IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION

THETA IP, LLC, Plaintiff, v. APPLE INC., Defendant.	Civil Action No.: 6:23-cv-00314 **JURY TRIAL DEMANDED**

THETA IP'S COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff Theta IP LLC ("Plaintiff" or "Theta"), through its attorneys, for its Complaint against Apple Inc. ("Apple" or "Defendant"), demands a trial by jury and alleges as follows:

FACTUAL INTRODUCTION

1. This case is about Apple's infringement of ground-breaking patents directed to reducing the power consumed by the receiver in cellular phones and other types of mobile devices. Infringement of Theta's patents enables Apple to realize significant product cost and size savings by utilizing smaller, less expensive batteries in their cellular phones, tablets, and watches without compromising performance—thus competing effectively with regard to the battery life of its cell phones and cellular-enabled mobile devices.

2. Cell phone ownership and usage skyrocketed in the last fifteen years as the cell phone became ubiquitous. New classes of mobile devices, along with the omnipresent cell phone, have been introduced on a yearly product cycle. Cell phones in particular have evolved from simple mobile phones to smart phones that might more aptly be called "Mobile Internet Appliances." For simplicity, the terms cellular phone, cell phone, mobile phone, and smart phone are used interchangeably herein. Mobile devices have rapidly evolved to support a wide array of

data-hungry applications that increase the demand for battery power in a market where consumers demand increased battery life along with expanded functionality. In parallel with consumer demand for increased functionality, the demand for larger screens has also increased power demands. Advances in battery and screen technology alone have been inadequate to meet consumer demand for increased battery life along with expanded functionality. The ever-present need to stay online and connected imposes ever-increasing demands for a battery life that is sufficient to satiate consumer expectations. At the same time, competing consumer demands for lighter, smaller, or thinner devices place limits on commercially viable battery size and weight. From the cell phone maker's perspective, a phone's battery comprises a substantial portion of the overall bill of material cost, so any need for a larger battery increases the cost of the finished goods. In addition, a smaller battery results in slimmer design form factor, and less weight, both with substantial influence on the overall competitiveness and market success of the product. Thus, decreasing a mobile phone's power consumption to maximize battery life is an imperative goal for engineers who design mobile devices.

3. Because the cell phone receiver must always be on to receive a cellular call, the cellular phone receiver consumes a significant portion of a phone's battery life. The lower the quality of an incoming signal, the more battery power is consumed. As a user moves farther away from a cellular tower, the signal level decreases and is often further degraded by interference from physical objects or other radio signals. Noise is also introduced from a variety of sources. Within a cellular device, a series of components operate in concert to amplify the signals received from the antenna and filter out the unwanted noise and interference. Achieving adequate performance, satisfactory to the consumer, with widely varying signal quality has always been a major challenge for cell phone makers.

4. Prior to the inventions of the Asserted Patents, cellular radio designers focused mostly on making sure the cell phone would operate in a "worst-case" scenario. A "worst-case" occurs when the desired signal strength is low, and interference and noise are high. Because conditions are not always "worst case," a cell phone designed to focus on a worst-case scenario consumes more power than is necessary for the actual operating conditions. Battery life was wasted by addressing conditions that were not always present.

5. Professor Yannis Tsividis is a renowned researcher and educator, widely recognized as a pioneer in integrated circuit design, circuits for signal processing, and adaptive-power circuits. A long-serving, tenured professor of electrical engineering at Columbia University in New York, he previously worked at Motorola Semiconductor and AT&T Bell Laboratories, and taught at the University of California, Berkeley, the National Technical University of Athens, the Massachusetts Institute of Technology, and the University of Paris. A large part of his academic and industry pursuits focused on delivering power-optimized solutions; in his words: "I have felt for a long time that, although it is necessary to dissipate power when you are doing something useful in circuits such as filters, dissipating such power when the signal does not demand it is a crime." Yannis Tsivdis, *Exploring and Explaining Circuits*, IEEE SOLID-STATE CIRCUITS MAG., Fall 2014, at 27.

6. Prof. Tsividis is a Life Fellow of the Institute of Electrical and Electronics Engineers (IEEE)—a distinction reserved for select members of the IEEE whose extraordinary accomplishments are deemed fitting of this prestigious recognition. He is also the recipient of numerous awards from Columbia University and the IEEE. The IEEE Solid State Circuits Magazine dedicated its Fall 2014 issue to recognizing Prof. Tsividis as a "Path-Breaking Researcher and Educator." In that issue, his colleague at Columbia University honored

Prof. Tsividis's quest to innovate: "He is genuinely interested in the research of others, stimulates the development of new ideas, and always strives to find the original source of ideas. But, like no other, he is able to identify new directions, even if it means going against what is considered common sense." Peter Kinget, *Guest Editorial: A Born Educator and Researcher*, IEEE SOLID-STATE CIRCUITS MAG., Fall 2014, at 13. Prof. Kinget is currently the Chairman of the Electrical Engineering Department at Columbia University. In 2019, the United States National Academy of Engineering elected Prof. Tsividis as a member for his contributions to analog and mixed-signal integrated circuit technology and engineering education, one of the highest professional honors awarded to an engineer.

7. Professor Tsividis co-founded Theta, along with Yannis Papananos, a Professor at the National Technical University of Athens. Prof. Tsividis maintained a position as a technical consultant throughout the life of Theta, during which time he helped the company design more power-efficient radio transceiver integrated circuits for use in the design of mobile devices of several kinds. In 2001, while working on Theta-related projects, Prof. Tsividis invented novel and path-breaking solutions that implement dynamic adjustment of operating characteristics of components within the radio's signal path to optimize power consumption based upon the signal strength of the desired signal(s) and interferer signal(s), which are claimed in the Asserted Patents. His inventions allow significant reduction in power consumption relative to a worst-case scenario (for which radios were designed and are required to operate). By optimizing the power of the radio circuitry in this way, mobile device makers could achieve improved battery life, or reduce the size and weight of the battery or the device, or both—depending on the marketing or design requirements.

8. Prof. Tsividis's inventions received significant academic and industry acclaim. Indeed, the need to optimize power was critical to achieving product designs that satisfied consumers' demand for devices that were "always connected," portable, and could operate for long periods of time without recharging. Prof. Tsividis has frequently been invited to present his research at academic and industry conferences, events, and training sessions. His inventions on dynamically controlling the power dissipation of mobile devices are now the subject of eight issued United States Patents that are assigned to Theta, five of which are asserted in this action.

9. Apple makes, imports, uses, offers, and sells in the United States various cellular smartphones under the iPhone brand name, various cellular connected tablets under the iPad brand name, and various cellular connected smartwatches under the Apple Watch brand name. As described in further detail herein, these constitute the Accused Products.

10. As described in further detail herein, Apple utilizes this patented technology in all of its most recent cell phone and cellular-enabled tablet and watch models. Indeed, Apple appears to include radios that employ these patented power-saving designs and methods across the entirety of its phone and cellular-enabled tablet and watch lineup offered in the United States. And Apple does so knowing not only of Prof. Tsividis's inventions, but also its unlawful practice of them.

11. By the nature of the Accused Products' design and configuration, Prof. Tsividis's claimed methods (which are asserted in this matter) are necessarily practiced each and every time that an accused Apple device is powered on or used. Indeed, Apple includes the infringing hardware and/or software configuration in each Accused Product, intending that the device carry out the claimed methods each and every time the device is powered on or used no matter the circumstances. Because the methods claimed in the Asserted Patents are so instrumental to the operation of the Accused Products, Apple does not provide any mechanism though which an end-

user could disable the accused functionality, and does not otherwise permit an end-user to use an Accused Product in a manner that avoids practicing the methods claimed in the Asserted Patents.

12. Apple recognizes significant financial benefit, competitive advantage, and market positioning value from its unauthorized practice of the Theta's patented inventions. By using Prof. Tsividis's power optimization strategies, Apple can market and sell mobile devices worldwide, including its many cell phones and cellular-enabled tablets and watches, that function for longer periods of time between recharges, without having to increase the capacity of the battery embedded in its devices. Apple is able to offer smaller, sleeker devices than it could without using Theta's patented improvements—and it enjoys significant savings in the complexity of the device's bill of material and hence manufacturing costs in the process. In addition, Apple's customers value battery life highly, and will and do pay more for devices that last longer between charges because of the benefits of Theta's patented inventions.

NATURE OF THE ACTION

13. This is an action for infringement of U.S. Patent No. 7,010,330 ("the '330 Patent"), U.S. Patent No. 10,129,825 ("the '825 Patent"), U.S. Patent No. 10,524,202 ("the '202 Patent") U.S. Patent No. 11,564,164 ("the '164 Patent"), and U.S. Patent No. 11,638,210 ("the '210 Patent") (collectively, the "Asserted Patents"). The Asserted Patents are attached hereto as Exhibits A – E.

THE PARTIES

14. Theta is a limited liability company organized under the laws of Delaware, with its principal place of business at 710 Inglenook Court, Coppell, Texas 75019.

15. Theta is the true and correct owner of the Asserted Patents and holds all rights necessary to bring this action.

16. On information and belief, Defendant Apple Inc. is a California corporation with its principal place of business at One Apple Park Way, Cupertino, California 95014. Apple may be served with process through its registered agent, CT Corporation System, 1999 Bryan St. Ste. 900, Dallas, Texas 75201-3136. Apple has multiple regular and established places of business in this District, including at 12535 Riata Vista Circle, Austin, Texas 78727 and 5501 West Parmer Lane, Austin, Texas 78727.

JURISDICTION AND VENUE

17. This action arises under the patent laws of the United States, Title 35 of the United States Code. Subject matter jurisdiction is proper in this Court pursuant to 28 U.S.C. §§ 1331 and 1338(a).

18. Venue is proper in this District under 28 U.S.C. §§ 1391(c) and 1400(b). Apple has regular and established places of business in this District, and in Texas, and at least some of its infringement of the Asserted Patents occurs in this District, and in Texas.

19. Apple is subject to this Court's specific and general personal jurisdiction pursuant to due process, due at least to its substantial business in this forum, including: (i) at least a portion of the infringements alleged herein; (ii) purposefully and voluntarily placing one or more infringing products into the stream of commerce with the expectation that they will be purchased by consumers in this forum; and (iii) regularly doing or soliciting business, engaging in other persistent courses of conduct, and/or deriving substantial revenue from goods and services provided to individuals in Texas and in this District.

20. Apple has transacted business in this District and has committed acts of patent infringement in this District. Additionally, Apple is registered to do business in the State of Texas, has offices and facilities in the State of Texas and this District, actively posts job listings for

positions in Texas and in this District, and actively directs its activities to customers located in the State of Texas and this District.

21. Jurisdiction over Apple in this matter is also proper inasmuch as Apple has voluntarily submitted itself to the jurisdiction of the courts by commencing litigations within the State of Texas, by registering with the Texas Secretary of State's Office to do business in the State of Texas, and by appointing a registered agent.

22. Apple personnel (including its employees and agents) directly infringe each Asserted Patent when Apple personnel design, test, demonstrate, or use the Accused Products within the United States, including (but not limited to) at Apple facilities within Texas and this District.

23. Venue is proper in this District pursuant to 28 U.S.C. § 1400(b) because, among other things, Apple has regular and established places of business in this District, including a campus at Riata Vista Circle, Austin, Texas 78727 and a new reportedly $1 billion campus at West Parmer Lane, Austin, Texas 78729.

See Apple Expands in Austin, https://www.apple.com/newsroom/2019/11/apple-expands-in-austin/.

24. Apple also operates a number of retail stores in this District through which it transacts business, including infringing use and sales of Apple products. This includes Apple retail stores located at 3121 Palm Way, Austin, TX 78758 and 2901 S. Capital of Texas Hwy, Austin TX 78746.

See Apple Retail Stores, United States, https://www.apple.com/retail/storelist/ (last visited April 26, 2023). The business conducted at such places is steady, uniform, orderly, and/or methodical, and is settled and not transient, including, but not limited to, distribution, sales, and/or offers for sale of infringing products. Apple also provides Accused Products to distributors and resellers operating in Texas and within this District. Through its online presence, and through numerous distributors and resellers (both online and brick-and-mortar), Apple directly and indirectly extracts significant revenues from Texas and this District.

25. Apple employs persons within this district that participate in Apple's infringing acts, including the development, testing, sale, and use of Accused Products. For example, on information and belief, Apple employs multiple radio frequency (RF) integrated circuit and module development engineers at its Austin, Texas facilities—and seeks to employ more. *See,*

e.g., Exhibits F – L; https://jobs.apple.com/en-us/search?location=austin-AST+austin-metro-area-AUSMETRO&team=wireless-hardware-HRDWR-WT (listing 23 openings as of April 26, 2023).

26. Apple has committed tortious acts of patent infringement within Texas and this District, and the causes of action set forth in this Complaint arise in part from those acts. Apple develops, manufactures, distributes, tests, markets, and sells mobile telephone and computing products that infringe the Asserted Patents, which are, and have been, offered for sale, sold (directly or through Apple's online store and distribution network), purchased, and used in Texas and within this District. Apple, directly or through its distribution network, also places infringing products within the stream of commerce, with the knowledge and/or understanding that such infringing products will be sold and/or used in Texas and in this District.

FACTUAL ALLEGATIONS

The Patented Inventions

27. Prof. Yannis Tsividis is a founder, consultant and shareholder of Theta; he invented the improvements that are described and claimed in the Asserted Patents while working on projects for Theta. At the time, Theta Microelectronics, Inc. was developing high performance wireless networking equipment for mobile devices. The Asserted Patents describe and claim systems and methods for reducing power dissipation in the receivers of battery powered mobile devices by varying the operational characteristics of components in the receiver signal path based upon the operating conditions in accordance with the claims.

28. Prof. Tsividis is a pioneer in the integrated circuits and systems field and is widely recognized for his contributions to the advancement of electrical engineering. Prof. Tsividis is the Edwin Howard Professor of Electrical Engineering at Columbia University. In addition to his selection as a Life Fellow of the IEEE, he received numerous awards and distinctions throughout

his career, including the Golden Jubilee Medal from the IEEE Circuits and Systems Society in 2000, the IEEE Undergraduate Teaching Award in 2005, and the IEEE Gustav Robert Kirchhoff Award in 2007. Prof. Tsividis is the recipient of the 1984 IEEE W.R.G. Baker Prize Award for the best IEEE publication, the 1986 European Solid-State Circuits Conference Best Paper Award, and the 1998 and 2008 IEEE Circuits and Systems Society Guillemin-Cauer Best Paper Awards. He is also the co-recipient of the 1987 IEEE Circuits and Systems Society Darlington Best Paper Award and the 2003 IEEE International Solid-State Circuits Conference L. Winner Outstanding Paper Award. In 2019, Prof. Tsividis was elected a member of the National Academy of Engineering (NAE), one of the highest professional honors awarded to an engineer, citing his "contributions to analog and mixed-signal integrated circuit technology and engineering education." *See* https://www.nae.edu/204145/Professor-Yannis-Tsividis.

29. Prof. Tsividis continues to receive recognition for the detailed teachings described and claimed in the Asserted Patents. By way of example, the IEEE Solid-State Circuits Magazine recently featured Prof. Tsividis and his explanation of related subject matter in its Fall 2018 issue, based on a presentation given at the Forum on Energy Efficient Analog Design, IEEE Solid-State Circuits Conference 2018. *See* Yannis Tsividis, *Signal-to-Noise Ratio, Dynamic Range, and Power Dissipation*, IEEE SOLID-STATE CIRCUITS MAG., Fall 2018, at 60. As discussed above, the Fall 2014 issue of the same trade publication featured Prof. Tsividis on the cover of a special edition dedicated to the recognition of his role as a "Path-Breaking Researcher and Educator." That issue featured his many contributions to solid-state circuits and systems education, metal-oxide semiconductor (MOS) modeling, and analog and integrated circuit (IC) design. Indeed, the detailed teachings and the inventions claimed in the Asserted Patents (and their predecessor patents) became fundamental to radio receiver design.

30. Theta IP is the owner by assignment of each of the Asserted Patents, each of which is presumed valid and enforceable.

31. The Theta/Tsividis family of patents that includes the Asserted Patents has been cited by United States Patent and Trademark Office examiners and applicants on numerous occasions, including in patent applications filed by Samsung, Qualcomm, Broadcom, Ericsson, Intel, Texas Instruments, and others.

32. In the years leading up to the claimed inventions, wireless connectivity was gaining in popularity. Increasingly, laptops were fitted with wireless networking cards. Mobile phone adoption was also on the rise, as was the rapid growth in use of cellular data. A downside of this connectivity was a corresponding drain on battery life, especially for mobile devices; the power consumed by a wireless transmitter and receiver reduces the usefulness of a device and sends a user on a hunt to recharge—or requires a larger battery to achieve the same battery life that would be achieved absent the wireless capabilities.

33. As the specifications of the Asserted Patents explain, one reason why this power drain was high is that electronic circuits are necessarily designed to function properly under worst-case operating conditions. For a wireless receiver, a worst-case condition occurs when the reception of the desired signal is low, while other transceivers, nearby electronic equipment, or other factors generate interfering signals and spurious noise. This worst-case condition is typically accompanied by a worst-case power consumption owing to the need for increased amplifier gain and bias and impedance adjustment to achieve and maintain adequate connectivity. If the mobile device fails to operate under a worst case condition, the consequence is dropped or disconnected calls or lost data, the bane of every cell phone user.

34. But a receiver of a wireless transceiver does not always operate in these worst-case conditions. For example, a base station, router, or access point may be nearby such that the received signal is strong. Also, there may be no interfering signals, or the interfering signals may be relatively weak. In these situations, receiver bias currents can be reduced below what is necessary for the worst-case condition. If this is done appropriately, power dissipation is reduced while signal-to-noise ratio is appropriately managed, and battery life is increased. Contrary to designing to, and always operating for, the "worst case," the Asserted Patents describe and claim methods that adapt to a better-than-worst-case condition, thus reducing circuit currents and therefore power dissipation and battery drain accordingly.

35. Prof. Tsividis's inventions use bias current control and varying impedance, gain, and other dynamic changes (separately or in combination) to reduce power dissipation when conditions are better than a worst case. For example, bias currents are reduced in response to a need for reduced signal handling capability and impedances are varied/controlled thus reducing required drive and other bias currents in response to a strong received signal or varying gain and/or impedances in response to a received signal in the presence of no or weak interfering signals.

36. The Asserted Patents claim various implementations of Prof. Tsividis's inventions. By way of example, the Asserted Patents teach that circuitry may be used to determine the signal strength of the desired signal and an interferer signal. That information about the desired signal and interferer signal is used to adjust the operating characteristics of the components in the receiver's signal path—for example, the amplifier(s), mixer(s), and/or filter(s)—relative to a worst-case condition. By varying a bias current and/or an impedance, power dissipation is lowered relative to a worst-case condition. The specification describes that operating parameters, including

bias current, impedance, and gain, are dynamically changed, either separately or in combination, to reduce power dissipation in response to better-than-worst case conditions.

37. The specification provides appropriate teachings to allow a person of ordinary skill in the art to practice the inventions in exemplary battery-powered mobile devices. Detailed figures and narrative descriptions explain the roles of the dynamic range and noise floors for particular operating conditions, and the effects that changes to biasing, gain, and impedances (as examples) will have on the operating characteristics of a receiver, as well as their attendant impact on power consumption. Indeed, the claims and specification provide appropriate direction to allow an ordinally skilled artisan to implement the claimed inventions without extensive experimentation.

38. An essential aspect of effective power management includes understanding when, how, and where energy is used in a device—in other words, how much energy does each component (or sub-system) consume, and under what circumstances. For example, a typical mobile phone is most often in a standby mode, where it is not in active use but must maintain contact with cellular towers so that it is prepared to receive an incoming call. In this state, the cellular radio subsystem (including its transceiver and related components) is most pronounced in its relative power consumption as compared with other components (e.g., the application processor, graphics, LCD, RAM, etc., none of which is in active use). While the phone is in active use, other subsystems may then consume more energy, but the cellular components continue to demand a significant share of the phone's available battery power. Optimizing power consumption of the phone's cellular receiver, therefore, offers a significant improvement in a mobile device's power consumption and attendant battery life across a wide array of usage scenarios.

39. The inventions described and claimed in the Asserted Patents provide important advances in mobile wireless communications, by offering novel solutions that allow for a

significant reduction in the power consumed by wireless receivers by responding to the conditions experienced by the device. By determining the signal levels of desired and interferer signals, it is possible to tune the operational characteristics of the components within a receiver's signal path to optimize the receiver's power consumption—with an attendant improvement to battery life.

