

Texas Instruments Inc.
(Petitioner)

v.

Parker Vision Inc.
(Patent Owner)

Petitioner's Demonstratives

Case IPR2024-00935

U.S. Patent Nos: 7,865,177

Before Hon. Michael R. Zecher, Bart A. Gerstenblith, and Iftikhar Ahmed
Administrative Patent Judges

FISH.

DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

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The '177 Patent

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

(54) **METHOD AND SYSTEM FOR DOWN-CONVERTING AN ELECTROMAGNETIC SIGNAL, AND TRANSFORMS FOR SAME, AND APERTURE RELATIONSHIPS**

(75) **Inventors:** David E. Sorrells, Jacksonville, FL (US); Michael J. Bultman, Jacksonville, FL (US); Robert W. Cook, Switzerland, FL (US); Richard C. Looke, Jacksonville, FL (US); Charley D. Moses, Jacksonville, FL (US); Gregory S. Rawlins, Lake Mary, FL (US); Michael W. Rawlins, Lake Mary, FL (US)

(73) **Assignee:** ParkerVision, Inc., Jacksonville, FL (US)

(*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 22 days.

(21) **Appl. No.:** 12/349,802

(22) **Filed:** Jan. 7, 2009

(65) **Prior Publication Data**
US 2009/0221257 A1 Sep. 3, 2009
Related U.S. Application Data

(60) Division of application No. 09/550,644, filed on Apr. 14, 2000, now Pat. No. 7,515,896, which is a continuation-in-part of application No. 09/521,879, filed on Mar. 9, 2000, now abandoned, and a continuation-in-part of application No. 09/293,342, filed on Apr. 16, 1999, now Pat. No. 6,687,493, which is a continuation-in-part of application No. 09/176,022, filed on Oct. 21, 1998, now Pat. No. 6,061,551.

(51) **Int. Cl.**
G06F 15/16 (2006.01)

(52) **U.S. Cl.** 455/413; 455/113

(58) **Field of Classification Search** 455/413, 455/113, 118, 130, 131, 182.1, 190.1, 191.1, 455/313, 323, 343, 350, 327/113, 375/130, 375/142, 143, 150, 152, 316, 343

See application file for complete search history.

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(10) **Patent No.:** US 7,865,177 B2
(45) **Date of Patent:** Jan. 4, 2011

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(Continued)

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DE 35 41 031 A1 5/1986

(Continued)

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Aghvami, H. et al., "Land Mobile Satellites Using the Highly Elliptic Orbits-The UK T-SAT Mobile Payload," *Fourth International Conference on Satellite Systems for Mobile Communications and Navigation*, IEE, pp. 147-153 (Oct. 17-19, 1988).

(Continued)

Primary Examiner—Sam Bhattacharya
(74) **Attorney, Agent, or Firm**—Sterne, Kessler, Goldstein & Fox, P.L.L.C.

(57) **ABSTRACT**
Methods, systems, and apparatuses, and combinations and sub-combinations thereof, for down-converting an electromagnetic (EM) signal are described herein. Briefly stated, in embodiments the invention operates by receiving an EM signal and recursively operating on approximate half cycles (1/2, 1/4, 2/8, etc.) of the carrier signal. The recursive operations can be performed at a sub-harmonic rate of the carrier signal. The invention accumulates the results of the recursive operations and uses the accumulated results to form a down-converted signal. In an embodiment, the EM signal is down-converted to an intermediate frequency (IF) signal. In another embodiment, the EM signal is down-converted to a baseband information signal. In another embodiment, the EM signal is a frequency modulated (FM) signal, which is down-converted to a non-FM signal, such as a phase modulated (PM) signal or an amplitude modulated (AM) signal.

15 Claims, 284 Drawing Sheets

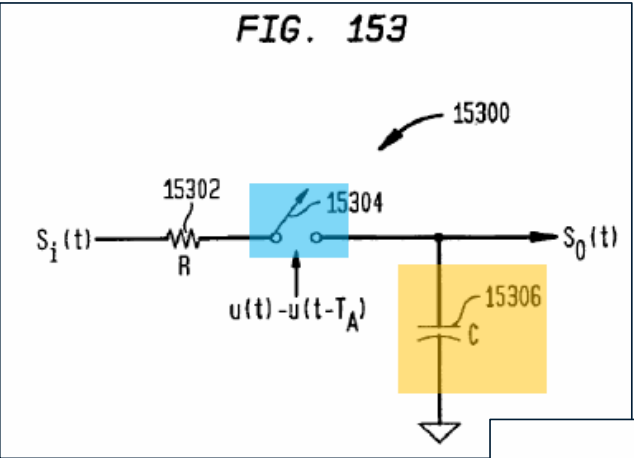
112 MODULATING BASEBAND SIGNAL F_{MB}

110 CARRIER SIGNAL F_C

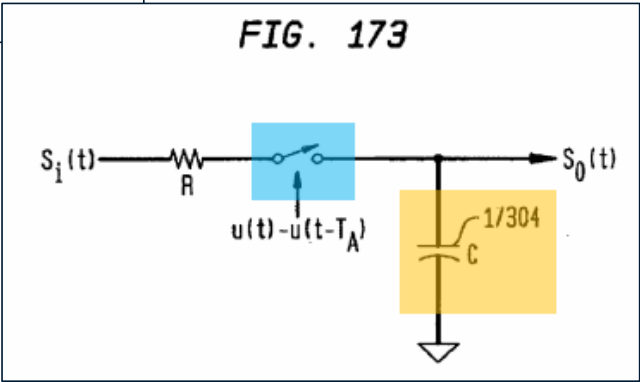
MODULATOR

114

MODULATED CARRIER SIGNAL F_{MC} 116

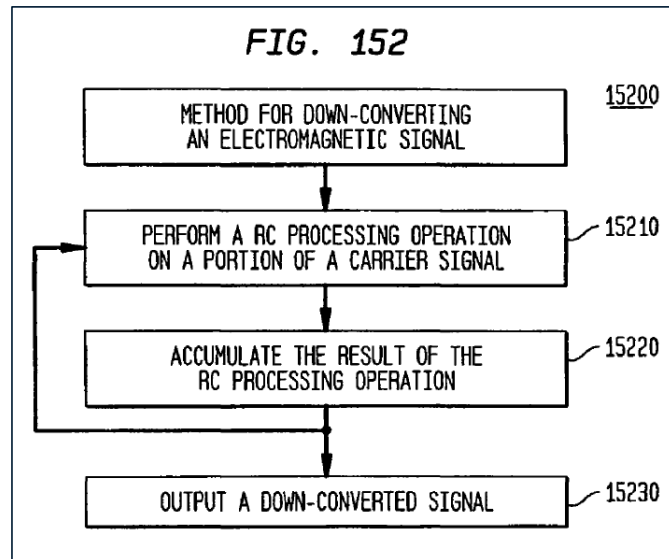


TI-1001, FIG. 173 (cited by POR at 60-61)



TI-1001, FIG. 173 (cited by POR at 61-62; Pet. Rep. 25-26)

The '177 Patent – A Method for Down-Converting Using Matched Filtering/Correlating Modules



TI-1001, FIG. 152 (cited by POR at 60; Pet. Rep. at 26-27)

14. A method for down-converting an electromagnetic signal, comprising:

- receiving an input signal at a first matched filtering/correlating module;
- down converting said input signal at said first matched filtering/correlating module according to a first control signal and outputting a first down-converted signal;
- receiving said input signal at a second matched filtering/correlating module;
- down-converting said input signal at said second matched filtering/correlating module according to a second control signal and outputting a second down-converted signal; and
- combining said second down-converted signal and said first down-converted signal to output a first channel down-converted signal.

TI-1001, 108:40-51 (annotated) (cited by Pet., 7)

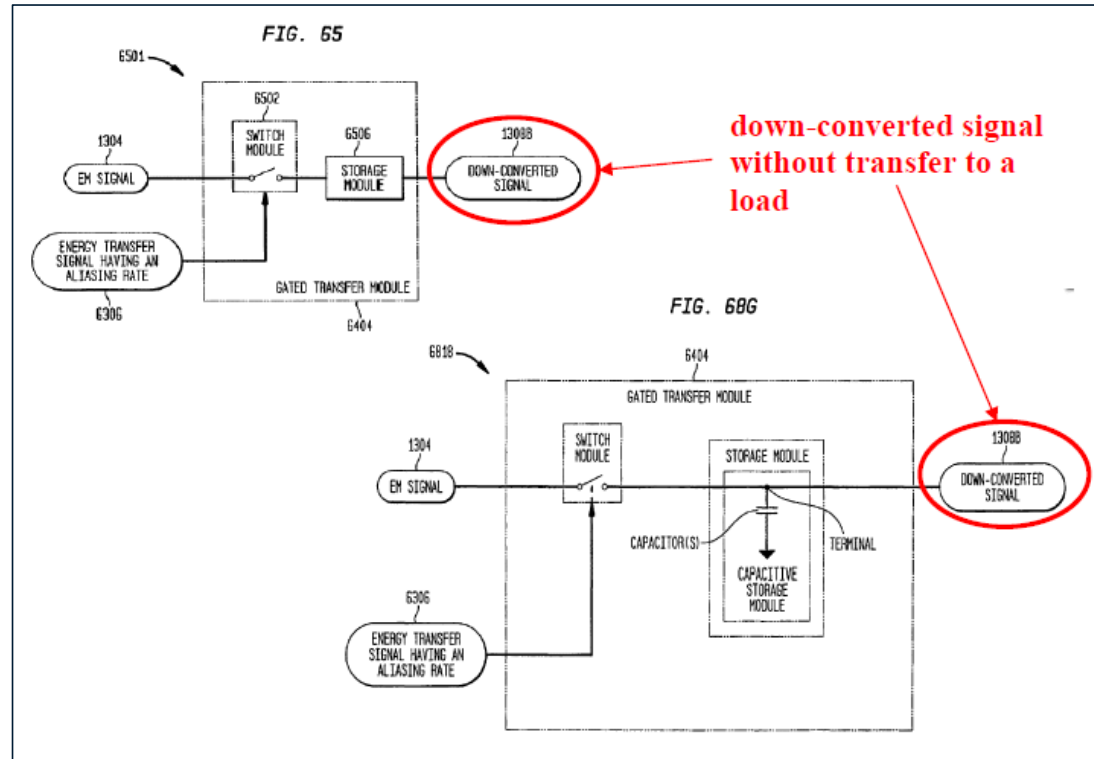
117 Patent – Issues Raised By PO

- Issues Raised
 - Whether Tayloe is prior art
 - Whether Tayloe renders claim 14 unpatentable under the correct construction of matched filtering / correlating module that does not require transferring to a load to form a down-converted signal
 - Whether Tayloe includes a matched filtering / correlating module that transfers to a load
 - Whether Razavi includes a matched filtering / correlating module that includes switches
 - Whether Razavi includes a matched filtering / correlating module with capacitors discharge through a load
- Undisputed
 - Tayloe-Based and Razavi-Based combinations sample using an aliasing rate, a non-negligible aperture, and synchrony
 - Tayloe-Based and Razavi-Based combinations render the claimed combining steps obvious
 - Tayloe-Based and Razavi-Based combinations perform down-conversion of an EM signal
 - The combination of Tayloe and TI Datasheet is obvious
 - The combination of Razavi and Uzunoglu is obvious

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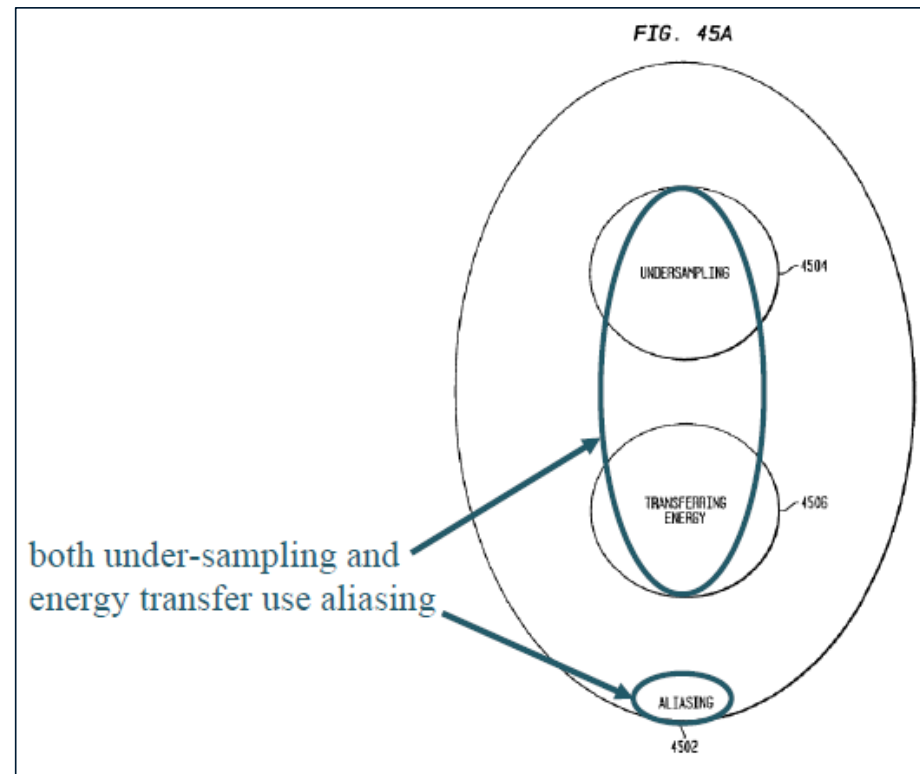
The Technology and Prior Art

Background of the Technology – Under-sampling and Energy Transfer



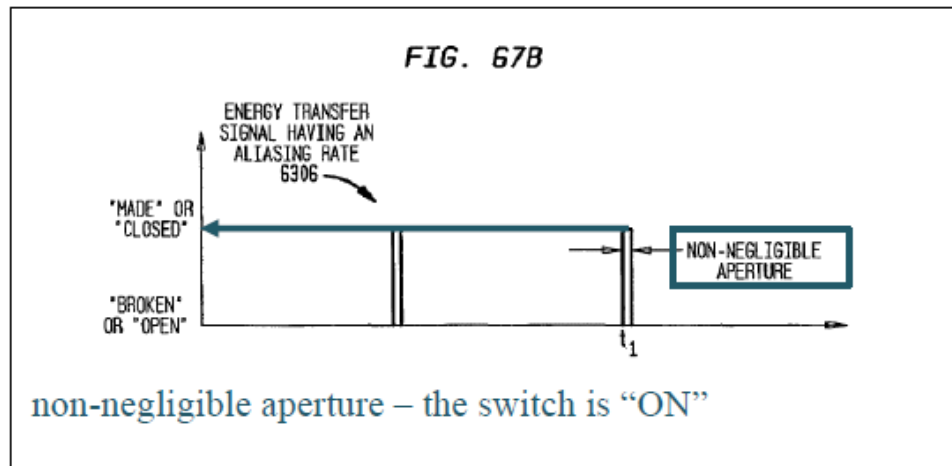
TI-1001, FIG. 65, 68G (cited by Pet. Rep. at 31; TI-1066, ¶ 15)

Background of the Technology – Under-sampling and Energy Transfer Use Aliasing



TI-1001, FIG. 45A (cited by Pet. Rep. at 33; ; TI-1066, ¶ 16)

Background of the Technology – Non-negligible Aperture



TI-1001, FIG. 67B (cited by Pet. Rep. at 32; ; TI-1066, ¶ 16)

0.1.2 Introduction to Energy Transfer

In an embodiment, the present invention transfers energy from an EM signal by utilizing an energy transfer signal instead of an under-sampling signal. Unlike under-sampling signals that have negligible aperture pulses, the energy transfer signal includes a train of pulses having non-negligible apertures that tend away from zero. This provides more time to transfer energy from an EM input signal. One direct benefit

TI-1001, 73:5-12 (cited by Pet. Rep. at 32; ; TI-1066, ¶ 60)

Background of the Technology – Matched Filtering / Correlating Modules Require Synchrony

undisputed

Dr. Galton's Declaration

correlating. The key common characteristic across all implementations is that “a matched filtering/correlating operation is performed on a portion of a carrier signal,” wherein the correlation signal is synchronous with the received signal, and, correspondingly, for the claimed down-converter embodiments described in

