UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MEDIATEK INC.,
Petitioner,

v.

PARKERVISION, INC.,
Patent Owner.

IPR2025-00030
Patent 8,498,593

DECLARATION OF PATENT OWNER'S EXPERT DR. DAVID RICKETTS

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I have personal knowledge of the facts set forth in this declaration and, if called to testify as a witness, would testify under oath as follows:

I. BACKGROUND

1. I have been retained as an expert on behalf of ParkerVision, Inc. ("ParkerVision") in the above-captioned matter (IPR2025-00030).

2. I have been asked by ParkerVision to provide my expert opinion regarding the validity of claims 1-20 of U.S. Patent No. 8,498,593 ("the '593 patent"). For the reasons set forth below, it is my opinion that claims 1-20 of the '593 patent are valid.

II. PROFESSIONAL QUALIFICATIONS

3. I am currently Full Professor of Electrical and Computer Engineering at the North Carolina State University. In my position I conduct research and teach undergraduate and graduate students in the area of electrical and computer engineering. The courses I teach include Advanced Analog Integrated Circuit ("IC") Design, Radio System Design, Analog Circuit Laboratory and Power Management IC Design. I also lead a research group that conducts research and design of electrical and electronic circuits, including millimeter wave and microwave circuits and systems, radio frequency identification ("RFID") circuits, wireless power transfer circuits, analog circuits, and radio frequency ("RF") circuits. In lead research in power electronics and power conversion integrated

circuits. I also conduct research in mixed signal RF/digital systems, including microcontroller-based Bluetooth systems. I have served in my current position since 2012.

4. Prior to my current position, I served as an Assistant Professor oF Electrical and Computer Engineering and Assistant Professor of Materials Science and Engineering at Carnegie Mellon University from 2006 to 2012.

5. I received my B.S. and M.S. in Electrical Engineering in 1995 and 1997, respectively, from Worcester Polytechnic Institute in Worcester, Massachusetts. I received my Ph.D. in Electrical Engineering from Harvard University in Cambridge, Massachusetts in 2006.

6. Prior to entering academia, I worked as an engineer in private industry holding several engineering and managerial positions where I developed and oversaw the development of electrical and electronic circuits, including those related to power transfer, power conversion, and semiconductor design in wired and wireless circuits and systems.

7. From 1995 to 1999, I held a position as an engineer and senior engineer at American Power Conversion, where I designed AC-DC and DC-DC converters. In 1996, I completed my master's Thesis with Analog Devices on the design of a 622 MHz Frequency Synthesizer.

8. From 1999 to 2001, I held a position as a Principal Consultant at Renaissance Design, Inc., where I designed power management ICs.

9. From 2000 to 2002, I held a position as a Manager of New Product Development at ON Semiconductor Corp., where I was responsible for six product development teams. In that role I oversaw the development of over twenty power management ICs in bipolar, CMOS, and BiCMOS technologies.

10. From 2002 to 2003, I held the position of Advanced System Engineering Manager at ON Semiconductor Corp., where I directed a team of system engineers to develop multi-phase power management ICs for Intel and AMD microprocessors.

11. In 2006 I received my PhD on the topic of advanced oscillator topologies. My work on integrated circuit oscillators was included in the 2008 McGraw-Hill Yearbook of Science and Technology and discussed in Nature, the pre-eminent science journal.

12. I have published at least 52 academic journal papers, as shown in my curriculum vitae, relating to various topics related to millimeter wave and microwave circuits and systems, RFID circuits, wireless power transfer circuits, analog circuits, and RF circuits.

13. I have been the author of at least 81 conference articles, as shown in my curriculum vitae, relating to various topics related to millimeter wave and microwave circuits and systems, RFID circuits, wireless power transfer circuits, analog circuits, and RF circuits.

14. My qualifications forming the opinion set forth in this declaration are summarized here and explained in more detail in my curriculum vitae, which is attached as Appendix A hereto.

15. Based on my experience in the wireless communications industry, I have a detailed understanding of radio frequency circuit design.

III. MATERIAL CONSIDERED

16. In preparing this declaration, I have reviewed the specification, claims and prosecution history of the ’593 patent.

17. I have reviewed and understand the following documents, as well as any other(s) cited herein.

Exhibit No.	Description
EX1001	U.S. Patent No. 8,498,593
EX1002	File History of U.S. Patent No. 8,498,593
EX1003	Larson Declaration
EX1005	U.S. Patent No. 8,116,704
EX1006	File History of U.S. Patent No. 8,116,704

Exhibit No.	Description
EX1007	U.S. Patent No. 7,427,897 ("Hau")
EX1008	U.S. Patent 7,061,213 ("Yoshida")
EX1009	EX1009 Sahu *et al.,* "A High-Efficiency Linear RF Power Amplifier With a Power-Tracking Dynamically Adaptive Buck-Boost Supply," IEEE Transactions On Microwave Theory And Techniques, Vol. 52, No. 1, January 2004 ("Sahu")
EX1011	U.S. Patent 6,646,511 ("Canyon")
EX1012	Ranjan *et al*, "Microwave Power Amplifiers with Digitally-Controlled Power Supply Voltage for High Efficiency and High Linearity," 2000 IEEE MTT-S Digest ("Ranjan")
EX1013	EX1013 International Patent Application Publication No. WO 2007/084033 A1 ("Lejon")
EX1015	Theodore Rappaport, *Wireless Communications: Principles and Practice*, 2nd ed. (excerpts)
EX1016	Kassakian *et al., Principles of Power Electronics*, 2nd ed. (excerpts)
EX1017	U.S. Patent No. 7,047,032 ("Yun")
EX1018	U.S. Patent Application Publication No. US2006/0001410 ("Ishikawa")
EX1024	James A. Kaehler, "Periodic-Switched Filter Networks: A Means of Amplifying and Varying Transfer Functions," *IEEE Journal of Solid-State Circuits*, Vol. SC-4, No. 4 (August 1969)
EX1025	U.S. Patent No. 8,571,135 B2
EX1026	Guinee *et al.,* "A Novel Estimation Procedure for the Aperture Time in Asynchronous Sinusoidal PWM Systems," The 2001 IEEE International Symposium on Circuits and Systems (Cat. No.01CH37196), Sydney, NSW, Australia, 2001, pp. 53-56 vol. 2
EX1027	*ParkerVision, Inc. v. MediaTek Inc. et al.*, Civ. No. 6:23-cv-00732, Motion for Extension of Time to Respond to Complaint (ECF No. 8) (W.D.Tex. Nov. 28, 2023)
EX1028	Krauss *et al.*, *Solid State Radio Engineering*, 1980 (excerpts)

IV. LEGAL STANDARDS

18. I am not an attorney, and I have not independently researched the law.

ParkerVision's counsel has explained certain legal principles to me that I have

relied on in forming my opinions set forth in this declaration. I have applied these legal principles in arriving at my opinions expressed in this declaration.

19. I have been informed and understand that an invention cannot be patented if the subject matter as a whole would have been obvious to a person of ordinary skill in the art at the time of the invention. Also, I understand that while the prior art is compared to each claim on an element-by-element basis, the claimed invention as a whole must have been obvious to one of ordinary skill in order for a claim to be invalid.

20. I understand that the fundamental question in analyzing obviousness is whether, at the time of the invention, the subject matter of the claimed invention as a whole would have been obvious to a person of ordinary skill in the art to which the subject matter pertains, taking into account: (a) the scope and content of the prior art; (b) the differences between the prior art and the claims at issue; (c) the level of ordinary skill in the art; and (d) any objective indicia of non-obviousness referred to as secondary considerations.

21. It is my understanding that objective indicia of non-obviousness (secondary considerations) include industry praise, commercial success, long-felt but unresolved need, copying, failure of others, and/or unexpected results. I also

understand that there should be a nexus between the objective indicia and the claimed invention.

22. I understand that multiple references can be combined, with one another and/or with the knowledge of a person of ordinary skill in the art, in rendering a claim obvious. I also understand, however, that obviousness cannot be established by simply demonstrating that each element was independently known in the prior art. Rather, it may be necessary to identify a reason, such as a teaching, suggestion, or motivation, that would have prompted a person of ordinary skill in the art to combine the elements in the way the claimed invention does.

23. I also understand that obviousness cannot be established through hindsight. I understand this to mean that the claimed invention cannot be used as a roadmap to combine elements from different pieces of prior art, or different embodiments of a single prior art reference, to create the claimed invention. I understand that the claimed invention as a whole must be compared to the prior artas a whole, and one must avoid aggregating pieces of prior art through hindsight that would not have been combined absent the patent inventor's insight.

V. LEVEL OF ORDINARY SKILL IN THE ART

24. I have been informed and understand that claims are construed from the perspective of a person of ordinary skill in the art ("POSITA") at the time of the claimed invention.

25. In my opinion, a POSITA at the time of the invention of the '593 patent would have: (a) a Bachelor of Science degree in electrical or computer engineering (or a related academic field), and at least two (2) additional years of work experience in the design and development of radio frequency circuits and/or systems, or (b) at least five (5) years of work experience and training in the design and development of radio frequency circuits and/or systems.

26. In view of my qualifications, experience, and understanding of the subject matter of the claimed invention, I believe that I meet the above-mentioned criteria and consider myself a person with at least ordinary skill in the art pertaining to the '593 patent.

VI. OVERVIEW OF BACKGROUND TECHNOLOGY

A. Power Supply

1. Switching Convertor

27. Switching converter power supplies convert electrical energy from one voltage level to another using high frequency switching devices in combination with e.g., inductors or capacitors. Unlike linear regulators, which dissipate excess energy as heat, switching converters achieve higher efficiency by alternately storing and transferring energy in discrete packets. The switching device introduces high-frequency components, which are filtered by passive components such as inductors and capacitors to produce a smooth DC output.

28. Control methods such as pulse-width modulation (PWM) or pulse-frequency modulation (PFM) are used to regulate the output voltage by adjusting the duty cycle or frequency of the switch. Feedback mechanisms are often included in switching convertors to maintain voltage stability under varying load and input conditions.

2. Step-Down (Buck) Convertor

29. Step-down (buck) converter is a switching convertor that converts an input voltage to a lower output voltage. It operates by rapidly switching a transistor on and off to control the flow of energy to an inductor, which in turn regulates the voltage delivered to the load.

30. Generally, a basic buck converter operates in two primary states: an on-state and an off-state.

31. In the on-state (when the switch is closed), current flows from the input supply through the switch and inductor to the output. The inductor stores energy in its magnetic field while also supplying current to the load.

32. In the off-state (when the switch is open), the inductor resists the sudden change in current and maintains current flow by forward-biasing a diode (or activating a synchronous switch). The stored energy in the inductor is released to the load and output capacitor.

33. By controlling the duration of the on-time relative to the switching period (i.e., the duty cycle), the average output voltage can be adjusted.

3. Step-Up (Boost) Convertor

34. Step-up (boost) converter is a switching convertor that converts an input voltage to a higher output voltage. It is commonly used in applications where the power source has a lower voltage than required by the load.

35. Like the buck converter, the boost converter operates by rapidly switching a transistor on and off, storing and releasing energy through the inductor.

36. Like the buck converter, the boost convertor also operates in an on-state and an off-state.

37. In the on-state (when the switch is closed), current flows from the input through the inductor and switch to ground. During this time, the inductor stores energy by building up a magnetic field. The diode is reverse-biased, preventing current from reaching the output.

38. In the off-state (when the switch is open), the inductor resists the sudden change in current. The stored energy is released, and the inductor current flows through the forward-biased diode to the output capacitor and load. This adds to the input voltage, effectively "boosting" the output above the input.

B. Power Amplifier

39. Power amplifiers (PAs) are used in radio frequency (RF) systems for increasing the power of modulated signals to levels suitable for wireless transmission. Their primary role is to amplify low-power RF signals generated by transmitters to sufficient power levels for effective radiation through antennas, while preserving signal integrity and minimizing distortion.

40. Performance of an RF power amplifiers are characterized by the following metrics:

Gain: The ratio of output power to input power, typically expressed in dB. It determines the amplification capability of the PA.

Peak Output Power: The maximum RF power the amplifier can deliver, typically specified at the 1 dB compression point (P1dB) or in terms of peak envelope power (PEP).

Linearity: The ability to amplify a signal without introducing distortion.

C. Power Efficiency

41. Power efficiency is a metric that measures the proportion of input power that is successfully converted into useful output power. High power efficiency is especially important in power-constrained environments, such as battery-operated devices and wireless transmitters.

42. Power efficiency η is defined as the ratio of output power Pout to input power Pin, generally expressed as a percentage:

$$\eta=(Pout/Pin)\times 100\%$$

In the context of power converters, Pin is the electrical power drawn from the source, and Pout is the power delivered to the load.

VII. THE '593 PATENT

43. The '593 patent is titled "Switching Power Supply." '593 patent, Title. It is directed towards "methods and systems for enhancing system efficiency in a power amplification, modulation, and transmission system." '593 patent, 1:31-33.

44. The '593 patent discloses that the overall system efficiency of a mobile device using a power amplification system for RF transmissions can be improved by optimizing power supply efficiency:

> The power supply efficiency directly affects the efficiency of the entire power amplification system using the power supply. Further, in the case of mobile or portable battery powered wireless devices including, but not limited to, cellular phones, wireless LAN devices, and WiMax devices and systems, voltage and current requirements of the radio frequency (RF) transmitter are largely determined by the power amplifier technology and system requirements. As such, the efficiency of the power supply of a power amplification system significantly affects the

> efficiency of the mobile device using said power amplification system.

'593 patent, 4:24-34.

45. The '593 patent illustrates the importance of power supply efficiency in connection with Figure 1, which shows "exemplary plots 102 and 104 of efficiency versus output current of a typical switching power supply for two exemplary values of output power." '593 patent, 4:15-17. '593 patent explains, in connection with Figure 1 (reproduced below), that the impact of power supply efficiency on overall system efficiency is significant, especially at lower output voltages:

> To highlight this problem, consider, for example, a scenario ***where the battery voltage (power supply input voltage, VIN) is 3.6 V and the output voltage (power supply output voltage, VOUT) is 3.16 V***, and where the power supply drives a ***power amplifier that is 50% efficient generating a +30 dBm output power***. Accordingly, the power supply current will be approximately 633 mA. From plot 102 of FIG. 1, ***this results in a power supply efficiency of approximately 94%***, which is 4% less than the optimum 98% achievable with a power supply current of approximately 190 mA.
>
> ***At lower output voltages (V_{OUT}), as illustrated in plot 104 for example, the problem becomes more pronounced***, and the power supply efficiency approaches approximately 80% at 633

> mA, which is 18% less efficient than when the power supply is operating in its optimum voltage and current range.
>
> ***The effect on system efficiency is significant***. For example, ***when the power amplifier is operating at 50% efficiency and the power supply is operating at 94% efficiency, the system efficiency is 0.5×0.94=0.47 or 47%***. Similarly, ***when the power amplifier is operating at 50% efficiency and the power supply is operating at 80% efficiency, the system efficiency is 0.5×0.8=0.4 or 40%***.

'593 patent, 4:35-56.

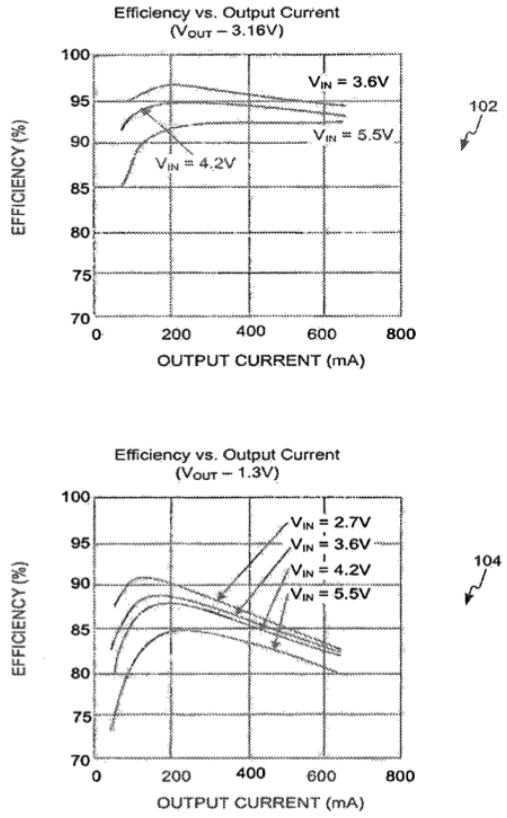


FIG. 1

'593 patent, Fig. 1.

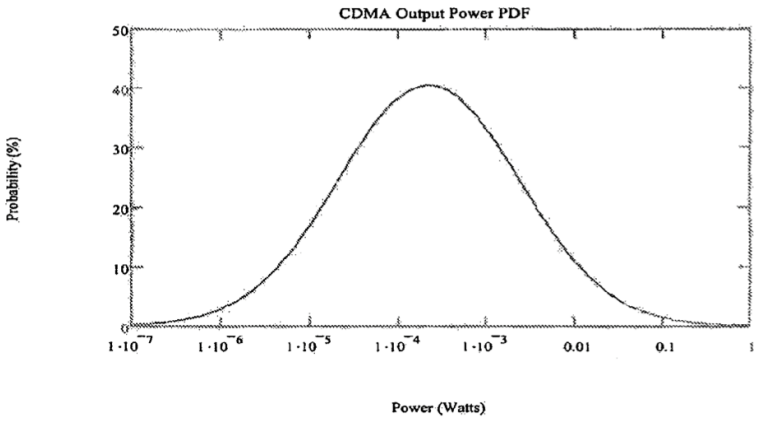
46. The '593 patent discloses "power supply design embodiments to enhance system efficiency." '593 patent, 4:59-60. The '593 patent discloses that "switching power supplies can be designed to operate in pre-determined output voltage and current ranges that result in increased efficiency of the power supply and consequently in increased system efficiency." '593 patent, 4:61-64. For example, "network characteristics and/or statistics" can be used to "design both the

power supply and the power amplifier for maximized system efficiency." '593 patent, 5:1-9.

47. As the '593 patent discloses in connection with the probability density function (PDF) shown in Figure 2, "since the probability of transmission at +17 dBm is higher than the probability of transmission at +30 dBm, system efficiency increases at +17 dBm will have a greater overall effect on extended battery life and/or battery size than system efficiency increases at +30 dBm":

> Based on PDF 200, it would be sufficient to increase system efficiency to design a power supply and/or amplifier system that maintains or increases the system efficiency at power levels below +30 dBm. Indeed, mathematical analysis shows that ***the mean or expected value of PDF 200 is approximately +17 dBm or 50 milliWatts (mW)***. Further, ***since the probability of transmission at +17 dBm is higher than the probability of transmission at +30 dBm, system efficiency increases at +17 dBm will have a greater overall effect on extended battery life and/or battery size than system efficiency increases at +30 dBm***.

'593 patent, 5:14-24.



