

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MEDIATEK INC.,

Petitioner,

v.

PARKERVISION, INC.,

Patent Owner.

PTAB Case No. IPR 2024-00150

Patent No. 7,292,835

**CORRECTED PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 7,292,835**

TABLE OF CONTENTS

	Page
I. INTRODUCTION	1
II. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(B)	3
A. REAL PARTY IN INTEREST	3
B. RELATED MATTERS	3
C. NOTICE OF COUNSEL AND SERVICE INFORMATION	4
III. REQUIREMENTS FOR <i>INTER PARTES</i> REVIEW	4
A. GROUNDS FOR STANDING	4
B. IDENTIFICATION OF CHALLENGE.....	5
1. Claims Challenged	5
2. The Prior Art	5
3. Grounds for Challenge	6
4. Statutory Grounds Of Challenge And Legal Principles.....	7
IV. BACKGROUND TECHNOLOGY.....	7
A. Wireless communications signals	7
B. “Modulating” Signals for Wireless Communications.....	8
1. Amplitude Modulation.....	9
2. Phase Modulation.....	10
3. Quadrature Amplitude Modulation (“QAM”)	11
V. OVERVIEW OF THE ’835 PATENT	14
A. Alleged Problem.....	14
B. Alleged Invention	14
C. The Examiner Did Not Consider or Analyze the Gibson, Schiltz, or Crols References Presented in This Petition During Original Prosecution.	19
VI. CLAIM CONSTRUCTION	20

TABLE OF CONTENTS (continued)

	Page
A. “cable modem” (Claim 1, Preamble).....	21
B. “storage module” (Claim 1).....	21
VII. OVERVIEW OF THE PRIOR ART REFERENCES	23
A. Gibson (Ex. 1004)	23
B. Schiltz (Ex. 1005).....	24
C. Crols (Ex. 1006)	26
D. DOCSIS References (Goldberg (Ex. 1007), Thacker (Ex. 1008)).....	29
E. ITU-T J.83 (Ex. 1009).....	31
F. AAPA	31
G. Motivation to Combine	32
1. Ground 1: Gibson and Schiltz.....	32
2. Ground 2: Crols.....	34
3. “Cable Modem”	37
VIII. LEVEL OF ORDINARY SKILL IN THE ART	40
IX. SPECIFIC GROUNDS FOR PETITION	41
A. Ground 1: Claims 1-5 are Unpatentable as Obvious Over Gibson and Schiltz.....	41
1. Claim 1	41
2. Claim 2: “The cable modem of claim 1, wherein said quadrature-phase oscillating signal is out of phase with said in-phase oscillating signal by substantially 90 degrees.”	55
3. Claim 3	56
4. Claim 4: “The cable modem of claim 3, wherein said first storage device is a first capacitor, and said second storage device is a second capacitor.”	63
5. Claim 5: “The system of claim 3, wherein said first reference potential is substantially equal to ground,	

TABLE OF CONTENTS (continued)

	Page
and said second reference potential is substantially equal to ground.”	64
B. Ground 2: Claims 1–5 are Unpatentable as Obvious Over Crols	65
1. Claim 1	65
2. Claim 2: “The cable modem of claim 1, wherein said quadrature-phase oscillating signal is out of phase with said in-phase oscillating signal by substantially 90 degrees.”	80
3. Claim 3	82
4. Claim 4: “The cable modem of claim 3, wherein said first storage device is a first capacitor, and said second storage device is a second capacitor.”	88
5. Claim 5: “The system of claim 3, wherein said first reference potential is substantially equal to ground, and said second reference potential is substantially equal to ground.”	89
C. Objective Indicia of Non-Obviousness	90
X. THE BOARD SHOULD INSTITUTE REVIEW	91
A. The Board Should Not Deny Institution under <i>Fintiv</i>	91
B. The Examiner Did Not Consider the Gibson, Schiltz, and Crol References Forming the Basis of This Petition.....	93
XI. CONCLUSION.....	94

EXHIBIT LIST

- Ex. 1001 U.S. Patent No. 7,292,835 (“’835 Patent”)
- Ex. 1002 Excerpts of ’835 Patent File History
- Ex. 1003 Declaration of Lawrence E. Larson, Ph.D. Regarding U.S. Patent No. 7,292,835 (“Larson Decl.”)
- Ex. 1004 U.S. Patent No. 4,682,117 (“Gibson”)
- Ex. 1005 U.S. Patent No. 5,339,459 (“Schiltz”)
- Ex. 1006 J. Crols, *A Single-Chip 900 MHz CMOS Receiver Front-End with a High Performance Low-IF Topology*, 30 IEEE JOURNAL OF SOLID-STATE CIRCUITS 1483 (Dec. 1995) (“Crols”)
- Ex. 1007 L. Goldberg, “MCNS/DOCSIS MAC Clears a Path for the Cable-Modem Invasion,” *Electronic Design*; Dec. 1, 1997; 45, 27; Materials Science & Engineering Collection pg. 69 (“Goldberg”)
- Ex. 1008 U.S. Patent No. 6,011,548 (“Thacker”)
- Ex. 1009 ITU-T J.83 Recommendation (April 1997) (“ITU-T J.83”)
- Ex. 1010 Declaration of Brenda Ray
- Ex. 1011 Declaration of June Munford
- Ex. 1012 Complaint for Patent Infringement, *ParkerVision, Inc. v. MediaTek Inc.*, No. 6:22-cv-01163 (W.D. Tex. November 10, 2022) (ECF 1).
- Ex. 1013 Amended Complaint for Patent Infringement, *ParkerVision, Inc. v. MediaTek Inc.*, No. 6:22-cv-01163 (W.D. Tex. March 8, 2023) (ECF 16).
- Ex. 1014 ParkerVision, Inc.’s Disclosure of Preliminary Infringement Contentions, *ParkerVision, Inc. v. MediaTek Inc.*, No. 6:22-cv-01163 (W.D. Tex. June 20, 2023).

- Ex. 1015 RESERVED
- Ex. 1016 Claim Construction Order, *ParkerVision, Inc. v. Intel Corp.*,
No. 6:20-cv-00108 (W.D. Tex. Jan. 26, 2021) (ECF 75).
- Ex. 1017 Claim Construction Order, *ParkerVision, Inc. v. LG Electronics, Inc.*, No. 6:21-cv-00520 (W.D. Tex. June 21, 2022) (ECF 55).
- Ex. 1018 Special Master’s Report and Recommendation Regarding Claim
Construction, *ParkerVision, Inc. v. Hisense Co.*, No. 6:20-cv-00870
(W.D. Tex. Aug. 29, 2022) (ECF 72).
- Ex. 1019 Agreed Scheduling Order, *ParkerVision, Inc. v. MediaTek Inc.*,
No. 6:22-cv-01163 (W.D. Tex. July 31, 2023) (ECF 44).
- Ex. 1020 U.S. District Courts – Federal Court Management Statistics, UNITED
STATES COURTS (March 31, 2023), available at
[https://www.uscourts.gov/sites/default/files/data_tables/fcms_na_dis
tprofile0630.2023.pdf](https://www.uscourts.gov/sites/default/files/data_tables/fcms_na_disprofile0630.2023.pdf).
- Ex. 1021 J. Crols, *A 1.5 GHz Highly Linear CMOS Downconversion Mixer*,
30 IEEE Journal Of Solid-State Circuits 736 (July 1995).
- Ex. 1022 Protective Order
- Ex. 1023 U.S. Patent No.6,088,569 (“Bach”)
- Ex. 1024 U.S. Patent No. 6,181,716 (“Lide”)

Pursuant to 35 U.S.C. § 311 and 37 C.F.R. § 42.100, MediaTek Inc. (“Petitioner”) petitions for *inter partes* review (“IPR”) of claims 1–5 (“challenged claims”) of U.S. Patent No. 7,292,835 (Ex. 1001, the “’835 Patent”).

I. INTRODUCTION

Although this is Petitioner’s first petition challenging claims of the ’835 Patent, the Board has previously found (in a proceeding brought by unrelated petitioners) certain ’835 Patent claims unpatentable, including independent claim 1. *TCL Indus. Holdings Co., Ltd. v. ParkerVision, Inc.*, IPR2021-00985, Final Written Decision, Paper 44 (PTAB Nov. 17, 2022) (“TCL IPR Final Written Decision”).¹ Dependent claims 2–5 were not at issue in the TCL IPR, and the present Petition challenging those claims was necessitated by Patent Owner’s litigation conduct following the TCL IPR final written decision.

¹ The final written decision in the TCL IPR is presently on appeal.

ParkerVision, Inc. v. TCL Indus. Holdings Co., Ltd., No. 2023-1417 (Fed. Cir.). If the Board’s finding of unpatentability is affirmed, and the USPTO issues a certificate canceling claim 1 pursuant to 35 U.S.C. § 318(b), the challenge to claim 1 in this Petition will be at issue only because claims 2–5 include the limitations of claim 1 (the independent claim from which they depend).

Indeed, Patent Owner’s infringement allegations in the MediaTek litigation have been a moving target. Specifically, on November 10, 2022, Patent Owner filed its original complaint against Petitioner in district court (“MediaTek litigation”), which asserted only claims 1 and 17. (Ex. 1012, p. 10.) The FWD in the TCL IPR issued just one week later, holding both ’835 Patent claims asserted in the MediaTek litigation (claims 1 and 17) unpatentable. Then, in March 2023, Patent Owner filed an amended complaint, removing allegations of infringement for claims 1 and 17 and newly asserting claims 3–5. (Ex. 1013, p. 17.) In its June 2023 preliminary infringement contentions, Patent Owner maintained the infringement allegations for claims 3–5, re-introduced the infringement allegations for claims 1 and 17, and asserted for the first time claims 2, 12–15, and 17–20. (Ex. 1014, p. 2.) Of the claims now at issue in the MediaTek litigation, Petitioner challenges in this Petition only those asserted claims not already found unpatentable in the TCL IPR (claims 2–5) and the independent claim from which they depend (claim 1).

For the reasons described herein, and for the reasons the Board already articulated in its Final Written Decision in the TCL IPR, Petitioner requests institution of *inter partes* review and cancellation of all challenged claims of the ’835 Patent.

II. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(B)

A. REAL PARTY IN INTEREST

MediaTek Inc., MediaTek USA Inc., MTK Wireless Limited (UK), Gaintech Co. Limited, and MediaTek Investment Singapore Pte. Ltd. are the real parties-in-interest.

B. RELATED MATTERS

Patent Owner asserts that Petitioner infringes the '835 Patent in *ParkerVision, Inc. v. MediaTek Inc.*, No. 6:22-cv-01163 (W.D. Tex.) (complaint filed November 10, 2022).

Additionally, Patent Owner has asserted the '835 Patent in the following litigations: *ParkerVision, Inc. v. TCL Industries Holdings Co., Ltd. et al*, No. 6:20-cv-00945 (W.D. Tex.); *ParkerVision, Inc. v. Hisense Co., Ltd. et al*, No. 6:20-cv-00870 (W.D. Tex.); *ParkerVision, Inc. v. ZyXEL Commc 'ns Corp.*, No. 6:20-cv-01010 (W.D. Tex.); *ParkerVision, Inc. v. Buffalo Inc.*, No. 6:20-cv-01009 (W.D. Tex.); *ParkerVision, Inc. v. LG Elecs., Inc.*, No. 6:21-cv-00520 (W.D. Tex.); *ParkerVision, Inc. v. Realtek Semiconductor Corp.*, 6:22-cv-01162 (W.D. Tex.).

The '835 Patent has been involved in the following PTAB proceedings: *TCL Indus. Holdings Co., Ltd. v. ParkerVision, Inc.*, No. IPR2021-00985 (PTAB); *LG Elecs., Inc. v. ParkerVision, Inc.*, No. IPR2022-00246 (PTAB) (joined to IPR2021-00985). The Board found claims 1, 12–15, and 17–20 unpatentable, and that

decision is presently on appeal in *ParkerVision, Inc. v. TCL Indus. Holdings Co., Ltd.*, No. 23-1417 (Fed. Cir.).

C. NOTICE OF COUNSEL AND SERVICE INFORMATION

Lead counsel: Jessica C. Kaiser, Reg. No. 58,937

Back-up counsel: Matthew C. Bernstein, *pro hac vice to be requested*;
Kyle R. Canavera, Reg. No. 72,167; Kevin A. Zeck, *pro hac vice to be requested*.

These attorneys can be reached by mail at Perkins Coie LLP, 11452 El Camino Real, Suite 300, San Diego, CA 92130; by phone at (858) 720-5700; and by fax at (858) 720-5799.

Petitioner consents to electronic service. All services and communications to the attorneys listed above may be sent to: PerkinsServiceMediatek-ParkerVisionIPRs@perkinscoie.com. A Power of Attorney is being filed concurrently.

III. REQUIREMENTS FOR *INTER PARTES* REVIEW

This Petition is complete, complies with all requirements and thus should be accorded a filing date as the date of filing of this Petition under 37 C.F.R. § 42.106.

A. GROUNDS FOR STANDING

Petitioner certifies that the '835 Patent is available for IPR and that the Petitioner is not barred or estopped from requesting IPR challenging claims of the '835 Patent on the grounds identified herein.

B. IDENTIFICATION OF CHALLENGE

1. Claims Challenged

The precise relief requested is that the Board institute an IPR trial on claims 1–5 of the '835 Patent on all presented grounds and cancel claims 1–5.

2. The Prior Art

The prior art references relied upon are prior art discussed or referred in the papers filed with Petition. *See* Exhibit List, *supra*. The prior art references relied upon in the specific invalidity grounds are listed below and are identified in connection with applicable subsections under 35 U.S.C. § 102.

1. U.S. Patent No. 4,682,117 (“Gibson”) (Ex. 1004) issued on July 21, 1987, and is prior art under 35 U.S.C. § 102(b) (pre-AIA);
2. U.S. Patent No. 5,339,459 (“Schiltz”) (Ex. 1005) issued on August 16, 1994, and is prior art under 35 U.S.C. § 102(b) (pre-AIA);
3. J. Crols, *A Single-Chip 900 MHz CMOS Receiver Front-End with a High Performance Low-IF Topology*, 30 IEEE JOURNAL OF SOLID-STATE CIRCUITS 1483 (Dec. 1995) (“Crols”) (Ex. 1006) published in December 1995 and is prior art under 35 U.S.C. § 102(b) (pre-AIA);
4. L. Goldberg, “MCNS/DOCSIS MAC Clears a Path for the Cable-Modem Invasion,” *Electronic Design*; Dec. 1, 1997; 45, 27; Materials Science & Engineering Collection pg. 69 (“Goldberg”) (Ex. 1007),

published on December 1, 1997 (see Ex. 1010, Declaration of Brenda Ray)² and is prior art under 35 U.S.C. § 102(b) (pre-AIA);

5. U.S. Patent No. 6,011,548 (“Thacker”) (Ex. 1008), was filed on September 4, 1998, and issued January 4, 2000, and is prior art under 35 U.S.C. §§ 102(a) and (e) (pre-AIA);
6. ITU-T J.83 Recommendation (April 1997) (“ITU-T J.83”) (Ex. 1009), was published in April 1997 and is prior art under 35 U.S.C. § 102(b); and
7. Applicant admitted prior art (“AAPA”), set forth in the ’835 Patent (Ex. 1001) at column 40, lines 17-35.

3. Grounds for Challenge

Ground	Basis	References	Challenged Claims
1	§ 103	Gibson, Schiltz	1–5
2	§ 103	Crols	1–5

As to both Grounds, if the Board finds that the preamble of claim 1 is

² Exhibit 1010 is re-submitted from the TCL IPR, and is Exhibit 1010 to the Petition in IPR2021-00985. The public availability of Goldberg is further evidenced by the Declaration of June Munford, Ex. 1011.

limiting—and thus requires a “cable modem”—then Petitioner submits that the challenged claims are unpatentable as obvious over the combinations above and further in view of publications (*e.g.*, Goldberg and Thacker) describing the then-existing cable modem standards (ITU-T J.83 and DOCSIS) and/or AAPA.

This Petition, supported by the declaration of Lawrence E. Larson, Ph.D. (“Larson Decl.” (Ex. 1003)), demonstrates that there is a reasonable likelihood that Petitioner will prevail with respect to cancellation of at least one challenged claim. *See* 35 U.S.C. § 314(a).

4. Statutory Grounds Of Challenge And Legal Principles

This Petition requests cancellation of claims 1–5 of the ’835 Patent under pre-AIA 35 U.S.C. §§ 102 and 103, and AIA 35 U.S.C. §§ 311 to 319 and 325(d).

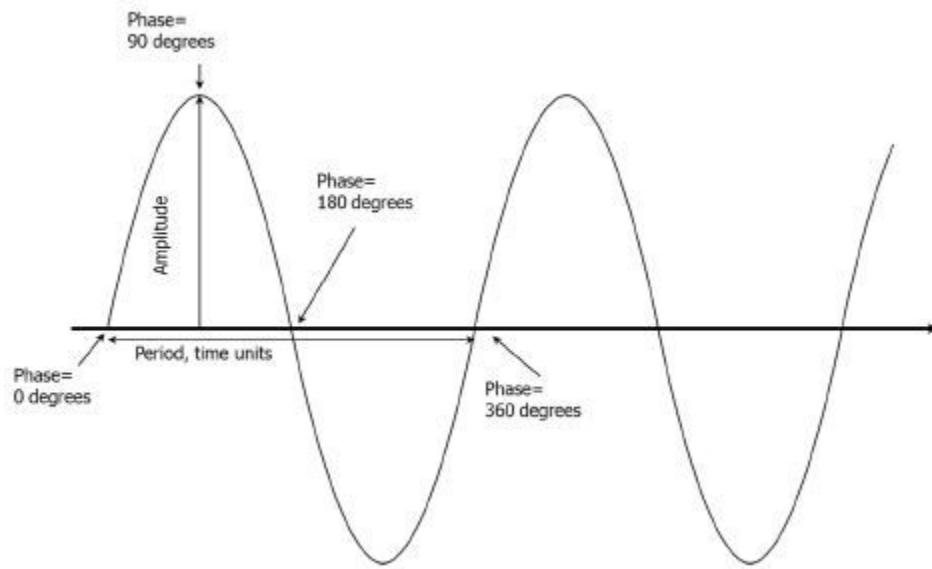
IV. BACKGROUND TECHNOLOGY

A. Wireless communications signals

Wireless devices (*e.g.*, cellular phones) exchange information by transmitting and receiving electromagnetic signals. These signals are communicated from one device’s transmitter to another device’s receiver. The challenged claims of the ’835 Patent focus on devices for receiving signals transmitted from another device.

Before transmission, information (*e.g.*, the voice information of a telephone call) exists as a “baseband signal,” which has a relatively low frequency. The

baseband signal is often a digital signal, and to transmit the baseband signal wirelessly, the digital signal sometimes is converted into an analog signal. As shown below, an analog signal is a continuous waveform that oscillates at a particular frequency between maximum and minimum values:



(Larson Decl., ¶¶28-30.)

B. “Modulating” Signals for Wireless Communications

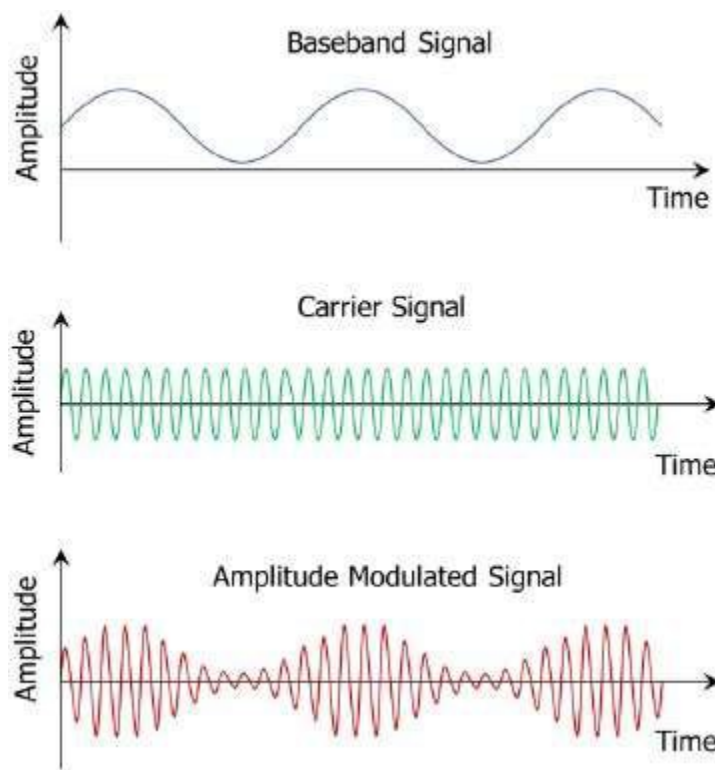
Because baseband signals have relatively low frequencies, they cannot be effectively transmitted through the air between wireless devices. Instead, a baseband signal must be “imprinted” onto a higher frequency signal—called a “carrier” signal—that can be transmitted more easily. This carrier signal “carries” the baseband signal through the air from one device to another device.

This process of “imprinting” a lower frequency baseband signal onto a higher frequency carrier signal is called “modulation.” Modulation is achieved by

modifying the frequency, phase, and/or amplitude of the carrier signal based on the frequency, phase, and/or amplitude of the baseband signal. The following describes well-known modulation techniques. (Larson Decl., ¶¶31-33.)

1. Amplitude Modulation

As shown below, modifying the carrier signal's amplitude based on the amplitude of the baseband signal is called “amplitude modulation.” In this case, the modified carrier signal is called an “amplitude modulated signal,” which can be transmitted wirelessly over the air.



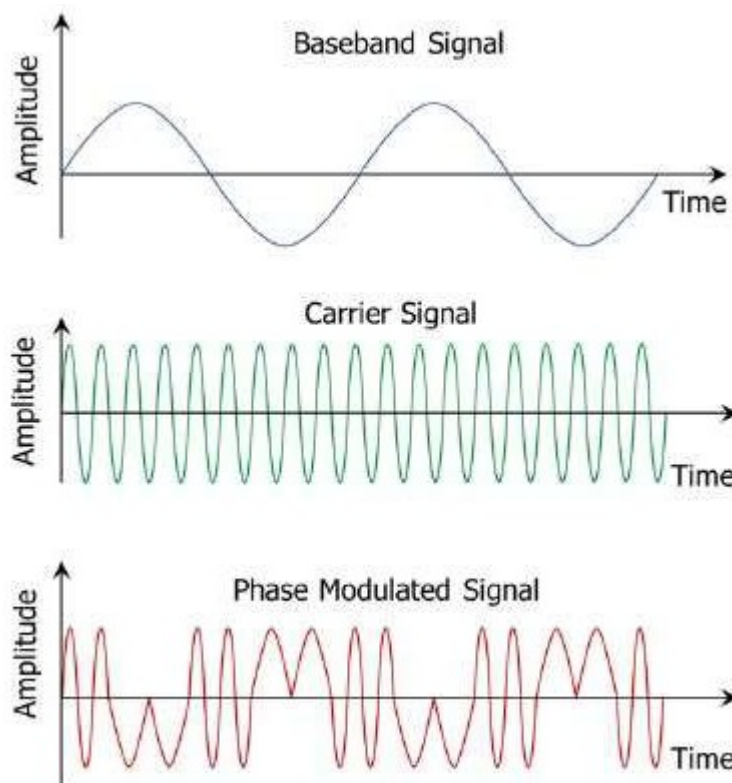
(Larson Decl., ¶34.)

The receiver “knows” the frequency of the unmodulated carrier signal ahead

of time. Thus, when it receives the amplitude modulated signal, it can recover the original baseband signal from the modulated signal by separating out the amplitude of carrier frequency. (Larson Decl., ¶¶34-35.)

2. Phase Modulation

A baseband signal can also be transmitted wirelessly to another device using phase modulation. In this case, the carrier signal's phase is modified based on the phase of the baseband signal, as shown below.



(Larson Decl., ¶36.)

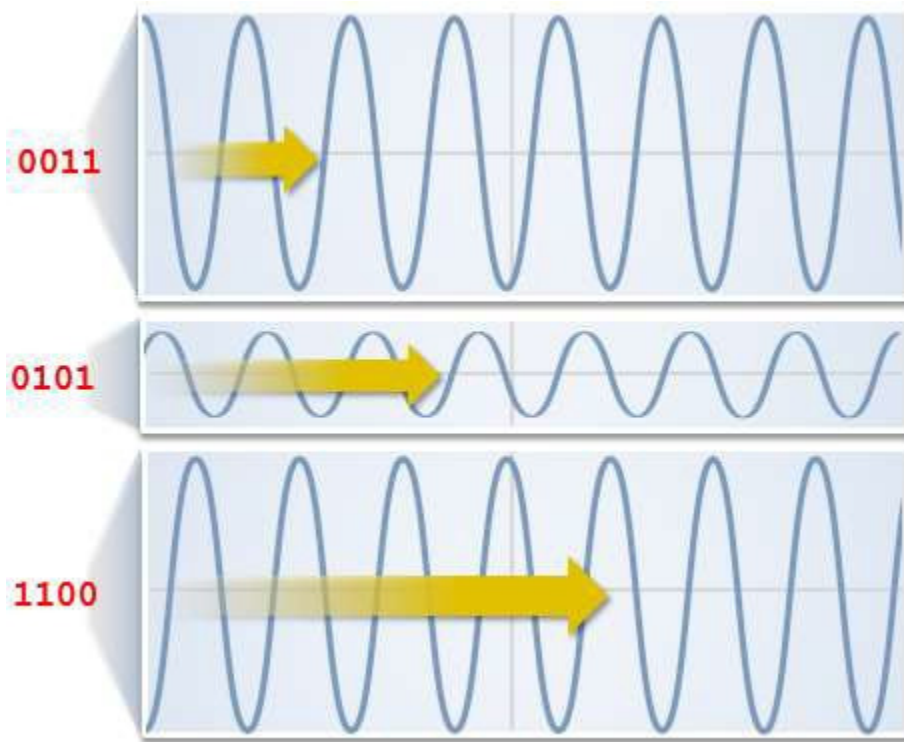
This modified carrier signal is called a “phase modulated signal,” which can be wirelessly transmitted. As with amplitude modulation, the receiver knows the

frequency of the carrier signal beforehand and can recover the baseband signal by extracting the phase of the carrier signal. (Larson Decl., ¶¶36-37.)

