

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NXP USA, INC.,
Petitioner,

v.

PARKERVISION, INC.,
Patent Owner.

IPR2024-01068
Patent No. 9,118,528

PETITION FOR *INTER PARTES* REVIEW

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EXHIBITS

Exhibit No.	Description
Ex1001	U.S. Patent No. 9,118,528 to David F. Sorrells, et al. (“the ’528 patent”)
Ex1002	Excerpts from the Prosecution History of the ’528 patent (“the Prosecution History”)
Ex1003	Declaration and Curriculum Vitae of Dr. Ian Galton
Ex1004	U.S. Patent No. 6,230,000 (“Tayloe”)
Ex1005	SN74CBT3253 Dual 1-of-4 FET Multiplexer/Demultiplexer Datasheet (“TI Datasheet”)
Ex1006	U.S. Patent No. 4,985,647 (“Kawada”)
Ex1007	C. Cahn, “Combined Digital Phase and Amplitude Modulation Communication Systems,” 1960 IEEE/IRE Transaction on Communication Systems, vol. 8, Issue 3 pp. 150-155
Ex1008	Complaint, <i>ParkerVision, Inc. v. NXP Semiconductors N.V.</i> , 6:23-cv-00389, W.D. Tex., filed May 19, 2023
Ex1009	ParkerVision, Inc.’s Proposed Claim Constructions, <i>NXP Semiconductors N.V.</i> , 6:23-cv-00389, W.D. Tex., filed February 14, 2024
Ex1010	ParkerVision Inc.’s Responsive Claim Construction Brief, <i>ParkerVision, Inc. v. NXP Semiconductors N.V.</i> , 6:23-cv-00389, W.D. Tex., filed March 29, 2024
Ex1011	Reserved

Ex1012	Claim Chart For Infringement of U.S. Patent No. 9,118,528 by NXP Chips, <i>ParkerVision, Inc. v. NXP Semiconductors N.V.</i> , 6:23-cv-00389, W.D. Tex., submitted November 22, 2023
Ex1013	Reserved
Ex1014	Declaration of June Ann Munford
Ex1015	Declaration of Rickea McLeod
Ex1016	Reserved
Ex1017	Razavi, <i>A 900-MHz CMOS Direct Conversion Receiver</i> , IEEE Symposium on VLSI Circuits, Kyoto, Japan, 1997, pp. 113-114, doi: 10.1109/VLSIC.1997.623833.
Ex1018	Declaration of Maureen Honeycutt
Ex1019-1020	Reserved
Ex1021	U.S. Patent No. US 7,065,327 (“MacNally”)
Ex1022	U.S. Provisional Patent Application 60/099,723 (“MacNally-Provisional”), filed September 10, 1998
Ex1023	International Publication No. WO 00/16492 (“Macnally”)
Ex1024-1026	Reserved
Ex1027	D. Scott Langford et al, “A BiCMOS Analog Front-end Circuit for an FDM-Based ADSL System," IEEE Journal of Solid-State Circuits, Vol. 33, no. 9, September 1998, 1383-1393
Ex1028-1040	Reserved
Ex1041	Stipulation

CLAIM LISTING

The challenged claims in this proceeding are claims 1-5, 8, 9, 11-23, 26, 27, 29-36 of the '528 patent, reproduced below:

Claim 1	
1[a]	A system for frequency down-converting a modulated carrier signal to a baseband signal, comprising:
1[b]	a first switch coupled to a first control signal which comprises a sampling aperture with a specified frequency, wherein the first switch is on and a portion of energy that is distinguishable from noise is transferred from the modulated carrier signal as an output of said first switch during the sampling aperture of said first switch;
1[c]	a first energy storage element that stores the transferred energy from the modulated carrier signal and outputs a down-converted in-phase baseband signal portion of said modulated carrier signal;
1[d]	a second switch coupled to a second control signal which comprises a sampling aperture with a specified frequency, wherein the second switch is on and a portion of energy that is distinguishable from noise is transferred from the modulated carrier signal as an output of said second switch during the sampling aperture of the second control signal;
1[e]	a second energy storage element that stores the transferred energy from the modulated carrier signal and outputs a down-converted inverted in-phase baseband signal portion of said modulated carrier signal;
1[f]	wherein the portions of transferred energy from each of the first and second switch are integrated over time to accumulate said portions of transferred energy from which said down-converted in-phase baseband signal portion and said down-converted inverted in-phase baseband signal portion are derived; and
1[g]	a first differential amplifier circuit that combines said down-converted in-phase baseband signal portion with said down-converted inverted in-phase baseband signal portion and outputs a first channel down-converted differential in-phase baseband signal.

Claim 2	
2	The system of claim 1, wherein said modulated carrier signal includes an amplitude variation.
Claim 3	
3	The system of claim 1, wherein said modulated carrier signal includes a phase variation.
Claim 4	
4	The system of claim 1, wherein said modulated carrier signal includes a combination of amplitude variation and phase variation.
Claim 5	
5	The system of claim 1, wherein the first switch is on for less than one-half cycle of the modulated carrier signal.
Claim 8	
8	The system of claim 1, wherein the first and second control signals each control a charging and discharging cycle of their respective energy storage element by respectively controlling the first and second switching devices so that for each switching device said portion of energy that is distinguishable from noise is transferred to the respective storage element when the switch is on during the charging cycle, and a portion of the transferred energy is discharged during the discharging part of the cycle for each respective switching device when the switching device is off.
Claim 9	
9	The system of claim 8, wherein for each respective storage element, the energy discharged during any given discharge cycle is not completely discharged, with the remaining undischarged energy from the given discharge cycle becoming an initial condition for the next charging cycle
Claim 11	
11	The system of claim 1, wherein the frequencies of the first and second apertures have periods that are two (2) percent or greater of the modulated carrier signal's period.
Claim 12	

12	The system of claim 1, wherein the frequencies of the first and second apertures have periods that are five (5) percent or greater of the modulated carrier signal's period.
Claim 13	
13	The system of claim 1, wherein the frequencies of the first and second apertures have periods that are ten (10) percent or greater of the modulated carrier signal's period.
Claim 14	
14	The system of claim 1, wherein the frequencies of the first and second apertures have periods that are twelve and a half (12.5) percent or greater of the modulated carrier signal.
Claim 15	
15	The system of claim 1, further comprising: a first filter that filters said down-converted in-phase baseband signal portion; and a second filter that filters said down-converted inverted in-phase baseband signal portion
Claim 16	
16	The system of claim 15, wherein the first and second filters each comprise a low-pass filter.
Claim 17	
17	The system of claim 1, wherein said portions of transferred energy from each of the first and second switch which are integrated over time to accumulate said portions of transferred energy are integrated by a separate integration module coupled to the output of each said first and second switch.
Claim 18	
18	The system of claim 1, wherein said first and second storage elements are capacitive storage circuits, and wherein said portions of transferred energy from each of the first and second switch which are integrated over time to accumulate said portions of transferred energy are integrated by the capacitive storage circuits as they accumulate charge during successive sampling apertures.

Claim 19	
19	The system of claim 1, further comprising:
19[a]	a third switch coupled to a third control signal which comprises a sampling aperture with a specified frequency, wherein the third switch is on and a portion of energy that is distinguishable from noise is transferred from the modulated carrier signal as an output of said third switch during the sampling aperture of the third control signal;
19[b]	a third energy storage element that stores the transferred energy from the modulated carrier signal and outputs a down-converted quadrature-phase baseband signal portion of said modulated carrier signal;
19[c]	a fourth switch coupled to a fourth control signal which comprises a sampling aperture with a specified frequency, wherein the fourth switch is on and a portion of energy that is distinguishable from noise is transferred from the modulated carrier signal as an output of said fourth switch during the sampling aperture of the fourth signal;
19[d]	a fourth energy storage element that stores the transferred energy from the modulated carrier signal and outputs a down-converted differential ¹ quadrature-phase baseband signal portion of said modulated carrier signal;
19[e]	wherein the portions of transferred energy from each of the third and fourth switch are integrated over time to accumulate said portions of transferred energy from which said down-converted quadrature-phase baseband signal portion and said down-converted differential ² quadrature-phase baseband signal portion are derived; and
19[f]	a second differential amplifier circuit that combines said down-converted quadrature-phase baseband signal portion with said down-converted differential ³ quadrature-phase baseband signal portion and outputs a second channel down-converted differential quadrature-phase baseband signal.

¹ “inverted”

² “inverted”

³ “inverted”

Claim 20	
20	The system of claim 19, wherein said modulated carrier signal includes an amplitude variation.
Claim 21	
21	The system of claim 19, wherein said modulated carrier signal includes a phase variation.
Claim 22	
22	The system of claim 19, wherein said modulated carrier signal includes a phase variation.
Claim 23	
23	The system of claim 19, wherein the third switch is on for less than one-half cycle of the modulated carrier signal.
Claim 26	
26	The system of claim 19, wherein the third and fourth control signals each control a charging and discharging cycle of their respective third and fourth energy storage element by respectively controlling the third and fourth switching devices so that for each third and fourth switching device a portion of energy that is distinguishable from noise is transferred to the respective third and fourth storage element when the respective switch is on during the charging cycle, and a portion of the transferred energy is discharged during the discharging part of the cycle for each respective third and fourth switching device when the respective switching device is off
Claim 27	
27	The system of claim 26, wherein for each respective energy storage element, the energy discharged during any given discharge cycle is not completely discharged, with the remaining undischarged energy from the given discharge cycle becoming an initial condition for the next charging cycle.
Claim 28	
28	The system of claim 26, wherein each said third and fourth control signal operates at an aliasing rate selected so that energy of the modulated carrier signal is sampled and differentially applied to the respective

	energy storage element at the frequency of the respective third and fourth control signal's aperture, and each respective third and fourth energy storage element generates, respectively, said differential down-converted in-phase baseband signal portion and said down-converted inverted in-phase baseband signal portion of said modulated carrier signal from the alternate charging and discharging applied to the respective energy storage elements.
Claim 29	
29	The system of claim 19, wherein the frequencies of the third and fourth apertures have periods that are two (2) percent or greater of the modulated carrier signal's period.
Claim 30	
30	The system of claim 19, wherein the frequencies of the third and fourth apertures have periods that are five (5) percent or greater of the modulated carrier signal's period.
Claim 31	
31	The system of claim 19, wherein the frequencies of third and fourth apertures have periods that are ten (10) percent or greater of the modulated carrier signal's period
Claim 32	
32	The system of claim 19, wherein the frequencies of third and fourth apertures have periods that are twelve and a half (12.5) percent or greater of the modulated carrier signal's period
Claim 33	
33	The system of claim 19, further comprising: a first filter that filters said down-converted in-phase baseband signal portion; a second filter that filters said down-converted inverted in-phase baseband signal portion; a third filter that filters said down-converted quadrature-phase baseband signal portion; a fourth filter that filters said down-converted inverted quadrature-phase baseband signal portion.
Claim 34	

34	The system of claim 33, wherein the first, second, third, and fourth filters each comprise a low-pass filter.
Claim 35	
35	The system of claim 19, wherein said portions of transferred energy from each of the first, second, third and fourth switch which are integrated over time to accumulate said portions of transferred energy are integrated by a separate integration module coupled to the output of each said first, second, third and fourth switch respectively
Claim 36	
36	The system of claim 19, wherein said first, second, third and fourth storage elements are capacitive storage circuits, and wherein said portions of transferred energy from each of the first, second, third, and fourth switch which are integrated over time to accumulate said portions of transferred energy are integrated by the capacitive storage circuits of the respective first, second, third and fourth storage elements as they accumulate charge during successive sampling apertures.

NXP USA, Inc. petitions for *inter partes* review of claims 1-5, 8, 9, 11-23, 26, 27, and 29-36 (“the Challenged Claims”) of U.S. Patent No. 9,118,528 (“the ’528 patent”). Compelling evidence presented herein demonstrates at least a reasonable likelihood that Petitioner will prevail with respect to at least one of the Challenged Claims.

I. REQUIREMENTS FOR IPR

A. Grounds for Standing

Petitioner certifies that the ’528 patent is available for IPR and that it is not barred or estopped from requesting review.

B. Challenge and Relief Requested

The Challenged Claims are unpatentable as identified in the table below and as further explained in this Petition and in the Declaration of Dr. Ian Galton. Ex1003, ¶¶23-326.

Ground	Claim(s)	35 U.S.C. § 103
1A	1, 5, 8, 9, 11-19, 23, 26, 27, 29-36	Tayloe, TI datasheet, and Macnally
1B	2-4, 20-22	Tayloe, TI datasheet, Macnally, and Cahn
2A	1, 5, 8-9, 11-19, 23, 26-28, 30-36	Razavi, and Macnally
2B	2-4, 20-22	Razavi, Macnally, and Cahn

Petitioner disputes that the Challenged Claims are entitled to the benefit of the entire priority claimed by the '528 patent, which includes continuations-in-part. Nonetheless, each reference pre-dates October 21, 1998 (“Critical Date”), the earliest possible priority date claimed by the '528 patent, and thus qualifies as prior art at least as shown in the table below.

Reference	Date	Pre-AIA Section
Tayloe	October 15, 1998 (filed)	102(e)
TI Datasheet	July 28, 1998 (publicly available)	102(a)
Cahn	1960 (published)	102(b)
Macnally	September 10, 1998	102(e)
Razavi	June, 1997	102(b)

As described in the Declaration of TI Senior Paralegal, Maureen Honeycutt (Ex1018), TI datasheet was publicly accessible to those interested in the operation of TI products on TI’s searchable website, beginning July 28, 1998. Ex1018, ¶¶12-17. Cahn was published in the September 1960 edition of *IRE Transactions on Communication* which was held, indexed, and publicly accessible at multiple libraries including the University of Pittsburgh since its publication. Ex1014, ¶¶6-9. Razavi was published in *1997 Symposium on VLSI Circuits*, which were acquired,

indexed, and made publicly accessible by SUNY Polytechnic Institute on or around October 13, 1997. Ex1014, ¶¶28-30. Furthermore, both were published by a “well-known, reputable compiler and publisher.” *Ericsson Inc. v. Intell. Ventures I LLC*, IPR2014-00527, Paper 41 at 10-11 (PTAB May 18, 2015); *see also VidStream LLC v. Twitter, Inc.*, 981 F.3d 1060, 1065-66 (Fed. Cir. 2020).

C. Claim Construction

Petitioner interprets the claims pursuant to their plain-and-ordinary meaning, except as explained below. Petitioner reserves the right to address any construction proposed by Patent Owner or the Board.

1. “Storage Element” or “Energy Storage Element”

The ’528 patent Claims recite “**storage element**” and “**energy storage element**” interchangeably. Ex1001, Claims 1, 8-9, 18.

The two terms are synonyms and should be construed to mean “*an element of a system that stores non-negligible amounts of energy from an input EM signal*,” as determined by the Board and affirmed by the Federal Circuit. IPR2020-01265, Paper 44 (invalidating claim 3 of US, 7,110,444); *ParkerVision, Inc. v. Vidal*, 88 F.4th 969, 976 (Fed. Cir. Dec. 15, 2023) (holding “ParkerVision acted as its own lexicographer to define the term ‘storage element’” and “the Board’s construction of ‘storage element’ [quoted above] correctly tracks the lexicography provided by [ParkerVision]”) (citing US6,061,551 (’551 patent), 66:55-67).

The Board’s construction of “storage element” in that case was based on the ’444 patent’s “incorporation of the ’551 patent by reference.” IPR2020-01265, Paper 44, 32. The same patent 6,061,551 is incorporated by reference in the ’528 patent. Ex1001, 1:30-34. As affirmed, *de novo*, by the Federal circuit, “[t]he critical paragraph [’551 patent, 66:55-67] clearly expresses an intent to define the term ‘storage element’” and “ParkerVision concedes as much.” *ParkerVision*, 88 F.4th 969, 976 (“... this paragraph of the ’551 patent then shifts to generally defining the terms ‘storage module’ and ‘storage capacitance’ ... as ‘terms,’ [used by] the patent document as a whole....”). The Federal Circuit thus rejected ParkerVision’s contention that “restricts a ‘storage element’ to an element of *an energy transfer system*” as if “this term [‘storage element’] by itself necessarily invokes *an entire energy transfer system*.” *Id.*; IPR2020-01265, Paper 44, 35-36 (“[t]his [critical] portion of the ’551 patent specification [66:59–67] provides a lexicographic definition of the systems to which the terms refer”).

The ’528 patent includes an identical disclosure to that deemed dispositive from the incorporated by reference ’551 patent. Ex1001, 73:9-22 (defining “storage module” and “storage capacitance”). “Energy storage element” should be construed in accordance with the express definition provided in the specification. *Martek Biosciences Corp. v. Nutrinova, Inc.*, 579 F.3d 1363, 1380 (Fed. Cir. 2009). ParkerVision cannot credibly dispute that this definition controls because it

advocated for this construction in a proceeding before the PTAB regarding a third ParkerVision Patent with the same disclosure, arguing that this passage in the specification “explicitly defines a storage module.” *RPX Corp. v. ParkerVision, Inc.*, IPR2014-00948, Paper 7 at 21-22 (PTAB Sep. 24, 2014).

No intrinsic evidence demands a different construction. Claim 1 of the ’528 patent merely mentions “system,” “energy,” and “transfer” in isolation, but does not recite “energy transfer system,” let alone restrict the claimed “storage element” to any energy transfer system. The five sentences from the specification relied on by ParkerVision are the same five sentences from the ’551 patent incorporated by reference. *Compare* Ex1001, 73:9-22 (cited by Ex1010 at 5) *with* ’551 patent, 66:55-67 (cited by *ParkerVision*, 88 F.4th 969, 976). The file history likewise does not support a different construction. §II.B (allowance after claim replacement with no discussion of any energy transformer system).

As demonstrated in §III, the proposed combinations teach the claimed “storage element” or “energy storage element,” even including the alleged condition of “low impedance load” that purportedly “goes to the heart of what makes an element, a ‘storage’ element.” IPR2020-01265, Paper 26 (PO Sur-reply),13; Ex1003, ¶¶72-80.

D. Level of Ordinary Skill in the Art

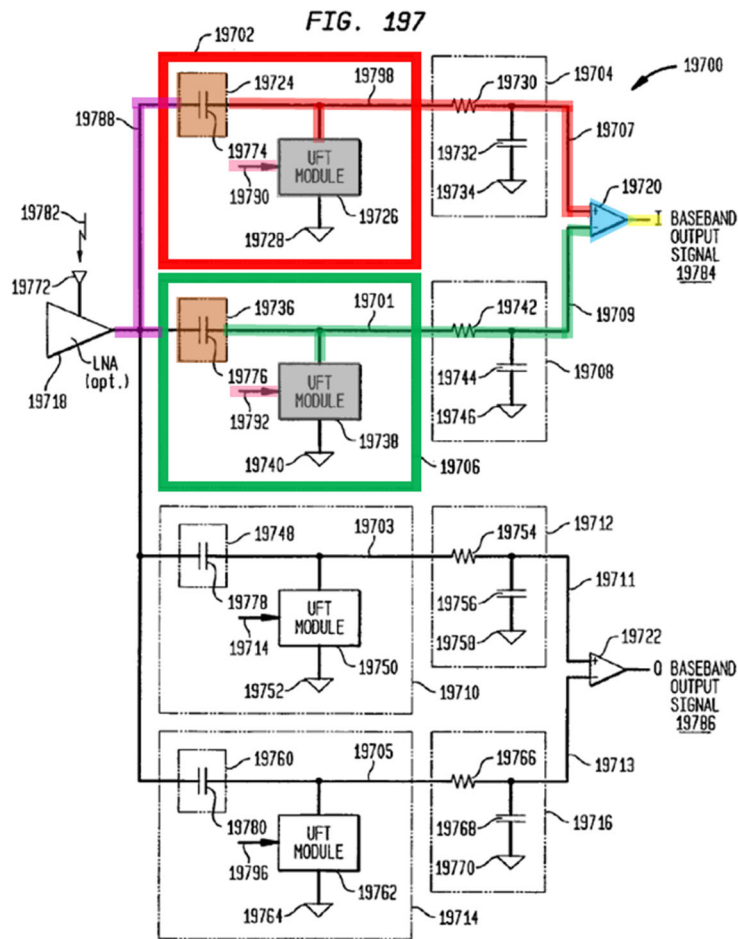
A person of ordinary skill in the art (“POSITA”) as of the ’528 patent’s priority date (October 21, 1998) would have had at least a bachelor’s degree in electrical engineering or a related subject and two or more years of experience in the field of EM circuit design. Less work experience may be compensated by a higher level of education, such as a master’s degree. Ex1003, ¶¶68-71.

II. THE ’528 PATENT

A. Brief Description

The ’528 patent purports to improve “conventional signal processing technology,” (Ex1001, 2:28-32), by “down-converting an electromagnetic (EM) signal.” *Id.*, Abstract.

Specifically, the ’528 patent describes “an example I/Q modulation receiver 19700 [that] receives, down-converts, and demodulates a I/Q modulated RF input signal 19782 to an I baseband output signal 19784, and a Q baseband output signal 19786.” Ex1001, 176:38-55, 56-60. The I/Q modulation receiver 19700 includes first (19702), second (19706), third (19710), and fourth (19714) processing modules, all receiving amplified I/Q signal 19788. *Id.*, 176:61-179:52.



Ex1001, FIG. 197 (annotated)

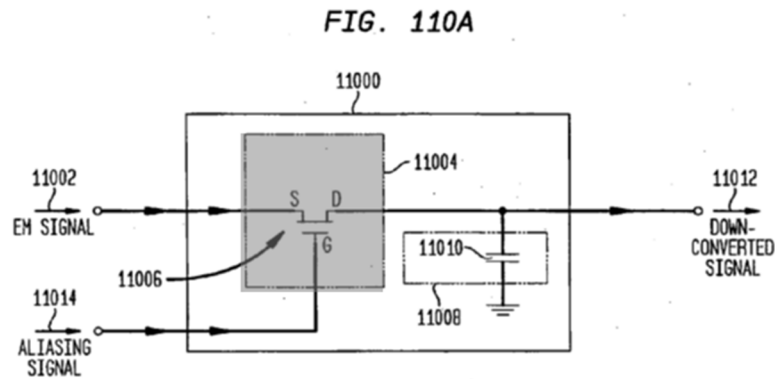
“First Processing module 19702 [red] down-converts the I-phase signal portion of amplified input I/Q signal 19788 [purple] according to an I control signal 19790 [orange].” Ex1001, 176:61-177:10 (“first Processing module 19702 comprises a first storage module 19724 [(brown)], a first UFT module 19726 [(gray)]” and “a switch contained within first UFT module 19726 opens and closes as a function of control signal 19790 [to generate] a down-converted signal, referred to as I output signal 19798”).

“Second Processing module 19706 down-converts the inverted I-phase signal portion of amplified input I/Q signal 19788 according to an inverted I control signal 19792.” Ex1001, 177:32-34, 36-48 (similar arrangement).

I output signal 19798 and inverted I output signal 19701 are filtered to generate, respectively, filtered I output signal 19707 and filtered inverted I output signal 19709. Ex1001, 177:16-30, 177:55-178:2. “First differential amplifier 19720 receives filtered I output signal 19707 [and] filtered inverted I output signal 19709” to generate “I baseband output signal 19784.” *Id.*, 178:3-8.

Similarly, third processing module 19710 and fourth processing module 19714 also operate on amplified input I/Q signal 19788 and produce, respectively, Q output signal 19703 and inverted Q output signal 19705, which are filtered and provided to “[s]econd differential amplifier 19722.” Ex1001, 178:26-179:22, 179:34-40.

The ’528 patent discloses examples of UFT module as FET switches. *E.g.*, 108:30-31(“an-channel FET 11006”), 109:56-57, 108:40-51; Ex1003, ¶52-61.



Ex1001, FIG. 110A (annotated)

The Challenged Claims are directed to the down-conversion apparatus shown in Fig. 197. For example, independent claim 1 recites two of the four processing modules, while dependent claim 19 recites the other two. Ex1001, 192:32-196:29; Ex1003, ¶¶62-63. As demonstrated in §III, these limitations were well-known before the Critical Date.

B. Prosecution History

The Challenged Claims were allowed when Applicant replaced original claim 1 with a new set of claims 2-37 citing, e.g., Fig. 197 of the specification. Ex1002, 1601-13 (Response on 3/9/2015 to Office Action). The new set of claims became issued claims 1-36. Ex1003, ¶64.

Applicant alleged that US 6,192,225 (Arpaia), the prior art applied by the Examiner, “does not mention any kind of sampling signal that, as applied to a switch, serves to provide energy of the modulated carrier signal [that] is sampled and

differentially applied to the respective integration module and energy storage elements at the frequency of the respective control signal's aperture as set forth in the claims.” Id., 1603 (emphasis original). Applicant further asserted that Arpaia does not teach or suggest “the portions of transferred energy from each of the first and second switch [being] integrated over time to accumulate said portions of transferred energy from which said down-converted in-phase baseband signal portion and said down-converted inverted in-phase baseband signal portion are derived,” as recited by issued claim 1. *Id.*, 1604; Ex1003, ¶¶65-66.