The Asserted Patents

40. Theta is the assignee and owner of all rights to enforce U.S. Patent No. 7,010,330, entitled "Power Dissipation Reduction in Wireless Transceivers," and has full rights to sue and recover damages from all past, present, and future infringements of the '330 Patent. The United States Patent and Trademark Office duly and legally issued the '330 Patent on March 7, 2006. Yannis Tsividis is the sole inventor of the inventions claimed in the '330 Patent. A true and correct copy of the '330 Patent is attached as **Exhibit A**.

41. The '330 Patent describes and claims methods for improving battery life in a wireless device by reducing the receiver's power dissipation by dynamically varying the impedance, bias current, or gain of one or more components in the receiver signal path based upon determined signal strengths. The '330 Patent describes, for example, making gain adjustments and dynamically adjusting impedance in circuits in portions of a received signal path, based on determination of signal strength. These dynamic adjustments save power and provide valuable improvement to battery life in varying real-world conditions.

42. Theta is the assignee and owner of all right to enforce U.S. Patent No. 10,129,825, entitled "Power Dissipation Reduction in Wireless Transceivers," and has full rights to sue and recover damages from all past, present and future infringements of the '825 Patent. The United States Patent and Trademark Office duly and legally issued the'825 Patent on November 13, 2018.

Yannis Tsividis is the sole inventor of the inventions claimed in the ’825 Patent. A true and correct copy of the ’825 Patent is attached as **Exhibit B**.

43. The ’825 Patent describes and claims methods for improving battery life in a wireless device by reducing the receiver’s power dissipation by dynamically changing the bias current, impedance, and/or gain of one or more components in the receiver signal when operating conditions are better than a worst-case power dissipation condition (i.e., when the signal strength of the desired signal is low and the signal strength of the interferer signal is high). The ’825 Patent describes various operating scenarios and associated adjustments in bias current, impedance, and/or gain to reduce power dissipation and save power.

44. Theta is the assignee and owner of all right to enforce U.S. Patent No. 10,524,202, entitled “Power Dissipation Reduction in Wireless Transceivers,” and has full rights to sue and recover damages from all past, present and future infringements of the ’202 Patent. The United States Patent and Trademark Office duly and legally issued the ’202 Patent on December 31, 2019. Yannis Tsividis is the sole inventor of the inventions claimed in the ’202 Patent. A true and correct copy of the ’202 Patent is attached as **Exhibit C**.

45. The ’202 Patent describes and claims methods for reducing power dissipation in wireless transceivers for operating conditions that vary between best-case and worst-case scenarios. The signal strengths of the desired and interferer signals are determined and compared. In response to the comparison, the gain, impedance, and/or bias current of one or more components in the receiver signal path is dynamically adjusted to reduce power consumption from the battery. The ’202 Patent additionally describes and claims dynamically adjusting operating parameters based on changes in interferer or desired signal strength.

46. Theta is the assignee and owner of all right to enforce U.S. Patent No. 11,129,164, entitled "Power Dissipation Reduction in Wireless Transceivers," and has full rights to sue and recover damages from all past, present and future infringements of the '164 Patent. The United States Patent and Trademark Office duly and legally issued the '164 Patent on January 24, 2023. Yannis Tsividis is the sole inventor of the inventions claimed in the '164 Patent. A true and correct copy of the '164 Patent is attached as **Exhibit D**.

47. The '164 Patent describes and claims systems for reducing power dissipation in wireless receivers, for operating conditions that vary from a worst-case scenario. The signal strength of one or more received signals are determined and in response to particular claimed improved signal condition of the interferer, the bias current of one or more components in the receiver signal path is dynamically adjusted to reduce power consumption from the battery. The bias current may be dynamically varied by adjustment of an impedance of a circuit.

48. Theta is the assignee and owner of all rights to enforce U.S. Patent No. 11,638,210, entitled "Power Dissipation Reduction in Wireless Transceivers," and has full rights to sue and recover damages from all past, present, and future infringements of the '210 Patent. The United States Patent and Trademark Office duly and legally issued the '210 Patent on April 25, 2023. Yannis Tsividis is the sole inventor of the inventions claimed in the '210 Patent. A true and correct copy of the '210 Patent is attached as **Exhibit E**.

49. The '210 Patent describes and claims systems that improve battery life in a wireless device by reducing the receiver's power dissipation—by dynamically varying an impedance affecting the receiver signal path based upon determined signal strengths. The '210 Patent describes, for example, dynamically adjusting impedance in circuits affecting portions of a received signal path, resulting in changes to the noise floor or maximum signal handling level,

based on operating conditions identified through determinations of desired and interferer signal strengths. These dynamic adjustments save power and provide valuable improvement to battery life in varying real-world conditions.

50. The Asserted Patents each claim priority to two Provisional U.S. Patent Applications filed on March 31, 2003, bearing Application Nos. 60/451,229 and 60/451,230. The disclosures in these Provisional Applications fully support the disclosures and claims of the Asserted Patents.

51. The applications for the ’825, ’202, and ’164 Patents were published prior to issuance, and the file wrappers made available for public access, on July 21, 2016, Mar. 22, 2018, and December 9, 2021 respectively.

52. The inventions taught and claimed in the Asserted Patents solved the problems described in their specifications and in this Complaint in unconventional ways that improved the functioning and performance of systems and methods of operating wireless receivers to reduce power consumption and improve battery life as compared to traditional approaches.

Apple’s Knowledge of Infringement

53. At various points circa 2006-2007, and again in 2012 and in 2016, Theta had discussions with Intel employees about its patents, including about U.S. Patent No. 7,010,330. In 2019, Apple acquired Intel’s wireless smartphone modem business, including patents, over 2000 employees, and their knowledge. *See, e.g.*, Apple to acquire the majority of Intel’s smartphone business, *available at* https://www.apple.com/newsroom/2019/07/apple-to-acquire-the-majority-of-intels-smartphone-modem-business/. On information and belief, Apple acquired Intel’s knowledge and learned of at least the ’330 Patent and Apple’s infringement of its claims, or was willfully blind to the possibility that it infringed the Asserted Patents.

54. Additionally, Apple became aware of the issued Asserted Patents and its infringement of them through filing and service of the Complaint in this action.

Apple's Infringing Products

55. Apple entered the smartphone market with the iPhone in 2007. Today, Apple is by far the largest smartphone company in the United States. In addition to mobile phones, Apple also offers tablet devices and watches that are also equipped with cellular communications capabilities that use infringing technology.

56. Because battery life is so important, as part of its marketing efforts, Apple frequently touts the battery life of its mobile products. Apple advertises, for example, "[a]ll-day battery life" and "[a] battery that's all in, all day." *See, e.g.*, https://www.apple.com/iphone-14-pro/. Apple understands and appreciates that offering products that can deliver superior battery life is instrumental to the success of its products. Additionally, Apple frequently refreshes its product lines to offer additional features and improved functionality over the prior generation.

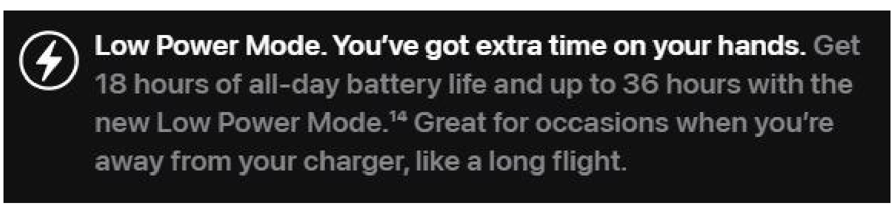
57. Apple makes, uses, sells, offers to sell, and/or imports into the United States a number of devices that are equipped with cellular communications capabilities and power-saving technologies that infringe the Asserted Patents, including at least the following product families branded under the Apple name: iPhone models (including, without limitation, iPhone 6, iPhone 6 Plus, iPhone 6s, iPhone 6s Plus, iPhone SE (1st Gen), iPhone 7, iPhone 7 Plus, iPhone 8, iPhone 8 Plus, iPhone X, iPhone XR, iPhone XS, iPhone XS Max, iPhone 11, iPhone 11 Pro, iPhone 11 Pro Max, iPhone SE (2nd Gen 2020), iPhone 12 mini, iPhone 12, iPhone 12 Pro, iPhone 12 Pro Max, iPhone 13 mini, iPhone 13, iPhone 13 Pro, iPhone 12 Pro Max, iPhone SE (3rd Gen 2022), iPhone 14, iPhone 14 Plus, iPhone 14 Pro, iPhone 14 Pro Max); cellular-enabled tablets sold under the "iPad" brand (including, without limitation, iPad, iPad mini, iPad Air, iPad Pro); cellular-

enabled watches sold under the "Apple Watch" brand (including, without limitation, Apple Watch Series 3, Apple Watch Series 4, Apple Watch Series 5, Apple Watch Series 6, Apple Watch Series 7, Apple Watch Series 8, Apple Watch SE, and Apple Watch Ultra). The Accused Products in this case include at least these products.

58. One of Apple's popular currently sold phones is the iPhone 14 Pro Max, depicted below:

59. In its marketing materials offering the iPhone 14 Pro for sale, including on its website, Apple advertises that with the phones you get "All-day battery life[3] even with so many new capabilities." https://www.apple.com/iphone-14-pro/. Apple makes these claims about its various Accused Products based on tests performed under good network conditions and default settings. *See e.g.*, https://www.apple.com/iphone/battery.html.

60. Apple makes similar claims for its other Accused Products. For example, the Watch Series 8 is also advertised as supporting "all-day battery life":



See, e.g., https://www.apple.com/apple-watch-series-8/.

61. Each of these battery life claims is accompanied by a disclaimer instructing consumers that power consumption and corresponding battery life, vary based on, *e.g.*, signal strength and network setting:

> All battery claims depend on the ***cellular network, location, signal strength***, feature configuration, usage, and many other factors; actual results will vary. Battery has limited recharge cycles and may eventually need to be replaced. Battery life and charge cycles vary by use and settings.

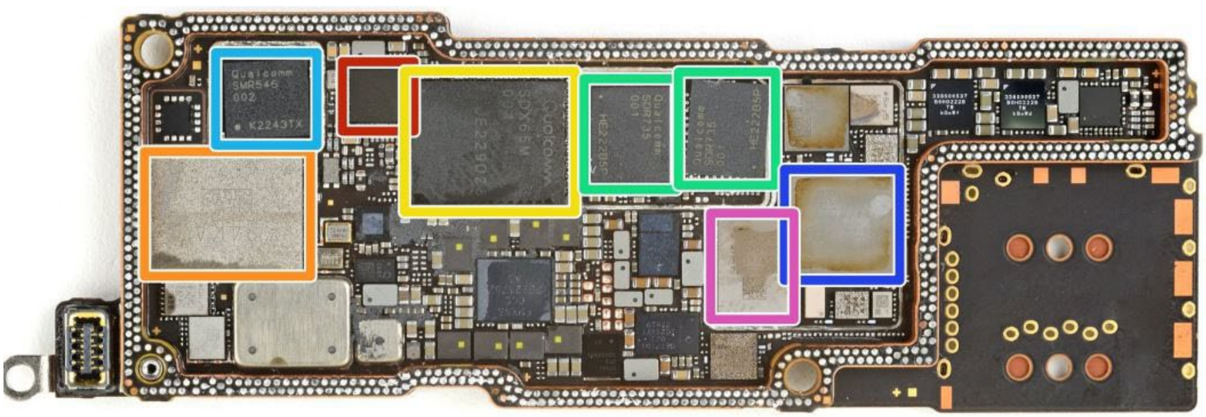
See, e.g., https://www.apple.com/iphone-14-pro/#footnote-3 (emphasis added); https://www.apple.com/iphone-12/specs/#footnote-12; https://www.apple.com/iphone-se/#footnote-3; https://www.apple.com/apple-watch-series-8/#footnote-14 ("Battery life varies by use, configuration, cellular network, signal strength, and many other factors; actual results will vary").

62. On information and belief, power consumption and corresponding battery life varies with, *e.g.*, signal strength because the Accused Products employ the dynamic power dissipation technology claimed in the Asserted Patents.

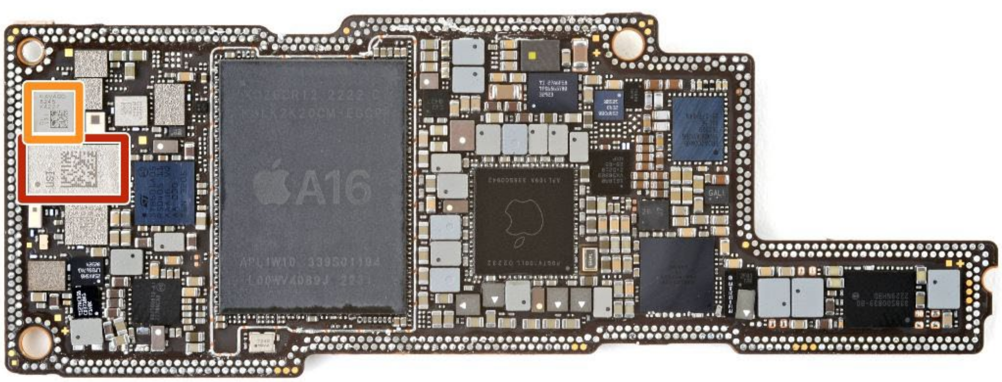
63. Apple is aware of the potential negative impact of bad signal conditions on battery life of, and corresponding consumer satisfaction with, the Accused Products. And in addition to employing the infringing technology to reduce cellular RF power consumption, Apple instructs customers about these effects. *See, e.g.*, Maximizing Battery Life and Lifespan, available at https://www.apple.com/batteries/maximizing-performance/ ("you've used your device in low-signal conditions, which has affected your battery life"):

> **No Cell Coverage and Low Signal.** This indicates either that you are in a poor cell coverage area and your iOS device is searching for a better signal or that you've used your device in low-signal conditions, which has affected your battery life.

64. Each of the Accused Products includes one or more cellular receiver signal paths, including RF Front End, transceiver integrated circuit, and modem components used in infringing the Asserted Patents. By way of example, the iPhone 14 Pro Max includes two Qualcomm SDR735 transceivers (green highlights below), a Qualcomm SMR546 transceiver (light blue), Qualcomm SDX65M modem (yellow), and multiple Skyworks Sky5 and Broadcom RF Front End components in the receive signal path, as seen in the image below:

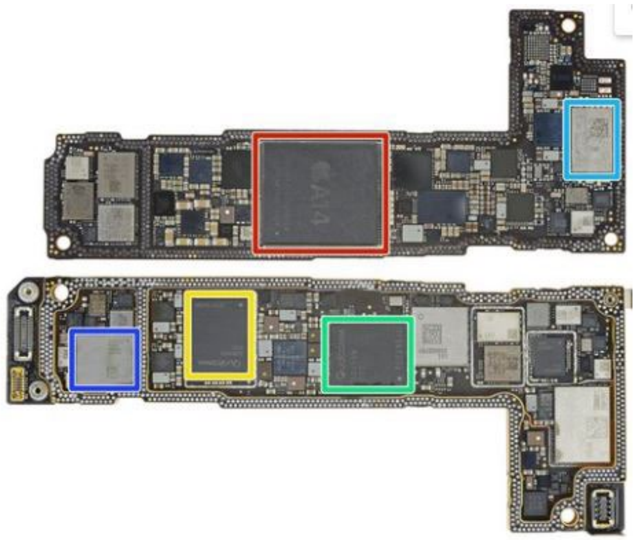


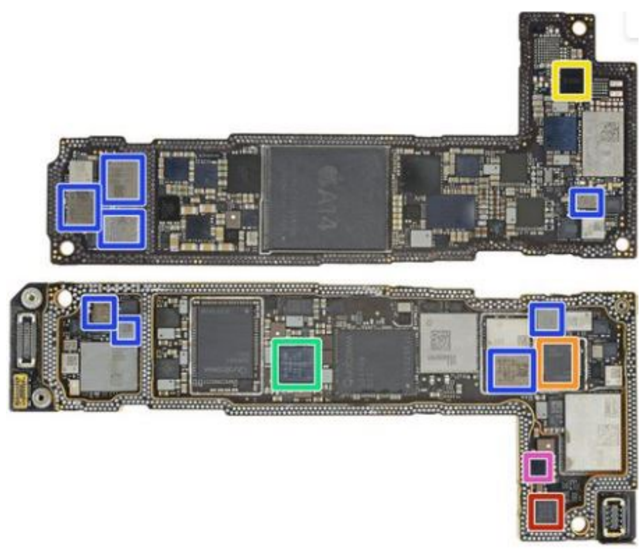
See https://www.ifixit.com/Guide/iPhone+14+Pro+Max+Chip+ID/153224.



In addition, Skyworks Sky5 and Broadcom AFEM-8245 (orange highlight) RF Front End chips are also visible in the image above. *Id.* On information and belief, each of these components discussed in this paragraph participate in infringement of the Asserted Patents.

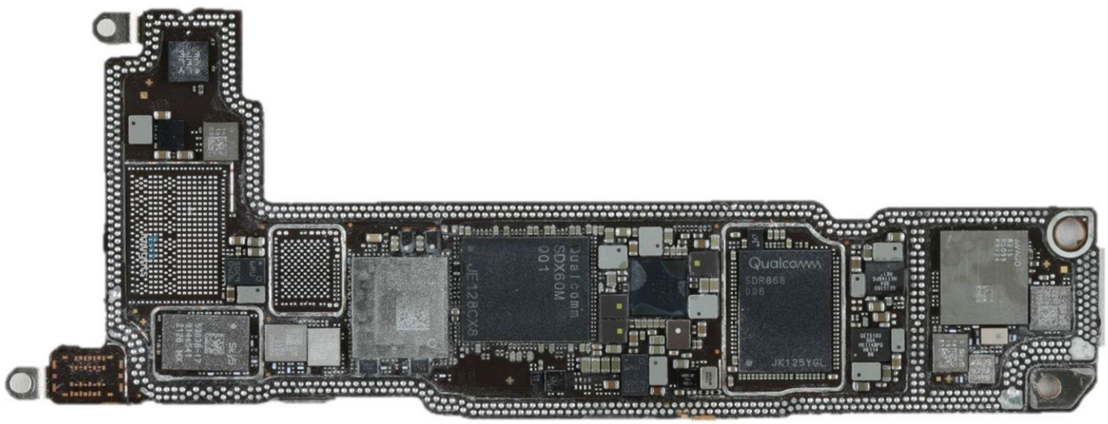
65. By way of further example: the Apple iPhone 12 and 12 Pro include Qualcomm modem and transceiver devices, along with RF Front End chips from Broadcom and Skyworks. *See* https://www.ifixit.com/Teardown/iPhone+12+and+12+Pro+Teardown/137669. The Qualcomm SDR865 (yellow highlight) and SMR526 (orange highlight) transceivers and SDX55M (large green highlight) modem components of the iPhone 12 can be seen below:





In addition, the Skyworks Sky5 and Broadcom AFEM-8200 RF Front End chips are also visible (dark blue highlights). See also https://unitedlex.com/insights/apple-iphone-12-pro-max-teardown-report/.

66. By way of further example: the Apple iPhone 13 includes Qualcomm modem and transceiver devices, along with RF Front End chips from Broadcom and Skyworks. *See* https://www.ifixit.com/Teardown/iPhone+12+and+12+Pro+Teardown/137669. The Qualcomm SDR868 transceiver and SDX60M modem components of the iPhone 13 can be seen below:

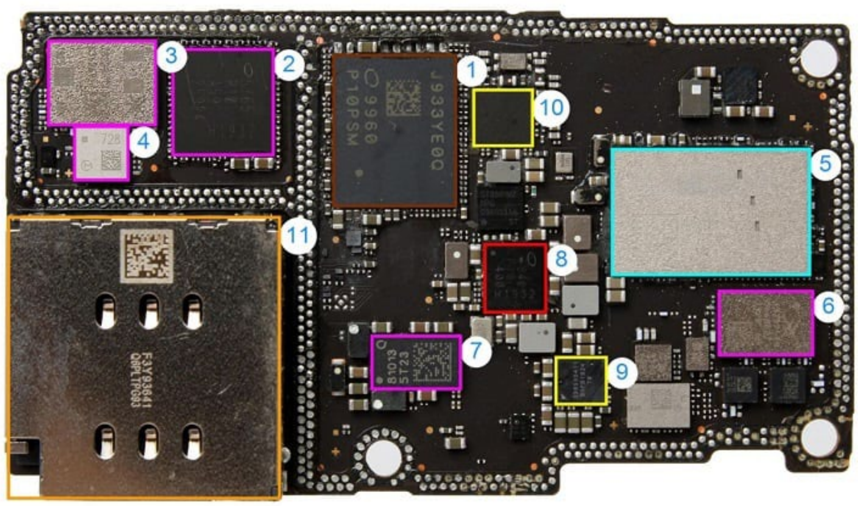


In addition, the Skyworks Sky5 and Broadcom AFEM-8215 RF Front End chips are also visible.