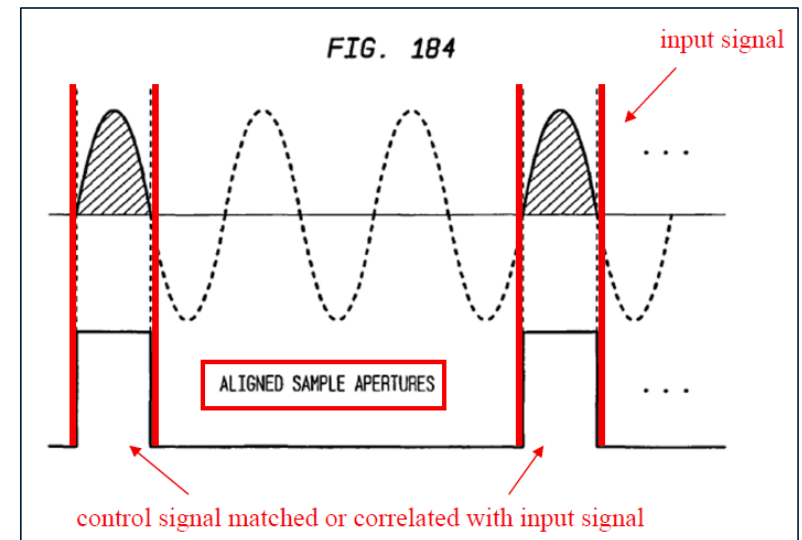
TI-1003, 38 (cited by Pet. At 4-5, Pet. Rep. at 22)

'177 Patent

In embodiments, when optimally configured, the example matched filter/correlator of FIG. 171 operates in synchronism with the half sine pulse $S_i(t)$ over the aperture T_A . Phase

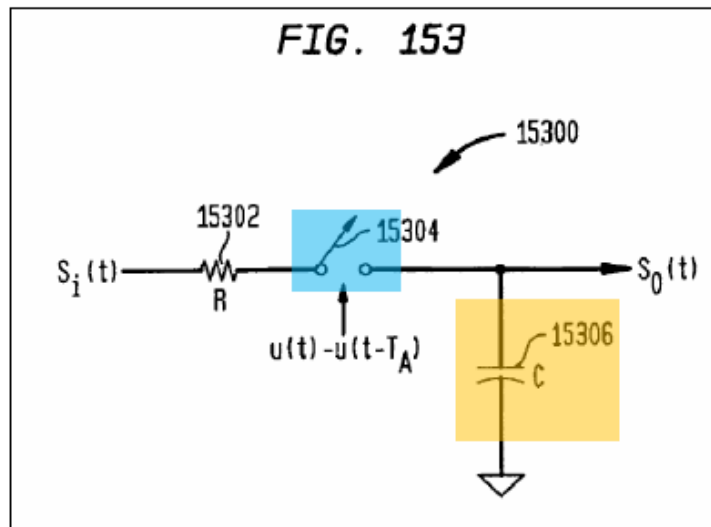
TI-1001, 145:15-18 (cited by Pet. at 4-5, Pet. Rep. at 34)

Petition

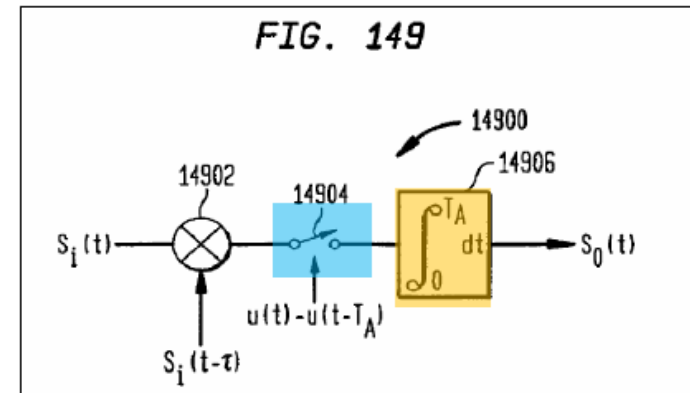


TI-1001, FIG. 184 (cited by Pet. at 11-12; TI-1003, ¶¶ 18-32)

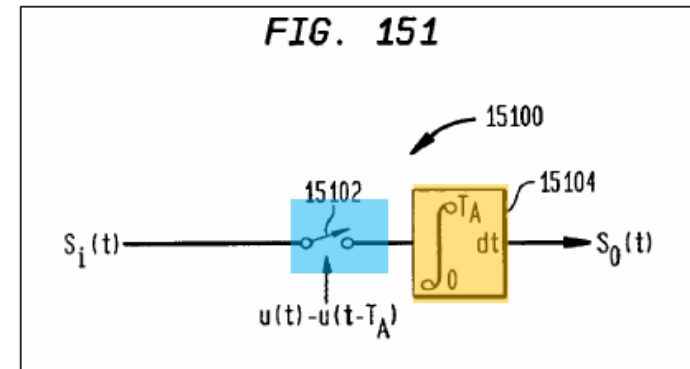
Background of the Technology – Examples of Matched Filtering / Correlating Modules



TI-1001, FIG. 153 (cited by POR at 59-61)



TI-1001, FIG. 149 (cited by POR at 59-61)

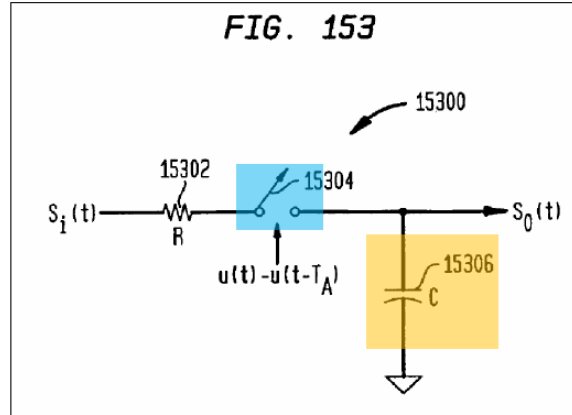


TI-1001, FIG. 151 (cited by POR at 59-61)

PO Agrees that FIG. 153 Is a Matched Filtering / Correlating Module

undisputed

Figure 152 discloses a method of down-converting an EM signal using an RC processor which can approximate a matched filtering/correlating operation. Id., 133:41-134:30.



POR, at 60

FIG. 153 illustrates an example RC processing system 15300, which can be used to implement method 15200. As

TI-1001, 134:32-33

Dr. Galton acknowledges that Figure 151 and 153 of the '177 patent show a matched filtering/correlating module. TI-1003, ¶¶132, 134.

POR, at 66

Background of the Technology – Matched Filtering / Correlating Modules Maximize SNR

Patent Owner's Response

Further, a POSITA understands that in order for a matched filter/correlator to function as a matched filter/correlator, it must produce an enhanced signal-to-noise ratio (SNR). Id., 130:34-37 (“Operating on an electromagnetic signal with a matched filtering/correlating process or processor produces enhanced (and in some cases the best possible) signal-to-noise ratio[sp] (SNR) for the processed waveform.”). Ex.-2024, ¶186.

EX.-2017 at 370, 378 (cited by POR at 11-12)

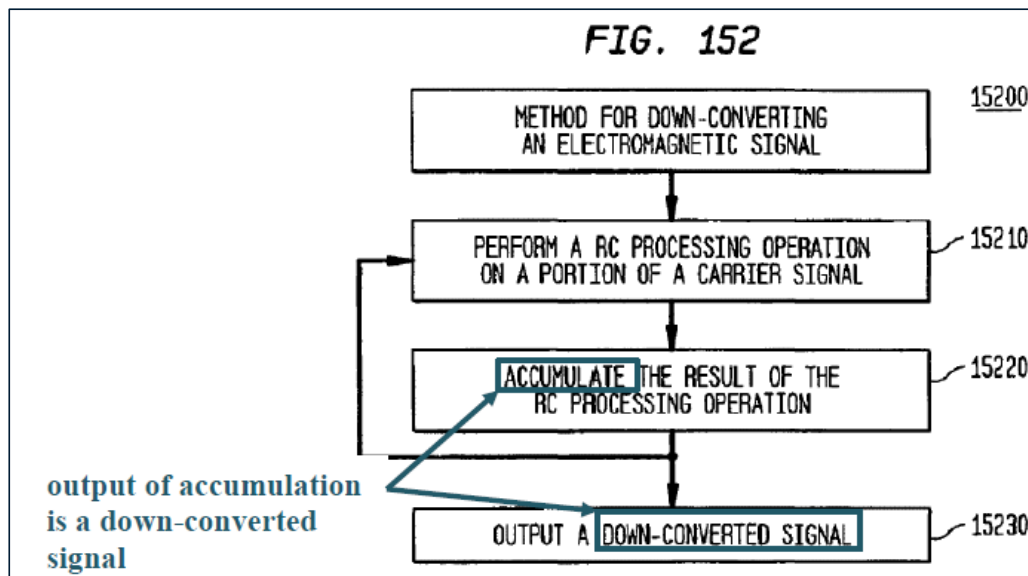
Properties of the Matched Filter. A matched filter has some interesting properties. Let us prove the most important property, which may be stated as follows: If a signal $s(t)$ is corrupted by AWGN, the filter with impulse response matched to $s(t)$ maximizes the output SNR.

EX.-2017 at 376 (cited by POR at 62-63)

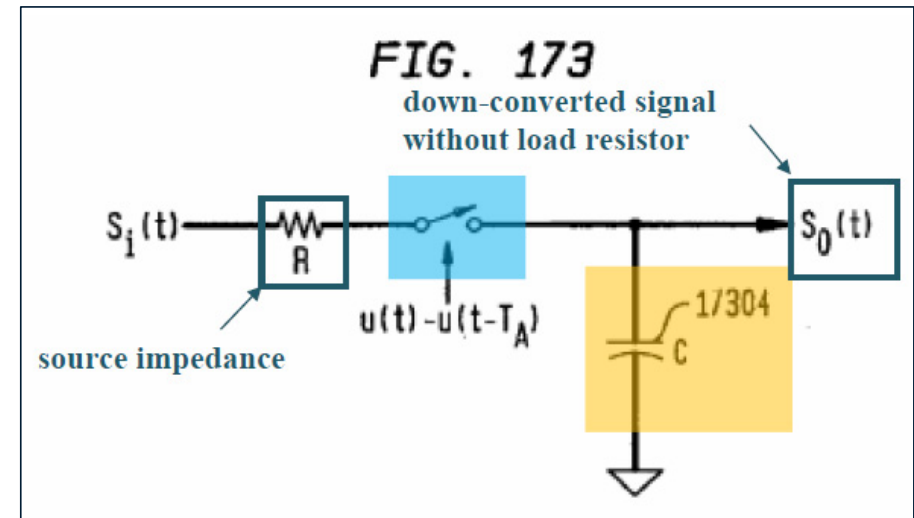
Background of the Technology – Alleged Invention

Use Matched Filtering / Correlating Modules to Down-Convert an EM Signal

'177 Patent



TI-1001, FIG. 152 (cited by Pet. Rep. at 25-27)



TI-1001, FIG. 171 (cited by POR, 61-62; Pet. Rep. at 25-27)

TI-1066, ¶¶ 5-15, 20, 23-24, 26)

The Prior Art – Tayloe

Tayloe (TI-1004)


US00623000B1

(12) **United States Patent**
Tayloe

(10) **Patent No.:** **US 6,230,000 B1**
(45) **Date of Patent:** **May 8, 2001**

(54) **PRODUCT DETECTOR AND METHOD THEREFOR**

(75) **Inventor:** **Daniel Richard Tayloe, Phoenix, AZ (US)**

(73) **Assignee:** **Motorola Inc., Schaumburg, IL (US)**

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

(21) **Appl. No.:** **09/173,030**
(22) **Filed:** **Oct. 15, 1998**

(51) **Int. Cl.:** **H04B 1/26; H04B 1/00**
(52) **U.S. Cl.:** **455/323; 455/303; 455/304; 455/313**

(58) **Field of Search:** 455/302, 303, 455/304, 324, 338, 339, 313, 318, 323, 375/323, 329, 332, 327/113, 45; 329/304

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5,150,124	9/1992	Moore et al.	342/68
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5,355,103 *	10/1994	Konak	455/289
5,557,642	9/1996	Williams	375/316
5,761,615 *	6/1998	Jaffee	455/314
5,805,083	9/1998	Hekkila et al.	
5,838,675 *	11/1998	Rauscher	370/343
5,999,574 *	12/1999	Sun et al.	375/326
6,073,001 *	6/2000	Solovier	455/323
6,088,581 *	7/2000	Bickley et al.	455/131

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0691733	6/1995	(EP)	1803B2/100
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14 Claims, 3 Drawing Sheets

(224169 9/1995 (GB) H03D7/00
9110283 12/1990 (WO) H03D3/00
9602977 7/1995 (WO) H04B1/26
9838732 2/1998 (WO) H03D7/00

OTHER PUBLICATIONS

Article entitled "A 1.5 GHz Highly Linear CMOS Down-conversion Mixer" published in IEEE Journal of Solid-State Circuits, vol. 30, No. 7, Jul. 1995.

Article entitled "Recent Advances in Shortwave Receiver Design" by Dr. Ulrich L. Rohde in QST, Nov. 1992.

Article "Asymmetric Polyphase Networks" by M.J. Gengell in Electrical Communication, vol. 48, No. 1 and 2, 1973.

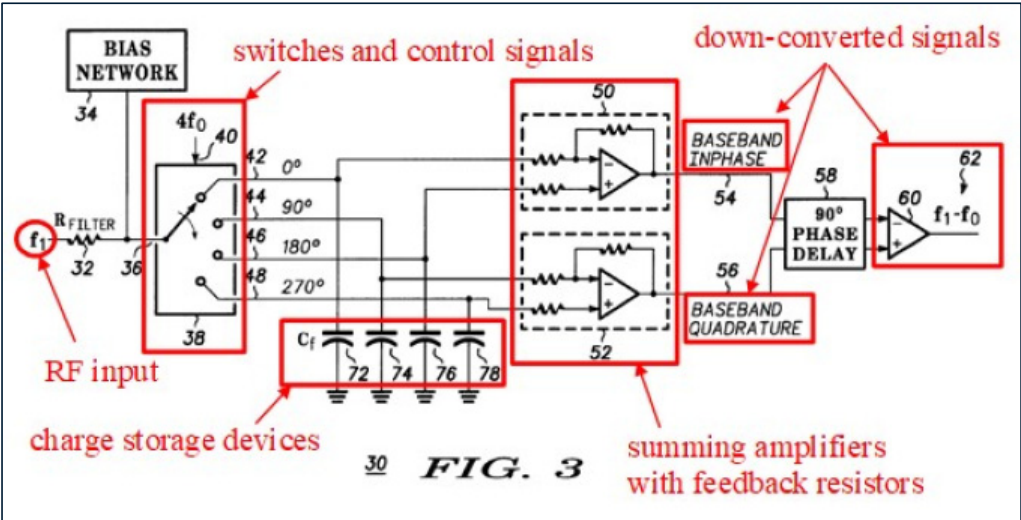
Article entitled "High-Performance, Single-Signal Direct-Conversion Receivers" by Rick Campbell—QST Magazine (Jan. 1993).

* cited by examiner

Primary Examiner—Dwayne Best
Assistant Examiner—Raymond B. Persino
(74) **Attorney, Agent, or Firm**—Dana B. LeMoine; Timothy J. Lorenz; Frank J. Bogacz

(57) **ABSTRACT**

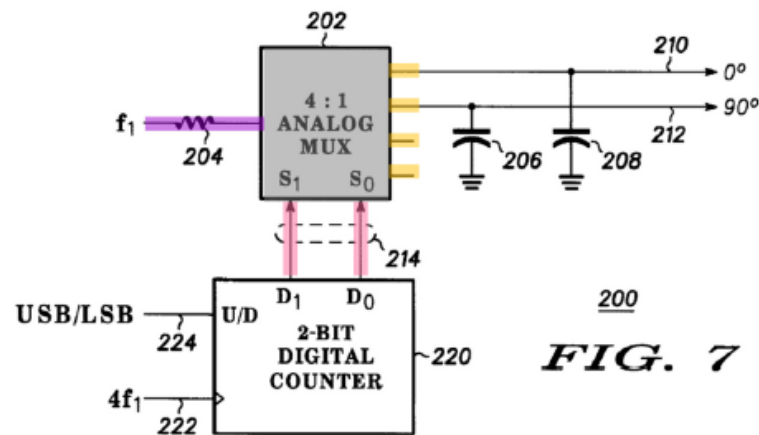
A product detector for converting a signal to baseband includes a commutating switch which serves to sample an RF waveform four times per period at the RF frequency. The samples are integrated over time to produce an average voltage at 0 degrees, 90 degrees, 180 degrees and 270 degrees. The average voltage at 0 degrees is the baseband in-phase signal, and the average voltage at 90 degrees is the baseband quadrature signal. Alternatively, to increase gain, the 0 degree average can be differentially summed with the 180 degree average to form the baseband in-phase signal, and the 90 degree average can be differentially summed with the 270 degree average to produce the baseband quadrature signal.



