

Patent Owner Demonstrative

Texas Instruments Incorporated (Petitioner)

v.

ParkerVision Inc. (Patent Owner)

Case: IPR2024-00934

U.S. Patent No. 7,496,342

Oral Hearing: September 9, 2025

DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

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Only Claims 19-21 Remain at Issue in this IPR

Ground 1A	DeMaw
Ground 2	Macnally

Claim Construction

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Claim Construction

“Switching Device”: an electronic device for opening and closing a circuit

- *Intel Corp. v. ParkerVision, Inc.*, IPR2021-00346, Paper 33, at 25-26 (PTAB July 20, 2022)

“Electrically Coupling”: indirectly or directly connecting such that an electric signal can flow between

- *Farmwald v. ParkerVision, Inc.*, IPR2014-01107, Paper 7, at 10 (PTAB Jan. 8, 2015)

“Controlling a Charging and Discharging Cycle”: plain and ordinary meaning

- No timing requirement for charging and discharging

The Claims Do Not Merely Pertain To Optimum/Workable Ranges

18. A method for down-converting an electromagnetic signal, comprising the steps of:

- (1) receiving an information signal;
- (2) inverting the information signal to generate an inverted information signal;
- (3) electrically coupling the information signal to a first capacitor and the inverted information signal to a second capacitor;
- (4) controlling a charging and discharging cycle of the first and second capacitors with first and second switching devices electrically coupled to the first and second capacitors, respectively; and

19. The method of claim **18**, wherein the first capacitor discharges between six percent to fifty percent of the total charge stored therein during a period of time that the first switching device is open, and wherein the second capacitor discharges between six percent to fifty percent of the total charge stored therein during a period of time that the second switching device is open.

Petitioner Has Not Established
Any Ground of Unpatentability

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Petitioner Has Not Established Any Ground of Unpatentability

All challenged claims require **both**:

- 1) the capacitors discharge between 6% and 50% ***when a switch is “open”/off; and***
- 2) the claimed percentage is calculated based on the ***“total charge stored [in the capacitor]”***

Petitioner failed to show either for all Grounds

Petitioner Has Not Established Any Ground of Unpatentability

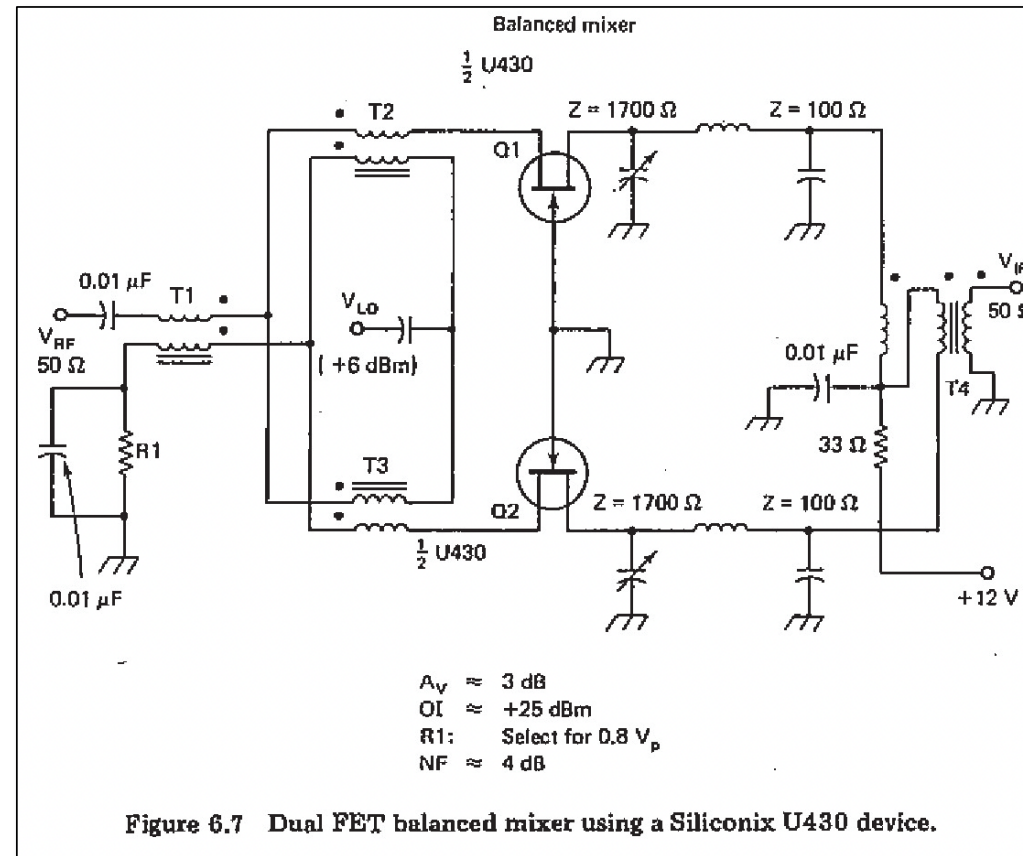
19. The method of claim 18, wherein the first capacitor discharges between six percent to fifty percent of the total charge stored therein during a period of time that the first switching device is open, and wherein the second capacitor discharges between six percent to fifty percent of the total charge stored therein during a period of time that the second switching device is open.

DeMaw (Ground 1A)

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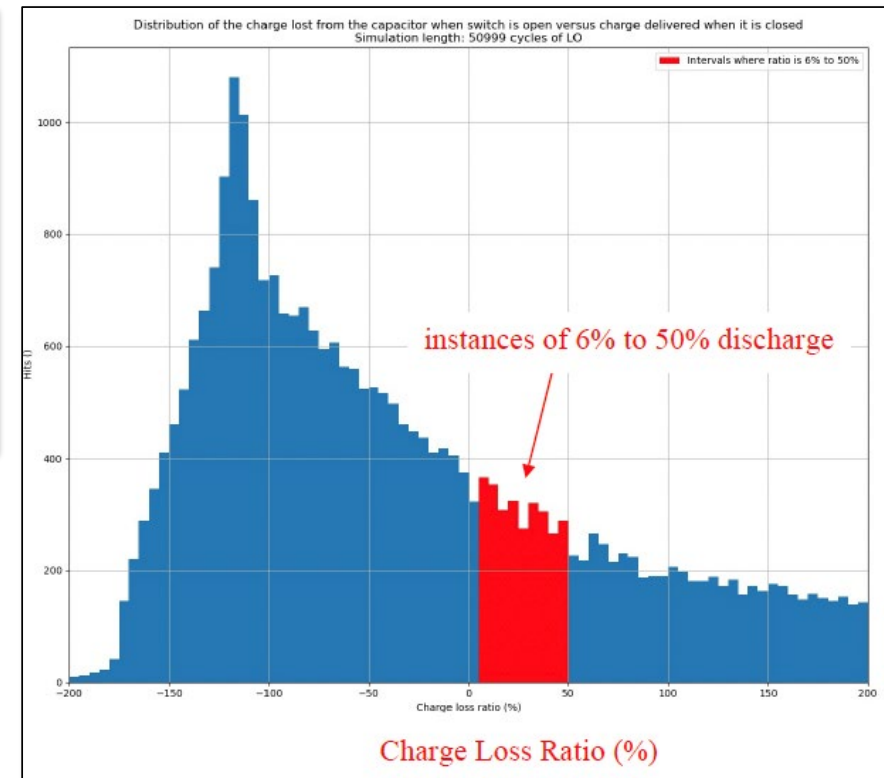
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Petitioner Fails to Show Obviousness Over DeMaw (Ground 1A)



The Petition Relies Solely on Simulations Performed by Galton for the Claimed Discharge Percentages

DeMaw teaches claim 19. Specifically, using the transition edges of the LO signal, and the knowledge that the switch opening and closing is dictated by the LO signal amplitude, the charge ratio of in claim 19 can be computed on a cycle-by-cycle basis using a python post-processing script applied to the raw simulation waveforms. This ratio was collected for 50,999 simulation cycles and plotted as a histogram, shown in DEMAW-SIM-FIG. 7. TI-1003, 114.



Galton's Original Calculation Ignores Accumulated Charge from Previous Cycles

Galton's *improperly* performs a cycle-by-cycle analysis:

With regards to the DeMaw in your original declaration, when you calculated the discharge percentages you did so by looking at what came into the capacitor in one charging cycle and what was discharged by the capacitor in the subsequent discharging cycle, correct?

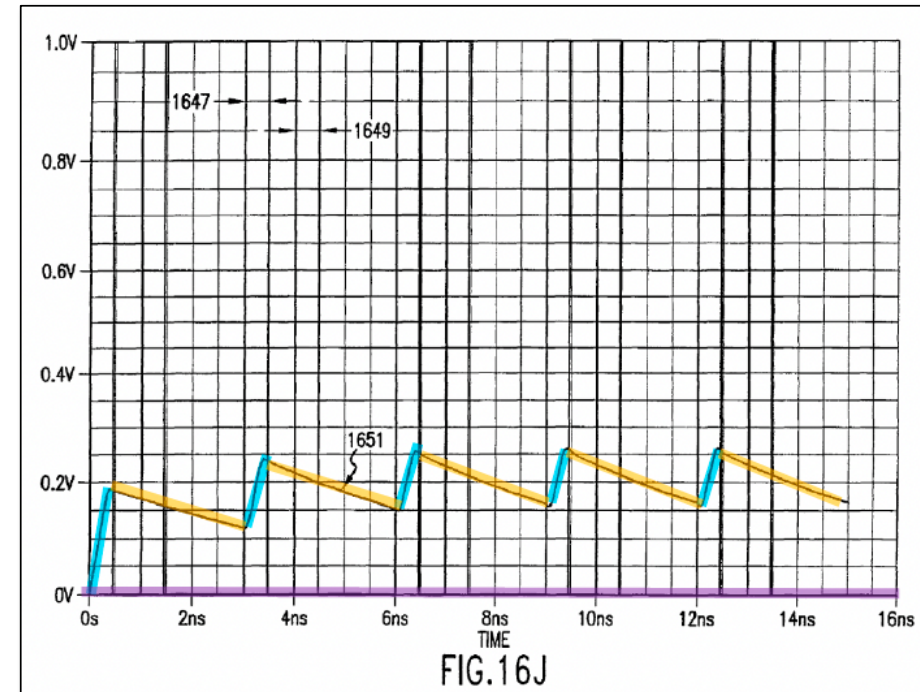
A Yes. That is what I did in my original declaration.

Galton's Original Calculation Ignores the Claim Language

Claims require “**total** charge stored”:

19. The method of claim 18, wherein the first capacitor discharges between six percent to fifty percent of the total charge stored therein during a period of time that the first switching device is open, and wherein the second capacitor discharges between six percent to fifty percent of the total charge stored therein during a period of time that the second switching device is open.

Charge **accumulates** over multiple charging cycle:



POR, 79-80; Sur-Reply, 7-11; Ex. 1001,
Claims 19-21, Fig. 16J.

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Petitioner Attempted to Re-write the Claims in Reply

Reply:

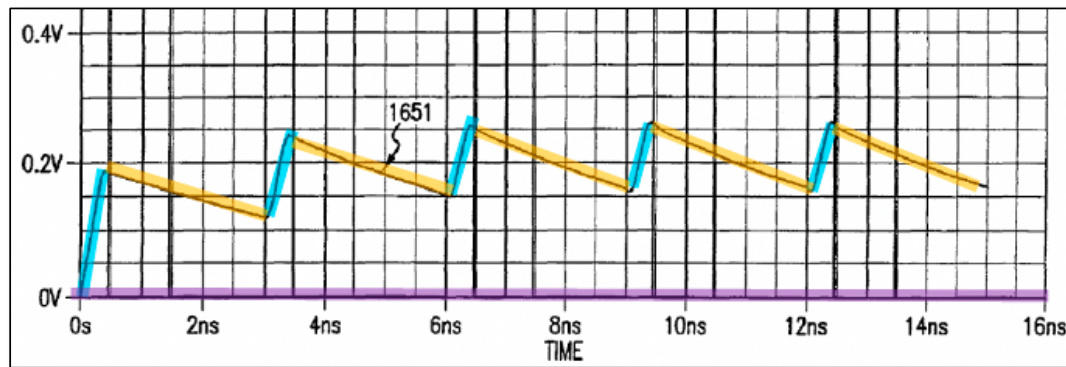
PO's interpretation of the "total charge stored" is incorrect. TI-1003, ¶114. Claim 18's circuit down-converts an EM signal by transferring energy, that was stored on a capacitor during an aperture period, by discharging the stored energy between aperture periods. TI-1001, 19:29-40, 38:4-15. The energy stored during the aperture period is the representative sample of the information signal. Thus, the change in the total charge stored during the aperture period, and not the entire charge stored by the capacitor, is the relevant charge for the down-conversion.

Rewrite of Claim Language:

"...wherein the first capacitor discharges between six percent to fifty percent of the **change in the** total charge stored therein during a period of time that the first switching device is open..."