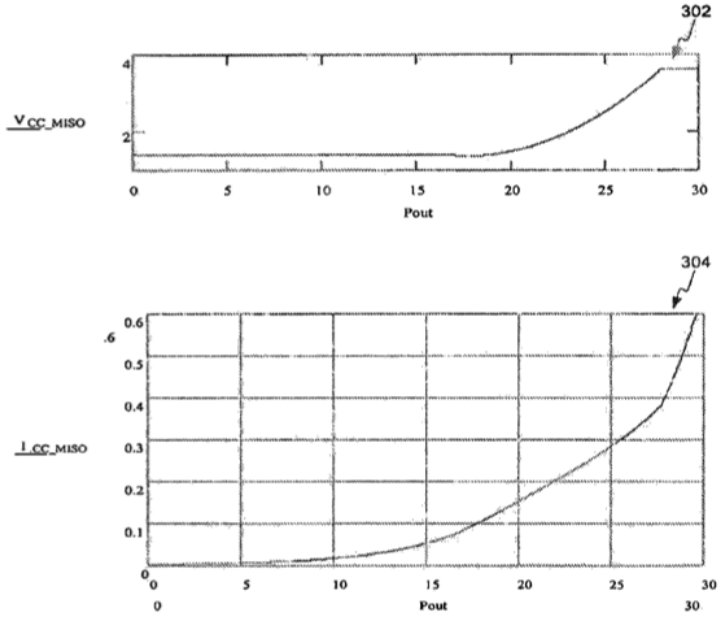
'593 patent, Fig. 2.

48. Based on the PDF of Figure 2, wherein the most probable output power occurs at +17 dBm, and the power supply output voltage and output current required by an exemplary MISO amplifier to achieve a CDMA power control range, as shown in Figure 3 (reproduced below), the '593 patent determines that the switching power supply should be designed to operate at its highest efficiency when its output voltage is approximately +1.39V and when its output current is approximately 100 mA:

> In an example MISO amplifier, the power supply output voltage is applied at the collector/drain of the MISO amplifier depending on the MISO amplifier configuration used. ***As illustrated in exemplary plot 302, the collector/drain voltage range of the MISO amplifier is +1.39V to +3.6V***. Also, ***for an output power of +17 dBm, the collector/drain voltage of the MISO amplifier is approximately +1.39V***.

> Accordingly, ***to achieve the highest system efficiency possible using example CDMA PDF 200, the switching power supply should be designed to operate at its highest efficiency when its output voltage is approximately +1.39V and, correspondingly from exemplary plot 304, when its output current is approximately 100 mA***.

'593 patent, 5:38-50.



'593 patent, Fig. 3.

49. The '593 patent discloses that the highest efficiency point of operation may vary according to the selected data modulation and transmission scheme, which includes GSM, W-CDMA, CDMA 2000, EvDO, EDGE, HSUPA, and OFDM. '593 patent, 5:51-60, 6:8-10.

50. "In addition to designing/controlling the power supply to operate optimally in terms of efficiency at the most probable output power," the '593 patent discloses that the overall power supply efficiency can be further improved by bypassing the power supply at pre-determined threshold." '593 patent, 6:21-28. Specifically, the '593 patent discloses that a "bypass switch control circuitry" can be used together with the power supple circuitry "to cause the bypass of the power supply circuitry when the pre-determined threshold is exceeded":

> Systems implementing some of the above described embodiments include ***a mechanism to bypass the power supply circuitry at a pre-determined threshold***, further increasing the system efficiency. ***In an implementation, a bypass switch control circuitry is used together with the power supply circuitry, to cause the bypass of the power supply circuitry when the pre-determined threshold is exceeded.***

'593 patent, 4:1-7.

51. The '593 patent discloses how the threshold for engaging or disengaging the bypass switch can be set in terms of output power or output voltage that corresponds to an output power:

> In addition to designing/controlling the power supply to operate optimally in terms of efficiency at the most probable output power, the overall power supply efficiency can be improved to increase system efficiency. As will be described in the exemplary

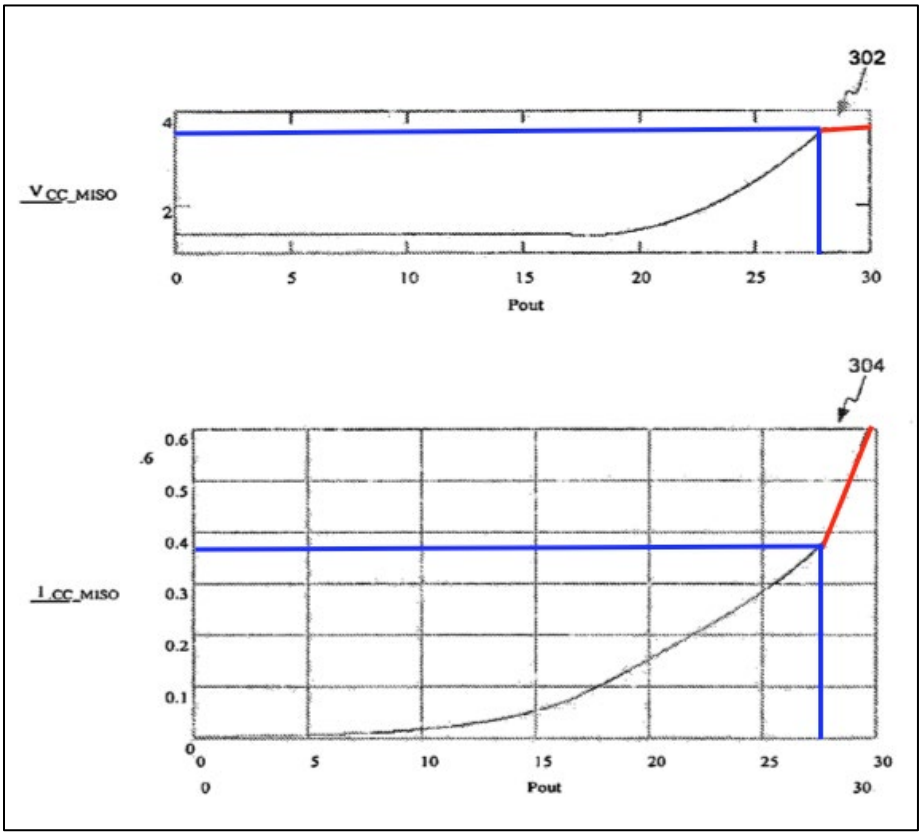
> embodiments below, ***the system efficiency can be further increased by bypassing the power supply when the required output voltage (or the output power) exceeds a pre-determined threshold***.

'593 patent, 6:21-28.

52. Figure 3 of the '593 patent shows the output power requirements of an exemplary MISO amplifier when operating in the CDMA power control range:

> Plots 302 and 304 illustrate the ***power supply output voltage and output current that are required by an example MISO amplifier to achieve a CDMA power control range***. For ease of illustration, the output power range in plots 302 and 304 is limited to 0 dBm to +30 dBm instead of −40 dBm to +30 dBm, since the most probable output power occurs at +17 dBm.

'593 patent, 5:32-37, 3:1-4 ("FIG. 3 illustrates exemplary plots of ***power supply output voltage and power supply output current versus output power*** of an example multiple-input-single-output (MISO) amplifier.").



'593 patent, Fig. 3 (annotated).

53. As shown in Figure 3, the collector/drain voltage range of the exemplary MISO amplifier is +1.39V to +3.6V:

> In an example MISO amplifier, ***the power supply output voltage is applied at the collector/drain of the MISO amplifier depending on the MISO amplifier configuration used***. As illustrated in exemplary plot 302, ***the collector/drain voltage range of the MISO amplifier is +1.39V to +3.6V.*** Also, for an output power of +17 dBm, the collector/drain voltage of the MISO amplifier is approximately +1.39V.

'593 patent, 5:38-44.

54. In view of the output power requirements of the exemplary MISO amplifier shown in Figure 3, the '593 patent discloses that "power supply bypass switch can be used to bypass the power supply ***when the power supply output voltage required by the MISO amplifier reaches 3.6V, which corresponds to an output power of +26 dBm or 400 mW***":

> For example, referring to exemplary plot 302, an optional power supply bypass switch can be used to bypass the power supply ***when the power supply output voltage required by the MISO amplifier reaches 3.6V, which corresponds to an output power of +26 dBm or 400 mW***. By bypassing the power supply, any loss in system efficiency due to the power supply efficiency can be eliminated.

'593 patent, 6:28-35.

55. The '593 patent explained in connection with Figure 4, that Threshold Voltage 414 is determined based on various power efficiency characteristics, including "network statistics," "network waveforms," "waveform efficiency requirements," "battery life requirements," "output power requirements," and/or "power supply current output requirements":

> Threshold Voltage 414 may be fixed or programmable. ***Threshold Voltage 414 may vary depending on network statistics and/or network waveforms including, but not limited to, GSM, W-CDMA, CDMA2000, EvDO, EDGE,***

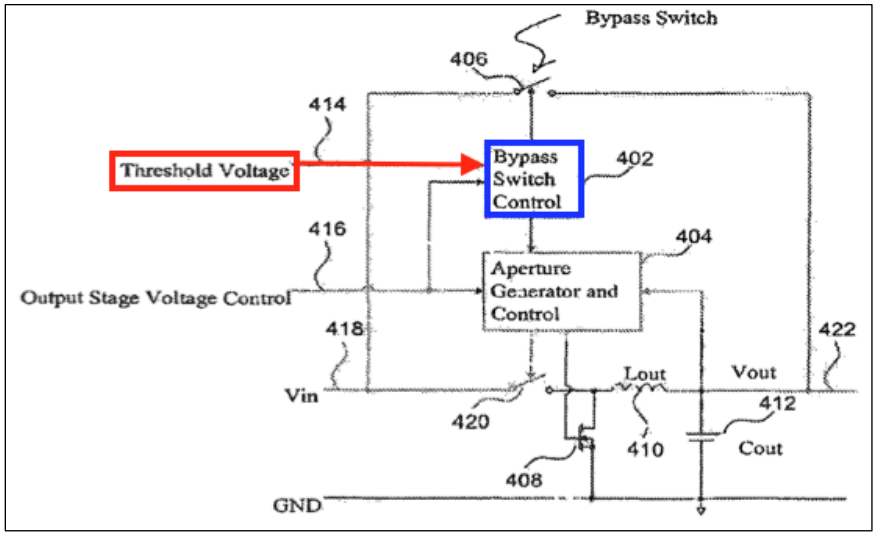
> ***HSUPA, OFDM, or others.*** In an embodiment, Threshold Voltage 414 can be changed in real time by wirelessly downloading information to the system. For example, Threshold Voltage 414 can be downloaded to the mobile device or portable unit using power supply 400 from a network provider. In another embodiment, ***Threshold Voltage 414 can be pre-programmed based on waveform efficiency requirements and/or modified or adjusted based on battery life requirements.*** In a further embodiment, ***Threshold Voltage 414 is modified based on output power requirements and/or on power supply current output requirements.***

'593 patent, 6:56-7:3.

56. As shown in Figure 4, Bypass Switch Control module 402 "receives Threshold Voltage signal 414 … [which] determines at which value of the power supply output voltage power supply 400 switches to bypass mode":

> ***Bypass Switch Control module 402 receives Threshold Voltage signal 414*** and Output Stage Voltage Control signal 416. ***Threshold Voltage signal 414 determines at which value of the power supply output voltage power supply 400 switches to bypass mode.*** Output Stage Voltage Control signal 416 includes information about the target power supply output voltage and thus allows Bypass Switch Control module 402 to determine the value of the power supply output voltage.

'593 patent, 7:50-58.



'593 patent, Fig. 4 (annotated).

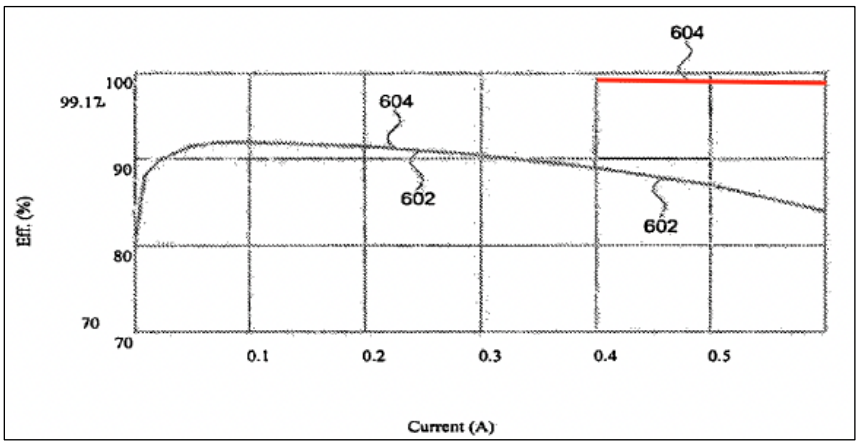
57. Bypass Switch Control module 402 controls Bypass Switch 406 and switches the power supply 400 to bypass mode when the power supply output voltage exceeds Threshold Voltage 414:

> ***Bypass Switch Control module 402 compares Threshold Voltage 414 and the value of the power supply output voltage to determine whether power supply 400 should switch to bypass mode. When the power supply output voltage exceeds Threshold Voltage 414, Bypass Switch Control module 402 controls Bypass Switch 406 to couple input voltage signal V_{IN} 418 to the power supply output node.*** At the same time, Bypass Switch Control module 402 controls Aperture Generator and Control module 404 to cause it to de-couple

> input voltage signal V_{IN} 418 from the collector/drain node of switching transistor 408 and to shut off switching transistor 408.

'593 patent, 7:59-8:3.

58. As the '593 patent explained in connection with Figure 6, for a switching power supply optimized for a +17 dBm output (based on the CDMA waveform), the bypass switch architecture discussed above activates when the power supply output voltage required by the MISO amplifier reaches 3.6V, which increases power efficiency when the required output power is equal to or greater than 400 mW (+26 dBm):



'593 patent, Fig. 6 (annotated). This corresponds to a power supply output voltage of 3.6V and current of 400mA:

> FIG. 6 is an example graph 600 that illustrates efficiency enhancement due to the use of a bypass switch architecture in a switching power supply. ***In example 600, the switching power***

> ***supply is optimized for a +17 dBm output (1.39V output voltage and 100 mA output current).***
>
> Efficiency curve 602 represents the efficiency versus the output current of the switching power supply without a bypass switch. Efficiency curve 604 represents the efficiency versus the output current of the switching power supply with a bypass switch. Note that the two efficiency curves 602 and 604 overlap with each other over the output current range from 0 to approximately 0.4 A.
>
> Without a bypass switch, as illustrated by efficiency curve 602, the switching power supply has its highest efficiency between 70 and 100 mA of output current, which renders the highest system efficiency of the exemplary MISO amplifier in the example network statistics.
>
> On the other hand, ***with a bypass switch architecture, as illustrated by efficiency curve 604, the power supply efficiency can be further increased when the output current exceeds 400 mA. This in turn increases the network system efficiency when the required output power is equal to or greater than 400 mW (+26 dBm).***

'593 patent, 9:20-42.

59. The '593 patent specification describes, in connection with Figure 5, "an Optional Load Current Sensing Circuit 504."

> FIG. 5 illustrates another example step down switching power

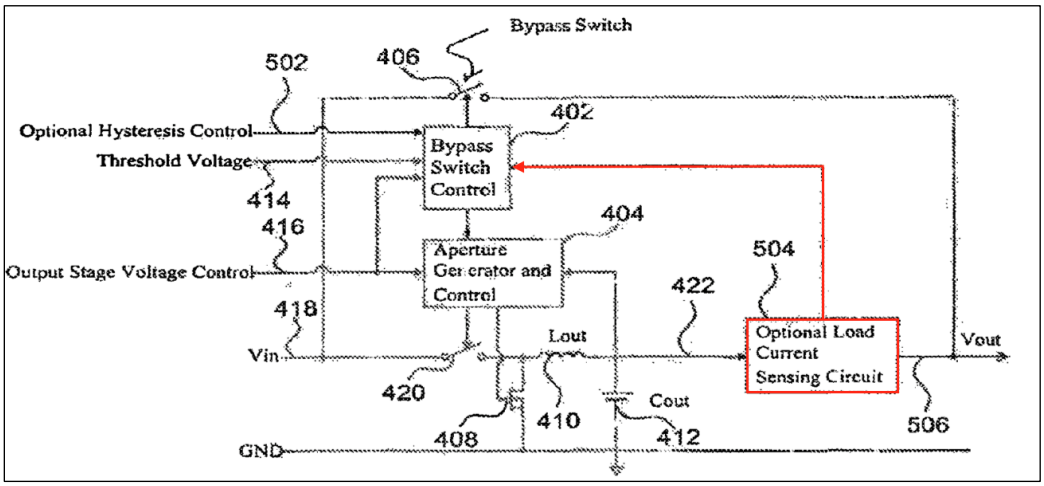
> supply 500 having a bypass switch architecture.
>
> Switching power supply 500 is similar in several respects to example power supply 400 of FIG. 4. Additionally, switching power supply 500 includes an Optional Hysteresis Control signal 502, which is received by Bypass Switch Control module402, and an ***Optional Load Current Sensing Circuit 504***.

'593 patent, 8:28-35.

60. "Optional Load Current Sensing Circuit 504 senses load current to determine any variations that may affect power supply output voltage $[V]_{out}$ 506," and provides "information about sensed load current, which can be used by Bypass Switch Control module 402 to control the operation mode of switching power supply 500."

> Optional Load Current Sensing Circuit 504 is coupled at output node 422 of power supply 500. In an embodiment, ***Load Current Sensing Circuit 504 senses load current to determine any variations that may affect power supply output voltage*** $[V]_{OUT}$ ***506***. Further, ***Optional Load Current Sensing Circuit 504 provides a feedback signal to Bypass Switch Control module 402.*** In an embodiment, the feedback signal includes information about sensed load current, which can be used by Bypass Switch Control module 402 to control the operation mode of switching power supply 500.

'593 patent, 9:1-10.



'593 patent, Fig. 5 (annotated).

VIII. CLAIM CONSTRUCTION

61. I understand that claim construction is the process of determining the meaning of words used in a patent claim in order to understand the meaning of the claim. I have been informed that claim construction is a matter of law and that claim construction will be determined by the Patent Trial and Appeal Board. I understand that the proper construction of a term is how a POSITA, at the time of the invention, would have understood the term based on its use in the claims, specification, and prosecution history of the patent. I further understand that the claims are not to be reviewed in this proceeding under the "broadest reasonable interpretation" standard.

A. "Power Efficiency"

62. Independent claims 1, 9, and 15 of the '593 patent recites, among other things, deactivating the claimed switching device "in response to a ***power***

efficiency of the power supply exceeding a predetermined threshold." '593 patent, Claims 1, 9, 15.

63. In my opinion, the term "power efficiency" was well-understood by a POSITA and does not require a construction.

64. I understand that Dr. Larson opined that the term "power efficiency" should be construed to mean "the output power of the power supply compared to its input power." Larson Decl., ¶83. I disagree with this construction for two reasons.

65. First, the term "power efficiency," both in the context of the '593 patent and as the term is understood generally by a POSITA, is not limited to power supply. The specification describes "power efficiency" with respect to the power supply, the power amplifier, as well as the overall system:

> The ***efficiency of a power supply*** directly affects the ***efficiency of the power amplification system*** using the power supply. … [V]oltage and current requirements of the radio frequency (RF) transmitter used in the devices are largely determined by the power amplifier technology and system requirements. As such, ***the power supply efficiency not only affects the efficiency of the power modulation and amplification system but also the efficiency of the mobile device using the power amplification system***.

'593 patent at 1:29–39. This is consistent with a POSITA's general understanding of power efficiency, which is not limited to efficiency of a power supply. Dr. Larson's construction, which defines "power efficiency" only with respect to the power supply, is too narrow in this regard.