3. Quadrature Amplitude Modulation (“QAM”)

QAM modulation involves *two* carrier waves of the same frequency that are out of phase with each other by 90 degrees, a condition known as “quadrature.” The amplitude of each of the two carrier waves are independently modified in amplitude to convey information. Often one signal is called the in-phase or “I” signal, and the other is called the quadrature-phase or “Q” signal. After modulation of these two carrier waves, the signals are combined and transmitted. (See ’835 Patent, 40:35-51.). The combined transmitted wave thus has variations in amplitude and phase, depending on the information that it conveys.

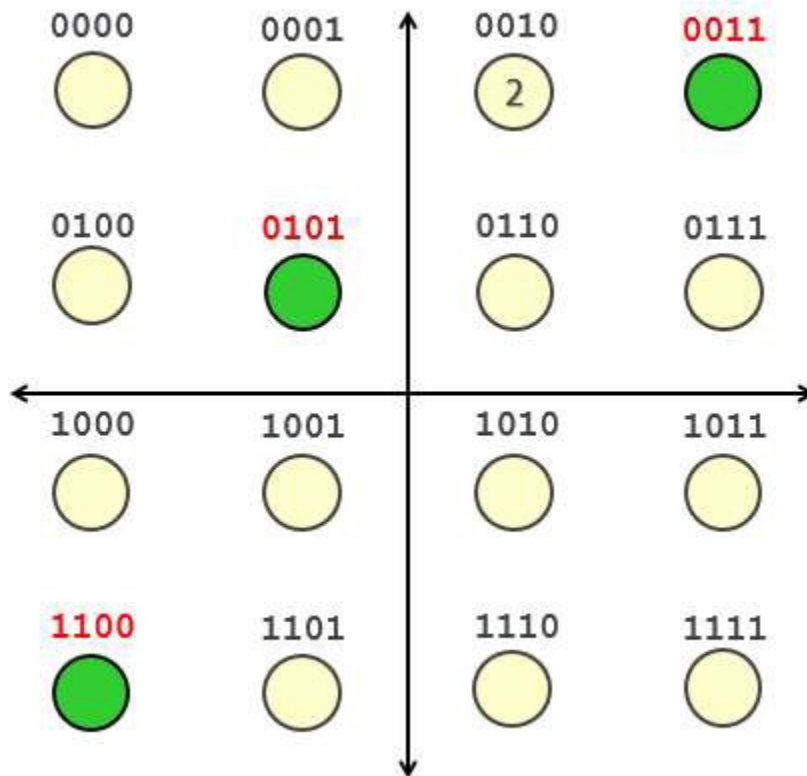
For example, if the baseband signal contains the bit string “0011” the QAM-modulated wave may have a first amplitude and a first phase as shown on the top of the figure below. When the baseband signal contains the bit string “0101” the QAM-modulated wave may have a second amplitude and a second phase as shown in the middle of the figure below. And when the baseband signal contains the bit string “1100” the QAM-modulated wave may have a third amplitude and a third phase, as shown in the bottom of the below figure:



(Larson Decl., ¶39.)

A QAM receiver receives the overall signal, which is a combination of both the amplitude-modulated I and Q carriers. The QAM receiver separates the in-phase modulated signal from the quadrature-phase modulated signal. Because the receiver “knows” the frequency of the unmodulated I and Q carrier signals ahead of time, it can recover the original baseband signals.

Recovery of the transmitted data is illustrated below with the aid of a “constellation” diagram, which plots the recovered I signal on the x-axis and the recovered Q signal on the y-axis:



(Larson Decl., ¶41.)

This example is known as “16-QAM” because the modulated wave transmits 16 symbols (with 4 bits per symbol). As seen in the above constellation diagram, when the receiver detects a symbol having an amplitude and phase corresponding to the green circle on the top right of the diagram, it interprets this as the bit string “0011.” When the receiver detects the green symbol in the upper left quadrant, it interprets it as the bit string “0101,” and when it detects the green symbol in the lower left quadrant,” it interprets it as “1100,” and so on. In this way, the receiver can demodulate the QAM-modulated signal and recover the transmitted information (*e.g.*, a transmitted bit string). (Larson Decl., ¶38.)

QAM modulation varies the phase *and* amplitude of a wave, and thus can transmit data faster than modulations that vary phase or amplitude alone. For example, 16-QAM transmits 4 bits per symbol. 64-QAM is faster still, as it can transmit 6 bits per symbol, and otherwise operates according to the same principles as 16-QAM. ('835 Patent, 47:6-14.)

V. OVERVIEW OF THE '835 PATENT

A. Alleged Problem

The '835 Patent discloses purportedly inventive receivers for use in “cable modem applications.” ('835 Patent, Abstract).

B. Alleged Invention

The '835 Patent purportedly teaches a wireless “QAM modulation mode receiver” used to down-convert and demodulate an input signal that is modulated according to QAM. ('835 Patent, 42:43-43:57, Fig. 54B.) The patent admits that QAM “is a well known technique for modulating digital signals using both amplitude and phase coding” (*Id.* at 40:37-51) and states that the receivers of the invention “may be implemented in cable modems.” (*Id.* at 40:52-61.) But the patent admits that “cable modem receivers ... of the present invention may be implemented using a variety of well known devices.” (*Id.* at 40:17-35 (listing prior art cable modem devices “manufactured by Broadcom”).)

The challenged claims and the specification recite a basic structure for

performing down-conversion, with nothing identified that is unique to “cable modems.” Figure 54B (shown below) shows a modem (5402) that receives a signal 5416, with the received signal 5416 comprising “two information signals modulated with an RF carrier signal according to” the QAM modulation technique. (’835 Patent, 42:43-43:57.)

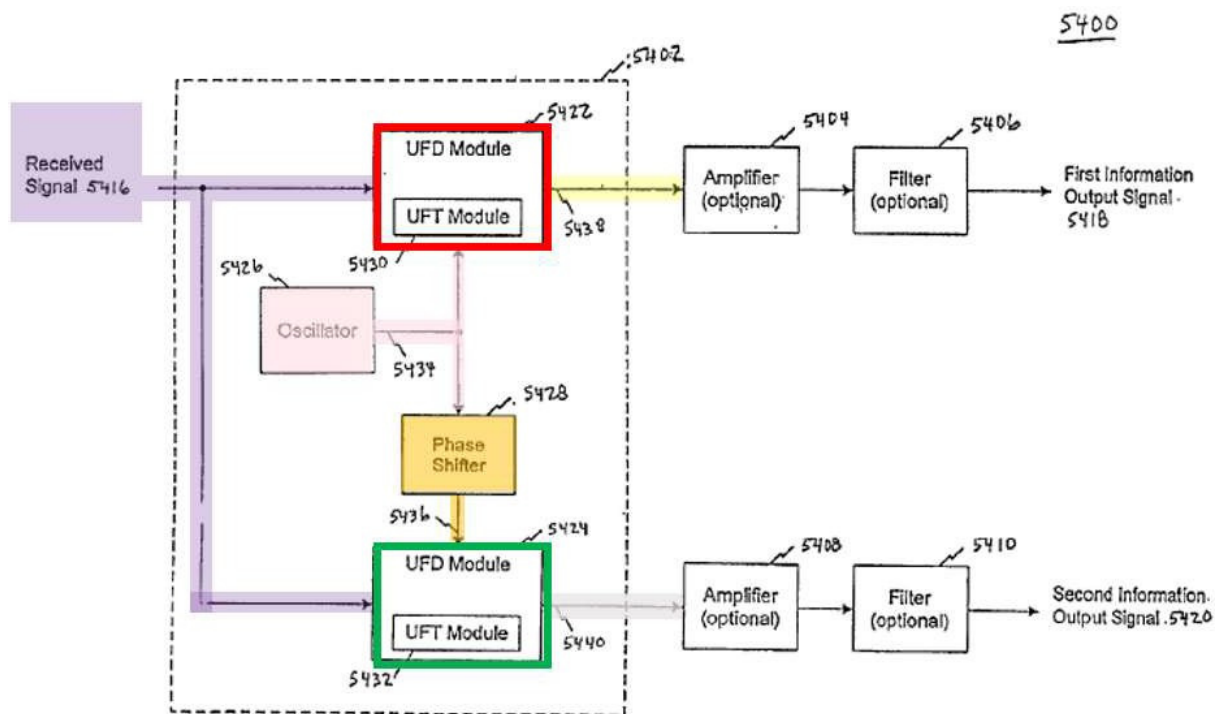


FIG. 54B

(’835 Patent, Fig. 54B.)³

This received RF electromagnetic signal is processed by two modules: a

³ All annotations and emphasis have been added unless otherwise noted.

first frequency down-conversion module 5422 and a second frequency down-conversion module 5424. In addition, the challenged claims include an oscillator 5426 that generates an in-phase oscillating signal 5434, and a phase-shifter 5428 that receives the in-phase oscillating signal and outputs a quadrature-phase oscillating signal 5436. Each down-conversion module comprises a frequency translation module (e.g., a switch, blue) and a storage module (e.g., a capacitor, brown), as shown for example in Figures 20A and 20A-1.

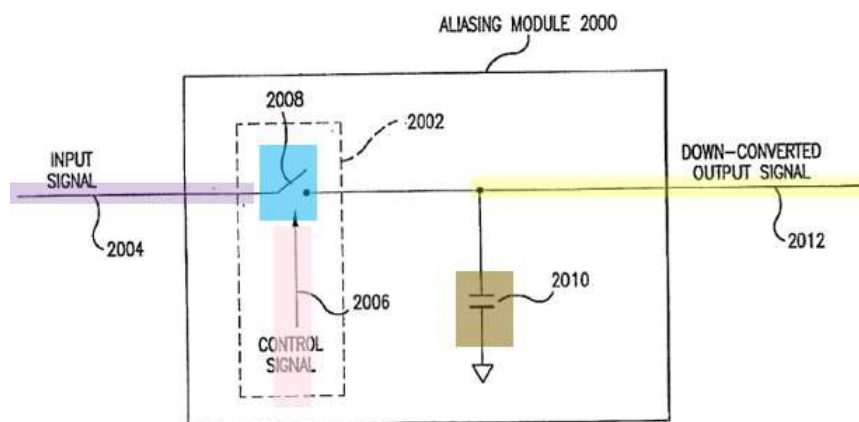


FIG. 20A

('835 Patent, Fig. 20A.)

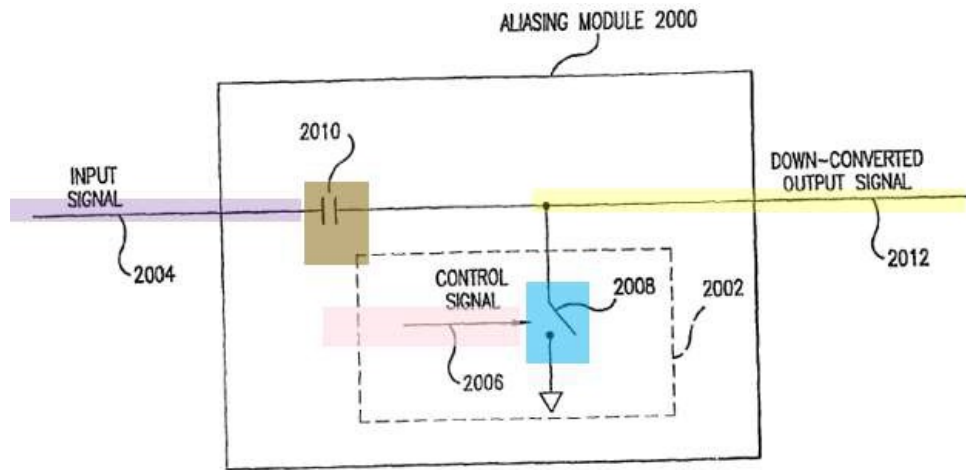


FIG. 20A-1

(’835 Patent, Fig. 20A-1.)

In Figure 54B of the ’835 Patent, the first-frequency translation module 5422 “samples” the RF signal 5416 at a rate that is a function of the in-phase oscillating signal 5434, creating a down-converted in-phase signal 5438 (yellow). Similarly, the second frequency translation module 5424 samples the RF signal 5416 at a rate that is a function of the quadrature-phase oscillating signal 5436, creating a down-converted quadrature-phase signal 5440 (gray). The down-converted “I” and “Q” signals may be “information” signals with “more than two possible states or voltage levels” according to the QAM modulation technique. (’835 Patent, 43:17-20, 43:32-34.)

Claim 1 is directed to the receiver of Figure 54B:

1. A cable modem for down-converting an electromagnetic signal having complex modulations, comprising:

an oscillator to generate an in-phase oscillating signal;
a phase shifter to receive said in-phase oscillating signal and to create a
quadrature-phase oscillating signal;
a first frequency down-conversion module to receive the electromagnetic
signal and said in-phase oscillating signal;
a second frequency down-conversion module to receive the electromagnetic
signal and said quadrature-phase oscillating signal; wherein
said first frequency down-conversion module further comprises a first
frequency translation module and a first storage module, wherein
said first frequency translation module samples the electromagnetic
signal at a rate that is a function of said in- phase oscillating signal,
thereby creating a first sampled signal; and
said second frequency down-conversion module further comprises a second
frequency translation module and a second storage module, wherein
said second frequency translation module sample the electromagnetic
signal at a rate that is a function of said quadrature-phase oscillating
signal, thereby creating a second sampled signal.

(’835 Patent, claim 1 (emphasis added); Larson Decl., ¶¶43-48, 51.) The additional
challenged claims 2–5 are reproduced below.

2. The cable modem of claim 1, wherein said quadrature-phase oscillating signal

is out of phase with said in-phase oscillating signal by substantially 90 degrees.

3. The cable modem of claim 1, wherein
said first storage device has a first storage first port and a first storage second
port,
said first storage first port being connected to said first sampled signal, and
said first storage second port is connected to a first reference potential, and
said second storage device has a second storage first port and a second storage
second port,
said second storage first port being connected to said second sampled signal,
and
said second storage second port is connected to a second reference potential.
4. The cable modem of claim 3, wherein said first storage device is a first
capacitor, and said second storage device is a second capacitor.
5. The system of claim 3, wherein said first reference potential is substantially
equal to ground, and said second reference potential is substantially equal to ground.

**C. The Examiner Did Not Consider or Analyze the Gibson, Schiltz,
or Crols References Presented in This Petition During Original
Prosecution.**

The application was filed on January 29, 2001. (Ex. 1002, 1-8.) On
August 30, 2001, the applicant filed a preliminary amendment, amending the
preamble of claim 1 by deleting “system” in favor of “cable modem,” and

amending the body of claim 1 by replacing “universal frequency transfer module” with “universal frequency translation module.” (Ex. 1002, 9-20.) The applicant did not provide a reason for either of these amendments. (*See id.*)

Along with a response to a restriction requirement, on December 28, 2004, the applicant amended claim 1 by deleting “universal” in the phrase “universal frequency down-conversion module.” (Ex. 1002, 31-47.) Shortly thereafter, the examiner allowed the claims, without having issued any rejections. (Ex. 1002, 48-53 (Feb. 10, 2005 Notice of Allowance).) The stated reason for allowance was that “the prior arts of record, in combination or individual, fail to show or make ... obvious” the invention recited in independent claim 1. (Ex. 1002, 52.) Then, on several occasions, the applicant requested continued prosecution to cite additional references. (Ex. 1002, 54-85.) Each time, the examiner repeated his previously-stated reason for allowance. (*Id.*)

None of the Gibson, Schiltz, or Crols references that form the grounds of this Petition was considered during prosecution. (Larson Decl., ¶¶49-50.)

VI. CLAIM CONSTRUCTION

Petitioner proposes construing certain terms in this IPR and submits that no other terms currently need to be construed. Depending on the issues raised by Patent Owner in co-pending litigation or in this proceeding, Petitioner reserves the right to construe other claim terms.

A. “cable modem” (Claim 1, Preamble)

The preamble of claim 1 recites “A cable modem for down-converting an electromagnetic signal having complex modulations.” In the TCL IPR, the Board found the preamble to be *non*-limiting, and thus did not find it necessary to construe the term or consider whether it was taught by the cable modem prior art references. TCL IPR Final Written Decision, pp. 24-25, 36. A cable modem is used to communicate with a cable TV network and, in the limited context of the ’835 Patent, allegedly can be wired or wireless. (’835 Patent, 36:19-25, 36:50-56 (“wired cable modem”), 37:24-30 (“wireless cable modem”), Fig. 45B (wireless cable modem 4522.)) Further, the invention “is not limited to” the DOCSIS (Data Over Cable Service Interface Specification) standard, as it can be used with “additional standards” (*e.g.*, ITU-T J.83) and can also be used in “non-standard configurations.” (*Id.* at 38:28-34.). Accordingly, if the preamble is limiting and if the Board finds it necessary to construe “cable modem” to resolve this IPR, the Board should find that any modem that can be used to down-convert modulated signals from a TV network is a “cable modem,” regardless of whether the modem is wired or wireless, and regardless of whether it complies with any cable data standard. (Larson Decl., ¶¶57-63.)

B. “storage module” (Claim 1)

Claim 1 recites (1) “a first storage module” and (2) a “a second storage

module.” In the TCL IPR, the Board construed “storage module” as “a module of a system that stores non-negligible amounts of energy from an input EM signal.” TCL IPR Final Written Decision, 21. The Board explained that it was re-adopting the same construction that it reached in yet another IPR (IPR2020-01265) involving a family member of the ’835 Patent, based in part on Patent Owner’s own argument the patents used their own lexicography for the “storage module” term. TCL IPR Final Written Decision, 14-21.

To the extent that the Board finds that construction of “storage module” is necessary, it should adopt the construction from the TCL IPR Final Written Decision for the reasons stated there and in IPR2020-01265.

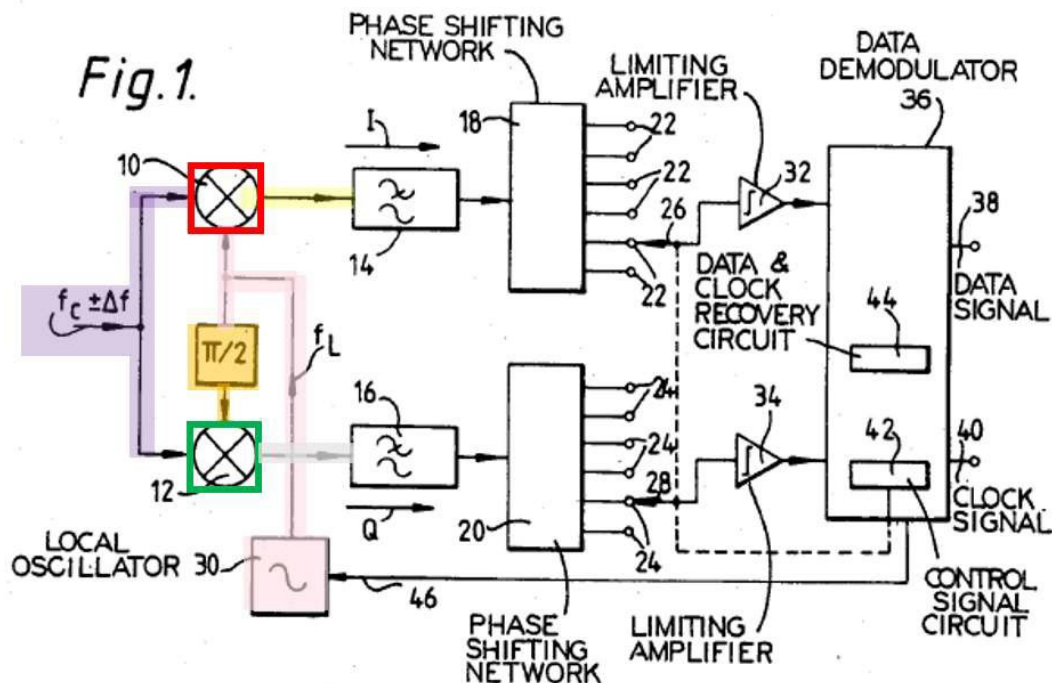
In prior litigation, Patent Owner attempted to read in functional language, *i.e.*, “for driving a low impedance load,” into similar claim terms from other of Patent Owner’s patents. (Ex. 1016: *compare* “Plaintiff’s Proposed Construction” *with* “Court’s Final Construction,” for each of claim terms: “energy storage element,” “energy storage device,” “energy storage module,” “storage element,” and “storage module.”) The Court rejected Patent Owner’s attempt to import such a limitation into the claims, *see id.*, and the PTAB should do the same if Patent Owner attempts to make the same argument here. In adopting its construction in the TCL IPR, the Board explicitly rejected similar constructions entered in two district court cases that incorporated reference to “an energy transfer system.”

TCL IPR Final Written Decision, 16 (addressing and rejecting claim constructions in Ex. 1017 and Ex. 1018). If Patent Owner renews that construction here, the Board should reject it at least for the reasons it did so previously. (Larson Decl., ¶¶66-67).

VII. OVERVIEW OF THE PRIOR ART REFERENCES

A. Gibson (Ex. 1004)

Like the '835 Patent, Gibson Figure 1 discloses a modem used to down-convert a modulated RF signal into an in-phase sampled signal ("I") and a quadrature-phase sampled signal ("Q"):



(Gibson, Fig. 1.)

The modem receives an input electromagnetic signal (purple) and has first and second frequency down-conversion modules (red and green, respectively), a

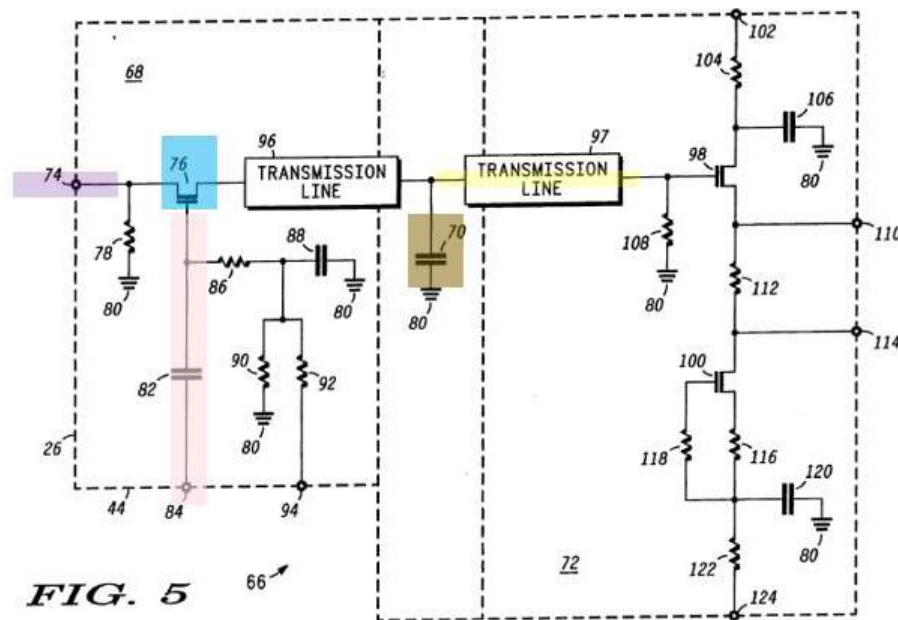
local oscillator to generate an in-phase oscillating signal (pink), and a phase-shifter to generate a quadrature-phase oscillating signal (orange). Gibson's first frequency down-conversion module (mixer 10, red) receives the electromagnetic signal (purple) and the in-phase oscillating signal (pink); while Gibson's second frequency down-conversion module (mixer 12, green) receives the electromagnetic signal (purple) and the quadrature-phase oscillating signal (orange).

Gibson discloses that the local oscillator frequency " f_L " is "substantially equal to carrier frequency f_c ." (Gibson, 2:55-60.) While the frequency of the in-phase and quadrature-phase oscillating signals (pink and orange above, respectively) are both equal to f_L , the oscillating signals are 90 degrees out of phase. (*Id.*). The first frequency down-conversion module (mixer 10, red) down-converts a modulated carrier signal (purple, $f_c \pm \Delta f$) to form an in-phase signal ("I," of frequency Δf). (Gibson, 2:55-3:2.) Similarly, the second frequency down-conversion module (mixer 12, green) down-converts the modulated carrier signal (purple, having frequency $f_c \pm \Delta f$) to form a quadrature-phase signal ("Q," of frequency Δf , shifted in phase by 90 degrees relative to "I"). (*See id.*; Larson Decl., ¶¶81-85.)

B. Schiltz (Ex. 1005)

Schiltz discloses a "high speed sample and hold circuit" comprising a switched capacitor, which circuit is used "as a mixer." (Schiltz, 1:5-10); *see also*

id. at 3:45-65, 4:29-32 (“Sample and hold circuit 26 operates as a downconverter in radio 10. Sample and hold circuit 26 converts a high frequency RF signal into an IF signal in a single operation.”), 6:3-10 (“Sample and hold circuit 26 ... samples the RF signal while the pulses supplied by pulse generator 30 (see FIG. 1) are active and holds the samples while the pulses are inactive.”), 7:58- 60, 10:15-17 (“[T]he present invention provides an improved radio which uses a sample and hold circuit in various mixing applications, such as down conversion.”), 10:29-31 (“[A] high bandwidth results when the sample and hold circuit is used as a mixer.”), 10:40-45 (“[T]hose skilled in the art will appreciate that radio and other architectures other than those described herein may utilize a sample and hold circuit as a mixer.”).) The structure of Schiltz’s sample and hold circuit (26) is shown in Figure 5 below, which discloses a mixer featuring a sampling switch 68 (comprising a field effect transistor 76, blue) and a “hold capacitor” 70 (brown):



(Schiltz, Fig. 5.)

The input electromagnetic signal (purple) enters at contact 74, which serves as the sampling input and couples to the source of field effect transistor 76 (blue). (Schiltz, 7:58-8:48.) Contact 84 serves as the input for a control oscillating signal (pink) for the sample and hold circuit 26, and couples to the gate of field effect transistor 76. (*Id.*; see also *id.* at Fig. 1 depicting “pulse generator 30.”) Field effect transistor 76 operates as a switch and samples the incoming signal. (*Id.* at 7:58-8:48.) The drain of field effect transistor 76 is coupled to “hold capacitor 70,” and serves as the output of the sample and hold switch 68, which outputs a sampled signal (yellow). (*Id.*; Larson Decl., ¶¶86-89.)