Petitioner's New Interpretation is Inconsistent with the Specification and Claim Language

Specification: charges build up over multiple cycles



Claim 18: “plurality of ... cycles”

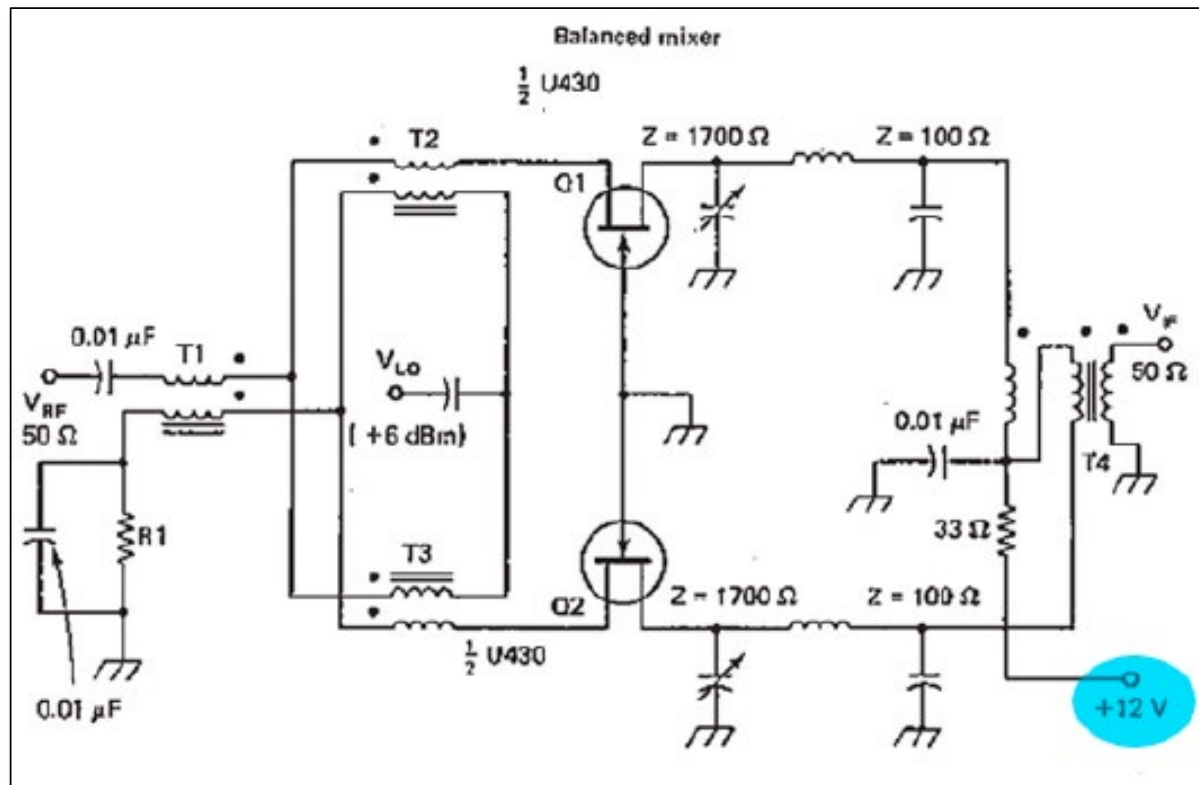
18. A method for down-converting an electromagnetic signal, comprising the steps of:

- (1) receiving an information signal;
- (2) inverting the information signal to generate an inverted information signal;
- (3) electrically coupling the information signal to a first capacitor and the inverted information signal to a second capacitor;
- (4) controlling a charging and discharging cycle of the first and second capacitors with first and second switching devices electrically coupled to the first and second capacitors, respectively; and
- (5) performing a plurality of charging and discharging cycles of the first and second capacitors to generate first and second down-converted information signals across first and second impedance devices, respectively;

wherein the information signal is used to store a charge on the first capacitor when the first switching device is closed and the inverted information signal is used to store a charge on the second capacitor when the second switching device is closed.

Galton's New Calculation Improperly Omits 12V Bias Voltage From "Total Charge Stored"

DeMaw *always* has 12V across the capacitors:



Q All right. So do you see on the right side of -- DeMaw which is PDF page 8, there's a Figure 6.7?

Do you see that?

A Yes.

Q Okay. And DeMaw discloses a 12-volt bias current, right, in the lower right-hand corner?

A Yes.

Q Okay. And the 12 volts is sitting on the capacitors of DeMaw, correct?

A The 12-volt bias does -- does set up a -- a constant voltage on those -- on those capacitors, yes, a bias voltage.

Sur-Reply, 11-13; Ex. 1016, Fig. 6.7;
Ex. 2047, 21:21-22:11.

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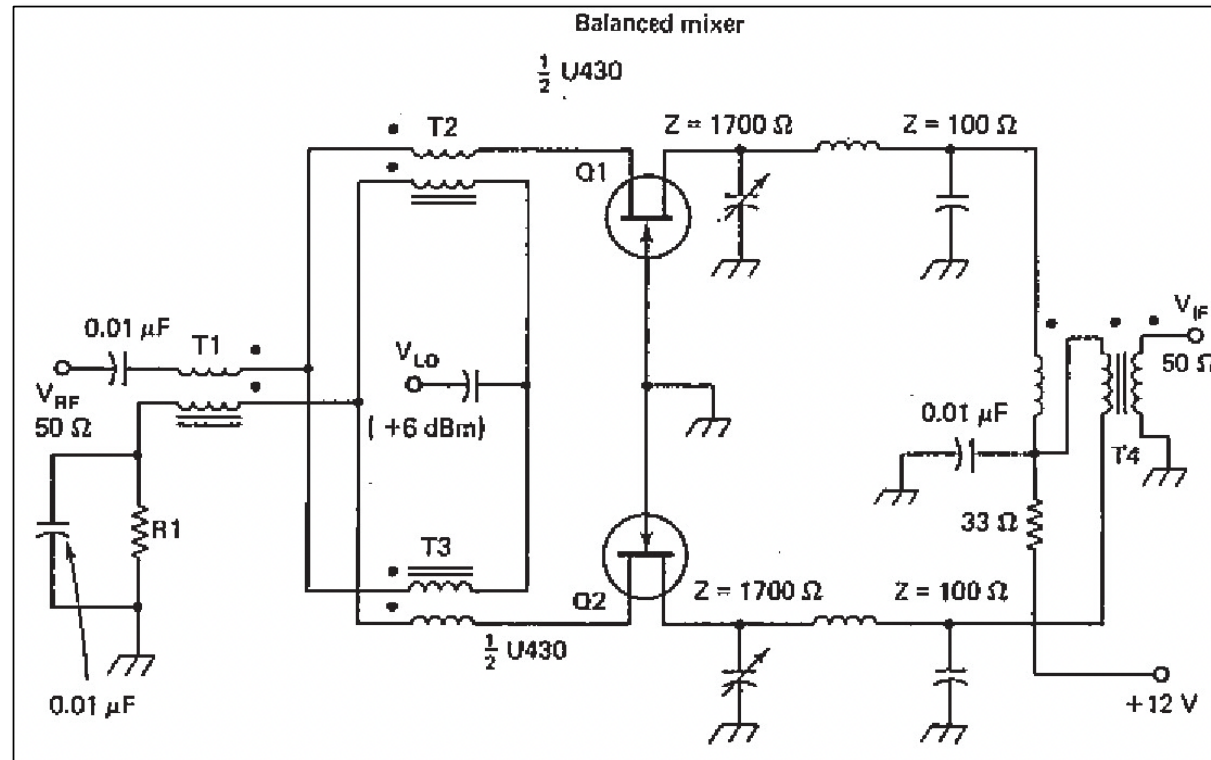
Petitioner/Galton Introduce New Theory/Calculation in Reply

Galton's new calculation ***improperly omits*** 12V bias voltage from "total charge stored"

In your new simulations that you performed
where it says "bias removed," that means you
removed the bias voltage that was sitting on those
capacitors, correct, in performing your
calculations of -- of discharge percentages,
correct?
A Yes.

DeMaw's JFETs Are Never Turned Off

DeMaw biases JFETs to *avoid pinch-off and remain on/open*:



$A_V \approx 3 \text{ dB}$
 $OI \approx +25 \text{ dBm}$
R1: Select for 0.8 V_p
 $NF \approx 4 \text{ dB}$

POR, 30; Sur-Reply, 13-15; Ex. 2021, ¶¶
136, 199-202; Ex. 1016, Fig. 6.7.

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Petitioner's Original Theory As To What It Means For a Switch To Be "Open"/Off

Petition: Switches are off when *drain currents are zero*

103. The switches are off when their drain currents are zero and on when their drain currents are non-zero.

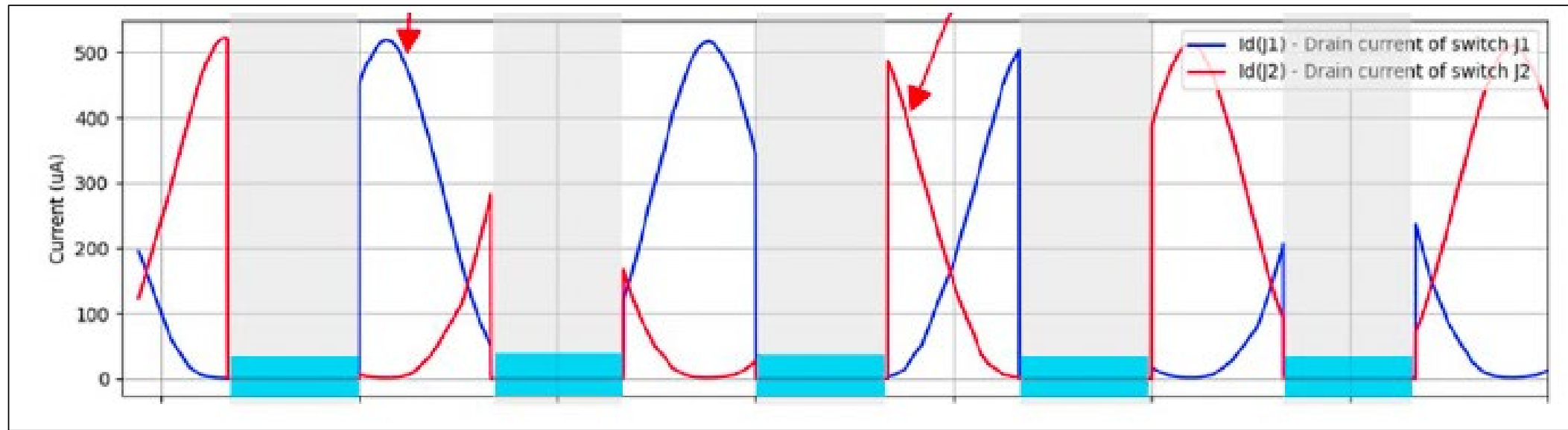
Q When the gate source voltage of the JFETs in DeMaw equals zero volts, the channel is open, allowing for conduction of current. Correct?

MR. MAGEE: Same objection.

A That is not correct. Open -- open means -- means it doesn't conduct. Closed means conduct. Like when you -- when you open a switch, the lights turn off. When you close a switch, the lights turn on.

Petitioner's Original Theory As To What It Means For a Switch To Be "Open"/Off

Original Simulation: Discrete periods of **zero** current



POR, 51; Sur-Reply, 16-18; Ex. 1003, ¶108;
Ex. 1042, ¶8; Ex.-2021, ¶¶285-86.

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Galton Admitted Mistakes In Original Simulations

Galton admitted that he used the ***wrong transistor model*** in original simulation:

Q Is there anything else in the circuit that you've changed in relation to Figure 6.7 of DeMaw?

A Well, unfortunately we -- we accidentally, as I mentioned, used the wrong models for the -- for the devices. They still work and the circuit still works, but -- and again, the conclusions don't change. But we accidentally didn't point the simulator to the -- to the Siliconix models. And so we ended up using generic JFETs models supplied by the simulator.