TI-1004, Fig. 3 (annotated) (cited by Pet., 14)

The Prior Art -- Tayloe

Tayloe (TI-1004)



TI-1004, 5:55-37 ("direct conversion receiver 30 (FIG. 3) utilizing an analog multiplexer and a digital counter as shown in FIG. 7 [annotated above]") (cited by Pet., 17)

The Prior Art – Tayloe Enhances SNR

undisputed

Tayloe (TI-1004)

to herein as a “Tayloe Product Detector.” The Tayloe Product Detector has many advantages. One advantage is low conversion loss. The Tayloe Product Detector can exhibit less than 1 dB of conversion loss, which is 6–7 dB improvement over the typical conversion loss of 7–8 dB in the prior art. This 6–7 dB conversion loss improvement translates into a 6–7 dB improvement in overall receiver noise figure. The noise figure improvement results in substantial receiver performance gains, in part because a pre-amplifier may become unnecessary as a result. The use of a pre-amplifier,

TI-1004, 3:6-13 (cited by Pet. at 35; TI-1003, ¶¶ 129-131)

The Prior Art – TI Data Sheet Switches

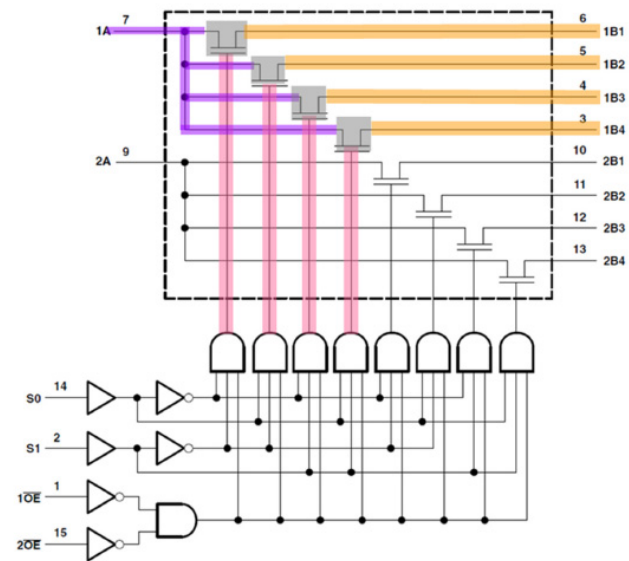
Tayloe (TI-1004)

EXPERIMENTAL RESULTS

A direct conversion receiver which utilizes a Tayloe Product Detector has been built. The receiver design is the same as direct conversion receiver **30** (FIG. 3) utilizing an analog multiplexer and a digital counter as shown in FIG. 7. The analog multiplexer is a Texas Instruments SN74BCT3253D. The digital counter is an industry standard 74ACT163. The analog multiplexer is a 5 volt part which has an effective input range of substantially zero to four volts. This represents the ability to handle input signals of up to substantially +19 dBm. This is advantageous in part because typical maximum signal ranges for prior art diode mixers is substantially +7 dBm. A further advantage is that analog multiplexers capable of operating at higher voltages can be readily obtained or easily designed, thereby increasing the dynamic range further.

TI-1004, 5:33-37 (cited by Pet., 18-19)

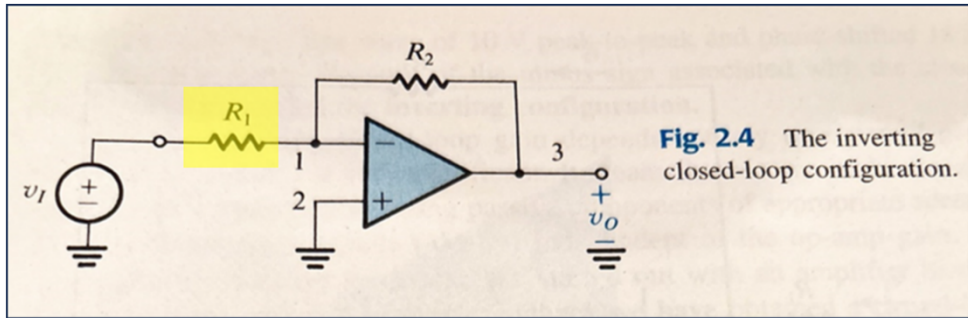
TI-Datasheet (TI-1005)



TI-1005, 2 (annotated) (cited by Pet., 19)

Conventional Op-Amp Circuit

Sedra/Smith Textbook (TI-1046)



TI-1046, Fig. 2.4 (annotated)

Input and Output Resistances

Assuming an ideal op amp with infinite open-loop gain, the input resistance of the closed-loop inverting amplifier of Fig. 2.4 is simply equal to R_1 . This can be seen from Fig. 2.5(b), where

$$R_i \equiv \frac{v_I}{i_1} = \frac{v_I}{v_I/R_1} = R_1$$

TI-1046, at 68 (annotated)

Dr. Galton's Declaration (TI-1066)

33. The accompanying text explains that the "the input resistance of the closed-loop inverting amplifier of FIG. 2.4 is simply equal to R_1 " (TI-1046, Page 68). It goes on to characterize the amplifier as having a "low input resistance" (TI-1046, Page 69), thereby implying that R_1 must have a "low" resistance, and characterizes a few mega-ohms as "impractically large" (TI-1046, Page 69).

TI-1066, ¶33 (cited by Reply, 23)

1055, Pages 719-720). Therefore, increasing the value of the resistance, R , increases the power of the noise introduced by the resistor. Consequently, a POSITA would understand that it is undesirable to use extremely large resistors in circuits like wireless receivers that must amplify very small signals, as the noise would severely degrade the receiver's noise figure.

TI-1066, ¶29 (cited by Reply, 23)

Conventional Op-Amp Circuit

Sedra/Smith Textbook (TI-1046)

The Closed-Loop Gain

We now wish to analyze the circuit in Fig. 2.4 to determine the closed-loop gain G , defined as

$$G \equiv \frac{v_O}{v_I}$$

We will do so assuming the op amp to be ideal. Figure 2.5(a) shows the equivalent circuit, and the analysis proceeds as follows: The gain A is very large (ideally infinite). If we assume that the circuit is “working” and producing a finite output voltage at terminal 3, then the voltage between the op amp input terminals should be negligibly small. Specifically, if we call the output voltage v_O , then, by definition,

$$v_2 - v_1 = \frac{v_O}{A} \approx 0$$

It follows that the voltage at the inverting input terminal (v_1) is given by $v_1 \approx v_2$. That is, because the gain A approaches infinity, the voltage v_1 approaches v_2 . We speak of this as the two input terminals “tracking each other in potential.” We also speak of a **virtual short circuit** that exists between the two input terminals. Here, the word *virtual* should be emphasized, and one should *not* make the mistake of physically shorting terminals 1 and 2 together while analyzing a circuit. A **virtual short circuit** means that whatever voltage is at 2 will automatically appear at 1 because of the infinite gain A . But terminal 2 happens to be connected to ground; thus $v_2 = 0$ and $v_1 \approx 0$. We speak of **terminal 1 as being a virtual ground**—that is, having zero voltage but not physically connected to ground.

TI-1046, at 65 (annotated)

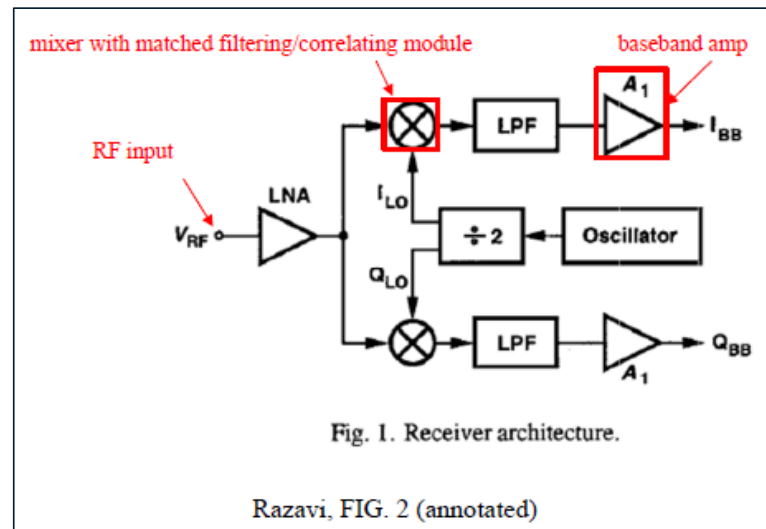
Dr. Galton's Declaration (TI-1066)

in claiming that the “−” terminal node would have a high impedance. However, the feedback resistor in conjunction with the high open loop gain that op-amps have by design cause the node at the “−” terminal to have a very low impedance. As a POSITA would have first learned in their freshman or sophomore undergraduate circuits courses, this node is referred to as a virtual ground precisely because the feedback changes the impedance at that node from having a very high value to having a very low value (a ground terminal ideally has zero impedance, so the term “virtual ground” is meant to signify that the node has such a low impedance that it virtually behaves as a ground connection). TI-1046, Page 65.

TI-1066, ¶17 (cited by Reply, 23)

The Prior Art – Razavi

Razavi (TI-1017)



TI-1017, Fig. 1 (annotated) (cited by Pet., 54-55;
TI-1003, ¶ 95)

FISH.
Confidential

PO Fails to Swear Behind

DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

Patent Owner Fails to Swear Behind

1

Uncorroborated inventor's testimony of conception and actual reduction to practice

Pet. Reply at 3-4, 7, 18-20

2

No evidence the schematics correspond to the chip tested by Boeing

Pet. Reply at 4-7

3

No evidence that schematics work or pertain to [REDACTED]

[REDACTED]

Pet. Reply at 7-16

4

No showing of constructive reduction to practice – See MTE

Pet. Reply at 17-18

Evidence to Antedate a Prior Art Reference Must Be Corroborated by More Than Just Inventor Testimony

1

***Apator Meters APS v. Kamstrup A/S*, 887 F.3d 1293, 1295 (Fed. Cir. 2018)**

It is well established, however, that when a party seeks to prove conception through an inventor's testimony the party must proffer evidence, "in addition to [the inventor's] own statements and documents," corroborating the inventor's testimony. *Mahurkar v. C.R. Bard, Inc.*, 79 F.3d 1572, 1577 (Fed. Cir. 1996); *Hahn v. Wong*, 892 F.2d 1028, 1032 (Fed. Cir. 1989).

...the "**evidence of corroboration must not depend solely on the inventor himself**." *Cooper v. Goldfarb*, 154 F.3d 1321, 1330 (Fed. Cir. 1998); see also *Hahn*, 892 F.2d at 1033 (corroborating evidence must be "independent of information received from the inventor").

(cited by Pet. Reply at 8)

Sorrells Testimony Is the Only Corroboration of PO's Documentary Evidence

1

Patent Owner's Response

David Sorrells (ParkerVision's CTO) confirmed that the above shows ParkerVision's [REDACTED] shown above to be last modified on March 6, 1997. Ex.-2016, ¶¶7-10; Ex.-2012, [REDACTED] Ex.-2016, ¶5. [REDACTED] Id.

POR at 24

Sorrells' Declaration

5. In the summer of 1996, ParkerVision began to design its first integrated circuit (IC) chip called "Eddie." ParkerVision completed the design of the Eddie chip by early 1997. The Eddie chip used [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
6. By early 1997, ParkerVision completed the layout for the Eddie chip.
7. The layout of the first Eddie chip can be found in a file [REDACTED] (Exhibit 2012).

EX2016 at ¶¶5-7

Sorrels Cannot Authenticate PO's Swear-behind Documents

1

Sorrels' Declaration

9. As can be seen (below left) in the properties of the [REDACTED] this file shows that it was last modified on March 6, 1997. As can be seen (below right) in the metadata from a Relativity database, it also shows that the file was last modified on March 6, 1997. This date is consistent with the time that the ParkerVision team and I were working on the layout of the Eddie chip.

EX2016, at ¶9

*Relativity database was not used
by ParkerVision in 1997-1998*

Sorrels' Deposition

Q. The list in Exhibit 2029, did you check the date on the document relative to the metadata for each of those documents?

A. Not for each one, no, sir. You know, it forked over a lot of them and so the decision was made to put everything that it forked over into the database. So, no, sir, I did not check each individual entry.

Q. Okay. Do you know if Relativity was used by ParkerVision in 1997-98?

A. I'm pretty comfortable with the answer of no.

Q. Do you know how the files got from ParkerVision into Relativity?

A. The answer is I do not know specifically.

TI-1068, 24:15-18 (cited by Pet. Mot. to Exclude 8-9)

Sorrels Cannot Authenticate PO's Swear-behind Documents

1

Patent Owner's Response

Mr. Sorrells confirmed that the ParkerVision team continuously worked on the Eddie chip and circuit board through the time it was tested/evaluated. *Id.*, ¶28.

Mr. Sorrells provided a list of ParkerVision files reflecting ParkerVision's continuous work. *Id.*, ¶¶28-30. Ex.-2029.

Mr. Sorrells authenticated all of the files listed or referenced above. *Id.*, ¶¶27, 31.

POR at 27

Mr. Sorrells has no knowledge of the Relativity database

Sorrels' Deposition

Q. And is the -- is it fair to say the Relativity database is stored on a hard drive or a server someplace?

A. I don't know where it's stored. I will tell you that it was readily available when I was looking at it with the attorneys.

Q. Do you know who maintains the server or hard drive that has the Relativity database?

MS. LEPORE: Objection, calls for speculation.

A. This is a deposition, so I can only guess. If you want me to guess, I will, but just know that it's speculation.

BY MR. GRISWOLD:

Q. Understood. So you don't know? You would have to guess?

A. Yes. *TI-1068, 21:5-21 (cited by Pet. Mot. to Exclude 8-9)*

No Evidence the Schematics Correspond to the Chip Tested by [REDACTED]

2

Dr. Dickens' Deposition

Q Okay. In reviewing this document, were you able to determine the circuit, schematic for the circuit, that was actually tested by [REDACTED]?

ATTORNEY CHARKOW: Objection. Form.

A No. No. They didn't provide a schematic of the actual test, device under test in the report.

EX2043, 72:11-17

Q Okay. And based on your review of this schematic and [REDACTED], can you determine if this was the circuit that was tested by [REDACTED]?

ATTORNEY CHARKOW: Objection to form.

A In my opinion, I don't believe this -- this circuit was the one that was actually tested, that was represented to be, but I don't think it was. And this looks to me, maybe an early version or something. But I would just be speculating. I don't know.

EX2043, 73:10-20

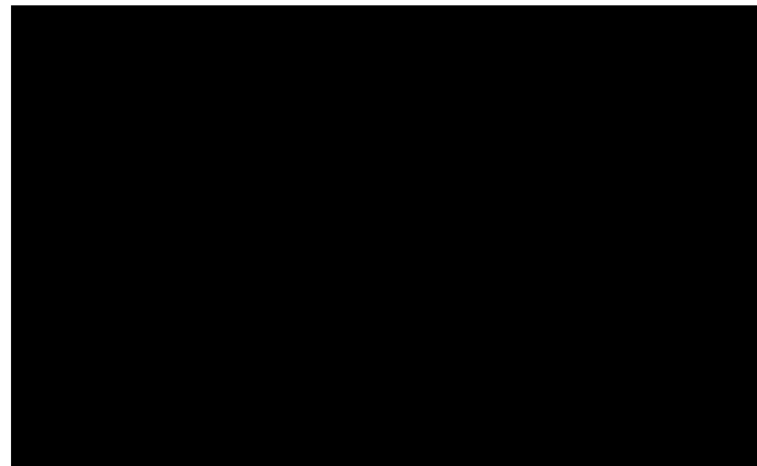
No Evidence the Schematics Correspond to the Chip Tested by [REDACTED]

2

Sorrels' Declaration

9. As can be seen (below left) in the properties of the [REDACTED] this file shows that it was last modified on March 6, 1997. As can be seen (below right) in the metadata from a Relativity database, it also shows that the file was last modified on March 6, 1997. This date is consistent with the time that the ParkerVision team and I were working on the layout of the Eddie chip.

