals 912 and 922 of crossbar switch 910 have P inputs, where P is an integer value that is equal to the total number of desired channels received by tuner1 610 and tuner2 720. Output terminal 924 of crossbar switch 910 have Q outputs, where Q is an integer value that is equal to the total number of desired channels received by tuner1 610 and tuner2 720.

[0051] In an embodiment, digital front end 930 may include a bank of R complex mixers that frequency shifts the received channels to a baseband. Digital front end 930 may combine digital front end 630 and 740 shown in FIG. 6. Similarly, a tiled up-conversion module 950 may include up-converter modules 650 and 760 of FIG. 6.

[0052] System 900 further includes a summing DAC that operates similarly as summing DAC 470 and 670 that have been described in detail in relation with respective FIG. 4 and FIG. 6 above. Thus, redundant description is omitted herein.

[0053] FIG. 10 is a simplified block diagram of a wideband multi-tuner receiver system 1000 according to another embodiment of the present invention. System 1000 includes at least tuner1 610 coupled with digital front end 630 through an analog-to-digital converter 620 and tuner2 720 coupled with digital front end 740 through an

analog-to-digital converter 730. System 1000 further includes a crossbar switch 1010 that is interposed between digital front ends 630, 740 and up-conversion modules 650, 760. Crossbar switch 1010 includes an input terminal 1012 having S inputs coupled with DFE 630 and an input terminal 1022 having T inputs coupled with DFE 740. In an embodiment, S is an integer value equal to the number of desired channels processed in DFE 630 and T is an integer value equal to the number of desired channels processed in DFE 740. Crossbar switch 1010 further includes an output terminal 1024 having U outputs coupled with up-converter module 650 and an output terminal 1024 having V outputs coupled with up-converter module 760. In an embodiment, the total number of the outputs U and V is equal to the sum of the inputs S and T. Thus, crossbar switch 1010 allows the routing of any channel from either DFE 630 or DFE 740 to up-converters 650 or 760. It is understood that system 1000 is not as flexible as system 900 because DFE 630 and DFE 740 are already pre-assigned to respective tuner1 (610) and tuner2 (720). However, this pre-assigned arrangement allows a simpler implementation of crossbar switch 1010 that operates at lower speeds.

[0054] While several embodiments in accordance with the present invention have been described, it is to be understood that the above description is intended to be illustrative and not restrictive. Many embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention should, therefore, be determined not with reference to the above description, but instead should be determined with reference to the appended claims along with their full scope of equivalents.

CLAIMS

What is claimed is:

1. A wideband receiver system comprising:

a mixer module configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;

a wideband analog-to-digital converter (ADC) module configured to digitize said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;

digital circuitry configured to:

select said plurality of desired television channels from said digitized plurality of frequencies; and

output said selected plurality of television channels to a demodulator as a digital datastream.

2. The wideband receiver system of claim 1, wherein said output of said digital datastream is via a serial interface.

3. The wideband receiver system of claim 1, wherein said output of said digital datastream is via a parallel interface.

4. The wideband receiver system of claim 1, wherein said mixer module comprises a first mixer configured to generate an in-phase signal and a second mixer configured to generate a quadrature signal.

5. The wideband receiver system of claim 1, wherein said a wideband analog-to-digital converter comprises:

a first ADC configured to generate a digital in-phase signal; and

a second ADC configured to generate a digital quadrature signal.

6. The wideband receiver system of claim 5, wherein said digital circuitry comprises a plurality of complex mixers configured to frequency shift said selected plurality of television channels.

7. The wideband receiver system f claim 6, wherein:

prior to said frequency shift, said selected plurality of television channels occupy non-contiguous portions of a frequency spectrum; and

after said frequency shift, said selected plurality of television channels occupy a contiguous frequency spectrum.

8. The wideband receiver system of claim 1, wherein said digital circuitry comprises a plurality of channel filters configured to perform said selection of said plurality of desired television channels.

9. The wideband receiver system of claim 8, wherein each one of said plurality of channel filters is a finite impulse response filter.

10. The wideband receiver system of claim 1, wherein said digital circuitry comprises a decimator circuit configured to decimate one or more of said selected plurality of television channels prior to said output of said selected plurality of television channels.

11. A method comprising:

in a wideband receiver system:

downconverting, by a mixer module of said wideband receiver system, a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;

digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system, said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;

selecting, by digital circuitry of said wideband receiver system, said plurality of desired television channels from said digitized plurality of frequencies; and

outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream.

12. The method of claim 11, comprising outputting, by said digital circuitry of said wideband receiver system, said digital datastream via a serial interface.

13. The method of claim 11, comprising outputting, by said digital circuitry of said wideband receiver system, said digital datastream via a parallel interface.

14. The method of claim 11, comprising:

generating, by a first mixer of said mixer module, an in-phase signal; and

generating, by a second mixer of said mixer module, a quadrature signal.

15. The method of claim 11, comprising:

generating, via a first ADC of said wideband analog-to-digital converter, a digital in-phase signal; and

generating, via a second ADC of said wideband analog-to-digital converter, a digital quadrature signal.

16. The method of claim 15, comprising frequency shifting said selected plurality of television channels via a plurality of complex mixers of said digital circuitry.

17. The method of claim 16, wherein:

prior to said frequency shifting, said selected plurality of television channels occupy non-contiguous portions of a frequency spectrum; and

after said frequency shifting, said selected plurality of television channels occupy a contiguous frequency spectrum.

18. The method of claim 11, wherein said digital circuitry comprises a plurality of channel filters configured to perform said selecting.

19. The method of claim 18, wherein each one of said plurality of channel filters is a finite impulse response filter.

20. The method of claim 11, comprising decimating, by said digital circuitry, one or more of said selected plurality of television channels prior to said outputting of said selected plurality of television channels.

ABSTRACT

A wideband receiver system comprises a mixer module, a wideband analog-to-digital converter (ADC) module, and digital circuitry. The mixer module is configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels. The wideband ADC module is configured to digitize the swatch of frequencies comprising the plurality of desired television channels and the plurality of undesired television channels. The digital circuitry is configured to select the desired plurality of television channels from the digitized plurality of frequencies, and output the selected plurality of television channels to a demodulator as a digital datastream.

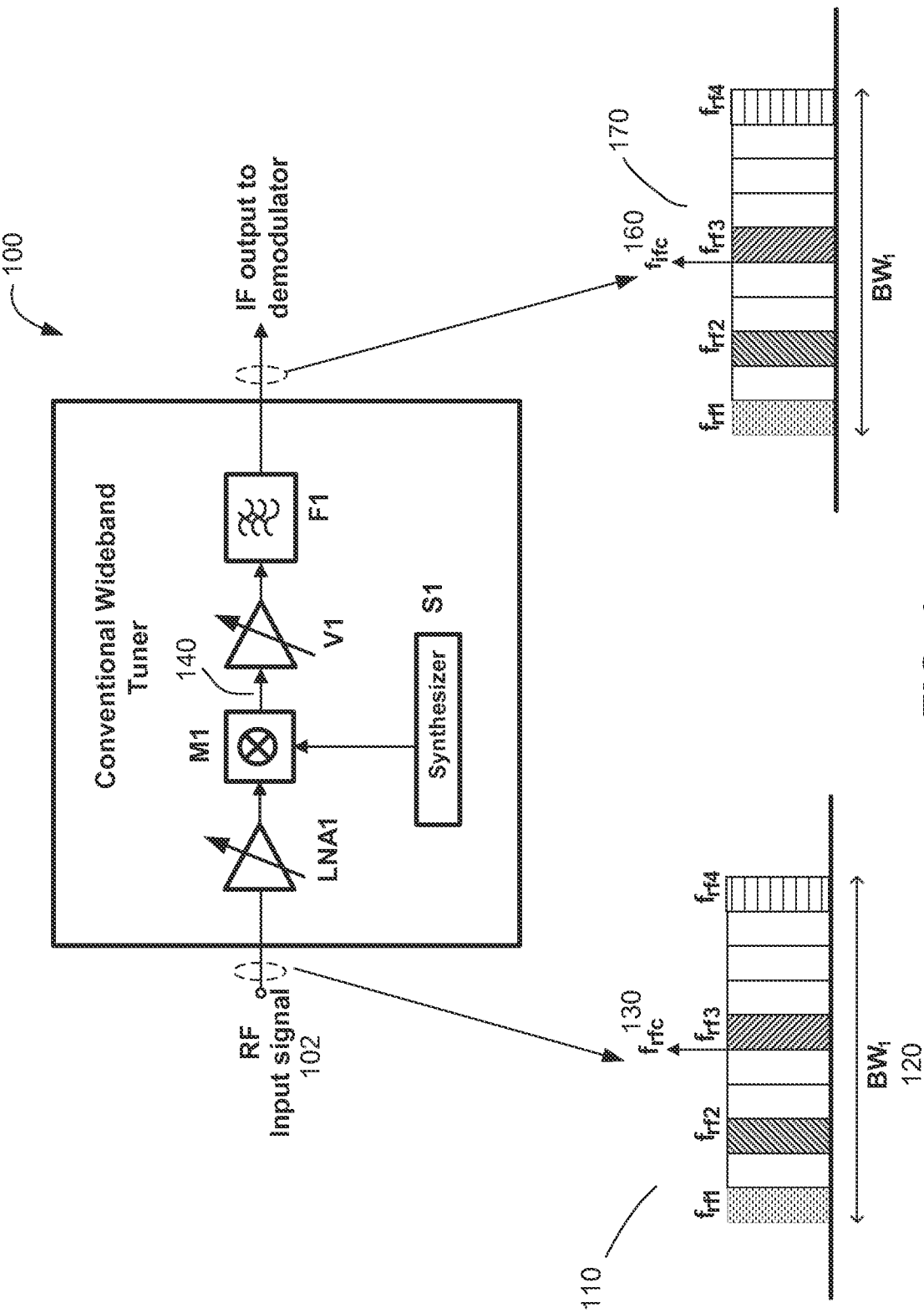


FIG. 1
(Prior Art)

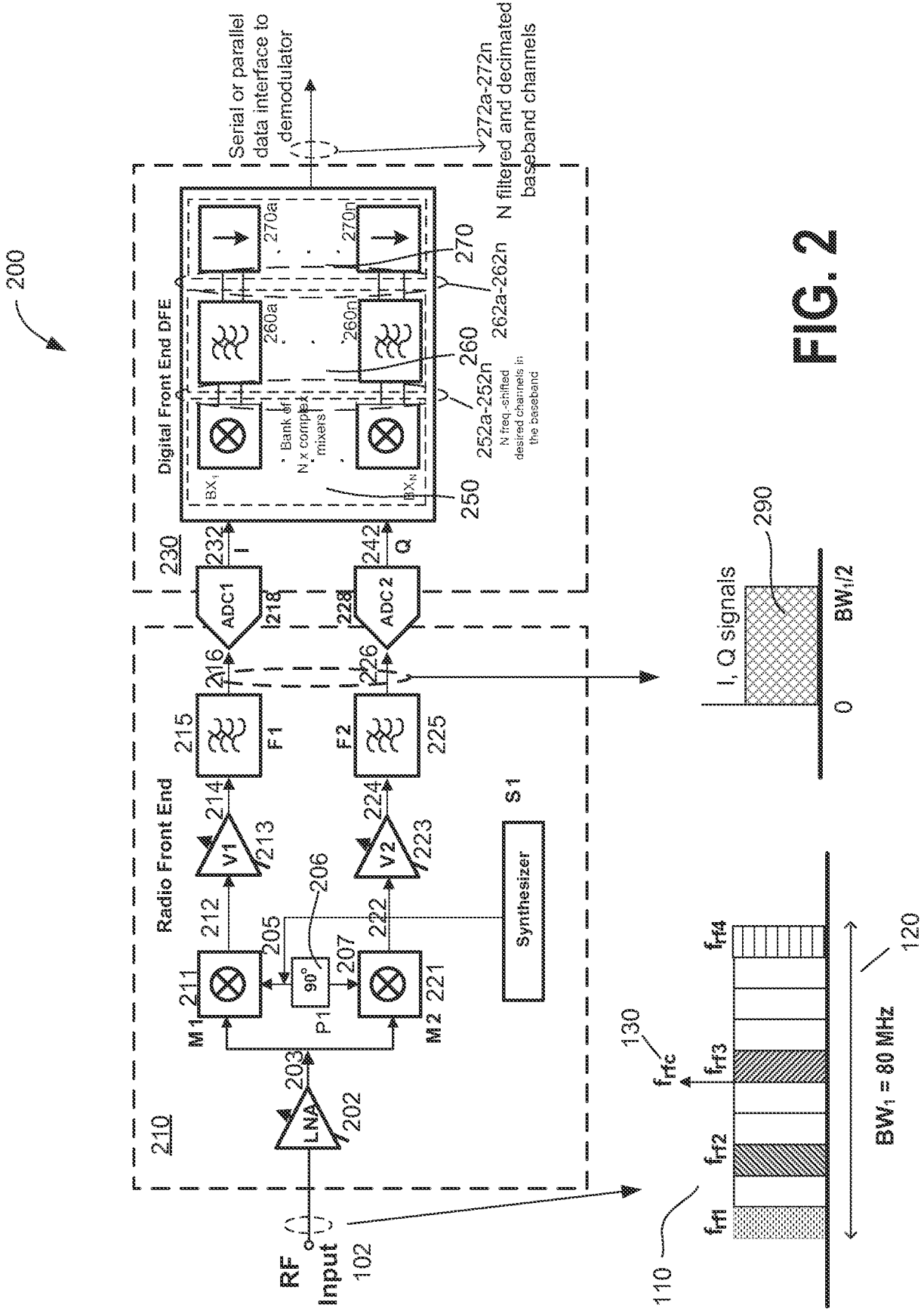

200
210
Radio Front End
RF Input
102
LNA
202
203
M1
211
M2
221
P1
90°
205
206
207
212
222
V1
213
214
V2
223
224
215
F1
225
F2
216
226
ADC1
218
ADC2
228
232
242
I
Q
230
Synthesizer
S1
Digital Front End DFE
BX1
BXN
Bank of N x complex mixers
260a
260n
270a
270n
250
260
270
252a-252n
N freq.-shifted desired channels in the baseband
262a-262n
272a-272n
N filtered and decimated baseband channels
Serial or parallel data interface to demodulator
I, Q signals
290
BW1/2
0
frf1
frf2
frfc
frf3
frf4
110
130
120
BW1 = 80 MHz

FIG. 2

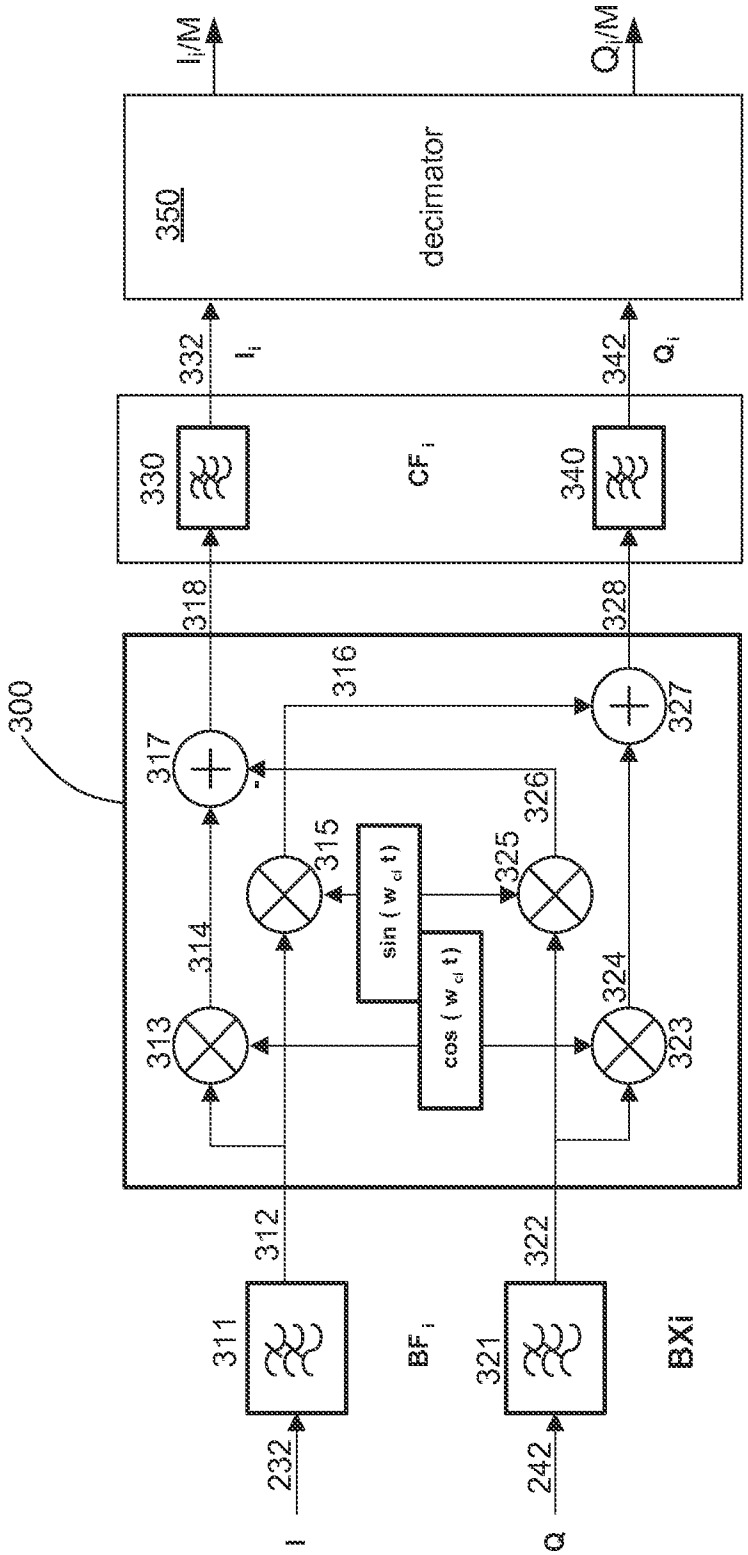

I
Q
232
242
311
321
312
322
BF$_i$
BXi
313
323
314
324
315
325
326
316
317
327
318
328
sin (w$_{ci}$ t)
cos (w$_{ci}$ t)
300
330
340
332
342
CF$_i$
I$_i$
Q$_i$
350
decimator
I$_i$/M
Q$_i$/M

FIG. 3

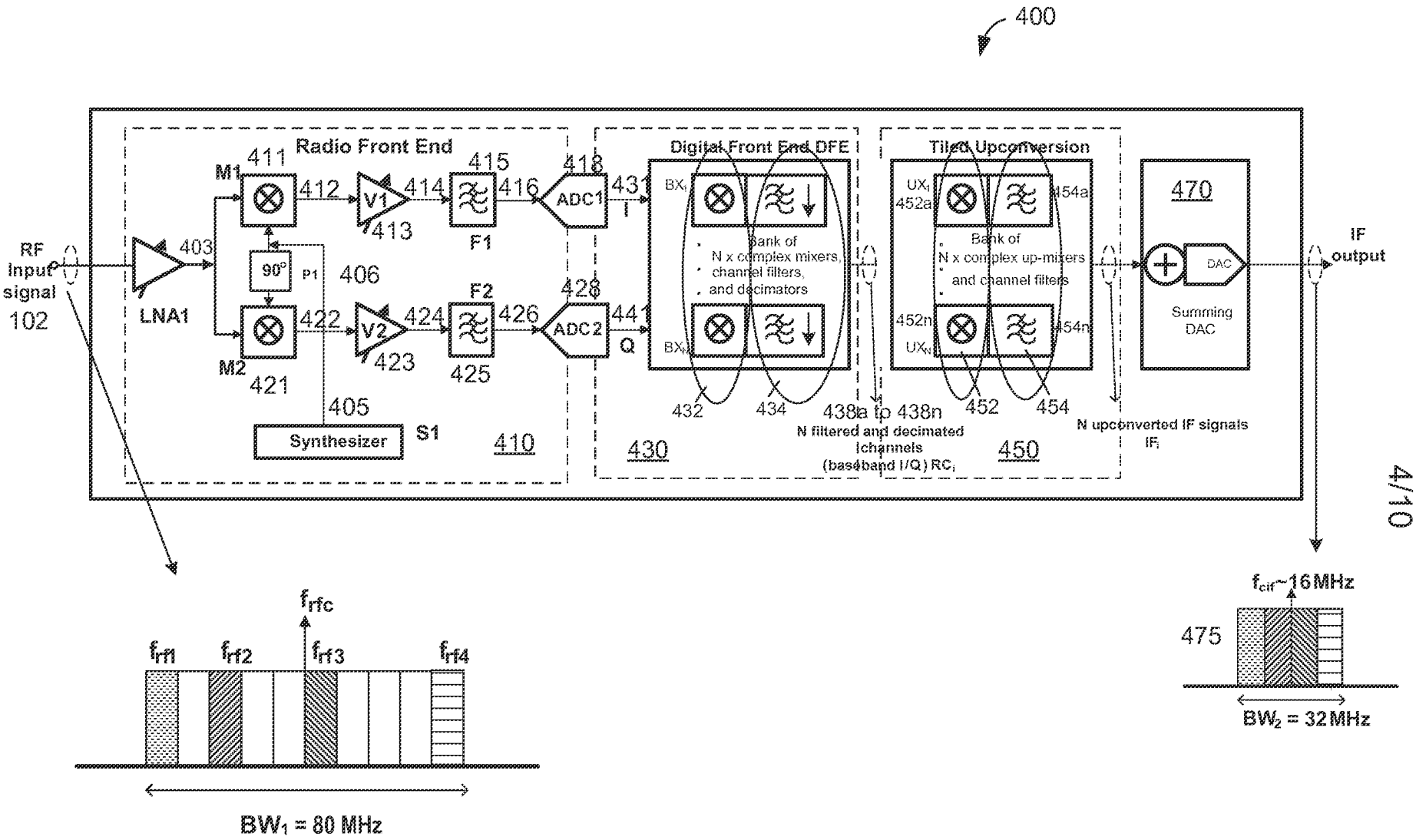

400
Radio Front End
Digital Front End DFE
Tiled Upconversion
RF Input signal
102
LNA1
403
M1
411
412
V1
413
414
415
F1
416
ADC1
418
I
431
90°
P1
406
405
Synthesizer
S1
410
M2
421
422
V2
423
424
F2
425
426
ADC2
428
Q
441
BX1
BXN
Bank of N x complex mixers, channel filters, and decimators
430
432
434
438a to 438n
N filtered and decimated channels (baseband I/Q) RC1
UX1
452a
UXN
452n
Bank of N x complex up-mixers and channel filters
450
454a
454n
452
454
N upconverted IF signals IFi
470
DAC
Summing DAC
IF output
frfc
frf1
frf2
frf3
frf4
BW1 = 80 MHz
fcif~16MHz
475
BW2 = 32MHz

FIG. 4

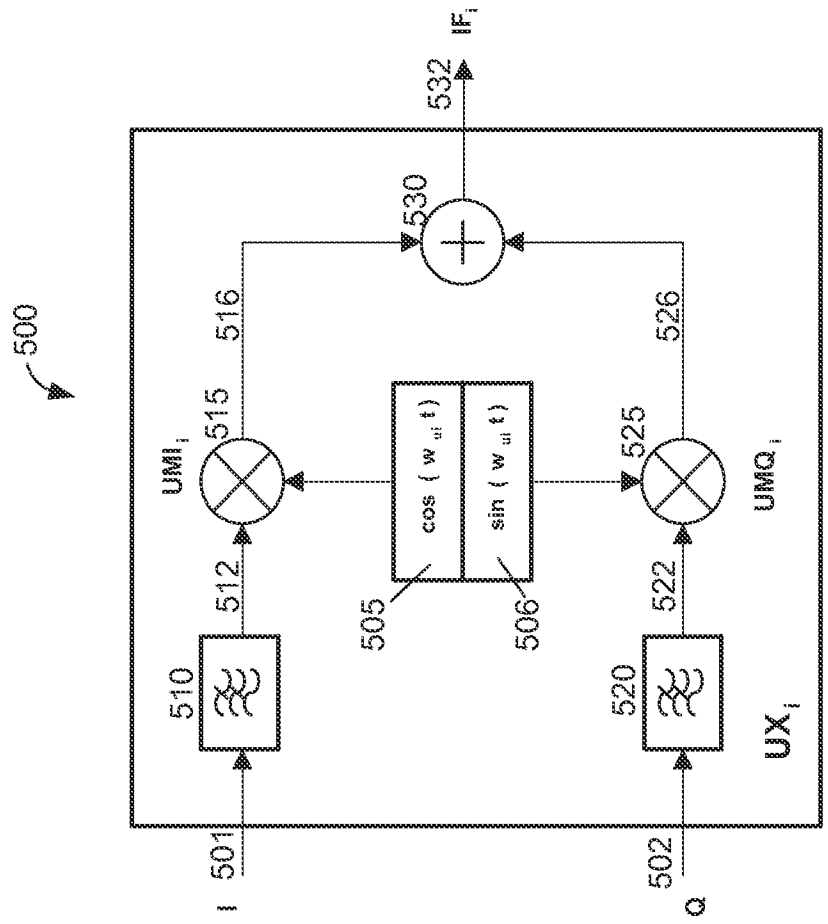

500
501
I
502
Q
510
512
520
522
505
506
cos (w ui t)
sin (w ui t)
515
525
516
526
530
532
UMI i
UMQ i
UX i
IF i

FIG. 5

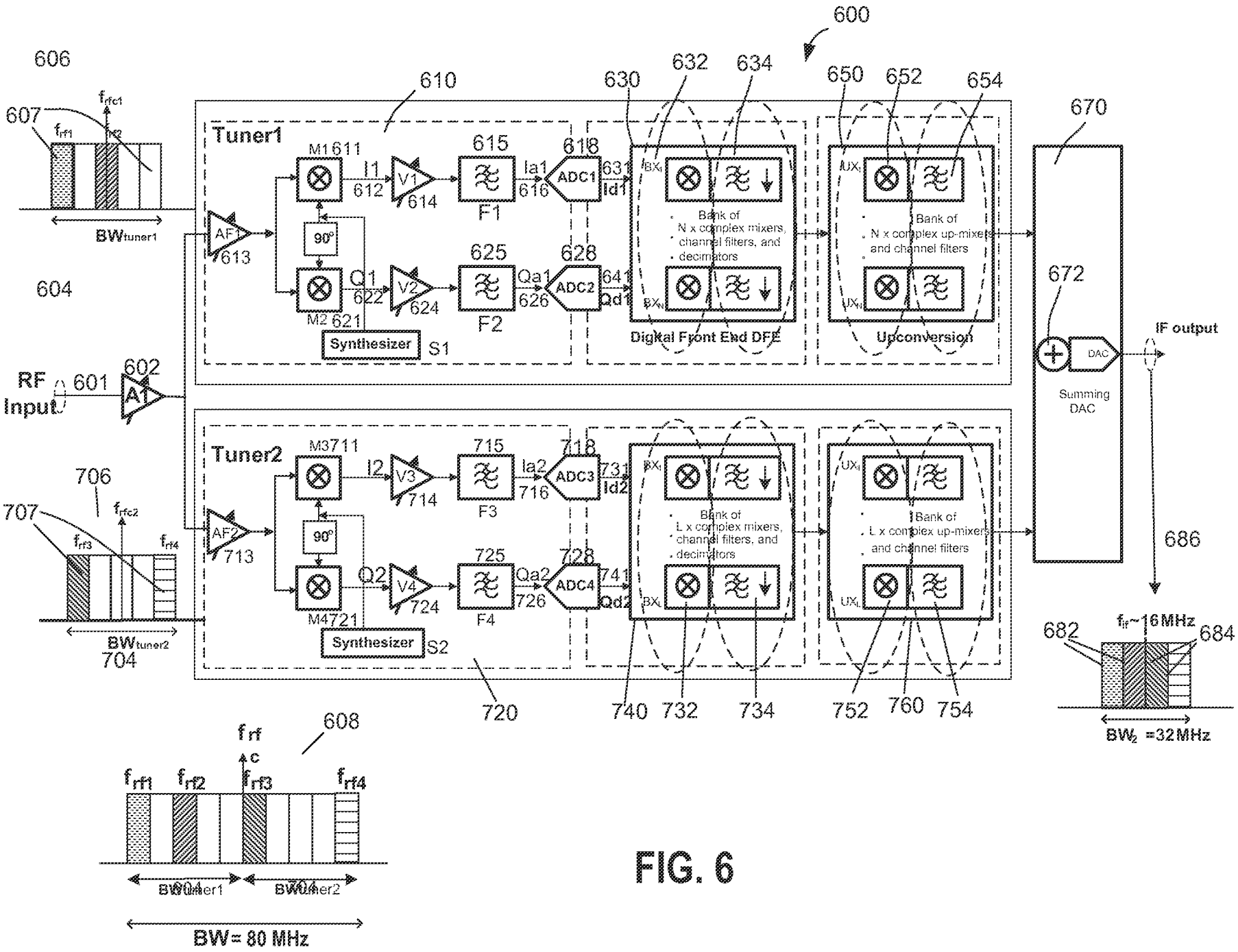

600
606
607
f_{rfc1}
f_{rf1}
f_{rf2}
BW_{tuner1}
610
Tuner1
M1 611
I1
612
V1
614
615
F1
618
Ia1
616
ADC1
631
Id1
AF1
613
90°
M2 621
Q1
622
V2
624
625
F2
628
Qa1
626
ADC2
641
Qd1
Synthesizer
S1
604
630
632
634
Bank of
N x complex mixers,
channel filters, and
decimators
Digital Front End DFE
650
652
654
Bank of
N x complex up-mixers
and channel filters
Upconversion
670
672
DAC
Summing
DAC
IF output
686
RF
Input
601
602
AF
Tuner2
M3 711
I2
714
715
F3
718
Ia2
716
ADC3
731
Id2
AF2
713
M4 721
Q2
724
725
F4
728
Qa2
726
ADC4
741
Qd2
Synthesizer
S2
720
740
732
734
752
760
754
706
707
f_{rfc2}
f_{rf3}
f_{rf4}
BW_{tuner2}
704
682
f_{if}~16MHz
684
BW_2 =32MHz
608
f_{rf}
c
f_{rf1}
f_{rf2}
f_{rf3}
f_{rf4}
BW_{tuner1}
BW_{tuner2}
BW= 80 MHz

FIG. 6

379

6/10

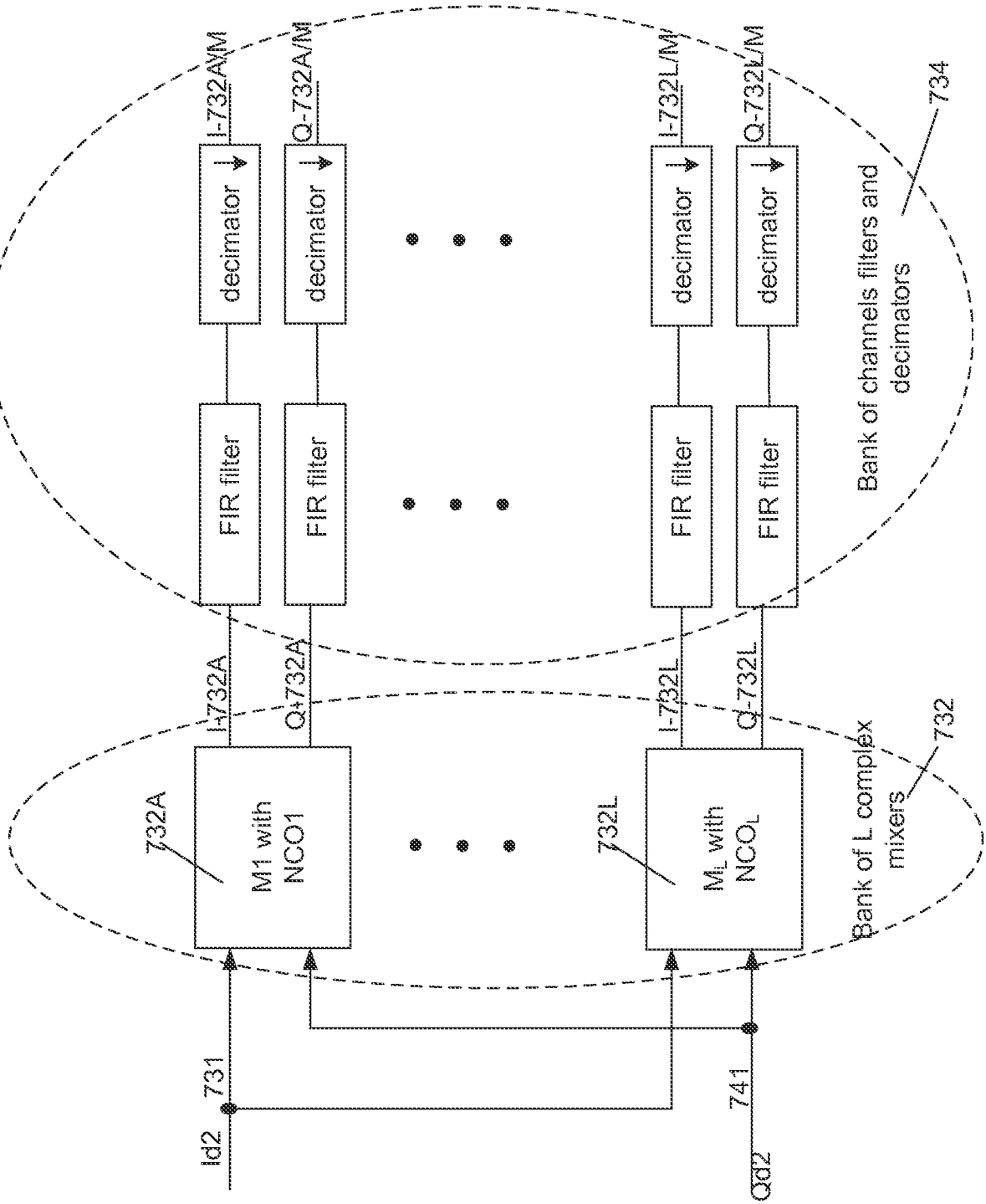

Id2
731
Qd2
741
732A
M1 with NCO1
732L
M_L with NCO_L
Bank of L complex mixers
732
I-732A
Q-732A
I-732L
Q-732L
FIR filter
decimator
I-732A/M
Q-732A/M
I-732L/M
Q-732L/M
Bank of channels filters and decimators
734

FIG. 7

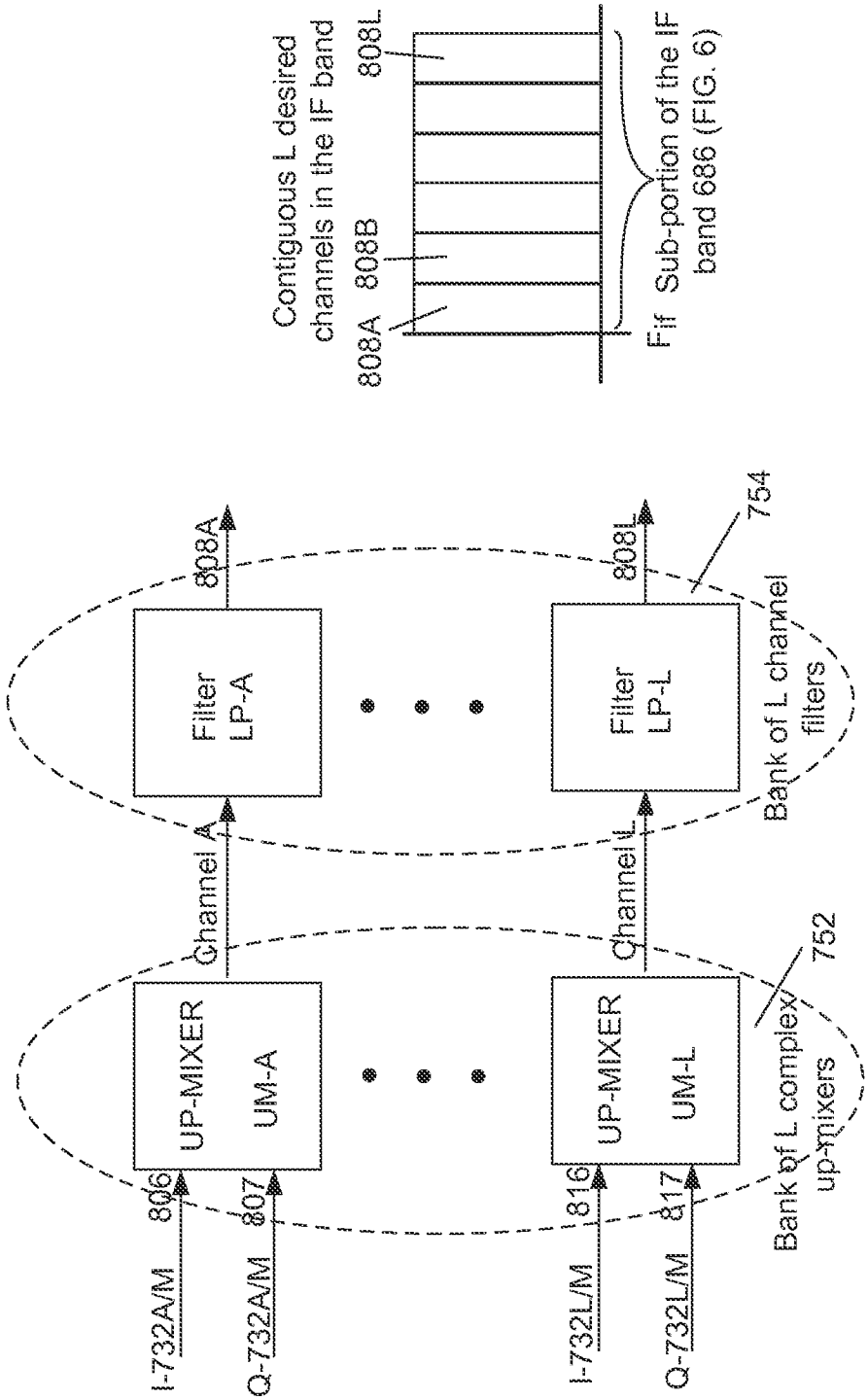

Contiguous L desired channels in the IF band
808L
808B
808A
Fif
Sub-portion of the IF band 686 (FIG. 6)
754
808A
808L
Filter LP-A
Filter LP-L
Bank of L channel filters
Channel A
Channel L
752
UP-MIXER UM-A
UP-MIXER UM-L
Bank of L complex up-mixers
806
807
816
817
I-732A/M
Q-732A/M
I-732L/M
Q-732L/M

FIG. 8

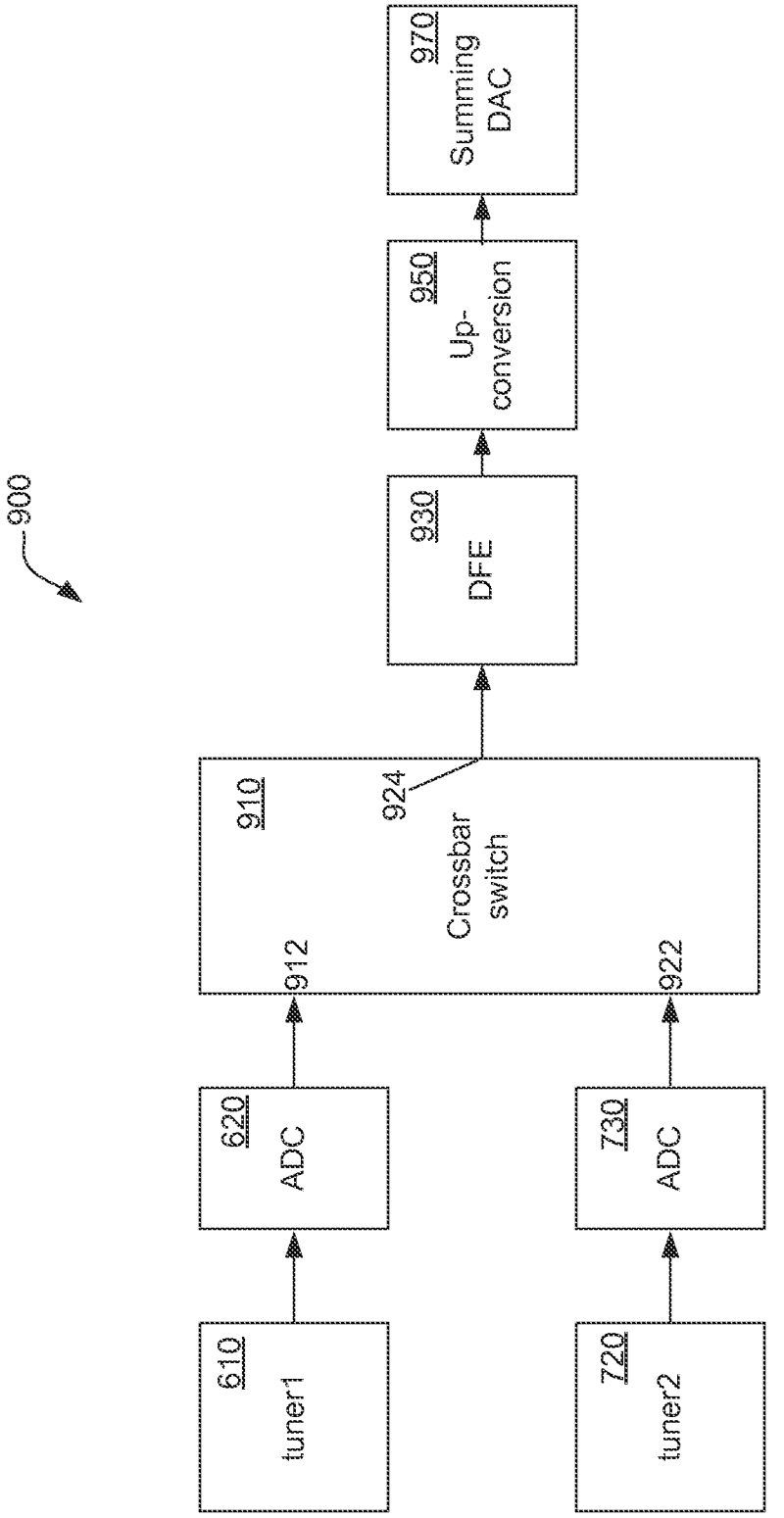

900
610
tuner1
620
ADC
720
tuner2
730
ADC
910
912
922
924
Crossbar switch
930
DFE
950
Up-conversion
970
Summing DAC

FIG. 9

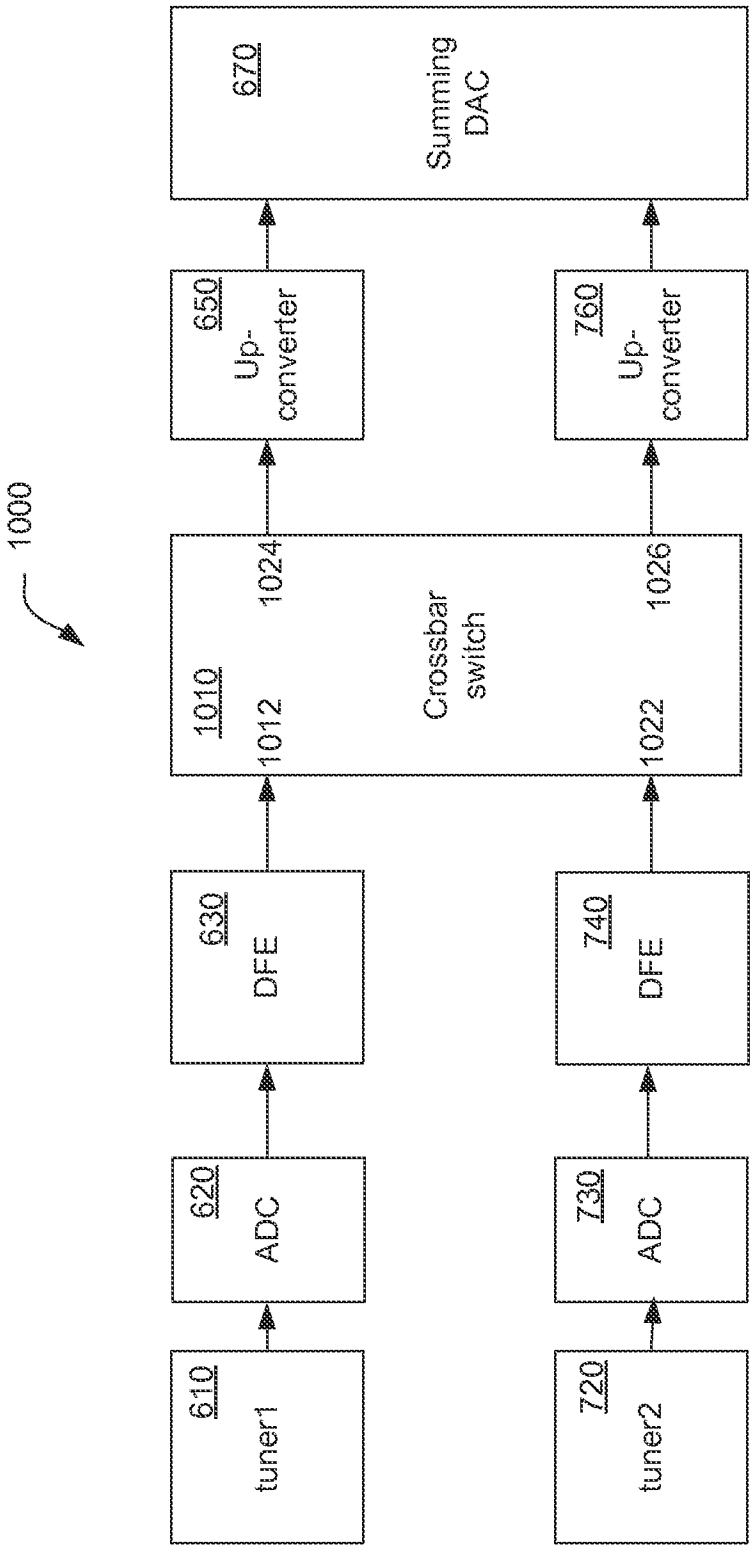

1000
610
tuner1
620
ADC
630
DFE
1010
1012
1024
Crossbar
switch
1022
1026
650
Up-
converter
670
Summing
DAC
720
tuner2
730
ADC
740
DFE
760
Up-
converter

FIG. 10

Attorney Docket No. 89194-002720US-883946

PTO/AIA/01 (06-12)
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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	WIDEBAND TUNER ARCHITECTURE

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 13/962,871

filed on August 8, 2013.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

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LEGAL NAME OF INVENTOR

Inventor: Madhukar Reddy Date (Optional) : _____

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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Attorney Docket No. 89194-002720US-883946

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LEGAL NAME OF INVENTOR

Inventor: Curtis Ling Date (Optional) :

Signature:

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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LEGAL NAME OF INVENTOR

Inventor: Tim Gallagher Date (Optional): _____

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

☑ Practitioners associated with Customer Number: 23,446

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications a ssigned only to the undersigned according to the USPTO assignment records or assignments docu ments attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

☑ The address associated with Customer Number: 23,446

OR

☐	Firm or Individual Name		
	Address		
	City		
	Country		
	Telephone		Email

Assignee Name and Address: MaxLinear, Inc.
2051 Palomar Airport Road, Suite 100
Carlsbad, CA 92011

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/SB/96 or equivalent) is required to be Filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature		Date	12DEC2012
Name	Curtis Ling, Ph.D.	Telephone	(760) 692-0711
Title	Chief Technology Officer		

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	WIDEBAND TUNER ARCHITECTURE
First Named Inventor/Applicant Name:	Madhukar Reddy
Filer:	Chad M. Gilles/Laura Foley
Attorney Docket Number:	28427US04

Filed as Small Entity

Filing Fees for Track I Prioritized Examination - Nonprovisional Application under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility filing Fee (Electronic filing)	4011	1	70	70
Utility Search Fee	2111	1	300	300
Utility Examination Fee	2311	1	360	360
Request for Prioritized Examination	2817	1	2000	2000
Pages:				
Claims:				
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Publ. Fee- Early, Voluntary, or Normal	1504	1	0	0
PROCESSING FEE, EXCEPT PROV. APPLS.	2830	1	70	70

Petition:	
Patent-Appeals-and-Interference:	
Post-Allowance-and-Post-Issuance:	
Extension-of-Time:	
Miscellaneous:	
Total in USD ($)	**2800**

Electronic Acknowledgement Receipt

EFS ID:	21407506
Application Number:	14614543
International Application Number:	
Confirmation Number:	5785
Title of Invention:	WIDEBAND TUNER ARCHITECTURE
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Customer Number:	23446
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Attorney Docket Number:	28427US04
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Filing Date:	
Time Stamp:	11:43:37
Application Type:	Utility under 35 USC 111(a)

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Exhibit 1013

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Classical and Modern Receiver Architectures

Shahriar Mirabbasi and Ken Martin, University of Toronto

ABSTRACT

This article is a review of several classical and modern wireless receiver architectures used in wideband wireless communication systems. The emphasis is on configurations suitable for integration on a single silicon chip. A full understanding of the design trade-offs discussed in this article is necessary for the proper introduction of a new modulation scheme presented in the companion article, "Hierarchical QAM: A Spectrally Efficient DC-Free Modulation Scheme" [1].

INTRODUCTION

The recent surge in applications of radio frequency (RF) transceivers has been accompanied by aggressive design goals such as low cost, low power dissipation, small form factor [2], and high-speed data transfer. These goals are driven by both the need for better portability and affordability, and the ever-increasing demand for higher-speed data communications. Such objectives, together with the usual bandwidth limitations, not only call for highly integrable transceiver architectures, but also for bandwidth-efficient modulation schemes.

To address the demand for better portability and affordability, recent research has been focused toward the development of monolithic transceiver architectures, especially using low-cost complementary metal-oxide semiconductor (CMOS) technology. This approach provides the possibility of integrating analog and digital circuitry on the same chip. In addition, the use of new systems and circuit design techniques facilitates the highest levels of receiver and transmitter integration [3]. Various suitable architectures have been proposed for implementation in deep-submicron CMOS technologies [2–5].

In this article, we review several classical and recently proposed receiver architectures, and discuss their advantages and disadvantages. In a companion article [1], a new spectrally efficient dc-free modulation scheme, suitable for highly integrable receiver architectures, is introduced.

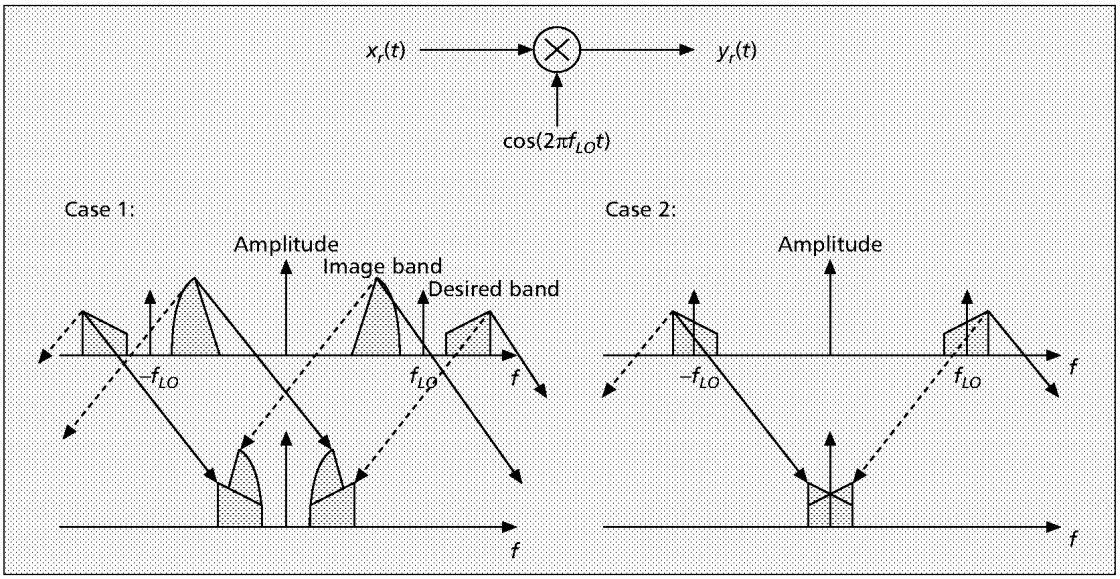


Figure 1. *Mixing a real signal with a real sinusoid for two cases, where f_{LO} is not equal (case 1) and equal (case 2) to the center freqeuncy of the desired signal. The spectra of the inputs of the mixer and the corresponding spectrum of the output of the mixer are shown.*

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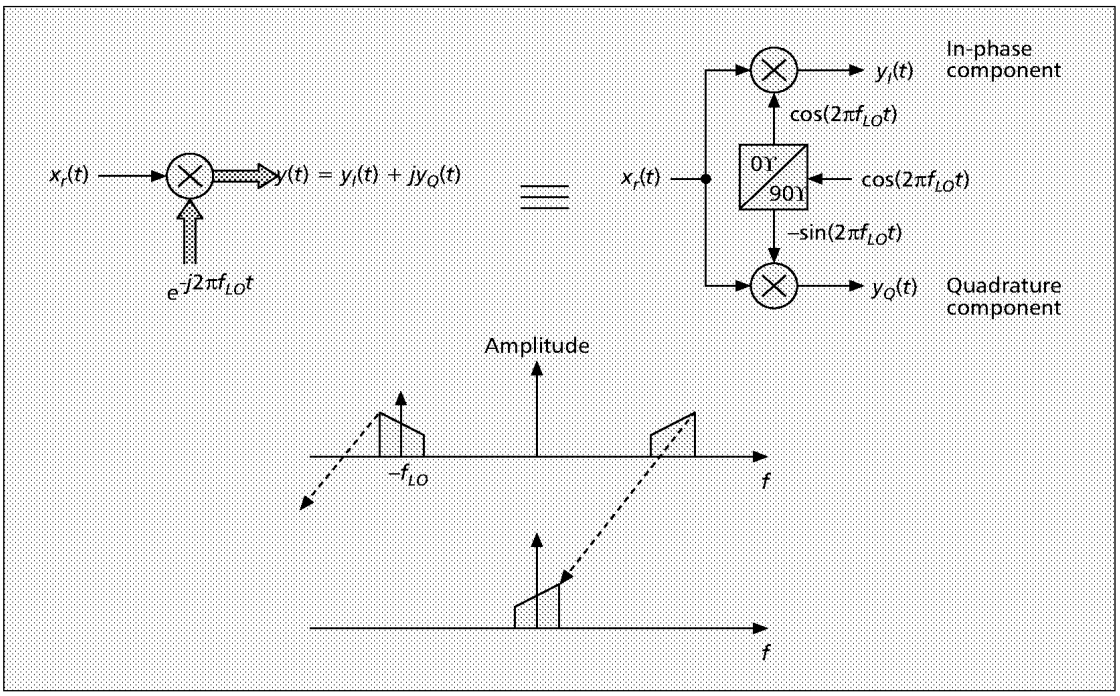


Figure 2. *Mixing a real signal with a complex exponential. The spectra of the real and complex inputs of the mixer, and the spectrum of the complex output of the mixer are shown. Here, complex signals are represented by double lines.*

To address the demand for better portability and affordability, recent research has been focused toward the development of monolithic transceiver architectures, especially using low-cost complementary metal-oxide semiconductor technology.

Background: Real and Complex Mixing

In preparation for the main discussion on receiver architectures, it is useful to review the *image band problem* related to frequency downconversion, an essential operation in any RF receiver. This will be done using complex representation of signals and complex mixing, techniques also useful for the discussions in the companion article [1].

Typically, frequency downconversion of a passband signal is performed by multiplying (mixing) the signal with a sinusoid such as $\cos(2\pi f_{LO}t)$. This is illustrated in Fig. 1 for the two cases in which the frequency of the sinusoid is different from and equal to the center frequency of the signal. Note that for a real signal, the negative and positive Fourier components are complex conjugates of each other. A multiplication in the time domain is equivalent to a convolution in the frequency domain. Since the Fourier transform of a sinusoid contains two equal-amplitude impulses symmetrically placed around zero on the frequency axis, the spectrum of the mixer output signal is the superposition of the positive and negative shifted versions of the spectrum of the input signal. As shown in Fig. 1, two frequency bands symmetric around the multiplying frequency are downconverted to the same output band. The undesired input signal band, which will be superimposed on the desired signal band after mixing, is called the *image band*. It is necessary to suppress any signal in the image band prior to the mixing operation. This is the task of the image-reject (IR) filter which usually precedes the mixer. In the special case where the multiplying frequency is equal to the center frequency of the incoming signal, the image band is the same as the signal band, and the image cannot be eliminated using filtering. Notice that the mixing operation with a real sinusoid generates additional signals above the multiplying frequency. In a typical receiver these high-frequency components (not shown explicitly in Fig. 1) are usually filtered out with a low-pass filter.

The previously discussed image problem arises due to the fact that the frequency spectrum of a real sinusoid contains impulses at both positive and negative frequencies. One way to avoid this problem is to mix the signal with a complex exponential, say $e^{-j2\pi f_{LO}t}$, which has only a single frequency component, in this case at a negative frequency ($-f_{LO}$). Although all physical signals are real, complex signals are a convenient mathematical representation for a pair of real signals [5, 6]. A complex signal, $x(t) = x_r(t) + jx_i(t)$, consists of a real part and an imaginary part, $x_r(t)$ and $x_i(t)$, respectively, where $x_r(t)$ and $x_i(t)$ are real signals and

$$j = \sqrt{-1}.$$

Complex signals are processed according to the rules of complex arithmetic. In general, they can have negative and positive frequency components totally different from each other. As an example, the complex exponential $e^{-j2\pi f_{LO}t} = \cos(2\pi f_{LO}t) - j\sin(2\pi f_{LO}t)$, has only a single negative-frequency component. Therefore, mixing a real signal with this negative-frequency complex exponential gives a complex signal whose spectrum is a shifted version of the real signal spectrum. *Theoretically*, this eliminates the image problem associated with frequency shifting when mixing with a real sinusoid.

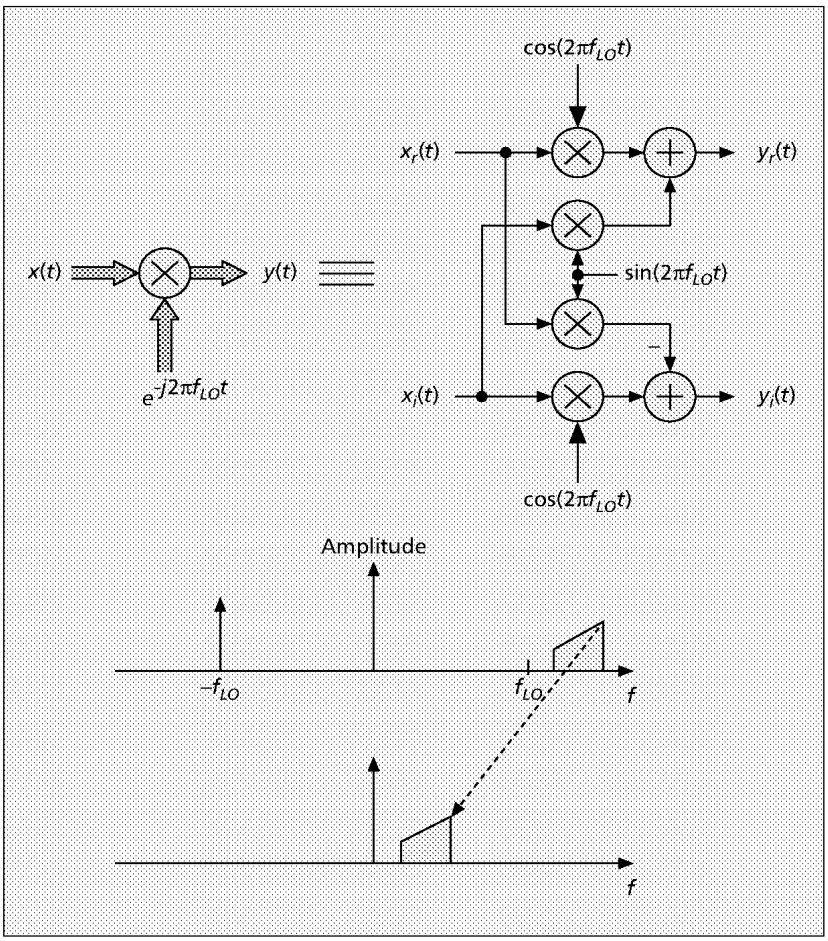


Figure 3. *Mixing a complex signal with a complex exponential. The spectra of the complex inputs of the mixer, and the spectrum of the complex output of the mixer are shown.*

The realization of a multiplier for mixing a real signal with a complex exponential requires two real multipliers, as illustrated in Fig. 2. The real and imaginary parts of the mixer output are called the *in-phase* (I) and *quadrature* (Q) components of the downconverted signal (since cosine and sine are in quadrature). In Fig. 2 the frequency of the complex exponential is chosen to be the same as the center frequency of the passband signal, for comparison with case 2 in Fig. 1. In this case there is no image problem associated with the complex mixer. As discussed in the following section, this fundamental property is used in homodyne receivers.

Now, consider the general case of mixing two complex signals $x(t) = x_r(t) + jx_i(t)$ and $z(t) = z_r(t) + jz_i(t)$: $x(t) \cdot z(t) = (x_r(t) \cdot z_r(t) - x_i(t) \cdot z_i(t)) + j(x_r(t) \cdot z_i(t) + x_i(t) \cdot z_i(t))$. A practical realization of this complex mixer using four real mixers is shown in Fig. 3. Complex mixing is used in IR mixers. These mixers are employed in some recently proposed receiver architectures, discussed later.

In some cases, only the real or imaginary part of a complex mixer output is of interest. One example is the quadrature amplitude modulation (QAM) system modulator [6]. Extracting the real (or imaginary) part of a complex mixer output can be implemented efficiently as shown in Fig. 4. Here, the complex mixer is implemented with two real mixers and one adder.

As a final point, it should be mentioned that in analyzing receivers for undesired image components, it is often necessary to isolate the positive and negative frequency components of the received signal. Figure 5 shows a block diagram of the system for converting an arbitrary complex signal into one that contains only the positive frequency components of the original signal. In this figure, the block with transfer function $-j \cdot \text{sgn}(\omega)$ is the well known Hilbert transformer which shifts its input signal phase by –90° for positive frequencies and +90° for negative frequencies.

Receiver Architectures

Most of the wireless transceivers used so far are based on a conventional heterodyne architecture. These transceivers have good performance, but suffer from high production costs and require a relatively large form factor due to expensive and nonintegrable RF and intermediate frequency (IF) filters. In this section we briefly review the conventional heterodyne receiver topology along with some other recently developed receiver architectures, and discuss their advantages and disadvantages. For each particular receiver architecture, there exists a corresponding transmitter architecture with essentially the same fundamental building blocks. The exception to this regards the transmitter power amplifier, which, although important, is beyond the scope of this article. Therefore, in our review we focus on receiver structures. Further discussions of transmitter architectures can be found in [5, 7].

Conventional Heterodyne Receivers

Most of today's commercially available RF transceivers utilize some variant of conventional heterodyne architecture. In a heterodyne receiver, as shown in Fig. 6, the RF front-end (preselection) filter serves to remove out-of-band signal energy as well as partially reject image band signals. After this prefiltering, the received signal is amplified by a low-noise amplifier (LNA). The IR filter following the LNA further attenuates the undesired signals at the image band frequencies. The desired signal at the output of the IR filter is then downconverted from the carrier frequency to a fixed IF by multiplication (mixing) with the output of a local oscillator (LO). Commonly, in heterodyne receivers, high-performance, low-phase-noise voltage-controlled oscillators (VCOs) employed as LOs are realized with discrete components such as high-quality-factor (Q) inductors and varactor diodes [3].

At the output of the mixer an IF filter, typically followed by a programmable-gain IF amplifier, selects the desired channel and reduces the distortion and dynamic range requirements of the subsequent receiver blocks [3]. The signal can be shifted to baseband and demodulated as shown in Fig. 6, or alternatively further downconverted to lower IFs, and then shifted to baseband and demodulated.

Since, at the carrier frequency, the desired band and image band are separated by twice the IF, it is desirable to choose a high IF to reduce

the requirements on the IR filter. In fact, if the IF is chosen high enough that the preselection RF filter can sufficiently attenuate the image band, it might be possible to directly connect the output of the LNA to the mixer without including an IR filter [7]. On the other hand, since channel selection in a heterodyne system is done at the IF, a low IF allows employment of higher-quality channel-select filters. Therefore, the choice of IF depends on the trade-off between image rejection and channel selection. Other factors influencing the choice of IF are availability and the physical size of commercial filters for different frequencies [2].

Conventionally, all the filters used in the heterodyne system are high-Q discrete component filters, such as surface acoustic wave (SAW) or ceramic filters. Compared to other more integrable receiver architectures, the heterodyne receiver has superior performance with respect to *selectivity*, a measure of a receiver's ability to separate the desired band around the carrier frequency from signals received at other frequencies, and *sensitivity*, the minimal signal at the receiver input for which there is sufficient signal-to-noise ratio (SNR) at the receiver output. This is achieved with the use of high-Q discrete components [3].

Employing high-Q elements does come with some drawbacks. A major limitation is that the off-chip IR filters have low input impedance. This requires a high drive capability for the preceding LNA, inevitably leading to more severe trade-offs between gain, noise figure, stability, and power dissipation in the amplifier [7]. Furthermore, these high-Q filters are difficult and somewhat impractical when realized at high frequencies in an integrated solution, primarily because integrated inductors have at best only moderate Q-factors. In addition, the narrowband discrete-component IF channel-select filter of the heterodyne receiver tailors the particular implementation to a specific standard [3].

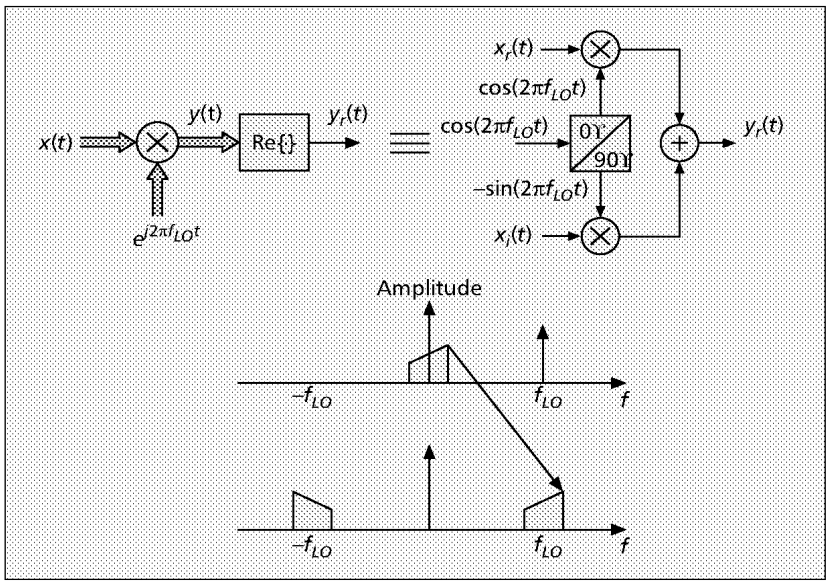


Figure 4. *An efficient implementation for a complex mixer when only a real part of the mixer output is of interest. The spectra of the complex inputs of the mixer, and the spectrum of the real part of the mixer output are shown. Note that since the final output is real signal, its spectrum is complex-conjugate symmetric.*

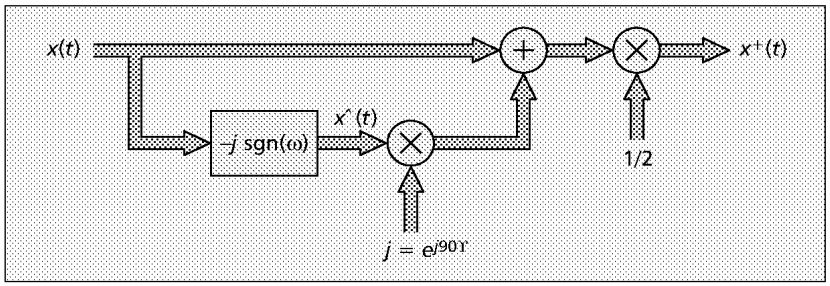


Figure 5. *A system that extracts positive frequency components of the input signal. By changing* $e^{j90°}$ *to* $e^{-j90°}$ *(i.e.,* j *to* –j*) in the multiplier, the system would extract the negative frequency components of the input.*

Direct-Conversion Architecture

Direct conversion, also known as *homodyne* or *zero-IF conversion*, is a natural approach to downconverting an RF signal directly to baseband. Alternately, one can think of choosing IF to be zero. This architecture, shown in Fig. 7, employs low-pass filtering in the baseband to suppress nearby interferers and select the desired channel. The quadrature downconversion (I and Q channels) is necessary in typical amplitude and phase or frequency modulated signals because in general the two side-bands of the RF spectrum are different. Mixing with a real sinusoid would result in irreversible corruption of the transmitted information [2]. Note that quadrature downconversion is equivalent to complex mixing, discussed previously (Fig. 2).

The homodyne architecture has several fundamental advantages over the heterodyne counterpart. The intermediary IF stages are removed,

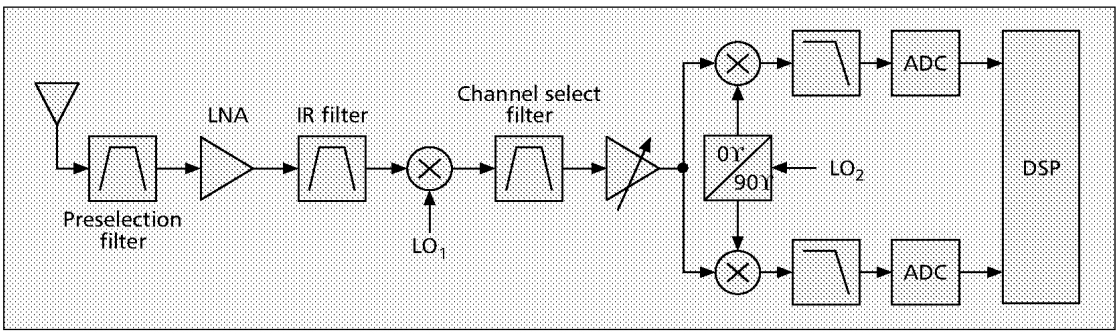


Figure 6. *A generic heterodyne receiver.*

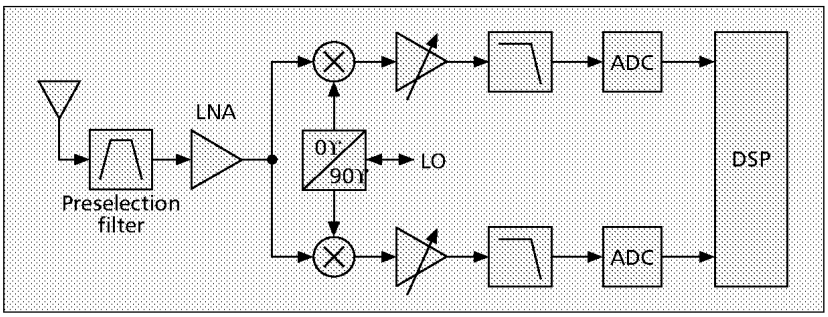


Figure 7. *A generic homodyne receiver.*

and the need for the IR filter is eliminated. Furthermore, the absence of the bulky off-chip IR filters removes the LNA requirement to drive a low impedance load. The functions of channel selection and subsequent amplification at a nonzero IF are replaced with low-pass filtering and baseband amplification, amenable to monolithic integration.

Despite this suitability for higher levels of integration, a homodyne receiver exacerbates a number of issues that either do not exist or are not as serious in a heterodyne receiver. Next, we will briefly review some of these issues.

DC-Offsets — Perhaps the most serious problem is that of dc-offset in the baseband section of the homodyne receiver [4]. These extraneous offset voltages can corrupt the desired signal and/or saturate the following stages. They arise due to the self-mixing phenomenon of the local oscillator or the in-band interferer, aside from the usual element mismatch in the signal path circuitry.

To better understand the origin of these offsets, consider the received signal path shown in Fig. 8. First, the isolation between the LO port and the inputs of the mixer and the LNA is not perfect, and a finite amount of feedthrough exists from the LO port to the other mixer input and to the input of the LNA. Known as *LO leakage*, this effect arises from capacitive and substrate coupling and, if the LO signal is provided externally, through bond-wire coupling. The leakage signal appearing at the inputs of the LNA and the mixer is now mixed with the original LO signal, thus producing a dc component at the output of the mixer. This LO self-mixing can be quite severe, and a time-varying dc-offset occurs when the LO signal leaks out through the antenna, and is radiated and reflected from nearby objects back to the receiver. A similar effect occurs if a large in-band interferer (in the passband of the RF preselection filter) leaks from the LNA output to the mixer LO port and gets multiplied by itself [7]. It should be noted that these dc-offsets exist in heterodyne receivers as well, but are mostly eliminated naturally by the IF band-pass filters.

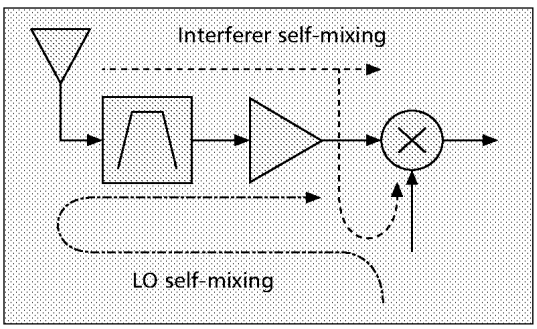


Figure 8. *Self-mixing of the LO and/or of an interferer in homodyne receiver front-end.*

Thus, direct-conversion receivers require appropriate methods to remove undesired dc offsets. A simple approach is to use ac-coupling in the downconverted signal path. However, since the spectra of all the spectrally efficient modulation schemes currently used exhibit significant energy at dc, such signals are corrupted by ac-coupling filters [4]. A better method is the use of baseband analog and/or digital signal processing (DSP) techniques for offset estimation and cancellation [3][7]. However, these techniques add complexity and do not solve the problems associated with $1/f$ noise at low frequencies in CMOS implementations, a significant issue.

A natural system solution to the dc offset problem in direct-conversion receivers is to minimize the baseband signal energy near dc by choosing a "dc-free" modulation scheme and use ac-coupling for offset elimination. This approach has been successfully used in pager systems with frequency shift keying (FSK) modulation, despite the spectral inefficiency of FSK [4]. In the companion article [1] we introduce a new spectrally efficient dc-free modulation scheme.

LO Leakage — In addition to introducing dc offsets, leakage of the LO signal to the antenna and radiation from there creates in-band interference for other receivers using the same standard [7]. This problem becomes less severe as more sections of RF receivers are fabricated on the same chip. With differential LOs, the net coupling to the antenna can approach acceptably low levels [2].

I/Q Mismatch — As mentioned earlier, for most currently used modulation schemes, a homodyne receiver must incorporate quadrature downconversion. This requires shifting either the RF signal or the LO output by 90°. Since phase-shifting the RF signal generally entails severe noise-power-gain trade-offs [2] and is especially difficult for the wideband signals used in high-data-rate systems, it is often desirable to shift the LO output (Fig. 7). In either case, the errors in the nominally 90° phase shift and mismatches between the amplitudes of the I and Q signal paths corrupt the downconverted signal constellation, thereby increasing the bit error rate. Note that all sections of the circuit in the I and Q paths contribute to gain and phase mismatches.

To gain more insight into the effect of I /Q mismatch, and show the versatility and convenience of using complex formulation, consider the practical case where the quadrature LO generates the complex signal $x_{LO}(t) = \cos(\omega_{LO}t) - j(1 + \varepsilon)\sin(\omega_{LO}t + \theta)$. Here, ε and θ represent LO gain and phase errors. One can rewrite the quadrature LO output as

$$x_{LO}(t) = \frac{1}{2}\left[1-(1+\varepsilon)e^{j\theta}\right]e^{j\omega_{LO}t} + \frac{1}{2}\left[1+(1+\varepsilon)e^{-j\theta}\right]e^{-j\omega_{LO}t}.$$

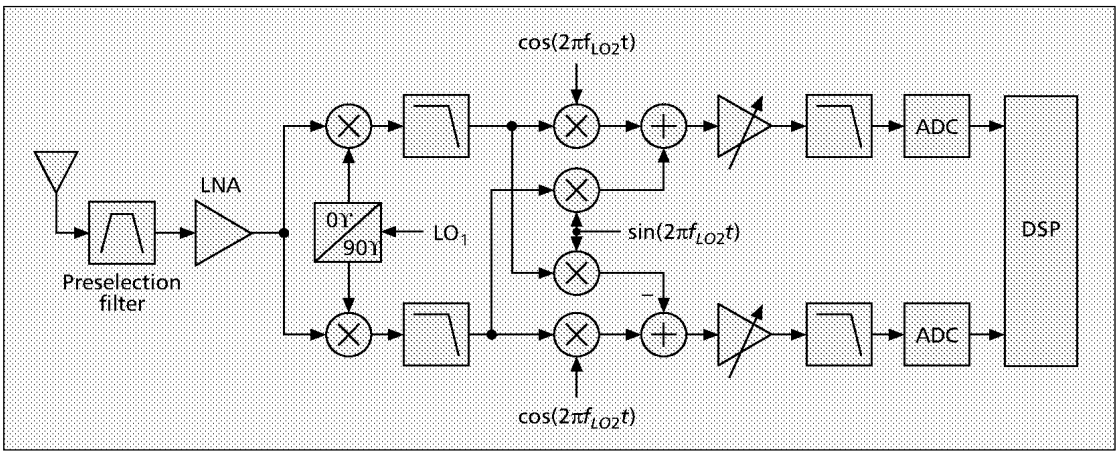


Figure 9. *A double-conversion wideband IF receiver.*

Aside from the problems mentioned here, direct-conversion receivers are sensitive to even-order distortions. Also, since the downconverted spectrum is located around zero frequency, the flicker noise of the devices has a profound effect on the SNR, a severe problem in CMOS implementations.

Ideally, the complex LO output should contain only the negative frequency. However, from the above expression it is apparent that, due to gain and phase errors, there is a positive frequency component with a magnitude of $|1 - (1 + \varepsilon)e^{j\theta}|/2$. This component causes interfering images and, if not compensated for, can deteriorate receiver performance. One can consider the effects of gain and phase mismatches separately. The magnitude of the undesired positive frequency component for gain mismatch is $|\varepsilon|/2$, and for phase mismatch $|\sin(\theta/2)|$, which can be approximated by $|\theta|/2$ when the phase mismatch is small.

Aside from the problems mentioned above, direct-conversion receivers are sensitive to even-order distortions. Also, since the downconverted spectrum is located around zero frequency, the flicker ($1/f$) noise of the devices has a profound effect on the SNR, a severe problem in CMOS implementations [2]. Furthermore, integrating the high-frequency low-phase-noise channel-select frequency synthesizer is difficult to achieve with low-Q VCOs available on integrated circuits [3].

Despite all these problems, direct-conversion transceivers for digital mobile phones using silicon bipolar technology have been in full production at Alcatel since 1991 [8]. The same company recently introduced a direct-conversion transceiver in a silicon germanium BiCMOS process [9] for the Global System for Mobile Communications (GSM) group of standards. In these transceivers, in order to handle the problems associated with static and dynamic dc offsets, DSP algorithms are used. These algorithms rely on the constant-envelope property of the modulation scheme used in GSM. To the best of the authors' knowledge, direct-conversion transceivers have not been used commercially in systems with nonconstant envelope modulation schemes, which are required in high-data-rate communication systems.

Wideband IF with Double-Conversion Receiver Architecture

This alternative architecture [3, 10], well suited to full integration, is shown in Fig. 9. In this receiver, after preselection filtering and amplification, all potential RF channels are complex-mixed and downconverted to IF. As discussed previously related to Fig. 2, there is no image problem. A second complex mixing is done from IF to baseband, using a tunable channel-select frequency-synthesizer. In this complex mixer, by properly adding the outputs of the real multipliers in pairs, the image frequencies are canceled while the desired channels add constructively. If the IF is chosen high enough, additional image rejection may be obtained from the RF front-end preselection filter [3].

Comparing the two integrated solutions discussed so far, in both architectures channel selection is performed at baseband, allowing the possibility of a programmable integrated channel-select filter for multistandard receiver applications. However, the wideband IF architecture has some advantages over the homodyne counterpart, which will now be discussed. Due to the fact that channel tuning is performed not using the first (RF) synthesizer but the lower-frequency (IF) LO, the RF LO can be implemented as a fixed-frequency crystal-controlled oscillator. Several techniques may be utilized to realize a low-phase-noise fixed LO with low-Q on-chip components [3]. Also, since tuning is performed with the IF LO operating at a lower frequency, the phase-noise performance of this oscillator can be significantly better than that of the tunable RF oscillator employed in a homodyne receiver. Furthermore, since in the wideband IF system there is no LO operating at the same frequency as the incoming RF carrier, the potential problems associated with LO leakage and time-varying dc offsets are minimized. Although in the wideband IF system the second LO is at the same frequency as the desired IF channel, the dc offset which results at the baseband from self-mixing is relatively constant and may be cancelled using adaptive signal processing methods [3].

The particular IR mixer used in this architecture, which is similar to the Weaver technique [11], has several advantages. First, lossy passive phase-shifting filters are not required in the signal path to generate the correct phase shift between the image and desired bands. Second, assuming again that the upconverted terms are removed, the image-rejection is very

As in wideband IF systems, if one employs two quadrature downconversion paths in a heterodyne receiver, then all of the required information for the separation of the wanted signal from unwanted signals, such as images, is available in the two IF signals.

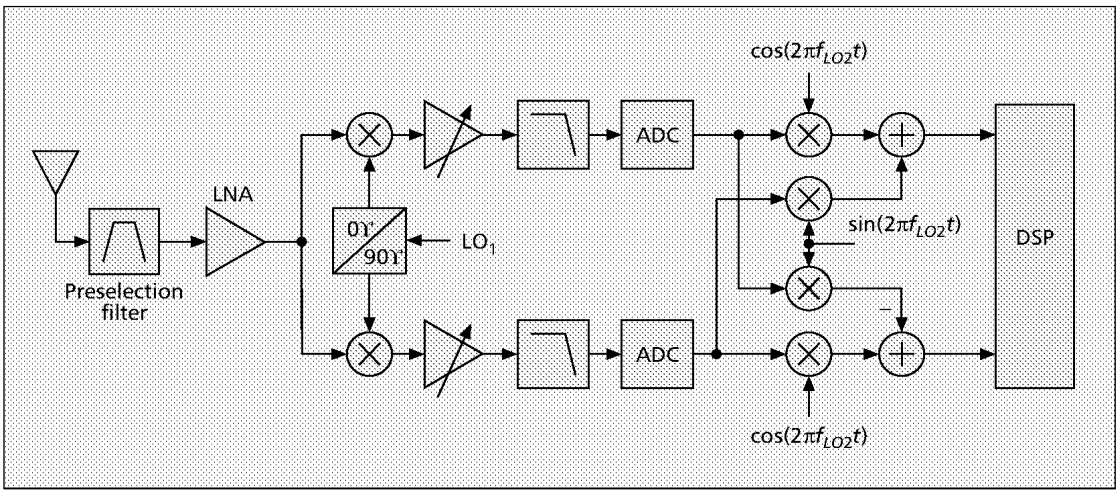


Figure 10. *A low-IF receiver.*

wideband. Also, it can be shown that the edge of the image attenuation band is set by the frequency of the first LO, which leads to the third advantage. If it is assumed that a multistandard-capable receiver is built where the frequency of the first LO can perform a course adjustment to accommodate the carrier frequency of a different standard, the image rejection will follow the first LO, and it can be thought of as a self-aligning IR mixer [3]. Note that the structure of this IR mixer (consisting of four multipliers and two adders) is the same as that of the complex mixer of Fig. 3. A detailed analysis of this IR mixer based on complex signal theory is given in [5].

The limitations of wideband IF receivers are as follows. Since the first LO is fixed in frequency, all channels must pass through the IF stage (the desired channel is selected using a second LO). This has two problematic implications: first, as a result of moving the channel selection to a lower frequency, the IF synthesizer requires a VCO with the capability of tuning across a broader frequency range as a percentage of the nominal operating frequency; second, by removing the channel-select filter at IF, strong adjacent channel interferers are now a concern for the second mixer stage as well as the baseband blocks. This implies a higher dynamic range requirement for these latter receiver stages. Also, as with conventional IR mixers, any I/Q phase and gain mismatch would degrade the performance of the receiver [3].

Low-IF Receiver Architecture

The idea behind low-IF topologies is similar to that of double-conversion wideband IF, and the goal is to combine the advantages of both heterodyne and homodyne receivers [12]. As in wideband IF systems, if one employs two quadrature downconversion paths in a heterodyne receiver, all of the required information for the separation of the wanted signal from unwanted signals, such as images, is available in the two IF signals.

Among the different low-IF topologies mentioned in [5, 10, 12], a preferred version is shown in Fig. 10. This architecture is fairly similar to that of the wideband IF architecture, although there are several subtle differences between the two. First is the choice of IF. While the IF in the wideband IF architecture is typically high, in the low-IF system the IF is chosen as low as one or two times the channel bandwidth. Note that this alleviates the dc offset problem in these two architectures compared to their homodyne counterparts, simply because after the first downconversion the wanted signal is not located around dc. Second, in the low-IF topology it is more feasible to sample the low-IF signal after the first mixer stage with a high resolution analog-to-digital convertor (ADC). Sampling at this point requires an ADC with higher resolution than that required after the IR mixer in wideband IF receivers, because in the former case the wanted signal and unwanted image are sampled. After the first mixer stage, the unwanted image can be much larger than the desired signal.

Although the low-IF architecture requires higher-performance ADCs than does the wideband IF architecture, the signal path to the ADC can be ac-coupled in the low-IF architecture, which in turn eliminates the need for complicated dc offset cancellation circuitry. *Another advantage of this low-IF topology is that part of the complex IR mixer is implemented in the digital domain with no gain and phase I/Q mismatches.* The I/Q imbalances introduced in the preceding analog sections can be corrected using adaptive techniques [13]. Therefore, this strategy shifts the hard specifications from the analog part to the ADCs. Since the performance of integrated ADCs is improving rapidly, this architecture will likely be preferred [12].

Finally, it should be noted that digitizing the received signal at the IF stage can also be employed in conventional heterodyne receiver systems. This approach is sometimes called *digital IF* [7]. In this architecture, the high ADC performance requirements are more challenging to accomplish within a reasonable power dissipation. Despite the advantage of avoiding the I and Q mismatches for typical first IFs in heterodyne receivers, this technique requires a prohibitively fast high-linearity high-dynamic-range ADC, currently limiting its utilization to only base stations [7].

CONCLUSION

In this tutorial, traditional and recent wireless receiver architectures suitable for a single-chip transceiver are reviewed. To simplify analysis of these architectures and gain more insight into their structures, complex signal representation is used. The advantages and disadvantages of each architecture are discussed with emphasis on practical considerations.

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BIOGRAPHIES

SHAHRIAR MIRABBASI [S] (shahriar@eecg.toronto.edu) received a B.Sc. degree in electrical engineering from Sharif University of Technology, Tehran, Iran, in 1990, and an M.A.Sc. degree in electrical engineering from the University of Toronto, Ontario, Canada, in 1997. During the summer of 1997 he worked at Gennum Corporation, Burlington, Ontario, Canada, on the design of cable equalizers for serial digital video andHDTV applications. He is currently working toward a Ph.D. degree in electrical engineering at the University of Toronto. His current research interests include highly integrable wireless transceiver architectures and bandwidth-efficient modulation schemes suitable for high data-rate communication systems.