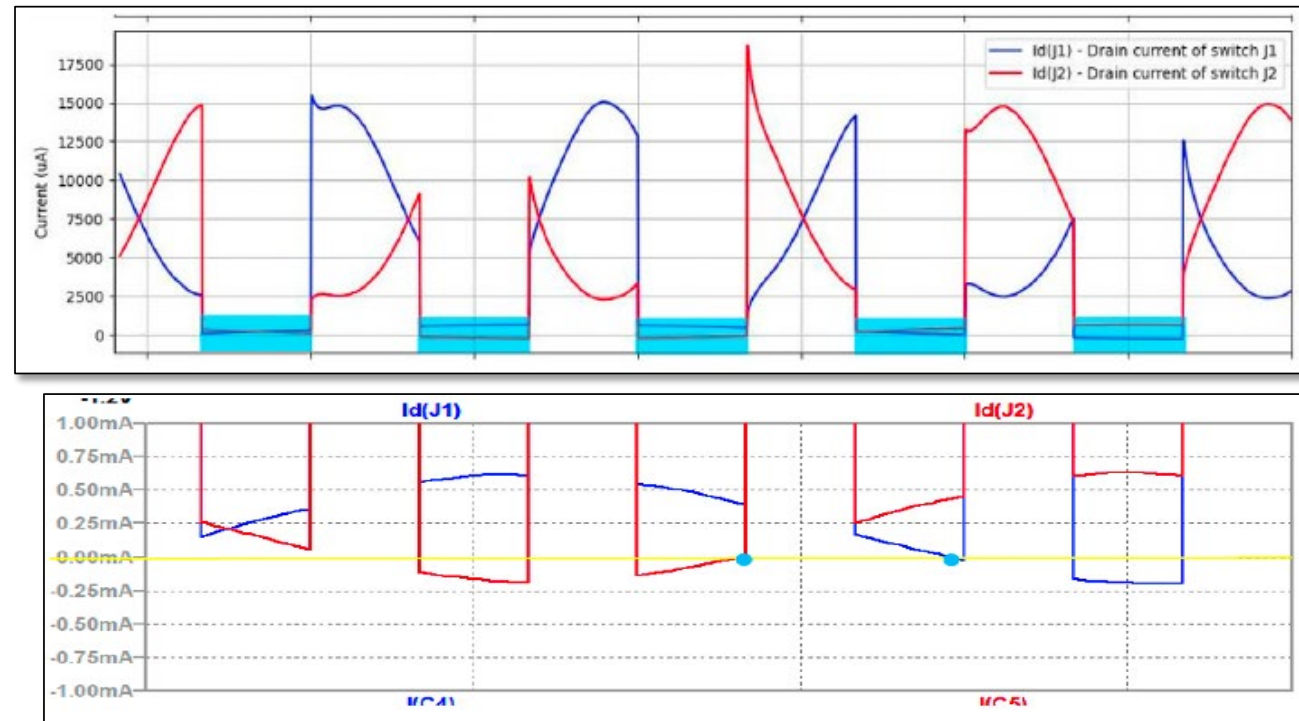
And so that was an inadvertent change.

Sur-Reply, 16; Ex. 2036, 51:14-52:3; 45:9-20; Ex. 2047, 14:19-15:3, 17:22-18:7.

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None of Galton's New Simulations Exhibits Periods of Zero Current

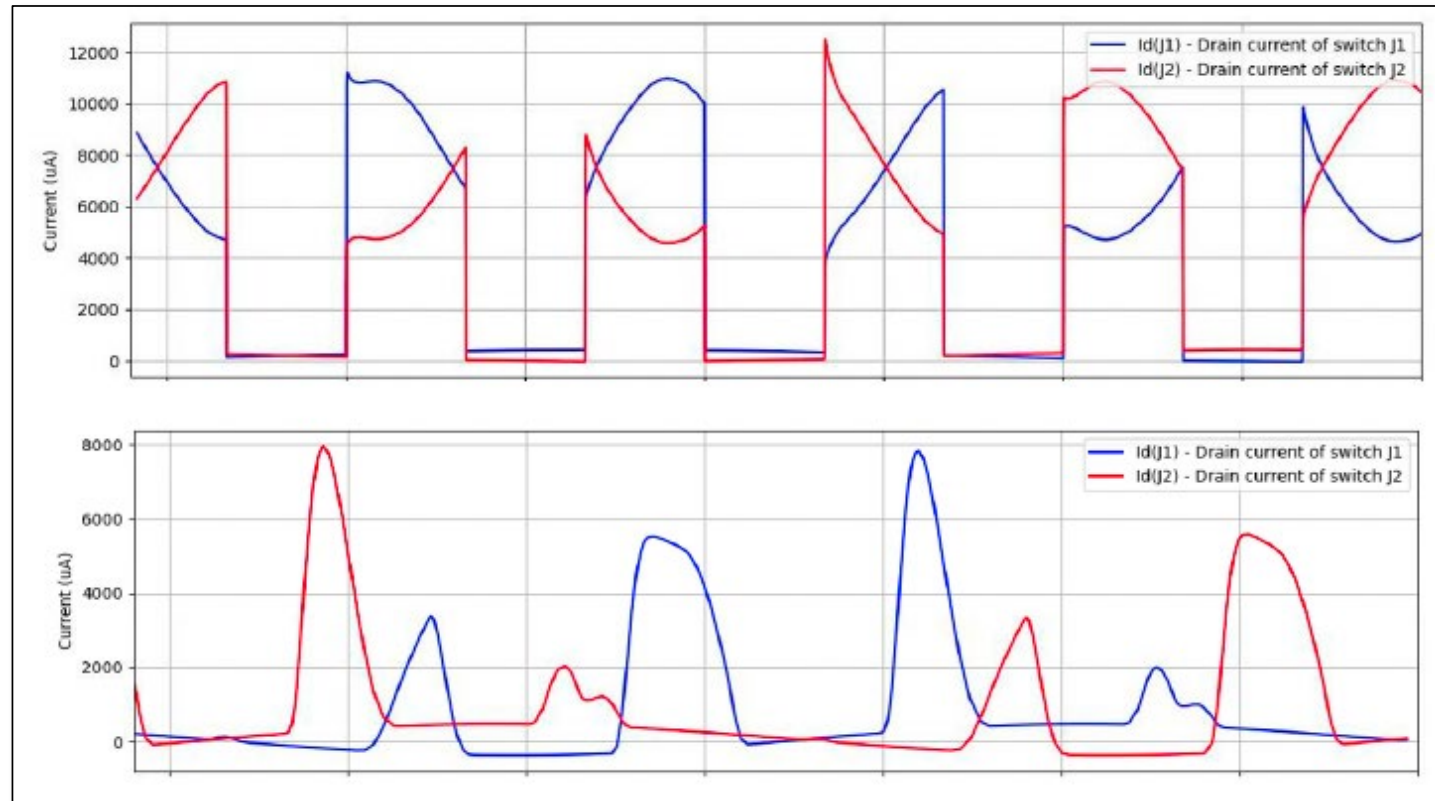


POR, 51; Sur-Reply, 16-18; Ex. 1003, ¶1108;
Ex. 1042, ¶18; Ex. 2021, ¶¶285-86.

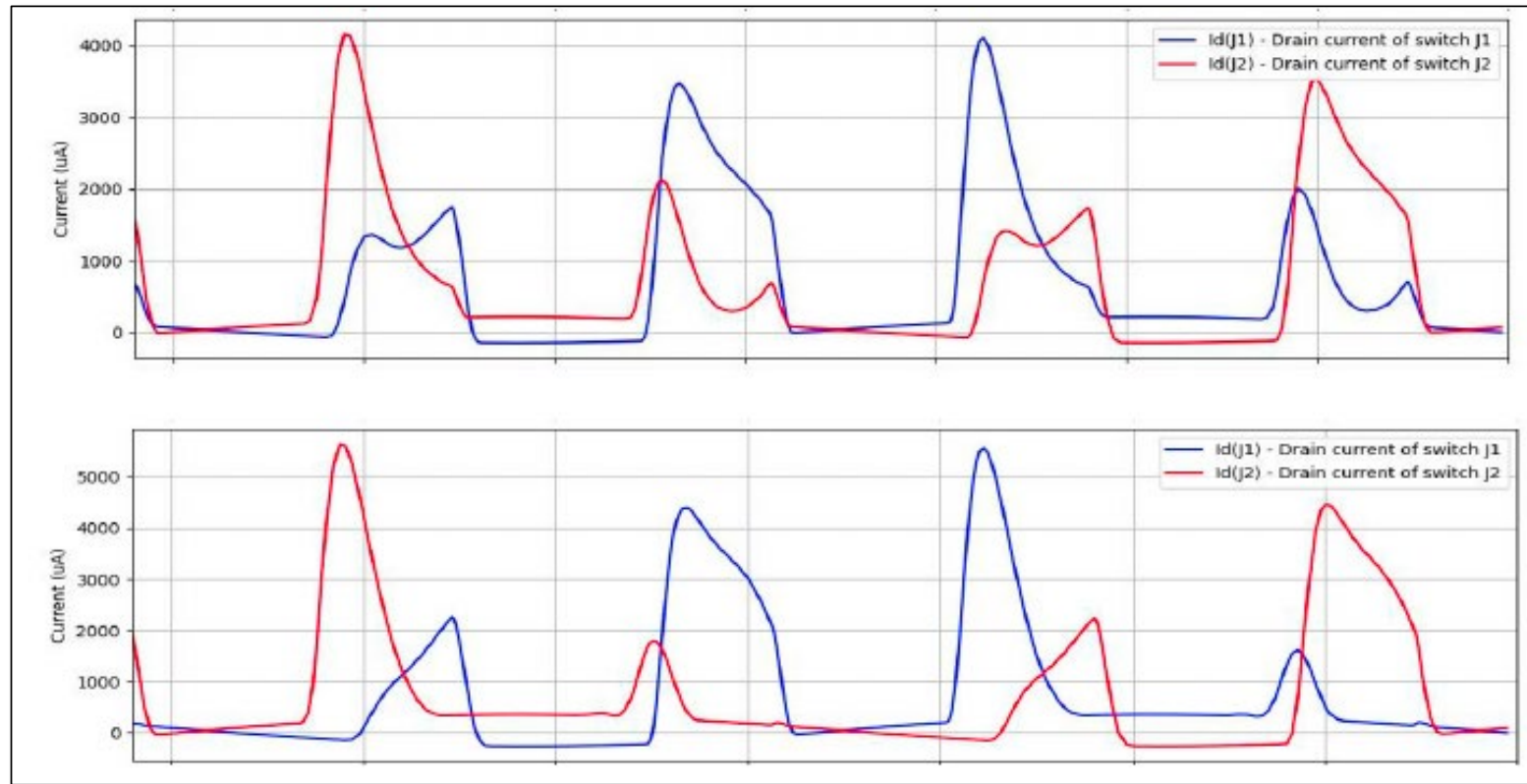
DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

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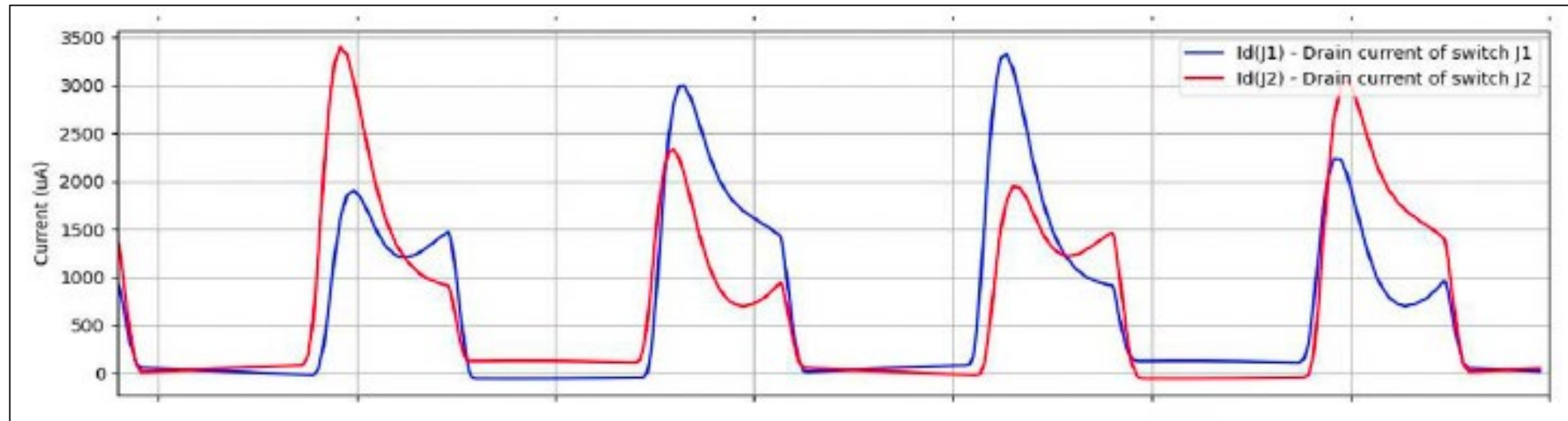
None of Galton's New Simulations Exhibits Periods of Zero Current



None of Galton's New Simulations Exhibits Periods of Zero Current



None of Galton's New Simulations Exhibits Periods of Zero Current



Petitioner Changes Theory As To What It Means For a Switch To Be “Open”/Off

PO’s argument the switches must entirely block current ignores that the ’342 patent characterizes “open” as when the control signal is “between apertures.” TI-1001, 38:4-15 (“capacitors are sized to discharge...during a period of time that a switching device is open (i.e., between apertures)” (emphasis added)).

Galton Undermines Petitioner's Alternative Theory

Galton admits that “between apertures” is not necessarily “open”/off

A POSITA would recognize that the control signal being “between apertures” does not automatically imply an “off” state of the JFET, contrary to what Dr. Ricketts argues. *See, e.g., EX2021, ¶117.*

Claim Language Contradicts Petitioner's Alternative Theory

19. The method of claim 18, wherein the first capacitor discharges between six percent to fifty percent of the total charge stored therein during a period of time that the first switching device is open, and wherein the second capacitor discharges between six percent to fifty percent of the total charge stored therein during a period of time that the second switching device is open.