As demonstrated below, the alleged features were well-known by the Critical Date.

III. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. [GROUND 1A] – Tayloe, TI datasheet, and Macnally render obvious claims 1, 5, 8, 9, 11-19, 23, 26, 27, 29-36

1. Tayloe

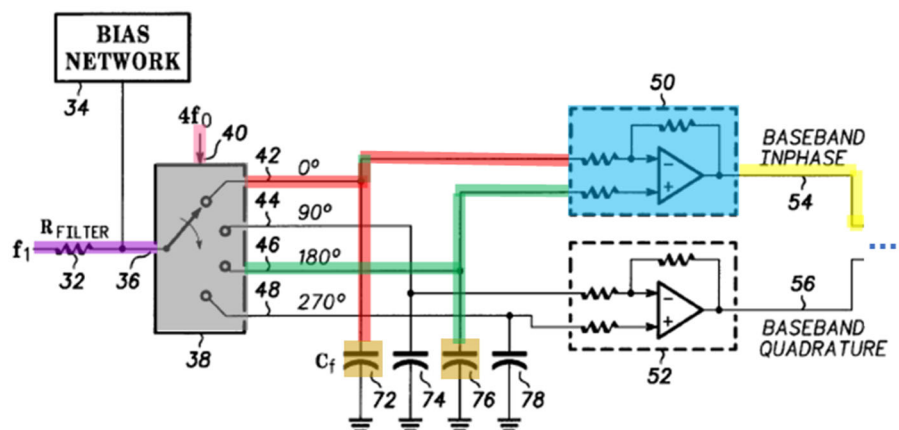
Tayloe describes a direct conversion receiver “for converting a signal to baseband.” Ex1004, Abstract, 1:51-52. Tayloe explains that its direct conversion receiver

includes a commutating switch which serves to sample an RF waveform four times per period at the RF frequency. The samples are integrated over time to produce an average voltage at 0 degrees, 90 degrees, 180 degrees and 270 degrees. The average voltage at 0 degrees is the baseband in-phase signal . . .

.

Id., Abstract. Tayloe discloses that, “to increase gain, the 0 degree average can be differentially summed with the 180 degree average to form the baseband in-phase signal” *Id.* Tayloe states that “[d]irect conversion receivers ... convert signals of interest directly to baseband ... from a radio frequency (RF)” *Id.*, 1:10–13.

Tayloe discloses an example of a direct conversion receiver, as annotated below:



30 **FIG. 3**

Ex1004, Fig. 3. The receiver receives an RF input signal f_1 and down-converts this signal. *Id.*, 2:13-67 (“[A]n RF ... signal f_1 [purple] is ... received by commutating switch 38 [gray] at input 36. Commutating switch 38 switches input 36 to outputs 42 [red], 44, 46 [green], and 48.... As commutating switch 38 cycles through the four outputs, capacitors 72-78 charge to voltage values substantially equal to the average value of the input signal during their respective quadrants.... The outputs of commutating switch 38 are input to summing amplifiers 50 [light blue] and 52.

Summing amplifier 50 [light blue] differentially sums the 0 degree output [(red)] and the 180 degree output [(green)], thereby producing baseband in-phase signal 54 [yellow].”); Ex1003, ¶¶81-84.

Tayloe’s receiver has four frequency down-conversion modules, labeled “0°,” “90°,” “180°,” and “270°,” each including a switch and a storage element (*e.g.*, capacitor). Ex1003, ¶85.

The 0° frequency down-conversion module provides a 0° down-converted signal 42 (red). Ex1004, 2:13-18 (“Commutating switch 38 switches input 36 to output[] 42 [(red)]....”), 2:46-48 (“Output 42 [(red)] represents the average value of the [RF] input signal [f_1 (purple)] during the first quarter wave of the period [of the input signal f_1], and is termed the 0 degree output.”); Ex1003, ¶86.

The 0° frequency down-conversion module includes a commutating switch 38 (gray)⁴, which periodically couples the input signal f_1 (purple) to the output 42.

⁴ Tayloe shows commutating switch 38 as a single component without specific structure. As explained below, a POSITA would have understood that Tayloe’s commutating switch 38, especially in view of TI Datasheet, comprises multiple switches.

Accordingly, as noted below, a POSITA would understand that each down-conversion module includes its own switch within the switch 38. TI-1003, ¶89.

Ex1004,2:16-26. Moreover, the rate at which commutating switch 38 periodically couples the input signal f_1 at input 36 (purple) to the output 42 is determined by a control signal ($4f_0$, pink) supplied to a control input 40 of the switch. *Id.*, 2:18-20; Ex1003, ¶87.

The 0° frequency down-conversion module also includes capacitor 72 (brown). “During the time that [the] switch 38 connects input 36 [receiving the RF input signal f_1] to output 42, charge builds up on capacitor 72.” Ex1004, 2:32-33. The voltage across the capacitor 72 corresponding to this charge constitutes the average value of the RF input signal f_1 during first quarter of the period of the signal f_1 and is output from the 0° frequency down-conversion module as the 0° down-converted signal 42 (red). *Id.*, 2:46-48, 2:18-26; Ex1003, ¶89.

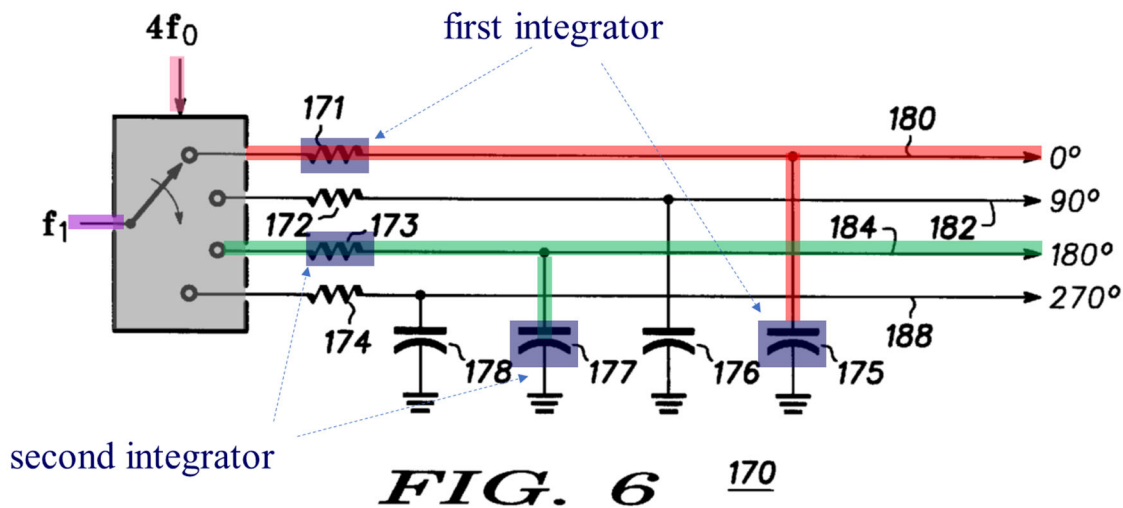
Similarly, the 180° frequency down-conversion module provides a 180° down-converted signal 46 (green). Ex1004, 2:13-18, 2:50-53 (“Output 46 [green] represents the average value of the input signal [f_1 (purple)] during the third quarter wave of the period [of the input signal f_1], and is termed the 180 degree output.”), 2:18-26; Ex1003, ¶90.

The 180° frequency down-conversion module includes commutating switch 38 (gray) and capacitor 76 (brown). When commutating switch 38 couples the input signal f_1 (purple) to the output 46, charge builds up on capacitor 76 (brown) in the same manner as charge builds up on capacitor 72 described above. Ex1004, 2:18-

38. Thus, voltage across capacitor 76 constitutes the average values of the RF input signal f_i during the third quarter of the period of the signal f_i and is output from the 180° frequency down-conversion module as the 180° down-converted signal 46 (green). *Id.*, 2:50-53, 2:18-26; Ex1003, ¶91.

The 90° and 270° frequency down-conversion modules each having a similar operation and structure. Ex1004, 2:35-39 (describing charge build up on respective capacitors). “As commutating switch 38 cycles through the four outputs, capacitors 72–78 charge to voltage values substantially equal to the average value of the input signal during their respective quadrants” *Id.*, 2:39-43. “Output 44 ... is termed the 90° degree output.” *Id.*, 2:48-50. “Output 48 ... is termed the 270° degree output.” *Id.*, 2:53-55; Ex1003, ¶92.

Tayloe also discloses “an alternate embodiment in which each integrating capacitor has its own resistor.” Ex1004, 4:48-49. Compared to Figure 3 (above), Figure 6 (below) of Tayloe shows “ 0° degree output 180 has a voltage controlled by the combination of capacitor 175 and resistor 171” and “ 180° degree output 184 has a voltage controlled by the combination of capacitor 177 and resistor 173.” *Id.*, 4:49-57 (“ 90° degree output 182 has a voltage controlled by the combination of capacitor 176 and resistor 172” and “ 270° degree output 188 has a voltage controlled by the combination of capacitor 178 and resistor 174.”); Ex1003, ¶93.

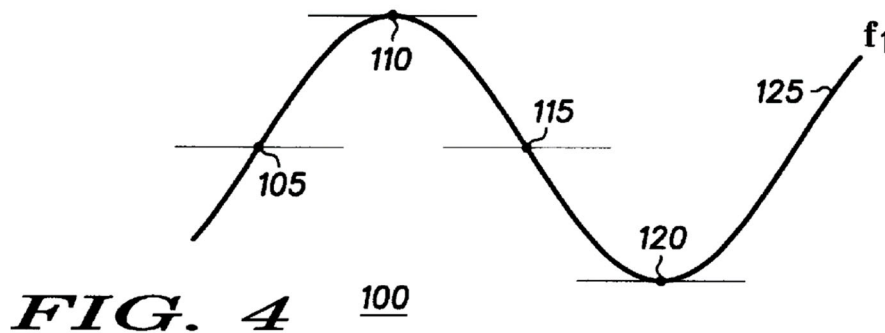


Ex1004, Figure 6 (annotated)

“Resistor 171 and capacitor 175 form a first integrator [(dark blue) for the 0° output (red) where the switch (gray)] connects the input to this first integrator for substantially 90 degree of the input signal [f_1 (purple)].” Ex1004, 4:57-60. Tayloe explains that “the remaining resistor/capacitor pairs [in Figure 6] also form integrators [including a second integrator (dark blue) for the 180° output (green)], each of which preferably integrates for substantially 90 degrees of the input signal [f_1 (purple)].” *Id.*, 4:60-67. Ex1003, ¶¶94-95.

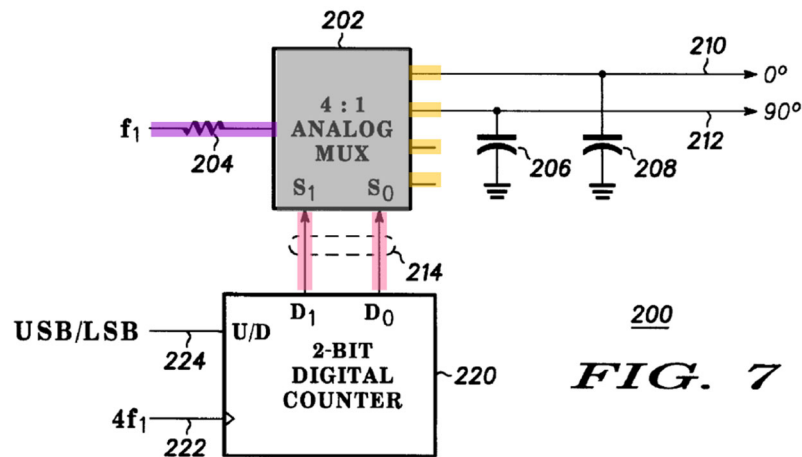
Returning to the example in Figure 3 annotated *supra*, Tayloe also discloses “[s]umming amplifier 52 differentially sums the 90 degree output and the 270 degree output, thereby producing base band quadrature signal 56.” *Id.*, 2:56-67; Ex1003, ¶¶96-98.

Tayloe's switch 38 is "controlled by a signal [pink] present at control input 40." Ex1004, 2:17-20. This control signal (pink) causes commutating switch 38 to couple the RF input signal f_1 to one of the four outputs 42, 44, 46, and 48 so that the RF input signal f_1 is sampled four times during a full cycle in which, as illustrated in Figure 4 (below), "[p]oint 105 represents the voltage to which capacitor 72 (FIG. 3) charges," "point 110 represents the voltage to which capacitor 74 charges, point 115 represents the voltage to which capacitor 76 charges, and point 120 represents the voltage to which capacitor 78 charges." *Id.*, 3:41-48; Ex1003, ¶99.



Ex1004, Figure 4

Tayloe further expressly discloses implementing "direct conversion receiver 30 (FIG. 3) utilizing an analog multiplexer and a digital counter as shown in FIG. 7 [annotated below]." Ex1004, 5:33-37; Ex1003, ¶100.



Ex1004, Figure 7 (annotated)

As an embodiment of commutating switch 38 (Figure 3), multiplexer 202 (above) acts as a demultiplexer, connecting a single input signal f_1 (purple) to one of four outputs (orange) based on control signals 214 (pink). Tayloe specifically discloses that “[t]he analog multiplexer is a Texas Instruments SN74BCT3253D.” *Id.*, 5:33-37⁵, 5:1-16 (“... input signal f_1 is connected to each of the four outputs of

⁵ Tayloe specifically refers to a TI “SN74BCT3253D” multiplexer. The “BCT” lettering (as opposed to “CBT”) is a typographical error. As noted in the Declaration of Maureen Honeycutt, TI’s records indicate the relevant multiplexer is number “SN74BCT3253”—as opposed to “SN74CBT3253”—which does not match any TI product. (TI-1018, ¶12.) The TI Datasheet is also descriptive of all SN74CBT3253 multiplexers, explaining that the “D” in the product number refers

analog multiplexer 202 for substantially 90 degrees of the input signal.”); Ex1003, ¶101.

The implementation details of the SN74CBT3253D multiplexer/demultiplexer are disclosed in TI Datasheet (Ex1005).

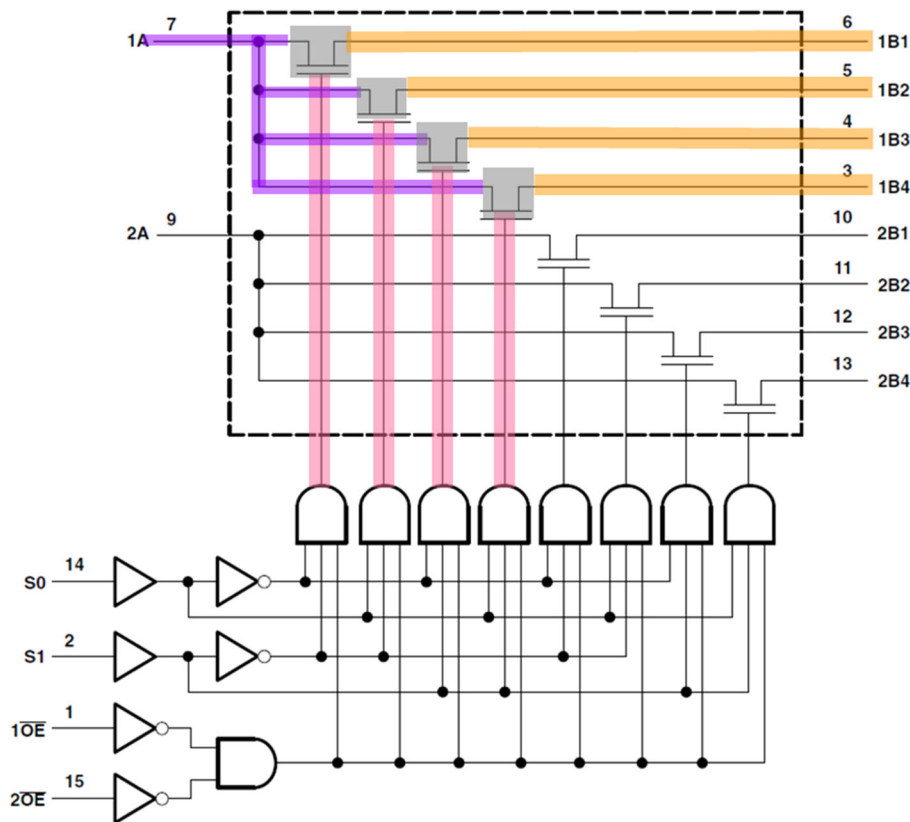
2. TI Datasheet

The TI Datasheet describes the SN74CBT3253 multiplexer/demultiplexer, a commercially available electronic component that can be used in a radio receiver such as Tayloe’s receiver. Ex1005, 1; Ex1004, 5:33-37 (referring to the SN74CBT3253 multiplexer))

Multiplexers are well-known electronic devices that receive multiple input signals and select one signal to be output. A multiplexer such as the one disclosed in TI Datasheet can also operate in reverse as a demultiplexer—receiving a single input signal and routing it to one of several output lines—as reflected in the device’s name (“SN74CBT3253 Dual 1 of 4 FET *Multiplexer/Demultiplexer*”). Ex1003, ¶¶103-04.

to a packaging option (“Plastic Small-Outline (D)”) for the SN74CBT3253 multiplexer. TI-1003, ¶102.

Tayloe uses the SN74CBT3253 multiplexer/demultiplexer as a demultiplexer. This SN74CBT3253 multiplexer/demultiplexer shows additional details of how Tayloe's commutating switch 38 would connect the single input signal to one of multiple output lines, and in particular, the demultiplexing operation is shown below.



Ex1005, 2 (annotated)

The TI multiplexer/demultiplexer has four switches (gray) that selectively supply the input signal 1A (purple) to one of four outputs 1B1-1B4 (orange) according to four control signals (pink), respectively. The control signals are generated based on control logic that ensures only one of the four switches is turned on at a time.

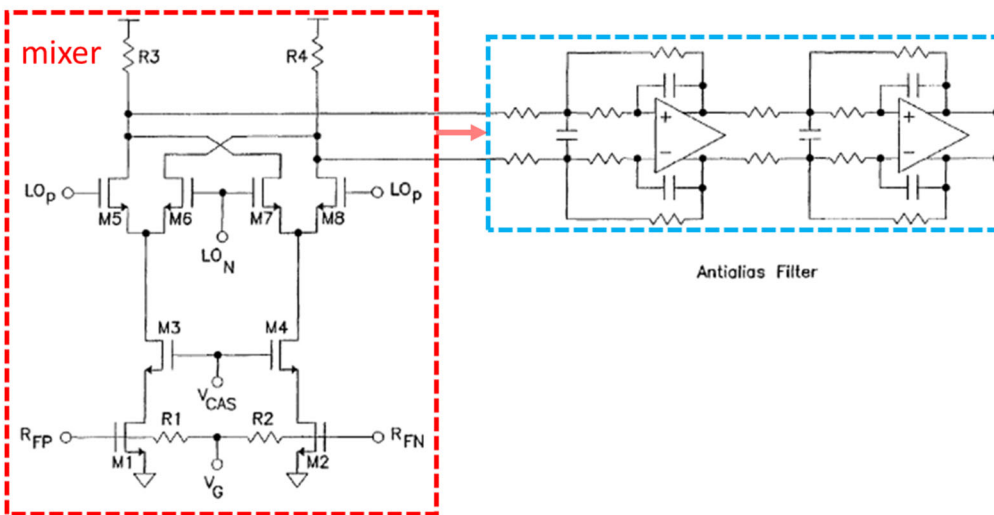
Ex1005, 1, Table 1. Ex1003, ¶¶105-07.

3. Macnally

Macnally describes “a single-chip CMOS direct conversion transceiver.”
Ex1021, 1:10-12, 1:44-46 (“A high level of integration is critical in lowering the cost of electronics for communication systems such as cellular phones, cordless phones, and wireless LANs”); Ex1022, 4⁶.

Macnally shows “[a] diagram of a mixer 142 and an antialiasing filter 144 with a cut-off frequency ...,” (Ex1021, 7:7-8; Ex1022, 8), as annotated below:

FIG. 3



Ex1021, Fig. 3; Ex1022, Fig. 3. Macnally discloses “[t]he output of the mixer [] is fed to a four-pole Butterworth antialiasing filter [] with a cut-off frequency of

⁶ Citations reference PDF pages.

2.4MHz.” Ex1021, 7:7-16, 7:17-29 (“Two biquad stages form the four-pole Butterworth anti-alias filter”), Fig. 1; Ex1022, 8, Fig. 1; Ex1003, ¶108-111 (explaining each biquad stage illustrated above includes a fully differential amplifier and noting an antialiasing filter is a low-pass filter).

Dynamic Drinkware Analysis

“[F]or a patent’s claims to be entitled to an earlier priority date, the patentee must demonstrate that the claims meet the requirements of 35 U.S.C. §120.” *In re NTP, Inc.*, 654 F.3d 1268, 1276 (Fed. Cir. 2011). In IPR, the patent owner bears the burden of production on this. *Dynamic Drinkware v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1380 (Fed. Cir. 2015).

Even if Patent Owner, here, argues it is entitled to its earliest priority date, Macnally remains prior art. Macnally is entitled to its provisional filing date, because Macnally and the Macnally-Provisional share virtually identical figures and similar descriptions of those figures. The Macnally-Provisional omits: the priority paragraph, the summary of the claims, some overview paragraphs, the abstract and claims. Macnally’s columns 5-8, the core of its description, is nearly identical to the provisional. The corresponding disclosures in the Macnally-Provisional supports at least one claim of Macnally (the patent). Ex1003, ¶ ¶112-114. For example, the direct conversion receiver of independent claim 7 (i.e., amplifier, mixer, baseband filter, and demodulator) is disclosed in Macnally-Provisional at Fig. 1 (system

showing amplifier (LNA), mixer, baseband filter, and BFSK demodulator), 10 (LNA depicted in Fig. 2), 11 (mixer and baseband filter (*i.e.*, antialias filter) depicted in Fig. 3), 12 (BFSK demodulator). Parallel citations to Macnally (Ex1021) and Macnally-Provisional (Ex1022) are provided throughout this Petition.

4. Combination

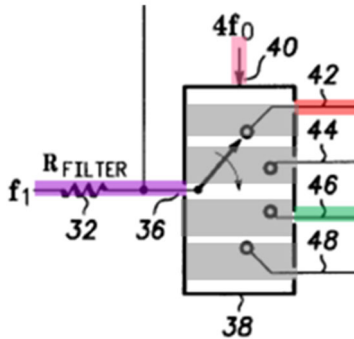
As explained *supra* §III.A.1, Tayloe discloses a direct conversion receiver using a commutating switch to “sample an RF waveform four times per period at the RF frequency” in which “[t]he samples are integrated over time to produce an average voltage at 0 degrees, 90 degrees, 180 degrees and 270 degrees” across the 360-degree full cycle. Ex1004, Abstract, 2:13-67 (one embodiment using separate capacitors 72, 74, 76, and 78), Figs. 3-4. Tayloe discloses “an alternate embodiment in which each integrating capacitor has its own resistor.” Ex1004, 4:48-57, Fig. 6. Tayloe further discloses implementing commutating switch 38 using the Texas Instruments (“TI”) SN74CBT3253D multiplexer/demultiplexer. Ex1004, 5:33-37, 5:1-16, Fig. 7.

As explained *supra* §III.A.2, TI Datasheet describes SN74CBT3253, a “dual 1-of-4 high-speed ... multiplexer/demultiplexer.” Ex1005, 1. TI Datasheet states “[t]he low on-state resistance of the switch allows connections to be made with minimal propagation delay.” *Id.*

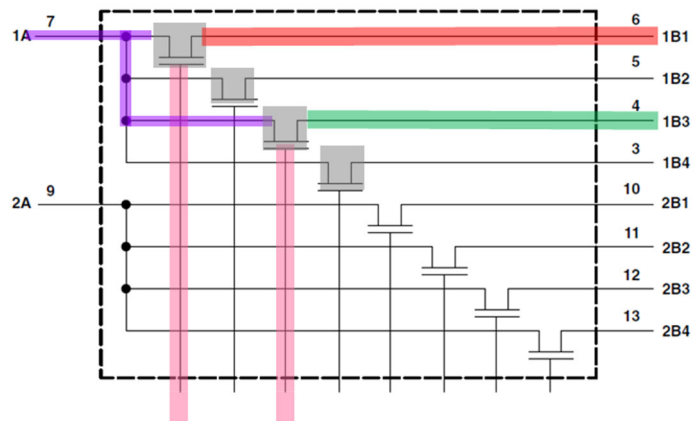
As explained *supra* §III.A.3, Macnally discloses examples of using antialiasing filters in an integrated transceiver device. Ex1021, Fig. 3, 1:44-46, 7:7-29; Ex1022, Fig. 3, 6, 8.

A POSITA would have found it obvious to combine relevant teachings from Tayloe, TI Datasheet, and Macnally. Ex1003, ¶¶124-130. ***First***, Tayloe expressly teaches four switches in a “direct conversion receiver 30 (FIG. 3) utilizing an analog multiplexer ... shown in FIG. 7” and specifically states “[t]he analog multiplexer is a Texas Instruments SN74BCT3253D.” Ex1004, 5:33-37. The characteristics described in the TI Datasheet are expressly included in Tayloe’s implementation, and a POSITA already knew the characteristics of the referenced TI multiplexer. Ex1003, ¶131.