66. Indeed, Dr. Larson's definition of "power efficiency" would have rendered the claim term "of the power supply" redundant. Replacing the term "power efficiency" with Dr. Larson's definition would result in claim limitations that state: "in response to [the output power ***of the power supply*** compared to its input power] ***of the power supply*** exceeding a predetermined threshold." '593 patent, Claims 1, 8, 15. This phrase is confusing and makes little sense.

67. Second, a POSITA would have understood that power efficiency is not merely a comparison of output and input power, as Dr. Larson suggests. Larson Decl., ¶83. Rather, it is a ratio of output power to input power, which could be expressed in percentage by multiplying the ratio by 100. This is consistent with the specification's descriptions of power efficiency, which calculates power efficiency as a ratio of power output to power input:

> To highlight this problem, consider, for example, a scenario where the battery voltage (power supply input voltage, VIN) is 3.6 V and the output voltage (power supply output voltage, VOUT) is 3.16 V, and where the power supply drives a power

> amplifier that is 50% efficient generating a +30 dBm output power.. … [T]his results in a power supply efficiency of approximately 94%.

'593 patent, 4:35-42. The specification went on to calculate system efficiency as the product of power amplifier efficiency and power supply efficiency, alternatively expressed in percentage:

> The effect on system efficiency is significant. For example, when the power amplifier is operating at 50% efficiency and the power supply is operating at 94% efficiency, ***the system efficiency is 0.5×0.94=0.47 or 47%***. Similarly, when the power amplifier is operating at 50% efficiency and the power supply is operating at 80% efficiency, ***the system efficiency is 0.5×0.8=0.4 or 40%***.

'593 patent, 4:50-56

68. Thus, it is my opinion that the plain and ordinary meaning of "power efficiency" is the ratio of output power to input power.

69. Dr. Larson also opined that, under his inaccurate definition of "power efficiency," the phrase "in response to a power efficiency of the power supply exceeding a predetermined threshold" should be construed to encompass "indirect measurements of power efficiency such as current or voltage, and should not be interpreted to require a direct measurement of power efficiency." Larson Decl., ¶83. I disagree.

70. To begin, this interpretation for the broader phrase does not meet Dr. Larson's own definition of "power efficiency," which requires a direct comparison of output and input power. A comparison of so-called "indirect measurements," such as voltage and current, would render different results, and thus cannot be used as substitutes for power. This is because power is a function of more than one electrical quantity. As was well-known by a POSITA, power is a function of (and is dependent on) voltage ***and*** current (i.e., P=IV). As such, power cannot be derived based on any one such quantity alone. Nor could a comparison of one electrical quantity (e.g., voltage, current, or resistance) at the output and input node be used to derive or even approximate a comparison of output and input power—these comparisons would only render the same result in the special (and exceedingly rare) case where the other dependent variable is the same at the input and output node (e.g., Pout/Pin would equal Vout/Vin ***only if*** Iout = Iin). This is almost never the case in the context of a switching power supply like that described in the '593 patent.

71. Dr. Larson's inconsistent interpretation of this claim term appears to stem from his misunderstanding of the '593 patent's disclosure.

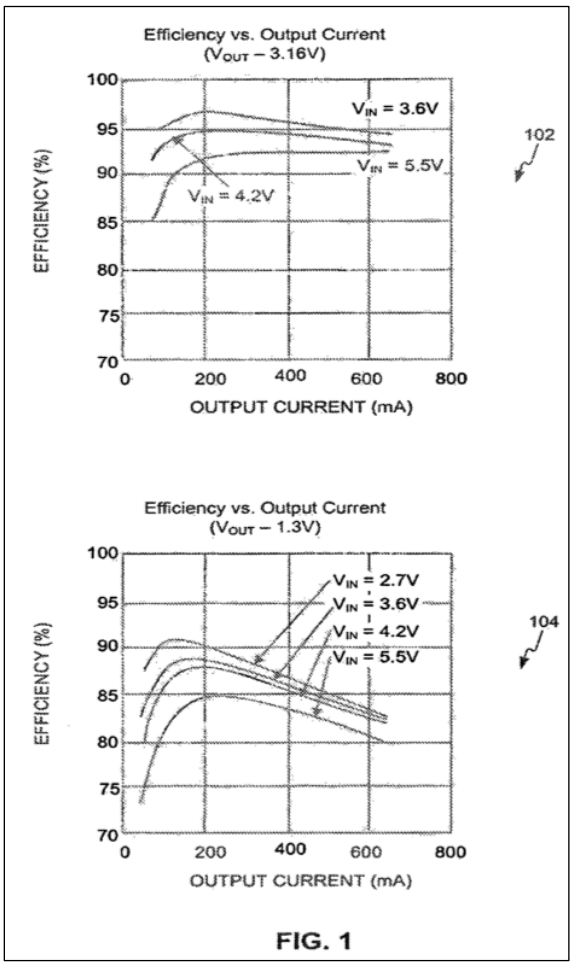
72. Dr. Larson observed that Figure 1 of the '593 patent "illustrates plots showing efficiency versus output current of a switching power supply," and noted

that the specification discloses, in connection with Figure 1, that "the power supply is most efficient when the output current is between 100 and 200 milliamps (ma) depending on the input and output voltages." Larson Decl., ¶84. Dr. Larson also noted the specification's disclosure of activating a bypass switch based on comparison of a threshold voltage to the power supply output voltage. Larson Decl., ¶85 (citing '593 patent, 2:21-22, 4:7-10, 7:59-8:8, 7:1-3, 8:41-60).

73. Based on these disclosure, Dr. Larson concluded that the specification does not "teach that the circuitry directly calculates the power efficiency (e.g., by comparing input and output power), much less does it teach whether to bypass the down-converter based on such a calculation." Larson Decl., ¶85. This conclusion is based on incorrect understanding of the '593 patent's disclosure.

74. As a threshold matter, I disagree with Dr. Larson that the claims require that "***the circuitry*** directly calculates the power efficiency." Larson Decl., ¶85. Consistent with the claim language, "power efficiency" and threshold thereof is "predetermined." '593 patent, Claims 1, 9 ,15. Thus, the claims do not require a calculation of power efficiency by the circuitry. Rather, the plain language of the claims requires determining the power efficiency characteristics of the power supply and setting a threshold based on that determination. This is consistent with the '593 patent's disclosures.

75. As described in connection with Figure 1 of the '593 patent, the power efficiency characteristics of an exemplary power supply was calculated.

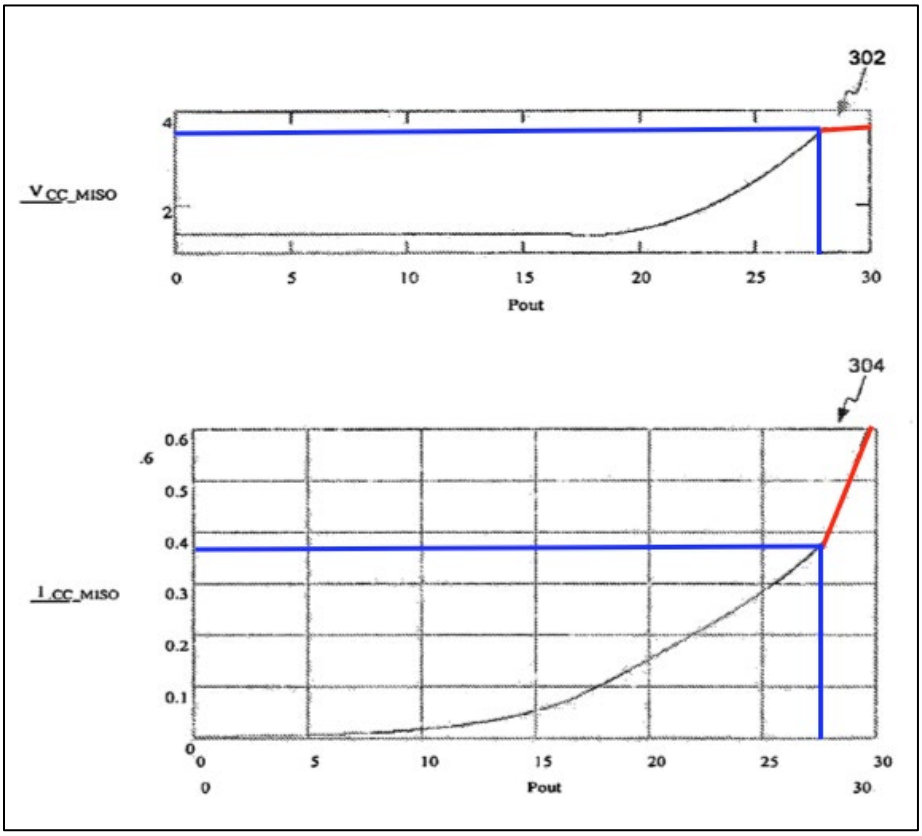


'593 patent, Fig. 1. Based on Figure 1 and the network characteristic of CDMA shown in Figure 2, it was determined that the power supply should be configured for optimal performance at +17 dBm. '593 patent, 5:10-24.

76. With reference to Figure 3, it was determined that +17 dBm corresponds to a power supply output voltage of +1.39V and output current of

100mA. ’593 patent, 5:25-50. Accordingly, the exemplary MISO amplifier is optimized for power efficiency at +1.39V and 100mA.

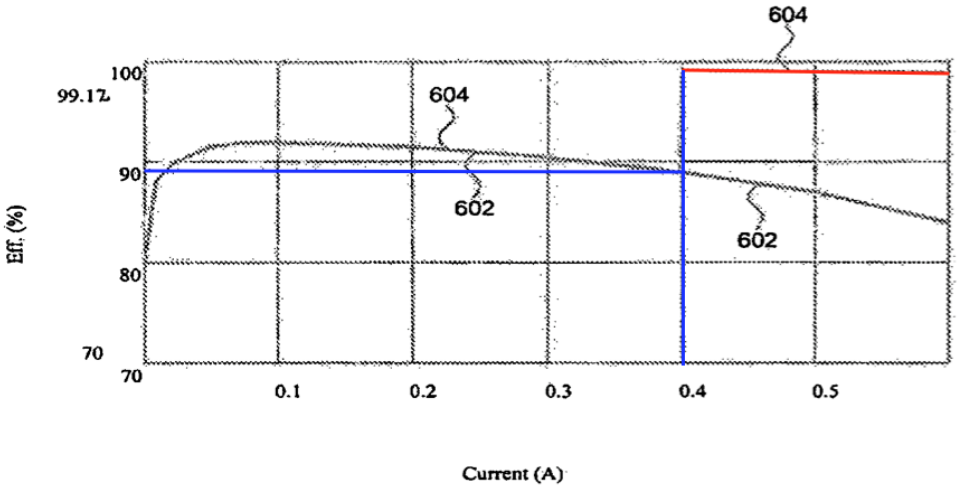
77. From there, and again with reference to Figure 3, it is determined that in the CDMA power control range of 0 to +30 dBm, the exemplary MISO amplifier has an operating voltage range between +1.39V to +3.6V. ’593 patent, 5:38-44. And at approximately +26 dBm or 400 mW RF power (blue line), the output power P_{out} of the exemplary MISO amplifier continues to increase even with a fixed power supply output voltage V_{CC_MISO} (red line). ’593 patent, 5:38-44. Accordingly, the ’593 patent discloses setting the threshold voltage at 3.6V, which corresponds to an output power of +26 dBm or 400 mW (blue line). ’593 patent, 9:20-42.



'593 patent, Fig. 3 (annotated).

78. As the specification explains in connection with Figure 6 (annotated and reproduced below), the resulting power supply design "is optimized for a +17 dBm output (1.39V output voltage and 100 mA output current)" based on the power efficiency characteristics of Figure 1 and the network characteristics of Figure 2. '593 patent, 9:20-42. And the 3.6V threshold for activating the bypass switch corresponds to a power supply output current of 400mA and a power efficiency of approximately 89% (blue line). '593 patent, 9:20-42. The increase in

power efficiency is illustrated by efficiency curve 604 (red line). '593 patent, 9:20-42.



'593 patent, Fig. 1 (annotated).

79. As I explained above, the '593 patent determines the threshold voltage based on power efficiency that was actually measured and calculated. The disclosures noted by Dr. Larson confirms this understanding.

80. With respect to the specification's disclosure in connection with Figure 1, a POSITA would have recognized that Figure 1 was plotted based on actual and direct calculation of power efficiency (e.g., based on actual voltage ***and*** current measurements). As shown in Figure 1 (reproduced below), the plots are produced by holding output voltage (Vout) and input voltage (Vin) constant. From there, power efficiency (for the specific Vout and Vin values) can be determined

by measuring input current and output current, and multiplying the measured current values respectively by the input and output voltage.

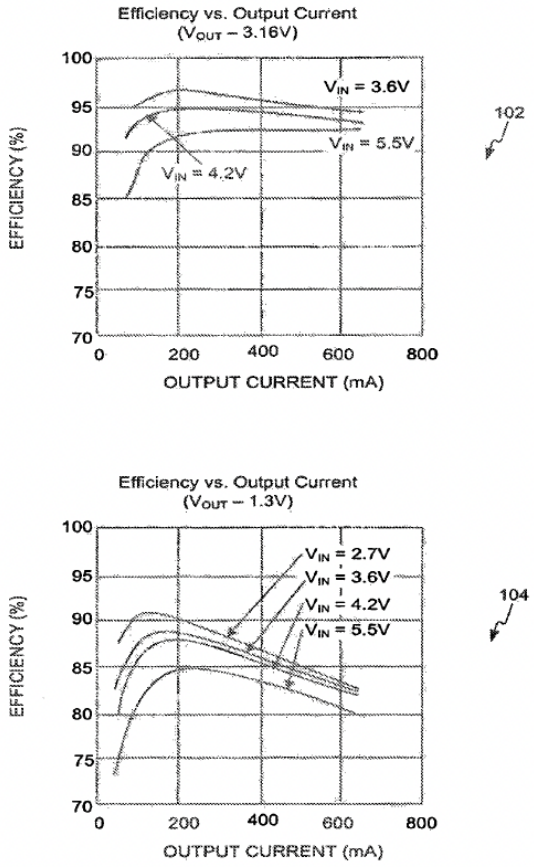
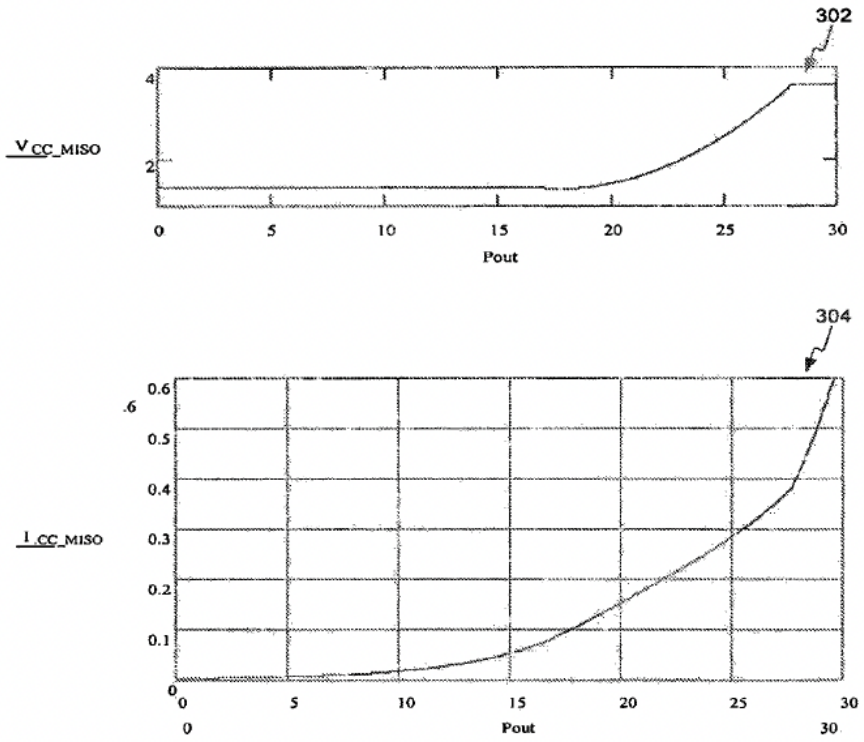


FIG. 1

'593 patent, Fig. 1. In contradiction to Dr. Larson's conclusion, Figure 1 in fact shows direct calculations of power efficiency. Only based on these power efficiency calculations and the resulting plots against output current, could a POSITA determine the power supply efficiency for a given output current measurement.

81. Likewise, with respect to the specification's disclosure of a threshold voltage used to determine whether to activate the bypass switch, the specification discloses, in connection with the exemplary embodiment of Figure 3, that it is determined in view of plots of input voltage (V_{CC_MISO}) and input current (I_{CC_MISO}) against output power (Pout):



'593 patent, Fig. 3.

> In an example MISO amplifier, ***the power supply output voltage is applied at the collector/drain of the MISO amplifier depending on the MISO amplifier configuration used***. As illustrated in exemplary plot 302, ***the collector/drain voltage range of the MISO amplifier is +1.39V to +3.6V.*** Also, for an

> output power of +17 dBm, the collector/drain voltage of the MISO amplifier is approximately +1.39V.

'593 patent, 5:38-44.

> For example, referring to exemplary plot 302, an optional power supply bypass switch can be used to bypass the power supply ***when the power supply output voltage required by the MISO amplifier reaches 3.6V, which corresponds to an output power of +26 dBm or 400 mW***. By bypassing the power supply, any loss in system efficiency due to the power supply efficiency can be eliminated.

'593 patent, 6:28-35. Dr. Larson is therefore incorrect when he concluded that the '593 patent does not teach direct calculation of power efficiency. Larson Decl., ¶85.

82. Dr. Larson further opined that dependent claims 2 and 6's requirements that the switching device be deactivated based on "load current" (claim 2) or "down-converted input voltage" (claim 6) "indicates that … indirect measurements … are within the scope of the broader claim language in claim 1." Larson Decl., ¶85. But dependent claims 2 and 6 do not recite "power efficiency," and a POSITA would not have read dependent claims 2 and 6 as within the scope of "power efficiency."

IX. OVERVIEW OF THE ALLEGED PRIOR ART

A. Hau

83. Hau is directed towards "power amplifiers used in battery powered mobile handsets." Hau, 1:7-11.

84. Hau allegedly improves upon prior art power amplifier devices in several respects. According to Hau, prior art devices that "monitor[] the output power of the power amplifier through the current in the voltage bias line to the power amplifier" have many undesirable effects, including "coupling loss (typically through a resistor or a current mirror) in the bias line." Hau, 2:1-11. This causes "voltage drop especially under high current operation, reducing the bias voltage available to the power amplifier and resulting in performance degradation":

> U.S. Pat. No. 6,081,161 ('161) to F. L. Dacus et al. and U.S. Pat. No. 6,646,511 ('511) to J. C. Canyon et al. provide other solutions. Both of these patents teach monitoring the output power of the power amplifier through the current in the voltage bias line to the power amplifier. The detected current sets the optimized bias voltage for the power amplifier. However, the coupling loss (typically through a resistor or a current mirror) in the bias line would cause voltage drop especially under high current operation, reducing the bias voltage available to the power amplifier and resulting in performance degradation.

Hau, 2:1-11.