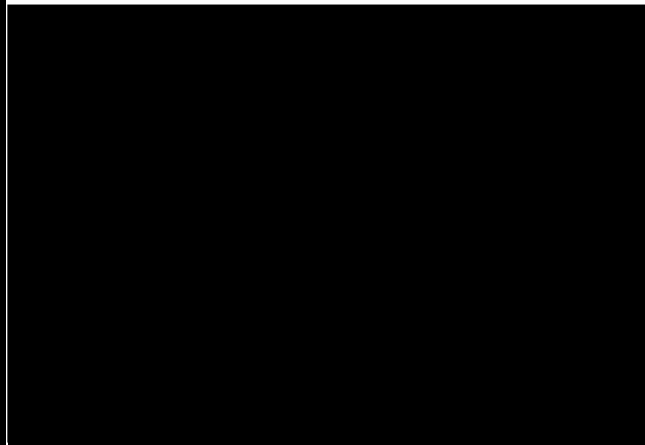
EX2016, ¶9 (cite by Pet. Reply at 3-4)



2

16. The layout of the circuit board (Exhibit 2013) can be seen below left and the schematic of the circuit board can be seen below right. Part 63 is shown both on the circuit board layout and schematic and represents the location of the Eddie chip on the circuit board. The layout of the circuit board was created in 1997.

EX2016, ¶ 16



FISH.

EX2016, ¶ 16

DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

No Evidence of Meeting All Claimed Features

3

Claim 14 requires “a first control signal” and “a second control signal”

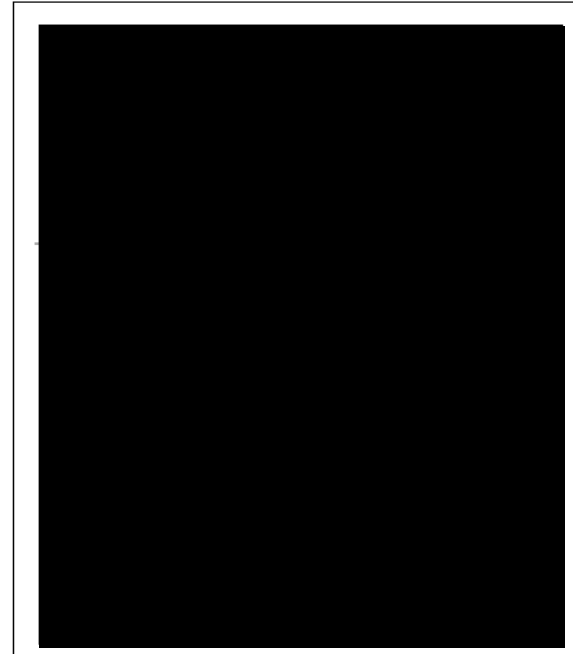
TI-1001, cl.14

Dr. Ricketts’ Deposition



TI-1065, 78:6-12 (citing by Pet. Reply at 8-9)

Dr. Dickens’ Declaration

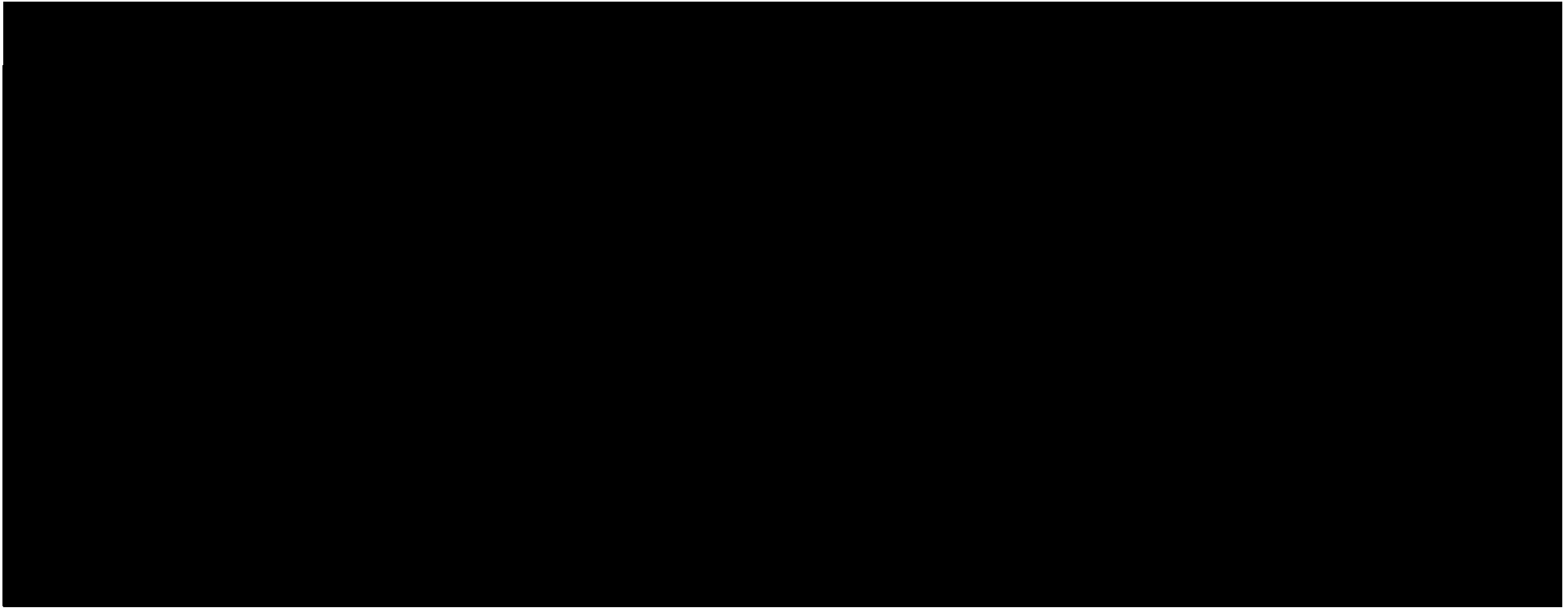


TI-1067, ¶13 (annotating EX2015, 5) (citing by Pet. Reply at 8-9)

No Evidence of meeting all claimed features

3

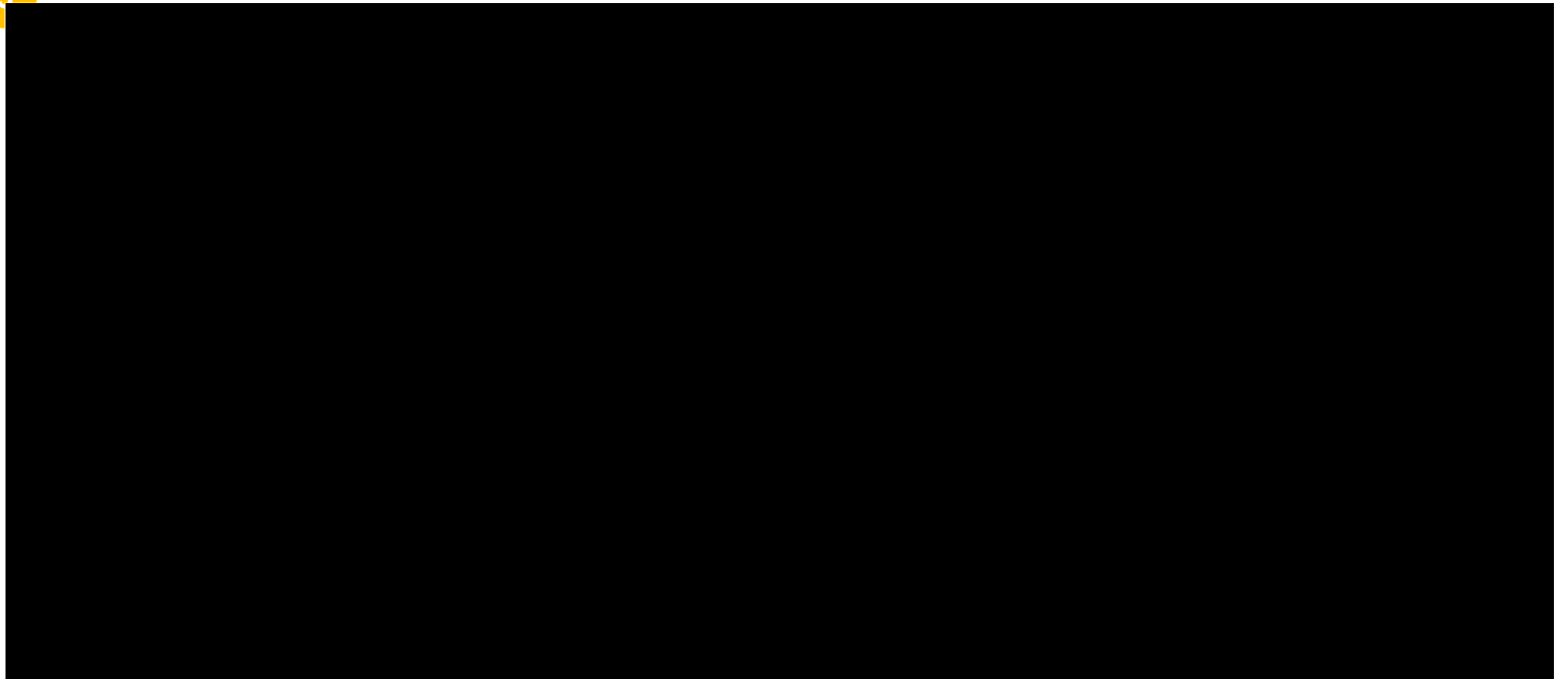
Asserted matched filtering / correlating modules under would not work



TI-1067, ¶16 (annotating EX2011) (citing by Pet. Reply at 10-12)

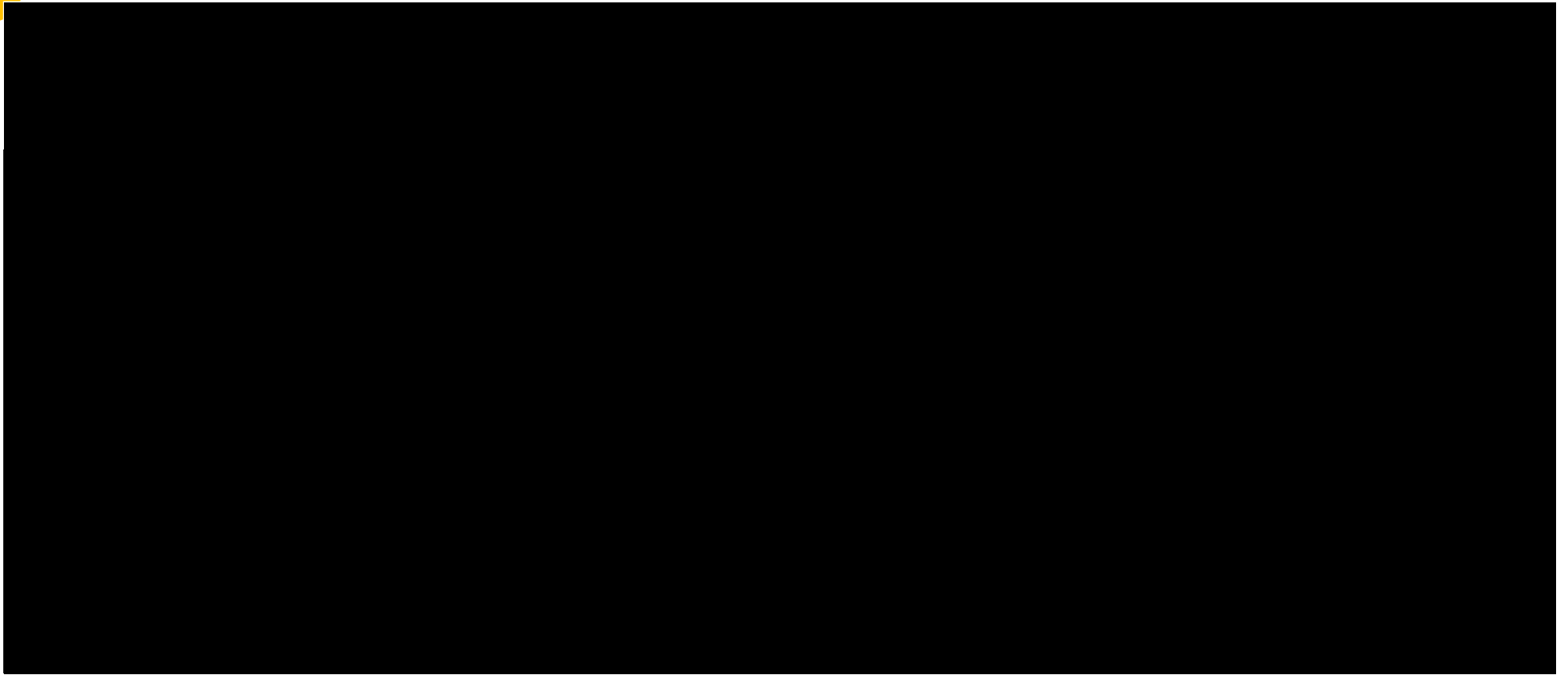
TI-1067, ¶¶ 17-20 (citing by Pet. Reply at 11-13)

No Evidence of meeting all claimed features



No Evidence of meeting all claimed features

3

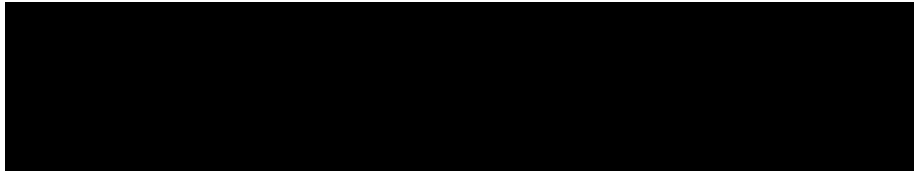


No Evidence of meeting all claimed features

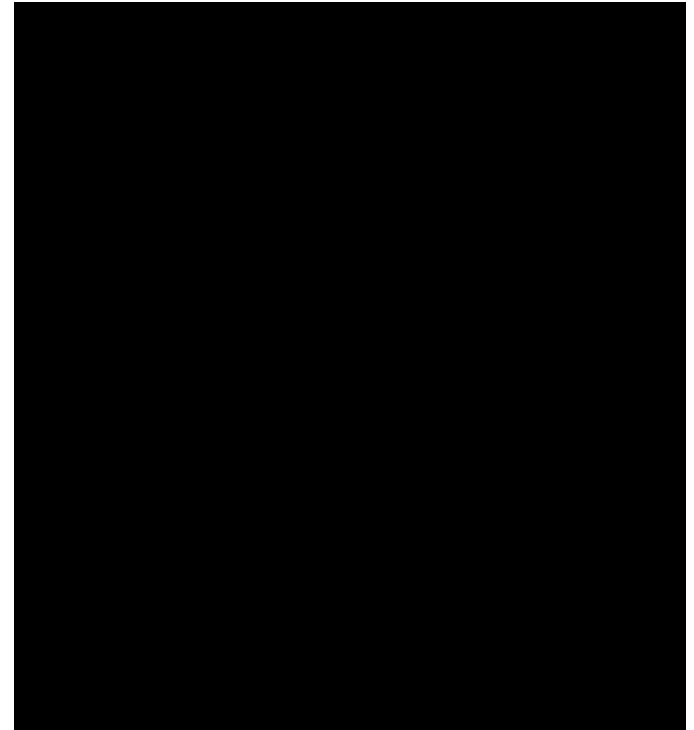
3

No independent corroboration of non-negligible aperture

Pet. Reply, 4-5



POR at 43, (reproducing EX.-2015 and citing EX.-2016, ¶ 5)



POR at 42 (reproducing EX.-2015 at 26)

No Evidence of meeting all claimed features

3

Petitioner Discusses the Relevancy of the 50% Duty Cycle

Pet. Reply, 4-5

Fourth, Petitioner argues that [REDACTED]
[REDACTED] Reply, 5, 22-23. The Reply does not explain how
this is even relevant to conception/reduction. Nevertheless, Sorrells's statement is
corroborated by the layout (Ex.-2012), which shows [REDACTED] and by
Ricketts's analysis of that circuitry. See Ex.-2015, 5, 16-18, 25-27. [REDACTED]

Sur-reply at 21.

down-convert it...."). The energy transfer "from the EM signal" to the capacitor
occurs "during a non-negligible aperture period." TI-1001, 106:30-53.