Additionally, a POSITA would have found it obvious to combine Tayloe and the TI Datasheet, using any four of the multiplexer switches (gray) from the multiplexer to implement Tayloe’s commutating switch 38.



Ex1004, Fig 3 (switch 38)



Ex1005, 1 (multiplexer/demultiplexer)

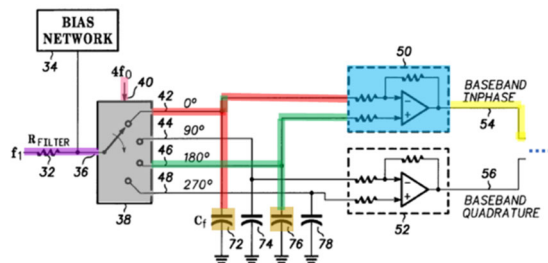
Because Tayloe expressly discloses the SN74CBT3253 multiplexer/demultiplexer and a datasheet is a well-known resource for learning detailed information of the multiplexer/demultiplexer, a POSITA would have been motivated to consult the TI Datasheet given Tayloe's express teachings of the SN74CBT3253 multiplexer. Ex1018, ¶¶10-14; Ex1003, ¶¶132-133. A POSITA would have also been motivated to use the multiplexer of the TI Datasheet to implement Tayloe's commutating switch 38 at least because Tayloe expressly teaches using an analog multiplexer, and the multiplexer of TI's Datasheet is a suitable analog multiplexer capable of performing the needed switching with the requisite number of channels. Ex1003, ¶134.

When viewing the detailed diagram of the SN74CBT3253 multiplexer, a POSITA would have been motivated to apply four of the multiplexer switches (gray squares (Ex1005, 1)) because each multiplexer switch is analogous to one of the four

switching paths when using Tayloe's commutating switch 38 (gray stripes (Ex1004, Fig. 3)). Ex1003, ¶135. Thus, a POSITA would have been inspired to implement the multiplexer switches from TI Datasheet in an analogous manner by “simple substitution of one known element for another.”⁷

A POSITA would have a reasonable expectation of success at combining Tayloe with TI Datasheet because the combination would have yielded predictable results (e.g., “low on-state resistance of the switch [which] allows connections to be made with minimal propagation delay”). Ex1005, 1; Ex1003, ¶136.

Second, a POSITA would have found it obvious to apply the separate integrator example from Fig. 6 of Tayloe to Tayloe's receiver depicted in Fig. 3, as annotated below.



30 FIG. 3

Ex1004, Fig. 3

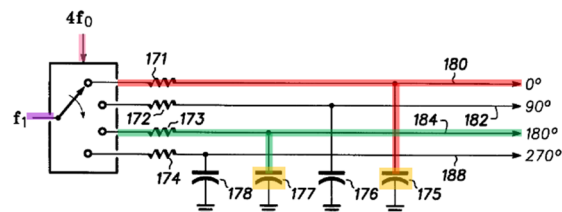
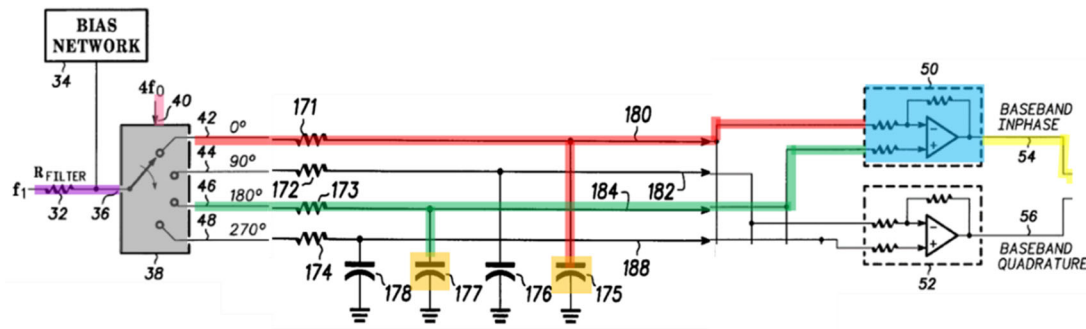


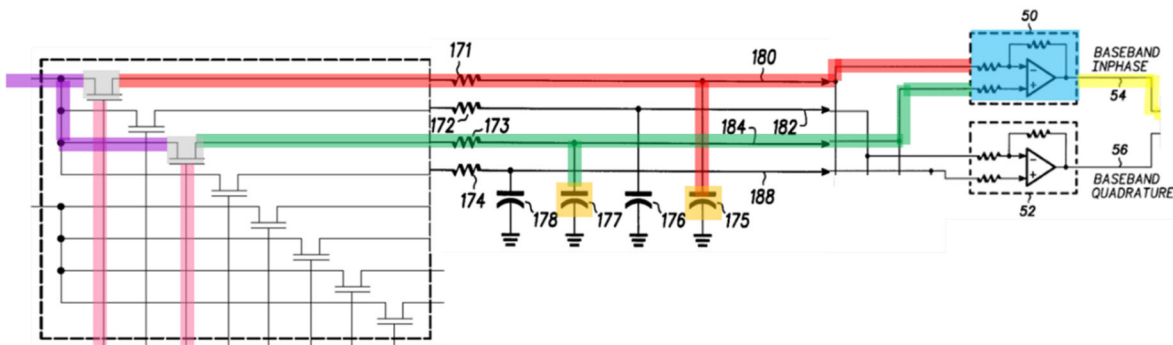
FIG. 6 170

Ex1004, Fig. 6

⁷ *KSR Int'l Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1731 (2007).



Combined Teachings of Ex1004

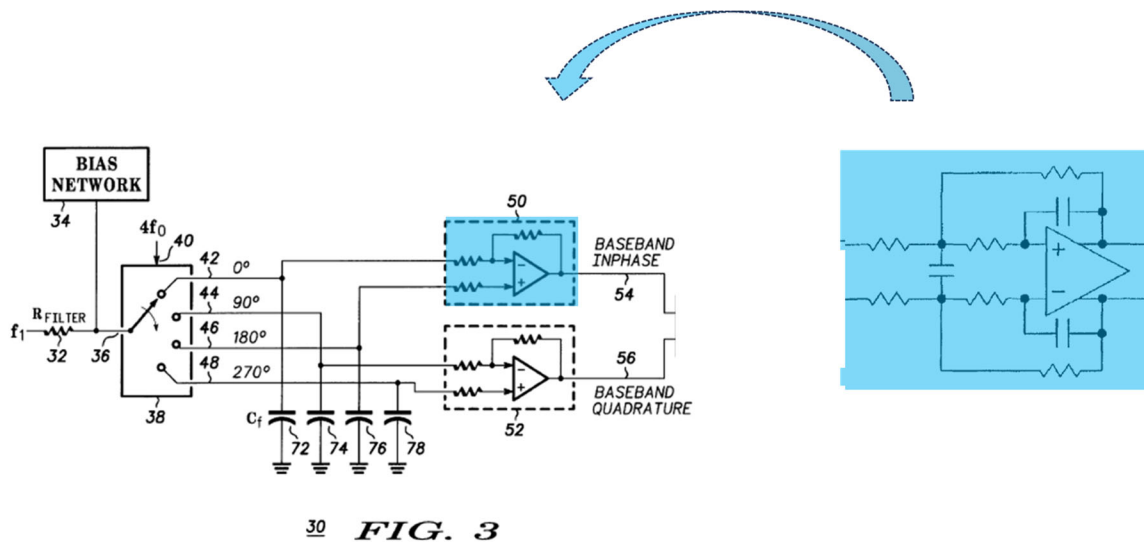


Combination System (using switch of Ex1005)

A POSITA would have been motivated to combine Figure 6 with Figure 3 of Tayloe at least because Tayloe specifically describes Figure 6 as “an alternate embodiment in which each integrating capacitor has its own resistor.” Ex1004, 4:46-49. As “an alternate embodiment” relative to the embodiment where capacitors 72-78 share a resistor 32, i.e., Figure 3, a POSITA would have understood the “alternate embodiment” as replacing a portion in Figure 3. While the “alternate embodiment” performs a similar function of the portion of Figure 3, it alone does not produce a baseband signal. Thus, a POSITA, seeking to generate a baseband signal with the “alternate embodiment” would have found it obvious to replace the existing

arrangement of capacitors in Figure 3 using the alternate arrangement where “each integrating capacitor has its own resistor,” as depicted in Figure 6. A POSITA would have a reasonable expectation of success because the replacement is no more than “a simple substitution of one known element for another”⁸ to obtain predictable results (i.e., “each integrating capacitor has its own resistor”). Ex1003, ¶¶135-139.

Third, a POSITA would have found it obvious to implement each of Tayloe’s differential amplifier circuits (light blue) (Ex1004, Fig. 3) as a fully differential operational amplifier configuration (light blue), as taught in Macnally (Ex1021/Ex1022, Fig. 3).

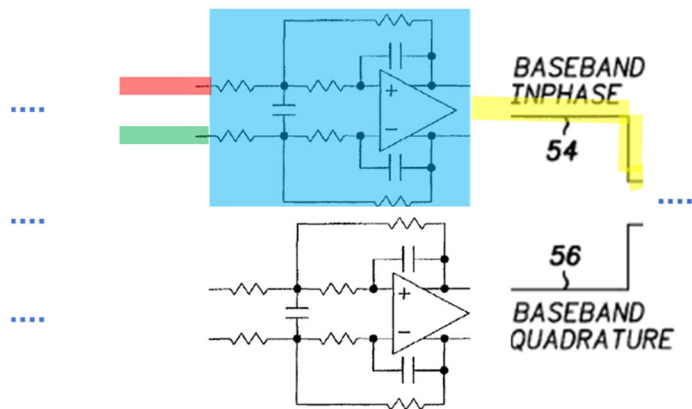


Ex1004, Fig. 3 (left)

Ex1021/Ex1022, Fig. 3 (right)

⁸ FN7

A POSITA would have been motivated to adapt Tayloe's system as a single-chip (i.e., integrated circuit known as IC) to meet relentless market demand for improved product size/performance, and decreased unit cost. Ex1003, ¶¶140-142 (citing Ex1021, 5:5-7; Ex1022, 5 ("high level of integration is critical in lowering the cost of electronics for communication systems such as cellular phones, cordless phones, and wireless LANs")). In doing so, a POSITA would have been inspired by several known advantages of using fully differential amplifiers and Macnally's topology for baseband processing on an IC. *First*, fully differential amplifiers operate on complementary signal components such that interference which equally corrupts both complementary signal components can be cancelled by taking the difference between the two complementary signal components. This known feature can minimize even order harmonic distortion, thus improving the linearity of amplifier output. Ex1003, ¶141. *Second*, each fully differential amplifier is laid out symmetrically on an integrated circuit (IC) to provide "a fully differential analog signal path [that] minimizes supply and substrate noise coupling [e.g., interference coupling from the substrate, power supply lines, and ground lines]." Ex1021, 6:64-65; Ex1022, 9; Ex1003, ¶141 (citing Ex1027, 1389). *Third*, among available design options for fully differential amplifiers, Macnally's configuration employs the Rauch biquad topology that can achieve a given power output with lower power input and reduced noise and distortion. *Id.* (citing Ex1027, 1388, Fig. 12).



Combined System (zoomed portion using circuits of Ex1021/Ex1022)

As explained by Dr. Galton, the differential output of Macnally's configuration is characteristic of on-chip baseband signals for subsequent on-chip processing, also in differential format. Ex1003, ¶142. A POSITA would understand the subsequent on-chip components would likewise be differential as in Macnally, *e.g.*, differential inputs/outputs for I and for Q in any subsequent circuit paths, phase shifters, amplifiers, and other components, eventually summing each differential pair with a summing amplifier, like Tayloe's amplifier 60. *Id.* Indeed, the implementation would have been a simple substitution of one known element (fully differential amplifier circuit of Macnally) for another (summing amplifier circuit of Tayloe) to obtain predictable results (*e.g.*, improved linearity and reduced power consumption for on-chip performance), and hence would have had a reasonable

expectation of success.⁹ Ex1003, ¶¶141-143 (noting success stories, and observing typical input impedance).

5. Analysis

Claim 1

1[a]

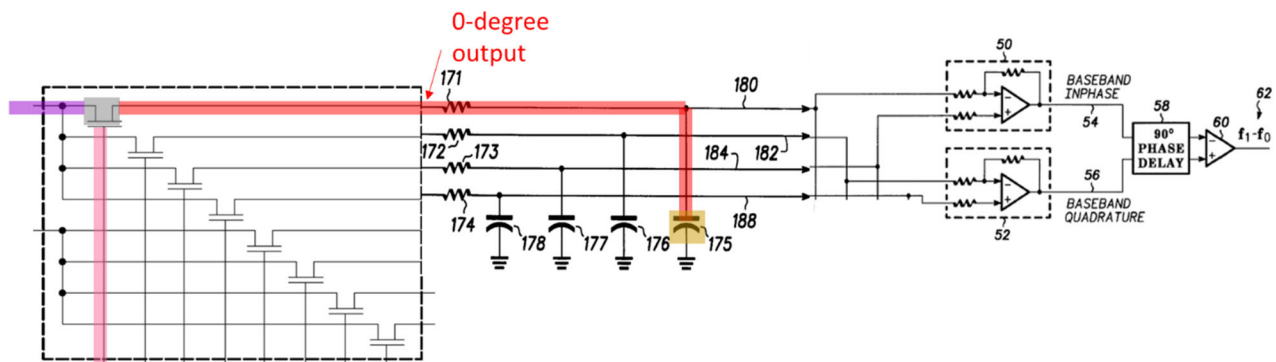
To the extent that preamble is deemed limiting, the combination system (Tayloe’s system using a multiplexor/demultiplexer design taught by TI Datasheet) is a system for frequency down-converting a modulated carrier signal to a baseband signal. *E.g.*, Ex1004, FIG. 3 (system diagram), 4-7, 1:5-6, 1:10-21 (“Direct conversion receivers ... convert signals of interest directly to baseband”), 2:6-8, 2:13-26, 2:46-55, 2:56-67, 3:58-4:45 (describing down-converting from frequency f_1 to Δf), 6:3-4, Abstract; §III.A.1-4. In the combination, each of the capacitor arrangements depicted in Fig. 3 (capacitors 72 to 78 sharing resistor 32) and Fig. 6 (capacitors 175 to 178 each has a pairing resistor) separately satisfy this element. Ex1003, ¶¶144-46.

1[b]

As explained *supra* §§III.A.1-4 and annotated below, the combination system includes a ***first switch*** (gray) coupled to a ***first control signal*** (pink). Ex1004, 2:5-

⁹ FN7

26 (“... the input signal [f_1 (purple)] is received by commutating switch 38 at input 36 [and] input 36 is switched [by a control signal (pink)] to each of the four outputs substantially once during each period of the input signal f_1 ”), Figs. 3, 6. In the combination system, commutating switch 38 is implemented as an analog multiplexor/demultiplexer 202, one example of which is the “Texas Instruments SN74[CBT]3253D” multiplexor/demultiplexer. Ex1004, 5:33-37, Fig. 7; Ex1005, 2; Ex1003, ¶¶146-47.



Combination System (using multiplexor/demultiplexer of Ex1005)¹⁰

The *first control signal* (pink) has *a sampling aperture* (e.g., up to 90 degree at the frequency of the input signal f_1) *with a specified frequency* (e.g., the rate of toggling the first switch (gray)). Ex1004, 2:18-20 (switch controlled by control

¹⁰ Although the integrator of FIG. 6 is depicted, the FIG. 3 embodiment also provides the relevant elements of claim 1.

signal), 2:27-32 (“... [switch] remains closed at each of the four outputs *for substantially 90 degrees* at the frequency of the input signal”); Ex1003, ¶148.

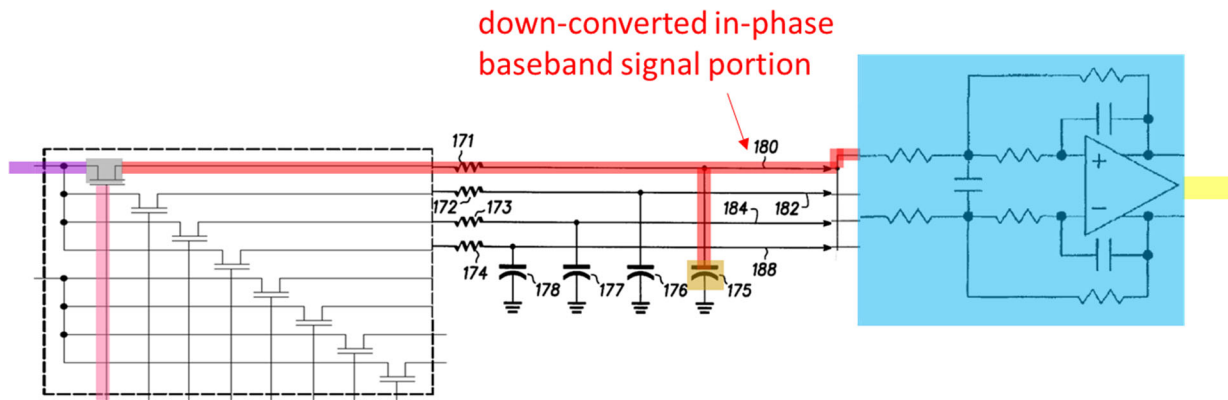
The first switch (gray) is on and *a portion of energy* that is distinguishable from noise is transferred *from the modulated carrier signal* (i.e., RF input signal f_1 (purple)) *as an output* (i.e., the 0-degree output) of said first switch *during the sampling aperture* (e.g., up to 90 degrees at the frequency of the input signal f_1) of said first switch. Ex1004, 2:27-32 (“... [switch] remains closed at each of the four outputs for substantially 90 degrees at the frequency of the input signal”), 2:33-45 (“[when switch] connects input 36 to output 42 [the 0-degree output], charge builds up on capacitor 72 [corresponding to capacitor 175 in Fig. 6]”); Ex1003, ¶149.

Tayloe makes clear the portion of energy is *distinguishable from noise* when “[o]utput 42 [the 0-degree output] represents the average value of the input signal during the first quarter wave of the period” for generating a baseband signal. Ex1004, 2:46-55, 5:1-16, Figs. 3-4, 6, 7; Ex1003, ¶150. The fact that the capacitor is charged to reflect the average value of the input signal during the first quarter wave, indicates that the portion of energy is distinguishable from noise. Ex1003, ¶150. Furthermore, Tayloe describes “information bearing signals...super imposed on f_1 ” converted to a baseband “signal of interest.” Ex1004, 3:62-4:8, 6:10-14. The portion of energy therefore reaches a threshold for the “signal of interest” to convey the “information.” Ex1003, ¶150.

Moreover, if a system operates to down-convert an electromagnetic signal, as described by Tayloe, (Ex1004, 5:30-60 (experiment results), then sufficient ***energy distinguishable from noise is transferred*** by virtue of the down-conversion process. *ParkerVision, Inc. v. Qualcomm, Inc.*, 621 F. App’x 1009, 1019 (Fed.Cir. Jul 31, 2015) (“... to determine whether or not energy in amounts distinguishable from noise has been transferred from the carrier signal, one may look to whether the down-converting circuit functions in practice. If a circuit successfully down-converts, that is proof that enough energy has been transferred to overcome the noise in the system.”). Ex1003, ¶¶146-51.

I/c]

As explained *supra* §§III.A.1-4 and annotated below, the combination system includes ***a first energy storage element*** (e.g., capacitor 175 (brown), or capacitor 72 of Fig. 3) that ***stores*** the transferred energy from the modulated carrier signal (purple) and ***outputs a down-converted in-phase baseband signal portion*** (red portion feeding into Macnally’s circuit (light blue)) of said modulated carrier signal (purple).



Combination System (using switch of Ex1005 and circuit of Ex1021/Ex1022)

In the combination annotated above, “[d]uring the time [the first switch] connects input 36 [receiving input signal (purple)] to output 42 [0-degree output], charge builds up on capacitor 72 [corresponding to capacitor 175 in Fig. 6].” *Id.*, 2:33-45, 2:46-55 (“Output 42 [0-degree output] represents the average value of the input signal during the first quarter wave of the period, and is termed the 0 degree output”), 2:56-59 (“...producing baseband in-phase signal”), 4:49-51, 2:27-32, 2:13-18. Figs. 3, 4, 6. The average value results in down-conversion, and a POSTIA would have recognized that the 0-degree output is an in-phase signal. Ex1003, ¶153.

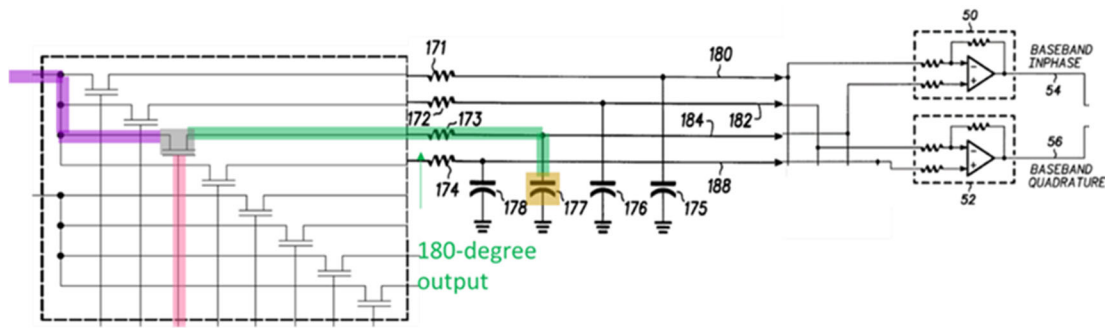
Taylor specifically describes that “0 degree output [is] used to generate baseband in-phase ... signal[,],” (Ex1004, 5:1-16), consistent with descriptions from the ’528 patent. Ex1001, Fig. 197 (first processing module 19702), 176:61-177:15; Ex1003, ¶154, §VI.C(technology background).

Consistent with Petitioner’s claim construction proposal *supra* §I.C.1, Taylor’s capacitor 175 (brown) (or capacitor 72 of Fig. 3) “*stores non-negligible*

amounts of energy from an input EM signal,” i.e., the RF input signal f_1 . Ex1003, ¶155. As observed by Dr. Galton, the differential amplifier circuit of Macnally provides *low impedance load* typically in the kilo ohm range, (Ex1003, §VI.D), which “goes to the heart of what makes an element, a ‘storage’ element,” as alleged by ParkerVision. IPR2020-01265, Paper 26 (PO Sur-reply), 13; Paper 18 (POR) at 46-50.

1[d]

As explained *supra* §§III.A.1-4 and annotated below (similar to [1b]), the combination system includes *a second switch* (gray) coupled to *a second control signal* (pink) which comprises *a sampling aperture* (e.g., up to 90 degrees at the frequency of the input signal f_1) *with a specified frequency* (e.g., the rate of toggling the second switch (gray)). Ex1004, 2:5-26 (“...input 36 is switched [by a control signal (pink)] to each of the four outputs”), 2:27-32, 5:1-16; Figs. 3, 6-7; Ex1005, 2; §III.A.4 (element 1[b]); Ex1003, ¶156.

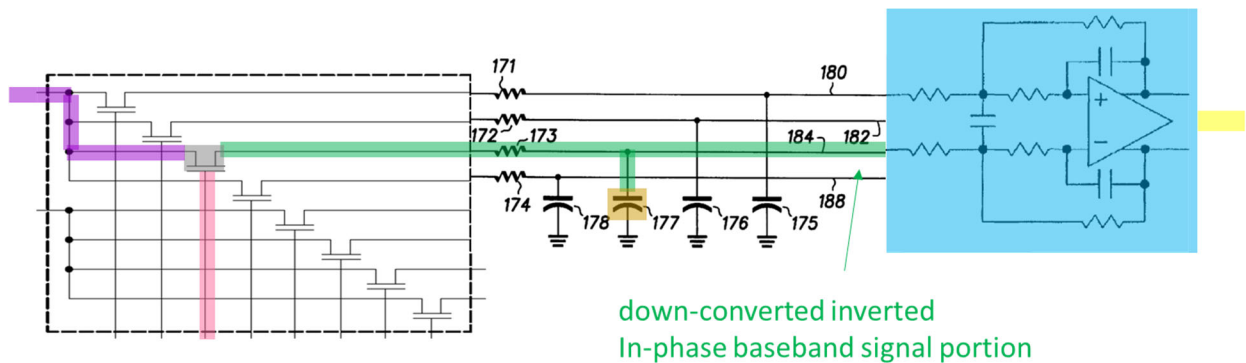


Combination System (using switch of Ex1005)

The second switch (gray) is on and *a portion of energy* that is distinguishable from noise is transferred *from the modulated carrier signal* (i.e., RF input signal f_1 (purple)) as an output (i.e., the 180-degree output) of said second switch *during the sampling aperture* (e.g., up to 90 degrees at the frequency of the input signal f_1) of the second control signal. Ex1004, 2:27-32 (switch (gray)) “remains closed at each of the four outputs for substantially 90 degrees at the frequency of the input signal” or “for less than 90 degrees”), 2:33-45 (charge builds up on corresponding capacitor), 2:46-55 (“the 180 degree output [in Fig. 3]”), 4:53-55 (“180 degree output 184 [in Fig. 6]”), 5:1-16 (180-degree output “can be utilized as embodied in FIG. 3 to achieve greater gain”), Figs. 3-4, 6-7; Ex1003, ¶157. Tayloe describes “information bearing signals...super imposed on f_1 ” converted to a baseband “signal of interest.” Ex1004, 3:62-4:8, 6:10-14. The portion of energy therefore reaches a threshold for the “signal of interest” to convey the “information.” Ex1003, ¶158.