85. Hau also states that prior art devices undesirably require the "use of external look up tables that are part of complex feedback loops for adjusting the power amplifier supply voltage," and "require additional calibration procedures and the operation is not adaptive within the power amplifier":

> Another limitation of prior art power amplifiers ('511) is their use of external look up tables that are part of complex feedback loops for adjusting the power amplifier supply voltage. Such control schemes require additional calibration procedures and the operation is not adaptive within the power amplifier.

Hau, 2:12-17.

86. According to Hau, another limitation of such prior art devices "is their dynamic control of the DC bias current through the gate node of the power amplifiers," which is "is ineffective in reducing current consumption of the power amplifiers over different output power level as compared to reducing the collector or drain bias supply voltage of the power amplifier":

> Another limitation of prior art power amplifiers ('161) is their dynamic control of the DC bias current through the gate node of the power amplifiers. As known to those skilled in the art, this technique is ineffective in reducing current consumption of the power amplifiers over different output power level as compared to reducing the collector or drain bias supply voltage of the

> power amplifier.

Hau, 2:18-24.

87. Unlike prior art devices that monitor output power through current measurements, Hau instead measures output voltage Vcc2 and "relies on the $(Vcc2)^2/R$= power relationship" to control its DC to DC convertor:

> Thus, the linear relationship between Pdet and Vcc2 is achieved, and the optimum output power of the power amplifier is controlled by Vcc2 accordingly. With this linear output relationship, the detector DC output voltage, Pdet, can control the DC to DC converter output directly, and eliminates the need of any look-up-table or complicated controller circuits used in the prior art. In addition, the prior art related the output current to the output power from the (I)(V)=power relationship, whereas the present invention relies on the $(Vcc2)^2/R$=power relationship.

Hau, 6:34-44.

88. Hau describes bypassing the DC to DC buck converter when the DC to DC buck converter reaches its "maximum voltage output" due to compliance,[1] not a property of the output load, but rather a property of the DC to DC converter.

[1] In this context, compliance would be understood by a POSITA as the minimum operating voltage of the converter. Many circuits requires a minimum voltage difference to operate. Here, it means the difference between Vout and Vin.

Hau, 5:39-51. As Hau explained in connection with the embodiment shown in Figure 6, an exemplary DC to DC buck converter powered by a 3.4V battery has an operating voltage range of about 0.5V to 3.0V. Hau, 5:39-51. Hau teaches that a bypass switch should be activated when the exemplary DC to DC buck converter reaches its maximum voltage output of 3.0V:

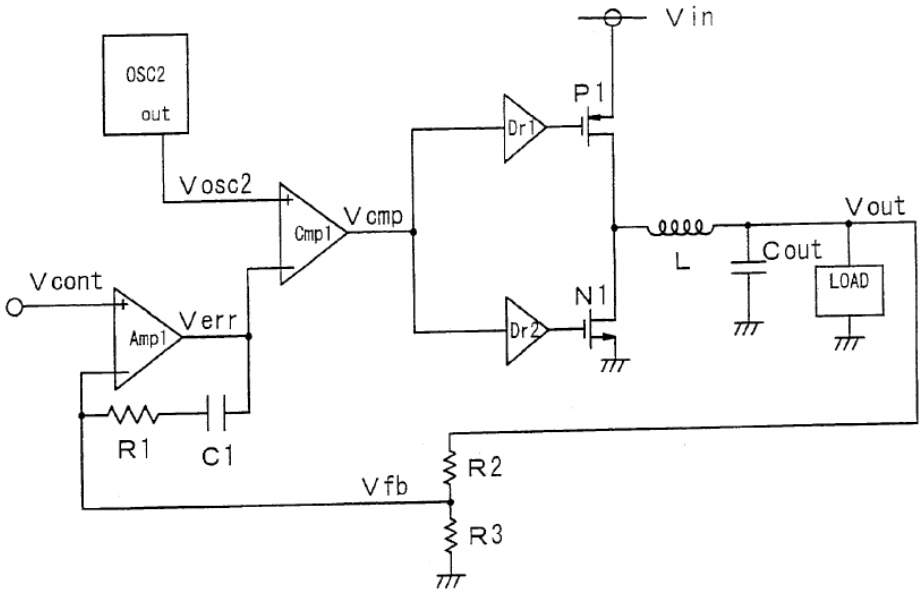
> The DC to DC converter is designed to power by the +3.4V battery and provide an output bias voltage, here Vcc2, that goes to both PA1 and PA2. In this example the Vcc2 ranges from a low of about 0.5V to about +3.0V. The +3.0V is the maximum voltage output of the typical DC to DC buck converter due to its compliance with the +3.4V input. At that point, a bypass switch is activated and through this switch virtually the full +3.4V is applied to the PA's. There is a bypass controller 74 that activates the bypass switch 72 when the Pdet reaches a given DC voltage set point that corresponds to a Vcc2 from the DC to DC converter of about +3.0V.

Hau, 5:39-51.

B. Yoshida

89. Yoshida teaches a step-down DC-DC convertor as shown below:

Fig. 29 Prior Art



Yoshida, Fig. 29.

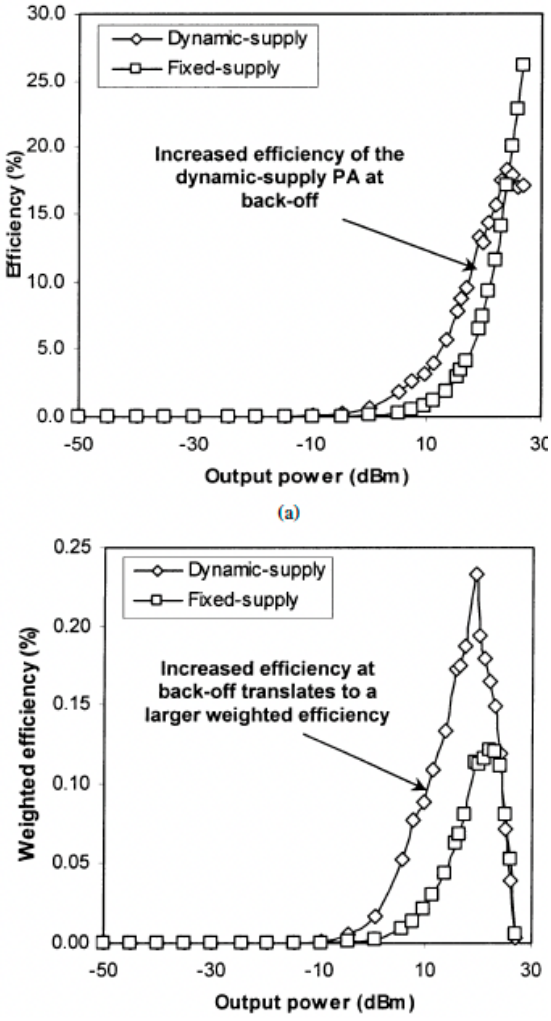
C. Sahu

90. Sahu is titled "A High-Efficiency Linear RF Power Amplifier With a Power-Tracking Dynamically Adaptive Buck-Boost Supply." Sahu, 112.

91. Sahu teaches that for a CDMA system, power amplifier ("PA") "operates mostly at 15-20 dB backoff from the peak power." Sahu, 113. Because PA rarely operates at peak output power, Sahu teaches that "it is extremely important to calculate the average efficiency when considering the optimum PA configuration." Sahu, 113. Sahu further teaches that "weighted average efficiency," which accounts for "the probability of operating at RF output power," can be used

to "measure of the effectiveness of the PA to convert the battery-stored energy into transmitted energy at the antenna." Sahu, 113.

92. As shown in Figure 8 of Sahu, the "weighted average efficiency" is used to evaluate the efficiency of Sahu's dynamic PA compared to a fixed supply PA. Sahu, 118-19.



Sahu, Fig. 8.

93. Sahu further teaches "Efficiency Enhancement Schemes Using Dynamic Supplies." Sahu 114-15. Based on these efficiency enhancement techniques, Sahu teaches a "Proposed System and Hardware Implementation." Sahu, 115-17. Sahu's proposed system was evaluated against fixed supply systems, and the experimental results show, among other things, that Sahu's proposed system has increased weighted efficiency as compared to fixed supply system. Sahu, 115-17.

D. Lejon

94. Lejon is directed toward LINC amplifier systems.

95. Specifically, Lejon discloses a "LINC out-phasing amplifier system," where "an input signal [single] is applied to a modulator (3) that splits the signal into two phasor fragments which are independently amplified." Lejon, Abstract.

96. As Lejon explained, in LINC amplifiers like those described in Lejon, "an input signal [single] is provided, e.g., as an in-phase (I) and quadrature phase (Q) signal." Lejon, 2:16-17.

97. As Lejon explained in connection with Figure 1, "a source (bandpass) signal [single] is typically separated into two (out-phased) constant-envelop signals by a signal component separator (SCS) or digital signal processor (DSP)." Lejon, 10:20-26.

E. Canyon

98. Canyon is directed towards "a system for increasing overall efficiency of a power amplifier by varying operating voltage applied to a power amplifier based upon the output power level of the power amplifier." Canyon, 1:20-23.

99. Canyon discloses a communication device that includes a power amplifier unit 120 and a power management unit 110. Canyon, 3:1-7.

100. Canyon's power management unit 110 includes a switching regulator 160, a controller 170, which receives a signal X from a current/power meter 180. If signal X is at a high power level, controller 170 activates bypass switch 190 to bypass regulator 160. Canyon, 3:8-4:29.

101. Canyon discloses, in connection with the embodiment of Figure 1, a "current meter 180 [that] monitors (measures) the DC current flow of the operating voltage supply Vbb provided to the power amplifier unit 120." Canyon, 3:14-19.

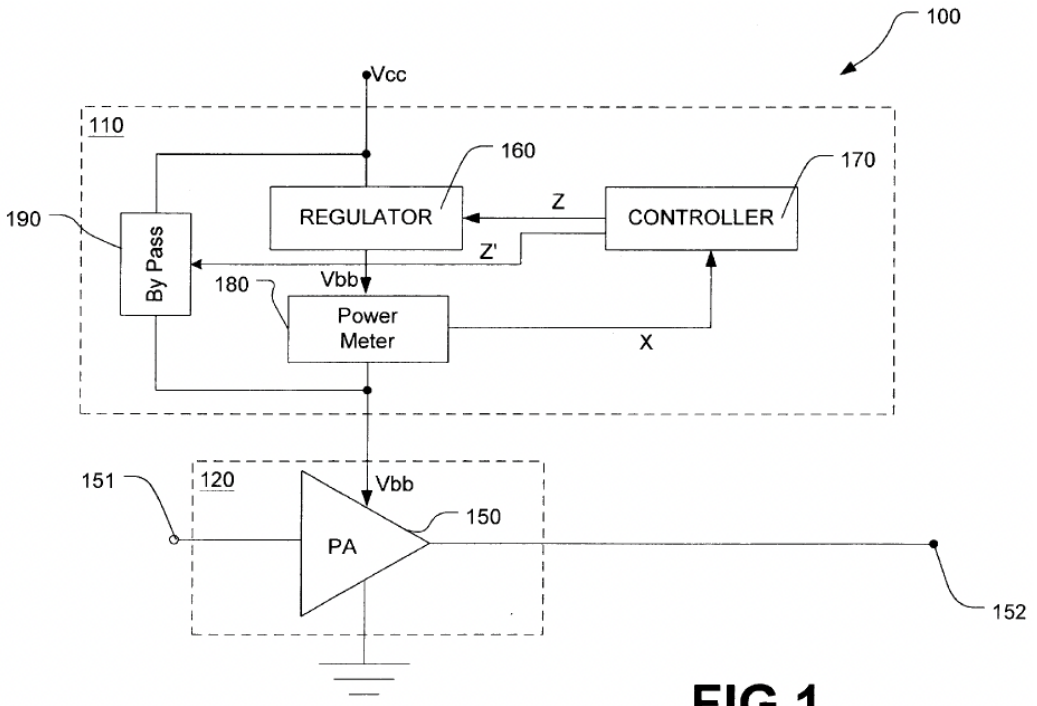


FIG.1

Canyon, Fig. 1.

102. Canyon discloses, in connection with the embodiment of Figure 2, that "bypass switch 190 is closed when the power output indicator signal X indicates that the power amplifier unit 120 is consuming, or operating at, a high power level." Canyon, 4:14-23. Canyon expressly provides what constitutes "a high power level"—"where the power amplifier unit is consuming a power level greater than 22-24 dBm":

> Bypass switch 190 is connected in parallel with the regulator 160 and receives input of the supply voltage Vcc. Bypass switch 190 is controlled by bypass signal Z′, that causes the bypass switch 190 to open or close. When bypass

> switch 190 is closed, the operating voltage Vbb applied to the power amplifier unit 120 preferably goes to the operating supply voltage Vcc. ***In a preferred embodiment, bypass switch 190 is closed when the power output indicator signal X indicates that the power amplifier unit 120 is consuming, or operating at, a high power level. For example, where the power amplifier unit is consuming a power level greater than 22-24 dBm, the bypass signal Z' may be output by the controller 170 to close the bypass switch 190.*** Once bypass switch 190 is closed, the operating voltage Vbb applied to the power amplifier unit 120 is effectively taken to a level approximately equal to the supply voltage Vcc.

Canyon, 4:14-29. Canyon also discloses, in connection with the embodiment of Figure 2, when the bypass switch should be open, such that the regulator 160 outputs a regulated operating voltage Vbb—when "the power output indicator signal X indicates that the power amplifier unit 120 is operating at a power level of less than, for example, 22 dBM":

> In a preferred embodiment, the regulator 160 outputs a operating voltage Vbb, to the power amplifier unit 120, of approximately 2.2 volts (+2.2 VDC) where ***the power output indicator signal X indicates that the power amplifier unit 120 is operating at a power level of less than, for example, 22 dBM***.

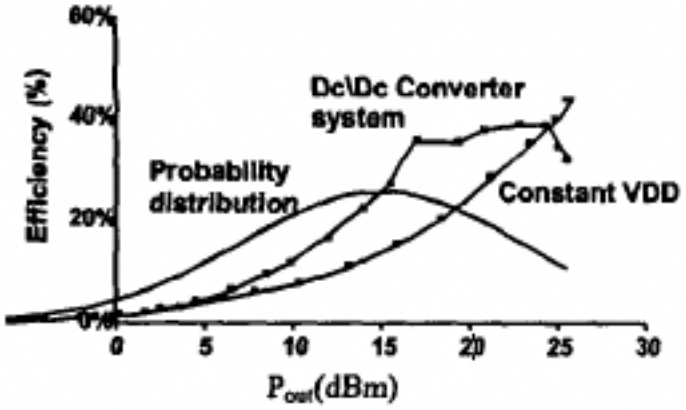
Canyon, 4:8-13.

F. Ranjan

103. Ranjan is an article titled "Microwave Power Amplifiers with Digitally-Controlled Power Supply Voltage for High Efficiency and High Linearity." Ranjan, 493.

104. Ranjan presents a power amplifier architecture comprising an amplifier "with an efficient, high modulation bandwidth DC-DC converter." Ranjan, 439.

105. Figure 3 of Ranjan shows the measured efficiency of an amplifier with constant VDD and with dc/dc converter. It also shows a representative distribution of output power for wireless application.



Ranjan, 494.

X. VALIDITY OF THE '593 PATENT

A. Ground 1A: Combination of Hau and Yoshida

1. Claims 1-20: the combination of Hau and Yoshida does not disclose controlling the switching device "in response to a power efficiency of the power supply exceeding a predetermined threshold"

106. In my opinion, the combination of Hau and Yoshida does not disclose nor suggest deactivating the switching device "in response to a power efficiency of the power supply exceeding a predetermined threshold," as required by each and every claim of the '593 patent.

107. Claim 1 (from which claims 2-8 depend) and claim 15 (from which claims16-20 depend) recite "an aperture generator and control module configured to control the switching device, wherein, ***in response to a power efficiency of the power supply exceeding a predetermined threshold***, the aperture generator and control module deactivates the switching device and passes the input voltage to the output voltage node." '593 patent, Claims 1-8, 16-20. Similarly, claim 9 (from which claims 10-14 depend) recites "***in response to a power efficiency of the power supplying exceeding a predetermined threshold***, de-activating the switching device and passing the input voltage to the output voltage node." '593 patent, Claims 9-14.

108. I understand that Dr. Larson opined that Hau discloses the claimed deactivation of the switching device "in response to a power efficiency of the power supply exceeding a predetermined threshold." Larson Decl., ¶¶122-30. I disagree.

109. As a threshold matter, I disagree with Dr. Larson that Hau's Pdet is an indicator of power efficiency. Larson Decl., ¶123. According to Dr. Larson, because Hau's battery voltage Vbatt is fixed, a higher Pdet corresponds to greater efficiency relative to the fixed input power:

> In Hau, the output power of the DC-DC regulator is based on current Icc2 and voltage Vcc2, where Vcc2 is linearly related to the voltage Vin. The voltage Pdet, which is proportional to the voltage Vin, is thus an indicator of the power output by the DC-DC buck regulator at Vcc2. Because the input power to the DC-DC buck regulator, Vbatt, is a fixed voltage, Pdet is also an indicator of the power efficiency of the DC-DC buck regulator because higher power indicated by Pdet corresponds to greater efficiency relative to the fixed input power.

Larson Decl., ¶123 (citations omitted). Dr. Larson's opinion in this regard is not accurate for several reasons.

110. First, Dr. Larson mixes RF power and supply power. Hau's Pdet is generated based on Vin, which "is an RF signal sensed from the output of the first

power amplifier PA1 that is input to the power detector 4." Hau, 4:16-17. Based on Vin (an RF signal), "[t]he power detector 4 outputs a DC voltage Pdet to a DC to DC converter in the power management unit 2." Hau, 4:18-21. Thus, Pdet is generated based on, and is an indicator of, an RF AC signal (Vin), which has no direct relation to the power efficiency of the DC power supply. RF power (upon which Pdet is based) cannot be an indicator of power efficiency of the power supply because they are separate circuits relating to distinct quantities (AC and DC, respectively).