KEN MARTIN [S'75-M'80-SM'89-F'91] received B.A.Sc., M.A.Sc., and Ph.D. degrees from the University of Toronto, Canada, in 1975, 1977, and 1980. From 1977 to 1978 he was a member of the scientific research staff at Bell Northern Research, Ottawa, Canada, where he did some of the early research in integrated switched-capacitor networks. Between 1980 and 1992 he was consecutively an assistant, associate, and full professor at the University of California at Los Angeles. In 1992 he accepted the endowed Stanley Ho Professorship in Microelectronics at the University of Toronto. He has co-authored a textbook entitled *Analog Integrated Circuit Design* (Wiley, 1997) in addition to three other books co-authored in cooperation with former Ph.D. students. His newest book, *Digital Integrated Circuit Design* (Oxford, 2000), was released in Oct. 1999. He has published over 100 papers and five patents. He was appointed Circuits and Systems IEEE Press Representative (1985–1986). He was selected by the Circuits and Systems Society for the Outstanding Young Engineer Award that was presented at the IEEE Centennial Keys to the Future Program in 1984. He was elected by the Circuits and Systems Society members to their administrative committee (ADCOM 1985-1987) and as a member of the Circuits and Systems BOG (1995-1997). He has served as Associate Editor of *Transactions on Circuits and Systems* from 1985 to 1987.

It should be noted that digitizing the received signal at the IF stage can also be employed in conventional heterodyne receiver systems. This approach is sometimes called "digital IF" architecture.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent of Madhukar Reddy et al.	§	REQUEST FOR *EX PARTE* REEXAMINATION
U.S. Patent No. 9,210,362	§	Attorney Docket No.: 50348.106
Filed: February 5, 2015	§	
Priority: April 17, 2009	§	Customer No.: 27683
Issued: December 8, 2015	§	Proceeding No.: *to be assigned*
Title: WIDEBAND TUNER ARCHITECTURE	§	

REQUEST FOR EX PARTE REEXAMINATION

Mail Stop *Ex Parte* Reexam
Hon. Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Pursuant to the provisions of 35 U.S.C. §§ 301-307, Unified Patents, LLC ("Requester") hereby requests an *ex parte* reexamination of claims 1 and 11 of United States Patent No. 9,210,362 ("the '362 Patent," EX1001), which issued on December 8, 2015, to Madhukar Reddy et al., resulting from U.S. Patent Application No. 14/614,543 filed on February 5, 2015, claiming priority to U.S. Provisional Patent Application No. 61/170,526 filed on April 17, 2009. The '362 Patent is presently assigned to Entropic Communications, LLC ("Entropic"). The assignment to Entropic is recorded in the U.S. Patent and Trademark Office ("USPTO") at reel/frame 055899/0291.

Requester submits that this Request presents prior art references and analysis that are non-cumulative of the prior art that was before the Examiner during the original prosecution of the '362 Patent and that claims 1 and 11 of the '362 Patent are invalid over these references. Requester

therefore requests that an order for reexamination and an Office Action rejecting claims 1 and 11 be issued.

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I. STATEMENT POINTING OUT SUBSTANTIAL NEW QUESTIONS OF PATENTABILITY

Prior to describing the substantial new questions of patentability presented in this Request, provided below is an overview of the '362 Patent, a discussion of claim construction, and a listing of the prior art being discussed in the present Request.

A. Overview of the '362 Patent and its History

(i) Scope of the '362 Patent

The '362 Patent is titled "Wideband Tuner Architecture" and it is directed to a "wideband receiver system" which "comprises a mixer module, a wideband analog-to-digital converter (ADC) module, and digital circuitry." '362 Patent (EX1001), Abstract. The '362 Patent Abstract parallels claim 11 closely, and states:

> "The mixer module is configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels. The wideband ADC module is configured to digitize the swatch of frequencies comprising the plurality of desired television channels and the plurality of undesired television channels. The digital circuitry is configured to select the desired plurality of television channels from the digitized plurality of frequencies, and output the selected plurality of television channels to a demodulator as a digital datastream."

'362 Patent (EX1001), Abstract.

Copies of the '362 Patent and its file history are provided as Exhibits 1001 and 1002, respectively. To provide a background of the '362 Patent, independent claim 11, for which reexamination is requested, is reproduced below.

> 11. A method comprising:
> in a wideband receiver system:
> downconverting, by a mixer module of said wideband receiver system, a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;
> digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system, said plurality of frequencies comprising said

plurality of desired television channels and said plurality of undesired television channels;

selecting, by digital circuitry of said wideband receiver system, said plurality of desired television channels from said digitized plurality of frequencies; and

outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream.

However, similar architectures and methods were known prior to the '362 Patent. For example, prior to the '362 Patent's priority date, McNeely disclosed a "method and apparatus … for simultaneous reception of a plurality of digital RF channels." McNeely (EX1003), Abstract. Pugel similarly disclosed a "desire to have a solution providing receiving and re-synthesizing of channels for distribution in a more optimal manner" and thus described a method and system for receiving signals "containing a plurality of channels" and "selecting channels from the plurality of channels" for transmission and output. Pugel (EX1004), 3:15–31. Claims 1 and 11 are rendered obvious by the teachings of Pugel, McNeely, and Gomez, as shown by the analysis presented in this request.

(i) Prosecution History of the '362 Patent

The '362 Patent issued from U.S. Application No. 14/614,543, filed on February 5, 2015 (the "'543 Application"). The '543 Application claims priority to multiple previous applications, the earliest of which, U.S. Provisional Patent Application No. 61/170,526, was filed April 17, 2009.

The claims filed with the '543 Application were not amended during prosecution. The claims were only rejected once, under the ground of double patenting over the parent patent. EX1002, pp. 80–84. The examiner did not reject the claims as anticipated by or obvious over any prior art. In the Notice of Allowance, the examiner provided "a statement of reasons for the indication of allowable subject matter: the prior art made of record teach a wideband receiver system but do not also teach digital circuitry configured to select a plurality of desired television channels from the digitized plurality of frequencies and output said plurality of television channels to a demodulator as a digital datastream." *Id.* at 62.

However, this Request presents and applies new prior art with analysis that discloses or renders obvious every feature of claims 1 and 11. Specifically, McNeely, Pugel, and Gomez were not considered by the examiner and render obvious each limitation of claims 1 and 11. Thus, the prior art presented in this Request, along with the analysis presented by Mr. Lipoff (attached as Exhibit 1008), presents substantial new questions of patentability.

Requester therefore asks that an Order for Reexamination be issued and that the reexamination proceeding continue to reject and cancel claims 1 and 11 of the '362 Patent.

B. Level of Ordinary Skill in the Art

A person of ordinary skill in the art at and before the priority date of the '362 Patent ("POSITA") would have had a bachelor's degree in electrical engineering, or a related subject, and two to three years of work experience in the field of radio frequency systems (e.g., cable television systems). A lack of experience can be remedied with additional education (e.g., a Master's degree), and likewise, a lack of education can be remedied with additional work experience (e.g., 5–6 years). Lipoff (EX1008), ¶¶ 45–47.

C. Claim Construction

"During patent examination, the pending claims must be 'given their broadest reasonable interpretation consistent with the specification.'" MPEP § 2111. The '362 Patent has not yet expired; thus, the broadest reasonable interpretation standard applies. MPEP § 2258. The present Request presents the following claim analysis in a manner that is consistent with the broadest reasonable interpretation consistent with the specification. Requester provides analysis below for consistency with a district court interpretation of the challenged claims.

(i) Order of Steps in Claim 11

In parallel district court litigation, the court construed claim 11 as follows: "[i]n Claim 11 of the '362 Patent, the 'digitizing …' step must be performed before the 'selecting …' step, and the 'selecting …' step must be performed before the 'outputting …' step. No other order of steps is required." EX1007, p. 52. In the court's analysis, the court noted that "the 'downconverting …' step and the 'digitizing …' step both refer to the same 'plurality of frequencies' without any indication that one of these steps must necessarily be performed before the other." *Id.* at p. 51.

D. Listing of Prior Art Patents and Printed Publications

Reexamination of claims 1 and 11 of the '362 Patent[1] is requested in view of the following references:

Exhibit 1003 ("McNeely") WO 2006/119490 to David Lowell McNeely, filed May 4, 2006, published November 9, 2006, which is prior art at least under pre-AIA 35 U.S.C. § 102(b).

Exhibit 1004 ("Pugel") WO 2007/145637 to Michael Anthony Pugel, filed June 16, 2006, published December 21, 2007, which is prior art at least under pre-AIA 35 U.S.C. § 102(b).

Exhibit 1005 ("Gomez") U.S. Patent No. 8,224,274 to Ramon Gomez et al., filed December 17, 2008, and issued July 17, 2012, which is prior art at least under pre-AIA 35 U.S.C. § 102(e).

McNeely, Pugel, and Gomez[2] were not cited or applied during the original prosecution of the '362 Patent. As demonstrated below, McNeely, Pugel, and Gomez present substantial new questions of patentability.

(i) Overview of McNeely

McNeely describes an "apparatus and method for performing frequency translation." McNeely (EX1003), Abstract. McNeely's apparatus includes a "receiver … for receiving and digitizing a plurality of first signals" and "recovering a set of selected channels from the plurality of first signals." *Id.* McNeely also describes "combining the set of selected channels to form a second signal and transmitting the second signal." *Id.* at 3:27–31.

McNeely is analogous art to the '362 Patent. Lipoff (EX1008), ¶¶ 61–62. The field of endeavor of the '362 Patent is "wideband receiver systems and methods having a wideband receiver that is capable of receiving multiple radio frequency channels located in a broad radio frequency spectrum." '362 Patent (EX1001), 1:15–18. McNeely discloses a receiver and

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[1] The '362 Patent issued from an application filed prior to the enactment of the America Invents Act ("AIA"). Thus, the pre-AIA statutory framework applies.

[2] U.S. Patent 7,421,259 to Gomez appears on the face of the '362 Patent, but is unrelated to the reference applied in this Request.

techniques applicable to signals occupying "1 GHz of bandwidth," (McNeely (EX1003), 7:9–11)[3] and is thus within the field of endeavor of the '362 Patent. McNeely is also reasonably pertinent to at least one problem addressed by the '362 Patent. The '362 Patent states it is "desirable to have wideband receiver systems that can increase the dynamic range without requiring expensive data conversion, filtering and channel selection at the demodulator." That is, the '362 Patent seeks to perform conversion, filtering, and channel selection from signals before those signals reach a demodulator. McNeely similarly discloses techniques of conversion, filtering and channel selection, and combined with the teachings of Pugel below, performs these functions on signals before those signals reach a demodulator. Lipoff (EX1008), ¶ 62. Accordingly, McNeely is analogous art to the '362 Patent for this reason as well.

(ii) Overview of Pugel

Pugel relates to "multi-channel television reception." Pugel (EX1004), ¶ 1. Pugel notes a "need for a digital television receiver capable of simultaneously receiving a plurality of channels." *Id.* at ¶ 8. Pugel describes a "method and apparatus … for simultaneous reception of a plurality of digital RF channels." Pugel (EX1004), Abstract. Pugel's method includes "receiving at least one multichannel RF input signal" and separating the RF input signal. *Id.* at ¶ 11. Subsequently, the analog signals are converted into "digital signals" and then demultiplexed "to recover the plurality of digital RF channels." *Id.* Pugel's method also includes "demodulating the plurality of digital RF channels." *Id.* at ¶ 12.

Pugel is analogous art to the '362 Patent. Lipoff (EX1008), ¶¶ 64–65. The field of endeavor of the '362 Patent is "wideband receiver systems and methods having a wideband receiver that is capable of receiving multiple radio frequency channels located in a broad radio frequency spectrum." '362 Patent (EX1001), 1:15–18. Pugel discloses techniques applicable to

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[3] The '362 Patent explains that a tuner, or receiver, designed to "concurrently receive several TV channels" is referred to as wideband (1:24–27), and it provides an example of a wideband receiver system having a "single very wide-band tuner" that receives signals having "80 MHz" of bandwidth (4:16–25). Because McNeely's receiver techniques are applicable to signals occupying 1 GHz of bandwidth (which is greater than the '362 Patent's example bandwidth), it too describes a wideband receiver. Lipoff (EX1008), ¶ 61 n.1.

"analog signals of differing frequency ranges" and is thus within the field of endeavor of the '362 Patent.[4] Pugel is also reasonably pertinent to at least one problem addressed by the '362 Patent. The '362 Patent states it is "desirable to have wideband receiver systems that can increase the dynamic range without requiring expensive data conversion, filtering and channel selection at the demodulator." As detailed above, the '362 Patent seeks to perform conversion, filtering, and channel selection on received signals before those signals reach a demodulator. Pugel discloses techniques of conversion, filtering and channel selection before signals reach a demodulator. Lipoff (EX1008), ¶ 65. Accordingly, Pugel is analogous art to the '362 Patent for this reason as well.

(iii) Overview of Gomez

Gomez describes a "frequency translation module for a broadband multi-channel communication system." As pertinent to the analysis in this Request, Gomez's frequency translation module (FTM) 100 includes a "tuner 201" which includes an "amplifier 300" and "mixers 301 and 303." Gomez (EX1005), 4:4–6. The mixer 301 may perform down conversion on a signal. *See id.* at 4:4–19.

Gomez is analogous art to the '362 Patent. Lipoff (EX1008), ¶¶ 67–68. The field of endeavor of the '362 Patent is "wideband receiver systems and methods having a wideband receiver that is capable of receiving multiple radio frequency channels located in a broad radio frequency spectrum." '362 Patent (EX1001), 1:15–18. Gomez similarly describes applicability to "a broadband multi-channel communication system" and is thus within the field of endeavor of the '362 Patent. For example, just as the '362 Patent discusses that wideband receivers receive multiple channels, Gomez also discloses its receivers may "receive a signal" including a "set of high-definition channels." Gomez (EX1005), 3:40–50. Gomez is also reasonably pertinent to at least one problem addressed by the '362 Patent. One problem addressed by the '362 Patent is the

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[4] As detailed above, the '362 Patent provides an example of a wideband receiver system having a "single very wide-band tuner" that receives signals having "80 MHz" of bandwidth (4:16–25). Pugel's receiver techniques, in one example, apply to signals having 300 MHz of bandwidth, (which is greater than the '362 Patent's example bandwidth), and thus it too describes a wideband receiver. Lipoff (EX1008), ¶ 64 n.2.

need for "expensive digital processing circuitry" and Gomez likewise addresses the issue of frequency translation modules being too "costly … for some applications." Gomez (EX1005), 1:49–52. Accordingly, Gomez is analogous art to the '362 Patent for this reason as well.

E. McNeely, Pugel, and Gomez Each Present Substantial New Questions of Patentability

As shown below, Requester submits that the prior art references McNeely, Pugel, and Gomez raise a "substantial question of patentability" because "the teaching of the (prior art) patents and printed publications is such that a reasonable examiner would consider the teaching to be important in deciding whether or not the claim is patentable." *See* MPEP § 2242 (emphasis in original). Further, the "same question of patentability as to the claim has not been decided by the Office in an earlier concluded examination or review of the patent" at least because none of the references were before the Office during the original prosecution of the '362 Patent. *See id.*; *id.* § 2216. Thus, as presented herein, each of McNeely, Pugel, and Gomez present a substantial new question of patentability.

The present Request proposes the following rejection based on McNeely, Pugel, and Gomez:

Proposed Rejection A1: Claims 1 and 11 are rendered obvious by McNeely and Pugel under 35 U.S.C. § 103(a).

Proposed Rejection B1: Claims 1 and 11 are rendered obvious by Pugel and Gomez under 35 U.S.C. § 103(a).

(i) McNeely Presents Substantial New Questions of Patentability

As demonstrated in the proposed rejection A1 below, McNeely, when combined with the teachings of Pugel, renders obvious claims 1 and 11 of the '362 Patent. Specifically, McNeely discloses or at least renders obvious substantially all elements of claims 1 and 11. McNeely therefore presents a substantial new question of patentability, and a reasonable examiner would consider the reference important in determining whether claims 1 and 11 are patentable, because McNeely was not cited by the examiner. A detailed explanation of the pertinence and manner of applying McNeely to the claim for which reexamination is requested is set for in Section II, below.

(ii) Pugel Presents Substantial New Questions of Patentability

As demonstrated in the proposed rejections A1 and B1 below, Pugel, when combined with the teachings of McNeely or Gomez, renders obvious claims 1 and 11 of the '362 Patent. Specifically, in the combination with McNeely, Pugel is relied upon to teach outputting television channels to a demodulator. In the combination with Gomez, Pugel is relied upon to disclose or at least render obvious substantially all elements of claims 1 and 11. Pugel therefore presents substantial new questions of patentability, and a reasonable examiner would consider the reference important in determining whether claims 1 and 11 are patentable, because Pugel was not cited by the examiner. A detailed explanation of the pertinence and manner of applying Pugel to the claim for which reexamination is requested is set forth in Section II below.

(iii) Gomez Presents Substantial New Questions of Patentability

As demonstrated in the proposed rejection B1 below, Gomez, when combined with the teachings of Pugel, renders obvious claims 1 and 11 of the '362 Patent. Specifically, Gomez discloses or teaches downconversion by a "mixer module" as recited in claims 1 and 11. Gomez therefore presents substantial new questions of patentability, and a reasonable examiner would consider the reference important in determining whether claims 1 and 11 are patentable, because Gomez was not cited by the examiner. A detailed explanation of the pertinence and manner of applying Gomez to the claim for which reexamination is requested is set forth in Section II below.

II. DETAILED EXPLANATION OF THE PERTINENCE AND MANNER OF APPLYING THE PRIOR ART REFERENCES TO EVERY CLAIM FOR WHICH REEXAMINATION IS REQUESTED

A. Proposed Rejections of the Claim

The present request presents proposed rejections based on the references McNeely, Pugel, and Gomez.

Proposed rejections A1 and B1 are based on obviousness under 35 U.S.C. § 103(a). Requester notes that, even if there are minor differences between cited disclosures of the prior art and the claimed concepts, the claims are still obvious, as a POSITA would not have appreciated "some new synergy" or unexpected results from the limitations given the disclosures of the prior art and the general knowledge of a POSITA. *KSR Intern. Co. v. Teleflex Inc.*, 550 US 398, 417

(2007). When compared with the prior art described below and in light of the knowledge of a POSITA, any "differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains." 35 U.S.C. § 103.

The proposed rejections are listed below and above and are described in further detail in the claim chart that follows below.

(i) Proposed Rejection A1: Claims 1 and 11 are rendered obvious by McNeely in view of Pugel under 35 U.S.C. § 103(a).

U.S. Patent No. 9,210,362	McNeely/Pugel
Claim 11[5]	
[11.0] A method comprising: in a wideband receiver system:	McNeely discloses or at least renders obvious a *method … in a wideband receiver system* (e.g., McNeely's apparatus including a receiver). First, McNeely discloses a *method*: "The disclosed embodiments relate to an apparatus and **method** for performing frequency translation." McNeely (EX1003), Abstract. Second, McNeely's method is performed *in a wideband receiver system*. The '362 Patent states: "Receivers used to down-convert and selectively filter TV channels are referred to as tuners, and **tuners designed to concurrently receive several TV channels are referred to as wideband tuners**." '362 Patent (EX1001), 1:24-27. Thus, a POSITA would have recognized a *wideband receiver system* as one which concurrently receives several TV channels. McNeely discloses such a system, as it states: "The present invention relates to an **apparatus** and method for performing frequency translation. The **apparatus includes a receiver** for receiving and digitizing a plurality of first signals, each signal containing channels and for simultaneously

[5] Emphasis added throughout unless otherwise specified.

U.S. Patent No. 9,210,362	McNeely/Pugel
	recovering a set of selected channels from the plurality of first signals." McNeely (EX1003), 3:20–24. "The single L-band signal, as an analog input, is processed through an RF processing block 210. The RF processing block 210 may contain circuitry for filtering undesired energy outside the signal frequency range, may correct for any frequency response errors introduced, and may amplify the signal to a level necessary for input to the analog to digital (A/D) converter 220." McNeely (EX1003), 9:7–12. "As previously described, each L-band signal may occupy 1 GHz of bandwidth, and a typical customer premises cable installation may only support less than 2 GHz of total signal bandwidth. The FTM 110 extracts certain ranges of frequencies containing selected physical channels as portions of the three L-band signals provided." McNeely (EX1003), 7:9–15. Because McNeely describes a receiver system that extracts certain ranges of frequencies containing multiple physical channels, it discloses, or at least renders obvious, performing its methods *in a wideband receiver system* as recited. Lipoff (EX1008), ¶¶ 70–75.

U.S. Patent No. 9,210,362	McNeely/Pugel
[11.1] downconverting, by a mixer module[6] of said wideband receiver system, a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;	McNeely discloses, or at least renders obvious *downconverting* (e.g., processing the L-band signal by positioning it in the correct frequency range), *by a mixer module* (e.g., mixing circuits of block 210) *of said wideband receiver system* (e.g., McNeely's apparaus including a receiver), *a plurality of frequencies* (e.g., the L-band signal) *that comprises a plurality of desired television channels* (e.g., set of selected channels) *and a plurality of undesired television channels* (e.g., the set of channels not selected). First, McNeely discloses *a mixer module of said wideband receiver system*: "The input RF processing block 210 may also contain any **mixing circuits** necessary to position the L-band signal in the correct frequency range for operation of the A/D converter 220." McNeely (EX1003), 9:12–15; Lipoff (EX1008), ¶ 77.

[6] The claimed "mixer module" does not invoke 35 U.S.C. § 112 ¶ 6 because a POSITA would have understood the term "to have a sufficiently definite meaning as the name for the structure that performs the function." MPEP 2181.A; Lipoff (EX1008), ¶¶ 40–42.

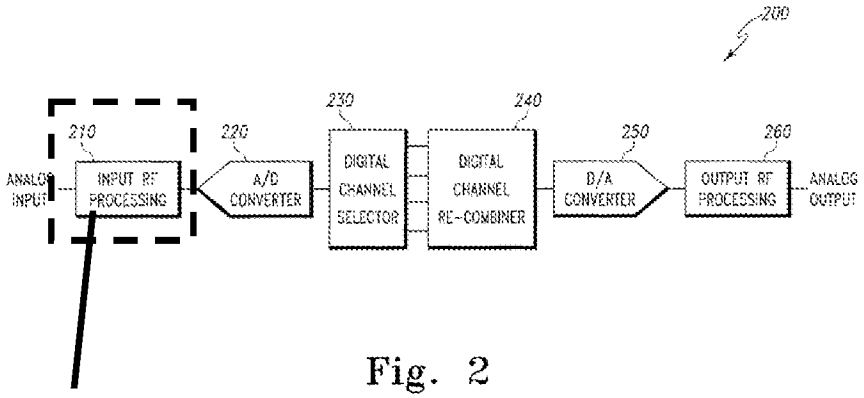


Fig. 2

McNeely (EX1003), Fig. 2 (annotated).

Second, McNeely teaches *downconverting ... a plurality of frequencies*.

As detailed in the above disclosure, the mixing circuits "position the L-band signal" (the analog input in Fig. 2) "in the correct frequency range." McNeely (EX1003), 9:12–15. In McNeely, "each L-band signal may occupy 1 GHz of bandwidth" (*id.*, 7:9–11) and thus, each signal comprises a *plurality of frequencies* as recited. Additionally, McNeely teaches that the "L-band signal" includes multiple "physical channels" (*id.*, 14:26–28) and thus, each L-band signal comprises a *plurality of frequencies* as recited.

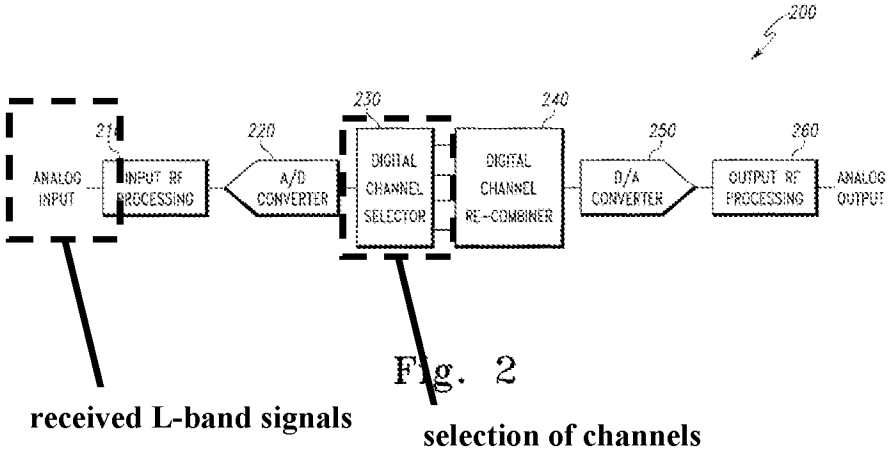
This disclosure corresponds to, and teaches to a POSITA, *downconverting*, because a POSITA would have recognized that it was well-known for receivers to use frequency translation techniques (like the technique of positioning the L-band signal disclosed in McNeely) to downconvert RF signals to a lower frequency. Lipoff (EX1008), ¶¶ 78–80 (citing, e.g., Tseng (EX1011), p. 1 ("directly downconvert the desired RF signal"); Li (EX1012), p. 1 ("Downconversion mixer is one of the important building blocks for RF transceviers"); Mirabbasi (EX1013), p. 133 ("frequency downconversion" is "an essential operation in any RF receiver.");

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	Feng (EX1006), p. 19 (in "modern communications, frequency translation is used in receivers to **downconvert RF to a lower frequency**."); '362 Patent (EX1001), 1:27–29 (admitting as prior art that "[e]xisting tuners for these applications **downconvert a swath of channels to an intermediate frequency**, which are then sent to a demodulator.")). For example, the Tseng paper states that downconverting a desired RF signal "can significantly relax the demand for fast ADCs." Tseng (EX1011), p. 1; *see also* Mirabbasi (EX1013), p. 136 (Figure 7 depicting downconversion before digitizing by an ADC). Consistent with the background knowledge of a POSITA, because McNeely also performs frequency positioning before digitizing by an analog-to-digital converter (ADC) as described below in limitation [11.2], a POSITA would have recognized McNeely to teach *downconverting* as recited. Additionally, McNeely teaches that the L-band signal input to the RF processing block 210 is in the 1–2 GHz frequency range (*see* McNeely (EX1003), 7:26–28). McNeely further teaches that the A/D converter acts upon processed L-band signals "between the frequencies of 975 and 1425 MHz." *Id.* at 9:16–19. Thus, McNeely repositions the signals to a lower frequency range and performs *downconverting* as recited. Lipoff (EX1008), ¶ 81. McNeely's disclosure is described in the context of a receiver, as detailed in the analysis of limitation [11.0] and thus, McNeely's description of "position[ing] the L-band signal in the correct frequency range" is a teaching of *downconverting ... a plurality of frequencies* as recited. Lipoff (EX1008), ¶ 80.[7]

[7] McNeely's later disclosure of digital channel selector 230 proceeding to "down-convert each of the individual physical channels that have been selected" does not impact this teaching of McNeely, as a POSITA would have recognized that this later reference to downconversion relates to later downconversion of **digital** signals, and thus does not impact McNeely's teaching of

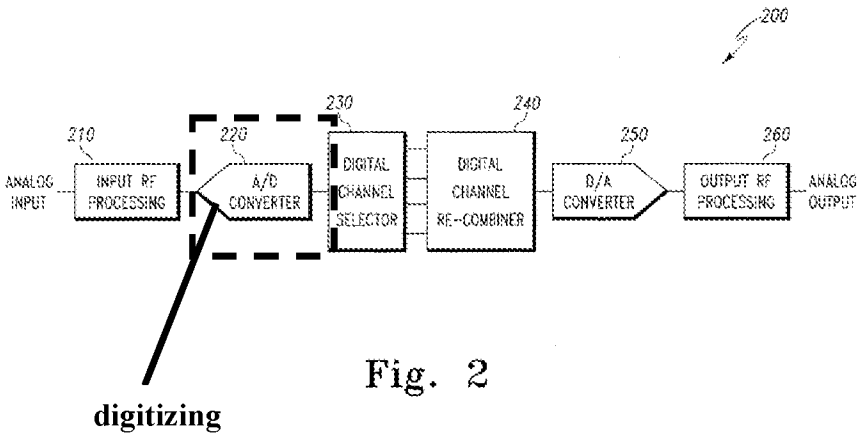
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	Third, McNeely teaches that the *plurality of frequencies … comprises a plurality of desired television channels and a plurality of undesired television channels*: "The apparatus includes a receiver for receiving and digitizing a plurality of first signals, each signal containing channels and for simultaneously **recovering a set of selected channels** from the plurality of first signals. The apparatus also includes a transmitter for combining the set of selected channels to produce a second signal." McNeely (EX1003), Abstract. McNeely also discloses: "A method (600) for providing frequency translation comprising: receiving (602) a first signal having a plurality of different frequency channels; selecting (606) a set of frequency channels from said plurality of different frequency channels;…" McNeely (EX1003), 22:7–11 (claim 13). Consistent with claim 13 and McNeely's disclosure, therefore, analog L-band signals ("a first signal having a plurality of different frequency channels") are received, processed, converted to digital, and then channel selection occurs in the digital channel selector 230

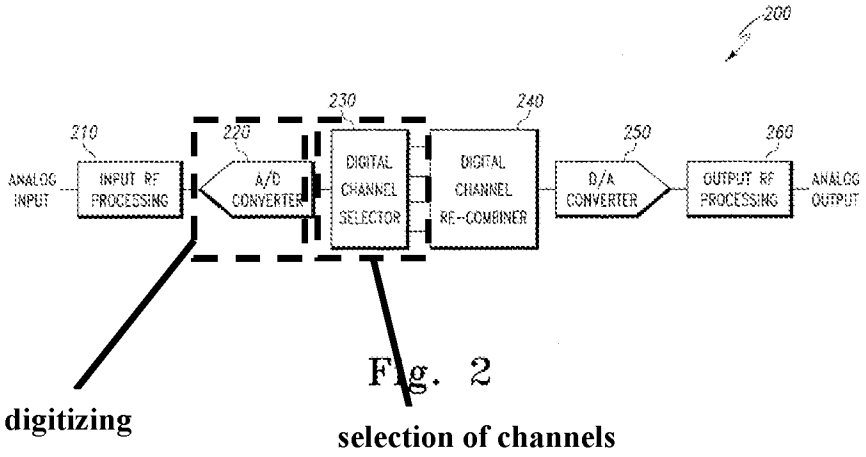
downconversion in its description of positioning L-band **analog** signals in the correct frequency range cited here. Lipoff (EX1008), ¶ 81.

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	("selecting (606) a set of frequency channels from said plurality of different frequency channels"). Thus, the received L-band signals (the received *plurality of frequencies*) includes the selected channels and the unselected channels (the *plurality of desired television channels and [] plurality of undesired television channels*). Additionally, in McNeely, the "selected channels" are recovered by the digital channel selector 230 in Figure 2, which occurs after the downconversion of the received signals (the analog input) by mixing circuits in the input RF processing block 210; thus, the received signals (the *plurality of frequencies*) includes the selected channels and the unselected channels (the *plurality of desired television channels and [] plurality of undesired television channels*).  **McNeely (EX1003), Fig. 2 (annotated)** The "set of selected channels" corresponds to the recited *plurality of desired television channels*. Lipoff (EX1008), ¶¶ 82–86. Further, because McNeely's receiver recovers a set of selected channels from the first signals, the channels not recovered from the first signals would correspondingly be the *plurality of undesired television channels* as recited. Lipoff (EX1008), ¶ 86.

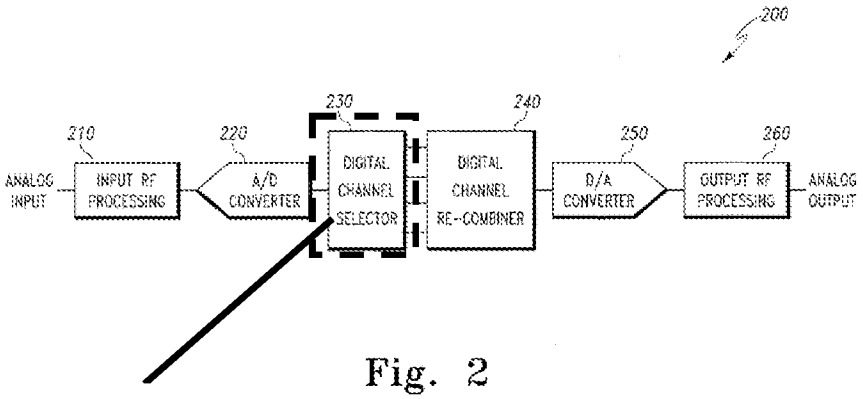
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	Thus, McNeely discloses, or at least renders obvious, this limitation. Lipoff (EX1008), ¶¶ 76–87.
[11.2] digitizing, by a wideband analog-to-digital converter (ADC) module[8] of said wideband receiver system, said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;	McNeely discloses, or at least renders obvious *digitizing* (e.g., digitizing the processed L-band signal into a series of samples), *by a wideband analog-to-digital converter (ADC) module* (e.g., A/D converter 220) *of said wideband receiver system* (e.g., McNeely's receiver system), *said plurality of frequencies* (e.g., the downconverted L-band signals) *comprising said plurality of desired television channels* (e.g., set of selected channels) *and said plurality of undesired television channels* (e.g., the set of unselected channels). First, McNeely discloses *digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system*: "The **A/D converter 220 digitizes the processed L-band signal into a series of samples**, each sample containing a group of bits. In an exemplary embodiment, the processed satellite signal is located between the frequencies of 975 and 1425 MHz. The A/D converter 220 samples the processed L-band signal at a rate of 933 megasamples per second (MSPS) generating a digital signal containing a series of samples, each sample represented by 8 bits. The A/D converter 220 may also generate a translated frequency image of the L-band signal essentially translating the signal from an initial frequency range in the analog domain to a different frequency range based on sampling principles."

[8] The claimed "wideband analog-to-digital converter (ADC) module" does not invoke 35 U.S.C. § 112 ¶ 6 because a POSITA would have understood the term "to have a sufficiently definite meaning as the name for the structure that performs the function." MPEP 2181.A; Lipoff (EX1008), ¶¶ 43–44.

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	McNeely (EX1003), 9:16–26. Because McNeely's A/D converter operates on a processed L-band signal between the frequencies of 975 and 1425 MHz (i.e., 450 MHz of bandwidth), the A/D converter is a *wideband analog-to-digital converter (ADC) module* as recited, at least because the 450 MHz bandwidth in McNeely is greater than the example wideband receiver system with an analog-to-digital converter in the '362 Patent which operates on a total of 80 MHz of bandwidth. Lipoff (EX1008), ¶¶ 89–90.  Fig. 2 **McNeely (EX1003), Fig. 2 (annotated)** "Turning now to FIG. 2 a block diagram 200 of an embodiment of the present invention is shown. The diagram shows an implementation of the FTM 110 that includes digital signal processing in order to increase the performance and available bandwidth for selected channels." McNeely (EX1003), 9:1–5. Second, because the A/D converter 220 in McNeely converts the signals from the input RF processing block 210, for the same reasons

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	as set forth in limitation [11.1], McNeely discloses, or at least renders obvious, that the digitizing is performed on the *plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels* as recited. Lipoff (EX1008), ¶¶ 91–92.  Fig. 2 **McNeely (EX1003), Fig. 2 (annotated)** Specifically, as detailed in the analysis of limitation [11.1], *supra*, in McNeely, the "selected channels" are recovered by the digital channel selector 230 in Figure 2, which occurs after the downconversion of the received signals by mixing circuits in the input RF processing block 210 and digitizing by A/D converter 220 thus, the digitized signals (the *plurality of frequencies*) includes the selected channels and the unselected channels (the *plurality of desired television channels and [] plurality of undesired television channels*). Thus, McNeely discloses, or at least renders obvious, this limitation. Lipoff (EX1008), ¶¶ 88–93.
[11.3] selecting, by digital circuitry of said wideband	McNeely discloses, or at least renders obvious *selecting* (e.g., selecting), *by digital circuitry* (e.g., digital channel selector 230) *of*

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receiver system, said plurality of desired television channels from said digitized plurality of frequencies; and	*said wideband receiver system* (e.g., McNeely's receiver system), *said plurality of desired television channels* (e.g., set of selected channels) *from said digitized plurality of frequencies* (e.g., the output of A/D converter 220): "The **A/D converter 220 digitizes the processed L-band signal into a series of samples**, each sample containing a group of bits. McNeely (EX1003), 9:16–26. As detailed above in the analysis of limitation [11.2], the L-band signal comprises the *plurality of desired television channels*. Lipoff (EX1008), ¶¶ 94–95. After digitizing the L-band signal into the samples, McNeely discloses: "The **digital channel selector 230** receives the sampled [L-band] signal and **proceeds to select** and down-convert **each of the individual physical channels that have been selected**. After processing, each of the selected individual channels are located within the same frequency range at or near to baseband, but are contained as individual signals on separate signal lines. The number of bits representing each selected individual channel may be different from the original sampled signal based on the processing method employed. The use of digital signal processing and processing of the signal in parallel permits narrower filtering constraints and more efficient channel selection within the FTM 110." McNeely (EX1003), 10:1–11.

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	 Fig. 2 **McNeely (EX1003), Fig. 2 (annotated)** "7. The apparatus (500) of claim 1, wherein said receiver (530a-c) further comprises a selector (360) operatively connected to said distributor (350) for selecting said plurality of selected channels." McNeely (EX1003), claim 7. "13. A method (600) for providing frequency translation comprising:… selecting (606).a set of frequency channels from said plurality of different frequency channels;" McNeely (EX1003), claim 13. "22. An apparatus (500) for frequency translation comprising.…

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	means for selecting (530a-c) a set of channels from said set of signals;" McNeely (EX1003), claim 22. Because McNeely discloses selecting each of the individual physical channels that have been selected by the digital channel selector, which is *digital circuitry*, it discloses, or at least renders obvious, *selecting, by digital circuitry of said wideband receiver system* (e.g., digital channel selector 230), *said plurality of television channels from said digitized plurality of frequencies* (the individual physical channels that have been selected). Lipoff (EX1008), ¶¶ 94–97.
[11.4] outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream.	McNeely and Pugel render obvious *outputting, by said digital circuitry* (e.g., digital channel selector 230 and digital channel re-combiner 240) *of said wideband receiver system* (e.g., McNeely's receiver system), *said selected plurality of television channels* (e.g., McNeely's selected channels) *to a demodulator* (e.g., Pugel's demodulator) *as a digital datastream* (e.g., selected digital signal). First, McNeely discloses *outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels ... as a digital datastream*: "Each of the individual selected channels is provided to the digital channel re-combiner 240. The **digital channel re-combiner 240** frequency translates the individual selected channels each to a different and separate frequency range and combines these signals together to form **a single selected digital signal**." McNeely (EX1003), 10:12–16. The output of "digital channel re-combiner 240" (i.e., the "single selected digital signal") is *a digital datastream* because, as shown in Figure 2, the output is transmitted (in McNeely) to the D/A converter

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	(digital-to-analog converter), and thus, a POSITA would have recognized the output as being a *digital datastream* as recited. Lipoff (EX1008), ¶¶ 99–100. In McNeely, the "selected digital signal" is supplied to the digital to analog (D/A) converter 250. However, it was known at the time of the '362 Patent that such digital signals could, and would be provided *to a demodulator* as recited. Lipoff (EX1008), ¶ 101. Specifically, Pugel teaches "demodulating the plurality of digital RF channels" in a system which "permits substantially simultaneous reception of a plurality of digital cable television channels within a single digital receiver circuit." Pugel (EX1004), ¶¶ 11–12. Pugel also discloses: > "The converted digital signals are coupled to the digital tuner 130, which demultiplexes the converted digital signals to generate a plurality of digital channel signals. **Each digital channel signal is then coupled to a separate demodulator 141, 142, 143**, which performs demodulation and forward-error-correction (FEC) operations appropriate for the content of that digital channel." Pugel (EX1004), ¶ 27. > "[A] plurality of demodulator circuits is coupled to the digital tuner, the plurality of demodulator circuits including at least a first demodulator circuit configured to receive and demodulate a first channel of the plurality of digital RF channels and a second demodulator circuit being configured to receive and demodulate a second channel of the plurality of digital RF channels."

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	Pugel (EX1004), ¶ 10. Thus, Pugel teaches *outputting ... to a demodulator* as recited. The combined teachings of McNeely and Pugel therefore render obvious this limitation. Lipoff (EX1008), ¶¶ 103–104. A POSITA would have been motivated to combine the teachings of McNeely and Pugel. Lipoff (EX1008), ¶¶ 105–109. First, McNeely acknowledges that demodulators were known: > "Likewise, other than the inventive concept, transmission concepts such as satellite transponders, down-link signals, eight-level vestigial sideband (8-VSB), Quadrature Amplitude Modulation (QAM), and receiver components such as a radio-frequency (RF) front-end, or receiver section, such as a low noise block, tuners, and **demodulators** is assumed." McNeely (EX1003), 5:16–21. > "At each installation location in the premises 120, the selected signal is provided to a standalone terminal 130 or to a combination settop box 140a-c and display device 150a-c. The terminal 130 and settop box 140a-c operate in a similar manner. Each of them receive the selected signal, tune to the desired physical channel within the selected signal, **demodulate the physical channel to produce a transport stream**, and extract the desired bit stream(s) from the transport stream." McNeely (EX1003), 8:1–7. The '362 Patent confirms demodulators were known, as it discloses in the Background:

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	"Existing tuners for these applications down convert a swath of channels to an intermediate frequency, **which are then sent to a demodulator.** Because the swath of channels is not contiguous, this swath includes the desired channels as well as undesired channels. The demodulator employs a high-speed data converter to capture this swath of desired and undesired channels in the digital domain and subsequently filters out the desired channels." '362 Patent (EX1001), 5:27-34. Given this knowledge in the art, a POSITA would have been motivated to combine the teachings of McNeely with Pugel as doing so would have been no more than the combination of known prior art elements. McNeely and Pugel disclose each and every limitation of the claims, albeit not within one reference. A POSITA could have, and would have been motivated to combine the teachings of McNeely with those of Pugel to provide for display of the selected TV channels on a display device (e.g., display device 150a-c in McNeely). In combination, each element performs the same function as previously: McNeely's apparatus downconverts, digitizes, and selects channels, and Pugel provides a demodulator that demodulates the channels for display. Additionally, the results of the combination would have been predictable, as McNeely acknowledges that demodulation was known in the context of its methods. Thus, a POSITA would have combined the teachings of McNeely and Pugel to render obvious this limitation. Lipoff (EX1008), ¶ 108. Additionally, a POSITA would have been motivated to combine the teachings of McNeely with Pugel as doing so would have been nothing more than the substitution of one known element for another to obtain predictable results. Specifically, combining the references would have involved no more than substituting McNeely's D/A

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	converter and output RF processing with Pugel's demodulator teachings. As detailed above, demodulators were well-known at the time of the '362 Patent, as Pugel discloses and as the '362 Patent itself admits. A POSITA would have found it straightforward to replace McNeely's components with Pugel's demodulator, and the results of such a substitution would have been predictable, as Pugel's demodulator would perform the same function in the combination as it did previously alone. Thus, a POSITA would have combined the teachings of McNeely and Pugel to render obvious this limitation. Lipoff (EX1008), ¶ 109.

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Claim 1	
[1.0] A wideband receiver system comprising:	*See* analysis of limitation [11.0], *supra*.
[1.1] a mixer module configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;	*See* analysis of limitation [11.1], *supra*.
[1.2] a wideband analog-to-digital converter (ADC) module configured to digitize said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;	*See* analysis of limitation [11.2], *supra*.
[1.3] digital circuitry configured to: select said plurality of desired television channels from said digitized plurality of frequencies; and	*See* analysis of limitation [11.3], *supra*.
[1.4] [digital circuitry configured to:]… output said selected plurality of television channels to a	*See* analysis of limitation [11.4], *supra*.

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demodulator as a digital datastream.	

(ii) Proposed Rejection B1: Claims 1 and 11 are obvious over Pugel in view of Gomez under 35 U.S.C. § 103(a).

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Claim 11	
[11.0] A method comprising: in a wideband receiver system:	Pugel discloses or at least renders obvious a *method … in a wideband receiver system* (e.g., Pugel's apparatus that receives input signals). First, Pugel discloses a *method*: "A **method** (400) processing signals comprising the steps of:" Pugel (EX1004), claim 18. Second, Pugel discloses a method *in a wideband receiver system*. The '362 Patent states: "Receivers used to down-convert and selectively filter TV channels are referred to as tuners, and **tuners designed to concurrently receive several TV channels are referred to as wideband tuners**." '362 Patent (EX1001), 1:24-27. Thus, a POSITA would have recognized a *wideband receiver system* as one which concurrently receives several TV channels. Pugel discloses: "An apparatus (100), comprising: first means for processing (111) an input signal comprising **signals in a first frequency band and signals in a second frequency band** to produce a first

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	analog signal including signals in the first frequency band and substantially excluding the signals in the second frequency band; second means for processing (112) the input signal comprising signals in a first frequency band and signals in a second frequency band to produce a second analog signal including signals in the second frequency band and substantially excluding the signals in the first frequency band;" Pugel (EX1004), claim 1. "The apparatus (100) of claim 1 **wherein said apparatus (100) processes frequencies between about 5 MHz and about 900 MHz**." Pugel (EX1004), claim 16. "A method and apparatus is presented for simultaneous reception of a plurality of digital RF channels. Specifically, N amplifier-filter circuits (111, 112, 113) are configured to receive and separate a multichannel analog RF input signal into N analog signals, each including a different frequency band." Pugel (EX1004), Abstract. "In operation, according to one embodiment, a multichannel analog RF input signal received at input coupler 101 is split into a plurality of substantially identical signals at splitter 102. Splitter 102 may include one or more amplifiers, filters, or other components (not shown) which reduce or overcome insertion loss or other adverse effects of the split, as should be apparent to one of ordinary skill in the art.

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	The plurality of amplifier-filter circuits 111, 112, 113 then segregates the multichannel analog input signal into a plurality of separate analog signals of differing frequency ranges, or 'bands.' Each separate analog signal is then converted from analog to digital form in an analog-to-digital converter 121, 122, 123." Pugel (EX1004), ¶ 24. "Each of the plurality of amplifier-filter banks or circuits 111, 112, 113 is configured to process frequencies within a specified band. For example, a first amplifier-filter circuit 111 may be configured to process frequencies from about 5 MHz to about 300 MHz, a second amplifier-filter circuit 112 may be configured for frequencies between about 300 MHz and about 600 MHz, and a third amplifier-filter circuit 113 may be configured for frequencies from about 600 MHz to about 900 MHz. In such an example, the present invention may be used to recover a plurality of digital cable television channels from a multichannel analog RF input signal which includes frequencies ranging from about 5 MHz to about 900 MHz." Pugel (EX1004), ¶ 28. "This combination of components permits substantially simultaneous reception of multiple digital cable channels within a **single digital receiver circuit** suitable for use with conventional cable delivery systems and at a reasonable cost." Pugel (EX1004), Abstract. Thus, because Pugel discloses an apparatus which processes frequencies in the range between 5 MHz and 900 MHz, it discloses,

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	or at least renders obvious, performing its methods *in a wideband receiver system* as recited. Lipoff (EX1008), ¶¶ 116–122.
[11.1] downconverting, by a mixer module of said wideband receiver system, a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;	Pugel and Gomez render obvious *downconverting* (e.g., Pugel's downconverting of digital signals), *by a mixer module* (e.g.., Gomez's teaching of mixers that downconvert) *of said wideband receiver system* (Pugel's apparatus), *a plurality of frequencies* (Pugel's plurality of separate analog signals of differing frequency ranges) *that comprises a plurality of desired television channels* (Pugel's digital channels desired to be recovered) *and a plurality of undesired television channels* (the channels in Pugel not desired to be recovered). First, Pugel discloses *downconverting ... a plurality of frequencies*. Pugel explains first that analog signals are received and converted to digital: "In operation, according to one embodiment, a multichannel analog RF input signal received at input coupler 101 is split into a plurality of substantially identical signals at splitter 102. Splitter 102 may include one or more amplifiers, filters, or other components (not shown) which reduce or overcome insertion loss or other adverse effects of the split, as should be apparent to one of ordinary skill in the art. The plurality of amplifier-filter circuits 111, 112, 113 then segregates the multichannel analog input signal into a **plurality of separate analog signals of differing frequency ranges**, or 'bands.' **Each separate analog signal is then converted from analog to digital form in an analog-to-digital converter 121, 122, 123**." Pugel (EX1004), ¶ 24.

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	After the analog frequencies are converted to digital, Pugel teaches *downconverting* the *plurality of frequencies*: "A method (400) processing signals comprising the steps of: (a) separating an input signal into a first analog signal and a second analog signal; (b) digitizing said first analog signal to generate a first digital signal; (c) digitizing said second analog signal to generate a second digital signal; (d) **downconverting** said first digital signal and said second signal; and (e) extracting desired television program information from said downconverted first digital signal and said second digital signal." Pugel (EX1004), claim 18. Pugel further states that "the digital tuner 130 may also perform a variety of other processing operations prior to providing digital channel signals suitable for use in each of the demodulation circuits 141, 142, 143" and that the digital tuner "may include a multitude of components configured as is well known in the art to recover a plurality of digital channel signals substantially simultaneously." Pugel (EX1004), ¶ 37. A POSITA would have recognized that such components used to recover a plurality of digital channel signals would include components to perform *downconverting*, as it was well-known prior to the '362 Patent to perform *downconverting* on signals. For example, as acknowledged by the '362 Patent and numerous contemporaneous references, *downconverting* was well-

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	known by POSITAs at the time of the '362 Patent. Lipoff (EX1008), ¶¶ 124–128 (citing, e.g., Tseng, Li, Mirabbasi, Feng). As detailed above in the Claim Construction section, the *downconverting* step may be performed prior to the *digitizing* step, as these two steps need not be performed in any specific order. EX1007, pp. 51–52. Pugel does not explicitly disclose that the downconverting is performed *by a mixer module of said wideband receiver system*. However, this was a known implementation detail at the time of the '362 Patent. For example, in the same field, Gomez describes: "Tuner 201 performs a dual frequency conversion to select and down-convert a desired or selected channel from a RF input signal 101. In doing so, amplifer 300 receives and amplifes RF input signal 101, which contains a plurality of television channels. Mixer 301 receives RF input signal 101 from amplifier 300 and also receives a local oscillator (LO) signal from PLL 304. For direct conversion, the frequency of PLL 304 is tuned to the frequency of the desired channel in RF input signal 101 so that it is down-converted to baseband, for further processing. For example, if the desired channel in RF input signal 101 is at 100 MHZ, then PLL 304 is tuned to 100 MHZ, so that **mixer 301 down-converts the desired channel in RF signal** 101 to DC." Gomez (EX1005), 4:6–19. Thus, Gomez teaches downconverting *by a mixer module*. Lipoff (EX1008), ¶¶ 129–130. A POSITA would have been motivated to combine the teachings of Gomez with Pugel, because doing so would have been nothing more

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	than the use of a known technique to improve a similar device in the same way. Pugel teaches that downconverting is performed, but it does not describe the circuitry for doing so. The '362 Patent Background acknowledges that "[e]xisting tuners … down-convert a swath of channels to an intermediate frequency." '362 Patent (EX1001), 1:27–29. The '362 Patent also acknowledges as prior art a "mixer" which "frequency down-converts the received RF input signal to a more convenient intermediate frequency (IF) band." *Id.* at 1:58–62. Thus, it was known to perform *downconverting* using a *mixer module*. Gomez explicitly teaches the circuitry (i.e., a mixer) to perform the known technique of downconversion. A POSITA would have been motivated to apply this teaching in Gomez of downconversion by a mixer module to the teachings of Pugel to provide the hardware necessary to perform Pugel's downconversion. The results would have been predictable to a POSITA, as the results would have simply represented Gomez's mixer module performing downconversion in the context of Pugel's system that also performs downconversion. Accordingly, a POSITA would have been motivated to combine the teachings for at least this reason. Lipoff (EX1008), ¶¶ 131–133. Likewise, combining the teachings of Gomez and Pugel would have been nothing more than combining prior art elements according to known methods to yield predictable results. Together, Pugel and Gomez include each element claimed, with the only difference being the lack of actual combination in a single prior art reference. A POSITA would have been motivated to, and would have been capable of, combining Gomez's teachings of downconversion by a mixer module with Pugel's teachings of downconversion, and in combination, each element performs the same function as it does separately. A POSITA would have further recognized the predictability of the combination, as the combination simply adds to

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	Pugel appropriate circuitry for performing the functions disclosed in Pugel. Accordingly, a POSITA would have been motivated to combine the teachings for this additional reason as well. Lipoff (EX1008), ¶ 134. Pugel explains that the *plurality of frequencies … comprises a plurality of desired television channels and a plurality of undesired television channels*: "The digital tuner 130 may include a channel selector 315 to permit selection of one or more particular **digital channels desired to be recovered**. For example, a selected set of digital cable television channels may be communicated to the digital tuner 130 via the channel selector 315 corresponding to a plurality of pay-per-view selections desired by members of a household; the digital tuner 130 may demultiplex only the digital channel signals corresponding to those digital cable television channels." Pugel (EX1004), ¶ 38. "It should be apparent that each digital RF channel signal may in turn carry or provide a plurality of data streams, e.g., audio, video, program information, or interactive content." Pugel (EX1004) ¶ 45. "FIG. 4 shows a flow diagram representation of a method of **receiving a plurality of digital RF channels** generally designated 400 in accordance with an aspect of the present invention….The method 400 begins at step 401 and proceeds to step 402 in which a multichannel analog RF input signal is separated into

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	a plurality of analog signals including at least first and second analog signals. In step 403, the first analog signal is converted into a first digital signal using a first analog-to-digital converter. In step 404, the second analog signal is converted into a second digital signal using a second analog-to-digital converter independently of the conversion performed in the first analog-to-digital converter. The first and second analog-to-digital converters may convert different frequency bands from analog to digital form, similar to analog-to-digital converters 121, 122, 123 described above with reference to FIGS. 1 and 2…. In step 405, the first digital signal (converted in the first analog-to-digital converter) and the second digital signal (converted in the second analog-to-digital converter) are demultiplexed to generate a plurality of digital RF channel signals including at least first and second digital RF channel signals." Pugel (EX1004), ¶¶ 43–45. Thus, in Pugel, the multichannel analog RF input signal includes all channels (desired and undesired), which signal is then digitized and downconverted (as detailed in Pugel's claim 18) in the process of recovering the digital channels desired to be recovered. Thus, the multichannel analog RF input signal, subsequently digitized, *comprises a plurality of desired television channels and a plurality of undesired television channels* as recited. In particular, because Pugel teaches selection of "digital channels **desired** to be recovered," a POSITA would have recognized that the signal also includes digital channels **not desired** to be recovered. Accordingly, the plurality of frequencies that is subsequently digitized and downconverted *comprises a plurality of desired*

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	television channels and a plurality of undesired television channels as recited. Thus, the combined teachings of Pugel and Gomez render obvious this limitation. Lipoff (EX1008), ¶¶ 123–138.
[11.2] digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system, said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;	Pugel discloses, or at least renders obvious, *digitizing* (e.g., converting), *by a wideband analog-to-digital converter (ADC) module* (e.g., analog-to-digital converters) *of said wideband receiver system* (e.g., Pugel's apparatus), *said plurality of frequencies* (e.g., Pugel's plurality of separate analog signals of differing frequency ranges) *comprising said plurality of desired television channels* (e.g., Pugel's digital channels desired to be recovered) *and said plurality of undesired television channels* (e.g., the channels in Pugel not desired to be recovered). First, Pugel discloses *a wideband analog-to-digital converter (ADC) module of said wideband receiver* system: "A plurality of **analog-to-digital converters** is provided, each respectively coupled to one of the plurality of amplifier-filter circuits, the plurality of analog-to-digital converters including at least a first analog-to-digital converter configured to receive the first analog signal and generate a first digital signal and a second analog-to-digital converter configured to receive the second analog signal and generate a second digital signal." Pugel (EX1004), ¶ 9. "In operation, according to one embodiment, a multichannel analog RF input signal received at input coupler 101 is split into a plurality of substantially identical signals at splitter 102. Splitter 102 may include one or more amplifiers, filters, or other

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	components (not shown) which reduce or overcome insertion loss or other adverse effects of the split, as should be apparent to one of ordinary skill in the art. The plurality of amplifier-filter circuits 111, 112, 113 then segregates the multichannel analog input signal into a **plurality of separate analog signals of differing frequency ranges**, or 'bands.' **Each separate analog signal is then converted from analog to digital form in an analog-to-digital converter 121, 122, 123**." Pugel (EX1004), ¶ 24. "In one embodiment, each amplifier/filter bank has particular characteristics that permit the passage of a specific range of frequencies substantially independent of the frequency selection characteristics of the other amplifier/filter banks. For example, one filter might have a pass-band of about 5 to about 300 MHz, while another filter might have a pass band of about 300 to about 600 MHz." Pugel (EX1004), ¶ 25. "**a first analog-to-digital converter (121)** for processing the first analog signal to produce a first digital signal representing the signals in the first frequency band; **a second analog-to-digital converter (122)** for processing the second analog signal to produce a second digital signal representing the signals in the second frequency band;" Pugel (EX1004), claim 1.

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	Because Pugel's analog-to-digital converters operate on frequencies ranging, in one example, from 300 to 600 MHz, Pugel's analog-to-digital converters teach *digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system* as recited. Second, Pugel discloses *digitizing ... said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels*: "A method (400) processing signals comprising the steps of: (a) separating an input signal into a first analog signal and a second analog signal; (b) **digitizing** said first analog signal to generate a first digital signal; (c) **digitizing** said second analog signal to generate a second digital signal; (d) downconverting said first digital signal and said second signal; and (e) extracting desired television program information from said downconverted first digital signal and said second digital signal." Pugel (EX1004), claim 18. As detailed in the analysis of limitation [11.1], *supra*, the *plurality of frequencies* comprises *said plurality of desired television channels and said plurality of undesired television channels* as recited. Specifically, because the digitizing occurs before the step of extracting desired television programs (the *selecting* step detailed below), all channels comprised in the input signal, including *desired*

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	television channels and *undesired television channels* are digitized as recited. Thus, Pugel discloses, or at least renders obvious, this limitation. Lipoff (EX1008), ¶¶ 139–144.
[11.3] selecting, by digital circuitry of said wideband receiver system, said plurality of desired television channels from said digitized plurality of frequencies; and	Pugel discloses, or at least renders obvious *selecting* (e.g., extracts or selects), *by digital circuitry* (e.g., digital channel selector of the digital tuner) *of said wideband receiver system* (e.g., Pugel's apparatus), *said plurality of desired television channels* (e.g., Pugel's digital channels desired to be recovered) *from said digitized plurality of frequencies* (e.g., from the digitized analog signals). Specifically, Pugel discloses extracting desired television programs (e.g., particular digital channels desired to be recovered) from the downconverted, digitized frequencies (e.g., the "downconvert[ed] … first digital signal and … second digital signal."). Pugel discloses: "The digital tuner 130 may include a **channel selector 315 to permit selection of one or more particular digital channels desired to be recovered**. For example, a selected set of digital cable television channels may be communicated to the digital tuner 130 via the channel selector 315 corresponding to a plurality of pay-per-view selections desired by members of a household; the digital tuner 130 may **demultiplex only the digital channel signals corresponding to those digital cable television channels**. Alternatively, the digital tuner 130 may be configured to demultiplex and recover all of the available digital channel signals." Pugel (EX1004), ¶ 38.

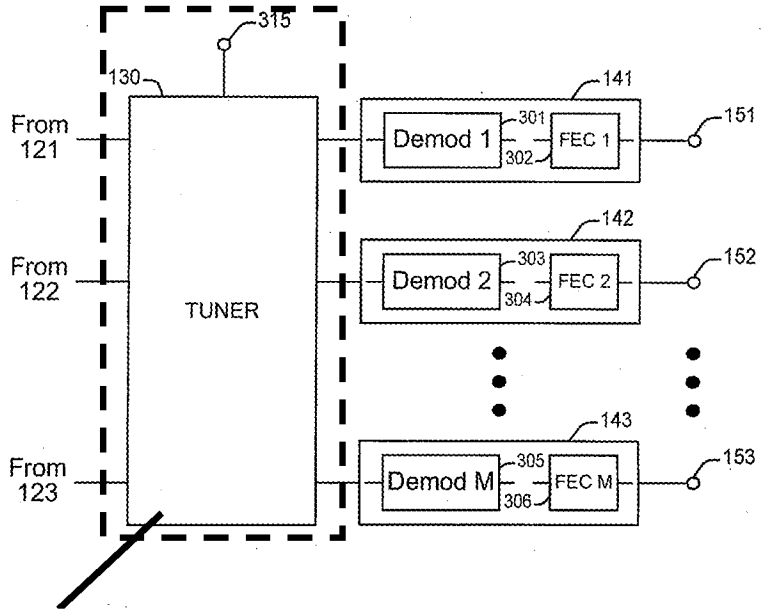


FIG. 3

Pugel (EX1004), Fig. 3 (annotated)

Pugel also refers to channel selection as "extracting," as it refers to this functionality in the claims as the tuner 130 (which includes channel selector 315) extracting desired information to be provided to demodulators (e.g., as shown in Fig. 3 above):

> "The apparatus (100) of claim 12 where said digital processor (130) multiplexes said first, second, and third digital signals, downconverts said multiplexed signal and extracts desired information to be coupled to said first and second demodulator circuits (141, 142)."

Pugel (EX1004), claim 14.

> "A method (400) processing signals comprising the steps of:
>
> (a) separating an input signal into a first analog signal and a second analog signal;

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	(b) digitizing said first analog signal to generate a first digital signal; (c) digitizing said second analog signal to generate a second digital signal; (d) downconverting said first digital signal and said second signal; and (e) **extracting desired television program information** from said downconverted first digital signal and said second digital signal." Pugel (EX1004), claim 18. "FIG. 4 shows a flow diagram representation of a method of **receiving a plurality of digital RF channels** generally designated 400 in accordance with an aspect of the present invention….The method 400 begins at step 401 and proceeds to step 402 in which a multichannel analog RF input signal is separated into a plurality of analog signals including at least first and second analog signals. In step 403, the first analog signal is converted into a first digital signal using a first analog-to-digital converter. In step 404, the second analog signal is converted into a second digital signal using a second analog-to-digital converter independently of the conversion performed in the first analog-to-digital converter. The first and second analog-to-digital converters may convert different frequency bands from analog to digital form, similar to analog-to-digital converters 121, 122, 123 described above with reference to FIGS. 1 and 2….

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	In step 405, the first digital signal (converted in the first analog-to-digital converter) and the second digital signal (converted in the second analog-to-digital converter) are demultiplexed to generate a plurality of digital RF channel signals including at least first and second digital RF channel signals." Pugel (EX1004), ¶¶ 42–45. "It should be apparent that **each digital RF channel** signal may in turn carry or provide a plurality of data streams, e.g., audio, video, **program information**, or interactive content." Pugel (EX1004), ¶ 45. "A method and apparatus is presented for simultaneous **reception of a plurality of digital RF channels**….This combination of components permits substantially **simultaneous reception of multiple digital cable channels** within a single digital receiver circuit suitable for use with conventional cable delivery systems and at a reasonable cost." Pugel (EX1004), Abstract. Because Pugel discloses extracting the desired television program information from the digital RF channels, and that the channel selector permits selection of digital RF channels desired to be recovered, Pugel discloses, or at least renders obvious, *selecting, by digital circuitry of said wideband receiver system* (e.g., channel selector 315), *said plurality of television channels from said digitized plurality of frequencies* (the digital channels desired to be recovered). Lipoff (EX1008), ¶¶ 145–148.

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[11.4] outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream.	Pugel discloses, or at least renders obvious *outputting* (e.g., coupling selected digital channels to a demodulator), *by said digital circuitry* (e.g., digital tuner) *of said wideband receiver system* (e.g., Pugel's apparatus), *said selected plurality of television channels* (e.g., Pugel's digital channels desired to be recovered) *to a demodulator* (e.g., demodulation circuits, including demodulators) *as a digital datastream* (e.g., digital channel signals). Pugel discloses: "In operation, according to one embodiment, a multichannel analog RF input signal received at input coupler 101 is split into a plurality of substantially identical signals at splitter 102. Splitter 102 may include one or more amplifiers, filters, or other components (not shown) which reduce or overcome insertion loss or other adverse effects of the split, as should be apparent to one of ordinary skill in the art. The plurality of amplifier-filter circuits 111, 112, 113 then segregates the multichannel analog input signal into a plurality of separate analog signals of differing frequency ranges, or 'bands.' **Each separate analog signal is then converted from analog to digital form in an analog-to-digital converter 121, 122, 123**." Pugel (EX1004), ¶ 24. "The converted digital signals are coupled to the digital tuner 130, which demultiplexes the converted digital signals to generate a plurality of digital channel signals. **Each digital channel signal is then coupled to a separate demodulator 141, 142, 143**, which performs demodulation and forward-error-correction (FEC) operations appropriate for the content of that digital channel."

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	Pugel (EX1004), ¶ 27. "In an alternate embodiment, in addition to the above **a plurality of demodulator circuits is coupled to the digital tuner**, the plurality of demodulator circuits including at least a first demodulator circuit configured to receive and **demodulate a first channel of the plurality of digital RF channels and a second demodulator circuit being configured to receive and demodulate a second channel of the plurality of digital RF channels**. The plurality of demodulator circuits includes circuitry configured for forward error correction." Pugel (EX1004), ¶ 10; *see also* ¶¶ 38 ("a selected set of digital cable television channels may be communicated to the digital tuner 130 via the channel selector 315…the digital tuner 130 may demultiplex only the digital channel signals corresponding to those digital cable television channels."), 39 ("the digital tuner 130 may also perform a variety of other processing operations prior to providing digital channel signals suitable for use in each of the demodulation circuits 141, 142, 143").

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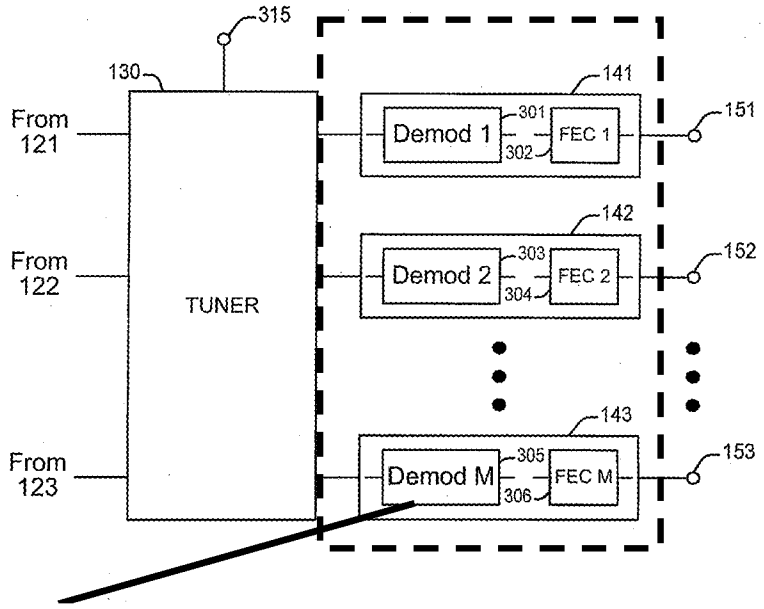


FIG. 3

Pugel (EX1004), Fig. 3 (annotated)

> "Each of the **demodulation circuits** 141, 142, 143 may include one or more demodulators 301, 303, 305 and forward-error-correction (FEC) circuitry 302, 304, 306, respectively."

Pugel (EX1004), ¶ 40.

Thus, Pugel teaches *outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream* as recited. Lipoff (EX1008), ¶¶ 149–151.

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Claim 1	
[1.0] A wideband receiver system comprising:	*See* analysis of limitation [11.0], *supra*.
[1.1] a mixer module configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;	*See* analysis of limitation [11.1], *supra*.
[1.2] a wideband analog-to-digital converter (ADC) module configured to digitize said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;	*See* analysis of limitation [11.2], *supra*.
[1.3] digital circuitry configured to: select said plurality of desired television channels from said digitized plurality of frequencies; and	*See* analysis of limitation [11.3], *supra*.
[1.4] [digital circuitry configured to:]… output said selected plurality of television channels to a	*See* analysis of limitation [11.4], *supra*.

U.S. Patent No. 9,210,362	Pugel/Gomez
demodulator as a digital datastream.	

III. DISCLOSURE OF CONCURRENT LITIGATION AND REEXAMINATION PROCEEDINGS

Requester is aware of the following litigations in which the '362 Patent is involved:

Entropic Communications, LLC v. Charter Communications, Inc., Case No. 2:22-cv-00125 (E.D. Tex.).

Entropic Communications, LLC v. Cox Communications, Inc. et al., Case No. 2:23-cv-01049 (C.D. Cal.).

Entropic Communications, LLC v. Comcast Corporation et al., Case No. 2:23-cv-01050 (C.D. Cal.).

IV. CERTIFICATION REGARDING NO ESTOPPEL

In accordance with 37 C.F.R. § 1.510(b)(6), the Requester hereby certifies that the estoppel provisions of 35 U.S.C. § 315(e)(1) or 35 U.S.C. § 325(e)(1) do not prohibit the Requester from filing this Request.

V. THIS REQUEST SHOULD NOT BE DENIED UNDER 35 U.S.C. § 325(D)

As discussed in Section I.D above, this Request raises substantial new questions of patentability with respect to the Challenged Claims. This Reexamination Request should ***not*** be rejected under 35 U.S.C. § 325(d), because none of the proposed rejections presented in this Request present prior art and arguments that includes "the same or substantially the same prior art or arguments" previously presented to the Office. *See* 35 U.S.C. § 325(d) ("In determining whether to institute or order a proceeding under this chapter, chapter 30, or chapter 31, the Director may take into account whether, and reject the petition or request because, the same or substantially the

same prior art or arguments previously were presented to the Office."). Thus, there is no basis to exercise discretion under 35 U.S.C. § 325(d).

VI. LIST OF EXHIBITS

Exhibit 1001	U.S. Patent No. 9,210,362
Exhibit 1002	File History of U.S. Patent No. 9,210,362
Exhibit 1003	WO 2006/119490 to David Lowell McNeely
Exhibit 1004	WO 2007/145637 to Michael Anthony Pugel
Exhibit 1005	U.S. Patent No. 8,224,274 to Ramon Gomez et al.
Exhibit 1006	"Frequency Translation Method for Low Frequency Variable Gain Amplification and Filtering," Mabel Y. Feng, June 2007
Exhibit 1007	Claim Construction Memorandum and Order, *Entropic Communications, LLC v. Charter Communications, LLC*, Case 2:220-cv-00125-JRG, Dkt. 123 (June 26, 2023)
Exhibit 1008	Declaration of Stuart Lipoff
Exhibit 1009	[reserved]
Exhibit 1010	[reserved]
Exhibit 1011	"Direct Downconversion of Multiband RF Signals Using Bandpass Sampling," Tseng et al., IEEE Transactions on Wireless Communications, 2006
Exhibit 1012	"RF CMOS Mixer Design and Optimization for Wideband CDMA Application," Li et al., IEEE 2000.
Exhibit 1013	"Classical and Modern Receiver Architectures," Mirabbasi et al., Topics in Circuits for Communications, IEEE 2000.

VII. CONCLUSION

For the reasons set forth above, it is clear that substantial new questions of patentability are raised in connection with claims 1 and 11 by this request for *ex parte* reexamination since claims 1 and 11 are rendered obvious in view of the above-listed prior art references. Therefore, Requester asks that this request for reexamination be granted and that claims 1 and 11 be canceled.

As identified in the attached Certificate of Service and in accordance with 37 C.F.R. §§ 1.33(c) and 1.510(b)(5), a copy of the present request, in its entirety, is being served to the address of the attorney or agent of record.

Please direct all correspondence in this matter to the undersigned.

Respectfully submitted,

/Raghav Bajaj/
Raghav Bajaj
Registration No. 66,630
Attorney for Requester

Dated: September 20, 2023
HAYNES AND BOONE, LLP
Customer No. 27683
Telephone: 512/867-8520
Facsimile: 214/200-0853
Attorney Docket No.: 50348.106

CERTIFICATE OF SERVICE

I hereby certify that this correspondence, all attachments, and any corresponding filing fee are being transmitted via the Electronic Filing System (Patent Center) with the United States Patent and Trademark Office on September 20, 2023.

/Raghav Bajaj/
Raghav Bajaj

VIII. CERTIFICATE OF SERVICE

The undersigned certifies that copies of the following,

(1) Request for Ex Parte Reexamination Transmittal Form;

(2) PTO 1449 Modified Form;

(3) Request for Ex Parte Reexamination; and

(4) Exhibits 1001 through 1008 and 1011 through 1013.

in their entirety were served on:

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET, SUITE 3400
CHICAGO, IL 60661

the attorney of record for the assignee of U.S. Patent No. 9,210,362, in accordance with 37 C.F.R. § 1.510(b)(5), on the 20th day of September 2023.

/Raghav Bajaj/
Raghav Bajaj
Registration No. 66,630

PTO/SB/57 (01-18)
Approved for use through 11/30/2024. OMB 0651-0064
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

(Also referred to as FORM PTO-1465)

REQUEST FOR *EX PARTE* REEXAMINATION TRANSMITTAL FORM

Address to:
Mail Stop *Ex Parte* Reexam
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Attorney Docket No.: 50348.106

Date: September 20, 2023

1. ☒ This is a request for *ex parte* reexamination pursuant to 37 CFR 1.510 of patent number 9,210,362 issued December 8, 2015. The request is made by:
   ☐ patent owner. ☒ third party requester.

2. ☒ The name and address of the person requesting reexamination is:
   Raghav Bajaj, HAYNES AND BOONE, LLP
   2323 Victory Avenue, Suite 700
   Dallas, Texas 75219

3. Requester ☐ asserts small entity status (37 CFR 1.27) or ☐ certifies micro entity status (37 CFR 1.29). Only a patent owner requester can certify micro entity status. Form PTO/SB/15A or B must be attached to certify micro entity status.

4. This request is accompanied by payment of the reexamination fee as set forth in:
   ☒ 37 CFR 1.20(c)(2); **or**
   ☐ 37 CFR 1.20(c)(1). **In checking this box for payment of the fee set forth in 37 CFR 1.20(c)(1), requester asserts that this request has forty (40) or fewer pages and complies with all other requirements of 37 CFR 1.20(c)(1).**

   Payment of the reexamination fee is made by the method set forth below.
   a. ☐ A check in the amount of $_____ is enclosed to cover the reexamination fee;
   b. ☒ The Director is hereby authorized to charge the reexamination fee to Deposit Account No. 50-6990;
   c. ☐ Payment by credit card. Form PTO-2038 is attached; **or**
   d. ☒ Payment made via EFS-Web.

   ☒ In addition, the Director is hereby authorized to charge any fee deficiencies to Deposit Account No. 50-6990.

5. ☒ Any refund should be made by ☐ check or ☒ credit to Deposit Account No. 50-6990. 37 CFR 1.26(c). If payment is made by credit card, refund must be to credit card account.

6. ☒ A copy of the patent to be reexamined having a double column format on one side of a separate paper is enclosed. 37 CFR 1.510(b)(4).

7. ☐ CD-ROM or CD-R in duplicate, Computer Program (Appendix) or large table
   ☐ Landscape Table on CD

A Federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with an information collection subject to the requirements of the Paperwork Reduction Act of 1995, unless the information collection has a currently valid OMB Control Number. The OMB Control Number for this information collection is 0651-0064. Public burden for this form is estimated to average 18 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the information collection. Send comments regarding this burden estimate or any other aspect of this information collection, including suggestions for reducing this burden to the Chief Administrative Officer, United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 or email InformationCollection@uspto.gov. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **If filing this completed form by mail, send to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

8. ☐ Nucleotide and/or Amino Acid Sequence Submission
If applicable, items a. – c. are required.
   a. ☐ Computer Readable Form (CRF)
   b. Specification Sequence Listing on:
      i. ☐ CD-ROM (2 copies) or CD-R (2 copies) **or**
      ii. ☐ paper
   c. ☐ Statements verifying identity of above copies.

9. ■ A copy of any disclaimer, certificate of correction or reexamination certificate issued in the patent is included.

10. ■ Reexamination of claim(s) 1 and 11 is requested.

11. ■ A copy of every patent or printed publication relied upon is submitted herewith including a listing thereof on Form PTO/SB/08, PTO-1449, or equivalent.

12. ■ An English language translation of all necessary and pertinent non-English language patents and/or printed publications is attached.

13. ■ The attached detailed request includes at least the following items:
   a. A statement identifying each substantial new question of patentability based on prior patents and printed publications. 37 CFR 1.510(b)(1).
   b. An identification of every claim for which reexamination is requested, and a detailed explanation of the pertinency and manner of applying the cited art to every claim for which reexamination is requested. 37 CFR1.510(b)(2).

14. ☐ A proposed amendment is included (only where the patent owner is the requester). 37 CFR 1.510(e).

15. ■ It is certified that the statutory estoppel provisions of 35 U.S.C. 315(e)(1) or 35 U.S.C. 325(e)(1) do not prohibit requester from filing this *ex parte* reexamination request. 37 CFR 1.510(b)(6).

16. Service
   a. ■ It is certified that a copy of this request (if filed by other than the patent owner) has been served in its entirety on the patent owner as provided in 37 CFR 1.33(c).

      The name and address of the party served are:

      MCANDREWS HELD & MALLOY, LTD
      500 WEST MADISON STREET, SUITE 3400
      CHICAGO, IL 60661

      Date of Service: September 20, 2023

   OR

   b. ☐ A duplicate copy is enclosed since service on patent owner was not possible. An explanation of the efforts made to serve patent owner **is attached**. See MPEP 2220.

17. Correspondence Address: Direct all communication about the reexamination to:

☒ The address associated with Customer Number: 27683

OR

☐ Firm or Individual Name _____
(at the address identified below)

Address

City	State	Zip

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18. ☒ The patent is currently the subject of the following concurrent proceeding(s):

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c. ☐ Copending Interference No. _____

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Entropic Communications, LLC v. Charter Communications, Inc., Case No. 2:22-cv-00125 (E.D. Tex.).; Entropic Communications, LLC v. Cox Communications, Inc. et al., Case No. 2:23-cv-01049 (C.D. Cal.).

Entropic Communications, LLC v. Comcast Corporation et al., Case No. 2:23-cv-01050 (C.D. Cal.).

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				Filing Date	Herewith
				First Inventor Name	Madhukar Reddy et al.
				Art Unit	TBD
				Examiner Name	TBD
SHEET	1	OF	1	Attorney Docket Number	50348.106

U. S. PATENTS				
Examiner's Initials	**Cite No.**	**Document Number**	**Issue Date MM-DD-YYYY**	**Name of Patentee or Applicant of Cited Document**
	Exhibit 1005	8,224,274	07-17-2012	Ramon Gomez et al.

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Customer No. 27683

Exhibit 1011

"Direct Downconversion of Multiband RF Signals Using Bandpass Sampling," Tseng et al., IEEE Transactions on Wireless Communications, 2006

Customer No.: 000027683

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Direct Downconversion of Multiband RF Signals Using Bandpass Sampling

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Abstract—**Bandpass sampling can be used by radio receivers to directly digitize the radio frequency (RF) signals. Although the bandpass sampling theory for single-band RF signals is well established, its counterpart for multiband RF signals is relatively immature. In this paper, we propose a novel and efficient method to find the ranges of valid bandpass sampling frequency for direct downconverting multiband RF signals. Simple formulas for the ranges of valid bandpass sampling frequency in terms of the frequency locations of the multiple RF bands are derived. The result can be used to design a multiband receiver for software defined radios.**

Index Terms—**Software defined radio, bandpass sampling, sampling methods, analog-digital conversion, signal sampling.**

I. Introduction

MOBILE communication standards emerged in an increasing speed in recent years. The software defined radio (SDR) [1], which was originally conceived for military applications [2], has the agility of changing its functionality through replacement of the application program and hence provides a relatively economical way to accommodate the rapid emerging mobile communication standards. The main philosophy in designing a SDR receiver front end is to push the analog-to-digital converter (ADC) as close to the antenna as possible. The ultimate goal, would be direct digitizing the radio frequency (RF) signal at the receiver antenna output [3]. To achieve this goal, one can manage to use a wideband high-speed ADC to convert the RF signal to digital. However, the required sampling rate for the ADC could often be too high to be attained if the Nyquist sampling theorem is to be satisfied [4]. Alternatively, being aware of the bandpass nature of the radio signal, one can use the bandpass sampling [5] instead to directly downconvert the desired RF signal from the RF to an intermediate frequency (IF). This can significantly relax the demand for fast ADCs and digital signal processors (DSPs) in a SDR design.

In military and commercial SDRs, there is a need for a single radio to communicate simultaneously with many radios using different RF bands and different modulation schemes [2], [6], [7], [8]. To attain this goal, methods for direct downconversion of multiband RF signals using a single ADC may be appreciated. One possible SDR receiver front end design fulfilling this purpose is shown in Fig. 1(a) [9], where the input signal to the ADC would be a multiband RF signal whose spectrum is like that shown in Fig. 1(b). A method to determine the bandpass sampling frequency for the ADC in Fig. 1(a) has been proposed in [9]. This method, however, is computationally intensive. Its computational complexity can be alleviated to certain extent by using the method presented in [10].

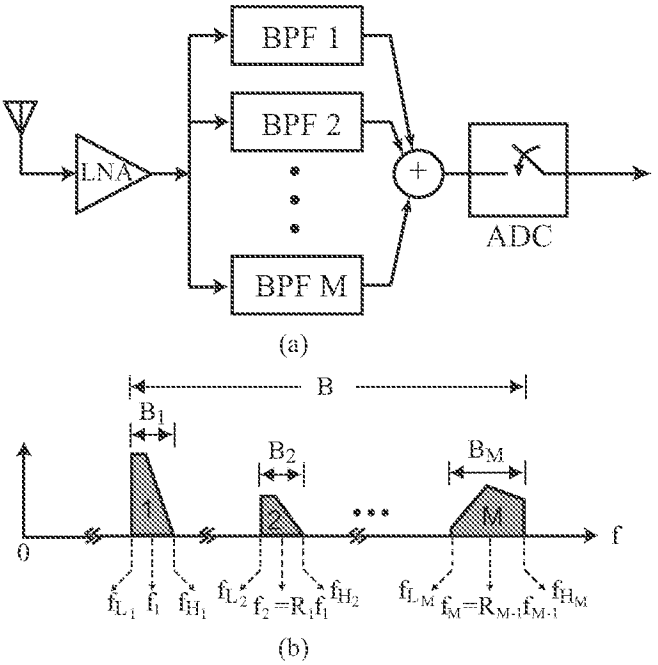


Fig. 1. (a) The SDR receiver front end. (b) The spectrum of the multiband RF signal at the input of the ADC.

In this paper, a novel method is proposed to obtain the valid bandpass sampling frequency ranges for direct downconversion of multiband RF signals. In the proposed method, we first observe that a valid sampling frequency must not cause aliasing in the sampled signal. To be immune from aliasing, the spectral replicas (which are produced by sampling) of the signals at different bands must be positioned in frequency in a particular order without overlapping in the sampled signal spectrum. By analyzing the constraints on the sampling frequency for all the possible orders of spectral replicas, we derive an efficient procedure for finding the valid sampling frequency ranges. Compared to the conventional approach, the proposed method is superior in the sense of both computational complexity and ease of implementation. Computer simulation on direct downconversion of multiband

Manuscript received August 11, 2003; revised November 13, 2003; accepted January 11, 2005. The associate editor coordinating the review of this letter and approving it for publication was T. Boucouvalas. This paper was presented in part at the IEEE International Conference on Communications (ICC'03), Anchorage, AK, May 2003.

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Digital Object Identifier 10.1109/TWC.2006.01012.

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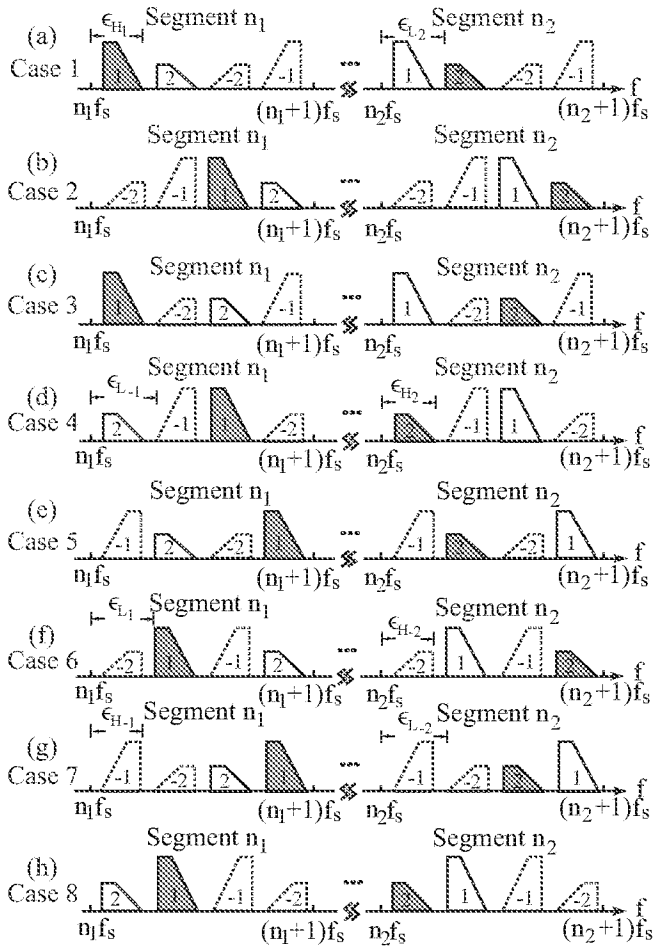


Fig. 2. The dual-band signal shown in Fig. 1(b) (assuming $M = 2$) after bandpass sampling. The 8 possible replica orders are shown in (a) to (h). The parameters ϵ_{L_i} and ϵ_{H_i} $(i = \pm 1, \pm 2)$ are defined in (a), (d), (f), and (g).

GSM signals is conducted to demonstrate the usage of the proposed method.

II. Bandpass Sampling Dual-band RF Signals

Consider the problem of sampling a dual-band RF signal whose spectrum is like that shown in Fig. 1(b) with $M = 2$. To be immune from aliasing, the sampling frequency f_s needs to be chosen without causing spectral overlapping in the sampled signal spectrum. This leads to the 8 possible replica orders shown in Fig. 2, where we use shaded trapezoids to denote the spectrum of the original signal, and solid and dashed trapezoids to denote the replicas for positive-frequency and negative-frequency spectra, respectively.

For a given replica order, the sampling frequency must satisfy two types of constraints: one is referred to as the neighbor constraint and the other is referred to as the boundary constraint in this paper. Note that, as shown in Figs. 2(a) and 2(b), the replicas '1' and '2' are neighbors in the first half of a segment in Case 1 and in the second half of a segment in Case 2. Since the positions of replica 'i' and '$-i$' are symmetric with respective to the midpoint of a segment, one can also see from Figs. 2(a) and 2(b) that the replicas '-2' and '-1' are neighbors in the second half of a segment in Case 1 and in the first half of a segment in Case 2. If those cases having the same neighboring replicas in either the first or the second half of a segment are considered as in one group, we may categorize the 8 cases in Fig. 2 into 4 groups, as shown in Table I, where the neighboring relation between two replicas j and k is denoted by $\langle j, k\rangle$. The two cases in each group have the same neighboring replicas and thus share the same neighbor constraint. However, they have different boundary constraints because the neighboring replicas show up in different halves of a segment.

TABLE I
The Neighbor Constraints for the 8 Cases in Fig. 2.