1[e]

As explained *supra* §§III.A.1-4 and annotated below, the combination system includes **a second energy storage element** (e.g., capacitor 177 (brown), or capacitor 76 of Fig. 3) that **stores** the transferred energy from the modulated carrier signal (purple) and **outputs a down-converted in-phase inverted baseband signal portion** (green portion feeding into Macnally's circuit (light blue)) of said modulated carrier signal (purple).



Combination System (using switch of Ex1005 and circuit of Ex1021/Ex1022)

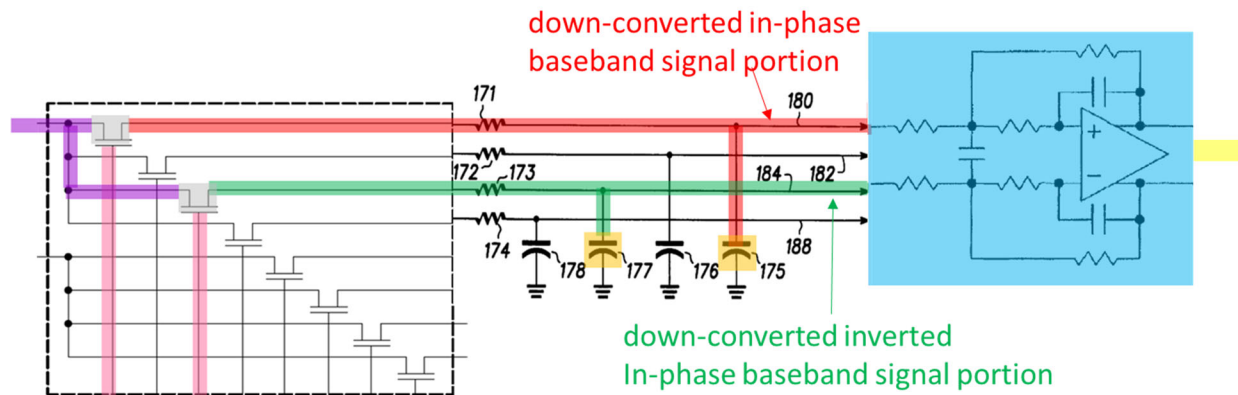
In the combination system, the switch (gray) “remains closed at each of the four outputs for substantially 90 degrees at the frequency of the input signal.” Ex1004, 2:27-32, 2:13-18. As a result, charge builds up on capacitor (brown). *Id.* 2:33-45, 2:46-55 (“... Output 46 [Fig. 3] represents the average value of the input signal during the third quarter wave of the period, and is termed the 180 degree output”), 4:49-51 (“... 180 degree output [Fig. 6] has a voltage controlled by the combination of capacitor and resistor 173”), Figs. 3-4, 6-7. A POSTIA would have recognized that the 180-degree output is an inverted signal. Ex1003, ¶¶159-60.

Tayloe explains that the 180-degree output “can be utilized as embodied in FIG. 3 to achieve greater gain” because the 180-degree output is an inverted version of the 0-degree output, and hence the inverted in-phase baseband signal, as described by the ’528 patent. Ex1001, Fig. 197 (second processing module 19706), 177:31-54 (“a switch ... opens and closes as a function of inverted I control signal ... As a result of the opening and closing of this switch ... a down-converted signal, referred to as the inverted I output signal, results”). Ex1003, ¶161 (further explanation).

Consistent with Petitioner’s claim construction proposal *supra* §I.C.1 and similar to 1[c], Tayloe’s capacitor 177 (brown) (or capacitor 74 of Fig. 3) “***stores non-negligible amounts of energy from an input EM signal,***” i.e., the RF input signal V_{RF} . Ex1003, ¶162 (noting ***low impedance load*** to Tayloe’s capacitor).

1[f]

As explained *supra* §§III.A.1-4 and annotated below, in the combination system, ***the portions of transferred energy*** from each of the first and second switch ***are integrated*** over time to accumulate said portions of transferred energy ***from which said down-converted in-phase baseband signal portion*** (red portion feeding into Macnally’s circuit (light blue)) ***and said down-converted inverted in-phase baseband signal portion*** (green portion feeding into Macnally’s circuit (light blue)) ***are derived.***

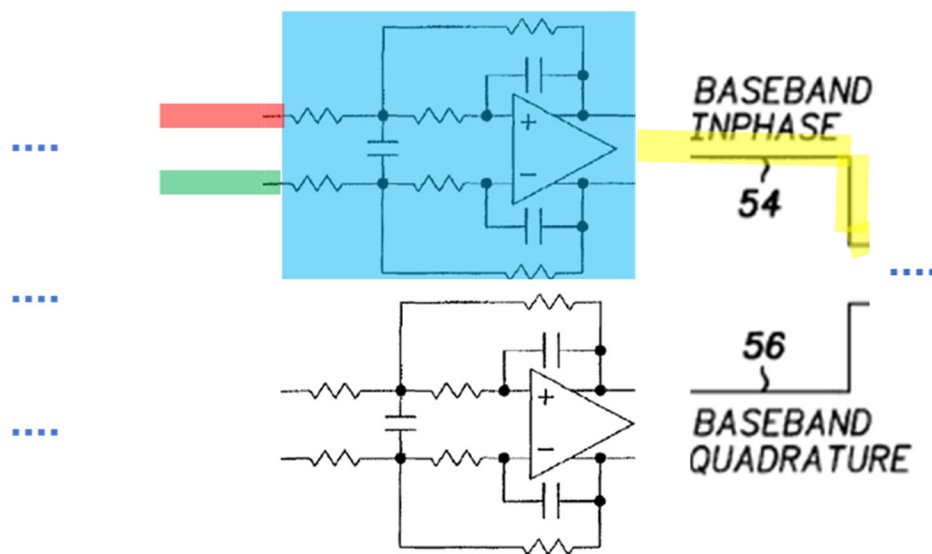


Combination System (using switch of Ex1005 and circuit of Ex1021/Ex1022)

Taylor describes that each capacitor 175, 176, 177, and 178 (and the corresponding capacitors in FIG. 3) are “integrating capacitors” where each has “its own resistor” so that “the combination of capacitor 175 and resistor 171” control the 0-degree output and “the combination of capacitor 177 and resistor 173” control the 180-degree output.” Ex1004, 3:54-4:4, 4:46-67 (“each [integrator] preferably integrates for substantially 90 degrees of the input signal.”), Abstract (“... *samples are integrated over time* to produce an average voltage at 0 degrees, 90 degrees, 180 degrees and 270 degrees...”). Moreover, Taylor discloses similar integrator operation in the example of Figure 3 using capacitors 72 and 76 respectively for the 0-degree and 180-degree outputs. Ex1004, 2:33-55 (“Each of the capacitors [Fig. 3] functions as a separate integrator, each integrating a separate quarter wave of the input signal.”), Figs. 3-4, 6-7; Ex1003, ¶¶164-65.

[1g]

As explained *supra* §§III.A.1-4 and annotated below, the combination system includes *a first differential amplifier circuit* (light blue) that *combines said down-converted in-phase baseband signal portion* (red portion) *with said down-converted inverted in-phase baseband signal portion* (green portion) *and outputs a first channel down-converted differential in-phase baseband signal* (yellow).



Combined System (zoomed portions using circuit of Ex1021/Ex1022)

“Summing amplifier 50 [implemented using a fully differential amplifier circuit of Macnally] differentially sums the 0 degree output 42 and the 180 degree output 46, thereby producing [first channel down-converted differential] baseband in-phase signal [as a differential output having two complementary components].”
Ex1004, 2:56-67, Abstract, Fig. 3; Ex1021, 5:64-67 (“fully-differential analog signal

path”)/Ex1022, 9, Fig. 3; Ex1003, ¶¶166-69 (details of fully differential amplifier for on-).

Accordingly, the combination system renders obvious claim 1.

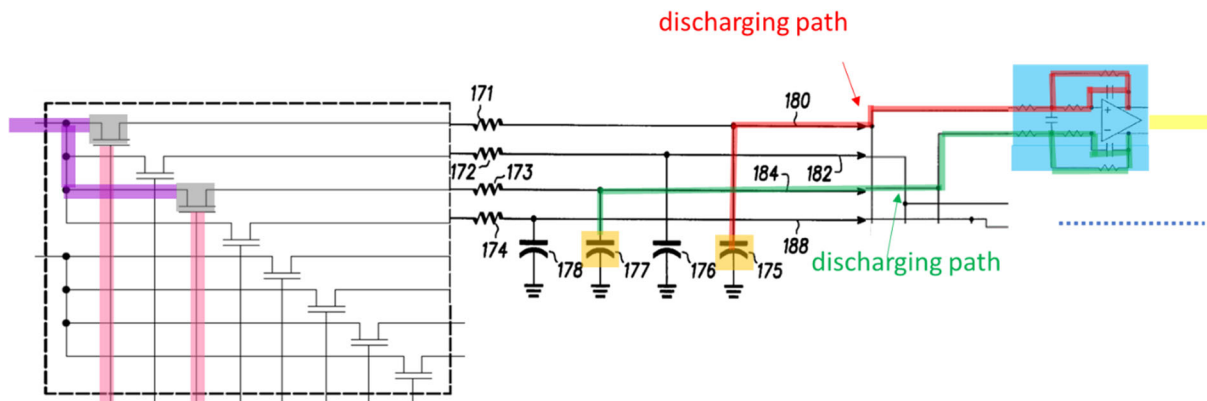
Claim 5

In the combination system, the first switch (gray) is on for less than one-half cycle of the modulated carrier signal (i.e., input signal). Tayloe explains that “commutating switch 38 [implemented as the TI multiplexer/demultiplexer] remains closed at each of the four outputs for substantially 90 degrees [less than one-half cycle] at the frequency of the input signal.” Ex1004, 2:27-32, 2:33-45, 2:46-55, 5:1-16, Figs. 3 (system diagram), 4 (waveform example where “[p]oint 105 represents the voltage to which capacitor 72 (FIG. 3) charges,” 3:40-48)), 6 (separate integrator), 7 (analog multiplexer/demultiplexer); Ex1003, ¶¶170-71 (A POSITA would understand a quarter wave is less than one-half cycle).

Claim 8

In the combination system, the first and second control signals (pink) each control a charging and discharging cycle for respective energy storage element (brown) by respectively controlling the first and second switches (gray). *Supra* 1[b], 1[d]. Specifically, for each switch (gray), the portion of energy that is distinguishable from noise is transferred to the respective storage element (brown) when the switch is on (i.e., CLOSED) during the charging cycle. *Id.* When the

switch (gray) is off (i.e., OPEN), a portion of the transferred energy (e.g., charge accumulated) is discharged, as annotated below for two discharging paths. Ex1003, ¶172-74 (further explanation).



Combination System (using switch of Ex1005 and circuit of Ex1021/Ex1022)

Claim 9

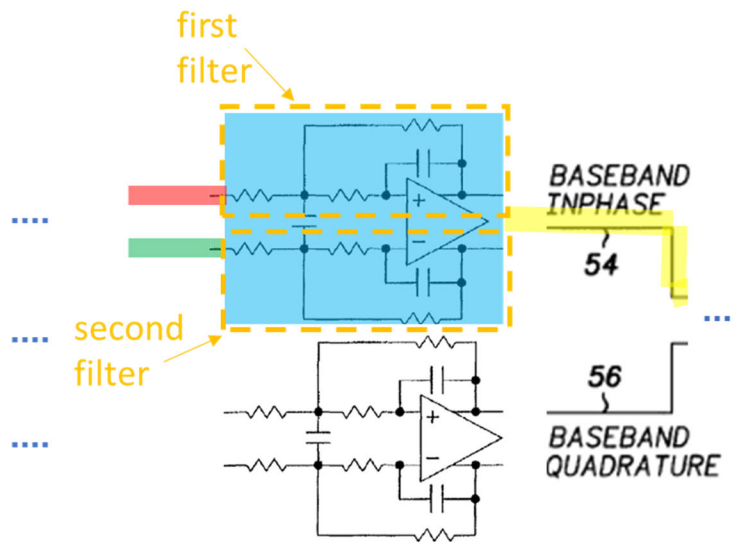
In the combination system, for each storage device (capacitor in brown), the energy discharged during any given discharge cycle is not completely discharged given the characteristics of the underlying circuit. Ex1003, ¶175 (additional details). The remaining undischarged energy from the given discharge cycle thus becomes an initial condition for the next charging cycle (when the switch is closed). *Id.*

Claims 11, 12, 13, 14

In the combination system, the frequencies of the first and second apertures (i.e., respective periods during which the first and second switches are closed to generate the 0-degree and 180-degree outputs) have periods that are substantially 25% of the modulated carrier's signal period, thus satisfying claim 11 (“***two (2) percent or greater***”), 12 (“***five (5) percent or greater***”), 13 (“***ten (10) percent or greater***”), and 14 (“***twelve and a half (12.5) percent or greater***”). Ex1004, Abstract, 2:18-27, 4:28-45; 4:58-63 (“each [integrator] preferably integrates for substantially 90 degrees of the input signal”); §III.A.1-4; Ex1003, ¶¶176-179 (A POSITA would understand each quadrant (90-degree) is 25%).

Claim 15

In the combination system, the differential amplifier circuits include a ***first filter*** (orange box) that filters the down-converted in-phase baseband signal portion (red), and a ***second filter*** (orange box) that filters the down-converted inverted in-phase baseband signal portion (green), as annotated below. §§III.A.1-4, §III.A.5 (1[c] (in-phase baseband), 1[e] (inverted in-phase baseband), 1[g] (differential amplifier circuit)). Ex1003, ¶180, §VI.D (amplifiers).



Combined System (zoomed portion using circuits of Ex1021/Ex1022)

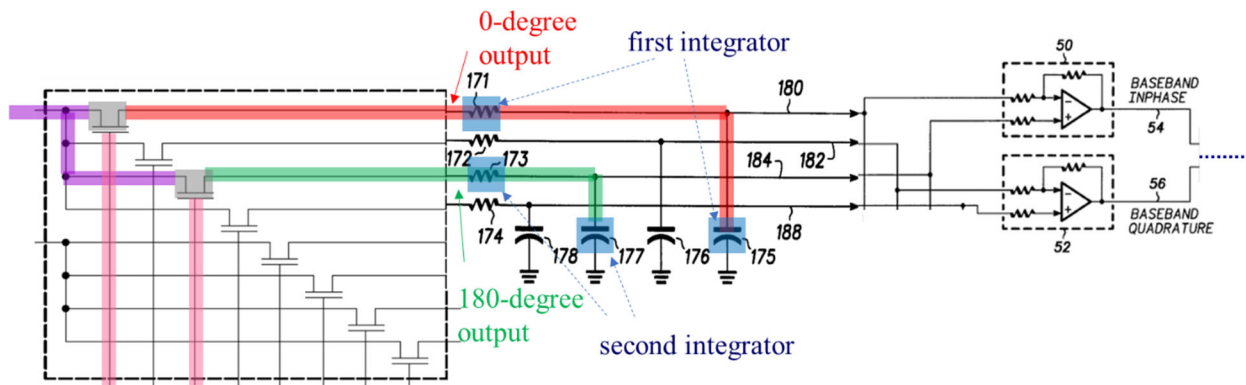
Claim 16

In the combination system, the first and second filters (orange boxes annotated above) each comprise a low-pass filter. §§III.A.3-4; Ex1014, 7:7-29 (discussing cut-off frequency); Ex1003, ¶181(explaining the RC network in conjunction with the amplifier forms a classical low-pass filter).

Claim 17

The combination system (each capacitor is paired with a separate resistor (Fig. 6)) renders obvious claim 17. As explained *supra* §§III.A.1-3 and annotated below, the combination system has ***a separate integration module coupled to the output of each said first and second switch*** (e.g., first integration module (combination of

capacitor 175 and resistor 171) coupled to the 0-degree output (red), and second integration module (combination of capacitor 177 and resistor 173) coupled to the 180-degree output (green). Ex1004, 4:48-49 (“... each integrating capacitor [namely, capacitors 175-178] has its own resistor”), 49-57 (“... 0 degree output 180 has a voltage controlled by the combination of capacitor 175 and resistor 171 ... 180 degree output 184 has a voltage controlled by the combination of capacitor 177 and resistor 173”).



Combination System (using switch of Ex1005)

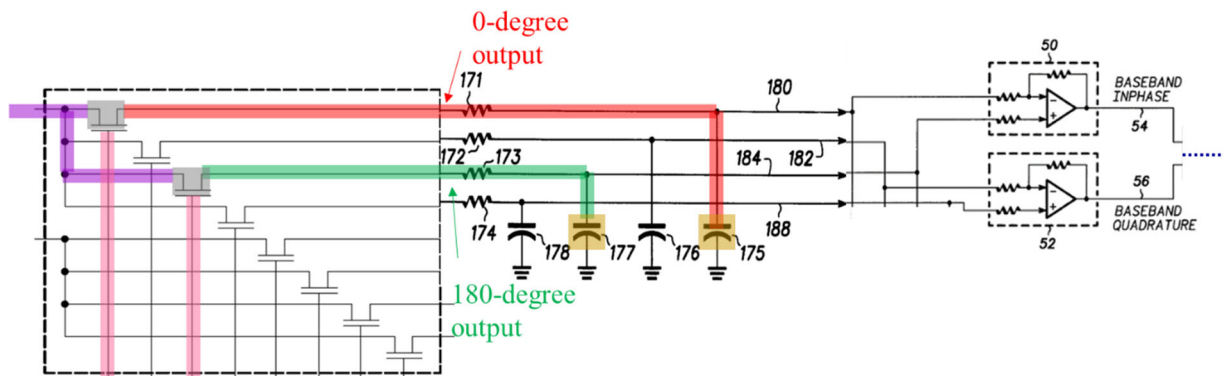
In the combination system, the first and second integration modules are **separate** from each other. The first integration module is not the same as first energy storage element (capacitor 175). Nor is second integration module identical to second energy storage element (capacitor 177). Ex1003, ¶¶183-84.

Moreover, *the portions of transferred energy from each of the first and second switch which are integrated over time to accumulate said portions of transferred energy are integrated by a separate integration module.* Id., 4:57-63

(“... resistor/capacitor pairs ... form integrators, each ... preferably integrates for substantially 90 degrees of the input signal.”), Fig. 6; Abstract, 2:27-55, 5:1-16, Fig. 3; Ex1003, ¶185.

Claim 18

The combination system renders obvious claim 18. As explained *supra* §§III.A.1-3 and annotated below, ***the first and second storage elements are capacitive elements*** (i.e., capacitor 175 (brown) for the 0-degree output (red) and capacitor 177 (brown) for the 180-degree output (green)). Ex1004, 4:48-51 (discussing “each integrating capacitor [including capacitor 175 for the 0-degree output and capacitor 177 for the 180-degree output]”), Ex1003, ¶186.



Combination System (using switch of Ex1005)

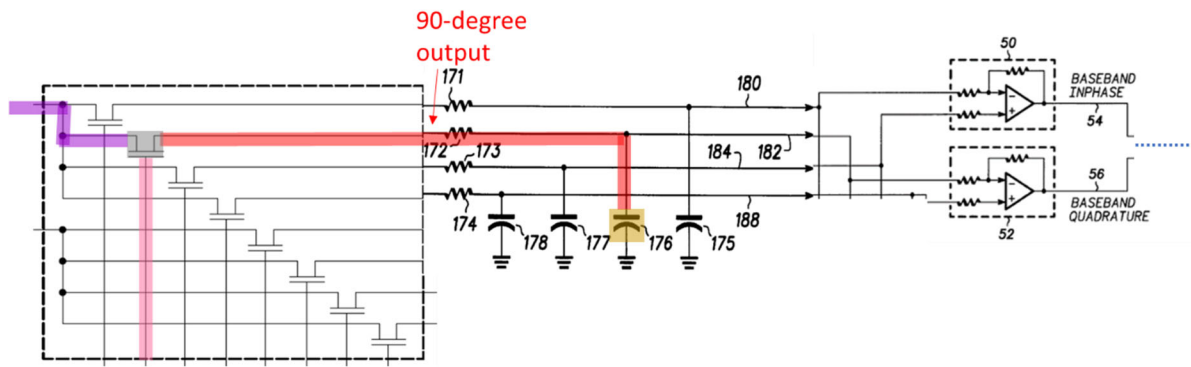
In the combination system, ***the portions of transferred energy from each of the first and second switch which are integrated over time to accumulate said portions of transferred energy are integrated by the capacitive storage circuits as***

they accumulate charge during successive sampling apertures (e.g., duration of switch closures). Tayloe explains that “commutating switch 38 [implemented as the TI multiplexer/demultiplexer] remains closed at each of the four outputs for substantially 90 degrees at the frequency of the input signal.” Ex1004, 2:27-32, 2:13-18, Abstract (“The samples are integrated over time to produce an average voltage at 0 degrees, 90 degrees, 180 degrees and 270 degrees.”). When a switch is ON, “charge builds up on” a corresponding capacitor. Ex1004, 2:33-45, 5:1-16 (0-degree output and 180-degree output to generate baseband in-phase signal), Figs. 3 (system diagram) 4 (waveform example), 6 (separate integrator), 7 (analog multiplexer/demultiplexer); Ex1003, ¶¶187-88.

Claim 19

19[a]

§III.A.5 (claim 1: combination system). Ex1003, ¶189. As explained *supra* §§III.A.1-4 and annotated below, the combination system provides a ***third switch*** (gray) coupled to a ***third control signal*** (pink) which comprises a ***sampling aperture*** (e.g., up to 90 degree at the frequency of the input signal f_i) with a ***specified frequency*** (i.e., rate of toggling the third switch). Ex1004, 2:5-32, 5:33-37, Figs. 3, 6-7; Ex1005, 2 (incorporated below); §III.A.4; Ex1003, ¶190.



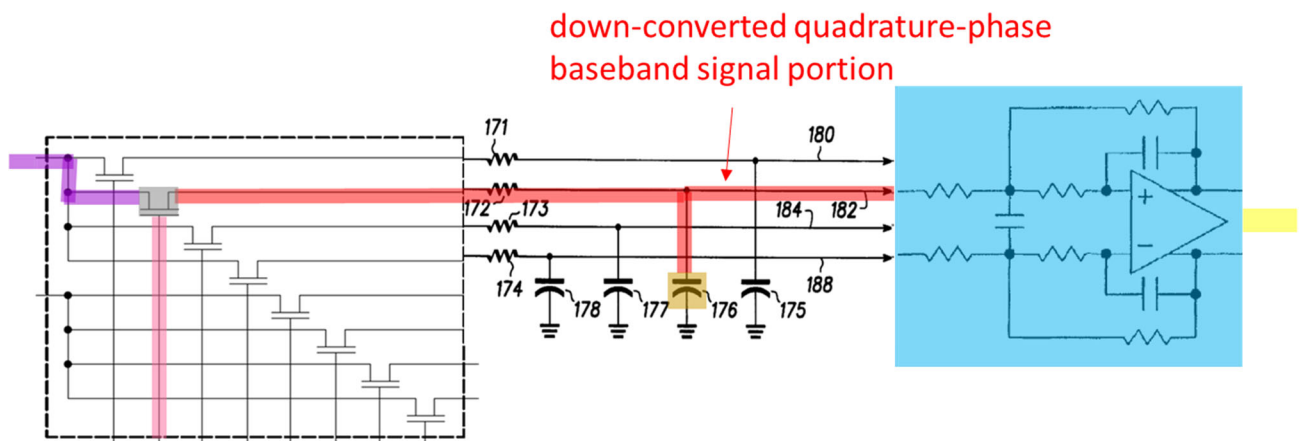
Combination System (using switch of Ex1005)

The third switch (gray) is on and *a portion of energy* that is distinguishable from noise is transferred *from the modulated carrier signal* (RF input signal f_1 (purple)) *as an output* (the 90-degree output) of said switch during the sampling aperture of the third control signal. Ex1004, 2:27-55, 5:1-16, Figs. 3-4, 6-7; §§III.A.4, III.A.5 (element 1[b] including “energy distinguishable from noise is transferred”); Ex1003, ¶191.