111. Second, while Dr. Larson is correct that Vbatt is a fixed voltage, that does not mean that "Pdet is also an indicator of the power efficiency of the DC-DC buck regulator." Larson Decl., ¶123. Under both Dr. Larson's and my proposed construction, the claimed "power efficiency" is a function of input and output power, which depends on both voltage and current. Pdet, however, only determines the DC-DC buck regulator's output voltage Vcc2. Hau, 4:19-21. Accordingly, even with a fixed Vbatt, Pdet does not provide information regarding current—Ibatt and Icc2. Dr. Larson's analysis ignores variation in input and output current, which respectively impacts input power and output power (as given by the P=VI relationship), and thus power efficiency as a whole. Thus, even if input battery voltage (Vbatt) is fixed (like in Hau), a higher output voltage (Vcc2,

determined based on Pdet) does not mean that there will be higher power efficiency at least because: (1) power amplifiers are not passive resistors and do not necessarily have a linear function of supply voltage versus power consumption; and (2) DC-DC convertor efficiency is non-linear. This is demonstrated in Figure 1 of the '593 patent, which shows a non-linear relationship between output current and power efficiency, even when Vin and Vout is fixed:

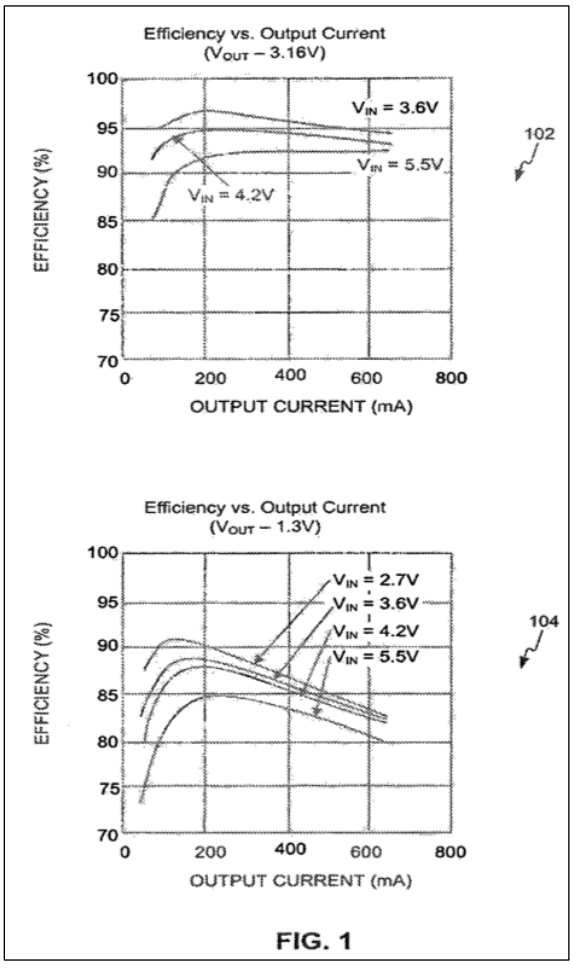


FIG. 1

'593 patent, Fig. 1.

112. In my opinion, Hau does not disclose deactivating the switching device "in response to a power efficiency of the power supply exceeding a predetermined threshold" because Hau's threshold for bypassing the DC to DC buck convertor is determined based on the operating range of the power supply. This does not involve calculation of power efficiency, nor does it ensure that the power supply is optimized for power efficiency.

113. Hau describes bypassing the DC to DC buck converter when the DC to DC buck converter reaches its "maximum voltage output" in view of compliance with the input voltage:

> The DC to DC converter is designed to power by the +3.4V battery and provide an output bias voltage, here Vcc2, that goes to both PA1 and PA2. In this example the Vcc2 ranges from a low of about 0.5V to about +3.0V. ***The +3.0V is the maximum voltage output of the typical DC to DC buck converter due to its compliance with the +3.4V input***. At that point, a bypass switch is activated and through this switch virtually the full +3.4V is applied to the PA's.

Hau, 5:40-48. A POSITA would have understood "compliance" to mean that the DC-DC convertor requires a minimum amount of input-output voltage differential to operate. As Hau explained by way of example, its DC-DC convertor requires a 0.4V minimum voltage differential (3.4V-3.0V) to operate in "compliance." Hau,

5:40-48. A POSITA would have recognized that Hau's DC-DC convertor would not operate properly if the input-output voltage differential is less than 0.4V. Hau, 5:39-51. As Hau explained in connection with the embodiment shown in Figure 6, an exemplary DC to DC buck converter powered by a 3.4V battery has an operating voltage range of about 0.5V to 3.0V. Hau, 5:39-51. Hau teaches that a bypass switch should be activated when the exemplary DC to DC buck converter reaches its maximum voltage output of 3.0V:

> The DC to DC converter is designed to power by the +3.4V battery and provide an output bias voltage, here Vcc2, that goes to both PA1 and PA2. In this example the ***Vcc2 ranges from a low of about 0.5V to about +3.0V. The +3.0V is the maximum voltage output of the typical DC to DC buck converter due to its compliance with the +3.4V input. At that point, a bypass switch is activated and through this switch virtually the full +3.4V is applied to the PA's.*** There is a bypass controller 74 that activates the bypass switch 72 when the Pdet reaches a given DC voltage set point that corresponds to a Vcc2 from the DC to DC converter of about +3.0V.

Hau, 5:39-51.

114. In other words, Hau's threshold is set based on the operating range of the power supply (i.e., "maximum voltage output") based solely on the properties and limitations of the power supply (i.e., compliance with minimum voltage

differential). This does not involve any calculation of power efficiency. Nor does it ensure power efficiency.

115. To the contrary, Hau sets its Pdet threshold when the DC to DC buck converter reaches its "maximum voltage output." Hau, 5:39-51. This is based on hardware limitations of the DC to DC buck convertor (i.e., it cannot operate above 3V when the battery is 3.4V due to compliance with minimum voltage differential), and not based on output power, let alone power efficiency.

116. For these reasons, it is my opinion that the combination of Hau and Yoshida does not disclose or suggest deactivating the switching device "in response to a power efficiency of the power supply exceeding a predetermined threshold," as required by each and every claim of the '593 patent.

2. Claim 2: Hau does not disclose "deactivate the switching device based on a load current at the output voltage node"

117. In my opinion, Hau does not disclose nor suggest "the aperture generator and control module is configured to deactivate the switching device based on a load current at the output voltage node," as required by claim 2.

118. Claim 2 recites "The power supply of claim 1, wherein the aperture generator and control module is configured to deactivate the switching device based on a load current at the output voltage node." '593 patent, Claim 2.

119. The '593 patent specification describes, in connection with Figure 5, "an Optional Load Current Sensing Circuit 504."

> FIG. 5 illustrates another example step down switching power supply 500 having a bypass switch architecture.
>
> Switching power supply 500 is similar in several respects to example power supply 400 of FIG. 4. Additionally, switching power supply 500 includes an Optional Hysteresis Control signal 502, which is received by Bypass Switch Control module402, and an ***Optional Load Current Sensing Circuit 504***.

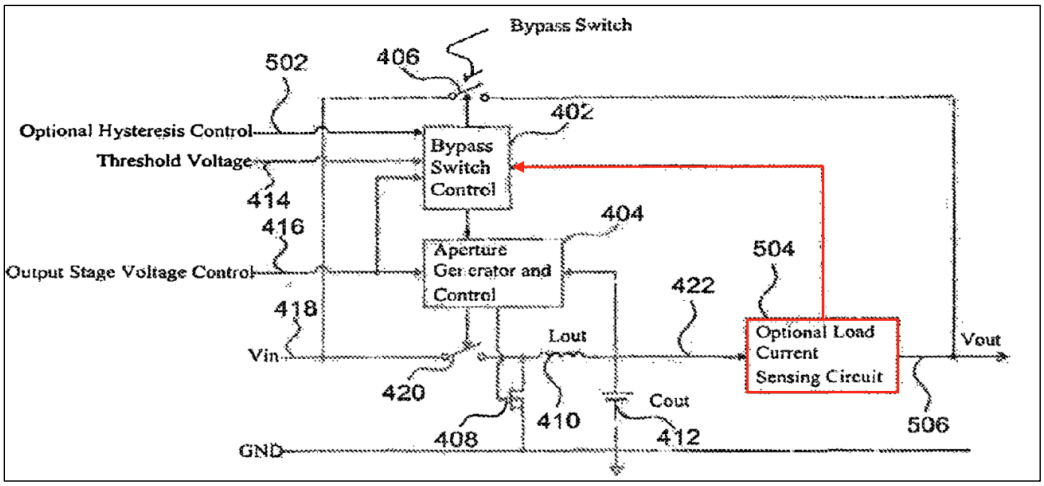
'593 patent, 8:28-35.

120. "Optional Load Current Sensing Circuit 504 senses load current to determine any variations that may affect power supply output voltage $[V]_{out}$ 506," and provides "information about sensed load current, which can be used by Bypass Switch Control module 402 to control the operation mode of switching power supply 500."

> Optional Load Current Sensing Circuit 504 is coupled at output node 422 of power supply 500. In an embodiment, ***Load Current Sensing Circuit 504 senses load current to determine any variations that may affect power supply output voltage*** $[V]_{OUT}$ ***506***. Further, ***Optional Load Current Sensing Circuit 504 provides a feedback signal to Bypass Switch Control module 402.*** In an embodiment, the feedback signal includes information about sensed load current, which can be

used by Bypass Switch Control module 402 to control the operation mode of switching power supply 500.

'593 patent, 9:1-10.



'593 patent, Fig. 5 (annotated).

121. I understand that Dr. Larson opined that Hau suggests the claimed "deactivate the switching device based on a load current at the output voltage node." Larson Decl., ¶¶131-32.

122. Dr. Larson acknowledges that Hau teaches controlling the bypass switch based on Pdet, which is a measurement of voltage that is derived from the RF AC input power, not current of the output power amplifier. Larson Decl., ¶131. I note that Hau does not describe any embodiment that involves measuring current. Nor does Hau describe any embodiment that controls the bypass switch based on current measurement.

123. Nonetheless, Dr. Larson opined that Hau's teaching of the "(I)(V)=power relationship" would have "suggest[ed] to a POSITA to use current measurements in the system of Hau to perform the same deactivating/bypass function." Larson Decl., ¶131. I disagree.

124. The proposed current measurement is of the DC-DC output current. The threshold in Hau is set by the RF AC power input. Dr. Larson has shown no relationship between the RF AC input power (not from the supply) and the output current of the DC-DC converter.

125. In addition, in my opinion, Hau explicitly discourages a POSITA from taking current measurements and using measured current to control its bypass switch. In particular, Hau expressly teaches that prior art devices that "monitor[] the output power of the power amplifier through the current in the voltage bias line to the power amplifier" have many undesirable effects, including "coupling loss (typically through a resistor or a current mirror) in the bias line." Hau, 2:1-11. This causes "voltage drop especially under high current operation, reducing the bias voltage available to the power amplifier and resulting in performance degradation":

> U.S. Pat. No. 6,081,161 ('161) to F. L. Dacus et al. and U.S. Pat. No. 6,646,511 ('511) to J. C. Canyon et al. provide other solutions. Both of these patents teach ***monitoring the output***

> ***power of the power amplifier through the current in the voltage bias line to the power amplifier***. The ***detected current sets the optimized bias voltage*** for the power amplifier. However, the ***coupling loss (typically through a resistor or a current mirror) in the bias line would cause voltage drop especially under high current operation, reducing the bias voltage available to the power amplifier and resulting in performance degradation***.

Hau, 2:1-11. Hau also states that such prior art devices undesirably require the "use of external look up tables that are part of complex feedback loops for adjusting the power amplifier supply voltage," and "require additional calibration procedures and the operation is not adaptive within the power amplifier":

> Another limitation of prior art power amplifiers ('511) is their ***use of external look up tables that are part of complex feedback loops for adjusting the power amplifier supply voltage***. Such control schemes ***require additional calibration procedures and the operation is not adaptive within the power amplifier***.

Hau, 2:12-17. Further, Hau states that another limitation of such prior art devices "is their dynamic control of the DC bias current through the gate node of the power amplifiers," which is "is ineffective in reducing current consumption of the power amplifiers over different output power level as compared to reducing the collector or drain bias supply voltage of the power amplifier":

> Another limitation of prior art power amplifiers ('161) is their

> ***dynamic control of the DC bias current*** through the gate node of the power amplifiers. As known to those skilled in the art, ***this technique is ineffective in reducing current consumption*** of the power amplifiers over different output power level ***as compared to reducing the collector or drain bias supply voltage*** of the power amplifier.

Hau, 2:18-24.

126. To improve upon prior art devices that monitor output power through current measurements, Hau expressly teaches away from measuring output current and "relat[ing] the output current to the output power from the (I)(V)=power relationship." Hau, 6:34-44. Instead, Hau teaches establishing a linear relationship between Pdet and Vcc2, and "relies on the $(Vcc2)^2/R$= power relationship" to control the output power of its DC to DC convertor:

> Thus, the linear relationship between Pdet and Vcc2 is achieved, and the optimum output power of the power amplifier is controlled by Vcc2 accordingly. With this linear output relationship, ***the detector DC output voltage, Pdet, can control the DC to DC converter output directly, and eliminates the need of any look-up-table or complicated controller circuits used in the prior art***. In addition, ***the prior art related the output current to the output power from the (I)(V)=power relationship, whereas the present invention relies on the $(Vcc2)^2/R$=power relationship.***

Hau, 6:34-44.

127. In view of the above disclosure in Hau, which expressly disparages the use of current measurements for monitoring output power and controlling the bypass switch, it is my opinion that Hau teaches away from the claimed "deactivate the switching device based on a load current at the output voltage node."

128. Dr. Larson further opined that "substituting a current measurement for a voltage measurement" would have been a simple substitute and a known alternative. Larson Decl., ¶132. I disagree.

129. Substituting Hau's voltage measurement of the RF AC input power (not the supply power) with the output DC current of the DC-DC converter is not a simple substitution. They are different quantities, dependent on different circuits and configurations thereof. The RF input power flows through the power amplifiers. The DC-DC output current biases the power amplifier and supply power for amplification of the RF input power.

130. In the case of Hau, even if a POSITA were to choose to ignore Hau's teaching of avoiding current measurements, it would not have been a simple substitution to place the voltage measurement of Pdet with a current measurement.

This is because the self-adaptive nature of Hau's power supply depends on the use of voltage measurement.

131. As Hau explained, the linear relationship between Vin (a measure of RF AC input power), the output voltage of the first stage power amplifier, Vcc2, the power supply voltage, and Pdet is what enables the current consumption optimization of Hau's device:

> As implemented herein t***he voltage, Vin, from the first stage of the power amplifier to the power detector 4 is used to adjust linearly the optimum supply voltage, Vcc2, that supplies current and optimizes the output power of the power amplifier.*** The ***output power of the power amplifier is proportional to the square of the voltage Vin***. The power detector 4 outputs an DC voltage, ***Pdet, which is proportional to the voltage Vin***. The DC to DC converter outputs a ***supply voltage Vcc2, which is linearly related to the voltage Vin.*** The ***maximum output voltage signal swing of the power amplifier is proportional to the square of the supply voltage Vcc2***. The ***maximum output power from the power amplifier is therefore directly proportional to the square of Vcc2.*** Thus, ***the linear relationship between Pdet and Vcc2 is achieved, and the optimum output power of the power amplifier is controlled by Vcc2 accordingly***. ***With this linear output relationship, the detector DC output voltage, Pdet, can control the DC to DC converter output directly, and eliminates the need of any look-up-table or complicated controller circuits used in***

> ***the prior art.*** In addition, the prior art related the output current to the output power from the (I)(V)=power relationship, whereas the present invention relies on the (Vcc2)2/R=power relationship.

Hau, 6:22-44.

132. Substituting Pdet's voltage measurement for current measurement destroys this linear relationship and fundamentally changes the way Hau operates. Hau does not teach nor suggest setting the optimal supply voltage (Vcc2) as a function of current measurement. Indeed, nothing in Hau indicates how Vcc2 could be set based on a linear relationship with current, from the output of the first stage power amplifier, the output of the power supply, or elsewhere. And Dr. Larson did not explain how such a substitution would nonetheless maintain Hau's linear relationships between Vin, Pdet, and Vcc2, which is critical to the self-adaptive nature of Hau's power supply. Accordingly, a POSITA would not know how nor would they be motivated to substitute Pdet's voltage measurement with a current measurement.

133. Thus, Dr. Larson is incorrect that Pdet's voltage measurement from the RF AC signal can be simply substituted for current measurement from the output of the DC-DC converter. Doing so fundamentally alters the design and operation of Hau.

134. For these reasons, it is my opinion that Hau does not disclose nor suggest "the aperture generator and control module is configured to deactivate the switching device based on a load current at the output voltage node," as required by claim 2.

3. Claims 5 and 11: Hau does not disclose "an output current at a maximum power efficiency associated with the down-converted input voltage"

135. In my opinion, Hau does not disclose "an output current at a maximum power efficiency associated with the down-converted input voltage," as required by claims 5 and 11.

136. Claim 5 recites "The power supply of claim 1, wherein the aperture generator and control module is configured to provide ***an output current at a maximum power efficiency associated with the down-converted input voltage***." Similarly, claim 11 recites "The method of claim 9, further comprising providing ***an output current at a maximum power efficiency associated with the down-converted voltage***." '593 patent, Claims 5, 11.

137. I understand that Dr. Larson opined that Hau teaches the limitations of claims 5 and 11 because Hau "provides a down-converted DC voltage at an 'optimum' output power," which "provides the most efficient current consumption for each power output level." Larson Decl., ¶133. I disagree.

138. Dr. Larson improperly conflates the concept of current consumption with power efficiency. These concepts, while related, are disparate and distinct from one another. Hau is directed towards "dynamically optimizing current consumption … of a power amplifier":

> The present invention is directed to ***dynamically optimizing current consumption*** and linearity of a power amplifier at each power level without the need for any external control in order to provide ***automatic current optimization for performance improvement while extending battery life***.

Hau, 2:36-40.

139. In the context of Hau, the "optimum power level" for "a particular bias supply voltage" is one that "provides the most efficient current consumption … while satisfying the linearity requirements":

> The "optimum" power level, which corresponds to a particular bias supply voltage (Vcc2 in FIG. 1), is constrained by the ACLR1 linearity specification mentioned above. FIG. 3 shows the performance of a preferred embodiment of the present invention in trace 30. The trace 32 illustrates an amplifier biased with a fixed bias voltage at 3.4V, which corresponds to the optimum bias supply voltage Vcc2required for maximum output power. ***The optimum bias voltage operation provides the most efficient current consumption for each power output level while satisfying the linearity requirements.*** The abscissa (horizontal

> axis) is in dBm and the ordinate (vertical axis) is in dBc. As pointed out before the figure-of-merit for interference between adjacent channels is at least −40 dBc.

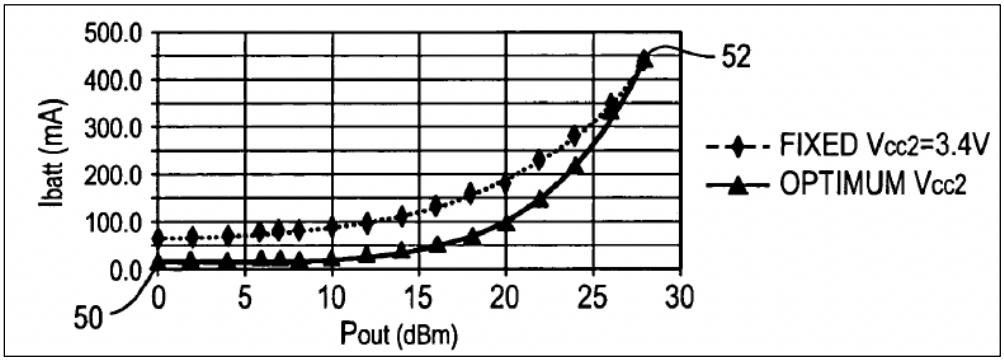
Hau, 4:44-57.

140. As described in connection with Figure 5, Hau allegedly achieves "significant reduction in current consumption" over the prior art based on a comparison of "battery current consumption" at various power level:

> FIG. 5 illustrates the battery current consumption (Ibatt) of the optimum power amplifier embodiment of the present invention compared to a power amplifier powered by a fixed +3.4V battery. At 0.0 dBm location 50 the current savings is over 50 mA from the battery while at the +28 dBm location 52 the current draws are equal between the two systems. Since this is the maximum output power, the full battery voltage is applied in both systems, so the current draw will be equal. But, notice that the battery current savings are 50 mA or more at output power below +25 dBm. Significant reduction in current consumption is achieved over a wide range of output power. The battery current consumption is calculated as:
>
> $$\text{Ibatt} = \frac{\text{Vcc 2} \times \text{Icc 2}}{\text{Vbatt} \times \text{DC to DC converter conversion efficiency}}$$
>
> Statistically, handsets transmit at maximum linear output power only for a small fraction of time, and most of the transmission takes place at a considerably lower power levels (10 dB or more

below maximum output power). Therefore, substantial battery current is saved for, probably, 95% of the time when the handsets are in use.