Group	Neighbors	Case	Shorthand	Constraint
1	$\langle 1, 2\rangle$ $\langle -2, -1\rangle$	1 2	$\epsilon_{H_1} \le \epsilon_{L_2}$	$f_s \le \frac{f_{L_2} - f_{H_1}}{n_2 - n_1}$
2	$\langle 1, -2\rangle$ $\langle 2, -1\rangle$	3 4	$\epsilon_{H_1} \le \epsilon_{L_{-2}}$	$f_s \ge \frac{f_{H_1} + f_{H_2}}{n_1 + n_2 + 1}$
3	$\langle -1, 2\rangle$ $\langle -2, 1\rangle$	5 6	$\epsilon_{H_{-1}} \le \epsilon_{L_2}$	$f_s \le \frac{f_{L_1} + f_{L_2}}{n_1 + n_2 + 1}$
4	$\langle -1, -2\rangle$ $\langle 2, 1\rangle$	7 8	$\epsilon_{H_{-1}} \le \epsilon_{L_{-2}}$	$f_s \ge \frac{f_{H_2} - f_{L_1}}{n_2 - n_1}$

For simplicity, we define ϵ_{L_i} and ϵ_{H_i} $(i = \pm 1, \pm 2)$ as the relative lowest and highest frequencies of replica 'i' in a segment, as shown in Figs. 2(a), 2(d), 2(f), and 2(g). By comparing Figs. 2(a), 2(d), 2(f), and 2(g) to Fig. 1(b), one can easily see that

$$\epsilon_{H_i} = f_{H_i} - n_i f_s, \quad i = 1, 2, \tag{1}$$

$$\epsilon_{H_{-i}} = (n_i + 1) f_s - f_{L_i}, \quad i = 1, 2, \tag{2}$$

$$\epsilon_{L_i} = f_{L_i} - n_i f_s, \quad i = 1, 2, \tag{3}$$

$$\epsilon_{L_{-i}} = (n_i + 1) f_s - f_{H_i}, \quad i = 1, 2. \tag{4}$$

In deriving (2) and (4), we have used the following relations

$$\epsilon_{H_{-i}} = f_s - \epsilon_{L_i}, \quad i = 1, 2, \tag{5}$$

$$\epsilon_{L_{-i}} = f_s - \epsilon_{H_i}, \quad i = 1, 2, \tag{6}$$

which are due to the fact that the relative positions of the replicas 'i' and '$-i$' in each segment are symmetric with respect to the midpoint of the segment.

Let's consider the neighbor constraint first. From Table I we see that the neighboring relation in Group *1* is $\langle 1, 2\rangle$ (or equivalently, $\langle -2, -1\rangle$). This relation may be written in a shorthand representation as $\epsilon_{H_1} \le \epsilon_{L_2}$ (see Fig. 2(a)), which can lead to $f_s \le \frac{f_{L_2} - f_{H_1}}{n_2 - n_1}$ with the aid of (1) and (3). Similarly, one can easily find the shorthand representations of the neighbor relations and their corresponding constraints on f_s for the other three groups. The result is summarized in Table I. The boundary constraints for each case can be obtained by observing Fig. 2. Taking Case 1 as an example, the neighboring replicas $\langle 1, 2\rangle$ must be completely inside the first half of a segment. We therefore see from Fig. 2(a) that the shorthand representations of the boundary constraints for spectra '1' and '2' are $\epsilon_{L_1} \ge 0$ and $\epsilon_{H_2} \le f_s/2$, respectively, which can result in $f_s \le \frac{f_{L_1}}{n_1}$ and $f_s \ge \frac{f_{H_2}}{n_2 + 1/2}$ by using (1) and (3). Following the same procedure, it is straightforward to derive the boundary constraints for all other cases. The result

TABLE II
THE BOUNDARY CONSTRAINTS FOR THE 8 CASES IN FIG. 2.

Spectrum	Group	Case	Shorthand	Constraint
'1'	*1*	1 3	$\epsilon_{L_1} \geq 0$	$f_s \leq \frac{f_{L_1}}{n_1}$
	2	2 4	$\epsilon_{H_{-1}} \leq \frac{f_s}{2}$	$f_s \leq \frac{f_{L_1}}{n_1+1/2}$
	3	5 7	$\epsilon_{L_{-1}} \geq 0$	$f_s \geq \frac{f_{H_1}}{n_1+1}$
	4	6 8	$\epsilon_{H_1} \leq \frac{f_s}{2}$	$f_s \geq \frac{f_{H_1}}{n_1+1/2}$
'2'	*1*	4 8	$\epsilon_{L_2} \geq 0$	$f_s \leq \frac{f_{L_2}}{n_2}$
	2	3 7	$\epsilon_{H_{-2}} \leq \frac{f_s}{2}$	$f_s \leq \frac{f_{L_2}}{n_2+1/2}$
	3	2 6	$\epsilon_{L_{-2}} \geq 0$	$f_s \geq \frac{f_{H_2}}{n_2+1}$
	4	1 5	$\epsilon_{H_2} \leq \frac{f_s}{2}$	$f_s \geq \frac{f_{H_2}}{n_2+1/2}$

is listed in Table II. Note that the boundary constraints for spectra '1' and '2' are listed separately in Table II. For each spectrum i ($i = 1, 2$), its boundary constraints for the 8 cases can be categorized into 4 groups. Each group includes 2 cases which share the same boundary constraint.

A valid sampling frequency must satisfy both the neighbor and boundary constraints. By combining Tables I and II, one obtains Table III (here $j = 1$, $k = 2$, and $M = 2$), where the ranges of valid sampling frequency for the 8 cases in Fig. 2 are shown.

III. BANDPASS SAMPLING M-BAND RF SIGNALS

In this section, the analysis described in Section II is extended to RF signals with an arbitrary number of bands. Consider an M-band RF signal shown in Fig. 1(b). When the M-band RF signal is sampled at f_s Hz, the spectrum of the sampled signal can be obtained by replicating the spectrum of the original signal at multiples of f_s. Due to spectral replication, there will be a replica of spectrum 'i' ($i = 1, 2, \ldots, M$) and a replica of spectrum '$-i$' in each segment of the spectrum of the sampled signal. For each pair of replicas 'i' and '$-i$', there are two choices of ordering them in a segment: placing replica 'i' in the first half and replica '$-i$' in the second half, or the other way around. Since there are M such pairs of replicas need to be allocated in a segment, the total number of choices is equal to 2^M. To be immune from aliasing, the M replicas allocated to the first half of a segment can not overlap. Hence there are $M!$ ways of ordering the allocated replicas. Therefore, the total number of possible replica orders in one segment is equal to $2^M \times M!$.

For each possible replica order in the first half of a segment, say, $\langle i_1, i_2, \ldots, i_M \rangle$ ($i_m \in \{\pm 1, \pm 2, \ldots, \pm M\}$ for $m = 1, 2, \ldots, M$), there are $M - 1$ neighbor constraints on the neighboring relations $\langle i_1, i_2 \rangle$, $\langle i_2, i_3 \rangle$, ..., $\langle i_{M-1}, i_M \rangle$ and 2 boundary constraints on replicas 'i_1' and 'i_M'. The neighbor constraint on any neighboring relation, say, $\langle j, k \rangle$, can be written in shorthand as $\epsilon_{H_j} \leq \epsilon_{L_k}$. The boundary constraint on a replica, say, 'j', in the first half of a segment is either $\epsilon_{L_j} \geq 0$ (if replica 'j' is ordered the first) or $\epsilon_{H_j} \leq \frac{f_s}{2}$ (if replica 'j' is ordered the last). The corresponding constraints on f_s for the shorthand representations can then be easily obtained with the aid of (1)-(4). By combining all the neighbor constraints on the neighboring relations $\langle i_1, i_2 \rangle$, $\langle i_2, i_3 \rangle$, ..., $\langle i_{M-1}, i_M \rangle$ and the boundary constraints on 'i_1' and 'i_M', one can obtain the range of valid sampling frequency for the replica order $\langle i_1, i_2, \ldots, i_M \rangle$.

IV. SEARCHING FOR THE RANGES OF VALID SAMPLING FREQUENCY

The derivation in Sections II and III shows how one can obtain the range of f_s for a particular replica order provided that n_i ($i = 1, 2, \ldots, M$) are given. Since n_i is the index of the segment where spectrum 'i' is located, we have

$$n_1 = \left\lfloor \frac{f_{L_1}}{f_s} \right\rfloor \leq \left\lfloor \frac{f_{L_1}}{2(B_1 + B_2 + \cdots + B_M)} \right\rfloor \tag{7}$$

where $\lfloor x \rfloor$ denotes the largest integer less than or equal to x, and B_1, B_2, ..., and B_M are defined in Fig. 1(b). In deriving (7), we have used the fact that the bandwidth of a segment should at least accommodate the $2M$ nonoverlapping replicas '1', '-1', '2', '-2', ..., 'M', and '$-M$' (i.e., $f_s \geq 2(B_1 + B_2 + \ldots + B_M)$). In addition, the center frequency of spectrum 'i' (say, f_i) is bounded by

$$n_i f_s < f_i < (n_i + 1) f_s. \tag{8}$$

Multiplying (8) by $\frac{R_i}{f_s}$ and using the relation $f_{i+1} = R_i f_i$ (see Fig. 1(b)), one obtains

$$R_i n_i < \frac{f_{i+1}}{f_s} < R_i (n_i + 1), \quad i = 1, 2, \ldots, M-1 \tag{9}$$

Taking $\lfloor \ \rfloor$ on (9) and using the fact that $n_{i+1} = \left\lfloor \frac{f_{i+1}}{f_s} \right\rfloor$, we have

$$\lfloor R_i n_i \rfloor \leq n_{i+1} \leq \lfloor R_i n_i + R_i \rfloor, \quad i = 1, 2, \ldots, M-1. \tag{10}$$

We see that the possible values of n_{i+1} can be determined given n_i.

Based on the above analysis, we may summarize the procedure for obtaining the ranges of valid sampling frequency for M-band RF signals as follows. First we choose an appropriate n_1 using (7), then we choose appropriate n_2, n_3, ..., and n_M using (10). Given the $(n_1, n_2, \ldots, n_M)$, we find the neighbor and boundary constraints for each of the $2^M \times M!$ possible replica orders. The combination of all the constraints yields the range of valid sampling frequency. The above procedure (called the standard procedure hereafter) is conceptually straightforward. However, for typical applications, one may find that examining all the possible replica orders eventually ends up with only few valid replica orders which yield nonempty sampling frequency ranges.

An alternative procedure to find the valid replica orders and their corresponding sampling frequency ranges for an M-band RF signal is to modify the standard procedure as follows. For a given $(n_1, n_2, \ldots, n_M)$, we first determine the valid replica orders for every pair of bands in the M bands. Namely, for any pair of bands, say, the j-th and k-th bands, one can use the procedure described in Section II for dual-band RF signals to determine the valid sampling frequency

TABLE III
THE RANGES OF VALID SAMPLING FREQUENCY FOR THE DUAL-BAND SIGNAL CONSISTING OF THE j-TH AND k-TH BANDS OF AN M-BAND RF SIGNAL.

Case	Range of Valid f_s
1	$\frac{f_{H_k}}{n_k+\frac{1}{2}} \le f_s \le \min\{\frac{f_{L_j}}{n_j}, \frac{f_{L_k}-f_{H_j}}{n_k-n_j}\}$
2	$\frac{f_{H_k}}{n_k+1} \le f_s \le \min\{\frac{f_{L_j}}{n_j+\frac{1}{2}}, \frac{f_{L_k}-f_{H_j}}{n_k-n_j}\}$
3	$\frac{f_{H_j}+f_{H_k}}{n_j+n_k+1} \le f_s \le \min\{\frac{f_{L_j}}{n_j}, \frac{f_{L_k}}{n_k+\frac{1}{2}}\}$
4	$\frac{f_{H_j}+f_{H_k}}{n_j+n_k+1} \le f_s \le \min\{\frac{f_{L_j}}{n_j+\frac{1}{2}}, \frac{f_{L_k}}{n_k}\}$
5	$\max\{\frac{f_{H_j}}{n_j+1}, \frac{f_{H_k}}{n_k+\frac{1}{2}}\} \le f_s \le \frac{f_{L_j}+f_{L_k}}{n_j+n_k+1}$
6	$\max\{\frac{f_{H_j}}{n_j+\frac{1}{2}}, \frac{f_{H_k}}{n_k+1}\} \le f_s \le \frac{f_{L_j}+f_{L_k}}{n_j+n_k+1}$
7	$\max\{\frac{f_{H_j}}{n_j+1}, \frac{f_{H_k}-f_{L_j}}{n_k-n_j}\} \le f_s \le \frac{f_{L_k}}{n_k+\frac{1}{2}}$
8	$\max\{\frac{f_{H_j}}{n_j+\frac{1}{2}}, \frac{f_{H_k}-f_{L_j}}{n_k-n_j}\} \le f_s \le \frac{f_{L_k}}{n_k}$

ranges for all the possible replica orders. The result would be that shown in Table III. Such a table is constructed for each pair of bands in the M bands, hence we have C_2^M tables like Table III. It is easy to see that an M-band replica order, say, $\langle i_1, i_2, \ldots, i_M\rangle$, is a valid replica order (which yields a nonempty sampling frequency range) only if $\langle i_1, i_2\rangle$, $\langle i_2, i_3\rangle$,. . ., and $\langle i_{M-1}, i_M\rangle$ are valid dual-band replica orders. That is, a valid M-band replica order must be a concatenation of valid replica orders in those C_2^M tables like Table III. Therefore, one can consider only those M-band replica orders which can be concatenated with the valid dual-band replica orders in the C_2^M tables instead of all the possible M-band replica orders. Suppose the number of the M-band replica orders which can be concatenated with the valid dual-band replica orders is small, it is shown in the Appendix that this alternative procedure can be more computationally efficient.

V. COMPUTER SIMULATION - DIRECT DOWNCONVERSION OF GSM SIGNALS

To demonstrate the usage of the proposed method, we conducted two simulations on direct downconverting GSM signals [11]. In the first simulation, the SDR receiver front end in Fig. 1(a) with $M = 2$ was used to directly downconvert the entire service bands of GSM 900 (935-960 MHz) and GSM 1800 (1805-1880 MHz) systems. Therefore, the input signal to the ADC is a dual-band RF signal like that shown in Fig. 1(b) with $M = 2$, where $f_1 = 947.5$, $f_2 = 1842.5$, $B_1 = 25$, and $B_2 = 75$ MHz.

Given the problem, we utilized the proposed method to find the ranges of valid sampling frequency. The result is shown in Table IV. In obtaining Table IV, we found that there were 12 possible (n_1, n_2)'s to be considered. Since Table III demands 35 operations (see Appendix), we see that $12 \times 35 = 420$ operations were used to obtain Table IV. If the method in [9] were used instead, testing the validity of all the frequencies from 100 to 935 MHz would be required. Even if the tests were conducted in steps of 1 MHz, we would still need 835 tests (each needs 12 operations). The number of tests could be reduced to 442 by using the method in [10]. However, the number of involved operations ($442 \times 12 = 5304$) would still be way larger than that for the proposed method.

TABLE IV
THE RANGES OF VALID SAMPLING FREQUENCY FOR THE DUAL-BAND GSM SIGNAL.

n_1	n_2	Case	Range of Valid f_s (MHz)
3	7	7	$240.000000 \le f_s \le 240.666667$
2	5	7	$320.000000 \le f_s \le 328.181818$
2	5	5	$341.818182 \le f_s \le 342.500000$
2	5	4	$355.000000 \le f_s \le 361.000000$
2	4	6	$384.000000 \le f_s \le 391.428571$
2	4	1	$417.777778 \le f_s \le 422.500000$
1	3	7	$480.000000 \le f_s \le 515.714286$
1	3	5	$537.142857 \le f_s \le 548.000000$
1	3	4	$568.000000 \le f_s \le 601.666667$
1	2	6	$640.000000 \le f_s \le 685.000000$
1	2	3	$710.000000 \le f_s \le 722.000000$
1	2	1	$752.000000 \le f_s \le 845.000000$

In the second simulation, the SDR receiver front end in Fig. 1(a) with $M = 3$ was used to receive signals from the GSM 900, GSM 1800, and GSM 1900 (1930-1990 MHz) systems. Therefore, the input signal to the ADC is a three-band RF signal. Given the received signal, we utilized the procedure described in Section IV to search for ranges of valid sampling frequency. Only 5 ranges of valid sampling frequency were found for all possible (n_1, n_2, n_3). By taking a closer look, we found that all the 5 ranges have $n_1 = 1$. With such a small value of n_1, the valid sampling frequencies in the 5 ranges are all higher than about 600 MHz. One way to lower the sampling rate is by using BPFs with bandwidths narrower than the GSM service bands in Fig. 1(a) to prefilter the received signal. By varying the center frequencies of the BPFs, any channel in the GSM service bands can be preselected as wanted.

As an example, in this simulation we assumed that three BPFs centering at $f_1 = 936$, $f_2 = 1806$, and $f_3 = 1931$ MHz and having a bandwidth of 2 MHz were used in Fig. 1(a). Hence the resulting signal to the ADC has three bands, where bands 1, 2, and 3 are at 935-937, 1805-1807, and 1930-1932 MHz, respectively. Using these parameters and following the procedure described in Section IV, a total of 611 ranges of valid sampling frequency were obtained for all possible (n_1, n_2, n_3). By examining the 611 valid ranges we found that, although the number of possible replica orders is 48, the maximum number of replica orders which can be concatenated with the dual-band valid replica orders is $L = 14$ for a given (n_1, n_2, n_3). Using the formulas in the Appendix we see that, in this case, the alternative procedure should be more computationally efficient than the standard procedure. To verify this, both the standard and the alternative procedures were used. The result shows that the alternative procedure indeed requires about 13% less CPU time than the standard procedure.

VI. CONCLUSION

In this paper, we have presented an efficient method to determine the ranges of valid bandpass sampling frequency for multiband RF signals. The result can be used to efficiently choose an appropriate bandpass sampling frequency for the ADC in a multiband SDR receiver front end. Note that the

selection of the sampling frequency could be more flexible if nonuniform sampling is allowed, but this would complicate the design of the direct downconverter. It could be beneficial if the sampling process is synchronized with the carrier of the transmitted RF signal. For example, one might be able to use the digital quadrature sampling technique [12] to simplify the data acquisition process.

There are some practical issues to be considered before using the proposed method. Firstly, in performing bandpass sampling, the analog input bandwidth of the ADC needs to meet the spectral range of the RF signals [3]. This is challenging because the attainable maximum analog input frequency of the ADC is limited by its aperture jitter [4]. Secondly, the relatively large sampling rate used by the proposed scheme suggests that high power dissipation is required [13]. This situation can only be improved through the advances of low power consumption ADC technologies (such as the CMOS technology). Thirdly, since the second-order or third-order product distortions caused by nonlinearities in the system could be downconverted to appear in the desired bands, special care should be taken in choosing the sampling frequency in case that nonlinearities exist. Lastly, the prefiltering RF filters need to have steep rolloffs to provide sufficient attenuation of adjacent channel signals, otherwise aliasing may occur in the sampled signal. The currently available RF filters (surface acoustic wave (SAW) or ceramic) have limited stopband attenuation and are designed for a fixed center frequency and a fixed bandwidth. They are not suitable for the proposed flexible filtering scheme. This might be able to be solved by using a micro-electro-mechanical structure (MEMS) filter in the future [14].

APPENDIX

It is easy to see that Tables I, II, and III require 7, 12, and 35 operations (adds, divides, or compares) for a given (n_1, n_2). For an M bands RF signal, we need to consider C_2^M neighbor constraint tables like Table I and C_2^M boundary constraint tables like Table II for a given $(n_1, n_2, \ldots, n_M)$. These tables require $7C_2^M + 12C_2^M = 19C_2^M$ operations. In addition, to see whether a particular replica order is valid, we need M compares. Since there are $2^M \times M!$ possible replica orders, we need a total of $M \times 2^M \times M!$ compares for each $(n_1, n_2, \ldots, n_M)$. The total number of operations required for the standard procedure is thus $M \times 2^M \times M! + 19C_2^M$ for each $(n_1, n_2, \ldots, n_M)$. If the alternative procedure is used, we need to consider C_2^M dual-band valid sampling frequency tables like Table III, which requires $35C_2^M$ operations. If the number of replica orders which can be obtained by concatenating the valid dual-band replica orders in the C_2^M tables is L for a given $(n_1, n_2, \ldots, n_M)$, we will need additional $L \times (2M - 3)$ compares to see whether the L replica orders are valid. The total number of operations required for the alternative procedure is thus $35C_2^M + L \times (2M - 3)$ for each $(n_1, n_2, \ldots, n_M)$. For typical applications, the number L is significantly smaller than the total number of replica orders $2^M \times M!$. Therefore, the alternative procedure is more computationally efficient when M is large. For example, if $M = 3$ and $L = 14$, the numbers of operations required by the standard and the alternative procedures are 201 and 147, respectively. The difference between the two numbers will in general increase with M.

ACKNOWLEDGMENT

This work was supported in part by the National Science Council under Contract NSC 91-2213-E-019-009.

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Exhibit 1003

WO 2006/119490 to David Lowell McNeely

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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
9 November 2006 (09.11.2006)

PCT

(10) International Publication Number
WO 2006/119490 A2

(51) International Patent Classification:
H04B 7/185 (2006.01)

(21) International Application Number:
PCT/US2006/017354

(22) International Filing Date: 4 May 2006 (04.05.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/677,563 4 May 2005 (04.05.2005) US

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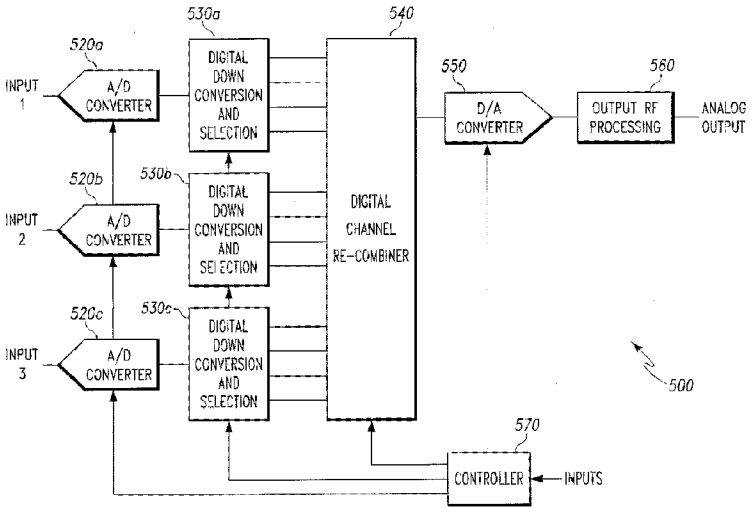
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: APPARATUS AND METHOD FOR FREQUENCY TRANSLATION



(57) Abstract: The disclosed embodiments relate to an apparatus and method for performing frequency translation. The apparatus includes a receiver (520a-c, 530a-c) for receiving and digitizing a plurality of first signals, each signal containing channels and for simultaneously recovering a set of selected channels from the plurality of first signals. The apparatus also includes a transmitter (540, 550, 560) for combining the set of selected channels to produce a second signal. The method of the present invention includes receiving a first signal (602) containing a plurality of different channels, selecting a set of selected channels (606) from the plurality of different channels, combining the set of selected channels (608) to form a second signal and transmitting the second signal (612).

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Apparatus and Method for Frequency Translation

This application claims the benefit under 35 U.S.C.§ 119 of a provisional application 60/677563 filed in the United States on May 4, 2005.

FIELD OF THE INVENTION

The present invention generally relates to communications systems. More specifically, the present invention relates to the receiving and retransmission of content within a communications system.

BACKGROUND OF THE INVENTION

This section is intended to introduce the reader to various aspects of art, which may be related to various aspects of the present invention that are described and/or claimed below. This discussion is believed to be helpful in providing the reader with background information to facilitate a better understanding of the various aspects of the present invention. Accordingly, it should be understood that these statements are to be read in this light, and not as admissions of prior art.

In today's data communication systems such as used in satellite TV, data of different types often reside in what are known as virtual channels. The data from these virtual channels is separately disassembled into data packets, aggregated within and across different data types into bit streams and conveyed by packet delivery systems. Data consumer appliances, such as satellite receivers, select from physical channels available to them, convert the signals on these channels to digital form (packets) and collect the data packets required to re-assemble the desired virtual channels of information (e.g., audio, video, program guide, transactional data, etc.). At different points along the data path between a content provider and a content consumer data

management opportunities occur. A piece of data may come from one of many sources, be routed through one of many satellites, pass through several of many transponders aboard the satellite, be received by a consumer antenna, and be distributed to places of consumption.

Consumer receivers are often capable of receiving only one of the physical channels from the satellite at a time for display. However, new receivers may contain advanced features the consumer can use. For instance, a receiving device may contain more than one tuner for use in either two picture simultaneous display systems or content recording. Additionally, consumer households often include multiple receivers, each receiver requiring the tuning of one or more channels for use.

The ever-expanding amount of content for delivery has made it very difficult to deliver that content to all places at all times. Systems receiving data from up to four separate satellites to deliver programming to the home can no longer deliver all of the content on one coaxial cable connection. Various approaches have been adapted including the use of multiple cables or complex switching arrangements. Many of these approaches are in some manner suboptimal for a home installation due to high cost or high complexity.

Another solution may be to employ a system of preselecting, combining, and redistributing the incoming content based on the physical channels requested by the user(s) using analog signal processing. As a result, only the channels required for delivery to the receivers in a household are selected from the initial available content. The desired channels may then be provided on a single cable that is relatively easy to distribute around the household. The solution relies on coarse analog signal tuning and re-mixing to move channels or frequency regions of signals from an original spectral location in frequency at the input to another spectral location in frequency on a common signal at the output. Further, channels or signal regions at the same frequency but on different satellites may be combined by moving one or both of the

original channels or regions. These relocated signals containing the desired channels are then provided on the single cable, eliminating the need for any additional switching and multiple cable connections.

The analog solution involving preselection, combination, and redistribution remains limited in the number of channels that can be provided due to the inherent shortcomings of performing the processing in the analog domain. Narrow band filters used to select individual physical channels while rejecting others are impractical at frequencies above the range of one gigahertz (GHz). Available filters having a practical bandwidth require additional channel separation in order to prevent undesired interferences in the output signal. Additionally as the desire to deliver more requested channels to the home increases, the subsequent increase in analog circuit complexity results in an expensive and inefficient design with potential problems due to analog crosstalk. Therefore there is a desire to have a solution providing receiving and re-synthesizing of channels for distribution in a more optimal manner.

SUMMARY OF THE INVENTION

The present invention relates to an apparatus and method for performing frequency translation. The apparatus includes a receiver for receiving and digitizing a plurality of first signals, each signal containing channels and for simultaneously recovering a set of selected channels from the plurality of first signals. The apparatus also includes a transmitter for combining the set of selected channels to produce a second signal.

The method of the present invention includes receiving a first signal containing a plurality of different channels, selecting a set of selected channels from the plurality of different channels, combining the set of selected channels to form a second signal and transmitting the second signal.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a block diagram of an exemplary system using the present invention.

FIG. 2 is a block diagram of an embodiment of the present invention

FIG. 3 is a block diagram of another embodiment of the present invention.

FIG. 4 is a block diagram of yet another embodiment of the present invention.

FIG. 5 is a block diagram of a further embodiment of the present invention.

FIG. 6 is a flow chart illustrating a method of the present invention.

The characteristics and advantages of the present invention may become more apparent from the following description, given by way of example.

DETAILED DESCRIPTION

One or more specific embodiments of the present invention will be described below. In an effort to provide a concise description of these embodiments, not all features of an actual implementation are described in the specification. It should be appreciated that in the development of

any such actual implementation, as in any engineering or design project, numerous implementation-specific decisions must be made to achieve the developers' specific goals, such as compliance with system-related and business-related constraints, which may vary from one implementation to another. Moreover, it should be appreciated that such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of this disclosure.

It is noted that familiarity with television broadcasting and receivers is assumed and is not described in detail herein. For example, other than the inventive concept, familiarity with current and proposed recommendations for TV standards such as National Television Systems Committee (NTSC), Phase Alternation Lines (PAL), Sequential Couleur Avec Memoire (SECAM), Advanced Television Systems Committee (ATSC), and Direct Broadcast Satellite (DBS) is assumed. Likewise, other than the inventive concept, transmission concepts such as satellite transponders, down-link signals, eight-level vestigial sideband (8-VSB), Quadrature Amplitude Modulation (QAM), and receiver components such as a radio-frequency (RF) front-end, or receiver section, such as a low noise block, tuners, and demodulators is assumed. Similarly, formatting and encoding methods (such as Moving Picture Expert Group (MPEG)-2 Systems Standard (ISO/IEC 13818-1)) for generating transport bit streams are well-known and not described herein. In addition, the inventive concept may be implemented using conventional programming techniques which, as such, will not be described herein.

The following describes a circuit used for processing satellite signals. Other systems utilized to receive other types of signals where the signal input may be supplied by some other means may include very similar structures. Those of ordinary skill in the art will appreciate that the embodiment of the circuits described herein is merely one potential

embodiment. As such, in alternate embodiments, the components of the circuit may be rearranged or omitted, or additional components may be added. For example, with minor modifications, the circuits described may be configured to for use in non-satellite video and audio services such as those delivered from a cable network. Further, the invention described could be used in conjunction with a home networking system. The device may receive inputs from a satellite or cable network, process them, and provide them as an output to the home network system. The output may in the form of a wired or wireless transmission.

Turning now to the drawings and referring initially to FIG. 1, an overall block diagram 100 of a system using the present invention is shown. FIG. 1 represents a typical satellite system installation at a customer home. A similar installation may also exist at an apartment complex or hotel where the system may be augmented with additional equipment often incorporated in multi-dwelling unit applications. Satellite transponders located on satellites 102a-c transmit satellite signals to satellite dishes 104a-c. Each satellite dish contains a reflector, a feed horn and a low noise block converter (LNB).

Each of the satellite signals may represent one or more individual physical channels. Each of the physical channels may in turn represent one or more preferably digital data streams of information combined together, encoded, and modulated using various analog and/or digital modulation techniques. The physical channels are often grouped to cover a limited frequency range such as 500 to 1000 MHz of bandwidth. The satellite signals are often located in the microwave frequency range, for instance 11-13 Gigahertz (GHz). The LNBs in the satellite dishes 104a-c will amplify and convert the satellite signal in the 11-13 GHz range to an L-band signal in the 1-2 GHz frequency range. Although three satellite dishes are shown, the orbital locations of the satellites 102a-c may permit using one satellite dish containing one reflector and three feed horns and LNBs. Also, systems may utilize more or fewer

than the three satellites signals illustrated here. The systems may additionally use techniques such as polarization diversity to increase the number of satellite signals delivered from each satellite.

Each of the three L-band signals from the satellite dishes 104a-c are provided through separate coaxial cables to a frequency translation module (FTM) 110. The three L-band signals in their entirety cannot be supplied through a single coaxial cable for delivery into the customer home, because the L-band signals occupy too much frequency bandwidth. As previously described, each L-band signal may occupy 1 GHz of bandwidth, and a typical customer premises cable installation may only support less than 2 GHz of total signal bandwidth. The FTM 110 extracts certain ranges of frequencies containing selected physical channels as portions of the three L-band signals provided. The FTM 110 also frequency translates the extracted ranges as needed and re-combines them to form a new single selected L-band signal. The process used by the FTM 110 may be described as a preselection of certain physical channels. However, the process used by the FTM 110 is different from a direct tuning of those certain physical channels since other energy besides the selected channel may be present, and the channels are then recombined to form a new signal for further distribution. Note that the FTM 110 may reside physically outside the customer home as shown, or may reside very near to the entry point into the customer home.

Once the FTM 110 has preselected the physical channels for use, the selected signal is provided over a single coaxial cable to the customer's premises 120. The selected signal may pass through a set of signal splitters 122a-c, as needed, to supply each of the locations for the premises installation. The splitters 122a-c may contain passive circuits such as transformers and resistors or may also contain amplifiers in order to increase the signal level at the installation location.

At each installation location in the premises 120, the selected signal is provided to a standalone terminal 130 or to a combination settop box 140a-c and display device 150a-c. The terminal 130 and settop box 140a-c operate in a similar manner. Each of them receive the selected signal, tune to the desired physical channel within the selected signal, demodulate the physical channel to produce a transport stream, and extract the desired bit stream(s) from the transport stream. The terminal 130 may be used for local storage of various bit streams or for distribution of these bitstreams over a different network such as a wireless network or an Ethernet connection. The settop box 140a-c converts the desired bitstream(s) into video and audio signals for display on the display device 150a-c.

The terminal 130 and settop boxes 140a-c may provide one or more control signals back onto the cable to the FTM 110. The control signal is generated based on inputs provided, for instance by a customer. The control signal sent to FTM 110 contains information necessary to perform the preselection of frequency ranges and physical channels from each of the L-band signals. The communication protocol to the FTM 110 may be done in a manner suitable for delivery as is known in the art, such as frequency shift keying FSK protocol. The control signal may alternately be supplied through a wireless link. Electrical power may also be passed through the coaxial cable to the FTM 110 and further on to the satellite dishes 104a-c.

As described earlier, a conventional FTM contains analog signal processing used for the filtering, mixing, and recombining of the L-band signals. Analog signal processing contains limitations when operating at high frequencies in the 1GHz range, and the complexity of the analog signal processor increases significantly with an increase of the number of selected physical channels. The utilization of digital signal processing within the FTM structure permits greater flexibility and removes some of the limitations of analog signal processing.

Turning now to FIG. 2 a block diagram 200 of an embodiment of the present invention is shown. The diagram shows an implementation of the FTM 110 that includes digital signal processing in order to increase the performance and available bandwidth for selected channels. In order to facilitate a further understanding of the invention, an FTM 110 will be described here using only a single L-band signal as an input. The single L-band signal, as an analog input, is processed through an RF processing block 210. The RF processing block 210 may contain circuitry for filtering undesired energy outside the signal frequency range, may correct for any frequency response errors introduced, and may amplify the signal to a level necessary for input to the analog to digital (A/D) converter 220. The input RF processing block 210 may also contain any mixing circuits necessary to position the L-band signal in the correct frequency range for operation of the A/D converter 220.

The A/D converter 220 digitizes the processed L-band signal into a series of samples, each sample containing a group of bits. In an exemplary embodiment, the processed satellite signal is located between the frequencies of 975 and 1425 MHz. The A/D converter 220 samples the processed L-band signal at a rate of 933 megasamples per second (MSPS) generating a digital signal containing a series of samples, each sample represented by 8 bits. The A/D converter 220 may also generate a translated frequency image of the L-band signal essentially translating the signal from an initial frequency range in the analog domain to a different frequency range based on sampling principles. A clock signal, not shown, is supplied to the A/D converter for performing the sampling. The clock signal may be generated by a crystal or as part of a voltage controlled oscillator. The clock signal may also directly, or through additional multipliers and dividers, supply signals to other blocks within the FTM 110.

The digital channel selector 230 receives the sampled signal and proceeds to select and down-convert each of the individual physical channels that have been selected. After processing, each of the selected individual channels are located within the same frequency range at or near to baseband, but are contained as individual signals on separate signal lines. The number of bits representing each selected individual channel may be different from the original sampled signal based on the processing method employed. The use of digital signal processing and processing of the signal in parallel permits narrower filtering constraints and more efficient channel selection within the FTM 110.

Each of the individual selected channels is provided to the digital channel re-combiner 240. The digital channel re-combiner 240 frequency translates the individual selected channels each to a different and separate frequency range and combines these signals together to form a single selected digital signal. The selected digital signal is supplied to a digital to analog (D/A) converter 250. The D/A converter 250 converts the selected digital signal to a selected analog signal. In a preferred embodiment, the selected digital signal provided to the D/A converter 250 is a series of 10 bit samples at a rate of 950 MSPS. The D/A converter 250 outputs a selected analog signal within a frequency range of DC to 475 MHz.

The selected analog signal is passed to the RF processing block 260. The RF processing block 260 provides any analog signal processing necessary to properly send the selected analog signal on the coaxial cable to the customer home. The RF processing block 260 may contain circuitry for filtering undesired signal energy outside the signal frequency range, such as the images produced by the sampling process in D/A converter 250. The RF processing block 260 may also correct for any other frequency response errors introduced, and may amplify the signal as necessary to provide the signal onto a coaxial cable. The RF

processing block 260 may also contain a mixing circuit necessary to position the selected analog signal in the correct L-band frequency range, for instance 975 - 1425 MHz.

Some additional circuitry may also be included such as circuitry for controlling the blocks, receiving and processing user inputs, and additional signal processing, although this circuitry is not shown here.

Turning now to FIG. 3, an illustrative block diagram of a circuit 300 of an embodiment of a portion of the present invention is shown. Circuit 300 represents circuitry contained with the digital channel converter block 230. A sampled signal, converted from an L-band signal by A/D converter 220, is provided to the sample demultiplexer 310. Sample demultiplexer 310 resamples at a demultiplexer sampling rate, F_F, (or post-decimation sampling rate) to provide a number of decimated sample streams in parallel.

Each of the decimated sample streams represents a sampled and time shifted version of the original signal with each of the folded spectra, from the decimation, aliased into the same decimated frequency space. The number of decimated sample streams, N, may be integrally related to the number of virtual channels in the original signal. In a preferred embodiment, the number of physical channels is sixteen. Further, the sample demulitplexer 310 sampling rate is preferably two times the data rate of one of the physical channels, or $F_F = 2F_S$ where F_s is the data rate of the physical channel. Each of the decimated sample streams passes through a sampling interface block 320. The sampling interface block 320 provides any sampling domain adjustments necessary in moving the signal from the A/D converter 220 and sample demulitplexer 310 to the filter bank 330a-N, connected to the sampling interface block 320. The filter bank 330a-N may provide a number of process steps including filtering the physical channels that are distributed within the decimated sample streams prior to the physical channels being separated. The filtering provides rejection of any energy not within a

physical channel while generating a reconstructive set of base signals for selecting out the physical channels in further downstream processing. The filter bank 330a-N may also provide a time realignment of each of the decimated sample streams. In a preferred embodiment, the filter bank 330a-N consists of a bank of bifurcated filters that collectively generate a filtered signal vector. Since all the bifurcated filters have a similar structure, only one bifurcated filter is described in detail herein.

A bifurcated filter may typically consist of two parallel branches of coefficient multiply and delay operations with the operations in each of the branches separately summed together. Each branch is designated as either an even output signal or an odd output signal. The number of multiply and delay operations in each branch may vary based on design criteria. For instance, sixteen weighted multiply and a number of coefficient multipliers may be used in each bifurcated filter. The delay element is controlled by a decimated sample clock signal, not shown, at a frequency F_f. The summing node separately adds together the values from each of the odd weighted multipliers and even weighted multipliers to form the odd and even output signal. The orientation of the filter branches and operations within the branches allows special properties to exist. These properties include amplitude inversion of the signal or time reversing the signal within the branch. As noted, other filter structures may be used, as known by those skilled in the art, in conjunction with the various techniques of simultaneous channel reception techniques.

The output signal, a filter signal vector containing 2N signal streams, from the filter bank 330a-N connects to a bank of summing nodes 340a-N. Referring to the preferred embodiment, the even and odd outputs from each of the different bifurcated filters may be combined in a cross-coupling pattern. The even output of filter 0 is summed with the odd output of filter N-1, even output of filter 1 with the odd output of filter N-2, and so on as shown. The summing nodes 340a-N generate a set of filtered sample streams.

The filtered sample streams at the output of summing nodes 340a-N connect to a distributor block 350. The main purpose of the distributor block 350 is to process the filtered sample streams generated by the filter block 330a-N and summing nodes 340a-N to reconstruct the set of physical channels, originally provided in the L-band signal, from the decimated and filtered sample streams. The processing may include recombining the streams in a manner using mathematical operations. In a preferred embodiment the distributor block 350 uses a type IV Discrete Cosine Transform (DCT) for processing the filtered sample streams. The bifurcated filter structure described previously further permits a small DCT structure in implementation by making use of the inversion and time reversal properties of the filter. The bifurcated filter structure may also permit use of a DCT employing a sparse matrix decomposition structure.

The combination of the filter bank 330a-N, summing node 340a-N, and distributor 350 results in generating a set of output streams, each representing the separated data content from a physical channel. The set of individual physical channels from the distributor 350 are generated from the set of decimated sample streams where each stream contains content from each of the physical channels in a sample aliased condition. It should be noted that other methods may be employed for accomplishing recovery of separate physical channels simultaneously from a single signal.

The output of distributor block 350 represents N individual physical channels positioned at or near to baseband frequency. Each physical channel, in digital signal form, may be located on a separate signal line at the output of distributor block 350. Each of the separate signal lines connect to a channel selector block 360. The channel selector block 360 may select a set of physical channels from the original N input channels provided. Any number of channels up to the full number N may be selected. For instance, four channels may be selected. The number of channels permitted for selection in channel selector block 360 is a

design choice, and the full number of permitted channels for selection does not have to be selected at any one time. Additionally, any further physical channel separation may be performed, such as removing any aliasing components present due to the complex form of the signal as a result of the previously described processing.

The channel selector block 360 receives inputs from a controller 370 regarding which, if any, of the originally received physical channels is currently requested by the customer. The controller 370 may connect to the sample demultiplexer 310, interface 320, filter bank 330a-N, and distributor 350 in addition to connecting to channel selector 360. The controller 370 may also provide an interface for user inputs or a communications input in order to receive and convey the user requested channel information from multiple locations. As described previously, the user inputs may be supplied through the signal cable or through some other communications means. Also, as described previously, a home or customer premises may supply more than one customer input. In addition, controller 370 may provide additional functions for operation of the demultiplexer 310, interface 320, filter bank 330a-N, and assembler 350, such as clock functions, as necessary. The controller 370 may also be embodied as a portion of a larger controller function responsible for controlling and managing, for instance, the entire FTM device.

Turning now to FIG. 4, a block diagram 400 of a further embodiment of the present invention is shown. FIG. 4 illustrates an implementation of the digital channel re-combiner 240. The M outputs, representing a set of selected physical channels, of channel selector 360 are provided to the assembler 410. As described previously, the M outputs of the channel selector 360 may be equal to or less than the N physical channels present in the original L-band signal. In a preferred embodiment, the assembler 410 may receive up to N inputs. If the number of signals provided from channel selector 360 is less than N, the remaining inputs of channel assembler 410 are placed in a condition of

"null" or no input. Additionally, the assembler 410 may also provide the ability to re-order the M input signals. For instance, if the M signals provided to the assembler 410 are physical channels in positions 1, 2, 3, and 4 from selection of the original N channels, the assembler 410 may re-position the M signals by addressing them as inputs 1, 5, 9, and N-1. In this manner, further processing, including internal or external filtering may be simplified. Also, the re-positioning permits re-spacing of the M signals.

The assembler 410 provides processing for converting the selected channels into a set of signals forming a base set of parallel data streams that can then be filtered prior to remultiplexing and converting to an analog signal. The channel re-combiner 410 provides N outputs as a set of converted sample streams to inverse filter bank 420a-N. The inverse filter bank 420a-N provides filtering and/or time delay operations necessary to permit signal remultiplexing. The output of the inverse filter bank 420a-N provides a set of inverse filtered sample streams.

The inverse filtered sample streams at the output of the inverse filter bank 420a-N are provided to the sample multiplexer 430. The sample multiplexer 430 re-combines the samples, in a time multiplexing fashion, into a single sample stream. The sampling rate of the new single sample stream is preferably $2NF_s$ (F_s is the data rate of one channel). Clock signals representing both the input parallel sample stream rate and the new sampling rate at the output of the sample multiplexer 430 are also provided.

In a preferred embodiment, the assembler 410 is realized as an inverse type IV DCT, and the filter bank 420a-N is realized as an effective inverse bifurcated filter bank with respect to filter bank 330a-N as previously described. In this and other possible approaches, advantages exist due to the sparse matrix factorization stages containing a defined sparse inverse as well as the complementary form of the filtering stages. For example, the Type IV DCT is its own inverse i.e.,

(DCT IV)^2=I (identity matrix), and the bifurcated filters work with the transform elements to shape the bands of independent physical channels. Also, the inverse filter bank 420a-N, shown as a bifurcated filter structure has a signal splitting at its input for providing a cross coupling of signals to the even and odd branches of the individual filters. After each branch in the individual filters has completed processing, the even and odd branches of each individual filter are summed together to form the individual output signal.

Alternatively, since the type IV DCT function in both the distributor 350 and assembler 410 may be the same, only one block for both operations may be used. For example, a single block may, in conjunction with a signal multiplexer (not shown), provide either an output signal representing the set of individual physical channels or the base set of parallel data streams in alternating operations.

A controller 470 may connect to the assembler 410, filter bank 420a-N, and sample multiplexer 430. The controller 470 may control the final selection process and ordering of selected physical channels in assembler 410. The controller 470 may follow a pre-programmed allocation and ordering algorithm, or may process user inputs to determine the allocation and ordering. The controller 470 may also provide an interface for user inputs or a communications input in order to receive and convey the user requested channel information from multiple locations. As described earlier, a home or customer premises may supply more than one customer input. In addition, controller 470 may provide additional functions for operation of the assembler 410, filter bank 420a-N, and multiplexer 430 such as clock functions, as necessary. The controller 470 may also be embodied as a portion of a larger controller function responsible for controlling and managing, for instance, the entire FTM device.

Additionally, if the M signals at the input to the assembler 410 are less than the N original channels, the channel re-combiner may also

change the overall sampling rate. The assembler 410 may be reconfigured to process the M signals in an M point transform, producing M parallel data streams. The filter bank may subsequently contain only M branches and the sample multiplexer process only M inputs. The clocks, supplied to the D/A converter as well as other blocks with diagram 400 may also be a scaled version of the clock used for digital channel selector 230. For instance, if M is one half the number N, then the clock signal for the digital channel re-combiner 240 may be one half the frequency of the clock signal for the digital channel selector 230. Note that the clock signal supplied to the other blocks working on parallel data streams may remain unaffected.

Further, the choice of value of M may be chosen to permit a maximum of allowable channels at any time. However, in actual operation, a number less than M channels may actually be in use.

Turning now to FIG. 5, a block diagram of another embodiment of the present invention is shown. FIG. 5 illustrates a three L-band signal input FTM utilizing the inventive concept described herein. Each L-band input signal is processed through RF input processing, not shown. Each L-band signal is further processed in A/D converter 520a-c, and digital channel selectors 530a-c as described previously. Also, D/A converter 550 and output RF processing block 560 operate as described previously.

Each digital channel selector 530a-c is capable of producing M outputs representing M physical channels where M is less than or equal to the N original physical channels from an L-band signal. Each L-band signal may provide a different number of physical channels.

The digital channel re-combiner 540 may process up to N channels in its assembler block as described above. The assembler in the digital channel re-combiner 540 also includes switching and selection circuits to manage which of the M inputs from each of the digital channel selectors 530a-c are processed in the digital channel re-combiner 540.

The management and switching function is controlled by the controller 570.

The controller 570 provides functions to ensure that a selected combination of the M outputs from the selectors 530a-c does not exceed the N inputs for selected channels possible for processing in digital channel re-combiner 540. The controller 570 receives inputs from the one or more users and processes the inputs to determine the correct combination of inputs. In a preferred embodiment, each of the digital channel selectors 530a-c may provide up to six signals to the digital channel re-combiner. The digital channel re-combiner 540 may accept only sixteen signals. The controller 570 may determine, for instance based on inputs from users, that only five inputs will be used from digital channel selectors 530a and 530b, and all six will be used from digital channel selector 530c. Additional user inputs may then require a change to this apportionment. The controller 570 may also provide control or other necessary signals such as clock signals to A/D converters 520a-c, digital channel selectors 530a-c and D/A converter 550.

The digital channel re-combiner 540 may also contain signal processing such as digital signal level adjustment applied to each of the selected channels. Level adjustment may allow all selected channels to be delivered at approximately the same signal level improving the operation of home equipment such as settop boxes.

Block diagram 500 forms a multi-input, single output channel selection, translation, and distribution device. The device produces an output of up to N channels in a single signal for delivery over a single coaxial cable, from an input containing up to three times N possible input channels presented in three separate signals. The use of three inputs is illustrative, and a greater or fewer number of inputs containing a greater or fewer number of possible input channels may be used.

Turning now to FIG. 6, a flow chart 600 showing an embodiment of the method of the present invention is shown. At step 602, one or more

incoming satellite signals are received by a device, such as the FTM device described previously in block diagram 500. Next, at 604, the incoming satellite signals are converted to digital signals. The conversion is preferably performed by A/D converters 530a-c, and may further include a processing means for separating the individual physical channels after the conversion such as described in digital channel selectors 530a-c.

Next, at step 606, the desired physical channels are selected to form a group of selected physical digital channels in parallel. The selected physical channels are selected in the digital channel selectors 530a-c based on requests by the customer's home equipment processes and managed by, for instance, controller 570. The controller 570 may be responsible for receiving and managing multiple requests and providing the proper information to the digital channel selectors 530a-c as well as the digital channel re-combiner 540.

The group of selected digital channels, at step 608, are re-combined in a frequency diverse manner to form a signal occupying a range of frequencies and containing the selected digital channels at separate frequencies. The recombination may include a means for processing the group of selected digital channels such as described for digital channel re-combiner 540. At step 610, the recombined frequency diverse signals are converted back into an analog signal containing the selected channels at separate frequencies. The conversion may be done using a D/A converter 550 and may also include any additional processing as described for output RF processing block 560. Finally, at step 612, the analog signal is sent or transmitted to additional devices, for instance devices found in customer premises connected by a single coaxial cable.

While the invention may be susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and have been described in detail herein. The

foregoing merely illustrates the principles of the invention and it will thus be appreciated that those skilled in the art will be able to devise numerous alternative arrangements which, although not explicitly described herein, embody the principles of the invention and are within its spirit and scope. For example, although illustrated in the context of separate functional elements, these functional elements may be embodied on one or more integrated circuits (ICs). Similarly, although shown as separate elements, any or all of the elements of may be implemented in hardware, software, or a combination of both. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the scope of the present invention as defined by the appended claims.

What is claimed is:

1. An apparatus (500) comprising:

a receiver (520a-c, 530a-c) for receiving and digitizing a plurality of first signals, each signal containing one or more different channels and for simultaneously recovering a plurality of selected channels from said plurality of first signals; and

a transmitter (540, 550, 560) for combining said plurality of selected channels and producing a second signal.

2. The apparatus (500) set forth in claim 1, wherein said receiver (520a-c, 530a-c) further comprises:

a sampler (310, 320, 330a-N) for sampling said plurality of first signals to provide a plurality of decimated sample streams; and

a distributor (350) operatively connected to said sampler (310, 320, 330a-N) for processing said plurality of decimated sample streams to provide output signals representative of said one or more different physical channels.

3. The apparatus (500) of claim 2, wherein said distributor (350) includes a transform element.

4. The apparatus (500) of claim 3, wherein said transform element performs matrix-based processing on said plurality of decimated sample steams using a sparse matrix factorization of a type IV discrete cosine transform.

5. The apparatus (500) of claim 2, wherein said sampler (310, 320, 330a-N) further comprises:

a demultiplexer (310) for demultiplexing the signal into said plurality of decimated sample streams; and

a plurality of filters (330a-N) operatively connected to said demultiplexer (310) for processing said plurality of decimated sample streams.

6. The apparatus (500) of claim 5, wherein said plurality of filters (330a-N) includes a plurality of bifurcated filters.

7. The apparatus (500) of claim 1, wherein said receiver (530a-c) further comprises a selector (360) operatively connected to said distributor (350) for selecting said plurality of selected channels.

8. The apparatus (500) of claim 1, wherein said transmitter (540, 550, 560) further comprises:

an assembler (410) that assembles said plurality of selected channels to provide a set of parallel data streams representing the combination of said plurality of channels; and

a converter (420a-N, 430) for converting said parallel data streams into said second signal.

9. The apparatus (500) of claim 8, wherein said assembler (410) includes a transform element.

10. The apparatus (500) of claim 9, wherein said transform element performs matrix-based processing on said plurality of selected channels using a sparse matrix factorization of type IV discrete cosine transform.

11. The apparatus (500) of claim 8, wherein said converter further comprises:

a plurality of filters (420a-N) for processing said plurality of parallel data streams; and

a multiplexer connected to said plurality of filters for multiplexing said plurality of parallel data streams into a single sample stream.

12. The apparatus (500) of claim 11, wherein said plurality of filters (420a-N) includes a plurality of bifurcated filters.

13. A method (600) for providing frequency translation comprising:

receiving (602) a first signal having a plurality of different frequency channels;

selecting (606) a set of frequency channels from said plurality of different frequency channels;

combining (608) said set of frequency channels to form a second signal; and

transmitting (612) said second signal.

14. The method (600) of claim 13, wherein the step of selecting further comprises:

processing (604) said first signal to provide a plurality of decimated sample streams; and

performing (606) a transform on said number of decimated sample streams to provide transform output signals.

15. The method (600) of claim 14, wherein the step of processing (604) includes:

demultiplexing the signal into the number of decimated sample streams; and

filtering said number of decimated sample streams with a plurality of filters for matching said transform.

16. The method (600) of claim 15, wherein said plurality of filters include a plurality of bifurcated filters and said transform is a type IV discrete cosine transform.

17. The method (600) of claim 13, wherein the step of selecting further comprises re-ordering said set of frequency channels.

18. The method (600) of claim 13, wherein said step of combining (608) further comprises:

performing transform-based processing on said set of different frequency channels to provide a plurality of parallel data streams; and

processing said plurality of parallel data streams to provide said second signal.

19. An integrated circuit (500) for use in a receiving system, which receives signals representing a plurality of channels, the integrated circuit comprising:

a demultiplexing element (310) for demultiplexing a received sampled signal to produce a plurality of first data streams;

a transform element (350, 410) for transforming said plurality of first data streams into a plurality of transform output signals, and for transforming at least two of said plurality of transform output signals into a plurality of second data streams; and

a multiplexing element (430) for mulitplexing said plurality of second data streams and outputting a sampled signal.

20. The integrated circuit (500) of claim 19, wherein said transform element (350, 410) uses a type IV discrete cosine transform.

21. The integrated circuit (500) of claim 20, further comprising:

a first filter element (330a-N) operative to filter said plurality of first data streams prior to providing said plurality of first data streams to said transform element; and

a second filter element (420a-N) operative to filter said plurality of second data streams prior to providing said plurality of second data streams to said multiplexing element.

22. An apparatus (500) for frequency translation comprising:

means for receiving (520a-c) a first signal having a plurality of different frequency channels;

means for translating (530a-c) said first signal into a set of signals representing said plurality of different frequency channels;

means for selecting (530a-c) a set of channels from said set of signals;

means for combining (540) said set of channels to form a second signal; and

means for transmitting (550, 560) said second signal.

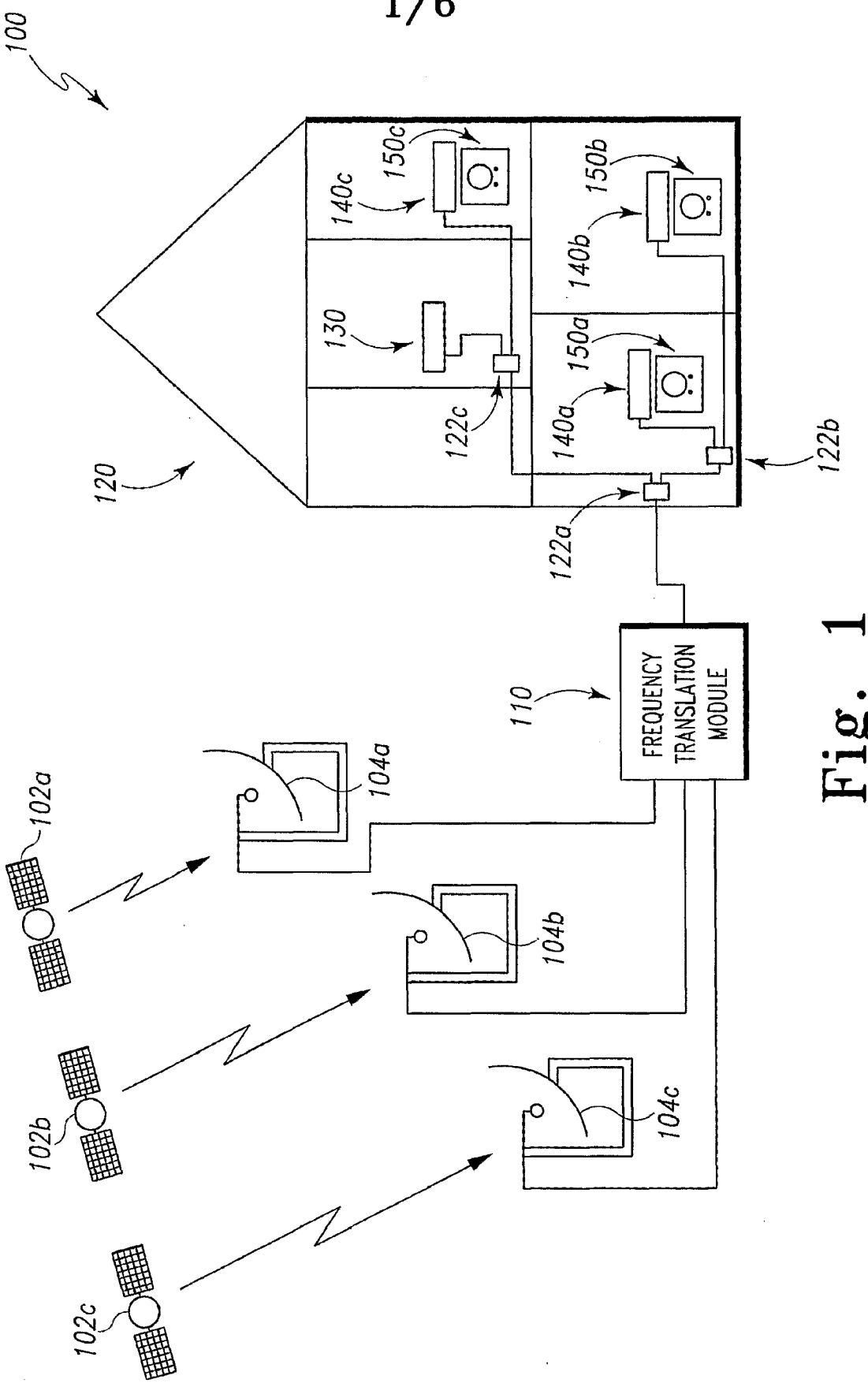

100
120
130
140a
140b
140c
150a
150b
150c
122a
122b
122c
110
FREQUENCY TRANSLATION MODULE
102a
102b
102c
104a
104b
104c

Fig. 1

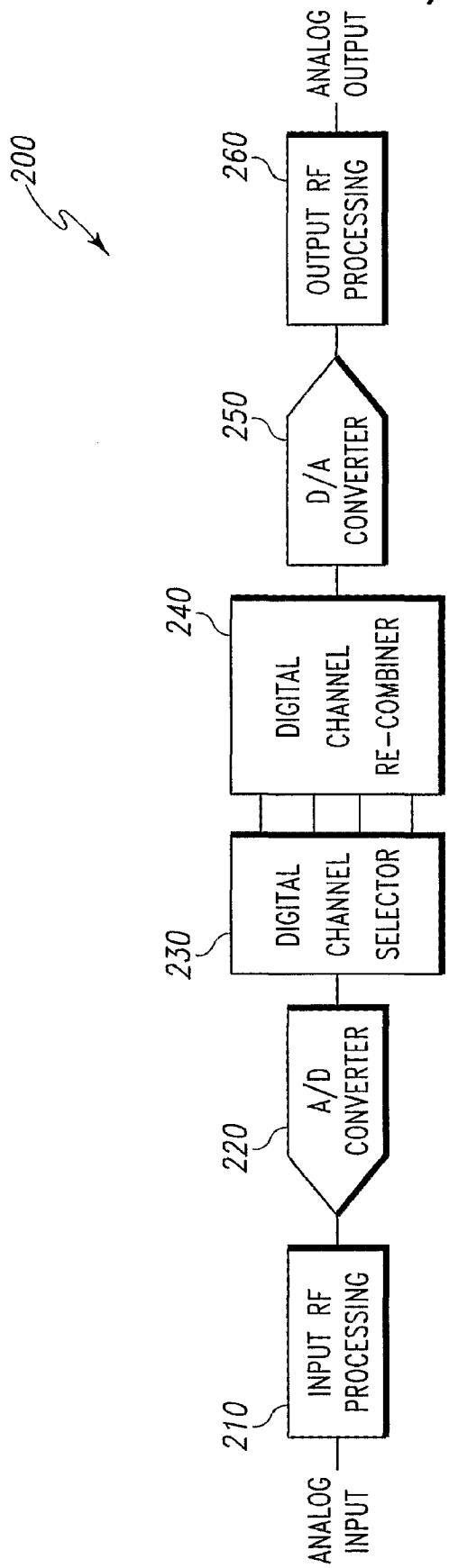

200
ANALOG INPUT
210
INPUT RF PROCESSING
220
A/D CONVERTER
230
DIGITAL CHANNEL SELECTOR
240
DIGITAL CHANNEL RE-COMBINER
250
D/A CONVERTER
260
OUTPUT RF PROCESSING
ANALOG OUTPUT

Fig. 2

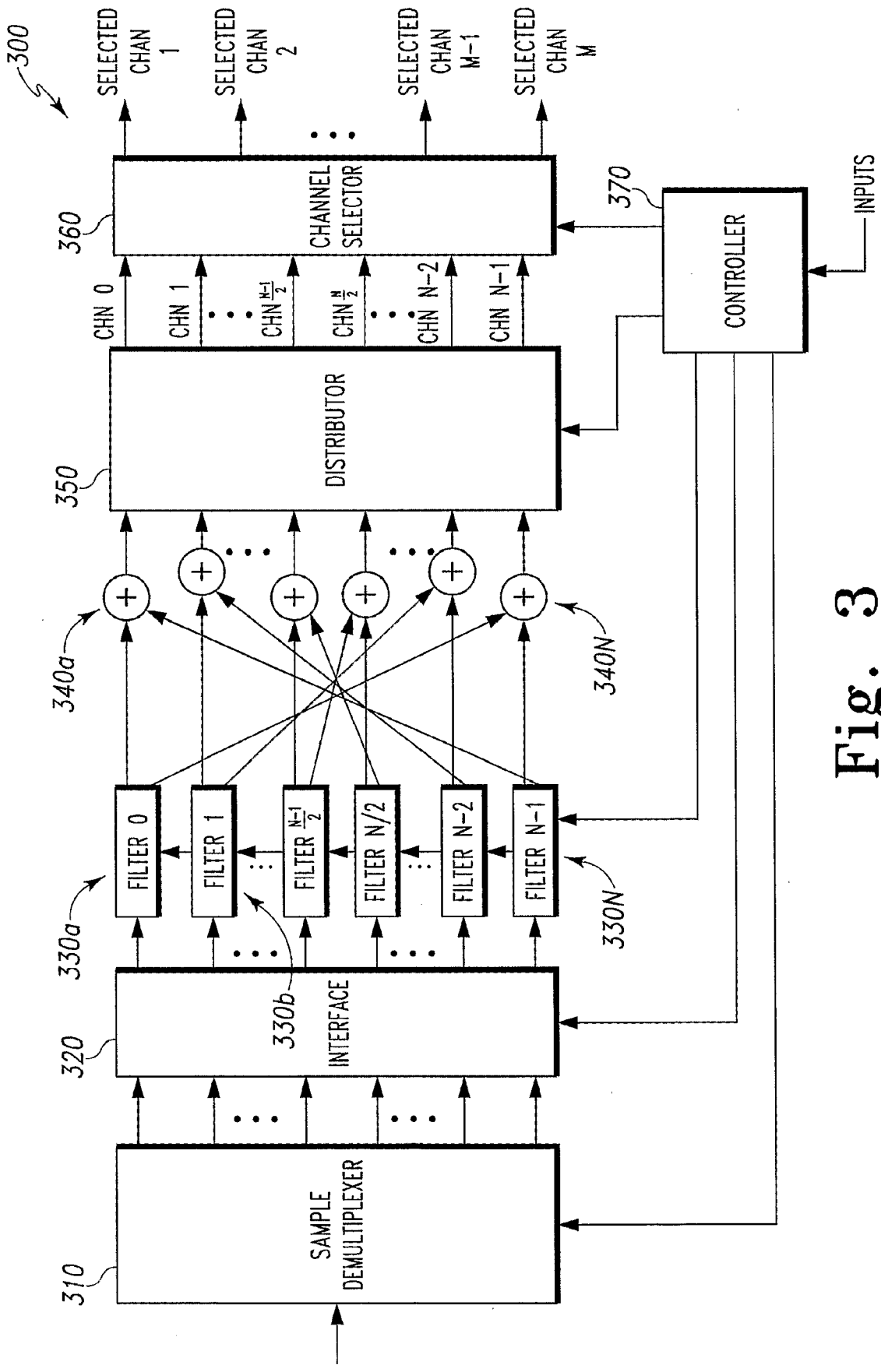

300
SELECTED CHAN 1
SELECTED CHAN 2
SELECTED CHAN M-1
SELECTED CHAN M
360
CHANNEL SELECTOR
370
CONTROLLER
INPUTS
CHN 0
CHN 1
CHN (N-1)/2
CHN N/2
CHN N-2
CHN N-1
350
DISTRIBUTOR
340a
340N
FILTER 0
FILTER 1
FILTER (N-1)/2
FILTER N/2
FILTER N-2
FILTER N-1
330a
330N
330b
320
INTERFACE
310
SAMPLE DEMULTIPLEXER

Fig. 3

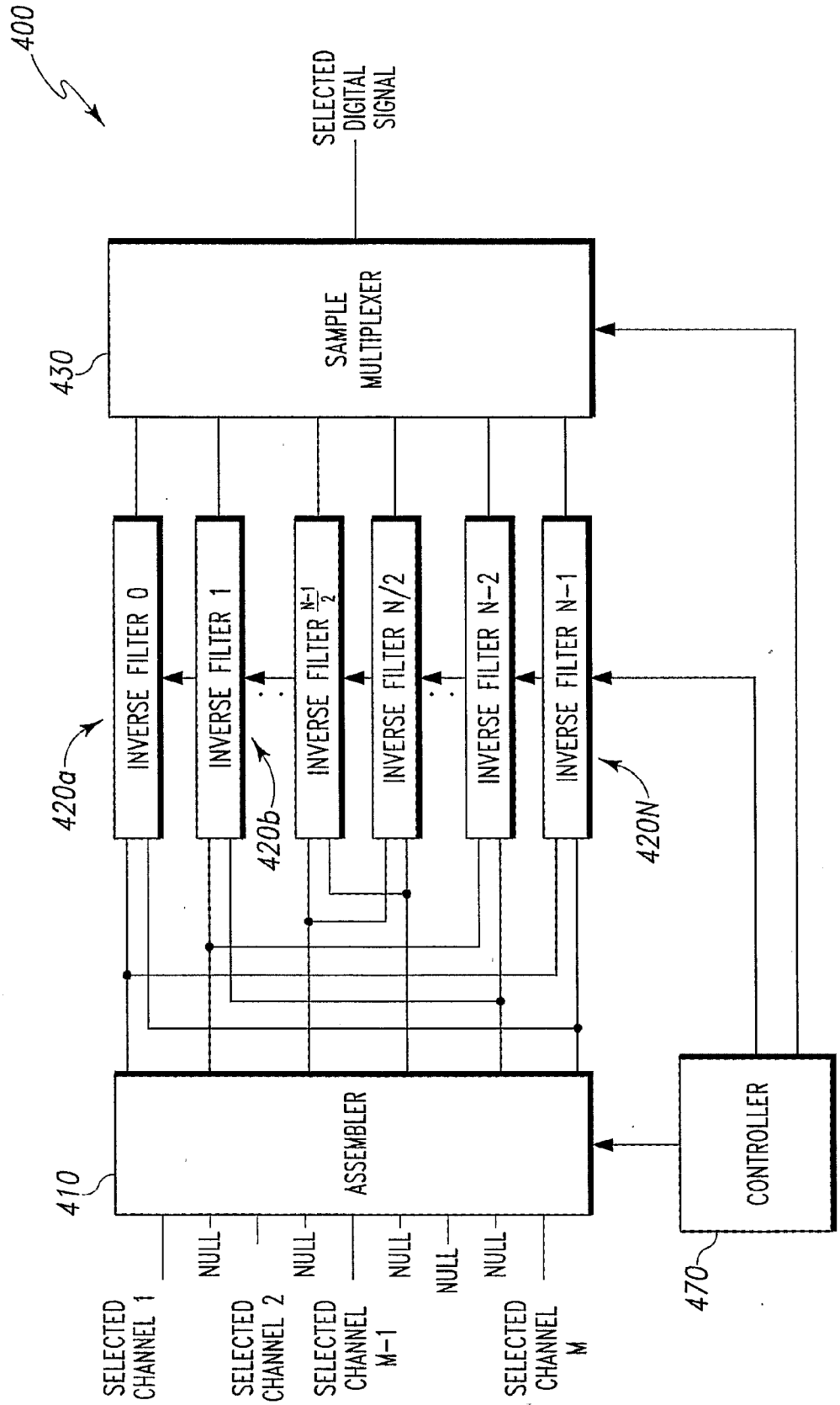

400
SELECTED DIGITAL SIGNAL
430
SAMPLE MULTIPLEXER
420a
INVERSE FILTER 0
INVERSE FILTER 1
420b
INVERSE FILTER $\frac{N-1}{2}$
INVERSE FILTER N/2
INVERSE FILTER N-2
INVERSE FILTER N-1
420N
410
ASSEMBLER
CONTROLLER
470
SELECTED CHANNEL 1
NULL
SELECTED CHANNEL 2
NULL
SELECTED CHANNEL M-1
NULL
NULL
NULL
SELECTED CHANNEL M

Fig. 4

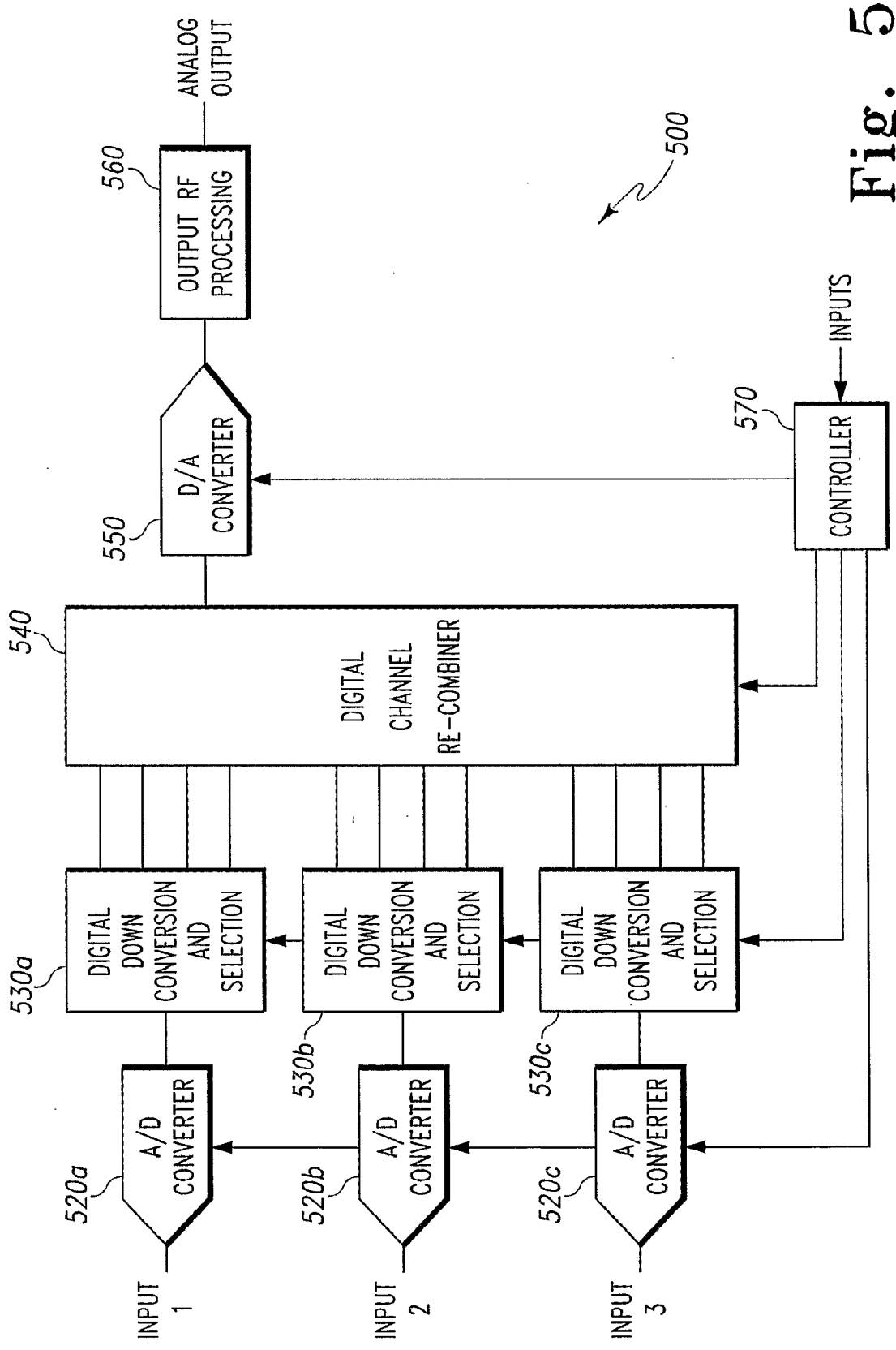

500
560
OUTPUT RF PROCESSING
ANALOG OUTPUT
550
D/A CONVERTER
570
CONTROLLER
INPUTS
540
DIGITAL CHANNEL RE-COMBINER
530a
DIGITAL DOWN CONVERSION AND SELECTION
530b
DIGITAL DOWN CONVERSION AND SELECTION
530c
DIGITAL DOWN CONVERSION AND SELECTION
520a
A/D CONVERTER
520b
A/D CONVERTER
520c
A/D CONVERTER
INPUT 1
INPUT 2
INPUT 3

Fig. 5

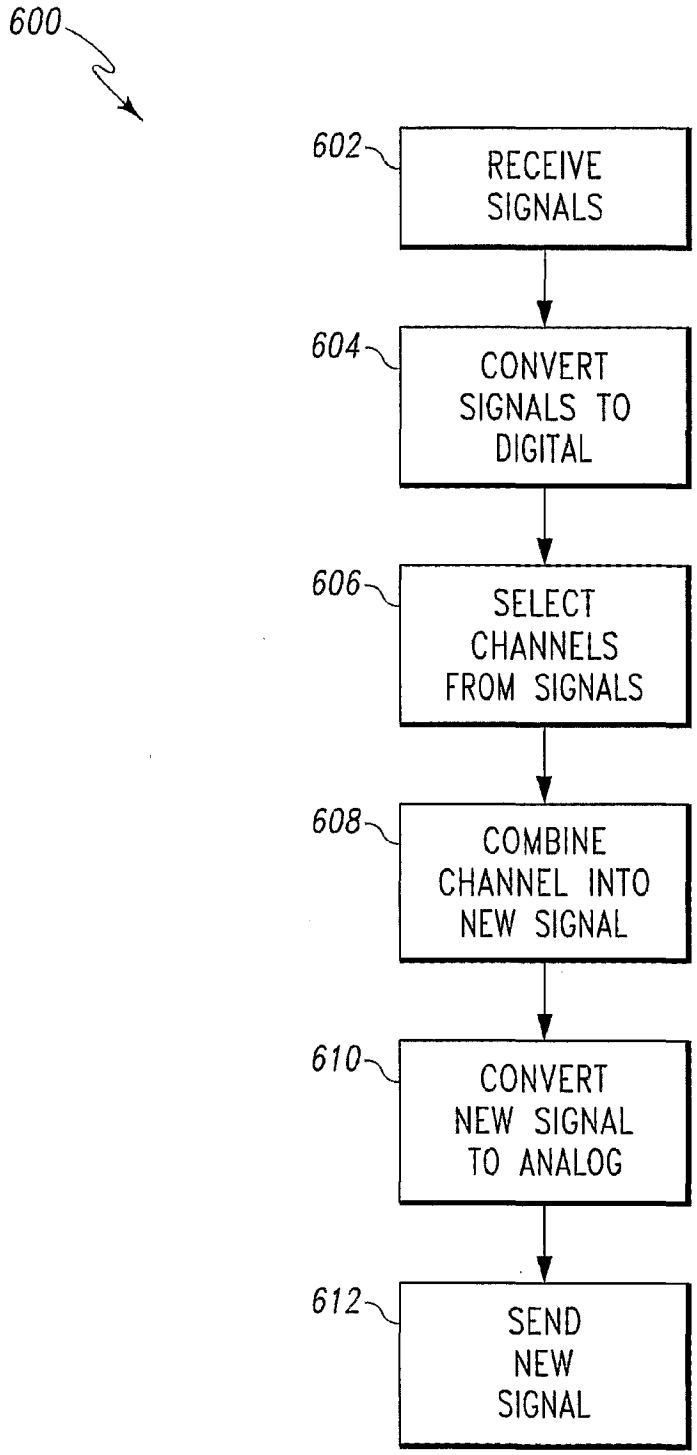

600
602
RECEIVE SIGNALS
604
CONVERT SIGNALS TO DIGITAL
606
SELECT CHANNELS FROM SIGNALS
608
COMBINE CHANNEL INTO NEW SIGNAL
610
CONVERT NEW SIGNAL TO ANALOG
612
SEND NEW SIGNAL

Fig. 6

Exhibit 1008

Declaration of Stuart Lipoff

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNIFIED PATENTS, LLC
Requester

v.

ENTROPIC COMMUNICATIONS, LLC
Patent Owner

Reexamination No. *to be assigned*
U.S. Patent 9,210,362

DECLARATION OF STUART LIPOFF

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I. INTRODUCTION

1. My name is Stuart Lipoff, and I am over 21 years and otherwise competent to make this Declaration. I make this Declaration based on facts and matters within my own knowledge and on information provided to me by others, and, if called as a witness, I could and would competently testify to the matters set forth herein.

2. I have been retained as a technical expert witness in this matter by Counsel for the Requester, Unified Patents, LLC ("Requester") to provide my independent opinions on certain issues requested by Counsel for Requester relating to the accompanying Ex Parte Reexamination of U.S. Patent No. 9,210,362 ("the '362 Patent"), challenging Claims 1 and 11 (the "Challenged Claims"). My compensation in this matter is not based on the substance of my opinions or on the outcome of this matter. I have been informed that Entropic Communications, LLC ("Patent Owner") is the purported owner of the '362 Patent. I note that I have no financial interest in Requester or Patent Owner, and I have no other interest in the outcome of this matter.

3. I have reviewed, had input into, and endorse the discussions in the Requester's Request for Ex Parte Reexamination of the '362 Patent (the "Request"), including the statements in the Request regarding the '362 Patent and its prosecution history, the scope of the claim, the prior art's disclosure of the claim, and the

statements throughout the Request regarding a POSITA's knowledge and understanding.

II. QUALIFICATIONS

4. In formulating my opinions, I have relied on my knowledge, training, and experience in the relevant field, which I have summarized below.

5. I am currently president of IP Action Partners Inc., a consulting practice that serves the telecommunications, information technology, media, electronics, and e-business industries.

6. I earned a Bachelor of Science degree in Electrical Engineering in 1968 and a second Bachelor of Science degree in Engineering Physics in 1969, both from Lehigh University. I earned a Master of Science degree in Electrical Engineering from Northeastern University in 1974, and then a Master of Business Administration degree from Suffolk University in 1983.

7. I hold a Federal Communications Commission ("FCC") General Radiotelephone License. I also hold a Certificate in Data Processing from the Institute for the Certification of Computing Professionals ("ICCP"), which is supported by the Association for Computing Machinery ("ACM").

8. I am also a registered professional engineer (PE) in the Commonwealth of Massachusetts and in the State of Nevada.

9. I am a fellow of the Institute of Electrical and Electronics Engineers

("IEEE") Consumer Electronics, Communications, Computer, Circuits, and Vehicular Technology Groups. I have been a member of the IEEE Consumer Electronics Society National Board of Governors (formerly known as the Administrative Committee) since 1981, and I was Boston Chapter Chairman of the IEEE Vehicular Technology Society from 1974 to 1976. I served as the 1996-1997 President of the IEEE Consumer Electronics Society, and from 1999 to 2018 I served as Chairman of the Society's Technical Activities and Standards Committee and as Vice President of Publications for the Society. Since 2018 I have served as Vice President of Standards and Industry Activities for the Society. I have also served as an Ibuka Award committee member for the IEEE's Award in the field of consumer electronics.

10. I have prepared and presented numerous papers at the IEEE and at other professional meetings. For example, in fall 2000, I served as general program chair for IEEE's Vehicular Technology Conference on advanced wireless communication technology. I have organized sessions at The International Conference on Consumer Electronics, and I was the 1984 program chairman. I conducted an eight-week IEEE-sponsored short course on Fiber Optics System Design. I received IEEE's Centennial Medal in 1984, and I received IEEE's Millennium Medal in 2000.

11. As Vice President and Standards Group Chairman for the Association of Computer Users ("ACU") from 1980 to 1983, I served as the ACU representative

to the ANSI X3 Standards Group. From 1976 to 1978, I served as Chairman of the task group on user rule compliance for the FCC's Citizens Advisory Committee on Citizen's Band Radio.

12. Over the last 25 years, I have been a member of the Society of Cable Television Engineers, the Association for Computing Machinery, and The Society of Motion Picture and Television Engineers. From 2001 to 2004, I served as a member of the USA advisory board to the National Science Museum of Israel. In 1998, I presented a short course on international product development strategies as a faculty member for Technion Institute of Management in Israel. From 2001 to 2003, I served as a member of the board or directors of The Massachusetts Future Problem Solving Program.

13. I am a named inventor on seven United States patents and have several publications on data communications in publications, including Electronics Design, Microwaves, EDN, the Proceedings of the Frequency Control Symposium, Optical Spectra, and IEEE publications.

14. During my professional career dating from 1969 to the present, I have been heavily engaged in the study, analysis, evaluation, design, and implementation of products and technology associated with consumer electronics and electronic appliances.

15. For 25 years, I worked for Arthur D. Little, Inc. ("ADL"), where I

became Vice President and Director of Communications, Information Technology, and Electronics ("CIE"). Prior to my time at ADL, I served as a Section Manager for Bell & Howell Communications Company for four years, and prior to that, as a Project Engineer for Motorola's Communications Division for three years.

16. At ADL, I was responsible for the firm's global CIE practice in laboratory- based contract engineering, product development, and technology-based consulting. At both Bell & Howell and Motorola, I had project design responsibility for wireless communication and paging products.

17. While employed at ADL, I served as the leader of a project that developed a series of specifications for residential cable modems known as Data over Cable Service Interface Specification, or "DOCSIS." The scope of work for this project included developing a roadmap and strategic framework for evolving the business from internet services to broadband services combining voice, data, and secure electronic content delivery. This project was performed by ADL under contract to the Multimedia Cable Network System ("MCNS") consortium and the specifications resulting from that project have since been adopted by the United Nations as a global telecommunications specification.

18. Following my time at ADL, I managed a project (through IP Action Partners) for Next Generation Network Architecture, LLC ("NGNA") that produced a five-year planning horizon for services and technology in the cable industry. The

services and vision were then mapped to overall architectures impacting network elements in the back office, head-end, outside plant, and customer premises, and documented in next generation network recommendations. The project involved coordination with senior technical staff of several multiple service operators ("MSOs") as well as interactions with over one hundred suppliers and vendors of systems, software, and products in the cable industry.

19. Additional details about my employment history, fields of expertise, and publications are included in my curriculum vitae (attached as Appendix A).

A. Materials Considered

20. As part of my work in forming my opinions in connection with this proceeding, I have reviewed the following materials, which I believe those in the field would reasonably rely upon in forming opinions regarding the subject matter of this proceeding:

Exhibit 1003	("McNeely") WO 2006/119490 to David Lowell McNeely
Exhibit 1004	("Pugel") WO 2007/145637 to Michael Anthony Pugel
Exhibit 1005	("Gomez") U.S. Patent No. 8,224,274 to Ramon Gomez et al.

For ease of citation, when I cite to any of the non-patent/application references, I refer to the exhibit page number added at the bottom or cover page.

III. LEGAL FRAMEWORK

21. I am a technical expert and do not offer any legal opinions. However, I have been informed about certain legal principles regarding patentability and related matters under United States patent law, which I have applied in performing my analysis and arriving at my technical opinions in this matter.

A. Anticipation

22. I am informed that a person cannot obtain a patent on an invention if it is anticipated by an earlier prior art reference. It is my understanding that, to anticipate a claim under 35 U.S.C. § 102, a reference must disclose each and every element of the claim, arranged as in the claim.

B. Obviousness

i. General Framework

23. I am informed that a person cannot obtain a patent on an invention if the differences between the invention and the prior art are such that the subject matter as a whole would have been to a person having ordinary skill in the art obvious at the time of the invention. I am informed that a conclusion of obviousness may be founded upon more than a single item of prior art. I am also informed that obviousness is determined by evaluating the following factors: (1) the scope and content of the prior art, (2) the differences between the prior art and the claim at issue, (3) the level of ordinary skill in the pertinent art, and (4) secondary

considerations of non-obviousness. In addition, the obviousness inquiry should not be done in hindsight. Instead, the obviousness inquiry should be done through the eyes of a person having ordinary skill in the art at the time of the alleged invention.

24. In considering whether certain prior art renders a particular patent claim obvious, I am informed that one must consider the scope and content of the prior art, examples of which include disclosures in patents, trade publications, journal articles, conference papers, industry standards, product literature and documentation, texts describing competitive technologies, requests for comment published by standard setting organizations, and materials from industry conferences.

25. I am informed that for a patent claim to be found obvious, the proper perspective to consider is that of a person having ordinary skill in the art (often referred to as a "PHOSITA," "POSITA," or "POSA") at the time of the alleged invention. I am informed that the factors to consider in determining the level of ordinary skill in the art include (1) the educational level and experience of people working in the field at the time the invention was made, (2) the types of problems faced in the art and the solutions found to those problems, and (3) the sophistication of the technology in the field.

ii. Analogous Art

26. I am informed that for a prior art reference to be proper for use in an obviousness analysis, the reference must be "analogous art" to the claimed

invention. I am informed that a reference is analogous art to the claimed invention if: (1) the reference is from the same field of endeavor as the claimed invention (even if it addresses a different problem); or (2) the reference is reasonably pertinent to the problem faced by the inventor (even if it is not in the same field of endeavor as the claimed invention). In order for a reference to be "reasonably pertinent" to the problem, it must logically have commended itself to an inventor's attention in considering his problem. In determining whether a reference is reasonably pertinent, one should consider the problem faced by the inventor, as reflected either explicitly or implicitly, in the specification. I believe that all of the references I considered in forming my opinions in this reexamination are well within the range of references a person having ordinary skill in the art would have consulted by the time of the invention to address the type of problems described in the Challenged Claims.

iii. Combining Known Elements in the Art, Common Sense

27. I am informed that, in order to establish that a claimed invention was obvious based on a combination of prior art elements, a clear articulation of the reason(s) why a claimed invention would have been obvious must be provided. Specifically, I am informed that, under the U.S. Supreme Court's KSR decision, a combination of multiple items of prior art renders a patent claim obvious when there was an apparent reason for a person having ordinary skill at the time of the invention to combine or modify the prior art. I am informed that such reason may include, but

is not limited to, one or more of the following rationales: (A) combining prior art methods according to known methods to yield predictable results; (B) substituting one known element for another to obtain predictable results; (C) using a known technique to improve a similar device in the same way; (D) applying a known technique to a known device ready for improvement to yield predictable results; (E) trying a finite number of identified, predictable potential solutions, with a reasonable expectation of success; (F) identifying that known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art; or (G) identifying an explicit teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine the prior art references to arrive at the claimed invention.

28. I am informed that the test for obviousness is *not* whether the features of a secondary reference may be *bodily incorporated* into the structure of the primary reference, but rather whether one of skill would have been motivated to combine the teachings of the prior art references to achieve the claimed invention. Nevertheless, I am informed that an invention that is a combination of prior art must do more than yield predictable results to be non-obvious and that, even where one or more motivations to combine exist, claims are not necessarily obvious unless a person

having ordinary skill in the art would have had a reasonable expectation of success in implementing or applying the proposed combination at the time of the invention.