Pet. Rep. at 31

As mentioned above, to show aliasing and a non-negligible aperture, PO
only cites to the Sorrells declaration that the circuit [REDACTED]
[REDACTED] and to nothing else. POR, 26-27, 52 (EX2016, ¶5, has no citations to other

Pet. Rep. at 22

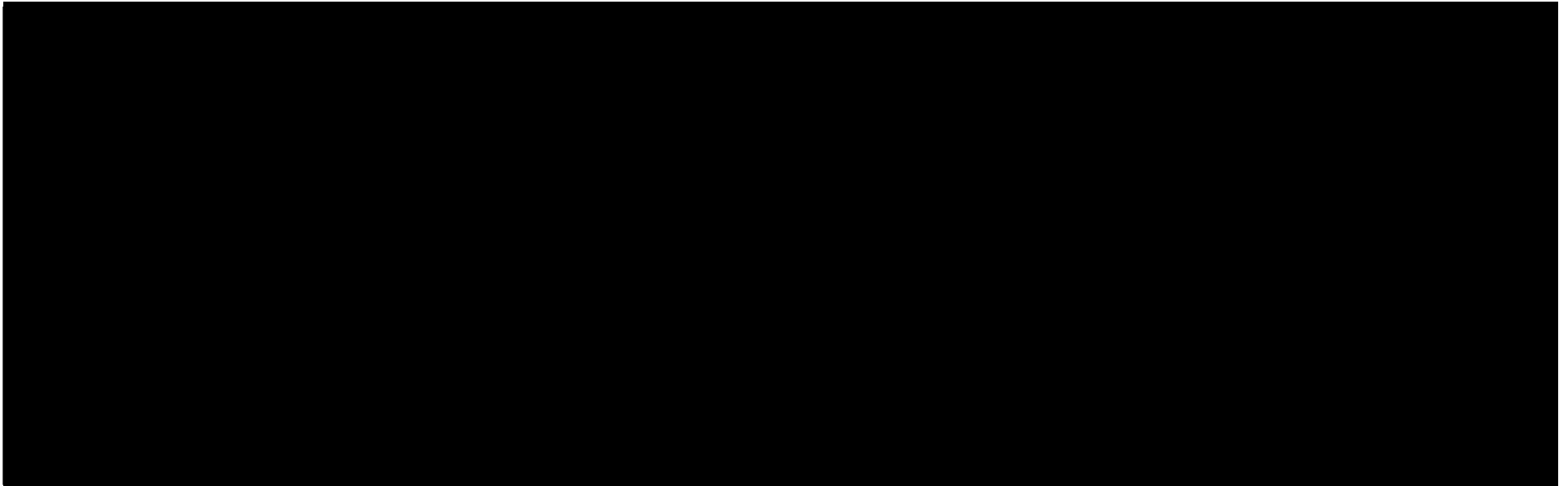
No Evidence of meeting all claimed features

3

No combining (under claim 14])

Pet. Reply, 12-13

Dr. Dickens' Declaration



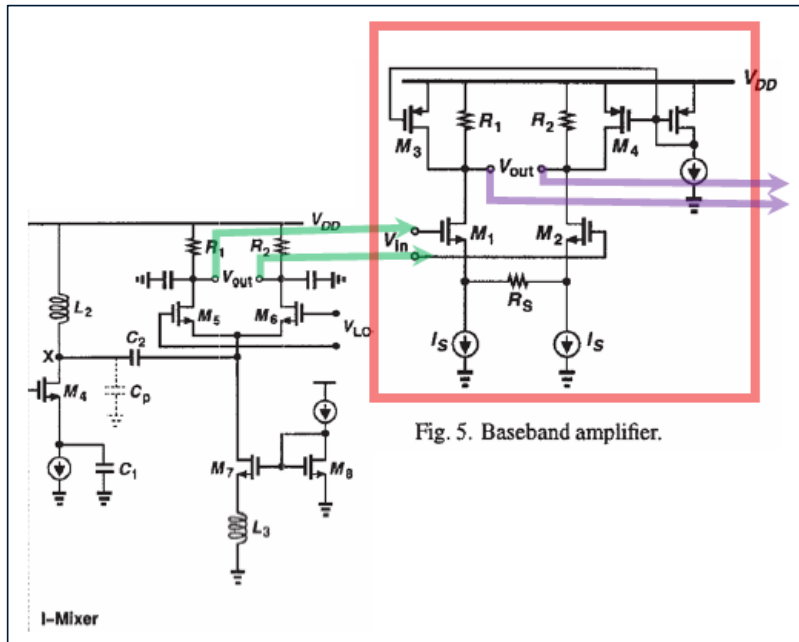
Ex.-2011.

TI-1067, ¶24 (annotating EX2011) (citing by Pet. Reply at 13-14)

No Evidence of meeting all claimed features

3

PO Fails to Link Galton's Discussion of Razavi to the Operation of EX.-2011 Circuitry



POR, 3 (citing by TI-1003, ¶187)

FISH.

DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

EX.-2011 (cited in POR 33) fr.com | 38

FISH.

Claim Construction

DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

Claim Construction Overview

- Construction of “matched filtering / correlating module” is disputed
- PO argues that Tayloe does not include a matched filtering / correlating module because Tayloe does not transfer energy to a load to form a down-converted signal or transfer available real power to a load and producing a down-converted signal
- The 177 patent does not require that a matched filtering / correlating module transferring energy to a load to produce a down-converted signal
- PO’s counter argument to Tayloe is entirely dependent on transferring energy to a load because they argue that Tayloe’s resistors are high-impedance, and thus no energy is transferred to them
- A correct construction of a matched filtering / correlating module is dispositive without having to determine whether Tayloe’s resistors are a low-impedance load
- Under PO’s constructions, however, Tayloe still renders claim 14 unpatentable because Tayloe’s resistors are low-impedance loads

Matched Filtering / Correlating Module

- Florida District Court
 - (a) linear time-variant circuitry ...
 - (b) that samples a modulated RF (radio frequency) carrier signal at an aliasing rate using a switch with an independent control input driven by a control signal with a non-negligible, periodic aperture, such that the samples, having non-negligible available energy, are accumulated and transferred to a load while the switch is closed ...
 - (c) and discharged through the load while the switch is open, ...
 - (d) thereby transferring available real power from the modulated RF carrier signal to the load and ...
 - (e) producing a down-converted signal with enhanced signal-to-noise ratio
- POR Construction
 - circuitry that samples an input signal at an aliasing rate using a switch such that energy of the input signal is integrated and transferred to a load to form a down-converted signal
- TI's Construction
 - plain-and-ordinary meaning
- WDTX Construction (Formerly "Special Master's Construction"; Adopted by J. Albright Nov 2024)
 - plain-and-ordinary meaning wherein the module samples an input signal at an aliasing rate
 - EX.-2006

Matched Filtering / Correlating Module

- Florida District Court
 - (a) linear time-variant circuitry ...
 - (b) that samples a modulated RF (radio frequency) carrier signal at an aliasing rate using a switch with an independent control input driven by a control signal with a non-negligible, periodic aperture, such that the samples, having non-negligible available energy, are accumulated and transferred to a load while the switch is closed ...
 - (c) and discharged through the load while the switch is open, ...
 - (d) thereby transferring available real power from the modulated RF carrier signal to the load and ...
 - (e) producing a down-converted signal with enhanced signal-to-noise ratio
POR at 99-100
- POR Construction
 - circuitry that samples an input signal at an aliasing rate using a switch such that energy of the input signal is integrated and transferred to a load to form a down-converted signal
POR at 98

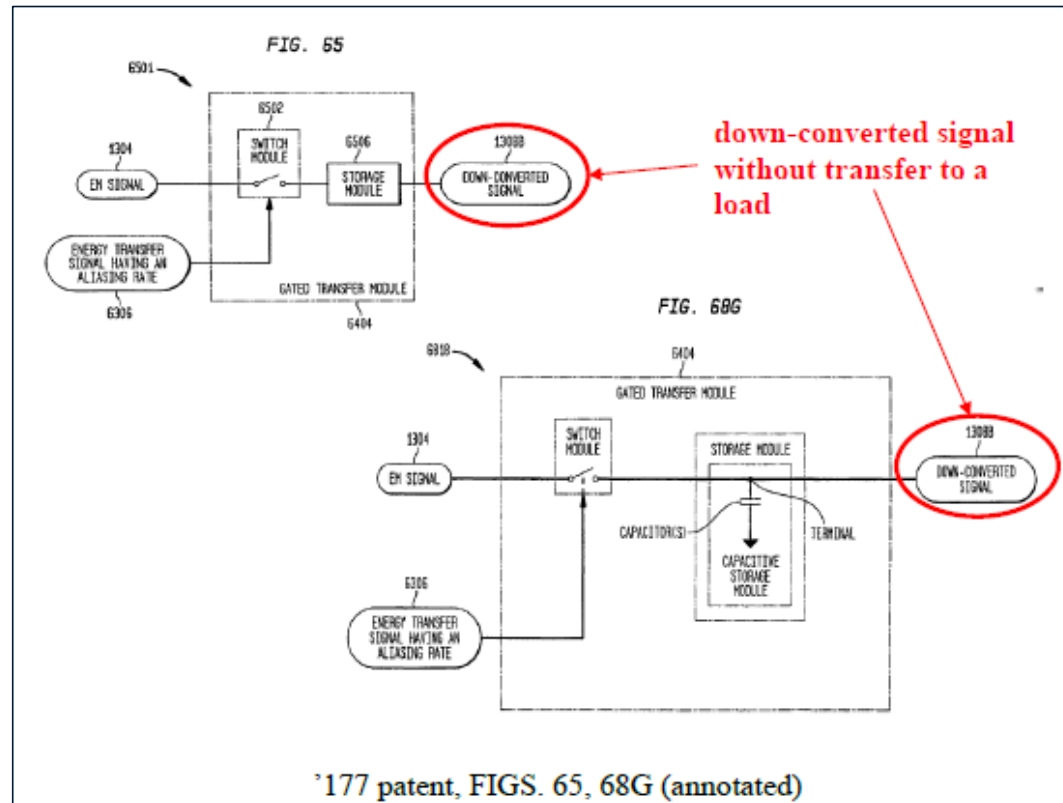
PO does not dispute that the remainder of the constructions are met

- Florida District Court
 - (a) linear time-variant circuitry ...
 - (b) that samples a modulated RF (radio frequency) carrier signal at an aliasing rate using a switch with an independent control input driven by a control signal with a non-negligible, periodic aperture, such that the samples, having non-negligible available energy, are accumulated and transferred to a load while the switch is closed ...
 - (c) and discharged through the load while the switch is open, ...
 - (d) thereby transferring available real power from the modulated RF carrier signal to the load and ...
 - (e) producing a down-converted signal with enhanced signal-to-noise ratio
- POR Construction
 - circuitry that samples an input signal at an aliasing rate using a switch such that energy of the input signal is integrated and transferred to a load to form a down-converted signal

Proper Claim Construction Outline

1. Energy transfer concept for down-conversion is not load-dependent
 1. Energy transfer is from the RF signal to the capacitor during the aperture period
 2. Patent describes an advantage of energy transfer as working even for low impedance loads
2. The example implementations of the matched filtering / correlating modules do not all include a load
 1. Separate sections where the patent adds a load resistor to provide further calculations of how the circuit would work
3. Maximizing charge on the capacitor does not include a Load impedance
4. Maximizing SNR does not require a load impedance
5. Transferring through the processor is not the same as transferring to a load, when the load is parallel to the capacitor

Energy Transfer Is Not Load Dependent



TI-1001, FIGS. 65, 68G (cited by Pet. Rep. at 31-32; TI-1066, ¶¶ 5, 15)

Energy Transfer Is Aperture Dependent

Dr. Galton's Declaration

'177 Patent

The goal of the storage modules **6506** and **6716** is to store non-negligible amounts of energy transferred from the EM signal **1304**. Amplitude reproduction of the original, unaffected EM input signal is not necessarily important. In an energy transfer environment, the storage module preferably has the capacity to handle the power being transferred, and to allow it to accept a non-negligible amount of power during a non-negligible aperture period.

TI-1001, 106:45-54 (cited by TI-1066, ¶¶ 16-17; Pet. Rep. 31-33)

The '177 patent clarifies that the energy transfer “from the EM signal” to the capacitor occurs “during a non-negligible aperture period.” TI-1001, 106:45-53 (“The goal of the storage modules 6506 and 6716 is to store non-negligible amounts of energy transferred from the EM signal 1304.”), 106:300-44 (describing that storage modules 6506 and 6716 can be capacitors).

17. The '177 patent makes it clear that the transfer of energy to achieve down-conversion is from the EM signal to the capacitor, and not from the EM signal to the load resistor. Put simply, during the non-negligible aperture period, when the switch is closed (“ON”), energy is transferred from the EM signal to the capacitor for storage.

TI-1066, ¶¶ 16-17 (cited by Pet. Rep. 31-33)

Energy Transfer Is Aperture Dependent

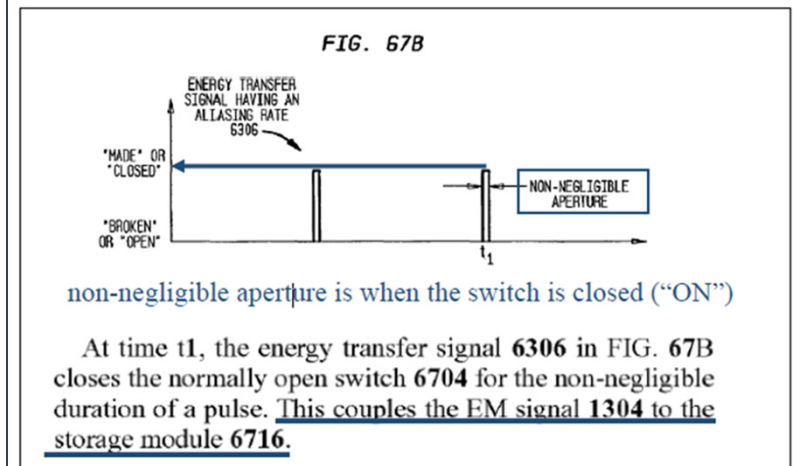
'177 Patent

In an energy transfer environment, the storage module, illustrated in FIG. 82 as a storage capacitance 8208, preferably has the capacity to handle the power being transferred, and to allow it to accept a non-negligible amount of power during a non-negligible aperture period. This allows the storage capacitance 8208 to store energy transferred from the input EM signal 8204, without substantial concern for accurately reproducing the original, unaffected voltage level of the input EM signal 8204. For example, in an embodiment, the

TI-1001, 73:54-65 (cited by Pet. Rep. 31-32)

Dr. Galton's Declaration

The non-negligible aperture and the appropriately selected capacitance is what "allows the storage capacitance 8208 to store energy transferred from the input EM signal 8204." TI-1001, 73:54-65. Note that the non-negligible aperture is the duration of the control signal that closes the switch:



TI-1001, 105, 37-40, FIG. 67B

TI-1066, ¶¶ 16)

Energy Transfer Works “even for lower impedance loads”

‘177 Patent

frequency. A low impedance load is one that is relatively significant. Another benefit of the energy transfer system **8202** is that the non-negligible amounts of transferred energy permit the energy transfer system 8202 to effectively drive loads that would otherwise be classified as low impedance loads in under-sampling systems and conventional sampling systems. In other words, the non-negligible amounts of transferred energy ensure that, even for lower impedance loads, the storage capacitance **8208** accepts and maintains sufficient energy or charge to drive the load **8202**. This is illustrated below in the timing diagrams of FIGS. **83A-F**.