C. Crols (Ex. 1006)

Like the '835 Patent, Crols Figure 12(b) discloses a modem used to down-

convert a modulated RF signal into an in-phase sampled signal (“I”) and a quadrature-phase sampled signal (“Q”):

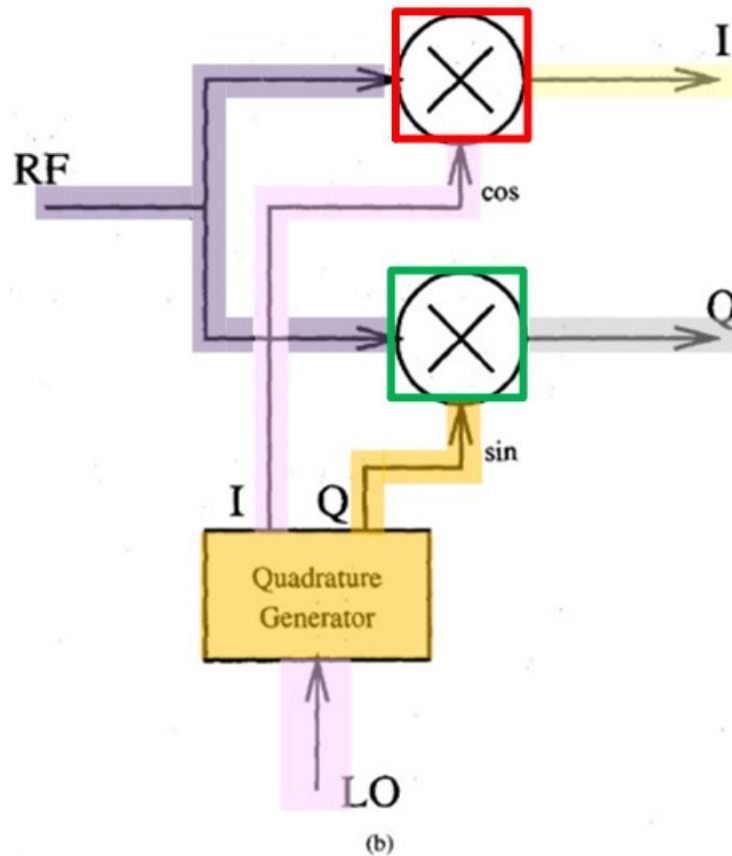


Fig. 12. (a) The conventional quadrature downconverter. (b) an alternative structure.

(Crols, Fig. 12(b).)

The modem receives an input electromagnetic signal (purple) and has first and second frequency down-conversion modules (red and green, respectively), a local oscillator to generate an in-phase oscillating signal (pink), and a phase-shifter to generate a quadrature-phase oscillating signal (orange). (Larson Decl., ¶¶91-93.) Crols’s first frequency down-conversion module (mixer, red) receives the

electromagnetic signal (purple) and the in-phase oscillating signal (pink); while Crols's second frequency down-conversion module (mixer, green) receives the electromagnetic signal (purple) and the quadrature-phase oscillating signal (orange). (Larson Decl., ¶93.) Crols discloses that in-phase and quadrature-phase signals have a 90 degree phase difference. (Crols, 1484; Larson Decl., ¶93.)

Crols discloses that the downconverter of Figure 12(b) is an alternative arrangement to the conventional downconverter of Figure 12(a), with the only structural difference being with the received RF signal or the local oscillator signal is put into quadrature. (Crols, 1489; Larson Decl., ¶92.) Both can be used as zero-IF, or “zero intermediate frequency,” downconverters. (See Crols, 1483; Larson Decl., ¶92.) Crols disclosed a new quadrature downconverter illustrated in Figures 13 and 15 that used four mixers instead of two in order to improve on some noise issues known to exist in the art with the conventional downconverters of Figures 12(a) and 12(b). (Crols, 1489–1490; Larson Decl., ¶94.) Nonetheless, the conventional zero-IF downconverters of Figure 12(a) and 12(b) was “used more and more in receivers for mobile wireless telecommunications applications” and were the “preferred topology” for a single-chip transceiver. (Crols, 1483; Larson Decl., ¶94.)

Crols also discloses with respect to Figure 17 a mixer structure for use in quadrature downconverters like those described elsewhere in Crols. (Crols, 1491;

Larson Decl., ¶¶95-96.)

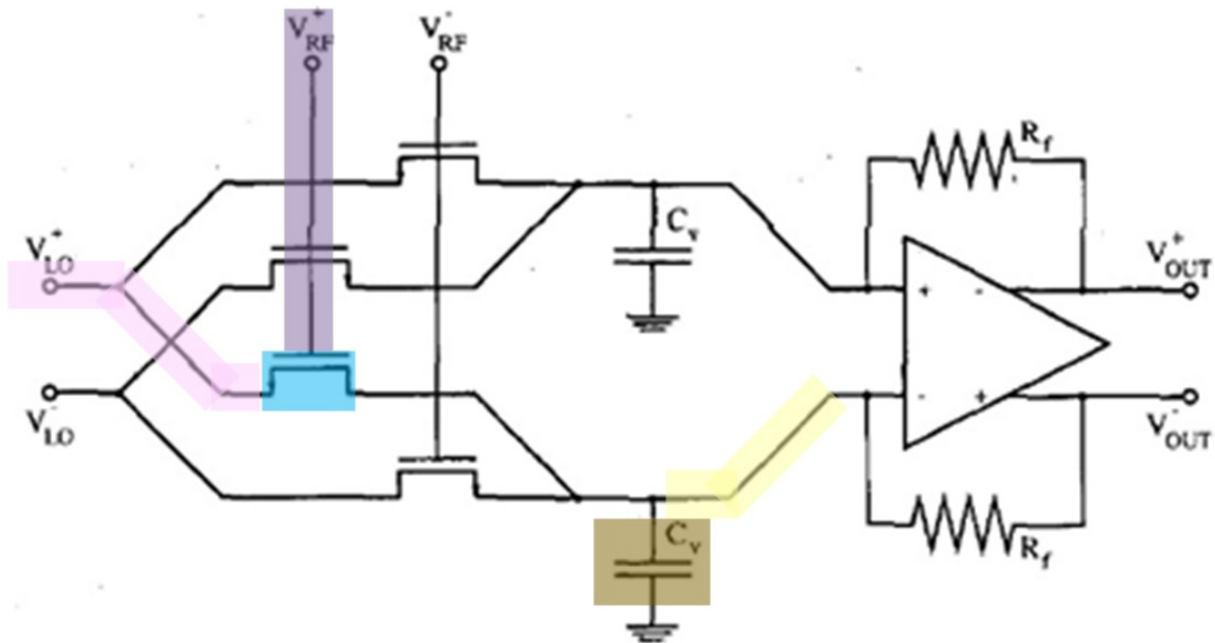


Fig. 17. The highly linear mixer topology.

(Crols, Fig. 17.)

The input electromagnetic signal V_{RF} (purple) couples to the gate of a CMOS transistor (blue). (Crols, 1491; Larson Decl., ¶97.) The input local oscillating signal V_{LO} (pink) couples to the source of CMOS transistor (blue). (Crols, 1491; Larson Decl., ¶97.) The drain of CMOS transistor (blue) is coupled to a "large capacitor[]" C_V (brown) and serves as the output of the downconverter circuit, which outputs a sampled signal (yellow). (Crols, 1491; Larson Decl., ¶97.)

D. DOCSIS References (Goldberg (Ex. 1007), Thacker (Ex. 1008))

As the '835 Patent acknowledges, "DOCSIS is a Cable Modem Standard that stands for Data Over Cable Service Interface Specification (DOCSIS), and

defines the interface requirements for cable modems involved in high-speed data transmission over cable television networks.” (’835 Patent, 40:8-12; *id.* at 40:17-35 (listing “well known devices” including DOCSIS-compliant cable modems).) DOCSIS was first released on March 26, 1997, and was described in patents and printed publications. (Larson Decl., ¶100; Ex. 1008, 1:30-40 (“MCNS released its ... DOCSIS ... to vendors in March 1997. Many vendors have announced plans to build products based on MCNS DOCSIS standard.”); Ex. 1007, 4-8). DOCSIS mandated the QAM modulation format. (Ex. 1008, 1:50-62; Ex. 1007, 5 (“[T]he shared downstream channel uses either 64- or 256- point quadrature-amplitude modulation (QAM).”). Figures 2 and 3 of Goldberg discloses some of the same Broadcom cable modem products, including the BCM3116 QAM receiver and the BCM3037 QPSK/16-QAM modulator (Ex. 1007, Figs. 2, 3), that the ’835 Patent admits were “well known devices.” (’835 Patent, 40:17-35).⁴

⁴ Other patents corroborate that DOCSIS was well-known before the priority date of the ’835 Patent. (U.S. Patent No. 6,088,569, 1:9-22 (“[O]ne such system is being proposed by the Multimedia Cable Network System (MCNS) consortium for data over cable television communication ... DOCSIS.”); U.S. Patent No. 6,181,716, 1:5-17 (“ DOCSIS 1.0 was ratified by the ... ITU ... in March of

E. ITU-T J.83 (Ex. 1009)

Another international cable data standard that was well established prior to the filing of the '835 Patent was the ITU-T J.83 standard that was used for QAM television. (Larson Decl., ¶¶104-105; Ex. 1009.)

F. AAPA

The '835 Patent discloses the following applicant-admitted prior art:

The cable modem receivers, transmitters, and transceivers of the present invention may be implemented using a variety of *well known devices*. In embodiments, these receivers, transmitters, and/or transceivers may be implemented by a BCM3415 CMOS Digital Cable Tuner, a BCM3125 QAMLink™ Universal Set-Top Box Transmission Solution, a BCM3120-Set-Top Box Transceiver, a BCM3116-QAMLink™ 64/256-QAM ITU-B Receiver, a BCM3118B-QAMLink™ 64/256-QAM DVB/DAVIC Receiver, a BCM3115-QAMLink™ 64/256-QAM Dual-Channel Receiver, a BCM3037-QAMLink™ QPSK/16-QAM Burst Modulator, a BCM3033-QAMLink™ Universal Modulator, a BCM3137- QAMLink™ QPSK/16-QAM Burst Demodulator, a BCM3360 QAMLink™ Single-Chip MCNS/DOCSIS Cable Modem, a BCM93310 DOCSIS External Cable Modem, a BCM93310i DOCSIS Internal PCI Cable Modem, and/or a BCM3300-QAMLink™ Single- Chip MCNS/DOCSIS Cable Modem, manufactured by Broadcom™ Corporation.

('835 Patent, 40:17-35 (emphasis added) (“AAPA”); Larson Decl., ¶¶106-108.)

Statements in a challenged patent like these may be used in IPR proceedings.

1998.”).

Koninklijke Philips v. Google, 948 F.3d 1330, 1337-38 (Fed. Cir. 2020) (holding that permissible uses of general knowledge include (1) supplying claim limitations; (2) supporting a motivation to combine; or (3) any other purpose related to patentability); *see also Qualcomm Inc. v. Apple Inc.*, 24 F.4th 1367, 1375–76 (Fed. Cir. 2022) (holding that AAPA cannot form the “basis” of an *inter partes* review, but reaffirming the permissible uses of AAPA identified in *Koninklijke Philips*); *Updated Guidance on the Treatment of Statements of the Applicant in the Challenged Patent in Inter Partes Reviews Under § 311*, pp. 3-6 (June 9, 2022).

Here, the AAPA is evidence of at least the general knowledge at the time of the invention that: (1) cable modems were known; (2) cable modems could demodulate QAM signals; and (3) standard-compliant cable modems were known.

G. Motivation to Combine

1. Ground 1: Gibson and Schiltz

A POSITA would have been motivated to combine the teachings of Gibson with Schiltz. In particular, a POSITA would have been motivated to use Schiltz’s sample and hold circuit (Schiltz, Figs. 1 and 5 at circuit 26) as the mixer in each of the two branches of Gibson’s receiver (Gibson, Fig. 2 at mixers 10 and 12). That is, Gibson as modified by Schiltz would use one instance of Schiltz’s sample and hold circuit as the mixer 10 in Gibson’s in-phase path, and another instance of Schiltz’s sample and hold circuit as the mixer 12 in Gibson’s quadrature-phase

path.

First, Gibson itself expressly discloses using a first mixer (Gibson, Fig. 2 at 10) to down-convert an electromagnetic signal (“ $f_C \pm \Delta f$ ”) by mixing the signal with an in-phase oscillating signal (“ f_L ”), and using a second mixer (Gibson, Fig. 1 at 12) to down-convert the electromagnetic signal by mixing it with a quadrature-phase oscillating signal (frequency “ f_L ” shifted by 90 degrees in phase). (Gibson, Fig. 1, 2:55- 3:2 (“... input signal ... is applied to quadrature mixers 10, 12 ...”). However, Gibson does not describe the inner workings of its mixers. Schiltz expressly teaches one of ordinary skill to use its “sample and hold circuit *as a mixer*” for down-conversion (like the mixers in Gibson). (Schiltz, 1:5-10 (emphasis added), 10:15-22 (“an improved radio which uses sample and hold circuit *in various mixing applications, such as down conversion* ... Due to the use of a sample and hold circuit *as a mixer*, only a single stage is required to down convert a high frequency RF signal[.]”) (emphasis added); Larson Decl., ¶¶113-114.)

Second, a POSITA would have recognized the benefits of using the sample and hold circuit as taught in Schiltz for each of the mixers disclosed by Gibson. For example, Schiltz encourages the use of a sample and hold circuit because “the sample and hold circuit may be accurately operated at high frequencies” and “may be applied to virtually any frequency RF and IF signals.” (Schiltz, 10:15-48;

Larson Decl., ¶115.)

Further, combining Gibson with Schiltz would have yielded only expected, predictable results. Each combination would have been (1) a combination of prior art elements according to known methods to yield predictable results, since a POSITA would have understood how to implement a sample and hold mixer (as taught by Schiltz) in the context of Gibson; and (2) obvious to try—a choice of one type of mixer from a finite number of identified, predictable solutions, with a reasonable expectation of success. *See KSR*, 550 U.S. at 416-17, 421; *Leapfrog Enters., Inc. v. Fisher-Price, Inc.*, 485 F.3d 1157, 1162 (Fed. Cir. 2007) (obvious to combine prior art with “technology that is commonly available and understood in the art”). (Larson Decl., ¶116.)

2. Ground 2: Crols

Crols on its own discloses all elements of the challenged claims, and thus renders the challenged claims obvious without further modification. “[I]t is well settled that ‘a disclosure that anticipates under § 102 also renders the claim invalid under § 103, for ‘anticipation is the epitome of obviousness.’” *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1373 (Fed. Cir. 2019) (quoting *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1548 (Fed. Cir. 1983)). However, to the extent that Patent Owner argues that Crols does not specifically teach the use of the mixer of Figure 17 with the downconverter of Figure 12(b), a POSITA would have found

that combination obvious. (Larson Decl., ¶¶199-206.) That is, the combination of Crols's downconverter of Figure 12(b) with Crols's mixer of Figure 17 would use one instance of the mixer of Figure 17 as the mixer in the downconverter's in-phase path, and another instance of the mixer of Figure 17 as the mixer in the downconverter's quadrature-phase path.

First, while Crols discloses a new quadrature downconverter (Figs. 13 and 15) that improved on the conventional quadrature downconverters (Figs. 12(a), 12(b)), a POSITA would have recognized that the conventional quadrature downconverters would have been desired implementations in many applications. (Larson Decl., ¶¶202-203, 205.) Crols discloses that the primary benefit of its new quadrature downconverter (Figs. 13 and 15) was to reduce mirror signal crosstalk due to phase errors in the local oscillator signal. (Crols, 1489; Larson Decl., ¶203.) A POSITA would have recognized that the effects of mirror signal crosstalk were effectively inconsequential in many applications, and that their presence could be reduced by improved local oscillator signal generation. (Larson Decl., ¶203.) In such cases, a POSITA would have been motivated to use either of the pre-existing quadrature downconverters (Figs. 12(a) and 12(b)). (*Id.*)

Second, a POSITA would have recognized that the benefits gained by the new quadrature downconverter disclosed in Crols would not have been significant enough to overcome the downsides of that approach, and thus reliance on either of

the pre-existing quadrature downconverters (Figs. 12(a) and 12(b)) would have been used. (Larson Decl., ¶204.) In particular, Crols's new quadrature downconverter used twice as many mixers (four) and twice as many quadrature generators (two) as the conventional quadrature downconverters. (Crols, 1489–1490; Larson Decl., ¶204.) A POSITA would have recognized that this doubling of the components would have effectively doubled the space taken by the downconverter circuit on the chip and doubled the cost for this portion of the downconverter circuit. (Larson Decl., ¶204.) These increases in size and cost would have discouraged designers from switching from the conventional quadrature downconverters (Figs. 12(a) and 12(b)) to the new design disclosed in Crols. (Larson Decl., ¶204.) This would have been especially true, where, as addressed in the preceding paragraph, the effects of mirror signal crosstalk were effectively inconsequential and/or where their presence was reduced by improved local oscillator signal generation. (Larson Decl., ¶203.)

Third, Crols itself discloses that the conventional zero-IF quadrature downconverters like those of Figures 12(a) and 12(b) were widely used in the field and seen as beneficial approaches. (Crols, 1983; Larson Decl., ¶205.) Crols observed that “the zero-IF downconversion topology is used more and more in receivers for mobile wireless telecommunications applications.” (Crols, 1483; Larson Decl., ¶205.) Crols observed that “the zero-IF downconverter [was] the

preferred topology in the research towards the fully integrated single-chip transceiver.” (Crols, 1483; Larson Decl., ¶205.) Indeed, as shown in papers cited by Crols and in other contemporaneous publications, the quadrature downconverter of Figure 12(b) was well-known and widely described as a standard arrangement for RF signal downconversion applications. (Larson Decl., ¶205.)

Further, combining the mixer of Figure 17 with the quadrature downconverter of Figure 12(b) would have yielded only expected, predictable results, and a POSITA would have done so with a reasonable expectation of success. (Larson Decl., ¶206.) Crols discloses that the quadrature downconverters of Figures 12(a) and 12(b) were conventional and known in the field. *See KSR*, 550 U.S. at 416-17, 421; *Leapfrog Enters., Inc.*, 485 F.3d at 1162 (obvious to combine prior art with “technology that is commonly available and understood in the art”). (Crols, 1489; Larson Decl., ¶¶202-203, 205-206.) Crols disclosed using the mixer of Figure 17 with a *more complicated* quadrature downconverter of Figures 13 and 15. (Crols, 1489–1490; Larson Decl., ¶206.) Hence, a POSITA would have found it simpler to use the mixer of Figure 17 with the more well-known quadrature downconverter topologies of Figures 12(a) or 12(b). (Larson Decl., ¶206.)

3. “Cable Modem”

If the Board finds that “cable modem” as recited in the preamble of claim 1

is limiting, a POSITA would have been motivated to use the modems of Gibson modified with Schiltz (Ground 1), and Crols (Ground 2), as “cable modems,” in view of the DOCSIS References (Thacker and Goldberg), ITU-T J.83, and AAPA.

First, the modems of Gibson modified with Schiltz (Ground 1), and Crols (Ground 2) are useful for down- converting an I/Q modulated electromagnetic signal. Thacker, Goldberg, and ITU-T J.83 show that cable data standards were released long before the priority date of the '835 Patent, and mandated use of I/Q modulation (*e.g.*, QAM) in cable modems. (Ex. 1008, 1:30-40, 1:50-62; Ex. 1007, 4; ITU-T J.83, 10, Table 1). After DOCSIS 1.0 and J.83 were each released in 1997, cable modems rapidly gained popularity, providing an incentive to use I/Q modems like those disclosed in primary references Gibson and Crols as cable modems. (Ex. 1008, 1:30-40, 1:50-62; Ex. 1007, 4 (“MCN/DOCSIS MAC Clears a Path for the Cable-Modem Invasion”); Larson Decl., ¶¶118, 188.)

Second, AAPA shows that QAM receivers (such as disclosed in Gibson and Crols) had been implemented in a “variety of well known devices,” including various QAM cable modems manufactured by Broadcom. ('835 Patent, 40:17-35.) This demonstrates that making and using such devices as the operative receiver in “cable modems” was within the general knowledge and level of skill in the art, supplying further motivation to use the modems of Gibson/Schiltz and Crols as cable modems. (Larson Decl., ¶¶119, 189.) *See Koninklijke Philips*, 948

F.3d at 1337-38. Indeed, some of the same Broadcom devices that the '835 Patent admits were “well known” are disclosed in Goldberg. (Ex. 1007, Figs. 2, 3; Larson Decl., ¶¶101, 119, 189.)

Third, neither the Patent Owner nor the examiner placed any criticality on the use of the structure recited in the body of claim 1 as a “cable modem” during prosecution (*see* Section V.C *supra*), and the body of the claim recites a structurally-complete invention capable of being used as a cable modem (as that term is used in the context of the '835 Patent's claims). The specification states that a “cable modem” can be wired *or* wireless, and can be compliant with DOCSIS *or* not compliant with any standard. (*See* Section VI.A *supra*.) Thus, within the context of the '835 Patent, a modem is a “cable modem” so long as it includes communication at RF frequencies over cables and this includes the communication of data for television. As discussed previously, this communication can be performed wirelessly within the context of the '835 Patent. For all these reasons, the preamble of claim 1 should be given *de minimis* (if any) patentable weight. *See* TCL IPR Final Written Decision, pp. 24-25, 36 (finding preamble non-limiting). In any event, the modems of Gibson modified with Schiltz and Crols, have the structure recited in claim 1, and a POSITA would have been motivated to use them as cable modems in view of Thacker, Goldberg, ITU-T J.83, and AAPA. (Larson Decl., ¶¶118-121, 188-191).

Finally, using the receivers of Grounds 1 and 2 as “cable modems” would have yielded only expected, predictable results. Especially in view of Thacker, Goldberg, and AAPA discussed above, each combination would have been (1) a combination of prior elements according to known methods to yield predictable results; (2) the use of known work in one field (RF down-conversion) to prompt a variation for use in a related field (cable data communications) in view of market incentives (e.g., DOCSIS); and (3) obvious to try, with a reasonable expectation of success. *See KSR*, 550 U.S. at 416-17, 421; *Leapfrog Enters., Inc.*, 485 F.3d at 1162. (Larson Decl., ¶¶121, 191).

VIII. LEVEL OF ORDINARY SKILL IN THE ART

As of the '835 Patent's alleged priority date, a POSITA 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 RF circuit design, or at least five years of work experience and training in the design and development of RF circuits and/or systems. Less work experience may be compensated by a higher level of education, such as a master's degree. (Larson Decl., ¶¶24-27; *see also* TCL IPR Final Written Decision, p. 13 (adopting the same).)

IX. SPECIFIC GROUNDS FOR PETITION

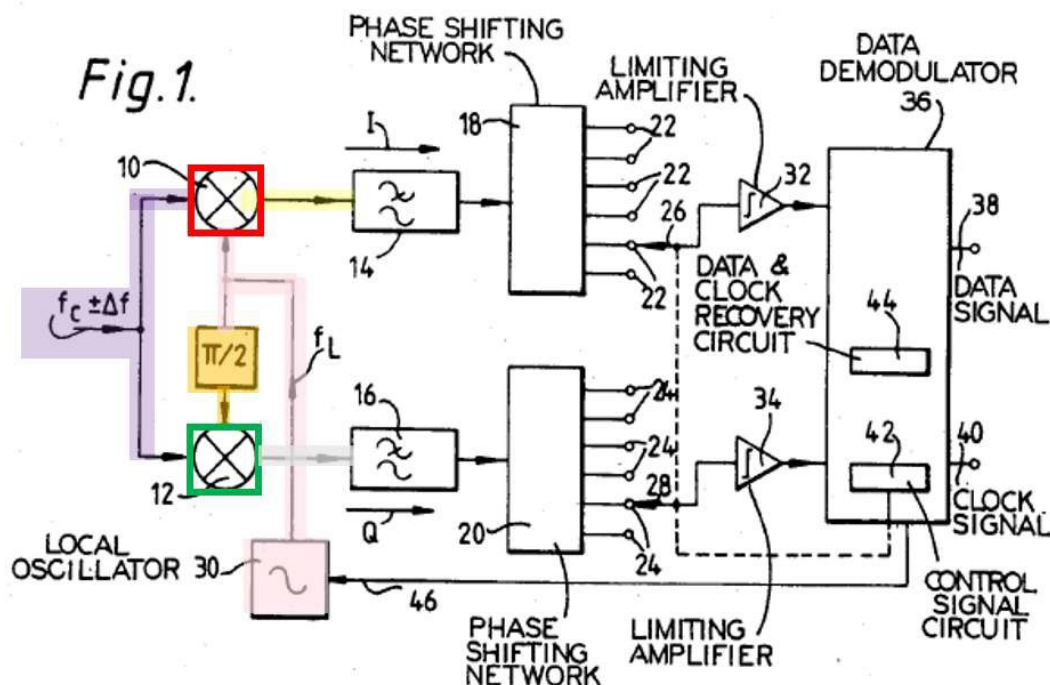
A. Ground 1: Claims 1-5 are Unpatentable as Obvious Over Gibson and Schiltz

As shown below, claims 1-5 are unpatentable as obvious over Gibson in view of Schiltz. If the preamble of claim 1 is limiting, and therefore requires a “cable modem,” then these claims are unpatentable as obvious over Gibson in view of Schiltz, and further in view of Thacker, Goldberg, ITU-T J.83, and/or AAPA.

1. Claim 1

- (a) Element [1Pre]: “A cable modem for down-converting an electromagnetic signal having complex modulations, comprising:”

Gibson discloses a modem for down-converting an electromagnetic signal having complex modulations:



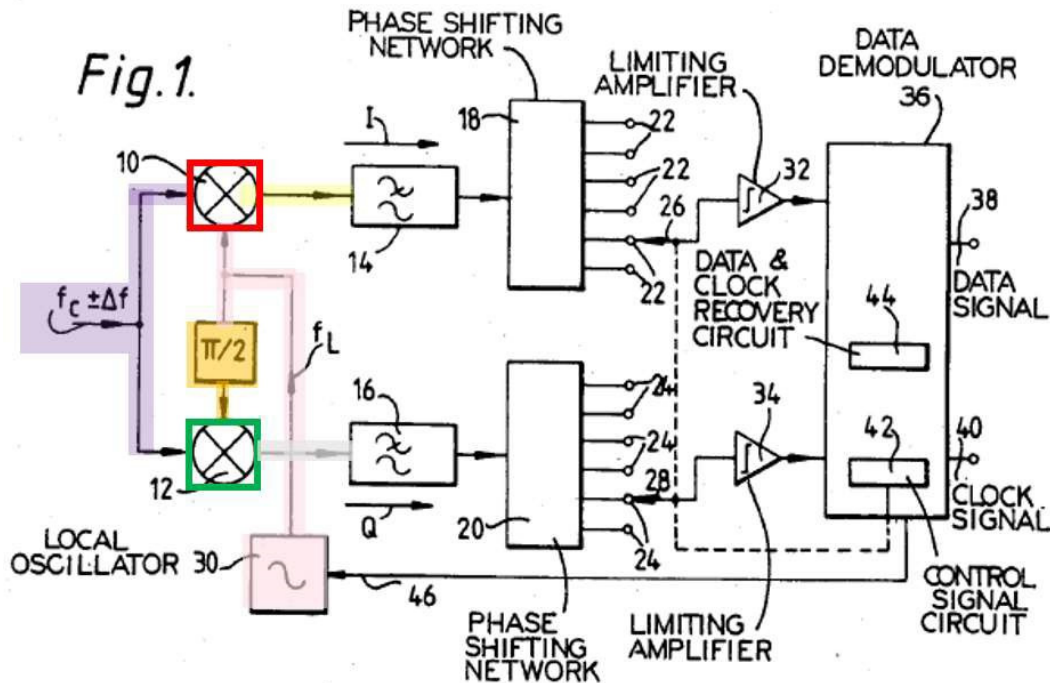
(Gibson, Fig. 1.) The modem down-converts the modulated carrier signal, for example from a 900 MHz signal to a 4 kHz signal. (Gibson, 2:55-3:21.)