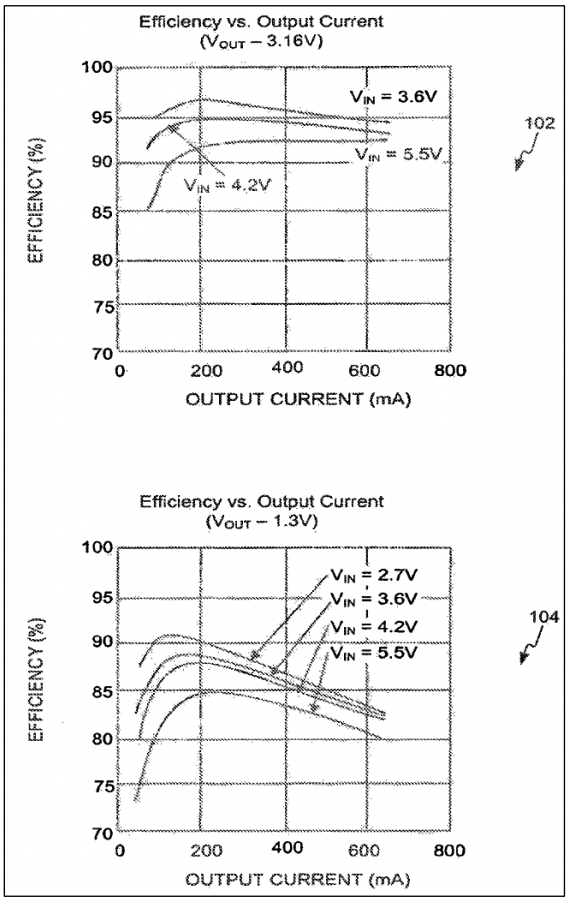
Hau, 4:66-5:22.



Hau, Fig, 5.

141. Accordingly, the object of Hau is to minimize input current at each output power level of the power amplifier (not the output current at the load of the DC-DC convertor (i.e., the power amplifier)).

142. But, as shown in Figure 1 of the ’593 patent, the relationship between output current and efficiency is non-linear:



EX1001, Fig. 1.

143. In addition, the relationship between input current and output current is also non-linear and non-monotonic because output current is dependent on output voltage and power supply efficiency. Thus, minimizing input current does not mean that the output current is optimized for maximimum power efficiency.

144. For these reason, it is my opinion that Dr. Larson's analysis for claims 5 and 11 is deficient. Hau's teaching of minimizing input current does not disclose

or suggest the claimed "output current at a maximum power efficiency associated with the down-converted input voltage," as required by claims 5 and 11.

4. Claims 6 and 12: Hau does not disclose "deactivat[e/ing] the switching device and pass[ing] the input voltage to the output voltage node [based on a/comprises] compar[ison of/ing] the down-converted [input] voltage to a threshold voltage"

145. In my opinion, Hau does not disclose the limitations of claims 6 and 12.

146. Claim 6 recites "the power supply of claim 1, wherein the aperture generator and control module is configured to ***deactivate the switching device and pass the input voltage to the output voltage node based on a comparison of the down-converted input voltage to a threshold voltage***." Similarly, claim 12 recites "The method of claim 9, wherein ***the de-activating comprises deactivating the switching device and passing the input voltage to the output voltage node comprises comparing the down-converted voltage to a threshold voltage***."

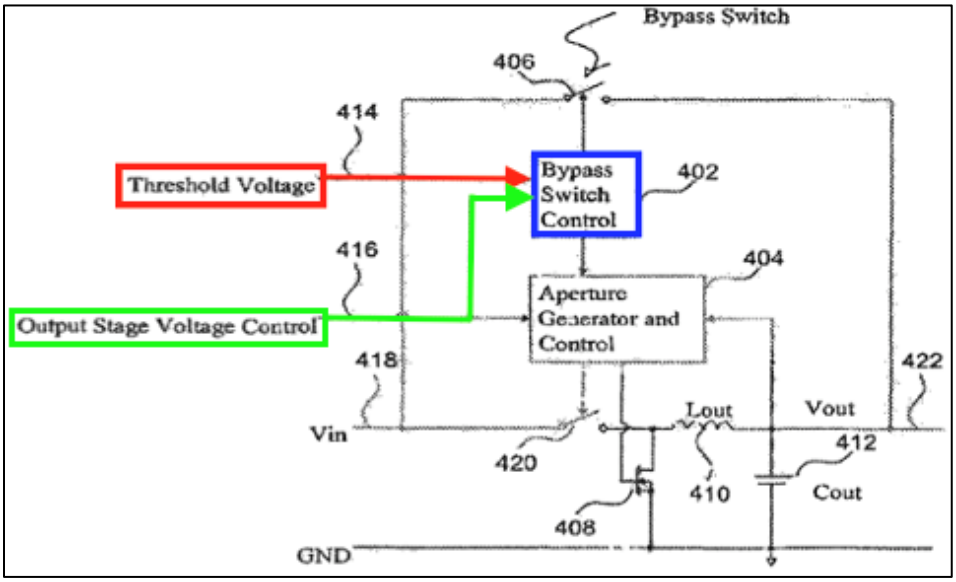
147. The '593 patent describes, in connection with Figure 4, that the Bypass Switch Control module 402 determines whether to switch to bypass mode by comparing Threshold Voltage 414 to "the ***value of the power supply output voltage*** to determine whether power supply 400 should switch to bypass mode":

> ***Bypass Switch Control module 402 receives Threshold Voltage signal 414 and Output Stage Voltage Control***

> ***signal 416. Threshold Voltage signal 414 determines at which value of the power supply output voltage power supply 400 switches to bypass mode. Output Stage Voltage Control signal 416 includes information about the target power supply output voltage and thus allows Bypass Switch Control module 402 to determine the value of the power supply output voltage.***
>
> ***Bypass Switch Control module 402 compares Threshold Voltage 414 and the value of the power supply output voltage to determine whether power supply 400 should switch to bypass mode.*** When the power supply output voltage exceeds Threshold Voltage 414, Bypass Switch Control module 402 controls Bypass Switch 406 to couple input voltage signal V IN 418 to the power supply output node. At the same time, Bypass Switch Control module 402 controls Aperture Generator and Control module 404 to cause it to de-couple input voltage signal V IN 418 from the collector/drain node of switching transistor 408 and to shut off switching transistor 408.

'528 patent, 7:50-8:3.

ParkerVision Exhibit 2001
MediaTek v. ParkerVision - IPR2025-00030



'528 patent, Fig. 4 (annotated).

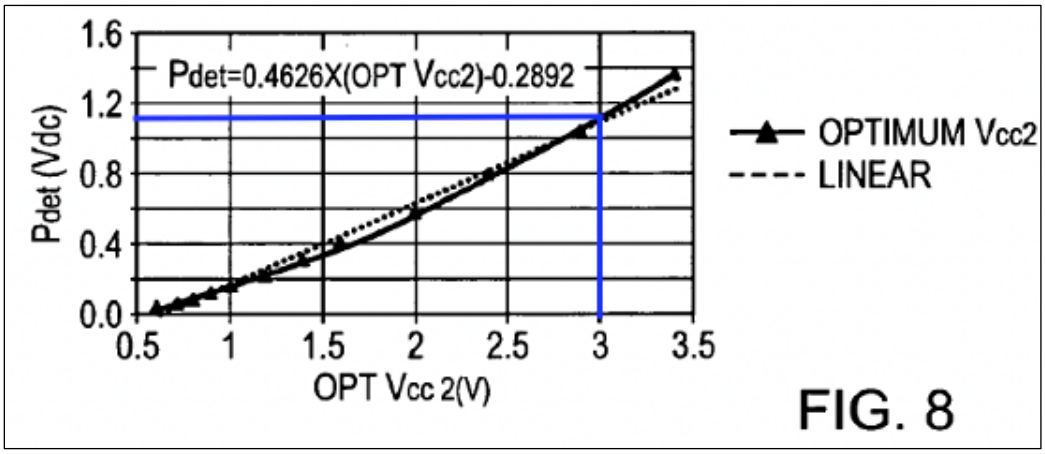
148. I understand that Dr. Larson opined that Hau teaches or suggests the limitations of claims 6 and 12 because "Pdet indicates Vcc2 (the down converted input voltage) and is compared to a 'threshold voltage' by the bypass controller." Larson Decl.,¶134. I disagree.

149. As Dr. Larson acknowledges, "Pdet is [merely] proportional to Vcc2." Larson Decl.,¶134. Indeed, Hau discloses, in connection with Figure 8, that "the relationship between the Pdet and the optimum Vcc2 output from the DC to DC converter … is ***approximately***, Pdet=0.4626x(OPT Vcc2)-0.2892:"

> FIG. 8 shows ***the relationship between the Pdet and the optimum Vcc2 output from the DC to DC converter***. The traces illustrate the small differences between a linear line and that achieved with the diode D2, as biased, in the power detector

of FIG. 7. With the components used in FIG. 7, ***the relationship is approximately, Pdet=0.4626×(OPT Vcc2)−0.2892.***

Hau, 6:15-21.



Hau, Fig. 8.

150. As Hau explained, "bypass controller 74 … activates the bypass switch 72 ***when the Pdet reaches a given DC voltage set point*** that corresponds to a Vcc2 from the DC to DC converter of ***about*** +3.0V." Hau, 5:48-51. As shown in Figure 8, when Vcc2 is 3.0V, Pdet is approximately 1.1V. Thus, Pdet does not equal Vcc2 (i.e., the down-converted input voltage by Hau's DC to DC convertor). And Hau's bypass switch 72 is activated based on a comparison of Pdet (not Vcc2) to the DC voltage set point.

151. Although Pdet has an approximate linear relationship with Vcc2, that is not enough to meet the claim language, which is clear and specific: bypass switch is activated "based on a comparison of the down-converted input voltage to

a threshold voltage." Indeed, Hau discloses that Pdet is based on Vin—an AC RF signal from the first stage power amplifier—which is also proportional to Vcc2:

> As implemented herein the voltage, Vin, from the first stage of the power amplifier to the power detector 4 is used to adjust linearly the optimum supply voltage, Vcc2, that supplies current and optimizes the output power of the power amplifier. The output power of the power amplifier is proportional to the square of the voltage Vin. ***The power detector 4 outputs an DC voltage, Pdet, which is proportional to the voltage Vin. The DC to DC converter outputs a supply voltage Vcc2, which is linearly related to the voltage Vin***.

Hau, 6:22-30.

152. By Dr. Larson's logic, the limitations of claim 6 and 12 is also met by comparing Vin (i.e., an AC RF signal from the first stage power amplifier) to a threshold voltage. This logic allows the claims to reach far beyond what is plainly stated as required by the claims—"a comparison of the down-converted input voltage to a threshold voltage."

153. For these reasons, it is my opinion that Hau does not disclose nor suggest the limitations of claims 6 and 12.

B. Ground 1B: Hau in View of Yoshida and Further in View of Sahu

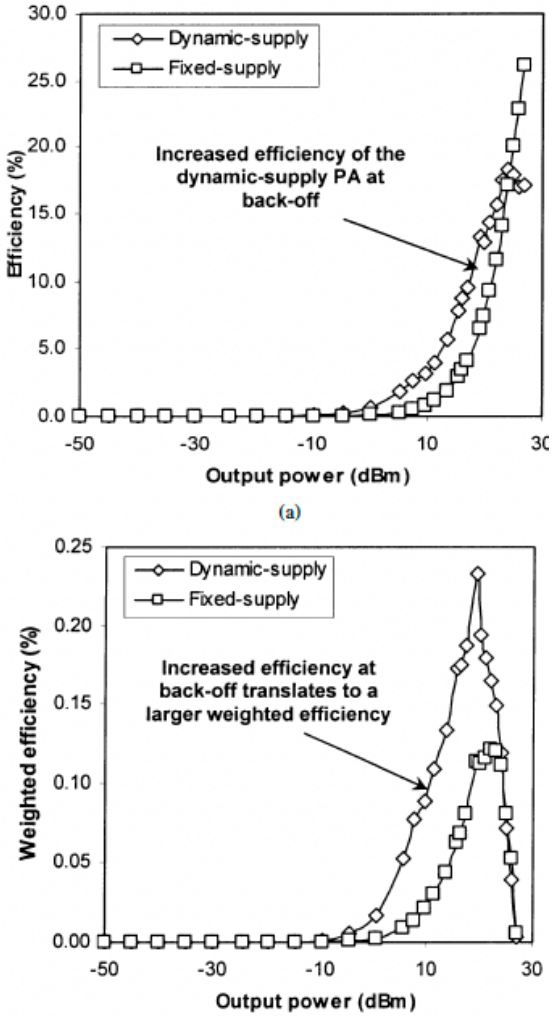
1. Claims 3-4, 8, 10, 13-14, 17-20: No motivation to combine Sahu with Hau and Yoshida

154. In my opinion, a POSITA would not have had reasons to combine Sahu with Hau and Yoshida.

155. I understand that Dr. Larson opined that a POSITA would "have been motivated to apply Sahu's teachings, of controlling the performance of a power supply ***based on the power levels most likely for a given transmission scheme***, to the variable power transmission power supply of Hau and Yoshida." Larson Decl., ¶154-56. I disagree.

156. Sahu teaches that for a CDMA system, power amplifier ("PA") "operates mostly at 15-20 dB backoff from the peak power." Sahu, 113. Because PA rarely operates at peak output power, Sahu teaches that "it is extremely important to calculate the average efficiency when considering the optimum PA configuration." Sahu, 113. Sahu further teaches that "weighted average efficiency," which accounts for "the probability of operating at RF output power," can be used to "measure of the effectiveness of the PA to convert the battery-stored energy into transmitted energy at the antenna." Sahu, 113.

157. As shown in Figure 8 of Sahu, the "weighted average efficiency" is used to evaluate (not to design) the efficiency of Sahu's dynamic PA compared to a fixed supply PA. Sahu, 118-19.



Sahu, Fig. 8.

158. Sahu further teaches "Efficiency Enhancement Schemes Using Dynamic Supplies." Sahu 114-15. Sahu teaches a "Proposed System and Hardware Implementation." Sahu, 115-17. Sahu's proposed system was evaluated

against fixed supply systems, and the experimental results show, among other things, that Sahu's proposed system has increased weighted efficiency as compared to fixed supply system. Sahu, 115-17.

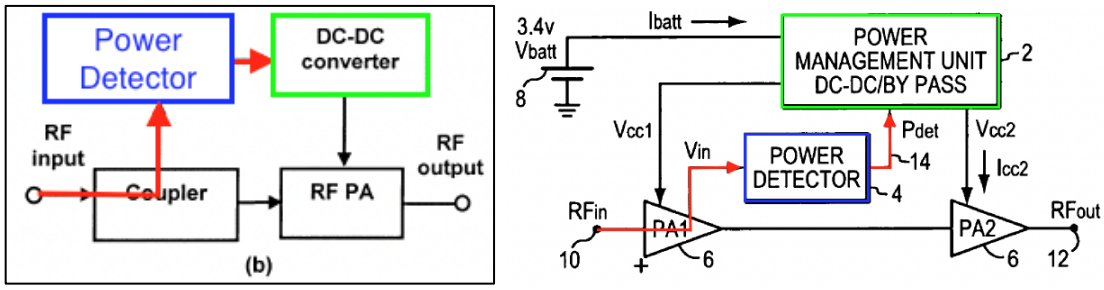
159. Notably, Sahu does not teach how to improve a system's weighted efficiency other than using a dynamic-supply system like that described in Sahu. According to Sahu, such dynamic-supply systems have improved weighted efficiency because they are more efficient at backoff power, which is where PA mostly operates in a CDMA system. Sahu, 113, 118-19. Sahu offers no other teaching to improve performance based on specific transmission standard.

160. Put differently, Sahu teaches a one-size-fits-all improvement—for transmission standards where PA most likely operates in backoff power, a dynamic-supply system like that described in Sahu (which is more efficient than fixed-supply system in backoff power) is advantageous. Sahu does not teach adapting the design and control of its system based on a specific transmission standard or modulation scheme—Sahu's system would have the same design, regardless of the standard or modulation scheme. Sahu simply shows that for one standard (CDMA) the average efficiency is higher that with a fixed supply.

161. To the extent a POSITA would have been motivated by Sahu (they wouldn't be) to calculate the "weighted average efficiency" of Hau's device (as

modified by Yoshida), such a skilled person nonetheless would not have been motivated to apply Sahu's teachings of controlling a power supply for increased PA efficiency in the backoff power region.

162. To begin, a POSITA would have recognized that the Hau/Yoshida device, like Sahu's device, are both dynamic supply systems that seek to improve efficiency in the "backoff" region. Hau, 1:33-61, 5:17-20; Sahu, 113. I note that Dr. Larson agrees with me in this regard. Larson Decl., ¶155. Thus, the Hau/Yoshida device already controls its power supply in the manner Sahu teaches would improve efficiency when operating in a CDMA system. Indeed, both Sahu and Hau similarly controls the power supply output voltage based on the RF input signal:



Compare Sahu, Fig. 3(b) (annotated) *with* Hau, Fig. 1 (annotated); Sahu, 115 (proposed implementation same as Fig. 3(a) except "power detector is used for the control signal generation circuit").

163. To the extent a POSITA was motivated (they wouldn't be) to calculate the weighted efficiency of the Hau/Yoshida device as taught by Sahu, and

found the weighted efficiency of the Hau/Yoshida device to be unsatisfactory, Sahu offers no suggestion for improvement. Indeed, a POSITA reading Sahu would have understood the Hau/Yoshida device to already employ the technique taught by Sahu for improved weighted efficiency for the CDMA standard—the use of a dynamic power supply for improved efficiency in the backoff power region.

164. Moreover, even if a POSITA would have found aspects of Sahu's implementation of a dynamic supply system to be desirable, such a skilled person would not have been motivated to apply those teachings to the Hau/Yoshida device, because Hau expressly teaches away from aspects of Sahu's implementation.

165. According to Hau, prior art systems with "dynamic control of the DC bias current *through the gate node* of the power amplifiers … is ineffective in reducing current consumption of the power amplifiers over different output power level as compared to reducing the collector or drain bias supply voltage of the power amplifier." Hau, 2:18-24. However, Sahu's power amplifier relies on dynamic gate bias current that Hau teaches away from. Sahu, 117 (describing a "Dynamic Gate Bias Generation Circuit").

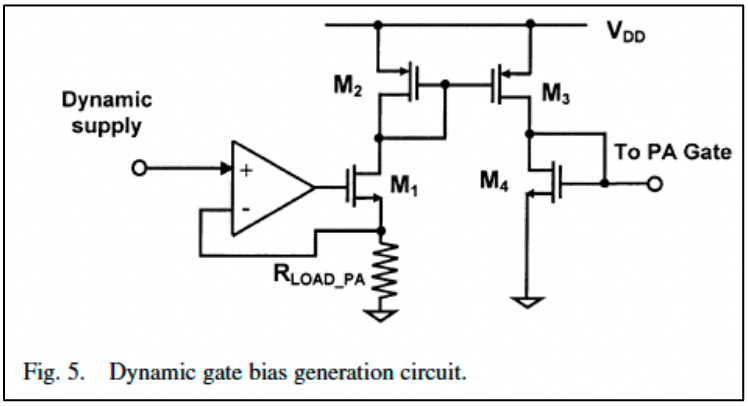


Fig. 5. Dynamic gate bias generation circuit.