19[b]

As explained *supra* §§III.A.1-4 and annotated below, the combination system includes *a third energy storage element* (e.g., capacitor 176 (brown), or capacitor 74 of Fig. 3) that *stores* the transferred energy from the modulated carrier signal (purple) and *outputs a down-converted quadrature-phase baseband signal portion* (red portion feeding into differential amplifier 52 implemented using Macnally’s circuit) of said modulated carrier signal (purple). Ex1004, 2:13-45 (charge builds up on capacitor 74 for the 90-degree output), 2:46-55 (90-degree output “represents

the average value of the input signal during the second quarter wave of the period”), 4:49-51 (“... 90 degree output 182 has a voltage controlled by the combination of capacitor 176 and resistor 172”), Figs. 3-4, 6-7; Ex1003, ¶192. Tayloe also describes “90 degree output [can be] used to generate baseband ... quadrature signal[]”, (Ex1004, 5:1-16), consistent with descriptions from the ’528 patent. Ex1001, Fig. 197, 178:34-42 (“a switch ... opens and closes as a function of Q control signal [to generate] a down converted signal”); Ex1003, ¶193.

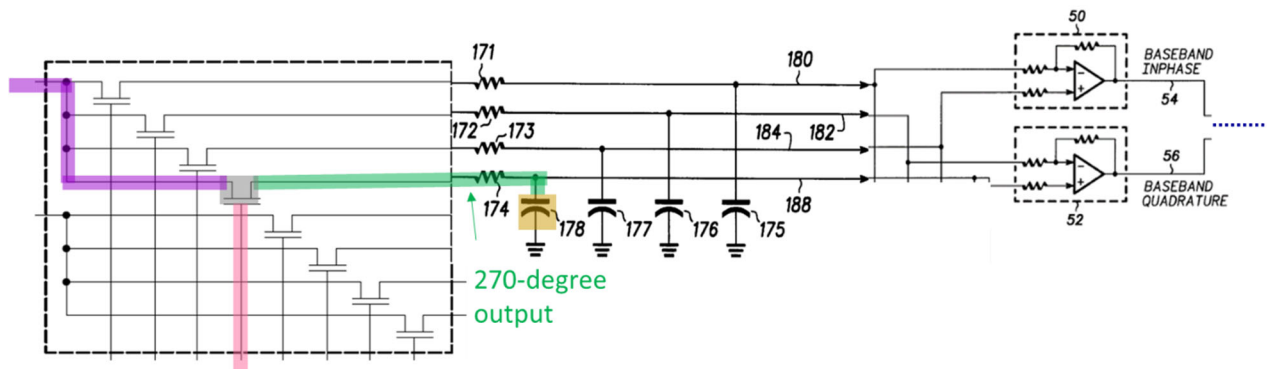


Combination System (using switch of Ex1005 and circuit of Ex1021)

Consistent with Petitioner’s claim construction proposal *supra* §I.C.1, Tayloe’s capacitor 177 (brown) (or capacitor 74 of Fig. 3) “*stores non-negligible amounts of energy from an input EM signal,*” i.e., the RF input signal f_1 . §III.A.5 (1[c]); Ex1003, ¶194.

19[c]

As explained *supra* §§III.A.1-4 and annotated below (similar to 19[a]), the combination system includes a **fourth switch** (gray) coupled to a **fourth control signal** (pink) which comprises a **sampling aperture** (e.g., up to 90 degrees at the frequency of the input signal f_1) with a **specified frequency** (e.g., rate of toggling the fourth switch (gray)). Ex1004, 2:5-26, 2:27-32, 5:1-16, Figs. 3, 6-7; Ex1005, 2; §III.A.5 (element 19[a]); Ex1003, ¶195.



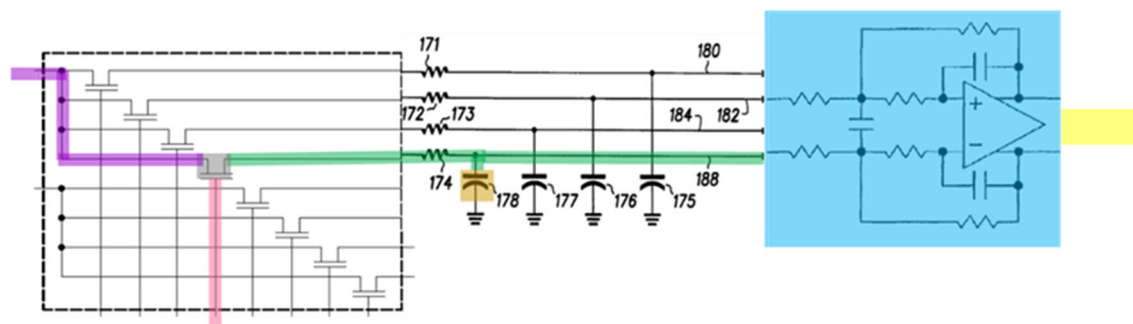
Combination System (using switch of Ex1005)

The fourth switch (gray) is on and **a portion of energy** that is distinguishable from noise is transferred **from the modulated carrier signal** (i.e., RF input signal f_1 (purple)) as an output (i.e., the 270-degree output) of said second switch **during the sampling aperture** (e.g., up to 90 degrees at the frequency of the input signal f_1) of the fourth control signal. Ex1004, 2:27-32, 2:33-45 (charge builds up on capacitor 78 for the 270-degree output), 2:46-55 (the 270-degree output “represents the average value of the input signal during the fourth quarter wave of the period”), 5:1-

16 (270-degree output “can be utilized as embodied in FIG. 3 to achieve greater gain”), Figs. 3-4, 6-7; Ex1003, ¶196.

19[d]

As explained *supra* §§III.A.1-4 and annotated below, the combination system includes **a fourth energy storage element** (e.g., capacitor 178 (brown), or capacitor 78 in Fig. 3) that **stores** the transferred energy from the modulated carrier signal (purple) and **outputs a down-converted inverted¹¹ quadrature-phase baseband signal portion** (green portion feeding into Macnally’s circuit) of said modulated carrier signal (purple). Ex1004, 2:27-45 (describing switch operations and capacitor charge build-up), 4:55-57 (describing 270-degree output); §III.A.5 (element 19[c]); Ex1003, ¶197.



Combination System (using switch of Ex1005 and circuit of Ex1021/Ex1022)

Tayloe explains that the 270-degree output “can be utilized as embodied in FIG. 3 to achieve greater gain” (Ex1005, 5:1-16) because the 270-degree output is

¹¹ FN1

an inverted version of the 90-degree output, and hence the inverted in-phase baseband signal consistent with descriptions provided by the '528 patent. Ex1001, Fig. 197 (fourth processing module 19714), 179:4-10 (“a switch ... opens and closes as a function of inverted Q control signal ... As a result of the opening and closing of this switch ... a down-converted signal, referred to as the inverted Q output signal, results”). Ex1003, ¶198.

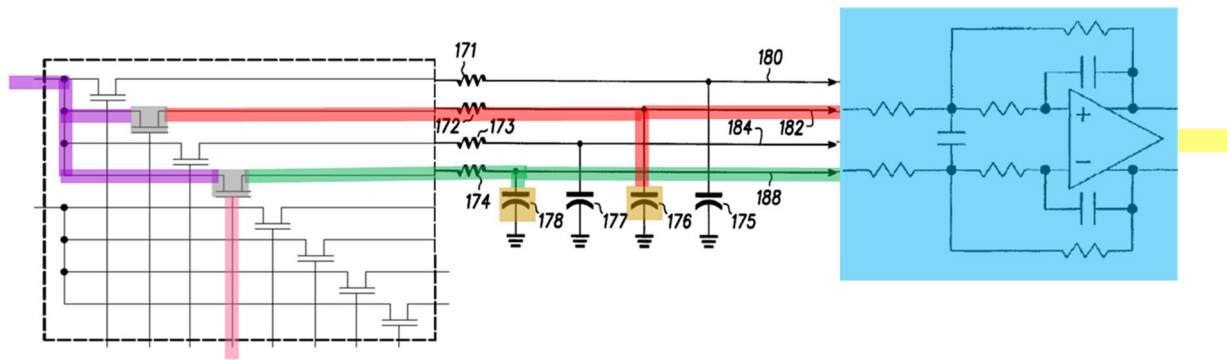
Consistent with Petitioner’s claim construction proposal *supra* §I.C.1 and similar to 19[b], Tayloe’s capacitor 178 (brown) (or capacitor 78 of Fig. 3) “***stores non-negligible amounts of energy from an input EM signal,***” i.e., the RF input signal V_{RF} . Ex1003, ¶199.

19[e]

As explained *supra* §§III.A.1-4 and annotated below, in the combination system, ***the portions of transferred energy*** from each of the third and fourth switch ***are integrated*** over time to accumulate said portions of transferred energy ***from which said down-converted quadrature-phase baseband signal portion*** (red portion) ***and said down-converted inverted¹² quadrature-phase baseband signal portion*** (green portion feeding) ***are derived***. Ex1004, 4:46-67 (describing resistor/capacitor pairs in Fig. 6 form integrators, each “preferably integrates for

¹² FN2

substantially 90 degrees of the input signal” to provide, e.g., the 90-degree and the 270-degree outputs), Abstract. Moreover, Tayloe discloses similar integrator operation in the example of Figure 3 using capacitors 74 and 78 respectively for the 90-degree and 270-degree outputs. Ex1004, 2:33-55 (“each [capacitor] integrating a separate quarter wave of the input signal.”), Figs. 3-4, 6-7; §III.A.5 (1[f]); Ex1003, ¶¶200.



Combination System (using switch of Ex1005 and circuit of Ex1021)

19[f]

As explained *supra* §§III.A.1-3 and annotated below, the combination system includes a *second differential amplifier circuit* (light blue) that *combines said down-converted quadrature-phase baseband signal portion* (red portion) *with said down-converted inverted*¹³ *quadrature-phase baseband signal portion* (green portion) *and outputs a second channel down-converted differential quadrature-*

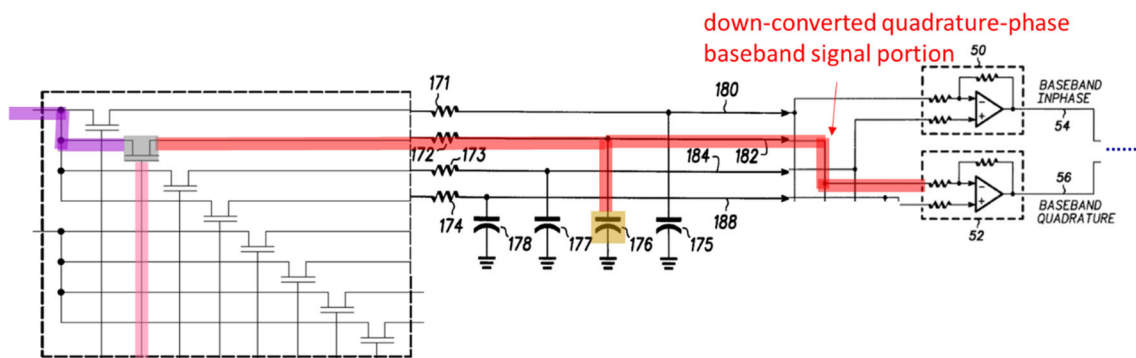
¹³ FN3

phase baseband signal (yellow). Ex1004, 2:56-67 (noting “[s]umming amplifier 52 [implemented using Macnally’s circuit] differentially sums the 90 degree output and the 270 degree output, thereby producing base band quadrature signal 56” and discuss explaining baseband in-phase signal are combined with baseband quadrature signal to generate signal of interest 62), Abstract, Fig. 3; §III.A.5 (1[g]); Ex1003, ¶¶201-202, §VI.

Accordingly, the combination system renders obvious claim 19.

Claim 23

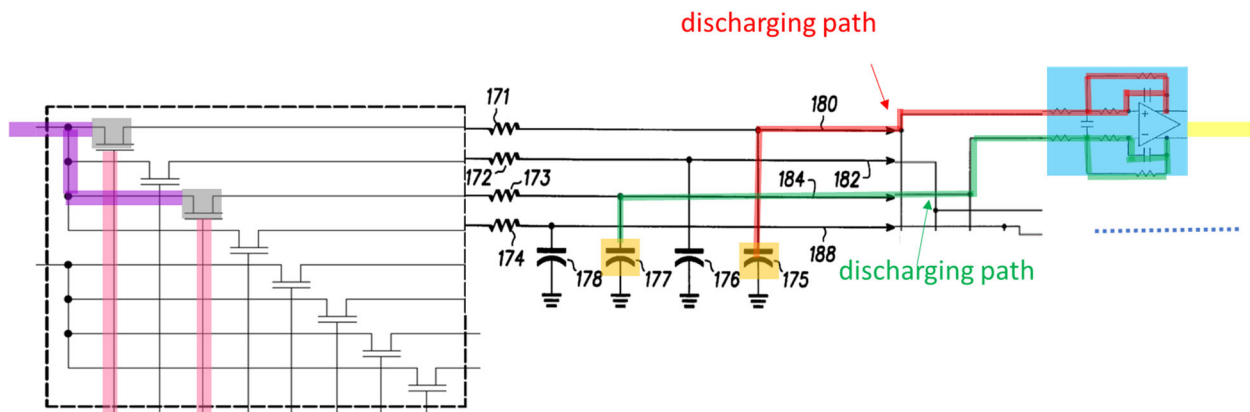
In the combination system, as annotated below, third switch (brown) is on for less than one-half cycle of the modulated carrier signal (i.e., input signal). Ex1004, 2:27-32, 33-45, 46-55, 5:1-16, Figs. 3-4, 6-7; §III.A.5 (claim 5); Ex1003, ¶203.



Combination System (using switch of Ex1005 and circuit of Ex1021/Ex1022)

Claim 26

Similar to claim 8, in the combination system, the third and fourth control signals (pink) each control a charging and discharging cycle for respective energy storage element (brown) by respectively controlling the third and fourth switches (gray). *Supra* 19[a], 19[c]. Specifically, for each switch (gray), the portion of energy that is distinguishable from noise is transferred to the respective storage element (brown) when the switch is on (i.e., CLOSED) during the charging cycle. *Id.* When the switch (gray) is off (i.e., OPEN), a portion of the transferred energy (e.g., charge accumulated) is discharged, as annotated below. Ex1003, ¶204.



Combination System (using switch of Ex1005 and circuit of Ex1021/Ex1022)

Claim 27

Similar to claim 9, in the combination system, for each storage device (capacitor in brown), the energy discharged during any given discharge cycle is not completely discharged. The remaining undischarged energy from the given

discharge cycle thus becomes an initial condition for the next charging cycle (when the switch is closed). Ex1003, ¶205.

Claims 28, 30, 31, 32

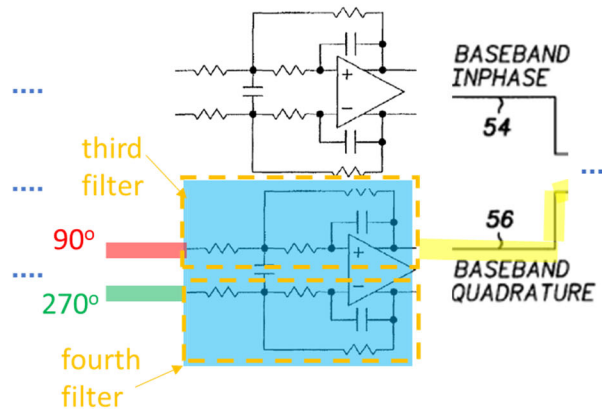
Similar to claim 11, in the combination system, the frequencies of the third and fourth apertures (i.e., respective periods during which the third and fourth switches are closed to generate the 90-degree and 270-degree outputs) have periods that are of the modulated carrier signal's period, thus satisfying claim 18 (“***two (2) percent or greater***”), 30 (“***five (5) percent or greater***”), 31 (“***ten (10) percent or greater***”), and 32 (“***twelve and a half (12.5) percent or greater***”). Ex1004, Abstract, 2:18-27, 4:28-45; 4:58-63, §III.A.1-5 (claim 11); Ex1003, ¶¶206-209.

Claim 33

As explained *supra* §III.A.5 (claim 15), in the combination, the differential amplifier circuits include a ***first filter*** that filters the down-converted in-phase baseband signal portion, and a ***second filter*** that filters the down-converted inverted in-phase baseband signal portion.

As annotated below, the combination system also includes a ***third filter*** (orange box) that filters the down-converted quadrature-phase baseband signal portion (red), and a ***fourth filter*** (orange box) that filters the down-converted

inverted quadrature baseband signal portion (green). §§III.A.1-4, §III.A.5 (19[b] (quadrature-phase baseband), 19[d] (inverted quadrature-phase baseband), 19[f] (differential amplifier circuit). Ex1003, ¶210-11.



Combined System (zoomed portion using circuits of Ex1021/Ex1022)

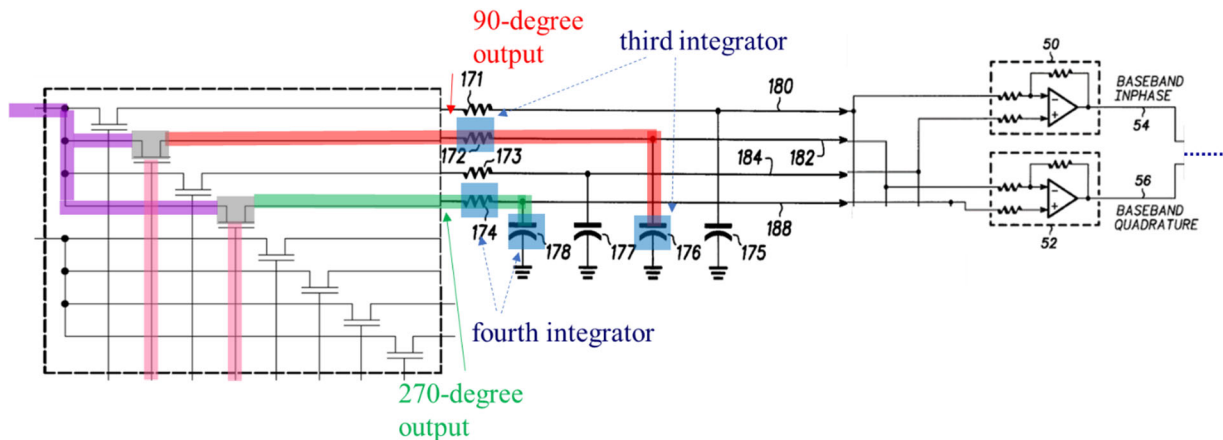
Claim 34

As explained *supra* §III.A.5 (claim 16), in the combination system (whether capacitors share a resistor (Fig. 3), or each capacitor is paired with a separate resistor (Fig. 6)), the first and second filters each comprise a low-pass filter. Further, the third and fourth filters each comprise a low-pass filter. §§III.A.3-4; Ex1014, 7:7-29 (discussing cut-off frequency); Ex1003, ¶212 (explaining the RC network in conjunction with an amplifier forms a classical low-pass filter, as relied on by Ex1012 (PV's infringement chart)).

Claim 35

35. The system of claim 19, wherein said portions of transferred energy from each of the first, second, third and fourth switch which are integrated over time to accumulate said portions of transferred energy are integrated by a separate integration module coupled to the output of each said first, second, third and fourth switch respectively.

Similar claim 17 *supra* §III.A.5, the combination system (each capacitor is paired with a separate resistor (Fig. 6)) has **a separate integration module** (separate capacitor-resistor pair) **coupled to the output of each of the first, second, third** (gray), and **fourth** (gray) **switch**. Ex1004, 4:48-49, 49-57. The integration modules are separate from each other. Each integration module is not the same as an energy storage element. Ex1003, ¶213.



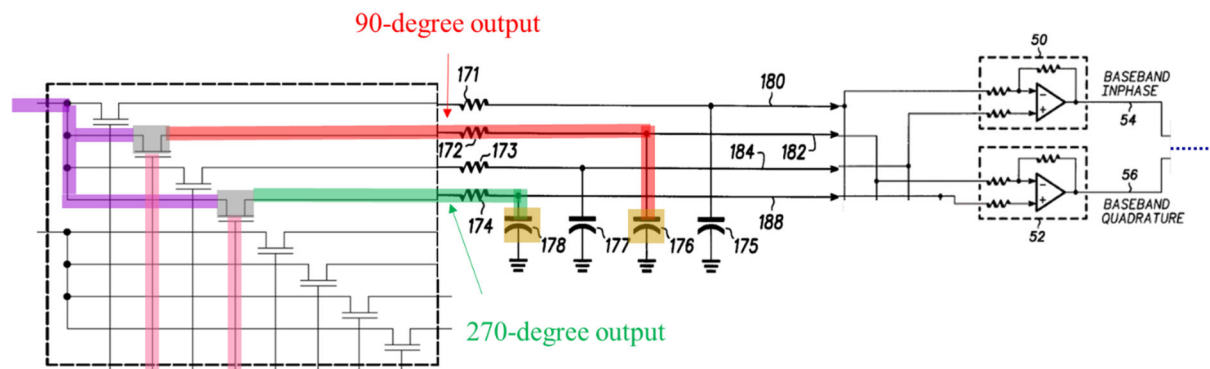
Combination System (using switch of Ex1005)

Moreover, **the portions of transferred energy from each of the first, second, third, and fourth switch which are integrated over time to accumulate said portions of transferred energy are integrated by a separate integration module.**

Id., 4:57-63 (“each [integration module] preferably integrates for substantially 90 degrees of the input signal.”), Fig. 6, Abstract, 2:27-55, 5:1-16, Fig. 3; Ex1003, ¶214.

Claim 36

Similar to claim 18 *supra* §III.A.5, in the combination system, *the first, second, third, and fourth storage elements are capacitive elements* (i.e., capacitors). Ex1004, 4:48-51 (discussing “each integrating capacitor”), Ex1003, ¶215.



Combination System (using switch of Ex1005)

In the combination system, *the portions of transferred energy from each of the first, second, third, and fourth switch which are integrated over time to accumulate said portions of transferred energy are integrated by the capacitive storage circuits as they accumulate charge during successive sampling apertures* (e.g., duration of switch closures). Tayloe explains that “commutating switch 38 [implemented as the TI multiplexer/demultiplexer] remains closed at each of the four

outputs for substantially 90 degrees at the frequency of the input signal.” Ex1004, 2:27-32, 2:13-18, Abstract (“The samples are integrated over time to produce an average voltage at 0 degrees, 90 degrees, 180 degrees and 270 degrees.”), 2:33-45 (charge builds up on each capacitor for each quadrant), 5:1-16, Figs. 3-7; Ex1003, ¶¶216-217.

B. [GROUND 1B] – Tayloe, TI datasheet, Macnally, and Cahn Render Obvious Claims 2-4, 20-22

1. Cahn

Cahn describes modulation techniques including amplitude modulation, phase modulation, and combined amplitude and phase modulation. Ex1007. After noting that “the use of multiple amplitude level to transmit digital information ... is well-known under the name quantized pulse-amplitude modulation,” and that “the possibility of employing multiple phase positions for the same purpose was [recently] explored,” Cahn describes “[a] combination of digital-amplitude and digital-phase modulation.” *Id.*, 150-51; Ex1003, ¶¶120-21 (noting Cahn as a seminal paper on modulation techniques from the 1960s).

2. Combination

In the combination system, Tayloe discloses modulation by noting “information bearing signals are superimposed on f_1 ,” (Ex1004, 4:5-8), after discussing an example in which “the integrated voltages on capacitors 72-78 ...

change at a rate equal to Δf , which is the frequency of the signal of interest at baseband,” (*id.*, 3:62-4:5), which a POSITA would recognize to include phase modulation. Ex1003, ¶217. Further, the relied-on portion of Tayloe’s circuit would be operable to down-convert amplitude, phase and combined amplitude and phase modulated input signals. *Id.* A POSITA would have found it obvious to apply the combination system to down-convert a RF signal modulated using amplitude modulation, phase modulation, or combined amplitude and phase modulation, because these were well-known established techniques commonly used to modulate signals for receivers. Ex1003, ¶218 (noting BFSK used in Ex1021, 7:45-51; Ex1022, 12). Indeed, the application would have been a combination of prior art elements according to known methods to yield predictable results (i.e., applying well-known modulation techniques).¹⁴ *Id.*

3. Analysis

Claims 2, 3, 4, 20, 21, 22

As explained *supra* §III.B.1-2 and III.A.1-4, it would have been obvious for the combination system to operate on modulated carrier signal that includes an amplitude variation (claims 2 and 20), a phase variation (claims 3 and 21), or a combination of amplitude variation and phase variation (claims 3 and 22) so that the

¹⁴ FN7

integrated voltages on the corresponding capacitors are processed accordingly to generate baseband signals that track “the information bearing signals.” Ex1004, 4:5-8; Ex1007, 150-51; Ex1003, ¶¶219-224 (A POSITA would know the processing details).