29. I also am informed that in conducting an obviousness analysis, a precise teaching directed to the specific subject matter of the challenged claim need not be sought out because it is appropriate to take account of the inferences and creative steps that a person having ordinary skill in the art at the time of the invention would employ. In other words, the prior art need not be directed towards solving the same specific problem as the problem addressed by the patent. Further, the individual prior art references themselves need not all be directed towards solving the same problem. The prior art considered can be directed to any need or problem known in the field of endeavor at the time of invention and can provide a reason for combining the elements of the prior art in the manner claimed. Common sense teaches that familiar items may have obvious uses beyond their primary purposes, and a person having ordinary skill in the art will often have been able to fit the teachings of multiple prior art references like pieces of a puzzle. I am informed that, under the *KSR* standard, common sense is important and should be considered.

30. I also am informed that the fact that a particular combination of prior art elements was "obvious to try" may indicate that the combination was obvious even if no one attempted the combination. If the combination was obvious to try (regardless of whether it was actually tried) or leads to anticipated success, then it is

likely the result of ordinary skill and common sense rather than innovation. I am further informed that in many fields it may be that there is little discussion of obvious techniques or combinations, and it often may be the case that market demand, rather than scientific literature or knowledge, will drive the design of an innovation. When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person having ordinary skill in the art has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation, but of ordinary skill and common sense.

iv. Teaching Away

31. I am informed that it is improper to combine references where the references teach away from their combination. I am informed that a reference may be said to teach away when a person of skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the patent applicant. In general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the patentee. I am informed that a reference teaches away, for example, if (1) the combination would produce a seemingly inoperative device, or (2) the references leave the impression that the product would not have the property sought by the

patentee. However, I am informed that a reference does not teach away if it merely expresses a general preference for an alternative invention but does not criticize, discredit, or otherwise discourage investigation into the invention claimed. Further, a person of skill will often appreciate that different courses of action often have simultaneous advantages and disadvantages, and I am informed the existence of such does not necessarily obviate a motivation to combine.

v. Secondary Considerations

32. I am informed that even if a *prima facie* case of obviousness is established, the final determination of obviousness must also consider "secondary considerations" if presented. I am informed that in most instances, the patentee raises these secondary considerations of non-obviousness. In that context, the patentee argues an invention would not have been obvious in view of these considerations, which include: (a) commercial success of a product due to the merits of the claimed invention; (b) a long-felt, but unsatisfied need for the invention; (c) failure of others to find the solution provided by the claimed invention; (d) deliberate copying of the invention by others; (e) unexpected results achieved by the invention; (f) praise of the invention by others skilled in the art; (g) lack of independent simultaneous invention within a comparatively short space of time; (h) teaching away from the invention in the prior art.

33. I am further informed that secondary-considerations evidence is only

relevant if the offering party establishes a connection, or nexus, between the evidence and the claimed invention. The nexus cannot be based on prior art features. For example, if commercial success of products allegedly embodying the claims is presented as a secondary indicium of non-obviousness, the patent owner must show that such success is due to features of the claimed invention, and not features unrelated to the claimed invention or that already existed in the prior art. The establishment of a nexus is a question of fact. While I understand that the Patent Owner here has not offered any secondary considerations at this time, I will supplement my opinions in the event that Patent Owner raises secondary considerations during the course of this proceeding.

C. Claim Construction

34. I am informed that in performing an obviousness analysis, it is necessary to understand the scope of the claims. I am also informed the first step in an unpatentability analysis, therefore, involves construing the claims. Second, the construed claim language is then compared to the disclosures of the prior art.

35. I am informed that claims in a reexamination are given their broadest reasonable interpretation consistent with the patent specification. I am informed that, for the purposes of claim construction, expert testimony may be helpful to provide background on the technology at issue, to explain how an invention works, to ensure an understanding of the technical aspects of the patent is consistent with that of a

POSITA, or to establish that a particular term in the patent had a particular meaning in the pertinent field at the time of the invention. However, I am also informed that it is not the role of technical experts to supplant the examiner or the USPTO in applying principles of claim interpretation.

36. For purposes of this proceeding, Counsel has instructed me to understand the claim terms of the Challenged Claim in a way that is generally consistent with the terms' broadest reasonable interpretation consistent with the specification of the '362 Patent. My analysis below is consistent with these principles. I provide analysis for certain terms below, and have interpreted the remainder of the claim terms in accordance with their broadest reasonable interpretation consistent with the specification.

i. Order of Steps in Claim 1

37. Claim 1 recites a step of "downconverting, by a mixer module of said wideband receiver system, a plurality of frequencies" and a step of "digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system, said plurality of frequencies."

38. I have been informed that a district court has construed these steps such that the two steps need not be performed in order. *See* EX1007. That is, the step of "downconverting … a plurality of frequencies" step does not need to be performed before the step of "digitizing … said plurality of frequencies."

39. I have applied this construction in my analysis below.

ii. **"mixer module"**

40. Claim 11 recites "downconverting, by a **mixer module** of said wideband receiver system, a plurality of frequencies..." Claim 1 recites a "**mixer module** configured to downconvert a plurality of frequencies…"

41. I understand that certain claim terms can be drafted in "means-plus-function" format, when the claim uses the term "means" (or another nonce word) for performing a function without reciting specific structure for performing the function. I understand that, in these circumstances, the claim is to be interpreted such that the structure for performing the function includes corresponding structure recited in the specification. However, I also understand that, even if a claim term uses the word "means" or a nonce word for performing a function, the term may not be considered a means-plus-function term if the claim term, to a POSITA, has sufficiently definite meaning as the name for structure that performs the function.

42. In the context of the claims' "mixer module" it is my opinion that a POSITA would have recognized the term to have a sufficiently definite meaning as the name for structure that performs the function in the claims of downconverting a plurality of frequencies. For example, the specification of the '362 Patent describes a "mixer" that performs this function, which a POSITA would understand as an example of the meaning of the "mixer module" recited in the claims.

iii. "wideband analog-to-digital converter (ADC) module"

43. Claim 11 recites "digitizing, by a **wideband analog-to-digital converter (ADC) module** of said wideband receiver system, said plurality of frequencies…" Claim 1 recites "a **wideband analog-to-digital converter (ADC) module** configured to digitize said plurality of frequencies…"

44. In the context of the claims' "wideband analog-to-digital converter (ADC) module" it is my opinion that a POSITA would have recognized the term to have a sufficiently definite meaning as the name for structure that performs the function in the claims of digitizing a plurality of frequencies. For example, the specification of the '362 Patent describes "[a]nalog-to-digital converters ADC1 218 and ADC2 228" that perform this function, which a POSITA would understand as an example of the meaning of the "wideband analog-to-digital converter (ADC) module" recited in the claims.

IV. OPINION

A. Level of Skill of a Person Having Ordinary Skill in the Art

45. I was asked to provide my opinion as to the level of skill of a person having ordinary skill in the field of the '362 Patent at the time of the claimed invention (referred to herein as a "POSITA"). I have been instructed to assume that the time of the claimed invention of the '362 Patent is April 17, 2009. In determining the characteristics of a POSITA, I was told to consider several factors, including the

type of problems encountered in the art, the solutions to those problems, the rapidity with which innovations are made in the field, the sophistication of the technology, and the education level of active workers in the field. I also placed myself back in the time frame of the claimed invention and considered the colleagues with whom I had worked at that time.

46. In my opinion, a POSITA would be a person having, as of April 17, 2009: (1) an undergraduate degree in electrical engineering, or a closely related field, or similar advanced post-undergraduate education; and (2) two to three years of work experience in the field of radio frequency systems (e.g., cable television systems), with more education substituting for less experience and vice versa. Such a person of ordinary skill in the art would have been capable of understanding the '362 Patent and the prior art references discussed herein.

47. Based on my education, training, and professional experience in the field of the claimed invention, I am familiar with the level and abilities of a POSITA. Additionally, I met at least these minimum qualifications at least as of April 17, 2009. Further, although my qualifications may exceed those of the hypothetical person defined above, my analysis and opinions regarding the '362 Patent have been rendered from the perspective of a POSITA during the relevant time frame.

B. Background of the Technology

i. Background of the '362 Patent

48. The '362 Patent is titled Wideband Tuner Architecture" and it is directed to a "wideband receiver system" which "comprises a mixer module, a wideband analog-to-digital converter (ADC) module, and digital circuitry." '362 Patent (EX1001), Abstract.

49. The '362 Patent Abstract provides a summary of the claims discussed below:

> A wideband receiver system comprises a mixer module, a wideband analog-to-digital converter (ADC) module, and digital circuitry. The mixer module is configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels. The wideband ADC module is configured to digitize the swatch of frequencies comprising the plurality of desired television channels and the plurality of undesired television channels. The digital circuitry is configured to select the desired plurality of television channels from the digitized plurality of frequencies, and output the selected plurality of television channels to a demodulator as a digital datastream.

'362 Patent (EX1001), Abstract.

50. In more detail, the '362 Patent purports to relate to "wideband receiver systems that are capable of receiving multiple desired television channels that extend over multiple non-contiguous portions of the broad frequency spectrum and grouping them into a contiguous, or substantially-contiguous, frequency spectrum."

'362 Patent (EX1001), 1:15-23. I note, however, that the claims challenged below do not discuss contiguous or non-contiguous portions of a frequency spectrum.

51. The '362 Patent details as background information that:

> "Receivers used to down-convert and selectively filter TV channels are referred to as tuners, and tuners designed to concurrently receive several TV channels are referred to as wideband tuners. Existing tuners for these applications down-convert a swath of channels to an intermediate frequency, which are then sent to a demodulator. Because the swath of channels is not contiguous, this swath includes the desired channels as well as undesired channels. The demodulator employs a high-speed data converter to capture this swath of desired and undesired channels in the digital domain and subsequently filters out the desired channels."

'362 Patent (EX1001), 1:24-34.

52. The '362 Patent notes that "channel frequencies may not be adjacent to each other" and as a result "the receiver system may have to concurrently receive several desired channels that may or may not be contiguous." '362 Patent (EX1001), 1:35-41. Thus, the "wideband receiver requirement poses a trade-off to the system to limit either the dynamic range of the wideband tuner or reduce the bandwidth covered by the tuner so that fewer channels may be received and processed by the demodulator." '362 Patent (EX1001), 1:41-45. The '362 Patent then goes through an example of a "conventional wideband tuner" which it alleges requires "very

expensive digital processing circuitry" and thus, the '362 Patent states it is "desirable to have wideband receiver systems that can increase the dynamic range without requiring expensive data conversion, filtering and channel selection at the demodulator." '362 Patent (EX1001), 1:46-2:27.

53. Figure 2 of the '362 Patent provides a "wideband receiver system 200 according to an embodiment of the present invention."

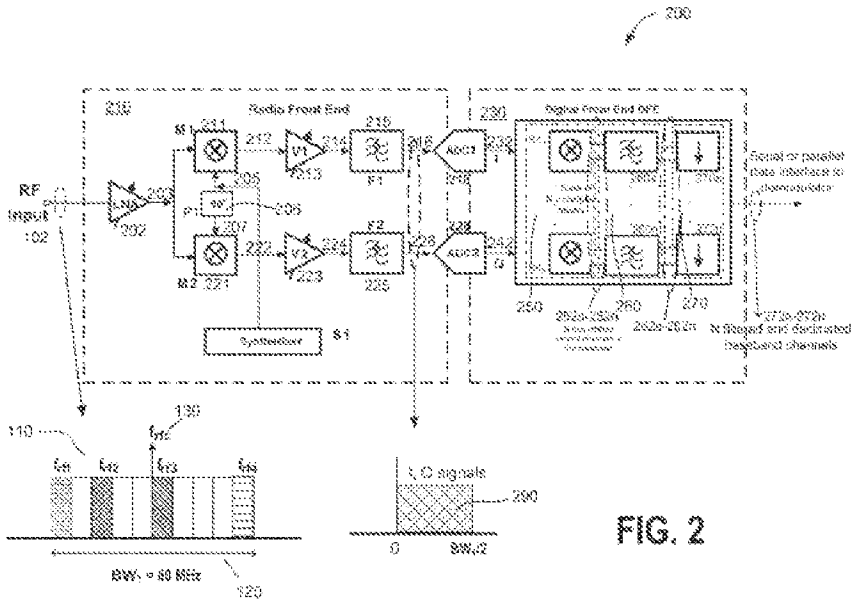


FIG. 2

54. In describing Figure 2, and with reference to the components and steps recited in the claims analyzed below, the '362 Patent explains the components of its system. For example, with respect to the claimed "wideband receiver system," the '362 Patent explains: "Wideband receiver system 200 includes a radio front end 210 and a digital front end 230. Radio front end 210 may be a single very wide-band tuner receiver that captures the desired swath of channels located in non-contiguous

portions of the spectrum having a frequency bandwidth BW1 120. In this example, the number of available channels in BW1 120 is assumed to be 10 with each channel occupying an 8 MHz bandwidth for a total of 80 MHz." '362 Patent (EX1001), 4:16-39.

55. The challenged claims also recite a "mixer module" and "downconverting, by a mixer module," which is explained in part by the '362 Patent as follows: "Mixers M1 211 and M2 221 may be conventional mixers formed using, for example, differential Gilbert cells. Each of the mixers 211 and 221 multiplies (mixes) an amplified RF signal 203 with a respective first oscillator frequency signal 205 and a second oscillator frequency signal 207 to generate an in-phase signal 212 and a quadrature signal 222 that have a phase shift of 90° degree between them." '362 Patent (EX1001), 4:40-5:12.

56. The challenged claims also recite "digitizing" which is described in part as follows: "Analog-to-digital converters ADC1 218 and ADC2 228 are high-speed (i.e., high sampling rate) converters to maximize the dynamic range. In an exemplary application, radio front end 210 operates as a nominal zero-IF down-mixer so that signals 216 and 226 have a nominal bandwidth 290 equal to one half of the RF signal bandwidth BW1 thanks to the complex down-mixer architecture. In other embodiment, radio front end 210 operates as a low-IF down-mixer so that the nominal bandwidth 290 of signals 216 and 226 is greater than one half of the

bandwidth BW1." '362 Patent (EX1001), 5:13-27.

57. Finally, the challenged claims recite "selecting" channels and "outputting" channels, which is described in part as follows: "ADC1 218 generates a digital signal I 232 that is a digital representation of the analog filtered signal 216; ADC2 228 generates a digital signal Q 242 that is a digital representation of the analog filtered signal 226." '362 Patent (EX1001), 5:28-48. Additionally: "Each of the N complex mixers 250 receives the digital signals I 232 and Q 242 from ADCs 218 and 228 to extract a different one of the desired channels and frequency-shifts the extracted signals to the baseband frequency." '362 Patent (EX1001), 5:49-61.

58. However, similar architectures and methods were known prior to the '362 Patent. For example, the Background section of the '362 Patent acknowledges that components such as mixers, analog-to-digital converters, and demodulators, were known prior to the '362 Patent. '362 Patent (EX1001), 1:24-2:23. Prior art references confirmed that these concepts were known. For example, prior to the '362 Patent's priority date, McNeely disclosed a "method and apparatus … for simultaneous reception of a plurality of digital RF channels." McNeely (EX1004), Abstract. Pugel similarly disclosed a "desire to have a solution providing receiving and re-synthesizing of channels for distribution in a more optimal manner" and thus described a method and system for receiving signals "containing a plurality of channels" and "selecting channels from the plurality of channels" for transmission

and output. Pugel (EX1003), 3:15–31.

59. Thus, the challenged claims recite nothing more than concepts and elements that were well-known prior to the '362 Patent.

C. Prior Art References

i. Overview of McNeely

60. McNeely describes an "apparatus and method for performing frequency translation." McNeely (EX1003), Abstract. McNeely's apparatus includes a "receiver … for receiving and digitizing a plurality of first signals" and "recovering a set of selected channels from the plurality of first signals." *Id.* McNeely also describes "combining the set of selected channels to form a second signal and transmitting the second signal." *Id.* at 3:27–31.

61. In my opinion, McNeely is analogous art to the '362 Patent. The field of endeavor of the '362 Patent is "wideband receiver systems and methods having a wideband receiver that is capable of receiving multiple radio frequency channels located in a broad radio frequency spectrum." '362 Patent (EX1001), 1:15–18. McNeely discloses a receiver and techniques applicable to signals occupying "1 GHz of bandwidth" (McNeely (EX1003), 7:9–11)[1] and is thus within the field of

[1] The '362 Patent explains that a tuner, or receiver, designed to "concurrently receive several TV channels" is referred to as wideband (1:24–27), and it provides an example of a wideband receiver system having a "single very wide-band tuner" that receives signals having "80 MHz" of bandwidth (4:16–25). Because McNeely's

endeavor of the '362 Patent.

62. McNeely is also reasonably pertinent to at least one problem addressed by the '362 Patent. The '362 Patent states it is "desirable to have wideband receiver systems that can increase the dynamic range without requiring expensive data conversion, filtering and channel selection at the demodulator." That is, the '362 Patent seeks to perform conversion, filtering, and channel selection from signals before those signals reach a demodulator. McNeely similarly discloses techniques of conversion, filtering and channel selection, and combined with the teachings of Pugel below, performs these functions on signals before those signals reach a demodulator.

ii. Overview of Pugel

63. Pugel relates to "multi-channel television reception." Pugel (EX1004), ¶ 1. Pugel notes a "need for a digital television receiver capable of simultaneously receiving a plurality of channels." *Id.* at ¶ 8. Pugel describes a "method and apparatus … for simultaneous reception of a plurality of digital RF channels." Pugel (EX1004), Abstract. Pugel's method includes "receiving at least one multichannel RF input signal" and separating the RF input signal. Pugel (EX1004), ¶ 11.

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receiver techniques are applicable to signals occupying 1 GHz of bandwidth (which is greater than the '362 Patent's example bandwidth), it too describes a wideband receiver.

Subsequently, the analog signals are converted into "digital signals" and then demultiplexed "to recover the plurality of digital RF channels." *Id.* Pugel's method also includes "demodulating the plurality of digital RF channels." *Id.* at ¶ 12.

64. In my opinion, Pugel is analogous art to the '362 Patent. The field of endeavor of the '362 Patent is "wideband receiver systems and methods having a wideband receiver that is capable of receiving multiple radio frequency channels located in a broad radio frequency spectrum." '362 Patent (EX1001), 1:15–18. Pugel discloses techniques applicable to "analog signals of differing frequency ranges" and is thus within the field of endeavor of the '362 Patent.[2]

65. Pugel is also reasonably pertinent to at least one problem addressed by the '362 Patent. The '362 Patent states it is "desirable to have wideband receiver systems that can increase the dynamic range without requiring expensive data conversion, filtering and channel selection at the demodulator." As detailed above, the '362 Patent seeks to perform conversion, filtering, and channel selection on received signals before those signals reach a demodulator. Pugel discloses techniques of conversion, filtering and channel selection before signals reach a

[2] As detailed above, the '362 Patent provides an example of a wideband receiver system having a "single very wide-band tuner" that receives signals having "80 MHz" of bandwidth (4:16–25). Pugel's receiver techniques, in one example, apply to signals having 300 MHz of bandwidth, (which is greater than the '362 Patent's example bandwidth), and thus it too describes a wideband receiver.

demodulator. Accordingly, Pugel is analogous art to the '362 Patent for this reason as well.

iii. Overview of Gomez

66. Gomez describes a "frequency translation module for a broadband multi-channel communication system." As pertinent to the analysis in this Request, Gomez's frequency translation module (FTM) 100 includes a "tuner 201" which includes an "amplifier 300" and "mixers 301 and 303." Gomez (EX1005), 4:4–6. The mixer 301 may perform down conversion on a signal. *See id.* at 4:4–19.

67. In my opinion, Gomez is analogous art to the '362 Patent. The field of endeavor of the '362 Patent is "wideband receiver systems and methods having a wideband receiver that is capable of receiving multiple radio frequency channels located in a broad radio frequency spectrum." '362 Patent (EX1001), 1:15–18. Gomez similarly describes applicability to "a broadband multi-channel communication system" and is thus within the field of endeavor of the '362 Patent. For example, just as the '362 Patent discusses that wideband receivers receive multiple channels, Gomez also discloses its receivers may "receive a signal" including a "set of high-definition channels." Gomez (EX1005), 3:40–50.

68. Gomez is also reasonably pertinent to at least one problem addressed by the '362 Patent. One problem addressed by the '362 Patent is the need for "expensive digital processing circuitry" and Gomez likewise addresses the issue of

frequency translation modules being too "costly … for some applications." Gomez (EX1005), 1:49–52. Accordingly, Gomez is analogous art to the '362 Patent for this reason as well.

D. Disclosure and Teachings of Prior Art References

i. Obviousness of Claims 1 and 11 by McNeely and Pugel

69. In my opinion, each and every limitation of claims 1 and 11 is rendered obvious by the combined teachings of McNeely and Pugel. The analysis below begins with independent claim 11 and then turns to independent claim 1.

Claim 11

[11.0] A method comprising: in a wideband receiver system

70. McNeely discloses or at least renders obvious a *method … in a wideband receiver system*.

71. McNeely discloses a *method*:

> "The disclosed embodiments relate to an apparatus and method for performing frequency translation."

McNeely (EX1003), Abstract.

72. The '362 Patent states: "Receivers used to down-convert and selectively filter TV channels are referred to as tuners, and **tuners designed to concurrently receive several TV channels are referred to as wideband tuners**." '362 Patent (EX1001), 1:24-27. Thus, a POSITA would have recognized a

wideband receiver system as one which concurrently receives several TV channels.

73. McNeely discloses such a system, as it states:

> "The present invention relates to an apparatus and method for performing frequency translation. The apparatus includes a receiver for receiving and digitizing a plurality of first signals, each signal containing channels and for simultaneously recovering a set of selected channels from the plurality of first signals."

McNeely (EX1003), 3:20–24.

> "The single L-band signal, as an analog input, is processed through an RF processing block 210. The RF processing block 210 may contain circuitry for filtering undesired energy outside the signal frequency range, may correct for any frequency response errors introduced, and may amplify the signal to a level necessary for input to the analog to digital (A/D) converter 220."

McNeely (EX1003), 9:7–12.

74. McNeely also states:

> "As previously described, each L-band signal may occupy 1 GHz of bandwidth, and a typical customer premises cable installation may only support less than 2 GHz of total signal bandwidth. The FTM 110 extracts certain ranges of frequencies containing selected physical channels as portions of the three L-band signals provided."

McNeely (EX1003), 7:9–15.

75. Because McNeely describes a receiver system that extracts certain

ranges of frequencies containing multiple physical channels, it discloses, or at least renders obvious, performing its methods *in a wideband receiver system* as recited.

[11.1] downconverting, by a mixer module of said wideband receiver system, a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;

76. McNeely discloses, or at least renders obvious, this limitation.

77. First, McNeely discloses *a mixer module of said wideband receiver system*:

> "The input RF processing block 210 may also contain any **mixing circuits** necessary to position the L-band signal in the correct frequency range for operation of the A/D converter 220."

McNeely (EX1003), 9:12–15.

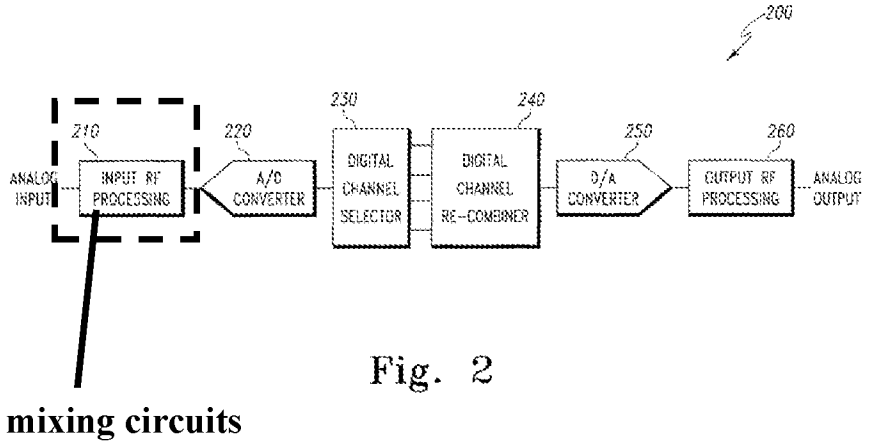


Fig. 2

McNeely (EX1003), Fig. 2 (annotated)

78. Second, McNeely teaches *downconverting ... a plurality of frequencies*. As detailed in the above disclosure, the mixing circuits "position the L-band signal"

(the analog input in Fig. 2) "in the correct frequency range." McNeely (EX1003), 9:12–15. In McNeely, "each L-band signal may occupy 1 GHz of bandwidth" (*id.*, 7:9–11) and thus, each signal comprises a *plurality of frequencies* as recited. Additionally, McNeely teaches that the "L-band signal" includes multiple "physical channels" (*id.*, 14:26–28) and thus, each L-band signal comprises *a plurality of frequencies* as recited.

79. McNeely's disclosure corresponds to, and teaches to a POSITA, *downconverting*, because a POSITA would have recognized that receivers use frequency translation techniques (like the technique disclosed in McNeely) to downconvert RF signals to a lower frequency. For example, the Tseng paper, which describes techniques in radio receivers, confirms that "one can use the bandpass sampling [5] instead to **directly downconvert the desired RF signal** from the RF to an intermediate frequency (IF)" which can "relax the demand for fast ADCs." Tseng (EX1011), p. 1. The Li paper states: "Downconversion mixer is one of the **important building blocks for RF transceivers** in wireless communications." Li (EX1012), p. 1. Li also depicts a "Direct downconversion transceiver." *Id.* at 2. Mirabbasi likewise states that "frequency downconversion" is "an essential operation in **any RF receiver**." Mirabbasi (EX1013), p. 133. The '362 Patent similarly acknowledges as background information: "Existing tuners for these applications **downconvert a swath of channels to an intermediate frequency**,

which are then sent to a demodulator." '362 Patent (EX1001), 1:27–29. Likewise, the Feng thesis, which discusses frequency translation, notes: "In modern communications, frequency translation is used in receivers to downconvert RF to a lower frequency…." Feng (EX1006), p. 19. The Tseng paper also states that downconverting a desired RF signal "can significantly relax the demand for fast ADCs." Tseng (EX1011), p. 1; see also Mirabbasi (EX1013), p. 136 (Figure 7 depicting downconversion before digitizing by an ADC). Consistent with the background knowledge of a POSITA, because McNeely also performs frequency positioning before digitizing by an analog-to-digital converter (ADC) as described below in limitation [11.2], a POSITA would have recognized McNeely to teach *downconverting* as recited.

80. Also, McNeely's disclosure is described in the context of a receiver, as detailed in the analysis of limitation [11.0] and thus, McNeely's description of "position[ing] the L-band signal in the correct frequency range" is a teaching of *downconverting … a plurality of frequencies* as recited.

81. Additionally, although McNeely later states that the digital channel selector 230 proceeds to "down-convert each of the individual physical channels that have been selected," a POSITA would have still understood that McNeely's discussion of "position[ing] the L-band signal in the correct frequency range for operation of the A/D converter" teaches *downconverting* as recited. This is because

the mixing circuits in McNeely downconvert **analog** RF signals so that they can be digitized by the A/D converter; for example, McNeely describes that the L-band signal input to the RF processing block 210 is in the 1-2 GHz frequency range (McNeely (EX1003), 7:26–28) but the A/D converter digitizes processed L-band signals in the 975-1425 MHz range (McNeely (EX1003), 9:16–19), indicating a repositioning to a lower frequency range, i.e., *downconverting*. Thus, the fact that later, **digitized** signals are also downconverted in McNeely, does not change that this disclosure of McNeely of repositioning by mixing circuits teaches *downconverting* as recited.

82. Third, McNeely teaches that the *plurality of frequencies … comprises a plurality of desired television channels and a plurality of undesired television channels*:

> "The apparatus includes a receiver for receiving and digitizing a plurality of first signals, each signal containing channels and for simultaneously **recovering a set of selected channels** from the plurality of first signals. The apparatus also includes a transmitter for combining the set of selected channels to produce a second signal."

McNeely (EX1003), Abstract.

83. McNeely also discloses:

> "A method (600) for providing frequency translation comprising: receiving (602) a first signal having a plurality of different frequency

channels;

selecting (606) a set of frequency channels from said plurality of different frequency channels;…"

McNeely (EX1003), 22:7–11 (claim 13).

84. Consistent with claim 13 and McNeely's disclosure, analog L-band signals ("a first signal having a plurality of different frequency channels") are received, processed, converted to digital, and then channel selection occurs in the digital channel selector 230 ("selecting (606) a set of frequency channels from said plurality of different frequency channels"). Thus, the received L-band signals (the received plurality of frequencies) includes the selected channels and the unselected channels (*the plurality of desired television channels and [] plurality of undesired television channels*).

85. Additionally, in McNeely, the "selected channels" are recovered by the digital channel selector 230 in Figure 2, which occurs after the downconversion of the received signals (the analog input) by mixing circuits in the input RF processing block 210; thus, the received signals (the *plurality of frequencies*) includes the selected channels and the unselected channels (the *plurality of desired television channels and [] plurality of undesired television channels*).

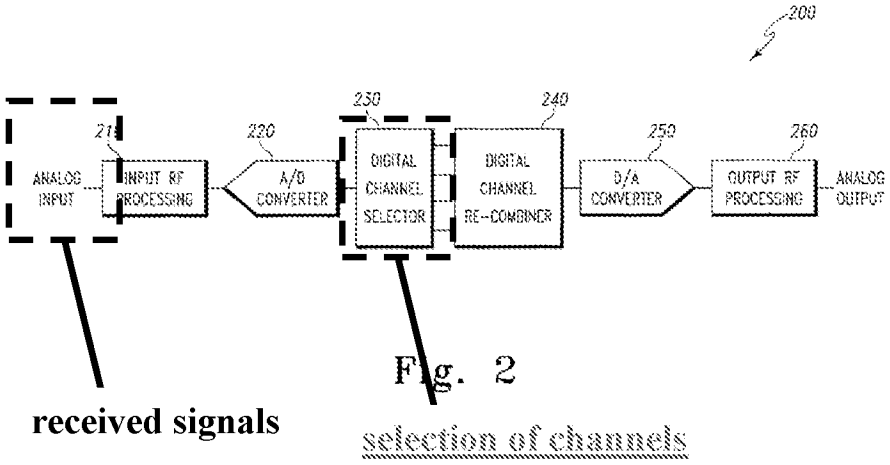


Fig. 2

McNeely (EX1003), Fig. 2 (annotated)

86. The "set of selected channels" corresponds to the recited *plurality of desired television channels*. Further, because McNeely's receiver recovers a set of selected channels from the first signals, the channels not recovered from the first signals would correspondingly be the *plurality of undesired television channels* as recited.

87. Thus, McNeely discloses, or at least renders obvious, this limitation.

[11.2] digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system, said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;

88. McNeely discloses, or at least renders obvious, this limitation.

89. First, McNeely discloses *digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver* system:

"The A/D converter 220 **digitizes the processed L-band signal into a series of samples**, each sample containing a group of bits. In an exemplary embodiment, the processed satellite signal is located between the frequencies of 975 and 1425 MHz. The A/D converter 220 samples the processed L-band signal at a rate of 933 megasamples per second (MSPS) generating a digital signal containing a series of samples, each sample represented by 8 bits. The A/D converter 220 may also generate a translated frequency image of the L-band signal essentially translating the signal from an initial frequency range in the analog domain to a different frequency range based on sampling principles."

McNeely (EX1003), 9:16–26.

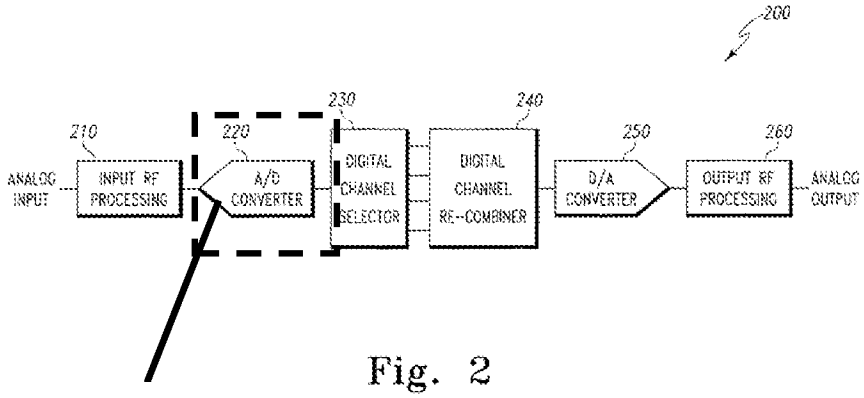


Fig. 2

McNeely (EX1003), Fig. 2

"Turning now to FIG. 2 a block diagram 200 of an embodiment of the present invention is shown. The diagram shows an implementation of the FTM 110 that includes digital signal processing in order to increase the performance and available bandwidth for selected channels."

McNeely (EX1003), 9:1–5.

90. Because McNeely's A/D converter operates on a processed L-band signal between the frequencies of 975 and 1425 MHz (i.e., 450 MHz of bandwidth), the A/D converter is a *wideband analog-to-digital converter (ADC) module* as recited, at least because the 450 MHz bandwidth in McNeely is greater than the example wideband receiver system with an analog-to-digital converter in the '362 which operates on a total of 80 MHz of bandwidth.

91. Second, because the A/D converter 220 in McNeely converts the signals from the input RF processing block 210, for the same reasons as set forth in limitation [11.1], McNeely discloses, or at least renders obvious, that the digitizing is performed on the *plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels* as recited.

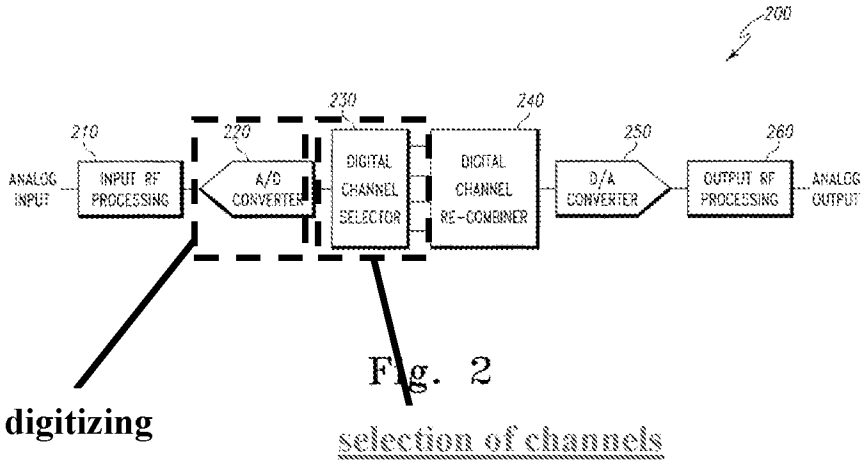


Fig. 2

McNeely (EX1003), Fig. 2 (annotated)

92. Specifically, as detailed in the analysis of limitation [11.1], *supra*, in McNeely, the "selected channels" are recovered by the digital channel selector 230 in Figure 2, which occurs after the downconversion of the received signals by mixing circuits in the input RF processing block 210 and digitizing by A/D converter 220 thus, the digitized signals (the *plurality of frequencies*) includes the selected channels and the unselected channels (the *plurality of desired television channels and [] plurality of undesired television channels*).

93. Thus, McNeely discloses, or at least renders obvious, this limitation.

[11.3] selecting, by digital circuitry of said wideband receiver system, said plurality of desired television channels from said digitized plurality of frequencies; and

94. McNeely discloses, or at least renders obvious, this limitation:

> "The A/D converter 220 **digitizes the processed L-band signal into a series of samples**, each sample containing a group of bits.

McNeely (EX1003), 9:16–26.

95. As detailed above in the analysis of limitation [11.2], the L-band signal comprises the *plurality of desired television channels*. After digitizing the L-band signal into the samples, McNeely discloses:

> "The **digital channel selector 230** receives the sampled [L-band] signal and **proceeds to select** and down-convert **each of the individual physical channels that have been selected**. After processing, each of the selected individual channels are located within the same frequency range at or near to baseband, but are contained as individual signals on

separate signal lines. The number of bits representing each selected individual channel may be different from the original sampled signal based on the processing method employed. The use of digital signal processing and processing of the signal in parallel permits narrower filtering constraints and more efficient channel selection within the FTM 110."

McNeely (EX1003), 10:1–11.

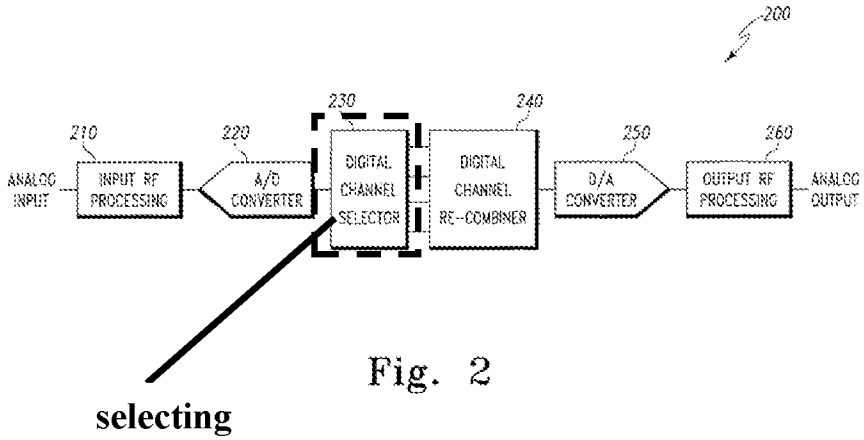


Fig. 2

McNeely (EX1003), Fig. 2 (annotated)

96. McNeely also discloses:

"7. The apparatus (500) of claim 1, wherein said receiver (530a-c) further comprises a selector (360) operatively connected to said distributor (350) for selecting said plurality of selected channels."

McNeely (EX1003), claim 7.

"13. A method (600) for providing frequency translation comprising:… selecting (606).a set of frequency channels from said plurality of

different frequency channels;"

McNeely (EX1003), claim 13.

"22. An apparatus (500) for frequency translation comprising….

means for selecting (530a-c) a set of channels from said set of signals;"

McNeely (EX1003), claim 22.

97. Because McNeely discloses selecting each of the individual physical channels that have been selected by the digital channel selector, which is *digital circuitry*, it discloses, or at least renders obvious, *selecting, by digital circuitry of said wideband receiver system* (e.g., digital channel selector 230), *said plurality of television channels from said digitized plurality of frequencies* (the individual physical channels that have been selected).

[11.4] outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream.

98. McNeely and Pugel render obvious this limitation.

99. First, McNeely discloses *outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels … as a digital datastream*:

> "Each of the individual selected channels is provided to the digital channel re-combiner 240. The digital channel re-combiner 240 frequency translates the individual selected channels each to a different and separate frequency range and combines these signals together to form **a single selected digital signal**."

McNeely (EX1003), 10:12–16.

100. The output of "digital channel re-combiner 240" (i.e., the "single selected digital signal") is *a digital datastream* because, as shown in Figure 2, the output is transmitted (in McNeely) to the D/A converter (digital-to-analog converter), and thus, a POSITA would have recognized the output as being a *digital datastream* as recited.

101. In McNeely, the "selected digital signal" is supplied to the digital to analog (D/A) converter 250. However, it was known at the time of the '362 Patent that such digital signals could, and would be provided *to a demodulator* as recited.

102. Specifically, Pugel teaches "demodulating the plurality of digital RF channels" in a system which "permits substantially simultaneous reception of a plurality of digital cable television channels within a single digital receiver circuit." Pugel (EX1004), ¶¶ 11–12.

103. Pugel also discloses:

> "The converted digital signals are coupled to the digital tuner 130, which demultiplexes the converted digital signals to generate a plurality of digital channel signals. **Each digital channel signal is then coupled to a separate demodulator 141, 142, 143**, which performs demodulation and forward-error-correction (FEC) operations appropriate for the content of that digital channel."

Pugel (EX1004), ¶ 27.

104. Thus, Pugel teaches *outputting ... to a demodulator* as recited. The combined teachings of McNeely and Pugel therefore render obvious this limitation.

105. A POSITA would have been motivated to combine the teachings of McNeely and Pugel.

106. First, McNeely acknowledges that demodulators were known:

> "Likewise, other than the inventive concept, transmission concepts such as satellite transponders, down-link signals, eight-level vestigial sideband (8-VSB), Quadrature Amplitude Modulation (QAM), and receiver components such as a radio-frequency (RF) front-end, or receiver section, such as a low noise block, tuners, and **demodulators** is assumed."

McNeely (EX1003), 5:16–21.

> "At each installation location in the premises 120, the selected signal is provided to a standalone terminal 130 or to a combination settop box 140a-c and display device 150a-c. The terminal 130 and settop box 140a-c operate in a similar manner. Each of them receive the selected signal, tune to the desired physical channel within the selected signal, **demodulate the physical channel to produce a transport stream**, and extract the desired bit stream(s) from the transport stream."

McNeely (EX1003), 8:1–7.

107. The '362 Patent confirms demodulators were known, as it discloses in the Background:

> "Existing tuners for these applications down convert a swath of

> channels to an intermediate frequency, which are then sent to a demodulator. Because the swath of channels is not contiguous, this swath includes the desired channels as well as undesired channels. The demodulator employs a high-speed data converter to capture this swath of desired and undesired channels in the digital domain and subsequently filters out the desired channels."

'362 Patent (EX1001), 5:27-34.

108. Given this knowledge in the art, a POSITA would have been motivated to combine the teachings of McNeely with Pugel as doing so would have been no more than the combination of known prior art elements. McNeely and Pugel disclose each and every limitation of the claims, albeit not within one reference. A POSITA could have, and would have been motivated to combine the teachings of McNeely with those of Pugel to provide for display of the selected TV channels on a display device (e.g., display device 150a-c in McNeely). In combination, each element performs the same function as previously: McNeely's apparatus downconverts, digitizes, and selects channels, and Pugel provides a demodulator that demodulates the channels for display. Additionally, the results of the combination would have been predictable, as McNeely acknowledges that demodulation was known in the context of its methods. Thus, a POSITA would have combined the teachings of McNeely and Pugel to render obvious this limitation.

109. Additionally, a POSITA would have been motivated to combine the

teachings of McNeely with Pugel as doing so would have been nothing more than the substitution of one known element for another to obtain predictable results. Specifically, combining the references would have involved no more than substituting McNeely's D/A converter and output RF processing with Pugel's demodulator teachings. As detailed above, demodulators were well-known at the time of the '362 Patent, as Pugel discloses and as the '362 Patent itself admits. A POSITA would have found it straightforward to replace McNeely's components with Pugel's demodulator, and the results of such a substitution would have been predictable, as Pugel's demodulator would perform the same function in the combination as it did previously alone. Thus, a POSITA would have combined the teachings of McNeely and Pugel to render obvious this limitation.

Claim 1

[1.0] A wideband receiver system comprising:

110. *See* analysis of limitation [11.0], *supra*.

[1.1] a mixer module configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;

111. *See* analysis of limitation [11.1], *supra*.

[1.2] a wideband analog-to-digital converter (ADC) module configured to digitize said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels:

112. *See* analysis of limitation [11.2], *supra*.

[1.3] digital circuitry configured to: select said plurality of desired television channels from said digitized plurality of frequencies; and

113. *See* analysis of limitation [11.3], *supra*.

[1.4] digital circuitry configured to:]… output said selected plurality of television channels to a demodulator as a digital datastream.

114. *See* analysis of limitation [1.4], *supra*.

ii. Obviousness of Claims 1 and 11 by Pugel and Gomez

115. In my opinion, each and every limitation of claims 1 and 11 is rendered obvious by the combined teachings of Pugel and Gomez. The analysis below begins with independent claim 11 and then continues to independent claim 1.

Claim 11

[11.0] A method comprising: in a wideband receiver system

116. Pugel discloses or at least renders obvious a *method … in a wideband receiver system*.

117. First, Pugel discloses a *method*:

"A **method** (400) processing signals comprising the steps of:"

Pugel (EX1004), claim 18.

118. Second, Pugel discloses a method *in a wideband receiver system*.

119. The '362 Patent states: "Receivers used to down-convert and selectively filter TV channels are referred to as tuners, and **tuners designed to concurrently receive several TV channels are referred to as wideband tuners**."

'362 Patent (EX1001), 1:24-27. Thus, a POSITA would have recognized a *wideband receiver system* as one which concurrently receives several TV channels.

120. Pugel discloses such a system, as it states:

> "An apparatus (100), comprising:
> first means for processing (111) an input signal comprising **signals in a first frequency band and signals in a second frequency band** to produce a first analog signal including signals in the first frequency band and substantially excluding the signals in the second frequency band;
> second means for processing (112) the input signal comprising signals in a first frequency band and signals in a second frequency band to produce a second analog signal including signals in the second frequency band and substantially excluding the signals in the first frequency band;"

Pugel (EX1004), claim 1.

121. Pugel also states:

> "The apparatus (100) of claim 1 **wherein said apparatus (100) processes frequencies between about 5 MHz and about 900 MHz**."

Pugel (EX1004), claim 16.

> "A method and apparatus is presented for simultaneous reception of a plurality of digital RF channels. Specifically, N amplifier-filter circuits (111, 112, 113) are configured to receive and separate a multichannel analog RF input signal into N analog signals, each including a different frequency band."

Pugel (EX1004), Abstract.

> "In operation, according to one embodiment, a multichannel analog RF input signal received at input coupler 101 is split into a plurality of substantially identical signals at splitter 102. Splitter 102 may include one or more amplifiers, filters, or other components (not shown) which reduce or overcome insertion loss or other adverse effects of the split, as should be apparent to one of ordinary skill in the art. The plurality of amplifier-filter circuits 111, 112, 113 then segregates the multichannel analog input signal into a plurality of separate analog signals of differing frequency ranges, or 'bands.' Each separate analog signal is then converted from analog to digital form in an analog-to-digital converter 121, 122, 123."

Pugel (EX1004), ¶ 24.

> "Each of the plurality of amplifier-filter banks or circuits 111, 112, 113 is configured to process frequencies within a specified band. For example, a first amplifier-filter circuit 111 may be configured to process frequencies from about 5 MHz to about 300 MHz, a second amplifier-filter circuit 112 may be configured for frequencies between about 300 MHz and about 600 MHz, and a third amplifier-filter circuit 113 may be configured for frequencies from about 600 MHz to about 900 MHz. In such an example, the present invention may be used to recover a plurality of digital cable television channels from a multichannel analog RF input signal which includes frequencies ranging from about 5 MHz to about 900 MHz."

Pugel (EX1004), ¶ 28.

122. Thus, because Pugel discloses an apparatus which processes frequencies in the range between 5 MHz and 900 MHz, it discloses, or at least renders obvious, performing its methods *in a wideband receiver system* as recited.

[11.1] downconverting, by a mixer module of said wideband receiver system, a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;

123. Pugel and Gomez render obvious this limitation.

124. First, Pugel discloses *downconverting ... a plurality of frequencies*. Pugel explains first that analog signals are converted to digital:

> "In operation, according to one embodiment, a multichannel analog RF input signal received at input coupler 101 is split into a plurality of substantially identical signals at splitter 102. Splitter 102 may include one or more amplifiers, filters, or other components (not shown) which reduce or overcome insertion loss or other adverse effects of the split, as should be apparent to one of ordinary skill in the art. The plurality of amplifier-filter circuits 111, 112, 113 then segregates the multichannel analog input signal into a **plurality of separate analog signals of differing frequency ranges**, or 'bands.' **Each separate analog signal is then converted from analog to digital form in an analog-to-digital converter 121, 122, 123**."

Pugel (EX1004), ¶ 24.

125. After the analog frequencies are converted to digital, Pugel teaches *downconverting* the *plurality of frequencies*:

"A method (400) processing signals comprising the steps of:

(a) separating an input signal into a first analog signal and a second analog signal;

(b) digitizing said first analog signal to generate a first digital signal;

(c) digitizing said second analog signal to generate a second digital signal;

(d) **downconverting** said first digital signal and said second signal; and

(e) extracting desired television program information from said downconverted first digital signal and said second digital signal."

Pugel (EX1004), claim 18.

126. As detailed above in the Claim Construction section, the *downconverting* step may be performed prior to the *digitizing* step, as these two steps need not be performed in any specific order. EX1007, pp. 51–52.

127. Pugel further states that "the digital tuner 130 may also perform a variety of other processing operations prior to providing digital channel signals suitable for use in each of the demodulation circuits 141, 142, 143" and that the digital tuner "may include a multitude of components configured as is well known in the art to recover a plurality of digital channel signals substantially simultaneously." Pugel (EX1004), ¶ 37.

128. A POSITA would have recognized that such components used to recover a plurality of digital channel signals would include components to perform *downconverting*, as it was well-known prior to the '362 Patent to perform *downconverting* on signals. For example, as acknowledged by the '362 Patent and

numerous contemporaneous references, such as Tseng, Li, Mirabbasi, and Feng, *downconverting* was well-known by POSITAs at the time of the '362 Patent.

129. However, Pugel does not explicitly disclose that the downconverting is performed *by a mixer module of said wideband receiver system*. This was a known implementation detail at the time of the '362 Patent. For example, in the same field, Gomez describes:

> "Tuner 201 performs a dual frequency conversion to select and down-convert a desired or selected channel from a RF input signal 101. In doing so, amplifer 300 receives and amplifes RF input signal 101, which contains a plurality of television channels. Mixer 301 receives RF input signal 101 from amplifier 300 and also receives a local oscillator (LO) signal from PLL 304. For direct conversion, the frequency of PLL 304 is tuned to the frequency of the desired channel in RF input signal 101 so that it is down-converted to baseband, for further processing. For example, if the desired channel in RF input signal 101 is at 100 MHZ, then PLL 304 is tuned to 100 MHZ, so that **mixer 301 down-converts the desired channel in RF signal** 101 to DC."

Gomez (EX1005), 4:6–19.

130. Thus, Gomez teaches downconverting *by a mixer module*.

131. A POSITA would have been motivated to combine the teachings of Gomez with Pugel, because doing so would have been nothing more than the use of a known technique to improve a similar device in the same way.

132. Pugel teaches that downconverting is performed, but it does not describe the circuitry for doing so. The '362 Patent Background acknowledges that "[e]xisting tuners … down-convert a swath of channels to an intermediate frequency." '362 Patent (EX1001), 1:27–29. The '362 Patent also acknowledges as prior art a "mixer" which "frequency down-converts the received RF input signal to a more convenient intermediate frequency (IF) band." *Id.* at 1:58–62. Thus, it was known to perform *downconverting* using a *mixer module*.

133. Gomez explicitly teaches the circuitry (i.e., a mixer) to perform the known technique of downconversion. A POSITA would have been motivated to apply this teaching in Gomez of downconversion by a mixer module to the teachings of Pugel to provide the hardware necessary to perform Pugel's downconversion.[3] The results would have been predictable to a POSITA, as the results would have simply represented Gomez's mixer module performing downconversion in the context of Pugel's system that also performs downconversion. Accordingly, a POSITA would have been motivated to combine the teachings for at least this reason.

[3] To the extent the *downconverting* limitation is not disclosed, or rendered obvious by Pugel alone, Gomez (and numerous other cited references) disclose a mixer module that downconverts an RF signal to a lower intermediate frequency that is more compatible with the Pugel A/D converters. It would have been obvious to a POSITA to combine the specific RF downconverting mixer module of Gomez with the Pugel system (in one example) by placing the Gomez downconverter in front of the Pugel 101 RF input and 102 splitter.

134. Likewise, combining the teachings of Gomez and Pugel would have been nothing more than combining prior art elements according to known methods to yield predictable results. Together, Pugel and Gomez include each element claimed, with the only difference being the lack of actual combination in a single prior art reference. A POSITA would have been motivated to, and would have been capable of, combining Gomez's teachings of downconversion by a mixer module with Pugel's teachings of downconversion, and in combination, each element performs the same function as it does separately. A POSITA would have further recognized the predictability of the combination, as the combination simply adds to Pugel appropriate circuitry for performing the functions disclosed in Pugel. Accordingly, a POSITA would have been motivated to combine the teachings for this additional reason as well.

135. Pugel explains that the *plurality of frequencies … comprises a plurality of desired television channels and a plurality of undesired television channels*:

> "The digital tuner 130 may include a channel selector 315 to permit selection of one or more particular **digital channels desired to be recovered**. For example, a selected set of digital cable television channels may be communicated to the digital tuner 130 via the channel selector 315 corresponding to a plurality of pay-per-view selections desired by members of a household; the digital tuner 130 may demultiplex only the digital channel signals corresponding to those

digital cable television channels."

Pugel (EX1004), ¶ 38.

"It should be apparent that each digital RF channel signal may in turn carry or provide a plurality of data streams, e.g., audio, video, program information, or interactive content."

Pugel (EX1004) ¶ 45.

"FIG. 4 shows a flow diagram representation of a method of **receiving a plurality of digital RF channels** generally designated 400 in accordance with an aspect of the present invention….The method 400 begins at step 401 and proceeds to step 402 in which a multichannel analog RF input signal is separated into a plurality of analog signals including at least first and second analog signals.

In step 403, the first analog signal is converted into a first digital signal using a first analog-to-digital converter. In step 404, the second analog signal is converted into a second digital signal using a second analog-to-digital converter independently of the conversion performed in the first analog-to-digital converter. The first and second analog-to-digital converters may convert different frequency bands from analog to digital form, similar to analog-to-digital converters 121, 122, 123 described above with reference to FIGS. 1 and 2….

In step 405, the first digital signal (converted in the first analog-to-digital converter) and the second digital signal (converted in the second analog-to-digital converter) are demultiplexed to generate a plurality of digital RF channel signals including at least first and second digital RF channel signals."

Pugel (EX1004), ¶¶ 43–45.

136. Thus, in Pugel, the multichannel analog RF input signal includes all channels (desired and undesired), which signal is then digitized and downconverted (as detailed in Pugel's claim 18) in the process of recovering the digital channels desired to be recovered. Thus, the multichannel analog RF input signal, subsequently digitized, *comprises a plurality of desired television channels and a plurality of undesired television channels* as recited.

137. In particular, because Pugel teaches selection of "digital channels **desired** to be recovered," a POSITA would have recognized that the signal also includes digital channels **not desired** to be recovered. Accordingly, the plurality of frequencies that is subsequently digitized and downconverted *comprises a plurality of desired television channels and a plurality of undesired television channels* as recited.

138. Thus, the combined teachings of Pugel and Gomez render obvious this limitation.

[11.2] digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system, said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;

139. Pugel discloses, or at least renders obvious, this limitation.

140. First, Pugel discloses *a wideband analog-to-digital converter (ADC) module of said wideband receiver* system:

"A plurality of **analog-to-digital converters** is provided, each respectively coupled to one of the plurality of amplifier-filter circuits, the plurality of analog-to-digital converters including at least a first analog-to-digital converter configured to receive the first analog signal and generate a first digital signal and a second analog-to-digital converter configured to receive the second analog signal and generate a second digital signal."

Pugel (EX1004), ¶ 9.

"In operation, according to one embodiment, a multichannel analog RF input signal received at input coupler 101 is split into a plurality of substantially identical signals at splitter 102. Splitter 102 may include one or more amplifiers, filters, or other components (not shown) which reduce or overcome insertion loss or other adverse effects of the split, as should be apparent to one of ordinary skill in the art. The plurality of amplifier-filter circuits 111, 112, 113 then segregates the multichannel analog input signal into a **plurality of separate analog signals of differing frequency ranges**, or 'bands.' **Each separate analog signal is then converted from analog to digital form in an analog-to-digital converter 121, 122, 123**."

Pugel (EX1004), ¶ 24.

"The plurality of amplifier-filter circuits 111, 112, 113 then segregates the multichannel analog input signal into a plurality of separate analog signals of differing frequency ranges, or 'bands.'"

Pugel (EX1004), ¶ 24.

"In one embodiment, each amplifier/filter bank has particular characteristics that permit the passage of a specific range of frequencies

> substantially independent of the frequency selection characteristics of the other amplifier/filter banks. For example, one filter might have a pass-band of about 5 to about 300 MHz, while another filter might have a pass band of about 300 to about 600 MHz."

Pugel (EX1004), ¶ 25.

> "a first analog-to-digital converter (121) for processing the first analog signal to produce a first digital signal representing the signals in the first frequency band;
> a second analog-to-digital converter (122) for processing the second analog signal to produce a second digital signal representing the signals in the second frequency band;"

Pugel (EX1004), claim 1.

141. Because Pugel's analog-to-digital converters operate on frequencies ranging, in one example, from 300 to 600 MHz, Pugel's analog-to-digital converters teach *digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system* as recited.

142. Second, Pugel discloses *digitizing ... said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels*:

> "A method (400) processing signals comprising the steps of:
> (a) separating an input signal into a first analog signal and a second analog signal;
> (b) **digitizing** said first analog signal to generate a first digital signal;

(c) **digitizing** said second analog signal to generate a second digital signal;

(d) downconverting said first digital signal and said second signal; and

(e) extracting desired television program information from said downconverted first digital signal and said second digital signal."

Pugel (EX1004), claim 18.

143. As detailed in the analysis of limitation [11.1], *supra*, the *plurality of frequencies* comprises *said plurality of desired television channels and said plurality of undesired television channels* as recited. Specifically, because the digitizing occurs before the step of extracting desired television programs (the *selecting* step detailed below), all channels comprised in the input signal, including *desired television channels* and *undesired television channels* are digitized as recited.

144. Thus, Pugel discloses, or at least renders obvious, this limitation.

[11.3] selecting, by digital circuitry of said wideband receiver system, said plurality of desired television channels from said digitized plurality of frequencies; and

145. Pugel discloses, or at least renders obvious, this limitation, as it discloses extracting desired television programs from the downconverted frequencies.

146. Pugel discloses:

"The digital tuner 130 may include a **channel selector 315 to permit selection of one or more particular digital channels desired to be recovered**. For example, a selected set of digital cable television

channels may be communicated to the digital tuner 130 via the channel selector 315 corresponding to a plurality of pay-per-view selections desired by members of a household; the digital tuner 130 may demultiplex only the digital channel signals corresponding to those digital cable television channels. Alternatively, the digital tuner 130 may be configured to demultiplex and recover all of the available digital channel signals."

Pugel (EX1004), ¶ 38.

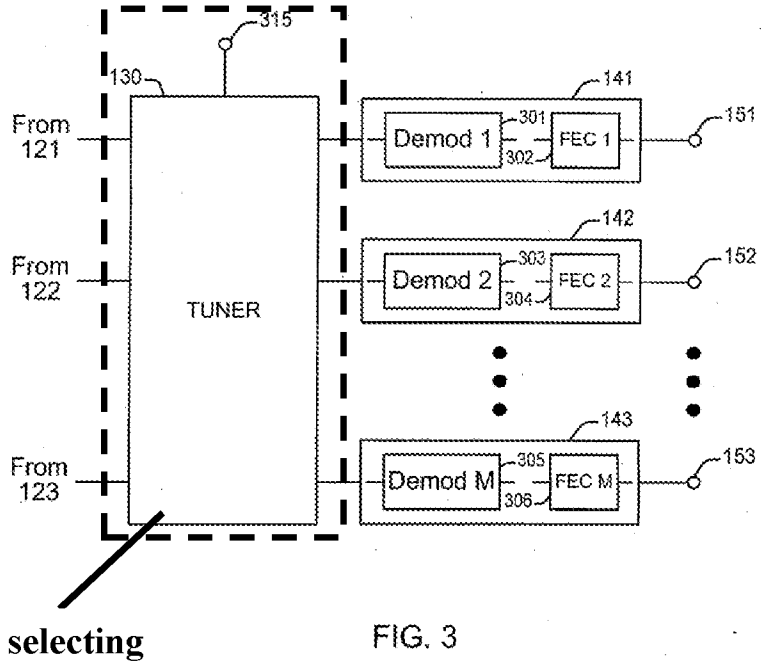


FIG. 3

Pugel (EX1004), Fig. 3 (annotated)

147. Pugel also refers to channel selection as "extracting," as it refers to this functionality in the claims as the tuner 130 (which includes channel selector 315) extracting desired information to be provided to demodulators (e.g., as shown in Fig.

3 above):

> "The apparatus (100) of claim 12 where said digital processor (130) multiplexes said first, second, and third digital signals, downconverts said multiplexed signal and **extracts desired information** to be coupled to said first and second demodulator circuits (141, 142)."

Pugel (EX1004), claim 14.

> "A method (400) processing signals comprising the steps of:
> (a) separating an input signal into a first analog signal and a second analog signal;
> (b) digitizing said first analog signal to generate a first digital signal;
> (c) digitizing said second analog signal to generate a second digital signal;
> (d) downconverting said first digital signal and said second signal; and
> **(e) extracting desired television program information** from said downconverted first digital signal and said second digital signal."

Pugel (EX1004), claim 18.

> "FIG. 4 shows a flow diagram representation of a method of **receiving a plurality of digital RF channels** generally designated 400 in accordance with an aspect of the present invention….The method 400 begins at step 401 and proceeds to step 402 in which a multichannel analog RF input signal is separated into a plurality of analog signals including at least first and second analog signals.
> In step 403, the first analog signal is converted into a first digital signal using a first analog-to-digital converter. In step 404, the second analog signal is converted into a second digital signal using a second analog-

> to-digital converter independently of the conversion performed in the first analog-to-digital converter. The first and second analog-to-digital converters may convert different frequency bands from analog to digital form, similar to analog-to-digital converters 121, 122, 123 described above with reference to FIGS. 1 and 2….
>
> In step 405, the first digital signal (converted in the first analog-to-digital converter) and the second digital signal (converted in the second analog-to-digital converter) are demultiplexed to generate a plurality of digital RF channel signals including at least first and second digital RF channel signals."

Pugel (EX1004), ¶¶ 43–45.

> "It should be apparent that **each digital RF channel** signal may in turn carry or provide a plurality of data streams, e.g., audio, video, **program information**, or interactive content."

Pugel (EX1004), ¶ 45.

> "A method and apparatus is presented for simultaneous **reception of a plurality of digital RF channels**….This combination of components permits substantially **simultaneous reception of multiple digital cable channels** within a single digital receiver circuit suitable for use with conventional cable delivery systems and at a reasonable cost."

Pugel (EX1004), Abstract

148. Because Pugel discloses extracting the desired television program information from the digital RF channels, and that the channel selector permits selection of digital RF channels desired to be recovered, Pugel discloses, or at least

renders obvious, *selecting, by digital circuitry of said wideband receiver system* (e.g., channel selector 315), *said plurality of television channels from said digitized plurality of frequencies* (the digital channels desired to be recovered).

[11.4] outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream.

149. Pugel discloses, or at least renders obvious, this limitation.

150. Pugel discloses:

> "In operation, according to one embodiment, a multichannel analog RF input signal received at input coupler 101 is split into a plurality of substantially identical signals at splitter 102. Splitter 102 may include one or more amplifiers, filters, or other components (not shown) which reduce or overcome insertion loss or other adverse effects of the split, as should be apparent to one of ordinary skill in the art. The plurality of amplifier-filter circuits 111, 112, 113 then segregates the multichannel analog input signal into a plurality of separate analog signals of differing frequency ranges, or 'bands.' Each separate analog signal is then converted from analog to digital form in an analog-to-digital converter 121, 122, 123."

Pugel (EX1004), ¶ 24

> "The converted digital signals are coupled to the digital tuner 130, which demultiplexes the converted digital signals to generate a plurality of digital channel signals. **Each digital channel signal is then coupled to a separate demodulator 141, 142, 143**, which performs demodulation and forward-error-correction (FEC) operations

appropriate for the content of that digital channel."

Pugel (EX1004), ¶ 27.

> "In an alternate embodiment, in addition to the above a plurality of demodulator circuits is coupled to the digital tuner, the plurality of demodulator circuits including at least **a first demodulator circuit configured to receive and demodulate a first channel** of the plurality of digital RF channels and **a second demodulator circuit being configured to receive and demodulate a second channel** of the plurality of digital RF channels. The plurality of demodulator circuits includes circuitry configured for forward error correction."

Pugel (EX1004), ¶ 10; *see also* ¶¶ 38 ("a selected set of digital cable television channels may be communicated to the digital tuner 130 via the channel selector 315…the digital tuner 130 may demultiplex only the digital channel signals corresponding to those digital cable television channels."), 39 ("the digital tuner 130 may also perform a variety of other processing operations prior to providing digital channel signals suitable for use in each of the demodulation circuits 141 , 142, 143").

> "Each of the demodulation circuits 141, 142, 143 may include one or more demodulators 301, 303, 305 and forward-error-correction (FEC) circuitry 302, 304, 306, respectively."

Pugel (EX1004), ¶ 40.

151. Thus, Pugel teaches *outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream* as recited.

Claim 1

[1.0] A wideband receiver system comprising:

152. *See* analysis of limitation [11.0], *supra.*

[1.1] a mixer module configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;

153. *See* analysis of limitation [11.1], *supra.*

[1.2] a wideband analog-to-digital converter (ADC) module configured to digitize said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels:

154. *See* analysis of limitation [11.2], *supra.*

[1.3] digital circuitry configured to: select said plurality of desired television channels from said digitized plurality of frequencies; and

155. *See* analysis of limitation [11.3], *supra.*

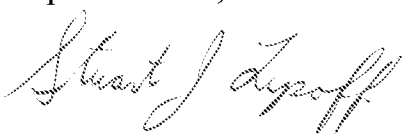
[1.4] digital circuitry configured to:]… output said selected plurality of television channels to a demodulator as a digital datastream.

156. *See* analysis of limitation [11.4], *supra.*

V. CONCLUSION

157. I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Date: September 18, 2023

By: 

Stuart Lipoff

Appendix A

Mr. Lipoff is president of IP Action Partners Inc, a consulting practice in TIME (telecommunications, information technology, media, electronics, and ebusiness) industries and technologies. He draws upon his 30+ years of experience in a wide variety of technologies and industries to assist clients with knowledge based consulting services involving complex business decisions and problem resolution.

Mr. Lipoff was employed 25 years by Arthur D Little, Inc (ADL) as VP and Director of Communications, Information Technology, and Electronics (CIE); 4 years by Bell & Howell Communications Company as a Section Manager, and 3 years by Motorola's Communications Division as a Project Engineer. At ADL he was responsible for the firm's global CIE practice in laboratory based contract engineering, product development, and technology based consulting. At both Bell & Howell and Motorola, he had project design responsibility for wireless communications and paging products.

Stuart Lipoff has Bachelor's Degrees in Electrical Engineering and in Engineering Physics, both from Lehigh University. He also has received a Masters Degree in Electrical Engineering from Northeastern University, and a MBA degree from Suffolk University.

Mr. Lipoff is a fellow of the IEEE Consumer Electronics, Communications, Computer, Circuits, and Vehicular Technology groups. He is a member of the IEEE Consumer Electronics Society National Administration Committee, and was the Boston Chapter Chairman of the IEEE Vehicular Technology Society. He served as 1996-7 President of the IEEE Consumer Electronics Society and as Chairman of the Consumer Electronics Society Technical Activities and Standards Committee; served as VP of Publications for The IEEE Consumer Electronics Society; and currently serves as VP of Industry Activities and Standards. He has also chaired the search committee for Sony supported Mazura Ibuka Award in consumer electronics and is a current committee member. As Vice President and Standards Group Chairman of the Association of Computer Users, he served as the ACU representative to The ANSI X3 Standards group. For the Federal Communications Commission's Citizens advisory committee on CB radio (PURAC), he served as Chairman of the task group on user rule compliance. He has been elected to membership in the Society of Cable Television Engineers (SCTE), The Association of Computing Machinery (ACM) , and The Society of Motion Picture and Television Engineers (SMPTE).

Stuart Lipoff holds a FCC General Radiotelephone License and a Certificate in Data Processing (CDP) from the ACM supported Institute for the Certification of Computing Professionals (ICCP). He is a registered professional engineer (by examination) in The Commonwealth of Massachusetts.

Mr. Lipoff holds seven USA patents and has published articles in Electronics Design, Microwaves, EDN, The Proceedings of the Frequency Control Symposium, Optical Spectra, and numerous IEEE publications. He has presented papers at many IEEE and other meetings. In the fall of 2000, he served as general program chair for The IEEE Vehicular Technology Conference

on advanced wireless communications technology. He has organized sessions at The International Conference on Consumer Electronics and was the 1984 program chairman. He conducted an eight week IEEE sponsored short course on Fiber Optics Systems Design. In 1984, he was awarded IEEE's Centennial Medal and in 2000 IEEE's Millennium Metal.

He has served as a member of the USA advisory board to the National Science Museum of Israel and has presented a short course on international product development strategies as a faculty member of Technion Institute of Management in Israel. He also as a member of the board of directors of The Massachusetts Future Problem Solving Program.

Mr Lipoff is internationally recognized as an authority and opinion leader in new economy related businesses and technology. Citations supporting his recognition can be found on his web site at http://www.ipaction.com .

Some examples of projects he has performed in the cable TV and telecommunications sector include:

- For Next Generation Network Architecture llc (NGNA llc) consortium of Comcast, Cox, and Time-Warner; he managed the project that produced a five year planning horizon vision for the services and technology the cable industry will seek to deploy. The services and vision were then mapped to overall architectures impacting network elements in the back office, head-end, outside plant, and customer premises and documented in next generation network recommendations. The project involved coordination with over fifty senior technical staff in the three cable MSO sponsors as well as interactions with over 100 suppliers of systems, software, and products to the cable industry. The recommendations and findings were wide ranging including, for example: software defined downloadable conditional access (CA) systems, migration of the outside plant from low to mid split, bridging from network CA to in-home network digital rights management systems (DRM), and migration from 1way to 2way digital TV.

- For Chameleon Network Inc (CNI), a consumer electronic wallet startup, he served as CTO developing overall systems architecture, prototype development, and developing an intellectual property patent portfolio for which he a named inventor. The CNI system employed multilayer security and feature management controls that facilitated trusted interactions between end consumers, bank financial service providers, and merchants.

- For Comcast, he explored opportunities to acquire spectrum to launch an advanced high speed public network wireless system that is optimized to deliver multimedia content such as video and music entertainment in addition to competitive voice services. This project involved looking beyond today's evolutionary air interface road maps to new 4th and 5th generation air interface technologies.

- Leadership of the project for CableLabs that studied the technology and economics of wireless personal communications technology. This project is highlighted in the history of CableLabs in their website as one of the significant accomplishments of The Labs. The

project included the selection of CDMA technologies and the development of strategies to compete with incumbent cellular carriers. This effort led to the formation of a consortium between Sprint and the cable MSOs that has evolved into the present Sprint PCS business.

- Security audit, design review, and recommendations for product improvement of a new digital rights management (DRM) hardware/software module developed by DataPlay for deployment in mass market advanced optical media and for electronic music distribution via the internet including meeting with each of the major record labels to satisfy their concerns regarding security robustness and ability to support flexible business models for content and rights management.

- For a project jointly funded by the RIAA and IFPI, on behalf of the music industry, he performed a project to identify technology solutions and business models to protect the music content on CD-Audio media. The project involved coordination with a committee of each of the major content owners and record labels.

- On behalf of a leading law firm representing TV-Com International, he supported the client as a damages expert in patent litigation related to digital conditional access and encryption technology employed to protect video entertainment delivered over cable television networks. This project required the develop of sophisticated financial models which demonstrated the value of the patents by computing the impact the technology had on the overall enterprise value of the defendant.

- On behalf of a leading law firm representing IPPV Enterprises, he supported the client as damages expert in patent ligtigation related to secure key exchange and key management as employed by the defendant- Echostar. As above, this project required the development of sophisticated financial models which demonstrated the value of the patents by computing the impact the technology had on the overall enterprise value of the defendant

- Leadership of the project which developed the series of DOCSIS specifications for high speed residential cable modems. The scope of work included developing a roadmap and strategic framework for evolving the business from simple high speed internet services to multimedia broadband services combining voice, data, and secure electronic content delivery. This project was performed under contract to the MCNS consortium of cable TV operators representing 85% of the subscriber base in North America and has since been adopted by the United Nations as a global telecommunications standard.

- Under contract to The National Cable Telecommunications Association (NCTA), he represented the point of view of the cable industry in an FCC workshop on universal broadband availability. This project involved a presentation on the technical capabilities of the cable industry DOCSIS cablemodem infrastructure, a comparison of cablemodem services with DSL, fiber to home, and wireless broadband. Issues related to net neutrality were included in the discussion. Following the FCC workshop, I was further commissioned

by NCTA to prepare a white paper comparing DOCSIS cablemodem services with fiber to the home services such as FiOS.

- For The National Association of Broadcasters (NAB) he managed a project to engage NAB members in the development of new applications and services for over-the-air radio and television broadcasting. The project included developing a list and priority recommendations for research projects for consideration of funding by NAB which would explore the most promising candidate research projects.

- For the cable operator consortium SpectrumCo I am supporting exploration of alternative means to provide competitive public network wireless services to existing cable and new customers. The project involves exploring 3rd and 4th generation wireless air-interface technologies and developing models that integrate capital expenditures forecasts with operating profits to develop financial performance perspectives of alternatives. A unique aspect of this project includes developing technology forecasts and estimates of subscriber equipment capable of supporting video and multimedia content delivery to handsets.

- For COMCAST Cablevision of Philadelphia, I assisted in the development of a family of advanced two-way, residential digital services, including: development of system/service concepts and specification/selection of a range of equipment to provide this service. Detailed operating and balance sheet financial models of were developed to measure financial attractiveness of alternatives and use as a tool to select specific strategies.

- For a division of Westinghouse in cooperation with Kansai Electric (Japan), I developed detailed business plans for the launch of cable TV and associated broadband services. The project involved demand studies to assess adoption and desires of consumers followed by recommendations on marketing, operating, and technology strategies.

- For the Westinghouse Teleprompter Cable Company, I studied the market for a fiberoptic based institutional data network in Pittsburgh and developed the business and financial models to examine the financial attractiveness of offering these services.

- For Times Mirror Cable TV, I developed business plans for the upgrade of selected systems to 2way capability and exploration of alternative telephony and other advanced services to be provided. I worked with the client to develop risk/reward perspectives for specific service options and develop a roadmap in order of most attractive priorities.

- Analysis and recommendations in a study funded by CableLabs which led to today's hybrid-fiber coax architecture widely deployed worldwide for delivering broadband multimedia services to the home. The project involved developing forecasts of technology trends in parallel with projecting the business applications. Detailed proforma financial models were developed to make the cost/benefit of deploying this technology visible to the cable industry, and strategies were developed and recommended to the industry.

- On behalf of a leading law firm representing TV-Com International, he supported the client as a damages expert in patent litigation related to digital conditional access and encryption technology employed to protect video entertainment delivered over cable television networks. This project required the develop of sophisticated financial models which demonstrated the value of the patents by computing the impact the technology had on the overall enterprise value of the defendant.

- On behalf of a leading law firm representing IPPV Enterprises, he supported the client as damages expert in patent litigation related to secure key exchange and key management as employed by the defendant- Echostar. As above, this project required the develop of sophisticated financial models which demonstrated the value of the patents by computing the impact the technology had on the overall enterprise value of the defendant

- Leadership of a project jointly funded by The National Association of Broadcasters and Maximum Service TV Association to analyze options to accelerate the adoption of digital TV technology by consumers. His recommendations were provided to the FCC and were the basis for the August 2002 report and order the FCC issued to mandate a roll-out schedule for digital TV receivers.

- For Bell South I contributed to a major operations improvement project involving developing forecasts of the future competitive environment, customer needs, a strategy to compete, and new business models. These forecasts were then applied to develop business redesign recommendations and a list of new services offerings.

- For Magnavox Cable TV (a division of N.A. Philips) I performed comparative cost and technical analysis of fiber optics versus conventional coax systems. This analysis was followed by the development of strategies and sales support materials to pitch the new HFC systems to cable TV operators.

- I performed additional work for The Cable Television Laboratories in which I studied the application of remote and distributed antennas supporting microcellular PCS on hybrid fiber-coax cable TV systems. A key issue explored was the requirement for the fiber optic portion of the plant to carry the PCS carriers in analog form and deal with the wide dynamic range demands for inbound signals.

- For a consortium of the major cable TV operators consisting of Comcast, Time Warner, Cox, and Rogers; I developed models for prediction of reliability of alternative HFC architectures and their suitability to provide local exchange voice services competitive with ILECs. The project required understanding the reliability specifications employed in conventional local exchange carrier telephone plant and the contributions between hardware, power, and workmanship failures. Each of three alternative fiber optic architectures for cable delivered voice telephony were studied and modeled to develop reliability predictions and recommendations were made as to which aspects of the three alternatives were the best choice for cable delivered voice telephony.

- For GTE Systems I prepared a presentation on developing commercial opportunities for wide-bandwidth ATM switching. The scope of applications included: metro area network LAN interconnect, broadcast studio digital video routing and switching, and distributed switching for digital wireless personal communications networks. The goal of the project was to explore cable TV and other commercial applications for their military systems broadband switching technology.

- For Bellcore (now Telcordia division of SAIC), I evaluated the R&D portfolio of their Applied Research Group. The main components of this portfolio were DWDM technologies for long haul interLATA communications as well as optical multiplexing components for passive optical network applications in cable TV and advanced broadband residential services. I provided R&D planning assistance on the allocation of funding and priorities to the R&D efforts and identified opportunities for securing intellectual property rights to critical R&D efforts.

- For the ViaSat Division of Modern Times Group (Sweden) he developed business plans for the launch of a new service that bundled discounted long distance telephone services with direct to home satellite TV services and other interactive services including gambling via the set-top box.

- For Magnavox Cable TV, he supported the development of a set-top-box cable converter with a microcomputer based user interface and conditional access system. The product was sold in both the USA and Canada.

- For Southern New England Telephone (SNET), he supported the launch of a video dial tone service. He contribution to the project included engineering and cost analysis of system alternatives as well as assisting with the preparing of RFPs for set-top-boxes and other network elements.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
90/019,255	**09/20/2023 02:38:27 PM ET**	**50348.106**

Title of Invention

WIDEBAND TUNER ARCHITECTURE

Application Information

APPLICATION TYPE	Utility / ex parte reexam	PATENT #	9210362
CONFIRMATION #	5785	FILED BY	Krista Myrick
PATENT CENTER #	62831599	FILING DATE	-
CUSTOMER #	23446	FIRST NAMED INVENTOR	Madhukar Reddy
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Raghav Bajaj

Documents

TOTAL DOCUMENTS: 16

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
50348.106 Entropic 362 Request.pdf		56	-	515 KB
50348.106 Entropic 362 Request-RXOSUB.R.pdf	(1-55)	55	Receipt of Original Ex Parte Request by Third Party	502 KB
50348.106 Entropic 362 Request-RXC/SR.pdf	(56-56)	1	Reexam Certificate of Service	150 KB
50348-106 Reexamination Transmittal.pdf		4	Receipt of Original Ex Parte Request by Third Party	285 KB
50348.106- PTO 1449 modified form - Ex Parte Reexam Request.pdf		1	Reexam - Info Disclosure Statement Filed by 3rd Party	151 KB

50348.106 Unified Entropic 362 - Power of Attorney.pdf	1	Power of Attorney	114 KB
EX1001 US9210362.pdf	20	Copy of patent for which reexamination is requested	1365 KB
EX1002 23446_14614543.pdf	165	Reexam - Affidavit/Declaration/Exhibit Filed by 3rd Party	6383 KB
EX1003 WO2006119490A2.pdf	33	Reexam - Affidavit/Declaration/Exhibit Filed by 3rd Party	4312 KB
EX1004 WO2007145637 Pugel.pdf	24	Reexam - Affidavit/Declaration/Exhibit Filed by 3rd Party	2484 KB
EX1005 US-8224274-B2 [Gomez].pdf	28	Reexam - Affidavit/Declaration/Exhibit Filed by 3rd Party	1296 KB
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EX1007 2_22-cv-00125-JRG_123_PRIMARY DOCUMENT.pdf	65	Reexam - Affidavit/Declaration/Exhibit Filed by 3rd Party	482 KB
EX1008 Lipoff Declaration.pdf	75	Reexam - Affidavit/Declaration/Exhibit Filed by 3rd Party	806 KB
EX1011 ching-hsiangtseng2006.pdf	6	Reexam - Affidavit/Declaration/Exhibit Filed by 3rd Party	207 KB
EX1012 rf-cmos-mixer-design-and-optimization-for-	7	Reexam - Affidavit/Declaration/Exhibit	529 KB

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Digest

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EX1006 Feng 4406233.pdf	B39B4D13AC5E894267C2918193CFC04ECEE110D5EC9DEE23 4FECF83F7AD077E6973933C6A2542EFE190F48A05F63C54A0 C5E9F9CE2A9160EEF3ECFFBF2201970
EX1007 2_22-cv-00125-JRG_123_PRIMARY DOCUMENT.pdf	64D11D7777525826DC215FCF0C8BD7A5A7A5EDC2C1074E7D 8B6532BAA48A2FCC44C406A4B418C85D92D796ACB4F42417E 17A0CD3352B3967B47DF8C16126AA7F
EX1008 Lipoff Declaration.pdf	21DCCB1D2E436E2B9DC4DF938DC3BB8A8071BEC94544BCE C0CEEF8FBDC262D1D54F6227B92C00EE256D5E90273140CD BDDE026936621575493621 5AB6668A0BF
EX1011 ching-hsiangtseng2006.pdf	468242435B2FBB68AE1E9DACD6A21270C0FFC5EAFE40754A9 346B514DA08DCA80686B60F31C758778F39BC15AC50C1AC4A 7A6289BF6742A8658CAAAA546FE801
EX1012 rf-cmos-mixer-design-and-optimization-for-wideband-cdma-applicat.pdf	6E58E74DC2361E50C0B92AB88B548931D1B78F5A9D9D10B88 13CF26F5EAFCC3994FE9F72E95C7C1AE774CB1C735194EE68 48A17191ECDB555976ECBD120E5A1D
EX1013 Mirabbasi.pdf	7F5D55879E0B773D7E2499EFE92B733BD6E0525A29824252AD D048B0EB0B4E5C6EFEACD529C442776DF3147B8DAF85A812 D8FD7C9D5715833D7AA7AFD2E28459

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Patent Assignment Abstract of Title

Total Assignments: 5

Application #: 14614543 **Filing Dt:** 02/05/2015 **Patent #:** 9210362 **Issue Dt:** 12/08/2015
PCT #: NONE **Intl Reg #:** **Publication #:** US20150156535 **Pub Dt:** 06/04/2015
Inventors: Madhukar Reddy, Curtis Ling, Tim Gallagher
Title: WIDEBAND TUNER ARCHITECTURE

Assignment: 1

Reel/Frame:	Received:	Recorded:	Mailed:	Pages:
042453 / 0001	05/12/2017	05/12/2017	05/23/2017	104

Conveyance: SECURITY AGREEMENT

Assignors: MAXLINEAR, INC. **Exec Dt:** 05/12/2017

ENTROPIC COMMUNICATIONS, LLC (F/K/A ENTROPIC COMMUNICATIONS, INC.) **Exec Dt:** 05/12/2017

EXAR CORPORATION **Exec Dt:** 05/12/2017

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Assignment: 2

Reel/Frame:	Received:	Recorded:	Mailed:	Pages:
053115 / 0842	07/01/2020	07/01/2020	07/06/2020	101

Conveyance: SUCCESSION OF AGENCY (REEL 042453 / FRAME 0001)

Assignor: JPMORGAN CHASE BANK, N.A. **Exec Dt:** 07/01/2020

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COLUMBUS, OH 43219

Assignment: 3

Reel/Frame:	Received:	Recorded:	Mailed:	Pages:
055779 / 0001	03/31/2021	03/31/2021	04/01/2021	58

Conveyance: RELEASE BY SECURED PARTY (SEE DOCUMENT FOR DETAILS).

Assignor: MUFG UNION BANK, N.A. **Exec Dt:** 03/31/2021

Assignees: MAXLINEAR, INC.
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REEXAM CONTROL NUMBER	FILING OR 371 (c) DATE	PATENT NUMBER
90/019,255	09/20/2023	

CONFIRMATION NO. 5785

Haynes and Boone, LLP
IP Section
2801 N. Harwood St.
Suite 2300
Dallas, TEXAS 75201

REEXAMINATION REQUEST NOTICE

Date Mailed: 10/25/2023

NOTICE OF REEXAMINATION REQUEST FILING DATE

(Third Party Requester)

Requester is hereby notified that the filing date of the request for reexamination is 09/20/2023, the date that the filing requirements of 37 CFR § 1.510 were received.

A decision on the request for reexamination will be mailed within three months from the filing date of the request for reexamination. (See 37 CFR 1.515(a)).

A copy of the Notice is being sent to the person identified by the requester as the patent owner. Further patent owner correspondence will be the latest attorney or agent of record in the patent file. (See 37 CFR 1.33). Any paper filed should include a reference to the present request for reexamination (by Reexamination Control Number).

cc: Patent Owner
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MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

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Legal Instruments Examiner
Central Reexamination Unit 571-272-7705; FAX No. 571-273-9900

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REEXAM CONTROL NUMBER	FILING OR 371 (c) DATE	PATENT NUMBER
90/019,255	09/20/2023	

CONFIRMATION NO. 5785

REEXAM ASSIGNMENT NOTICE

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SUITE 3400
CHICAGO, IL 60661

OC000000062514604

Date Mailed: 09/28/2023

NOTICE OF ASSIGNMENT OF REEXAMINATION REQUEST

The above-identified request for reexamination has been assigned to Art Unit 3992. All future correspondence to the proceeding should be identified by the control number listed above and directed to the assigned Art Unit.

A copy of this Notice is being sent to the latest attorney or agent of record in the patent file or to all owners of record. (See 37 CFR 1.33(c)). If the addressee is not, or does not represent, the current owner, he or she is required to forward all communications regarding this proceeding to the current owner(s). An attorney or agent receiving this communication who does not represent the current owner(s) may wish to seek to withdraw pursuant to 37 CFR 1.36 in order to avoid receiving future communications. If the address of the current owner(s) is unknown, this communication should be returned within the request to withdraw pursuant to Section 1.36.

NOTICE OF USPTO EX PARTE REEXAMINATION PATENT OWNER STATEMENT WAIVER PROGRAM

The USPTO has implemented a pilot program where, after a reexamination proceeding has been granted a filing date and before the examiner begins his or her review, the patent owner may orally waive the right to file a patent owner's statement. See *"Pilot Program for Waiver of Patent Owner's Statement in Ex Parte Reexamination Proceedings,"* 75 FR 47269 (August 5, 2010). One goal of the pilot program is to reduce the pendency of reexamination proceedings and improve the efficiency of the reexamination process.

Ordinarily when ex parte reexamination is ordered, the USPTO must wait until after the receipt of the patent owner's statement and the third party requester's reply, or after the expiration of the time period for filing the statement and reply (a period that can be as long as 5 to 6 months), before mailing a first determination of patentability. The USPTO's first determination of patentability is usually a first Office action on the merits or a Notice of Intent to Issue Reexamination Certificate (NIRC).

Under the pilot program, the patent owner's oral waiver allows the USPTO to act on the first determination of patentability immediately after determining that reexamination will be ordered, and in a suitable case issue the reexamination order and the first determination of patentability (which could be a NIRC if the claims under reexamination are confirmed) at the same time.

Benefits to the Patent Owner for participating in this pilot program include reduction in pendency.