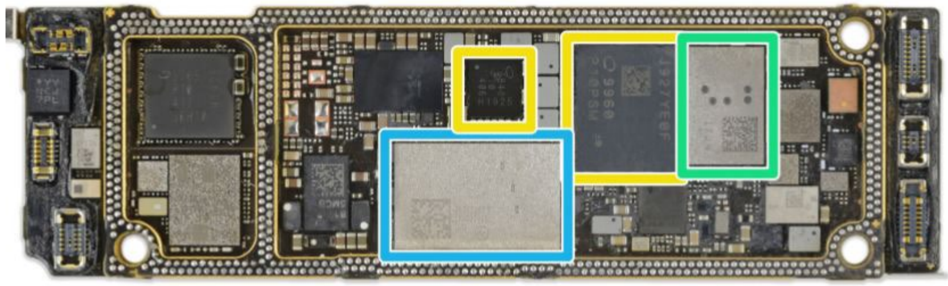
67. By way of further examples: the iPhone 6s includes a Qualcomm MDM9635M modem component with a Qualcomm WTR3925 transceiver integrated circuit (https://www.ifixit.com/Teardown/iPhone+6s+Teardown/48170); CDMA versions of the iPhone 7 (model A1779) include a Qualcomm MDM9645M X12 LTE modem with Qualcomm WTR4905 and WTR3925 transceivers and Skyworks RF Front End components (https://www.ifixit.com/Teardown/iPhone+7+Teardown/67382); CDMA versions of the iPhone 8 (model A1863) and iPhone 8 Plus (model A1864) include a Qualcomm MDM9655 X16 LTE modem with Qualcomm WTR5975 transceiver and RF Front end components from Broadcom and Skyworks. (https://www.ifixit.com/Teardown/iPhone+8+Plus+Teardown/97482); CDMA versions of the iPhone X (model A1865) include a Qualcomm MDM9655 X16 LTE modem with

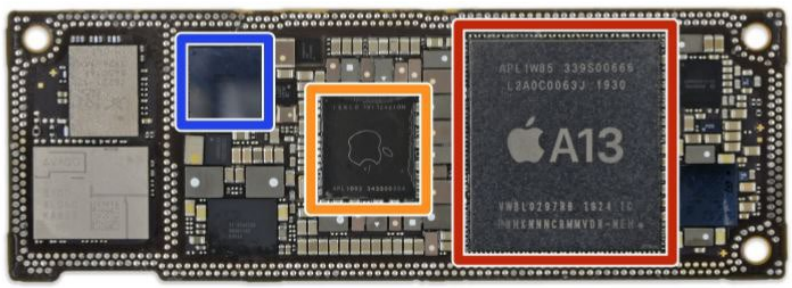
Qualcomm WTR5975 transceiver and RF Front end components from Broadcom and Skyworks (https://www.ifixit.com/Teardown/iPhone+X+Teardown/98975).

68. Certain generations and models of Apple iPhones use transceiver and/or modem components of Intel rather than Qualcomm in the receiver signal path, and also infringe the Asserted Patents. For example, the iPhone 11 Pro Max uses the Intel PMB9960 modem (XMM7660, chip 1 below) and PMB5765 transceiver (chip 2), along with RF Front End components from, *e.g.*, Skyworks (SKY78233-17, chip 3). *See* https://electronics360.globalspec.com/article/14583/teardown-apple-iphone-11-pro-max:

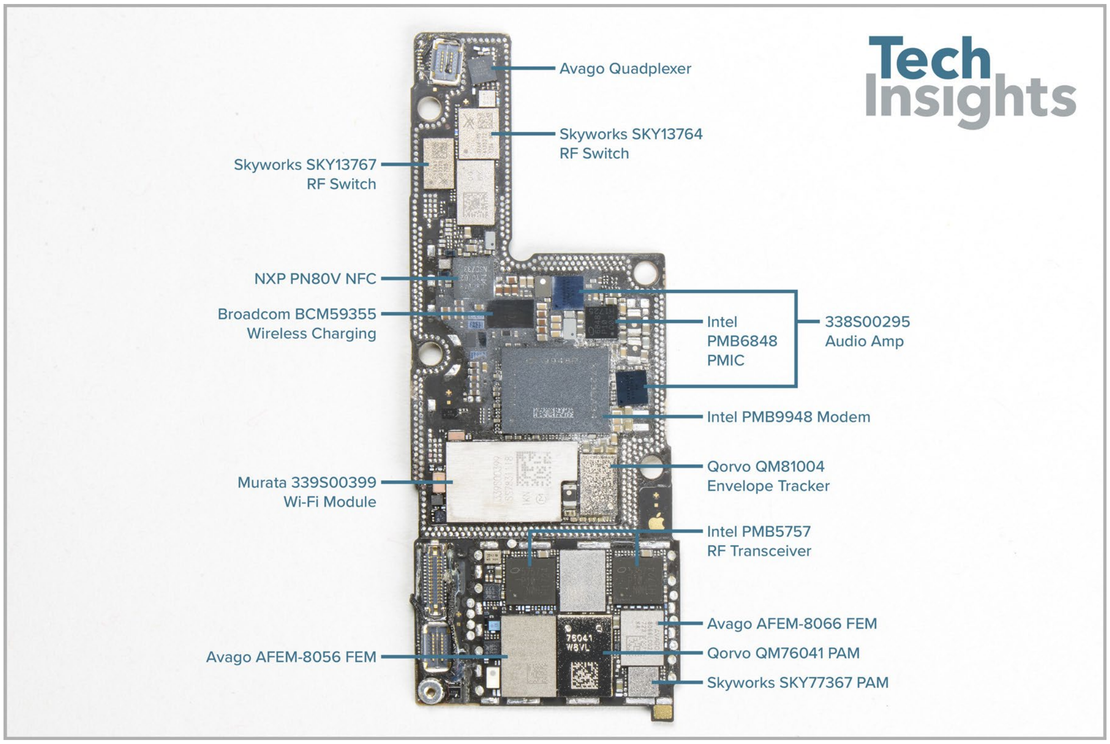


See also https://www.ifixit.com/Teardown/iPhone+11+Teardown/126192:

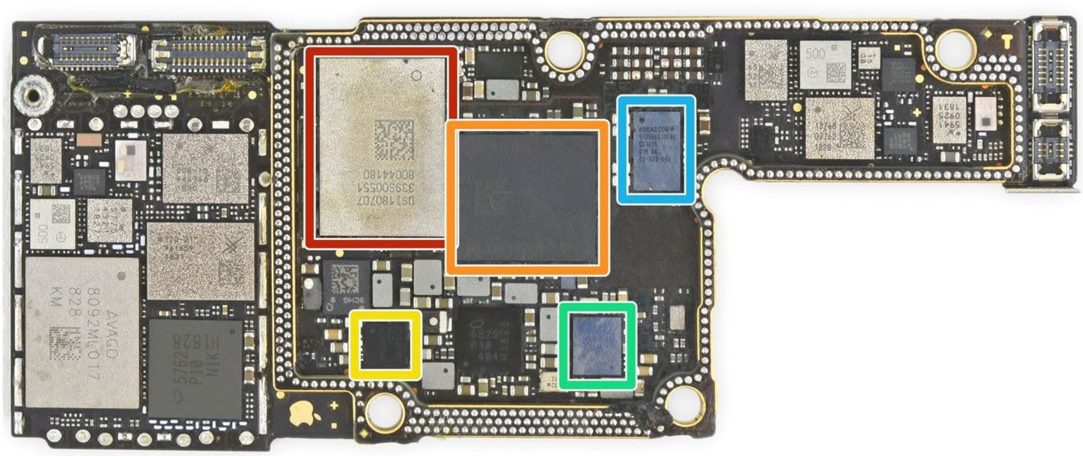




69. By way of further examples: GSM versions of the iPhone 7 (model A1778) include an Intel PMB9943 (XMM7360) modem with an Intel PMB5750 transceiver. *See* https://www.techinsights.com/blog/apple-iphone-7-teardown. GSM versions of the iPhone 8 (model A1905) and iPhone 8 Plus (model A1897) use an Intel PMB9948 (XMM7480) modem with an Intel PMB5757 transceiver. *See* https://www.techinsights.com/blog/apple-iphone-8-plus-teardown. GSM versions of the iPhone X (model A1901) use an Intel PMB9948 (XMM7480) modem with an Intel PMB5757 transceiver, and RF Front end components from Broadcom and Skyworks. *See* https://www.techinsights.com/blog/apple-iphone-x-teardown.



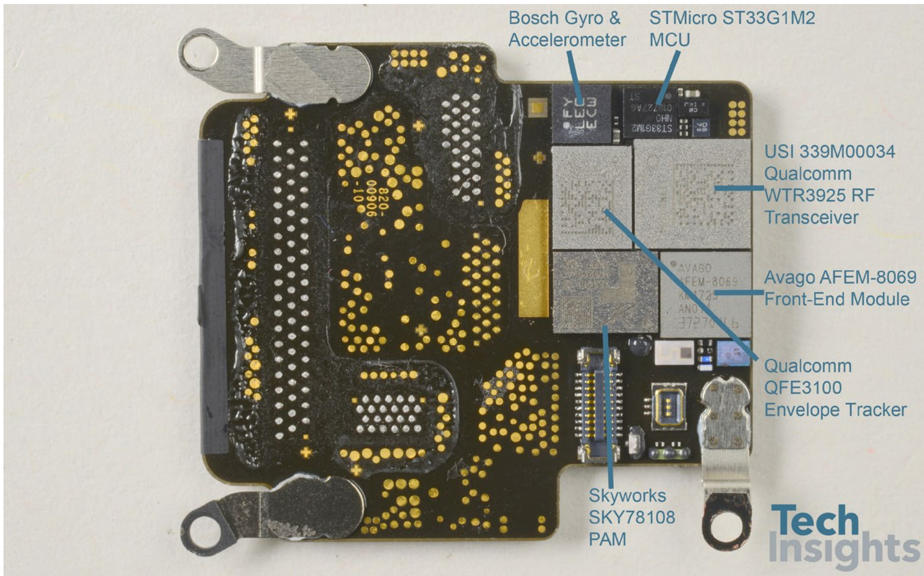
70. By way of further example, the iPhone XS and iPhone XS Max include an Intel PMB9955 (XMM7560) modem with an Intel PMB5762 RF transceiver and RF Front end components from manufacturers including Broadcom and Skyworks. *See* https://www.ifixit.com/Teardown/iPhone+XS+and+XS+Max+Teardown/113021.



.

71. On information and belief, Apple uses these and similar components in the RF receiver signal paths of its accused iPad and Watch products. For example, the Apple Watch Series

3 included a Qualcomm MDM9635M LTE modem and WTR3925 transceiver. *See* https://www.techinsights.com/blog/apple-watch-series-3-teardown:



72. Qualcomm also advertises its Mobile Platform solutions and their components with heavy emphasis on their power-saving features—including as implemented in Apple devices. *See, e.g.*, https://www.qualcomm.com/news/releases/2017/05/08/qualcomm-snapdragon-660-and-630-mobile-platforms-drive-advanced-photography; https://www.qualcomm.com/content/dam/qcomm-martech/dm-assets/documents/qualcomm-rf-front-end-infographic.pdf; https://www.qualcomm.com/content/dam/qcomm-martech/dm-assets/documents/prod_brief_qcom_x65.pdf; https://www.qualcomm.com/news/releases/2021/02/qualcomm-announces-worlds-first-10-gigabit-5g-modem-rf-system.

73. Intel also advertises its RF modem solutions and their components with heavy emphasis on their power-saving features—including as implemented in Apple devices. *See, e.g.*, https://newsroom.intel.com/newsroom/wp-content/uploads/sites/11/2017/02/XMM7560-Fact-Sheet.pdf ("Size and power efficiency are also key benefits of the Intel XMM 7560 modem, which

offers envelope tracking and other power optimization features to help extend battery life within a wide range of form factors, from smartphones and phablets to tablets and PCs.")

74. Skyworks also advertises its RF Front End with heavy emphasis on their power-saving features—including as implemented in Apple devices. *See, e.g.*, https://www.skyworksinc.com/en/system-solutions/sky5 ("Delivering breakthrough performance, footprint and power efficiency"); https://www.skyworksinc.com/en/System-Solutions/Sky5-Ultra ("The platform features best-in-class transmit and receive capabilities with unprecedented efficiency and output power, enabling highly reliable network connections while optimizing battery life—both critical for 5G applications").

75. Apple's Accused Products benefit in power-saving performance and increased selling price from including the infringing technology in components from Qualcomm, Intel, and other manufacturers. *See, e.g.*, https://www.qualcomm.com/products/technology/modems/rf.

76. To the extent that additional Apple products incorporate or include transceiver and/or RF Front End components that operate in a manner that is not colorably different from these Accused Products described herein, then such additional Apple products are also "Accused Products."

77. To the extent that additional Apple products include power-saving functionality that operates in a manner that is not colorably different than described herein, even if delivered without the use of particular components or component manufacturers mentioned herein, then such additional Apple products are also "Accused Products."

78. As explained herein, and as will be further described in infringement contentions in this case, the Accused Products practice one or more claims of the Asserted Patents. Apple is not authorized or licensed to practice Theta's claimed inventions, nor are any of Apple's

component suppliers, vendors, customers, or end-users. As discussed in further detail below, Apple's infringement is knowing and willful.

FIRST COUNT (INFRINGEMENT OF U.S. PATENT NO. 7,010,330)

79. Theta incorporates by reference the allegations set forth in the paragraphs above as though fully set forth herein.

80. Apple makes, uses, sells, and/or offers to sell in the United States, and/or imports into the United States products that directly infringe the '330 Patent each and every time they are powered on and used as intended (i.e., to connect to cellular wireless networks) by an end-user, including the Accused Products identified herein. Making, using, selling, offering, and importing of the Accused Products infringes at least claim 23 of the '330 Patent, as detailed herein.

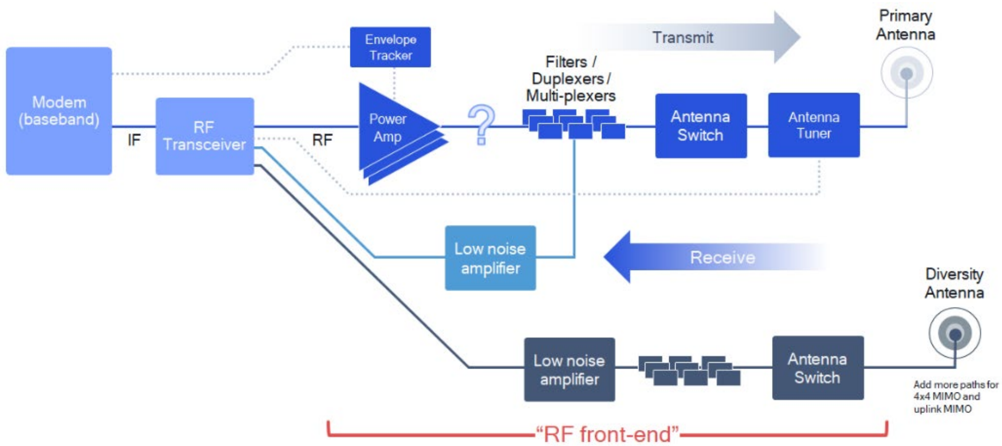
81. On information and belief, the Accused Products employ power-saving techniques that dynamically adjust impedance of components in the receiver signal path in response to determined desired and interferer signal strengths in accordance with the '330 Patent claims.

82. The Accused Products infringe at least claim 23 of the '330 Patent. Each Accused Product includes wireless transceiver circuitry necessary for the device to offer cellular calling and/or cellular data capabilities. The transceiver circuitry includes a receiver signal path.

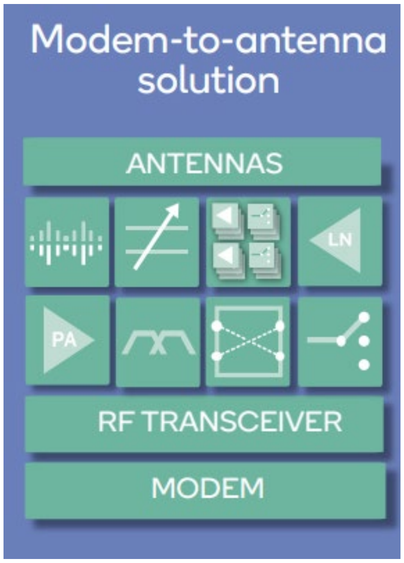
83. The Accused Products receive wireless signals, including both a desired signal(s) (i.e., a signal that carries the voice or data of interest) and interferer signal(s). These signals are received by the transceiver circuitry via an input from an antenna in the Accused Product.

84. The wireless transceivers in the Accused Products include at least one signal path comprised of a plurality of circuits, including a low-noise amplifier, a mixer, and a low-pass filter. By way of example, as discussed above, many Apple Accused Products use Qualcomm mobile RF components in their receive signal paths. Qualcomm provides high-level depictions of

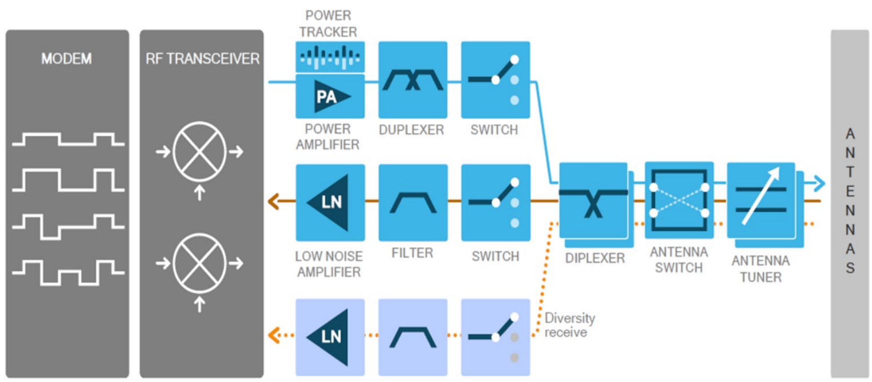
representative signal paths of its Snapdragon 4G and 5G mobile platforms as used in the Accused Products by Apple—indicating that the components include such features:



See, e.g., https://developer.qualcomm.com/blog/5g-modems-rf-and-antennas-getting-mmwave-data-device.



See also https://www.qualcomm.com/content/dam/qcomm-martech/dm-assets/documents/qualcomm-rf-front-end-infographic.pdf.



RF Front End

See also https://www.forbes.com/sites/tiriasresearch/2017/02/22/qualcomm-adds-complete-rf-portfolio-paves-way-to-5g/.

85. On information and belief, RF Transceiver components from Qualcomm used by Apple in the Accused Products have internal signal paths comprising a low-noise amplifier, with an output coupled to a mixer, with an output coupled to a low-pass filter.

86. The Accused Products also include circuitry coupled to the signal path for determining signal strength. By way of example, the desired signal strength is displayed in iconic form as the "bar" indicator on each Accused Product and can also be accessed via administrative functions:

Cell signal. The number of bars indicates the signal strength of your cellular service. If there's no signal, "No Service" appears.

Dual cell signals. On models with Dual SIM, the upper row of bars indicates the signal strength of the line you use for cellular data. The lower row of bars indicates the signal strength of your other line. If there's no signal, "No Service" appears. To see the status icons with their corresponding cellular plan labels and carrier names, open Control Center.

See, e.g., https://support.apple.com/guide/iphone/learn-the-meaning-of-the-status-icons-iphef7bb57dc/ios.

87. The Accused Products also includes circuitry coupled to the signal path for determining the signal strength of the interferer signal. By way of example, multiple patents of

Qualcomm—filed after and citing to Prof. Tsividis' inventions—discuss jammer detection circuitry. *See, e.g.*, U.S. Patent No. 8,781,426 at 3:44–59, 9:50–61 ("For example, the bias current may be increased when jammers are detected or decreased when jammers are not detected. The bias current may also be adjusted by different amounts depending on the jammer strength."). "Jammer" refers to an interferer signal or signals. On information and belief, Qualcomm includes jammer detection circuitry in components used by Apple in the Accused Products. The jammer detection feature in the Accused Products determines the jammer signal strength levels.

88. The Accused Products also dynamically adjust impedance of circuit components in the signal path, including to reduce a switching current, in response to the signal strength measurements described herein.