C. [GROUND 2A] – Razavi and Macnally Render Obvious Claims 1, 5, 8-9, 11-19, 23, 26-28, 30-36

1. Razavi

Razavi describes “the design of a single-chip 900-MHz CMOS direct conversion receiver (DCR) [including] quadrature mixers [blue], simple low-pass filters (LPFs), [and] baseband amplifiers, A1,” as annotated in Fig. 1 below:

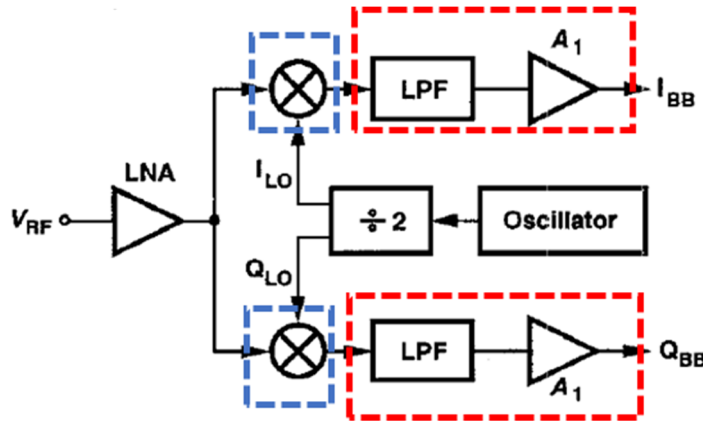
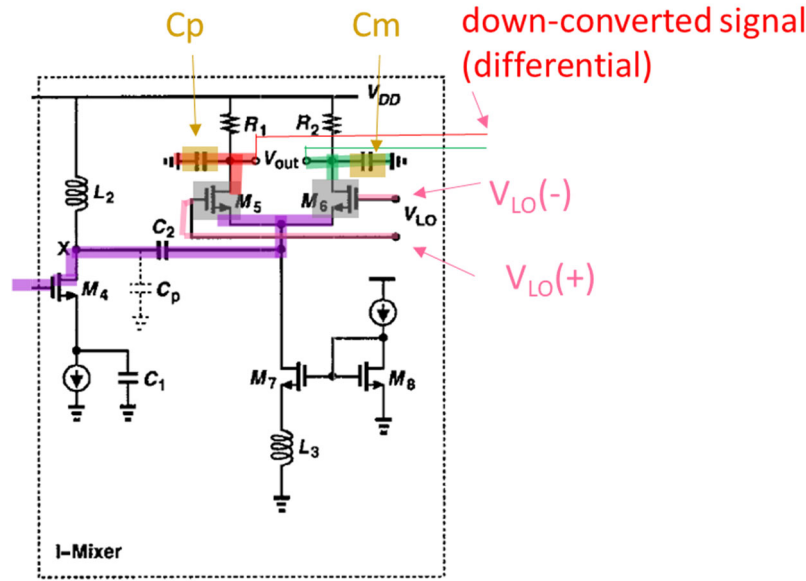


Fig. 1. Receiver architecture.

Ex1017, 113. Razavi’s mixer includes “a switching pair M₅-M₆ [gray],” as annotated below:



Id., Fig. 2. In the illustrated in-phase mixer, the switching pair M₅ and M₆ are alternately turned on or off under the control of V_{LO}, which has an upper component (V_{LO}(-)) and a lower component (V_{LO}(+)) oscillating in complementary manner relative to each other. Ex1003, ¶¶114-117 (illustrating square waveforms of complementary V_{LO} components operating on the switching pair). Each time M₅ is turned on, its gate is CLOSED and the drain terminal is conducting so that charges are accumulated on capacitor C_p in the presence of resistor R₁. Meanwhile, the M₆ is turned off. This on-duration for M₅ corresponds to the period where V_{LO}(+) is high, charging capacitor C_p in the presence of resistor R₁, and M₆ is turned off because V_{LO}(-) is low. When M₅ is subsequently turned off, a portion of the accumulated charge is discharged. During this period M₅ is off, V_{LO}(+) is high and M₆ is turned on so that charges are accumulated on capacitor C_m in the presence of

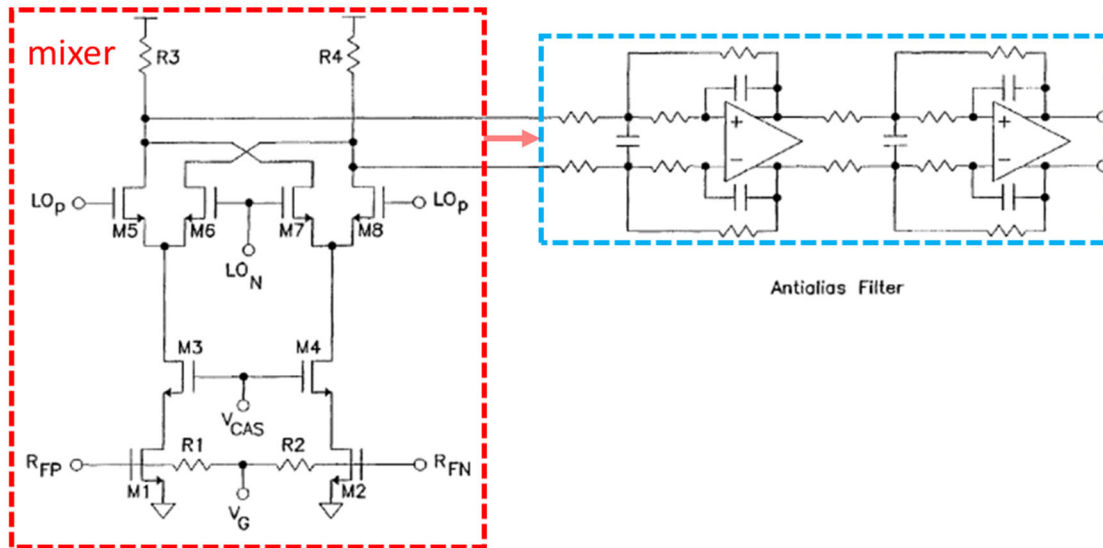
resistor R_2 . A portion of the accumulated charges is similarly discharged when M_6 is turned off. The cycle then repeats. Ex1003, ¶¶117-18.

While the above annotation shows in-phase (I) mixer with symmetric pairs of transistors (M_5 and M_6), capacitors, and resistors (R_1 and R_2), Razavi also identifies the quadrature (Q) mixer. *Id.*; Ex1003, ¶119. A POSITA would understand from the context of the description that both mixers are similarly constructed, or at least find it obvious given the similar function, inputs and outputs. Ex1017, 113 and Fig. 1. The I-mixer and the Q-mixer respectively output an in-phase down-converted signal and a quadrature down-converted signal, both in differential format. Ex1017, Fig. 1. Razavi further describes design options for further processing of the down-converted signal using baseband amplifier and low-pass filter (red in above-annotated Fig. 1), with preliminary results summarized at Table 1. Ex1017, 113-114, Figs. 4, 5; Ex1003, ¶119.

2. Combination

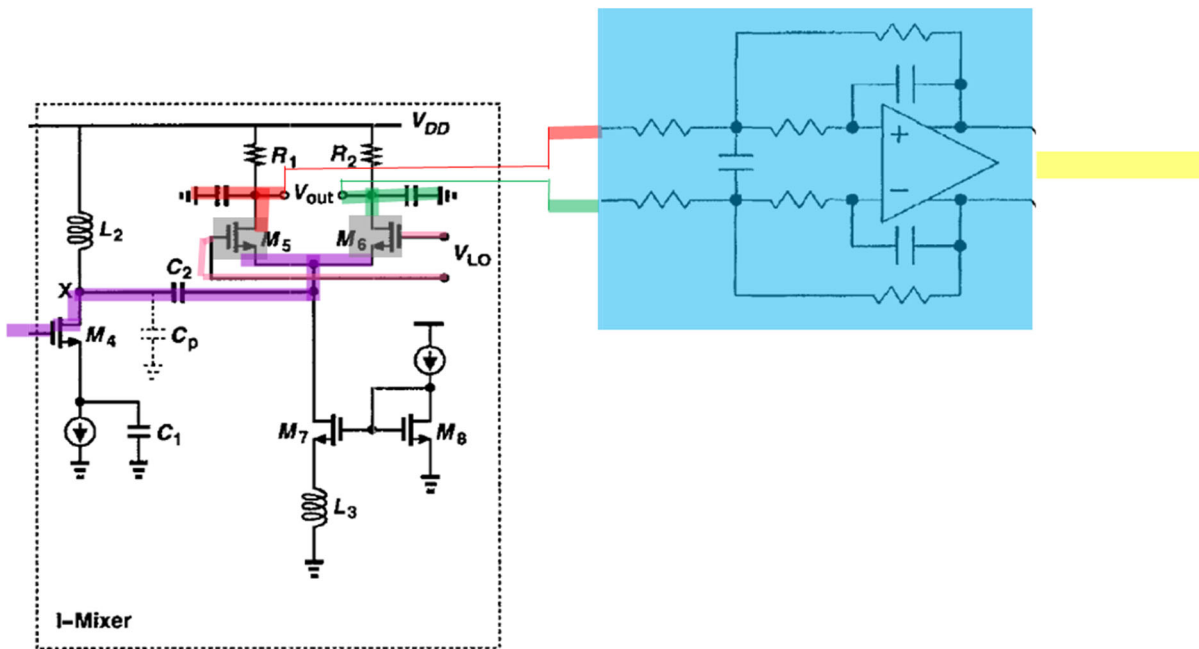
As explained *supra* §III.A.3, Macnally discloses examples of using antialiasing filters in an integrated transceiver device. Ex1021, Fig. 3 (annotated below), 1:10-12, 1:44-46, 7:7-8; Ex1022, Fig. 3, pp. 4, 8; Ex1003, ¶226.

FIG. 3



Ex1021/Ex1022, Fig. 3 (annotated)

A POSITA would have found it obvious to incorporate Macnally's fully differential amplifier circuits in Razavi's receiver to process the down-converted signals, as annotated below. Ex1017, Figs. 1-2, 4-5; Ex1021/Ex1022, Fig. 3.



Combination Receiver (using Macnally's circuit (light blue))

A POSITA would have been motivated to incorporate Macnally's fully differential amplifier circuits in Razavi's receiver to supply low-pass filtering advocated by Razavi. *Id.*; Ex1021, 1:35-50; Ex1022, 4. Acknowledging "output nodes of the mixer are loaded with on-chip capacitors to suppress high-frequency components," Razavi states "channel-selection filtering is not included," thus indicating the need for channel-selection filtering, which a POSITA would understand as low-pass filtering because Razavi performs "direction conversion" to baseband. Ex1017, 113. Indeed, Razavi provides "three permutations in Fig. 4 [depicting high-level examples of] "a low-pass filter suppresses out-of-channel interferers," (*id.*), albeit with no further details of filter design. As explained *supra* §III.A.3, Macnally provides details of a fully differential amplifier circuit that

performs low-pass filtering to process “mixer output.” Ex1021, 7:7-16, 7:17-29 (“anti-alias filter”), Fig. 1; Ex1022, 8 (same), Fig. 1. A POSITA would have recognized the benefits of applying the example circuit of Macnally to complement Razavi’s receiver design and achieve both amplification and “channel-selection filtering” at baseband. Ex1017, 113; Ex1003, ¶¶227-228.

The modification would have had a reasonable expectation of success because it would have been a combination of prior art elements according to known methods to yield predictable results¹⁵ (using Macnally’s fully differential amplifier circuit, a known low-pass filter, consistent with one design option disclosed by Razavi). Ex1021/Ex1022, Fig. 3; Ex1017, Fig. 4(a); Ex1003, ¶229.

3. Analysis

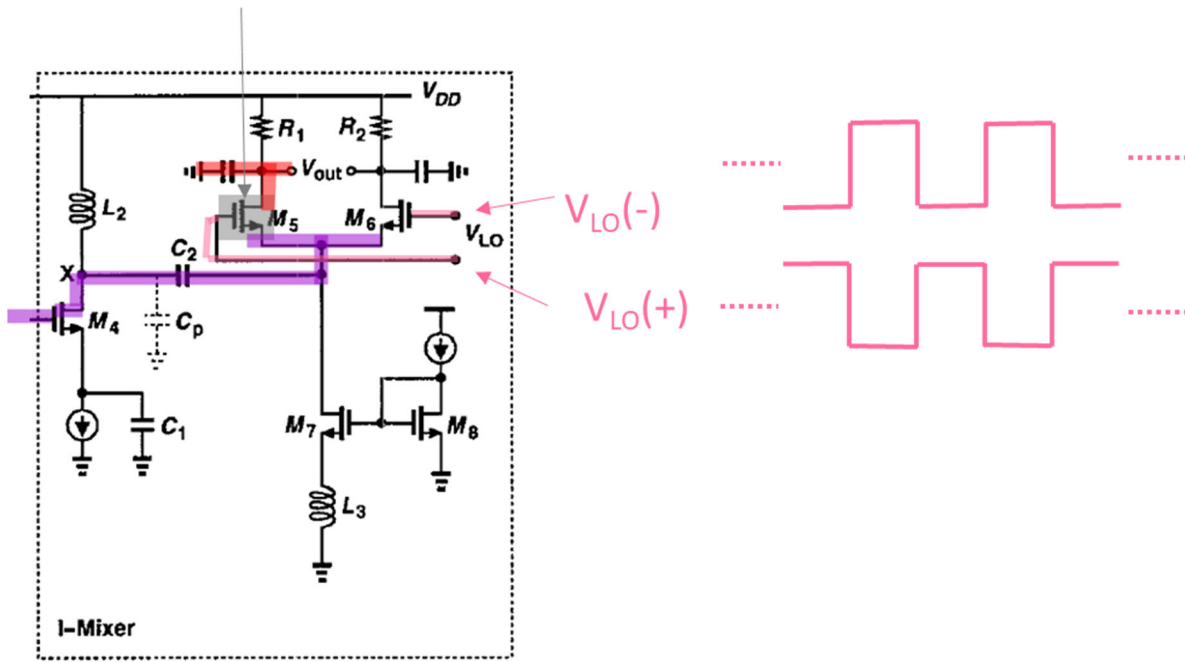
Claim 1

To the extent the preamble is deemed limiting, the combination receiver (Razavi’s receiver using Macnally’s circuits) is a system for frequency down-converting a modulated carrier signal to a baseband signal. Ex1017 113, Fig. 1; Ex1021/Ex1022, Figs. 1, 3; Ex1003, ¶230.

1/b]

¹⁵ FN7

As explained *supra* §§III.C.1-2 and annotated below, the combination receiver includes a **first switch** (M_5 (gray)) coupled to a **first control signal** ($V_{LO}(+)$ (pink)) which comprises a **sampling aperture** (the period when M_5 is CLOSED, which lasts approximately half the period of the oscillating frequency of V_{LO}) with a specified frequency (the oscillating frequency of V_{LO}). Ex1003, ¶231; Ex1017, 1.



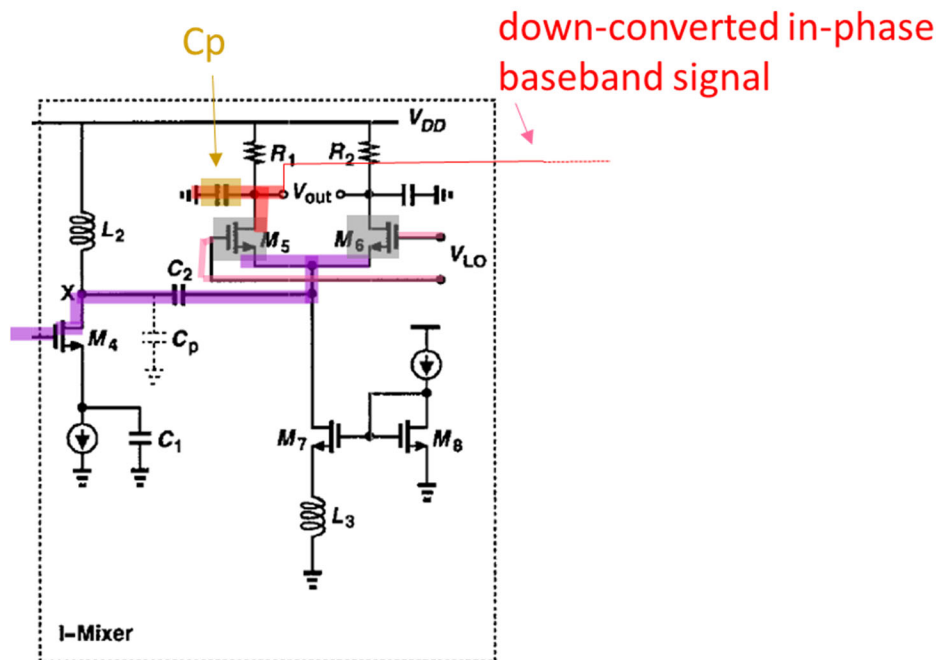
Ex1017, Fig. 2 (annotated)

In the combination receiver, the first switch (M_5 (gray)) is on so that the drain terminal starts conducting and **a portion of energy that is distinguishable from noise** is transferred from the modulated carrier signal (V_{RF} (purple)) as an output of said first switch (V_{out} (red) above M_5 (gray)) during the sampling aperture of said first

switch (when M₅ is ON), consistent with portions of the '528 Specification that allegedly lend support to the Challenged Claims. Ex1001, Fig. 197, 176:66-177:16. Razavi describes experiment results, further demonstrating sufficient energy distinguishable from noise is transferred via direct conversion. Ex1017, Table 1; §III.A.5(1[b]); Ex1003, ¶232.

 $1[c]$

As explained *supra* §§III.C.1-2 and annotated below, the combination receiver includes a ***first energy storage element*** (capacitor C_p (brown)) coupled to a ***first control signal*** (V_{LO} lower (pink)) and outputs a ***down-converted in-phase baseband signal portion*** (red portion exiting in-phase (I) mixer) of said modulated carrier signal (V_{RF} (purple)).



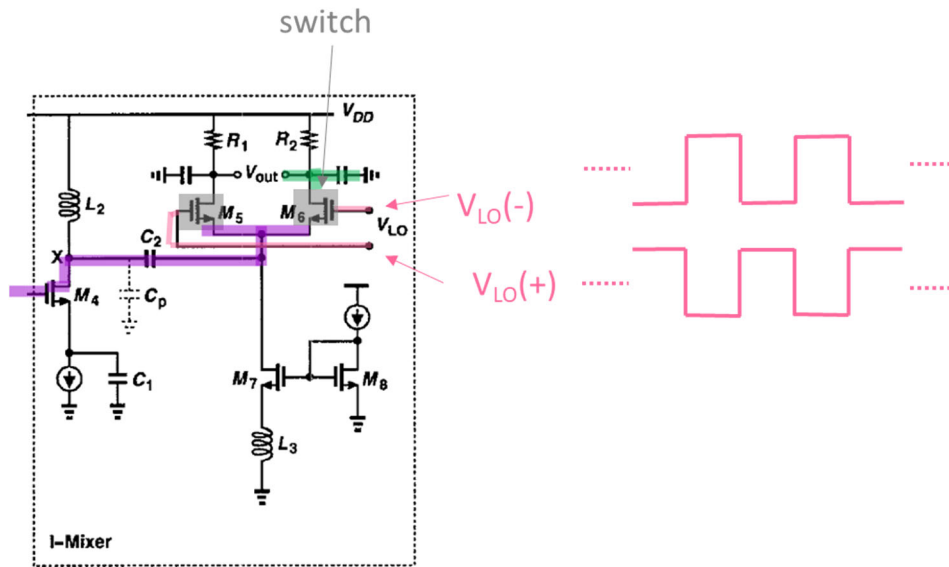
Ex1017 (annotated)

As explained in 1[b], when M_5 (gray) is on, the drain terminal starts conducting and the capacitor C_p (brown) stores the transferred energy and outputs a down-converted in-phase baseband portion (red portion) of V_{RF} (purple) in the same manner as described by the '528 patent. Ex1001, Fig. 197 (first processing module 19702), 176:61-177:15. Ex1003, ¶¶233-234.

Consistent with Petitioner's claim construction proposal *supra* §I.C.1, Razavi's capacitor C_p (brown) "***stores non-negligible amounts of energy from an input EM signal,***" *i.e.*, the RF input signal V_{RF} , to provide sufficient energy for outputting the down-converted signal. As observed by Dr. Galton, the differential amplifier circuit of Macnally provides ***low impedance load*** typically in the kilo ohm range, (Ex1003, ¶235), which allegedly "goes to the heart of what makes an element, a 'storage' element." IPR2020-01265, Paper 26 (PO Sur-reply). 13. As above, Ravazi's experiment results further demonstrate sufficient energy distinguishable from noise. *Supra*, 1[b]; Ex1017, Table 1; §III.A.5(1[b]); Ex1003, ¶232.

1[d]

As explained *supra* §§III.C.1-2 and annotated below, the combination receiver includes a ***second switch*** (M_6 (gray)) coupled to a ***second control signal*** (V_{LO} (-) (pink)) which comprises a sampling aperture (the period when M_6 is CLOSED, which lasts approximately half the period of the oscillating frequency of V_{LO}) with a specified frequency (the oscillating frequency of V_{LO}). Ex1003, ¶236.



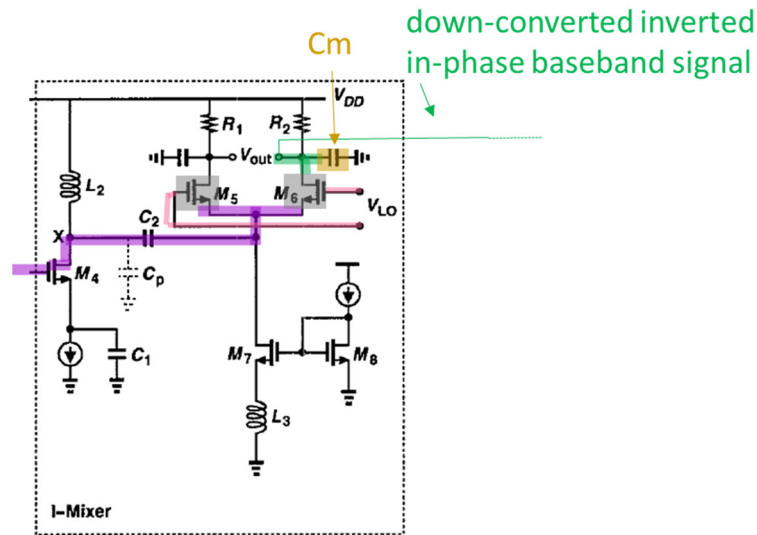
Ex1017, Fig. 2 (annotated)

In the combination receiver, the second switch (M_6 (gray)) is on so that the drain terminal starts conducting and *a portion of energy that is distinguishable from noise* is transferred from the modulated carrier signal (V_{RF} (purple)) as an output of said first switch (V_{out} (green) above M_6 (gray)) during the sampling aperture of said first switch (when M_6 is ON), consistent with portions of the '528 Specification that allegedly lend support to the Challenged Claims. Ex1001, Fig. 197, 177:31-48; Ex1003, ¶237 (V_{out} terminals in Ravazi are complementary).

1[e]

As explained *supra* §III.C.1-2, and annotated below, the combination receiver includes a *second energy storage element* (capacitor C_m (brown)) coupled to a *second control signal* ($V_{LO} (-)$ (pink)) and outputs a *down-converted in-phase*

baseband signal portion (green portion exiting in-phase (I) mixer) of said modulated carrier signal (V_{RF} (purple)).



Ex1017, Fig. 2 (annotated)

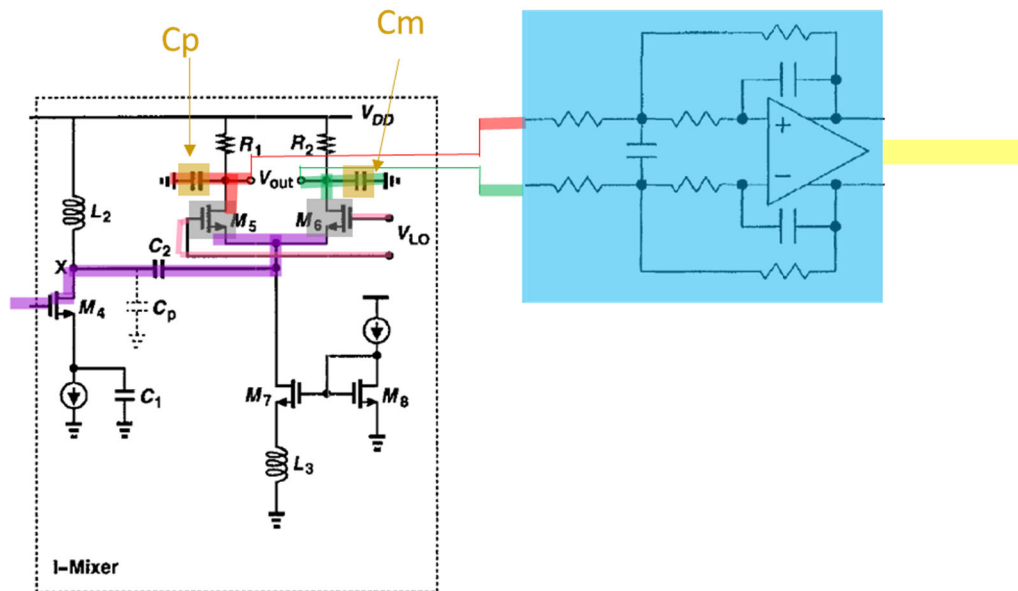
Consistent with Petitioner’s claim construction proposal *supra* §I.C.1 and similar to 1[c], Razavi’s capacitor Cm (brown) “**stores non-negligible amounts of energy from an input EM signal,**” i.e., the RF input signal V_{RF} , to provide sufficient energy for outputting the down-converted signal. Ex1003, ¶¶239-240 (discussing low input impedance of Macnally’s circuit provides a low impedance load to capacitor Cm of Razavi).