To participate in this pilot program, Patent Owners may contact the USPTO's Central Reexamination Unit (CRU) at 571-272-7705. The USPTO will make the oral waiver of record in the reexamination file in an interview summary and a copy will be mailed to the patent owner and any third party requester.

cc: Third Party Requester(if any)
Haynes and Boone, LLP
IP Section
2801 N. Harwood St.
Suite 2300
Dallas, TEXAS 75201

/rbell/

Legal Instruments Examiner
Central Reexamination Unit 571-272-7705; FAX No. 571-273-9900

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Director of the United States Patent and Trademark Office

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Kathi Vidal

Kathi Vidal
Under Secretary of Commerce for Intellectual Property and
Director of the United States Patent and Trademark Office

Derrick Brent
Deputy Under Secretary of Commerce for Intellectual Property and
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BIB DATA SHEET

CONFIRMATION NO. 5785

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
90/019,255	09/20/2023 RULE	455	3992	50348.106

APPLICANTS

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INVENTORS

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IP Section Haynes and Boone, LLP, Residence Not Provided;
CURTIS LING, CARLSBAD, CA;
TIM GALLAGHER, CARLSBAD, CA;

**** CONTINUING DATA ***************************

This application is a REX of 14/614,543 02/05/2015 PAT 9210362
which is a CON of 13/962,871 08/08/2013 PAT 9100622
which is a CON of 12/762,900 04/19/2010 PAT 8526898
which claims benefit of 61/170,526 04/17/2009

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****

Foreign Priority claimed ❑ Yes ❑ No 35 USC 119(a-d) conditions met ❑ Yes ❑ No Verified and Acknowledged _____ Examiner's Signature	❑ Met after Allowance _____ Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
				20	2

ADDRESS

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500 WEST MADISON STREET
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CHICAGO, IL 60661
UNITED STATES

TITLE

WIDEBAND TUNER ARCHITECTURE

FILING FEE RECEIVED		
0.00	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	❑ All Fees ❑ 1.16 Fees (Filing) ❑ 1.17 Fees (Processing Ext. of time) ❑ 1.18 Fees (Issue) ❑ Other _____ ❑ Credit

BIB (Rev. 05/07).

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CONFIRMATION NO. 5785

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
90/019,255	09/20/2023 RULE	455	3992	50348.106

APPLICANTS

ENTROPIC COMMUNICATIONS LLC(OWNER), Residence Not Provided;
RAGHAV BAJAJ, DALLAS, TX;

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9210362, Residence Not Provided;
IP Section Haynes and Boone, LLP, Residence Not Provided;
CURTIS LING, CARLSBAD, CA;
TIM GALLAGHER, CARLSBAD, CA;

**** CONTINUING DATA ***************************

This application is a REX of 14/614,543 02/05/2015 PAT 9210362
which is a CON of 13/962,871 08/08/2013 PAT 9100622
which is a CON of 12/762,900 04/19/2010 PAT 8526898
which claims benefit of 61/170,526 04/17/2009

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****

Foreign Priority claimed ❑ Yes ❑ No 35 USC 119(a-d) conditions met ❑ Yes ❑ No Verified and Acknowledged _____ Examiner's Signature	❑ Met after Allowance _____ Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
				20	2

ADDRESS

MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
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UNITED STATES

TITLE

WIDEBAND TUNER ARCHITECTURE

FILING FEE RECEIVED		
0.00	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	❑ All Fees ❑ 1.16 Fees (Filing) ❑ 1.17 Fees (Processing Ext. of time) ❑ 1.18 Fees (Issue) ❑ Other _____ ❑ Credit

BIB (Rev. 05/07).

Litigation Search Report CRU 3999

Reexamination Control No. 90/019,255

To:	LIE	**From:**	MANUEL SALDANA
Location:	REM04C71	**Location:**	REM04C71
Art Unit:	3992	**Phone:**	571-272-7740
Date:	31 October 2023	**E-mail:**	MANUEL.SALDANA@USPTO.GOV

Search Notes

(CLOSED) 2:23cv1050, Entropic Communications, Llc V. Comcast Corporation Et Al

(OPEN) 2:23cv1049, Entropic Communications, Llc V. Cox Communications, Inc. Et Al

(OPEN) 2:22cv125, Entropic Communications, Llc V. Charter Communications, Inc. Et Al

1. Performed a KeyCite Search in Westlaw, which retrieves all history on the patent including any litigation.
2. Performed a search on the patent in Lexis CourtLink for any open dockets or closed cases.
3. Performed a search in Lexis in the Federal Courts and Administrative Materials databases for any cases found.
4. Performed a search in Lexis in the IP Journal and Periodicals database for any articles on the patent.
5. Performed a search in Lexis in the news databases for any articles about the patent or any articles about litigation on this patent.

Paper No. 20231031

LexisNexis

User Name: Manuel Saldana
Date and Time: Tuesday, October 31, 2023 11:31:00AM EDT
Job Number: 209366376

Document (1)

1. *2:23cv1049, Entropic Communications, Llc V. Cox Communications, Inc. Et Al*

Client/Matter: -None-
Search Terms: number(2:23CV1049)
Search Type: Natural Language
Narrowed by:

Content Type	Narrowed by
Dockets	Case Status: Open,Unknown,Closed

2:23cv1049, Entropic Communications, Llc V. Cox Communications, Inc. Et Al

US District Court Docket

United States District Court, California Central

(Western Division - Los Angeles)

This case was retrieved on 10/26/2023

Header

Case Number: 2:23cv1049
Date Filed: 02/10/2023
Assigned To: Judge John W. Holcomb
Referred To: Magistrate Judge Karen E. Scott
Nature of Suit: Patent (830)
Cause: Patent Infringement
Lead Docket: None
Other Docket: 2:22cv07775
Jurisdiction: Federal Question

Class Code: Open
Statute: 35:271
Jury Demand: Plaintiff
Demand Amount: $0
NOS Description: Patent

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Cox Communications California, LLC **Defendant**	Mitchell G. Stockwell LEAD ATTORNEY;PRO HAC VICE;ATTORNEY TO BE NOTICED Kilpatrick Townsend and Stockton LLP 1100 Peachtree Street, Suite 2800 Altanta, GA 30309-4530 USA 404-815-6214 Fax: 404-541-3403 Email:Mstockwell@kilpatricktownsend.Com Andrew N. Saul PRO HAC VICE;ATTORNEY TO BE NOTICED Kilpatrick Townsend and Stockton LLP 1100 Peachtree Street Ne, Suite 2800 Atlanta, GA 30309 USA 404-815-6500 Fax: 404-815-5555 Email:Asaul@kilpatricktownsend.Com April Elizabeth Isaacson ATTORNEY TO BE NOTICED

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MaxLinear Communications LLC **Counter Defendant**	
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Proceedings

#	Date	Proceeding Text	Source
1	02/10/2023	COMPLAINT Receipt No: ACACDC-34782888 - Fee: $402, filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Exhibit 1, # 2 Exhibit 2, # 3 Exhibit 3, # 4 Exhibit 4, # 5 Exhibit 5, # 6 Exhibit 6, # 7 Exhibit 7, # 8 Exhibit 8, # 9 Exhibit 9, # 10 Exhibit 10, # 11 Exhibit 11, # 12 Exhibit 12, # 13 Exhibit 13, # 14 Exhibit 14, # 15 Exhibit 15, # 16 Exhibit 16, # 17 Exhibit 17) (Attorney Christina N. Goodrich added to party Entropic Communications, LLC(pty:pla))(Goodrich, Christina) (Entered: 02/10/2023)	
2	02/10/2023	CIVIL COVER SHEET filed by Plaintiff Entropic Communications, LLC. (Goodrich, Christina) (Entered: 02/10/2023)	
3	02/10/2023	Request for Clerk to Issue Summons on Complaint (Attorney Civil Case Opening),, 1 filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Proposed Summons to CoxCom, LLC, # 2 Proposed Summons to Cox Communications California,	

#	Date	Proceeding Text	Source
		LLC)(Goodrich, Christina) (Entered: 02/10/2023)	
4	02/10/2023	Certification and NOTICE of Interested Parties filed by Plaintiff Entropic Communications, LLC, (Goodrich, Christina) (Entered: 02/10/2023)	
5	02/10/2023	NOTICE of Related Case(s) filed by Plaintiff Entropic Communications, LLC. Related Case(s): 2:23-cv-01047; 2:22-cv-07775-JWH-JEM; 2:22-cv-07959-JWH-JEM (Goodrich, Christina) (Entered: 02/10/2023)	
6	02/10/2023	REPORT ON THE FILING OF AN ACTION Regarding a Patent or a Trademark (Initial Notification) filed by Entropic Communications, LLC. (Goodrich, Christina) (Entered: 02/10/2023)	
7	02/13/2023	NOTICE OF ASSIGNMENT to District Judge Otis D. Wright, II and Magistrate Judge Jean P. Rosenbluth. (lh) (Entered: 02/13/2023)	
8	02/13/2023	NOTICE TO PARTIES OF COURT-DIRECTED ADR PROGRAM filed. (lh) (Entered: 02/13/2023)	
9	02/13/2023	Notice to Counsel Re Consent to Proceed Before a United States Magistrate Judge. (lh) (Entered: 02/13/2023)	
10	02/13/2023	21 DAY Summons Issued re Complaint (Attorney Civil Case Opening), 1 as to Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC. (Attachments: # 1 Summons as to Defendant CoxCom, LLC, # 2 Summons as to Defendant Cox Communications California, LLC) (lh) (Entered: 02/13/2023)	
11	02/14/2023	MINUTE ORDER (IN CHAMBERS) by Judge Otis D. Wright, II. This action has been assigned to the calendar of Judge Otis D. Wright II. Counsel are STRONGLY encouraged to review the Central District's website for additional information. See minute order for details. (lom) (Entered: 02/14/2023)	
12	02/15/2023	ORDER RE TRANSFER PURSUANT TO GENERAL ORDER 21-01-Related Case- filed. Related Case No: 2:22-cv-07775 JWH(JEMx). Case transferred from Magistrate Judge Jean P. Rosenbluth and Judge Otis D. Wright, II to Judge John W. Holcomb and Magistrate Judge Karen E. Scott for all further proceedings. The case number will now reflect the initials of the transferee Judge 2:23-cv-01049 JWH(KESx). Signed by Judge John W. Holcomb (rn) (Entered: 02/15/2023)	
13	02/21/2023	MINUTE ORDER TO SHOW CAUSE REGARDING CONSOLIDATION (IN CHAMBERS) by Judge John W. Holcomb. The Court ORDERS the parties to show cause why these two cases-Nos. 2:23-CV-01049-JWH-KES AND 2:23-CV-01050-JWH-KES should not be consolidated for pretrial purposes in view of the overlap in subject matter. The parties are DIRECTED to file no later than 3/10/23, a joint response detailing their collective or respective positions regarding pretrial consolidation. A hearing on the Order to Show Case is SET for March 31, 2023 at 9:00 a.m.. IT IS SO ORDERED. (yl) (Entered: 02/22/2023)	
14	02/23/2023	STANDING ORDER by Judge John W. Holcomb. (cla) (Entered: 02/23/2023)	
15	02/23/2023	PROOF OF SERVICE Executed by Plaintiff Entropic Communications, LLC, upon Defendant Cox Communications, Inc. served on 2/15/2023, answer due 3/8/2023. Service of the Summons and Complaint were executed upon Lynanne Gares, Managing Agent, Corporation Service Company in compliance with Federal Rules of Civil Procedure by service on a domestic corporation, unincorporated association, or public entity.Original Summons NOT returned. (Goodrich, Christina) (Entered: 02/23/2023)	

#	Date	Proceeding Text	Source
16	02/23/2023	PROOF OF SERVICE Executed by Plaintiff Entropic Communications, LLC, upon Defendant CoxCom, LLC served on 2/16/2023, answer due 3/9/2023. Service of the Summons and Complaint were executed upon Trudy Desbiens, CSC Authorized Agent in compliance with Federal Rules of Civil Procedure by service on a domestic corporation, unincorporated association, or public entity.Original Summons NOT returned. (Goodrich, Christina) (Entered: 02/23/2023)	
17	02/23/2023	PROOF OF SERVICE Executed by Plaintiff Entropic Communications, LLC, upon Defendant Cox Communications California, LLC served on 2/16/2023, answer due 3/9/2023. Service of the Summons and Complaint were executed upon Trudy Desbiens, CSC Authorized Agent in compliance with Federal Rules of Civil Procedure by service on a domestic corporation, unincorporated association, or public entity.Original Summons NOT returned. (Goodrich, Christina) (Entered: 02/23/2023)	
18	03/06/2023	APPLICATION of Non-Resident Attorney Jason A. Engel to Appear Pro Hac Vice on behalf of Plaintiff Entropic Communications, LLC (Pro Hac Vice Fee - $500 Fee Paid, Receipt No. ACACDC-34906348) filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Proposed Order) (Goodrich, Christina) (Entered: 03/06/2023)	
19	03/06/2023	APPLICATION of Non-Resident Attorney Darlene F. Ghavimi to Appear Pro Hac Vice on behalf of Plaintiff Entropic Communications, LLC (Pro Hac Vice Fee - $500 Fee Paid, Receipt No. ACACDC-34906355) filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Proposed Order) (Goodrich, Christina) (Entered: 03/06/2023)	
20	03/06/2023	APPLICATION of Non-Resident Attorney James A. Shimota to Appear Pro Hac Vice on behalf of Plaintiff Entropic Communications, LLC (Pro Hac Vice Fee - $500 Fee Paid, Receipt No. ACACDC-34906366) filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Proposed Order) (Goodrich, Christina) (Entered: 03/06/2023)	
21	03/07/2023	NOTICE of Appearance filed by attorney April Elizabeth Isaacson on behalf of Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC (Attorney April Elizabeth Isaacson added to party Cox Communications California, LLC(pty:dft), Attorney April Elizabeth Isaacson added to party Cox Communications, Inc.(pty:dft), Attorney April Elizabeth Isaacson added to party CoxCom, LLC(pty:dft))(Isaacson, April) (Entered: 03/07/2023)	
22	03/07/2023	NOTICE of Appearance filed by attorney Rishi Gupta on behalf of Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC (Attorney Rishi Gupta added to party Cox Communications California, LLC(pty:dft), Attorney Rishi Gupta added to party Cox Communications, Inc.(pty:dft), Attorney Rishi Gupta added to party CoxCom, LLC(pty:dft))(Gupta, Rishi) (Entered: 03/07/2023)	
23	03/07/2023	NOTICE of Deficiency in Electronically Filed Pro Hac Vice Application RE: APPLICATION of Non-Resident Attorney Darlene F. Ghavimi to Appear Pro Hac Vice on behalf of Plaintiff Entropic Communications, LLC (Pro Hac Vice Fee - $500 Fee Paid, Receipt No. ACACDC-34906355) 19 . The following error(s) was/were found: Local Rule 83-2.1.3.3(d) Certificate of Good Standing not attached for every state court listed to which the applicant has been admitted. Other error(s) with document(s): Missing GSC from NJ. (lt) (Entered: 03/07/2023)	

#	Date	Proceeding Text	Source
24	03/08/2023	Joint STIPULATION Extending Time to Answer the complaint as to Cox Communications, Inc. answer now due 4/7/2023, re Complaint (Attorney Civil Case Opening),, 1 filed by Plaintiff Entropic Communications, LLC.(Goodrich, Christina) (Entered: 03/08/2023)	
25	03/08/2023	NOTICE of Appearance filed by attorney Kenneth Bridges on behalf of Plaintiff Entropic Communications, LLC (Attorney Kenneth Bridges added to party Entropic Communications, LLC(pty:pla))(Bridges, Kenneth) (Entered: 03/08/2023)	
26	03/08/2023	Joint STIPULATION Extending Time to Answer the complaint as to CoxCom, LLC answer now due 4/8/2023, re Complaint (Attorney Civil Case Opening),, 1 filed by Plaintiff Entropic Communications, LLC.(Goodrich, Christina) (Entered: 03/08/2023)	
27	03/08/2023	Joint STIPULATION Extending Time to Answer the complaint as to Cox Communications California, LLC answer now due 4/8/2023, re Complaint (Attorney Civil Case Opening),, 1 filed by Plaintiff Entropic Communications, LLC.(Goodrich, Christina) (Entered: 03/08/2023)	
28	03/08/2023	Text Only ORDER GRANTING APPLICATION of Non-Resident Attorney Jason A. Engel to Appear Pro Hac Vice on behalf of Plaintiff Entropic Communications, LLC 18 , APPLICATION of Non-Resident Attorney Darlene F. Ghavimi to Appear Pro Hac Vice on behalf of Plaintiff Entropic Communications, LLC 19 , APPLICATION of Non-Resident Attorney James A. Shimota to Appear Pro Hac Vice on behalf of Plaintiff Entropic Communications, LLC 20 by Judge John W. Holcomb. THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (cla) TEXT ONLY ENTRY (Entered: 03/08/2023)	
29	03/10/2023	RESPONSE filed by Plaintiff Entropic Communications, LLCto Minutes of In Chambers Order/Directive - no proceeding held,,, Set/Reset Hearing,, 13 - JOINT RESPONSE TO OSC RE CONSOLIDATION (Goodrich, Christina) (Entered: 03/10/2023)	
30	03/16/2023	APPLICATION of Non-Resident Attorney Mitchell G. Stockwell to Appear Pro Hac Vice on behalf of Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC (Pro Hac Vice Fee - $500 Fee Paid, Receipt No. ACACDC-34967403) filed by Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC. (Attachments: # 1 Certificate of Good Standing - GA State Bar, # 2 Proposed Order Proposed Order) (Attorney Mitchell G Stockwell added to party Cox Communications California, LLC(pty:dft), Attorney Mitchell G Stockwell added to party Cox Communications, Inc.(pty:dft), Attorney Mitchell G Stockwell added to party CoxCom, LLC(pty:dft)) (Stockwell, Mitchell) (Entered: 03/16/2023)	
31	03/16/2023	NOTICE of Deficiency in Electronically Filed Pro Hac Vice Application RE: APPLICATION of Non-Resident Attorney Mitchell G. Stockwell to Appear Pro Hac Vice on behalf of Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC (Pro Hac Vice Fee - $500 Fee Paid, Receipt No. ACACDC-34967403) 30 . The following error(s) was/were found: Local Rule 5-4.3.4 Application not hand-signed. Please note that electronic, image or stamp signatures are not allowed for either applicant or local counsel. See Instructions for Applicants (1). (lt) (Entered: 03/16/2023)	
32	03/20/2023	Text Only ORDER GRANTING APPLICATION of Non-Resident Attorney Mitchell G. Stockwell to Appear Pro Hac Vice on behalf of Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC 30 by Judge John W.	

#	Date	Proceeding Text	Source
		Holcomb. THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (cla) TEXT ONLY ENTRY (Entered: 03/20/2023)	
33	03/21/2023	Joint STIPULATION to Continue Hearing on Order to Show Cause re Consolidation from March 31, 2023 to April 21, 2023 Re: Minutes of In Chambers Order/Directive - no proceeding held.,, Set/Reset Hearing,, 13 filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Proposed Order on Joint Stipulation to Request Continuance)(Goodrich, Christina) (Entered: 03/21/2023)	
34	03/23/2023	APPLICATION of Non-Resident Attorney Michael J. Turton to Appear Pro Hac Vice on behalf of Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC (Pro Hac Vice Fee - $500 Fee Paid, Receipt No. ACACDC-35006990) filed by Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC. (Attachments: # 1 Certificate of Good Standing - GA State Bar, # 2 Certificate of Good Standing - TX State Bar, # 3 Proposed Order Proposed Order) (Attorney Michael J. Turton added to party Cox Communications California, LLC(pty:dft), Attorney Michael J. Turton added to party Cox Communications, Inc.(pty:dft), Attorney Michael J. Turton added to party CoxCom, LLC(pty:dft)) (Turton, Michael) (Entered: 03/23/2023)	
35	03/23/2023	ORDER GRANTING JOINT STIPULATION TO REQUEST CONTINUANCE OF HEARING ON ORDER TO SHOW CAUSE REGARDING CONSOLIDATION by Judge John W. Holcomb, re Stipulation to Continue 33 . it is hereby ORDERED that the March 31, 2023, hearing on the Order to Show Cause Regarding Consolidation is CONTINUED from March 31, 2023, to April 21, 2023, at 9:00 a.m. IT IS SO ORDERED. (et) (Entered: 03/23/2023)	
36	03/28/2023	APPLICATION of Non-Resident Attorney Vaibhav P. Kadaba to Appear Pro Hac Vice on behalf of Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC (Pro Hac Vice Fee - $500 Fee Paid, Receipt No. ACACDC-35031686) filed by Vaibhav P. Kadaba Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC. (Attachments: # 1 Certificate of Good Standing - GA State Bar, # 2 Proposed Order Proposed Order) (Attorney Vaibhav P Kadaba added to party Cox Communications California, LLC(pty:dft), Attorney Vaibhav P Kadaba added to party Cox Communications, Inc.(pty:dft), Attorney Vaibhav P Kadaba added to party CoxCom, LLC(pty:dft)) (Kadaba, Vaibhav) (Entered: 03/28/2023)	
37	03/28/2023	APPLICATION of Non-Resident Attorney Christopher S. Leah to Appear Pro Hac Vice on behalf of Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC (Pro Hac Vice Fee - $500 Fee Paid, Receipt No. ACACDC-35035078) filed by Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC. (Attachments: # 1 Certificate of Good Standing - GA State Bar, # 2 Proposed Order Proposed Order) (Gupta, Rishi) (Entered: 03/28/2023)	
38	03/29/2023	Text Only ORDER GRANTING APPLICATION of Non-Resident Attorney Michael J. Turton to Appear Pro Hac Vice on behalf of Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC 34 , APPLICATION of Non-Resident Attorney Vaibhav P. Kadaba to Appear Pro Hac Vice on behalf of Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC 36 , APPLICATION of Non-Resident Attorney Christopher S. Leah to Appear Pro Hac Vice on behalf of Defendants Cox Communications California, LLC, Cox	

#	Date	Proceeding Text	Source
		Communications, Inc., CoxCom, LLC 37 by Judge John W. Holcomb. THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (cla) TEXT ONLY ENTRY (Entered: 03/29/2023)	
39	03/31/2023	Joint STIPULATION for Extension of Time to File Answer to May 8, 2023 re Complaint (Attorney Civil Case Opening)., 1 filed by Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC. (Attachments: # 1 Proposed Order)(Isaacson, April) (Entered: 03/31/2023)	
40	03/31/2023	NOTICE of Appearance filed by attorney Sarah Y Kamran on behalf of Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC (Attorney Sarah Y Kamran added to party Cox Communications California, LLC(pty:dft), Attorney Sarah Y Kamran added to party Cox Communications, Inc.(pty:dft), Attorney Sarah Y Kamran added to party CoxCom, LLC(pty:dft))(Kamran, Sarah) (Entered: 03/31/2023)	
42	04/03/2023	MINUTE ORDER TO SHOW CAUSE REGARDING APPOINTMENT OF SPECIAL MASTER REGARDING DISCOVERY DISPUTES (IN CHAMBERS) by Judge John W. Holcomb. These cases will likely generate a substantial number of discovery disputes. For that reason, the Court is considering appointing a Special Master to assist the Court in managing and deciding discovery matters, and, therefore, it issues this order to show cause (OSC). For the foregoing reasons, the Court hereby ORDERS as follows: 1. No later than April 14, 2023, the parties are DIRECTED to respond to this OSC by each filing a statement either consenting to the appointment of a Special Master for discovery purposes or showing cause why a Special Master should not be appointed. 2. A hearing on this OSC is SET for April 21, 2023, at 9:00 a.m. See minute order for details. (lom) (Entered: 04/04/2023)	
41	04/04/2023	ORDER GRANTING TO REQUEST AN ADDITIONAL 30-DAY EXTENSION OF TIME FOR DEFENDANTS TO ANSWER OR OTHERWISE RESPOND TO PLAINTIFF'S COMPLAINT 39 by Judge John W. Holcomb. It is hereby ORDERED that the deadline for Defendants to answer or otherwise respond to Plaintiff's Complaint is EXTENDED up to and including May 8, 2023. (lom) (Entered: 04/04/2023)	
43	04/07/2023	APPLICATION of Non-Resident Attorney Courtney S. Dabbiere to Appear Pro Hac Vice on behalf of Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC (Pro Hac Vice Fee - $500 Fee Paid, Receipt No. ACACDC-35100112) filed by Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC. (Attachments: # 1 Certificate of Good Standing - GA State Bar, # 2 Proposed Order) (Gupta, Rishi) (Entered: 04/07/2023)	
44	04/11/2023	Text Only ORDER GRANTING APPLICATION of Non-Resident Attorney Courtney S. Dabbiere to Appear Pro Hac Vice on behalf of Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC 43 by Judge John W. Holcomb. THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (cla) TEXT ONLY ENTRY (Entered: 04/11/2023)	
45	04/14/2023	STATEMENT JOINTLY SUBMITTED BY THE PARTIES IN RESPONSE TO ORDER TO SHOW CAUSE RE APPOINTMENT OF A SPECIAL MASTER filed by Plaintiff Entropic Communications, LLC re: Minutes of In Chambers Order/Directive - no proceeding held,,,, Set/Reset Deadlines/Hearings,,, 42 . (Goodrich, Christina) (Entered: 04/14/2023)	
46	04/17/2023	Notice OF INTERESTED PARTIES (LOCAL RULE 7.1-1)	

#	Date	Proceeding Text	Source
		(AMENDED) filed by Plaintiff Entropic Communications, LLC. (Goodrich, Christina) (Entered: 04/17/2023)	
47	04/18/2023	Notice of Appearance or Withdrawal of Counsel: for attorney Peter E Soskin counsel for Plaintiff Entropic Communications, LLC. Adding Peter Soskin as counsel of record for Entropic Communications, LLC for the reason indicated in the G-123 Notice. Filed by Plaintiff Entropic Communications, LLC. (Attorney Peter E Soskin added to party Entropic Communications, LLC(pty:pla))(Soskin, Peter) (Entered: 04/18/2023)	
48	04/21/2023	MINUTE ORDER OF HEARING RE: ORDER TO SHOW CAUSE RE CONSOLIDATION held before Judge John W. Holcomb. Counsel state their appearances. The Court confers with counsel regarding the posture of the case. For the reasons stated on the record, the parties are DIRECTED to meet and confer regarding a proposed order pertaining to consolidation and the appointment of Special Master. IT IS SO ORDERED. Court Reporter: Debbie Hino-Span. (yl) (Entered: 04/24/2023)	
49	05/08/2023	ANSWER to Complaint (Attorney Civil Case Opening),, 1 with JURY DEMAND - Answer and Defenses to Complaint filed by Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC.(Isaacson, April) (Entered: 05/08/2023)	
50	05/08/2023	CORPORATE DISCLOSURE STATEMENT - DEFENDANTS FED. R. CIV. P. 7.1 DISCLOSURE STATEMENT AND L.R. 7.1-1 NOTICE OF INTERESTED PARTIES filed by Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC identifying Cox Enterprises, Inc. as Corporate Parent. (Isaacson, April) (Entered: 05/08/2023)	
51	05/14/2023	TRANSCRIPT for proceedings held on 4/21/2023 at 8:59 a.m. ****Transcript may be viewed at the court public terminal or purchased through Court Reporter DEBBIE HINO-SPAAN at: WEBSITE www.debbiehinospaan.com; E-mail, dhinospaan@yahoo.com before the deadline for Release of Transcript restriction. After that date, it may be obtained from the Court Reporter or through PACER. Additional formats of the transcript (ASCII, Condensed, and Word Indexing/Concordance) are also available to be purchased at any time through the Court Reporter. Notice of Intent to Redact due within 7 days of this date.** Redaction Request due 6/5/2023. Redacted Transcript Deadline set for 6/14/2023. Release of Transcript Restriction set for 8/14/2023. (dhs) (Entered: 05/14/2023)	
52	05/14/2023	NOTICE OF FILING TRANSCRIPT filed for proceedings 4/21/2023 at 8:59 a.m. re Transcript 51 THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (dhs) TEXT ONLY ENTRY (Entered: 05/14/2023)	
53	05/17/2023	ORDER SETTING SCHEDULING CONFERENCE by Judge John W. Holcomb. Scheduling Conference set for 6/30/2023 at 9:00 AM before Judge John W. Holcomb. (cla) (Entered: 05/17/2023)	
54	05/17/2023	SCHEDULING NOTICE AND ORDER by Judge John W. Holcomb: On its own motion, the Court SETS a Status Conference on June 9, 2023, at 11:00 a.m. The parties are DIRECTED to file a Joint Status Report no later than Friday, May 26, 2023, that includes an update regarding the appointment of a Special Master and case consolidation. The parties are DIRECTEDto appear in person in Courtroom 9D, on the 9th Floor of the Ronald Reagan Federal Building and United States Courthouse at 411 W. Fourth Street Santa Ana, CA 92701. IT IS SO ORDERED.THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (cla) TEXT ONLY ENTRY (Entered:	

#	Date	Proceeding Text	Source
		05/17/2023)	
55	05/26/2023	STATUS REPORT re Consolidation and Appointment of Special Master Prepared Jointly by All Parties filed by Plaintiff Entropic Communications, LLC. (Goodrich, Christina) (Entered: 05/26/2023)	
56	05/26/2023	APPLICATION of Non-Resident Attorney George C. Summerfield to Appear Pro Hac Vice on behalf of Plaintiff Entropic Communications, LLC (Pro Hac Vice Fee - $500 Fee Paid, Receipt No. ACACDC-35393516) filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Proposed Order) (Goodrich, Christina) (Entered: 05/26/2023)	
57	05/30/2023	SCHEDULING NOTICE AND ORDER by Judge John W. Holcomb: On its own motion, the Court CONTINUES the Status Conference from June 9, 2023, at 11:00 a.m., to June 9, 2023, at 9:00 a.m. ***TIME CHANGE ONLY*** The parties are DIRECTED to appear in person in Courtroom 9D, on the 9th Floor of the Ronald Reagan Federal Building and United States Courthouse at 411 W. Fourth Street Santa Ana, CA 92701. IT IS SO ORDERED.THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (ev) TEXT ONLY ENTRY (Entered: 05/30/2023)	
58	05/31/2023	Text Only ORDER GRANTING APPLICATION of Non-Resident Attorney George C. Summerfield to Appear Pro Hac Vice on behalf of Plaintiff Entropic Communications, LLC 56 by Judge John W. Holcomb. THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (ev) TEXT ONLY ENTRY (Entered: 05/31/2023)	
59	06/06/2023	Joint STIPULATION to Continue Scheduling Conference from June 30, 2023 to July 21, 2023 Re: Initial Order Setting R26 Scheduling Conference - form only 53 filed by Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC. (Attachments: # 1 Proposed Order)(Isaacson, April) (Entered: 06/06/2023)	
60	06/08/2023	Joint STIPULATION for Order to Appoint Special Master filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Affidavit of David M. Keyzer Pursuant to Fed. R. Civ. P. 53(b)(3)(A), # 2 Proposed Order)(Goodrich, Christina) (Entered: 06/08/2023)	
61	06/09/2023	MINUTE ORDER OF STATUS CONFERENCE held before Judge John W. Holcomb. For the reasons stated on the record, the Court hereby ORDERS as follows: The parties Joint Stipulation for Continuance of the Scheduling Conference [ECF No. 59] is APPROVED. The Scheduling Conference is CONTINUED to July 21, 2023, at 11:00 a.m. IT IS SO ORDERED. Court Reporter: Debbie Hino-Span. (yl) (Entered: 06/13/2023)	
62	07/05/2023	ORDER APPOINTING DAVID KEYZER, ESQ. AS SPECIAL MASTER FOR DISCOVERY PURPOSES by Judge John W. Holcomb, re Stipulation 60 : Pursuant to Fed. R. Civ. P. 53(b)(3)(A), and good cause shown, it is hereby ORDERED as follows: 1. Appointment: The Court determines that the appointment of David Keyzer, Esq. (the "Special Master") is appropriate under Rule 53(a)(1)(C) of the Federal Rules of Civil Procedure to address pretrial matters that cannot be effectively and timely addressed by an available district judge or magistrate judge in this district. (see document for further details) (bm) (Entered: 07/05/2023)	
63	07/07/2023	JOINT REPORT Rule 26(f) Discovery Plan ; estimated length of trial 6 to 8 days, filed by Plaintiff Entropic Communications, LLC.. (Goodrich, Christina) (Entered: 07/07/2023)	

#	Date	Proceeding Text	Source
64	07/10/2023	SCHEDULING NOTICE AND ORDER by Judge John W. Holcomb: On its own motion, the Court CONTINUES the Scheduling Conference from Friday, July 21, 2023, to Wednesday, August 9, 2023, at 10:00 a.m. The parties are DIRECTED to appear in person in Courtroom 9D, on the 9th Floor of the Ronald Reagan Federal Building and United States Courthouse at 411 W. Fourth Street Santa Ana, CA 92701. IT IS SO ORDERED.THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (cla) TEXT ONLY ENTRY (Entered: 07/10/2023)	
65	07/17/2023	TRANSCRIPT for proceedings held on 6/9/2023 at 9:05 a.m. ****Transcript may be viewed at the court public terminal or purchased through Court Reporter DEBBIE HINO-SPAAN at: WEBSITE www.debbiehinospaan.com; E-mail, dhinospaan@yahoo.com before the deadline for Release of Transcript restriction. After that date, it may be obtained from the Court Reporter or through PACER. Additional formats of the transcript (ASCII, Condensed, and Word Indexing/Concordance) are also available to be purchased at any time through the Court Reporter. Notice of Intent to Redact due within 7 days of this date.** Redaction Request due 8/7/2023. Redacted Transcript Deadline set for 8/17/2023. Release of Transcript Restriction set for 10/16/2023. (dhs) (Entered: 07/17/2023)	
66	07/17/2023	NOTICE OF FILING TRANSCRIPT filed for proceedings 6/9/2023 at 9:05 a.m. re Transcript 65 THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (dhs) TEXT ONLY ENTRY (Entered: 07/17/2023)	
67	07/24/2023	Notice of Special Master Order No. SM-1 filed by Special Master David M Keyzer, pursuant to July 5, 2023 appointment Order, setting special master preliminary conference for July 26, 2023, at 12:00 P.M., by videoconference (Attachments: # 1 Special Master Order No. SM-1)(Keyzer, David) (Entered: 07/24/2023)	
68	07/26/2023	Notice of Special Master Minutes filed by Special Master David M Keyzer, minutes of preliminary conference conducted by the special master on July 26, 2023, pursuant to the Court's July 5, 2023 Order appointing special master (Attachments: # 1 Special Master Minutes)(Keyzer, David) (Entered: 07/26/2023)	
69	08/01/2023	Notice of Appearance or Withdrawal of Counsel: for attorney Cassidy Young counsel for Plaintiff Entropic Communications, LLC. Adding Cassidy Young as counsel of record for Plaintiff Entropic Communications, LLC for the reason indicated in the G-123 Notice. Filed by Plaintiff Entropic Communications, LLC. (Attorney Cassidy Young added to party Entropic Communications, LLC(pty:pla))(Young, Cassidy) (Entered: 08/01/2023)	
70	08/04/2023	Notice of Special Master Order No. SM-2 filed by Special Master David M Keyzer, regarding Discovery Dispute Resolution Procedures (Attachments: # 1 Special Master Order No. SM-2 re Discovery Dispute Resolution Procedures)(Keyzer, David) (Entered: 08/04/2023)	
71	08/09/2023	HEARING RE: SCHEDULING CONFERENCE held before Judge John W. Holcomb. Counsel are DIRECTED to meet and confer forthwith regarding the Claim Construction Schedule. The parties are DIRECTED to file no later than August 18, 2023, a Stipulation and Proposed Order setting a Claim Construction Schedule. IT IS SO ORDERED. Court Reporter: Miriam Baird. (yl) (Entered: 08/14/2023)	
72	08/18/2023	TRANSCRIPT for proceedings held on 8/9/23. Court Reporter/Electronic Court Recorder: miriam baird, phone number	

#	Date	Proceeding Text	Source
		mvb11893@acl.com. Transcript may be viewed at the court public terminal or purchased through the Court Reporter/Electronic Court Recorder before the deadline for Release of Transcript Restriction. After that date it may be obtained through PACER. Notice of Intent to Redact due within 7 days of this date. Redaction Request due 9/8/2023. Redacted Transcript Deadline set for 9/18/2023. Release of Transcript Restriction set for 11/16/2023. (Baird, Miriam) (Entered: 08/18/2023)	
73	08/18/2023	NOTICE OF FILING TRANSCRIPT filed for proceedings 8/9/23 re Transcript 72 THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (Baird, Miriam) TEXT ONLY ENTRY (Entered: 08/18/2023)	
74	08/18/2023	STIPULATION for Order Setting Claim Construction Schedule filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Proposed Order)(Young, Cassidy) (Entered: 08/18/2023)	
75	08/21/2023	ORDER GRANTING STIPULATION SETTING CLAIM CONSTRUCTION SCHEDULE by Judge John W. Holcomb. The dates for the claim construction are as follows: The Claim Construction hearing is on Tuesday, July 16, 2024, at 10:00 a.m.. The Reply Claim is due Friday, June 21, 2024. The Completion of Claim Discovery is due Friday, May 3, 2024 (SEE DOCUMENT FOR FURTHER DETAILS). IT IS SO ORDERED. (yl) (Entered: 08/22/2023)	
76	08/25/2023	APPLICATION to file document - Amended Answer, Defenses and Counterclaims under seal filed by Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC. (Attachments: # 1 Proposed Order Granting Mot. to Seal, # 2 Redacted Document - Memo ISO Mot to Amend Answer, # 3 Redacted Document - Amended Answer, # 4 Redacted Document - Exh. A to Amended Answer)(Isaacson, April) (Entered: 08/25/2023)	
77	08/25/2023	SEALED DECLARATION IN SUPPORT OF APPLICATION to file document - Amended Answer, Defenses and Counterclaims under seal 76 filed by Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC. (Attachments: # 1 Unredacted Document - Memo ISO Mot to Amend Answer, # 2 Unredacted Document - Amended Answer, # 3 Unredacted Document - Ex. A to Amended Answer)(Isaacson, April) (Entered: 08/25/2023)	
78	08/25/2023	CERTIFICATE OF SERVICE filed by Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC, re Sealed Declaration in SupportDeclaration, 77 served on August 25, 2023. (Isaacson, April) (Entered: 08/25/2023)	
79	08/25/2023	NOTICE OF MOTION AND MOTION to AMEND ANSWER AND JOINDER filed by Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC. Motion set for hearing on 9/22/2023 at 08:45 AM before Judge John W. Holcomb. (Attachments: # 1 Memorandum of Points and Authorities - REDACTED, # 2 Proposed Order, # 3 - Amended Answer - REDACTED, # 4 Exhibit A to Amended Answer - REDACTED, # 5 Exhibit B to Amended Answer, # 6 Exhibit C to Amended Answer, # 7 Exhibit D to Amended Answer, # 8 - Redline Compare Original Answer to Amended Answer - REDACTED) (Isaacson, April) (Entered: 08/25/2023)	
80	08/28/2023	SCHEDULING NOTICE AND ORDER by Judge John W. Holcomb: On its own motion, the Court RESETS the hearing on Defendant's Motion to Amend Answer to Complaint [ECF No. 79] to September 22, 2023, at 9:00 a.m. ***TIME CHANGE ONLY***	

#	Date	Proceeding Text	Source
		The parties are DIRECTED to appear in person in Courtroom 9D, on the 9th Floor of the Ronald Reagan Federal Building and United States Courthouse at 411 W. Fourth Street Santa Ana, CA 92701. IT IS SO ORDERED. THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (cla) TEXT ONLY ENTRY (Entered: 08/28/2023)	
81	08/30/2023	ORDER GRANTING COX COMMUNICATIONS, INC., COXCOM, LLC, AND COX COMMUNICATIONS CALIFORNIA, LLC'S APPLICATION FOR LEAVE TO FILE UNDER SEAL by Judge John W. Holcomb. The Court, having considered all papers filed in support of the application finds that there is a good cause for granting the application in its entirety. Accordingly, it is hereby ORDERED that Plaintiff's Application is GRANTED. IT IS SO ORDERED.(yl) (Entered: 08/31/2023)	
82	08/31/2023	SEALED DOCUMENT - Memo of Points and Authorities for Cox's Motion for Leave to Amend Answer re NOTICE OF MOTION AND MOTION to AMEND ANSWER AND JOINDER 79 , Order on Motion for Leave to File Document Under Seal, 81 filed by Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC. (Attachments: # 1 Unredacted Document - Amended Answer, # 2 Unredacted Document - Exhibit A to Amended Answer)(Isaacson, April) (Entered: 08/31/2023)	
83	09/01/2023	NOTICE OF NON-OPPOSITION to NOTICE OF MOTION AND MOTION to AMEND ANSWER AND JOINDER 79 filed by Plaintiff Entropic Communications, LLC. (Young, Cassidy) (Entered: 09/01/2023)	
84	09/14/2023	Joint STIPULATION to Waive Oral Argument for Hearing on Defendants' Motion for Leave to Amend Answer filed by Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC. (Attachments: # 1 Proposed Order)(Isaacson, April) (Entered: 09/14/2023)	
85	09/15/2023	(IN CHAMBERS) ORDER by Judge John W. Holcomb: The Court finds that the Defendant's Motion for Leave to Amend Answer to Complaint [ECF No. 79] is appropriate for resolution without a hearing. See Fed. R. Civ. P. 78; L.R. 7-15. Accordingly, the Court VACATES the hearing set on September 22, 2023. The motion stands submitted on the papers timely filed. IT IS SO ORDERED. THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (cla) TEXT ONLY ENTRY (Entered: 09/15/2023)	
86	10/05/2023	ORDER GRANTING MOTION OF DEFENDANTS COX COMMUNICATIONS, INC.; COXCOM, LLC; AND COX COMMUNICATIONS CALIFORNIA, LLC FOR LEAVE TO AMEND ANSWER AND JOINDER [ECF NO. 79] by Judge John W. Holcomb. The Court GRANTS Cox's Motion for Leave to Amend. The Court need not decide whether Rule 15 or Rule 16 applies because Cox has met both standards. Under Rule 16, Cox has shown good cause by acting with diligence and filing this motion based on information obtained somewhat recently during discovery. The Court also GRANTS Cox's Motion for Joinder. Cox has at least met the permissive Rule 20 standard. MaxLinear may be joined at least because Cox asserts breach of contract and unjust enrichment claims against MaxLinear and because there are common question of fact surrounding the DOCSIS License Agreement, which potentially affects Entropics allegations of patent infringement. Entropic presents no evidence or argument countering Cox's joinder request. For the foregoing reasons, the Court GRANTS Cox's Motion. Cox is DIRECTED to file its amended answer and counterclaims no later than October 20, 2023. IT IS SO ORDERED. (See document for further details) (yl)	

#	Date	Proceeding Text	Source
		(Entered: 10/06/2023)	
87	10/06/2023	SEALED DOCUMENT - Amended Answer, Defenses and Counterclaims re Complaint (Attorney Civil Case Opening),, 1 , Order on Motion for Leave,,,, 86 filed by Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC. (Attachments: # 1 Exhibit A to the Complaint - SEALED, # 2 Exhibit B to the Complaint, # 3 Exhibit C to the Complaint, # 4 Exhibit D to the Complaint)(Isaacson, April) (Entered: 10/06/2023)	
88	10/06/2023	CERTIFICATE OF SERVICE filed by Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC, re Sealed Document, 87 - Amended Answer, Defenses and Counterclaims served on October 6, 2023. (Isaacson, April) (Entered: 10/06/2023)	
89	10/12/2023	SEALED DOCUMENT Counterclaims on ENTROPIC COMMUNICATIONS LLC; MAXLINEAR, INC.; MAXLINEAR COMMUNICATIONS LLC re Order on Motion for Leave,,,, 86 filed by Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC. (Attachments: # 1 Exhibit A - SEALED, # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D)(Isaacson, April) (Entered: 10/12/2023)	
90	10/12/2023	Request for Clerk to Issue Summons on Sealed Document, 89 filed by Counter-Claimants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC. (Isaacson, April) (Entered: 10/12/2023)	
91	10/12/2023	CERTIFICATE OF SERVICE filed by Counter-Claimants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC, re Sealed Document, 89 served on 10/12/23. (Isaacson, April) (Entered: 10/12/2023)	
92	10/13/2023	STIPULATION to Continue Deadline to Respond to Counterclaims from October 27, 2023 to November 27, 2023 filed by Counter-Defendant Entropic Communications, LLC. (Attachments: # 1 Proposed Order)(Young, Cassidy) (Entered: 10/13/2023)	
93	10/16/2023	STIPULATION to Consolidate Cases as to 2:23-cv-01049 and 2:23-cv-01050 filed by Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC. (Attachments: # 1 Proposed Order)(Isaacson, April) (Entered: 10/16/2023)	
94	10/16/2023	ANSWER to Complaint (Attorney Civil Case Opening),, 1 with JURY DEMAND - Amended Answer, Defenses and Counterclaims, COUNTERCLAIM against Entropic Communications, LLC, MaxLinear Communications LLC filed by Defendants Cox Communications California, LLC, CoxCom, LLC, Cox Communications, Inc.. (Attachments: # 1 Exhibit A to the Complaint - Redacted, # 2 Exhibit B to the Complaint, # 3 Exhibit C to the Complaint, # 4 Exhibit D to the Complaint)(Isaacson, April) (Entered: 10/16/2023)	
95	10/16/2023	ORDER GRANTING JOINT STIPULATION TO CONSOLIDATE CASES 93 by Judge John W. Holcomb. The Parties' Joint Stipulation to Consolidate Cases is GRANTED. The following cases are CONSOLIDATED into a single action for pretrial purposes through the date of the Markman hearing: Case No. 2:23-cv-01049-JWH-KES and Case No. 2:23-cv-01050-JWH-KES. The Clerk is DIRECTED to close the following case administratively: Case No. 2:23-cv-01050-JWH-KES. IT IS SO ORDERED. (yl) (Entered: 10/17/2023)	
96	10/18/2023	21 DAY Summons Issued as to Counter defendants MaxLinear Communications LLC, and MaxLinear, Inc.. (yl) (Entered: 10/18/2023)	

#	Date	Proceeding Text	Source
97	10/19/2023	APPLICATION of Non-Resident Attorney Andrew N. Saul to Appear Pro Hac Vice on behalf of Counter Claimants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC, Defendants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC (Pro Hac Vice Fee - $500 Fee Paid, Receipt No. ACACDC-36255900) filed by Defendants and Counter-Claimants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC. (Attachments: # 1 Proposed Order) (Gupta, Rishi) (Entered: 10/19/2023)	
98	10/24/2023	Text Only ORDER GRANTING APPLICATION of Non-Resident Attorney Andrew N. Saul to Appear Pro Hac Vice on behalf of Counter Claimants Cox Communications California, LLC, Cox Communications, Inc., CoxCom, LLC, Defendants Cox Communications California, LLC, Cox Communications, Inc 97 by Judge John W. Holcomb. THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (cla) TEXT ONLY ENTRY (Entered: 10/24/2023)	
99	10/24/2023	STIPULATION for Protective Order filed by Plaintiff Entropic Communications, LLC.(Goodrich, Christina) (Entered: 10/24/2023)	
100	10/24/2023	STIPULATION for Protective Order filed by Plaintiff Entropic Communications, LLC.(Goodrich, Christina) (Entered: 10/24/2023)	
101	10/24/2023	(IN CHAMBERS) ORDER by Judge John W. Holcomb: The Court has reviewed the parties' Stipulation [ECF No. 92], and it is hereby APPROVED. Entropic's deadline to respond to Cox's Counterclaims [ECF No.87] is CONTINUED from October 27, 2023, to November 27, 2023. IT IS SO ORDERED. THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (cla) TEXT ONLY ENTRY (Entered: 10/24/2023)	
102	10/30/2023	Notice of Special Master Order No. SM-4 filed by Special Master David M Keyzer. setting special master discovery hearing for November 3, 2023, at 12:30 P.M., by videoconference (Attachments: # 1 Special Master Order No. SM-4)(Keyzer, David) (Entered: 10/30/2023)	Events since last full update
103	10/30/2023	Joint STIPULATION Extending Time to Answer the complaint as to MaxLinear Communications LLC answer now due 12/8/2023, re Answer to Complaint (Attorney Civil Case Opening),, Counterclaim, 94 filed by Defendants MaxLinear Communications LLC; MaxLinear, Inc.. (Attachments: # 1 Proposed Order)(Attorney Rose S Lee added to party MaxLinear Communications LLC(pty:cd), Attorney Rose S Lee added to party MaxLinear, Inc.(pty:cd))(Lee, Rose) (Entered: 10/30/2023)	Events since last full update

Patents

Number	Title	Issued	Class	Subclass
8,223,775	Architecture for a flexible and high-performance gateway cable modem	07/17/2012	370	401
8,284,690	Receiver determined probe	10/09/2012	370	252
8,792,008	Method and apparatus for spectrum monitoring	07/29/2014	348	192
9,210,362	Wideband tuner architecture	12/08/2015	1	1
9,825,826	Method and apparatus for spectrum monitoring	11/21/2017	1	1
10,135,682	Method and system for service group management in a cable network	11/20/2018	1	1
11,381,866	Cable television device	07/05/2022	1	1
11,399,206	Method for receiving a television signal	07/26/2022	1	1

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End of Document

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Job Number: 209366960

Document (1)

1. *2:22cv125, Entropic Communications, Llc V. Charter Communications, Inc. Et Al*

Client/Matter: -None-
Search Terms: number(2:22CV125)
Search Type: Natural Language
Narrowed by:

Content Type	Narrowed by
Dockets	Case Status: Open,Unknown,Closed

2:22cv125, Entropic Communications, Llc V. Charter Communications, Inc. Et Al

US District Court Docket

United States District Court, Texas Eastern

(Marshall)

This case was retrieved on 10/31/2023

Header

Case Number: 2:22cv125

Date Filed: 04/27/2022
Assigned To: District Judge Rodney Gilstrap
Nature of Suit: Patent (830)
Cause: Patent Infringement
Lead Docket: None
Other Docket: 2:22cv00050, 2:22cv00051, 2:22cv00052
Jurisdiction: Federal Question

Class Code: Open
Statute: 35:271
Jury Demand: Plaintiff
Demand Amount: $0
NOS Description: Patent

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Proceedings

#	Date	Proceeding Text	Source
1	04/27/2022	COMPLAINT against Charter Communications, Inc., Spectrum Advanced Services, LLC, Spectrum Management Holding Company, LLC (Filing fee $ 402 receipt number 0540-8892861.), filed by Entropic Communications, LLC. (Attachments: # 1 Civil Cover Sheet, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Exhibit F, # 8 Exhibit G, # 9 Exhibit H, # 10 Exhibit I, # 11 Exhibit J, # 12 Exhibit K, # 13 Exhibit L)(Hill, Jack) (Entered: 04/27/2022)	
2	04/27/2022	Notice of Filing of Patent/Trademark Form (AO 120). AO 120 mailed to the Director of the U.S. Patent and Trademark Office. (Hill, Jack) (Entered: 04/27/2022)	
3	04/27/2022	CORPORATE DISCLOSURE STATEMENT filed by Entropic Communications, LLC identifying Corporate Parent Entropic Holdings, LLC for Entropic Communications, LLC. (Hill, Jack) (Entered: 04/27/2022)	
4	04/27/2022	DEMAND for Trial by Jury by Entropic Communications, LLC. (Hill, Jack) (Entered: 04/27/2022)	
	04/27/2022	Case assigned to District Judge Rodney Gilstrap. (ch,) (Entered: 04/27/2022)	
	04/27/2022	In accordance with the provisions of 28 USC Section 636(c), you are hereby notified that a U.S. Magistrate Judge of this district court is available to conduct any or all proceedings in this case including a jury or non-jury trial and to order the entry of a final judgment. The form Consent to Proceed Before Magistrate Judge is available on our website. All signed consent forms, excluding pro se parties, should be filed electronically using the event Notice Regarding Consent to Proceed Before Magistrate Judge. (ch,) (Entered: 04/27/2022)	
5	04/27/2022	SUMMONS Issued as to Charter Communications, Inc., Spectrum Advanced Services, LLC, Spectrum Management Holding Company, LLC. (Attachments: # 1 Summons(es), # 2 Summons(es))(ch,) (Entered: 04/27/2022)	
6	05/09/2022	SUMMONS Returned Executed by Entropic Communications, LLC. Charter Communications, Inc. served on 5/3/2022, answer due 5/24/2022. (Hill, Jack) (Entered: 05/09/2022)	
7	05/09/2022	SUMMONS Returned Executed by Entropic Communications, LLC. Spectrum Advanced Services, LLC served on 5/3/2022.	

#	Date	Proceeding Text	Source
		answer due 5/24/2022. (Hill, Jack) (Entered: 05/09/2022)	
8	05/09/2022	SUMMONS Returned Executed by Entropic Communications, LLC. Spectrum Management Holding Company, LLC served on 5/3/2022, answer due 5/24/2022. (Hill, Jack) (Entered: 05/09/2022)	
9	05/18/2022	NOTICE of Attorney Appearance by Andrea Leigh Fair on behalf of Entropic Communications, LLC (Fair, Andrea) (Entered: 05/18/2022)	
10	05/23/2022	Defendant's Unopposed First Application for Extension of Time to Answer Complaint re Charter Communications, Inc., Spectrum Advanced Services, LLC, Spectrum Management Holding Company, LLC.(Dacus, Deron) (Entered: 05/23/2022)	
	05/23/2022	Defendant's Unopposed First Application for Extension of Time to Answer Complaint is granted pursuant to Local Rule CV-12 for Spectrum Management Holding Company, LLC to 6/23/2022; Spectrum Advanced Services, LLC to 6/23/2022; Charter Communications, Inc. to 6/23/2022. 30 Days Granted for Deadline Extension.(nkl,) (Entered: 05/23/2022)	
11	05/23/2022	Defendant's Unopposed Second Application for Extension of Time to Answer Complaint re Charter Communications, Inc., Spectrum Advanced Services, LLC, Spectrum Management Holding Company, LLC.(Dacus, Deron) (Entered: 05/23/2022)	
	05/23/2022	Defendant's Unopposed Second Application for Extension of Time to Answer Complaint is granted pursuant to Local Rule CV-12 for Spectrum Management Holding Company, LLC to 7/8/2022; Spectrum Advanced Services, LLC to 7/8/2022; Charter Communications, Inc. to 7/8/2022. 15 Days Granted for Deadline Extension.(nkl,) (Entered: 05/23/2022)	
12	05/24/2022	AMENDED COMPLAINT against Charter Communications, Inc., Spectrum Advanced Services, LLC, Spectrum Management Holding Company, LLC, filed by Entropic Communications, LLC. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D, # 5 Exhibit E, # 6 Exhibit F, # 7 Exhibit G, # 8 Exhibit H, # 9 Exhibit I, # 10 Exhibit J, # 11 Exhibit K, # 12 Exhibit L, # 13 Exhibit M, # 14 Exhibit N)(Hill, Jack Wesley) (Entered: 05/24/2022)	
13	06/14/2022	ORDER - Scheduling Conference set for 7/19/2022 10:00 AM before District Judge Rodney Gilstrap. Signed by District Judge Rodney Gilstrap on 6/14/2022. (ch,) (Entered: 06/15/2022)	
14	07/06/2022	NOTICE of Discovery Disclosure by Entropic Communications, LLC (P.R. 3-1 and P.R. 3-2 Disclosures) (Hill, Jack Wesley) (Entered: 07/06/2022)	
15	07/08/2022	NOTICE of Attorney Appearance - Pro Hac Vice by Palak Mayani Parikh on behalf of Charter Communications, Inc., Spectrum Advanced Services, LLC, Spectrum Management Holding Company, LLC. Filing fee $ 100, Receipt #ATXEDC-9010087. (nkl,) (Entered: 07/08/2022)	
16	07/08/2022	NOTICE of Attorney Appearance - Pro Hac Vice by Albert John Boardman on behalf of All Defendants. Filing fee $ 100, receipt number ATXEDC-9010246. (Boardman, Albert) (Entered: 07/08/2022)	
17	07/08/2022	NOTICE of Attorney Appearance - Pro Hac Vice by David S Benyacar on behalf of All Defendants. Filing fee $ 100, receipt number ATXEDC-9010286. (Benyacar, David) (Entered: 07/08/2022)	
18	07/08/2022	MOTION to Dismiss For Improper Venue Pursuant to FRCP 12(b)(3) by Charter Communications, Inc., Spectrum Advanced Services, LLC, Spectrum Management Holding Company, LLC. (Attachments: # 1 Declaration - Armstrong, # 2 Declaration -	

#	Date	Proceeding Text	Source
		Burdett, # 3 Declaration - Nelson, # 4 Declaration - Smith, # 5 Text of Proposed Order)(Dacus, Deron) (Entered: 07/08/2022)	
19	07/08/2022	CORPORATE DISCLOSURE STATEMENT filed by Charter Communications, Inc., Spectrum Advanced Services, LLC, Spectrum Management Holding Company, LLC (Dacus, Deron) (Entered: 07/08/2022)	
20	07/08/2022	NOTICE of Attorney Appearance - Pro Hac Vice by Daniel Reisner on behalf of All Defendants. Filing fee $ 100, receipt number ATXEDC-9010457. (Reisner, Daniel) (Entered: 07/08/2022)	
21	07/13/2022	NOTICE of Attorney Appearance - Pro Hac Vice by James A Shimota on behalf of Entropic Communications, LLC. Filing fee $ 100, receipt number ATXEDC-9017573. (Shimota, James) (Entered: 07/13/2022)	
22	07/13/2022	NOTICE of Attorney Appearance - Pro Hac Vice by Jason A Engel on behalf of Entropic Communications, LLC. Filing fee $ 100, receipt number ATXEDC-9017576. (Engel, Jason) (Entered: 07/13/2022)	
23	07/13/2022	NOTICE of Attorney Appearance by George C Summerfield on behalf of Entropic Communications, LLC (Summerfield, George) (Entered: 07/13/2022)	
	07/19/2022	Minute Entry for proceedings held before District Judge Rodney Gilstrap: Scheduling Conference held on 7/19/2022. Counsel for the parties appeared. Court asked whether they consented to trial before the U.S. Magistrate Judge. Court then gave counsel Claim Construction and Jury Selection/Trial dates. (Court Reporter Shawn McRoberts, RMR, CRR) (aeb) (Entered: 07/19/2022)	
24	07/22/2022	Joint MOTION for Extension of Time to File Response/Reply as to 18 MOTION to Dismiss For Improper Venue Pursuant to FRCP 12(b)(3) and for Limited Expedited Venue Discovery by Entropic Communications, LLC. (Attachments: # 1 Text of Proposed Order)(Hill, Jack Wesley) (Entered: 07/22/2022)	
25	07/25/2022	ORDER granting 24 Joint MOTION for Extension of Time to File Response/Reply as to 18 MOTION to Dismiss For Improper Venue Pursuant to FRCP 12(b)(3) and for Limited Expedited Venue Discovery ORDERED that the parties may conduct venue discovery subject to the agreements set forth in the Motion. (Dkt. No. 24 at 23.) It is ORDERED that the venue discoveryshall be completed by September 30, 2022 and the deadline for Entropics response to Charters Motionto Dismiss for Improper Venue (Dkt. No. 18) is extended until October 14, 2022. Signed by District Judge Rodney Gilstrap on 7/25/2022. (ch,) (Entered: 07/25/2022)	
26	08/02/2022	Unopposed MOTION for Extension of Time to File by Charter Communications, Inc., Spectrum Advanced Services, LLC, Spectrum Management Holding Company, LLC. (Attachments: # 1 Text of Proposed Order)(Dacus, Deron) (Entered: 08/02/2022)	
27	08/03/2022	ORDER granting 26 Unopposed MOTION for Extension of Time to File Docket Control Order. Signed by District Judge Rodney Gilstrap on 8/3/2022. (ch,) (Entered: 08/03/2022)	
28	08/05/2022	NOTICE of Attorney Appearance - Pro Hac Vice by Nicholas F. Lenning on behalf of Entropic Communications, LLC. Filing fee $ 100, receipt number ATXEDC-9055865. (Lenning, Nicholas) (Entered: 08/05/2022)	
29	08/05/2022	Agreed MOTION for Entry of Docket Control Order by Entropic Communications, LLC. (Attachments: # 1 Text of Proposed Order)(Hill, Jack Wesley) (Entered: 08/05/2022)	
30	08/05/2022	Agreed MOTION for Entry of Discovery Order by Entropic Communications, LLC. (Attachments: # 1 Text of Proposed Order)(Hill, Jack Wesley) (Entered: 08/05/2022)	

#	Date	Proceeding Text	Source
31	08/09/2022	Unopposed MOTION for Extension of Time to File by Charter Communications, Inc., Spectrum Advanced Services, LLC, Spectrum Management Holding Company, LLC. (Attachments: # 1 Text of Proposed Order)(Dacus, Deron) (Entered: 08/09/2022)	
32	08/09/2022	Agreed MOTION for Entry of Protective Order by Entropic Communications, LLC. (Attachments: # 1 Text of Proposed Order)(Hill, Jack Wesley) (Entered: 08/09/2022)	
33	08/10/2022	ORDER granting 31 Motion for Extension of Time to File Disclosures. Signed by District Judge Rodney Gilstrap on 8/10/2022. (ch,) (Entered: 08/10/2022)	
34	08/10/2022	DISCOVERY ORDER granting 30 Agreed MOTION for Entry of Discovery Order. Signed by District Judge Rodney Gilstrap on 8/10/2022. (ch,) (Entered: 08/10/2022)	
35	08/10/2022	DOCKET CONTROL ORDER granting 29 Agreed MOTION for Entry of Docket Control Order. Pretrial Conference set for 10/30/2023 09:00 AM before District Judge Rodney Gilstrap., Amended Pleadings due by 3/28/2023., Jury Selection set for 12/4/2023 09:00AM before District Judge Rodney Gilstrap., Markman Hearing set for 6/13/2023 09:00 AM before District Judge Rodney Gilstrap., Motions due by 10/10/2023., Proposed Pretrial Order due by 10/23/2023.). Signed by District Judge Rodney Gilstrap on 8/10/2022. (ch,) (Entered: 08/10/2022)	
36	08/10/2022	STIPULATED PROTECTIVE ORDER. Signed by District Judge Rodney Gilstrap on 8/10/2022. (ch,) (Entered: 08/10/2022)	
37	08/15/2022	NOTICE by Charter Communications, Inc., Spectrum Advanced Services, LLC, Spectrum Management Holding Company, LLC Notice of Compliance (Dacus, Deron) (Entered: 08/15/2022)	
38	08/18/2022	NOTICE of Discovery Disclosure by Entropic Communications, LLC (Initial Disclosures) (Hill, Jack Wesley) (Entered: 08/18/2022)	
39	08/30/2022	Agreed MOTION Agreed Motion for Entry of First Amended Docket Control Order re 35 Order,,, Terminate Motions,,, Scheduling Order,. by Charter Communications, Inc., Spectrum Advanced Services, LLC, Spectrum Management Holding Company, LLC. (Attachments: # 1 Text of Proposed Order)(Dacus, Deron) (Entered: 08/30/2022)	
40	08/31/2022	FIRST AMENDED DOCKET CONTROL ORDER granting 39 Agreed MOTION Agreed Motion for Entry of First Amended Docket Control Order re 35 Order. Signed by District Judge Rodney Gilstrap on 8/31/2022. (ch,) (Entered: 09/01/2022)	
41	09/08/2022	NOTICE by Charter Communications, Inc., Spectrum Advanced Services, LLC, Spectrum Management Holding Company, LLC Notice of Compliance (Dacus, Deron) (Entered: 09/08/2022)	
42	09/23/2022	Unopposed MOTION for Extension of Time to File Response/Reply as to 18 MOTION to Dismiss For Improper Venue Pursuant to FRCP 12(b)(3) by Entropic Communications, LLC. (Attachments: # 1 Text of Proposed Order)(Hill, Jack Wesley) (Entered: 09/23/2022)	
43	09/26/2022	ORDER granting 42 Unopposed MOTION for Extension of Time to File Response/Reply as to 18 MOTION to Dismiss For Improper Venue Pursuant to FRCP 12(b)(3) , 18 MOTION to Dismiss For Improper Venue Pursuant to FRCP 12(b)(3) Responses due by 11/11/2022. Signed by District Judge Rodney Gilstrap on 9/26/2022. (ch,) (Entered: 09/27/2022)	
44	09/27/2022	NOTICE of Attorney Appearance by Matthew Alexander Blair on behalf of Entropic Communications, LLC (Blair, Matthew) (Entered: 09/27/2022)	
45	09/28/2022	NOTICE of Attorney Appearance by Darlene Fae Ghavimi on behalf of All Plaintiffs (Ghavimi, Darlene) (Entered: 09/28/2022)	

#	Date	Proceeding Text	Source
46	10/25/2022	Unopposed MOTION for Extension of Time to File Response/Reply as to 18 MOTION to Dismiss For Improper Venue Pursuant to FRCP 12(b)(3) by Entropic Communications, LLC. (Attachments: # 1 Text of Proposed Order)(Hill, Jack Wesley) (Entered: 10/25/2022)	
47	10/31/2022	ORDER granting 46 Unopposed MOTION for Extension of Time to File Response/Reply as to 18 MOTION to Dismiss For Improper Venue Pursuant to FRCP 12(b)(3) . Signed by District Judge Rodney Gilstrap on 10/31/2022. (ch,) (Entered: 10/31/2022)	
48	12/02/2022	Unopposed MOTION for Extension of Time to File Response/Reply as to 18 MOTION to Dismiss For Improper Venue Pursuant to FRCP 12(b)(3) by Entropic Communications, LLC. (Attachments: # 1 Text of Proposed Order)(Hill, Jack Wesley) (Entered: 12/02/2022)	
49	12/08/2022	ORDER granting 48 Unopposed MOTION for Extension of Time to File Response/Reply as to 18 MOTION to Dismiss For Improper Venue Pursuant to FRCP 12(b)(3) , 18 MOTION to Dismiss For Improper Venue Pursuant to FRCP 12(b)(3) Responses due by 1/6/2023. Signed by District Judge Rodney Gilstrap on 12/8/2022. (ch,) (Entered: 12/08/2022)	
50	01/04/2023	NOTICE of Attorney Appearance by Elizabeth Anne Long on behalf of All Defendants (Long, Elizabeth) (Entered: 01/04/2023)	
51	01/04/2023	Unopposed MOTION for Extension of Time to File Response/Reply as to 18 MOTION to Dismiss For Improper Venue Pursuant to FRCP 12(b)(3) by Entropic Communications, LLC. (Attachments: # 1 Text of Proposed Order)(Hill, Jack Wesley) (Entered: 01/04/2023)	
52	01/05/2023	ORDER granting 51 Unopposed MOTION for Extension of Time to File Response/Reply as to 18 MOTION to Dismiss For Improper Venue Pursuant to FRCP 12(b)(3). Extended to 1/10/2023. Signed by District Judge Rodney Gilstrap on 1/5/2023. (ch,) (Entered: 01/05/2023)	
53	01/10/2023	AMENDED COMPLAINT (Second) against Charter Communications, Inc., filed by Entropic Communications, LLC. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D, # 5 Exhibit E, # 6 Exhibit F, # 7 Exhibit G, # 8 Exhibit H, # 9 Exhibit I, # 10 Exhibit J, # 11 Exhibit K, # 12 Exhibit L, # 13 Exhibit M, # 14 Exhibit N)(Hill, Jack Wesley) (Entered: 01/10/2023)	
54	01/10/2023	SEALED RESPONSE to Motion re 18 MOTION to Dismiss For Improper Venue Pursuant to FRCP 12(b)(3) filed by Entropic Communications, LLC. (Attachments: # 1 Declaration of M. Blair, # 2 Exhibit A to Blair Declaration, # 3 Exhibit B to Blair Declaration, # 4 Exhibit C to Blair Declaration, # 5 Exhibit D to Blair Declaration, # 6 Exhibit E to Blair Declaration, # 7 Exhibit F to Blair Declaration, # 8 Exhibit G to Blair Declaration, # 9 Exhibit H to Blair Declaration, # 10 Exhibit I to Blair Declaration, # 11 Exhibit J to Blair Declaration, # 12 Exhibit K to Blair Declaration, # 13 Exhibit L to Blair Declaration, # 14 Exhibit M to Blair Declaration, # 15 Exhibit N to Blair Declaration, # 16 Exhibit O to Blair Declaration, # 17 Exhibit P to Blair Declaration, # 18 Exhibit Q to Blair Declaration, # 19 Exhibit R to Blair Declaration, # 20 Exhibit S to Blair Declaration, # 21 Exhibit T to Blair Declaration, # 22 Exhibit U to Blair Declaration, # 23 Exhibit V to Blair Declaration, # 24 Exhibit W to Blair Declaration, # 25 Exhibit X to Blair Declaration, # 26 Exhibit Y to Blair Declaration, # 27 Text of Proposed Order proposed order)(Hill, Jack Wesley) (Entered: 01/10/2023)	
55	01/17/2023	REPLY to Response to Motion re 18 MOTION to Dismiss For	

#	Date	Proceeding Text	Source
		Improper Venue Pursuant to FRCP 12(b)(3) filed by Charter Communications, Inc., Spectrum Advanced Services, LLC, Spectrum Management Holding Company, LLC. (Long, Elizabeth) (Entered: 01/17/2023)	
56	01/18/2023	REDACTION to 54 Sealed Response to Motion,,, by Entropic Communications, LLC. (Attachments: # 1 Declaration of M. Blair, # 2 Exhibit A through E to Blair Declaration (Sealed in Entirety), # 3 Exhibit F to Blair Declaration, # 4 Exhibit G through H to Blair Declaration (Sealed in Entirety), # 5 Exhibit I to Blair Declaration, # 6 Exhibit J to Blair Declaration, # 7 Exhibit K to Blair Declaration, # 8 Exhibit L to Blair Declaration, # 9 Exhibit M to Blair Declaration, # 10 Exhibit N to Blair Declaration, # 11 Exhibit O to Blair Declaration, # 12 Exhibit P to Blair Declaration, # 13 Exhibit Q to Blair Declaration, # 14 Exhibit R to Blair Declaration, # 15 Exhibit S to Blair Declaration, # 16 Exhibit T to Blair Declaration, # 17 Exhibit U to Blair Declaration, # 18 Exhibit V to Blair Declaration, # 19 Exhibit W to Blair Declaration, # 20 Exhibit X to Blair Declaration, # 21 Exhibit Y to Blair Declaration (Sealed in Entirety), # 22 Text of Proposed Order proposed order)(Hill, Jack Wesley) (Entered: 01/18/2023)	
57	01/19/2023	NOTICE of Attorney Appearance - Pro Hac Vice by Melissa A. Brown on behalf of All Defendants. Filing fee $ 100, receipt number ATXEDC-9315923. (Brown, Melissa) (Entered: 01/19/2023)	
58	01/23/2023	Unopposed MOTION for Extension of Time to File Answer re 53 Amended Complaint, by Charter Communications, Inc.. (Attachments: # 1 Text of Proposed Order)(Dacus, Deron) (Entered: 01/23/2023)	
59	01/25/2023	ORDER granting 58 Unopposed MOTION for Extension of Time to File Answer re 53 Amended Complaint. Charter Communications, Inc. answer due 1/30/2023.. Signed by District Judge Rodney Gilstrap on 1/25/2023. (ch,) (Entered: 01/25/2023)	
60	01/27/2023	NOTICE of Attorney Appearance - Pro Hac Vice by Kenneth H. Bridges on behalf of Entropic Communications, LLC. Filing fee $ 100, receipt number ATXEDC-9330960. (Bridges, Kenneth) (Entered: 01/27/2023)	
61	01/30/2023	SEALED MOTION to Dismiss by Charter Communications, Inc.. (Attachments: # 1 Text of Proposed Order, # 2 Declaration, # 3 Exhibit 1, # 4 Exhibit 2, # 5 Exhibit 3, # 6 Exhibit 4, # 7 Exhibit 5, # 8 Exhibit 6, # 9 Exhibit 7, # 10 Exhibit 8, # 11 Exhibit 9, # 12 Exhibit 10, # 13 Exhibit 11, # 14 Exhibit 12)(Dacus, Deron) (Entered: 01/30/2023)	
62	02/06/2023	REDACTION to 61 SEALED MOTION to Dismiss by Charter Communications, Inc.. (Attachments: # 1 Text of Proposed Order, # 2 Declaration, # 3 Exhibit 1, # 4 Exhibit 2, # 5 Exhibit 3, # 6 Exhibit 4, # 7 Exhibit 5, # 8 Exhibit 6, # 9 Exhibit 7-12)(Dacus, Deron) (Entered: 02/06/2023)	
63	02/06/2023	STIPULATION of Dismissal by Charter Communications, Inc.. (Dacus, Deron) (Entered: 02/06/2023)	
64	02/06/2023	Unopposed MOTION Motion to Amend Case Caption re 63 Stipulation of Dismissal by Charter Communications, Inc.. (Attachments: # 1 Text of Proposed Order)(Dacus, Deron) (Entered: 02/06/2023)	
65	02/07/2023	ORDER re 63 Stipulation of Dismissal without prejudice as too Spectrum Advanced Services, LLC and Spectrum Management Holding Company, LLC. Signed by District Judge Rodney Gilstrap on 2/7/2023. (ch,) (Entered: 02/07/2023)	
66	02/08/2023	Unopposed MOTION for Extension of Time to File Response/Reply as to 61 SEALED MOTION to Dismiss by	

#	Date	Proceeding Text	Source
		Entropic Communications, LLC. (Attachments: # 1 Text of Proposed Order)(Fair, Andrea) (Entered: 02/08/2023)	
67	02/10/2023	ORDER granting 66 Unopposed MOTION for Extension of Time to File Response/Reply as to 61 SEALED MOTION to Dismiss . 61 SEALED MOTION to Dismiss Responses due by 2/20/2023. Signed by District Judge Rodney Gilstrap on 02/10/2023. (klc,) (Entered: 02/10/2023)	
68	02/21/2023	SEALED RESPONSE to Motion re 61 SEALED MOTION to Dismiss filed by Entropic Communications, LLC. (Attachments: # 1 Affidavit Declaration of M. Blair, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Exhibit F, # 8 Exhibit G, # 9 Exhibit H, # 10 Exhibit I, # 11 Exhibit J, # 12 Exhibit K, # 13 Exhibit L, # 14 Exhibit M, # 15 Exhibit N, # 16 Exhibit O, # 17 Exhibit P, # 18 Exhibit Q, # 19 Exhibit R, # 20 Exhibit S, # 21 Exhibit T, # 22 Exhibit U, # 23 Exhibit V, # 24 Exhibit W, # 25 Exhibit X, # 26 Exhibit Y, # 27 Exhibit Z, # 28 Exhibit AA, # 29 Exhibit AB, # 30 Exhibit AC, # 31 Text of Proposed Order)(Hill, Jack Wesley) (Entered: 02/21/2023)	
69	02/27/2023	Unopposed MOTION for Extension of Time to File by Charter Communications, Inc.. (Attachments: # 1 Text of Proposed Order)(Dacus, Deron) (Entered: 02/27/2023)	
70	02/28/2023	REDACTION to 68 Sealed Response to Motion,, by Entropic Communications, LLC. (Attachments: # 1 Affidavit Declaration of M. Blair, # 2 Exhibit A-E, # 3 Exhibit F, # 4 Exhibit G-H, # 5 Exhibit I, # 6 Exhibit J, # 7 Exhibit K, # 8 Exhibit L, # 9 Exhibit M, # 10 Exhibit N, # 11 Exhibit O, # 12 Exhibit P, # 13 Exhibit Q, # 14 Exhibit R, # 15 Exhibit S, # 16 Exhibit T, # 17 Exhibit U, # 18 Exhibit V, # 19 Exhibit W, # 20 Exhibit X, # 21 Exhibit Y-AB, # 22 Exhibit AC, # 23 Text of Proposed Order)(Hill, Jack Wesley) (Entered: 02/28/2023)	
71	02/28/2023	ORDER granting 69 Motion for Extension of Time to File Reply. Signed by District Judge Rodney Gilstrap on 2/28/2023. (ch,) (Entered: 02/28/2023)	
72	02/28/2023	Agreed MOTION to Amend/Correct 40 Order on Motion for Miscellaneous Relief by Entropic Communications, LLC. (Attachments: # 1 Text of Proposed Order)(Fair, Andrea) (Entered: 02/28/2023)	
73	03/02/2023	SECOND AMENDED DOCKET CONTROL ORDER granting 72 Agreed MOTION to Amend/Correct 40 Order on Motion for Miscellaneous Relief. Signed by District Judge Rodney Gilstrap on 3/2/2023. (ch,) (Entered: 03/02/2023)	
74	03/06/2023	Sealed Document. SUPPLEMENT re 68 SEALED RESPONSE to Motion re 61 SEALED MOTION to Dismiss filed by Entropic Communications, LLC. (Hill, Jack Wesley) (Entered: 03/06/2023)	
75	03/09/2023	SEALED REPLY to Response to Motion re 61 SEALED MOTION to Dismiss filed by Charter Communications, Inc.. (Attachments: # 1 Declaration, # 2 Exhibit 13, # 3 Exhibit 14)(Dacus, Deron) (Entered: 03/09/2023)	
76	03/13/2023	REDACTION to 74 Sealed Document by Entropic Communications, LLC. (Hill, Jack Wesley) (Entered: 03/13/2023)	
77	03/13/2023	Unopposed MOTION for Extension of Time to File Response/Reply as to 61 SEALED MOTION to Dismiss (to File Sur-Reply) by Entropic Communications, LLC. (Attachments: # 1 Text of Proposed Order)(Hill, Jack Wesley) (Entered: 03/13/2023)	
78	03/15/2023	ORDER granting 77 Unopposed MOTION for Extension of Time to File Response/Reply as to 61 SEALED MOTION to Dismiss (to File Sur-Reply), 61 SEALED MOTION to Dismiss Responses due by 3/23/2023. Signed by District Judge Rodney Gilstrap on 3/15/2023. (ch,) (Entered: 03/16/2023)	

#	Date	Proceeding Text	Source
79	03/16/2023	REDACTION to 75 Sealed Reply to Response to Motion re 61 Motion to Dismiss filed by Charter Communications, Inc.. (Attachments: # 1 Declaration, # 2 Exhibit 13, # 3 Exhibit 14)(Brown, Melissa) (Entered: 03/16/2023)	
80	03/23/2023	SEALED SUR-REPLY to Reply to Response to Motion re 61 SEALED MOTION to Dismiss filed by Entropic Communications, LLC. (Hill, Jack Wesley) (Entered: 03/23/2023)	
81	03/29/2023	NOTICE of Attorney Appearance - Pro Hac Vice by Katherine L. Allor on behalf of Entropic Communications, LLC. Filing fee $ 100, receipt number ATXEDC-9426592. (Allor, Katherine) (Entered: 03/29/2023)	
82	03/29/2023	NOTICE of Attorney Appearance - Pro Hac Vice by Peter E. Soskin on behalf of Entropic Communications, LLC. Filing fee $ 100, receipt number ATXEDC-9426688. (Soskin, Peter) (Entered: 03/29/2023)	
83	04/03/2023	REDACTION to 80 Sealed Sur-Reply to Reply to Response to Motion by Entropic Communications, LLC. (Hill, Jack Wesley) (Entered: 04/03/2023)	
84	04/04/2023	Sealed Document. Joint Claim Construction and Pre-Hearing Statement (P.R. 4-3) (Shimota, James) (Entered: 04/04/2023)	
85	04/05/2023	NOTICE by Charter Communications, Inc. of Service of Expert Witness Disclosures Pursuant to PR 4-3(b) (Dacus, Deron) (Entered: 04/05/2023)	
86	04/12/2023	NOTICE of Attorney Appearance - Pro Hac Vice by Samuel Patrick Richey on behalf of Entropic Communications, LLC. Filing fee $ 100, receipt number ATXEDC-9448177. (Richey, Samuel) (Entered: 04/12/2023)	
87	04/14/2023	***WITHDRAWN PER ORDER #94*** SEALED MOTION to Disqualify Cathleen Quigley by Entropic Communications, LLC. (Attachments: # 1 Declaration of James Shimota, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Text of Proposed Order)(Shimota, James) Modified on 5/9/2023 (ch,). (Entered: 04/14/2023)	
88	04/19/2023	Agreed MOTION to Amend/Correct Docket Control Order by Entropic Communications, LLC. (Attachments: # 1 Text of Proposed Order)(Fair, Andrea) (Entered: 04/19/2023)	
89	04/20/2023	AMENDED DOCKET CONTROL ORDER granting 88 Agreed MOTION to Amend/Correct Docket Control Order. Signed by District Judge Rodney Gilstrap on 4/20/2023. (ch,) (Entered: 04/21/2023)	
90	04/27/2023	Unopposed MOTION for Extension of Time to File Response/Reply as to 87 SEALED MOTION to Disqualify Cathleen Quigley by Charter Communications, Inc.. (Attachments: # 1 Text of Proposed Order)(Brown, Melissa) (Entered: 04/27/2023)	
92	05/05/2023	Unopposed MOTION to Withdraw 87 SEALED MOTION to Disqualify Cathleen Quigley by Entropic Communications, LLC. (Attachments: # 1 Text of Proposed Order)(Hill, Jack Wesley) (Entered: 05/05/2023)	
93	05/05/2023	ORDER granting 90 Unopposed MOTION for Extension of Time to File Response/Reply as to 87 SEALED MOTION to Disqualify Cathleen Quigley , 87 SEALED MOTION to Disqualify Cathleen Quigley Responses due by 5/5/2023. Signed by District Judge Rodney Gilstrap on 5/5/2023. (ch,) (Entered: 05/08/2023)	
94	05/08/2023	ORDER granting 92 Motion to Withdraw 87 SEALED MOTION to Disqualify >. Signed by District Judge Rodney Gilstrap on 5/8/2023. (ch,) (Entered: 05/09/2023)	
95	05/09/2023	NOTICE by Entropic Communications, LLC of Compliance	

#	Date	Proceeding Text	Source
		Regarding Technical Tutorial (Fair, Andrea) (Entered: 05/09/2023)	
96	05/09/2023	NOTICE of Attorney Appearance - Pro Hac Vice by Amy L DeWitt on behalf of Charter Communications, Inc.. Filing fee $ 100, receipt number ATXEDC-9490163. (DeWitt, Amy) (Entered: 05/09/2023)	
97	05/09/2023	PLAINTIFF'S OPENING CLAIM CONSTRUCTION BRIEF filed by Entropic Communications, LLC. (Attachments: # 1 Exhibit 1 - U.S. Patent No. 8,223,775, # 2 Exhibit 2 - U.S. Patent No. 8,792,008, # 3 Exhibit 3 - U.S. Patent No. 9,825,826, # 4 Exhibit 4 - U.S. Patent No. 8,284,690, # 5 Exhibit 5 - U.S. Patent No. 9,210,362, # 6 Exhibit 6 - U.S. Patent No. 10,135,682, # 7 Exhibit 7 - Rebuttal Declaration of Richard A. Kramer, # 8 Exhibit 8 - Declaration of Dr. Kevin Almeroth, # 9 Exhibit 9 - Almeroth Condensed Deposition Transcript, # 10 Exhibit 10 - IEEE Dictionary, # 11 Exhibit 11 - Email from A. Boardman)(Fair, Andrea) (Entered: 05/09/2023)	
98	05/10/2023	NOTICE by Charter Communications, Inc. - Joint Notice of Redaction of Docket 91 - (Attachments: # 1 Exhibit 1 - Redacted Order. dated May 3, 2023 to the docket in 22-cv-125 (ED Tex))(Brown, Melissa) (Entered: 05/10/2023)	
99	05/11/2023	Opposed MOTION TO CONSOLIDATE THIS ACTION WITH NO. 2:23-CV-00052-JRG AND TO AMEND THE CASE SCHEDULE by Charter Communications, Inc.. (Attachments: # 1 Ex 1 - Proposed Consolidated Order, # 2 Ex 2 - Claim Charts, # 3 Text of Proposed Order)(Reisner, Daniel) (Entered: 05/11/2023)	
100	05/11/2023	ORDER - Court hereby appoints David Keyzer as the Courts technical advisor. Signed by District Judge Rodney Gilstrap on 5/11/2023. (ch,) (Entered: 05/12/2023)	
101	05/17/2023	Sealed Document. Defendant's Answer to Second Amended Complaint (Dacus, Deron) (Entered: 05/17/2023)	
102	05/17/2023	NOTICE of Attorney Appearance - Pro Hac Vice by Courtney Neufeld on behalf of Entropic Communications, LLC. Filing fee $ 100, receipt number ATXEDC-9505527. (Neufeld, Courtney) (Entered: 05/17/2023)	
103	05/18/2023	NOTICE of Attorney Appearance - Pro Hac Vice by Connor James Meggs on behalf of Entropic Communications, LLC. Filing fee $ 100, receipt number ATXEDC-9506343. (Meggs, Connor) (Entered: 05/18/2023)	
104	05/23/2023	REPLY to 97 Claim Construction Brief,. filed by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration of Albert Boardman in Support of Charter's Responsive Claim Construction Brief, # 2 Exhibit 1, # 3 Exhibit 2, # 4 Exhibit 3, # 5 Exhibit 4, # 6 Exhibit 5)(Long, Elizabeth) (Entered: 05/23/2023)	
105	05/24/2023	REDACTION to 101 Sealed Document Answer by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 05/24/2023)	
106	05/25/2023	FILED IN ERROR PER ATTORNEY Unopposed MOTION for Extension of Time to File Response/Reply as to 99 Opposed MOTION TO CONSOLIDATE THIS ACTION WITH NO. 2:23-CV-00052-JRG AND TO AMEND THE CASE SCHEDULE by Entropic Communications, LLC. (Attachments: # 1 Proposed Order)(Hill, Jack Wesley) Modified on 5/25/2023 (nkl,). (Entered: 05/25/2023)	
	05/25/2023	***FILED IN ERROR PER ATTORNEY. Document # 106, Unopposed MOTION for Extension of Time to File Response/Reply. PLEASE IGNORE.*** (nkl,) (Entered: 05/25/2023)	
107	05/25/2023	NOTICE by Charter Communications, Inc. of its Designation of Daniel L. Reisner as Lead Counsel (Long, Elizabeth) (Entered: 05/25/2023)	

#	Date	Proceeding Text	Source
108	05/26/2023	Unopposed MOTION for Leave to Supplement Infringement Contentions by Entropic Communications, LLC. (Attachments: # 1 Proposed Order)(Fair, Andrea) (Entered: 05/26/2023)	
109	05/26/2023	Unopposed MOTION for Extension of Time to File Response/Reply as to 99 Opposed MOTION TO CONSOLIDATE THIS ACTION WITH NO. 2:23-CV-00052-JRG AND TO AMEND THE CASE SCHEDULE by Entropic Communications, LLC. (Attachments: # 1 Proposed Order)(Hill, Jack Wesley) (Entered: 05/26/2023)	
110	05/30/2023	PLAINTIFF'S REPLY CLAIM CONSTRUCTION BRIEF filed by Entropic Communications, LLC. (Attachments: # 1 Exhibit 12 - U.S. Patent Publication No. 2021/0337543, # 2 Exhibit 13 - Newtons Telecom Dictionary Excerpt, # 3 Exhibit 14 - Microsoft Computer Dictionary Excerpt, # 4 Exhibit 15 - Entropic's Technology Tutorial Slides)(Shimota, James) (Entered: 05/30/2023)	
111	05/31/2023	ORDER Before the Court is Plaintiff's Unopposed Motion for Leave to Supplement Infringement Contentions filed by Entropic Communications LLC. (Dkt. No. 109 .) In the Motion, Entropic requests leave to supplement its infringement contentions. (Id. at 1.) Entropic served its supplemental infringement contentions on March 10, 2023. (Id.) The Motion is unopposed. (Id. at 1, 3) Having considered the Motion, and noting its unopposed nature, the Court finds that it should be and hereby is GRANTED. Accordingly, the Court ORDERS that Entropic is granted leave to supplement its infringement contentions as requested. Signed by District Judge Rodney Gilstrap on 5/30/2023. (psm) (Entered: 05/31/2023)	
112	05/31/2023	ORDER Before the Court is the Unopposed Motion for Extension of Time to Respond to Charter's Motion to Consolidate filed by Plaintiff Entropic Communications, LLC. (Dkt. No. 109 .) In the Motion, Entropic requests an extension of time to file a response in opposition to Defendant Charter Communications, Inc.'s Motion to Consolidate and Amend the Case Schedule (Dkt. No. 99). (Id. at 1.) The requested extension would move the deadline for Entropic to file its opposition up to and including May 31, 2023. (Id.) The Motion is unopposed. (Id. at 1, 3.) Having considered the Motion, and noting its unopposed nature, the Court finds that it should be and hereby is GRANTED. Accordingly, the Court ORDERS that the deadline for Entropic to file a response to the Motion to Consolidate is extended up to and including May 31, 2023. Signed by District Judge Rodney Gilstrap on 5/30/2023. (psm) (Entered: 05/31/2023)	
113	05/31/2023	RESPONSE in Opposition re 99 Opposed MOTION TO CONSOLIDATE THIS ACTION WITH NO. 2:23-CV-00052-JRG AND TO AMEND THE CASE SCHEDULE filed by Entropic Communications, LLC. (Attachments: # 1 Proposed Order Proposed Order)(Hill, Jack Wesley) (Entered: 05/31/2023)	
114	06/02/2023	P.R. 4-5(d) Joint Claim Construction Chart by Charter Communications, Inc.. (Attachments: # 1 Exhibit A(Long, Elizabeth) (Entered: 06/02/2023)	
115	06/06/2023	Amended P.R. 4-5(d) Joint Claim Construction Chart by Charter Communications, Inc.. (Attachments: # 1 Exhibit A)(Long, Elizabeth) (Entered: 06/06/2023)	
116	06/08/2023	REPLY to Response to Motion re 99 Opposed MOTION TO CONSOLIDATE THIS ACTION WITH NO. 2:23-CV-00052-JRG AND TO AMEND THE CASE SCHEDULE filed by Charter Communications, Inc.. (Attachments: # 1 Declaration of Daniel Reisner)(Brown, Melissa) (Entered: 06/08/2023)	