To the extent that the preamble is limiting and the electromagnetic signal must have “complex modulations,” Gibson discloses that the invention works with I/Q modulation, which were complex modulation formats within the general knowledge of a POSITA at the time. (’835 Patent, Fig. 1, 2:55- 3:21; Larson Decl., ¶124.)

And to the extent that the preamble is limiting and requires a “cable modem,” it would have been obvious to use the modem of Gibson (as modified by Schiltz, discussed below) as a cable modem, in view of Thacker, Goldberg, ITU-T J.83, and/or AAPA. *See* Section VII.G.3 *supra*.

(b) Element [1A]: “an **oscillator** to generate an in-phase oscillating signal;”

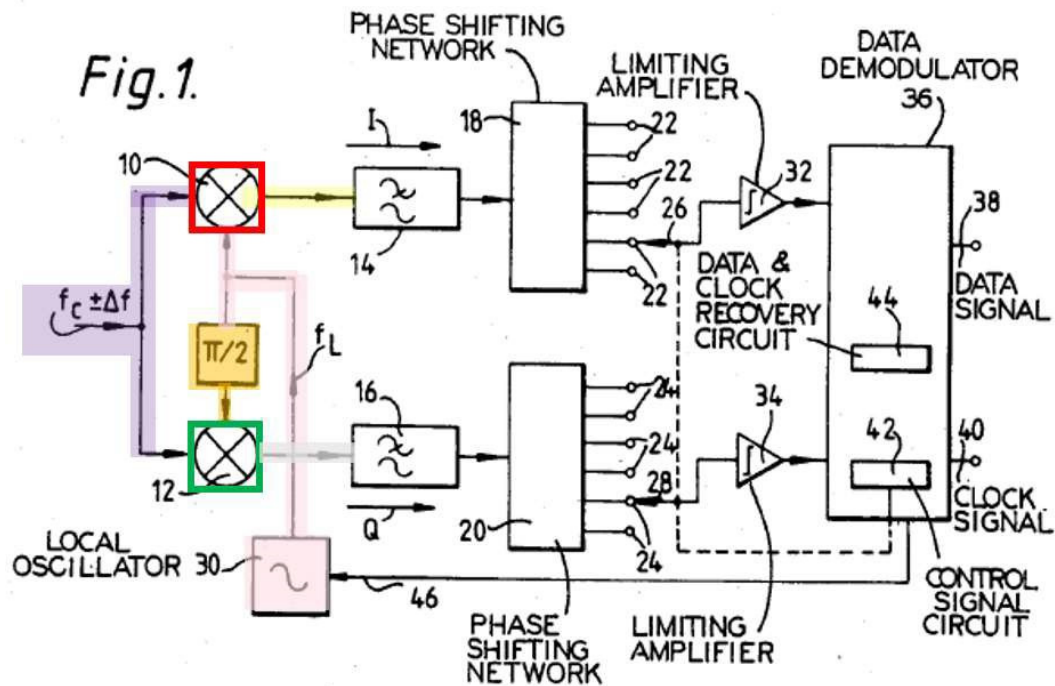
Gibson discloses an oscillator (30) to generate an in-phase oscillating signal (f_L):



(Gibson, Fig. 1; *see also id.* at 2:56-3:2; Larson Decl., ¶126.)

(c) Element [1B]: “a **phase shifter** to receive said in-phase oscillating signal and to create a quadrature-phase oscillating signal;”

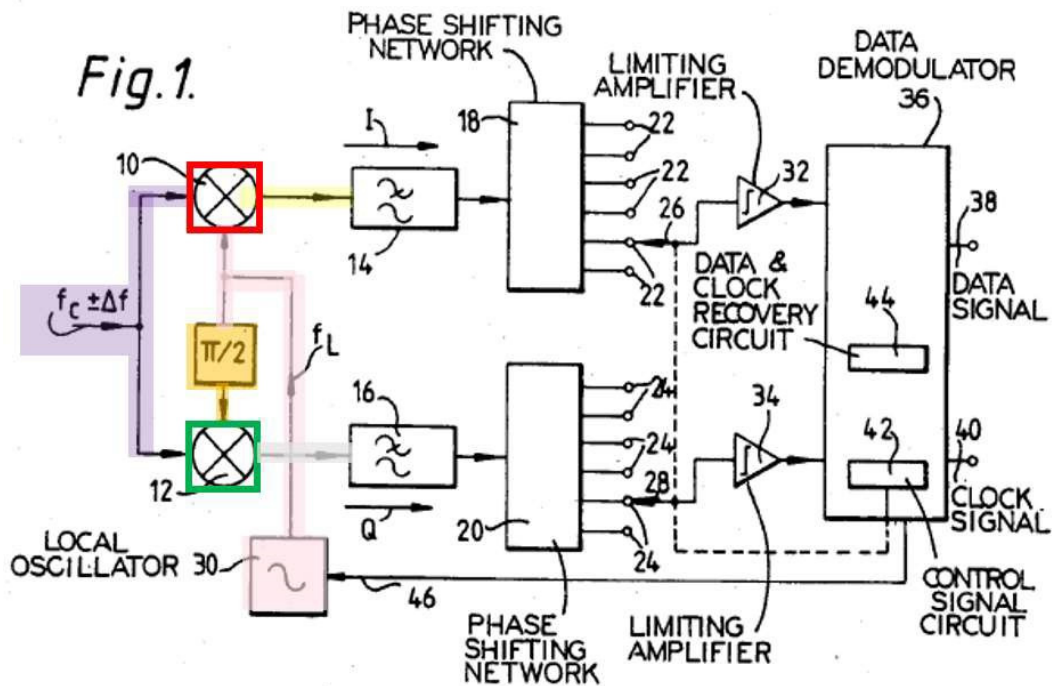
Gibson discloses a phase shifter ($\pi/2$) to receive said in phase oscillating signal (pink, f_L) and to create a quadrature-phase oscillating signal (orange signal output from “ $\pi/2$ ” to green mixer 12):



(Gibson, Fig. 1; *see also id.* at 2:56-3:2; Larson Decl., ¶127.)

- (d) Element [1C]: “a first frequency down-conversion module to receive the electromagnetic signal and said in-phase oscillating signal;”

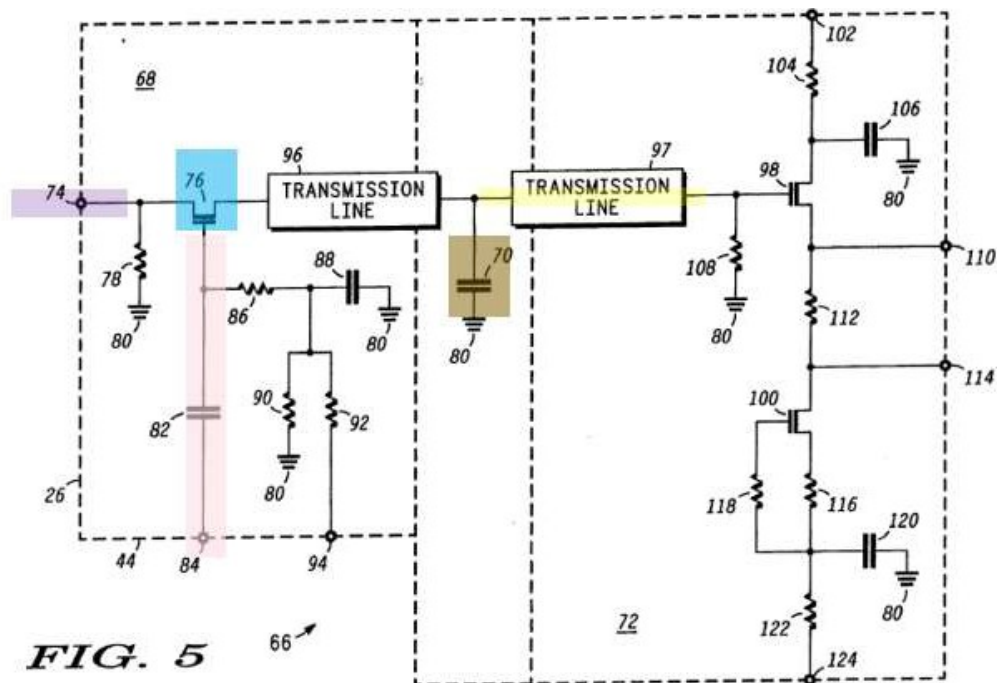
Gibson discloses a first frequency down-conversion module (mixer 10, red) to receive the electromagnetic signal (purple “ $f_c \pm \Delta f$ ”) and said in-phase oscillating signal (pink, f_L):



(Gibson, Fig. 1.)

To the extent it is argued or determined that Gibson does not disclose Element [1C], Schiltz discloses a frequency down-conversion module, specifically, a “high speed sample and hold circuit” used “as a mixer.” (Schiltz, 1:5-10; *id.* at 3:45- 65, 4:29-32 (“Sample and hold circuit 26 operates as a downconverter in radio 10. Sample and hold circuit 26 converts a high frequency RF signal into an IF signal in a single operation.”), 6:3-10 (“Sample and hold circuit 26 ... samples the RF signal while the pulses supplied by pulse generator 30 (see FIG. 1) are active and holds the samples while the pulses are inactive.”), 7:58-60.)

The structure of Schiltz's sample and hold circuit (26) shown in Figure 5⁵ discloses a mixer having a sampling switch 68 (comprising a field effect transistor 76, blue) and a "hold capacitor" 70 (brown):



(Schiltz, Fig. 5.)

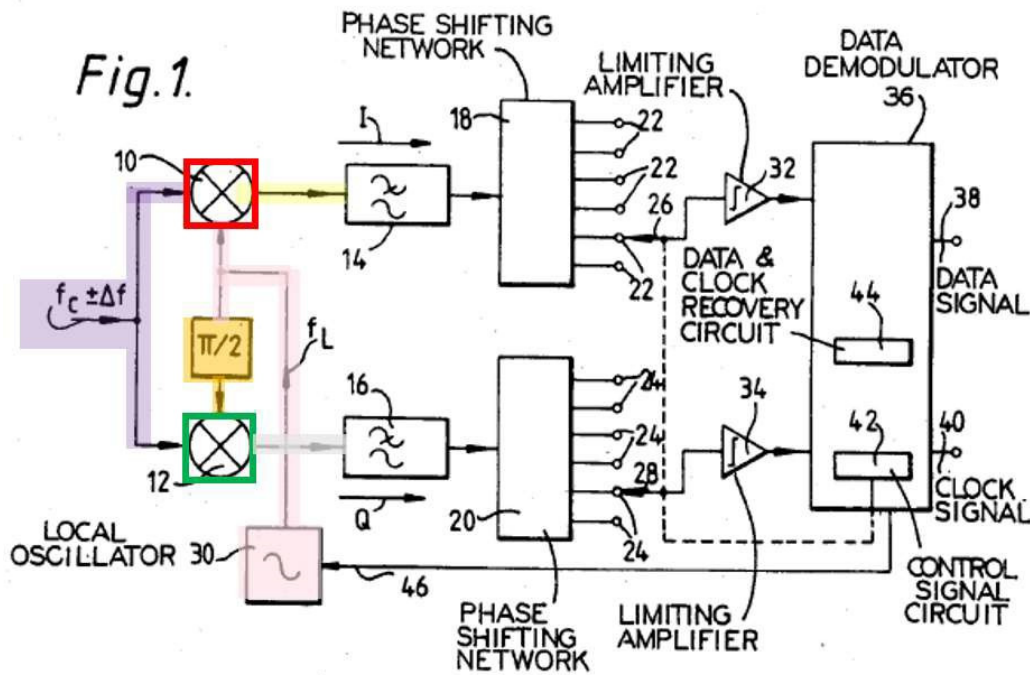
The input electromagnetic signal (purple) enters at contact 74, which serves as the sampling input and couples to a source of field effect transistor 76 (blue).

⁵ Schiltz, 5:63-6:6 (“Sample and hold circuit 26 (see FIG. 1) samples the RF signal while the pulses supplied by the pulse generator 30 (see FIG. 1) are active and holds the samples while the pulses are inactive.”); 7:43-45 (“[T]he discussion of Figure 5 is presented from the perspective of sample and hold circuit 26.”).

(Schiltz, 7:58-8:48.). Contact 84 serves as the input for a control oscillating signal (pink) for the sample and hold circuit 26, and couples to a gate of field effect transistor 76. (*Id.*; *see also id.* at Fig. 1 (depicting “impulse generator 30”), 4:8-13 (“Oscillator 32 couples to an input of an impulse generator 34 ... A stream of sampling pulses at a pulse rate of f_s results.”).) Field effect transistor 76 operates as a switch and samples the incoming signal. (*Id.* at 7:58-8:48). A drain of FET 76 is coupled to “a first node of hold capacitor 70” and serves as the output of the sample and hold switch 68, which outputs a sampled signal (yellow). (*Id.*; Larson Decl., ¶¶127-132.) Motivations to combine the references are set forth above in Section VII.G.1.

(e) **Element [1D]: “a second frequency down-conversion module to receive the electromagnetic signal and said quadrature-phase oscillating signal; wherein”**

Gibson discloses a second frequency down-conversion module (mixer 12, green) to receive the electromagnetic signal (purple) and said quadrature-phase oscillating signal (orange):



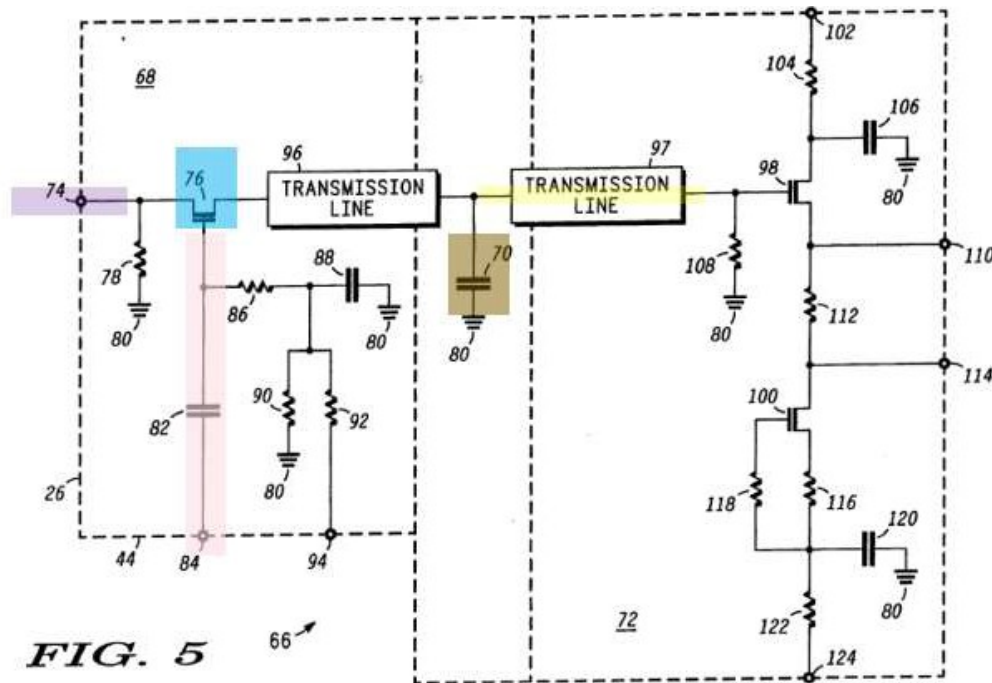
(Gibson, Fig. 1.)

To the extent it is argued or determined that Gibson does not disclose Element [1D], it would have been obvious to use the frequency down-conversion module of Schiltz in place of the second mixer of Gibson in the same manner and for the same reasons as discussed previously for Gibson’s first mixer with respect to Element [1C]. (Larson Decl., ¶¶133-134.)

(f) Element [1E]: “said first frequency down-conversion module further comprises a first frequency translation module”

As shown above, Gibson discloses a first mixer 10 but does not expressly disclose that it has a switch (if a “frequency translation module” requires one). As discussed above with respect to Elements [1C] and [1D], Schiltz discloses a mixer

comprising a switch (FET 76, blue) coupled to a storage module (capacitor 70, brown):



(Schiltz, Fig. 5.)

It would have been obvious to use the mixer of Schiltz for each of the mixers (10, 12) in Gibson for the reasons discussed above with respect to Elements [1C] and [1D]. (Larson Decl., ¶¶135-136.)

(g) Element [1F]: “and a *first storage module*,”

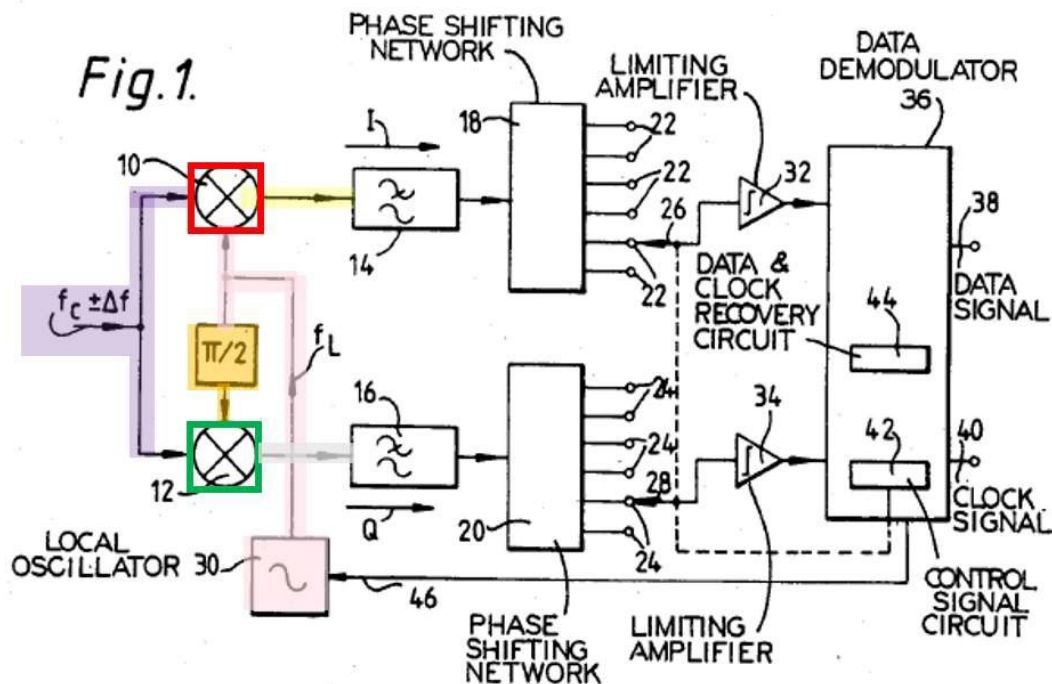
Gibson does not expressly disclose that first mixer 10 has a storage module (e.g., capacitor). As discussed above with respect to Elements [1C], [1D], and [1E], Schiltz discloses a mixer comprising a switched capacitor, and it would have been obvious to use such a mixer in the modem of Gibson for the reasons

discussed above with respect to Elements [1C] and [1D]. (Larson Decl., ¶¶137-138.)

In the TCL IPR, the Board found that the switched capacitor 70 in Schiltz satisfies the “first storage module” claim element. TCL IPR Final Written Decision, pp. 85-88.

- (h) **Element [1G]: “wherein said first frequency translation module samples the electromagnetic signal at a rate that is a function of said in-phase oscillating signal, thereby creating a first sampled signal; and”**

Gibson discloses that the first frequency down-conversion module (mixer 10) mixes the electromagnetic signal (purple) with the in-phase oscillating signal (pink):



(Gibson, Fig. 1.)

Gibson does not expressly disclose sampling. As discussed above with respect to Elements [1C], [1D], [1E], and [1F], Schiltz discloses a mixer module comprising a pulse generator and a switched capacitor acting as a “sample and hold circuit.” As seen in Figures 1 and 5 of Schiltz, that mixer module uses an input oscillating signal (pink, such as the one shown as an input to mixer 10 in Figure 1 of Gibson) to generate a stream of oscillating sampling pulses⁶ in order to control FET switch 76 which, in conjunction with “hold capacitor 70,” samples the incoming RF signal (purple) to create a first sampled signal (yellow):

⁶ Schiltz, 4:8-13 (“Oscillator 32 [of FIG. 1] couples to an input of an impulse generator 34 ... A stream of sampling pulses at a pulse rate of f_s results”); *see also* 7:43-45 (“[T]he discussion of Figure 5 is presented from the perspective of sample and hold circuit 26 [of FIG. 1].”).

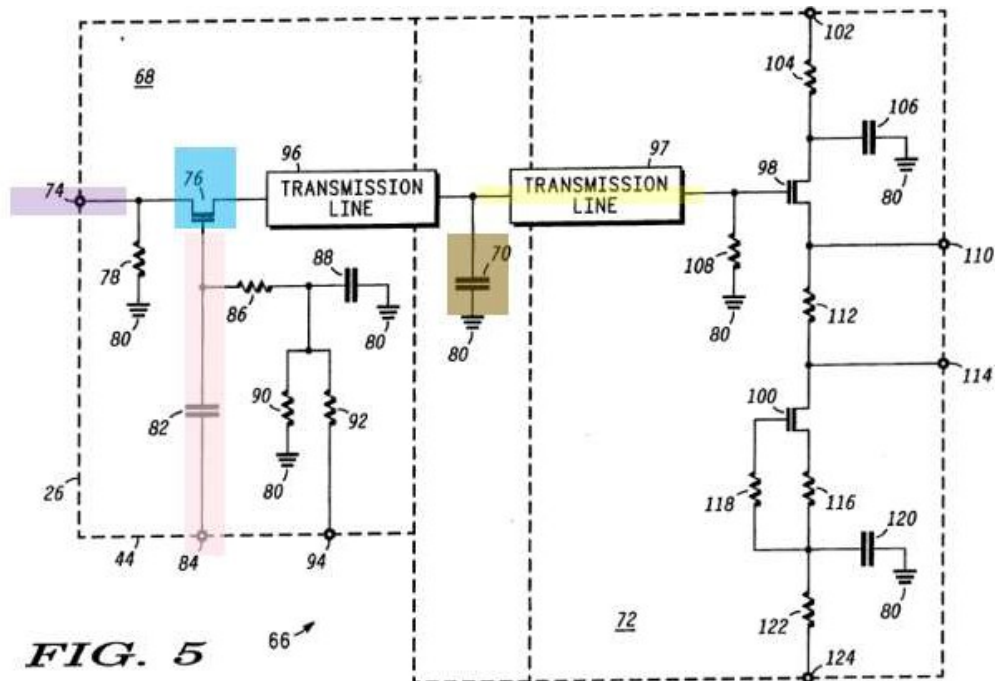


FIG. 5

(Schiltz, Fig. 5.)

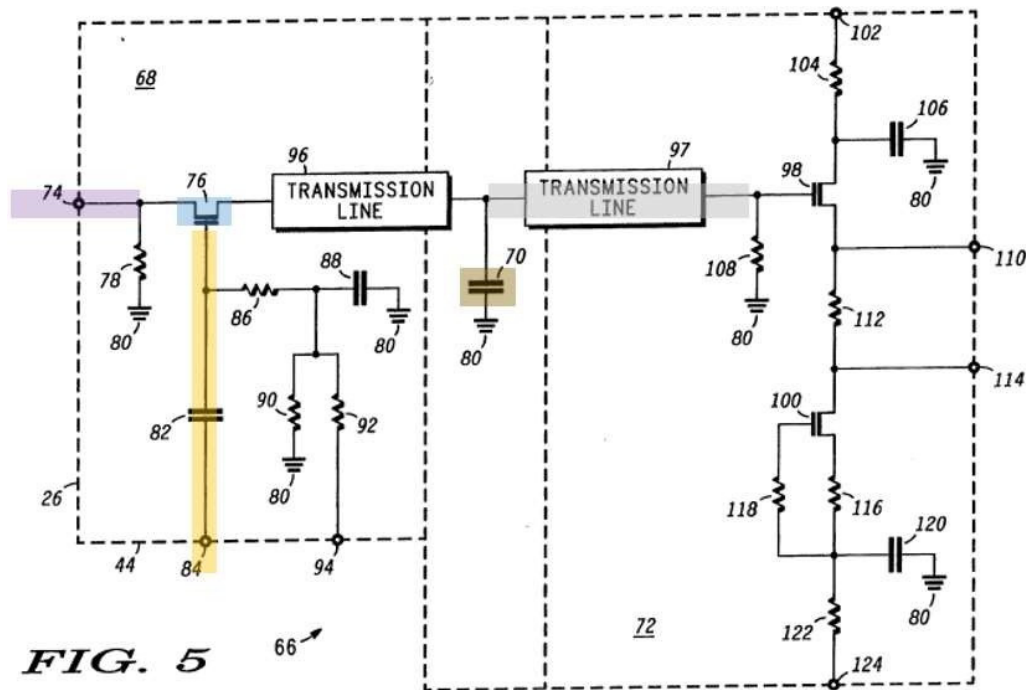
It would have been obvious to use the sampling mixer of Schiltz in place of the mixers (10, 12) in Gibson, for the reasons discussed previously in Section VII.G.1. (Larson Decl., ¶¶139-141.)