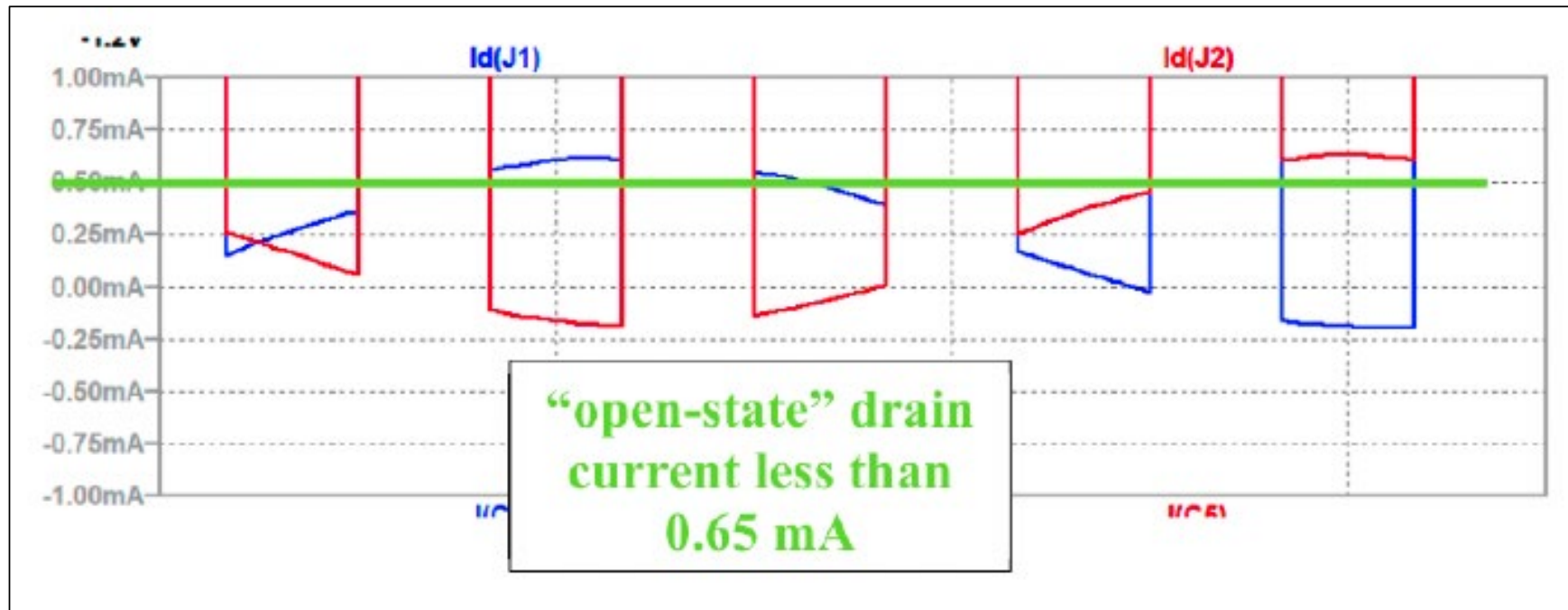
Petitioner Changes Theory As To What It Means For a Switch To Be “Open”/Off

Switch is “open” at *unspecified non-zero* current

PO’s argument the switches must entirely block current ignores that the ’342 patent characterizes “open” as when the control signal is “between apertures.” TI-1001, 38:4-15 (“capacitors are sized to discharge...during a period of time that a switching device is open (i.e., between apertures)” (emphasis added)).

Petitioner's Alternative Theory is Arbitrary

Reply: Arbitrarily asserts that any current below 0.65mA is “*effectively*” off



Reply 12-14; Sur-Reply, 22-23;
Ex. 2021, ¶285.

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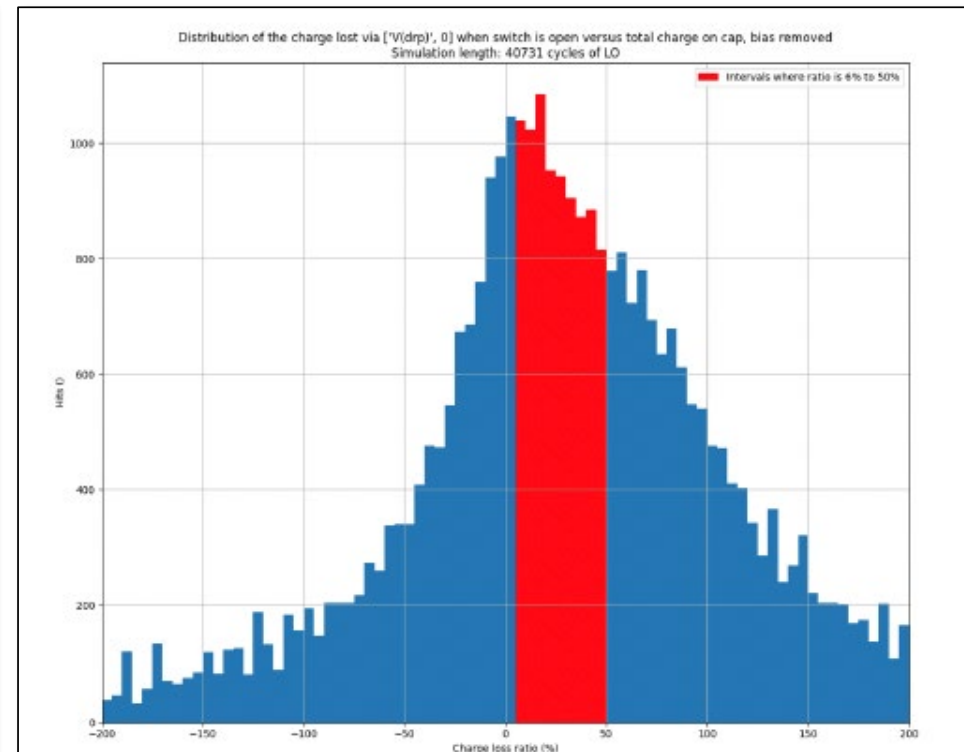
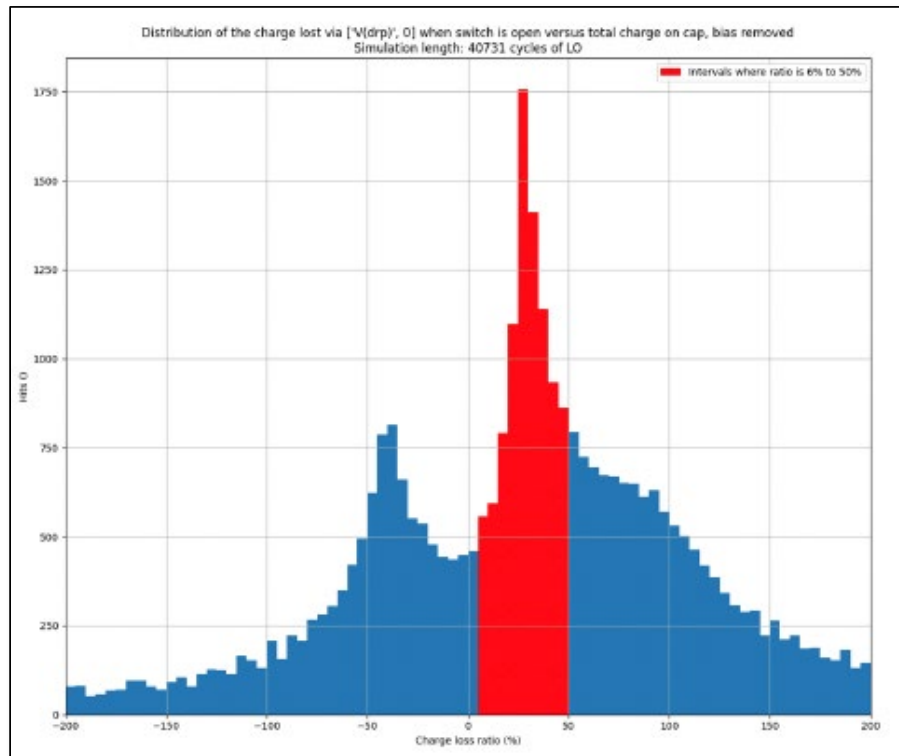
30

Galton Has Not Shown Any Discharge Percentage Occurs When DeMaw's JFET Is "Open"

Q When you were doing the -- the new calculations in your most recent declaration using Dr. Ricketts' view of "total charge stored therein," did you calculate the discharge percentages using the discharge that was occurring for the entire time between apertures?

A I did.

Galton's New Calculations Are During The Entire Aperture Period



Sur-Reply, 26; Ex. 1060, ¶58.

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Petitioner's Argument Regarding Inoperability Is A Red Herring

Petition:

103. The switches are off when their drain currents are zero and on when their drain currents are non-zero. An example of one such off-period is annotated

Reply:

If an absolute “off-state” were imposed onto the claimed switching devices (*i.e.*, active switching devices, like MOSFETs or JFETs), the claims could never be satisfied because no practical switching devices would suffice.¹

Petitioner Cannot Rely on Oxner

Petition:

In discussing DeMaw, RPX noted that the circuit of Figure 6.7 “had a similar configuration to FIG. 16H of the ’342 patent, which the switches upstream of the capacitor.” Petition, PTAB-IPR2014-01107, 17-18. DeMaw, itself, notes that Figure 6.7 is similar (but not identical) to a circuit suggested in Oxner. DeMaw, 196.

Here, DeMaw is a different circuit than Oxner.

Reply:

In fact, Oxner, from where DeMaw derives its circuit, lists multiple suitable JFETs. TI-1041, 6-33; TI-1016, 8 (referencing Oxner). Oxner evinces that DeMaw need not use a U430 JFET, and that a POSITA would consider JFET selection routine optimization. TI-1060, ¶¶11-15.

Petitioner Misrepresents Ricketts' Opinion

426. Using the data from Dr. Galton's own simulation results and plugging the data into the correct formula demonstrates that nearly all of the percentage discharged falls outside the ranges set forth in claims 19-21. Nevertheless, to the extent any percentages fall within the claimed ranges, these do not reflect when the switch is open, as required by the claim.

Petitioner Misrepresents Ricketts' Opinion

318. Significantly, the Section III waveforms (DEMAW-SIM-FIG. 5.2, 5.3, 5.4, 5.5, 5.6) in Dr. Galton's Second Declaration confirm my analysis from Section XIII.B.2 above: with the correct U430 model, and even with all of Dr. Galton's new changes, the JFETs never turn "off." Instead, they conduct continuously in both directions—consistent with the expected behavior of a non-sampling mixer as disclosed in DeMaw. See Appendix B (showing zoomed-in waveforms of the Section III simulations).

DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

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Galton's Original Calculation Ignores "Total Charge Stored"

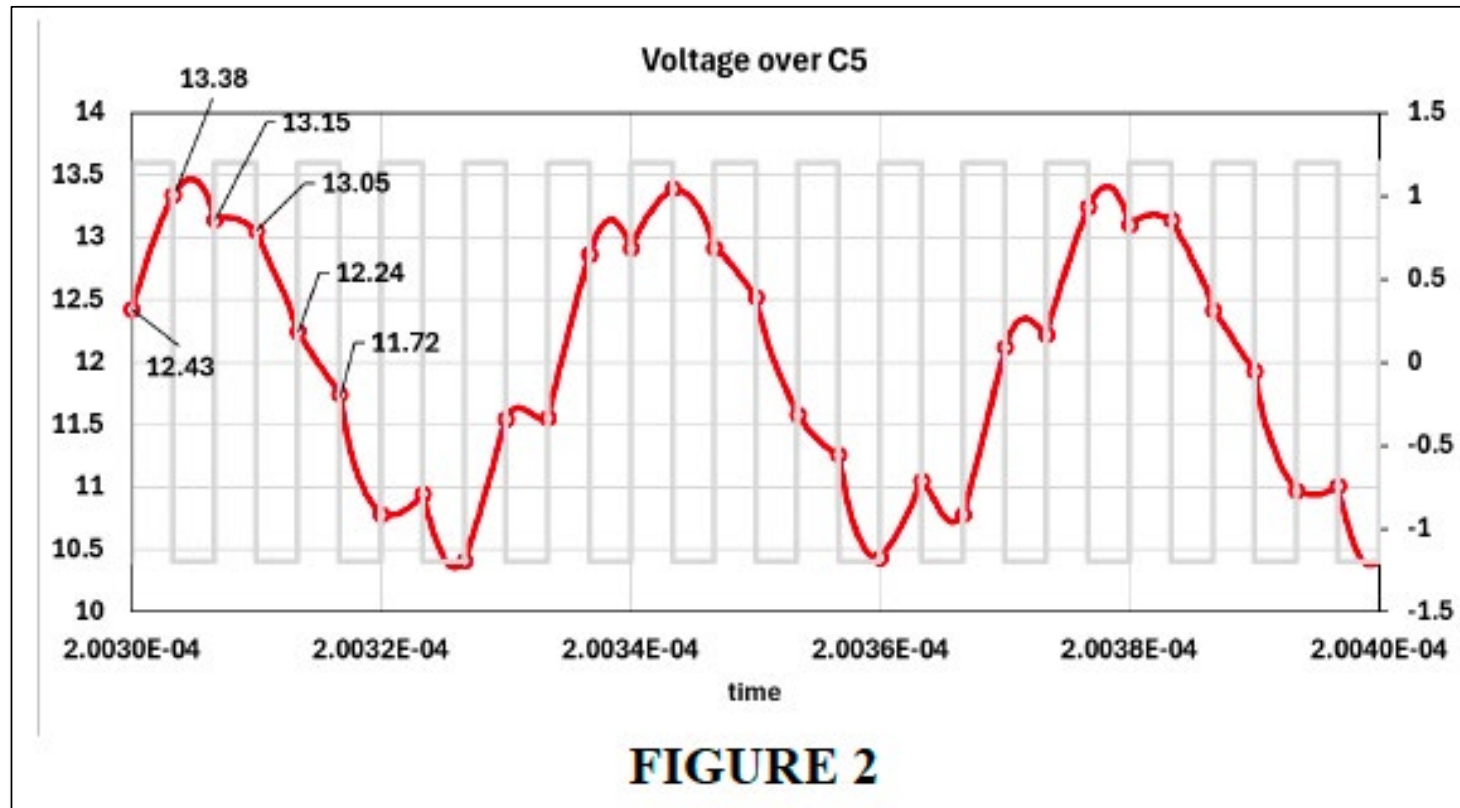
Galton's **incorrect formula** for calculating discharge percentage:

$$\% \text{ discharge} = \frac{\text{Charge discharged during the period switch is open}}{\text{Charge stored in the *same* cycle}}$$