#	Date	Proceeding Text	Source
117	06/12/2023	NOTICE by Entropic Communications, LLC re 97 Claim Construction Brief,, Corrected Exhibit 7 (ECF No. 97-7) (Attachments: # 1 Exhibit Corrected Exhibit 7)(Hill, Jack Wesley) (Entered: 06/12/2023)	
118	06/13/2023	Minute Entry for proceedings held before District Judge Rodney Gilstrap: Markman Hearing held on 6/13/2023. (from 09:02 AM to 12:49 PM) (Court Reporter Shelly Holmes) (Attachments: # 1 Attorney Attendance Sheet) (aeb) (Entered: 06/13/2023)	
119	06/15/2023	SUR-REPLY to Reply to Response to Motion re 99 Opposed MOTION TO CONSOLIDATE THIS ACTION WITH NO. 2:23-CV-00052-JRG AND TO AMEND THE CASE SCHEDULE filed by Entropic Communications, LLC. (Attachments: # 1 Exhibit A - Declaration of James Shimota)(Shimota, James) (Entered: 06/15/2023)	
120	06/21/2023	USCA FEDERAL CIRCUIT - ORDER filed directing Entropic Communications, LLC to respond to the petition no later than seven days from the date of filing of this order. Any reply in support of the petition is due no later than three days thereafter (23-136) (ch,) (Entered: 06/21/2023)	
121	06/22/2023	NOTICE of Attorney Appearance by Paul Isaac Margulies on behalf of Charter Communications, Inc. (Margulies, Paul) (Entered: 06/22/2023)	
122	06/23/2023	NOTICE of Attorney Appearance - Pro Hac Vice by Marc A Cohn on behalf of Charter Communications, Inc.. Filing fee $ 100, receipt number ATXEDC-9566636. (Cohn, Marc) (Entered: 06/23/2023)	
123	06/26/2023	CLAIM CONSTRUCTION MEMORANDUM OPINION AND ORDER. Signed by District Judge Rodney Gilstrap on 6/26/2023. (ch,) (Entered: 06/26/2023)	
124	06/27/2023	NOTICE of Attorney Appearance by Jacob Michael Bass on behalf of Charter Communications, Inc. (Bass, Jacob) (Entered: 06/27/2023)	
125	06/27/2023	NOTICE OF FILING OF OFFICIAL TRANSCRIPT of Proceedings held on 3/13/23 (Claim Construction Hearing) before Judge Rodney Gilstrap. Court Reporter/Transcriber: Shelly Holmes, CSR, TCRR,Telephone number: (903) 794-1018 (Shelly_Holmes@txed.uscourts.gov). NOTICE RE REDACTION OF TRANSCRIPTS: The parties have seven (7) days to file with the Court a Notice of Intent to Request Redaction of this transcript. If no such Notice is filed, the transcript will be made remotely electronically available to the public without redaction after 90 calendar days. The policy is located on our website at www.txed.uscourts.gov Transcript may be viewed at the court public terminal or purchased through the Court Reporter/Transcriber before the deadline for Release of Transcript Restriction. After that date it may be obtained through PACER.. Motion to Redact due 7/18/2023. Release of Transcript Restriction set for 9/25/2023. (Holmes, Shelly) (Entered: 06/27/2023)	
126	07/05/2023	NOTICE of Attorney Appearance - Pro Hac Vice by Ketajh Brown on behalf of Entropic Communications, LLC. Filing fee $ 100, receipt number ATXEDC-9583870. (Brown, Ketajh) (Entered: 07/05/2023)	
127	07/06/2023	NOTICE of Attorney Appearance - Pro Hac Vice by David Eric Shapland on behalf of Charter Communications, Inc.. Filing fee $ 100, receipt number ATXEDC-9585909. (Shapland, David) (Entered: 07/06/2023)	
128	07/10/2023	PAPER TRANSCRIPT REQUEST by Charter Communications, Inc. for proceedings held on 6-13-23- Claim Construction Hearing before Judge Gilstrap. (Dacus, Deron) (Main Document 128	

#	Date	Proceeding Text	Source
		replaced with flattened image on 7/10/2023) (ch,). (forwarded to Shelly Holmes) Modified on 7/10/2023 (ch,). (Entered: 07/10/2023)	
129	07/10/2023	ORDER - Court has received Mr. Keyzers invoice for services through June 27, 2023, court hereby ORDERS payment to be promptly made as follows. Signed by District Judge Rodney Gilstrap on 7/10/2023. (ch,) (Entered: 07/10/2023)	
130	07/11/2023	***WITHDRAWN PER #140**Unopposed SEALED MOTION to Compel Responses to Interrogatories 8, 16, 23, and 29 by Charter Communications, Inc.. (Attachments: # 1 Proposed Order)(Long, Elizabeth) Modified on 7/28/2023 (ch,). (Entered: 07/11/2023)	
131	07/12/2023	Joint MOTION for Leave to Supplement Contentions by Entropic Communications, LLC. (Attachments: # 1 Proposed Order)(Hill, Jack Wesley) (Entered: 07/12/2023)	
132	07/13/2023	ORDER granting 131 Joint MOTION for Leave to Supplement Contentions. Signed by District Judge Rodney Gilstrap on 7/13/2023. (ch,) (Entered: 07/14/2023)	
133	07/14/2023	NOTICE of Attorney Appearance - Pro Hac Vice by Christina N Goodrich on behalf of Entropic Communications, LLC. Filing fee $ 100, receipt number ATXEDC-9600975. (Goodrich, Christina) (Entered: 07/14/2023)	
134	07/18/2023	REDACTION to 130 Unopposed SEALED MOTION to Compel Responses to Interrogatories 8, 16, 23, and 29 by Charter Communications, Inc.. (Attachments: # 1 Proposed Order)(Brown, Melissa) (Entered: 07/18/2023)	
135	07/21/2023	SEALED MOTION for Leave to Supplement Infringement Contentions by Entropic Communications, LLC. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Proposed Order)(Shimota, James) (Entered: 07/21/2023)	
136	07/21/2023	Joint MOTION for Extension of Time to Complete Discovery (Joint Motion to Complete Limited Fact Discovery Out of Time) by Entropic Communications, LLC. (Attachments: # 1 Proposed Order)(Shimota, James) (Entered: 07/21/2023)	
137	07/24/2023	NOTICE of Attorney Appearance by Charles Everingham, IV on behalf of Entropic Communications, LLC (Everingham, Charles) (Entered: 07/24/2023)	
138	07/25/2023	ORDER granting 136 Joint MOTION for Extension of Time to Complete Discovery (Joint Motion to Complete Limited Fact Discovery Out of Time). Signed by District Judge Rodney Gilstrap on 7/25/2023. (ch,) (Entered: 07/25/2023)	
139	07/27/2023	Unopposed MOTION to Withdraw 130 Unopposed SEALED MOTION to Compel Responses to Interrogatories 8, 16, 23, and 29 by Charter Communications, Inc.. (Attachments: # 1 Proposed Order)(Long, Elizabeth) (Entered: 07/27/2023)	
140	07/28/2023	ORDER granting 139 Motion to Withdraw 130 Unopposed SEALED MOTION to Compel Responses to Interrogatories 8, 16, 23, and 29 . Signed by District Judge Rodney Gilstrap on 7/28/2023. (ch,) (Entered: 07/28/2023)	
141	07/28/2023	SEALED MOTION to Strike the Expert Report of David O. Taylor by Entropic Communications, LLC. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Proposed Order)(Shimota, James) (Entered: 07/28/2023)	
142	07/31/2023	REDACTION to 87 SEALED MOTION to Disqualify Cathleen Quigley by Entropic Communications, LLC. (Attachments: # 1 Declaration of James Shimota, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Proposed Order)(Shimota, James) (Entered: 07/31/2023)	
143	08/07/2023	SEALED RESPONSE to Motion re 135 SEALED MOTION for	

#	Date	Proceeding Text	Source
		Leave to Supplement Infringement Contentions filed by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration Declaration of Paul Margulies, # 2 Exhibit 1, # 3 Exhibit 2, # 4 Exhibit 3, # 5 Exhibit 4, # 6 Exhibit 5, # 7 Exhibit 6)(Margulies, Paul) (Entered: 08/07/2023)	
144	08/11/2023	SEALED RESPONSE to Motion re 141 SEALED MOTION to Strike the Expert Report of David O. Taylor filed by Charter Communications, Inc. (Long, Elizabeth) (Entered: 08/11/2023)	
145	08/14/2023	Joint MOTION for Leave to File Supplement Expert Reports by Charter Communications, Inc.. (Attachments: # 1 Proposed Order)(Long, Elizabeth) (Entered: 08/14/2023)	
146	08/14/2023	REDACTION to 143 Sealed Response to Motion, by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration of Paul Margulies, # 2 Exhibit 1-6)(Brown, Melissa) (Entered: 08/14/2023)	
147	08/14/2023	SEALED REPLY to Response to Motion re 135 SEALED MOTION for Leave to Supplement Infringement Contentions filed by Entropic Communications, LLC. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D)(Shimota, James) (Entered: 08/14/2023)	
148	08/15/2023	ORDER granting 145 Joint MOTION for Leave to File Supplement Expert Reports. Signed by District Judge Rodney Gilstrap on 8/15/2023. (ch,) (Entered: 08/16/2023)	
149	08/17/2023	REDACTION to 135 SEALED MOTION for Leave to Supplement Infringement Contentions by Entropic Communications, LLC. (Shimota, James) (Entered: 08/17/2023)	
150	08/18/2023	REDACTION to 144 Sealed Response to Motion DEFENDANT CHARTER COMMUNICATIONS, INC.'S OPPOSITION TO PLAINTIFFS MOTION TO STRIKE THE EXPERT REPORT OF DAVID O. TAYLOR by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 08/18/2023)	
151	08/18/2023	SEALED REPLY to Response to Motion re 141 SEALED MOTION to Strike the Expert Report of David O. Taylor filed by Entropic Communications, LLC. (Attachments: # 1 Affidavit/Declaration of Jim Shimota, # 2 Exhibit A)(Shimota, James) (Entered: 08/18/2023)	
152	08/22/2023	SEALED SUR-REPLY to Reply to Response to Motion re 135 SEALED MOTION for Leave to Supplement Infringement Contentions filed by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration of Paul Margulies, # 2 Exhibit 7, # 3 Exhibit 8, # 4 Exhibit 9)(Margulies, Paul) (Entered: 08/22/2023)	
153	08/23/2023	Agreed MOTION to Amend/Correct Docket Control Order by Entropic Communications, LLC. (Attachments: # 1 Text of Proposed Order)(Shimota, James) (Entered: 08/23/2023)	
154	08/25/2023	ORDER granting 153 Motion to Amend/Correct. Signed by District Judge Rodney Gilstrap on 8/24/23. (bga) (Entered: 08/25/2023)	
155	08/28/2023	SEALED RESPONSE by Charter Communications, Inc. to 151 Sealed Reply to Response to Motion filed by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 08/28/2023)	
156	08/29/2023	REDACTION to 152 Sealed Sur-Reply to Reply to Response to Motion, by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration of Paul Margulies, # 2 Exhibit 7, # 3 Exhibit 8, # 4 Exhibit 9)(Brown, Melissa) (Entered: 08/29/2023)	
157	08/29/2023	MEMORANDUM OPINION AND ORDER - denying 99 . Signed by District Judge Rodney Gilstrap on 8/29/2023. (ch,) (Entered: 08/30/2023)	
158	08/29/2023	MEMORANDUM OPINION AND ORDER - denying 135 Motion for Leave to Supplement Infringement Contentions. Signed by District	

#	Date	Proceeding Text	Source
		Judge Rodney Gilstrap on 8/29/2023. (ch,) (Entered: 08/30/2023)	
159	08/31/2023	Unopposed SEALED MOTION Motion for Leave to Take Third-Party Deposition of Vantiva USA LLC by Entropic Communications, LLC. (Attachments: # 1 Affidavit/Declaration of James Shimota In Support Of Motion for Leave, # 2 Exhibit A to Shimota Declaration, # 3 Exhibit B to Shimota Declaration, # 4 Exhibit C to Shimota Declaration, # 5 Exhibit D to Shimota Declaration, # 6 Exhibit E to Shimota Declaration, # 7 Proposed Order)(Shimota, James) (Entered: 08/31/2023)	
160	09/01/2023	ORDER granting 159 Sealed Motion. Signed by District Judge Rodney Gilstrap on 09/01/2023. (klc,) (Entered: 09/01/2023)	
161	09/05/2023	ORDER USCA FEDERAL CIRCUIT - filed denying 2 Petition for Writ of Mandamus filed by Charter Communications, Inc (23-136) (ch,) (Entered: 09/05/2023)	
162	09/05/2023	REDACTION to 155 Response to Non-Motion Defendant Charter Communications, Inc.'s Sur-Reply in Further Opposition to Plaintiff's Motion to Strike the Expert Report of David O. Taylor by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 09/05/2023)	
163	09/07/2023	NOTICE of Designation of Mediator. Gary McGowan, filed by Entropic Communications, LLC. (Hill, Jack Wesley) (Entered: 09/07/2023)	
164	09/07/2023	AGREED MOTION to Amend/Correct Docket Control Order by Charter Communications, Inc.. (Attachments: # 1 Proposed Order)(Long, Elizabeth) (Entered: 09/07/2023)	
165	09/10/2023	FIFTH AMENDED DOCKET CONTROL ORDER granting 164 AGREED MOTION to Amend/Correct Docket Control Order. Signed by District Judge Rodney Gilstrap on 9/10/2023. (ch,) (Entered: 09/11/2023)	
166	09/11/2023	SEALED MOTION CHARTER'S MOTION TO STRIKE DR. SOURI'S IMPROPER OPINIONS by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration Declaration of E. Long ISO Charter's Motion to Strike Dr. Souri's Improper Opinions, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Exhibit F, # 8 Proposed Order)(Long, Elizabeth) (Entered: 09/11/2023)	
167	09/11/2023	SEALED MOTION CHARTER'S MOTION TO STRIKE DR. KRAMER'S IMPROPER OPINIONS by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration Declaration of Elizabeth Long In Support of Charter's Motion to Strike Dr. Kramer's Improper Opinions, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Proposed Order)(Long, Elizabeth) (Entered: 09/11/2023)	
168	09/11/2023	MOTION to Strike Opinions of Steven Goldberg by Entropic Communications, LLC. (Attachments: # 1 Affidavit/Declaration of Jim Shimota, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Exhibit F, # 8 Proposed Order)(Shimota, James) (Entered: 09/11/2023)	
169	09/11/2023	SEALED MOTION CHARTER'S MOTION TO EXCLUDE THE EXPERT OPINIONS OF STEPHEN DELL by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration Declaration of Elizabeth Long In Support of Charter's Motion to Exclude The Expert Opinions of Stephen Dell, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Exhibit F, # 8 Exhibit G, # 9 Exhibit H, # 10 Exhibit I, # 11 Exhibit J, # 12 Exhibit K, # 13 Proposed Order)(Long, Elizabeth) (Entered: 09/11/2023)	
170	09/11/2023	MOTION for Summary Judgment Of No Invalidity Under 32 U.S.C. 102 & 103 by Entropic Communications, LLC. (Attachments: # 1	

#	Date	Proceeding Text	Source
		Affidavit/Declaration of Jim Shimota, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Proposed Order)(Shimota, James) (Entered: 09/11/2023)	
171	09/11/2023	SEALED MOTION CHARTER'S MOTION TO STRIKE ENTROPIC'S IMPROPER SECONDARY CONSIDERATIONS POSITIONS by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration Declaration of Elizabeth Long In Support of Charter's Motion to Strike Entropic's Improper Secondary Considerations Positions, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Exhibit F, # 8 Exhibit G, # 9 Exhibit H, # 10 Proposed Order)(Long, Elizabeth) (Entered: 09/11/2023)	
172	09/11/2023	SEALED MOTION (CHARTER'S MOTION FOR PARTIAL SUMMARY JUDGMENT OF NO PRE-SUIT DAMAGES) by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration of Elizabeth Long In Support of Charter's Motion for Partial Summary Judgment of No Pre-Suit Damage, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Exhibit F, # 8 Exhibit G, # 9 Exhibit H, # 10 Exhibit I, # 11 Exhibit J, # 12 Exhibit K, # 13 Exhibit L, # 14 Exhibit M, # 15 Exhibit N, # 16 Exhibit O, # 17 Exhibit P, # 18 Proposed Order)(Long, Elizabeth) (Entered: 09/11/2023)	
173	09/11/2023	SEALED MOTION (CHARTER'S MOTION FOR SUMMARY JUDGMENT OF INVALIDITY OF THE ASSERTED CLAIMS OF THE '362 PATENT) by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration of Elizabeth Long In Support of Charter's Motion for Partial Summary Judgment of No Pre-Suit Damage, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Exhibit F, # 8 Exhibit G, # 9 Exhibit H, # 10 Exhibit I, # 11 Exhibit J, # 12 Exhibit K, # 13 Proposed Order)(Long, Elizabeth) (Entered: 09/11/2023)	
174	09/11/2023	SEALED MOTION to Strike Opinions of Christopher Bakewell by Entropic Communications, LLC. (Attachments: # 1 Affidavit/Declaration of James Shimota, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Exhibit F, # 8 Exhibit G, # 9 Exhibit H, # 10 Exhibit I, # 11 Exhibit J, # 12 Exhibit K, # 13 Exhibit L, # 14 Exhibit M, # 15 Exhibit N, # 16 Exhibit O, # 17 Exhibit P, # 18 Exhibit Q, # 19 Exhibit R, # 20 Exhibit S, # 21 Exhibit T, # 22 Exhibit U, # 23 Exhibit V, # 24 Exhibit W, # 25 Exhibit X, # 26 Exhibit Y, # 27 Exhibit Z, # 28 Exhibit AA, # 29 Exhibit AB, # 30 Exhibit AC, # 31 Affidavit/Declaration of Darlene Ghavimi, # 32 Exhibit A - to Ghavimi Declaration)(Shimota, James) (Additional attachment(s) added on 9/12/2023: # 33 Proposed Order) (nkl,). (Entered: 09/11/2023)	
175	09/11/2023	SEALED MOTION to Strike Opinions of Dr. Kevin Almeroth by Entropic Communications, LLC. (Attachments: # 1 Affidavit/Declaration of James Shimota, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Exhibit F, # 8 Exhibit G, # 9 Exhibit H, # 10 Exhibit I, # 11 Exhibit J, # 12 Proposed Order)(Shimota, James) (Entered: 09/11/2023)	
176	09/11/2023	SEALED MOTION (CHARTER'S MOTION FOR SUMMARY JUDGMENT OF NON-INFRINGEMENT OF THE ASSERTED CLAIMS OF THE '682 AND '690 PATENTS) by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration OF ELIZABETH LONG IN SUPPORT OF CHARTER'S MOTION FOR SUMMARY JUDGMENT OF NON-INFRINGEMENT OF THE ASSERTED CLAIMS OF THE '682 AND '690 PATENTS, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Exhibit F, # 8 Exhibit G, # 9 Exhibit H, # 10 Exhibit I, # 11 Exhibit J, # 12 Exhibit K, # 13 Exhibit L, # 14 Exhibit M, # 15	

#	Date	Proceeding Text	Source
		Exhibit N, # 16 Exhibit O, # 17 Exhibit P, # 18 Exhibit Q, # 19 Exhibit R, # 20 Exhibit S, # 21 Exhibit T, # 22 Exhibit U, # 23 Exhibit V, # 24 Proposed Order)(Long, Elizabeth) (Entered: 09/11/2023)	
177	09/11/2023	SEALED MOTION for Summary Judgment of No License Defense Based on DOCSIS by Entropic Communications, LLC. (Attachments: # 1 Affidavit/Declaration of James Shimota, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Proposed Order)(Shimota, James) (Entered: 09/11/2023)	
178	09/12/2023	Filed in Error. Attorney to Refile MOTION for Summary Judgment for Summary Judgment of No License Defense Based on DOCSIS by Entropic Communications, LLC. (Attachments: # 1 Affidavit/Declaration of James Shimota, # 2 Exhibit A, # 3 Exhibit B, # 4 Proposed Order)(Shimota, James) Modified on 9/12/2023 (klc,). (Entered: 09/12/2023)	
179	09/12/2023	SEALED MOTION of Partial Summary Judgment That Devices With MaxLinear Chips are Not Non-Infringing Alternatives Affecting the Reasonable Royalty Rate by Entropic Communications, LLC. (Attachments: # 1 Affidavit/Declaration of James Shimota, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Exhibit F, # 8 Proposed Order)(Shimota, James) (Entered: 09/12/2023)	
180	09/12/2023	SEALED MOTION for Summary Judgment of No Unclean Hands Defense by Entropic Communications, LLC. (Attachments: # 1 Affidavit/Declaration of James Shimota, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Proposed Order)(Shimota, James) (Entered: 09/12/2023)	
181	09/12/2023	MOTION for Summary Judgment of Validity Under 35 U.S.C. 101 (CORRECTION OF ECF DOCUMENT TITLE) by Entropic Communications, LLC. (Attachments: # 1 Affidavit/Declaration of James Shimota, # 2 Exhibit A, # 3 Exhibit B, # 4 Proposed Order)(Shimota, James) (Entered: 09/12/2023)	
182	09/18/2023	AGREED MOTION to Amend/Correct 165 Order on Motion to Amend/Correct Docket Control Order by Entropic Communications, LLC. (Attachments: # 1 Proposed Order)(Shimota, James) (Entered: 09/18/2023)	
183	09/18/2023	REDACTION to 166 SEALED MOTION CHARTER'S MOTION TO STRIKE DR. SOURI'S IMPROPER OPINIONS by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit, # 4 Exhibit, # 5 Exhibit, # 6 Exhibit, # 7 Exhibit, # 8 Proposed Order)(Long, Elizabeth) (Entered: 09/18/2023)	
184	09/18/2023	REDACTION to 167 SEALED MOTION CHARTER'S MOTION TO STRIKE DR. KRAMER'S IMPROPER OPINIONS by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit, # 4 Exhibit, # 5 Exhibit, # 6 Proposed Order)(Long, Elizabeth) (Entered: 09/18/2023)	
185	09/18/2023	REDACTION to 169 SEALED MOTION CHARTER'S MOTION TO EXCLUDE THE EXPERT OPINIONS OF STEPHEN DELL by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit, # 4 Exhibit, # 5 Exhibit, # 6 Exhibit, # 7 Exhibit, # 8 Exhibit, # 9 Exhibit, # 10 Exhibit, # 11 Exhibit, # 12 Exhibit, # 13 Proposed Order)(Long, Elizabeth) (Entered: 09/18/2023)	
186	09/18/2023	REDACTION to 171 SEALED MOTION CHARTER'S MOTION TO STRIKE ENTROPIC'S IMPROPER SECONDARY CONSIDERATIONS POSITIONS by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit, # 4 Exhibit, # 5 Exhibit, # 6 Exhibit, # 7 Exhibit, # 8 Exhibit, # 9 Exhibit, # 10 Proposed Order)(Long, Elizabeth) (Entered:	

#	Date	Proceeding Text	Source
		09/18/2023)	
187	09/18/2023	REDACTION to 172 SEALED MOTION (CHARTER'S MOTION FOR PARTIAL SUMMARY JUDGMENT OF NO PRE-SUIT DAMAGES) by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit, # 4 Exhibit, # 5 Exhibit, # 6 Exhibit, # 7 Exhibit, # 8 Exhibit, # 9 Exhibit, # 10 Exhibit, # 11 Exhibit, # 12 Exhibit, # 13 Exhibit, # 14 Exhibit, # 15 Exhibit, # 16 Exhibit, # 17 Exhibit, # 18 Proposed Order)(Long, Elizabeth) (Entered: 09/18/2023)	
188	09/18/2023	REDACTION to 173 SEALED MOTION (CHARTER'S MOTION FOR SUMMARY JUDGMENT OF INVALIDITY OF THE ASSERTED CLAIMS OF THE '362 PATENT) by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit, # 4 Exhibit, # 5 Exhibit, # 6 Exhibit, # 7 Exhibit, # 8 Exhibit, # 9 Exhibit, # 10 Exhibit, # 11 Exhibit, # 12 Exhibit, # 13 Proposed Order)(Long, Elizabeth) (Entered: 09/18/2023)	
189	09/18/2023	REDACTION to 176 SEALED MOTION (CHARTER'S MOTION FOR SUMMARY JUDGMENT OF NON-INFRINGEMENT OF THE ASSERTED CLAIMS OF THE '682 AND '690 PATENTS) by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit, # 4 Exhibit, # 5 Exhibit, # 6 Exhibit, # 7 Exhibit, # 8 Exhibit, # 9 Exhibit, # 10 Errata, # 11 Exhibit, # 12 Exhibit, # 13 Exhibit, # 14 Exhibit, # 15 Exhibit, # 16 Exhibit, # 17 Exhibit, # 18 Exhibit, # 19 Exhibit, # 20 Exhibit, # 21 Exhibit, # 22 Exhibit, # 23 Exhibit, # 24 Proposed Order)(Long, Elizabeth) (Entered: 09/18/2023)	
190	09/20/2023	NOTICE of Attorney Appearance - Pro Hac Vice by Michael T Pieja on behalf of Entropic Communications, LLC. Filing fee $ 100, receipt number ATXEDC-9713369. (Pieja, Michael) (Entered: 09/20/2023)	
191	09/20/2023	NOTICE of Attorney Appearance - Pro Hac Vice by Alan E Littmann on behalf of Entropic Communications, LLC. Filing fee $ 100, receipt number ATXEDC-9713422. (Littmann, Alan) (Entered: 09/20/2023)	
192	09/20/2023	NOTICE of Attorney Appearance - Pro Hac Vice by Doug Winnard on behalf of Entropic Communications, LLC. Filing fee $ 100, receipt number ATXEDC-9713441. (Winnard, Doug) (Additional attachment(s) added on 9/20/2023: # 1 Sealed Attachment) (nkl,). (Entered: 09/20/2023)	
193	09/20/2023	NOTICE of Attorney Appearance - Pro Hac Vice by Shaun Zhang on behalf of Entropic Communications, LLC. Filing fee $ 100, receipt number ATXEDC-9713465. (Zhang, Shaun) (Entered: 09/20/2023)	
194	09/20/2023	NOTICE of Attorney Appearance - Pro Hac Vice by Jennifer M. Hartjes on behalf of Entropic Communications, LLC. Filing fee $ 100, receipt number ATXEDC-9713473. (Hartjes, Jennifer) (Entered: 09/20/2023)	
195	09/21/2023	ORDER granting 182 AGREED MOTION to Amend/Correct 165 Order on Motion to Amend/Correct Docket Control Order. Signed by District Judge Rodney Gilstrap on 9/21/2023. (ch,) (Entered: 09/21/2023)	
196	09/25/2023	SEALED RESPONSE to Motion re 167 SEALED MOTION CHARTER'S MOTION TO STRIKE DR. KRAMER'S IMPROPER OPINIONS filed by Entropic Communications, LLC. (Attachments: # 1 Declaration of James Shimota, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Exhibit F, # 8 Exhibit G, # 9 Proposed Order)(Shimota, James) (Entered: 09/25/2023)	
197	09/25/2023	RESPONSE in Opposition re 172 SEALED MOTION (CHARTER'S MOTION FOR PARTIAL SUMMARY JUDGMENT	

#	Date	Proceeding Text	Source
		OF NO PRE-SUIT DAMAGES) filed by Entropic Communications, LLC. (Attachments: # 1 Proposed Order)(Shimota, James) (Entered: 09/25/2023)	
198	09/25/2023	SEALED ADDITIONAL ATTACHMENTS to Main Document: 197 Response in Opposition to Motion. (Declaration of James Shimota in Support of Plaintiff's Opposition) (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D, # 5 Exhibit E, # 6 Exhibit F, # 7 Exhibit G)(Shimota, James) (Entered: 09/25/2023)	
199	09/25/2023	***FILED IN ERROR***Additional Attachments to Main Document: 197 Response in Opposition to Motion.. (Attachments: # 1 Exhibit H (Public))(Shimota, James) Modified on 9/25/2023 (ch,). (Entered: 09/25/2023)	
	09/25/2023	***FILED IN ERROR. FILED UNDER THE WRONG EVENT Document # 199, Additional attachments. PLEASE IGNORE.*** (ch,) (Entered: 09/25/2023)	
200	09/25/2023	REDACTION to 198 Sealed Additional Attachments to Main Document, by Entropic Communications, LLC. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D, # 5 Exhibit E, # 6 Exhibit F, # 7 Exhibit G, # 8 Exhibit H)(Shimota, James) (Entered: 09/25/2023)	
201	09/25/2023	SEALED RESPONSE to Motion re 171 SEALED MOTION CHARTER'S MOTION TO STRIKE ENTROPIC'S IMPROPER SECONDARY CONSIDERATIONS POSITIONS filed by Entropic Communications, LLC. (Attachments: # 1 Declaration of Nicholas Lenning, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Exhibit F, # 8 Exhibit G, # 9 Exhibit H, # 10 Exhibit I, # 11 Exhibit J, # 12 Exhibit K, # 13 Exhibit L, # 14 Exhibit M, # 15 Exhibit N, # 16 Proposed Order)(Shimota, James) (Entered: 09/25/2023)	
202	09/25/2023	SEALED RESPONSE to Motion re 180 SEALED MOTION for Summary Judgment of No Unclean Hands Defense filed by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration Declaration of Elizabeth Long, # 2 Exhibit D, # 3 Exhibit E, # 4 Exhibit F, # 5 Exhibit G, # 6 Exhibit H, # 7 Exhibit I, # 8 Exhibit J, # 9 Exhibit K, # 10 Exhibit L, # 11 Exhibit M, # 12 Exhibit N, # 13 Exhibit O, # 14 Exhibit P, # 15 Exhibit Q, # 16 Exhibit R, # 17 Proposed Order)(Reisner, Daniel) (Entered: 09/25/2023)	
203	09/25/2023	SEALED RESPONSE to Motion re 169 SEALED MOTION CHARTER'S MOTION TO EXCLUDE THE EXPERT OPINIONS OF STEPHEN DELL filed by Entropic Communications, LLC. (Attachments: # 1 Declaration of James Shimota, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Exhibit F, # 8 Exhibit G, # 9 Exhibit H, # 10 Exhibit I, # 11 Exhibit J, # 12 Exhibit K, # 13 Exhibit L, # 14 Exhibit M, # 15 Exhibit N, # 16 Proposed Order)(Shimota, James) (Entered: 09/25/2023)	
204	09/25/2023	***FILED IN ERROR***SEALED RESPONSE to Motion re 181 MOTION for Summary Judgment of Validity Under 35 U.S.C. 101 (CORRECTION OF ECF DOCUMENT TITLE) filed by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration of Elizabeth Long, # 2 Exhibit E, # 3 Proposed Order)(Reisner, Daniel) Modified on 9/26/2023 (ch,). (Entered: 09/25/2023)	
205	09/25/2023	SEALED RESPONSE to Motion re 166 SEALED MOTION CHARTER'S MOTION TO STRIKE DR. SOURI'S IMPROPER OPINIONS filed by Entropic Communications, LLC. (Attachments: # 1 Declaration of James Shimota, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Exhibit F, # 8 Exhibit G, # 9 Exhibit H, # 10 Exhibit I, # 11 Exhibit J, # 12 Exhibit K, # 13 Exhibit L, # 14 Exhibit M, # 15 Exhibit N, # 16 Exhibit O, # 17	

#	Date	Proceeding Text	Source
		Proposed Order)(Shimota, James) (Entered: 09/25/2023)	
206	09/25/2023	SEALED RESPONSE to Motion re 170 MOTION for Summary Judgment Of No Invalidity Under 32 U.S.C. 102 & 103 filed by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration of Elizabeth Long, # 2 Exhibit E, # 3 Proposed Order)(Reisner, Daniel) (Entered: 09/25/2023)	
207	09/25/2023	RESPONSE in Opposition re 173 SEALED MOTION (CHARTER'S MOTION FOR SUMMARY JUDGMENT OF INVALIDITY OF THE ASSERTED CLAIMS OF THE '362 PATENT) filed by Entropic Communications, LLC. (Attachments: # 1 Proposed Order)(Shimota, James) (Entered: 09/25/2023)	
208	09/25/2023	SEALED ADDITIONAL ATTACHMENTS to Main Document: 207 Response in Opposition to Motion, (Declaration of James Shimota in Support of Plaintiff's Opposition). (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D)(Shimota, James) (Entered: 09/25/2023)	
209	09/25/2023	RESPONSE to Motion re 181 MOTION for Summary Judgment of Validity Under 35 U.S.C. 101 (CORRECTION OF ECF DOCUMENT TITLE), 178 MOTION for Summary Judgment for Summary Judgment of No License Defense Based on DOCSIS filed by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration of Elizabeth Long, # 2 Exhibit C, # 3 Exhibit D, # 4 Exhibit E, # 5 Exhibit F, # 6 Exhibit G, # 7 Exhibit H, # 8 Exhibit I, # 9 Exhibit J, # 10 Proposed Order)(Reisner, Daniel) (Entered: 09/25/2023)	
210	09/25/2023	SEALED RESPONSE to Motion re 176 SEALED MOTION (CHARTER'S MOTION FOR SUMMARY JUDGMENT OF NON-INFRINGEMENT OF THE ASSERTED CLAIMS OF THE '682 AND '690 PATENTS) filed by Entropic Communications, LLC. (Attachments: # 1 Declaration of James Shimota, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Exhibit F, # 8 Exhibit G, # 9 Proposed Order)(Shimota, James) (Entered: 09/25/2023)	
211	09/25/2023	SEALED RESPONSE to Motion re 179 SEALED MOTION of Partial Summary Judgment That Devices With MaxLinear Chips are Not Non-Infringing Alternatives Affecting the Reasonable Royalty Rate filed by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration of Elizabeth Long, # 2 Exhibit G, # 3 Exhibit H, # 4 Exhibit I, # 5 Exhibit J, # 6 Errata K, # 7 Exhibit L, # 8 Exhibit M, # 9 Exhibit N, # 10 Proposed Order)(Reisner, Daniel) (Entered: 09/25/2023)	
212	09/25/2023	SEALED RESPONSE to Motion re 174 SEALED MOTION to Strike Opinions of Christopher Bakewell filed by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration of Elizabeth Long, # 2 Exhibit AD, # 3 Exhibit AE, # 4 Exhibit AF, # 5 Exhibit AG, # 6 Exhibit AH, # 7 Exhibit AI, # 8 Exhibit AJ, # 9 Exhibit AK, # 10 Exhibit AL, # 11 Exhibit AM, # 12 Exhibit AN, # 13 Exhibit AO, # 14 Exhibit AP, # 15 Exhibit AQ, # 16 Exhibit AR, # 17 Exhibit AS, # 18 Exhibit AT, # 19 Exhibit AU, # 20 Exhibit AV, # 21 Proposed Order)(Reisner, Daniel) (Entered: 09/25/2023)	
213	09/25/2023	SEALED RESPONSE to Motion re 175 SEALED MOTION to Strike Opinions of Dr. Kevin Almeroth filed by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration of Elizabeth Long, # 2 Exhibit K, # 3 Exhibit L, # 4 Exhibit M, # 5 Exhibit N, # 6 Exhibit O, # 7 Exhibit P, # 8 Exhibit Q, # 9 Exhibit R, # 10 Exhibit S, # 11 Exhibit T, # 12 Proposed Order)(Reisner, Daniel) (Entered: 09/25/2023)	
214	09/25/2023	SEALED RESPONSE to Motion re 168 MOTION to Strike Opinions of Steven Goldberg filed by Charter Communications,	

#	Date	Proceeding Text	Source
		Inc.. (Attachments: # 1 Affidavit/Declaration of Elizabeth Long, # 2 Exhibit G, # 3 Exhibit H, # 4 Exhibit I, # 5 Exhibit J, # 6 Exhibit K, # 7 Exhibit L, # 8 Proposed Order)(Reisner, Daniel) (Entered: 09/25/2023)	
215	09/25/2023	SEALED RESPONSE to Motion re 177 SEALED MOTION for Summary Judgment of No License Defense Based on DOCSIS filed by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration of Elizabeth Long, # 2 Exhibit E, # 3 Exhibit F, # 4 Exhibit G, # 5 Exhibit H, # 6 Exhibit I, # 7 Exhibit J, # 8 Exhibit K, # 9 Exhibit L, # 10 Exhibit M, # 11 Exhibit N, # 12 Exhibit O, # 13 Exhibit P, # 14 Exhibit Q, # 15 Exhibit R, # 16 Exhibit S, # 17 Exhibit T, # 18 Exhibit U, # 19 Exhibit V, # 20 Exhibit W, # 21 Exhibit X, # 22 Proposed Order)(Reisner, Daniel) (Entered: 09/25/2023)	
	09/26/2023	***FILED IN ERROR. PER ATTORNEY Document # 204, Sealed Response. PLEASE IGNORE.*** (ch,) (Entered: 09/26/2023)	
216	09/26/2023	OPPOSED MOTION to Amend/Correct Docket Control Order by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit, # 4 Proposed Order)(Long, Elizabeth) (Entered: 09/26/2023)	
217	10/02/2023	SEALED REPLY to Response to Motion re 167 SEALED MOTION CHARTER'S MOTION TO STRIKE DR. KRAMER'S IMPROPER OPINIONS filed by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 10/02/2023)	
218	10/02/2023	SEALED REPLY to Response to Motion re 172 SEALED MOTION (CHARTER'S MOTION FOR PARTIAL SUMMARY JUDGMENT OF NO PRE-SUIT DAMAGES) filed by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration OF ELIZABETH LONG IN SUPPORT OF CHARTER'S REPLY BRIEF IN SUPPORT OF ITS MOTION FOR PARTIAL SUMMARY JUDGMENT OF NO PRE-SUIT DAMAGES, # 2 Exhibit - Q PRESUIT DAMAGES SJ)(Long, Elizabeth) (Entered: 10/02/2023)	
219	10/02/2023	REDACTION to 202 Sealed Response to Motion,, re 180 SEALED MOTION for Summary Judgment of No Unclean Hands Defense by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit, # 4 Exhibit, # 5 Exhibit, # 6 Exhibit, # 7 Exhibit, # 8 Exhibit, # 9 Exhibit, # 10 Exhibit, # 11 Exhibit, # 12 Exhibit, # 13 Exhibit, # 14 Exhibit, # 15 Exhibit, # 16 Exhibit, # 17 Proposed Order)(Long, Elizabeth) (Entered: 10/02/2023)	
220	10/02/2023	REDACTION to 206 Sealed Response to Motion, re 170 MOTION for Summary Judgment Of No Invalidity Under 35 U.S.C. 102 & 10 by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Proposed Order)(Long, Elizabeth) (Entered: 10/02/2023)	
221	10/02/2023	REDACTION to 211 Sealed Response to Motion, re 179 SEALED MOTION of Partial Summary Judgment That Devices With MaxLinear Chips are Not Non-Infringing Alternatives Affecting the Reasonable Royalty Rate f by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit, # 4 Exhibit, # 5 Exhibit, # 6 Exhibit, # 7 Exhibit, # 8 Exhibit, # 9 Exhibit, # 10 Proposed Order)(Long, Elizabeth) (Entered: 10/02/2023)	
222	10/02/2023	REDACTION to 212 Sealed Response to Motion,, re 174 SEALED MOTION to Strike Opinions of Christopher Bakewell by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit, # 4 Exhibit, # 5 Exhibit, # 6 Exhibit, # 7 Exhibit, # 8 Exhibit, # 9 Exhibit, # 10 Exhibit, # 11 Exhibit, # 12 Exhibit, # 13 Exhibit, # 14 Exhibit, # 15 Exhibit, # 16 Exhibit, # 17 Exhibit, # 18 Exhibit, # 19 Exhibit, # 20 Exhibit, # 21 Proposed Order)(Long,	

#	Date	Proceeding Text	Source
		Elizabeth) (Entered: 10/02/2023)	
223	10/02/2023	REDACTION to 214 Sealed Response to Motion, re 168 MOTION to Strike Opinions of Steven Goldberg by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit, # 4 Exhibit, # 5 Exhibit, # 6 Exhibit, # 7 Exhibit, # 8 Proposed Order)(Long, Elizabeth) (Entered: 10/02/2023)	
224	10/02/2023	REDACTION to 215 Sealed Response to Motion,, re 177 SEALED MOTION for Summary Judgment of No License Defense Based on DOCSIS by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit, # 4 Exhibit, # 5 Exhibit, # 6 Exhibit, # 7 Exhibit, # 8 Exhibit, # 9 Exhibit, # 10 Exhibit, # 11 Exhibit, # 12 Exhibit, # 13 Exhibit, # 14 Exhibit, # 15 Exhibit, # 16 Exhibit, # 17 Exhibit, # 18 Exhibit, # 19 Exhibit, # 20 Exhibit, # 21 Exhibit, # 22 Proposed Order)(Long, Elizabeth) (Entered: 10/02/2023)	
225	10/02/2023	REDACTION to 213 Sealed Response to Motion, re 175 SEALED MOTION to Strike Opinions of Dr. Kevin Almeroth by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit, # 4 Exhibit, # 5 Exhibit, # 6 Exhibit, # 7 Exhibit, # 8 Exhibit, # 9 Exhibit, # 10 Exhibit, # 11 Exhibit, # 12 Proposed Order)(Long, Elizabeth) (Entered: 10/02/2023)	
226	10/03/2023	***FILED IN ERROR***RESPONSE in Support re 173 SEALED MOTION (CHARTER'S MOTION FOR SUMMARY JUDGMENT OF INVALIDITY OF THE ASSERTED CLAIMS OF THE '362 PATENT) filed by Charter Communications, Inc.. (Long, Elizabeth) Modified on 10/3/2023 (ch,). (Entered: 10/03/2023)	
	10/03/2023	***FILED IN ERROR. FILED UNDER THE WRONG EVENT Document # 226, Response. PLEASE IGNORE.*** (ch,) (Entered: 10/03/2023)	
227	10/03/2023	***FILED IN ERROR***RESPONSE to Motion re 173 SEALED MOTION (CHARTER'S MOTION FOR SUMMARY JUDGMENT OF INVALIDITY OF THE ASSERTED CLAIMS OF THE '362 PATENT) CHARTER'S REPLY IN FURTHER SUPPORT OF ITS MOTION FOR SUMMARY JUDGMENT OF INVALIDITY OF THE ASSERTED CLAIMS OF THE '362 PATENT filed by Charter Communications, Inc.. (Long, Elizabeth) Modified on 10/3/2023 (ch,). (Entered: 10/03/2023)	
	10/03/2023	***FILED IN ERROR. PLEASE FILE YOUR REPLY UNDER CORRECT EVENT Document # 227, Response to Motion. PLEASE IGNORE.*** (ch,) (Entered: 10/03/2023)	
228	10/03/2023	REPLY to Response to Motion re 173 SEALED MOTION (CHARTER'S MOTION FOR SUMMARY JUDGMENT OF INVALIDITY OF THE ASSERTED CLAIMS OF THE '362 PATENT) CHARTER'S REPLY IN FURTHER SUPPORT OF ITS MOTION FOR SUMMARY JUDGMENT OF INVALIDITY OF THE ASSERTED CLAIMS OF THE '362 PATENT filed by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 10/03/2023)	
229	10/03/2023	***DEFICIENT DOCUMENT***SEALED ADDITIONAL ATTACHMENTS to Main Document: 228 Reply to Response to Motion,. DECLARATION OF ELIZABETH LONG IN SUPPORT OF CHARTER'S REPLY IN SUPPORT OF ITS MOTION FOR SUMMARY JUDGMENT OF INVALIDITY OF THE ASSERTED CLAIMS OF THE '362 PATENT (Attachments: # 1 Exhibit L, # 2 Exhibit M)(Long, Elizabeth) Modified on 10/3/2023 (ch,). (Entered: 10/03/2023)	
230	10/03/2023	SEALED REPLY to Response to Motion re 176 SEALED MOTION (CHARTER'S MOTION FOR SUMMARY JUDGMENT OF NON-INFRINGEMENT OF THE ASSERTED CLAIMS OF THE '682 AND '690 PATENTS) filed by Charter Communications, Inc..	

#	Date	Proceeding Text	Source
		(Long, Elizabeth) (Entered: 10/03/2023)	
	10/03/2023	NOTICE of Deficiency regarding the 229 submitted Needs Certificate of Authorization to file under seal and Certifiicate of Service. Correction should be made by one business day (ch,) (Entered: 10/03/2023)	
231	10/03/2023	Additional Attachments to Main Document: 230 Sealed Reply to Response to Motion,.. (Attachments: # 1 Exhibit W, # 2 Exhibit X)(Long, Elizabeth) (Entered: 10/03/2023)	
232	10/03/2023	SEALED ADDITIONAL ATTACHMENTS to Main Document: 228 Reply to Response to Motion,. DECLARATION OF ELIZABETH LONG IN SUPPORT OF CHARTER'S REPLY IN SUPPORT OF ITS MOTION FOR SUMMARY JUDGMENT OF INVALIDITY OF THE ASSERTED CLAIMS OF THE '362 PATENT (Attachments: # 1 Exhibit L, # 2 Exhibit M)(Long, Elizabeth) (Entered: 10/03/2023)	
233	10/03/2023	SEALED REPLY to Response to Motion re 166 SEALED MOTION CHARTER'S MOTION TO STRIKE DR. SOURI'S IMPROPER OPINIONS filed by Charter Communications, Inc..CHARTER'S REPLY BRIEF IN SUPPORT OF ITS MOTION TO STRIKEDR. SOURI'S IMPROPER OPINIONS (Long, Elizabeth) (Entered: 10/03/2023)	
234	10/03/2023	SEALED REPLY to Response to Motion re 171 SEALED MOTION CHARTER'S MOTION TO STRIKE ENTROPIC'S IMPROPER SECONDARY CONSIDERATIONS POSITIONS filed by Charter Communications, Inc.. (Attachments: # 1 DECLARATION OF ELIZABETH LONG IN SUPPORT OF CHARTER'S MOTION TO STRIKE ENTROPICS IMPROPER SECONDARY CONSIDERATIONS POSITIONS(Long, Elizabeth) (Entered: 10/03/2023)	
235	10/03/2023	REPLY to Response to Motion re 168 MOTION to Strike Opinions of Steven Goldberg filed by Entropic Communications, LLC. (Shimota, James) (Entered: 10/03/2023)	
236	10/03/2023	REPLY to Response to Motion re 170 MOTION for Summary Judgment Of No Invalidity Under 32 U.S.C. 102 & 103 filed by Entropic Communications, LLC. (Shimota, James) (Entered: 10/03/2023)	
237	10/03/2023	SEALED REPLY to Response to Motion re 177 SEALED MOTION for Summary Judgment of No License Defense Based on DOCSIS filed by Entropic Communications, LLC. (Attachments: # 1 Declaration of James Shimota, # 2 Exhibit E)(Shimota, James) (Entered: 10/03/2023)	
238	10/03/2023	SEALED REPLY to Response to Motion re 180 SEALED MOTION for Summary Judgment of No Unclean Hands Defense filed by Entropic Communications, LLC. (Shimota, James) (Entered: 10/03/2023)	
239	10/03/2023	SEALED REPLY to Response to Motion re 169 SEALED MOTION CHARTER'S MOTION TO EXCLUDE THE EXPERT OPINIONS OF STEPHEN DELL filed by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration OF ELIZABETH LONG IN SUPPORT OF CHARTER'S REPLY IN SUPPORT OF ITS MOTION TO EXCLUDE THE OPINIONS OF STEPHEN DELL, # 2 Exhibit L, # 3 Exhibit M)(Long, Elizabeth) (Entered: 10/03/2023)	
240	10/03/2023	SEALED REPLY to Response to Motion re 174 SEALED MOTION to Strike Opinions of Christopher Bakewell filed by Entropic Communications, LLC. (Shimota, James) (Entered: 10/03/2023)	
241	10/03/2023	SEALED REPLY to Response to Motion re 175 SEALED MOTION to Strike Opinions of Dr. Kevin Almeroth filed by Entropic Communications, LLC. (Attachments: # 1 Declaration of James Shimota, # 2 Exhibit K)(Shimota, James) (Entered: 10/03/2023)	

#	Date	Proceeding Text	Source
242	10/03/2023	SEALED REPLY to Response to Motion re 179 SEALED MOTION of Partial Summary Judgment That Devices With MaxLinear Chips are Not Non-Infringing Alternatives Affecting the Reasonable Royalty Rate filed by Entropic Communications, LLC. (Shimota, James) (Entered: 10/03/2023)	
243	10/03/2023	REPLY to Response to Motion re 181 MOTION for Summary Judgment of Validity Under 35 U.S.C. 101 (CORRECTION OF ECF DOCUMENT TITLE) filed by Entropic Communications, LLC. (Attachments: # 1 Declaration of James Shimota, # 2 Exhibit C)(Shimota, James) (Entered: 10/03/2023)	
244	10/03/2023	OPPOSED SEALED MOTION for Leave to File Out of Time Plaintiff's Motion to Compel Testimony and Documents Improperly Withheld as Privileged by Entropic Communications, LLC. (Attachments: # 1 Declaration of Nicholas Lenning, # 2 Lenning Declaration, Ex. A, # 3 Lenning Declaration, Ex. B, # 4 Lenning Declaration, Ex. C, # 5 Lenning Declaration, Ex. D, # 6 Lenning Declaration, Ex. E, # 7 Lenning Declaration, Ex. F, # 8 Lenning Declaration, Ex. G, # 9 Lenning Declaration, Ex. H, # 10 Lenning Declaration, Ex. I, # 11 Lenning Declaration, Ex. J, # 12 Lenning Declaration, Ex. K, # 13 Declaration of Peter Soskin, # 14 Soskin Declaration, Ex. A, # 15 Soskin Declaration, Ex. B, # 16 Soskin Declaration, Ex. C, # 17 Proposed Order)(Shimota, James) (Entered: 10/03/2023)	
245	10/03/2023	OPPOSED SEALED MOTION to Compel Testimony and Documents Improperly Withheld as Privileged by Entropic Communications, LLC. (Attachments: # 1 Declaration of Nicholas Lenning, # 2 Lenning Declaration, Ex. A, # 3 Lenning Declaration, Ex. B, # 4 Lenning Declaration, Ex. C, # 5 Lenning Declaration, Ex. D, # 6 Lenning Declaration, Ex. E, # 7 Lenning Declaration, Ex. F, # 8 Lenning Declaration, Ex. G, # 9 Lenning Declaration, Ex. H, # 10 Lenning Declaration, Ex. I, # 11 Lenning Declaration, Ex. J, # 12 Lenning Declaration, Ex. K, # 13 Lenning Declaration, Ex. L, # 14 Lenning Declaration, Ex. M, # 15 Lenning Declaration, Ex. N, # 16 Lenning Declaration, Ex. O, # 17 Declaration of Peter Soskin, # 18 Soskin Declaration, Ex. A, # 19 Soskin Declaration, Ex. B, # 20 Soskin Declaration, Ex. C, # 21 Proposed Order)(Shimota, James) (Entered: 10/03/2023)	
246	10/10/2023	SUR-REPLY to Reply to Response to Motion re 172 SEALED MOTION (CHARTER'S MOTION FOR PARTIAL SUMMARY JUDGMENT OF NO PRE-SUIT DAMAGES) filed by Entropic Communications, LLC. (Shimota, James) (Entered: 10/10/2023)	
247	10/10/2023	REDACTION to 217 Sealed Reply to Response to Motion to Strike Dr. Kramer's Improper Opinions by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 10/10/2023)	
248	10/10/2023	REDACTION to 218 Sealed Reply to Response to Motion, FOR PARTIAL SUMMARY JUDGMENT OF NO PRE-SUIT DAMAGES by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit)(Long, Elizabeth) (Entered: 10/10/2023)	
249	10/10/2023	REDACTION to 230 Sealed Reply to Response to Motion, FOR SUMMARY JUDGMENT OF NON-INFRINGEMENT OF THE ASSERTED CLAIMS OF THE '682 AND '690 PATENTS by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 10/10/2023)	
250	10/10/2023	REDACTION to 233 Sealed Reply to Response to Motion, TO STRIKE DR. SOURI'S IMPROPER OPINIONS by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 10/10/2023)	
251	10/10/2023	REDACTION to 234 Sealed Reply to Response to Motion, TO STRIKE ENTROPIC'S IMPROPER SECONDARY	

#	Date	Proceeding Text	Source
		CONSIDERATIONS POSITIONS by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration)(Long, Elizabeth) (Entered: 10/10/2023)	
252	10/10/2023	REDACTION to 239 Sealed Reply to Response to Motion, TO EXCLUDE THE EXPERT OPINIONS OF STEPHEN DELL by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit)(Long, Elizabeth) (Entered: 10/10/2023)	
253	10/10/2023	REDACTION to 232 Sealed Additional Attachments to Main Document, 228 Reply to Response to Motion,. DECLARATION OF ELIZABETH LONG IN SUPPORT OF CHARTER'S REPLY IN SUPPORT OF ITS MOTION FOR SUMMARY JUDGMENT OF INVALIDITY OF THE ASSERTED CLAIMS OF THE '362 PATENT by Charter Communications, Inc.. (Attachments: # 1 Exhibit, # 2 Exhibit)(Long, Elizabeth) (Entered: 10/10/2023)	
254	10/10/2023	SUR-REPLY to Reply to Response to Motion re 167 SEALED MOTION CHARTER'S MOTION TO STRIKE DR. KRAMER'S IMPROPER OPINIONS filed by Entropic Communications, LLC. (Shimota, James) (Entered: 10/10/2023)	
255	10/10/2023	SEALED ADDITIONAL ATTACHMENTS to Main Document: 254 Sur-Reply to Reply to Response to Motion (Declaration of James Shimota in Support of Entropic's Sur-Reply) (Attachments: # 1 Exhibit H)(Shimota, James) (Entered: 10/10/2023)	
256	10/10/2023	SUR-REPLY to Reply to Response to Motion re 173 SEALED MOTION (CHARTER'S MOTION FOR SUMMARY JUDGMENT OF INVALIDITY OF THE ASSERTED CLAIMS OF THE '362 PATENT) filed by Entropic Communications, LLC. (Shimota, James) (Entered: 10/10/2023)	
257	10/10/2023	OPPOSED SEALED MOTION in Limine by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Exhibit E, # 7 Exhibit F, # 8 Exhibit G, # 9 Exhibit H, # 10 Exhibit I, # 11 Exhibit J, # 12 Exhibit K, # 13 Exhibit L, # 14 Exhibit M, # 15 Exhibit N, # 16 Exhibit O, # 17 Proposed Order)(Brown, Melissa) (Entered: 10/10/2023)	
258	10/10/2023	OPPOSED SEALED MOTION IN LIMINE by Entropic Communications, LLC. (Attachments: # 1 SEALED Declaration of Michael T. Pieja, # 2 Exhibit A - SEALED Boglioli 8-11-23 Dep Tr (excerpts), # 3 Exhibit B - SEALED Entropic Witness List, # 4 Exhibit C - SEALED Charter Witness List, # 5 Exhibit D - SEALED Bakewell Reb. Rpt. (excerpts), # 6 Exhibit E - SEALED Dell Rpt. (excerpts), # 7 Exhibit F - SEALED Kirchoff 8-16-23 Dep Tr (excerpts), # 8 Exhibit G - SEALED Cangiane 07-17-23 Dep Tr (excerpts), # 9 Exhibit H - SEALED Almeroth Reb. Rpt. (excerpts), # 10 Proposed Order)(Pieja, Michael) (Entered: 10/10/2023)	
259	10/11/2023	RESPONSE in Opposition re 216 OPPOSED MOTION to Amend/Correct Docket Control Order filed by Entropic Communications, LLC. (Attachments: # 1 Proposed Order)(Shimota, James) (Entered: 10/11/2023)	
260	10/11/2023	SEALED SUR-REPLY to Reply to Response to Motion re 166 SEALED MOTION CHARTER'S MOTION TO STRIKE DR. SOURI'S IMPROPER OPINIONS filed by Entropic Communications, LLC. (Attachments: # 1 Declaration of James Shimota, # 2 Exhibit P)(Shimota, James) (Entered: 10/11/2023)	
261	10/11/2023	REDACTION to 141 SEALED MOTION to Strike the Expert Report of David O. Taylor by Entropic Communications, LLC. (Shimota, James) (Entered: 10/11/2023)	
262	10/11/2023	SUR-REPLY to Reply to Response to Motion re 168 MOTION to Strike Opinions of Steven Goldberg filed by Charter	

#	Date	Proceeding Text	Source
		Communications, Inc.. (Long, Elizabeth) (Entered: 10/11/2023)	
263	10/11/2023	REDACTION to 151 Sealed Reply to Response to Motion by Entropic Communications, LLC. (Shimota, James) (Entered: 10/11/2023)	
264	10/11/2023	SUR-REPLY to Reply to Response to Motion re 170 MOTION for Summary Judgment Of No Invalidity Under 32 U.S.C. 102 & 103 filed by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 10/11/2023)	
265	10/11/2023	REDACTION to 174 SEALED MOTION to Strike Opinions of Christopher Bakewell by Entropic Communications, LLC. (Attachments: # 1 Affidavit/Declaration of James Shimota, # 2 Affidavit/Declaration of Darlene Ghavimi)(Shimota, James) (Entered: 10/11/2023)	
266	10/11/2023	SUR-REPLY to Reply to Response to Motion re 181 MOTION for Summary Judgment of Validity Under 35 U.S.C. 101 (CORRECTION OF ECF DOCUMENT TITLE) filed by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 10/11/2023)	
267	10/11/2023	SEALED SUR-REPLY to Reply to Response to Motion re 177 SEALED MOTION for Summary Judgment of No License Defense Based on DOCSIS filed by Charter Communications, Inc. (Long, Elizabeth) (Entered: 10/11/2023)	
268	10/11/2023	SEALED SUR-REPLY to Reply to Response to Motion re 179 SEALED MOTION of Partial Summary Judgment That Devices With MaxLinear Chips are Not Non-Infringing Alternatives Affecting the Reasonable Royalty Rate filed by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 10/11/2023)	
269	10/11/2023	REDACTION to 175 SEALED MOTION to Strike Opinions of Dr. Kevin Almeroth by Entropic Communications, LLC. (Attachments: # 1 Affidavit/Declaration of James Shimota)(Shimota, James) (Entered: 10/11/2023)	
270	10/11/2023	SEALED SUR-REPLY to Reply to Response to Motion re 180 SEALED MOTION for Summary Judgment of No Unclean Hands Defense filed by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 10/11/2023)	
271	10/11/2023	SEALED SUR-REPLY to Reply to Response to Motion re 174 SEALED MOTION to Strike Opinions of Christopher Bakewell filed by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 10/11/2023)	
272	10/11/2023	REDACTION to 177 SEALED MOTION for Summary Judgment of No License Defense Based on DOCSIS by Entropic Communications, LLC. (Attachments: # 1 Affidavit/Declaration of James Shimota)(Shimota, James) (Entered: 10/11/2023)	
273	10/11/2023	SEALED SUR-REPLY to Reply to Response to Motion re 175 SEALED MOTION to Strike Opinions of Dr. Kevin Almeroth filed by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 10/11/2023)	
274	10/11/2023	REDACTION to 179 SEALED MOTION of Partial Summary Judgment That Devices With MaxLinear Chips are Not Non-Infringing Alternatives Affecting the Reasonable Royalty Rate by Entropic Communications, LLC. (Attachments: # 1 Affidavit/Declaration of James Shimota)(Shimota, James) (Entered: 10/11/2023)	
275	10/11/2023	REDACTION to 180 SEALED MOTION for Summary Judgment of No Unclean Hands Defense by Entropic Communications, LLC. (Attachments: # 1 Affidavit/Declaration of James Shimota)(Shimota, James) (Entered: 10/11/2023)	
276	10/11/2023	REDACTION to 237 Sealed Reply to Response to Motion, by Entropic Communications, LLC. (Shimota, James) (Entered:	

#	Date	Proceeding Text	Source
		10/11/2023)	
277	10/11/2023	REDACTION to 238 Sealed Reply to Response to Motion by Entropic Communications, LLC. (Shimota, James) (Entered: 10/11/2023)	
278	10/11/2023	REDACTION to 240 Sealed Reply to Response to Motion by Entropic Communications, LLC. (Shimota, James) (Entered: 10/11/2023)	
279	10/11/2023	REDACTION to 241 Sealed Reply to Response to Motion by Entropic Communications, LLC. (Shimota, James) (Entered: 10/11/2023)	
280	10/11/2023	REDACTION to 242 Sealed Reply to Response to Motion, by Entropic Communications, LLC. (Shimota, James) (Entered: 10/11/2023)	
281	10/11/2023	SEALED SUR-REPLY to Reply to Response to Motion re 169 SEALED MOTION CHARTER'S MOTION TO EXCLUDE THE EXPERT OPINIONS OF STEPHEN DELL filed by Entropic Communications, LLC. (Attachments: # 1 Declaration of Nicholas Lenning, # 2 Lenning Declaration, Ex. A)(Shimota, James) (Entered: 10/11/2023)	
282	10/11/2023	SEALED SUR-REPLY to Reply to Response to Motion re 171 SEALED MOTION CHARTER'S MOTION TO STRIKE ENTROPIC'S IMPROPER SECONDARY CONSIDERATIONS POSITIONS filed by Entropic Communications, LLC. (Attachments: # 1 Declaration of Nicholas Lenning, # 2 Lenning Declaration, Ex. A)(Shimota, James) (Entered: 10/11/2023)	
283	10/11/2023	SEALED SUR-REPLY to Reply to Response to Motion re 176 SEALED MOTION (CHARTER'S MOTION FOR SUMMARY JUDGMENT OF NON-INFRINGEMENT OF THE ASSERTED CLAIMS OF THE '682 AND '690 PATENTS) filed by Entropic Communications, LLC. (Attachments: # 1 Declaration of James Shimota, # 2 Exhibit A)(Shimota, James) (Entered: 10/11/2023)	
284	10/12/2023	NOTICE by Entropic Communications, LLC of Request for Daily Trial Transcripts and Real-Time Reporting (Fair, Andrea) (Entered: 10/12/2023)	
285	10/13/2023	NOTICE by Charter Communications, Inc. NOTICE OF REQUEST FOR DAILY TRANSCRIPTS AND REAL TIME REPORTING (Long, Elizabeth) (Entered: 10/13/2023)	
286	10/13/2023	NOTICE of Attorney Appearance by Johnny Ward, Jr on behalf of Entropic Communications, LLC (Ward, Johnny) (Entered: 10/13/2023)	
287	10/13/2023	OPPOSED MOTION for Leave to File Out of Time Plaintiff's Supplemental Motion to Strike Opinions of Christopher Bakewell by Entropic Communications, LLC. (Attachments: # 1 Proposed Order)(Shimota, James) (Entered: 10/13/2023)	
288	10/13/2023	***DEFICIENT DOCUMENT***SEALED ADDITIONAL ATTACHMENTS to Main Document: 287 OPPOSED MOTION for Leave to File Out of Time Plaintiff's Supplemental Motion to Strike Opinions of Christopher Bakewell. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D)(Shimota, James) Modified on 10/16/2023 (ch,). (Entered: 10/13/2023)	
289	10/13/2023	MOTION to Strike Supplemental Motion to Strike Opinions of Christopher Bakewell by Entropic Communications, LLC. (Attachments: # 1 Proposed Order)(Shimota, James) (Entered: 10/13/2023)	
290	10/13/2023	***DEFICIENT DOCUMENT***SEALED ADDITIONAL ATTACHMENTS to Main Document: 289 MOTION to Strike Supplemental Motion to Strike Opinions of Christopher Bakewell. (Attachments: # 1 Exhibit A, # 2 Exhibit B)(Shimota, James)	

#	Date	Proceeding Text	Source
		Modified on 10/16/2023 (ch,). (Entered: 10/13/2023)	
	10/16/2023	NOTICE of Deficiency regarding the 288 submitted Needs Certificate of Authorization to file under seal and Certifiicate of Service. Correction should be made by one business day (ch,) (Entered: 10/16/2023)	
	10/16/2023	NOTICE of Deficiency regarding the 290 submitted Needs Certificate of Authorization to file under seal and Certifiicate of Service. Correction should be made by one business day (ch,) (Entered: 10/16/2023)	
291	10/16/2023	SEALED ADDITIONAL ATTACHMENTS to Main Document: 287 OPPOSED MOTION for Leave to File Out of Time Plaintiff's Supplemental Motion to Strike Opinions of Christopher Bakewell. (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D)(Shimota, James) (Entered: 10/16/2023)	
292	10/16/2023	SEALED ADDITIONAL ATTACHMENTS to Main Document: 289 MOTION to Strike Supplemental Motion to Strike Opinions of Christopher Bakewell. (Attachments: # 1 Exhibit A, # 2 Exhibit B)(Shimota, James) (Entered: 10/16/2023)	
293	10/16/2023	REDACTION to 196 Sealed Response to Motion, by Entropic Communications, LLC. (Shimota, James) (Entered: 10/16/2023)	
294	10/16/2023	REDACTION to 201 Sealed Response to Motion,, by Entropic Communications, LLC. (Shimota, James) (Entered: 10/16/2023)	
295	10/16/2023	REDACTION to 203 Sealed Response to Motion,, by Entropic Communications, LLC. (Shimota, James) (Entered: 10/16/2023)	
296	10/16/2023	REDACTION to 205 Sealed Response to Motion,, by Entropic Communications, LLC. (Shimota, James) (Entered: 10/16/2023)	
297	10/16/2023	REDACTION to 210 Sealed Response to Motion, by Entropic Communications, LLC. (Shimota, James) (Entered: 10/16/2023)	
298	10/16/2023	REDACTION to 260 Sealed Sur-Reply to Reply to Response to Motion, by Entropic Communications, LLC. (Shimota, James) (Entered: 10/16/2023)	
299	10/16/2023	REDACTION to 281 Sealed Sur-Reply to Reply to Response to Motion, by Entropic Communications, LLC. (Shimota, James) (Entered: 10/16/2023)	
300	10/16/2023	REDACTION to 282 Sealed Sur-Reply to Reply to Response to Motion, by Entropic Communications, LLC. (Shimota, James) (Entered: 10/16/2023)	
301	10/16/2023	REDACTION to 283 Sealed Sur-Reply to Reply to Response to Motion, by Entropic Communications, LLC. (Shimota, James) (Entered: 10/16/2023)	
302	10/16/2023	OPPOSED MOTION for Leave to Serve Mr. Dell's Third Supplemental Expert Report Out of Time by Entropic Communications, LLC. (Attachments: # 1 Proposed Order)(Shimota, James) (Entered: 10/16/2023)	
303	10/16/2023	SEALED ADDITIONAL ATTACHMENTS to Main Document:. (Attachments: # 1 Exhibit A, # 2 Exhibit B)(Shimota, James) (Entered: 10/16/2023)	
304	10/17/2023	REDACTION to 258 OPPOSED SEALED MOTION IN LIMINE by Entropic Communications, LLC. (Attachments: # 1 Declaration of Michael T. Pieja, # 2 Additional Attachment(s) Exhibits A-H Filed Under Seal)(Pieja, Michael) (Entered: 10/17/2023)	
305	10/17/2023	REPLY to Response to Motion re 216 OPPOSED MOTION to Amend/Correct Docket Control Order filed by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 10/17/2023)	
	10/17/2023	Pretrial Conference originally set for 10/30/2023 has been RESET for 11/6/2023 at 09:00 AM in Ctrm 106 (Marshall) before District Judge Rodney Gilstrap. (aeb) (Entered: 10/17/2023)	

#	Date	Proceeding Text	Source
306	10/17/2023	NOTICE of Attorney Appearance by William Owen Young, Jr on behalf of Charter Communications, Inc. (Young, William) (Entered: 10/17/2023)	
307	10/17/2023	REDACTION to 257 OPPOSED SEALED MOTION in Limine by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit A (under seal), # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D - O (under seal), # 6 Proposed Order)(Brown, Melissa) (Entered: 10/17/2023)	
308	10/18/2023	AGREED MOTION to Amend/Correct 195 Order on Motion to Amend/Correct by Entropic Communications, LLC. (Shimota, James) (Entered: 10/18/2023)	
309	10/18/2023	NOTICE of Attorney Appearance - Pro Hac Vice by Thomas J. Carr on behalf of Charter Communications, Inc.. Filing fee $ 100, receipt number ATXEDC-9764999. (Carr, Thomas) (Entered: 10/18/2023)	
310	10/18/2023	NOTICE of Attorney Appearance - Pro Hac Vice by Natalie Steiert on behalf of Charter Communications, Inc.. Filing fee $ 100, receipt number ATXEDC-9765076. (Steiert, Natalie) (Entered: 10/18/2023)	
311	10/18/2023	SEALED RESPONSE to Motion re 244 OPPOSED SEALED MOTION for Leave to File Out of Time Plaintiff's Motion to Compel Testimony and Documents Improperly Withheld as Privileged filed by Charter Communications, Inc. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit, # 4 Exhibit, # 5 Exhibit, # 6 Exhibit, # 7 Exhibit, # 8 Proposed Order)(Long, Elizabeth) (Entered: 10/18/2023)	
312	10/18/2023	SEALED RESPONSE to Motion re 245 OPPOSED SEALED MOTION to Compel Testimony and Documents Improperly Withheld as Privileged filed by Charter Communications, Inc. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit, # 4 Exhibit, # 5 Exhibit, # 6 Proposed Order)(Long, Elizabeth) (Entered: 10/18/2023)	
313	10/18/2023	UNOPPOSED MOTION to Withdraw as Attorney Paul I. Margulies by Charter Communications, Inc.. (Attachments: # 1 Proposed Order)(Long, Elizabeth) (Entered: 10/18/2023)	
314	10/18/2023	REDACTION to 267 Sealed Sur-Reply to Reply to Response to Motion FOR SUMMARY JUDGMENT OF NO LICENSE DEFENSE BASED ON DOCSIS by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 10/18/2023)	
315	10/18/2023	REDACTION to 268 Sealed Sur-Reply to Reply to Response to Motion, PARTIAL SUMMARY JUDGMENT THAT DEVICES WITH MAXLINEAR CHIPS ARE NOT NON-INFRINGING ALTERNATIVES AFFECTING THE REASONABLE ROYALTY RATE by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 10/18/2023)	
316	10/18/2023	REDACTION to 270 Sealed Sur-Reply to Reply to Response to Motion FOR SUMMARY JUDGMENT OF NO UNCLEAN HANDS DEFENSE by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 10/18/2023)	
317	10/18/2023	REDACTION to 271 Sealed Sur-Reply to Reply to Response to Motion TO STRIKE OPINIONS OF CHRISTOPHER BAKEWELL by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 10/18/2023)	
318	10/18/2023	REDACTION to 273 Sealed Sur-Reply to Reply to Response to Motion TO STRIKE OPINIONS OF DR. KEVIN ALMEROTH by Charter Communications, Inc.. (Long, Elizabeth) (Entered: 10/18/2023)	
319	10/19/2023	SEVENTH AMENDED DOCKET CONTROL ORDER granting 308 Motion to Amend/Correct. Signed by District Judge Rodney	

#	Date	Proceeding Text	Source
		Gilstrap on 10/19/2023. (ch,) (Entered: 10/20/2023)	
320	10/19/2023	ORDER granting 313 Motion to Withdraw as Attorney. Attorney Paul Isaac Margulies terminated. Signed by District Judge Rodney Gilstrap on 10/19/2023. (ch,) (Entered: 10/20/2023)	
321	10/20/2023	NOTICE by Entropic Communications, LLC re 244 OPPOSED SEALED MOTION for Leave to File Out of Time Plaintiff's Motion to Compel Testimony and Documents Improperly Withheld as Privileged Fully Briefed - Notice to Forgo Reply (Shimota, James) (Entered: 10/20/2023)	
322	10/20/2023	NOTICE by Entropic Communications, LLC re 245 OPPOSED SEALED MOTION to Compel Testimony and Documents Improperly Withheld as Privileged Fully Briefed - Notice to Forgo Reply (Shimota, James) (Entered: 10/20/2023)	
323	10/23/2023	SEALED RESPONSE to Motion re 258 OPPOSED SEALED MOTION IN LIMINE filed by Charter Communications, Inc. (Attachments: # 1 Affidavit/Declaration Long Decl ISO Charter Response to Entropic's MILs, # 2 Exhibit Ex. I, # 3 Exhibit Ex. J, # 4 Exhibit Ex. K, # 5 Exhibit Ex. L, # 6 Exhibit Ex. M, # 7 Exhibit Ex. N, # 8 Exhibit Ex. O, # 9 Proposed Order Proposed Order)(Long, Elizabeth) (Entered: 10/23/2023)	
324	10/23/2023	SEALED RESPONSE to Motion re 257 OPPOSED SEALED MOTION in Limine filed by Entropic Communications, LLC. (Attachments: # 1 SEALED Declaration of Michael T. Pieja, # 2 Exhibit P - SEALED Goldberg Rpt (excerpts), # 3 Exhibit Q - SEALED Interrog Resp (excerpts), # 4 Proposed Order)(Pieja, Michael) (Entered: 10/23/2023)	
325	10/25/2023	REDACTION to 311 Sealed Response to Motion, FOR LEAVE TO FILE OUT OF TIME PLAINTIFFS MOTION TO COMPEL by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit, # 4 Exhibit, # 5 Exhibit, # 6 Exhibit, # 7 Exhibit, # 8 Proposed Order)(Long, Elizabeth) (Entered: 10/25/2023)	
326	10/25/2023	REDACTION to 312 Sealed Response to Motion, to Compel Testimony and Documents Improperly Withheld as Privilege by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration, # 2 Exhibit, # 3 Exhibit, # 4 Exhibit, # 5 Exhibit, # 6 Proposed Order)(Long, Elizabeth) (Entered: 10/25/2023)	
327	10/30/2023	REDACTION to 323 Sealed Response to Motion, MOTION IN LIMINE by Charter Communications, Inc.. (Attachments: # 1 Affidavit/Declaration Long Decl ISO Charter Response to Entropic's MILs, # 2 Exhibit Ex. I, # 3 Exhibit Ex. J, # 4 Exhibit Ex. K, # 5 Exhibit Ex. L, # 6 Exhibit Ex. M, # 7 Exhibit Ex. N, # 8 Exhibit Ex. O, # 9 Proposed Order Proposed Order)(Long, Elizabeth) (Entered: 10/30/2023)	
328	10/30/2023	RESPONSE in Opposition re 287 OPPOSED MOTION for Leave to File Out of Time Plaintiff's Supplemental Motion to Strike Opinions of Christopher Bakewell filed by Charter Communications, Inc.. (Attachments: # 1 Proposed Order)(Long, Elizabeth) (Entered: 10/30/2023)	
329	10/30/2023	SEALED RESPONSE to Motion re 289 MOTION to Strike Supplemental Motion to Strike Opinions of Christopher Bakewell filed by Charter Communications, Inc. (Attachments: # 1 Affidavit/Declaration Long Decl ISO Charter Opp'n to Motion to Strike Bakewell, # 2 Exhibit Ex. A, # 3 Exhibit Ex. B, # 4 Exhibit Ex. C, # 5 Exhibit Ex. D, # 6 Exhibit Ex. E, # 7 Exhibit Ex. F, # 8 Proposed Order Proposed Order)(Long, Elizabeth) (Entered: 10/30/2023)	
330	10/30/2023	RESPONSE in Opposition re 302 OPPOSED MOTION for Leave	

#	Date	Proceeding Text	Source
		to Serve Mr. Dell's Third Supplemental Expert Report Out of Time filed by Charter Communications, Inc.. (Attachments: # 1 Proposed Order Proposed Order)(Long, Elizabeth) (Entered: 10/30/2023)	
331	10/30/2023	SEALED ADDITIONAL ATTACHMENTS to Main Document: 330 Response in Opposition to Motion, (Attachments: # 1 Exhibit Ex. C, # 2 Exhibit Ex. D, # 3 Exhibit Ex. E)(Long, Elizabeth) (Entered: 10/30/2023)	
332	10/30/2023	REDACTION to 324 Sealed Response to Motion, by Entropic Communications, LLC. (Attachments: # 1 Declaration of Michael T. Pieja, # 2 Exhibit P - Goldberg Rpt (excerpts), # 3 Exhibit Q - Filed Under Seal, # 4 Proposed Order)(Pieja, Michael) (Entered: 10/30/2023)	
333	10/31/2023	Sealed Document. Joint Proposed Pretrial Order (Attachments: # 1 Exhibit A, # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D, # 5 Exhibit E, # 6 Exhibit F, # 7 Exhibit G, # 8 Exhibit H, # 9 Exhibit I)(Shimota, James) (Entered: 10/31/2023)	Events since last full update

Patents

Number	Title	Issued	Class	Subclass
8,223,775	Architecture for a flexible and high-performance gateway cable modem	07/17/2012	370	401
8,284,690	Receiver determined probe	10/09/2012	370	252
8,792,008	Method and apparatus for spectrum monitoring	07/29/2014	348	192
9,210,362	Wideband tuner architecture	12/08/2015	1	1
9,825,826	Method and apparatus for spectrum monitoring	11/21/2017	1	1
10,135,682	Method and system for service group management in a cable network	11/20/2018	1	1

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Documents (2)

1. *Entropic Communs., LLC v. Charter Communs, Inc., 2023 U.S. Dist. LEXIS 152025*

Client/Matter: -None-
Search Terms: 9,210,362
Search Type: Natural Language
Narrowed by:

Content Type	Narrowed by
Cases	-None-

2. *Entropic Commc'ns, LLC v. Charter Commc'ns, Inc., 2023 U.S. Dist. LEXIS 109786*

Client/Matter: -None-
Search Terms: 9,210,362
Search Type: Natural Language
Narrowed by:

Content Type	Narrowed by
Cases	-None-

Neutral
As of: October 31, 2023 3:24 PM Z

Entropic Communs., LLC v. Charter Communs, Inc.

United States District Court for the Eastern District of Texas, Marshall Division

August 29, 2023, Decided; August 29, 2023, Filed

CIVIL ACTION NO. 2:22-CV-00125-JRG

Reporter
2023 U.S. Dist. LEXIS 152925 *; 2023 WL 5613185

ENTROPIC COMMUNICATIONS, LLC, Plaintiff, v. CHARTER COMMUNICATIONS, INC., Defendant.

Prior History: Entropic Commchs, LLC v. Charter Commchs, Inc., 2023 U.S. Dist. LEXIS 109786 (E.D. Tex., June 26, 2023)

Core Terms

consolidation, argues, cases

Counsel: **[*1]** For Entropic Communications, LLC, Plaintiff: Darlene Fae Ghavimi, LEAD ATTORNEY, K&L Gates, LLP, Austin, TX; James A Shimota, LEAD ATTORNEY, Jason A Engel, Katherine L. Allor, K&L Gates LLP - Chicago, Chicago, IL; Andrea Leigh Fair, Jack Wesley Hill, Ward, Smith & Hill, PLLC, Longview, TX; Connor James Meggs, K&L Gates LLP, Los Angeles, CA; Courtney Neufeld, Nicholas F. Lenning, K&L Gates LLP, Seattle, WA; George C Summerfield, K & L Gates LLP - Chicago, Chicago, IL; Kenneth H. Bridges, Bridges IP Consulting, Nashville, TN; Matthew Alexander Blair, K&L Gates, Austin, TX; Peter E. Soskin, K&L Gates LLP - San Francisco, San Francisco, CA; Samuel Patrick Richey, K&L Gates LLP, Chicago, IL.

For Charter Communications, Inc., Defendant: Daniel Reisner, Palak Mayani Parikh, LEAD ATTORNEYS, Albert John Boardman, Elizabeth Anne Long, Melissa A. Brown, Arnold & Porter Kaye Scholer LLP, New York, NY; Paul Isaac Margulies, LEAD ATTORNEY, Amy L DeWitt, Arnold & Porter Kaye Scholer, LLP - Wash DC, Washington, DC; David S Benyacar, Kaye Scholer - New York, New York, NY; Deron R Dacus, The Dacus Firm, PC, Tyler, TX; Marc A Cohn, PRO HAC VICE, Arnold & Porter Kaye Scholer LLP, Washington, DC.

Judges: RODNEY GILSTRAP, **[*2]** UNITED STATES DISTRICT JUDGE.

Opinion by: RODNEY GILSTRAP

Opinion

MEMORANDUM OPINION AND ORDER

I. INTRODUCTION

Before the Court is Defendant Charter Communications, Inc.'s ("Charter") Opposed Motion to Consolidate this Action with No. 2:23-cv-00052-JRG and to Amend the Case Schedule (the "Motion"). (Dkt. No. 99.) In the Motion, Charter requests that the above-captioned case (the "First Action") be consolidated with the *Entropic Communications, LLC v. Charter Communications, Inc.*, Case No. 2:23-cv-052-JRG (the "Second Action") pursuant to Federal Rule of Civil Procedure 42(a). (Dkt. No. 99 at 1.) Plaintiff Entropic Communications, LLC ("Entropic") opposes the Motion. (Dkt. No. 113.) For the following reasons, the Court finds that the Motion should be **DENIED**.

II. BACKGROUND

Entropic filed the First Action on April 27, 2022. (Dkt. No. 1.) It asserts that Charter infringes six U.S. Patents, including U.S. Patent No. ***9,210,362*** (the "'362 Patent"). (Dkt. No. 15 at ¶ 1.) The First Action is set to for trial on December 4, 2023 (Dkt. No. 154.)

Entropic filed the Second Action on February 10, 2023. 2:23-cv-052-JRG, Dkt. No. 1. In this action, Entropic asserts that Charter infringes U.S. Patent Nos. 11,381,866 (the "'866 Patent") and 11,399,206 (the "'206 Patent"). 2:23-cv-052-JRG, Dkt. No. 11 at 2. These patents are from the same family as **[*3]** the '362 Patent from the First Action. (Dkt. No. 99 at 1.) Accordingly, the '362, '866, and '206 Patents share a specification and inventors, and have similar claims.

(*Id.*) The Second Action, which is currently consolidated with 2:23-cv-051-JRG, is set for trial on October 7, 2024. 2:23-cv-051-JRG, Dkt. No. 52.

III. LEGAL STANDARD

Under Rule 42(a), where actions involve a common question of law or fact, "the court *may* . . . consolidate the actions." ContentGuard Holdings, Inc. v. Google, Inc., Nos. 2:14-cv-00061-JRG, Nos. 2:13-cv-01112, 2014 U.S. Dist. LEXIS 51676, 2014 WL 1477670, at *4 (E.D. Tex. Apr. 15, 2014) (quoting Fed. R. Civ. P. 41(a)) (emphasis in original)). This rule "is permissive and vests a purely discretionary power in the district court." *Id.* (quoting Whiteman v. Pirie, 220 F.2d 914, 918 (5th Cir. 1955)).

IV. ANALYSIS

Charter argues that the Court should consolidate the First and Second Actions because the law and facts substantially overlap. (Dkt. No. 99 at 7.) The '362, '866, and '206 Patents share the same specification and inventors, and have similar claims. (*Id.* at 7-8.) Moreover, the Accused Products and Accused Services have the same definition in each Action. (*Id.* at 8.) Charter further argues that trying the First and Second cases separately will lead to jury confusion because the jury in the Second Action will be required to account for the events that occurred in the First Action. (*Id.* at 9-10.) Moreover, Charter argues, consolidation would avoid substantial **[*4]** inefficiencies, namely litigating claim splitting and issue preclusion in the Second Action. (*Id.* at 10-14.) Last, Charter argues that if the Court adopts Charter's proposed schedule, there is no prejudice to Entropic. (*Id.* at 14-15.) Under Charter's proposed schedule, the consolidated case would proceed to trial in April 2024. (Dkt. No. 99-1 at 1.) Charter argues that there would be no prejudice to Entropic because the shorter time-to-trial for the Second Action would offset the longer time-to-trial in the First Action. (Dkt. No. 99 at 14-15.) Charter further argues that there is no prejudice to Entropic because Entropic is a non-practicing entity seeking only money damages. (*Id.* at 14.)

In response, Entropic argues that it is not possible to assess whether consolidation would promote efficiency given that the Second Action is in its earliest stages. (Dkt. No. 113 at 4-7.) Further, Entropic argues that consolidation would force Entropic to present too many complex, technical issues to a jury, making the presentation of evidence even more difficult for the jury to grapple with. (*Id.* at 8-9.) Last, Entropic argues that any delay in trial in the First Action would be prejudicial. (*Id.* ***[*5]*** at 9-10.)

In reply Charter argues that Entropic's argument that consolidation would mean there is "too much material" in one case rings hollow because (1) Entropic previously indicated that "it would be amenable to consolidation" and (2) Entropic filed a case in California that included all eight patents from both the First and Second Actions here. (Dkt. No. 116 at 1 (citing Dkt. No. 113 at 2).) Moreover, Charter notes that Entropic does not dispute the risks of jury confusion. (*Id.* at 2.) Further, the fact that the cases are at different stages is the fault of Entropic, Charter argues. (*Id.* at 3-4.) Finally, Charter argues that there is minimal prejudice to Entropic because the delay in time-to-trial is for a specified length, and, in any event, any prejudice to Entropic is far outweighed by the prejudice of forcing Charter to litigate two very similar cases instead of just one. (*Id.* at 4-5.)

In sur-reply Entropic argues that it only ever stated that it would "consider" consolidation on the existing trial schedule. (Dkt. No. 118 at 1.) Moreover, the other cases that Entropic filed which include all eight patents from the First and Second Actions here, were not filed in front of this **[*6]** Court, but in front of a Court that does not have a tradition of one-week trials. (*Id.* at 1-2.)

The Court, in its discretion, finds that the First and Second Actions should not be consolidated. The cases are simply too far apart for it to be practical to consolidate them at this point. The First Action is nearing the end of expert discovery, while fact discovery is just opening in the Second Action. Further, Entropic should not have to delay in bringing its case to trial before a jury. *See* Koninklijke KPN N.V. v. Telefonaktiebolaget LM Ericsson, No. 2:21-CV-00113-JRG, 2022 U.S. Dist. LEXIS 222609, 2022 WL 17484264, at *2 (E.D. Tex. July 7, 2022) ("this Court has repeatedly found that a delay in recovering monetary damages is far from non-prejudicial") (quotations omitted).

The Court is sympathetic to Charter's concern that it should not have to litigate the same case twice, but this concern is overstated. It is the Court's expectation that discovery between these actions will overlap, such that discovery does not have to be wholly duplicative between the First and Second Actions. The Court also expects that the similarities between the patents-in-suit will simplify claim construction. Moreover, the Court will

instruct the jury and cabin party arguments to limit jury confusion, which is an inherent risk when any single case from a group of **[*7]** complex cases goes to trial. Charter may litigate claim-splitting and issue preclusion if it wishes. Entropic knew the risks of bringing two cases that cover similar subject matter and it is not unfair to Charter to ask it to defend itself.