As explained in 1[d], when M6 (gray) is on, the drain terminal starts conducting and the second capacitor (brown) stores the transferred energy and outputs a down-converted inverted in-phase baseband portion (green portion) of V_{RF}

(purple) in the same manner as described by the '528 patent. Ex1001, Fig. 197 (second processing module 19706), 177:31-54; Ex1003, ¶241.

1[f]

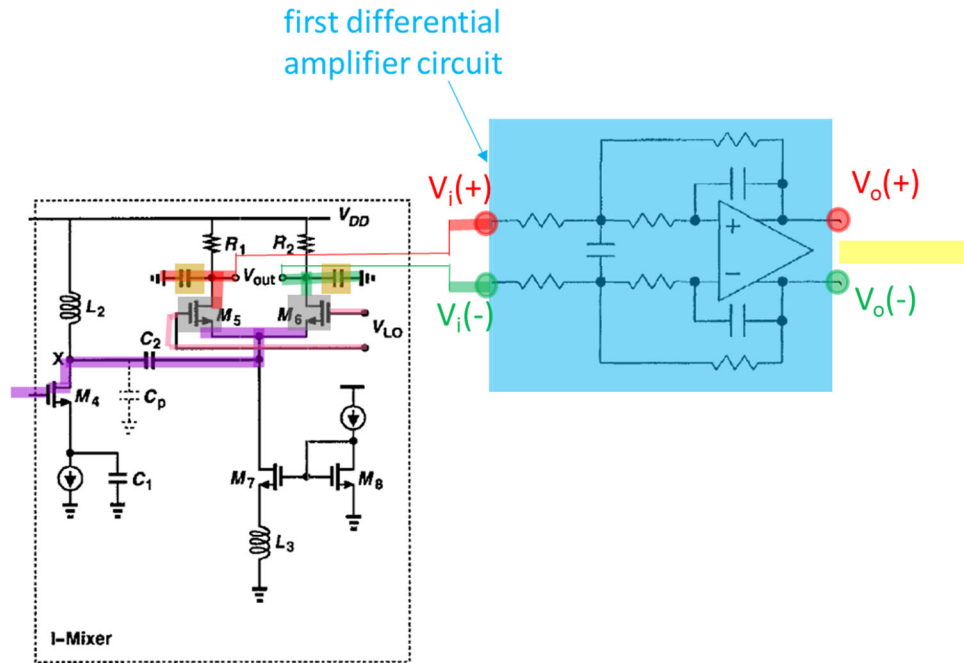
As explained *supra* §§III.C.1-2 and annotated below, in the combination system, ***the portions of transferred energy*** from each of the first and second switch ***are integrated*** (e.g., on each respective capacitor C_p/C_m (brown)) over time (when the coupled-to transistor switch is on) to accumulate said portions of transferred energy ***from which said down-converted in-phase baseband signal portion*** (red portion feeding into Macnally's circuit) ***and said down-converted inverted in-phase baseband signal portion*** (green portion feeding into Macnally's circuit) ***are derived***. Ex1003, ¶¶242-43; §III.C.3 (1[c], 1[e]).



Combination Receiver (using circuit of Ex1021/1022)

[1g]

As explained §§III.C.1-2 and annotated below, the combination receiver includes a **first differential amplifier circuit** (light blue) that **combines** said down-converted in-phase baseband signal portion (red portion) with said down-converted inverted in-phase baseband signal portion (green portion) and outputs a first channel down-converted differential in-phase baseband signal (yellow portion).



Combined Receiver (using circuit of Ex1021/1022)

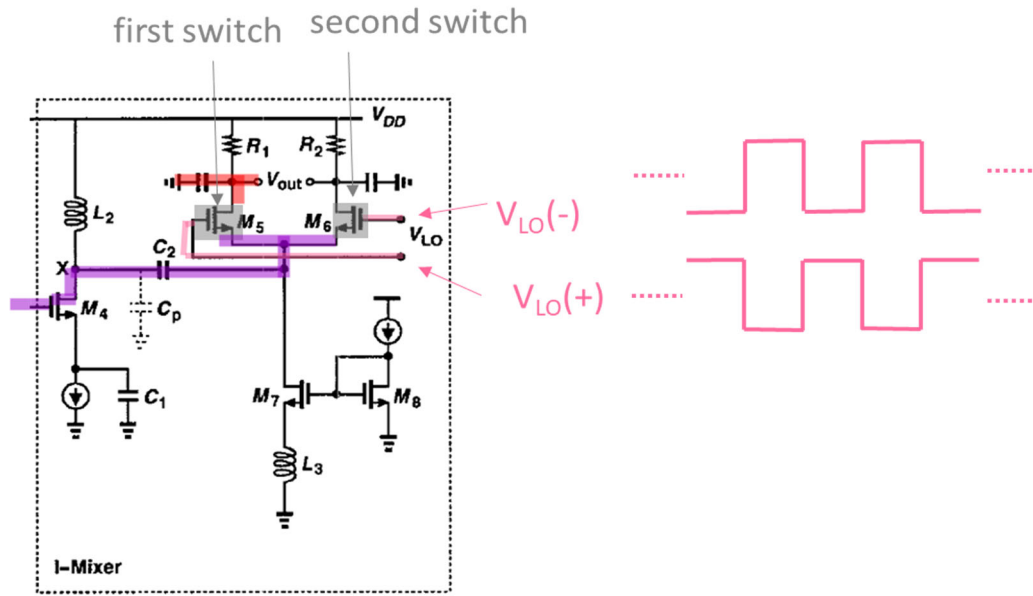
The first differential amplifier circuit (light blue) combines the down-converted in-phase baseband signal portion (red portion) with the down-converted inverted in-phase baseband signal portion (green portion) because each of the two complementary signal components at the output (i.e., $V_o(+)$ and $V_o(-)$) is a result of

both of the two complementary signal components at the input (i.e., $V_i(+)$ and $V_i(-)$). Ex1003, ¶¶244-46 (explaining $V_o(+) = A \cdot (V_i(+) - V_i(-))/2$, and $V_o(-) = -A \cdot (V_i(+) - V_i(-))/2$, where A is the amplification factor, and noting that a POSITA would have understood that a single-ended amplifier was usually used to generate the output signal off-chip, and would have found it obvious to use a singled-ended amplifier, as needed).

Accordingly, the combination receiver renders obvious claim 1. Ex1003, ¶247.

Claim 5

As explained *supra* §§III.C.1-2, the first switch (M_5) turns on when $V_{LO}(+)$ is substantially larger than $V_{LO}(-)$, and the second switch (M_6) turns on when $V_{LO}(-)$ is substantially larger than $V_{LO}(+)$. As annotated below, $V_{LO}(+)$ and $V_{LO}(-)$ are complementary components of V_{LO} , a differential signal.



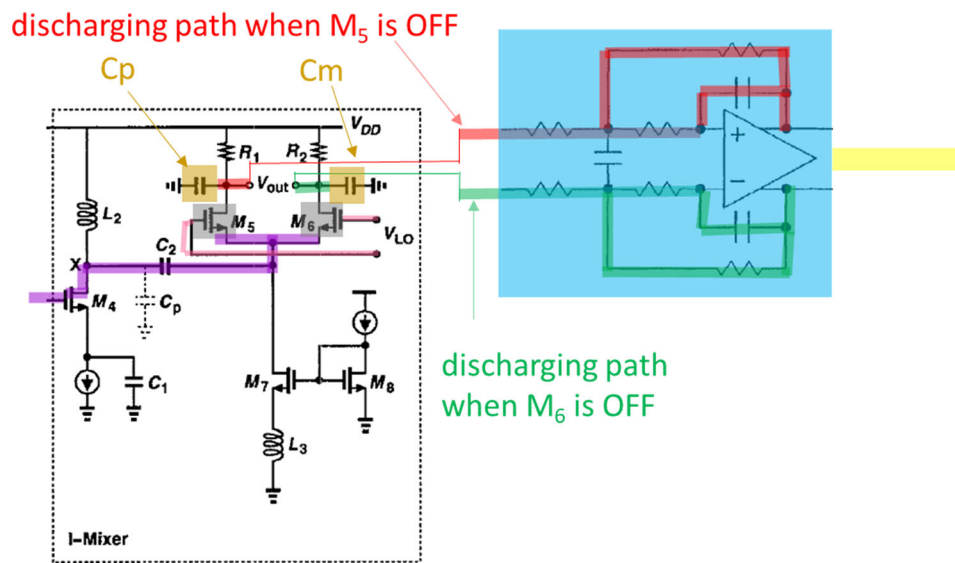
Ex1017, Fig. 2 (annotated)

As a direct conversion receiver, the oscillating frequency of V_{LO} is nominally the same as the carrier frequency of the input RF signal. As a result of transistor switching time, the period for each switch to be turned on is less than one-half cycle of the modulated carrier signal (i.e., input RF signal). Ex1003, ¶¶248-250.

Claim 8

In the combination system receiver, the first and second control signals (pink) each control a charging and discharging cycle for respective energy storage element (brown) by respectively controlling the first and second switches (gray). III.C.3(1[b], 1[d]). Specifically, for each switch (gray), the portion of energy that is

distinguishable from noise is transferred to the respective storage element (brown) when the switch is on during the charging cycle. *Id.* When the switch (gray) is off (i.e., OPEN), a portion of the transferred energy (e.g., charge accumulated) is discharged, as annotated below for one switch. Ex1003, ¶251-52 (further explaining discharge path and leaky circuitry due to low (i.e., kilo ohm range) impedance load).



Combination Receiver (using circuit of Ex1021/Ex1022)

Claim 9

In the combination receiver, for each storage device (capacitor in brown), the energy discharged during any given discharge cycle is not completely discharged. Ex1003, ¶¶253-254 (noting “the charge stored on each capacitor discharges proportionally to $e^{-t/RC}$, where t is time, C is the capacitance, and R is the equivalent

resistance through which the capacitor is discharged” and “the capacitor never fully discharges”). The remaining undischarged energy from the given discharge cycle thus becomes an initial condition for the next charging cycle (when the switch is closed). *Id.*

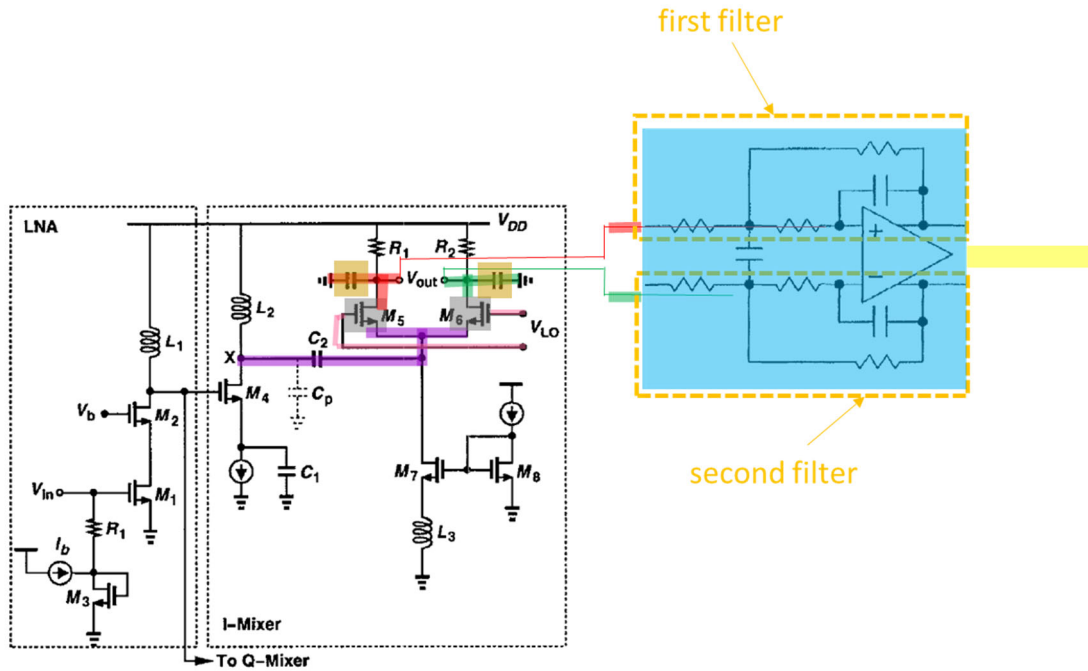
Claims 11, 12, 13, 14

As explained *supra* §III.C.3 (claim 5), the frequencies of the first and second apertures (i.e., respective periods during which the first and second switches are closed to generate in-phase baseband signal and in-phase inverted baseband signal) have periods that are less than 50% of the modulated carrier signal’s period, thereby satisfying claim 11 (“***two (2) percent or greater***”), 12 (“***five (5) percent or greater***”), 13 (“***ten (10) percent or greater***”), and 14 (“***twelve and a half (12.5) percent or greater***”). Ex1003, ¶255-262.

Claim 15

In the combination receiver, the differential amplifier circuits include a ***first filter*** (orange box) that filters the down-converted in-phase baseband signal portion (red), and a ***second filter*** (orange box) that filters the down-converted inverted in-phase baseband signal portion (green), as annotated below. §§III.C.1-2, §III.A.3

(1[c] (in-phase baseband), 1[e] (inverted in-phase baseband), [1g] (differential amplifier circuit); Ex1003, ¶¶263-264.



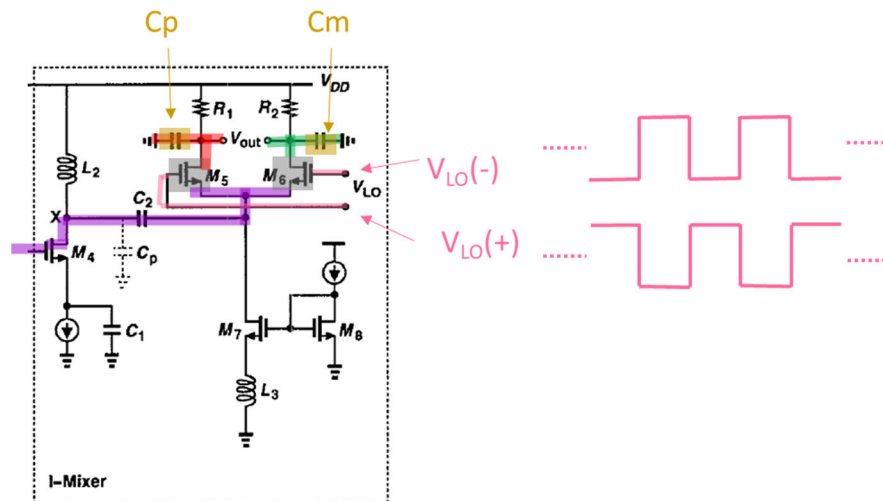
Combined Receiver (using circuit of Ex1021/Ex1022)

Claim 16

In the combination receiver, the first and second filters (orange boxes annotated above) each comprise a low-pass filter. §§III.C.1-2; Ex1021, 7:7-29 (discussing cut-off frequency); Ex1022, 11 (same); Ex1003, ¶¶265-266 (the RC network forms a classical low-pass filter).

Claim 18

As explained *supra* §§III.C.1-2 and annotated below, in the combination receiver, portions of transferred energy from each of the ***first*** (M₅) and ***second*** (M₆) ***switch*** (gray) which are integrated over time to accumulate said portions of transferred energy are integrated by the ***capacitive storage circuits*** (capacitors C_p and C_m (brown), grounds and conductors to C_p/C_m/V_{out}) as they accumulate charge during ***successive sampling apertures*** (successive windows when the coupled-to switch is ON as controlled by V_{LO}(+) and V_{LO}(-) (pink)).



Ex1017, Fig. 2 (annotated)

In operation, the capacitive storage circuits integrate portions of transferred energy from the coupled-to switches (M_5 and M_6) to accumulate the portions of transferred energy during successive windows when the coupled-to switch is ON, consistent with the '528 Specification. Ex1001, Fig. 197 (first processing module 19702), 176:61-177:15; Ex1003, ¶270-272.

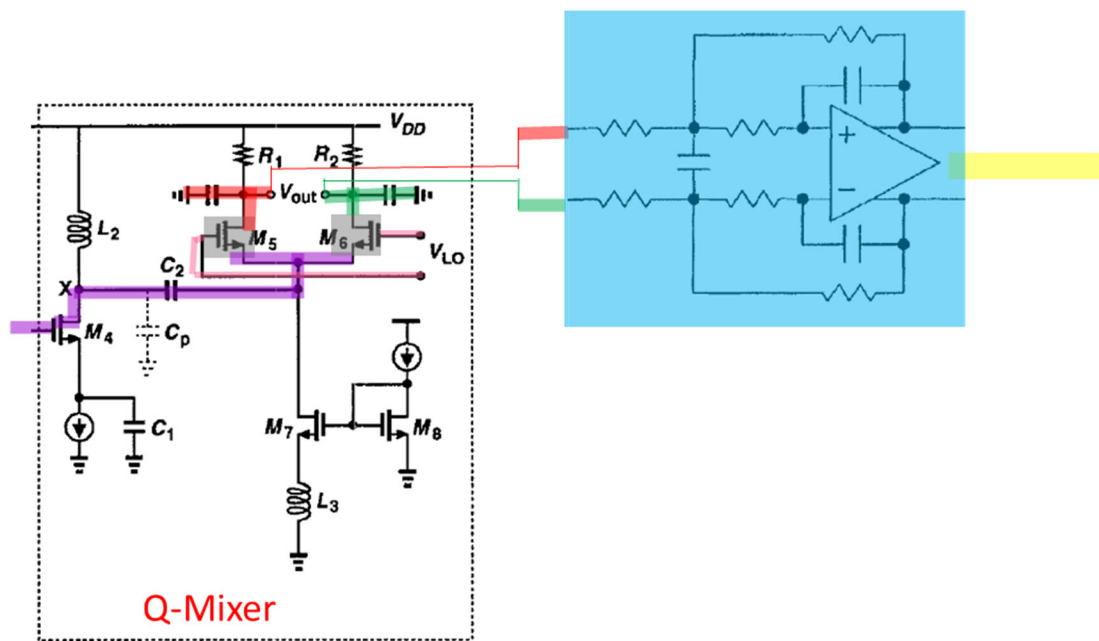
Claim 19

19[a]

§III.C.3 (claim 1); Ex1003, ¶¶273-275.

19[b]

As explained *supra* §§III.C.1-2 and annotated below, the combination system provides a quadrature (Q) mixer (similar to the I-mixer) that includes a **third switch** (M_5 (gray)) coupled to a **third control signal** (V_{LO} (+) (pink)) which comprises a **sampling aperture** (e.g., on-duration of the third switch) with a **specified frequency** (i.e., a toggling rate of the third switch). Ex1017, 113, Fig. 2 (Q-mixer instantiated below); §III.C.2; Ex1003, ¶¶276-277.

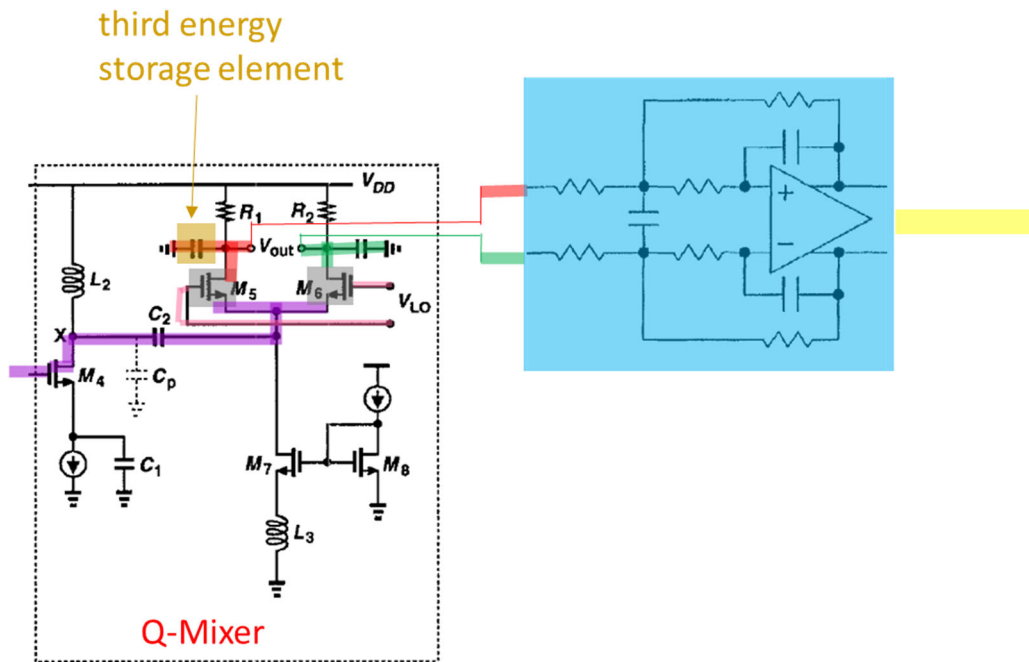


Combination Receiver (using circuits of Ex1021/Ex1022)

The third switch (M_5 (gray)) is on and *a portion of energy* that is distinguishable from noise is transferred *from the modulated carrier signal* (RF input signal (purple)) *as an output* (red) of said switch during the sampling aperture (on-duration) of the third control signal. Ex1017, 113, Fig. 2; §§III.C.2, III.A.5 (element 1[b] including “energy distinguishable from noise is transferred”); Ex1003, ¶278.

19[c]

As explained *supra* §§III.C.1-2 and annotated below, the combination receiver includes *a third energy storage element* (e.g., capacitor (brown)) that *stores* the transferred energy from the modulated carrier signal (purple) and *outputs a down-converted quadrature-phase baseband signal portion* (red portion feeding into Macnally’s circuit (light blue)) of said modulated carrier signal (purple). Ex1017, 113, Fig. 2; Ex1021/Ex1022, Fig. 3; Ex1003, ¶¶279-280.

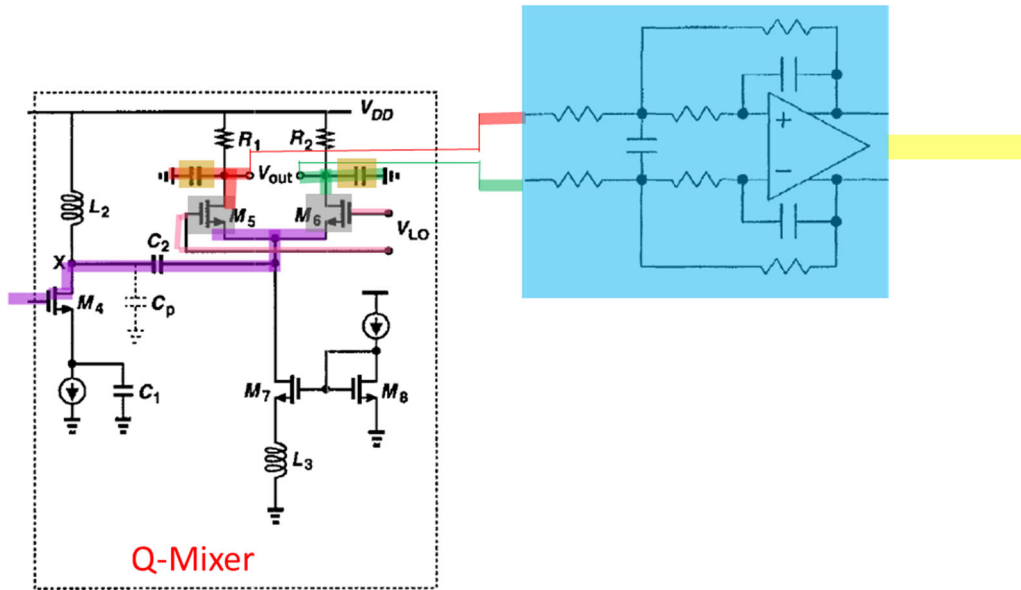


Combination Receiver (using circuit of Ex1021/Ex1022)

Consistent with Petitioner's claim construction proposal *supra* §I.C.1, Razavi's capacitor (brown) "*stores non-negligible amounts of energy from an input EM signal,*" i.e., the RF input signal. §III.C.3 (1[c]); Ex1003, ¶281.

19[d]

As explained *supra* §§III.C.1-2 and annotated below, the combination system provides a quadrature (Q) mixer (similar to the I-mixer) that includes a *fourth switch* (M_6 (gray)) coupled to a *fourth control signal* ($V_{LO}(-)$ (pink)) which comprises a *sampling aperture* (e.g., on-duration of the fourth switch) with a *specified frequency* (i.e., a toggling rate of the fourth switch). Ex1017, 113, Fig. 2 (Q-mixer instantiated below); §III.C.2.