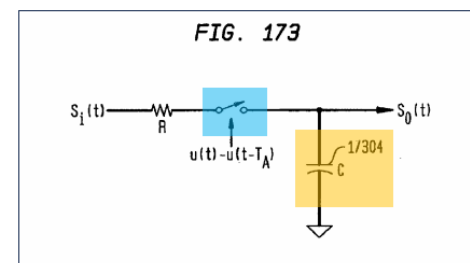
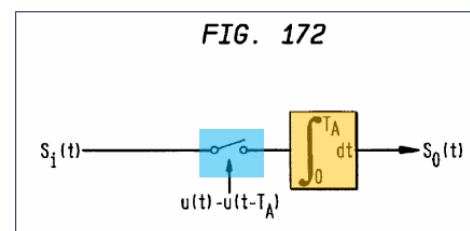
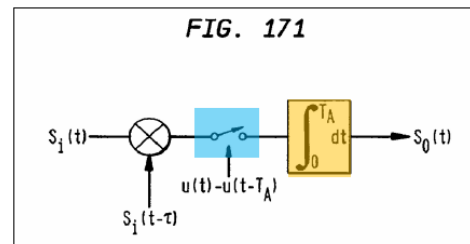
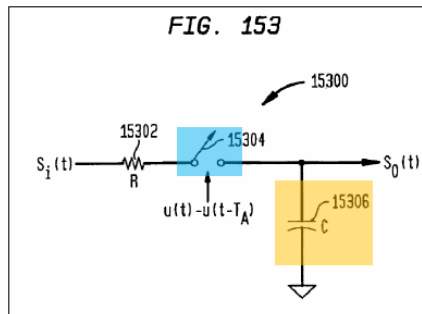
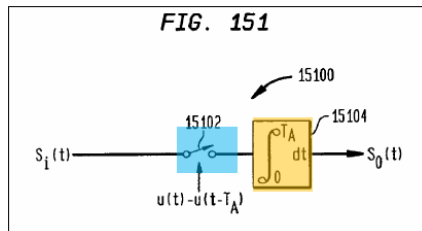
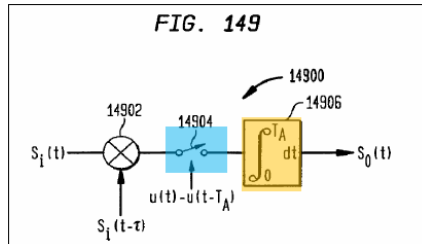
TI-1001, 74:16-18 (cited by Pet. Rep. at 33-34; TI-1066, ¶ 18)

Dr. Galton’s Declaration

18. At best, the ‘177 patent states that a benefit of the energy transfer system is the ability to drive low-impedance loads. But the ‘177 patent states that, “the non-negligible amounts of transferred energy ensure that, even for low impedance loads, the storage capacitance 8208 accepts and maintains sufficient energy or charge to drive the load.” ‘177 patent, 74:16-18 (emphasis added). This statement implies that energy transfer is achieved with or without a load. Likewise the ‘177 patent states that for under-sampling, “loads can be classified as high impedance loads or low impedance loads.” ‘177 patent, 74:5-6. This is further evidence that a low-impedance load is not required for energy transfer to occur.

TI-1066, ¶ 18 (cited by Pet. Rep. at 33-34)

The Matched Filtering / Correlating Embodiments Do Not Include a Load



Dr. Galton's Declaration

6. According to the '177 patent, down-converting does not require transferring to a load to form a down-converted signal, regardless of the magnitude of the impedance of that load. For example, the POR uses FIG. 173 (also shown in FIG. 149) as an example matched filtering/correlating module that uses capacitor 17304 as an integrator. POR, 61-62. The implementation in FIG. 173 has no load, yet its output is the down-converted signal:

TI-1066, ¶ 6 (cited by Pet. Rep. at 25-26)

TI-1001, FIGS. 149, 151, 153, 171, 172, 173 (cited by POR at 58-64)

Maximizing Charge Using Matched Filtering / Correlating Modules Are Load-Independent

Dr. Galton's Declaration

8. Likewise, the equations describing the design methodology to achieve maximum charge accumulation for the RC processor of FIG. 173 do not depend on the load. For example, the '177 patent describes the charge to be dependent on the voltage V_0 and capacitance c :

Note that EQ (37) does not contain a load resistance (recall that R is the source resistance, not a load resistance). Yet, as I explain shortly, if a load resistor were added to the RC processor of Fig. 173, then $V_0(t)$, and, hence, EQ (37) would

TI-1066, ¶¶ 8-11 (cited by Pet. Rep. 27-29)

'177 Patent

Maximizing the charge, q , requires maximizing EQ. (37) with respect to t and β

40

$$\frac{\partial^2 V_0(t)}{\partial t \partial \beta} = 0 \quad \text{EQ. (55)}$$

45

It is easier, however, to set $R=1$, $T_A=1$, $A=1$, $f_A=T_A^{-1}$ and then calculate $q=cV_0$ from the previous equations by recognizing that

50

$$q = \frac{\beta^{-1}}{R} V_0 = cV_0,$$

charge independent of load impedance

55

which produces a normalized response.

E.g., '177 patent, 146:37-55 (where $\beta = (RC)^{-1}$, and R is the source impedance),

and where EQ. 37 is:

$$V_0(t) = \int_{-\infty}^{\infty} A \sin(\pi f_A \tau + \phi) \cdot \frac{e^{-\frac{(t-\tau)}{RC}}}{RC} \left[\begin{array}{l} u(t-\tau) - \\ u(t-\tau-T_A) \end{array} \right] d\tau \quad \text{EQ. (37)}$$

where

$$f_A \Delta 2f = T_A^{-1}$$

TI-1001, FIGS. 146:37-55 (cited by Pet. Rep. 28-29)

TI-1066, ¶¶ 8-11.

fr.com | 50

177 Patent Relates SNR to Aperture and Capacitor Size, Not Load Impedance

'177 Patent

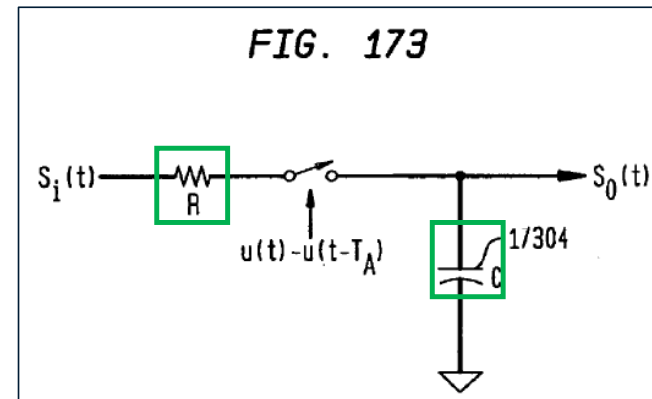
The charge accumulates over several apertures, and SNR is simultaneously optimized melding the best of two features of the present invention. Checking CV for $\beta T_A \approx 1.95$ vs. $\beta T_A = 0.25$ confirms that charge is optimized for the latter.

5.2 Load Resistor Consideration

TI-1001, 147:31-35 (cited by Pet. Rep. at 30)

In certain embodiments, it turns out that for an ideal matched filter the optimum sampling point corresponding to correlator peak is precisely T_A . However, in embodiments, for the RC processor, the peak output of occurs at approximately $0.75 T_A$ for large β (i.e., $\beta=2.6$). That is because the impulse response is not perfectly matched to the carrier signal. However, as β is reduced significantly, the RC processor response approaches the efficiency of the finite time integrating processor response in terms of SNR performance. As β is lowered, the optimal SNR point occurs closer to T_A , which simplifies design greatly. Embodiments of the present invention provides excellent energy accumulation over T_A for low β , particularly when simplicity is valued.

TI-1001, 143:38-51



TI-1001, FIG. 173 (cited by Pet. Rep. 28-30)

Solving the differential equation for $V_o(t)$ permits an optimization of $\beta=(RC)^{-1}$ for maximization of V_o .

TI-1001, FIG. 173 (cited by Pet. Rep. 28-30)

171. Notice the inclusion of the source impedance, R , along with the switch and capacitor. This simple embodiment nev-

TI-1001, 145:52-53 (cited by Pet. Rep. 27)

177 Patent Relates SNR to Aperture and Capacitor Size, Not Load Impedance

'177 Patent

Illustrative SNR performance values of the three example processor embodiments of the present invention are summarized in the table below:	
Performance Relative to the Performance of an Optimal Matched Filter Embodiment	
Example Matched Filter	
$SNR_{MF} = \frac{T_A}{2N_0}$	0 dB
Example Integrator Approximate	
$SNR_{INT} = \frac{4T_A}{\pi^2 N_0}$	-.91 dB
Example RC Approximate (3 example cases for reference)	
$SNR_{RC} = \frac{V_0(t)^2 \cdot 2}{\beta N_0} \cong \frac{.2142}{N_0}$	-3.7 dB, at $T_A = 1, \beta = 2.6$
$SNR_{RC} \cong \frac{.377}{N_0}$	-1.2 dB, at $T_A = .75, \beta = 2.6$
$SNR_{RC} \cong \frac{.405}{N_0}$	-.91 dB at $T_A = 1, \beta \leq .25$

TI-1001, 151:50-152:10 (cited by Pet. Rep. 30; TI-1066, ¶¶ 12-13)

Galton Declaration

12. The '177 patent also provides an analysis of the SNR performance for three embodiments, including the RC processor embodiment of FIG. 173:
13. Note that the general SNR expression in the table for the RC approximate embodiment is proportional to the square of the voltage $V_0(t)$. As I explained above, if a load resistor, R_L , were present, $V_0(t)$, would depend on R_L , e.g., it would decrease as R_L is decreased. Therefore, the SNR would decrease with R_L if a load resistor were included. Yet, the SNR expressions for the three specific design examples of the RC approximate embodiment, i.e., $0.2132/N_0$, $0.377/N_0$, and $0.405/N_0$, do not depend on R_L (T_A and β are not functions of R_L). This is further evidence that the invention does not require the inclusion of a load resistance.

TI-1066, ¶¶ 12-13

177 Patent Additionally Considers the Effects of a Load Resistor Use-Case

177 patent

5.2 Load Resistor Consideration

The general forms of the differential equation and transfer function, described above, for embodiments of the present invention are the same as for a case involving a load resistor, R_L , applied across capacitor, C . FIG. 175A illustrates an example RC processor embodiment 17502 of the present invention having a load resistance 17504 across a capacitance 17506.

TI-1001, 147:39-42 (cited by Pet. Rep. at 29-30)

Galton Declaration

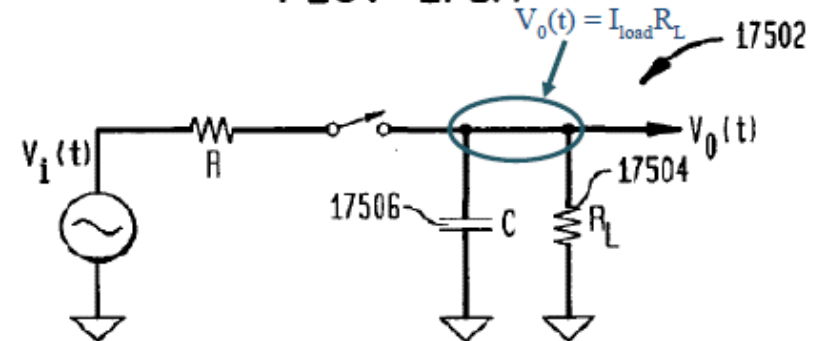
9. A load resistor is merely an *optional* component of the '177 patent's alleged invention. For example, the '177 patent presents an embodiment of the alleged invention shown in FIG. 175A, which adds a load resistor, R_L , to the RC processor of FIG. 173. TI-1001, 147:39-42 ("FIG. 175A illustrates an example RC processor embodiment 17502 of the present invention having a load resistance 17504 across a capacitance 17506.").

TI-1066, ¶¶ 9-11 (cited by Pet. Rep. at 29-30)

Galton Declaration

As R_L decreases, $V_0(t)$ decreases ($V = iR$)
Therefore, the charge q stored on C also decreases by $q = cV_0(t)$

FIG. 175A



TI-1066, ¶¶ 9-11
Pet. Rep. at 29-30
TI-1001, FIG. 175A (annotated))

177 Patent Additionally Considers the Effects of a Load Resistor Use-Case

'177 Patent

5.2 Load Resistor Consideration

The general forms of the differential equation and transfer function, described above, for embodiments of the present invention are the same as for a case involving a load resistor, R_L , applied across capacitor, C. FIG. 175A illustrates an example RC processor embodiment 17502 of the present invention having a load resistance 17504 across a capacitance 17506.

TI-1001, 147:39-42 (cited by Pet. Rep. at 29-30; TI-1066, ¶¶ 10)

Galton Declaration

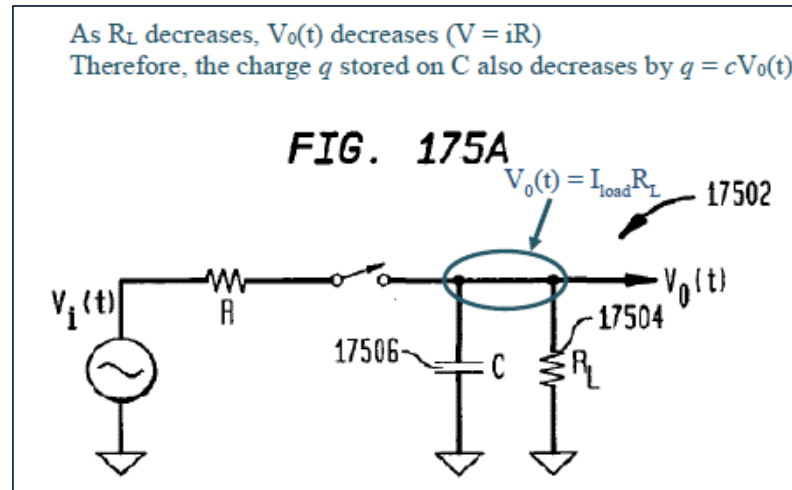
10. Moreover, the '177 patent provides a separate section in which it considers the effect of adding the optional load resistance, R_L . TI-1001, 147:35-149:20 ("5.2 Load Resistor Consideration"). That the '177 patent illustrates the load resistor considerations to the RC processor separately from RC processor without a load resistor is further evidence that the '177 patent does not require a load to achieve down-conversion.

TI-1066, ¶ 10 (cited by Pet. Rep. at 29-30)

Load R_L Dissipates Energy from EM Signal

Reply

As R_L decreases, $V_0(t)$ decreases ($V = iR$)
Therefore, the charge q stored on C also decreases by $q = cV_0(t)$



Pet. Rep. at 29-30 (citing TI-1001, FIG. 175A (annotated))

In the “Overview of *the Invention*,” the patent states that “[a] matched filtering/correlating process also *preserves the energy of the electromagnetic signal and transfers it through the processor.*” *Id.*, 130:37-39. Ex.-2024, ¶174.

POR at 57

FISH.

The Tayloe-Based Ground

DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

Topics for the Tayloe-Based Ground

- I. TI's application of prior art meets all claim limitations
- II. Tayloe's Resistor Is a Low-Impedance Load
- III. PO Does Not Challenge that Tayloe Combines to Form a
- IV. PO Does Not Challenge the Combination
- V. TI has proffered reasonable expectations of success

Taylor-Based Combination Renders Claim 14 Obvious

1 first matched filtering / correlating module

Pet. Reply at 23

2 second matched filtering / correlating module

Pet. Reply at 24

3 combining

Pet. Reply at 25

Obvious to Combine Tayloe and TI Datasheet

105. Additionally, a POSITA would have also 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 switch box 38 of Figure 3, such as annotated below.

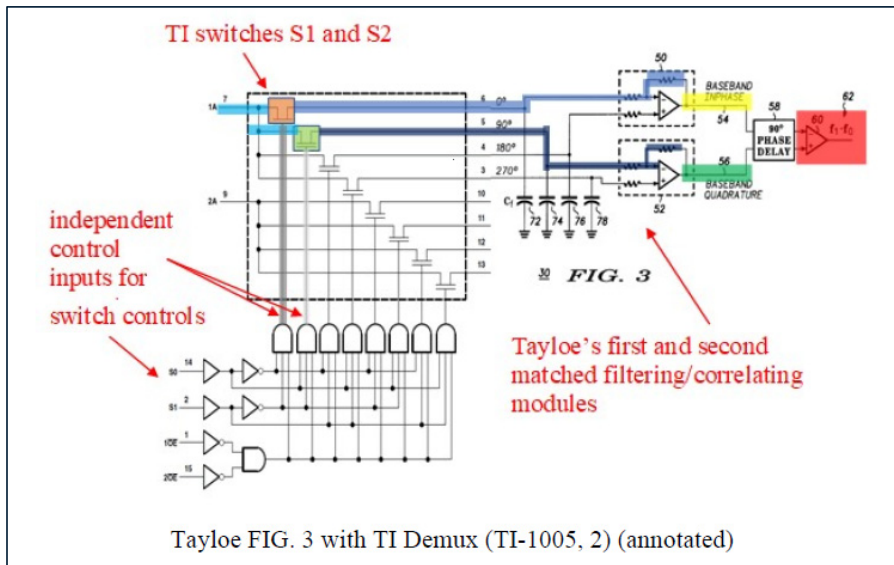
undisputed

106. 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 for a more complete understanding of Tayloe's express teachings of the SN74CBT3253 multiplexer, the only matching multiplexer available at the time, as evidenced by the declaration by Maureen Honeycutt, the TI Senior Paralegal.