It is not lost upon the Court that this ruling may require some additional costs that the parties (and the Court) must bear. However, these additional costs are, in the Court's view, insufficient to overcome the burdens of consolidating two cases that are at very different stages of development and readiness.

V. CONCLUSION

For the foregoing reasons, the Court finds that the Motion (Dkt. No. 99) should be and hereby is **DENIED**.

So ORDERED and SIGNED this 29th day of August, 2023.

/s/ Rodney Gilstrap

RODNEY GILSTRAP

UNITED STATES DISTRICT JUDGE

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Neutral
As of: October 31, 2023 3:24 PM Z

Entropic Commc'ns, LLC v. Charter Commc'ns, Inc.

United States District Court for the Eastern District of Texas, Marshall Division

June 26, 2023, Decided; June 26, 2023, Filed

CASE NO. 2:22-CV-00125-JRG

Reporter
2023 U.S. Dist. LEXIS 109786 *; 2023 WL 4181266

ENTROPIC COMMUNICATIONS, LLC, Plaintiff, v. CHARTER COMMUNICATIONS, INC., Defendant.

Subsequent History: Motion denied by, Without prejudice Entropic Commc'ns, LLC v. Charter Commc'ns, Inc., 2023 U.S. Dist. LEXIS 152927 (E.D. Tex., Aug. 29, 2023)

Motion denied by Entropic Commuus., LLC v. Charter Commuus, Inc., 2023 U.S. Dist. LEXIS 152925 (E.D. Tex., Aug. 29, 2023)

Related proceeding at Entropic Commc'ns, LLC v. Charter Commc'ns, Inc., 2023 U.S. Dist. LEXIS 152924 (E.D. Tex., Aug. 29, 2023)

Petition denied by In re Charter Commc'ns, Inc., 2023 U.S. App. LEXIS 23486 (Fed. Cir., Sept. 5, 2023)

Core Terms

probe, cable, modem, networking, plurality, engine, signal, parameters, specification, channels, processor, functions, television, digitized, node, proposed construction, comprising, recites, metric, argues, terms, module, ordinary meaning, plain meaning, patent, frequencies, indefiniteness, composite, messages, profile

Counsel: **[*1]** For Entropic Communications, LLC, Plaintiff: Darlene Fae Ghavimi, LEAD ATTORNEY, K&L Gates, LLP, Austin, TX; James A Shimota, LEAD ATTORNEY, Jason A Engel, Katherine L. Allor, K&L Gates LLP - Chicago, Chicago, IL; Andrea Leigh Fair, Jack Wesley Hill, Ward, Smith & Hill, PLLC, Longview, TX; Connor James Meggs, K&L Gates LLP, Los Angeles, CA; Courtney Neufeld, Nicholas F. Lenning, K&L Gates LLP, Seattle, WA; George C Summerfield, K & L Gates LLP - Chicago, Chicago, IL; Kenneth H. Bridges, Bridges IP Consulting, Nashville, TN; Matthew Alexander Blair, K&L Gates, Austin, TX; Peter E. Soskin, K&L Gates LLP - San Francisco, San Francisco, CA; Samuel Patrick Richey, K&L Gates LLP, Chicago, IL.

For Charter Communications, Inc., Defendant: Daniel Reisner, Palak Mayani Parikh, LEAD ATTORNEYS, Albert John Boardman, Elizabeth Anne Long, Melissa A. Brown, Arnold & Porter Kaye Scholer LLP, New York, NY; Paul Isaac Margulies, LEAD ATTORNEY, Amy L DeWitt, Arnold & Porter Kaye Scholer, LLP - Wash DC, Washington, DC; David S Benyacar, Kaye Scholer - New York, New York, NY; Deron R Dacus, The Dacus Firm, PC, Tyler, TX; Marc A Cohn, PRO HAC VICE, Arnold & Porter Kaye Scholer LLP, Washington, DC.

Judges: RODNEY GILSTRAP, **[*2]** UNITED STATES DISTRICT JUDGE.

Opinion by: RODNEY GILSTRAP

Opinion

CLAIM CONSTRUCTION MEMORANDUM OPINION AND ORDER

Before the Court is the Opening Claim Construction Brief (Dkt. No. 97) filed by Plaintiff Entropic Communications, LLC ("Plaintiff" or "Entropic"). Also before the Court are the Responsive Claim Construction Brief (Dkt. No. 104) filed by Defendant Charter Communications, Inc. ("Defendant" or "Charter") and Plaintiff's reply (Dkt. No. 110). The Court held a hearing on June 13, 2023.

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I. BACKGROUND

Plaintiff alleges infringement of United States Patents No. 8,223,775 ("the '775 Patent"), 8,792,008 ("the '008 Patent"), 9,825,826 ("the '826 Patent"), 8,284,690 ("the '690 Patent"), **[*4]** ***9,210,362*** ("the '362 Patent"), and 10,135,682 ("the '682 Patent") (collectively, the "patents-in-suit"). (Dkt. 97, Exs. 1-6.)

II. LEGAL PRINCIPLES

It is understood that "[a] claim in a patent provides the metes and bounds of the right which the patent confers on the patentee to exclude others from making, using or selling the protected invention." *Burke, Inc. v. Bruno Indep. Living Aids, Inc., 183 F.3d 1334, 1340 (Fed. Cir. 1999)*. Claim construction is an issue of law for the court to decide. *Markman v. Westview Instruments, Inc., 52 F.3d 967, 970-71 (Fed. Cir. 1995)* (en banc), *aff'd*, *517 U.S. 370, 116 S. Ct. 1384, 134 L. Ed. 2d 577 (1996)*.

"In some cases, however, the district court will need to look beyond the patent's intrinsic evidence and to consult extrinsic evidence in order to understand, for example, the background science or the meaning of a term in the relevant art during the relevant time period." *Teva Pharms. USA, Inc. v. Sandoz, Inc., 574 U.S. 318, 135 S. Ct. 831, 841, 190 L. Ed. 2d 719 (2015)* (citation omitted). "In cases where those subsidiary facts are in dispute, courts will need to make subsidiary factual findings about that extrinsic evidence. These are the 'evidentiary underpinnings' of claim construction that we discussed in *Markman*, and this subsidiary factfinding must be reviewed for clear error on appeal." *Id.* (citing *517 U.S. 370*).

To ascertain the meaning of claims, courts look to three primary sources: the claims, the specification, and the prosecution history. *Markman, 52 F.3d at 979*. The **[*5]** specification must contain a written description of the invention that enables one of ordinary skill in the art to make and use the invention. *Id.* A patent's claims must be read in view of the specification, of which they are a part. *Id.* For claim construction purposes, the description may act as a sort of dictionary, which explains the invention and may define terms used in the claims. *Id.* "One purpose for examining the specification is to determine if the patentee has limited the scope of the claims." *Watts v. XL Sys., Inc., 232 F.3d 877, 882 (Fed. Cir. 2000)*.

Nonetheless, it is the function of the claims, not the specification, to set forth the limits of the patentee's invention. Otherwise, there would be no need for claims. *SRI Int'l v. Matsushita Elec. Corp., 775 F.2d 1107, 1121 (Fed. Cir. 1985)* (en banc). The patentee is free to be his own lexicographer, but any special definition given to a word must be clearly set forth in the specification. *Intellicall, Inc. v. Phonometrics, Inc., 952 F.2d 1384, 1388 (Fed. Cir. 1992)*. Although the specification may indicate that certain embodiments are preferred, particular embodiments appearing in the specification will not be read into the claims when the claim language is broader than the embodiments. *Electro Med. Sys., S.A. v. Cooper Life Sciences, Inc., 34 F.3d 1048, 1054 (Fed. Cir. 1994)*.

This Court's claim construction analysis is substantially guided by the Federal Circuit's decision in *Phillips v. AWH Corporation, 415 F.3d 1303 (Fed. Cir. 2005)* (en banc). In *Phillips*, the court set forth several **[*6]** guideposts that courts should follow when construing claims. In particular, the court reiterated that "the claims of a patent define the invention to which the patentee is entitled the right to exclude." *Id. at 1312* (quoting *Innova/Pure Water, Inc. v. Safari Water Filtration Sys., Inc., 381 F.3d 1111, 1115 (Fed. Cir. 2004)*). To that end, the words used in a claim are generally given their ordinary and customary meaning. *Id.* The ordinary and customary meaning of a claim term "is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, i.e., as of the effective filing date of the patent application." *Id. at 1313*. This principle of patent law flows naturally from the recognition that inventors are usually persons who are skilled in the field of the invention and that patents are addressed to, and intended to be read by, others skilled in the particular art. *Id.*

Despite the importance of claim terms, *Phillips* made clear that "the person of ordinary skill in the art is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification." *Id.* Although the claims themselves may provide guidance as to the meaning of particular terms, those terms **[*7]** are part of "a fully integrated written instrument." *Id. at 1315* (quoting *Markman, 52 F.3d at 978*). Thus, the *Phillips* court emphasized the specification as being the primary basis for construing the claims. *Id. at 1314-17*. As the Supreme Court stated long ago, "in case of doubt or ambiguity it is proper in all cases to refer back to the descriptive portions of the specification to aid in solving the doubt or in ascertaining the true intent and meaning of the

language employed in the claims." Bates v. Coe, 98 U.S. 31, 38, 25 L. Ed. 68, 1879 Dec. Comm'r Pat. 365 (1878). In addressing the role of the specification, the Phillips court quoted with approval its earlier observations from Renishaw PLC v. Marposs Societa' per Azioni, 158 F.3d 1243, 1250 (Fed. Cir. 1998):

> Ultimately, the interpretation to be given a term can only be determined and confirmed with a full understanding of what the inventors actually invented and intended to envelop with the claim. The construction that stays true to the claim language and most naturally aligns with the patent's description of the invention will be, in the end, the correct construction.

Phillips, 415 F.3d at 1316. Consequently, Phillips emphasized the important role the specification plays in the claim construction process.

The prosecution history also continues to play an important role in claim interpretation. Like the specification, the prosecution history helps to demonstrate how the inventor **[*8]** and the United States Patent and Trademark Office ("PTO") understood the patent. Id. at 1317. Because the file history, however, "represents an ongoing negotiation between the PTO and the applicant," it may lack the clarity of the specification and thus be less useful in claim construction proceedings. *Id.* Nevertheless, the prosecution history is intrinsic evidence that is relevant to the determination of how the inventor understood the invention and whether the inventor limited the invention during prosecution by narrowing the scope of the claims. *Id.*; *see* Microsoft Corp. v. Multi-Tech Sys., Inc., 357 F.3d 1340, 1350 (Fed. Cir. 2004) (noting that "a patentee's statements during prosecution, whether relied on by the examiner or not, are relevant to claim interpretation").

Phillips rejected any claim construction approach that sacrificed the intrinsic record in favor of extrinsic evidence, such as dictionary definitions or expert testimony. The *en banc* court condemned the suggestion made by Texas Digital Systems, Inc. v. Telegenix, Inc., 308 F.3d 1193 (Fed. Cir. 2002), that a court should discern the ordinary meaning of the claim terms (through dictionaries or otherwise) before resorting to the specification for certain limited purposes. Phillips, 415 F.3d at 1319-24. According to Phillips, reliance on dictionary definitions at the expense of the specification had the effect of "focus[ing] the **[*9]** inquiry on the abstract meaning of words rather than on the meaning of claim terms within the context of the patent." Id. at 1321. Phillips emphasized that the patent system is based on the proposition that the claims cover only the invented subject matter. *Id.*

Phillips does not preclude all uses of dictionaries in claim construction proceedings. Instead, the court assigned dictionaries a role subordinate to the intrinsic record. In doing so, the court emphasized that claim construction issues are not resolved by any magic formula. The court did not impose any particular sequence of steps for a court to follow when it considers disputed claim language. Id. at 1323-25. Rather, Phillips held that a court must attach the appropriate weight to the intrinsic sources offered in support of a proposed claim construction, bearing in mind the general rule that the claims measure the scope of the patent grant.

The Supreme Court of the United States has "read [35 U.S.C.] § 112, ¶ 2 to require that a patent's claims, viewed in light of the specification and prosecution history, inform those skilled in the art about the scope of the invention with reasonable certainty." Nautilus, Inc. v. Biosig Instruments, Inc., 572 U.S. 898, 910, 134 S. Ct. 2120, 2129, 189 L. Ed. 2d 37 (2014). "A determination of claim indefiniteness is a legal conclusion that is drawn from the court's **[*10]** performance of its duty as the construer of patent claims." Datamize, LLC v. Plumtree Software, Inc., 417 F.3d 1342, 1347 (Fed. Cir. 2005) (citations and internal quotation marks omitted), *abrogated on other grounds by* Nautilus, 572 U.S. 898. "Indefiniteness must be proven by clear and convincing evidence." Sonix Tech. Co. v. Publ'ns Int'l, Ltd., 844 F.3d 1370, 1377 (Fed. Cir. 2017).

III. AGREED TERMS

In their April 4, 2023 P.R. 4-3 Joint Claim Construction and Prehearing Statement, the parties submitted the following agreed-upon constructions (Dkt. No. 84, at 1):

Go to table2

IV. DISPUTED TERMS IN U.S. PATENT NO. 8,223,775

The '775 Patent, titled "Architecture for a Flexible and High-Performance Gateway Cable Modem," issued on July 17, 2012, and bears a filing date of September 30, 2003. The Abstract of the '775 Patent states:

> A cable modem system and architecture. A cable modem engine performs all cable modem

functions, **[*11]** and a data networking engine performs all data and home networking functions. The cable modem engine is completely partitioned from the data networking engine. DOCSIS and VoIP functionality is implemented in the cable modem engine. The VoIP functionality may be in accordance with the Packet-Cable specification. The data networking functionality provided by the data networking engine may be in accordance with the CableHome specification.

1. "a data networking engine implemented in a first circuit that includes at least one processor . . ." and "a cable modem engine implemented in a second circuit that includes at least one processor . . ."

Go to table3

(Dkt. No. 84, at A-1; Dkt. No. 97, at 6; Dkt. No. 104, at 4; Dkt. No. 115, Ex. **[*12]** A, at 1.)

(a) The Parties' Positions

Plaintiff argues that "data networking" and "cable modem" were well-known phrases at the time of the invention and that the generic word "engine," as modified by the phrases "data networking" and "cable modem," would have been readily understood by a person of ordinary skill in this art. (Dkt. No. 97, at 6-7.) Plaintiff also argues that Defendant's indefiniteness arguments should be rejected because "electrical engineers routinely design subcomponents of consumer electronics, even if the components reside on the same chip," and "[a] POSITA would have no trouble determining where one circuit begins and another ends, because integrating functional blocks on 'a chip' does not render them indistinguishable." (*Id.*, at 8.)

Defendant responds that "[t]here is no disclosure of a DNE or CME implemented in any circuit, much less two circuits which are 'separate' from one another." (Dkt. No. 104, at 5.) Defendant argues that Plaintiff cannot simply chose whatever meaning or "level" of the word "circuit" suits its infringement contentions. (*See id.*, at 6-8.)

Plaintiff replies that the term "circuit" is readily understandable and that the specification discloses **[*13]** separation of functions. (Dkt. No. 110, at 1.)

At the June 13, 2023 hearing, Plaintiff argued that although the functionality of the first circuit and the second circuit must be separate, this does not necessarily require physical separation. Defendant responded that it is *not* arguing that the first circuit and the second circuit must be on separate *chips*, but the problem, Defendant argued, is that this claim uses "circuit" in a subjective way and, as a result, there is no way for a person of skill in the art to know if these limitations are satisfied.

(b) Analysis

Claim 18 of the '775 Patent recites (emphasis added):

> 18. A cable modem system comprising:
>
> *a data networking engine implemented in a first circuit that includes at least one processor*, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment;
>
> *a cable modem engine implemented in a second circuit that includes at least one processor*, the second circuit being *separate* from the first circuit, the cable modem engine programmed with software that when executed **[*14]** by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media, and the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine, the cable modem engine including a DOCSIS controller and a DOCSIS MAC processor, the DOCSIS MAC processor configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the DOCSIS controller in order to boost downstream throughput; and
>
> a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine.

The specification discloses "functional partitioning" and also contrasts the disclosed cable modem system with "current stand-alone cable modem chips":

> Functional Partitioning. Cable modem 100 completely partitions **[*15]** data networking functions . . . from DOCSIS cable modem functionality.
> * * *
> A chip implementing cable modem system 100 will have only a small incremental hardware cost/functional increase over current stand-alone cable modem chips.

'775 Patent at 4:13-16 & 4:58-60; *see id.* at FIGS. 1 and 2 (illustrating data networking engine ("DNE") 120 and cable modem engine ("CME") 110).

Such disclosure regarding "functionality" is consistent with the technical dictionary cited by Defendant's expert, which defines "circuit" as:

> 1. Any path that can carry electrical current. 2. A combination of electrical components interconnected to perform a particular task. At one level, a computer consists of a single circuit; at another, it consists of hundreds of interconnected circuits.

(Dkt. No. 97, Ex. 8, Apr. 4, 2023 Almeroth Decl., App'x C, *Microsoft Computer Dictionary* 99 (5th ed. 2002).)

The specification and this extrinsic evidence are thus consistent with Plaintiff's interpretation that the phrases "first circuit" and "second circuit" are not limited to specific established structures but rather refer to interconnected electrical components that implement the data networking engine functionality and the cable modem **[*16]** engine functionality. *Cf. Linear Tech. Corp. v. Impala Linear Corp., 379 F.3d 1311, 1320 (Fed. Cir. 2004)* ("when the structure-connoting term 'circuit' is coupled with a description of the circuit's operation, sufficient structural meaning generally will be conveyed to [POSITAs]").

Further, although the claim requires "the second circuit being separate from the first circuit," the "first circuit" and "second circuit" need not be physically separated, such as on separate chips, for example. *Cf. Linear Tech. Corp. v. Int'l Trade Comm'n, 566 F.3d 1049, 1055 (Fed. Cir. 2009)* ("We agree with the Commission's construction of 'second circuit' and 'third circuit,' defining the terms broadly to not require entirely separate and distinct circuits."). This is true even if the disclosed cable modem system 100 is implemented as a "System-on-a-Chip" ("SoC") because even if the SoC is considered to be a single "circuit" (*see* Dkt. No. 97, at 8; *see also* Dkt. No. 104, Ex. 2, May 4, 2023 Kramer dep. at 127:13-22 ("a System on a Chip can be considered an integrated circuit")), this circuit can itself be understood as being composed of multiple circuits. The opinions of Defendant's expert to the contrary are unpersuasive. (*See* Dkt. No. 97, Ex. 8, Apr. 4, 2023 Almeroth Decl. at ¶¶ 64-68.)

Thus, Defendant does not meet its burden to show any lack of reasonable **[*17]** certainty. *Nautilus, 572 U.S. at 910*. The *Dow* and *Teva* cases cited by Defendant do not compel otherwise because, for example, the present case does not involve different potential methods of measurement. *See Dow Chemical Co. v. Nova Chemicals Corp. (Canada), 803 F.3d 620, 631, 634 (Fed. Cir. 2015)* (finding indefiniteness as to "a slope of strain hardening coefficient greater than or equal to 1.3"); *see also Teva Pharmaceuticals USA, Inc. v. Sandoz, Inc., 789 F.3d 1335, 1338, 1344-45 (Fed. Cir. 2015)* (finding indefiniteness as to "a molecular weight of about 5 to 9 kilodaltons").

The Court therefore hereby expressly rejects Defendant's indefiniteness argument. Defendant presents no alternative proposed constructions, and no further construction is necessary.

The Court accordingly hereby construes **"a data networking engine implemented in a first circuit that includes at least one processor . . ."** and **"a cable modem engine implemented in a second circuit that includes at least one processor . . ."** to have their **plain meaning. 2. "data bus"**

Go to table1

(Dkt. No. 84, at A-2; Dkt. No. 97, at 9; Dkt. No. 104, at 8; Dkt. No. 115, Ex. A, at 2.)

(a) The Parties' Positions

Plaintiff argues that the meaning of "data bus" is well known to persons of ordinary skill in the **[*18]** art. (Dkt. No. 97, at 9.)

Defendant responds that, in light of the prosecution history, "the 'data bus' limitation is irreconcilable with the 'completely partitioned' limitation, and claim 18 is therefore indefinite." (Dkt. No. 104, at 8 (citation omitted).)

Plaintiff replies that Defendant's argument is untenable because "[p]rosecution history disclaimers operate to narrow what would otherwise fall within a claim; they do not operate to invalidate claims by eliminating elements

textually present." (Dkt. No. 110, at 2.)

At the June 13, 2023 hearing, the parties argued this term together with the above-discussed ". . . in a first circuit . . ." and ". . . in a second circuit . . ." terms.

(b) Analysis

Defendant does not dispute that "data bus" is a well-known term in the relevant art. (*See* Dkt. No. 97, Ex. 10, *The IEEE Standard Dictionary of Electrical and Electronics Terms* 252 (defining "data bus" as "a bus used to communicate data to and from a processing unit or a storage device").)

The parties' dispute pertains not to the term "data bus" in isolation but rather to the accompanying "wherein" clause, which the parties present as a distinct disputed term and which is addressed separately **[*19]** below.

The Court therefore hereby construes **"data bus"** to have its **plain meaning**.

3. "wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine"

Go to table5

(Dkt. No. 84, at A-4; Dkt. No. 97, at 10; Dkt. No. 104, at 8; Dkt. No. 115, Ex. A, at 2-3.)

(a) The Parties' Positions

Plaintiff argues:

> The disputed claim language explicitly recites that the functions of the DNE [(data networking engine)] and CME [(cable modem engine)] are partitioned. This distinction is key because functions can be partitioned in hardware, software, or both. Functional partitioning is explicitly described in the specification as 'localizing' the cable modem and data networking functions in the separate **[*20]** engines:
> * * *
> A POSITA would understand that connecting the DNE and CME (e.g., via a data bus) does not eliminate the compartmentalization of their respective functions."

(Dkt. No. 97, at 10 (citations omitted).)

Defendant responds as to this term together with the term "data bus," which is addressed above. (*See* Dkt. No. 104, at 8.) Plaintiff replies likewise. (*See* Dkt. No. 110, at 2-3.)

At the June 13, 2023 hearing, the parties argued this term together with the above-discussed ". . . in a first circuit . . ." and ". . . in a second circuit . . ." terms.

(b) Analysis

Claim 18 of the '775 Patent recites (emphasis added):

> 18. A cable modem system comprising:
> a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment;
>
> a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed **[*21]** by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media, and the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine, the cable modem engine including a DOCSIS controller and a DOCSIS MAC processor, the DOCSIS MAC processor configured to process downstream PDU packets and *forward the processed packets directly to the data networking engine* without the involvement of the DOCSIS controller in order to boost downstream throughput; and
>
> a *data bus* that connects the data networking engine to the cable modem engine, *wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine.*

The specification discloses "localizing" the *functions*:

> Functional Partitioning. Cable modem 100 completely partitions data networking *functions* (advanced bridging/routing, NAT/firewall, VPN, web server and **[*22]** CableHome applications) from DOCSIS cable modem *functionality*. This is accomplished by localizing data networking *functions* in the data networking engine processor and localizing cable modem *functions* in the cable modem engine processor.

'775 Patent at 4:13-19 (emphasis added). Further, the claim itself recites that the cable modem engine "forward[s] the processed packets directly to the data networking engine," thus implying that such communication is not inconsistent with the cable modem engine and the data networking engine being "completely partitioned" from one another. *See id.* at Figs. 1 & 2 (illustrating data path 118 between CME and DNE); *see also id.* at 3:15-17 ("DS PDU packets are forwarded by [the DOCSIS MAC processor] directly to [DNE] 120 along path 118, bypassing controller 116").

The prosecution history cited by Defendant does not compel otherwise. The patentee distinguished the "Brooks" reference (United States Patent Application Publication No. 2001/0039600) as follows:

> [T]he Office Action make the conclusion statement [s*ic*] that "the data networking engine and cable modem engines are represented in Figures 1 and 2 of the [Brooks] reference" . . . . However, Applicant is uncertain **[*23]** how any reasonable interpretation of these Figures can provide correspondence. For example, Figure 2 of [Brooks] discloses only two processors, each of which, therefore, must correspond to the claimed data-networking and cable-modem engines. However, the discussion of Figure 2 makes clear that the cable modem functions are performed by CMAC unit 224 . . . . Therefore, in order for the cable modem engine to contain a processor and perform the CMAC functions as claimed, the cited cable modem engine must include circuitry to connect the processors with the CMAC unit. Because available *connecting circuitry would be shared with the other processor*, Applicant is uncertain how the asserted cable modem engine and home networking engine can be completely partitioned as claimed.

(Dkt. No. 97, Ex. 8, Apr. 4, 2023 Almeroth Decl., App'x G, Apr. 5, 2010 Response to Final Office Action, at 6 (ENTROPIC_CHARTER_0000108) (p. 236 of 290 of Ex. 8) (emphasis added).)

After an advisory action by the examiner, the patentee explained further, distinguishing Brooks as using processors that were not functionally separate:

> The Examiner's apparent designation of the first processor 102 in Brooks '600 as the "data **[*24]** networking engine," and the second processor 104 and the CMAC/CPHY block (114, 118, 224 and 228) as the "cable modem engine," further does not square with the claim 1 feature that "the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine," and the claim 15 feature of "partitioning the data networking engine from the cable modem engine so that the data and home networking functionality is completely decoupled from the DOCSIS and VOOP functionality." This is because the CMAC/CPHY block (114, 118, 224 and 228) communicates with both the processors 102 and 104 by sharing the same data paths and sharing the same direct memory access controller. (See peripheral bus 112 — bridge 110 — system bus 108 in Fig. 1 and APB 214 — OMA Controller/ASB-APB Bridge 212 — ASB 210 in Fig. 2, and paragraphs 0034 and 0035).
>
> Further, accepting the Examiner's assertion that first processor 102 handles data networking *functionality*, and considering the description of paragraphs 0025 and 0026 that processor 102 is programmed to implement the desired MAC *functionality* (which would include typical DOCSIS MAC **[*25]** *functionality*), leads to a conclusion that the Brooks '600 processor 102 does not implement a complete partitioning or a completely decoupled arrangement of the data networking engine from the cable modem engine.
>
> Thus, Brooks '600 does not provide the complete partitioning or completely decoupled arrangement of the data networking engine from the cable modem engine that the Examiner apparently asserts it does.

(*Id.*, June 7, 2010 Response to Final Office Action, at 9 (ENTROPIC_CHARTER_0000134) (p. 254 of 290 of Ex. 8) (emphasis added); *see id.*, at 7-9 (ENTROPIC_CHARTER_0000132-34) (pp. 252-54 of 290 of Ex. 8).)

The patentee thus distinguished Brooks as lacking *functional* separation because what the examiner identified as the cable modem engine in Brooks required

interaction with the "CMAC unit," and, the patentee argued, such interaction involved circuitry that was shared with what the examiner identified as the data networking engine in Brooks. (*See id.*) Thus, no relevant disclaimer is apparent, and in particular the patentee did not disclaim having a data bus that connects the data networking engine to the cable modem engine, as recited in above-reproduced Claim 1 of the '775 Patent. *See Omega Eng'g Inc. v. Raytek Corp., 334 F.3d 1314, 1324 (Fed. Cir. 2003)* ("prosecution **[*26]** disclaimer promotes the public notice function of the intrinsic evidence and protects the public's reliance on *definitive* statements made during prosecution") (emphasis added); *see also id. at 1325-26* ("for prosecution disclaimer to attach, our precedent requires that the alleged disavowing actions or statements made during prosecution be both *clear and unmistakable*") (emphasis added).

The Court therefore hereby expressly rejects Defendant's proposal that the cable modem engine and the data networking engine cannot share any connecting circuitry, data paths, or memory devices.

The Court accordingly hereby construes **"wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine"** to mean **"wherein the cable modem engine and the data networking engine are not necessarily physically separate but are functionally separate such that the cable modem functions are performed only by the cable modem engine and the home networking functions are performed only by the data networking engine."**

4. "DOCSIS functions"

Go to table6

(Dkt. No. 84, at A-5; Dkt. No. 97, at 11; Dkt. No. 104, at 8; Dkt. No. 115, Ex. A, at 3.)

(a) The Parties' Positions

Plaintiff argues that Defendant's proposal is contrary to the doctrine of claim differentiation. (Dkt. No. 97, at 12.)

Defendant responds:

> According to claim 19, all DOCSIS functions are localized in the CME. However, as explained . . . above, the specification explains that the sine qua non of a CME is that it 'performs all cable modem functions' including 'the entire DOCSIS cable modem functionality.' Accordingly, claim 19 is redundant and does not further limit the scope of claim 18. Otherwise, the term 'cable modem engine' is indefinite.

(Dkt. No. 104, at 9.)

Plaintiff replies that there is no redundancy because "Claim 18 recites the broader 'cable modem functions,' which does not necessarily have the same scope as 'all *DOCSIS* functions,' referring to the DOCSIS standard." (Dkt. No. 110, at 3.)

At the June 13, 2023 hearing, the parties argued this term together with the above-discussed ". . . in a first circuit . . ." and ". . . in a second circuit . . ." terms.

(b) Analysis **[*28]**

Claim 19 of the '775 Patent depends from Claim 18 and recites:

> 19. A cable modem system as claimed in claim 18, wherein all DOCSIS functions are localized in the cable modem engine.

Plaintiff applies the doctrine of claim differentiation, arguing:

> Claim 18 states that the CME comprises a processor, programmed with software, that when executed causes the CME to perform "cable modem functions other than the home networking functions performed by the [DNE]." Dependent claim 19 increases the burden on the CME—"all DOCSIS functions are localized in the [CME]." Logically, claim 18 does not require that each and every DOCSIS function be executed by the circuitry of the CME, while claim 19 does.

(Dkt. No. 97, at 12.)

As a general matter, "[c]laim differentiation is 'not a hard and fast rule,' but rather a presumption that will be overcome when the specification or prosecution history dictates a contrary construction." *GPNE Corp. v. Apple Inc., 830 F.3d 1365, 1371 (Fed. Cir. 2016)*.

Defendant argues that this limitation set forth in Claim 19 is redundant (and thus does not imply the absence of such a limitation in Claim 18) because Claim 18, read in light of the specification, already requires this limitation. (*See* Dkt. No. 104, at 9.) Defendant argues that "cable modem **[*29]** engine" "is a phrase coined by the inventors" and "[i]f it does not refer to the components of a cable modem that perform all the cable modem

functions, then there is no way to know what it is." (*Id.*, at 9.)

Defendant cites disclosure in the Abstract that the CME "performs all cable modem functions" and "implements the entire DOCSIS cable modem functionality." '775 Patent at Abstract & 2:55-56. The Abstract, however, is not limiting, and the portion of the written description cited by Defendant does not purport to limit the entire claimed invention but rather describes a particular embodiment of "cable modem engine 110." *See* Phillips, 415 F.3d at 1323. Further, there is a "presumption that each claim in a patent has a different scope." Comark Communs., Inc. v. Harris Corp., 156 F.3d 1182, 1187 (Fed. Cir. 1998). The contrary opinion of Defendant's expert is unpersuasive. (*See* Dkt. No. 97, Ex. 8, Apr. 4, 2023 Almeroth Decl. at ¶ 36 (citing '775 Patent at 2:15-17 ("In one implementation, the VoIP functionality provided by the cable modem is in accordance with the PacketCable specification and the data networking functionality provided by the data networking engine is in accordance with the CableHome specification."), 2:23-24 ("Data and home networking functionality is provided by a data networking engine, **[*30]** and DOCSIS and VoIP functionality is provided by a cable modem engine.") & 4:19-21).)

The Court therefore hereby expressly rejects Defendant's attempted reliance on Claim 19 to arrive at a narrow interpretation of "cable modem engine" in Claim 18, and no further construction is necessary as to Claim 19. *See* U.S. Surgical Corp. v. Ethicon, Inc., 103 F.3d 1554, 1568 (Fed. Cir. 1997) ("Claim construction is a matter of resolution of disputed meanings and technical scope, to clarify and when necessary to explain what the patentee covered by the claims, for use in the determination of infringement. It is not an obligatory exercise in redundancy."); *see also* O2 Micro Int'l Ltd. v. Beyond Innovation Tech. Co., 521 F.3d 1351, 1362 (Fed. Cir. 2008) ("[D]istrict courts are not (and should not be) required to construe every limitation present in a patent's asserted claims."); Finjan, Inc. v. Secure Computing Corp., 626 F.3d 1197, 1207 (Fed. Cir. 2010) ("Unlike O2 Micro, where the court failed to resolve the parties' quarrel, the district court rejected Defendants' construction."); ActiveVideo Networks, Inc. v. Verizon Commc'ns, Inc., 694 F.3d 1312, 1326 (Fed. Cir. 2012); Summit 6, LLC v. Samsung Elecs. Co., Ltd., 802 F.3d 1283, 1291 (Fed. Cir. 2015); Bayer Healthcare LLC v. Baxalta Inc., 989 F.3d 964, 977-79 (Fed. Cir. 2021).

The Court accordingly hereby construes **"DOCSIS functions"** to have its **plain meaning**.

5. "DOCSIS MAC processor" and "DOCSIS controller"

Go to table7

(Dkt. No. 84, at A-6; Dkt. No. 97, at 12; Dkt. No. 115, Ex. A, at 1-2.)

(a) The Parties' Positions

Plaintiff urges that Defendant's proposals would improperly limit these terms to specific exemplary embodiments described in the specification. (Dkt. No. 97, at 12.) Plaintiff also argues that Defendants have already agreed that these are *not* means-plus-function terms governed by 35 U.S.C. § 112, ¶ 6. (*Id.*) Further, Plaintiff submits that "[t]he Federal Circuit and this Court have held that the terms 'processor' and 'controller' denote known classes of structures—generally understood to POSITAs." (*Id.* (citations omitted).)

Defendant responds that "[n]either the phrase 'DOCSIS MAC processor' nor 'DOCSIS controller' has a plain meaning." (Dkt. No. 104, at 9.) Defendant also argues that Plaintiff's proposed construction would either contradict the specification **[*32]** or "make it impossible to distinguish a DOCSIS MAC processor from a DOCSIS controller." (*Id.*, at 9-10.) Defendant urges that "[t]he only construction of DOCSIS MAC processor and DOCSIS controller that both comports with the specification and provides a basis for distinguishing between the two is a construction whereby each refers to the corresponding device described in the specification." (*Id.*, at 11.)

Plaintiff replies that "the claims themselves describe the functions of the DOCSIS MAC processor and DOCSIS controller," and "Charter has made no argument that the DOCSIS MAC processor and DOCSIS controller should be limited to the specific ARM-based embodiments disclosed in the specification." (Dkt. No. 110, at 3-4.)

At the June 13, 2023 hearing, Defendant submitted that the DOCSIS controller disclosed in the specification performs some MAC functions. Defendant argued that this makes it impossible to distinguish between a "DOCSIS MAC processor" and a "DOCSIS controller," which, in turn, Defendant argued makes it impossible to determine whether an accused instrumentality meets the limitation of "forward[ing] the processed packets

directly to the data networking engine without the involvement **[*33]** of the DOCSIS controller."

(b) Analysis

Claim 18 of the '775 Patent recites (emphasis added):

> 18. A cable modem system comprising:
> a data networking engine implemented in a first circuit that includes at least one processor, the data networking engine programmed with software that when executed by the at least one processor of the first circuit causes the data networking engine to perform home networking functions including interfacing with customer provided equipment;
>
> a cable modem engine implemented in a second circuit that includes at least one processor, the second circuit being separate from the first circuit, the cable modem engine programmed with software that when executed by the at least one processor of the second circuit causes the cable modem engine to perform cable modem functions other than the home networking functions performed by the data networking engine, the cable modem functions including interfacing with cable media, and the cable modem engine configured to enable upgrades to its software in a manner that is independent of upgrades to the software of the data networking engine, the cable modem engine including a *DOCSIS controller* and a *DOCSIS MAC processor*, the *DOCSIS MAC processor* ***[*34]*** configured to process downstream PDU packets and forward the processed packets directly to the data networking engine without the involvement of the *DOCSIS controller* in order to boost downstream throughput; and
> a data bus that connects the data networking engine to the cable modem engine, wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine.

The words "processor" and "controller" refer to known classes of structures in the relevant art, and the parties agree that "DOCSIS" (Data Over Cable Service Interface Specification) and DOCSIS "MAC" (Medium Access Control) have been well-known at all relevant times. (*See, e.g.*, Dkt. No. 97, Ex. 7, Apr. 14, 2023 Kramer Decl. at ¶ 84.)

Defendant proposes to limit these terms to the particular DOCSIS controller and DOCSIS MAC processor disclosed in the specification, but Defendant does not show any definition or disclaimer that would warrant a narrowing of these terms. *See* *Thorner v. Sony Computer Ent. Am. LLC*, 669 F.3d 1362, 1367 (Fed. Cir. 2012) ("The patentee is free to choose a broad term and expect to obtain the full scope of its plain and ordinary meaning unless the patentee explicitly redefines the **[*35]** term or disavows its full scope.").

Moreover, other claims of the patent-in-suit can be considered. *See* *Phillips*, 415 F.3d at 1314. Claim 1 recites a "DOCSIS MAC processor" and a "DOCSIS controller," and Claim 12 depends from Claim 1 and recites that "the DOCSIS MAC processor is an ARM9TDMI-based RISC processor, and wherein the DOCSIS controller is an ARM940-based RISC processor." Because claim terms should be interpreted consistently throughout all of the claims of a particular patent, *id.*, the doctrine of claim differentiation weighs against limiting the "DOCSIS MAC processor" and a "DOCSIS controller" to ARM9TDMI, ARM940, or any other particular specific implementation.

The disclosure in the specification regarding "functional blocks" is also consistent with interpreting these terms broadly rather than limiting them to particular types of processors. *See* '775 Patent at 2:55-3:38; *see also* Dkt. No. 97, Ex. 7, Apr. 14, 2023 Kramer Decl. at ¶¶ 92-93.

Further, Defendant cites disclosure in which the DOCSIS controller is involved with MAC functions (*see* '775 Patent at 3:27-48), but although the claim requires a "DOCSIS MAC processor configured to . . . forward the processed packets directly to the data networking engine without the involvement **[*36]** of the DOCSIS controller," the absence of involvement of the DOCSIS controller in this particular operation does not preclude the DOCSIS controller from being involved with other MAC functions.

Finally, Defendant cites the opinions of its expert that a person of ordinary skill in the art would be unable to distinguish between a "DOCSIS MAC processor" and a "DOCSIS controller," but these opinions are unpersuasive, particularly given that DOCSIS is a well-established standard and that MAC is also a well-known term in the relevant art. (*See* Dkt. No. 97, Ex. 8, Apr. 4, 2023 Almeroth Decl. at ¶¶ 76-77.) Any remaining question regarding distinguishing between a "DOCSIS MAC processor" and a "DOCSIS controller" pertains to factual questions of infringement rather than any legal question for claim construction. *See* *PPG Indus. v. Guardian Indus. Corp.*, 156 F.3d 1351, 1355 (Fed. Cir.

1998) ("after the court has defined the claim with whatever specificity and precision is warranted by the language of the claim and the evidence bearing on the proper construction, the task of determining whether the construed claim reads on the accused product is for the finder of fact"); *see also* Acumed LLC v. Stryker Corp., 483 F.3d 800, 806 (Fed. Cir. 2007) ("[t]he resolution of some line-drawing problems . . . is properly left to the trier of **[*37]** fact") (citing PPG, 156 F.3d at 1355); Eon Corp. IP Holdings LLC v. Silver Spring Networks, Inc., 815 F.3d 1314, 1318-19 (Fed. Cir. 2016) (citing PPG, 156 F.3d at 1355; citing Acumed, 483 F.3d at 806).

The Court therefore hereby expressly rejects Defendant's proposed constructions, and no further construction is necessary. *See* U.S. Surgical, 103 F.3d at 1568; *see also* O2 Micro, 521 F.3d at 1362; Finjan, 626 F.3d at 1207; ActiveVideo, 694 F.3d at 1326; Summit 6, 802 F.3d at 1291; Bayer, 989 F.3d at 977-79.

The Court accordingly hereby construes **"DOCSIS MAC processor"** and **"DOCSIS controller"** to have their **plain meaning**.

V. DISPUTED TERMS IN U.S. PATENT NO. 9,825,826

The '826 Patent is a continuation of the '008 Patent.

Plaintiff submits: "The '826 and the '008 Patents disclose methods and apparatuses that can be implemented in Customer Premises Equipment (CPE) that enable the CPE to: receive a cable or satellite television signal, digitize said signal, determine a characteristic of the digitized signal, and then report the determined characteristic back to the source of the signal (*i.e.*, the network-based service providers) without interrupting normal customer service." (Dkt. No. 97 at 3.)

The '008 Patent, titled "Method and Apparatus for Spectrum Monitoring," issued on July 29, 2014, and bears an earliest priority date of September 8, 2011. The Abstract of the '008 Patent states:

> A system, such as a satellite reception assembly or customer premises gateway, may comprise an analog-to-digital converter operable to digitize a signal spanning an entire television spectrum (e.g., cable television **[*38]** spectrum or satellite television spectrum) comprising a plurality of television channels. The system may comprise a signal monitor operable to analyze a signal to determine a characteristic of the signal. The system may comprise a data processor operable to process a television channel to recover content carried on the television channel. The system may comprise a channelizer operable to select first and second portions of the signal, and concurrently output the first portion to the signal monitor and the second portion to the data processor.

6. "network management messages"

Go to table8

(Dkt. No. 84, at A-8; Dkt. No. 97, at 15; Dkt. No. 104, at 12; Dkt. No. 115, Ex. A, at 5.)

(a) The Parties' Positions

Plaintiff argues that "[t]he Court should construe this term according to its plain and ordinary meaning because 'network management message' is a plain English phrase that means exactly what it says," and "[t]he '826 Patent's specification confirms the **[*39]** phrase is meant to convey all its ordinary possibilities, in disclosing a list of exemplary types/uses of the messages." (Dkt. No. 97, at 15 (citations omitted).)

Defendant responds that Plaintiff attempts to encompass implementations in which the set-top box returns only a measured characteristic and nothing else to the headend, which Defendant argues is inconsistent with the claim requirement that "said measured characteristic is *different than* said network management messages." (Dkt. No. 104, at 12 (emphasis modified).)

Plaintiff replies that Defendant improperly relies on claim language in the parent '008 Patent in an attempt to limit Claim 1 of the continuation '826 Patent. (Dkt. No. 110, at 4.) Plaintiff also argues that Defendant's argument pertains to a question of fact, not claim construction. (*Id.*)

At the June 13, 2023 hearing, Defendant submitted that although Defendant is *not* arguing that the message cannot include the measured characteristic, the message must include something that is *not* the measured characteristic. As for Plaintiff's interpretation that a *message* conveying just the measured characteristic is "different" than the measured characteristic *itself*, Defendant argued that this would **[*40]** vitiate the claim requirement that "said measured characteristic is different than said network management messages."

(b) Analysis

Claim 1 of the '826 Patent recites (emphasis added):

> 1. A method comprising:
> performing by one or more circuits of a receiver coupled to a television and data service provider headend via a hybrid fiber coaxial (HFC) network:
> receiving, via said HFC network, a signal that carries a plurality of channels, wherein said channels comprise one or both of television channels and data channels;
> digitizing said received signal to generate a digitized signal;
> selecting a first portion of said digitized signal;
> selecting a second portion of said digitized signal;
> processing said selected second portion of said digitized signal to recover information carried in said plurality of channels;
> analyzing said selected first portion of said digitized signal to measure a characteristic of said received signal; and
>
> controlling the transmission of *network management messages* back to said headend based on said measured characteristic of said received signal, wherein said measured characteristic is different than said *network management messages*.

On one hand, the specification discloses that messages **[*41]** sent to the headend can include measured characteristics:

> The CMTS 114 may process the messages and, in an example embodiment, adjust transmission parameters (e.g., modulation parameters, transmit power, frequency offsets, etc.) and/or perform other maintenance/management based on the received messages.
> * * *
>
> Such message may comprise, for example, network status updates indicating whether one or more communication parameters of one or more received television or DOCSIS channels are outside acceptable bounds, and/or *conveying measured/determined characteristics* back to a source of the received signal (e.g., back to a cable headend).

'826 Patent at 3:11-15 & 3:63-4:2 (emphasis added).

On the other hand, the claim here at issue, Claim 1 of the '826 Patent, recites that "said measured characteristic is *different than* said network management messages." Thus, simply sending the measured characteristic to the headend is insufficient to meet this claim limitation. Also of note, this contrasts with the recital in Claim 1 of the related '008 Patent of "report[ing] said determined characteristic to a source of said received signal."

Nonetheless, Defendant's proposal of an "*analysis* of the measured characteristics" lacks sufficient **[*42]** support in the specification. Defendant cites disclosures regarding "analyz[ing]" and whether one or more channels are "outside acceptable bounds":

> The monitoring module 154 may be operable to *analyze* the band CJ+1 that it receives from the channelizer 102 to *measure/determine characteristics* such as, for example, signal power level vs. frequency, delay vs. frequency, phase shift vs. frequency, type and/or amount of modulation, code rate, interference levels, signal to noise ratio, a transfer function of the channel of [*sic*] over which the signal was received, an impulse response of the channel over which the signal was received, and/or any other characteristic that may help assess characteristics of the channel over which the signal was received, assess characteristics of the transmitter that sent the signal and/or any otherwise be pertinent to performance of the communication system. . . . Additionally or alternatively, the control signal(s) 160 output by the monitoring module 154 may control the transmission of network management/maintenance messages by the device 150. Such message may comprise, for example, network status updates indicating whether one or more communication parameters **[*43]** of one or more received television or DOCSIS channels are *outside acceptable bounds*, and/or conveying *measured/determined* characteristics back to a source of the received signal (e.g., back to a cable headend)[.]

Id. at 3:45-4:2 (emphasis added).

This disclosure regarding "acceptable bounds" relates to a specific feature of a particular embodiment and does not warrant introducing a "status" or "analysis" limitation into the construction of "network management messages." *See Phillips*, 415 F.3d at 1323. Further, this disclosure that "[t]he monitoring module 154 may be operable to analyze the band CJ+1 that it receives from the channelizer 102 to measure/determine characteristics" likewise pertains to a particular

embodiment and, moreover, this usage of "analyze" merely reflects what is already recited elsewhere in the claim, namely "analyzing said selected first portion of said digitized signal to measure a characteristic of said received signal." Defendant's proposal of construing "network management messages" in terms of an "analysis" would tend to confuse rather than clarify the scope of the claim.

Nonetheless, although the claim already recites "transmission of network management messages back to said headend **[*44]** *based on* said measured characteristic of said received signal," Defendant's proposal of "based on" will assist the finder of fact in understanding that merely sending the measured characteristic is insufficient. *See* *01 Communique Laboratory, Inc. v. LogMeIn, Inc.*, 687 F.3d 1292, 1296 (Fed. Cir. 2012) ("01 Communique has not cited, and we have not discovered, any authority for the proposition that construction of a particular claim term may not incorporate claim language circumscribing the meaning of the term.").

Finally, Defendant discusses Plaintiff's infringement contentions (*see* Dkt. No. 104, at 12-13), but any remaining dispute pertains to factual questions regarding infringement rather than any legal question for claim construction. *See* *PPG*, 156 F.3d at 1355; *see also* *Acumed*, 483 F.3d at 806 (citing *PPG*, 156 F.3d at 1359); *Eon*, 815 F.2d at 1318-19 (citing *PPG*, 156 F.3d at 1355; citing *Acumed*, 483 F.3d at 806).

The Court therefore hereby construes **"network management messages"** to mean **"messages which report on the network based on the measured characteristics."**

VI. DISPUTED TERMS IN U.S. PATENT NO. 8,792,008

7. "operable to"

Go to table9

(Dkt. No. 84, at A-8; Dkt. No. 97, at 16; Dkt. No. 104, at 13.)

In their Amended Patent Rule 4-5(d) Joint Claim Construction Chart, the parties agree that "operable **[*45]** to" should be construed to mean "configured to." (Dkt. No. 115, Ex. A, at 3.)

The Court therefore hereby construes **"operable to"** to mean **"configured to."**

8. "digitize a received signal spanning an entire television spectrum comprising a plurality of television channels"

Go to table10

(Dkt. No. 84, at A-9; Dkt. No. 97, at 16; Dkt. No. 104, at 13; Dkt. No. 115, Ex. A, at 3-4.)

(a) The Parties' Positions

Plaintiff argues that "[t]he plain language of the claim recites '*comprising* a plurality of television channels,' indicating that the 'received signal spanning an entire television spectrum' is *not limited* to only television channels." (Dkt. No. 97, at 16.) Plaintiff also argues that the specification confirms this understanding. (*See id.*, at 17.)

Defendant responds that "'[s]pan' is a plain English word which means the full extent of something from end to end (*e.g.*, 'wing span,' 'life span,' 'span of a bridge')." **[*46]** (Dkt. No. 104, at 14.)

Plaintiff replies that "a television spectrum may contain inside it something in addition to individual television channels," and "[i]t does not cease being a television spectrum if non-video signals are added within the block." (Dkt. No. 110, at 4-5.)

At the June 13, 2023 hearing, Defendant alternatively proposed: "The 'received signal' contains only television channels and data channels which fall between television channels."

(b) Analysis

Claim 1 of the '008 Patent recites (emphasis added):

> 1. A system comprising:
>
> an analog-to-digital converter operable to *digitize a received signal spanning an entire television spectrum comprising a plurality of television channels*, said digitization resulting in a digitized signal;
>
> a signal monitor operable to:
>
> analyze said digitized signal to determine a characteristic of said digitized signal; and

> report said determined characteristic to a source of said received signal;
>
> a data processor operable to process a television channel to recover content carried on the television channel; and
>
> a channelizer operable to:
>
> select a first portion of said digitized signal;
>
> select a second portion of said digitized signal; and
>
> concurrently output said first **[*47]** portion of said digitized signal to said signal monitor and said second portion of said digitized signal to said data processor.

As a general matter, "[t]he transitional term 'comprising' . . . is open-ended and does not exclude additional, unrecited elements or method steps." *See* Gillette Co. v. Energizer Holdings, Inc., 405 F.3d 1367, 1371 (Fed. Cir. 2005).

Defendant submits authority that "[t]he usage 'comprising' means that additional components may be present in the device, but does not change the elements that are stated in the claim." Outside the Box Innovations, LLC v. Travel Caddy, Inc., 695 F.3d 1285, 1305 (Fed. Cir. 2012).

But although the claim language refers to "television spectrum" and refers to the television spectrum comprising television channels, this does *not* preclude non-television channels from being present within that spectrum. In other words, Defendant has not shown that this usage of "comprising" is somehow closed-ended. Also, Defendant's reliance at the June 13, 2023 hearing on a general-purpose dictionary definition of "spanning" as referring to the "extent" of something "between any two limits," even if found relevant, is unpersuasive. *Collins English Dictionary* (30th ed.).

This finding is consistent with disclosures in the specification that the received signal may include data from an IP network or may include DOCSIS channels: **[*48]**

> For downstream traffic, the headend 108 may receive television signals via the antenna 102 and the satellite dish 104, and *may receive data via the IP network 106*. The switch 110 may convey the television signals to the video modulator 112 and the data to the CMTS 114. The video modulator 112 may modulate the received television signals onto a carrier. The CMTS 114 may modulate the received data onto carrier. The splitter/combiner 116 may *combine the outputs* of the video modulator 112 and the CMTS 114 resulting in a frequency division multiplexed (FDM) *signal comprising one or more television channels and/or one or more DOCSIS channels*.
>
> * * *
>
> The RF receive front-end 158 may be operable to process a received RF signal S to generate a digital signal D. The signal S may be the result of *a plurality of television and/or DOCSIS channels* being frequency division multiplexed into a *single signal*. The signal S may occupy a frequency band from F_{lo} to F_{hi}.

'008 Patent at 2:44-54 & 3:12-16 (emphasis added); *see id.* at 4:45-47 ("The data processing module 156 may process one or more of bands C_1—C_J to recover data on one or more channels (e.g., television and/or DOCSIS channels) . . . .") & 5:60-62 ("Accordingly, **[*49]** for cable television/DOCSIS, the ADC 256 may be operable to digitize the entire cable downstream (e.g., from ~55 MHz to ~1002 MHz).").

Further, Defendant points to the express recital in Claim 1 of the '826 Patent that the received signal comprises "one or both of television and data channels," but this recital in a different independent claim in a different (albeit related) patent does not imply or otherwise justify a narrow interpretation of the disputed term in Claim 1 of the '008 Patent. Further, as Plaintiff argued at the June 13, 2023 hearing, whereas Claim 1 of the '826 Patent allows for there being only data channels, Claim 1 of the '008 Patent requires television channels.

Finally, at the June 13, 2023 hearing, Defendant proposed that "[t]he 'received signal' contains only television channels and data channels which fall between television channels." Defendant thus proposes that a data channel cannot overlap (or be subsumed within) a television channel. As discussed above, Defendant does not demonstrate that the disputed term precludes the presence of data channels within the same spectrum as television channels. The Court therefore rejects Defendant's alternative proposal.

The Court thus hereby expressly rejects Defendant's **[*50]** proposed constructions. No further construction is necessary. *See* U.S. Surgical, 103 F.3d at 1568; *see also* O2 Micro, 521 F.3d at 1362; Finisar, 626 F.3d at 1207; ActiveVideo, 694 F.3d at 1328; Summit 6, 802 F.3d at 1291; Saver, 980 F.3d at 977-79.

The Court accordingly hereby construes **"digitize a**

received signal spanning an entire television spectrum comprising a plurality of television channels" to have its **plain meaning**.

9. "signal monitor," "data processor," and "channelizer"

Go to table11

(Dkt. No. 84, at A-9; Dkt. No. 97, at 17; Dkt. No. 104, at 14; Dkt. No. 115, Ex. A, at 4.)

(a) The Parties' Positions

Plaintiff argues that Defendant's proposal should be rejected because "[n]o phrase [in the claim] even arguably related to separateness is present," and "the specification is clear that these three items do *not* have to be implemented on separate pieces of hardware." (Dkt. No. 97, at 17.)

Defendant responds:

> Entropic contends that there need not be any 'separateness' between the three, and that they can all refer to the same physical **[*51]** device. Entropic provides no support for its contention that this is the 'plain and ordinary meaning' of these terms, or any facts to overcome the presumption that each of these must be a distinct physical component. . . . Nor could Entropic possibly overcome this presumption, as neither the claims nor the specification make any sense unless each of the three is a separate device.

(Dkt. No. 104, at 14-15 (citation omitted).)

Plaintiff replies that Defendant is attempting to argue a question of fact regarding what is separate, as part of claim construction, which Plaintiff submits is improper. (Dkt. No. 110, at 5.) Plaintiff also submits that "[b]y the priority date (2011), it was exceedingly common for a single SoC [(System on a Chip)] to embody many functional elements, as a POSITA would have been well aware." (*Id.* (footnote omitted).)

At the June 13, 2023 hearing, Defendant argued that these terms refer to three structures that might even be on a single chip but that nonetheless must be physically separate pieces of hardware.

(b) Analysis

Claim 1 of the '008 Patent recites (emphasis added):

> 1. A system comprising:
>
> an analog-to-digital converter operable to digitize a received signal spanning an entire **[*52]** television spectrum comprising a plurality of television channels, said digitization resulting in a digitized signal;
>
> a *signal monitor* operable to:
>
> analyze said digitized signal to determine a characteristic of said digitized signal; and report said determined characteristic to a source of said received signal;
>
> a *data processor* operable to process a television channel to recover content carried on the television channel; and
>
> a *channelizer* operable to:
>
> select a first portion of said digitized signal;
>
> select a second portion of said digitized signal; and
>
> concurrently output said first portion of said digitized signal to said *signal monitor* and said second portion of said digitized signal to said *data processor*.

As a general matter, "[w]here a claim lists elements separately, 'the clear implication of the claim language' is that those elements are 'distinct component[s]' of the patented invention." *Becton, Dickinson & Co. v. Tyco Healthcare Grp., LP, 616 F.3d 1249, 1254 (Fed. Cir. 2010)*; *see Kyocera Senco Indus. Tools Inc. v. Int'l Trade Comm'n, 22 F.4th 1369, 1382 (Fed. Cir. 2022)* (listing components separately in a claim gives rise to "a presumption that those components are distinct").

Defendant does not show, however, that a requirement for "distinct" components, *id.*, necessarily requires separate pieces of hardware. Also, the specification discloses that "[t]he various **[*53]** modules of the subassembly 174," including "the signal monitor 154, data processor 156, and channelizer 152," "may reside in . . . one or more integrated circuits." *See id.* at 4:56-59 & Fig. 1C. Defendant argues that "[w]hat this sentence means is that each individual module can be one or more integrated circuits, not that all of the different modules can be one device" (Dkt. No. 104, at 16), but here, too, the patentee did not express or imply any physical separation.

Finally, at the June 13, 2023 hearing, Defendant

emphasized disclosure regarding "[t]he parallel arrangement of the monitoring module 154 and data processing module 156," but this disclosure pertains to a specific embodiment and therefore should not be imported into the claim. *See* Phillips, 415 F.3d at 1323. Also, Defendant does not show that a "parallel arrangement" necessarily implies physically separate structures.

The Court therefore hereby expressly rejects Defendant's proposed construction. No further construction is necessary. *See* U.S. Surgical, 103 F.3d at 1568; *see also* O2 Micro, 521 F.3d at 1362; Finisar, 626 F.3d at 1207; ActiveVideo, 694 F.3d at 1326; Summit 6, 802 F.3d at 1291; Bayer, 989 F.3d at 977-79.

The Court accordingly hereby construes **"signal monitor," "data processor,"** and **"channelizer"** to have their **plain meaning**.

VII. DISPUTED TERMS IN U.S. PATENT NO. 8,284,690

The '690 Patent, titled "Receiver Determined Probe," issued **[*54]** on October 9, 2012, and bears an earliest priority date of December 15, 2008. Plaintiff submits that the '690 Patent "relates generally to aiding in the diagnosis of problems with subscriber services." (Dkt. No. 97 at 4.)

The Abstract of the '690 Patent states:

> According to various embodiments of the disclosed method and apparatus, nodes on a network are programmed to generate a probe transmission in response to a request from the node that will be receiving the probe. The receiving node may generate a probe request that specifies a plurality of parameters, such as a modulation profile for the probe; the payload content of the probe; the number of times to transmit the probe; a number of symbols for the payload of the probe; a preamble type for the probe; a cyclic-prefix length for the payload of the probe; a transmit power for the probe; and a transmit power scaling factor for the payload of the probe.

10. "probe" and "physical layer probe"

Go to table12

(Dkt. No. 84, at A-10; Dkt. No. 97, at 18; Dkt. No. 104, at 18; Dkt. No. 115, Ex. A, at 7-9 & 11.)

(a) The Parties' Positions

Plaintiff argues that these are different terms and are therefore presumed to have different meanings. (Dkt. No. 97, at 18.) Plaintiff also argues that "Charter's proposed construction imposes on 'probe' a lengthy requirement of a specific function, in clear violation of the rule against importing the specification into the claim." (*Id.* (citation omitted).)

Defendant responds: "Entropic asserts that 'probe' should be construed according to its plain and ordinary meaning, but it does not explain which of the many 'plain meanings' of the word 'probe' applies. Charter's construction, taken from the patent specification, *is* the plain meaning in the context of probes sent between nodes in a network. The DOCSIS specification confirms this." (Dkt. No. 104, at 18.) As for Defendant's proposal of "packet," **[*56]** Defendant submits that "'[p]acket' is in the construction to avoid having the word 'probe' in the construction of 'probe' and because probes *are* packets." (*Id.*)

Plaintiff replies that "Charter grounds its argument to limit 'probe' based on *post-priority, extrinsic* evidence," and "Charter's focus seems to be on the DOCSIS 3.1 cable modems accused of infringement in this case, thereby committing error in construing the claims with reference to the accused devices." (Dkt. No. 110, at 6 (citation omitted).) Also, "with respect to 'physical layer probe,' Charter errs by importing an embodiment into the claims." (*Id.*)

At the June 13, 2023 hearing, Plaintiff alternatively proposed that a "probe" is "a signal used to determine one or more characteristics of a channel." Defendant disagreed with Plaintiff's alternative proposal, but Defendant had no objection to replacing "packet" with "signal" in Defendant's proposed construction.

(b) Analysis

The specification discloses that "probes" are used, for example, to determine characteristics of channels:

> In some instances, probes are sent between nodes of the network in order to allow a receiving node on the network to determine some of the characteristics **[*57]** of the channel between the receiving node and the transmitting node. These

> probes are typically well defined. Accordingly, the receiving node knows before reception what reference signal was transmitted. By comparing the reference probe with the actual received probe, the receiver can determine some of the characteristics of the channel between the transmitting and receiving node.
> * * *
> In various embodiments, these receiver determined probes may be used in a variety of applications. For example, the probes may be used to reach or discover hidden nodes; in networks employing orthogonal frequency division multiple access (OFDMA), the probes may be used for OFDMA subchannel assessment; or in networks accessible by content providers, the probes may be used for off-site network diagnosis.
> * * *
>
> In block 204, the requesting node receives the probe generated according to its earlier probe request. The received probe may then be used in further processing in block 205. In one embodiment, the received probe may be used in channel analysis to determine a bitloading table, FEC and other communication parameters for OFDM or OFDMA signals for future transmissions from the probe transmitter. In another **[*58]** embodiment, post reception processing might comprise generating a report from the probe and transmitting this probe report to the requesting node or to a designated entity.

'690 Patent at 1:48-57, 2:20-27 & 6:59-7:11.

Claim 9 of the '690 Patent is limited to a "physical layer probe," and the subsequent recitals of "the probe" in Claim 9 can be readily understood as referring back to the recital of a "physical layer probe" (emphasis added):

> 9. A method comprising:
>
> a) a first node transmitting a probe request to a second node, the probe request specifying a first plurality of probe parameters for *a physical layer probe*, the first plurality of probe parameters comprising a form for *the probe* including a modulation profile for *the probe*;
>
> b) the first node receiving *the probe* from the second node, wherein *the probe* is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node.

The other independent claim of the '690 Patent that recites a "probe" is Claim 1, which recites (emphasis added):

> 1. A method comprising:
>
> a) receiving in a first node, a probe request specifying a first plurality of parameters associated with the generation and transmission **[*59]** of *a probe*, wherein the first plurality of parameters at least specify content payload of *the probe* and a second node;
>
> b) determining a second plurality of parameters associated with generation and transmission of *the probe*;
>
> c) generating *the probe* in accordance with the first plurality of parameters and the second plurality of parameters, wherein *the probe* has a form dictated by the first plurality of parameters; and
>
> d) transmitting *the probe* from the first node to the second node.

Defendant argues that a "probe," even in Claim 1, is necessarily a physical layer signal. In some cases, "[d]ifferent terms or phrases in separate claims may be construed to cover the same subject matter where the written description and prosecution history indicate that such a reading of the terms or phrases is proper." *Nystrom v. TREX Co., Inc.*, 424 F.3d 1136, 1143 (Fed. Cir. 2005). Defendant submits that the patent speaks only of generating physical layer ("PHY") packets. (Dkt. No. 104, at 18 (citing '690 Patent at 3:3-5, 3:40-64 & 5:59).) Defendant also submits authority that "[t]he preference for giving meaning to all terms, however, is not an inflexible rule that supersedes all other principles of claim construction." *SimpleAir, Inc. v. Sony Ericsson Mobile Commc'ns AB*, 820 F.3d 419, 429 (Fed. Cir. 2016) (citation omitted).

Defendant also cites the DOCSIS specification, **[*60]** which states "[a] probe is a wideband physical-layer signal . . . ." (Dkt. No. 104, Ex. 4, *Data-Over-Cable Service Interface Specifications, DOCSIS 3.1*, at 20 & 57 (CHARTER_ENTROPIC00101891 & CHARTER_ENTROPIC00101928).) This statement, however, is not set forth as a broadly applicable definition but rather is set forth as part of a discussion of a specific feature. *See id.*

On balance, using a "physical layer" probe is a specific feature of particular disclosed embodiments that should not be imported into the claims. *See Phillips*, 415 F.3d at 1323. To the extent Defendant maintains that a

"probe" must be a "physical layer" probe because no other type of probe is disclosed in the specification. Defendant's argument perhaps may pertain to arguments regarding the enablement or written description requirements but does warrant importing such a limitation into the claims.

Further, the recital of "a probe" in Claim 1 and "a physical layer probe" in Claim 9, as set forth above, weighs at least somewhat further against Defendant's proposal of limiting "probe" to being a "physical layer probe." *See id. at 1314* (noting that "terms are normally used consistently throughout the patent," and "[o]ther claims of the patent in question, **[*61]** both asserted and unasserted, can also be valuable sources of enlightenment as to the meaning of a claim term").

As for Defendant's proposal of referring to a "packet," Defendant submits that the patent relates to packet-based networks, disclosing for example:

> In the illustrated embodiment, the communications protocol specifies a packet based communications system. In this embodiment, physical layer (PHY) packets comprise preambles and payloads.

'690 Patent at 3:40-44. The specification, however, refers more broadly to a probe "signal." *Id.* at 1:48-57. As noted above, at the June 13, 2023 hearing, Defendant was amenable to replacing "packet" with "signal."

Finally, at the June 13, 2023 hearing, Defendant urged that Plaintiff is attempting to interpret "probe" to encompass *new* information, which Defendant argued is contrary to the specification and the plain meaning of "probe" as referring to a signal that is already known (so that it can be compared to a reference signal). Defendant's argument in this regard is persuasive at least so far as "probe" should be limited to a signal that can be compared to a reference signal having a known form, and this is consistent with the Description of the Related **[*62]** Art portion of the specification. *See* '690 Patent at 1:48-57 (reproduced above).

The Court therefore hereby construes these disputed terms as follows:

Go to table 13

11. "probe request"

Go to table 14

(Dkt. No. 84, at A-11; Dkt. No. 97, at 19; Dkt. No. 104, at 19; Dkt. No. 115, Ex. A, at 7-12.)

(a) The Parties' Positions

Plaintiff argues that "[t]he plain language of the claims confirms that 'probe request' means exactly what it sounds like—a request for a probe." (Dkt. No. 97, at 19.) Plaintiff also argues that Defendant's **[*63]** proposed construction is confusing and incorporates features that are recited elsewhere in the claims. (*Id.*, at 20.)

Defendant responds that "'probe request' could not possibly have had a plain and ordinary meaning in the context of the alleged invention" because "*[t]he probe request is the invention.*" (Dkt. No. 104, at 19.) Defendant submits that "the specification explains exactly what this allegedly novel 'probe request' is." (*Id.*) Further, Defendant argues that "to whatever extent the inventor's definition of 'probe request' makes that definition redundant with other claim language, the inventor's definition still governs . . . ." (*Id.*, at 20.)

Plaintiff replies that "well-known components can be used or joined in novel ways," and "[h]ere, 'probe request' means simply a request for a probe," which "must meet certain criteria, but those are defined by the other elements of the claim, not by 'probe request' itself." (Dkt. No. 110, at 7.) Plaintiff also argues that "[Defendant's] resort to lexicography fails because the relied-upon passage is a description, not a definition which meets the high and 'exacting' legal hurdle." (*Id.* (citation omitted).)

At the June 13, 2023 hearing, Plaintiff **[*64]** argues that a "probe request" could specify things other than form, such as transmission power.

(b) Analysis

Claim 1 of the '690 Patent recites (emphasis added):

> 1. A method comprising:
>
> a) receiving in a first node, a *probe request* specifying a first plurality of parameters associated with the generation and transmission of a probe, wherein the first plurality of parameters at least specify content payload of the probe and a second node;
>
> b) determining a second plurality of parameters associated with generation and transmission of the probe;

c) generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters; and
d) transmitting the probe from the first node to the second node.

The Brief Summary section of the specification states:

> The receiving node may generate a probe request that specifies a plurality of parameters to be used in such a "receiver determined" probe to generate a probe having the "form" specified by these parameters. Accordingly, the probe request specifies a plurality of parameters associated with the generation and transmission of a probe, including the content **[*65]** of a payload of the probe. In one embodiment, the parameters further include: the modulation profile for the probe; the payload content of the probe; the number of times to transmit the probe; the number of symbols for the payload of the probe; the preamble type for the probe; the cyclic-prefix length for the payload of the probe; the transmit power for the probe; and the transmit power scaling factor for the payload of the probe. Accordingly, the probe that is transmitted in response to the probe request will have a form dictated by the parameters specified in the probe request.

'690 Patent at 2:3-19.

Contrary to Defendant's suggestion that this disclosure amounts to a definition, no lexicography is apparent. That is, Defendant does not identify any expression of a clear intent by the patentee to set forth a definition for the term "probe request." *See* Infeto Access, Inc. v. EchoStar Satellite Corp., 383 F.3d 1295, 1301 (Fed. Cir. 2004) ("It is well-established that the patentee can act as his own lexicographer, so long as he *clearly* states any special definitions of the claim terms in the patent specification or file history.") (emphasis added) (citing Vitronics, 90 F.3d at 1582).

Nonetheless, "terms coined by the inventor are best understood by reference to the specification." Interval Inc. v. Merial Ltd., 617 F.3d 1282, 1287 (Fed. Cir. 2010) (citing Phillips, 415 F.3d at 1315). Plaintiff replies **[*66]** that "'probe request' means simply a request for a probe," but Plaintiff does not demonstrate that the term "probe request" has any established meaning in the art. The above-reproduced disclosure explains that, as used in the '690 Patent, a probe request is sent by one network node to another network node and defines the form of a probe to be generated and transmitted.

As for Defendant's proposal that "[t]he probe request specifies at least the content payload of the probe," however, the above-reproduced disclosure refers to the payload but the above-reproduced claim language already specifically recites "the first plurality of parameters at least specify content payload of the probe and a second node," which weighs against including this specific requirement in the construction of "probe request." *See, e.g.*, Apple, Inc. v. Ameranth, Inc., 842 F.3d 1229, 1237 (Fed. Cir. 2016) ("Construing a claim term to include features of that term already recited in the claims would make those expressly recited features redundant.").

The Court therefore hereby construes **"probe request"** to mean **"a request, sent by one network node to another network node, that specifies the form of a probe to be generated and transmitted."**

12. "generating the probe in accordance with the first [*67] plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters," "wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node," and "the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe"

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(Dkt. No. 84, at A-11—A-12; Dkt. No. 97, at 21; Dkt. No. 104, at 20; Dkt. No. 115, Ex. A, at 7-8 & 10-11.)

(a) The Parties' Positions **[*68]**

Plaintiff argues that these terms are not indefinite because "[a] POSITA would understand there are two sets of parameters—one set which relates to the probe's *form*, and another set relating to any characteristic of the probe." (Dkt. No. 97, at 21.)

Defendant argues that "the claims cover the form of the probe being determined only by the parameters in the probe request," and "[t]his renders the claims indefinite" because "[i]f the parameters determined by the probe transmitter are used to generate the probe, those parameters necessarily contribute to defining the form of the probe," and "it is impossible to imagine a parameter used to generate a probe that does not relate to its

form." (Dkt. No. 104, at 21.)

Plaintiff replies that "the probe may be based on additional information, namely 'information that previously existed within the transmitting node.'" (Dkt. No. 110, at 8 (citing '690 Patent at 6:42-45).)

At the June 13, 2023 hearing, Defendant urged that any parameter used to generate something is related to its form. Plaintiff responded that the probe transmitter can define some parameters, such as transmission power, based on information existing within the transmitter.

(b) Analysis

Claim 1 **[*69]** of the '690 Patent recites (emphasis added):

> 1. A method comprising:
> a) receiving in a first node, a probe request specifying a first plurality of parameters associated with the generation and transmission of a probe, wherein the first plurality of parameters at least specify content payload of the probe and a second node;
> b) determining a second plurality of parameters associated with generation and transmission of the probe;
>
> *c) generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters*; and
> d) transmitting the probe from the first node to the second node.

The "generating . . ." limitation thus involves a "first plurality of parameters" that dictates the form of the probe and a "second plurality of parameters" that is *not* recited as dictating the form of the probe. The manner in which "generating the probe" is "in accordance" with the "second plurality of parameters" thus is not recited.

Defendant does not show that this gives rise to any inconsistency. The same is true as to the ". . . is generated . . ." and "parameters" limitations recited in Claim 9 of the '690 Patent. The indefiniteness **[*70]** opinion of Defendant's expert is unpersuasive. (*See* Dkt. No. 104, Ex. 8, Apr. 4, 2023 Almeroth Decl. at ¶ 84.) Moreover, the opinion of Plaintiff's expert is persuasive that the "second plurality of parameters" could, for example, affect a payload portion of a probe without affecting the form of the probe. (Dkt. No. 97, Ex. 7, Apr. 14, 2023 Kramer Decl. at ¶ 138.)

Also, Plaintiff persuasively argued at the June 13, 2023 hearing that the transmitter of a probe could define some non-form parameters, such as transmission power, timing, or destination, "based upon information that previously existed within the transmitting node." *See* '690 Patent at 6:33-45.

Finally, Defendant argues that "the specification says nothing about putting parameters into probe payloads." (Dkt. No. 104, at 22.) This argument perhaps may pertain to arguments regarding enablement or written description, but this does not raise any concern regarding indefiniteness.

The Court therefore hereby expressly rejects Defendant's indefiniteness argument, and Defendant presents no alternative proposed constructions.

The Court accordingly hereby construes these terms to have their **plain meaning**.

VIII. DISPUTED TERMS IN U.S. PATENT NO. *9,210,362*

The '362 Patent, titled "Wideband **[*71]** Tuner Architecture," issued on December 8, 2015, and bears an earliest priority date of April 19, 2010. Plaintiff submits that the '362 Patent "relates generally to a receiver system configured to receive a number of channels across a broad radio frequency (RF) spectrum." Dkt. No. 97 at 5.

The Abstract of the '362 Patent states:

> A wideband receiver system comprises a mixer module, a wideband analog-to-digital converter (ADC) module, and digital circuitry. The mixer module is configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels. The wideband ADC module is configured to digitize the swatch [*sic*, swath] of frequencies comprising the plurality of desired television channels and the plurality of undesired television channels. The digital circuitry is configured to select the desired plurality of television channels from the digitized plurality of frequencies, and output the selected plurality of television channels to a demodulator as a digital datastream.

13. "downconverting . . . a plurality of frequencies"

and Order of Steps in Claim 11

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(Dkt. No. 84, at A-13; Dkt. No. 97, at 22 & 24; Dkt. No. 104, at 24; Dkt. No. 115, Ex. A, at 12-13.)

(a) The Parties' Positions

Plaintiff submits that "[t]here seems to be general agreement that downconverting is well-understood" and that "[t]he process brings 'down' the frequency of a signal, using a 'mixer' or a 'mixing' process." (Dkt. No. 97, at 23.) Plaintiff argues that no order of steps is required because "[t]here is no grammatical or logical reason why digitizing cannot occur before downconverting or *vice versa* since claim 11 states these steps are performed on the same object—the 'plurality of frequencies.'" (Dkt. No. 97, at 25.) Plaintiff also argues that "because the digitizing step does not refer to the output of the 'downconverting' step (but rather its input), the claim itself **[*73]** requires no particular order of those steps." (*Id.*, at 24.) Further, Plaintiff argues that "[v]iewed in light of the differently ordered embodiments disclosed in the specification, Charter's request for an order of the steps limitation is nothing more than a second attempt by Charter to require that the claimed downconverting is done on an analog signal only." (*Id.*, at 25-26.) Finally, Plaintiff argues that there is no basis for limiting the downconverting to only "radio frequency (RF)" signals. (*Id.*)

Defendant responds that "the language of claim 11 itself dictates that the steps be performed in the order written," and "even if the structure of the claim did not mandate the order of the steps (it does), the specification 'directly or implicitly requires' that the claims be performed in order." (Dkt. No. 104, at 24 & 25 (citation omitted).) "Finally," Plaintiff submits, "claim 11 is written to track the order in which the steps are performed in the specification." (*Id.*, at 26.)

Plaintiff replies that "read in light of the specification, the claim envisions digital and/or analog downconversion of desired and undesired channels." (Dkt. No. 110, at 9.)

At the June 13, 2023 hearing, Defendant **[*74]** argued that Plaintiff is attempting to excise the entire invention from the claim because the purported invention is to reduce the need for expensive analog-to-digital converters by downconverting *before* digitizing. *See* '362 Patent at 2:20-27 & 2:45-55. Plaintiff responded that the Defendant's argument is unavailing because the specification also discloses digital downconversion. *See id.* at 5:31-58 & 9:11-34.

(b) Analysis

"As a general rule, '[u]nless the steps of a method [claim] actually recite an order, the steps are not ordinarily construed to require one.'" *Mformation Techs., Inc. v. Research in Motion Ltd., 764 F.3d 1392, 1398 (Fed. Cir. 2014)* (quoting *Interactive Gift Express, Inc. v. CompuServe Inc., 256 F.3d 1323, 1342 (Fed. Cir. 2001)*).

Courts apply a two-part test to determine whether a particular order of steps is required: "First, we look to the claim language to determine if, as a matter of logic or grammar, they must be performed in the order written," and "[i]f not, we next look to the rest of the specification to determine whether *it* directly or implicitly requires such a narrow construction." *Altiris, Inc. v. Symantec Corp., 318 F.3d 1363, 1369-70 (Fed. Cir. 2003)* (citation omitted).

Claim 11 of the '362 Patent recites (emphasis added):

> 11. A method comprising:
> in a wideband receiver system:
>
> *downconverting*, by a mixer module of said wideband receiver system, *a plurality of frequencies* that comprises a plurality of desired television channels **[*75]** and a plurality of undesired television channels;
>
> *digitizing*, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system, *said plurality of frequencies* comprising said plurality of desired television channels and said plurality of undesired television channels;
>
> *selecting*, by digital circuitry of said wideband receiver system, said plurality of desired television channels from *said digitized plurality of frequencies*; and
>
> *outputting*, by said digital circuitry of said wideband receiver system, *said selected plurality of television channels* to a demodulator as a digital datastream.

In some cases, "the sequential nature of the claim steps

is apparent from the plain meaning of the claim language." *See Mantech Envtl. Corp. v. Hudson Envtl. Servs., Inc.*, 152 F.3d 1368, 1376 (Fed. Cir. 1998); *see also E-Pass Techs., Inc. v. 3Com Corp.*, 473 F.3d 1213, 1222 (Fed. Cir. 2007) ("[B]ecause the language of most of the steps of its method claim refer to the completed results of the prior step, E—Pass must show that all of those steps were performed in order.").

Here, the "downconverting . . ." step and the "digitizing . . ." step both operate on the same "plurality of frequencies," and there is no reference to "completed results of the prior step." *Id.* Rather, the "downconverting . . ." step and the "digitizing . . ." step both refer **[*76]** to the same "plurality of frequencies" without any indication that one of these steps must necessarily be performed before the other. Further, because the "digitizing . . ." step could potentially be performed before the "downconverting . . ." step, the Court rejects Defendant's proposal to limit "downconverting . . . a plurality of frequencies" to downconverting a plurality of frequencies of an *analog* radio frequency (RF) signal.

The "selecting . . ." step, by contrast, refers to "said digitized plurality of frequencies." The "digitizing . . ." step must therefore be performed before the "selecting . . ." step. *Id.*

The "outputting . . ." step refers to "said selected plurality of television channels." The "selecting . . ." step must therefore be performed before the "outputting . . ." step. *Id.*

Finally, Defendant does not persuasively justify limiting the claim to "radio frequency (RF)" signals. Defendant's reliance on the "complex mixer module" 211/221 illustrated in Figure 2 is unavailing. (*See* Dkt. No. 104, at 25-26 (discussing '362 Patent at Fig. 2).) To the extent the specification discloses downconverting radio frequencies, the use of radio frequencies is a particular feature of disclosed **[*77]** embodiments that should not be imported into the claim. *See Phillips*, 415 F.3d at 1323.

The Court therefore hereby construes these disputed terms as follows:

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IX. DISPUTED TERMS IN U.S. PATENT NO. 10,135,682

The '682 Patent, titled "Method and System for Service Group Management in a Cable System," issued on November 20, 2018, and bears an earliest priority date of July 23, 2012. Plaintiff submits that the '682 Patent "relates generally to organizing cable modems (CMs) into service groups based on signal-to-noise ratio (SNR) related metrics." (Dkt. No. 97, at 5.)

The Abstract of the '682 Patent states:

> A cable modem termination system (CMTS) may determine, for a plurality of cable modems served by the CMTS, a corresponding plurality of SNR-related metrics. The CMTS may assigning [*sic*] the modems among a plurality of service groups based on the SNR-related metrics. For any one of the modems, the CMTS may configure physical layer communication **[*78]** parameters to be used by the one of the modems based on a SNR-related metric of a service group to which the one of the modems is assigned. The physical layer communication parameters may include one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate. The CMTS and the modems may communicate using orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers, and the physical layer communication parameters may be determined on a per-subcarrier basis.

14. "a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics"

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(Dkt. No. 84, at A-14; Dkt. No. 97, at 26; Dkt. No. 104, at 27; Dkt. No. 115, Ex. A, at 14.)

(a) The Parties' Positions

Plaintiff argues that "[a]ny POSITA familiar with hybrid fiber coaxial ('HFC') networks understands what is meant by an SNR profile and SNR-related **[*79]** metrics," and "the adjectives 'worst-case' and 'composite' have plain meanings to a POSITA." (Dkt. No. 97, at 26 (citations omitted).) Plaintiff also argues that "[t]he specification confirms the claim terms are used in accord with a POSITA's expectations." (*Id.*)

Defendant responds that "[t]here is nothing about this

limitation that finds any support in the specification." (Dkt. No. 104, at 27.) Defendant argues: "In view of the specification, 'composite SNR-related metric' *cannot* mean a 'composite *best-case* SNR profile.' It can only refer to the 'worst-case.' And the claim is therefore indefinite, as there is no difference between 'composite SNR-related metric' and 'worst-case SNR profile.'" (*Id.*, at 28.)

Plaintiff replies that "Charter's indefiniteness position is a chain of argument ultimately resting on a false equivalence of 'composite SNR-related metric' and 'worst-case SNR profile,'" but "[t]hey are not the same thing." (Dkt. No. 110, at 9.) Plaintiff also submits that "composite metrics based on SNR-related metrics generally (not merely worst-case) are, in fact, disclosed." (*Id.* (citing '682 Patent at 4:40-52).)

At the June 13, 2023 hearing, Defendant argued that Plaintiff does not provide **[*80]** any purported plain meaning for this "composite" term. Defendant submitted that the specification discloses only a "composite worst-case SNR profile." *See* '682 Patent at 4:9-20. Defendant urged that the disputed term is indefinite because the "composite SNR-related metric" cannot be based on the "worst-case SNR profile" if they are both the same thing. Plaintiff responded that "composite" means that something is for more than one cable modem and that a "profile" is something that involves multiple attributes (such as several frequency ranges). Plaintiff concluded that a person of ordinary skill in the art would understand that the term "composite SNR-related metric" relates to multiple cable modems and could be a profile (such as for several different frequency ranges) or could instead be a single composite metric, such as an average.

(b) Analysis

Claim 1 of the '682 Patent recites (emphasis added):

> 1. A method comprising:
>
> determining, by a cable modem termination system (CMTS), for each cable modem served by said CMTS, a *corresponding signal-to-noise ratio (SNR) related metric*;
>
> assigning, by said CMTS, each cable modem among a plurality of service groups based on a respective *corresponding SNR-related metric* ***[*81]*** ;
>
> generating, by said CMTS for each one of said plurality of service groups, *a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics* corresponding to said one of said plurality of service groups;
>
> selecting, by said CMTS, one or more physical layer communication parameter to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and
>
> communicating, by said CMTS, with one or more cable modems corresponding to said one of said plurality of service groups using said selected one or more physical layer communication parameter.

Defendant argues that the specification fails to distinguish between "a composite SNRrelated metric" and "a worst-case SNR profile." This argument perhaps may pertain to arguments regarding enablement or written description, but Defendant does not show any lack of reasonable certainty in the claim language itself. Rather, the claim merely recites a worst-case SNR profile that is based on the SNR-related metrics that correspond to each cable modem, and the composite SNR-related metric, in turn, is based on the worst-case SNR profile. The opinions of Plaintiff's **[*82]** expert are further persuasive in this regard. (*See* Dkt. No. 97, Ex. 7, Apr. 14, 2023 Kramer Decl. at ¶¶ 166 & 168-169; *see, e.g.*, '682 Patent at 4:9-20, 5:7-12 & 5:42-57 & Fig. 2C.) Plaintiff's arguments at the June 13, 2023 hearing (summarized above) are likewise persuasive.

The Court therefore hereby expressly rejects Defendant's indefiniteness argument, and Defendant presents no alternative proposed construction.

The Court accordingly hereby construes **"a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics"** to have its **plain meaning**.

15. "service group[s]"

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(Dkt. No. 84, at A-15; Dkt. No. 97, at 28; Dkt. No. 104, at 28-29; Dkt. No. 115, Ex. A, at 14.)

(a) The Parties' Positions

Plaintiff argues that "[a] 'service group' is a plain English term, and the claim and specification confirm that the groups consist of cable modems (CMs), not *channels*."

(Dkt. **[*83]** No. 97, at 28.) "Furthermore," Plaintiff argues, "Charter is attempting to join the upstream and downstream channels without basis in the claim language and contrary to the specification." (*Id.*)

Defendant responds that "[t]he DOCSIS specification itself provides the plain meaning definition of a 'cable modem service group' in the cable television industry (a definition Charter identified in the P.R. 4-3 statement but which Entropic entirely ignores in its brief) . . . ." (Dkt. No. 104, at 29 (citation omitted).)

Plaintiff replies that "[n]othing in the opposition overcomes the central point—the '682 Patent is described in terms of service groups consisting of groups of cable modems (CMs)." (Dkt. No. 110, at 9.) Plaintiff also argues that "whatever DOCSIS might have later said, its use of terms cannot overcome the '682 Patent's usage." (*Id.*, at 10.)

At the June 13, 2023 hearing, the parties submitted this disputed term without oral argument.

(b) Analysis

Claim 1 of the '682 Patent recites (emphasis added):

> 1. A method comprising:
> determining, by a cable modem termination system (CMTS), for each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;
>
> assigning, by said CMTS, each cable modem among **[*84]** a plurality of *service groups* based on a respective corresponding SNR-related metric;
>
> generating, by said CMTS for each one of said plurality of *service groups*, a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of *service groups*;
>
> selecting, by said CMTS, one or more physical layer communication parameter to be used for communicating with said one of said plurality of *service groups* based on said composite SNR-related metric; and
>
> communicating, by said CMTS, with one or more cable modems corresponding to said one of said plurality of *service groups* using said selected one or more physical layer communication parameter.

Defendant relies on the following portion of a DOCSIS specification:

> Cable Modem Service Group
> In the HFC plant topology, the complete set of downstream and upstream channels within a single CMTS that a single Cable Modem could potentially receive or transmit on. In most HFC deployments, a CM-SG corresponds to a single Fiber Node. Usually, a CM-SG serves multiple CMs.

(Dkt. No. 104, Ex. 5, *Data-Over-Cable Service Interface Specifications, DOCSIS 3.0*, at 11 (CHARTER_ENTROPIC00101160).) **[*85]**

Because this definition refers to a set of channels that each cable modem can use (rather than a set of cable modems in a system of cable modems), this definition does not inform how the term "service group" is used in the '682 Patent, which refers to grouping cable modems:

> FIGS. 4A and 4B illustrate the network of FIG 1, with different groupings of CMs [(cable modems)] based on one or both of: measured performance metric(s) and location within the HFC network.
> * * *
> While FIGS. 3A and 3B depict SNR profiles and location as two separate bases on which to assign CMs to service groups, the two may be used in combination.

See '682 Patent at 2:24-27 & 6:39-41.