89. For example, on information and belief, RF Transceiver components from Qualcomm used by Apple in the Accused Products have programmable "gain states" which affect variable bias currents and/or impedances in the circuits. *See, e.g.*, U.S. Patent No. 8,521,198, "Dynamic LNA Switch Points Based on Channel Conditions," at 8:58–60 ("The jammer indicators from all jammer detectors may be used to select the switch points, gain, and/or bias of the LNA").

90. By way of further example, a page from the WTR3925 transceiver datasheet, available online, confirms that the device has programmable gain modes to control, e.g., the LNA performance and power consumption at different desired signal strengths and jammer signal strengths:

Table 3-8 UMTS Rx performance specifications (cont.)

Parameter	Comments	Min	Typ	Max	Unit
Survivable input level (LNA off)		–	–	+23	dBm
Input VSWR (in-band)	50 Ω single-ended; external match		–	2:1	–
LO to RF leakage (in-band)	All gain modes; at LNA input	–	–	-60	dBm
Residual sideband level (uncal)	Due to amplitude and phase imbalance	–	-35	-28	dBc
DC offset at I/Q outputs [1]		-100	–	100	mV
Single-ended I/Q load capacitance [2]	Each BBI and BBQ pin	–	–	12	pF
Gain mode G0					
Voltage conversion gain		49	53	57	dBV/V
Noise figure [3]	Small signal, single sideband	–	2.3	3.0	dB
Input IP3 [4] (ACS) Rel 99/HSDPA/HSUPA/HSPA+ DC-HSPA+/3C-HSPA+	 S = -90 dBm, J1 = J2 = -44 dBm S = -90 dBm, J1 = J2 = -47 dBm	 -22 -22	 -10 -10	 – –	 dBm dBm
Input IP3 [5] (triple beat)	S = -90; J = -55; TX1 = TX2 = -33 dBm	-7	-1	–	dBm
Input IP2 [6]	S = -90 dBm; TX1 = TX2 = -30 dBm	–	54	–	dBm
Gain mode G1					
Voltage conversion gain		40	44	48	dBV/V
Noise figure [3]	Small signal, single sideband	–	3.5	4.5	dB
Input IP3 [4] (ACS)	S = -90 dBm, J1 = J2 = -47 dBm	-12	-10	–	dBm
Input IP3 [5] (triple beat)	S = -90; J = -55; TX1 = TX2 = -33 dBm	-7	-1	–	dBm
Gain mode G2					
Voltage conversion gain		22	26	30	dBV/V
Noise figure [3]	Small signal, single sideband	–	16	19	dB
Gain mode G3					
Voltage conversion gain		13	17	21	dBV/V
Noise figure [3]	Small signal, single sideband	–	26	29	dB

Ref: 80-NH379-1

91. Qualcomm has previously marketed infringing receiver technology under the name "IntelliCeiver." On information and belief, while Qualcomm no longer advertises using the IntelliCeiver term, the same or materially similar technology has been utilized in subsequent generations of Qualcomm's transceiver and RF Front End components, including those used by Apple in the Accused Products. Qualcomm's IntelliCeiver Data Review presentation identifies the variable gain states and their effect on current consumption:

Ciccarelli, Steven (stevenc) 05/11/05

QUALCOMM CDMA Technologies — IntelliCeiver™

Current Consumption (mA)

Cell, PRx Only	High Lin	Mid Lin	Low Lin	delta
Idle	25.5	13.0	14.5	11.0
G0	61.1	43.0	30.4	30.7
G1	55.3	37.1	30.0	25.3
G2	51.0	32.9	27.4	23.6
G3	51.0	32.9	27.4	23.6
G4	51.0	32.9	27.4	23.6

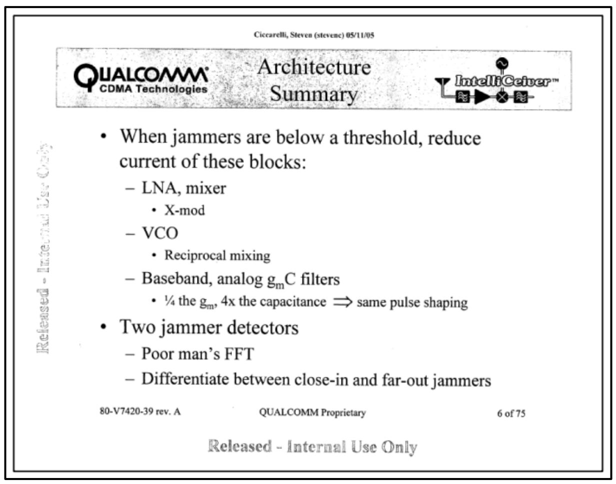
- Limited sample size and early data
- G0 = highest gain
- G4 = lowest gain
- PCS addressed in commercial samples

80-V7420-39 rev. A QUALCOMM Proprietary 12 of 75

See "IntelliCeiver Data Review" documents attached to U.S. Provisional Application No.

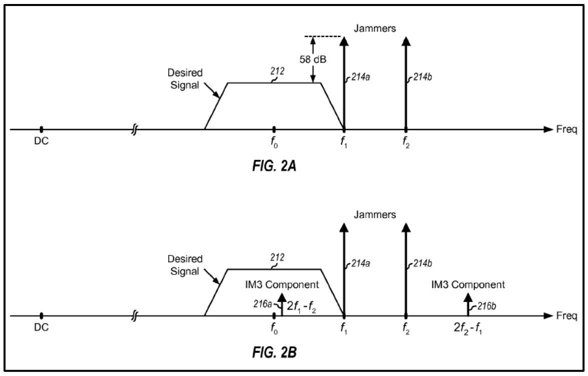
60/800,484 filed on May 15, 2006, *available at* https://patentcenter.uspto.gov/applications/60800484/ifw/docs.

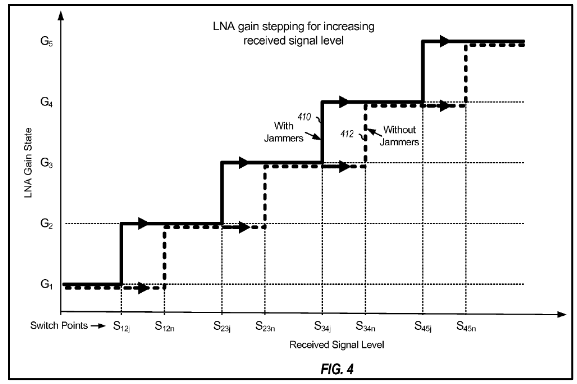
92. Qualcomm's IntelliCeiver, and successor technology, determines interferer levels in a received signal and adjusts the current consumption of components within the receiver signal path, including the amplifiers, filters, and mixers based on the operational characteristic encountered by the receiver, to optimize power dissipation:



Id.

93. In the Accused Products, the bias current of one or more of the plurality of circuits in the receiver signal path is adjusted based upon the determined desired signal strength and interferer signal strength. *See, e.g.*, U.S. Patent No. 8,521,198 at 9:17–19 ("A bias selector 542 receives the jammer indicator and/or the received signal level and generates a bias control for LNA 120."). For example, on information and belief, measured changes in the determined desired signal strength and/or interferer signal strength cause adjustments to the gain state (or gain mode) of the system.





See, e.g., *id.* at 3:56–4:59, Figs. 2A, 2B, 4.

94. On information and belief, in the Accused Products, the impedance of one or more of the plurality of circuits in the receiver signal path is also adjusted—based upon the change in gain state caused by measured changes in the determined desired signal strength and/or interferer signal strength—according to claim 23 of the ’330 Patent.

95. Apple directly infringes the apparatus claims of the ’330 Patent by making, using, selling, offering for sale, and/or importing the Accused Products.

96. Each and every time an Accused Product is powered on and used as intended, the Accused Product is configured to and does operate according to the claims of the ’330 Patent, and practices the method(s) claimed in the ’330 Patent, constituting direct infringement by its user(s). By way of example, such users include Apple’s customers, as well as Apple personnel acting within the scope of their employment with Apple, including by testing and using the Accused Products in the United States.

97. Apple has injured Theta and is liable to Theta for directly infringing one or more claims of the ’330 Patent, including, without limitation, claim 23 pursuant to 35 U.S.C. § 271(a).

98. Apple also infringes the ’330 Patent under 35 U.S.C. § 271(b) & (c).

99. Apple knowingly encourages and intends to induce infringement of the ’330 Patent by making, using, offering for sale, and/or selling products in the United States, and/or importing

them into the United States, including, but not limited to, the Accused Products, with knowledge of the ’330 Patent and with knowledge and specific intention that such products will be used by its customers and personnel, and that such use will necessarily result in infringement of the ’330 Patent. Apple had actual knowledge of the ’330 Patent and that its actions would lead to infringement, and/or Apple had knowledge of the foregoing by way of willful blindness to the existence of the ’330 Patent and to the fact that its actions would lead to infringement.

100. Apple also contributes to the infringement of the ’330 Patent. Apple makes, uses, sells, and/or offers to sell products in the United States, and/or imports them into the United States, including, but not limited to, the ’330 Accused Products, with knowledge of the ’330 Patent, knowing that those products constitute a material part of the claimed invention, that they are especially made or adapted for use in infringing the ’330 Patent, and that they are not staple articles or commodities of commerce capable of substantial non-infringing use. Apple had actual knowledge of the ’330 Patent, and that its products constitute a material part of the invention and are especially made or adapted for use in infringing the invention, and that the products are not staple articles or commodities of commerce capable of substantial non-infringing use, and/or Apple had knowledge of the foregoing by way of willful blindness to the existence of the ’330 Patent, to the fact that its products constitute a material part of the invention and are especially made or adapted for use in infringing the invention, and to the fact that the products are not staple articles or commodities of commerce capable of substantial non-infringing use.

101. Apple has had knowledge of the infringing nature of its activities, including that any use of the Accused Products as intended would directly infringe the devices and methods claimed in the ’330 Patent, and nevertheless continued, and continues its infringing activities with respect to the ’330 Patent.

102. Apple intended that its customers and personnel infringe the asserted claims because practice of the asserted claims was necessary in order to achieve the battery life touted in Apple's promotional materials. Indeed, Apple touted the advantages of the battery life and physical characteristics (e.g., weight, size, and availability of larger screens) that could not be achieved in the advertised form factors but for the implementation of Prof. Tsividis' claimed methods.

103. As described herein, the claims of the '330 Patent are necessarily infringed when the Accused Products are powered on and used as intended. No mechanism is provided to prevent a user from practicing the claims, and users are barred by license from disabling or altering the relevant functionality of the Accused Products. Thus, there are no substantial non-infringing uses of the Accused Products.

104. Apple's infringement of the '330 Patent has been and continues to be deliberate and willful, and therefore, this is an exceptional case warranting an award of enhanced damages and attorneys' fees pursuant to 35 U.S.C. §§ 284–285. On information and belief, Apple had knowledge of the issued '330 Patent prior to the filing of this Complaint, including by way of willful blindness. And Apple had actual knowledge of the '330 Patent at least with the filing of this Complaint. After acquiring that knowledge, Apple infringed the '330 Patent, and in doing so, it knew, or should have known, that its conduct amounted to infringement of the '330 Patent.

105. As a result of Apple's infringement of the '330 Patent, Theta has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Apple's infringement, but in no event less than a reasonable royalty with interest and costs.

SECOND COUNT (INFRINGEMENT OF U.S. PATENT NO. 10,129,825)

106. Theta incorporates by reference the allegations set forth in the paragraphs above as though fully set forth herein.

107. Apple makes, uses, sells, and/or offers to sell in the United States, and/or imports into the United States products that directly infringe the '825 Patent each and every time they are powered on and used as intended (i.e., to connect to cellular wireless networks) by an end-user, including the Accused Products identified herein. Use of the Accused Products infringes at least claim 3 of the '825 Patent.

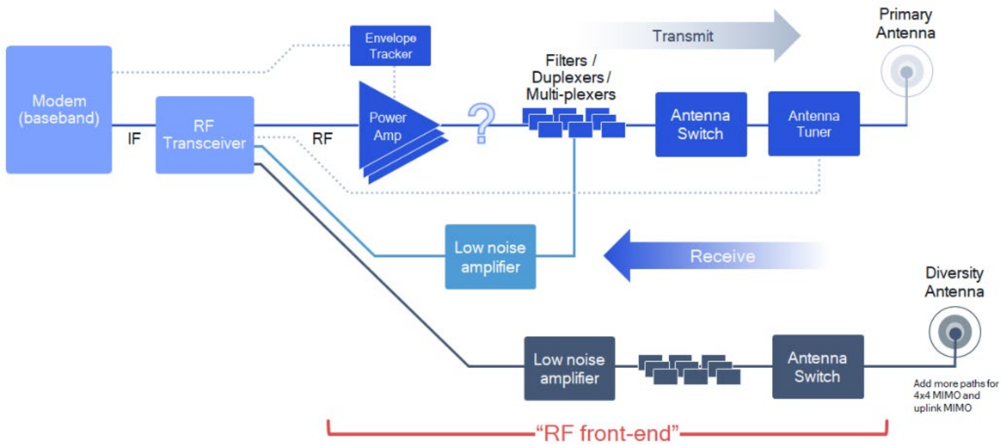
108. On information and belief, the Accused Products employ power-saving techniques that dynamically adjust bias current and/or impedance of components in the receiver signal path in response to determined desired and interferer signal strengths in accordance with the '825 Patent claims, including through techniques employed in transceiver, modem, and RF Front End components of the Accused Products.

109. The Accused Products infringe at least claim 3 of the '825 Patent. Each Accused Product is a battery powered portable wireless device. Each includes wireless transceiver circuitry necessary for the device to offer cellular calling and/or cellular data capabilities. The transceiver circuitry includes a receiver signal path.

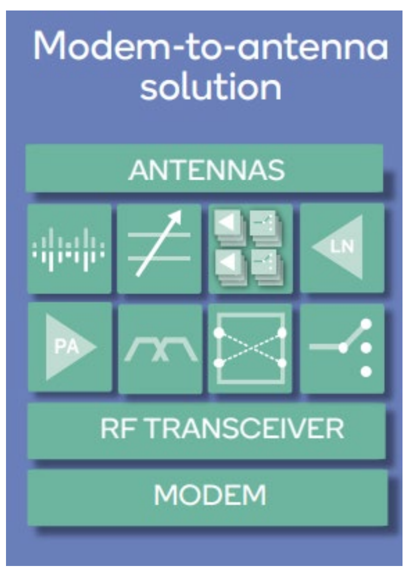
110. The Accused Products receive wireless signals, including both a desired signal(s) (i.e., a signal that carries the voice or data of interest) and interferer signal(s). These signals are received by the transceiver circuitry via an input from an antenna in the Accused Products.

111. The wireless transceivers in the Accused Products include at least one signal path comprised of a plurality of circuits, including an amplifier, a filter, and a mixer. By way of example, as discussed above, many Apple Accused Products use Qualcomm mobile RF

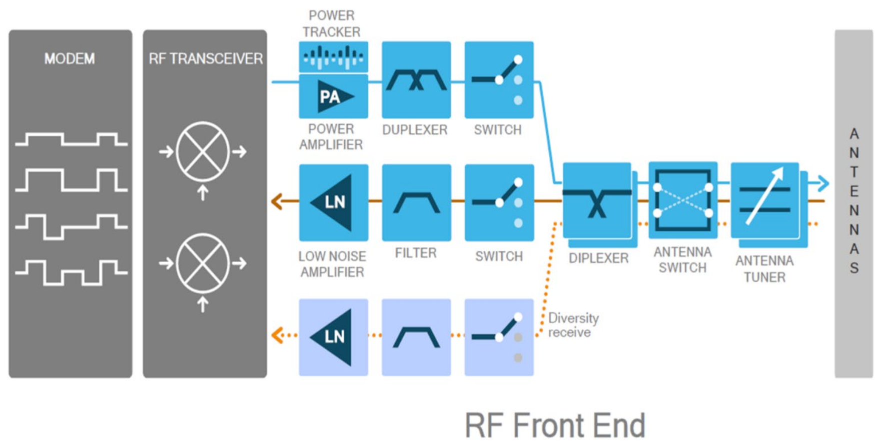
components in their receive signal paths. Qualcomm provides high-level depictions of representative signal paths of its Snapdragon 4G and 5G mobile platforms as used in the Accused Products by Apple—indicating that the components include such features:



See, e.g., https://developer.qualcomm.com/blog/5g-modems-rf-and-antennas-getting-mmwave-data-device.



See also https://www.qualcomm.com/content/dam/qcomm-martech/dm-assets/documents/qualcomm-rf-front-end-infographic.pdf.



See also https://www.forbes.com/sites/tiriasresearch/2017/02/22/qualcomm-adds-complete-rf-portfolio-paves-way-to-5g/.

112. The Accused Products also include circuitry coupled to the signal path for determining signal strength. By way of example, the desired signal strength is displayed in iconic form as the "bar" indicator on each Accused Product and can also be accessed via administrative functions:

Cell signal. The number of bars indicates the signal strength of your cellular service. If there's no signal, "No Service" appears.

Dual cell signals. On models with Dual SIM, the upper row of bars indicates the signal strength of the line you use for cellular data. The lower row of bars indicates the signal strength of your other line. If there's no signal, "No Service" appears. To see the status icons with their corresponding cellular plan labels and carrier names, open Control Center.

See, e.g., https://support.apple.com/guide/iphone/learn-the-meaning-of-the-status-icons-iphef7bb57dc/ios.

113. The Accused Products also includes circuitry for determining the signal strength of the interferer signal. By way of example, multiple patents of Qualcomm—filed after and citing to Prof. Tsividis' inventions—discuss jammer detection circuitry. *See, e.g.*, U.S. Patent No. 8,781,426 at 3:44-59, 9:50-61 ("For example, the bias current may be increased when jammers are detected or decreased when jammers are not detected. The bias current may also be adjusted by

different amounts depending on the jammer strength.”). “Jammer” refers to an interferer signal or signals. On information and belief, Qualcomm includes jammer detection circuitry in components used by Apple in the Accused Products. The jammer detection feature in the Accused Products determines the jammer signal strength levels in order to optimize power consumption.

114. Consistent with exemplary claim 3 of the ’825 Patent, a worst-case power dissipation condition occurs when the signal strength of the desired signal is low, and the signal strength of the interferer signal is high in relation to it. In such case in the Accused Products, it is necessary to amplify the received signal to a stage where the desired signal is detectible using a gain stage. Such amplification will also amplify the interferer (jammer) signal necessitating, for example, high bias currents to achieve sufficient linearity and dynamic range. Adjustments may also be required to reduce gain in order to stay within the maximum signal strength that the device can receive in a particular signal condition.

115. The receivers in the Accused Products achieve a reduction in power dissipation by dynamically altering the bias currents and/or impedances of the components in the signal receive path. For example, on information and belief, the transceiver and RF Front End amplifier components used by Apple in the Accused Products have programmable “gain states” which affect variable bias currents and/or impedances in the circuits. *See, e.g.*, U.S. Patent No. 8,521,198, “Dynamic LNA Switch Points Based on Channel Conditions,” at 8:58–60 (“The jammer indicators from all jammer detectors may be used to select the switch points, gain, and/or bias of the LNA”).

116. By way of further example, on information and belief, RF Front End Components from Qualcomm, Skyworks, and other manufacturers used by Apple in the Accused Products have programmable “gain states” which affect variable current and power dissipation in their low noise amplifier (LNA) elements. For example, a Skyworks datasheet, available online, confirms that the

various front end modules containing LNAs that are marketed by Skyworks employ software programmable registers to control the LNA gain state and bias, effecting the current and power dissipation in their amplifier components:

SKYWORKS®

PRELIMINARY DATA SHEET

SKY5®-3735-21: LB / LMB / MB / HB and 4x4 MIMO Diversity Receive Module

Applications

- Antenna cable loss compensation circuit
- 2G / 3G / 4G / 5G multimode cellular handsets (5G NR, LTE, UMTS, CDMA2000, EDGE, and GSM)
- Embedded data cards

Features

- Rx diversity FEM with the following integrated filter bands:
  - B8 (925 to 960 MHz)
  - B26/5/18/19 (859 to 894 MHz)
  - B3 (1805 to 1880 MHz)
  - B39 (1880 to 1920 MHz)
  - B25(2) (1930 to 1995 MHz)
  - B34 (2010 to 2025 MHz)
  - B66(1/4) (2110 to 2200 MHz)
  - B40 (2300 to 2400 MHz)
  - B41(38) (2496 to 2690 MHz)
  - B7 (2620 to 2690 MHz)
- Low insertion loss
- Integrated downlink carrier aggregation (CA) support for B1-3-7, B1-3-41, B34-39-41, B40-41, B1-B40-B41, B1-3-40, B7-40, and B3-B40-B41
- High-performance variable gain LNAs
- High-performance Multi-On, N-Plexing technology enabling superior non-CA and CA performance
- TRX switch ports:
  - MHB_TRX1
  - LB_TRX1
  - LB_TRX2
  - LB_TRX3

Skyworks Green™ products are compliant with all applicable legislation and are halogen-free. For additional information, refer to *Skyworks Definition of Green™*, document number SQ04-0074.