Correct formula for calculating discharge percentage:

$$\% \text{ discharge} = \frac{\text{Charge discharged during the period switch is open}}{\text{Total charge stored at the beginning of the discharge period}}$$

Ricketts' Analysis

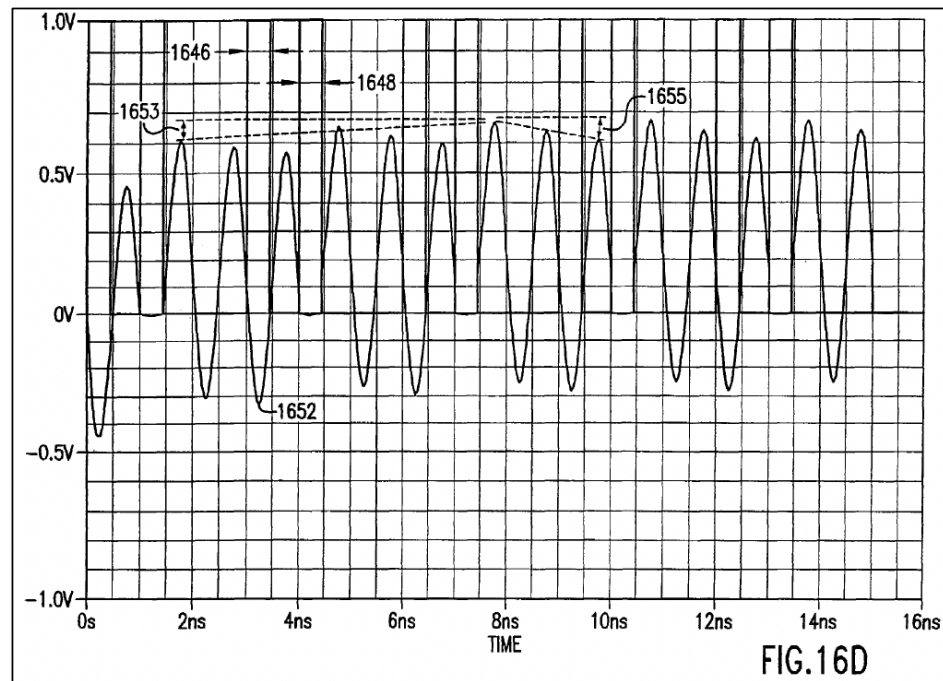


POR, 81-85; Ex. 2021, ¶¶416-25.

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Specification Does Not Support Galton's Ignoring DeMaw's Bias Current



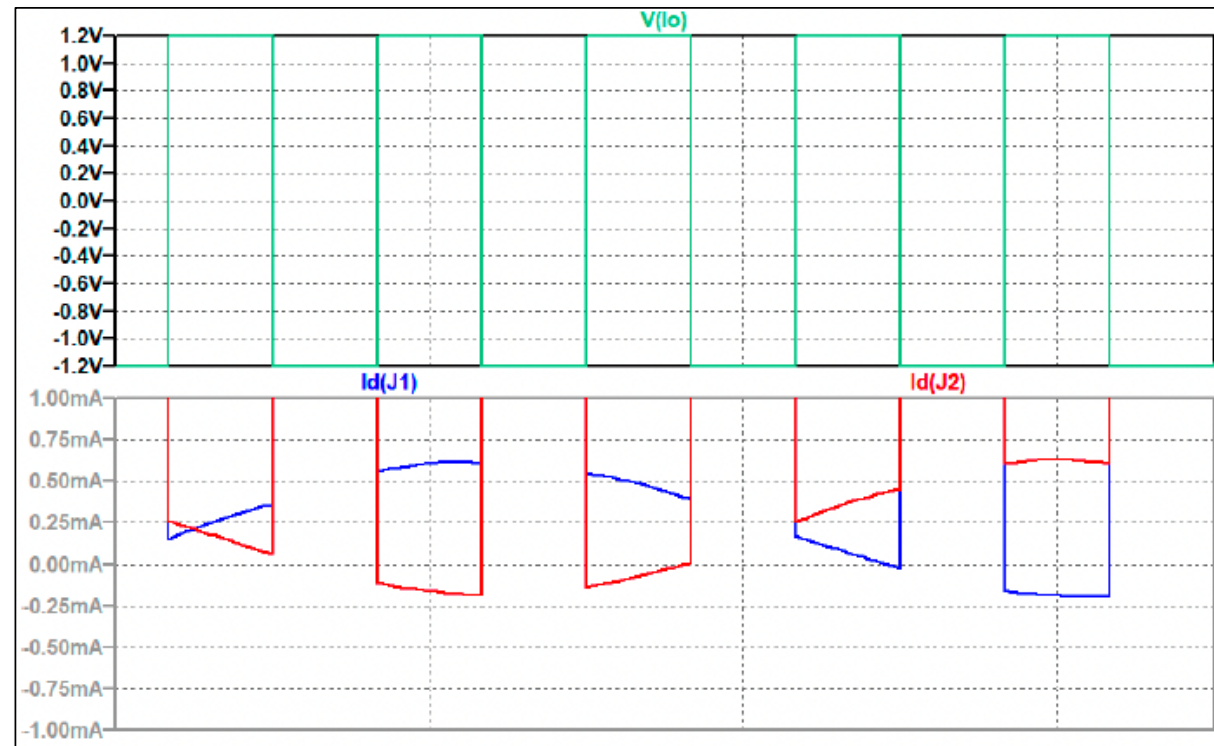
For example, rail to rail dynamic range is possible with minimal increase in power. In an example integrated circuit embodiment, UFD module 1832 provides +55 dmb IP2, +15 dbm IP3, at 3.3V, 4.4 ma, -15 dmb LO. GSM system requirements are +22 dbm IP2, -10.5 dmb IP3. CDMA system requirements are +50 dmb IP2, +10 dbm IP3. Accordingly, the invention satisfies these standards.

In an example integrated circuit embodiment, the present invention provides +55 dmb IP2, +15 dbm IP3, @3.3V, 4.4 ma, -15 dmb LO. GSM system requirements are +22 dbm IP2, -10.5 dmb IP3. CDMA system requirements are +50 dmb IP2, +10 dbm IP3.

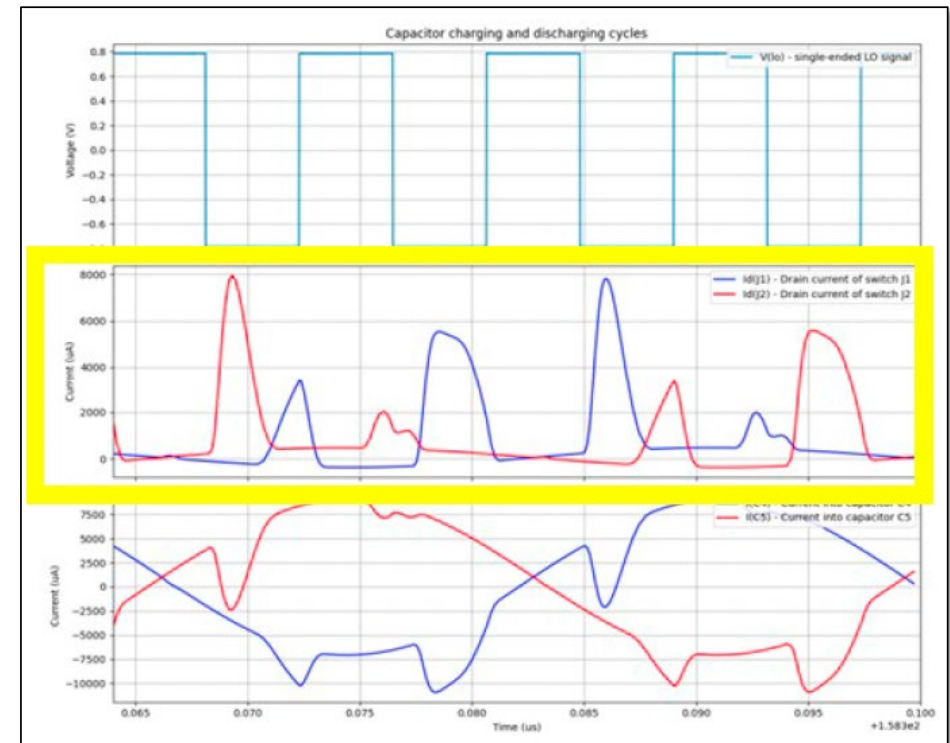
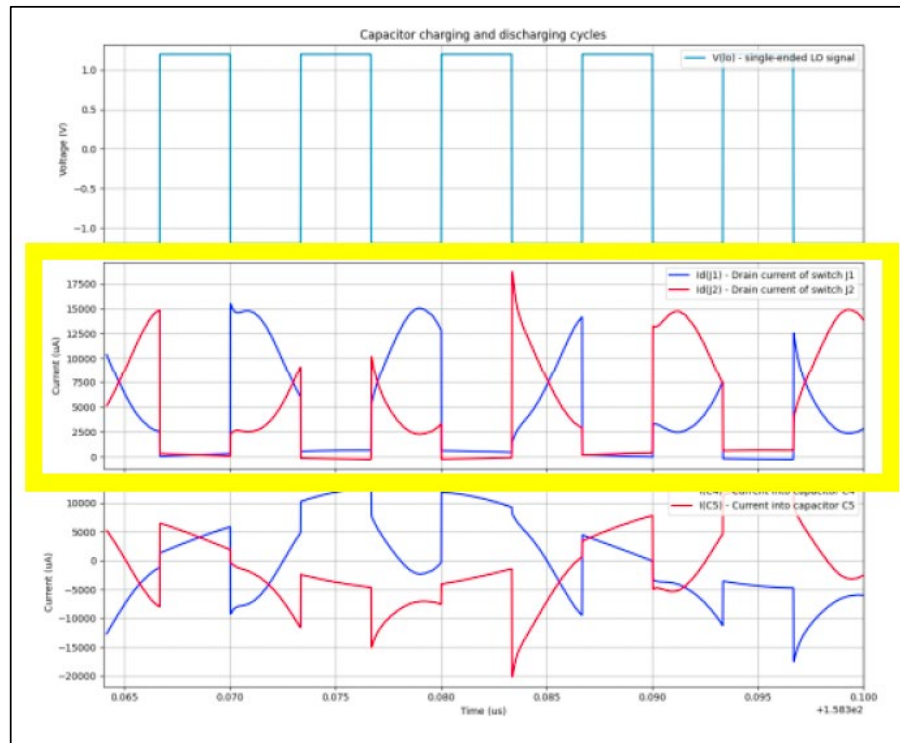
Petitioner Ignores DeMaw's Express Teaching

PO next complains about Dr. Galton's biasing network as resulting in "a gate-source voltage (V_{GS}) at or near the JFET's pinch-off voltage." POR, 43 (emphasis added). DeMaw recommends (does not require) a V_{GS} of 0.8 the pinchoff voltage, which is "near the JFET's pinch-off voltage." *Id.* Thus, PO's complaint lacks merit.

High LO Does Not Indicate That The Switch Is Open



High LO Does Not Indicate That The Switch Is Open



POR, 87-89.