The Court therefore hereby expressly rejects Defendant's proposed construction. No further construction is necessary, particularly in light of the above-noted context provided by the specification. *See U.S. Surgical*, 103 F.3d at 1568; ***see also*** *O2 Micro*, 521 F.3d at 1362; *Finjan*, 626 F.3d at 1207; *ActiveVideo*, 694 F.3d at 1326; *Summit 6*, 802 F.3d at 1291; *Bayer*, 989 F.3d at 977-79.

The Court accordingly hereby construes **"service group[s]"** to have its **plain meaning**.

16. "[communicating with/corresponding to] said one of said plurality of service groups"

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(Dkt. No. 84, at A-16; Dkt. No. 97, at 30; Dkt. No. 104, at 30; Dkt. No. 115, Ex. A, at 14-15.)

(a) The Parties' Positions

Plaintiff argues that "Claim 1 itself of the '682 Patent is clear on how service groups, composed of cable modems, and the CMTS communicate . . . ." (Dkt. No. 97, at 30.) Plaintiff also submits that "[t]he specification has a multitude of references to the communication with the service group by way of, for example, physical layer parameters since the invention could not work without communication." (*Id.* (citations omitted).) "Further," Plaintiff argues, "the terms 'communicating,' 'corresponding,' and 'plurality' each have plain English meanings that are well-understood, and the combination of the terms do not create any ambiguity." (*Id.*)

Defendant responds: "There is no antecedent basis for 'said one of said plurality of service groups,' and there is no way to know which one service group among the 'plurality of service groups' the 'communicating' and 'corresponding' steps should be performed on. The claim is therefore indefinite." (Dkt. No. 104, at 30.)

Plaintiff replies:

> The '682 Patent criticizes the folly of lumping all CMs together **[*87]** in a "lowest common denominator" approach. '682 Patent, 5:50-57. Instead, the '682 Patent groups CMs based on their performance (SNR). For each group, the invention can choose communication parameters based on group performance. The chosen parameters are used to communicate with that group. *E.g., id.* at 5:42-50. This is precisely what the claim does. The "generating" step requires creating a composite metric for each service group. The "selecting step" uses the composite metric for a particular service group to choose one or more parameter(s) to use with *that* group. The "communicating" step uses the selected parameter(s) to communicate with *that* group.

(Dkt. No. 110, at 10.)

At the June 13, 2023 hearing, the parties submitted this disputed term without oral argument.

(b) Analysis

Claim 1 of the '682 Patent recites (emphasis added):

> 1. A method comprising:
> determining, by a cable modem termination system (CMTS), for each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;
>
> assigning, by said CMTS, each cable modem among *a plurality of service groups* based on a respective corresponding SNR-related metric;
>
> generating, by said CMTS for *each one of said plurality of service groups*, a composite **[*88]** SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to *said one of said plurality of service groups*;
>
> selecting, by said CMTS, one or more physical layer communication parameter to be used for communicating with *said one of said plurality of service groups* based on said composite SNR-related metric; and
>
> communicating, by said CMTS, with one or more cable modems corresponding to *said one of said plurality of service groups* using said selected one or more physical layer communication parameter.

The recital of "a plurality of service groups" provides antecedent basis for "said plurality of service groups."

The parties dispute whether the recital of "*each one of* said plurality of service groups" provides antecedent basis for "*said one of* said plurality of service groups."

At first blush, the recital of "*said one* of said plurality of service groups" appears to fail to specify *which* one of the *plurality* of service groups. This is the opinion of Defendant's expert. (Dkt. No. 97, Ex. 8, Apr. 4, 2023 Almeroth Decl. at ¶ 97 ("there is no way to know which one service group among the 'plurality of service groups' is being referred to").)

A **[*89]** fair reading, however, is that "*said one of* said plurality of service groups" refers back to "each *one of* said plurality of service groups." In other words, the steps that refer to "said one of said plurality of service groups" must be performed for each and every one of the plurality of service groups. This is apparent on the face of the claim and is also consistent with Figure 3A of the '682 Patent referring to determining parameters "*per* service group," and the opinion of Plaintiff's expert is further persuasive. (*See* Dkt. No. 97, Ex. 7, Apr. 14, 2023 Kramer Decl. at ¶¶ 176-77.) The contrary opinion of Defendant's expert is unpersuasive. (Dkt. No. 97, Ex. 8, Apr. 4, 2023 Almeroth Decl. at ¶ 97.)

Indeed, the claim recites only *one* "one of said plurality of service groups," so the reference to "said one" is reasonably clear. Thus, to whatever extent this term is deemed to lack *explicit* antecedent basis, the

antecedent basis is *implicit*. *See* Energizer Holdings Inc. v. Int'l Trade Comm'n, 435 F.3d 1366, 1371 (Fed. Cir. 2006) (holding that "an anode gel comprised of zinc as the active anode component" provided implicit antecedent basis for "said zinc anode"); *see also Ex Parte Porter*, 25 U.S.P.Q.2d (BNA) 1144, 1145 (B.P.A.I. 1992) ("The term 'the controlled fluid' . . . finds reasonable antecedent basis in the previously recited 'controlled **[*90]** stream of fluid . . . ."); Fisher-Price, Inc. v. Graco Children's Prods., No. 05-1258, 154 F. App'x 903, 909 (Fed. Cir. Nov. 4, 2005) ("[a] claim is not invalid for indefiniteness if its antecedent basis is present by implication") (citations omitted). The burden is on Defendant to show a lack of reasonable certainty, and Defendant has not met that burden. *See* Nautilus, 572 U.S. at 910; *see also* Sonix, 844 F.3d at 1377.

The Court therefore hereby expressly rejects Defendant's indefiniteness argument, and Defendant presents no alternative proposed construction.

The Court accordingly hereby construes **"[communicating with/corresponding to] said one of said plurality of service groups"** to have its **plain meaning**.

X. CONCLUSION

The Court adopts the constructions set forth in this opinion for the disputed terms of the patents-in-suit, and as summarized below.

Go to table21

The parties are **[*93]** **ORDERED** that they may not refer, directly or indirectly, to each other's claim construction positions in the presence of the jury. Likewise, the parties are **ORDERED** to refrain from mentioning any portion of this opinion, other than the actual definitions adopted by the Court, in the presence of the jury. Any reference to claim construction proceedings is limited to informing the jury of the definitions adopted by the Court.

So ORDERED and SIGNED this 26th day of June, 2023.

/s/ Rodney Gilstrap

RODNEY GILSTRAP

UNITED STATES DISTRICT JUDGE

Table1 (*Return to related document text*)

I. BACKGROUND

II. LEGAL PRINCIPLES

III. AGREED TERMS

IV. DISPUTED TERMS IN U.S. PATENT NO. 8,223,775

1. "a data networking engine implemented in a first circuit that includes at least one processor . . ." and "a cable modem engine implemented in a second circuit that includes at least one processor . . ."

2. "data bus"

3. "wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine"

4. "DOCSIS functions"

5. "DOCSIS MAC processor" and "DOCSIS controller"

V. DISPUTED TERMS IN U.S. PATENT NO. 9,825,826

6. "network management messages"

VI. DISPUTED TERMS IN U.S. PATENT NO. 8,792,008

7. "operable to"

8. "digitize a received signal spanning an entire television spectrum comprising a plurality **[*3]** of television channels"

9. "signal monitor," "data processor," and "channelizer"

VII. DISPUTED TERMS IN U.S. PATENT NO. 8,284,690

10. "probe" and "physical layer probe"

11. "probe request"

12. "generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters," "wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node," and "the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe"

VIII. DISPUTED TERMS IN U.S. PATENT NO. *9,210,362*

13. "downconverting . . . a plurality of frequencies" and Order of Steps in Claim 11

IX. DISPUTED TERMS IN U.S. PATENT NO. 10,135,682

14. "a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics"

15. "service group[s]"

16. "[communicating with/corresponding to] said one of said plurality of service groups" ... 58

X. CONCLUSION

Table1 (*Return to related document text*)

Table2 (*Return to related document text*)

Term	Construction
modem engine configured to enable o its software in a manner that is nt of upgrades to the software of the orking engine" nt, Claim 18)	Plain and ordinary meaning
am PDU packets" nt, Claim 18)	Plain and ordinary meaning
rs" nt, Claims 1, 9)	Plain and ordinary meaning
d with [the] generation and on of [a/the] probe" nt, Claim 1)	Plain and ordinary meaning
analog-to-digital converter (ADC) nt, Claim 1)	Plain and ordinary meaning

Table2 (*Return to related document text*)

Table3 (*Return to related document text*)

"a data networking engine implemented in a first circuit that includes at least one processor . . ."
('775 Patent, Claim 18)

Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	Indefinite

"a cable modem engine implemented in a second circuit that includes at least one processor . . ."
('775 Patent, Claim 18)

Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	Indefinite

Table3 (*Return to related document text*)

Table4 (*Return to related document text*)

"data bus"

('775 Patent, Claim 18)

iff's Proposed Construction	**Defendant's Proposed Construction**
and ordinary meaning. nstruction necessary.	Indefinite

Table4 (*Return to related document text*)

Table5 (*Return to related document text*)

"wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home networking functions performed by the data networking engine"

('775 Patent, Claim 18)

Plaintiff's Proposed Construction	**Defendant's Proposed Construct**
Plain and ordinary meaning. No construction necessary.	The cable modem engine and the d networking engine do not share any connecting circuitry, data paths, or memory dev

Table5 (*Return to related document text*)

Table6 (*Return to related document text*)

"DOCSIS functions"
('775 Patent, Claim 19)

oposed Construction	Defendant's Proposed Construction [*27]
nary meaning. n necessary.	Plain and ordinary meaning. No construction necessary. This limitation does not change the scope of claim 18.

Table6 (*Return to related document text*)

Table7 (*Return to related document text*)

"DOCSIS MAC processor"
('775 Patent, Claim 18)

sed Construction	Defendant's Proposed Construction
y meaning. necessary.	The DOCSIS MAC processor as described in the patent specification (see, **[*31]** e.g., '775 Patent at 3:1-20; 4:41-57; id. at FIGs. 1 & 2). Otherwise indefinite.

"DOCSIS controller"
('775 Patent, Claim 18)

sed Construction	Defendant's Proposed Construction
y meaning. necessary.	The DOCSIS controller as described in the patent specification (see, e.g., '775 Patent at 3:21-48; 4:41-57; id. at FIGs. 1 & 2). Otherwise indefinite.

Table7 (*Return to related document text*)

Table8 (*Return to related document text*)

"network management messages"
('826 Patent, Claim 1)

oposed Construction	Defendant's Proposed Construction
nary meaning. n necessary.	Messages which report on the status of the network based on an analysis of the measured characteristics.

Table8 (*Return to related document text*)

Table9 (*Return to related document text*)

"operable to"
('008 Patent, Claim 1)

Plaintiff's Proposed Construction	Defendant's Proposed Construction
Plain and ordinary meaning. No construction necessary.	Configured to

Table9 (*Return to related document text*)

Table10 (*Return to related document text*)

"digitize a received signal spanning an entire television spectrum comprising a plurality of television channels"
('008 Patent, Claim 1)

Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	The "received signal" contains only television channels.

Table10 (*Return to related document text*)

Table11 (*Return to related document text*)

"signal monitor"
"data processor"
"channelizer"
('008 Patent, Claim 1)

osed Construction	Defendant's Proposed Construction
ary meaning. necessary.	Three separate pieces of hardware, configured to perform the functions the claim ascribes to the signal monitor, data processor, and channelizer, respectively.

Table11 (*Return to related document text*)

Table12 (*Return to related document text*)

"probe"
('690 Patent, Claims 1, 7, 8, 9, 11)

sed Construction	Defendant's Proposed Construction
meaning. ecessary.	A packet transmitted to a network node which the node compares to a reference packet having a known form in order to determine **[*55]** characteristics of the channel on which the packet was transmitted.

"physical layer probe"
('690 Patent, Claim 9)

sed Construction	Defendant's Proposed Construction
meaning. ecessary.	"Physical layer probe" means probe. Otherwise indefinite.

Table12 (*Return to related document text*)

Table13 (*Return to related document text*)

Term	Construction
Claim 11)	**"a signal transmitted to a network node that the network node can compare to a reference signal having a known form in order to determine characteristics of the channel on which the signal was transmitted"**
ver probe" Claim 9)	**Plain meaning** (apart from the Court's construction of probe," above)

Table13 (*Return to related document text*)

Table14 (*Return to related document text*)

"probe request"
('690 Patent, Claims 1, 7, 8, 9, 11, 15, 16)

Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	A request sent by a first network node to a second network node which defines the form of a probe to be generated and transmitted by the second network node. The probe request specifies at least the content payload of the probe.

Table14 (*Return to related document text*)

Table15 (*Return to related document text*)

	"generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters" ('690 Patent, Claim 1)
	"wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node" ('690 Patent, Claim 9)
	"the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe" ('690 Patent, Claim 9)
Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	Indefinite

Table15 (*Return to related document text*)

Table16 (*Return to related document text*)

"downconverting . . . a plurality of frequencies"
('362 Patent, Claim 11)

Plaintiff's [*72] Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	Downconverting a plurality of frequencies of an analog radio frequency (RF) signal.

Order of Steps
('362 Patent, Claim 11)

Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	Claimed steps must be performed in the order recited in the claim.

Table16 (*Return to related document text*)

Table17 (*Return to related document text*)

Term	Construction
"downconverting . . . a plurality of frequencies" ('362 Patent, Claim 11)	**Plain meaning**
Order of Steps in Claim 11 of the '362 Patent	**In Claim 11 of the '362 Patent, the "digitizing . . ." step must be performed before the "selecting . . ." step, and the "selecting . . ." step must be performed before the "outputting . . ." step. No other order of steps is required.**

Table17 (*Return to related document text*)

Table18 (*Return to related document text*)

"a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics"
('682 Patent, Claim 1)

Plaintiff's Proposed Construction	**Defendant's Proposed Construction**
Plain and ordinary meaning. No construction necessary.	Indefinite

Table18 (*Return to related document text*)

Table19 (*Return to related document text*)

"service group[s]"
('682 Patent)

oposed Construction	**Defendant's Proposed Construction**
inary meaning. on necessary.	A "service group" is the complete set of downstream and upstream channels within a single CMTS that a single cable modem could potentially receive or transmit on.

Table19 (*Return to related document text*)

Table20 (*Return to related document text*)

[communicating with/corresponding to] said one of said plurality of service groups"
('682 Patent, Claim 1)

ed Construction	**Defendant's Proposed Construction**
dinary meaning. cessary.	Indefinite

Table20 (*Return to related document text*)

Table21 (*Return to related document text*)

Disputed Term	The Court's Construction
"a data networking engine implemented in a first circuit that includes at least one processor . . ." ('775 Patent, Claim 18)	Plain meanings.
"a cable modem engine implemented in a second circuit that includes at least one processor . . ." ('775 Patent, Claim 18)	
"data bus" ('775 Patent, Claim 18)	Plain meaning
"wherein the cable modem functions performed by the cable modem engine are completely partitioned from the home **[*91]** networking functions performed by the data networking engine" ('775 Patent, Claim 18)	"wherein the cable modem engine and the data networking engine are not necessarily physically separate but are functionally separate such that the cable modem functions are performed only by the cable modem engine and the home networking functions are performed only by the data networking engine"
"DOCSIS functions" ('775 Patent, Claim 19)	Plain meaning.
"DOCSIS MAC processor" ('775 Patent, Claim 18)	Plain meanings.
"DOCSIS controller" ('775 Patent, Claim 18)	

Disputed Term	The Court's Construction
"network management messages" ('826 Patent, Claim 1)	"messages which report on the network based on the measured characteristics"
"operable to" ('008 Patent, Claim 1)	"configured to"
"digitize a received signal spanning an entire television spectrum comprising a plurality of television channels" ('008 Patent, Claim 1)	Plain meaning.
"signal monitor" "data processor" "channelizer" ('008 Patent, Claim 1)	Plain meanings.
"probe" ('690 Patent, Claims 1, 7, 8, 9, 11)	"a signal transmitted to a network node that the network node can compare to a reference signal having a known form in order to determine characteristics of the channel on which the signal was transmitted"
"physical layer probe" ('690 Patent, Claim 9)	Plain meaning (apart from the Court's construction of "probe," above).
"probe request" ('690 Patent, Claims 1, 7, 8, 9, 11, 15, 16)	"a request, sent by one network node to another network **[*92]** node, that specifies the form of a probe to be generated and transmitted"
"generating the probe in accordance with the first plurality of parameters and the second plurality of parameters, wherein the probe has a form dictated by the first plurality of parameters"	Plain meanings.

Disputed Term	The Court's Construction
('690 Patent, Claim 1)	
"wherein the probe is generated in accordance with the first plurality of parameters and in accordance with a second plurality of parameters determined by the second node" ('690 Patent, Claim 9)	
"the first plurality of probe parameters comprising a form for the probe including a modulation profile for the probe" ('690 Patent, Claim 9)	
"downconverting . . . a plurality of frequencies" ('362 Patent, Claim 11)	Plain meaning.
Order of Steps ('362 Patent, Claim 11)	In Claim 11 of the '362 Patent, the "digitizing . . ." step must be performed before the "selecting . . ." step, and the "selecting . . ." step must be performed before the "outputting . . ." step. No other order of steps is required.
"a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics" ('682 Patent, Claim 1)	Plain meaning.
"service group[s]" ('682 Patent)	Plain meaning.
"[communicating with/corresponding to] said one of said plurality of service groups"	Plain meaning.

Disputed Term	The Court's Construction
('682 Patent, Claim 1)	

Table21 (*Return to related document text*)

End of Document

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User Name: Manuel Saldana
Date and Time: Tuesday, October 31, 2023 11:23:00AM EDT
Job Number: 209365341

Documents (2)

1. *Maxlinear Inc Awarded Patent for Wideband Tuner Architecture*

Client/Matter: -None-
Search Terms: 9,210,362
Search Type: Natural Language
Narrowed by:

Content Type	Narrowed by
News	-None-

2. *Maxlinear Inc Awarded Patent for Wideband Tuner Architecture*

Client/Matter: -None-
Search Terms: 9,210,362
Search Type: Natural Language
Narrowed by:

Content Type	Narrowed by
News	-None-

Maxlinear Inc Awarded Patent for Wideband Tuner Architecture

Global IP News. Information Technology Patent News

December 8, 2015 Tuesday

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Length: 298 words

Body

Publication Name: Information Technology Patent News Patent Application Number: 14/614,543 Patent Publication Number: ***9,210,362*** International Patent Classification Codes: H04N 5/50 (20130101), H04B 1/0014 (20130101), H04N 21/4263 (20130101), H04N 21/4383 (20130101), H04N 21/454 (20130101), H04N 21/6193 (20130101) Patent Status: Granted

Alexandria, Dec. 8 -- Maxlinear Inc has been awarded a patent for wideband tuner architecture. This invention was developed by Reddy Madhukar, Ling Curtis and Gallagher Tim. The patent application number is 14/614,543. The International Patent Classification codes are H04B 1/16 (20060101), H04N 21/438 (20110101), H04N 21/426 (20110101), H04B 1/00 (20060101), H04N 5/50 (20060101), H04N 21/454 (20110101) and H04N 21/61 (20110101). Cooperative Patent Classification codes are H04N 5/50 (20130101), H04B 1/0014 (20130101), H04N 21/4263 (20130101), H04N 21/4383 (20130101), H04N 21/454 (20130101) and H04N 21/6193 (20130101).

The abstract released by U.S. Patent and Trademark Office states, "A wideband receiver system comprises a mixer module, a wideband analog-to-digital converter (ADC) module, and digital circuitry. The mixer module is configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels. The wideband ADC module is configured to digitize the swatch of frequencies comprising the plurality of desired television channels and the plurality of undesired television channels. The digital circuitry is configured to select the desired plurality of television channels from the digitized plurality of frequencies, and output the selected plurality of television channels to a demodulator as a digital datastream."

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Maxlinear Inc Awarded Patent for Wideband Tuner Architecture

Global IP News. Information Technology Patent News

December 8, 2015 Tuesday

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Length: 300 words

Dateline: New Delhi

Body

FULL TEXT

Publication Name: Information Technology Patent News**Patent Application Number:** 14/614,543**Patent Publication Number:** ***9,210,362*****International Patent Classification Codes:** H04N 5/50 (20130101), H04B 1/0014 (20130101), H04N 21/4263 (20130101), H04N 21/4383 (20130101), H04N 21/454 (20130101), H04N 21/6193 (20130101)**Patent Status:** Granted

Alexandria, Dec. 8 -- Maxlinear Inc has been awarded a patent for wideband tuner architecture. This invention was developed by Reddy Madhukar, Ling Curtis and Gallagher Tim. The patent application number is 14/614,543. The International Patent Classification codes are H04B 1/16 (20060101), H04N 21/438 (20110101), H04N 21/426 (20110101), H04B 1/00 (20060101), H04N 5/50 (20060101), H04N 21/454 (20110101) and H04N 21/61 (20110101). Cooperative Patent Classification codes are H04N 5/50 (20130101), H04B 1/0014 (20130101), H04N 21/4263 (20130101), H04N 21/4383 (20130101), H04N 21/454 (20130101) and H04N 21/6193 (20130101).

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Document (1)

1. *2:23cv1050 Entropic Communications, Llc V. Comcast Corporation Et Al*

Client/Matter: -None-
Search Terms: number(2:23CV1050)
Search Type: Natural Language
Narrowed by:

Content Type	Narrowed by
Dockets	Case Status: Open,Unknown,Closed

2:23cv1050, Entropic Communications, Llc V. Comcast Corporation Et Al

US District Court Docket

United States District Court, California Central

(Western Division - Los Angeles)

This case was retrieved on 10/25/2023

Header

Case Number: ***2:23cv1050***

Date Filed: 02/10/2023
Assigned To: Judge John W. Holcomb
Referred To: Magistrate Judge Karen E. Scott
Nature of Suit: Patent (830)
Cause: Patent Infringement
Lead Docket: 2:23cv01049
Other Docket: 2:22cv07775
Jurisdiction: Federal Question

Class Code: Closed
Closed: 10/16/2023
Statute: 35:271
Jury Demand: Plaintiff
Demand Amount: $0
NOS Description: Patent

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Proceedings

#	Date	Proceeding Text	Source
1	02/10/2023	COMPLAINT Receipt No: ACACDC-34782917 - Fee: $402, filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Exhibit 1, # 2 Exhibit 2, # 3 Exhibit 3, # 4 Exhibit 4, # 5 Exhibit 5, # 6 Exhibit 6, # 7 Exhibit 7, # 8 Exhibit 8, # 9 Exhibit 9, # 10 Exhibit 10, # 11 Exhibit 11, # 12 Exhibit 12, # 13 Exhibit 13, # 14 Exhibit 14, # 15 Exhibit 15, # 16 Exhibit 16, # 17 Exhibit 17) (Attorney Christina N. Goodrich added to party Entropic Communications, LLC(pty:pla))(Goodrich, Christina) (Entered: 02/10/2023)	
2	02/10/2023	CIVIL COVER SHEET filed by Plaintiff Entropic Communications, LLC. (Goodrich, Christina) (Entered: 02/10/2023)	

#	Date	Proceeding Text	Source
3	02/10/2023	Request for Clerk to Issue Summons on Complaint (Attorney Civil Case Opening),, 1 filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Proposed Summons to Comcast Cable Communications, LLC, # 2 Proposed Summons to Comcast Cable Communications Management, LLC)(Goodrich, Christina) (Entered: 02/10/2023)	
4	02/10/2023	Certification and NOTICE of Interested Parties filed by Plaintiff Entropic Communications, LLC. (Goodrich, Christina) (Entered: 02/10/2023)	
5	02/10/2023	NOTICE of Related Case(s) filed by Plaintiff Entropic Communications, LLC. Related Case(s): 2:23-cv-01048; 2:23-cv-01049; 2:22-cv-07775-JWH-JEM; 2:22-cv-07959-JWH-JEM (Goodrich, Christina) (Entered: 02/10/2023)	
6	02/10/2023	REPORT ON THE FILING OF AN ACTION Regarding a Patent or a Trademark (Initial Notification) filed by Entropic Communications, LLC. (Goodrich, Christina) (Entered: 02/10/2023)	
7	02/13/2023	NOTICE OF ASSIGNMENT to District Judge Andre Birotte Jr and Magistrate Judge Autumn D. Spaeth. (lh) (Entered: 02/13/2023)	
8	02/13/2023	NOTICE TO PARTIES OF COURT-DIRECTED ADR PROGRAM filed. (lh) (Entered: 02/13/2023)	
9	02/13/2023	Notice to Counsel Re Consent to Proceed Before a United States Magistrate Judge. (lh) (Entered: 02/13/2023)	
10	02/13/2023	21 DAY Summons Issued re Complaint (Attorney Civil Case Opening), 1 as to Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Attachments: # 1 Summons as to Defendant Comcast Cable Communications, LLC, # 2 Summons as to Comcast Cable Communications Management, LLC) (lh) (Entered: 02/13/2023)	
11	02/14/2023	STANDING ORDER upon filing of the complaint by Judge Andre Birotte Jr. (cb) (Entered: 02/14/2023)	
12	02/15/2023	ORDER RE TRANSFER PURSUANT TO GENERAL ORDER 21-01-Related Case- filed. Related Case No: 2:22-cv-07775 JWH(JEMx). Case transferred from Judge Andre Birotte Jr and Magistrate Judge Autumn D. Spaeth to Judge John W. Holcomb and Magistrate Judge Karen E. Scott for all further proceedings. The case number will now reflect the initials of the transferee Judge 2:23-cv-01050 JWH(KESx). Signed by Judge John W. Holcomb (rn) (Entered: 02/15/2023)	
13	02/21/2023	MINUTE ORDER TO SHOW CAUSE REGARDING CONSOLIDATION (IN CHAMBERS) by Judge John W. Holcomb. The Court ORDERS the parties to show cause why these two cases-Nos. 2:23-cv-01049-JWH-KES and 2:23-cv-01050-JWH-KES should not be consolidated for pretrial purposes in view of the overlap in subject matter. The parties are DIRECTED to file no later than March 10, 2023, a joint response detailing their collective or respective positions regarding pretrial consolidation. A hearing on this Order to Show Cause is SET for March 31, 2023, at 9:00 a.m. in Courtroom 9D of the Ronald Reagan Federal Building and U.S. Courthouse, 411 W. 4th Street, Santa Ana, California. IT IS SO ORDERED. (yl) (Entered: 02/22/2023)	
14	02/23/2023	STANDING ORDER by Judge John W. Holcomb. (cla) (Entered: 02/23/2023)	
15	02/23/2023	PROOF OF SERVICE Executed by Plaintiff Entropic Communications, LLC, upon Defendant Comcast Corporation served on 2/16/2023, answer due 3/9/2023. Service of the Summons and Complaint were executed upon Diana Ruiz, Authorized Agent, CT Corporation System in compliance with	

#	Date	Proceeding Text	Source
		Federal Rules of Civil Procedure by service on a domestic corporation, unincorporated association, or public entity.Original Summons NOT returned. (Goodrich, Christina) (Entered: 02/23/2023)	
16	02/23/2023	PROOF OF SERVICE Executed by Plaintiff Entropic Communications, LLC, upon Defendant Comcast Cable Communications, LLC served on 2/16/2023, answer due 3/9/2023. Service of the Summons and Complaint were executed upon Diana Ruiz, Authorized Agent, CT Corporation System in compliance with Federal Rules of Civil Procedure by service on a domestic corporation, unincorporated association, or public entity.Original Summons NOT returned. (Goodrich, Christina) (Entered: 02/23/2023)	
17	02/23/2023	PROOF OF SERVICE Executed by Plaintiff Entropic Communications, LLC, upon Defendant Comcast Cable Communications Management, LLC served on 2/16/2023, answer due 3/9/2023. Service of the Summons and Complaint were executed upon Diana Ruiz, Authorized Agent, CT Corporation System in compliance with Federal Rules of Civil Procedure by service on a domestic corporation, unincorporated association, or public entity.Original Summons NOT returned. (Goodrich, Christina) (Entered: 02/23/2023)	
18	03/08/2023	Notice of Appearance or Withdrawal of Counsel: for attorney Krishnan Padmanabhan counsel for Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. Adding Krishnan Padmanabhan as counsel of record for Comcast Corporation; Comcast Cable Communications, LLC; and Comcast Cable Communications Management, LLC for the reason indicated in the G-123 Notice. Filed by Defendants Comcast Corporation; Comcast Cable Communications, LLC; and Comcast Cable Communications Management, LLC. (Attorney Krishnan Padmanabhan added to party Comcast Cable Communications Management, LLC(pty:dft), Attorney Krishnan Padmanabhan added to party Comcast Cable Communications, LLC(pty:dft), Attorney Krishnan Padmanabhan added to party Comcast Corporation(pty:dft))(Padmanabhan, Krishnan) (Entered: 03/08/2023)	
19	03/08/2023	Joint STIPULATION Extending Time to Answer the complaint as to All Defendants, re Complaint (Attorney Civil Case Opening)., 1 filed by Plaintiff Entropic Communications, LLC.(Goodrich, Christina) (Entered: 03/08/2023)	
20	03/10/2023	RESPONSE filed by Plaintiff Entropic Communications, LLCto Minutes of In Chambers Order/Directive - no proceeding held,,, Set/Reset Hearing,, 13 - JOINT RESPONSE TO OSC RE CONSOLIDATION (Goodrich, Christina) (Entered: 03/10/2023)	
21	03/21/2023	Joint STIPULATION to Continue Hearing on Order to Show Cause re Consolidation from March 31, 2023 to April 21, 2023 Re: Minutes of In Chambers Order/Directive - no proceeding held,,, Set/Reset Hearing,, 13 filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Proposed Order on Joint Stipulation to Request Continuance)(Goodrich, Christina) (Entered: 03/21/2023)	
22	03/23/2023	ORDER GRANTING JOINT STIPULATION TO REQUEST CONTINUANCE OF HEARING ON ORDER TO SHOW CAUSE REGARDING CONSOLIDATION by Judge John W. Holcomb, re Stipulation to Continue 21 , it is hereby ORDERED that the March 31, 2023, hearing on the Order to Show Cause Regarding Consolidation is CONTINUED from March 31, 2023, to April 21, 2023, at 9:00 a.m. IT IS SO ORDERED. (et) (Entered: 03/23/2023)	

#	Date	Proceeding Text	Source
23	03/30/2023	Joint STIPULATION for Extension of Time to File Answer to May 8, 2023 re Complaint (Attorney Civil Case Opening)., 1 filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Attachments: # 1 Proposed Order)(Padmanabhan, Krishnan) (Entered: 03/30/2023)	
24	03/30/2023	ORDER GRANTING JOINT STIPULATION TO REQUEST AN ADDITIONAL 30-DAY EXTENSION OF TIME FOR DEFENDANT TO ANSWER OR OTHERWISE RESPOND TO PLAINTIFF'S COMPLAINT by Judge John W. Holcomb. Having considered the Parties Joint Stipulation, and for good cause shown, it is hereby ORDERED that the deadline for Defendants to answer or otherwise respond to Plaintiff's Complaint is EXTENDED up to and including May 8, 2023. IT IS SO ORDERED (See document for further details) (yl) (Entered: 03/31/2023)	
25	04/03/2023	MINUTE ORDER TO SHOW CAUSE REGARDING APPOINTMENT OF SPECIAL MASTER REGARDING DISCOVERY DISPUTES (IN CHAMBERS) by Judge John W. Holcomb. These cases will likely generate a substantial number of discovery disputes. For that reason, the Court is considering appointing a Special Master to assist the Court in managing and deciding discovery matters, and, therefore, it issues this order to show cause (OSC). For the foregoing reasons, the Court hereby ORDERS as follows: 1. No later than April 14, 2023, the parties are DIRECTED to respond to this OSC by each filing a statement either consenting to the appointment of a Special Master for discovery purposes or showing cause why a Special Master should not be appointed. 2. A hearing on this OSC is SET for April 21, 2023, at 9:00 a.m. See minute order for details. (lom) (Entered: 04/04/2023)	
26	04/14/2023	STATEMENT JOINTLY SUBMITTED BY THE PARTIES IN RESPONSE TO ORDER TO SHOW CAUSE RE APPOINTMENT OF A SPECIAL MASTER filed by Plaintiff Entropic Communications, LLC re: Minutes of In Chambers Order/Directive - no proceeding held,,,, Set/Reset Deadlines/Hearings,,, 25 . (Goodrich, Christina) (Entered: 04/14/2023)	
27	04/17/2023	APPLICATION of Non-Resident Attorney James A. Shimota to Appear Pro Hac Vice on behalf of Plaintiff Entropic Communications, LLC (Pro Hac Vice Fee - $500 Fee Paid, Receipt No. ACACDC-35149476) filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Proposed Order) (Goodrich, Christina) (Entered: 04/17/2023)	
28	04/17/2023	Notice OF INTERESTED PARTIES (LOCAL RULE 7.1-1) (AMENDED) filed by Plaintiff Entropic Communications, LLC. (Goodrich, Christina) (Entered: 04/17/2023)	
29	04/18/2023	Notice of Appearance or Withdrawal of Counsel: for attorney Peter E Soskin counsel for Plaintiff Entropic Communications, LLC. Adding Peter Soskin as counsel of record for Entropic Communications, LLC for the reason indicated in the G-123 Notice. Filed by Plaintiff Entropic Communications, LLC. (Attorney Peter E Soskin added to party Entropic Communications, LLC(pty:pla))(Soskin, Peter) (Entered: 04/18/2023)	
30	04/20/2023	APPLICATION of Non-Resident Attorney Saranya Raghavan to Appear Pro Hac Vice on behalf of Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation (Pro Hac Vice Fee - $500 Fee Paid, Receipt No. ACACDC-35173283) filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation.	

#	Date	Proceeding Text	Source
		(Attachments: # 1 Proposed Order) (Attorney Diana Hughes Leiden added to party Comcast Cable Communications Management, LLC(pty:dft), Attorney Diana Hughes Leiden added to party Comcast Cable Communications, LLC(pty:dft), Attorney Diana Hughes Leiden added to party Comcast Corporation(pty:dft)) (Leiden, Diana) (Entered: 04/20/2023)	
31	04/21/2023	MINUTE ORDER OF HEARING RE: ORDER TO SHOW CAUSE held before Judge John W. Holcomb. For the reasons stated on the record, the parties are DIRECTED to meet and confer regarding a proposed order pertaining to consolidation and the appointment of Special Master. IT IS SO ORDERED. Court Reporter: Debbie Hino-Span. (yl) (Entered: 04/24/2023)	
32	04/24/2023	Text Only ORDER GRANTING APPLICATIONS of Non-Resident Attorney James A. Shimota, to Appear Pro Hac Vice on behalf of Plaintiff Entropic Communications, LLC 27 , and Non-Resident Attorney Saranya Raghavan, to Appear Pro Hac Vice on behalf of Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, and Comcast Corporation 30 by Judge John W. Holcomb. THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (ev) TEXT ONLY ENTRY (Entered: 04/24/2023)	
33	05/05/2023	Joint STIPULATION for Extension of Time to File Answer to May 15, 2023 re Complaint (Attorney Civil Case Opening),, 1 filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Attachments: # 1 Proposed Order)(Padmanabhan, Krishnan) (Entered: 05/05/2023)	
34	05/08/2023	ORDER GRANTING STIPULATION TO EXTEND TIME TO RESPOND TO COMPLAINT by Judge John W. Holcomb. Having considered the Parties' Joint Stipulation, and for good cause shown, it is hereby ORDERED that the deadline for Defendants to respond to Plaintiffs Complaint is EXTENDED up to and including May 15, 2023. IT IS SO ORDERED. (yl) (Entered: 05/08/2023)	
35	05/14/2023	TRANSCRIPT for proceedings held on 4/21/2023 at 8:59 a.m. ****Transcript may be viewed at the court public terminal or purchased through Court Reporter DEBBIE HINO-SPAAN at: WEBSITE www.debbiehinospaan.com; E-mail, dhinospaan@yahoo.com before the deadline for Release of Transcript restriction. After that date, it may be obtained from the Court Reporter or through PACER. Additional formats of the transcript (ASCII, Condensed, and Word Indexing/Concordance) are also available to be purchased at any time through the Court Reporter. Notice of Intent to Redact due within 7 days of this date.** Redaction Request due 6/5/2023. Redacted Transcript Deadline set for 6/14/2023. Release of Transcript Restriction set for 8/14/2023. (dhs) (Entered: 05/14/2023)	
36	05/14/2023	NOTICE OF FILING TRANSCRIPT filed for proceedings 4/21/2023 at re Transcript 35 THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (dhs) TEXT ONLY ENTRY (Entered: 05/14/2023)	
37	05/15/2023	APPLICATION of Non-Resident Attorney Brian E. Ferguson to Appear Pro Hac Vice on behalf of Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation (Pro Hac Vice Fee - $500 Fee Paid, Receipt No. ACACDC-35315149) filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Attachments: # 1 Proposed Order) (Leiden, Diana) (Entered: 05/15/2023)	

#	Date	Proceeding Text	Source
38	05/15/2023	APPLICATION to file document (Memorandum of Points & Authorities ISO Motion to Dismiss; and Exhibits A, B, C & D to Padmanabhan Declaration in Support Thereof) under seal filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Attachments: # 1 Proposed Order, # 2 Redacted Document - Memorandum of Points & Authorities ISO Motion to Dismiss, # 3 Redacted Document - Exhibit A to Padmanabhan Decl., # 4 Redacted Document - Exhibit B to Padmanabhan Decl., # 5 Redacted Document - Exhibit C to Padmanabhan Decl., # 6 Redacted Document - Exhibit D to Padmanabhan Decl.)(Padmanabhan, Krishnan) (Entered: 05/15/2023)	
39	05/15/2023	SEALED DECLARATION IN SUPPORT OF APPLICATION to file document (Memorandum of Points & Authorities ISO Motion to Dismiss; and Exhibits A, B, C & D to Padmanabhan Declaration in Support Thereof) under seal 38 filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Attachments: # 1 Unredacted Document - Memorandum of Points & Authorities ISO Motion to Dismiss, # 2 Unredacted Document - Exhibit A to Padmanabhan Decl., # 3 Unredacted Document - Exhibit B to Padmanabhan Decl., # 4 Unredacted Document - Exhibit C to Padmanabhan Decl., # 5 Unredacted Document - Exhibit D to Padmanabhan Decl.)(Padmanabhan, Krishnan) (Entered: 05/15/2023)	
40	05/15/2023	NOTICE OF MOTION AND MOTION to Dismiss Complaint Under F.R.C.P. 12(b)(6) filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. Motion set for hearing on 6/30/2023 at 09:00 AM before Judge John W. Holcomb. (Attachments: # 1 Declaration of Krishnan Padmanabhan, # 2 Exhibit A (Redacted), # 3 Exhibit B (Redacted), # 4 Exhibit C (Redacted), # 5 Exhibit D (Redacted), # 6 Exhibit E, # 7 Proposed Order) (Padmanabhan, Krishnan) (Entered: 05/15/2023)	
41	05/15/2023	Corporate Disclosure Statement and Notice of Interested Parties filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Padmanabhan, Krishnan) (Entered: 05/15/2023)	
42	05/15/2023	PROOF OF SERVICE filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation, re Sealed Declaration in SupportDeclaration,, 39 served on 5/15/2023. (Padmanabhan, Krishnan) (Entered: 05/15/2023)	
43	05/16/2023	NOTICE of Deficiency in Electronically Filed Pro Hac Vice Application RE: APPLICATION of Non-Resident Attorney Brian E. Ferguson to Appear Pro Hac Vice on behalf of Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation (Pro Hac Vice Fee - $500 Fee Paid, Receipt 37 . The following error(s) was/were found: Local Rule 5-4.3.4 Application not hand-signed. Other error(s) with document(s): Please note t-hat electronic, image or stamp signatures are not allowed for either applicant or local counsel. See Instructions for Applicants (1). (lt) (Entered: 05/16/2023)	
44	05/17/2023	ORDER SETTING SCHEDULING CONFERENCE by Judge John W. Holcomb. Scheduling Conference set for 6/30/2023 at 9:00 AM before Judge John W. Holcomb. (cla) (Entered: 05/17/2023)	

#	Date	Proceeding Text	Source
45	05/17/2023	SCHEDULING NOTICE AND ORDER by Judge John W. Holcomb: On its own motion, the Court SETS a Status Conference on June 9, 2023, at 11:00 a.m. The parties are DIRECTED to file a Joint Status Report no later than Friday, May 26, 2023, that includes an update regarding the appointment of a Special Master and case consolidation. The parties are DIRECTEDto appear in person in Courtroom 9D, on the 9th Floor of the Ronald Reagan Federal Building and United States Courthouse at 411 W. Fourth Street Santa Ana, CA 92701. IT IS SO ORDERED.THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (cla) TEXT ONLY ENTRY (Entered: 05/17/2023)	
46	05/17/2023	APPLICATION of Non-Resident Attorney Nicholas F. Lenning to Appear Pro Hac Vice on behalf of Plaintiff Entropic Communications, LLC (Pro Hac Vice Fee - $500 Fee Paid, Receipt No. ACACDC-35334406) filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Proposed Order) (Goodrich, Christina) (Entered: 05/17/2023)	
47	05/17/2023	ORDER by Judge John W. Holcomb: Granting 38 Defendants' APPLICATION For Leave to File Under Seal In Connection With Defendants' Motion to Dismiss Under Fed. R.Civ.P.12(B)(6). SEE DOCUMENT FOR FURTHER INFORMATION. (twdb) (Entered: 05/18/2023)	
48	05/18/2023	SEALED NOTICE OF MOTION AND MOTION TO DISMISS UNDER F.R.C.P. 12(b)(6) re Order on Motion for Leave to File Document Under Seal, 47 filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. Motion set for hearing on 6/30/2023 at 09:00 AM before Judge John W. Holcomb. (Attachments: # 1 Exhibit A to Padmanabhan Decl., # 2 Exhibit B to Padmanabhan Decl., # 3 Exhibit C to Padmanabhan Decl., # 4 Exhibit D to Padmanabhan Decl.)(Padmanabhan, Krishnan) (Entered: 05/18/2023)	
49	05/19/2023	Text Only ORDER GRANTING APPLICATION of Non-Resident Attorney Brian E. Ferguson to Appear Pro Hac Vice on behalf of Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation 37 , APPLICATION of Non-Resident Attorney Nicholas F. Lenning to Appear Pro Hac Vice on behalf of Plaintiff Entropic Communications, LLC 46 by Judge John W. Holcomb. THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (cla) TEXT ONLY ENTRY (Entered: 05/19/2023)	
50	05/22/2023	APPLICATION to file document (Motion to Dismiss, Exhibits A and P to Padmanabhan Declaration, and Declaration of David L. Marcus) under seal filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Attachments: # 1 Proposed Order, # 2 Redacted Document - Motion to Dismiss, # 3 Redacted Document - Exhibit A to Padmanabhan Decl., # 4 Redacted Document - Exhibit P to Padmanabhan Decl., # 5 Redacted Document - Declaration of David Marcus)(Padmanabhan, Krishnan) (Entered: 05/22/2023)	
51	05/22/2023	SEALED DECLARATION IN SUPPORT OF APPLICATION to file document (Motion to Dismiss, Exhibits A and P to Padmanabhan Declaration, and Declaration of David L. Marcus) under seal 50 filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Attachments: # 1 Unredacted Document - Motion to Dismiss, # 2 Unredacted Document - Exhibit A to Padmanabhan Decl., # 3 Unredacted Document - Exhibit P to	

#	Date	Proceeding Text	Source
		Padmanabhan Decl., # 4 Unredacted Document - Declaration of David Marcus)(Padmanabhan, Krishnan) (Entered: 05/22/2023)	
52	05/22/2023	NOTICE OF MOTION AND MOTION to Dismiss Under F.R.C.P. 12(b)(1) filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. Motion set for hearing on 6/30/2023 at 09:00 AM before Judge John W. Holcomb. (Attachments: # 1 Declaration of David L. Marcus (Redacted), # 2 Declaration of Krishnan Padmanabhan, # 3 Exhibit A (Redacted), # 4 Exhibit B, # 5 Exhibit C, # 6 Exhibit D, # 7 Exhibit E, # 8 Exhibit F, # 9 Exhibit G, # 10 Exhibit H, # 11 Exhibit I, # 12 Exhibit J, # 13 Exhibit K, # 14 Exhibit L, # 15 Exhibit M, # 16 Exhibit N, # 17 Exhibit O, # 18 Exhibit P (Redacted), # 19 Exhibit Q, # 20 Proposed Order Granting Motion to Dismiss) (Padmanabhan, Krishnan) (Entered: 05/22/2023)	
53	05/22/2023	CERTIFICATE OF SERVICE filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation, re Sealed Declaration in SupportDeclaration,, 51 served on 5/22/2023. (Padmanabhan, Krishnan) (Entered: 05/22/2023)	
54	05/23/2023	APPLICATION to file document (Docket Entries 50-2 and 52) under seal filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Attachments: # 1 Proposed Order)(Padmanabhan, Krishnan) (Entered: 05/23/2023)	
55	05/23/2023	ORDER by Judge John W. Holcomb: Granting 50 Defendants' APPLICATION For Leave to File Under Fed.R.Civ.P 12(B) (1). SEE DOCUMENT FOR FURTHER INFORMATION. (twdb) (Entered: 05/23/2023)	
56	05/23/2023	NOTICE OF MOTION AND MOTION to Dismiss Under F.R.C.P. 12(b)(1) filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. Motion set for hearing on 6/30/2023 at 09:00 AM before Judge John W. Holcomb. (Attachments: # 1 Declaration of David L. Marcus (Redacted), # 2 Declaration of Krishnan Padmanabhan, # 3 Exhibit A (Redacted), # 4 Exhibit B, # 5 Exhibit C, # 6 Exhibit D, # 7 Exhibit E, # 8 Exhibit F, # 9 Exhibit G, # 10 Exhibit H, # 11 Exhibit I, # 12 Exhibit J, # 13 Exhibit K, # 14 Exhibit L, # 15 Exhibit M, # 16 Exhibit N, # 17 Exhibit O, # 18 Exhibit P (Redacted), # 19 Exhibit Q. # 20 Proposed Order Granting Motion to Dismiss) (Padmanabhan, Krishnan) (Entered: 05/23/2023)	
57	05/23/2023	SEALED NOTICE OF MOTION AND MOTION to Dismiss Under Fed. R. Civ. P. 12(B)(1) re Order on Motion for Leave to File Document Under Seal 55 filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. Motion set for hearing on 6/30/2023 at 09:00 AM before Judge John W. Holcomb. (Attachments: # 1 Exhibit A to Padmanabhan Decl., # 2 Exhibit P to Padmanabhan Decl., # 3 Declaration of David L. Marcus ISO Motion to Dismiss)(Padmanabhan, Krishnan) (Entered: 05/23/2023)	
58	05/25/2023	ORDER GRANTING DEFENDANTS' APPLICATION TO FILE UNDER SEAL IN CONNECTION WITH DEFENDANTS' MOTION TO DISMISS UNDER FED. R. CIV. P. 12(B)(1) by Judge John W. Holcomb. It is hereby ORDERED that Defendants' sealing application is GRANTED. (SEE DOCUMENT FOR FURTHER DETAILS.) (rolm) (Entered: 05/25/2023)	
59	05/26/2023	STATUS REPORT re Consolidation and Appointment of Special	

#	Date	Proceeding Text	Source
		Master Prepared Jointly by All Parties filed by Plaintiff Entropic Communications, LLC. (Goodrich, Christina) (Entered: 05/26/2023)	
60	05/26/2023	APPLICATION of Non-Resident Attorney George C. Summerfield to Appear Pro Hac Vice on behalf of Plaintiff Entropic Communications, LLC (Pro Hac Vice Fee - $500 Fee Paid, Receipt No. ACACDC-35393519) filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Proposed Order) (Goodrich, Christina) (Entered: 05/26/2023)	
61	05/30/2023	SCHEDULING NOTICE AND ORDER by Judge John W. Holcomb: On its own motion, the Court CONTINUES the Status Conference from June 9, 2023, at 11:00 a.m., to June 9, 2023, at 9:00 a.m. ***TIME CHANGE ONLY*** The parties are DIRECTED to appear in person in Courtroom 9D, on the 9th Floor of the Ronald Reagan Federal Building and United States Courthouse at 411 W. Fourth Street Santa Ana, CA 92701. IT IS SO ORDERED.THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (ev) TEXT ONLY ENTRY (Entered: 05/30/2023)	
62	05/31/2023	Text Only ORDER GRANTING APPLICATION of Non-Resident Attorney George C. Summerfield to Appear Pro Hac Vice on behalf of Plaintiff Entropic Communications, LLC 60 by Judge John W. Holcomb. THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (ev) TEXT ONLY ENTRY (Entered: 05/31/2023)	
63	06/05/2023	FIRST AMENDED COMPLAINT against Defendats All Defendants amending Complaint (Attorney Civil Case Opening),, 1 , filed by Plaintiff Entropic Communications, LLC (Attachments: # 1 Exhibit 1, # 2 Exhibit 2, # 3 Exhibit 3, # 4 Exhibit 4, # 5 Exhibit 5, # 6 Exhibit 6, # 7 Exhibit 7, # 8 Exhibit 8, # 9 Exhibit 9, # 10 Exhibit 10, # 11 Exhibit 11, # 12 Exhibit 12, # 13 Exhibit 13, # 14 Exhibit 14, # 15 Exhibit 15, # 16 Exhibit 16, # 17 Exhibit 17)(Meggs, Connor) (Entered: 06/05/2023)	
64	06/05/2023	APPLICATION to file document First Amended Complaint under seal filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Redacted Document First Amended Complaint, # 2 Proposed Order)(Meggs, Connor) (Entered: 06/05/2023)	
65	06/05/2023	SEALED DECLARATION IN SUPPORT OF APPLICATION to file document First Amended Complaint under seal 64 filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Unredacted Document First Amended Complaint)(Meggs, Connor) (Entered: 06/05/2023)	
66	06/06/2023	NOTICE OF ERRATA filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation, correcting Sealed Declaration in SupportDeclaration,, 39 , SEALED NOTICE OF MOTION AND MOTION TO DISMISS UNDER F.R.C.P. 12(b)(6) re Order on Motion for Leave to File Document Under Seal, 47 48 (specifically as to Exhibit A only at [39-2][48-1]) ((Padmanabhan, Krishnan) (Entered: 06/06/2023)	
67	06/06/2023	SEALED DOCUMENT Corrected Exhibit A to Declaration of Krishnan Padmanabhan re Sealed Declaration in SupportDeclaration,, 39 , SEALED NOTICE OF MOTION AND MOTION TO DISMISS UNDER F.R.C.P. 12(b)(6) re Order on Motion for Leave to File Document Under Seal, 47 48 , Order on Motion for Leave to File Document Under Seal, 47 filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Attachments: # 1 Exhibit A to Padmanabhan	

#	Date	Proceeding Text	Source
		Decl.)(Padmanabhan, Krishnan) (Entered: 06/06/2023)	
68	06/06/2023	DECLARATION of Louis Campbell re Errata, 66 in Support of Notice of Errata to Comcast Defendants' Motion to Dismiss Under FRCP 12(b)(6) 40 48 filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Padmanabhan, Krishnan) (Entered: 06/06/2023)	
69	06/06/2023	CERTIFICATE OF SERVICE filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation, re Sealed Document., 67 served on 6/6/2023. (Padmanabhan, Krishnan) (Entered: 06/06/2023)	
70	06/06/2023	Joint STIPULATION to Continue Scheduling Conference from 6/30/2023 to 7/21/2023 Re: Initial Order Setting R26 Scheduling Conference - form only 44 filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Attachments: # 1 Proposed Order)(Padmanabhan, Krishnan) (Entered: 06/06/2023)	
71	06/06/2023	NOTICE OF LODGING filed re Amended Complaint/Petition,, 63 (Attachments: # 1 Exhibit A - Redlined First Amended Complaint)(Goodrich, Christina) (Entered: 06/06/2023)	
72	06/08/2023	Joint STIPULATION for Order to Appoint Special Master filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Affidavit of David M. Keyzer Pursuant to Fed. R. Civ. P. 53(b)(3)(A), # 2 Proposed Order)(Goodrich, Christina) (Entered: 06/08/2023)	
73	06/09/2023	MINUTES OF HEARING RE: STATUS CONFERENCE held before Judge John W. Holcomb. Counsel state their appearances. The Court confers with counsel regarding the posture of the case and case schedule. For the reasons stated on the record, the Court hereby ORDERS as follows: 1. In view of the filing of a First Amended Complaint 63 , Defendants Motion to Dismiss 40 and Defendants Sealed Motion to Dismiss 48 52 57 are DENIED as moot. 2. The parties' Joint Stipulation for Continuance of the Scheduling Conference 65 is APPROVED. The Scheduling Conference is CONTINUED to July 21, 2023, at 11:00 a.m. Court Reporter: Debbie Hino-Spaan. (rolm) (Entered: 06/13/2023)	
74	06/20/2023	APPLICATION to file document (Motion to Dismiss under FRCP 12(b)(1) or 12(b)(6) and Exhibits A, Q, S, T, U and V thereto) under seal filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Attachments: # 1 Proposed Order, # 2 Redacted Document - Motion to Dismiss Under FRCP 12(b)(1) or 12(b)(6) in the Alternative, # 3 Redacted Document - Exhibit A, # 4 Redacted Document - Exhibit Q, # 5 Redacted Document - Exhibit S, # 6 Redacted Document - Exhibit T, # 7 Redacted Document - Exhibit U, # 8 Redacted Document - Exhibit V)(Padmanabhan, Krishnan) (Entered: 06/20/2023)	
75	06/20/2023	SEALED DECLARATION IN SUPPORT OF APPLICATION to file document (Motion to Dismiss under FRCP 12(b)(1) or 12(b)(6) and Exhibits A, Q, S, T, U and V thereto) under seal 74 filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Attachments: # 1 Unredacted Document - Motion to Dismiss Under FRCP 12(b)(1) or 12(b)(6), # 2 Unredacted Document - Exhibit A, # 3 Unredacted Document - Exhibit Q, # 4 Unredacted Document - Exhibit S, # 5 Unredacted Document - Exhibit T, # 6 Unredacted Document - Exhibit U, # 7 Unredacted Document - Exhibit V)(Padmanabhan, Krishnan) (Entered: 06/20/2023)	

#	Date	Proceeding Text	Source
76	06/20/2023	NOTICE OF MOTION AND MOTION to Dismiss Under 12(b)(1) or 12(b)(6) in the Alternative filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. Motion set for hearing on 7/21/2023 at 09:00 AM before Judge John W. Holcomb. (Attachments: # 1 Exhibit A (Redacted), # 2 Exhibit B, # 3 Exhibit C, # 4 Exhibit D, # 5 Exhibit E, # 6 Exhibit F, # 7 Exhibit G, # 8 Exhibit H, # 9 Exhibit I, # 10 Exhibit J, # 11 Exhibit K, # 12 Exhibit L, # 13 Exhibit M, # 14 Exhibit N, # 15 Exhibit O, # 16 Exhibit P, # 17 Exhibit Q (Redacted), # 18 Exhibit R, # 19 Exhibit S (Redacted), # 20 Exhibit T (Redacted), # 21 Exhibit U (Redacted), # 22 Exhibit V (Redacted), # 23 Exhibit W, # 24 Exhibit X, # 25 Proposed Order Granting Motion to Dismiss) (Padmanabhan, Krishnan) (Entered: 06/20/2023)	
77	06/21/2023	CERTIFICATE OF SERVICE filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation, re Sealed Declaration in SupportDeclaration,, 75 served on 6/20/2023. (Padmanabhan, Krishnan) (Entered: 06/21/2023)	
78	06/23/2023	ORDER GRANTING DEFENDANTS' APPLICATION FOR LEAVE TO FILE UNDER SEAL IN CONNECTION WITH DEFENDANTS MOTION TO DISMISS UNDER FED. R. CIV. P. 12(B)(1) OR 12(B)(6) IN THE ALTERNATIVE by Judge John W. Holcomb. It is hereby ORDERED that defendant's sealing application is GRANTED. (See document for further details)(yl) (Entered: 06/23/2023)	
79	06/23/2023	EX PARTE APPLICATION to Continue Hearing on Motion to Dismiss from July 21, 2023 to September 22, 2023 Re: NOTICE OF MOTION AND MOTION to Dismiss Under 12(b)(1) or 12(b)(6) in the Alternative 76 filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Declaration of Nicholas F. Lenning, # 2 Exhibit A, # 3 Exhibit B, # 4 Exhibit C, # 5 Exhibit D, # 6 Proposed Order) (Goodrich, Christina) (Entered: 06/23/2023)	
80	06/23/2023	APPLICATION to file document under seal filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Redacted Document Ex Parte Application, # 2 Proposed Order)(Goodrich, Christina) (Entered: 06/23/2023)	
81	06/23/2023	SEALED DECLARATION IN SUPPORT OF APPLICATION to file document under seal 80 filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Unredacted Document Ex Parte Application)(Goodrich, Christina) (Entered: 06/23/2023)	
82	06/24/2023	OPPOSITION to EX PARTE APPLICATION to Continue Hearing on Motion to Dismiss from July 21, 2023 to September 22, 2023 Re: NOTICE OF MOTION AND MOTION to Dismiss Under 12(b)(1) or 12(b)(6) in the Alternative 76 79 filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Attachments: # 1 Declaration of Krishnan Padmanabhan, # 2 Exhibit A to Padmanabhan Decl., # 3 Exhibit B to Padmanabhan Decl., # 4 Exhibit C to Padmanabhan Decl.)(Padmanabhan, Krishnan) (Entered: 06/24/2023)	
83	06/26/2023	ORDER DENYING PLAINTIFF'S EXPARTE APPLICATIONS [ECF No. 87 in the MOCA Case and ECF No. 79 in the Cable Case] (IN CHAMBERS) by Judge John W. Holcomb. For those reasons, the Court hereby ORDERS as follows: For those reasons, the Court hereby ORDERS as follows:For those reasons, the Court hereby ORDERS as follows: Comcast's request to impose sanctions for Entropic's alleged needless multiplication of these proceedings is DENIED. IT IS SO ORDERED. (See document for further details) (yl) (Entered: 06/26/2023)	

#	Date	Proceeding Text	Source
84	06/27/2023	SEALED NOTICE OF MOTION AND MOTION to Dismiss Under FRCP 12(b)(1) or 12(b)(6) in the Alternative, and Sealed Exhibits A, Q, S, T, U, and V in Support Thereof re Order on Motion for Leave to File Document Under Seal, 78 filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. Motion set for hearing on 7/21/2023 at 09:00 AM before Judge John W. Holcomb. (Attachments: # 1 Exhibit A, # 2 Exhibit Q, # 3 Exhibit S, # 4 Exhibit T, # 5 Exhibit U, # 6 Exhibit V)(Leiden, Diana) (Entered: 06/27/2023)	
85	06/28/2023	CERTIFICATE OF SERVICE filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation, re SEALED NOTICE OF MOTION AND MOTION to Dismiss Under FRCP 12(b)(1) or 12(b)(6) in the Alternative, and Sealed Exhibits A, Q, S, T, U, and V in Support Thereof re Order on Motion for Leave to File Document Under Seal, 78 84 served on 6/28/2023. (Leiden, Diana) (Entered: 06/28/2023)	
86	06/30/2023	MEMORANDUM in Opposition to NOTICE OF MOTION AND MOTION to Dismiss Under 12(b)(1) or 12(b)(6) in the Alternative 76 filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Objections to Evidence Submitted in Support of Motion to Dismiss, # 2 Proposed Order re Evidentiary Objections)(Goodrich, Christina) (Entered: 06/30/2023)	
87	06/30/2023	APPLICATION to file document under seal filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Redacted Document Opposition to Motion to Dismiss, # 2 Proposed Order)(Goodrich, Christina) (Entered: 06/30/2023)	
88	06/30/2023	SEALED DECLARATION IN SUPPORT OF APPLICATION to file document under seal 87 filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Unredacted Document Opposition to Motion to Dismiss)(Goodrich, Christina) (Entered: 06/30/2023)	
89	07/05/2023	ORDER GRANTING ENTROPIC'S APPLICATION TO FILE OPPOSITION TO MOTION TO DISMISS UNDER SEAL by Judge John W. Holcomb granting 87 APPLICATION (bm) (Entered: 07/05/2023)	
90	07/05/2023	ORDER APPOINTING DAVID KEYZER, ESQ. AS SPECIAL MASTER FOR DISCOVERY PURPOSES by Judge John W. Holcomb, re Stipulation 72 : Pursuant to Fed. R. Civ. P. 53(b)(3)(A), and good cause shown, it is hereby ORDERED as follows: 1. Appointment: The Court determines that the appointment of David Keyzer, Esq. (the "Special Master") is appropriate under Rule 53(a)(1)(C) of the Federal Rules of Civil Procedure to address pretrial matters that cannot be effectively and timely addressed by an available district judge or magistrate judge in this district. (see document for further details) (bm) (Entered: 07/05/2023)	
91	07/07/2023	NOTICE OF ERRATA filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation, correcting NOTICE OF MOTION AND MOTION to Dismiss Under 12(b)(1) or 12(b)(6) in the Alternative 76 (Attachments: # 1 Declaration of Krishnan Padmanabhan ISO Defendants' Motion to Dismiss Under FRCP 12(b)(1) or 12(b)(6))(Padmanabhan, Krishnan) (Entered: 07/07/2023)	
92	07/07/2023	APPLICATION to file document (Comcast's Reply in Support of Motion to Dismiss; and Exhibits 1 and 2 to Declaration of David Marcus in Support Thereof) under seal filed by Defendants	

#	Date	Proceeding Text	Source
		Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Attachments: # 1 Proposed Order Granting Leave to File Under Seal, # 2 Redacted Document - Comcast's Reply ISO Motion to Dismiss, # 3 Redacted Document - Exhibit 1 to Marcus Decl. ISO Motion to Dismiss, # 4 Redacted Document - Exhibit 2 to Marcus Decl. ISO Motion to Dismiss)(Padmanabhan, Krishnan) (Entered: 07/07/2023)	
93	07/07/2023	SEALED DECLARATION IN SUPPORT OF APPLICATION to file document (Comcast's Reply in Support of Motion to Dismiss; and Exhibits 1 and 2 to Declaration of David Marcus in Support Thereof) under seal 92 filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Attachments: # 1 Unredacted Document - Comcast's Reply ISO Motion to Dismiss, # 2 Unredacted Document - Exhibit 1 to Marcus Decl. ISO Motion to Dismiss, # 3 Unredacted Document - Exhibit 2 to Marcus Decl. ISO Motion to Dismiss)(Padmanabhan, Krishnan) (Entered: 07/07/2023)	
94	07/07/2023	REPLY in Support of NOTICE OF MOTION AND MOTION to Dismiss Under 12(b)(1) or 12(b)(6) in the Alternative 76 filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Attachments: # 1 Comcast's Response to Entropic's Objections to Exhibits Filed ISO Motion to Dismiss, # 2 Declaration of David Marcus ISO Motion to Dismiss, # 3 Exhibit 1 to Marcus Decl. (Redacted), # 4 Exhibit 2 to Marcus Decl. (Redacted))(Padmanabhan, Krishnan) (Entered: 07/07/2023)	
95	07/07/2023	CERTIFICATE OF SERVICE filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation, re Sealed Declaration in SupportDeclaration,, 93 served on 7/7/2023. (Padmanabhan, Krishnan) (Entered: 07/07/2023)	
96	07/07/2023	JOINT REPORT Rule 26(f) Discovery Plan ; estimated length of trial 6 to 8 days, filed by Plaintiff Entropic Communications, LLC.. (Goodrich, Christina) (Entered: 07/07/2023)	
97	07/10/2023	SCHEDULING NOTICE AND ORDER by Judge John W. Holcomb: On its own motion, the Court CONTINUES the hearing on Defendant's Motion to Dismiss [ECF No. 76], Defendant's Sealed Motion to Dismiss [ECF No. 84], and the Scheduling Conference from Friday, July 21, 2023, to Wednesday, August 9, 2023, at 10:00 a.m. The parties are DIRECTED to appear in person in Courtroom 9D, on the 9th Floor of the Ronald Reagan Federal Building and United States Courthouse at 411 W. Fourth Street Santa Ana, CA 92701. IT IS SO ORDERED. THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (cla) TEXT ONLY ENTRY (Entered: 07/10/2023)	
98	07/11/2023	ORDER GRANTING DEFENDANTS' APPLICATION FOR LEAVE TO FILE UNDER SEAL IN CONNECTION WITH DEFENDANTS' REPLY IN SUPPORT OF MOTION TO DISMISS UNDER FED. R. CIV. P. 12(B)(1) OR 12(B)(6) IN THE ALTERNATIVE by Judge John W. Holcomb. It is hereby ORDERED that Defendant's sealing application is GRANTED. IT IS SO ORDERED. (See document for further details) (yl) (Entered: 07/12/2023)	
99	07/12/2023	SEALED REPLY RE NOTICE OF MOTION AND MOTION to Dismiss Under 12(b)(1) or 12(b)(6) in the Alternative 76 , Order on Motion to Dismiss, 98 filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Attachments: # 1 Exhibit 1 to Marcus Decl., # 2 Exhibit 2 to Marcus	

#	Date	Proceeding Text	Source
		Decl.)(Padmanabhan, Krishnan) (Entered: 07/12/2023)	
100	07/12/2023	CERTIFICATE OF SERVICE filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation, re Sealed Reply, 99 served on 7/12/2023. (Padmanabhan, Krishnan) (Entered: 07/12/2023)	
101	07/14/2023	Notice of Appearance or Withdrawal of Counsel: for attorney Kenneth Bridges counsel for Plaintiff Entropic Communications, LLC. Adding Kenneth Bridges as counsel of record for Entropic Communications, LLC for the reason indicated in the G-123 Notice. Filed by Plaintiff Entropic Communications, LLC. (Attorney Kenneth Bridges added to party Entropic Communications, LLC(pty:pla))(Bridges, Kenneth) (Entered: 07/14/2023)	
102	07/17/2023	TRANSCRIPT for proceedings held on 6/9/2023 at 9:05 a.m. ****Transcript may be viewed at the court public terminal or purchased through Court Reporter DEBBIE HINO-SPAAN at: WEBSITE www.debbiehinospaan.com; E-mail, dhinospaan@yahoo.com before the deadline for Release of Transcript restriction. After that date, it may be obtained from the Court Reporter or through PACER. Additional formats of the transcript (ASCII, Condensed, and Word Indexing/Concordance) are also available to be purchased at any time through the Court Reporter. Notice of Intent to Redact due within 7 days of this date.** Redaction Request due 8/7/2023. Redacted Transcript Deadline set for 8/17/2023. Release of Transcript Restriction set for 10/16/2023. (dhs) (Entered: 07/17/2023)	
103	07/17/2023	NOTICE OF FILING TRANSCRIPT filed for proceedings 6/9/2023 at 9:05 a.m. re Transcript 102 THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (dhs) TEXT ONLY ENTRY (Entered: 07/17/2023)	
104	07/24/2023	Notice of Special Master Order No. SM-1 filed by Special Master David M Keyzer, pursuant to July 5, 2023 appointment Order, setting special master preliminary conference for July 26, 2023, at 12:00 P.M., by videoconference (Attachments: # 1 Special Master Order No. SM-1)(Keyzer, David) (Entered: 07/24/2023)	
105	07/26/2023	Notice of Special Master Minutes filed by Special Master David M Keyzer, minutes of preliminary conference conducted by the special master on July 26, 2023, pursuant to the Court's July 5, 2023 Order appointing special master (Attachments: # 1 Special Master Minutes)(Keyzer, David) (Entered: 07/26/2023)	
106	08/01/2023	Notice of Appearance or Withdrawal of Counsel: for attorney Cassidy Young counsel for Plaintiff Entropic Communications, LLC. Adding Cassidy Young as counsel of record for Plaintiff Entropic Communications, LLC for the reason indicated in the G-123 Notice. Filed by Plaintiff Entropic Communications, LLC. (Attorney Cassidy Young added to party Entropic Communications, LLC(pty:pla))(Young, Cassidy) (Entered: 08/01/2023)	
107	08/04/2023	Notice of Special Master Order No. SM-2 filed by Special Master David M Keyzer, regarding Discovery Dispute Resolution Procedures (Attachments: # 1 Special Master Order No. SM-2 re Discovery Dispute Resolution Procedures)(Keyzer, David) (Entered: 08/04/2023)	
108	08/08/2023	NOTICE of Appearance filed by attorney Kelsi Robinson on behalf of Plaintiff Entropic Communications, LLC (Attorney Kelsi Robinson added to party Entropic Communications, LLC(pty:pla))(Robinson, Kelsi) (Entered: 08/08/2023)	
109	08/09/2023	NOTICE TO FILER OF DEFICIENCIES in Electronically Filed Document RE: Notice of Appearance 108 . The following error(s)	

#	Date	Proceeding Text	Source
		was/were found: Incorrect event selected. Correct event to be used is: Notice of Appearance or Withdrawal of Counsel G123.. In response to this notice, the Court may: (1) order an amended or correct document to be filed; (2) order the document stricken; or (3) take other action as the Court deems appropriate. You need not take any action in response to this notice unless and until the Court directs you to do so. (ak) (Entered: 08/09/2023)	
110	08/09/2023	NOTICE OF LODGING filed Slides Presented at August 9, 2023 Hearing re MEMORANDUM in Opposition to Motion, 86 (Young, Cassidy) (Entered: 08/09/2023)	
112	08/09/2023	HEARING RE: MOTION OF DEFENDANT DISH NETWORK CORPORATIONS TO DISMISS COUNTS VI AND X OF THE COMPLAINT [ECF No. 50]; SCHEDULING CONFERENCE held before Judge John W. Holcomb. For the reasons stated on the record, the Court takes the motion [ECF No. 50] under submission. Also for the reasons stated in open court, it is hereby ORDERED as follows: Counsel are DIRECTED to meet and confer forthwith regarding the Claim Construction Schedule. The parties are DIRECTED to file no later than August 18, 2023, a Stipulation and Proposed Order setting a Claim Construction Schedule. IT IS SO ORDERED. Court Reporter: Miriam Baird. (yl) (Entered: 08/11/2023)	
111	08/10/2023	NOTICE OF LODGING filed Slides Presented at August 9, 2023 Hearing re NOTICE OF MOTION AND MOTION to Dismiss Under 12(b)(1) or 12(b)(6) in the Alternative 76 (Padmanabhan, Krishnan) (Entered: 08/10/2023)	
113	08/18/2023	TRANSCRIPT for proceedings held on 8/9/23. Court Reporter/Electronic Court Recorder: miriam baird, phone number mvb11893@aol.com. Transcript may be viewed at the court public terminal or purchased through the Court Reporter/Electronic Court Recorder before the deadline for Release of Transcript Restriction. After that date it may be obtained through PACER. Notice of Intent to Redact due within 7 days of this date. Redaction Request due 9/8/2023. Redacted Transcript Deadline set for 9/18/2023. Release of Transcript Restriction set for 11/16/2023. (Baird, Miriam) (Entered: 08/18/2023)	
114	08/18/2023	NOTICE OF FILING TRANSCRIPT filed for proceedings 8/9/23 re Transcript 113 THERE IS NO PDF DOCUMENT ASSOCIATED WITH THIS ENTRY. (Baird, Miriam) TEXT ONLY ENTRY (Entered: 08/18/2023)	
115	08/18/2023	SUPPLEMENT to MEMORANDUM in Opposition to Motion, 86 filed by Plaintiff Entropic Communications, LLC. (Young, Cassidy) (Entered: 08/18/2023)	
116	08/18/2023	STIPULATION for Order Setting Claim Construction Schedule filed by Plaintiff Entropic Communications, LLC. (Attachments: # 1 Proposed Order)(Young, Cassidy) (Entered: 08/18/2023)	
117	08/21/2023	ORDER by Judge John W. Holcomb GRANTING Stipulation Setting Claim Construction Schedule 116 as follows: Claim Construction Hearing set for 7/16/2024 at 10:00 AM. (See document for further information). (jp) (Entered: 08/22/2023)	
118	09/01/2023	SUPPLEMENT to NOTICE OF MOTION AND MOTION to Dismiss Under 12(b)(1) or 12(b)(6) in the Alternative 76 filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation. (Padmanabhan, Krishnan) (Entered: 09/01/2023)	
119	10/16/2023	Joint STIPULATION to Consolidate Cases as to 2:23-cv-01049-JWH-KES, and 2:23-cv-01050-JWH-KES filed by Defendants Comcast Cable Communications Management, LLC, Comcast Cable Communications, LLC, Comcast Corporation.	

#	Date	Proceeding Text	Source
		(Attachments: # 1 Proposed Order)(Padmanabhan, Krishnan) (Entered: 10/16/2023)	
120	10/16/2023	ORDER GRANTING JOINT STIPULATION TO CONSOLIDATE 119 CASES by Judge John W. Holcomb. The Parties Joint Stipulation to Consolidate Cases is GRANTED. The following cases are CONSOLIDATED into a single action for pretrial purposes through the date of the Markman hearing: Case No. 2:23-cv-01049-JWH-KES and Case No. 2:23-cv-01050-JWH-KES. The Clerk is DIRECTED to close the following case administratively: Case No. 2:23-cv-01050-JWH-KES. IT IS SO ORDERED. Cases associated with Lead Case 2:23-cv-01049-JWH-KES (yl) (Entered: 10/17/2023)	

Patents

Number	Title	Issued	Class	Subclass
8,223,775	Architecture for a flexible and high-performance gateway cable modem	07/17/2012	370	401
8,284,690	Receiver determined probe	10/09/2012	370	252
8,792,008	Method and apparatus for spectrum monitoring	07/29/2014	348	192
9,210,362	Wideband tuner architecture	12/08/2015	1	1
9,825,826	Method and apparatus for spectrum monitoring	11/21/2017	1	1
10,135,682	Method and system for service group management in a cable network	11/20/2018	1	1
11,381,866	Cable television device	07/05/2022	1	1
11,399,206	Method for receiving a television signal	07/26/2022	1	1

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
90/019,255	09/20/2023	9210362	50348.106	5785

23446 7590 11/01/2023
MCANDREWS HELD & MALLOY, LTD
500 WEST MADISON STREET
SUITE 3400
CHICAGO, IL 60661

EXAMINER	
LIE, ANGELA M	

ART UNIT	PAPER NUMBER
3992	

MAIL DATE	DELIVERY MODE
11/01/2023	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Order Granting Request For Ex Parte Reexamination	Control No. 90/019,255	Patent Under Reexamination 9210362	
	Examiner ANGELA M LIE	Art Unit 3992	AIA (FITF) Status No

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

The request for *ex parte* reexamination filed 09/20/2023 has been considered and a determination has been made. An identification of the claims, the references relied upon, and the rationale supporting the determination are attached.

Attachments: a)☐ PTO-892, b)☑ PTO/SB/08, c)☐ Other: ____

1. ☑ The request for *ex parte* reexamination is GRANTED.

RESPONSE TIMES ARE SET AS FOLLOWS:

For Patent Owner's Statement (Optional): TWO MONTHS from the mailing date of this communication (37 CFR 1.530 (b)). **EXTENSIONS OF TIME ARE GOVERNED BY 37 CFR 1.550(c).**

For Requester's Reply (optional): TWO MONTHS from the **date of service** of any timely filed Patent Owner's Statement (37 CFR 1.535). **NO EXTENSION OF THIS TIME PERIOD IS PERMITTED.** If Patent Owner does not file a timely statement under 37 CFR 1.530(b), then no reply by requester is permitted.

/ANGELA M LIE/ Primary Examiner, Art Unit 3992		

cc:Requester (if third party requester)

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

35 USC 325(d)

A review of the post grant history for the underlying patent indicates that there have been no other Office post grant challenges made to the patent (Reexamination Proceedings or *Inter Partes* Review, Post Grant Review, Covered Business Method trials). Accordingly, a discretionary denial of reexamination pursuant to 35 USC 325(d) is not applicable.

Reexamination

Claims 1 and 11 are pending in the Request for Reexamination dated September 20th, 2023.

DECISION ON REQUEST FOR REEXAMINATION

A substantial new question of patentability affecting claims 1 and 11 of US Patent No. 9,210,362 to Reddy et al (the '362 patent, hereafter) is raised by the request for ex parte reexamination.

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The References

(1) "McNeely" WO 2006/119490 to David Lowell McNeely, filed May 4, 2006, published November 9, 2006,

(2) "Pugel" WO 2007/145637 to Michael Anthony Pugel, filed June 16, 2006, published December 21, 2007.

(3) "Gomez" U.S. Patent No. 8,224,274 to Ramon Gomez et al., filed December 17, 2008, and issued July 17, 2012.

Prosecution History

The US Application with a serial number 14/614,543 has been filed on February 5th, 2015. The application included twenty claims with independent claims 1 and 11. On May 14th, 2015, the Examiner has rejected claim 1-20 over claims 1-27 of the US Patent No. 8,526,898 under nonstatutory double patenting. On May 15th, 2015, the Patent Owner filed terminal disclaimer and the Examiner has allowed the claims on August 7th, 2015. As reasons for allowance, the Examiner stated that the prior art made of record teaches a wideband receiver system but does not teach digital circuitry configured to

select a plurality of desired television channels from the digitized plurality of frequencies and output the plurality of television channels to a demodulator as a digital datastream.

Accordingly, the Examiner considers the underlined limitations as the basis for determining whether Substantial New Question of patentability is raised.

Claim 1: A wideband receiver system comprising: a mixer module configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels; a wideband analog-to-digital converter (ADC) module configured to digitize said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels; digital circuitry configured to: select said plurality of desired television channels from said digitized plurality of frequencies; and output said selected plurality of television channels to a demodulator as a digital datastream.

Claim 11: A method comprising: in a wideband receiver system: downconverting, by a mixer module of said wideband receiver system, a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels; digitizing, by a wideband analog-to-digital converter (ADC) module of said wideband receiver system, said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels; selecting, by digital circuitry of said wideband receiver system, said plurality of desired television channels from said digitized plurality of frequencies; and outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream.

Substantial New Question of Patentability

SNQ#1. The Request indicates that the Requester believes McNeely in view of Pugel raises a substantial new question of patentability as to claims 1 and 11.

(See Request Pages 14-32)

With respect to the independent claims 1 and 11, McNeely in view of Pugel raises a substantial new question of patentability because McNeely in view of Pugel teaches the following new, non-cumulative technical feature that may raise a substantial new question of patentability:

"... *selecting, by digital circuitry of said wideband receiver system, said plurality of desired television channels from said digitized plurality of frequencies [1]; and outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream. [2]*"

McNeely in view of Pugel teach the above features which may raise substantial new question of patentability. The limitation [1] is taught by McNeely in column 9:16-26, wherein "*The A/D converter 220 digitizes the processed L-band signal into a series of samples, each sample containing a group of bits*", wherein L-band signal comprises the plurality of desired television channels. See also 10:1-11, wherein channels are being selected. Figure 2 also depicts element 230 which is "digital channel selector". Moreover, claims 7, 13 and 22 are also directed to selecting channels. Limitation [2] is taught by McNeely and Pugel because they "render obvious outputting, by said digital circuitry (e.g., digital channel selector 230 and digital channel recombiner 240)

of said wideband receiver system (e.g. McNeely's receiver system), the selected plurality of television channels (e.g., McNeely's selected channels) to a demodulator (e.g., Pugel's demodulator) as a digital datastream (e.g., selected digital signal)". See McNeely, 10:12-16. Pugel further teaches "*demodulating the plurality of digital RF channels*" and he also teaches receiving plurality of "*digital cable television channels within a single digital receiver circuit*" (paragraphs [0011] and [0012]). Pugel also discloses that *"each digital channel signal is then coupled to a separate demodulator 141, 142 and 143*" (paragraphs [0027] and [0010]).

Therefore, a reasonable examiner would find combination of McNeely and Pugel teachings to be important in determining the patentability of claims 1 and 11 of the '362 patent. The teachings of McNeely and Pugel discussed herein are not cumulative to any written discussion on the record of the teachings of the prior art, were not previously considered nor addressed during a prior examination, and the same question was not the subject of a final holding of invalidity in the Federal Courts.

SNQ#2. The Request indicates that the Requester believes Pugel in view of Gomez raises a substantial new question of patentability as to claims 1 and 11.

(See Request Pages 32-51)

With respect to the independent claims 1 and 11, Pugel in view of Gomez raises a substantial new question of patentability because Pugel in view of Gomez teaches the following new, non-cumulative technical feature that may raise a substantial new question of patentability:

"... selecting, by digital circuitry of said wideband receiver system, said plurality of desired television channels from said digitized plurality of frequencies [1]; and outputting, by said digital circuitry of said wideband receiver system, said selected plurality of television channels to a demodulator as a digital datastream. [2]"

Limitation [1] is taught by Pugel. He teaches "*selecting (e.g., extracts or selects),by digital circuitry(e.g., digital channel select or of the digital tuner) of said wide band receiver system(e.g., Pugel's apparatus), said plurality of desired television channels (e.g., Pugel's digital channels desired to be recovered) from said digitized plurality of frequencies (e.g., from the digitized analog signals). Specifically, Pugel discloses extracting desired television programs (e.g., particular digital channels desired to be recovered) from the down converted, digitized frequencies (e.g., the "downconvert[ed]... first digital signal and ... second digital signal.")*" paragraph [0038] and Figure 3, wherein tuner 130 corresponds to the selecting unit, and wherein "extracting" corresponds to the step of selection, wherein desired information is extracted to be provided to demodulator. See also paragraphs [0042] – [0045] and Abstract. Limitation [2] is also taught by Pugel in paragraphs [0010], [0024], [0040] and Figure 3. More specifically Pugel teaches that each separate analog signal is converted from analog to digital form in an analog-to-digital converter 121, 122 and 123. Each digital channel signal is coupled to a separate demodulator 141, 142 and 143. Then a plurality of demodulator circuits is coupled to the digital tuner.

Therefore, a reasonable examiner would find Pugel in view of Gomez teaching to be important in determining the patentability of claims 1 and 11 of the '362 patent. The teachings of Pugel in view of Gomez discussed herein are not cumulative to any written discussion on the record of the teachings of the prior art, were not previously considered nor addressed during a prior examination, and the same question was not the subject of a final holding of invalidity in the Federal Courts.

NOTICE RE PATENT OWNER'S CORRESPONDENCE ADDRESS

Effective May 16, 2007, 37 CFR 1.33(c) has been revised to provide that: The Patent owner's correspondence address for all communications in an ex parte reexamination is designated as the correspondence address of the patent.

Revisions and Technical Corrections Affecting Requirements for Ex Parte 72 FR 18892 (April, 16, 2007) (Final Rule)

The correspondence address for any pending reexamination proceeding not having the same correspondence address as that of the patent is, by way of this revision to 37 CFR 1.33(c), automatically changed to that of the patent file as of the effective date.

This change is effective for any reexamination proceeding which is pending before the Office as of May 16, 2007, including the present reexamination proceeding, and to any reexamination proceeding which is filed after that date.

Parties are to take this change into account when filing papers, and direct communications accordingly.

In the event the patent owner's correspondence address listed in the papers (record) for the present proceeding is different from the correspondence address of the patent, it is strongly encouraged that the patent owner affirmatively file a Notification of Change of Correspondence Address in the reexamination proceeding and/or the patent (depending on which address patent owner desires), to conform the address of the proceeding with that of the patent and to clarify the record as to which address should be used for correspondence.

Telephone Numbers for reexamination inquiries:

Reexamination	(571) 272-7703
Central Reexam Unit (CRU)	(571) 272-7705
Reexamination Facisimile Transmission No.	(571) 273-9900

Conclusion

Claims 1 and 11 are ordered for reexamination.

Extensions of time under 37 CFR 1.136(a) will not be permitted in these proceedings because the provisions of 37 CFR 1.136 apply only to "an applicant" and not to parties in a reexamination proceeding. Additionally, 35 U.S.C. 305 requires that reexamination proceedings "will be conducted with special dispatch" (37 CFR 1.550(a)). Extension of time in reexamination proceedings are provided for in 37 CFR 1.550(c). After the filing of a request for reexamination by a third party requester, any document filed by either the patent owner of the third party requester must be served on the other

party (or parties where two or more third-party-requester proceedings are merged) in the reexamination proceeding in the manner provided in 37 CFR 1.248. See 37 CFR 1.550(f).

The patent owner is reminded of the continued responsibility under 37 CFR 1.565(a) to apprise the Office of any litigation activity, or other prior or concurrent proceeding, throughout the course of this reexamination proceeding. The third party requester is also reminded of the ability to similarly apprise the Office of any such activity or proceeding throughout the course of this reexamination proceeding. See MPEP § 2207, 2282 and 2286.

All correspondence relating to this *ex parte* reexamination proceeding should be directed:

By EFS-Web: Registered Users may submit correspondence via EFS-Web, at https://efs.uspto.gov/efile/myportal/efs-registered.

By Mail to: Mail Stop *Ex Parte* Reexam
Central Reexamination Unit
Commissioner for Patents
United States Patent & Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

By FAX to: (571) 273-9900
Central Reexamination Unit

By hand: Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314

EFS-Web offers the benefit of quick submission to the particular area of the Office that needs to act on the correspondence. Also, EFS-Web submissions are "soft-

scanned" (i.e., electronically uploaded) directly into the official file for the reexamination proceeding, which offers parties the opportunity to review the content of their submission after the "soft scanning" process is complete.

Any inquiry concerning this communication should be directed to the Central Reexamination Unit at telephone number 571-272-7705.

/ANGELA M LIE/
Primary Examiner, Art Unit 3992

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Primary Examiner, Art Unit 3992

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Supervisory Patent Examiner, Art Unit 3992

Reexamination	Application/Control No.	Applicant(s)/Patent Under Reexamination
	90/019,255	9210362
	Certificate Date	Certificate Number

Requester Correspondence Address: ☐ Patent Owner ☑ Third Party
Haynes and Boone, LLP 2801 N. Harwood St. Suite 2300 Dallas TX 75201

LITIGATION REVIEW ☐	(examiner initials)	(date)
Case Name		Director Initials

COPENDING OFFICE PROCEEDINGS	
TYPE OF PROCEEDING	NUMBER

/ANGELA M LIE/ Primary Examiner, Art Unit 3992	

In place of PTO-1449 Form	U. S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE			*Complete if Known*	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(use as many sheets as necessary)*				Application Number	In Ex Parte Reexamination of 9,210,362
				Filing Date	Herewith
				First Inventor Name	Madhukar Reddy et al.
				Art Unit	TBD
				Examiner Name	TBD
SHEET	1	OF	1	Attorney Docket Number	50348.106

U. S. PATENTS				
Examiner's Initials	**Cite No.**	**Document Number**	**Issue Date MM-DD-YYYY**	**Name of Patentee or Applicant of Cited Document**
/A.M.L/	Exhibit 1005	8,224,274	07-17-2012	Ramon Gomez et al.

U. S. PATENT APPLICATION PUBLICATIONS				
Examiner's Initials	**Cite No.**	**Document Number**	**Publication Date MM-DD-YYYY**	**Name of Patentee or Applicant of Cited Document**

FOREIGN PATENT DOCUMENTS					
Examiner's Initials	**Cite No.**	**Foreign Patent Document (Country Code – Number – Kind)**	**Publication Date MM-DD-YYYY**	**Patentee or Applicant of Cited Document**	**Translation Y/N**
/A.M.L/	Exhibit 1003	WO 2006/119490	11-09-2006	David Lowell McNeely	
/A.M.L/	Exhibit 1004	WO 2007/145637	12-21-2007	Michael Anthony Pugel	

NON-PATENT LITERATURE DOCUMENTS		
Examiner's Initials	**Cite No.**	**Include name of the author (in CAPITAL LETTERS), title of the article, title of the item, date, page(s), volume-issue number(s), publisher, city/country where published**

Examiner Signature	/ANGELA M LIE/	Date Considered	10/30/2023

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include a copy of this form with next communication to applicant.

Customer No. 27683