- (i) **Element [1H]: “said second frequency down-conversion module further comprises a second frequency translation module”**

The first and second mixers of Gibson (10, 12) are structurally identical, and it would have been obvious to use the sample and hold mixer of Schiltz as a mixer in Gibson for the reasons discussed previously in Element [1E]. In particular, the mixer of Schiltz has a frequency translation module, *i.e.*, a switch (FET 76, blue), that is in turn coupled to a capacitor (70, brown), which down-converts the

incoming RF signal (purple) to create a second sampled signal (gray)

(Larson Decl., ¶¶142-145):



(Schiltz, Fig. 5.)

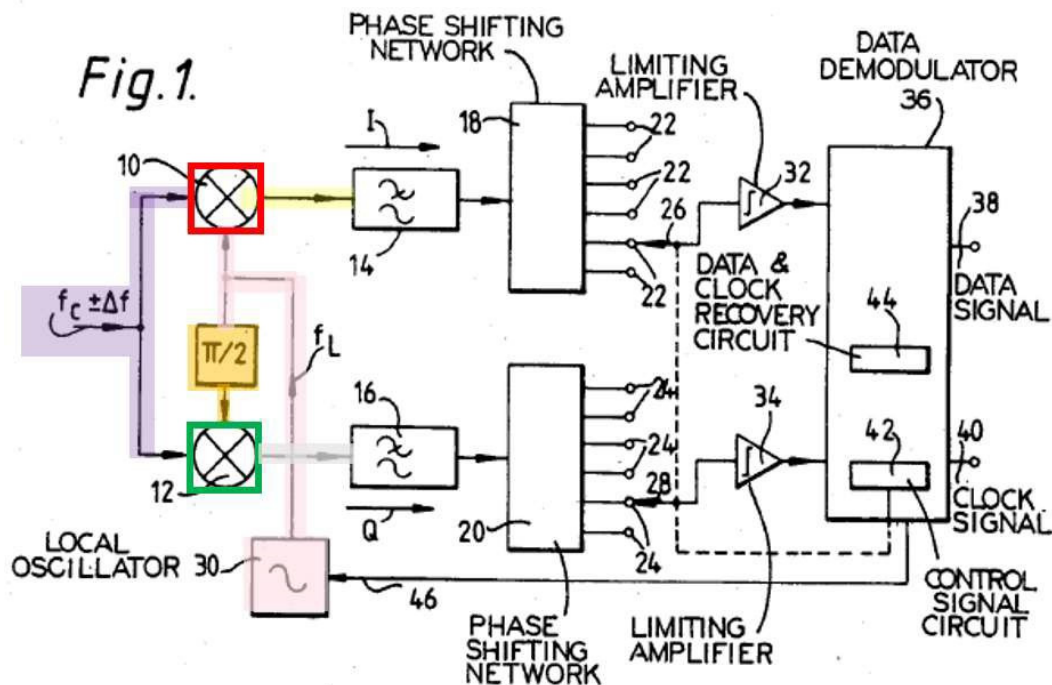
(j) Element [1I]: “and a second storage module,”

As discussed above, the mixer of Schiltz includes a storage module (capacitor 70). (Larson Decl., ¶145). In the TCL IPR, the Board found that the switched capacitor 70 in Schiltz satisfies the “second storage module” claim element. TCL IPR Final Written Decision, pp. 91-92.

(k) Element [1J]: “wherein said second frequency translation module samples the electromagnetic signal at a rate that is a function of said quadrature-phase

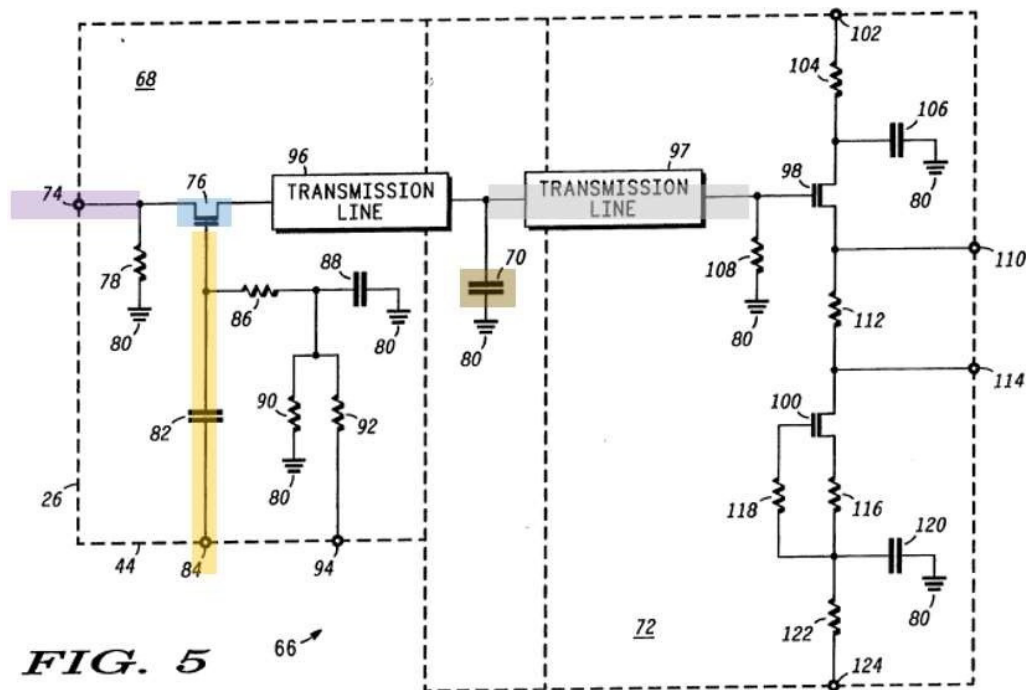
oscillating signal, thereby creating a second sampled signal.

Gibson discloses that the second frequency down-conversion module (mixer 12) samples the electromagnetic signal (purple) at a rate that is a function of the quadrature-phase oscillating signal (orange):



(Gibson, Fig. 1.)

As discussed with respect to Element [1G], Schiltz discloses a mixer comprising a switched capacitor acting as a “sample and hold circuit.” As seen in Figure 5 of Schiltz, that mixer uses an oscillating signal (orange, such as the quadrature-phase one shown as an input to mixer 12 in Figure 1 of Gibson) in order to control FET switch 76 which, in conjunction with “hold capacitor 70,” samples the incoming RF signal (purple) to create a sampled signal (gray):

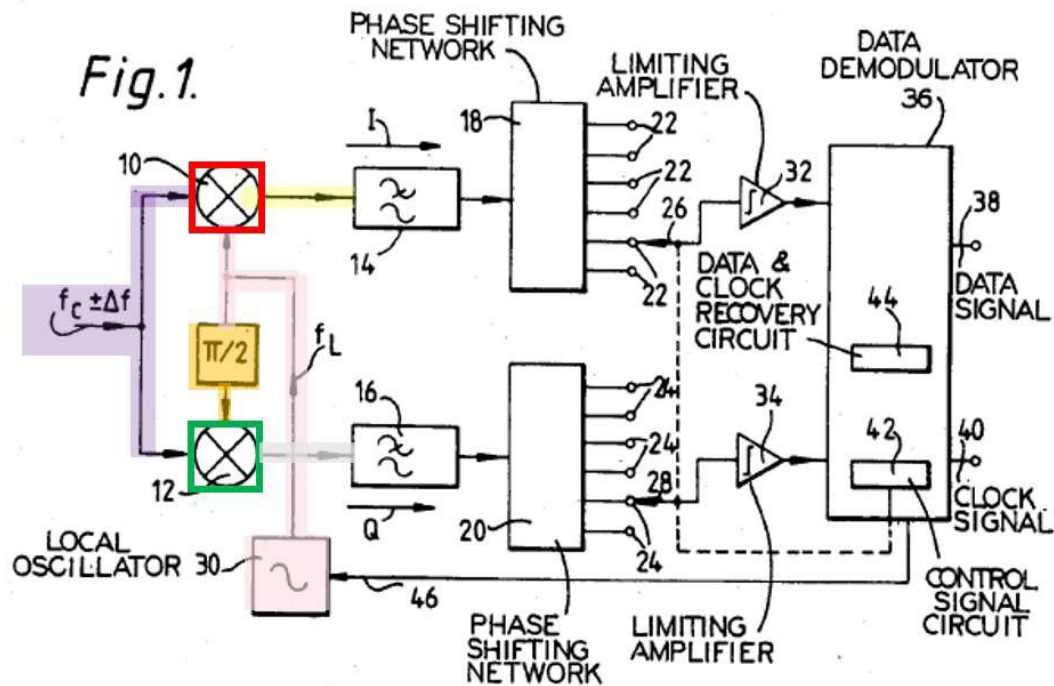


(Schiltz, Fig. 5.)

It would have been obvious to use the sampling mixer of Schiltz in place of the mixers (10, 12) in Gibson, for the reasons discussed previously in Section VII.G.1 (Larson Decl., ¶¶146-148.)

2. Claim 2: “The cable modem of claim 1, wherein said quadrature-phase oscillating signal is out of phase with said in-phase oscillating signal by substantially 90 degrees.”

Gibson discloses a phase shifter ($\pi/2$) to receive said in phase oscillating signal (pink, f_L) and to create a quadrature-phase oscillating signal (orange signal output from “ $\pi/2$ ” to green mixer 12):



(Gibson, Fig. 1.) A POSITA would have recognized that the quadrature-phase oscillating signal (orange) is out of phase with the in-phase oscillating signal (pink) by substantially 90 degrees, at least because “ $\pi/2$ ” is the radian representation of, and equivalent to, 90 degrees. (Gibson, Fig. 1, 2:56-3:2; Larson Decl., ¶¶149-152.)

3. Claim 3

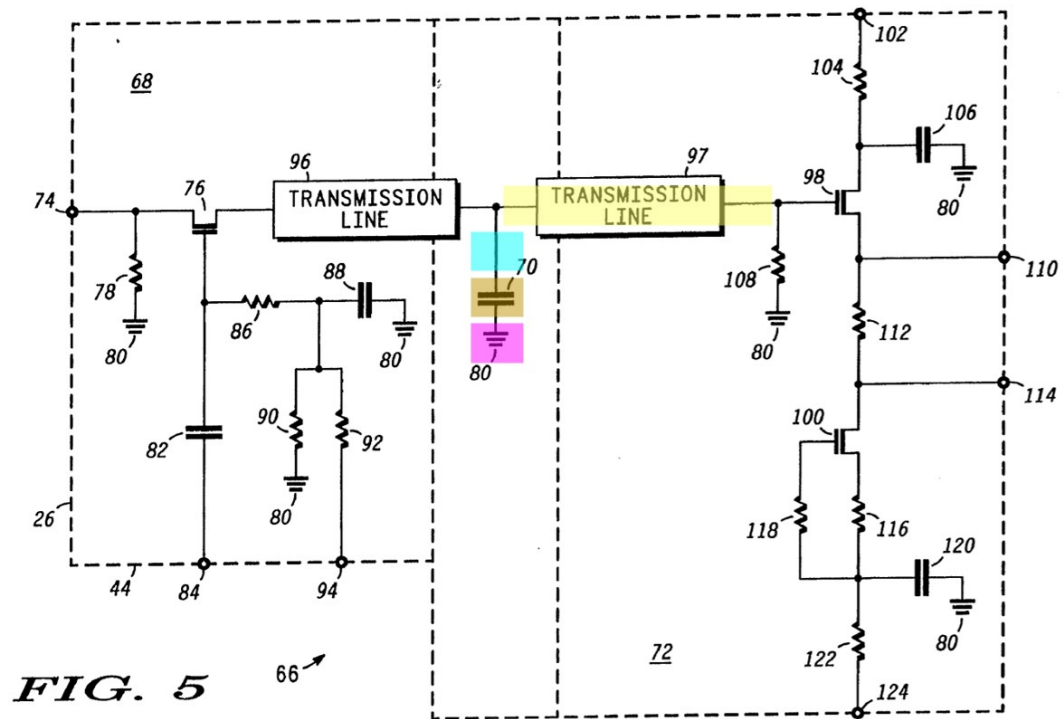
As explained above for Elements [1C] and [1D], and in Section VII.G.1, a POSITA would have found it obvious to use the frequency down-conversion module of Schiltz (including Schiltz’s sample and hold circuit 26 shown in Figure 5) in place of each of mixers 10 and 12 in Gibson.

(a) **Element [3A]: “wherein said first storage device has a first storage first port and a first storage second port,”**

As explained above for Element [1F], Gibson as modified by Schiltz includes a “first storage module”⁷ which would be capacitor 70 (brown) in sample and hold circuit 26, which replaces Gibson’s mixer 10 in the combination. (Schiltz, Fig. 5, 7:58-59.) The capacitor 70 includes a “first storage first port” in the form of the top electrical connection (cyan) shown in Figure 5, which is connected to transmission line 97. (Schiltz, Fig. 5, 8:20-28; Larson Decl., ¶157.) The capacitor 70 includes a “first storage second port” in the form of the bottom electrical connection (magenta), which is connected to ground terminal 80. (Schiltz, Fig. 5, 8:20-28; Larson Decl., ¶158.)

⁷ There is no verbatim antecedent basis for “said first storage device.”

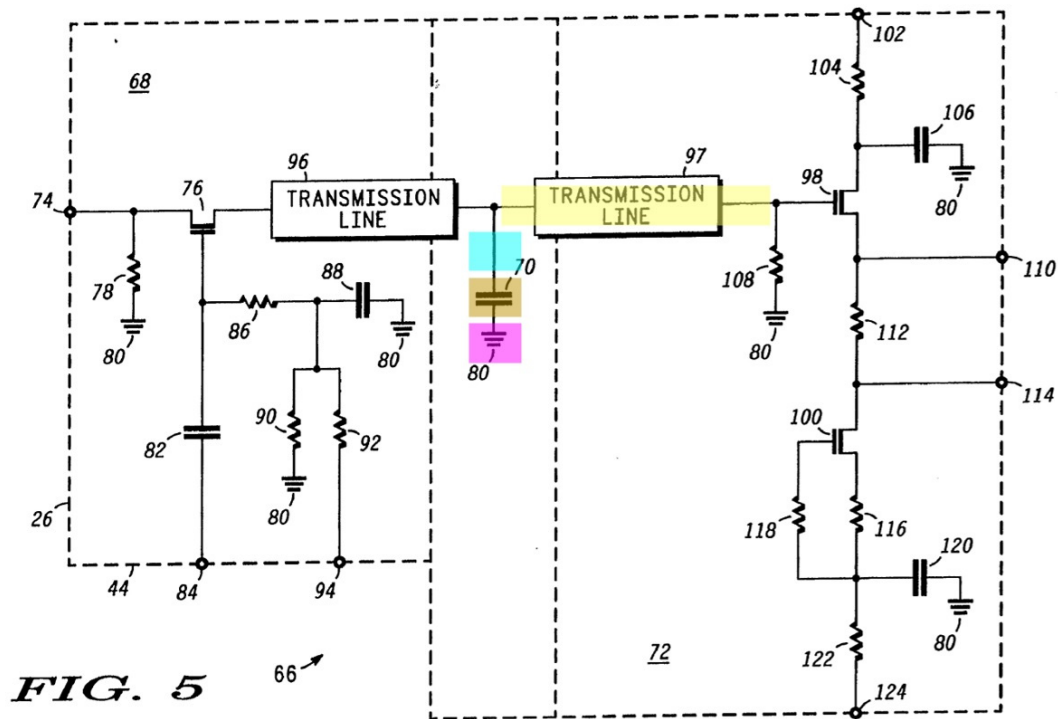
However, a POSITA would have understood “said first storage *device*” in claim 3 to refer to the “first storage *module*” in claim 1. (Larson Decl., ¶155.)



(Schiltz, Fig. 5.)

(b) Element [3B]: “said first storage first port being connected to said first sampled signal,”

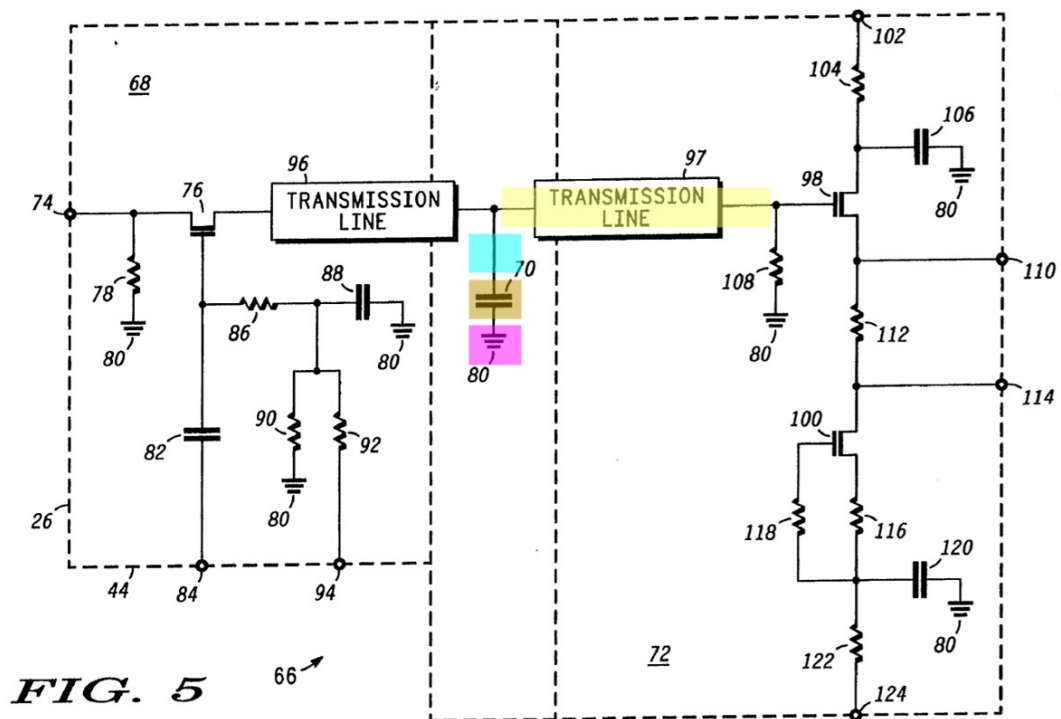
As explained above for Element [1G], Gibson as modified by Schiltz includes a “first sampled signal” along transmission line 97 (yellow). Schiltz demonstrates in Figure 5 that the top electrical connection (“first storage first port,” cyan) of capacitor 70 is connected to the transmission line 97 (“first sampled signal,” yellow). (Schiltz, Fig. 5, 8:20-28; Larson Decl., ¶¶159-160.)



(Schiltz, Fig. 5.)

(c) Element [3C]: “and said first storage second port is connected to a first reference potential,”

Schiltz demonstrates in Figure 5 that the bottom electrical connection (“first storage second port,” magenta) of capacitor 70 is connected to the ground terminal 80 (“first reference potential”). (Schiltz, Fig. 5, 8:20-28; Larson Decl., ¶¶162-163.) A POSITA would have recognized that a ground terminal is a common type of reference potential in electrical circuits, and is used as a reference potential in Schiltz’s circuit 26. (Schiltz, Fig. 5, 8:20-28; *see also id.* at 7:65-68 (“...a ground terminal 80, which is adapted to receive a common potential”); Larson Decl., ¶164.)



(Schiltz, Fig. 5.)

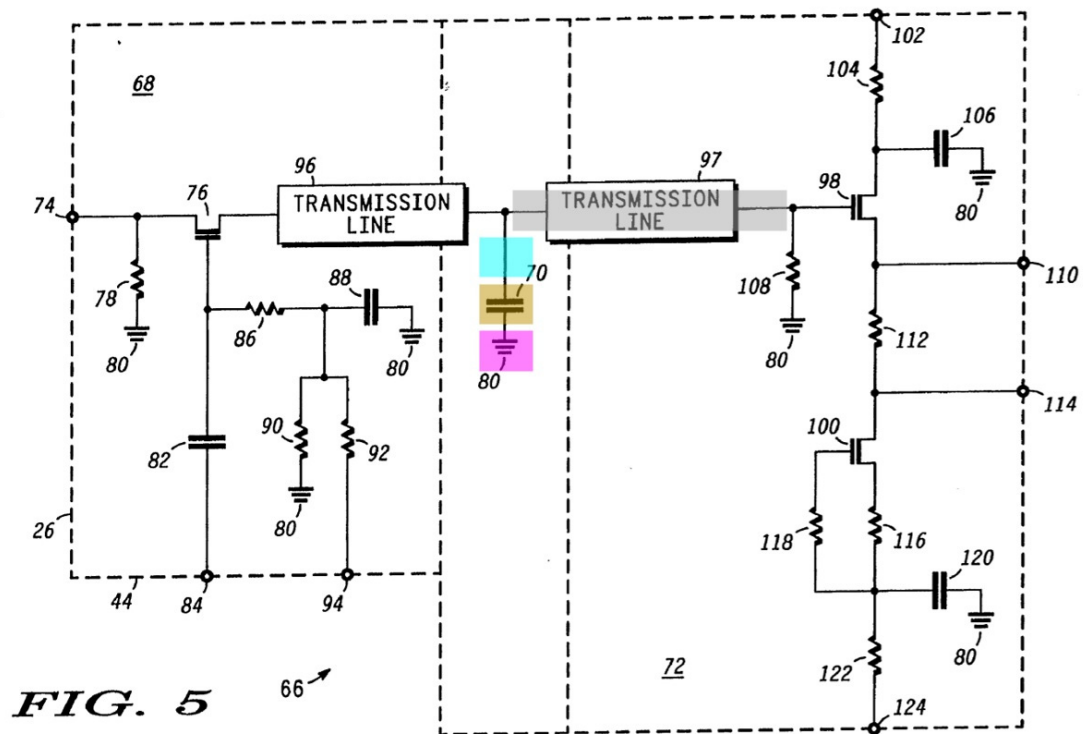
- (d) **Element [3D]: “and said second storage device has a second storage first port and a second storage second port,”**

As explained above for Element [1I], Gibson as modified by Schiltz includes a “second storage module”⁸ in the form of capacitor 70 (brown) in sample and hold circuit 26, which replaces Gibson’s mixer 12 in the combination. (Schiltz, Fig. 5,

⁸ There is no verbatim antecedent basis for “said second storage device.”

However, a POSITA would have understood “said second storage *device*” in claim 3 to refer to the “second storage *module*” in claim 1. (Larson Decl., ¶166.)

7:58-59.) The capacitor 70 includes a “second storage first port” in the form of the top electrical connection (cyan) shown in Figure 5, which is connected to transmission line 97. (Schiltz, Fig. 5, 8:20-28; Larson Decl., ¶¶167-168.) The capacitor 70 includes a “second storage second port” in the form of the bottom electrical connection (magenta), which is connected to ground terminal 80. (Schiltz, Fig. 5, 8:20-28; Larson Decl., ¶169.)

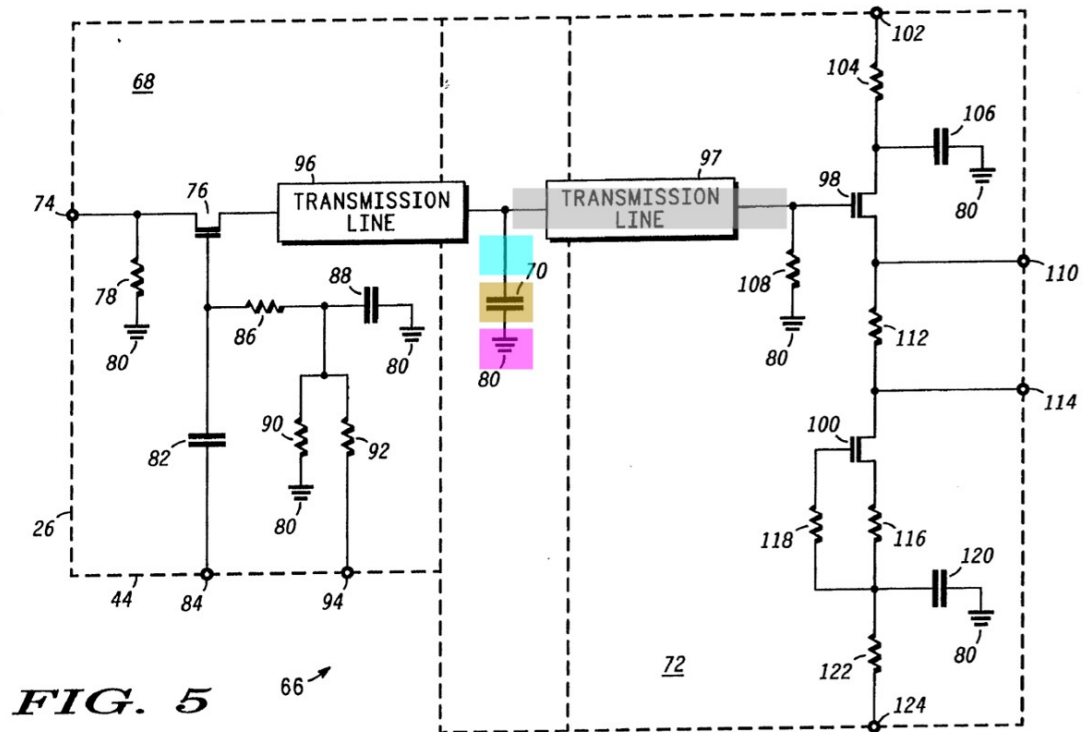


(Schiltz, Fig. 5.)

(e) **Element [3E]: “said second storage first port being connected to said second sampled signal,”**

As explained above for Element [1J], Gibson as modified by Schiltz includes a “second sampled signal” along transmission line 97 (gray). Schiltz

demonstrates in Figure 5 that the top electrical connection (“second storage first port,” cyan) of capacitor 70 is connected to the transmission line 97 (“second sampled signal,” gray). (Schiltz, Fig. 5, 8:20-28; Larson Decl., ¶¶170-171.)