- Auxiliary LNA ports:
  - LNA_AuxIN_MHB1 4x4 (1805 to 2700 MHz)
  - LNA_AuxIN_MHB3 4x4 (2300 to 2700 MHz)
  - LNA_AuxIN_HB (2300 to 2700 MHz)
  - LNA_AuxIN_MB1 (1452 to 2400 MHz)
  - LNA_AuxIN_MB2 (1452 to 2200 MHz)
  - LNA_AuxIN_LB1 (717 to 768 MHz)
  - LNA_AuxIN_LB2 (617 to 960 MHz)
  - LNA_AuxIN_LB3 (758 to 803 MHz)
- Integrated MIPI RFFE interface
- Small size 4.2 × 6.2 × 0.7 (max) mm 47-lead package
- Lead (Pb)-free and RoHS-compliant (MSL3 @ 260 °C per JEDEC J-STD-020)

Description

The SKY53735-21 is a low-band (LB)/low-mid-band (LMB) / mid-band (MB) / high-band (HB) diversity receive module to be used in a cellular mobile device. The device supports cellular diversity receiver functions and is scalable to support 4x4 MIMO regional and roaming band requirements.

The diversity module supports all key 2, and 3 carrier aggregation band combinations.

High-performance, multi-gain mode LNAs are integrated enabling compatibility to next generation LNA-less LTE transceivers.

The SKY53735-21 is compatible with 3GPP GSM, WCDMA, LTE, LTE-A and 5G standards and includes filters for the following service bands: B8, B26/5/18/19, B3, B39, B25(2), B34, B66(1/4), B40, B41(38), and B7.

Figure 1 shows the functional block diagram for the SKY53735-21, and the pinout is shown in Figure 2. Signal pin assignments and functional pin descriptions are described in Table 1.

Skyworks Solutions, Inc. • Phone [781] 376-3000 • Fax [781] 376-3100 • sales@skyworksinc.com • www.skyworksinc.com
205376F • Skyworks Proprietary Information • Products and Product Information are Subject to Change Without Notice • January 7, 2020 1

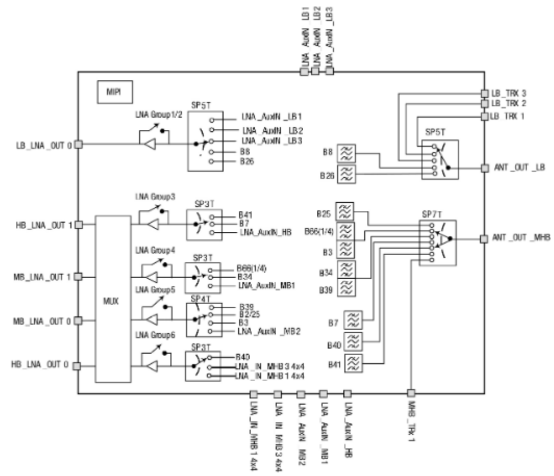


Figure 1. SKY53735-21 Functional Block Diagram

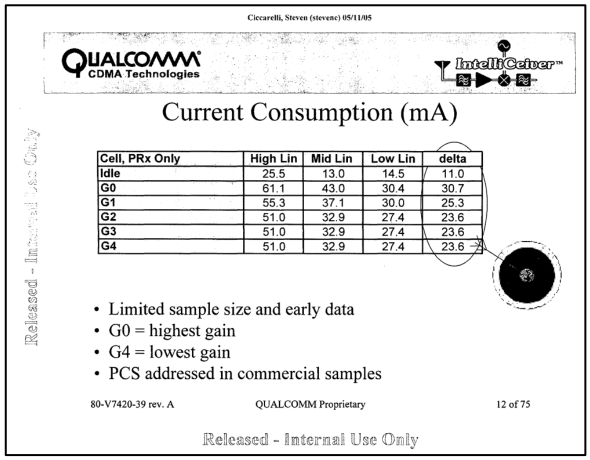
LNA Power Control Block	14	0x0E	LNA Group1 Gain/Bias	5:3	LNA Group1 Gain	000	LNA Gain Control (Gain setting options selected in bit [0] of Register 0x15)	0x00	G7 (highest gain)
								0x01	G6
								0x02	G5
								0x03	G4
								0x04	G3
								0x05	G2
								0x06	G1
								0x07	G0 (lowest gain)
				2:0	LNA Group1 Bias	000	LNA Bias Control	0x00	bias0 (lowest bias)
								0x01	bias1
								0x02	bias2
								0x03	bias3
								0x04	bias4
								0x05	bias5
								0x06	bias6
								0x07	bias7 (highest bias)

Table 10. B41 RF Performance

Parameter	Symbol	Gain State	Mode 0 Min	Mode 0 Typ	Mode 0 Max	Mode 1 Min	Mode 1 Typ	Mode 1 Max	Unit
Frequency	B41	mode0 = [G7,G6,G5,G4,G3,G2,G1,G0] mode1 = [G7,G6,G5,G4,G3,G2,G1]	2496		2690	2496		2690	MHz
LNA current	IDD	G7		9.6			9.6		mA
		G6		5.1			5.1		
		G5		4.2			2.9		
		G4		2.9			2.5		
		G3		2.9			1.4		
		G2		2.9			0.3		
		G1		1.5			0.3		
		G0		0.3			NA		

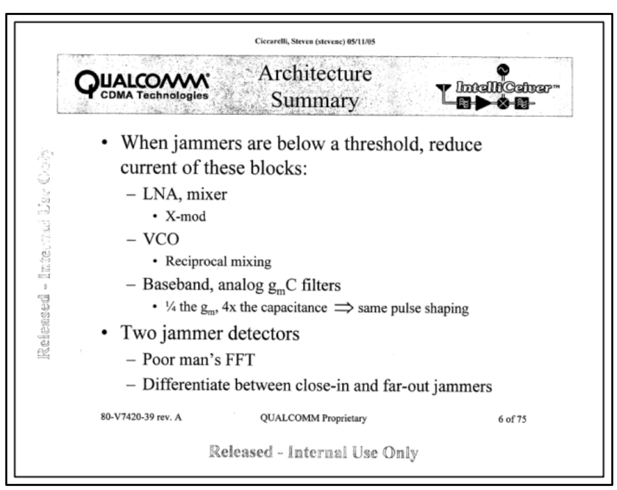
117. Qualcomm has previously marketed infringing receiver technology under the name “IntelliCeiver.” On information and belief, while Qualcomm no longer advertises using the IntelliCeiver term, the same or materially similar technology has been utilized in subsequent

generations of Qualcomm's transceiver and RF Front End components, including those used by Apple in the Accused Products. Qualcomm's IntelliCeiver Data Review presentation identifies the variable gain states and their effect on current consumption:



See "IntelliCeiver Data Review" documents attached to U.S. Provisional Application No. 60/800,484 filed on May 15, 2006, *available at* https://patentcenter.uspto.gov/applications/60800484/ifw/docs.

118. Qualcomm's IntelliCeiver, and successor technology, determines interferer levels in a received signal and adjusts the current consumption of components within the receiver signal path, including the amplifiers, filters, and mixers based on the operational characteristic encountered by the receiver, to optimize power dissipation:



Id.

119. By way of further example, on information and belief, transceiver components from Qualcomm used by Apple in the Accused Products have programmable "gain states" which affect variable current and power dissipation in their low noise amplifier (LNA) elements. For example, a page from the WTR3925 transceiver datasheet, available online, confirms that the device has programmable gain modes to control, e.g., the LNA performance and power consumption at different desired signal strengths and jammer signal strengths:

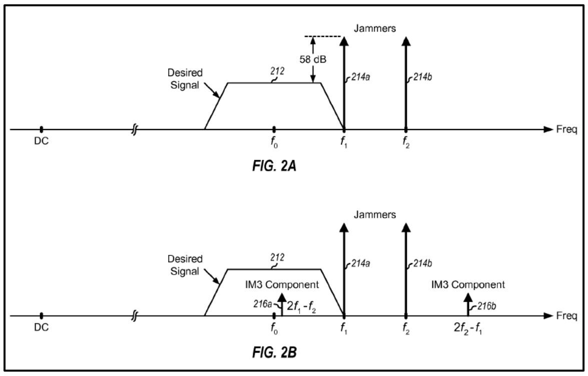
Table 3-8 UMTS Rx performance specifications (cont.)

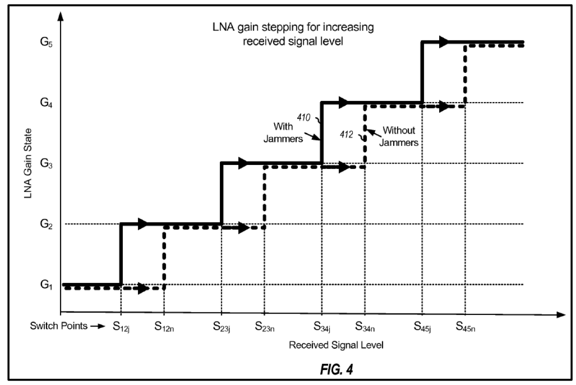
Parameter	Comments	Min	Typ	Max	Unit
Survivable input level (LNA off)		–	–	+23	dBm
Input VSWR (in-band)	50 Ω single-ended; external match		–	2:1	–
LO to RF leakage (in-band)	All gain modes; at LNA input	–	–	-60	dBm
Residual sideband level (uncal)	Due to amplitude and phase imbalance	–	-35	-28	dBc
DC offset at I/Q outputs [1]		-100	–	100	mV
Single-ended I/Q load capacitance [2]	Each BBI and BBQ pin	–	–	12	pF
Gain mode G0					
Voltage conversion gain		49	53	57	dBV/V
Noise figure [3]	Small signal, single sideband	–	2.3	3.0	dB
Input IP3 [4] (ACS)					
Rel 99/HSDPA/HSUPA/HSPA+	S = -90 dBm, J1 = J2 = -44 dBm	-22	-10	–	dBm
DC-HSPA+/3C-HSPA+	S = -90 dBm, J1 = J2 = -47 dBm	-22	-10	–	dBm
Input IP3 [5] (triple beat)	S = -90; J = -55; TX1 = TX2 = -33 dBm	-7	-1	–	dBm
Input IP2 [6]	S = -90 dBm; TX1 = TX2 = -30 dBm	–	54	–	dBm
Gain mode G1					
Voltage conversion gain		40	44	48	dBV/V
Noise figure [3]	Small signal, single sideband	–	3.5	4.5	dB
Input IP3 [4] (ACS)	S = -90 dBm, J1 = J2 = -47 dBm	-12	-10	–	dBm
Input IP3 [5] (triple beat)	S = -90; J = -55; TX1 = TX2 = -33 dBm	-7	-1	–	dBm
Gain mode G2					
Voltage conversion gain		22	26	30	dBV/V
Noise figure [3]	Small signal, single sideband	–	16	19	dB
Gain mode G3					
Voltage conversion gain		13	17	21	dBV/V
Noise figure [3]	Small signal, single sideband	–	26	29	dB

Ref: 80-NH379-1

120. In the Accused Products, the bias current of one or more of the plurality of circuits in the receiver signal path is adjusted based upon the determined desired signal strength and interferer signal strength. *See, e.g.*, U.S. Patent No. 8,521,198 at 9:17–19 ("A bias selector 542 receives the jammer indicator and/or the received signal level and generates a bias control for LNA 120."). For example, on information and belief, when the interferer signal is high and the signal strength of the desired signal is low, as measured in the Accused Products, and the desired signal is larger than in a worst-case power dissipation condition, the bias current(s) of one or more of the

circuits in the receiver signal path of the wireless transceiver are changed compared to the worst-case power dissipation condition, thereby saving power (e.g., the gain is changed from a G0 state to a G1 state, or G1 to G2 state, etc.).





See, e.g., *id.* at 3:56-4:59, Figs. 2A, 2B, 4.

121. On information and belief, in the Accused Products, the impedance of one or more of the plurality of circuits in the receiver signal path is also adjusted based upon the determined desired signal strength and interferer signal strength, according to the additional elements of claim 8 of the ’825 Patent.

122. Each and every time an Accused Product is powered on and used as intended, the Accused Product practices the method(s) claimed in the ’825 Patent, constituting direct infringement by its user(s). By way of example, such users include Apple’s customers, as well as Apple personnel acting within the scope of their employment with Apple, including by testing and using the Accused Products in the United States.

123. Apple has injured Theta and is liable to Theta for directly infringing one or more claims of the ’824 Patent, including, without limitation, claim 3 pursuant to 35 U.S.C. § 271(a).

124. Apple also infringes the ’825 Patent under 35 U.S.C. § 271(b) & (c).

125. Apple knowingly encourages and intends to induce infringement of the ’825 Patent by making, using, offering for sale, and/or selling products in the United States, and/or importing

them into the United States, including, but not limited to, the Accused Products, with knowledge of the ’825 Patent and with knowledge and specific intention that such products will be used by its customers and personnel, and that such use will necessarily result in infringement of the ’825 Patent. Apple had actual knowledge of the ’825 Patent and that its actions would lead to infringement by end-users, and/or Apple had knowledge of the foregoing by way of willful blindness to the existence of the ’825 Patent and to the fact that its actions would lead to infringement by end-users.

126. Apple also contributes to the infringement of the ’825 Patent. Apple makes, uses, sells, and/or offers to sell products in the United States, and/or imports them into the United States, including but not limited to the Accused Products, with knowledge of the ’825 Patent, knowing that those products constitute a material part of the claimed invention, that they are especially made or adapted for use in infringing the ’825 Patent, and that they are not staple articles or commodities of commerce capable of substantial non-infringing use. Apple had actual knowledge of the ’825 Patent, and that its products constitute a material part of the invention and are especially made or adapted for use in infringing the invention, and that the products are not staple articles or commodities of commerce capable of substantial non-infringing use, and/or Apple had knowledge of the foregoing by way of willful blindness to the existence of the ’825 Patent, to the fact that its products constitute a material part of the invention and are especially made or adapted for use in infringing the invention, and to the fact that the products are not staple articles or commodities of commerce capable of substantial non-infringing use.

127. Apple has had knowledge of the infringing nature of its activities, including that any use of the Accused Products as intended would directly infringe the methods claimed in the

’825 Patent, and nevertheless continued, and continues its infringing activities with respect to the ’825 Patent.

128. Apple intended that its customers and personnel infringe the asserted claims because practice of the asserted claims was necessary in order to achieve the battery life touted in Apple’s promotional materials. Indeed, Apple touts the advantages of the battery life and physical characteristics (e.g., weight, size, and availability of larger screens) that could not be achieved in the advertised form factors but for the implementation of Prof. Tsividis’ claimed methods.

129. As described herein, the claimed methods are necessarily practiced when the Accused Products are powered on and used as intended. No mechanism is provided to prevent a user from practicing the claimed methods, and users are barred by license from disabling or altering the relevant functionality of the Accused Products. Thus, there are no substantial non-infringing uses of the Accused Products.

130. Apple’s infringement of the ’825 Patent has been and continues to be deliberate and willful, and therefore, this is an exceptional case warranting an award of enhanced damages and attorneys’ fees pursuant to 35 U.S.C. §§ 284–285. On information and belief, Apple had knowledge of the issued ’825 Patent prior to the filing of this Complaint, including by way of willful blindness. And Apple had actual knowledge of the ’825 Patent at least with the filing of this Complaint. After acquiring that knowledge Apple infringed the ’825 Patent, and in doing so, it knew, or should have known, that its conduct amounted to infringement of the ’825 Patent.

131. As a result of Apple’s infringement of the ’825 Patent, Theta has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Apple’s infringement, but in no event less than a reasonable royalty with interest and costs.

THIRD COUNT (INFRINGEMENT OF U.S. PATENT NO. 10,524,202)

132. Theta incorporates by reference the allegations set forth in the paragraphs above as though fully set forth herein.

133. Apple makes, uses, sells, and/or offers to sell in the United States, and/or imports into the United States products that directly infringe the ’202 Patent each and every time they are powered on and used as intended (i.e., to connect to cellular wireless networks) by an end-user, including the Accused Products identified herein. Use of the Accused Products infringes at least claim 7 of the ’202 Patent.

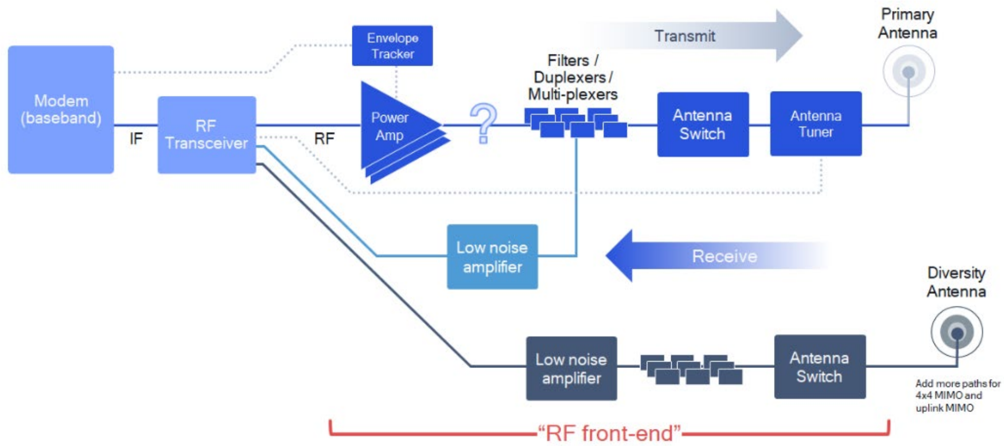
134. On information and belief, the Accused Products employ power-saving techniques that dynamically adjust gain, bias, and/or impedance of components in the receiver signal path in response to determined desired and interferer signal strengths, thereby controlling power dissipation, in accordance with the ’202 Patent claims, including through techniques employed in transceiver, modem, and RF Front End components of the Accused Products.

135. The Accused Products infringe at least claim 7 of the ’202 Patent. Each Accused Product is a battery powered portable wireless device. Each includes wireless transceiver circuitry necessary for the device to offer cellular calling and/or cellular data capabilities. The transceiver circuitry includes a receiver signal path.

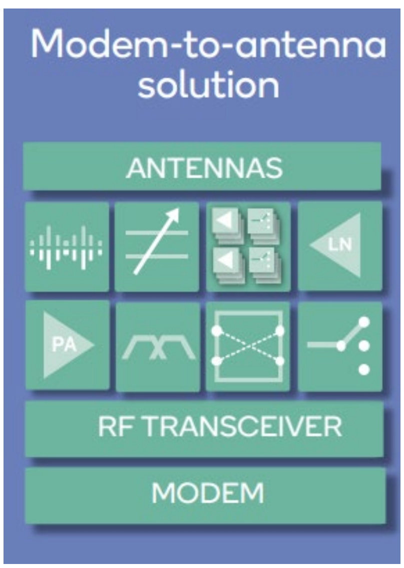
136. The Accused Products receive wireless signals, including both a desired signal(s) (i.e., a signal that carries the voice or data of interest) and interferer signal(s). These signals are received by the transceiver circuitry via an input from an antenna in the Accused Product.

137. The wireless transceivers in the Accused Products include at least one signal path comprised of a plurality of circuits, including an amplifier, a filter, and a mixer. By way of example, as discussed above many Apple Accused Products use Qualcomm mobile RF

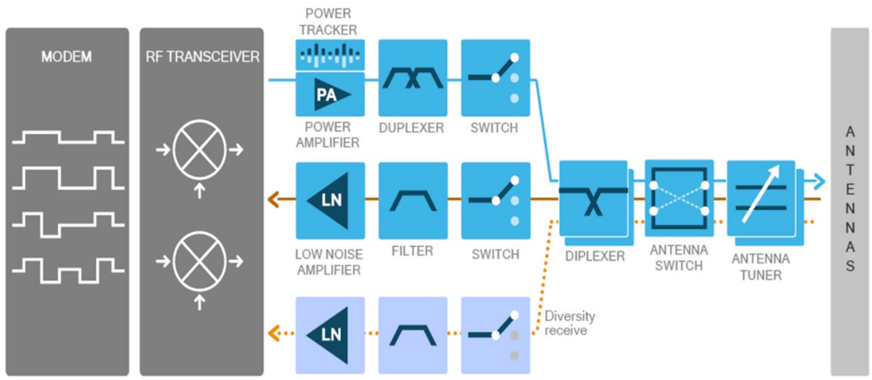
components in their receive signal paths. Qualcomm provides high-level depictions of representative signal paths of its Snapdragon 4G and 5G mobile platforms as used in the Accused Products by Apple—indicating that the components include such features:



See, e.g., https://developer.qualcomm.com/blog/5g-modems-rf-and-antennas-getting-mmwave-data-device.



