

UNITED STATES INTERNATIONAL TRADE COMMISSION

WASHINGTON, D.C.

Before the Honorable Charles E. Bullock

Chief Administrative Law Judge

In the Matter of

CERTAIN ELECTRONIC DEVICES,
INCLUDING MOBILE PHONES, TABLET
COMPUTER, AND COMPONENTS
THEREOF

Investigation No. 337-TA-1038

RESPONDENT APPLE INC.'S OPENING CLAIM CONSTRUCTION BRIEF

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I. INTRODUCTION

In this Investigation, the parties have undertaken vastly different approaches to claim construction. For its proposed definitions, Apple has faithfully applied the claim construction framework that the Federal Circuit has set forth in *Phillips* and its progeny. That is, where the asserted claims use terms in accordance with their customary usage, Apple has proposed plain meaning definitions tethered to that usage. Where the named inventors used their specification and/or file history to ascribe a specific meaning to a claim term—e.g., by offering a specialized definition or by making clear that a particular disclosed feature is a necessary part of “the invention”—Apple has proposed constructions capturing those meanings, where possible using the inventors’ own words. And where the asserted claims contain limitations so ambiguous that a competitor would be unable to determine with reasonable certainty whether their conduct falls within the scope of the claim, Apple has asked for those limitations to be found indefinite.

By contrast, Nokia’s proposed definitions reveal a calculated effort to leverage the claim construction process solely to advance litigation strategy. For some terms, Nokia advocates overbroad constructions riddled with vague and expansive language—in a transparent effort to cover features of Apple’s accused products that the claims, as properly construed, simply cannot reach. For other limitations, Nokia seeks to inject unjustified narrowing limitations—in a plain attempt to avoid invalidating prior art. And for terms that Apple has established as indefinite, Nokia has offered multiple different constructions—reinforcing that even the patentee cannot understand the terms with reasonable certainty—that are themselves indefinite and incorrect. The Federal Circuit has repeatedly criticized this type of tactical approach to claim construction, and it should be rejected here as well.

Accordingly, Apple’s proposed constructions should be adopted.

II. U.S. PATENT NO. 7,653,366 (“THE ’366 PATENT”)

The ’366 patent, which issued on January 26, 2010, is titled “Hybrid Switched Mode/Linear Power Amplifier Power Supply for Use in Polar Transmitter.” (Ex. 1 [’366 patent].) The claims generally relate to a DC-DC converter consisting of “a switch mode part” and “a linear mode part” that are connected “in parallel.” Among other things, the switch mode part must provide greater output power than the linear mode part, and also must be operable in two different modes: a “slave mode controlled by the linear mode part” and a “master mode.”

A. Technology Background

1. Voltage, Current, Resistance, and Power

The ’366 specification refers to certain concepts relevant to electrical circuits, including “voltage,” “current,” “resistance,” and “power.”

Current (commonly represented as “I” and measured in units of “amperes” or “amps”) is the flow of electrical charge through a conductor (e.g., a wire). The flow of current through a circuit is analogous to the flow of water through a pipe. (Ex. 2 [Expert Rep. of David K. Choi, Ph.D. (“Choi Rep.”)] ¶ 35.)

Voltage (commonly represented as “V” and measured in units of “volts”) is the electrical pressure in a circuit—i.e., the difference in potential energy between two points in the circuit, analogous to water pressure in a pipe. Generally, voltage causes current to flow from a point of higher voltage in the circuit to a point of lower voltage. (*Id.* ¶ 36.)

Resistance (commonly represented as “R” and measured in units of “ohms”) resists the flow of current through a conductor. This is similar to how a partial blockage in a pipe restricts the flow of water through the pipe. (*Id.* ¶ 37.)

Power (commonly represented as “P” and measured in units of “watts”) is equal to the voltage across a component multiplied by current flowing through the component. (*Id.* ¶ 38.)¹

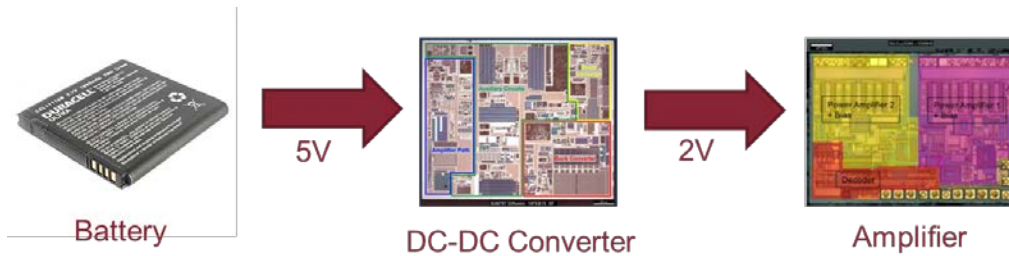
2. Voltage Regulators

Typically, a battery or other power source in an electrical circuit supplies energy that makes the electrical components in the circuit work. Different components in a device (e.g., a display screen, speaker, amplifier) may require different levels of voltage or, relatedly, power, to operate. For example, a battery’s output voltage may be 3 volts, but a circuit component may require that no more than 1.2 volts be applied to operate, and a different component may require 3.3 volts to operate. To account for these differing requirements, electrical circuits can use one or more “voltage regulators,” which are components that can convert an input at one voltage into an output at a different voltage. (*Id.* ¶ 39.)