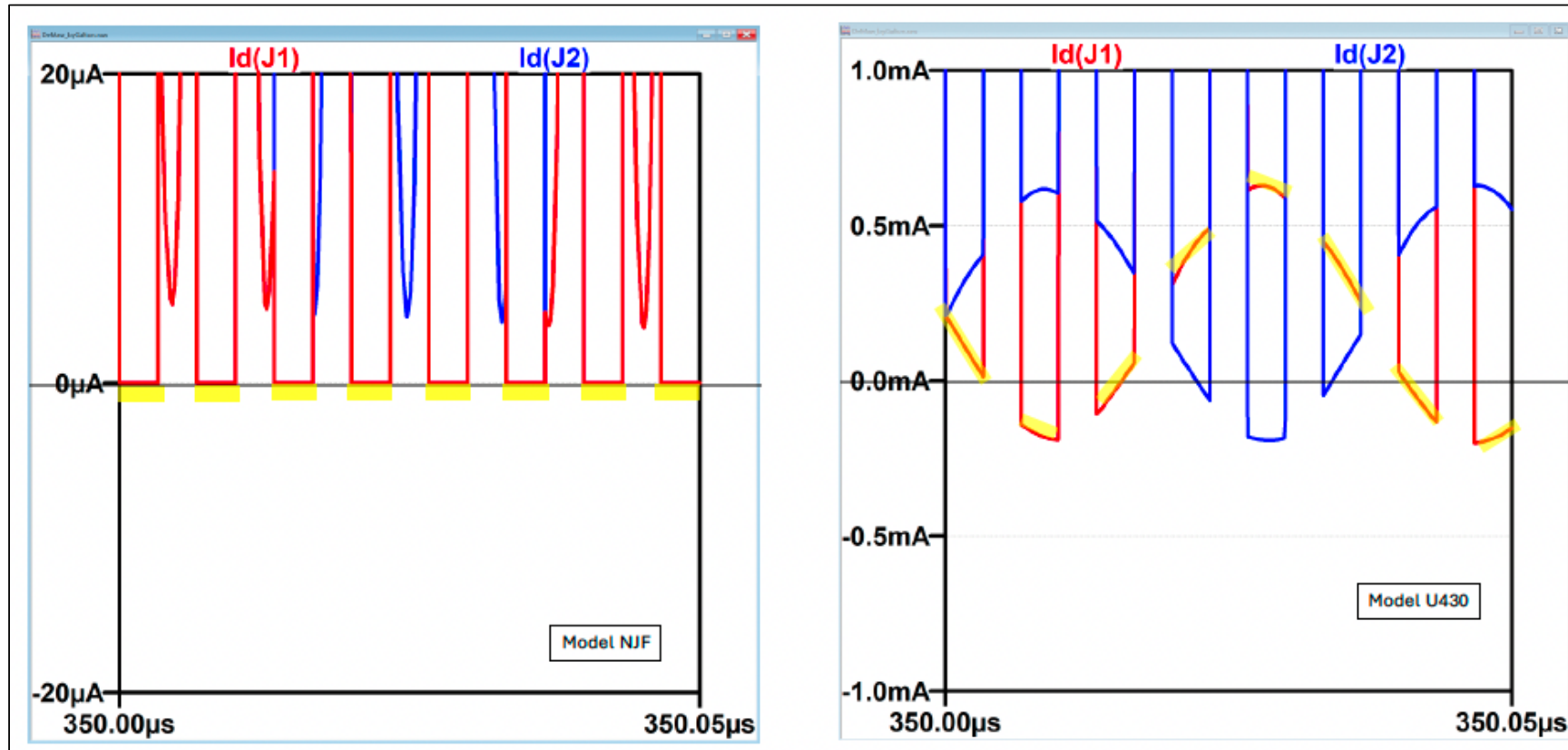
DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

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Galton Overstates Discharge Period

436. By defining the “switch open period” as the entire LO high interval, Dr. Galton’s analysis includes time segments during which the transistor is clearly conducting current. This inflates the time interval over which voltage is measured and distorts the computed discharge percentage. For example, if LO is high from time t_0 to t_1 , but the drain current remains non-zero for all or part of that window, then the switch is not actually “open” during the full period. By including that full interval in his calculation, Dr. Galton overstates the duration of discharge, which biases the percentage downward or causes incorrect interpretation of charging versus discharging behavior.

Using The Correct Transistor Model Dramatically Changes Simulation Results



POR, 46-48; Ex. 2021, ¶¶257-67.

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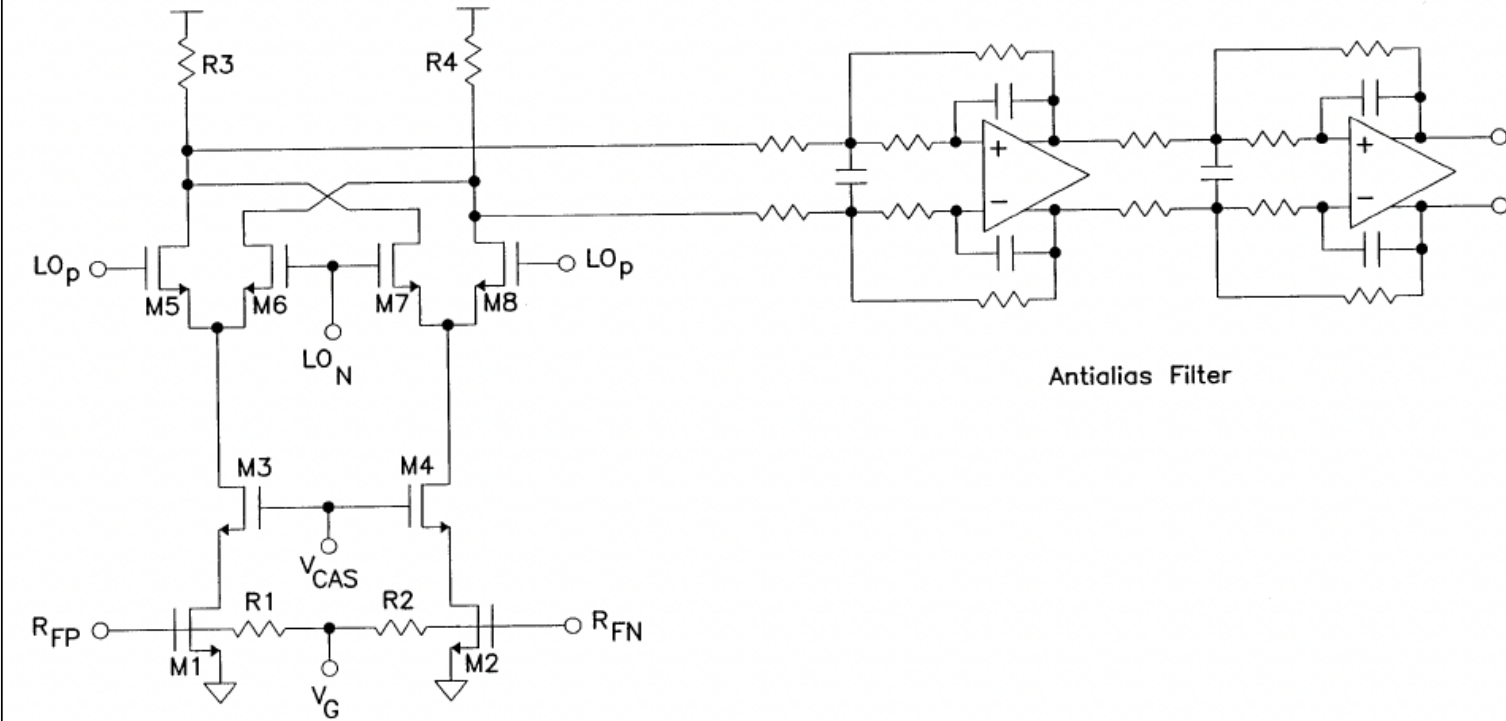
Macnally (Ground 2)

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Petitioner Fails to Show Obviousness Over Macnally (Ground 2)

FIG. 3



POR, 90-102; Sur-Reply, 26-41; Ex. 1023.

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MacNally Does Not Disclose The Claimed “Coupling”

18. A method for down-converting an electromagnetic signal, comprising the steps of:

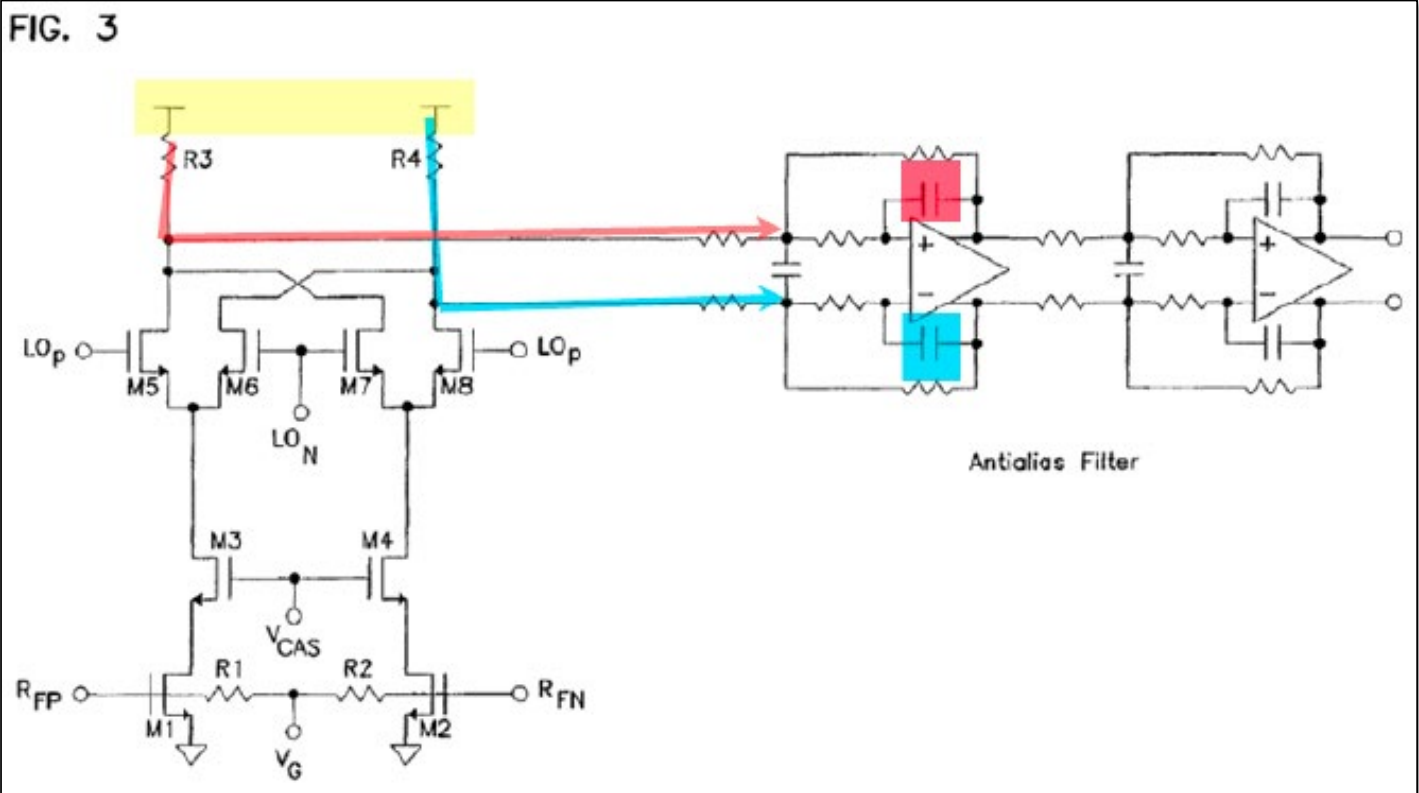
- (1) receiving an information signal;
- (2) inverting the information signal to generate an inverted information signal;
- (3) electrically coupling the information signal to a first capacitor and the inverted information signal to a second capacitor;

“Electrically coupling”: “indirectly or directly connecting such that an *electrical signal can flow between.*”

Petitioner Concedes That Macnally's Capacitors Do Not Receive the R_{FP}/R_{FN} Signals

86. A POSITA would understand that the information signal applied at the gate-side of M1 and M2 is essentially the same information signal on the drain current flowing through M1 and M2. The RF_P input signal causes M1 to behave like a variable current source, which consequently causes the otherwise constant bias current through M1 to vary in proportion to the RF_P input signal. Same for RF_N and M2, the inverted information signal. Thus, the information and inverted information carried by the RF_P and RF_N inputs are translated to the current flowing in the mixer. But the information is preserved. Pet. 61-62.

Current That Flows To Macnally's Capacitors Comes From The Power Supply—Not From RF Signal Paths



POR, 93-94; Sur-Reply, 27-28; Ex. 2021, ¶¶ 452-53.