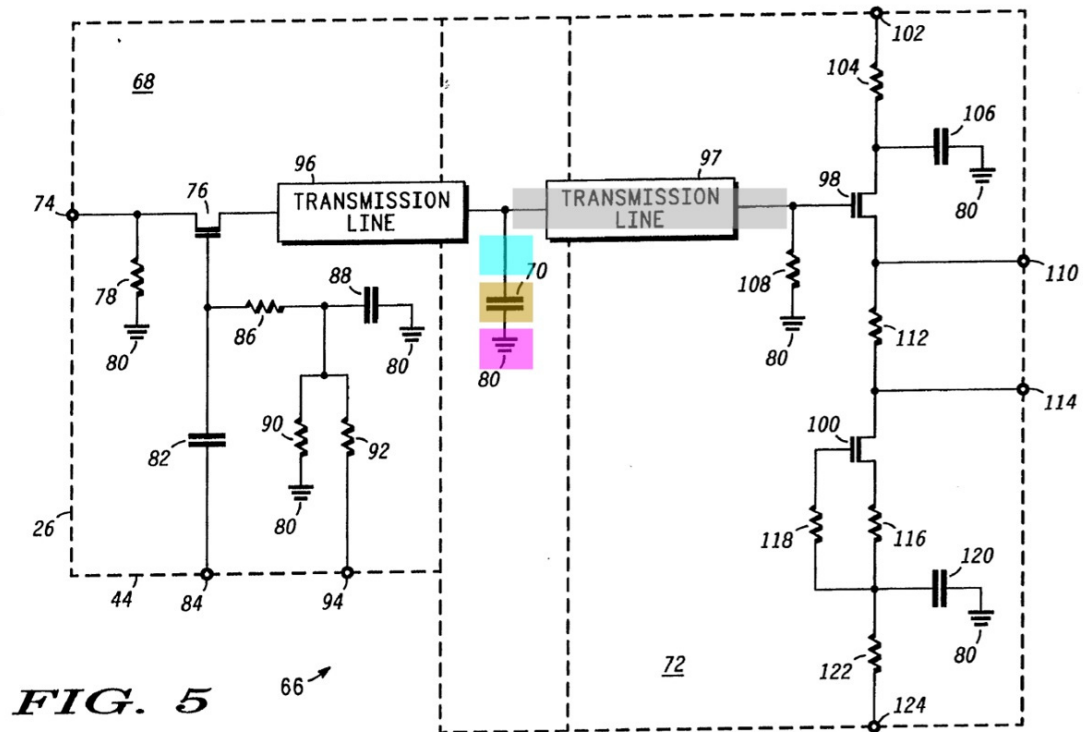


(Schiltz, Fig. 5.)

(f) Element [3F]: “and said second storage second port is connected to a second reference potential.”

Schiltz demonstrates in Figure 5 that the bottom electrical connection (“second storage second port,” magenta) of capacitor 70 is connected to the ground terminal 80 (“second reference potential”). (Schiltz, Fig. 5, 8:20-28; Larson Decl., ¶¶173-174.) A POSITA would have recognized that a ground terminal is a common type of reference potential in electrical circuits, and is used as a reference

potential in Schiltz's circuit 26. (Schiltz, Fig. 5, 8:20-28; *see also id.* at 7:65-68 (“...a ground terminal 80, which is adapted to receive a common potential”); Larson Decl., ¶175.)

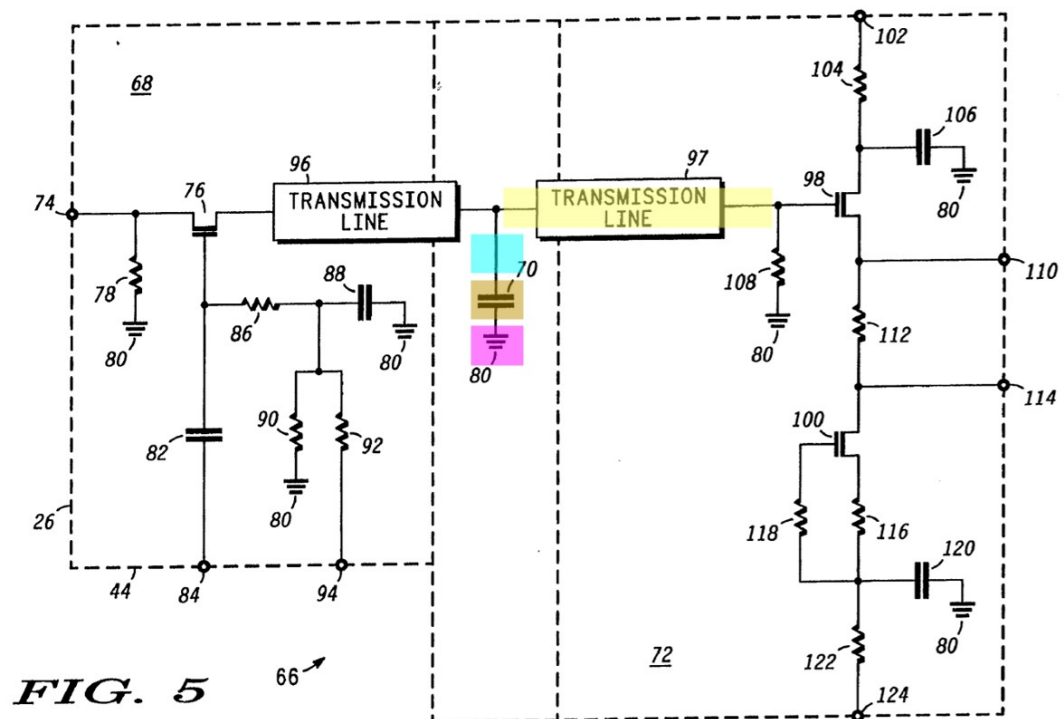


(Schiltz, Fig. 5.)

4. **Claim 4:** “The cable modem of claim 3, wherein said first storage device is a first capacitor, and said second storage device is a second capacitor.”

As explained above for Elements [1C] and [1D], and in Section VII.G.1, a POSITA would have found it obvious to use the frequency down-conversion module of Schiltz (including Schiltz's sample and hold circuit 26 shown in Figure 5) in place of each of mixers 10 and 12 in Gibson. As a result, Gibson as

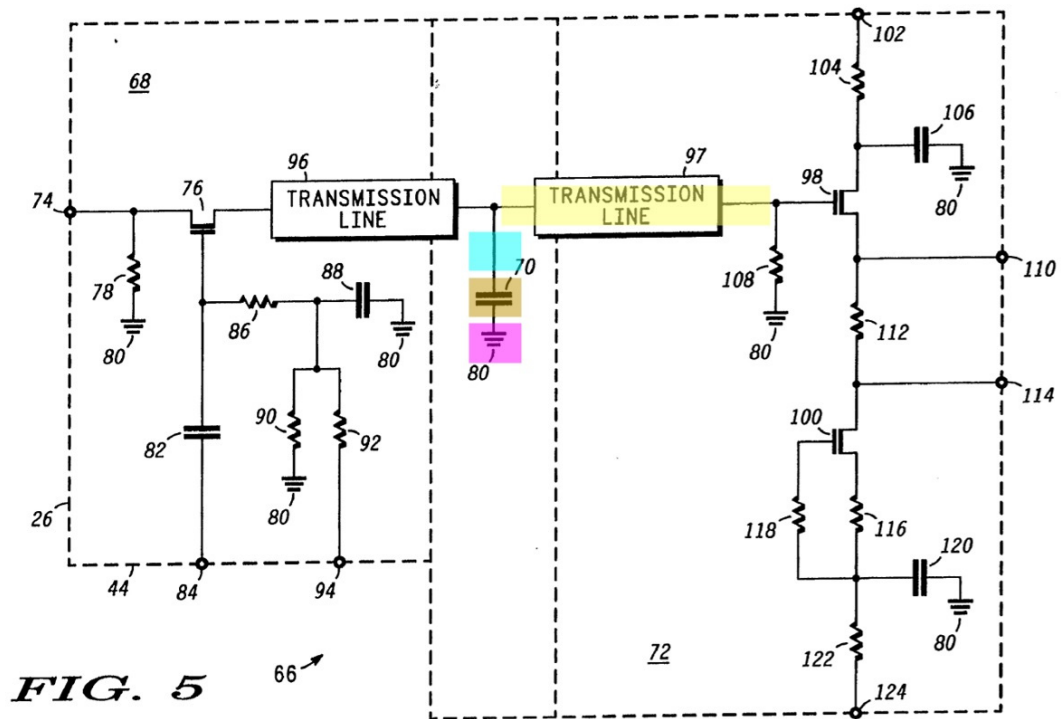
modified by Schiltz would include a first instance of Schiltz's capacitor 70 as the first storage device and a second instance of Schiltz's capacitor 70 as the second storage device. (Schiltz, Fig. 5, 8:20-28; Larson Decl., ¶¶176-178.)



(Schiltz, Fig. 5.)

5. **Claim 5:** “The system of claim 3, wherein said first reference potential is substantially equal to ground, and said second reference potential is substantially equal to ground.”

As explained above for Elements [3C] and [3F], the first reference potential and the second reference potential are provided by Schiltz's ground terminal 80, which provides a reference potential that is equal to ground. (Schiltz, Fig. 5, 8:20-28; Larson Decl., ¶¶179-184.)



(Schiltz, Fig. 5.)

B. Ground 2: Claims 1–5 are Unpatentable as Obvious Over Crols

As shown below, claims 1-5 are unpatentable as obvious over Crols. If the preamble of claim 1 is limiting, and therefore requires a “cable modem,” then these claims are unpatentable as obvious over Crols, and further in view of Thacker, Goldberg, ITU-T J.83, and/or AAPA.

1. Claim 1

- (a) Element [1Pre]: “A cable modem for down-converting an electromagnetic signal having complex modulations, comprising:”

Crols discloses a modem for down-converting an electromagnetic signal having complex modulations:

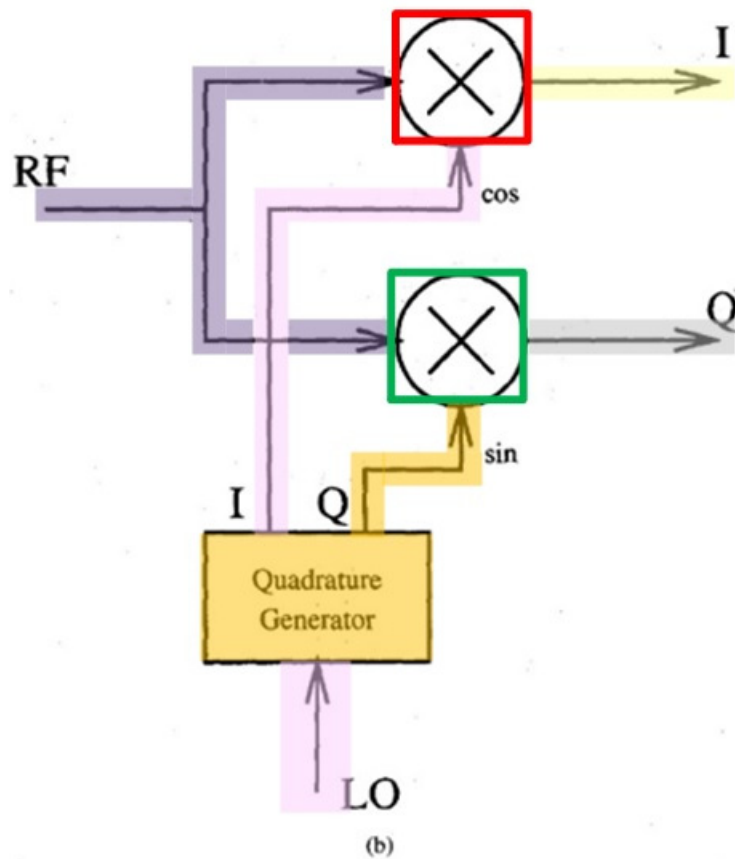


Fig. 12. (a) The conventional quadrature downconverter. (b) an alternative structure.

(Crols, Fig. 12(b).) The modem down-converts the modulated carrier signal, for example from a 900 MHz signal to a 0 Hz signal. (Crols, 1483, 1489; Larson Decl., ¶¶192-193.)

To the extent that the preamble is limiting and the electromagnetic signal must have “complex modulations,” Crols discloses that it works with complex signals, including I/Q modulation. (Crols, 1483, 1489; *see also* ’835 Patent, Fig. 1, 2:55- 3:21; Larson Decl., ¶194.)

To the extent that the preamble is limiting and requires a “cable modem,” it

would have been obvious to use the modem of Crols as a cable modem, in view of Thacker, Goldberg, ITU-T J.83, and/or AAPA. See Section VII.G.3 *supra*.

(b) Element [1A]: “an oscillator to generate an in-phase oscillating signal;”

Crols discloses an oscillator to generate an in-phase oscillating signal (LO):

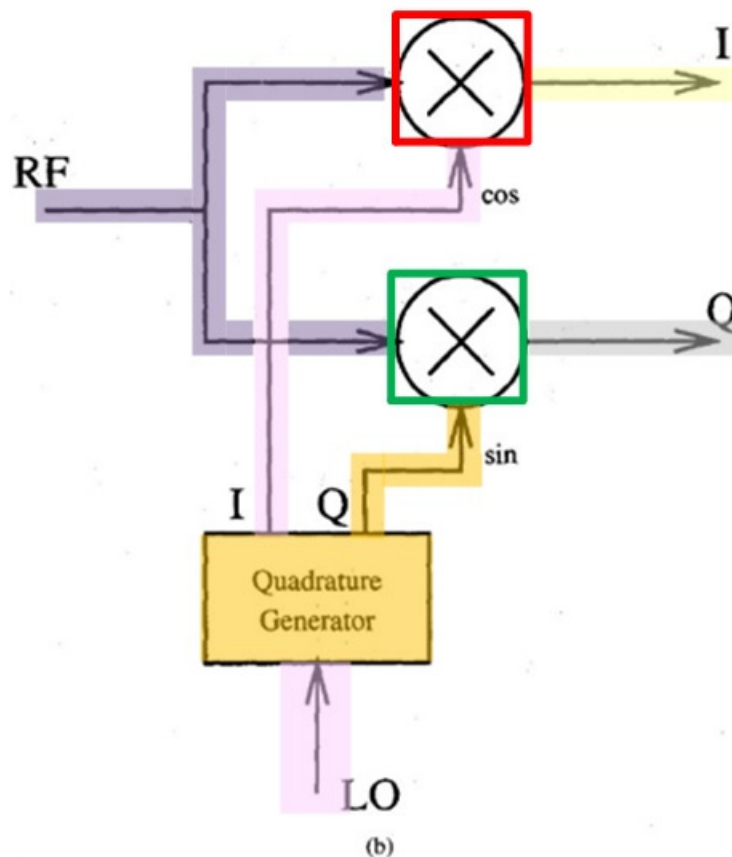


Fig. 12. (a) The conventional quadrature downconverter. (b) an alternative structure.

(Crols, Fig. 12(b); Larson Decl., ¶196.) While Crols does not explicitly show a functional block for the oscillator, a POSITA would have understood that the LO, “local oscillator,” signal in Crols was generated by a local oscillator. (Crols, 1483, 1489; Larson Decl., ¶196.)

- (c) Element [1B]: “a phase shifter to receive said in-phase oscillating signal and to create a quadrature-phase oscillating signal;”

Crols discloses a phase shifter (Quadrature Generator) to receive said in phase oscillating signal (pink, LO and I) and to create a quadrature-phase oscillating signal (orange signal output from “Quadrature Generator” to green mixer):

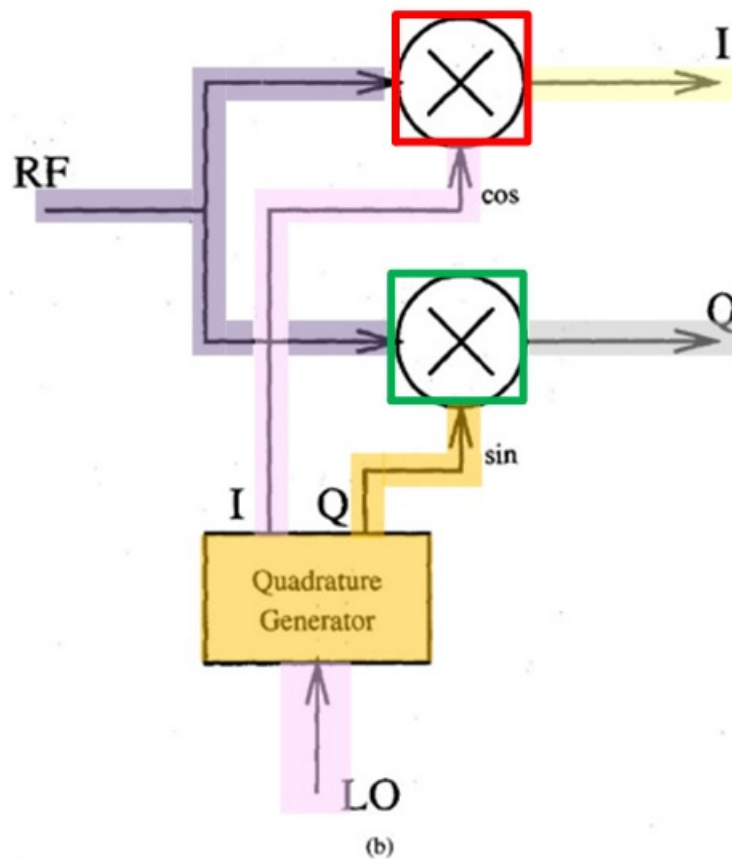


Fig. 12. (a) The conventional quadrature downconverter. (b) an alternative structure.

(Crols, Fig. 12(b); Larson Decl., ¶197.)

- (d) Element [1C]: “a first frequency down-conversion module to receive the electromagnetic signal and said

in-phase oscillating signal;”

Crols discloses a first frequency down-conversion module (mixer, red) to receive the electromagnetic signal (purple, RF) and said in-phase oscillating signal (pink, LO and I):

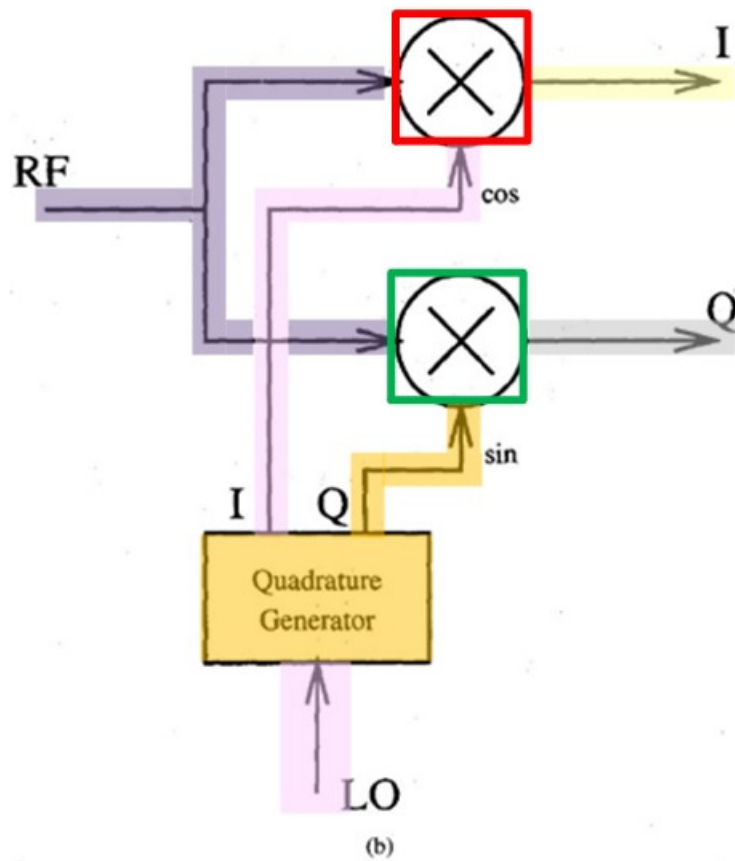


Fig. 12. (a) The conventional quadrature downconverter. (b) an alternative structure.

(Crols, Fig. 12(b); Larson Decl., ¶198.)

Crols discloses a specific mixer topology to use as a frequency down-conversion module. (Crols, 1491, Fig. 17; Larson Decl., ¶199.) The structure of Crols’s mixer is shown in Figure 17, and Crols discloses that the mixer has a

CMOS transistor (blue) and a capacitor C_V (brown):

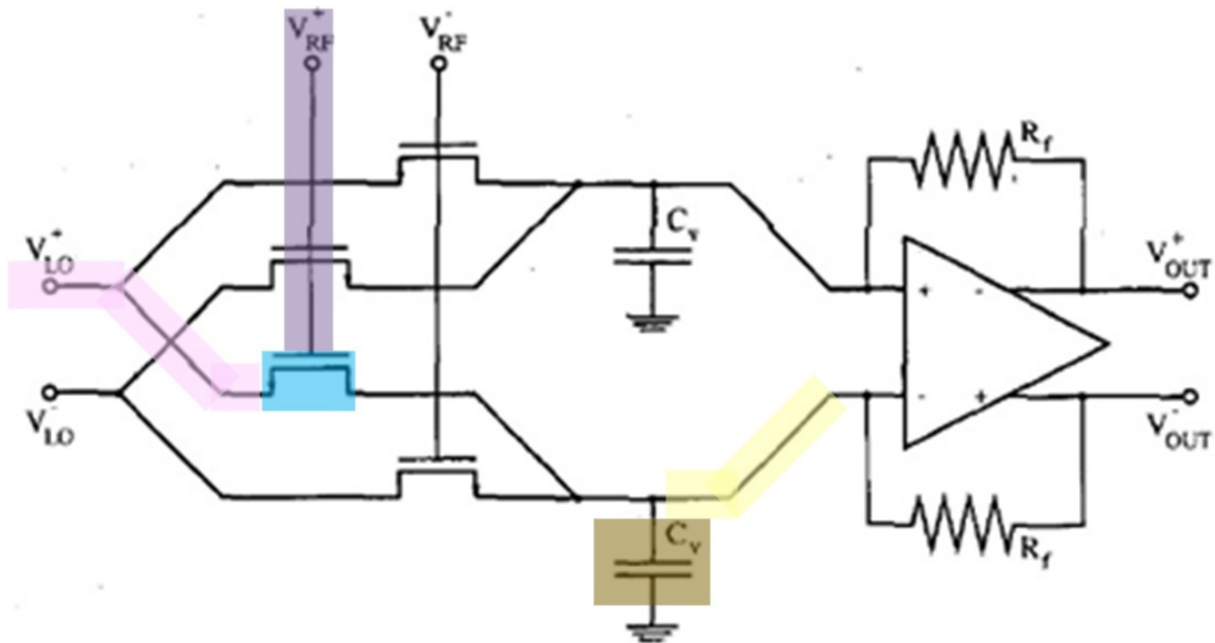


Fig. 17. The highly linear mixer topology.

(Crols, Fig. 17.)

The input electromagnetic signal V_{RF} (purple) couples to the gate of a CMOS transistor (blue). (Crols, 1491; Larson Decl., ¶200.) The input local oscillating signal V_{LO} (pink) couples to the source of CMOS transistor (blue). (Crols, 1491; Larson Decl., ¶200.) The drain of CMOS transistor (blue) is coupled to a “larger capacitor[]” C_V (brown) and serves as the output of the downconverter circuit, which outputs a sampled signal (yellow). (Crols, 1491; Larson Decl., ¶200.) Motivations to modify Crols to use the mixer topology of Figure 17 (switch (FET) followed by a capacitor) with the downconverter of Figure 12(b) are set forth

above in Section VII.G.2.

- (e) **Element [1D]: “a second frequency down-conversion module to receive the electromagnetic signal and said quadrature-phase oscillating signal; wherein”**

Crols discloses a second frequency down-conversion module (mixer, green) to receive the electromagnetic signal (purple) and said quadrature-phase oscillating signal (orange):

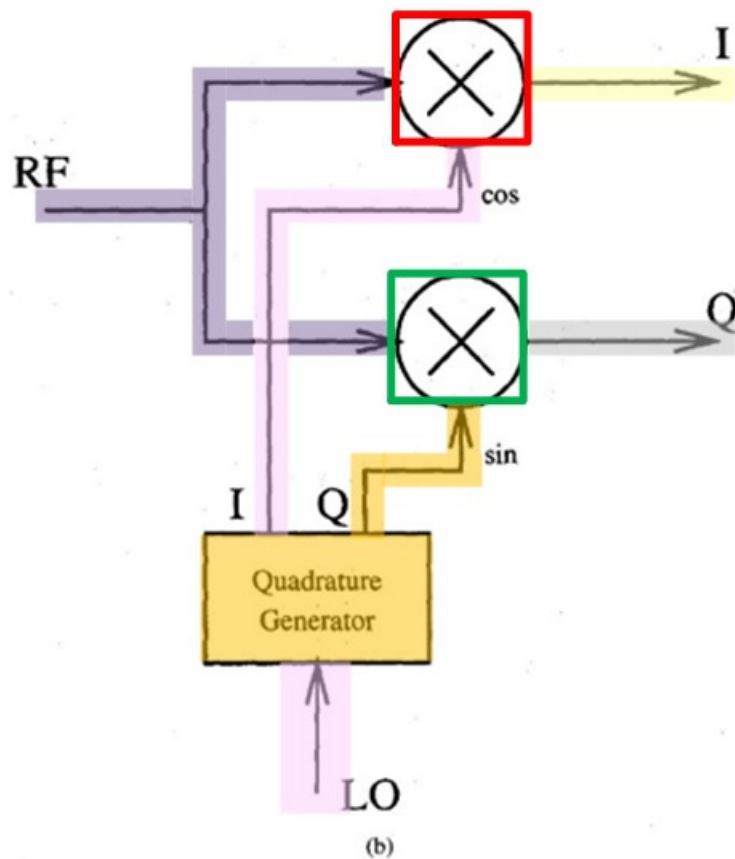


Fig. 12. (a) The conventional quadrature downconverter. (b) an alternative structure.

(Crols, Fig. 12(b); Larson Decl., ¶207.)

It would have been obvious to use the frequency down-conversion module

of Figure 17 of Crols as the mixer in the quadrature downconverter of Figure 12(b) in the same manner and for the same reasons as discussed previously for Crols's first mixer with respect to Element [1C]. (Larson Decl., ¶208.)