Sahu, Fig. 5.

166. Therefore, a POSITA would have understood Hau to teach away from the power amplifier implementation described in Sahu. Neither Hau nor Sahu disclose or suggest, and Dr. Larson does not explain, how the Hau/Yoshida device can be modified to further improve weighted efficiency for CDMA or other transmission standard.

167. At best, a POSITA might have been motivated by Sahu to calculate the "weighted average efficiency" of the combined Hau/Yoshida device to evaluate its efficiency for a transmission standard. But, as discussed above, Sahu does not teach, and a POSITA would not have been motivated to adapt the Hau/Yoshida device based on probable transmission power level of a specific transmission standard.

168. For these reasons, it is my opinion that a POSITA would not have motivation to combine Sahu with Hau and Yoshida in a manner that renders the claimed invention of the ’593 patent obvious.

2. Claims 3-4, 10, 19: Combination of Sahu, Hau, and Yoshida does not disclose or suggest controlling the switching device “based on a probable output power point of operation for a selected modulation scheme based on one or more power efficiency characteristics of an electronic device coupled to the power supply”

169. In my opinion, the combination of Sahu, Hau, and Yoshida does not disclose or suggest controlling the claimed switching device “based on a probable output power point of operation for a selected modulation scheme based on one or more power efficiency characteristics of an electronic device coupled to the power supply,” as required by claims 3 (from which claim 4 depends), 10, and 19.

170. Dr. Larson began his analysis for these claim limitations by characterizing Sahu’s teachings relating to the calculation of the weighted average efficiency for a particular modulation scheme. Larson Decl., ¶¶157-59. From there, Dr. Larson opined that “It would further have been obvious to optimize the performance of the system taught by Hau (in view of Yoshida) in the same manner taught by Sahu, in which case the DC-DC buck converter of Hau (using the PWM control circuitry of Yoshida) would be controlled based on the efficiency at a

probable point of operation associated with a particular modulation scheme." Larson Decl., ¶160.

171. As I explained in Section X.B.1, a POSITA would not have been motivated to apply Sahu's efficiency optimization techniques to the Hau/Yoshida device. Sahu does not teach controlling the power supply (let alone the claimed switching device) "based on a probable output power point of operation for a selected modulation scheme," as required by the claims. Like Hau, Sahu teaches controlling a dynamic power supply based on RF input power. Sahu teaches that such dynamic-supply system is more efficient when the PA is operating in the backoff power region, which is more likely than when the PA is operating at maximum power (at least for the CDMA standard). Because "PA … rarely operates at [peak] power level … it is extremely important to calculate the average efficiency when considering the optimum PA configuration." Sahu, 113. As a figure of merit, Sahu calculated the weighted average efficiency of its proposed implementation of a dynamic-supply system and showed that its proposed system is more efficient than a fixed-supply system at backoff power. Nevertheless, Sahu does not teach how to improve the weighted average efficiency of a PA system other than to use a dynamic power supply.

172. The Hau/Yoshida device is already a dynamic supply device that, according to Sahu, provides improved weighted average efficiency. Sahu offers no other suggestion for improving efficiency in the probable output power level. And a POSITA would not have been motivated to modify the Hau/Yoshida device in view of Sahu's specific implementation because Hau expressly teaches away from it. Thus, even if a POSITA was motivated by Sahu to calculate the weighted average efficiency of the Hau/Yoshida device, such a skilled person would have found no suggestions for improvement.

3. Claims 8 and 13: Combination of Sahu, Hau, and Yoshida does not disclose or suggest "programming the threshold voltage based on a communication waveform efficiency, battery life associated with an electronic device coupled to the power supply, or a combination thereof"

173. In my opinion, the combination of Sahu, Hau, and Yoshida does not disclose or suggest "programming the threshold voltage based on a communication waveform efficiency, battery life associated with an electronic device coupled to the power supply, or a combination thereof," as required by claims 8 and 13.

174. Dr. Larson opined that it would "have been obvious to a POSITA to program the threshold as taught by Hau (that is, the power level at which the bypass is activated) to correspond to the point where a fixed power supply becomes more efficient as taught by Sahu." Larson Decl., ¶¶165-68. I disagree.

175. To begin, a POSITA would have recognized that Figure 8(a) of Sahu relates to specific devices that were tested. A POSITA also would have recognized that Sahu's implementation of a "dynamic-supply" is different from the Hau/Yoshida device and includes undesirable components according to Hau. *See* discussion in Section X.B.1. Further, a POSITA would not have analogized Sahu's fixed-supply system with Hau's bypass pathway without the benefit of hindsight. Sahu compared the weighted efficiency of its proposed dynamic-supply system with that of a fixed-supply system to demonstrate the merit of its own system, which does not include a bypass switch like that described in Hau. As I discussed in Section X.A.1, Hau teaches a bypass switch that is closed based on hardware limitations of the DC-DC convertor, not on power efficiency considerations such as communication waveform efficiency. In my view, Dr. Larson pieced Sahu and Hau together based on the inventive ideas disclosed in the '593 patent. Without the benefit of hindsight and the '593 patent's disclosure, a POSITA would not have equated the two unrelated systems in Figure 8(a) of Sahu to the system described in Hau.

176. Moreover, I disagree with Dr. Larson that Figure 8(a) shows "communication waveform efficiency." Larson Decl., ¶¶167. According to Dr. Larson, Figure 8(a) shows "communication waveform efficiency" because it shows

efficiency "obtained with a specific transmission scheme … using a particular communication waveform." Larson Decl., ¶¶167. But Figure 8(a) does not depend on a particular communication waveform. Figure. 8(a) plots the drain efficiency vs. output power for a dynamic and fixed VDD. That is, for Sahu's dynamic supply PA and fixed supply PA, Figure 8(a) does not and would not change based on the communication waveform used to obtain the result. Thus, even if a figure similar to Sahu's Figure 8(a) is plotted to compare the efficiency of the Hau/Yoshida device's dynamic mode and bypass mode, and a similar crossover point can be identified, this crossover point is nonetheless not based on "communication waveform efficiency."

C. Ground 1C Hau in view of Yoshida and Lejon

1. Claim 16: Lejon does not disclose a MISO amplifier

177. In my opinion, Lejon does not disclose or suggest a "wherein the electronic device comprises a multiple-input-single-output (MISO) amplifier," as required by claim 16.

178. Dr. Larson opined that "Lejon's Figures 9 and 10 teach examples of amplifiers with two inputs and a single [output]." Larson Decl., ¶¶182-84; *see also* Larson Decl., ¶¶176-81. I disagree.

179. Lejon discloses a "LINC out-phasing amplifier system," where "***an input signal [single]*** is applied to a modulator (3) that ***splits the signal into two***

phasor fragments which are independently amplified." Lejon, Abstract. As Lejon explained, in LINC amplifiers like those described in Lejon, "***an input signal [single] is provided***, e.g., as an in-phase (I) and quadrature phase (Q) signal." Lejon, 2:16-17. As Lejon explained in connection with Figure 1, "***a source (bandpass) signal [single]*** is typically separated into two (out-phased) constant-envelop signals by a signal component separator (SCS) or digital signal processor (DSP)." Lejon, 10:20-22.

180. Thus, LINC amplifiers like those described in Lejon receives a single input (which are split into two phasor components) and provides a single output. In my opinion, such LINC amplifiers do not constitute MISO amplifier as required by claim 16.

D. Ground 2A: Canyon in View of Ranjan

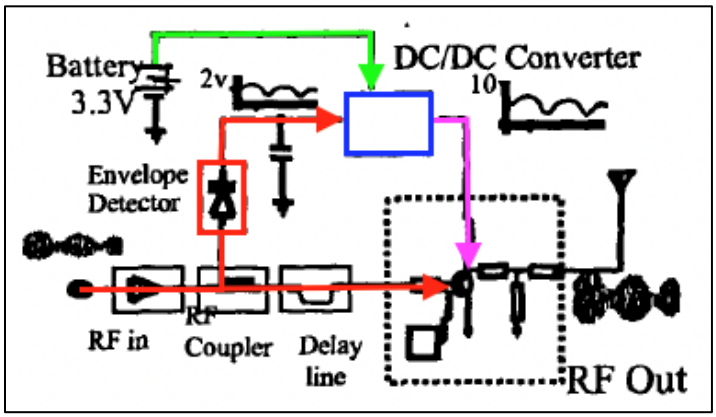
1. Claims 1-20: No motivation to combine Canyon with Ranjan

181. In my opinion, a POSITA would not have had reasons to combine Canyon and Ranjan.

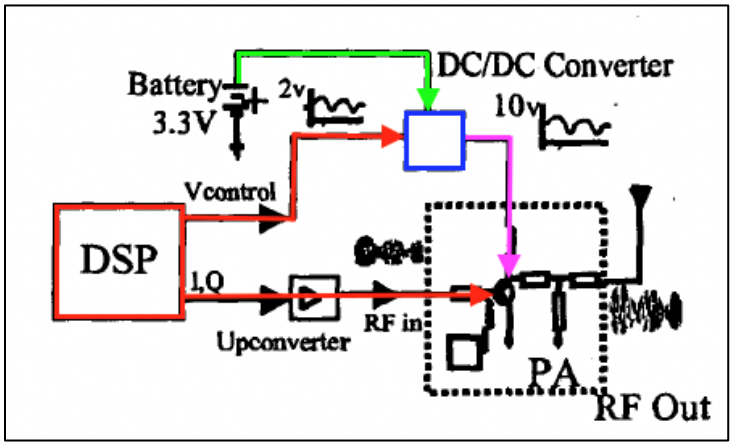
182. Dr. Larson opined that "a POSITA would have recognized that in a power supply such as Canyon with a voltage regulator and a bypass switch, maximum overall efficiency would be achieved by setting the threshold to operate the bypass switch at the point where a fixed power supply (the bypass path)

becomes more efficient than the variable power supply from the regulator." Larson Decl., ¶¶191-97. I disagree.

183. As a threshold matter, I note that Ranjan's power amplifier and DC-DC convertor design is fundamentally different from Canyon's. Ranjan discloses an amplifier architecture that controls the power supply output voltage based on the RF input signal. Ranjan, 493. Figure 1a of Ranjan discloses a "previously reported system based on an envelope detector to control the power supply voltage:"

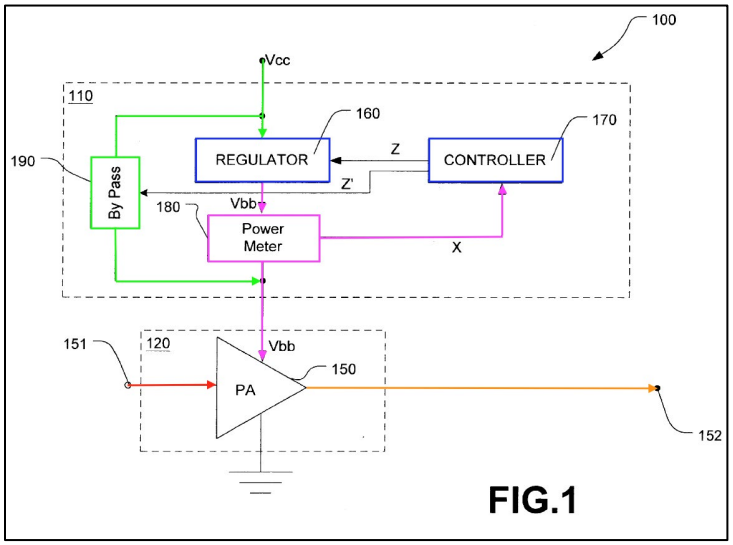


Ranjan, Fig. 1a (annotated). As shown above, the DC/DC Convertor (blue) controls the power supply output voltage (pink arrow) based on an envelope detector signal derived from RF input signal (red arrow). Similarly, Figure 1b shows a configuration involving a DSP:



Ranjan, Fig. 1b (annotated). Neither of the power amplifier architecture disclosed in connection with Figs. 1a and 1b of Ranjan includes a bypass switch.

184. In contrast, Canyon discloses controlling the power supply output voltage based on power supply current output or amplifier power output. As shown in Figure 1, Canyon's controller controls its regulator (blue) and bypass switch (green) based on power supply output current (pink arrow). Canyon, 3:1-42.



Canyon, Fig. 1 (annotated). And as shown in Figure 2, Canyon discloses an alternative embodiment where the controller controls the regulator (blue) and bypass switch (green) based on power amplifier output power (orange arrow). Canyon, 3:43-4:29.

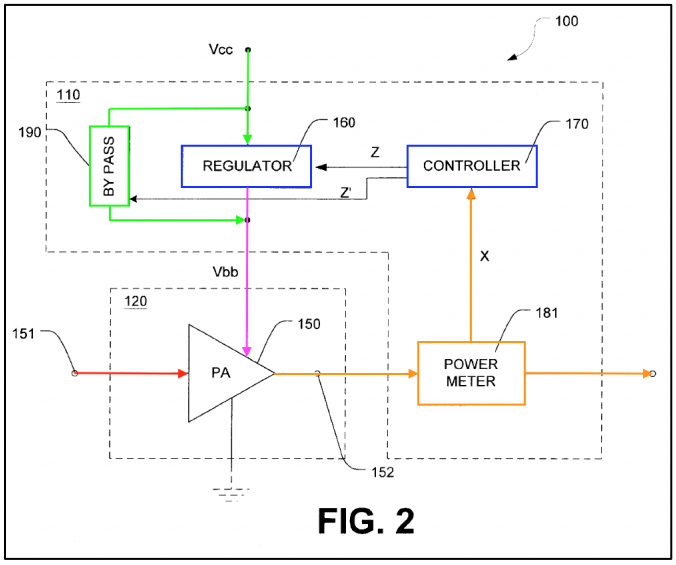


FIG. 2

Canyon, Fig. 2 (annotated). Unlike Ranjan, Canyon nowhere discloses a control scheme that involves taking measurements at the RF input signal (red).

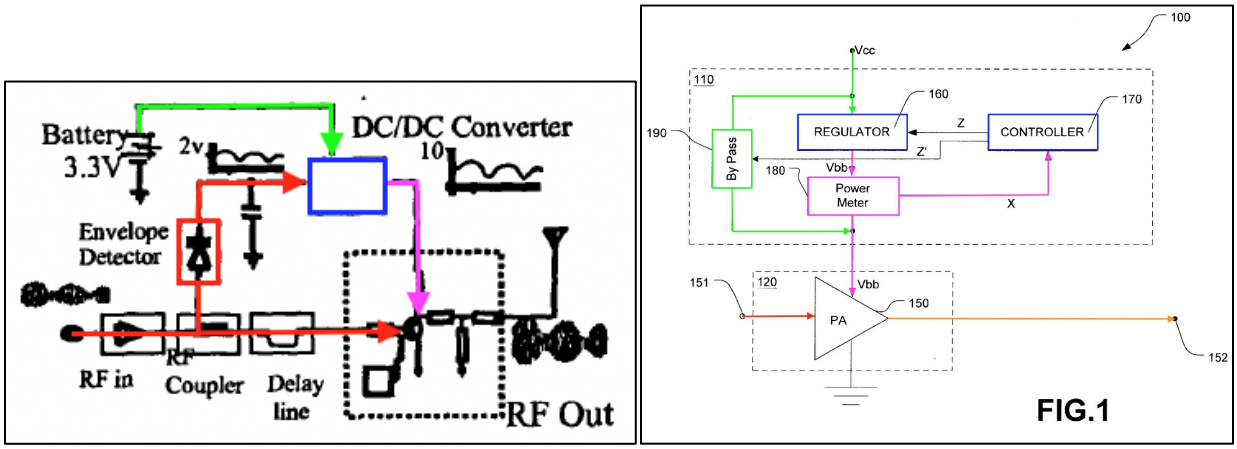


FIG.1

Compare Ranjan, Fig. 1a *with* Canyon, Fig. 1.

185. Given Ranjan and Canyon employ fundamentally distinct control schemes for controlling their respective power supply output voltage, it is my opinion that a POSITA would not have expected Canyon's system to perform similarly to Ranjan's system. Further, it is my opinion that a POSITA would not have found the measured efficiency of Ranjan's system shown in Figure 3 to be indicative of the efficiency of Canyon's system. In my opinion, Dr. Larson analysis is based on hindsight bias when he equated Canyon's system to two separate circuits in Ranjan (*see* Larson Decl., ¶196), neither of which operates in manner similar to Canyon's system.

186. Moreover, it is my opinion that a POSITA would not have looked to Ranjan to determine the threshold for opening and closing Canyon's bypass switch for several reasons.

187. First, contrary to Dr. Larson's opinion (Larson Decl., ¶193), Canyon expressly discloses when to open and close its bypass switch. Canyon discloses, in connection with the embodiment of Figure 2, that "bypass switch 190 is closed when the power output indicator signal X indicates that the power amplifier unit 120 is consuming, or operating at, a high power level." Canyon, 4:14-23. Canyon expressly provides what constitutes "a high power level"—"where the power amplifier unit is consuming a power level greater than 22-24 dBm":

> Bypass switch 190 is connected in parallel with the regulator 160 and receives input of the supply voltage Vcc. Bypass switch 190 is controlled by bypass signal Z′, that causes the bypass switch 190 to open or close. When bypass switch 190 is closed, the operating voltage Vbb applied to the power amplifier unit 120 preferably goes to the operating supply voltage Vcc. ***In a preferred embodiment, bypass switch 190 is closed when the power output indicator signal X indicates that the power amplifier unit 120 is consuming, or operating at, a high power level. For example, where the power amplifier unit is consuming a power level greater than 22-24 dBm, the bypass signal Z' may be output by the controller 170 to close the bypass switch 190.*** Once bypass switch 190 is closed, the operating voltage Vbb applied to the power amplifier unit 120 is effectively taken to a level approximately equal to the supply voltage Vcc.

Canyon, 4:14-29. Canyon also discloses, in connection with the embodiment of Figure 2, when the bypass switch should be open, such that the regulator 160 outputs a regulated operating voltage Vbb—when "the power output indicator signal X indicates that the power amplifier unit 120 is operating at a power level of less than, for example, 22 dBM":

> In a preferred embodiment, the regulator 160 outputs a operating voltage Vbb, to the power amplifier unit 120, of approximately 2.2 volts (+2.2 VDC) where ***the power output indicator signal X***

> ***indicates that the power amplifier unit 120 is operating at a power level of less than, for example, 22 dBM***.

Canyon, 4:8-13. Thus, Canyon's description as to when to open and close the bypass switch of the Figure 2 embodiment is complete. A POSITA would have had no reason to consult a separate literature (like Ranjan), which describes a fundamentally disparate power supply control scheme (that does not even involve a bypass switch), for purposes of deviating from Canyon's explicit and specific teachings of closing the bypass switch at high power level (i.e., 22-24 dBm).

188. Second, even if a POSITA were to look to Ranjan for guidance on how to determine the threshold for opening and closing the bypass switch for other embodiments of Canyon (e.g., the embodiment of Figure 1, which Dr. Larson relies upon for disclosing the claim limitations), such a skilled person would have found nothing in Ranjan to aid in that determination.