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ParkerVision Exhibit 2048
TI v. ParkerVision - IPR2024-00934

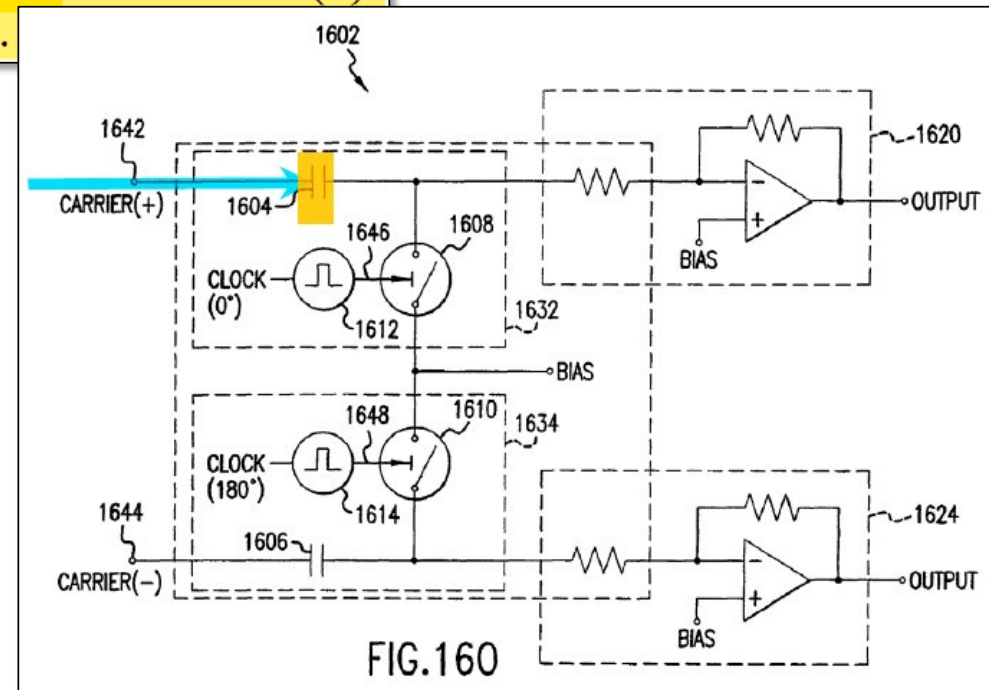
Current That Flows To Macnally's Capacitors Comes From The Power Supply—Not From RF Signal Paths

Reply:

The RF_P input signal causes M1 to behave like a variable resistor, which consequently causes the otherwise constant bias current through M1 to vibrate at the same frequency as the RF_P input signal, communicating the information from the RF_P input signal to the bias current. TI-1060, ¶¶86-89; EX2021, ¶202. Same for RF_N and M2, the inverted information signal. TI-1060, ¶86. Thus, the information and inverted information carried by the RF_P and RF_N inputs are translated to the current flowing in the mixer. *Id.*

Petitioner Misrepresents the Specification

In step 6204, the received RF information signal is electrically coupled to a capacitor. For the receiver shown in FIG. 16O, the RF signal is electrically coupled to the carrier(+) port of receiver 1602 and capacitor 1604.

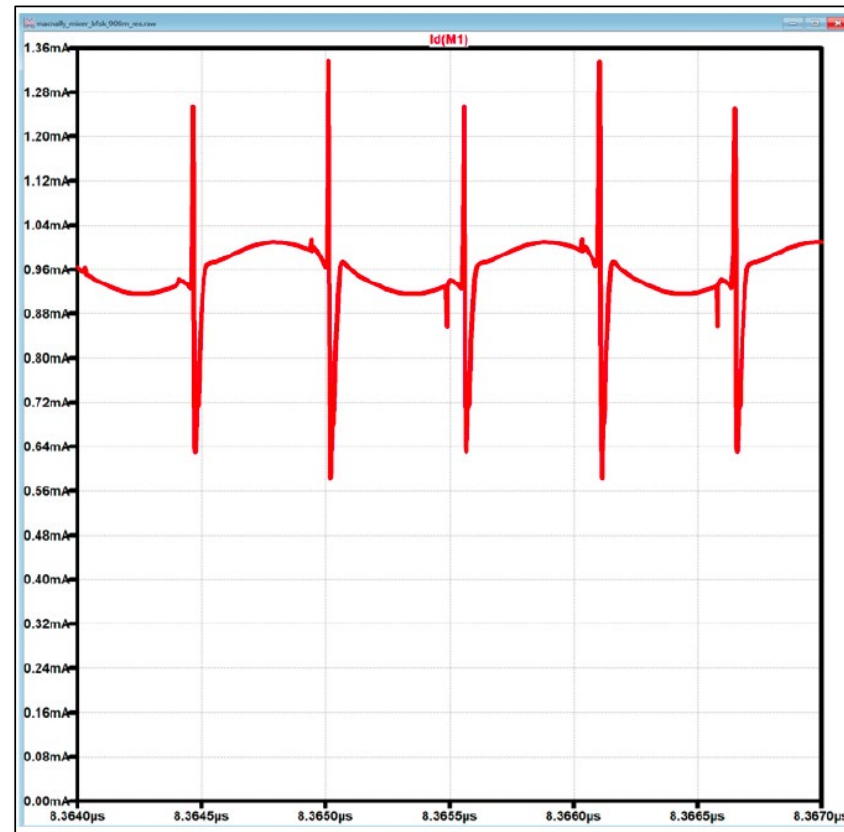


Reply, 24-27; Sur-Reply, 29-31;
Ex. 1001,49:43-46, Fig. 16O.

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Ricketts' Testing Showing That Current Only Flows in Downward Direction in Macnally is Unrebutted



POR, 95-97; Sur-Reply, 31-32;
Ex. 2021, ¶1457.

DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

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Petitioner's Assertion That Electrons Flow to Macnally's Capacitors Is Unsupported By Galton

Reply:

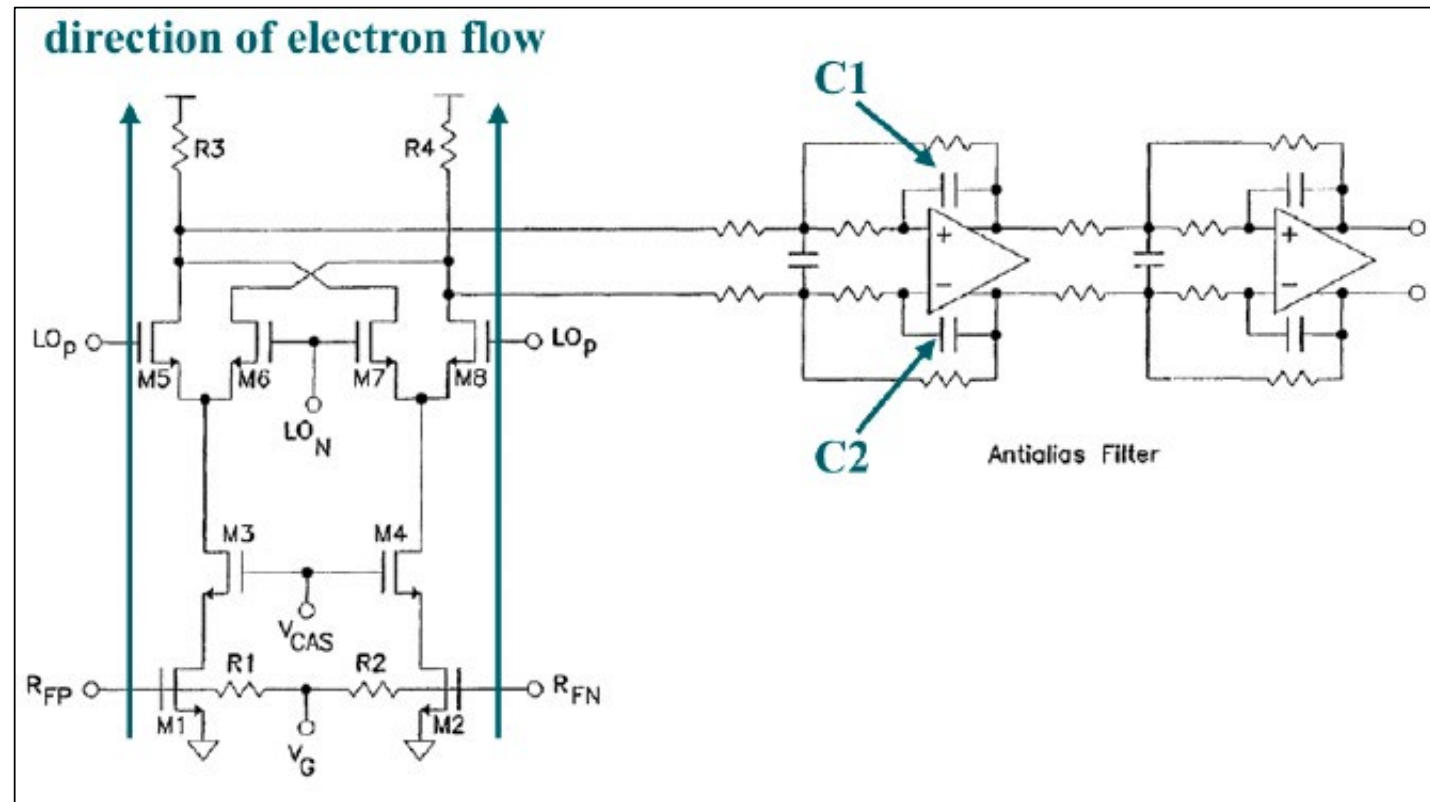
As shown, the electron flow is from the source to the drain. TI-1060, ¶¶133-135; EX2021, ¶¶39, 41. PO's argument that current in Macnally "flows downward" misleadingly applies conventional current, which was arbitrarily defined to flow from positive to negative. TI-1060, ¶135. In Macnally electrons flow from ground through transistors M1-M8 and resistors R3 and R4 and capacitors C1 and C2. *Id.*

Petitioner's Assertion That Electrons Flow to Macnally's Capacitors Is Unsupported By Galton

Galton:

Dr. Ricketts's argument presented in Paragraphs 222-225 that current can only flow downward towards ground ignores the fact that electrons actually flow upward through transistors M1– M8 and resistors R3 and R4 toward the positive power supply terminal:

Petitioner's Assertion That Electrons Flow to Macnally's Capacitors Is Unsupported By Galton



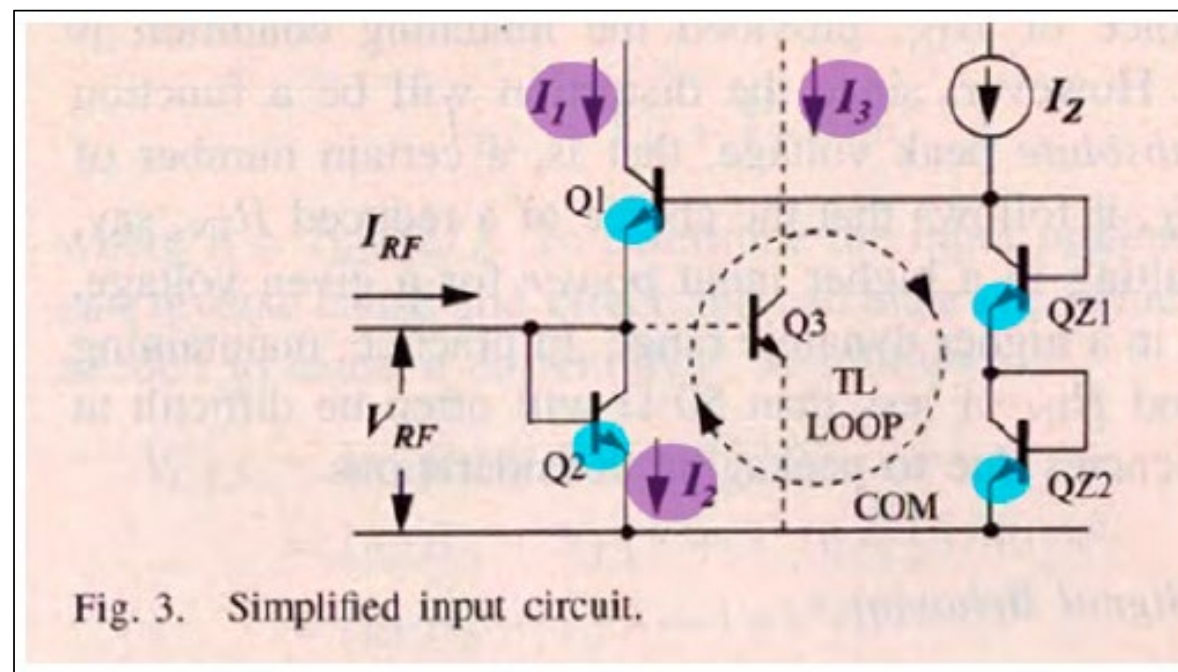
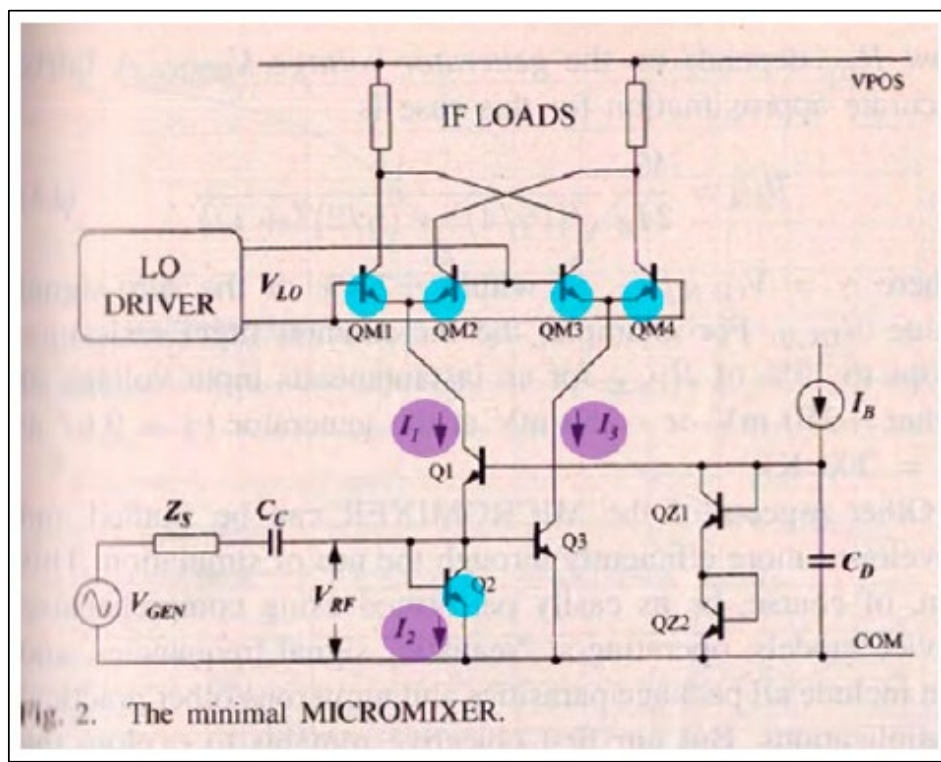
Reply, 28; Sur-Reply, 32-33.

DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

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The Claims Should Be Analyzed Based On Conventional Current—Not Electron Flow

Petitioner's **own** technical references use **conventional current**:



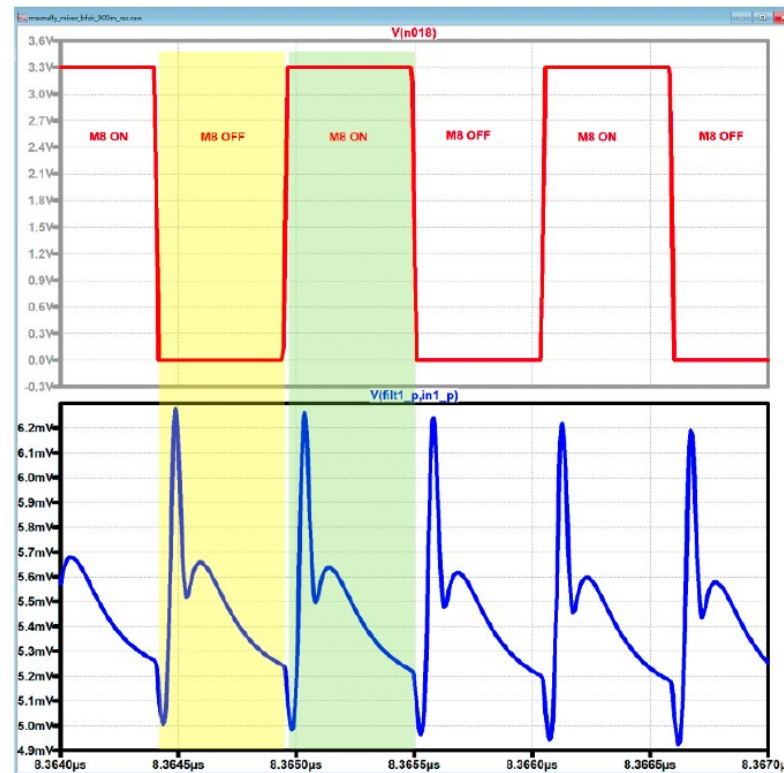
Macnally Does Not Disclose a “Switching Device”

18. A method for down-converting an electromagnetic signal, comprising the steps of:

- (1) receiving an information signal;
- (2) inverting the information signal to generate an inverted information signal;
- (3) electrically coupling the information signal to a first capacitor and the inverted information signal to a second capacitor;
- (4) controlling a charging and discharging cycle of the first and second capacitors with first and second switching devices electrically coupled to the first and second capacitors, respectively; and

“Switching device”: an electronic component for opening and closing a circuit

Macnally's M5 and M8 Do Not Open and Close a Circuit



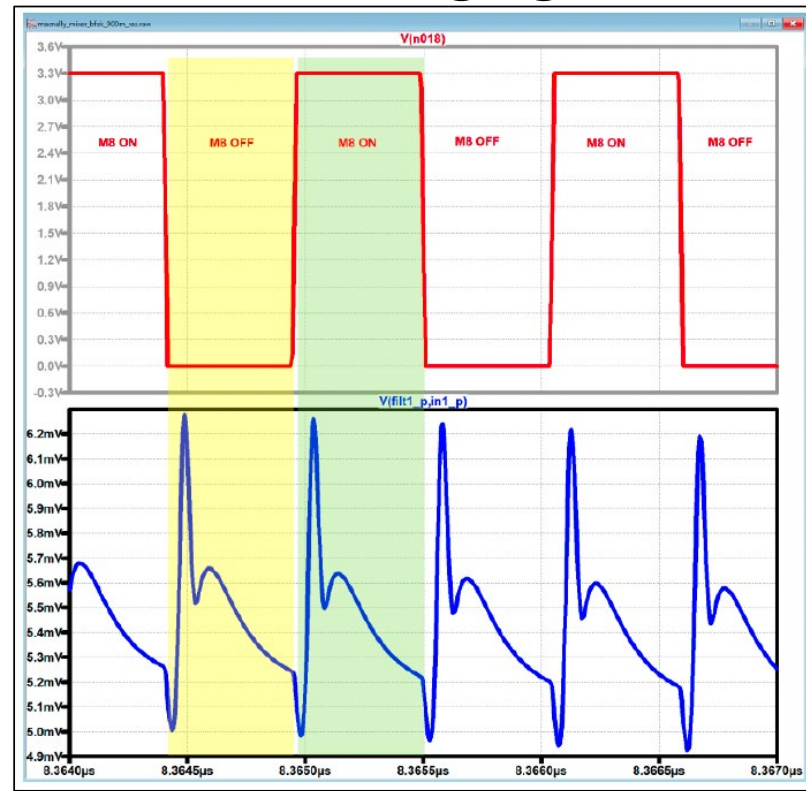
POR, 98-99; Reply, 28-29; Sur-Reply, 36-38; Ex.2021, ¶462.

DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

59

Macnally Does Not Disclose the Claimed Discharge Percentage

When M5 and M8 are open/off, **both** charging and discharging occur:



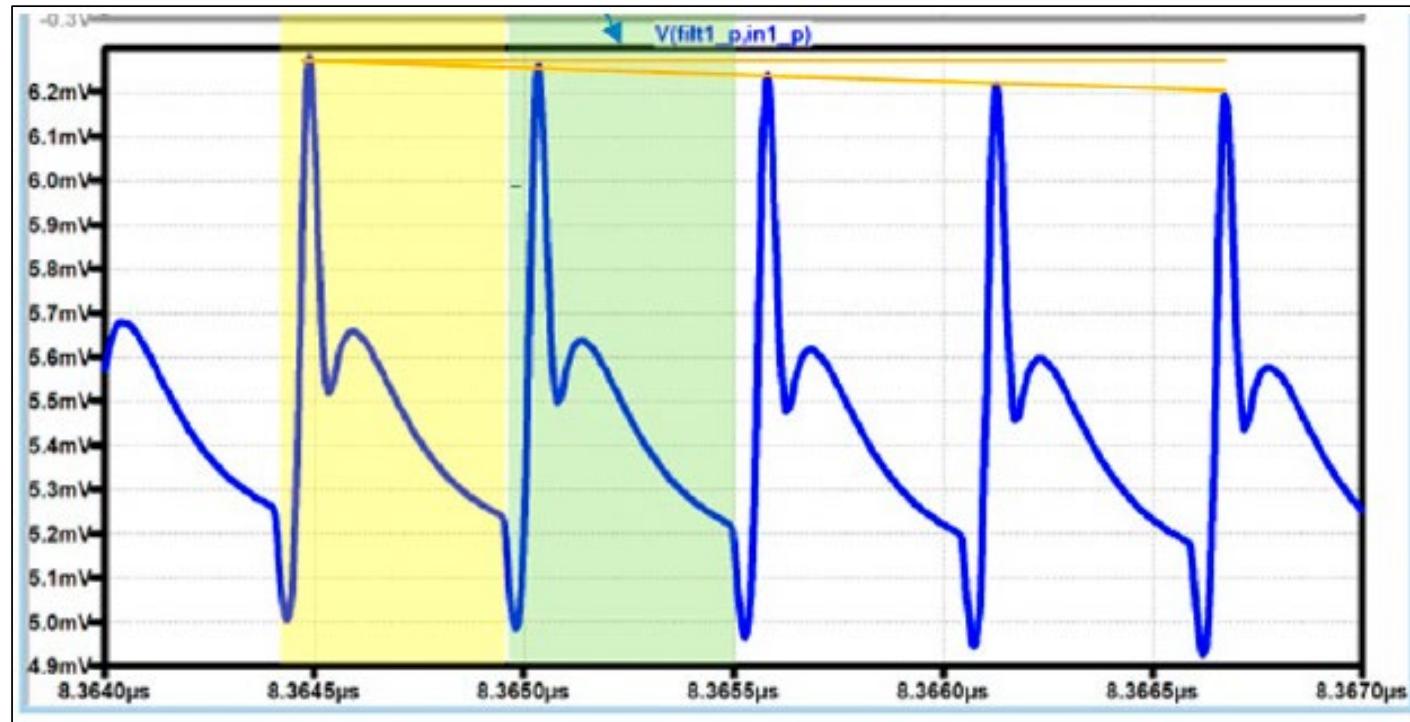
Sur-Reply, 38-41; Ex.2021, ¶462.

DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

60

Macnally Does Not Disclose the Claimed Discharge Percentage

Discharge is only a fraction of 0.1mV or 1.6%:



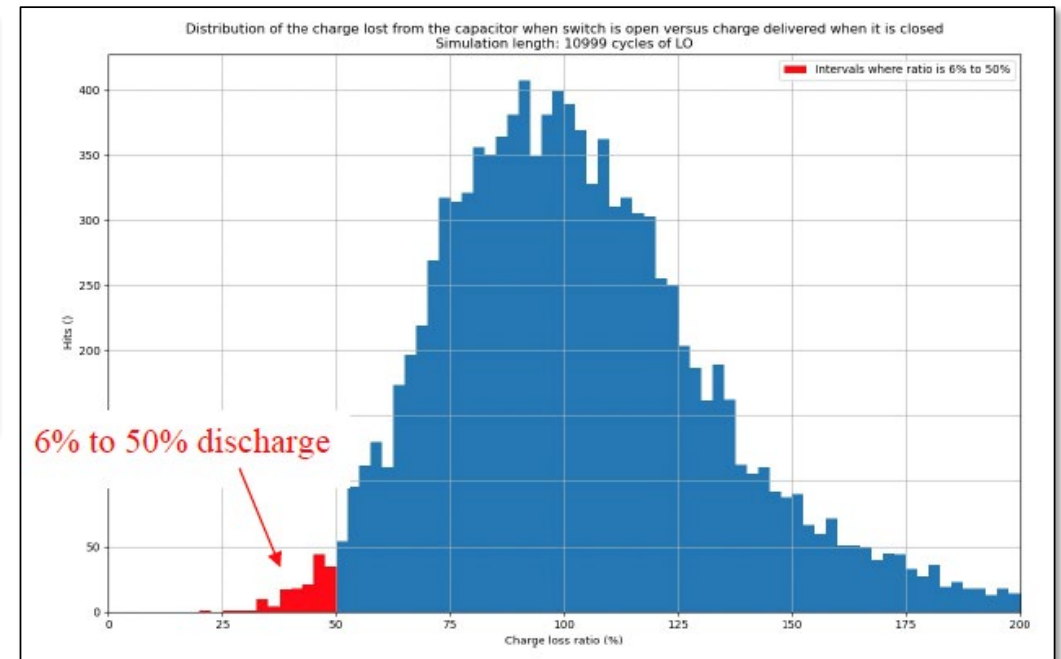
Sur-Reply, 38-41; Ex.2021, ¶462.

DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

61

Galton Provides No Explanations as to How the Percentages Were Calculated

Macnally teaches claim 19. As the mixer switches are driven by the full-swing LO clock signal, it is possible to compute the intervals of time when the switches are open versus closed. TI-1003, 149. The identical post-processing script that was used to generate figure DEMAW-SIM-FIG. 7 is used to generate MACNALLY-SIM-FIG. 4, below. A region of occurrences within the 6% to 50% range is marked in red. *Id.*



Petitioner's Reply Violates 37 C.F.R. §§ 42.6(a)(3) and 42.22(a)(2)

Petitioner submitted two declarations from Dr. Galton (“Galton”): Ex.-1060, which spans *94 pages* (over *16,600 words/139 paragraphs*) of *substantive* analysis; and Ex.-1042, which spans *164 pages* (over *9,400 words/169 paragraphs*) of *substantive* analysis.