See also https://www.qualcomm.com/content/dam/qcomm-martech/dm-assets/documents/qualcomm-rf-front-end-infographic.pdf.



RF Front End

See also https://www.forbes.com/sites/tiriasresearch/2017/02/22/qualcomm-adds-complete-rf-portfolio-paves-way-to-5g/.

138. Consistent with exemplary claim 7 of the '202 Patent, the Accused Products operate between a worst-case condition when the signal strength of the desired signal is low, and the signal strength of the interferer signal is high in relation to it, and a best-case condition when the signal strength of the desired signal is high, and the signal strength of the interferer signal is low in relation to it. For example, as discussed herein, the Accused Products operate across ranges of signal conditions utilizing multiple dynamically configurable gain states, which are switched between based on signal conditions and which effect the gain, bias, and/or impedance of circuit components such as, e.g., low noise amplifiers.

139. The Accused Products also include circuitry coupled to the signal path for determining signal strength. By way of example, the desired signal strength is displayed in iconic form as the "bar" indicator on each Accused Product and can also be accessed via administrative functions:

Cell signal. The number of bars indicates the signal strength of your cellular service. If there's no signal, "No Service" appears.

Dual cell signals. On models with Dual SIM, the upper row of bars indicates the signal strength of the line you use for cellular data. The lower row of bars indicates the signal strength of your other line. If there's no signal, "No Service" appears. To see the status icons with their corresponding cellular plan labels and carrier names, open Control Center.

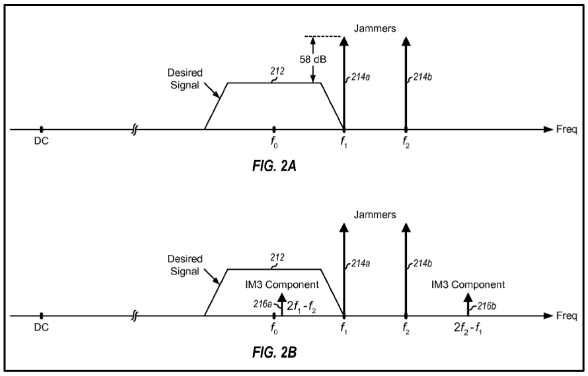
See, e.g., https://support.apple.com/guide/iphone/learn-the-meaning-of-the-status-icons-iphef7bb57dc/ios.

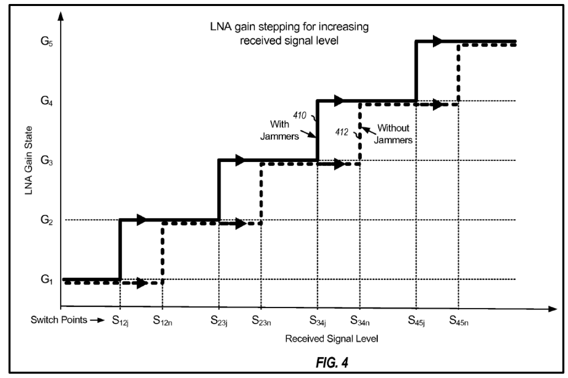
140. The Accused Products also includes circuitry for determining the signal strength of the interferer signal. By way of example, multiple patents of Qualcomm—filed after and citing to Prof. Tsividis' inventions—discuss jammer detection circuitry. *See, e.g.*, U.S. Patent No. 8,781,426 at 3:44-59, 9:50-61 ("For example, the bias current may be increased when jammers are detected or decreased when jammers are not detected. The bias current may also be adjusted by different amounts depending on the jammer strength."). "Jammer" refers to an interferer signal or signals. On information and belief, Qualcomm includes jammer detection circuitry in components used by Apple in the Accused Products. The jammer detection feature in the Accused Products determines the jammer signal strength levels in order to optimize power consumption.

141. The Accused Products compare the strength of the desired signal to the strength of the interferer signal. For example, on information and belief Apple's Accused Products using Qualcomm Mobile Platform components implement infringing comparisons:

> A comparator (Comp) 520 compares the filtered signal against a jammer threshold, V*th*, and provides a jammer indicator signal. The jammer threshold, V_{th}, may be programmed by the digital processor 150 to different levels based on the current gain state of the receiver, or channel conditions, or received signal strength.

See, e.g., U.S. Patent No. 8,521,198 at 8:30–35.





See also id. at Figs 2A, 2B, 4.

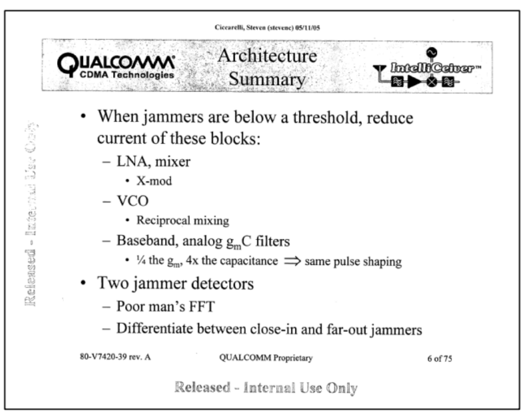
142. The Accused Products achieve control of power dissipation by dynamically altering the gain, bias currents, and/or impedances of the components in the receiver signal path based on the signal strength comparison. For example, on information and belief the transceiver and RF Front End amplifier components used by Apple in the Accused Products have programmable "gain states" which affect variable bias currents and/or impedances in the circuits. *See, e.g.*, U.S. Patent No. 8,521,198, "Dynamic LNA Switch Points Based on Channel Conditions," at 8:58–60 ("The jammer indicators from all jammer detectors may be used to select the switch points, gain, and/or bias of the LNA").

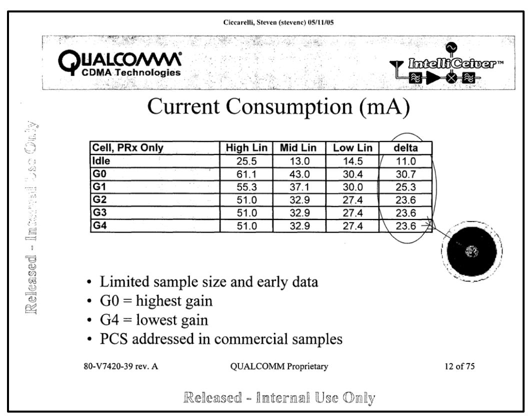
143. By way of further example, on information and belief, RF Front End Components from Qualcomm, Skyworks, and other manufacturers used by Apple in the Accused Products have programmable "gain states" which affect variable current and power dissipation in their low noise amplifier (LNA) elements. For example, a Skyworks datasheet, available online, confirms that the various front end modules containing LNAs that are marketed by Skyworks employ software programmable registers to control the LNA gain state and bias, effecting the current and power dissipation in their amplifier components:

Table 10. B41 RF Performance

Parameter	Symbol	Gain State	Mode 0 Min	Mode 0 Typ	Mode 0 Max	Mode 1 Min	Mode 1 Typ	Mode 1 Max	Unit
Frequency	B41	mode0 = [G7,G6,G5,G4,G3,G2,G1,G0] mode1 = [G7,G6,G5,G4,G3,G2,G1]	2496		2690	2496		2690	MHz
LNA current	IDD	G7		9.6			9.6		mA
		G6		5.1			5.1		
		G5		4.2			2.9		
		G4		2.9			2.5		
		G3		2.9			1.4		
		G2		2.9			0.3		
		G1		1.5			0.3		
		G0		0.3			NA		

144. Qualcomm has previously marketed infringing receiver technology under the name "IntelliCeiver." On information and belief, while Qualcomm no longer advertises using the IntelliCeiver term, the same or materially similar technology has been utilized in subsequent generations of Qualcomm's transceiver and RF Front End components, including those used by Apple in the Accused Products. Qualcomm's "IntelliCeiver Data Review" presentation identifies the variable gain states and their effect on current consumption. Qualcomm's IntelliCeiver, and successor technology, determines interferer levels in a received signal and adjusts the current consumption of components within the receiver signal path, including the amplifiers, filters, and mixers based on the operational characteristic encountered by the receiver, to optimize power dissipation:





145. By way of further example, on information and belief, transceiver components from Qualcomm used by Apple in the Accused Products have programmable "gain states" which affect variable current and power dissipation in their low noise amplifier (LNA) elements. For example,

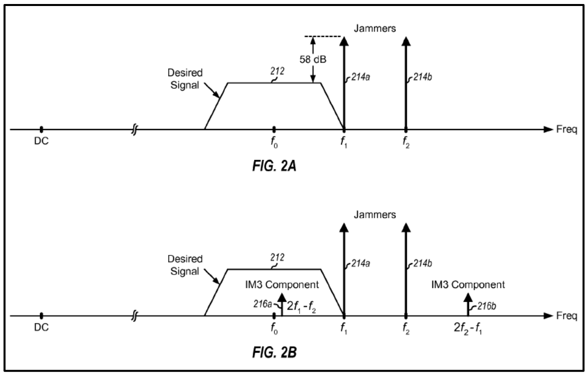
a page from the WTR3925 transceiver datasheet, available online, confirms that the device has programmable gain modes to control, e.g., the LNA performance and power consumption at different desired signal strengths and jammer signal strengths:

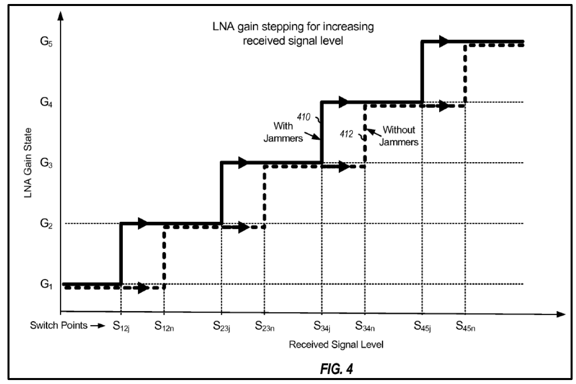
Table 3-8 UMTS Rx performance specifications (cont.)

Parameter	Comments	Min	Typ	Max	Unit
Survivable input level (LNA off)		–	–	+23	dBm
Input VSWR (in-band)	50 Ω single-ended; external match		–	2:1	–
LO to RF leakage (in-band)	All gain modes; at LNA input	–	–	-60	dBm
Residual sideband level (uncal)	Due to amplitude and phase imbalance	–	-35	-28	dBc
DC offset at I/Q outputs [1]		-100	–	100	mV
Single-ended I/Q load capacitance [2]	Each BBI and BBQ pin	–	–	12	pF
Gain mode G0					
Voltage conversion gain		49	53	57	dBV/V
Noise figure [3]	Small signal, single sideband	–	2.3	3.0	dB
Input IP3 [4] (ACS)					
Rel 99/HSDPA/HSUPA/HSPA+	S = -90 dBm, J1 = J2 = -44 dBm	-22	-10	–	dBm
DC-HSPA+/3C-HSPA+	S = -90 dBm, J1 = J2 = -47 dBm	-22	-10	–	dBm
Input IP3 [5] (triple beat)	S = -90; J = -55; TX1 = TX2 = -33 dBm	-7	-1	–	dBm
Input IP2 [6]	S = -90 dBm; TX1 = TX2 = -30 dBm	–	54	–	dBm
Gain mode G1					
Voltage conversion gain		40	44	48	dBV/V
Noise figure [3]	Small signal, single sideband	–	3.5	4.5	dB
Input IP3 [4] (ACS)	S = -90 dBm, J1 = J2 = -47 dBm	-12	-10	–	dBm
Input IP3 [5] (triple beat)	S = -90; J = -55; TX1 = TX2 = -33 dBm	-7	-1	–	dBm
Gain mode G2					
Voltage conversion gain		22	26	30	dBV/V
Noise figure [3]	Small signal, single sideband	–	16	19	dB
Gain mode G3					
Voltage conversion gain		13	17	21	dBV/V
Noise figure [3]	Small signal, single sideband	–	26	29	dB

Ref: 80-NH379-1

146. In the Accused Products, the gain, bias current, and/or impedance of one or more of the plurality of circuits in the receiver signal path is adjusted based upon the determined desired signal strength and interferer signal strength comparison. *See, e.g.*, U.S. Patent No. 8,521,198 at 9:17–19 ("A bias selector 542 receives the jammer indicator and/or the received signal level and generates a bias control for LNA 120."). For example, on information and belief, when the signal conditions improve to be better than in a worst-case condition, the gain state of one or more of the circuits in the receiver signal path of the wireless transceiver are changed compared to the worst-case power dissipation condition, thereby controlling power dissipation (*e.g.*, the gain is changed from a G0 state to a G1 state, or G1 to G2 state, etc.).





See, e.g., *id.* at Figs. 2A, 2B, 4.

147. Each and every time an Accused Product is powered on and used as intended, the Accused Product practices the method(s) claimed in the ’202 Patent, constituting direct infringement by its user(s). By way of example, such users include Apple’s customers, as well as Apple personnel acting within the scope of their employment with Apple, including by testing and using the Accused Products in the United States.

148. Apple has injured Theta and is liable to Theta for directly infringing one or more claims of the ’202 Patent, including, without limitation, claim 7 pursuant to 35 U.S.C. § 271(a).

149. Apple also infringes the ’202 Patent under 35 U.S.C. § 271(b) & (c).

150. Apple knowingly encourages and intends to induce infringement of the ’202 Patent by making, using, offering for sale, and/or selling products in the United States, and/or importing them into the United States, including, but not limited to, the Accused Products, with knowledge of the ’202 Patent and with knowledge and specific intention that such products will be used by its customers and personnel, and that such use will necessarily result in infringement of the ’202 Patent. Apple had actual knowledge of the ’202 Patent and that its actions would lead to infringement by end-users, and/or Apple had knowledge of the foregoing by way of willful blindness to the existence of the ’202 Patent and to the fact that its actions would lead to infringement by end-users.

151. Apple also contributes to the infringement of the ’202 Patent. Apple makes, uses, sells, and/or offers to sell products in the United States, and/or imports them into the United States, including but not limited to the Accused Products, with knowledge of the ’202 Patent, knowing that those products constitute a material part of the claimed invention, that they are especially made or adapted for use in infringing the ’202 Patent, and that they are not staple articles or commodities of commerce capable of substantial non-infringing use. Apple had actual knowledge of the ’202 Patent, and that its products constitute a material part of the invention and are especially made or adapted for use in infringing the invention, and that the products are not staple articles or commodities of commerce capable of substantial non-infringing use, and/or Apple had knowledge of the foregoing by way of willful blindness to the existence of the ’202 Patent, to the fact that its products constitute a material part of the invention and are especially made or adapted for use in infringing the invention, and to the fact that the products are not staple articles or commodities of commerce capable of substantial non-infringing use.

152. Apple has had knowledge of the infringing nature of its activities, including that any use of the Accused Products as intended would directly infringe the methods claimed in the ’202 Patent, and nevertheless continued, and continues its infringing activities with respect to the ’202 Patent.

153. Apple intended that its customers and personnel infringe the asserted claims because practice of the asserted claims was necessary in order to achieve the battery life touted in Apple’s promotional materials. Indeed, Apple touted the advantages of the battery life and physical characteristics (e.g., weight, size, and availability of larger screens) that could not be achieved in the advertised form factors but for the implementation of Prof. Tsividis’ claimed methods.

154. As described herein, the claimed methods are necessarily practiced when the Accused Products are powered on and used as intended. No mechanism is provided to prevent a user from practicing the claimed methods, and users are barred by license from disabling or altering the relevant functionality of the Accused Products. Thus, there are no substantial non-infringing uses of the Accused Products.

155. Apple's infringement of the '202 Patent has been and continues to be deliberate and willful, and therefore, this is an exceptional case warranting an award of enhanced damages and attorneys' fees pursuant to 35 U.S.C. §§ 284–285. On information and belief, Apple had knowledge of the issued '202 Patent prior to the filing of this Complaint, including by way of willful blindness. And Apple had actual knowledge of the '202 Patent at least with the filing of this Complaint. After acquiring that knowledge Apple infringed the '202 Patent, and in doing so, it knew, or should have known, that its conduct amounted to infringement of the '202 Patent.

156. As a result of Apple's infringement of the '202 Patent, Theta has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Apple's infringement, but in no event less than a reasonable royalty with interest and costs.

FOURTH COUNT (INFRINGEMENT OF U.S. PATENT NO. 11,564,164)

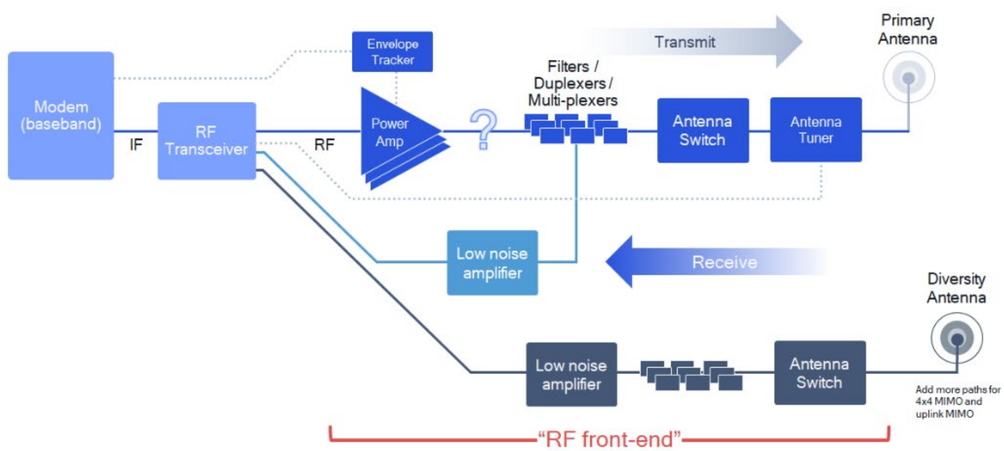
157. Theta incorporates by reference the allegations set forth in the paragraphs above as though fully set forth herein.

158. Apple makes, uses, sells, and/or offers to sell in the United States, and/or imports into the United States products that directly infringe the '164 Patent each and every time they are powered on and used as intended (i.e., to connect to cellular wireless networks) by an end-user, including the Accused Products identified herein. Making, using, selling, offering, and importing of the Accused Products infringes at least claim 5 of the '164 Patent.

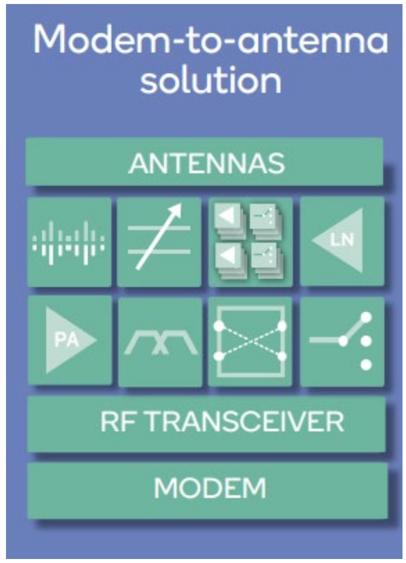
159. On information and belief, the Accused Products employ power-saving techniques that dynamically vary a bias current of circuits in the receiver signal path in response to determined interferer signal strengths, thereby controlling power dissipation, in accordance with the '164 Patent claims, including through techniques employed in transceiver, modem, and RF Front End components of the Accused Products.

160. Each Accused Product is a battery powered portable wireless device. Each includes wireless transceiver circuitry necessary for the device to offer cellular calling and/or cellular data capabilities. The transceiver circuitry includes at least one receiver signal path, spanning one or more transceiver integrated circuit, modem, and RF Front End components.