189. Cayon describes when to open and close its bypass switch in connection with the embodiment of Figure 2. *See* Canyon, 4:14-46. The embodiment of Figure 2 includes a power meter 180 that is connected to the output 152 of power amplifier 150 to measure the power output of amplifier 150:

> A power management unit 110 is provided. Power management unit 110 includes a power meter 180, a controller 170, a regulator 160 and a bypass switch 190.

> ***The output 152 of power amplifier 150 is connected to a power meter 180.***
>
> ***Power meter 180 monitors (measures) the power at the output of the power amplifier 152 of power amplifier 150*** and generates a power output indicator signal X.

Canyon, 3:50-57. As discussed above, Canyon discloses, in connection with this Figure 2 embodiment, that the bypass switch is open when power meter measures an output power level of less than 22 dBm, and close when power meter measures an output power level of greater than 22-24 dBm. Canyon, 4:8-29.

190. Unlike the embodiment of Figure 2, which includes a power meter 180 that measures the output power of the amplifier, the embodiment of Figure 1 instead includes a "current meter 180 [that] monitors (measures) the DC current flow of the operating voltage supply Vbb provided to the power amplifier unit 120." Canyon, 3:14-19.

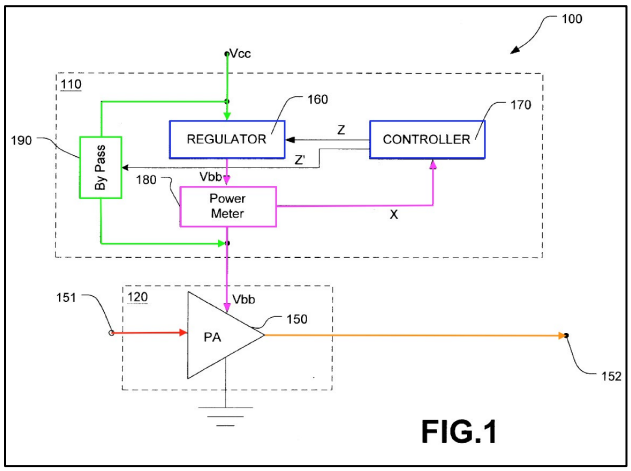


FIG.1

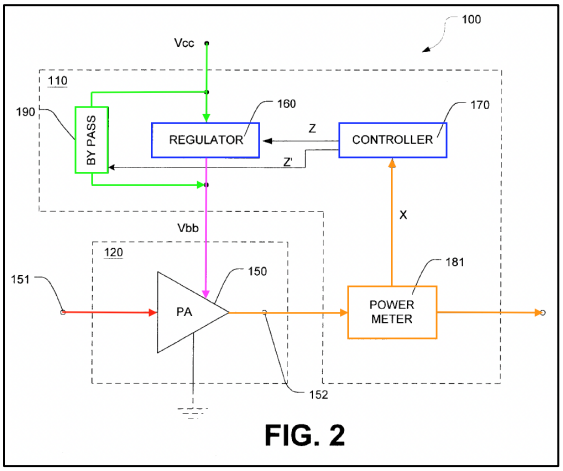


FIG. 2

Compare Canyon, Fig. 1 *with* Canyon, Fig. 2.

191. Dr. Larson did not provide any analysis as to whether Canyon's description (in connection with the Figure 2 embodiment) of operating its bypass switch based on measured output power level of the amplifier is applicable to the Figure 1 embodiment, which does not measure output power of the amplifier. In my opinion, a POSITA would not have known how to control the bypass switch of Figure 1 in the manner described for the embodiment of Figure 2. In fact, Canyon does not describe at all the function of the bypass switch in Figure 1.

192. A POSITA would have recognized that the output power level of the power amplifier unit 120 is a function of: (1) the power level of the input RF signal 151 (red arrow above); and (2) the gain of the power amplifier at a given bias voltage Vbb. Canyon does not disclose how to determine output power level of the power amplifier (required by the Figure 2 embodiment to determine when to close the bypass switch) based solely on power supply output current Ibb (the only measurement for controlling the bypass switch in the Figure 1 embodiment).

193. Although Canyon suggests that "it is possible to determine the power output of the power amplifier unit 120" based on the power supply output current Ibb, it does not specify how:

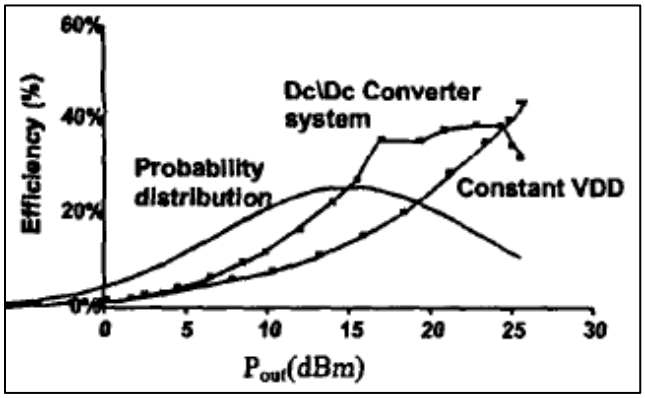
> ***By monitoring the current Ibb drawn by the power amplifier unit 120, it is possible to determine the power output of***

> ***the power amplifier unit 120***. In this way, ***for a given current flow indicator signal X, there is a corresponding output power level at which the power amplifier unit 120 operates***. By monitoring the current Ibb drawn by the power amplifier unit 120, it is possible to determine the power output of the power amplifier unit 120. In this way, ***the current signal X can also be considered indicative of the power output level of the power amplifier unit 120***.

Canyon, 3:20-30.

194. With no further guidance from Canyon, a POSITA would not have known how to determine output power of the power amplifier (for operating the bypass switch as described for the Figure 2 embodiment) solely based on output current of the power supply (as described for the Figure 1 embodiment). And a POSTIA would have found nothing in Ranjan that fills that gap.

195. Figure 3 of Ranjan shows the "[m]easured efficiency of amplifier with constant VDD and with dc/dc converter, at different ***output power levels***." Ranjan, 494.



Ranjan, Fig. 3. Critically, Ranjan nowhere discloses any relationship between power supply output current and power amplifier output power. Thus, a POSITA seeking to determine a threshold for closing the bypass switch based on measured output current of the power supply (as described in the Figure 1 embodiment) would have found no guidance from Canyon's Figure 2 embodiment (which requires measured amplifier output power) nor Ranjan (same).

196. Accordingly, it is my opinion that a POSITA would not have been motivated to set the threshold to operate Canyon's bypass switch based on the teachings of Ranjan. With respect to the Figure 2 embodiment, Canyon's teaching on how to set this bypass threshold is complete, and there is no need to consult Ranjan, which relates to a fundamentally different power supply control scheme that does not include a bypass switch. With respect to the Figure 1 embodiment, Canyon's teaching is deficient as to how the bypass threshold of the Figure 2

embodiment can be applied, but Ranjan does not provide any guidance to fill that gap.

2. Claims 1-20: Canyon alone or in view of Ranjan does not disclose controlling the switching device "in response to a power efficiency of the power supply exceeding a predetermined threshold"

197. In my opinion, the combination of Canyon and Ranjan does not disclose nor suggest deactivating the switching device "in response to a power efficiency of the power supply exceeding a predetermined threshold," as required by each and every claim of the '593 patent.

198. Dr. Larson relies on Canyon's Figure 1 embodiment in his analysis of other claim limitations. *See, e.g.*, Larson Decl., ¶¶199-207. For this claim limitation, however, Dr. Larson relies on Canyon's descriptions relating to the Figure 2 embodiment. Larson Decl., ¶¶209-211, 213-15. Dr. Larson did not provide any analysis as to whether Canyon's description (in connection with the Figure 2 embodiment) of operating its bypass switch based on measured output power level of the amplifier is applicable to the Figure 1 embodiment. As I discussed in Section X.D.1 above, Canyon does not disclose how to determine the output power level of the amplifier (as required for controlling the bypass switch in the Figure 2 embodiment) based solely on the output current of the power supply (as described for the Figure 1 embodiment).

199. As discussed in Section X.D.1, Cayon describes when to open and close its bypass switch in connection with the embodiment of Figure 2. *See* Canyon, 4:14-46. The embodiment of Figure 2 includes a power meter 180 that is connected to the output 152 of power amplifier 150 to measure the power output of amplifier 150:

> A power management unit 110 is provided. Power management unit 110 includes a power meter 180, a controller 170, a regulator 160 and a bypass switch 190.
> ***The output 152 of power amplifier 150 is connected to a power meter 180.***
> ***Power meter 180 monitors (measures) the power at the output of the power amplifier 152 of power amplifier 150*** and generates a power output indicator signal X.

Canyon, 3:50-57. Canyon discloses, in connection with this Figure 2 embodiment, that the bypass switch is open when power meter measures an output power level of less than 22 dBm, and close when power meter measures an output power level of greater than 22-24 dBm. Canyon, 4:8-29.

200. Unlike the embodiment of Figure 2, which includes a power meter 180 that measures the output power of the amplifier, the embodiment of Figure 1 instead includes a "current meter 180 [that] monitors (measures) the DC current

flow of the operating voltage supply Vbb provided to the power amplifier unit 120." Canyon, 3:14-19.

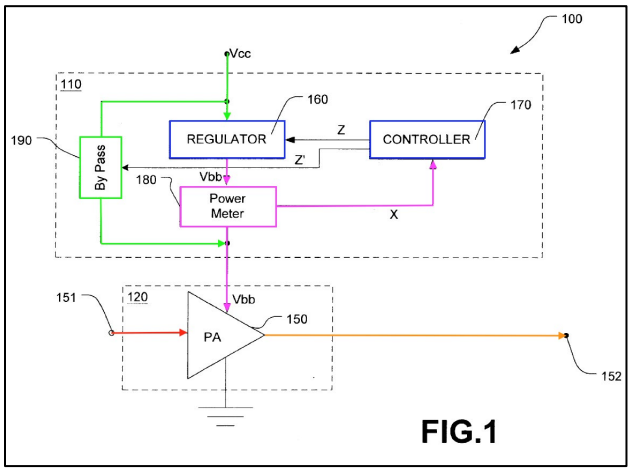


FIG.1

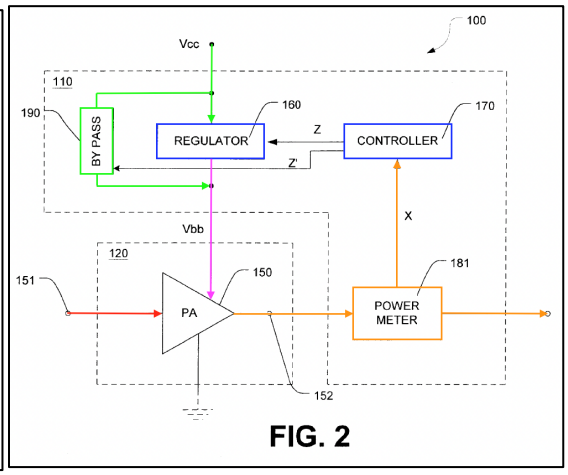


FIG. 2

Compare Canyon, Fig. 1 *with* Canyon, Fig. 2.

201. Although Canyon suggests that "it is possible to determine the power output of the power amplifier unit 120" based on the power supply output current Ibb, it does not specify how:

> ***By monitoring the current Ibb drawn by the power amplifier unit 120, it is possible to determine the power output of the power amplifier unit 120***. In this way, ***for a given current flow indicator signal X, there is a corresponding output power level at which the power amplifier unit 120 operates***. By monitoring the current Ibb drawn by the power amplifier unit 120, it is possible to determine the power output of the power amplifier unit 120. In this way, ***the current signal X can also be considered indicative of the power output level of the power amplifier unit 120***.

Canyon, 3:20-30.

202. With no further guidance from Canyon, a POSITA would not have known how to control the bypass switch of the Figure 1 embodiment in accordance to Canyon's description for the Figure 2 embodiment. Thus, Canyon alone does not disclose, in connection with Figure 1, the claimed control of the switching device "in response to a power efficiency of the power supply exceeding a predetermined threshold."

203. And as I discussed in Section X.D.1, a POSITA would have found nothing in Ranjan that fills the gap between Canyon's Figure 1 and Figure 2 embodiments.

204. Accordingly, it is my opinion that Canyon alone or in view of Ranjan does not render any of the challenged claims obvious.

3. Claims 3-4, 10, 19: Ranjan does not disclose controlling the switching device "based on a probable output power point of operation for a selected modulation scheme based on one or more power efficiency characteristics of an electronic device coupled to the power supply," as required by claims 3-4, 10, and 19

205. As discussed in Section X.D.1, it is my opinion that a POSITA would not have reason to combine Canyon and Ranjan. For those reasons, Canyon in view of Ranjan does not render this claim limitation obvious.

206. Moreover, Ranjan does not disclose controlling the switching device "based on a probable output power point of operation for a selected modulation scheme based on one or more power efficiency characteristics of an electronic device coupled to the power supply," as required by claims 3-4, 10, and 19.

207. Ranjan merely discloses that "average efficiency can be computed based on power usage probabilities:"

> A suitable average efficiency can be computed based on power usage probabilities. A representative probability distribution of output power in cellular phone applications is shown in Fig. 3.

Ranjan, 494. Ranjan nowhere discloses controlling the switching device based on the computed average efficiency. Indeed, as shown in Figure 3 of Ranjan, as annotated by Dr. Larson, the threshold (annotated in red) is not determined based on power usage probabilities, and is instead based on a comparison of the measured efficiency between amplifier with constant VDD and DC-DC convertor:

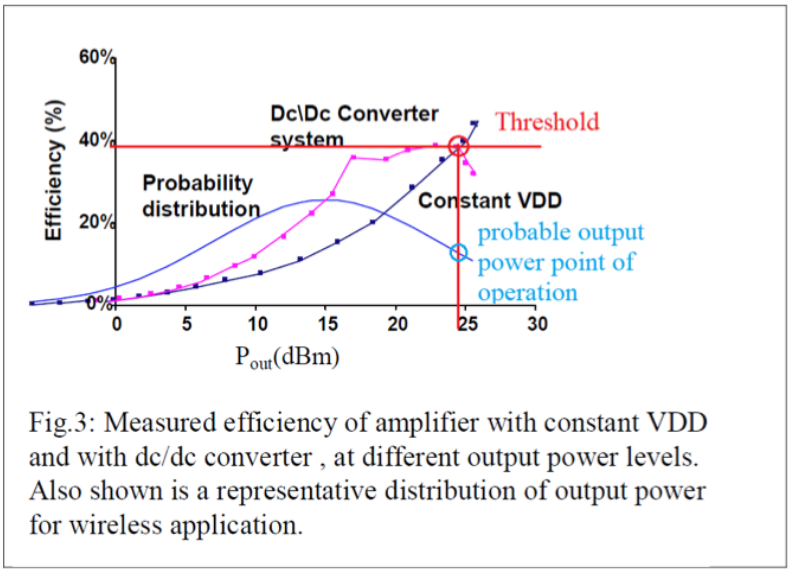


Fig.3: Measured efficiency of amplifier with constant VDD and with dc/dc converter , at different output power levels. Also shown is a representative distribution of output power for wireless application.

Larson Decl., ¶215 (original). This comparison, however, is hindsight driven as nowhere in Ranjan is it disclosed that the intersection of the DC/DC converter line and the constant VDD has any significance or should be used for anything.

208. Accordingly, it is my opinion that Canyon in view of Ranjan does not render obvious claims 3-4, 10, and 19.

E. Ground 2B: Canyon in View of Ranjan and Further in View of Hau

1. Claims 6 and 12: the combination of Canyon, Ranjan and Hau does not disclose nor suggest "deactivat[e/ing] the switching device and pass[ing] the input voltage to the output voltage node [based on a/comprises] compar[ison of/ing] the down-converted [input] voltage to a threshold voltage"

209. In my opinion, the combination of Canyon, Ranjan and Hau does not disclose nor suggest "deactivat[e/ing] the switching device and pass[ing] the input

voltage to the output voltage node [based on a/comprises] compar[ison of/ing] the down-converted [input] voltage to a threshold voltage," as required by claims 6 and 12.

210. Dr. Larson opined that Hau discloses the limitations of claims 6 and 12 for reasons similar to those he provided for Ground 1A.

211. For similar reasons I discussed in Section X.A.4 of this declaration, it is my opinion that Hau does not disclose the limitations of claims 6 and 12.

2. Claims 8 and 13: the combination of Canyon, Ranjan and Hau does not disclose nor suggest "programming the threshold voltage based on a communication waveform efficiency, battery life associated with an electronic device coupled to the power supply, or a combination thereof"

212. In my opinion, the combination of Canyon, Ranjan, and Hau does not disclose nor suggest "programming the threshold voltage based on a communication waveform efficiency, battery life associated with an electronic device coupled to the power supply, or a combination thereof," as required by claims 8 and 13.

213. Dr. Larson opined that Hau teaches "a threshold setting," which can somehow be programmed based on the spectrum efficiency of a particular modulation scheme:

> As discussed in §VII.A.1.b, ***a POSITA would have understood that spectrum efficiency represents efficiency of a***

> ***communication waveform***, which is related to the modulation scheme, such as WCDMA. Therefore, Canyon in view of Ranjan further in view of Hau teaches ***setting the voltage threshold (the threshold voltage is programmed) based on spectrum efficiency of, e.g., WCDMA (a communication waveform efficiency)***.

Larson Decl., ¶¶249-51. Respectfully, Dr. Larson's opinion for this claim limitation makes very little sense.

214. Spectral efficiency generally refers to a wireless communication modulation scheme's efficiency in transmitting data over a limited frequency spectrum or bandwidth. It is calculated based on the maximum bit rate (bit/s) throughput divided by the bandwidth (Hz) of a communication channel, and has a unit of measurement of bit/s/Hz. Dr. Larson correctly describes this in ¶52 of his background section.

215. In contrast, Hau's threshold is based on Pdet, which is derived from the output voltage of the first stage power amplifier. Hau, 6:22-44. While power amplifier design and configurations may have impact on the frequency domain, Hau does not disclose, and Dr. Larson did not explain, how the Pdet threshold can be programmed based on spectral efficiency considerations. Indeed, a POSITA would have known that improvements in spectral efficiency often come at the price of higher current consumption, in conflict with Hau's stated objective. Neither Hau

nor Dr. Larson explain how the Pdet threshold can be set on balance between spectral efficiency and current consumption.

216. Because a POSITA would not have known how to program Hau's threshold based on spectrum efficiency, it is my opinion that the combination of Canyon, Ranjan, and Hau does not disclose or suggest the limitations of claims 8 and 13.

F. Ground 2C: Canyon in View of Ranjan and Further in View of Lejon

1. Claim 16: Lejon does not disclose or suggest a MISO amplifier

217. For similar reasons I discussed in Section X.C.1 for Ground 1C, it is my opinion that Lejon does not disclose or suggest "wherein the electronic device comprises a multiple-input-single-output (MISO) amplifier," as required by claim 16.

XI. SUPPLEMENTATION

218. I reserve the right to supplement the opinions set forth in this declaration to (a) respond to any argument that Petitioner or its expert raise and/or (b) consider new information that becomes available to me from Petitioner, its expert, or otherwise.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.

ParkerVision Exhibit 2001
MediaTek v. ParkerVision - IPR2025-00030

Date: August 7, 2025

Dr. David Ricketts