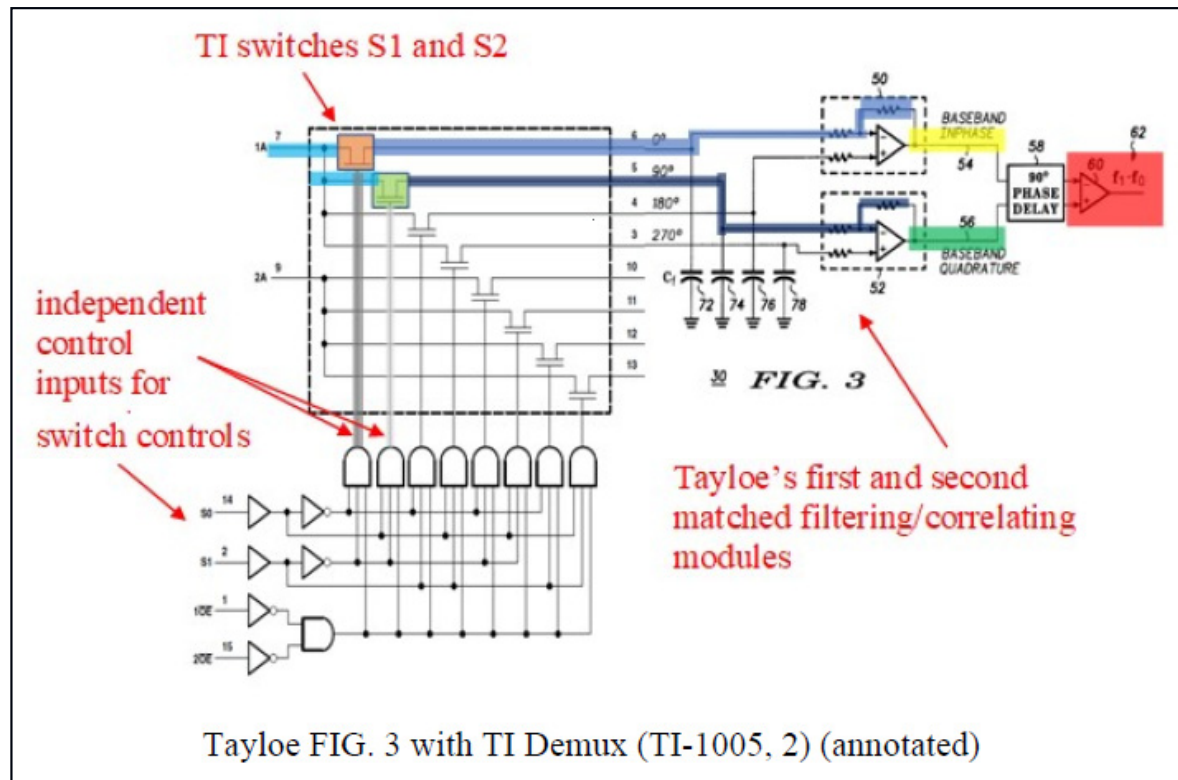
107. A POSITA would have also been motivated to use the multiplexer of the TI Datasheet in Tayloe's implementation of switch box 38 at least because Tayloe expressly teaches using a multiplexer, and the multiplexer of TI's datasheet is a suitable multiplexer because Tayloe demonstrated experimental results using it.

TI-1003, ¶¶ 105-106 (cited by Pet. 21-24)



TI-1003, ¶ 105 (Pet. 21-24)

Taylor-Based Combination Renders Obvious the first and Second Matched Filtering / Correlating Modules



Pet. 22 (citing to TI-1003, ¶¶100-109)

Tayloe Performs Energy Transfer

116. The input to Tayloe's circuit is a modulated RF carrier signal, referred to in Tayloe as f_1 . *See, e.g.*, Tayloe, 2:13-14, 3:40-4:1 (describing f_1 as an input signal, f_0 as the carrier frequency, where $f_1 - f_0 = 0$); *see also, id.*, 1:14-16. The

120. Tayloe also explains that the aperture period is non-negligible. For example, Tayloe explains that “the control signal input to control input 40 is substantially equal to four times the local oscillator frequency,” and as a result, “input 36 is switched to each of the four outputs substantially once during each period of the input signal f_1 .” *See, e.g.*, Tayloe, 2:21-26. Therefore, the aperture period is equal to a quarter period f_1 , which is certainly non-negligible.

TI-1003, 116-120 (cited by Pet. at 28-30)

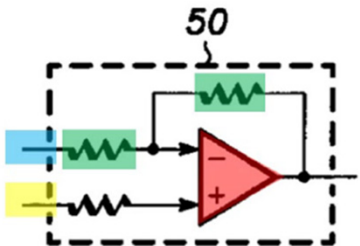
Galton Explained That Voltage Sampling and Energy Sampling Are Not Competing Technologies

59. Dr. Ricketts characterizes Tayloe as disclosing voltage sampling and not an energy transfer system, which he states are “competing technological solutions” for down-conversion. Ex. 2024 ¶ 210, 212. This is a fundamental mischaracterization of the Tayloe invention. The Tayloe invention connects each capacitor to the RF input signal for a quarter of each local oscillator period, thereby charging the capacitor. As Dr. Ricketts acknowledges, the energy stored on a capacitor is $\frac{1}{2} \cdot C \cdot V^2$. Ex. 2024 ¶ 75. This energy comes from the input signal when the corresponding switch is closed, it gets transferred to the capacitor via current, and power, which is energy per unit time, is voltage times current. Moreover, a

TI-1066, ¶ 59-60

TI Demonstrated Low Input Impedance in Tayloe

PO SurReply



Not true

As shown above, the experts agree that the yellow input has high resistance/impedance. Ricketts explains that the blue input must match the yellow input's impedance/resistance, meaning it also must be high.¹¹ POR,61 (citing Ex.-2024, ¶220). The Reply fails to address this argument. Thus, the POR/Ricketts remain un rebutted on this point.¹²

EX2024, ¶¶219-220 (annotating TI-1004 at Fig. 3)
(cited by Reply at 61)

No support

¹¹ Because there is no mechanism in Tayloe's amplifier to change the high impedance "+" input to low impedance, the only way to match inputs is to make the green resistors high resistance.

¹² The Reply generally discusses Sedra (TI-1046). But Sedra, which has its "+" input connected to ground, is not the same configuration as shown in Tayloe. Ex.-2042,15:5-11.

Virtual ground

TI-1066 at ¶ 34 (cited by Reply at 38)

TI Demonstrated Low Input Impedance in Tayloe

Dr. Galton's Deposition

In Figure 3 of Tayloe, the positive terminal of the op-amp circuits are not connected to ground, correct?

A. That is correct; but from a analysis point of view, as long as that voltage is held constant, it's equivalent to being connected to ground, as far as the -- the impedance goes and as far as the -- the small signal behavior of the circuit goes.

EX2042, 17:7-15

Dr. Galton's Declaration

in claiming that the “-” terminal node would have a high impedance. However, the feedback resistor in conjunction with the high open loop gain that op-amps have by design cause the node at the “-” terminal to have a very low impedance. As a POSITA would have first learned in their freshman or sophomore undergraduate circuits courses, this node is referred to as a virtual ground precisely because the feedback changes the impedance at that node from having a very high value to having a very low value (a ground terminal ideally has zero impedance, so the term “virtual ground” is meant to signify that the node has such a low impedance that it virtually behaves as a ground connection). TI-1046, Page 65.

Virtual ground

TI-1066 at ¶ 34 (cited by Reply at 38)

Galton Confirmed that Tayloe's Circuitry Operates Like Sedra

Dr. Galton's Deposition

43. Paragraph 231 of Dr. Rickett's Declaration is another example of where Dr. Ricketts has contradicted himself. Ex. 2024 ¶ 231. In this case, he correctly points out that a POSITA would know that the op-amp within summing amplifier 50 establishes "a virtual short between the amplifier input terminals" (where he is referring to the "+" and "-" terminals of the op-amp in each of summing amplifier 50 and summing amplifier 51), meaning that the terminals have the same voltage. Dr. Ricketts is correct that a POSITA would know this because it is a well-known effect of feedback around an op-amp. Referring to Figure 3 and the supporting text of the Tayloe patent, it is clear that during the time interval when the commutating switch connects the RF input signal to capacitor 72 and the top input of summing amplifier 50, the input signal is not connected to capacitor 76 and the bottom input of summing amplifier 50. As there is essentially no discharge path for capacitor 76 during this time interval (because the high impedance of the

Dr. Galton's Declaration

"+" terminal of the op-amp is very high, as Dr. Ricketts correctly pointed out), the voltage at the bottom input of summing amplifier 50 is held constant over the time interval. Therefore, for the reason pointed out by Dr. Ricketts above, the voltage at the node connected to the "-" terminal of the op-amp also stays constant during the time interval. The impedance of a node which is held at a constant voltage regardless of the current flowing into the node is zero by definition. Therefore, the impedance looking into the top input to summing amplifier 50 is just the resistance of the resistor that connects the top input of summing amplifier 50 to the "-" terminal of the op-amp. As explained above, Tayloe recommends using a 100 ohm resistor, which implies that the top input of summing amplifier 50 has an input impedance of 100 ohms.

TI-1066 at ¶ 43 (cited by Reply at 38-39)

Galton Confirmed that Tayloe's Circuitry Operates Like Sedra

Dr. Galton's Deposition

51. The Figure shown above differs from summing amplifier 50 in Fig. 3 of the Tayloe patent in that '+' terminal of the op-amp in the latter is connected to capacitor 74 and the 180° output of commutating switch 38 through the positive input resistor, whereas in the former it is connected to ground. However, these differences do not affect the reasoning behind the TI-1046 textbook's conclusions stated above for two reasons. One reason is that negligible current flows through the positive input resistor because of the high input impedance looking into the '+' terminal of the op-amp, which essentially negates the effect of the positive input resistor. The other reason is that the analysis used to show that a virtual

Dr. Galton's Declaration

input resistor. The other reason is that the analysis used to show that a virtual ground occurs at the '-' terminal of the op-amp in the figure above does not require that the '+' terminal is held at ground; it is simply necessary for the '+' terminal to be held at a fixed voltage for the analysis to be valid. As the voltage across capacitor 76 in Fig. 3 of the Tayloe patent only changes when commutating switch 38 closes, and this happens only for a quarter of each period, it follows that the '+' terminal of the op-amp is held at a constant voltage for three quarters of each period. Hence, the TI-1046 textbook's conclusions mentioned above hold for three quarters of each period. As the resistor values are fixed, it follows from the TI-1046 textbook's conclusion that a negative input resistor in summing amplifier 50 of Fig. 3 in the Tayloe patent with a resistance of a few mega-ohms would be "impractically large."

TI-1066 at ¶ 51 (cited by Reply at 38-39)

Tayloe Includes a Low-Impedance Load and Transfers Energy

Dr. Galton

32. As discussed above, PO's inclusion of "transferred to a load" is not required by the '177 patent for the matched filtering/correlating module "to form a down-converted signal." But even if it were required, Tayloe describes transferring energy to a low-impedance load as described below.

TI-1066, ¶ 32

POR

(green) for controlling the switch, a "storage" capacitor A low impedance is what enables a storage capacitor to discharge its energy when the switch is OFF (open).

POR at 19

passing through the switch. Since the load is low impedance, when the switch is OFF (opened), as shown in Figure 82B above (right), energy (orange) stored in the "storage" capacitor 8208 is discharged to the low impedance load 8218.

POR at 20

Tayloe Includes a Low-Impedance Load

52. Thus, while it is true that an op-amp in isolation exhibits high-impedance, neither the op-amp from TI-1046's Fig 2.4 nor the summing amplifier 50 of Fig. 3 in the Tayloe patent is in isolation. Rather, both op-amps are in an inverting, closed-loop configuration, with an input resistor, e.g., R1 in the figure above, and a feedback resistor, e.g., R2 in the figure above.

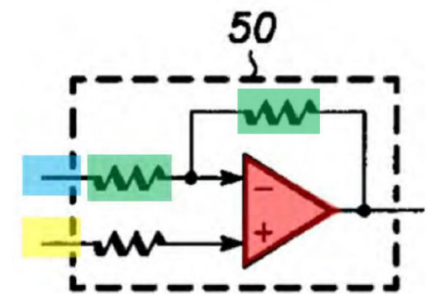
53. Consequently, Dr. Ricketts is wrong in representing that the resistance of the negative input resistor of summing amplifier 50 in Fig. 3 of the Tayloe patent "must...be very high impedance" (e.g., in the 2 mega-ohm). EX2024, ¶ 228, FN9.

54. A POSITA would have found it obvious to select resistance of the negative input resistor of summing amplifier 50 in Fig. 3 of the Tayloe patent that is far lower than the 2 mega-ohm value proposed by Dr. Ricketts.

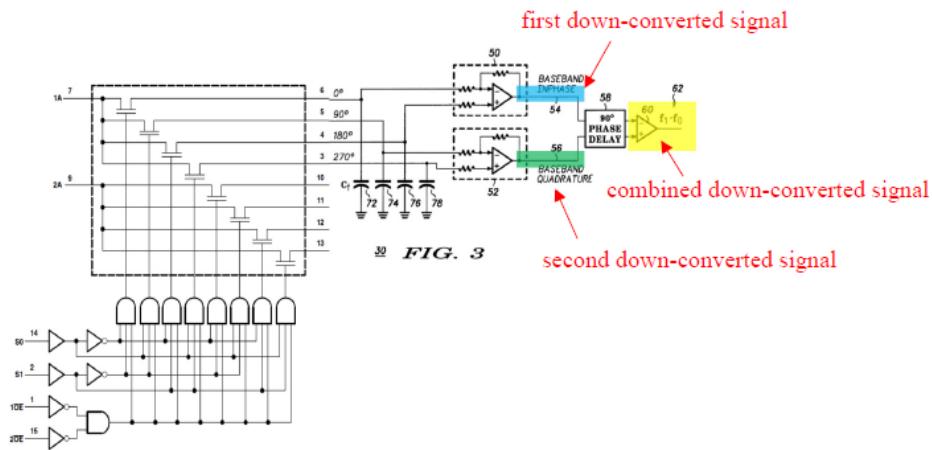
TI-1066, ¶ 52-54 (cited by Pet. Rep. at 35-37)

in claiming that the "-" terminal node would have a high impedance. However, the feedback resistor in conjunction with the high open loop gain that op-amps have by design cause the node at the "-" terminal to have a very low impedance. As a POSITA would have first learned in their freshman or sophomore undergraduate circuits courses, this node is referred to as a virtual ground precisely because the feedback changes the impedance at that node from having a very high value to having a very low value (a ground terminal ideally has zero impedance, so the term "virtual ground" is meant to signify that the node has such a low impedance that it virtually behaves as a ground connection) TI-1046, Page 65.

TI-1066, ¶ 34 (cited by Pet. Rep. at 36-37)



Taylor-Based Combination Teaches Down-Converting



Taylor, FIG. 3 + TI Datasheet (annotated)

TI-1003. ¶ 155 (cited by Pet. 51-54)

For example, Tayloe describes that the baseband in-phase signal 54 and the baseband quadrature signal 56 are combined by the summing amplifier 60, as shown in FIG. 3. Tayloe, 2:65-67; TI-1003, 155.

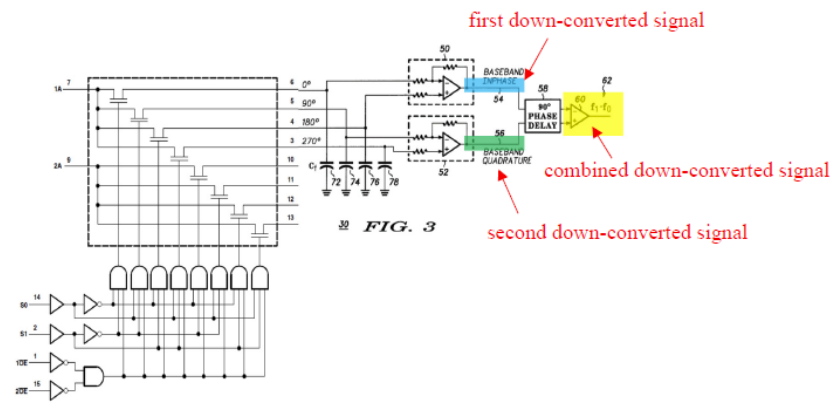
The signal of interest f_2 is a baseband signal where the input signal f_1 has the carrier signal f_0 removed. In cases where the carrier signal f_0 is tuned to the input signal f_1 , the signal of interest $f_1 - f_0$ is exactly at baseband, meaning that not even an intermediate frequency carrier is present.

TI-1003. ¶ 155 (cited by Pet. 51-54)

Tayloe Teaches “combining”

undisputed

155. Tayloe teaches element 14.5. For example, under ParkerVision’s constructions, Tayloe describes that the baseband in-phase signal 54 and the baseband quadrature signal 56 are combined by the summing amplifier 60, as shown in FIG. 3. Tayloe, 2:65-67.