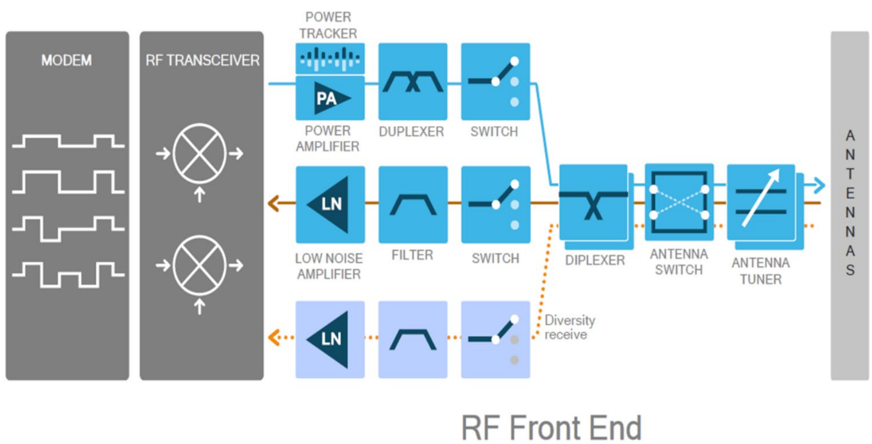
161. The Accused Products include at least one receiver and receiver signal path comprised of a plurality of circuits, including an amplifier, a filter, and a mixer. By way of example, as discussed above many Apple Accused Products use Qualcomm mobile RF components in their receive signal paths. Qualcomm provides high-level depictions of representative signal paths of its Snapdragon 4G and 5G mobile platforms as used in the Accused Products by Apple—indicating that the components include such features:



See, *e.g.*, https://developer.qualcomm.com/blog/5g-modems-rf-and-antennas-getting-mmwave-data-device.



See also https://www.qualcomm.com/content/dam/qcomm-martech/dm-assets/documents/qualcomm-rf-front-end-infographic.pdf.



See also https://www.forbes.com/sites/tiriasresearch/2017/02/22/qualcomm-adds-complete-rf-portfolio-paves-way-to-5g/.

162. The Accused Products receive wireless signals, including both a desired signal(s) (i.e., a signal that carries the voice or data of interest) and interferer signal(s). These signals are received by the receiver signal path circuitry via an input from an antenna in the Accused Product.

163. The Accused Products also include circuitry for determining the signal strength of the interferer signal. By way of example, multiple patents of Qualcomm—filed after and citing to Prof. Tsividis' inventions—discuss jammer detection circuitry. *See, e.g.*, U.S. Patent No. 8,781,426 at 3:44-59, 9:50-61 ("For example, the bias current may be increased when jammers are detected or decreased when jammers are not detected. The bias current may also be adjusted by different amounts depending on the jammer strength."). "Jammer" refers to an interferer signal or signals. On information and belief, Qualcomm includes jammer detection circuitry in components used by Apple in the Accused Products. The jammer detection feature in the Accused Products determines the jammer signal strength levels in order to optimize power consumption.

164. The Accused Products determine an operating condition for the circuits of the receiver signal path based on, *inter alia*, the strength of the interferer signal. For example, on information and belief Apple's Accused Products using Qualcomm Mobile Platform components Products compare the strength of the desired signal to the strength of the interferer signal:

> A comparator (Comp) 520 compares the filtered signal against a jammer threshold, V*th*, and provides a jammer indicator signal. The jammer threshold, V_{th}, may be programmed by the digital processor 150 to different levels based on the current gain state of the receiver, or channel conditions, or received signal strength.

See, e.g., U.S. Patent No. 8,521,198 at 8:30–35.

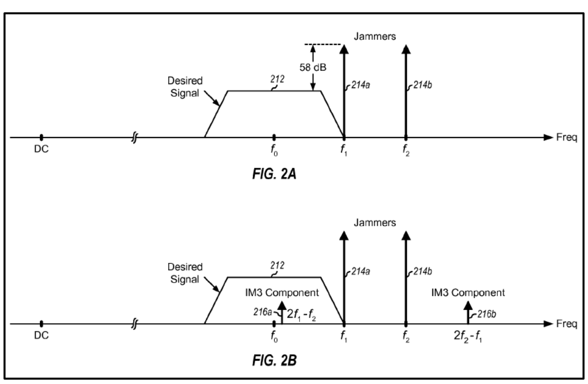


FIG. 2A
FIG. 2B

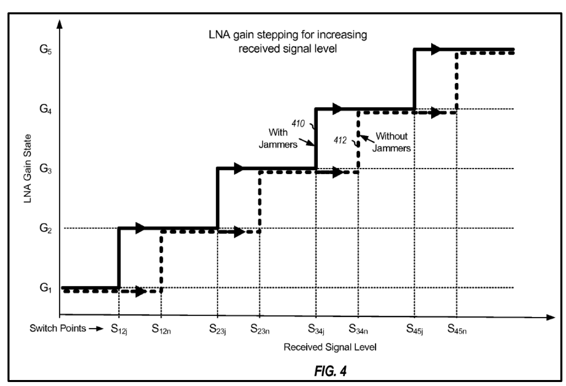


FIG. 4

See also id. at Figs 2A, 2B, 4.

165. Consistent with exemplary claim 5 of the '164 Patent, the Accused Products operate from one or more worst-case conditions with worst case power dissipations, and dynamically adapt to determined better operating conditions. For example, as discussed herein, the Accused Products operate across ranges of signal conditions utilizing multiple dynamically configurable gain states, which are switched between based on signal conditions and which effect the bias current of circuit components such as, e.g., low noise amplifiers. The better than worst case operating conditions in which parameters are dynamically adjusted include when the strength of the interferer signal changes relative to a worst case operating condition.

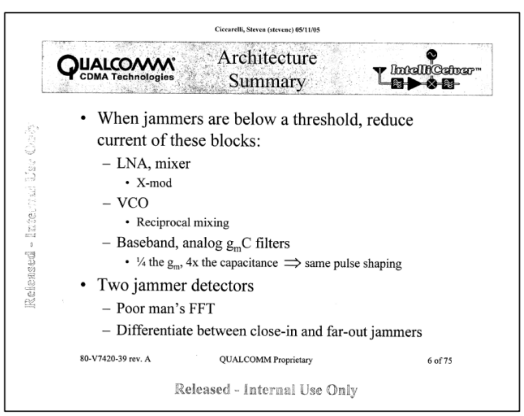
166. The Accused Products achieve control of power consumption from the battery by dynamically altering the bias currents of the components in the receiver signal path based on the determined operating condition. For example, on information and belief the transceiver and RF Front End amplifier components used by Apple in the Accused Products have programmable "gain states" which affect variable bias currents and/or impedances in the circuits. *See, e.g.*, U.S. Patent No. 8,521,198, "Dynamic LNA Switch Points Based on Channel Conditions," at 8:58–60 ("The jammer indicators from all jammer detectors may be used to select the switch points, gain, and/or bias of the LNA").

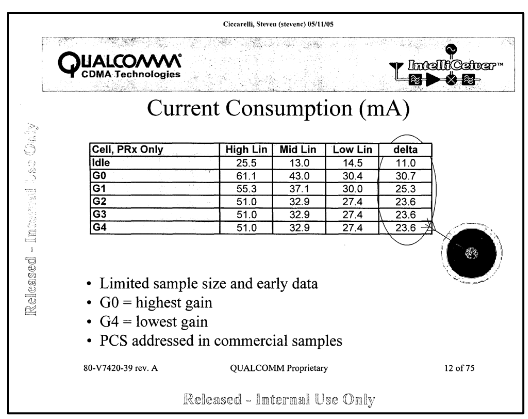
167. By way of further example, on information and belief, RF Front End Components from Qualcomm, Skyworks, and other manufacturers used by Apple in the Accused Products have programmable "gain states" which affect variable bias current and power dissipation in their low noise amplifier (LNA) elements. For example, a Skyworks datasheet, available online, confirms that the various front end modules containing LNAs that are marketed by Skyworks employ software programmable registers to control the LNA gain state and bias, effecting the current and power dissipation in their amplifier components:

Table 10. B41 RF Performance

Parameter	Symbol	Gain State	Mode 0 Min	Mode 0 Typ	Mode 0 Max	Mode 1 Min	Mode 1 Typ	Mode 1 Max	Unit
Frequency	B41	mode0 = [G7,G6,G5,G4,G3,G2,G1,G0] mode1 = [G7,G6,G5,G4,G3,G2,G1]	2496		2690	2496		2690	MHz
LNA current	IDD	G7		9.6			9.6		mA
		G6		5.1			5.1		
		G5		4.2			2.9		
		G4		2.9			2.5		
		G3		2.9			1.4		
		G2		2.9			0.3		
		G1		1.5			0.3		
		G0		0.3			NA		

168. Qualcomm has previously marketed infringing receiver technology under the name "IntelliCeiver." On information and belief, while Qualcomm no longer advertises using the IntelliCeiver term, the same or materially similar technology has been utilized in subsequent generations of Qualcomm's transceiver and RF Front End components, including those used by Apple in the Accused Products. Qualcomm's "IntelliCeiver Data Review" presentation identifies the variable gain states and their effect on current consumption. Qualcomm's IntelliCeiver, and successor technology, determines interferer levels in a received signal and adjusts the bias current and resulting current consumption of components within the receiver signal path, including the amplifiers, filters, and mixers, based on the operational characteristic encountered by the receiver, to optimize power dissipation:





169. By way of further example, on information and belief, transceiver components from Qualcomm used by Apple in the Accused Products have programmable "gain states" which affect variable current and power dissipation in their low noise amplifier (LNA) elements. For example,

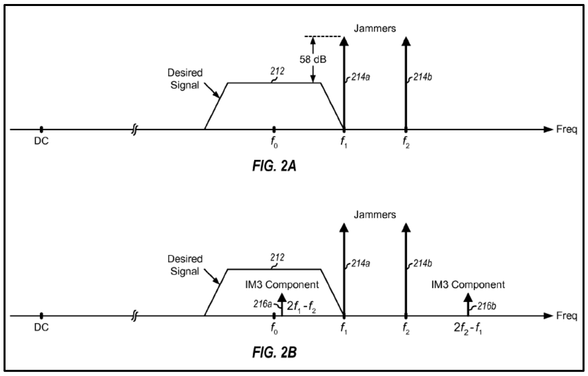
a page from the WTR3925 transceiver datasheet, available online, confirms that the device has programmable gain modes to control, e.g., the LNA performance and power consumption at different desired signal strengths and jammer signal strengths:

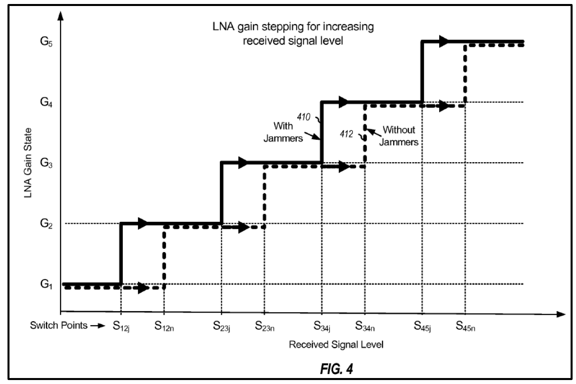
Table 3-8 UMTS Rx performance specifications (cont.)

Parameter	Comments	Min	Typ	Max	Unit
Survivable input level (LNA off)		–	–	+23	dBm
Input VSWR (in-band)	50 Ω single-ended; external match		–	2:1	–
LO to RF leakage (in-band)	All gain modes; at LNA input	–	–	-60	dBm
Residual sideband level (uncal)	Due to amplitude and phase imbalance	–	-35	-28	dBc
DC offset at I/Q outputs [1]		-100	–	100	mV
Single-ended I/Q load capacitance [2]	Each BBI and BBQ pin	–	–	12	pF
Gain mode G0					
Voltage conversion gain		49	53	57	dBV/V
Noise figure [3]	Small signal, single sideband	–	2.3	3.0	dB
Input IP3 [4] (ACS)					
Rel 99/HSDPA/HSUPA/HSPA+	S = -90 dBm, J1 = J2 = -44 dBm	-22	-10	–	dBm
DC-HSPA+/3C-HSPA+	S = -90 dBm, J1 = J2 = -47 dBm	-22	-10	–	dBm
Input IP3 [5] (triple beat)	S = -90; J = -55; TX1 = TX2 = -33 dBm	-7	-1	–	dBm
Input IP2 [6]	S = -90 dBm; TX1 = TX2 = -30 dBm	–	54	–	dBm
Gain mode G1					
Voltage conversion gain		40	44	48	dBV/V
Noise figure [3]	Small signal, single sideband	–	3.5	4.5	dB
Input IP3 [4] (ACS)	S = -90 dBm, J1 = J2 = -47 dBm	-12	-10	–	dBm
Input IP3 [5] (triple beat)	S = -90; J = -55; TX1 = TX2 = -33 dBm	-7	-1	–	dBm
Gain mode G2					
Voltage conversion gain		22	26	30	dBV/V
Noise figure [3]	Small signal, single sideband	–	16	19	dB
Gain mode G3					
Voltage conversion gain		13	17	21	dBV/V
Noise figure [3]	Small signal, single sideband	–	26	29	dB

Ref: 80-NH379-1

170. In the Accused Products, the bias current of one or more of the plurality of circuits in the receiver signal path is adjusted based upon the determined operating condition, which is based on the determined interferer signal strength. *See, e.g.*, U.S. Patent No. 8,521,198 at 9:17–19 ("A bias selector 542 receives the jammer indicator and/or the received signal level and generates a bias control for LNA 120."). For example, on information and belief, when the signal conditions improve to be better than in a worst-case condition, the gain state of one or more of the circuits in the receiver signal path of the wireless transceiver are changed compared to the worst-case power dissipation condition (*e.g.*, the gain is changed from a G0 state to a G1 state, or G1 to G2 state, etc.), which involves dynamically varying a bias current, and thereby controlling power dissipation.





See, e.g., *id.* at Figs. 2A, 2B, 4.

171. On information and belief, in the Accused Products, the impedance of one or more of the plurality of circuits in the receiver signal path is adjusted—in order to dynamically vary a bias current based on interferer signal strength—according to claim 7 of the ’164 Patent

172. Apple directly infringes the apparatus claims of the ’164 Patent by making, using, selling, offering for sale, and/or importing the Accused Products.

173. Each and every time an Accused Product is powered on and used as intended, the Accused Product is configured to and does operate according to the claims of the ’164 Patent, constituting direct infringement by its user(s). By way of example, such users include Apple’s customers, as well as Apple personnel acting within the scope of their employment with Apple, including by testing and using the Accused Products in the United States.

174. Apple has injured Theta and is liable to Theta for directly infringing one or more claims of the ’164 Patent, including, without limitation, claim 5 pursuant to 35 U.S.C. § 271(a).

175. Apple also infringes the ’164 Patent under 35 U.S.C. § 271(b) & (c).

176. Apple knowingly encourages and intends to induce infringement of the ’164 Patent by making, using, offering for sale, and/or selling products in the United States, and/or importing them into the United States, including, but not limited to, the Accused Products, with knowledge of the ’164 Patent and with knowledge and specific intention that such products will be used by its

customers and personnel, and that such use will necessarily result in infringement of the '164 Patent. Apple had actual knowledge of the '164 Patent and that its actions would lead to infringement by end-users, and/or Apple had knowledge of the foregoing by way of willful blindness to the existence of the '164 Patent and to the fact that its actions would lead to infringement by end-users.

177. Apple also contributes to the infringement of the '164 Patent. Apple makes, uses, sells, and/or offers to sell products in the United States, and/or imports them into the United States, including but not limited to the Accused Products, with knowledge of the '164 Patent, knowing that those products constitute a material part of the claimed invention, that they are especially made or adapted for use in infringing the '164 Patent, and that they are not staple articles or commodities of commerce capable of substantial non-infringing use. Apple had actual knowledge of the '164 Patent, and that its products constitute a material part of the invention and are especially made or adapted for use in infringing the invention, and that the products are not staple articles or commodities of commerce capable of substantial non-infringing use, and/or Apple had knowledge of the foregoing by way of willful blindness to the existence of the '164 Patent, to the fact that its products constitute a material part of the invention and are especially made or adapted for use in infringing the invention, and to the fact that the products are not staple articles or commodities of commerce capable of substantial non-infringing use.

178. Apple has had knowledge of the infringing nature of its activities, including that any use of the Accused Products as intended would directly infringe the claims in the '164 Patent, and nevertheless continued, and continues its infringing activities with respect to the '164 Patent.

179. Apple intended that its customers and personnel infringe the asserted claims because practice of the asserted claims was necessary in order to achieve the battery life touted in

Apple's promotional materials. Indeed, Apple touted the advantages of the battery life and physical characteristics (e.g., weight, size, and availability of larger screens) that could not be achieved in the advertised form factors but for the implementation of Prof. Tsividis' claimed methods.

180. As described herein, the claims are necessarily practiced when the Accused Products are powered on and used as intended. No mechanism is provided to prevent a user from practicing the claims, and users are barred by license from disabling or altering the relevant functionality of the Accused Products. Thus, there are no substantial non-infringing uses of the Accused Products.

181. Apple's infringement of the '164 Patent has been and continues to be deliberate and willful, and therefore, this is an exceptional case warranting an award of enhanced damages and attorneys' fees pursuant to 35 U.S.C. §§ 284–285. On information and belief, Apple had knowledge of the issued '164 Patent prior to the filing of this Complaint, including by way of willful blindness. And Apple had actual knowledge of the '164 Patent at least with the filing of this Complaint. After acquiring that knowledge Apple infringed the '164 Patent, and in doing so, it knew, or should have known, that its conduct amounted to infringement of the '164 Patent.

182. As a result of Apple's infringement of the '164 Patent, Theta has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Apple's infringement, but in no event less than a reasonable royalty with interest and costs.

FIFTH COUNT (INFRINGEMENT OF U.S. PATENT NO. 11,368,210)

183. Theta incorporates by reference the allegations set forth in the paragraphs above as though fully set forth herein.

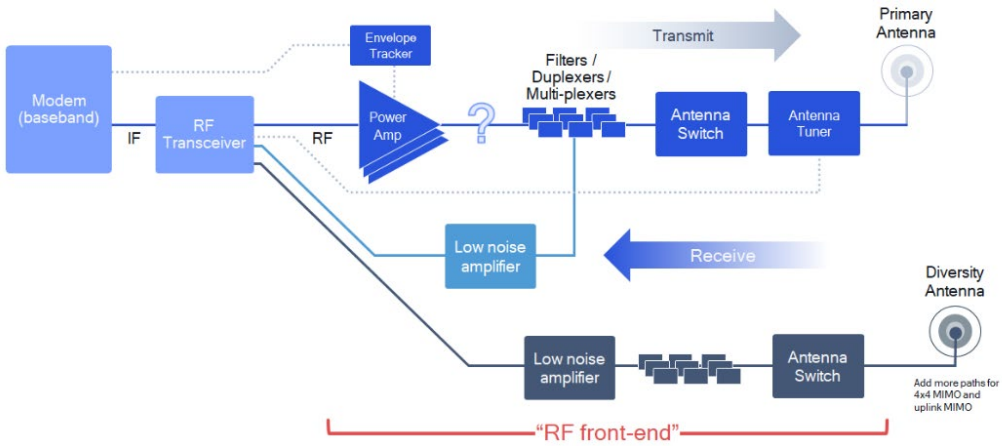
184. Apple makes, uses, sells, and/or offers to sell in the United States, and/or imports into the United States products that directly infringe the ’210 Patent each and every time they are powered on and used as intended (i.e., to connect to cellular wireless networks) by an end-user, including the Accused Products identified herein. Making, using, selling, offering, and importing of the Accused Products infringes at least claim 3 of the ’210 Patent.

185. On information and belief, the Accused Products employ power-saving techniques that dynamically vary an impedance affecting the the receiver signal path in response to determined desired and interferer signal strengths, thereby controlling power dissipation, in accordance with the ’210 Patent claims, including through techniques employed in transceiver, modem, and RF Front End components of the Accused Products.

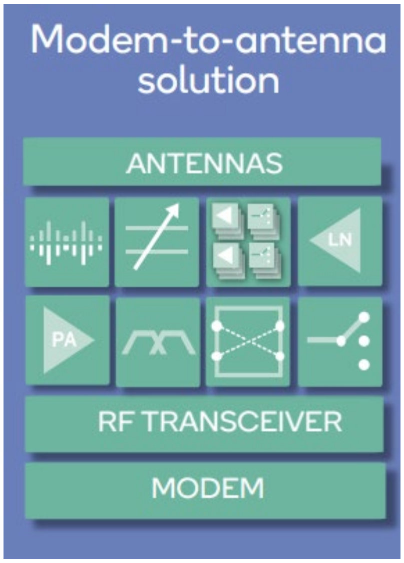
186. Each Accused Product is a battery powered portable wireless device. Each includes wireless receiver circuitry necessary for the device to offer cellular calling and/or cellular data capabilities. Operation of the Accused Product according to the inventions of the claims results in power dissipation reduction in the wireless receiver, and a corresponding reduction in a drain on battery life.