(f) Element [1E]: “said first frequency down-conversion module further comprises a first frequency translation module”

As discussed above with respect to Elements [1C] and [1D], Crols discloses a mixer comprising a switch (CMOS transistor, blue) coupled to a storage module (capacitor C_V , brown):

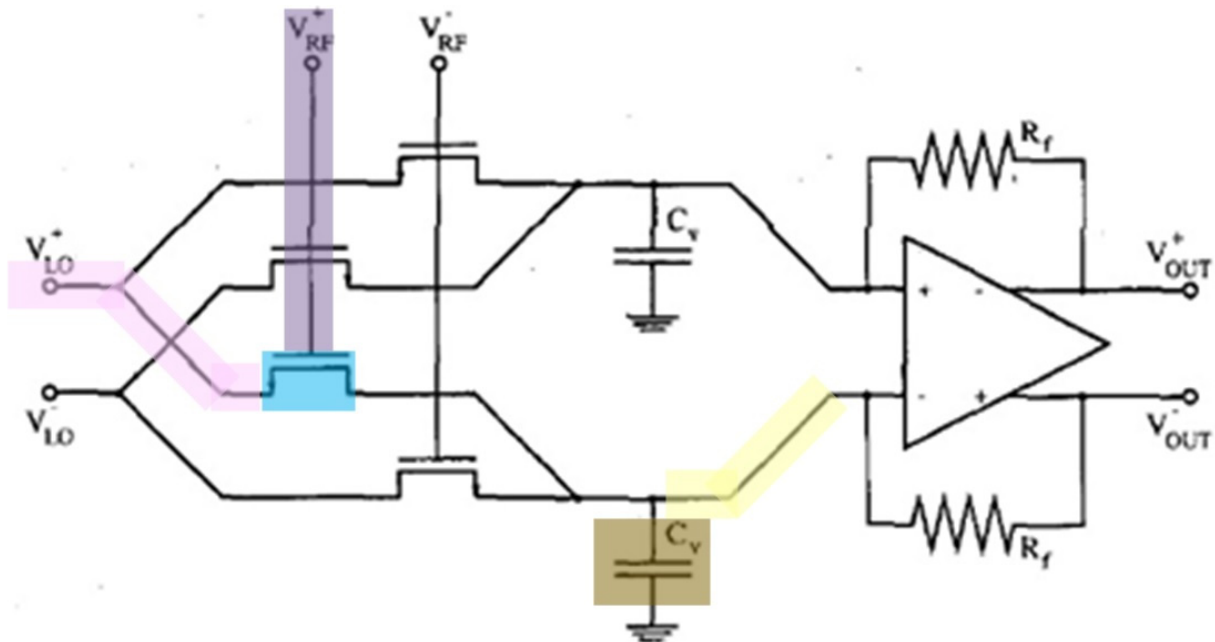


Fig. 17. The highly linear mixer topology.

(Crols, Fig. 17.)

It would have been obvious to use the frequency down-conversion module of Figure 17 of Crols as the mixer in the quadrature downconverter of Figure 12(b)

or the reasons discussed above with respect to Elements [1C] and [1D].

(Larson Decl., ¶¶209-211.)

(g) Element [1F]: “and a first storage module,”

As discussed above with respect to Elements [1C], [1D], and [1E], Crols discloses in Figure 17 a mixer comprising a switched capacitor C_v (“first storage module”), and it would have been obvious to use such a mixer in the modem of Figure 12(b) of Crols for the reasons discussed above with respect to Elements [1C] and [1D]. (Larson Decl., ¶212.)

In the TCL IPR, the Board found that its construction of “storage module” as “a module of a system that stores non-negligible amounts of energy from an input EM signal” is met where the module stores energy “in amounts distinguishable from noise,” which in term is met if the module “successfully down-converts” the input EM signal. TCL IPR Final Written Decision, 46-58. In applying that analysis to the prior art references at issue in the TCL IPR, the Board found this requirement of successful down conversion to be met so long as the prior art was enabled for its disclosed purpose. TCL IPR Final Written Decision, 58 (relying on presumption of enablement), 88 (same).

Crols meets this threshold requirement at least because Crols explains that the mixer of Figure 17 successfully downconverters an incoming EM signal. Crols, 1491. Crols in fact discloses that a receiver using the mixer of Figure 17

was created and operated successfully. Crols, 1491. Furthermore, Crols identifies an earlier publication that disclosed the mixer of Figure 17. Crols, 1491 (citing reference [12]). That publication disclosed that the mixer of Figure 17 was created and operated successfully. Ex. 1021. Therefore, the mixer of Figure 17, including in combination with the well-known quadrature downconverter of Figure 12(b), successfully downconverted an EM signal as described in Crols. (Larson Decl., ¶213.)

Furthermore, Patent Owner has accused substantially the same structure in the MediaTek products as being a “first storage module.” So at least under Patent Owner’s apparent interpretation of this claim element, the switched capacitor C_V of Crols is a “first storage module.”

- (h) Element [1G]: “wherein said first frequency translation module samples the electromagnetic signal at a rate that is a function of said in-phase oscillating signal, thereby creating a first sampled signal; and”**

Crols discloses that the first frequency down-conversion module (mixer, red) mixes the electromagnetic signal (purple) with the in-phase oscillating signal (pink):

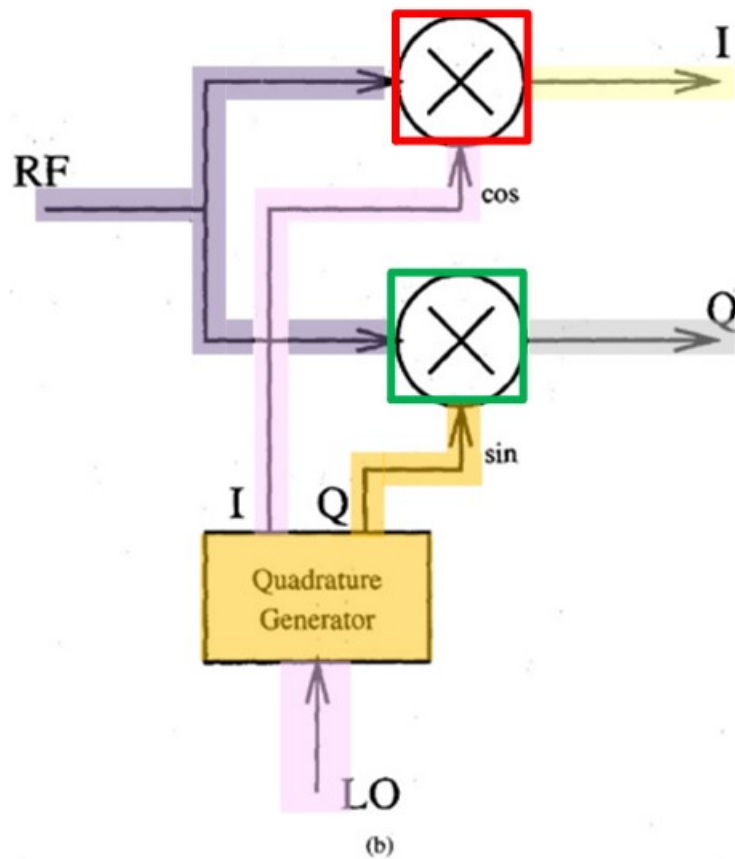


Fig. 12. (a) The conventional quadrature downconverter. (b) an alternative structure.

(Crols, Fig. 12(b); Larson Decl., ¶214.)

As discussed above with respect to Elements [1C], [1D], and [1E], Crols discloses with respect to Figure 17 a mixer module comprising a switched CMOS transistor. Crols discloses that the operation of the downconverter modules are by sampling using the mixers in the quadrature downconverters. (Crols, 1487–1488, 1490; Larson Decl., ¶216.) As seen in Figure 17 of Crols, that mixer module uses an input oscillating signal (pink, such as the one shown as an input to the mixer, red in Figure 12(b) of Crols) which is a stream of oscillating sampling pulses in order

to control CMOS transistor (blue), in conjunction with capacitor C_V (brown), samples the incoming RF signal (purple) to create a first sampled signal (yellow):

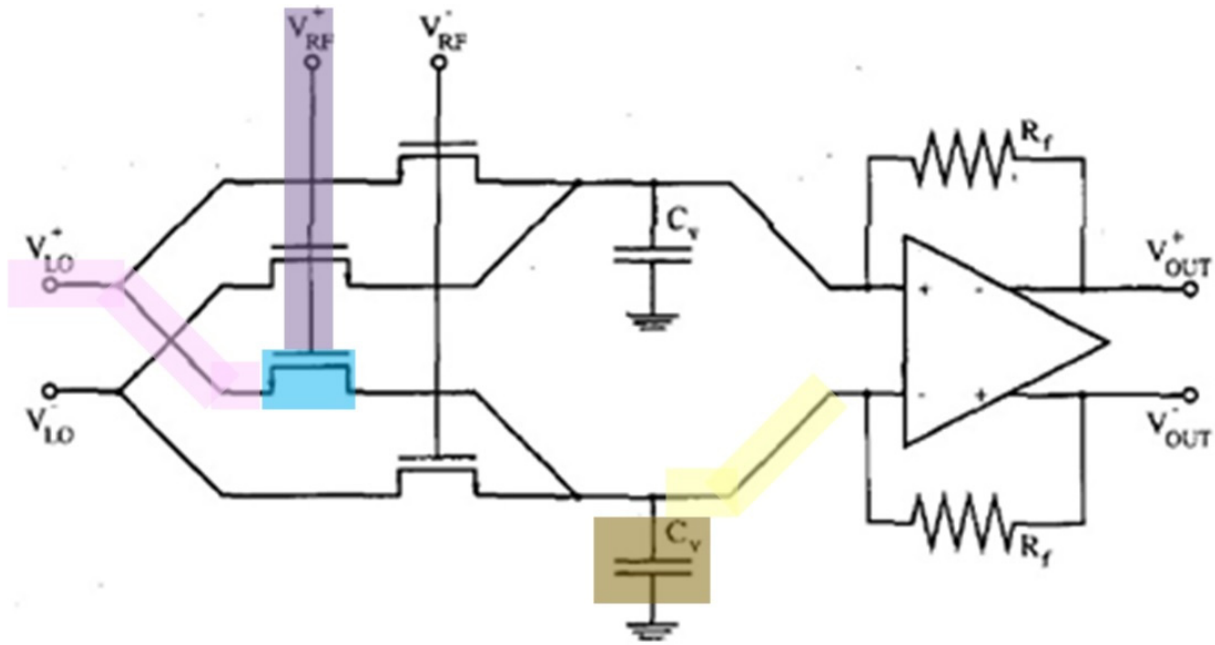


Fig. 17. The highly linear mixer topology.

(Crols, Fig. 17; Larson Decl., ¶215.) A POSITA would have understood that the sampling of the electromagnetic signal (V_{RF}^+) was performed at a rate that is a function of the in-phase oscillating signal (V_{LO}^+), at least because the switch in Figure 17 generates an output signal that is a multiplication of the electromagnetic signal (V_{RF}^+) and the in-phase oscillating signal (V_{LO}^+), and which has a resulting frequency that is the difference between the frequency of the electromagnetic signal (V_{RF}^+) and the in-phase oscillating signal (V_{LO}^+). (Larson Decl., ¶217.)

It would have been obvious to use the frequency down-conversion module

of Figure 17 of Crols as the mixer in the quadrature downconverter of Figure 12(b) for the reasons discussed previously in Section VII.G.2. (Larson Decl., ¶¶198-206.)

(i) Element [1H]: “said second frequency down-conversion module further comprises a second frequency translation module”

The first and second mixers in the downconverter of Figure 12(b) of Crols (red, green) are structurally identical, and it would have been obvious to use the mixer of Figure 17 of Crols in the quadrature downconverter of Figure 12(b) for the reasons discussed previously in Element [1E]. In particular, the mixer of Figure 17 has a frequency translation module, *i.e.*, a CMOS transistor (blue), that is in turn coupled to a capacitor (C_V , brown), which down-converts the incoming RF signal (purple) to create a second sampled signal (gray):

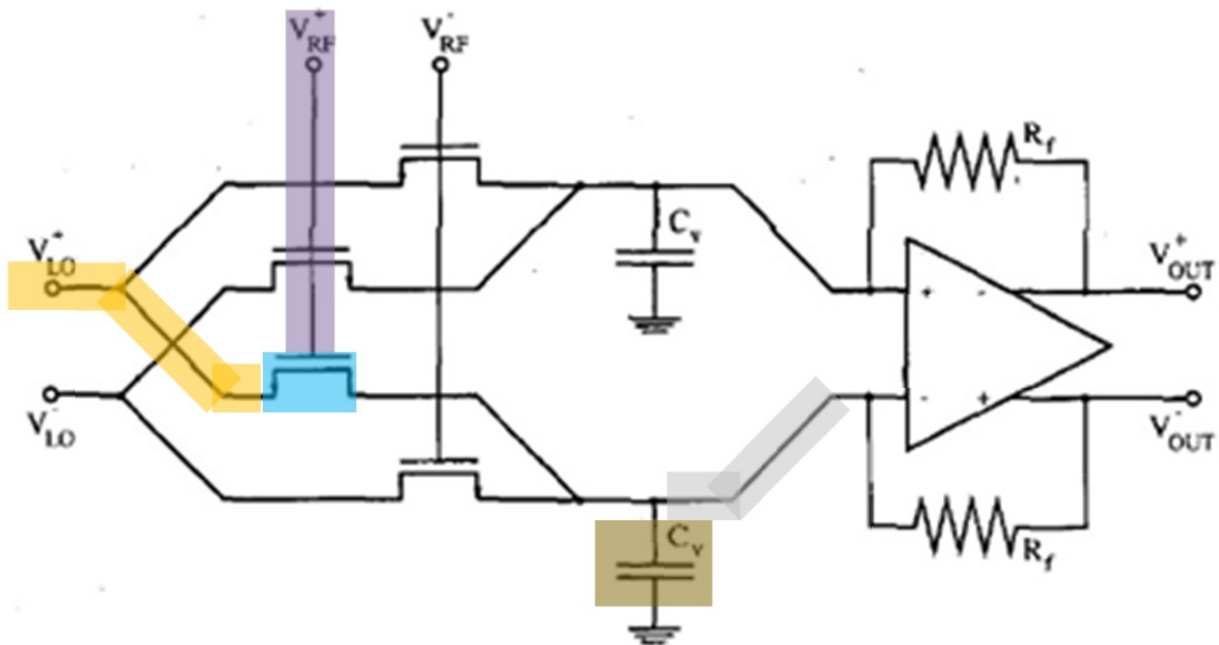


Fig. 17. The highly linear mixer topology.

(Crols, Fig. 17; Larson Decl., ¶¶219-221.)

(j) Element [1I]: “and a second storage module,”

As discussed above, especially for Element 1[F], the mixer of Crols includes a storage module (capacitor C_V). (Larson Decl., ¶222.)

(k) Element [1J]: “wherein said second frequency translation module samples the electromagnetic signal at a rate that is a function of said quadrature-phase oscillating signal, thereby creating a second sampled signal.”

Crols discloses that the second frequency down-conversion module (mixer, green) samples the electromagnetic signal (purple) at a rate that is a function of the quadrature-phase oscillating signal (orange):

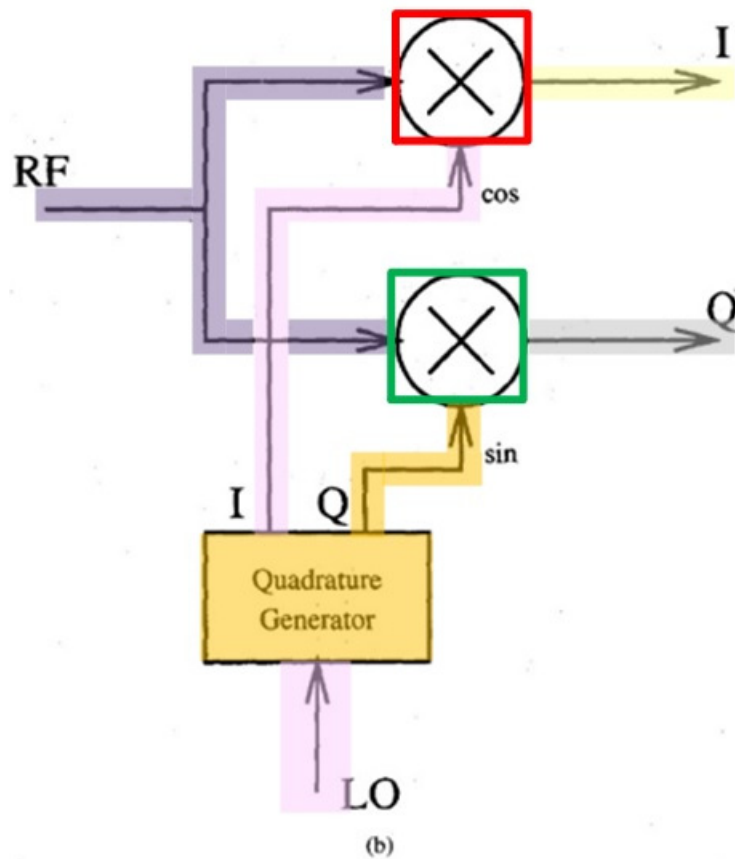


Fig. 12. (a) The conventional quadrature downconverter. (b) an alternative structure.

(Crols, Fig. 12(b); Larson Decl., ¶223.)

As discussed with respect to Element [1G], Crols discloses with respect to Figure 17 a mixer module comprising a switched CMOS transistor. As seen in Figure 17 of Crols, that mixer module uses an input oscillating signal (orange, such as the one shown as an input to the mixer, green in Figure 12(b) of Crols) which is a stream of oscillating sampling pulses in order to control CMOS transistor (blue), in conjunction with capacitor C_V (brown), samples the incoming RF signal (purple) to create a second sampled signal (grey):

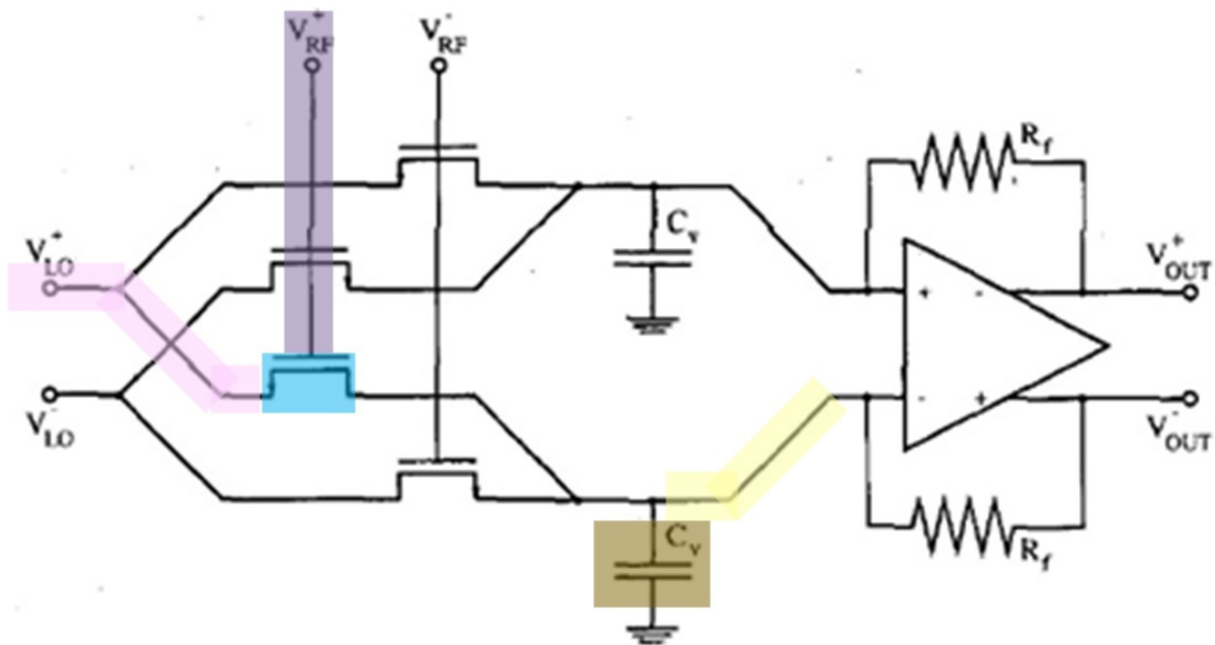


Fig. 17. The highly linear mixer topology.

(Crols, Fig. 17; Larson Decl., ¶¶224-226.) As discussed for Element [1G], a POSITA would have understood that the sampling of the electromagnetic signal (V_{RF}^+) was performed at a rate that is a function of the in-phase oscillating signal (V_{LO}^+). (Larson Decl., ¶226.)

It would have been obvious to use the frequency down-conversion module of Figure 17 of Crols as the mixer in the quadrature downconverter of Figure 12(b) for the reasons discussed previously in Section VII.G.2. (Larson Decl., ¶224.)

2. Claim 2: “The cable modem of claim 1, wherein said quadrature-phase oscillating signal is out of phase with said in-phase oscillating signal by substantially 90 degrees.”

Crols discloses a phase shifter (Quadrature Generator) to receive said in phase oscillating signal (pink, LO) and to create a quadrature-phase oscillating

signal (orange signal Q output from “Quadrature Generator” to mixer, green):

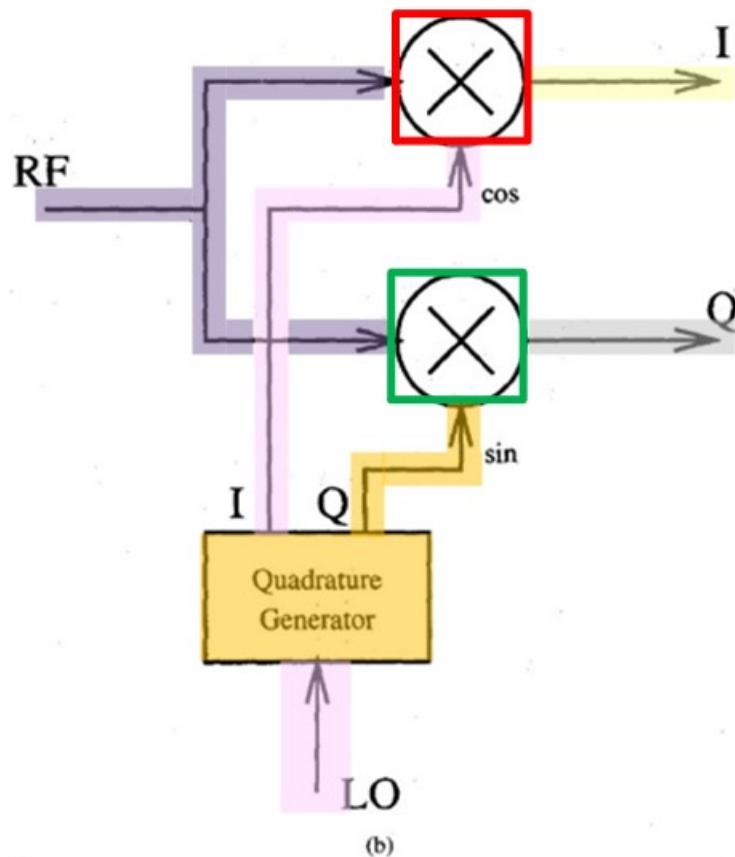


Fig. 12. (a) The conventional quadrature downconverter. (b) an alternative structure.

(Crols, Fig. 12(b); Larson Decl., ¶230.) A POSITA would have recognized that the quadrature-phase oscillating signal (orange) is out of phase with the in-phase oscillating signal (pink) by substantially 90 degrees, at least because Crols explains that “generation of the quadrature signal is based on the 90° phase-difference between a pole and zero with the same cutoff frequency,” and it was common knowledge in the art that a quadrature signal was offset by 90 degrees from the in-phase signal. (Crols, 1483–1484; Larson Decl., ¶231.)

3. Claim 3

As explained above for Elements [1C] and [1D], and in Section VII.G.2, a POSITA would have found it obvious to use the mixer of Figure 17 of Crols in the quadrature downconverter of Figure 12(b) of Crols.

(a) Element [3A]: “wherein said first storage device has a first storage first port and a first storage second port,”

As explained above for Element [1F], Crols includes a “first storage module” in the form of capacitor C_V (brown) in a first mixer. (Crols, 1491, Fig. 17.) The capacitor C_V includes a “first storage first port” in the form of the top electrical connection (cyan) shown in Figure 17, which is connected to the sampled signal line (yellow). (Crols, 1491, Fig. 17; Larson Decl., ¶236.) The capacitor C_V includes a “first storage second port” in the form of the bottom electrical connection (magenta), which is connected to the ground terminal. (Crols, 1491, Fig. 17; Larson Decl., ¶237.)

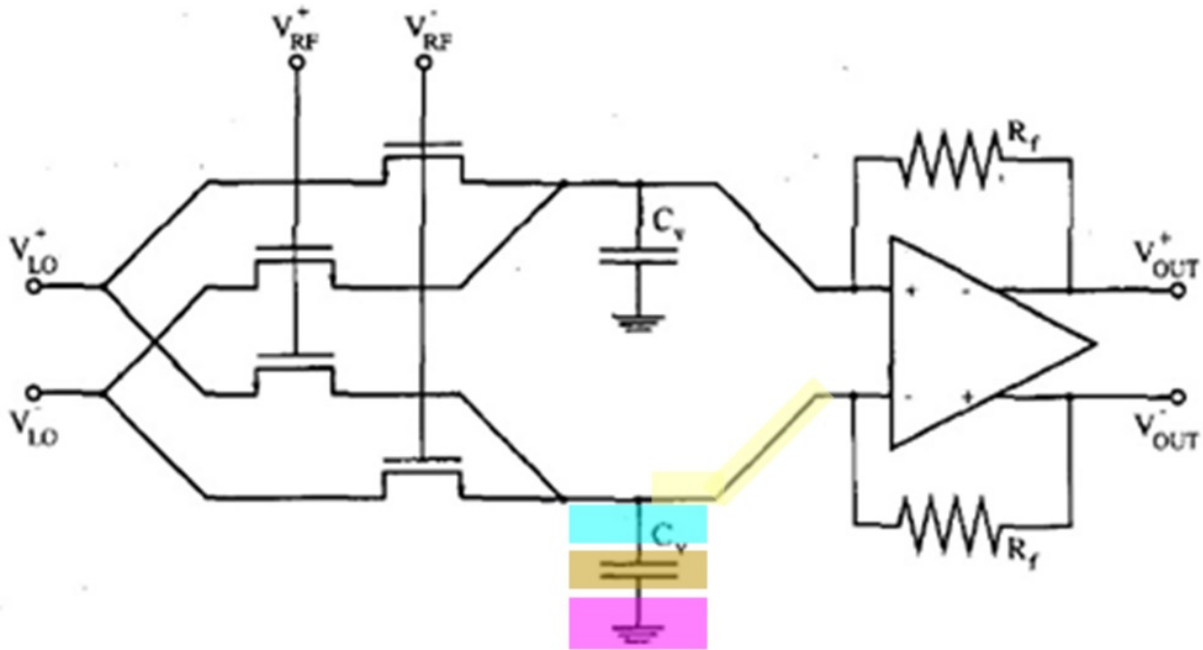


Fig. 17. The highly linear mixer topology.

(Crols, Fig. 17.)