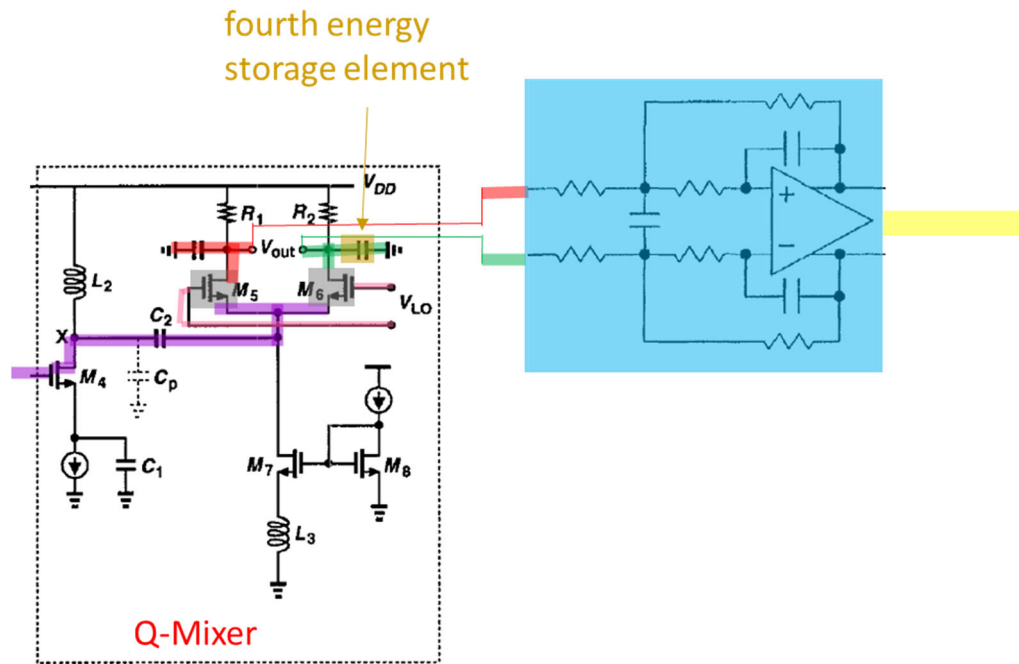
Combination Receiver (using circuit of Ex1021/Ex1022)

The fourth switch (M₆ gray) is on and *a portion of energy* that is distinguishable from noise is transferred *from the modulated carrier signal* (RF input signal (purple)) *as an output* (red) of said switch during the sampling aperture (on-duration) of the fourth control signal. Ex1017, 113, Fig. 2; §§III.C.2, III.A.5 (element 1[b] including “energy distinguishable from noise is transferred”); Ex1003, ¶¶282-284.

19[e]

As explained *supra* §§III.C.1-2 and annotated below, the combination receiver includes *a fourth energy storage element* (e.g., capacitor (brown)) that *stores* the transferred energy from the modulated carrier signal (purple) and *outputs a down-converted quadrature-phase baseband signal portion* (green portion

feeding into Macnally's circuit) of said modulated carrier signal (purple). Ex1017, 113, Fig. 2; Ex1021/Ex1022, Fig. 3; Ex1003, ¶¶285-286.



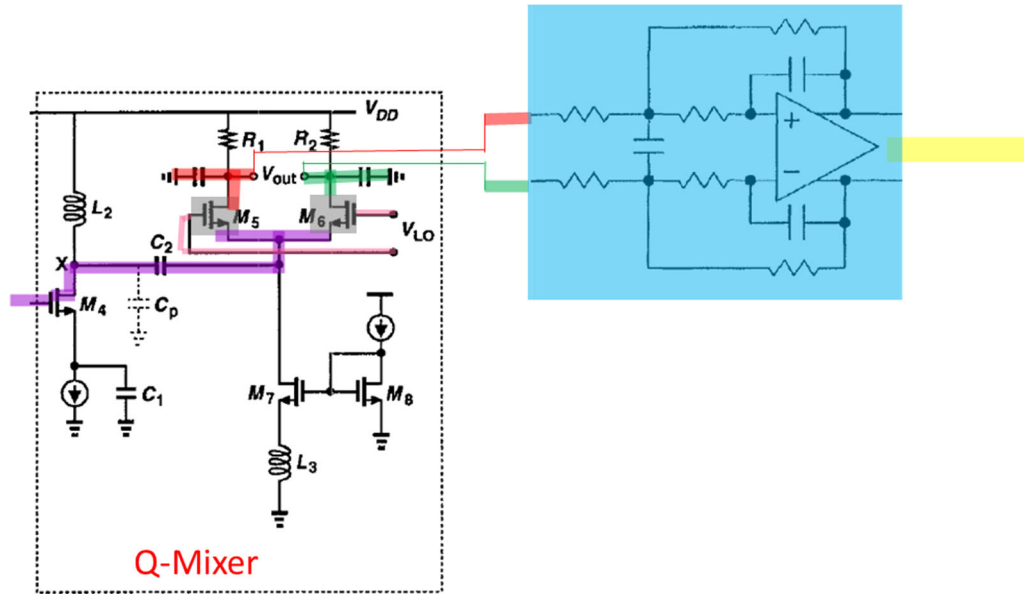
Combination Receiver (using circuit (light blue) of Ex1021/Ex1022)

Consistent with Petitioner's claim construction proposal *supra* §I.C.1, Razavi's capacitor (brown) likewise "*stores non-negligible amounts of energy from an input EM signal,*" i.e., the RF input signal. §III.C.3 (1[c]); Ex1003, ¶287.

19[f]

As explained *supra* §§III.C.1-2 and annotated below, in the combination receiver, *the portions of transferred energy* from each of the third and fourth switch *are integrated* over time to accumulate said portions of transferred energy *from which said down-converted quadrature-phase baseband signal portion* (red portion feeding into Macnally's circuit (light blue)) *and said down-converted*

differential quadrature-phase baseband signal portion (green portion feeding into Macnally's circuit (light blue)) *are derived*. Ex1003, ¶¶288-289.



Combination Receiver (using circuit (light blue) of Ex1021/Ex1022)

19[g]

As explained *supra* §§III.A.1-3 and annotated below, the combination system includes a *second differential amplifier circuit* (light blue) that *combines said down-converted quadrature-phase baseband signal portion* (red portion feeding into Macnally's circuit) *with said down-converted differential quadrature-phase baseband signal portion* (green portion feeding into Macnally's circuit) *and outputs a second channel down-converted differential quadrature-phase baseband signal* (yellow). Ex1017, 113, Figs. 2, 4-5; Ex1021/Ex1022, Fig. 3; §III.A.5 (1[g]); Ex1003, ¶¶290-292 (fulsome explanation).

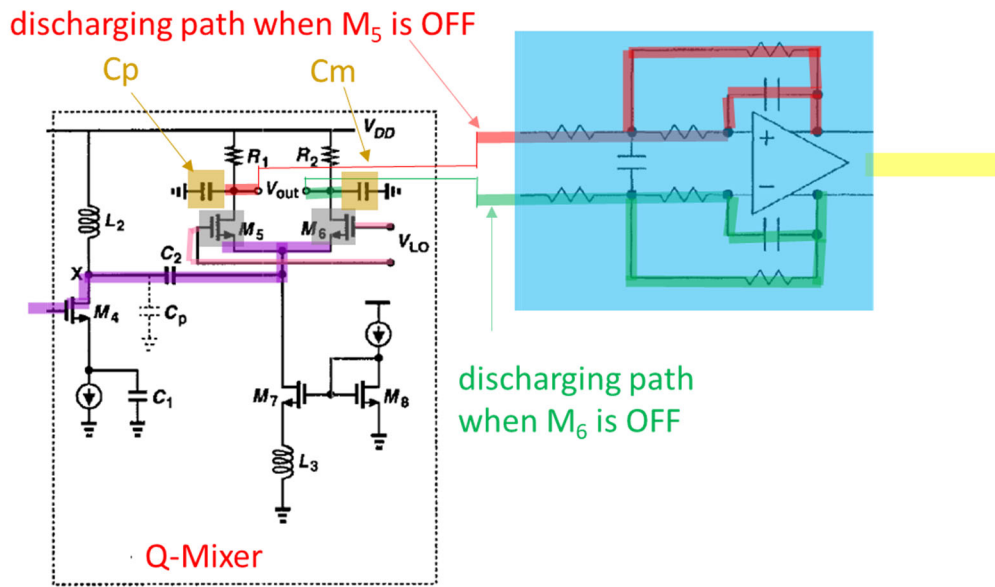
Accordingly, the combination receiver renders obvious claim 19.

Claim 23

As explained *supra* §§III.C.2, III.C.3 (claim 19), in the combination receiver, Razavi further provides a quadrature (Q) mixer configured in the same manner as the in-phase mixer. Like the first switch on the in-phase mixer, the third switch on the Q-mixer of the combination receiver is on for less than one-half cycle of the modulated carrier signal. §III.C.3 (claim 5); Ex1003, ¶¶293-294.

Claim 26

Similar to claim 8, in the combination receiver with the quadrature (Q) mixer, the third and fourth control signals ($V_{LO}(+)$ and $V_{LO}(-)$ pink) each control a charging and discharging cycle for respective energy storage element (C_p and C_m (brown)) by respectively controlling the third and fourth switches (M_5 and M_6 (gray)). *Supra* §§III.C.2, 3 (8, 19[a], 19[c]). Specifically, for each switch (gray), the portion of energy that is distinguishable from noise is transferred to the respective storage element (brown) when the switch is on (i.e., CLOSED) during the charging cycle. *Id.* When the switch (gray) is off (i.e., OPEN), a portion of the transferred energy (e.g., charge accumulated) is discharged, as annotated below. Ex1003, ¶¶295-296 (discharging also pass through R_1 and R_2).



Combination Receiver (Q-mixer (Ex1017) coupled to circuit (Ex1021/Ex1022))

Claim 27

Similar to claim 9, in the combination receiver with the quadrature (Q) mixer, for each storage device (capacitor C_p and C_m (brown as annotated above)), the energy discharged during any given discharge cycle is not completely discharged. The remaining undischarged energy from the given discharge cycle thus becomes an initial condition for the next charging cycle (when the switch is closed). Ex1003, ¶297-298.

Claims 28, 30, 31, 32

Similar to claim 11, in the combination receiver with the quadrature (Q) mixer, the frequencies of the third and fourth apertures (i.e., respective periods

during which the third and fourth switches are closed to generate the quadrature baseband signal and the quadrature inverted baseband signal) likewise have periods that are less than 50% of the modulated carrier signal's period, thereby satisfying claim 28 (“*two (2) percent or greater*”), 30 (“*five (5) percent or greater*”), 31 (“*ten (10) percent or greater*”), and 32 (“*twelve and a half (12.5) percent or greater*”). §III.C.1-3 (claims 11, 19); Ex1003, ¶¶299-306.

Claim 33

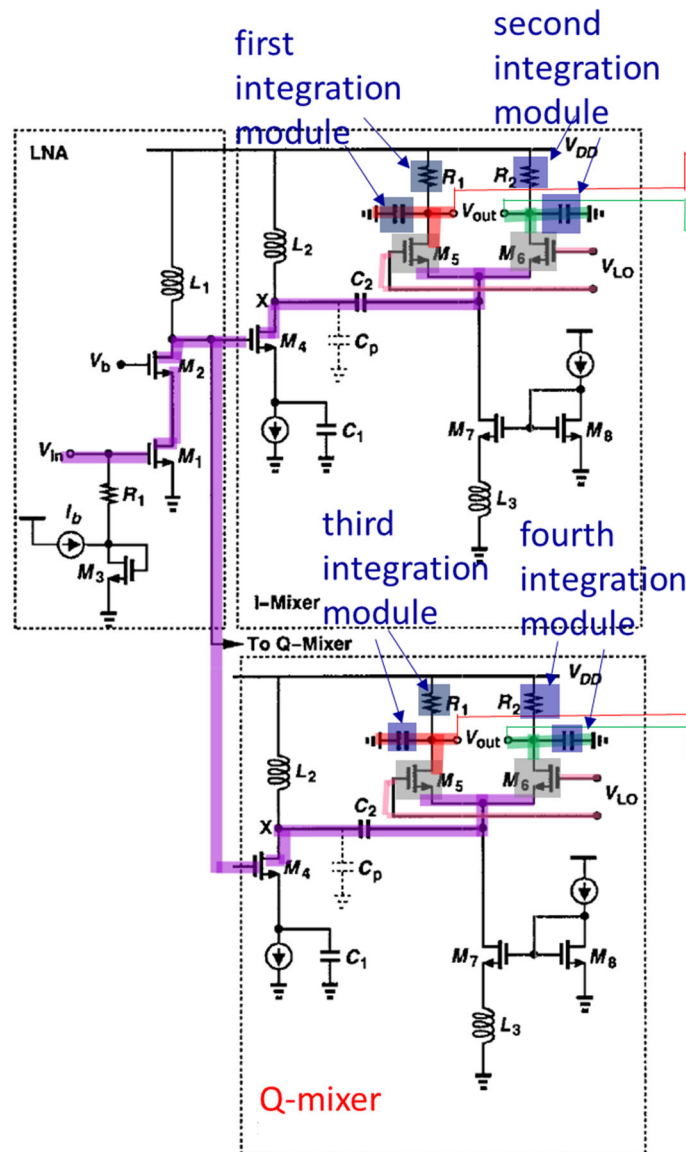
As explained *supra* §III.C.2 (claim 15), the combination receiver has an in-phase (I) mixer coupled to a ***first filter*** (orange box) that filters the down-converted in-phase baseband signal portion (red), and a ***second filter*** (orange box) that filters the down-converted inverted in-phase baseband signal portion (green).

As annotated below, the combination receiver also has a quadrature (Q) mixer coupled to a ***third filter*** (orange box) that filters the down-converted quadrature-phase baseband signal portion (red), and a ***fourth filter*** (orange box) that filters the down-converted inverted quadrature baseband signal portion (green). §§III.C.1-2, §III.C.3 (19[b] (quadrature-phase baseband), 19[d] (inverted quadrature-phase baseband), 19[f] (differential amplifier circuit). Ex1003, ¶¶307-309.

Combination Receiver (I-mixer/Q-mixer of Ex1017, circuits of Ex1021/Ex1022)

Claim 35

Similar to claim 17 (*supra* §III.C.3), the combination receiver has *a separate integration module* (separate capacitor-resistor pair) *coupled to the output of each of the first, second, third* (gray), and *fourth* (gray) *switch*. Ex1017, Fig. 2. The integration modules are positioned separately on the I-mixer and the Q-mixer.

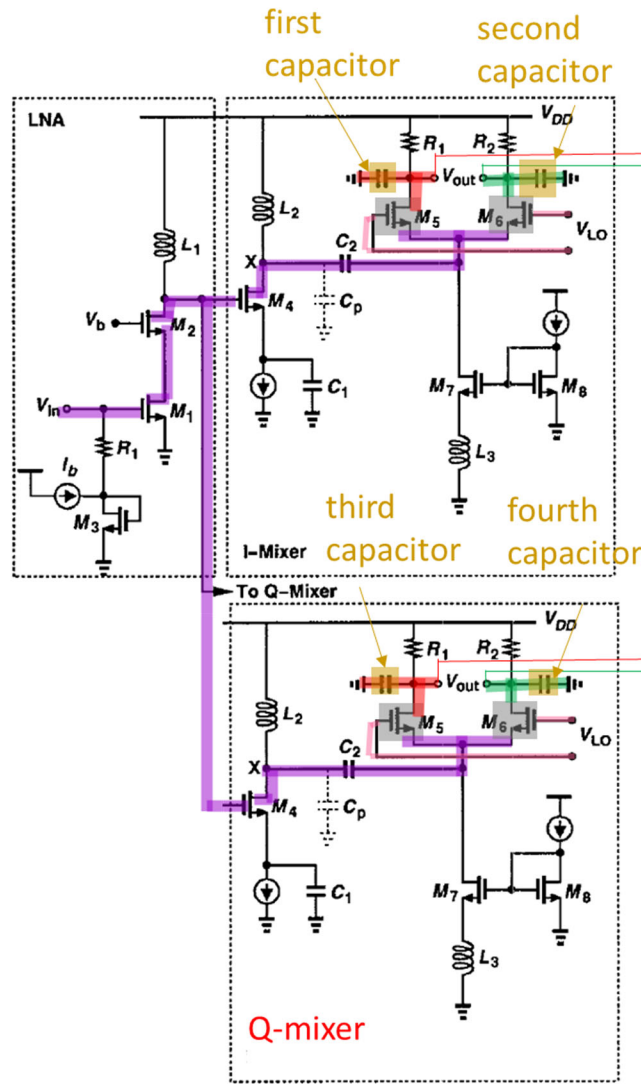


Combination Receiver (zoomed portions of I-mixer/Q-mixer of Ex1017)

Each separate integration module integrates *the portions of transferred energy from each of the first, second, third, and fourth switch which are integrated over time to accumulate said portions of transferred energy*. §III.C.2; Ex1017, Fig. 2; Ex1003, ¶¶312-314 (both the capacitor and the resistor in each separate capacitor-resistor pair are involved in charging/integration).

Claim 36

Similar to claim 18 (*supra* §III.C.3) and as annotated below, in the combination receiver, *the first, second, third, and fourth storage elements are capacitive elements* (i.e., capacitors C_p and C_m on I-mixer and Q-mixer). Ex1017, Fig. 2.



Combination Receiver (zoomed portions of I-mixer/Q-mixer of Ex1017)

In the combination receiver, *the portions of transferred energy from each of the first, second, third, and fourth switch which are integrated over time to accumulate said portions of transferred energy are integrated by the capacitive storage circuits as they accumulate charge during successive sampling apertures* (e.g., duration of switch closures). Ex1003, ¶¶315-317.

**D. [GROUND 2B] – Razavi, Macnally, and Cahn Render Obvious
Claims 2-4, 20-22**

1. Combination

As explained *supra* §III.B.1, Cahn discloses amplitude modulation, phase modulation, and combined amplitude and phase modulation. Ex1007, 150-51. Razavi reveals receiver design options “depending on ... the type of modulation”). Ex1017, 113. Macnally describes an example where “the resulting I and Q signals are fed to BFSK demodulator.” Ex1021, 7:46-47; Ex1022, 12. Aside from such disclosures, a POSITA would have found it obvious to apply the combination receiver to down-convert a RF signal modulated using these well-known established techniques. Ex1003, ¶318. Indeed, the application would have been a combination of prior art elements according to known methods to yield predictable results¹⁶ (i.e., applying well-known modulation techniques).

2. Analysis

Claims 2, 3, 4, 20, 21, 22

As explained *supra* §III.D.1 and III.C.1-3, it would have been obvious for the combination receiver to operate on modulated carrier signal that includes an

¹⁶ FN7

amplitude variation (claims 2 and 20), a phase variation (claims 3 and 21), or a combination of amplitude variation and phase variation (claims 4 and 22) the down-converted baseband signals are processed accordingly. Ex1017, Figs. 1-2; Ex1007, 150-51; Ex1003, ¶319-323 (A POSITA would know processing details).

IV. PTAB DISCRETION SHOULD NOT PRECLUDE INSTITUTION

A. 35 U.S.C. §325(d) – *Advanced Bionics*

Advanced Bionics and the *Becton* factors strongly favor institution. None of the prior art references advanced in this Petition were previously applied by the Office. There is no indication in the '528 patent's file history that the Examiner substantively considered any of the prior art applied in this Petition, nor that art or arguments substantially similar to those raised here were considered. Tayloe and Razavi have been relied upon in other IPRs challenging patents owned by Patent Owner which may involve related technology. However, the fact that none of the cited references were previously applied to the '528 patent favors institution.

B. 35 U.S.C. §314(a) – *General Plastic*

Petitioner has filed a timely Motion for Joinder. The Board has held that such a motion, where the joinder petitioner agrees to a passive “understudy” role, “effectively neutraliz[es] the *General Plastic* factors.” *Apple Inc. v. Uniloc 2017 LLC*, IPR2018-00580, Paper 13 at 10 (PTAB Aug. 21, 2018); *see also Celltrion, Inc.*

v. Genentech, Inc., IPR2018-01019, Paper 11 at 10 (PTAB Oct. 30, 2018) (stating the joinder motion “effectively obviates any concerns of serial harassment and unnecessary expenditure of resources”). A limited exception to this rule applies where the joinder petitioner previously filed its own petition which was denied. *See Apple Inc. v. Uniloc 2017 LLC*, IPR2020-00854, Paper 9 (PTAB Oct. 28, 2020) (precedential). Because NXP has not previously filed a challenge to the ’528 patent, and this Petition is accompanied by a motion for joinder, the *General Plastic* factors do not support discretionary denial.

C. 35 U.S.C. §314(a) – *Fintiv*

In *Apple Inc. v. Fintiv, Inc.*, the Board enumerated six factors that it will assess in determining whether to exercise discretion to deny institution under §314(a) based on co-pending litigation. IPR2020-00019, Paper 11 at 2-3 (PTAB Mar. 20, 2020) (precedential). The USPTO issued updated discretionary denial guidance on the *Fintiv* factors and confirmed that “the PTAB will not discretionarily deny institution in view of parallel district court litigation where a petitioner presents a stipulation not to pursue in a parallel proceeding the same grounds or any grounds that could have reasonably been raised before the PTAB.” *See* USPTO Memorandum, *Interim Procedure for Discretionary Denials*, 3 (June 21, 2022). Here, Petitioner has eliminated any risk of duplicated effort by voluntarily presenting a *Sotera* stipulation to Patent Owner. Ex1041; *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019,

Paper 12 (PTAB Dec. 1, 2020). For at least this reason, and considering the compelling merits of the above-detailed grounds, discretionary denial is unwarranted and would be unjust.

V. CONCLUSION AND FEES

The Challenged Claims are unpatentable. Petitioner authorizes charge of fees to Deposit Account 50-0259.

VI. MANDATORY NOTICES UNDER 37 C.F.R § 42.8(A)(1)

A. Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1)

Petitioner identifies itself, NXP Semiconductors N.V., NXP B.V., and Freescale Semiconductor Holdings V, Inc. as real parties-in-interest to this proceeding.

B. Related Matters Under 37 C.F.R. § 42.8(b)(2)

The '528 patent is the subject of a civil action between the parties, *ParkerVision, Inc. v. NXP Semiconductors NV et al*, 6-23-cv-00389 (WDTX) filed May 19, 2023, as well as multiple other civil actions including *ParkerVision, Inc. v. Texas Instruments Incorporated*, 6-23-cv-00384 (WDTX) filed May 18, 2023; *ParkerVision, Inc. v. Realtek Semiconductor Corp.*, 6-23-cv-00374 (WDTX) filed May 16, 2023, *ParkerVision, Inc. v. MediaTek, Inc. et al*, 6-23-cv-00375 (WDTX) filed May 16, 2023; *ParkerVision, Inc. v. LG Electronics, Inc.*, 6-21-cv-00520 (WDTX) filed May 22, 2021; *ParkerVision, Inc. v. Buffalo Inc.*, 6-20-cv-01009

(WDTX) filed Oct. 30, 2020; *ParkerVision, Inc. v. ZyXEL Communications Corporation*, 6-20-cv-01010 (WDTX) filed Oct. 30, 2020; *ParkerVision, Inc. v. TCL Industries Holdings Co., Ltd. et al*, 6-20-cv-00945 (WDTX) filed Oct. 12, 2020; *ParkerVision, Inc. v. Hisense Co., Ltd. et al*, 6-20-cv-00870 (WDTX) filed Sep. 24, 2020; *ParkerVision, Inc. v. TCL Technology Group Corp. et al*, 5-20-cv-01030 (CDCA) filed May 14, 2020; *ParkerVision, Inc. v. Intel Corporation*, 6-20-cv-00108 (WDTX) filed Feb. 11, 2020; *ParkerVision, Inc. v. LG Electronics, Inc. et al*, 2-17-cv-05359 (DNJ) filed Jul. 21, 2017; *RF Capable Integrated Circuits and Products Containing the Same*, 337-TA-982 (ITC) filed Dec. 14, 2015 and *ParkerVision, Inc. v. Apple Inc. et al*, 3-15-cv-01477 (MDFL) filed Dec. 14, 2015.

The '528 patent has been challenged before the PTAB in IPR2024-00936. Petitioner has concurrently filed a Motion seeking joinder to that proceeding.

C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

Petitioner provides the following designation of counsel.

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D. Service Information

Please address all correspondence and service to the address listed above.
Petitioner consents to electronic service by email at the email addresses listed above
(cc'ing anna.hearn-darst@bracewell.com).

Respectfully submitted,

Dated June 20, 2024

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CERTIFICATION UNDER 37 CFR § 42.24

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter Partes* Review totals 13,995 words, fewer than the 14,000 allowed under 37 CFR § 42.24.

Dated June 20, 2024

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CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on June 20, 2024, a complete and entire copy of this Petition for *Inter Partes* Review and all supporting exhibits were provided by Federal Express, to the Patent Owner, by serving the correspondence address of record as follows:

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60 East South Temple, Suite 1000
Salt Lake City, UT 84111

The undersigned further certifies that courtesy copies of the foregoing documents were served via electronic mail upon Patent Owner's counsel of record in IPR2023-00936 as follows:

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