187. The Accused Products receive wireless signals, including both a desired signal(s) (i.e., a signal that carries the voice or data of interest) and interferer signal(s). These signals are received by the receiver signal path circuitry via an input from an antenna in the Accused Product.

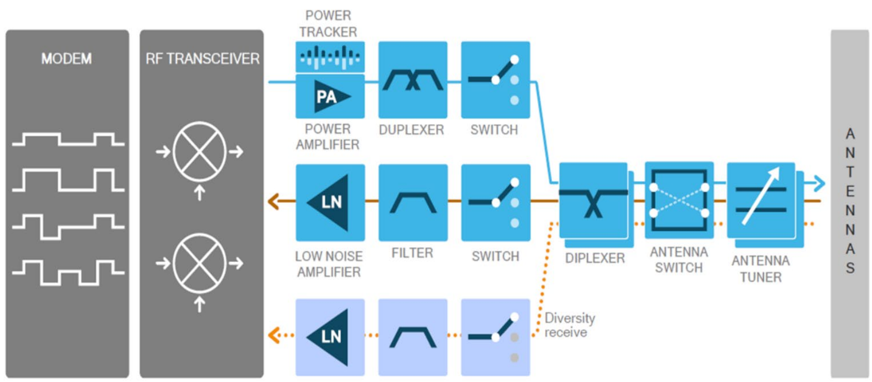
188. The Accused Products include at least one receiver and receiver signal path comprised of a plurality of circuits. By way of example, as discussed above many Apple Accused Products use Qualcomm mobile RF components in their receive signal paths. Qualcomm provides high-level depictions of representative signal paths of its Snapdragon 4G and 5G mobile platforms as used in the Accused Products by Apple—indicating that the components include such features:



S*ee, e.g.*, https://developer.qualcomm.com/blog/5g-modems-rf-and-antennas-getting-mmwave-data-device.



See also https://www.qualcomm.com/content/dam/qcomm-martech/dm-assets/documents/qualcomm-rf-front-end-infographic.pdf.



RF Front End

See also https://www.forbes.com/sites/tiriasresearch/2017/02/22/qualcomm-adds-complete-rf-portfolio-paves-way-to-5g/.

189. The receiver signal path of the Accused Products includes circuitry for determining the signal strength of the desired signal. By way of example, the desired signal strength is displayed in iconic form as the "bar" indicator on each Accused Product and can also be accessed via administrative functions:

Cell signal. The number of bars indicates the signal strength of your cellular service. If there's no signal, "No Service" appears.

Dual cell signals. On models with Dual SIM, the upper row of bars indicates the signal strength of the line you use for cellular data. The lower row of bars indicates the signal strength of your other line. If there's no signal, "No Service" appears. To see the status icons with their corresponding cellular plan labels and carrier names, open Control Center.

See, e.g., https://support.apple.com/guide/iphone/learn-the-meaning-of-the-status-icons-iphef7bb57dc/ios.

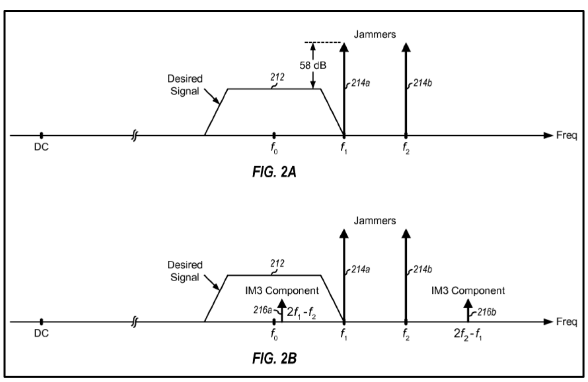
190. The receiver signal path of the Accused Products also includes circuitry for determining the signal strength of the interferer signal. By way of example, multiple patents of Qualcomm—filed after and citing to Prof. Tsividis' inventions—discuss jammer detection circuitry. *See, e.g.*, U.S. Patent No. 8,781,426 at 3:44-59, 9:50-61 ("For example, the bias current may be increased when jammers are detected or decreased when jammers are not detected. The

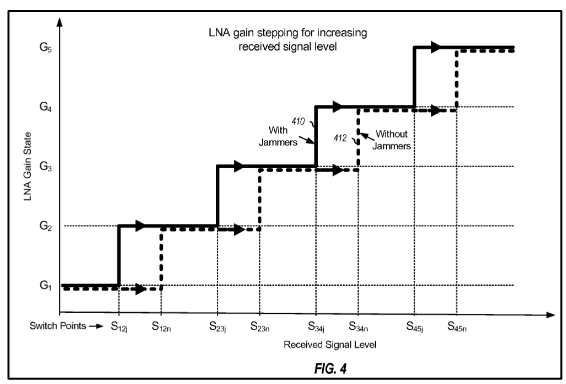
bias current may also be adjusted by different amounts depending on the jammer strength."). "Jammer" refers to an interferer signal or signals. On information and belief, Qualcomm includes jammer detection circuitry in components used by Apple in the Accused Products. The jammer detection feature in the Accused Products determines the jammer signal strength levels in order to optimize power consumption.

191. The Accused Products vary an impedance affecting the receiver signal path based on, *inter alia*, the strength of the determined desired and interferer signals. For example, on information and belief Apple's Accused Products using Qualcomm Mobile Platform components Products determine and also compare the strength of the desired signal to the strength of the interferer signal:

> A comparator (Comp) 520 compares the filtered signal against a jammer threshold, V*th*, and provides a jammer indicator signal. The jammer threshold, V_{th}, may be programmed by the digital processor 150 to different levels based on the current gain state of the receiver, or channel conditions, or received signal strength.

See, e.g., U.S. Patent No. 8,521,198 at 8:30–35.





See also id. at Figs 2A, 2B, 4.

192. Consistent with exemplary claim 3 of the '210 Patent, the Accused Products operate from one or more signal conditions, and dynamically adapt to determined different operating conditions. For example, as discussed herein, the Accused Products operate across ranges of signal

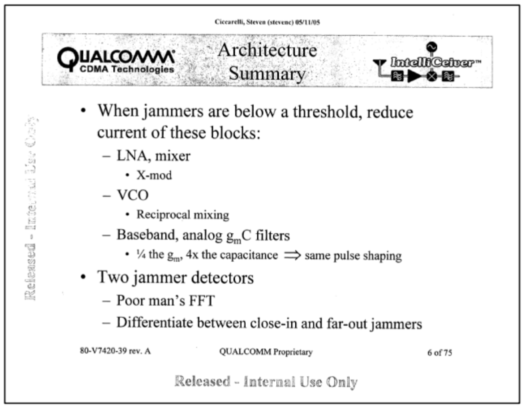
conditions utilizing multiple dynamically configurable gain states, which are switched between based on signal conditions and which affect, *e.g.*, an impedance and the resulting noise floor and current consumption of circuit components such as, *e.g.*, low noise amplifiers. The determined operating conditions in which parameters are dynamically adjusted (*e.g.*, increased) include when the strength of the interferer signal and the strength of the desired signal are both large.

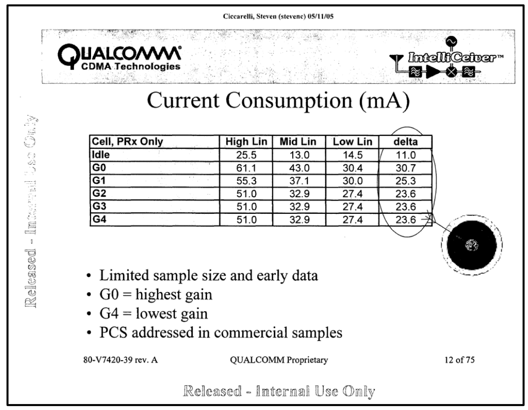
193. The Accused Products achieve control of power consumption from the battery by dynamically increasing an impedance affecting components in the receiver signal path based on the determined operating condition. For example, on information and belief the transceiver and RF Front End amplifier components used by Apple in the Accused Products have programmable "gain states" which affect variable bias currents and/or impedances in the circuits. *See, e.g.*, U.S. Patent No. 8,521,198, "Dynamic LNA Switch Points Based on Channel Conditions," at 8:58–60 ("The jammer indicators from all jammer detectors may be used to select the switch points, gain, and/or bias of the LNA").

194. By way of further example, on information and belief, RF Front End Components from Qualcomm, Skyworks, and other manufacturers used by Apple in the Accused Products have programmable "gain states" which affect variable impedance and power dissipation in their low noise amplifier (LNA) elements.

195. Qualcomm has previously marketed infringing receiver technology under the name "IntelliCeiver." On information and belief, while Qualcomm no longer advertises using the IntelliCeiver term, the same or materially similar technology has been utilized in subsequent generations of Qualcomm's transceiver and RF Front End components, including those used by Apple in the Accused Products. Qualcomm's "IntelliCeiver Data Review" presentation identifies the variable gain states and their effect on current consumption. Qualcomm's IntelliCeiver, and

successor technology, determines interferer levels in a received signal and adjusts an impedance and/or bias current, and resulting current consumption of components within the receiver signal path, including the amplifiers, filters, and mixers, based on the operational characteristic encountered by the receiver, to optimize power dissipation:





Cell, PRx Only	High Lin	Mid Lin	Low Lin	delta
Idle	25.5	13.0	14.5	11.0
G0	61.1	43.0	30.4	30.7
G1	55.3	37.1	30.0	25.3
G2	51.0	32.9	27.4	23.6
G3	51.0	32.9	27.4	23.6
G4	51.0	32.9	27.4	23.6

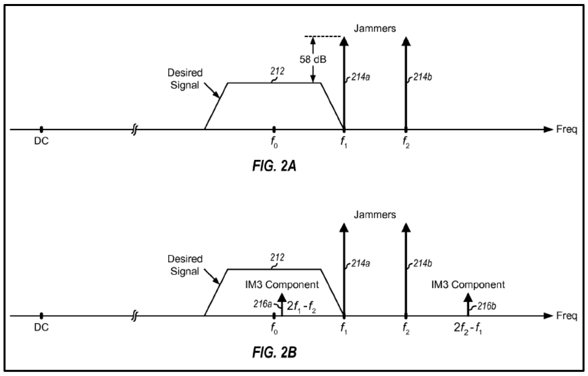
196. By way of further example, on information and belief, transceiver components from Qualcomm used by Apple in the Accused Products have programmable "gain states" which affect variable current and power dissipation in their low noise amplifier (LNA) elements. For example, a page from the WTR3925 transceiver datasheet, available online, confirms that the device has programmable gain modes to control, e.g., the LNA performance and power consumption at different desired signal strengths and jammer signal strengths:

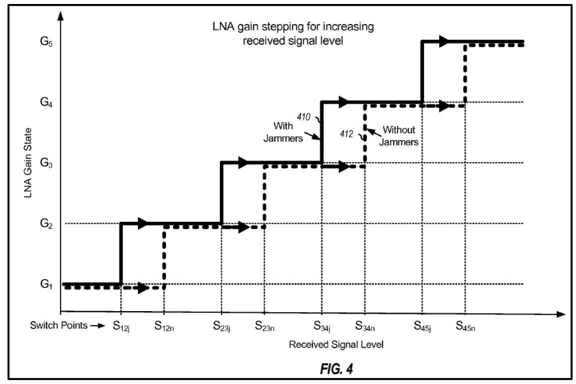
Table 3-8 UMTS Rx performance specifications (cont.)

Parameter	Comments	Min	Typ	Max	Unit
Survivable input level (LNA off)		–	–	+23	dBm
Input VSWR (in-band)	50 Ω single-ended; external match		–	2:1	–
LO to RF leakage (in-band)	All gain modes; at LNA input	–	–	-60	dBm
Residual sideband level (uncal)	Due to amplitude and phase imbalance	–	-35	-28	dBc
DC offset at I/Q outputs [1]		-100	–	100	mV
Single-ended I/Q load capacitance [2]	Each BBI and BBQ pin	–	–	12	pF
Gain mode G0					
Voltage conversion gain		49	53	57	dBV/V
Noise figure [3]	Small signal, single sideband	–	2.3	3.0	dB
Input IP3 [4] (ACS) Rel 99/HSDPA/HSUPA/HSPA+ DC-HSPA+/3C-HSPA+	 S = -90 dBm; J1 = J2 = -44 dBm S = -90 dBm, J1 = J2 = -47 dBm	 -22 -22	 -10 -10	 – –	 dBm dBm
Input IP3 [5] (triple beat)	S = -90; J = -55; TX1 = TX2 = -33 dBm	-7	-1	–	dBm
Input IP2 [6]	S = -90 dBm; TX1 = TX2 = -30 dBm	–	54	–	dBm
Gain mode G1					
Voltage conversion gain		40	44	48	dBV/V
Noise figure [3]	Small signal, single sideband	–	3.5	4.5	dB
Input IP3 [4] (ACS)	S = -90 dBm, J1 = J2 = -47 dBm	-12	-10	–	dBm
Input IP3 [5] (triple beat)	S = -90; J = -55; TX1 = TX2 = -33 dBm	-7	-1	–	dBm
Gain mode G2					
Voltage conversion gain		22	26	30	dBV/V
Noise figure [3]	Small signal, single sideband	–	16	19	dB
Gain mode G3					
Voltage conversion gain		13	17	21	dBV/V
Noise figure [3]	Small signal, single sideband	–	26	29	dB

Ref: 80-NH379-1

197. In the Accused Products, an impedance of one or more of the plurality of circuits in the receiver signal path is adjusted based upon the determined operating condition, which is based on the determined desired and interferer signal strengths. *See, e.g.*, U.S. Patent No. 8,521,198 at 9:17–19 ("A bias selector 542 receives the jammer indicator and/or the received signal level and generates a bias control for LNA 120."). For example, on information and belief, when the signal conditions are determined to be that both the desired and interferer signals are large, the gain state of one or more of the circuits in the receiver signal path of the wireless transceiver is changed. As a result, an impedance affecting the receiver signal path is increased, causing the noise floor of the receiver to also be increased, and requiring reduced power consumption.





See, e.g., *id.* at Figs. 2A, 2B, 4.

198. On information and belief, in the Accused Products, the impedance of one or more of the plurality of circuits in the receiver signal path is adjusted—in order to dynamically vary performance (*e.g.*, raising the noise floor) and reduce current consumption—based on the determined desired and interferer signal strength—according to claim 3 of the '210 Patent.

199. Apple directly infringes the apparatus claims of the '210 Patent by making, using, selling, offering for sale, and/or importing the Accused Products.

200. Each and every time an Accused Product is powered on and used as intended, the Accused Product is configured to and does operate according to the claims of the '210 Patent, constituting direct infringement by its user(s). By way of example, such users include Apple's customers, as well as Apple personnel acting within the scope of their employment with Apple, including by testing and using the Accused Products in the United States.

201. Apple has injured Theta and is liable to Theta for directly infringing one or more claims of the '210 Patent, including, without limitation, claim 3 pursuant to 35 U.S.C. § 271(a).

202. Apple also infringes the '210 Patent under 35 U.S.C. § 271(b) & (c).

203. Apple knowingly encourages and intends to induce infringement of the '210 Patent by making, using, offering for sale, and/or selling products in the United States, and/or importing them into the United States, including, but not limited to, the Accused Products, with knowledge

of the ’210 Patent and with knowledge and specific intention that such products will be used by its customers and personnel, and that such use will necessarily result in infringement of the ’210 Patent. Apple had actual knowledge of the ’210 Patent and that its actions would lead to infringement by end-users, and/or Apple had knowledge of the foregoing by way of willful blindness to the existence of the ’210 Patent and to the fact that its actions would lead to infringement by end-users.

204. Apple also contributes to the infringement of the ’210 Patent. Apple makes, uses, sells, and/or offers to sell products in the United States, and/or imports them into the United States, including but not limited to the Accused Products, with knowledge of the ’210 Patent, knowing that those products constitute a material part of the claimed invention, that they are especially made or adapted for use in infringing the ’210 Patent, and that they are not staple articles or commodities of commerce capable of substantial non-infringing use. Apple had actual knowledge of the ’210 Patent, and that its products constitute a material part of the invention and are especially made or adapted for use in infringing the invention, and that the products are not staple articles or commodities of commerce capable of substantial non-infringing use, and/or Apple had knowledge of the foregoing by way of willful blindness to the existence of the ’210 Patent, to the fact that its products constitute a material part of the invention and are especially made or adapted for use in infringing the invention, and to the fact that the products are not staple articles or commodities of commerce capable of substantial non-infringing use.

205. Apple has had knowledge of the infringing nature of its activities, including that any use of the Accused Products as intended would directly infringe the claims in the ’210 Patent, and nevertheless continued, and continues its infringing activities with respect to the ’210 Patent.

206. Apple intended that its customers and personnel infringe the asserted claims because practice of the asserted claims was necessary in order to achieve the battery life touted in Apple's promotional materials. Indeed, Apple touted the advantages of the battery life and physical characteristics (e.g., weight, size, and availability of larger screens) that could not be achieved in the advertised form factors but for the implementation of Prof. Tsividis' claimed methods.

207. As described herein, the claims are necessarily practiced when the Accused Products are powered on and used as intended. No mechanism is provided to prevent a user from practicing the claims, and users are barred by license from disabling or altering the relevant functionality of the Accused Products. Thus, there are no substantial non-infringing uses of the Accused Products.

208. Apple's infringement of the '210 Patent has been and continues to be deliberate and willful, and therefore, this is an exceptional case warranting an award of enhanced damages and attorneys' fees pursuant to 35 U.S.C. §§ 284–285. On information and belief, Apple had knowledge of the issued '210 Patent prior to the filing of this Complaint, including by way of willful blindness. And Apple had actual knowledge of the '210 Patent at least with the filing of this Complaint. After acquiring that knowledge Apple infringed the '210 Patent, and in doing so, it knew, or should have known, that its conduct amounted to infringement of the '210 Patent.

209. As a result of Apple's infringement of the '210 Patent, Theta has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Apple's infringement, but in no event less than a reasonable royalty with interest and costs.

PRAYER FOR RELIEF

WHEREFORE, Theta prays for judgment and seeks relief against Apple as follows:

A. For judgment that Apple has infringed and/or continues to infringe one or more claims of the Asserted Patents, directly, and/or indirectly by way of inducement or contributory infringement;

B. For a preliminary and permanent injunction against Apple, its respective officers, agents, servants, employees, attorneys, parent and subsidiary corporations, assigns and successors in interest, and those persons in active concert or participation with them, enjoining them from infringement, inducement of infringement, and contributory infringement of the Asserted Patents, including, but not limited to, an injunction against making, using, selling, and/or offering for sale within the United States, and importing into the United States, any products and/or services that infringe the Asserted Patents;

C. For judgment awarding Theta damages adequate to compensate it for Apple's infringement of the Asserted Patents, including all pre-judgment and post-judgment interest;

D. For judgment that Apple has willfully infringed and continues to willfully infringe one or more claims of the Asserted Patents;

E. For judgment that Apple has infringed in bad faith and continues to infringe one or more claims of the Asserted Patents in bad faith;

F. For judgment awarding enhanced damages pursuant to 35 U.S.C. § 284;

G. For judgment awarding pre-issuance damages pursuant to 35 U.S.C. § 154(d);

H. For judgment imposing a mandatory future royalty payable on each and every product or service sold by Apple in the future that is found to infringe the

Asserted Patents and on all future products and services which are not colorably different from products found to infringe;

I. For judgment awarding attorneys' fees pursuant to 35 U.S.C. § 285 or otherwise permitted by law;

J. For judgment awarding costs of suit; and

K. For judgment awarding Theta such other and further relief as the Court may deem just and proper.

DEMAND FOR JURY TRIAL

Pursuant to Rule 38(b) of the Federal Rules of Civil Procedure, Theta hereby demands a trial by jury of this action.

Dated: April 28, 2023

Respectfully submitted,

/s/ Denise M. De Mory
Denise M. De Mory (*Pro Hac Vice* to be filed)
California State Bar No. 168076
Corey Johanningmeier (*Pro Hac Vice* to be filed)
California State Bar No. 251297
BUNSOW DE MORY LLP
701 El Camino Real
Redwood City, CA 94063
Telephone: (650) 351-7241
Facsimile: (415) 426-4744
ddemory@bdiplaw.com
cjohanningmeier@bdiplaw.com

Attorney in charge for Plaintiff Theta IP, LLC

B. Russell Horton
State Bar No. 10014450
GEORGE BROTHERS KINCAID & HORTON, L.L.P.
114 West 7th Street, Ste. 1100
Austin, Texas 78701
(512) 495-1400 Telephone
(512) 499-0094 Facsimile
rhorton@gbkh.com

Attorneys for Plaintiff Theta IP, LLC