(b) Element [3B]: “said first storage first port being connected to said first sampled signal,”

As explained above for Element [1G], Crols includes a “first sampled signal” along the line (yellow) to which the capacitor C_v is coupled. Crols demonstrates in Figure 17 that the top electrical connection (“first storage first port,” cyan) of capacitor C_v is connected to the first sampled signal (yellow).

(Crols, 1491, Fig. 17; Larson Decl., ¶¶238-241.)

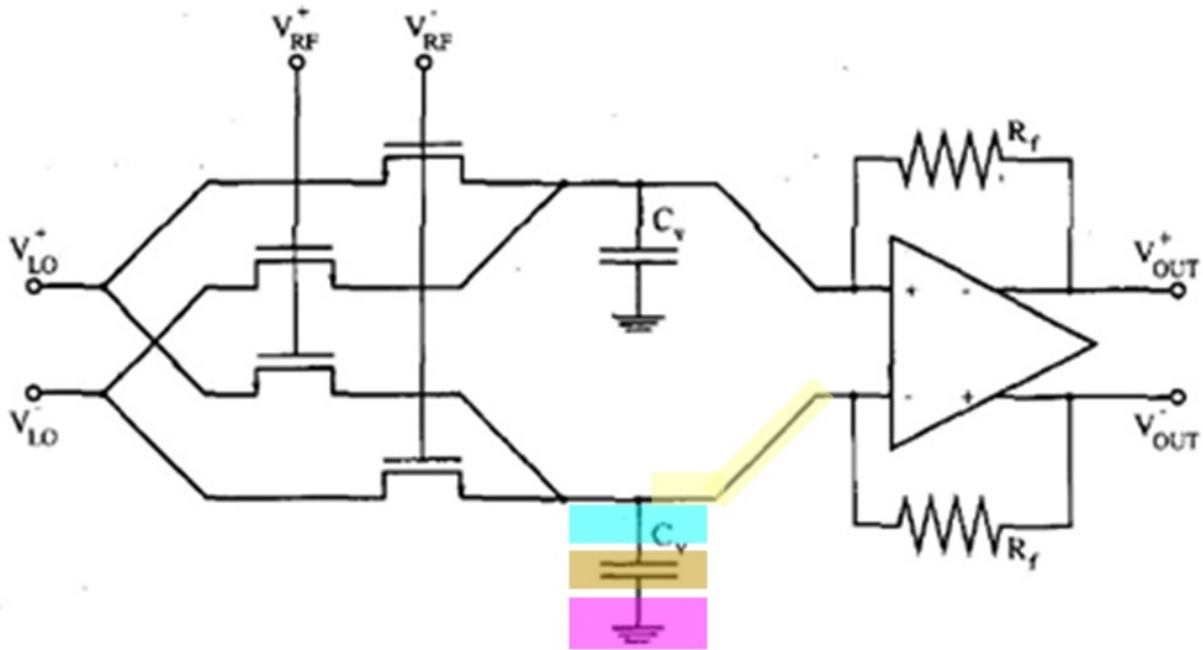


Fig. 17. The highly linear mixer topology.

(Crols, Fig. 17.)

(c) Element [3C]: “and said first storage second port is connected to a first reference potential,”

Crols demonstrates in Figure 17 that the bottom electrical connection (“first storage second port,” magenta) of capacitor C_v is connected to a ground terminal (“first reference potential”). (Crols, 1491, Fig. 17; Larson Decl., ¶244.) A POSITA would have recognized that a ground terminal is a common type of reference potential in electrical circuits, and is used as a reference potential in Crols’s mixer of Figure 17. (Crols, 1491, Fig. 17; Larson Decl., ¶245.)

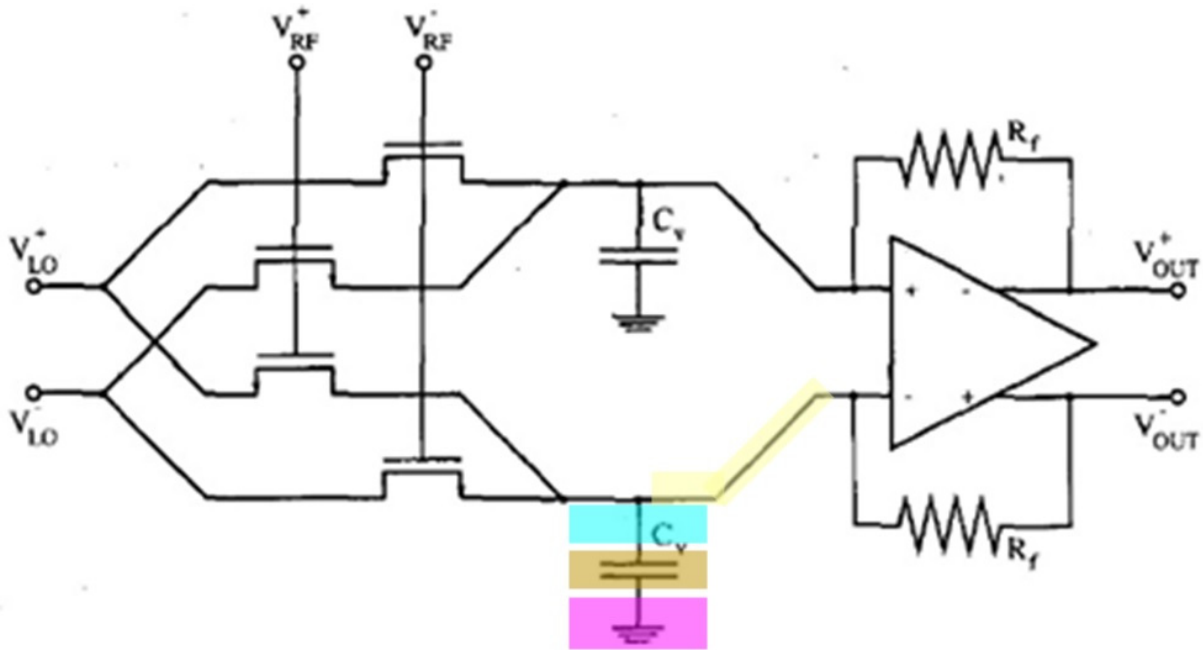


Fig. 17. The highly linear mixer topology.

(Crols, Fig. 17.)

- (d) **Element [3D]: “and said second storage device has a second storage first port and a second storage second port,”**

As explained above for Element [1I], Crols includes a “second storage module” in the form of capacitor C_v (brown) in a second mixer. (Crols, 1491, Fig. 17.) The capacitor C_v includes a “second storage first port” in the form of the top electrical connection (cyan) shown in Figure 17, which is connected to the sampled signal line (grey). (Crols, 1491, Fig. 17; Larson Decl., ¶249.) The capacitor C_v includes a “second storage second port” in the form of the bottom electrical connection (magenta), which is connected the ground terminal. (Crols,

1491, Fig. 17; Larson Decl., ¶250.)

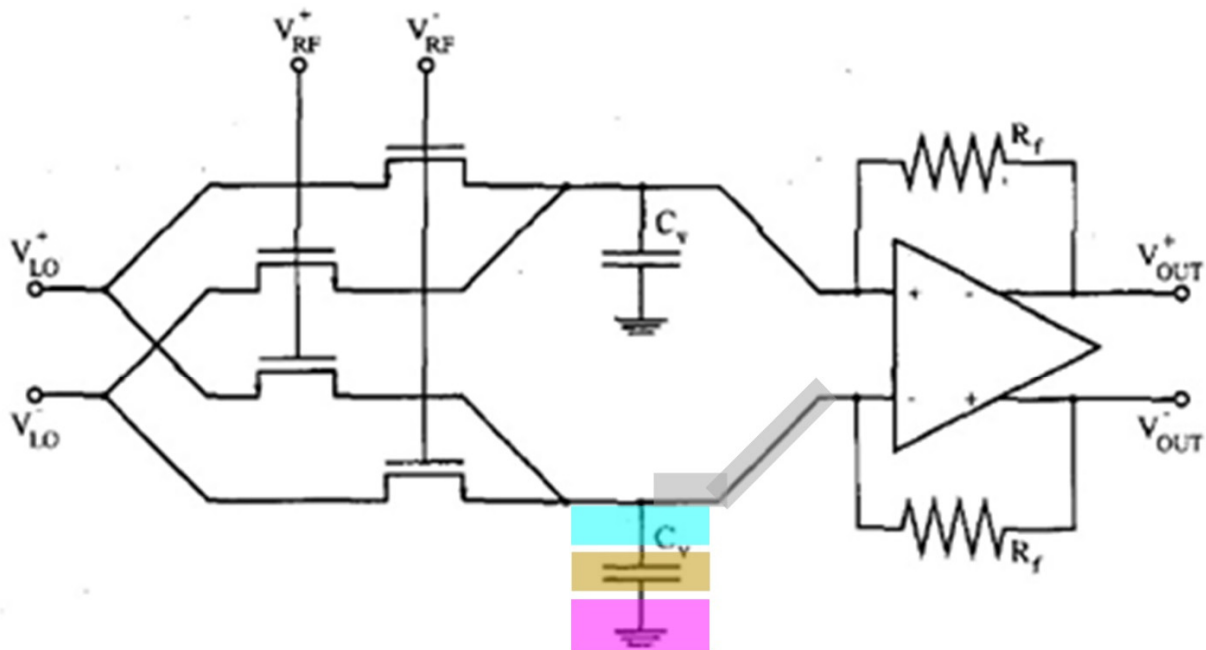


Fig. 17. The highly linear mixer topology.

(Crols, Fig. 17.)

(e) **Element [3E]: “said second storage first port being connected to said second sampled signal,”**

As explained above for Element [1J], Crols includes a “second sampled signal” along the line (gray) to which the capacitor C_V is coupled. Crols demonstrates in Figure 17 that the top electrical connection (“second storage first port,” cyan) of capacitor C_V is connected to the second sampled signal (gray).

(Crols, 1491, Fig. 17; Larson Decl., ¶¶252-254.)

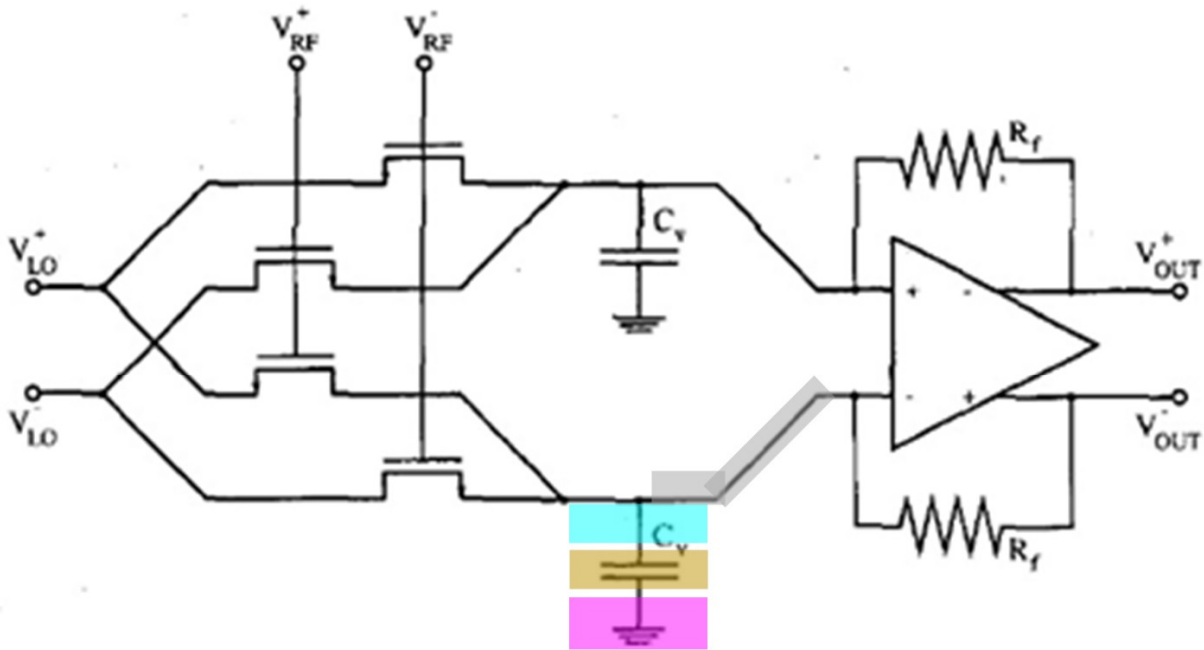


Fig. 17. The highly linear mixer topology.

(Crols, Fig. 17.)

(f) Element [3F]: “and said second storage second port is connected to a second reference potential.”

Crols demonstrates in Figure 17 that the bottom electrical connection (“second storage second port,” magenta) of capacitor C_v is connected to a ground terminal (“second reference potential”). (Crols, 1491, Fig. 17; Larson Decl., ¶257.) A POSITA would have recognized that a ground terminal is a common type of reference potential in electrical circuits, and is used as a reference potential in Crols’s mixer of Figure 17. (Crols, 1491, Fig. 17; Larson Decl., ¶258.)

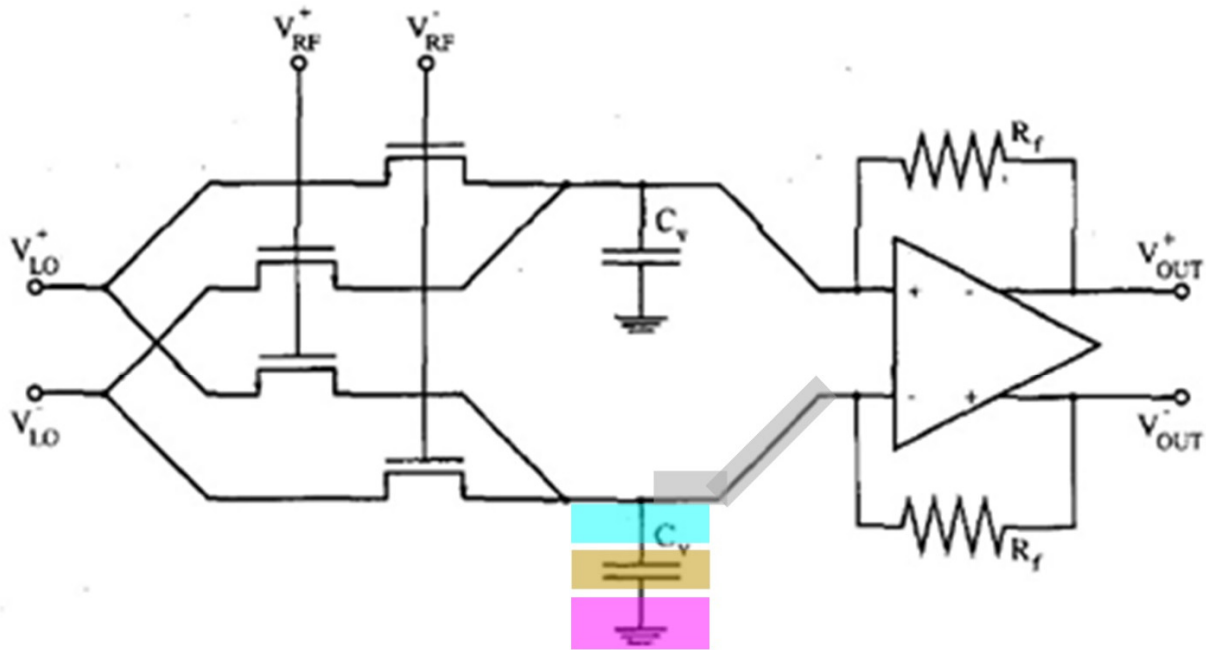


Fig. 17. The highly linear mixer topology.

(Crols, Fig. 17.)

4. **Claim 4:** “The cable modem of claim 3, wherein said first storage device is a first capacitor, and said second storage device is a second capacitor.”

As explained above for Elements [1C] and [1D], and in Section VII.G.2, POSITA would have found it obvious to use the mixer of Figure 17 of Crols in the quadrature downconverter of Figure 12(b) of Crols. As a result, Crols would include a first instance of Crols’s capacitor C_v as the first storage device and a second instance of Crols’s capacitor C_v as the second storage device, one in each mixer. (Crols, 1491, Fig. 17; Larson Decl., ¶¶259-261.)

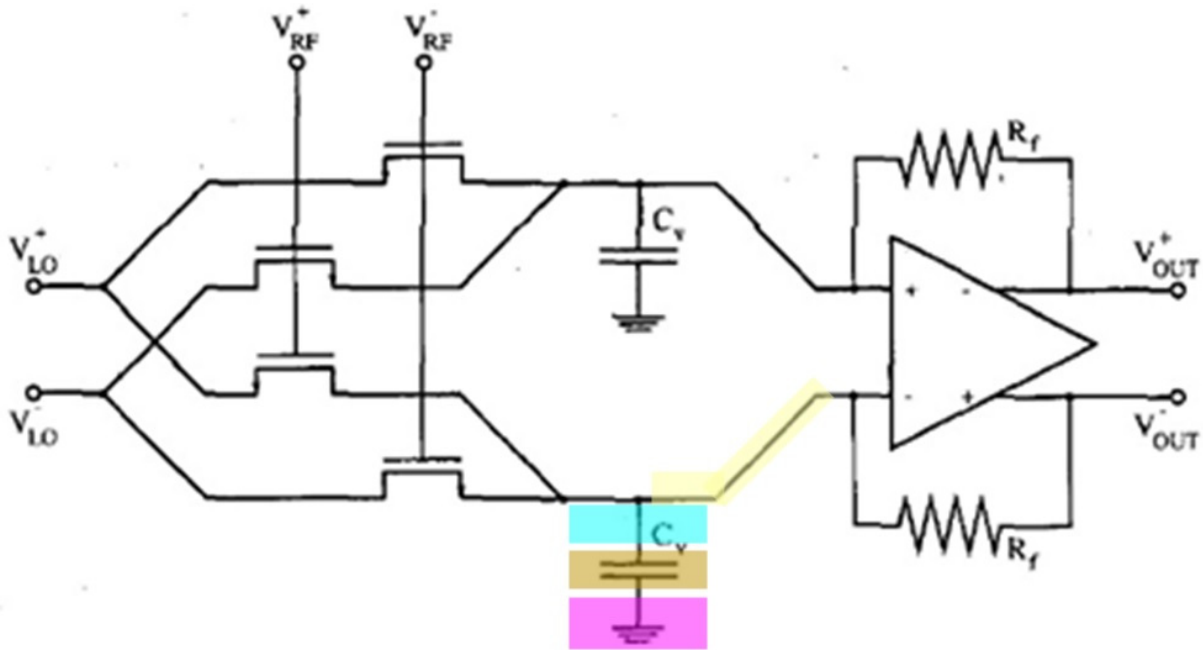


Fig. 17. The highly linear mixer topology.

(Crols, Fig. 17.)

5. **Claim 5:** “The system of claim 3, wherein said first reference potential is substantially equal to ground, and said second reference potential is substantially equal to ground.”

As explained above for Elements [3C] and [3F], the first reference potential and the second reference potential are provided by Crols’s ground terminal in each mixer, which provides a reference potential that is equal to ground. (Crols, 1491, Fig. 17; Larson Decl., ¶¶262-267.)

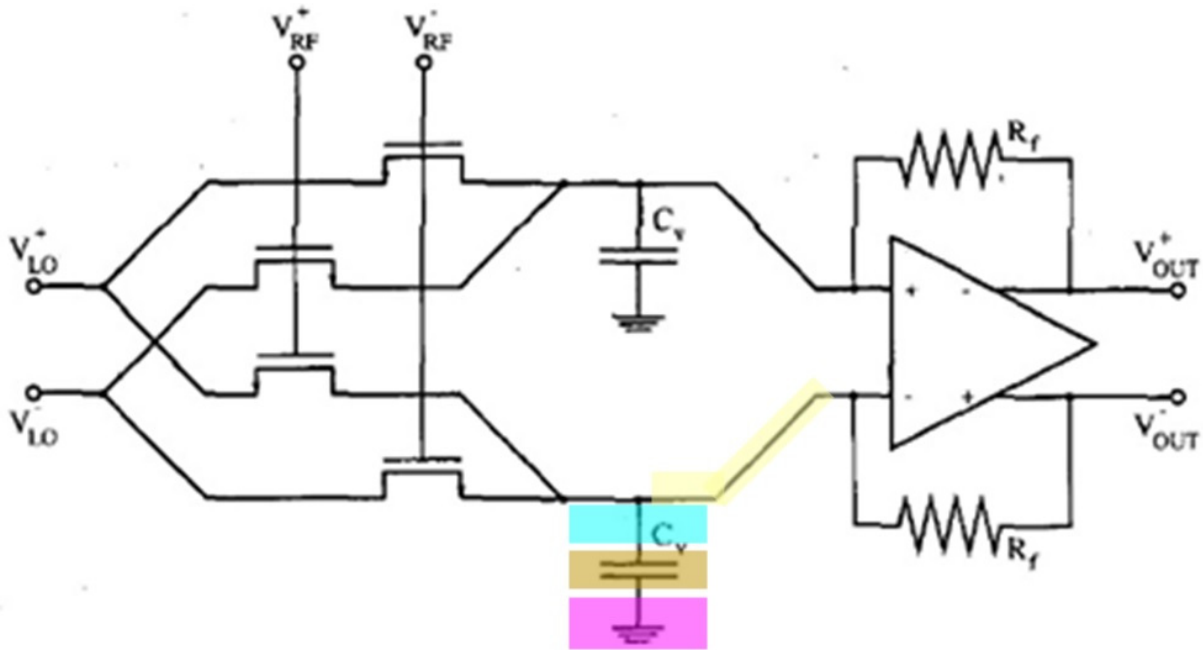


Fig. 17. The highly linear mixer topology.

(Crols, Fig. 17.)

C. Objective Indicia of Non-Obviousness

In the TCL IPR, Patent Owner argued that objective indicia of non-obviousness demonstrated non-obviousness of the claims. TCL IPR Final Written Decision, p. 63. The Board found Patent Owner to have provided only “weak evidence of nonobviousness,” considered that evidence, and found that it did not outweigh the invalidity showing for, among other grounds, the combination of Gibson and Schiltz. TCL IPR Final Written Decision, pp. 63-68. Petitioner is not presently aware of any other evidence of objective indicia of non-obviousness that is relevant to this proceeding.

X. THE BOARD SHOULD INSTITUTE REVIEW

A. The Board Should Not Deny Institution under *Fintiv*.

The Board should not deny institution under 35 U.S.C. § 314(a). On balance, the factors set forth in *Apple Inc. v. Fintiv, Inc.* favor institution. *See* IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential) .

First, no stay has been requested, nor has the district court considered a stay in the underlying litigation. As such, “this factor does not weigh in favor or against” the Board exercising discretion here. *Intel Corp. v. ParkerVision Inc.*, No. IPR2020-01265 (Paper 10) at 18 (PTAB Jan. 28, 2021).

Second, it is very early in the district court case. A *Markman* hearing is set for January 10, 2024, fact discovery is stayed until the *Markman* hearing, and trial is not scheduled until December 3, 2024. (Ex. 1019.) However, the Board will consider the median time to trial in the district where the parallel litigation is pending, and not just the scheduled trial date. *See Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation*, pp. 7-8 (June 21, 2022); Decision, Paper 13, pp. 8-9. The most recent statistics indicate that the median time from filing to trial in the Western District of Texas is 26.4 months. (Ex. 1020, p. 37.) Therefore, the expected trial date, based on the November 10, 2022 filing of the complaint, is January 22, 2025. A final written decision, on the other hand, would issue around May 2025, shortly after the

expected trial date.

Third, because the district court case is in the preliminary stages, the parties and court have not invested significant time and resources. Fact discovery is stayed until the *Markman* hearing in January 2024, and the court has not issued any orders related to the patent at issue in this petition. *See Apple*, 2020 WL 2126495 at *4 (“If, at the time of the institution decision, the district court has not issued orders related to the patent at issue in the petition, this fact weighs against exercising discretion to deny institution under *NHK*.”). At the expected time of the institution decision, and assuming no delays in the district court’s current scheduling order, fact discovery will still be ongoing, expert discovery will not yet have begun, and dispositive motions will also remain. Ex. 1019. Thus, much work as to invalidity will remain in the district court following institution.

Petitioner is filing this Petition expeditiously, about five months after Patent Owner served its preliminary infringement contentions (on June 20, 2023) and less than two months after Petitioner served its preliminary invalidity contentions (on September 18, 2023). (Ex. 1012.) *Apple*, 2020 WL 2126495 at *5 (“If the evidence shows that the petitioner filed the petition expeditiously, such as promptly after becoming aware of the claims being asserted, this fact has weighed against exercising the authority to deny institution under *NHK*.”). Given the lengthy specification of the ’835 Patent (over 100 pages), and the time reasonably

required to prepare this Petition, Petitioner has acted with diligence.

Fourth, the issue of overlap between the issues raised in the Petition and the related litigations is neutral. This factor alone is insufficient to justify exercising discretion to deny institution in light of the other factors, and in any case a Final Written Decision would streamline the district court litigation.

Finally, the merits of this petition are compelling. Indeed, the Board already found claim 1 unpatentable based on the Gibson and Schiltz combination in the TCL IPR, and this Petition shows that same combination, as well as the Crols reference, also renders newly challenged dependent claims 2-5 unpatentable as obvious. *See Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation*, pp. 3-6 (June 21, 2022) (stating that “the PTAB will not deny institution based on *Fintiv* if there is compelling evidence of unpatentability).

B. The Examiner Did Not Consider the Gibson, Schiltz, and Crol References Forming the Basis of This Petition

The Board should also decline to exercise its discretion to deny review under 35 U.S.C. § 325(d) at least because the Examiner did not analyze the prior art forming the basis of this Petition; indeed, the two main references (Gibson and Crols) were not even cited during prosecution. *See* Section V.C; *Unified Patents, Inc. v. Berman*, No. IPR2016-01571, Paper 10 at *12-*13 (P.T.A.B. Dec. 14, 2016)

(instituting grounds relying on art not cited previously) (informative).

XI. CONCLUSION

Based on the foregoing, Petitioner respectfully requests institution of *inter partes* review to cancel claims 1–5 of the '835 Patent.

Dated: January 26, 2024

Respectfully submitted,

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CERTIFICATE OF WORD COUNT UNDER 37 CFR §42.24(d)

Under 37 C.F.R. §42.24(d), the undersigned certifies that the word count for this *Petition for Inter Partes Review* totals 13,025, excluding the parts exempted by 37 C.F.R. §42.24(a).

The word count was made using the built-in word count function in the Microsoft® Word software used to prepare this document.

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a true copy of this CORRECTED PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 7,292,835 was served via email to the attorneys listed in the mandatory notice for Patent Owner:

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