Tayloe, FIG. 3 + TI Datasheet (annotated)

TI-1003, ¶143 (cited by Pet. 52)

FISH.

The Razavi-Based Ground

DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

Topics for the Razavi-Based Ground

- I. Razavi teaches various features
 - 1. Switching pair
 - 2. Transferring energy from the modulated carrier signal to the capacitor

Razavi-Uzunoglu Combination Is Obvious

Undisputed

189. A POSITA would have been motivated to combine Razavi with Uzunoglu to synchronize the control signal from the local oscillator signal of Razavi with the carrier frequency of the RF input signal. A POSITA would have

TI-1003, ¶ 189 (cited by Pet. at 72-78)

191. In addition, a POSITA would have recognized that synchronization offers the potential advantage of reducing circuit complexity. For example, a POSITA would have recognized that using an SO like that of Uzunoglu in Razavi would have reduced the circuit complexity by allowing the elimination of one of the mixer circuits (e.g., the quadrature mixer), as well as the circuitry following that mixer circuit (e.g., lowpass filter, amplifier, analog-to-digital converter, and subsequent digital signal processing). Additionally, using SO eliminates (or at least, reduces) the need for post processing of the two baseband signals to correct for the difference between the RF input signal's carrier frequency and the frequency of V_{LO} .

TI-1003, ¶ 191 (cited by Pet. at 72-78)

192. A POSITA would have had a reasonable expectation of success implementing SO circuitry, like that of Uzunoglu. First, Uzunoglu provides details for how its SO should be implemented and discusses implementation and configuration details. *See, e.g.,* Uzunoglu, 4-12 (discussing experimental results). In addition, Uzunoglu also provides other circuit designs that a POSITA could try to use as an alternative, while also teaching the advantages of its own design. Uzunoglu, 1, 12 (listing prior art references).

TI-1003, ¶ 192 (cited by Pet. at 72-78)

C. Ground 2B: Razavi in view of Uzunoglu

Uzunoglu is only being used for the concept of synchrony and does not resolve the deficiencies of Razavi. Ex.-2024, ¶337.

Thus, Razavi in view of Uzunoglu does not disclose, teach, or suggest all of the elements of claim 14 of the '177 patent for all the same reasons discussed above in Sections VIII.B.1 and 2. Ex.-2024, ¶338.

POR at 111

Razavi's Circuit Operates at an Aliasing Rate and a Non-Negligible Aperture

Undisputed

Razavi

Aliasing Rate

This paper describes the design of a single-chip 900-MHz CMOS direct conversion receiver (DCR) fabricated in a digital 0.6- μm technology and operating from a 3-V supply.

Fig. 3 illustrates the LO and the divide-by-two circuit. Using a cross-coupled pair M_1 - M_2 and 10-nH inductors L_1 and L_2 , the oscillator operates at 1.8 GHz while directly driving the divider. The latter is configured as a master-slave flipflop driven differentially through M_3 - M_4 and M_5 - M_6 . Proper sizing of the devices in each latch provides division speeds in excess of 2 GHz even with the relatively heavy capacitive loading imposed by the switching pairs in the quadrature mixers. Resistors R_5 and R_6 shift the high level of I_{LO} and Q_{LO} down to avoid driving the mixer switching pairs into the triode region.

TI-1017 at 1 (cited by Pet. at 61; Pet. Rep. at 40)

Patent Owner's Response

Non-negligible Aperture

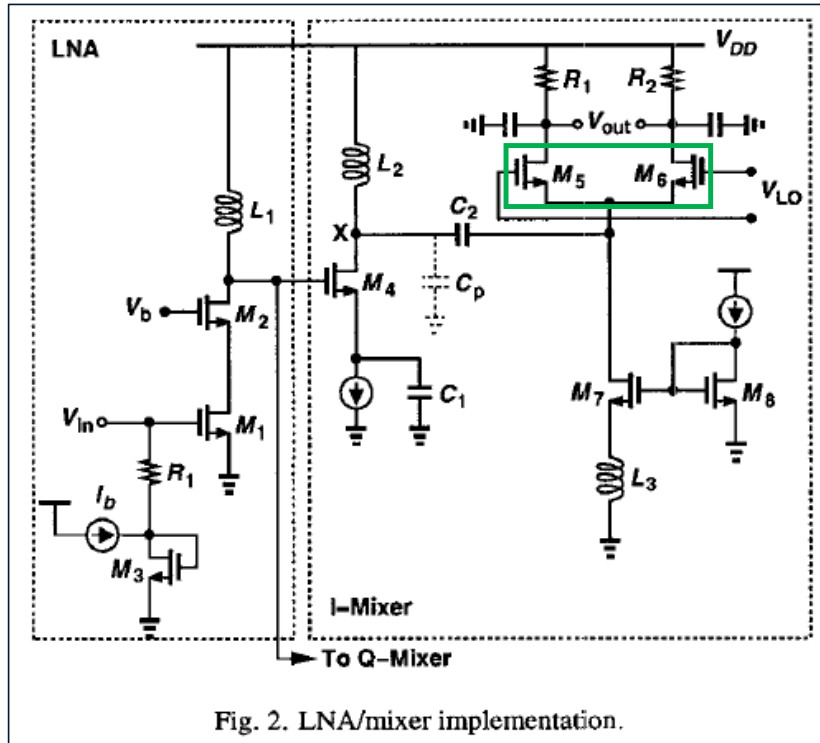
A POSITA understands that Razavi uses a 50% duty cycle LO because the oscillator is symmetric. Ex.-2024, ¶266.

POR at 89

*TI-1017, at 1-2 (cited by:
Pet. at 58-59, 62, 67
Pet. Rep. at 42;
TI-1003, ¶¶ 95, 160, 166, 178;
TI-1066, ¶¶ 101-103)*

Razavi Teaches Switches

Razavi



The mixer employs a single-balanced topology consisting of an input transistor M_4 and a switching pair M_5 - M_6 . In order to

Dr. Galton's Declaration

101. In other words, Razavi's cross-coupling square up a sinusoidal waveform or other input signal and output a waveform that resembles a square wave, rather than a sinusoidal wave. This is why Razavi refers to transistors M_5 and M_6 as a "switching pair"; they are controlled by the I_{LO} voltages, which abruptly transition (like square waves) to cause the transistors to act as switches.

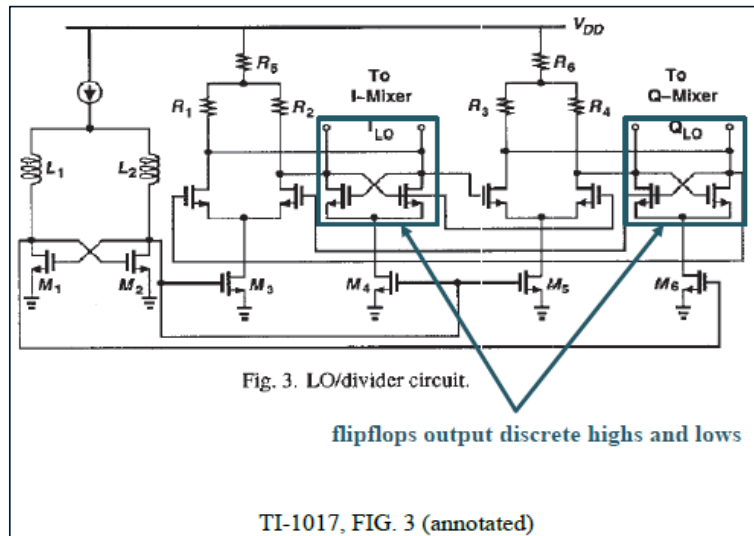
102. Moreover, M_5 and M_6 would introduce more noise into the output signal if the LO were sinusoidal relative to the case where the LO signal approximates a square wave. For these reasons, a POSITA would recognize Razavi's I_{LO} (for the I-mixer) and Q_{LO} (for the Q-mixer) are not sinusoidal in shape.

TI-1066, ¶¶ 101-102)

TI-1017, at 1-2 (cited by:
Pet. at 58-59, 62, 67
Pet. Rep. at 42;
TI-1003, ¶¶ 95 160, 166, 178;
TI-1066, ¶¶ 101-102)

Razavi Uses a Squared-up LO

Razavi



flipflops output discrete highs and lows

TI-1017, FIG. 3 (annotated)

TI-1017, at 1-2 (cited by Pet. Rep. at 42)

Dr. Galton's Declaration

inaccurate. In Razavi, the LOs (i.e., the I_{LO} for the I-mixer and Q_{LO} for the Q-mixer) exhibit waveforms that are squared up. In more detail, the differential

TI-1066, at 100-102 (cited by Pet. Rep. at 42-43)

Dr. Galton's Declaration

101. In other words, Razavi's cross-coupling square up a sinusoidal waveform or other input signal and output a waveform that resembles a square wave, rather than a sinusoidal wave. This is why Razavi refers to transistors M_5 and M_6 as a "switching pair"; they are controlled by the I_{LO} voltages, which abruptly transition (like square waves) to cause the transistors to act as switches.

TI-1066, ¶¶ 100-102 (cited by Pet. Rep. at 42-43)

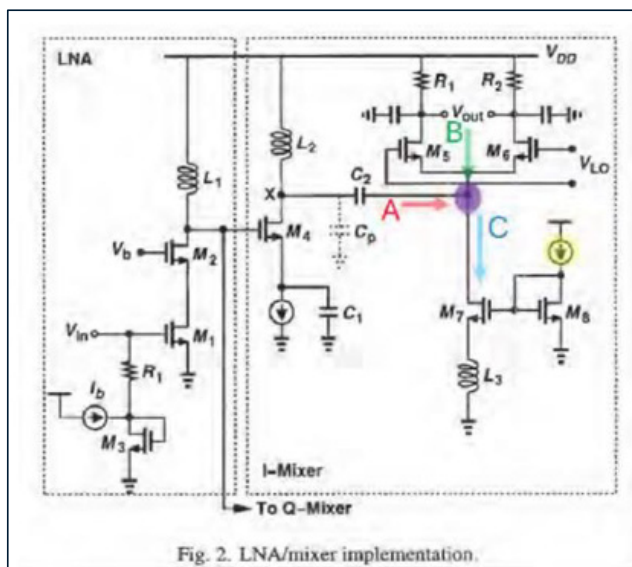
Dr. Ricketts Depo

6 Q Okay. What's that portion of the divider
7 circuit where those two transistors are crossed?
8 A So the -- Razavi describes these as master-slave
9 flip-flop. And so flip-flops are -- have latches in
10 them. And so the cross-coupled is a -- is a latch. So
11 you can set one side being low, the other side being
12 high, or vice versa, and it will hold it there until you
13 actively reset it or set it to a different output.

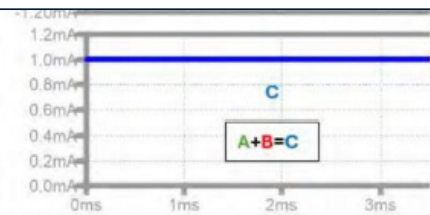
TI-1065, 104:6-13 (cited by Pet. Rep. at 42-43)

Razavi Discharges Through Resistors

Patent Owner's Response



98. Dr. Ricketts' annotation demonstrates transferring energy as an output of Razavi's switch (i.e., M5 and M6). As reproduced below, "current A," as annotated by PV to represent "the RF input signal flowing into the node," causes "current B," which, in PV's description, is "flowing from VDD to M7," to oscillate so that the oscillation is reflected on Vout terminals, and hence energy is transferred from the RF input signal. *E.g.*, EX2024, ¶¶ 94-96.²



POR, 68-69 (annotating EX1017, FIG. 2)

TI-1066, at 100-102 (cited by Pet. Rep. at 42-43)

FISH.

Motion to Exclude

DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

Exhibits 2010-2014, 2019-2022, 2027, 2029 should be excluded

- I. Exhibits 2010-2014, 2019-2022, 2027, 2029 are not authenticated
- II. Exhibits 2010-2014, 2019-2022, 2027, 2029 are inadmissible

Sorrels lacks personal knowledge of the Relativity database

Sorrels' Declaration

29. ParkerVision files related to the design, development, testing, and/or evaluation of the [REDACTED] discussed above are maintained in a Relativity database. The Relativity database shows the metadata including file extension, file name, and last modified date of these files. A search of the database was run. Below is an excerpt from the search.

EX2016, at ¶29

*Relativity database was not used
by ParkerVision in 1997-1998*

Sorrels' Deposition

Q. The list in Exhibit 2029, did you check the date on the document relative to the metadata for each of those documents?

A. Not for each one, no, sir. You know, it forked over a lot of them and so the decision was made to put everything that it forked over into the database. So, no, sir, I did not check each individual entry.

Q. Okay. Do you know if Relativity was used by ParkerVision in 1997-98?

A. I'm pretty comfortable with the answer of no.

Q. Do you know how the files got from ParkerVision into Relativity?

A. The answer is I do not know specifically.

TI-1068, 24:7-21 (cited by Pet. Mot. to Exclude 8-9)

Sorrels cannot authenticate documents from the Relativity database

Patent Owner's Response

Mr. Sorrells confirmed that the ParkerVision team continuously worked on

██████████ through the time it was tested/evaluated. *Id.*, ¶28.

Mr. Sorrells provided a list of ParkerVision files reflecting ParkerVision's continuous work. *Id.*, ¶¶28-30. Ex.-2029.

Mr. Sorrells authenticated all of the files listed or referenced above. *Id.*, ¶¶27,

31.

POR at 27

Mr. Sorrells has no knowledge of the Relativity database

Sorrels' Deposition

Q. And is the -- is it fair to say the Relativity database is stored on a hard drive or a server someplace?

A. I don't know where it's stored. I will tell you that it was readily available when I was looking at it with the attorneys.

Q. Do you know who maintains the server or hard drive that has the Relativity database?

MS. LEPORE: Objection, calls for speculation.

A. This is a deposition, so I can only guess. If you want me to guess, I will, but just know that it's speculation.

BY MR. GRISWOLD:

Q. Understood. So you don't know? You would have to guess?

A. Yes.

TI-1068, 21:5-21 (cited by Pet. Mot. to Exclude 8-9)

Inventor's testimony of conception must be corroborated

Pet. Mot to Exclude, 5

1171. Because an inventor tends to “describe his actions in an unjustifiably self-serving manner,” inventor testimony alone, without more, is not considered credible for the purposes of corroborating documentary evidence purporting to show earlier conception/reduction-to-practice to antedate a prior art reference. *Chen v. Bouchard*, 347 F.3d 1299, 1309 (Fed. Cir. 2003); *see also In re NTP, Inc.*, 654 F.3d 1279, 1291 (Fed. Cir. 2011) (“It would be strange indeed to say that [an inventor], who filed the... affidavit that needs corroborating, can by his own testimony provide that corroboration.”). As a result, such uncorroborated inventor testimony is insufficient to satisfy the strict rules pertaining to authentication of business records under FRE 803(6)(E) and 902(11). Accordingly, business records that are only corroborated by inventor testimony are inadmissible hearsay.

Unauthenticated documents purporting to antedate are inadmissible

Pet. Reply ISO Mot. to Exclude, 3

None of the exhibits has been properly authenticated by, e.g., someone with “knowledge” of the Relativity database. *Supra* §I; Pet. Mot., 5-11. The Federal Circuit has repeatedly explained that, when, as here, PO attempts to antedate the prior art, PO initially bears “the burden of production” including authenticated documents. *Dynamic Drinkware*, 800 F.3d 1379. PO has not met its burden to produce the requisite authentication.

BACKUP SLIDES

FISH.

DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

Use of expert declaration

- The Board has recently endorsed use of expert testimony to further explain the knowledge of a POSITA and support a motivation to combine. See https://www.uspto.gov/sites/default/files/documents/aapa_memo_final_signed.pdf?utm_campaign=subscriptioncenter&utm_medium=email&utm_source=govdelivery

deny an IPR petition that fails to comply with Rule 104(b)(4). General knowledge may still be used in an IPR to support a motivation to combine or to demonstrate the knowledge of a person having ordinary skill in the art. See, e.g., *Unification Techs. LLC v. Micron Tech. Inc.*, 2024 WL 3738401, at *7 (Fed. Cir. Aug. 9, 2024) (affirming use of general knowledge in an IPR proceeding in the form of expert testimony and AAPA to demonstrate how a skilled artisan would have understood a prior art reference's disclosure as teaching a claim limitation).