One type of voltage regulator is a “DC-DC converter.”² Like all voltage regulators, a DC-DC converter converts an input voltage (e.g., a voltage received from a battery) to a different voltage, and then outputs that new voltage to one or more downstream components generally referred to as a “load.” For example, as shown below, a DC-DC converter might receive an input of 5 volts from a battery, which it reduces to a 2-volt output that is supplied to a load, such as an amplifier (a type of component discussed further below):

¹ These concepts are related. Using Ohm’s Law, one can calculate the amount of voltage by multiplying current by resistance ($V = I * R$), the amount of current by dividing voltage by resistance ($I = V / R$), the amount of resistance by dividing voltage by current ($R = V / I$), and the amount of power by multiplying voltage by current ($P = V * I$). (*Id.* ¶ 38 n.1.)

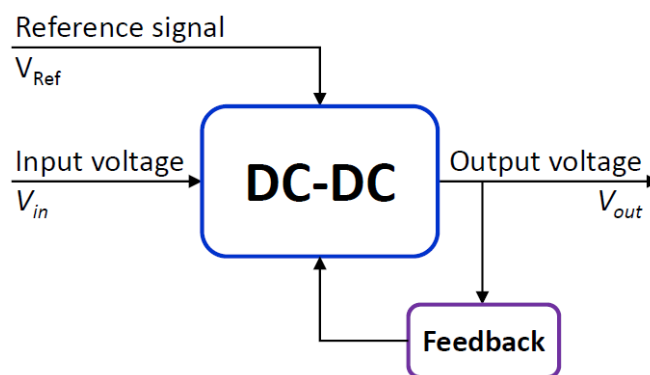
² “Direct current” (DC) refers to an electrical charge (i.e., current) that flows in only one direction. In this way, DC systems differ from “alternating current” (AC) systems, in which electrical charges can reverse direction at regular intervals. (*Id.* ¶ 40 n.2.)



A DC-DC converter also could be designed to take the same 5-volt input and increase it to an even higher output voltage (e.g., to 12 volts). (*Id.* ¶¶ 40-41.)

Some DC-DC converters can vary the output voltage depending on changing energy demands of the load. A load may require more voltage at certain times than at other times, and the DC-DC converter may need to supply a higher or lower voltage level depending on those changing demands. Converters commonly receive a “reference signal” from an external source that dictates the level of the converter’s desired output voltage at that particular time. (*Id.* ¶ 42.)

To ensure that the output voltage of a DC-DC converter remains stable at a desired level, a circuit designer can use a “feedback” loop—which compares the output voltage of the DC-DC converter to the desired output voltage and acts to ensure that the two values match. An example feedback loop is shown below:



In this example, the received reference signal (V_{Ref}) specifies the desired output voltage. The DC-DC converter (in blue) receives the input voltage (V_{in}) and converts it to the desired output voltage (V_{out}) specified by the reference signal. That output voltage is then fed back as an input

using the purple “Feedback” loop shown at the bottom of the figure. If the output voltage detected in the feedback loop differs from the desired output voltage specified by the reference signal, the converter adjusts its output voltage until the actual output voltage and desired output voltage are equal. (*Id.* ¶¶ 43-44.)

3. Linear and Switching Regulators

There are two basic types of DC-DC converters: “linear regulators” and “switching regulators.” As the ’366 patent admits, both types of regulators were well known in the prior art. (Ex. 1 [’366 patent], 2:13-38, Figs. 1A, 1B, 3A, 3B, 4A, 4B (describing “conventional” uses of linear and switching regulators); Ex. 2 [Choi Rep.] ¶ 45.)

A linear regulator receives an input voltage and **reduces** it to a desired output voltage by dissipating the excess voltage (i.e., the difference between the input voltage and output voltage to be supplied to the load) in the form of heat. A linear regulator can adjust to variations in power or voltage demands almost instantaneously, and its output voltage typically has minimal distortion or noise. But linear regulators can be inefficient when there is a significant difference between the input and output voltages because burning off excess voltage as heat wastes energy, which can be especially problematic in devices with a limited power source (e.g., battery-powered devices). (Ex. 1 [’366 patent], 2:16-18; Ex. 2 [Choi Rep.] ¶ 46.)

Unlike linear regulators (which can only **reduce** an input voltage), switching regulators can be designed to produce an output voltage that is **either higher or lower** than the input voltage. A switching regulator that reduces the input voltage is called a “buck” or “step-down” regulator, and a switching regulator that increases the input voltage is called a “boost” or “step-up” regulator. (Ex. 1 [’366 patent], 19:58-63; Ex. 2 [Choi Rep.] ¶ 47.)

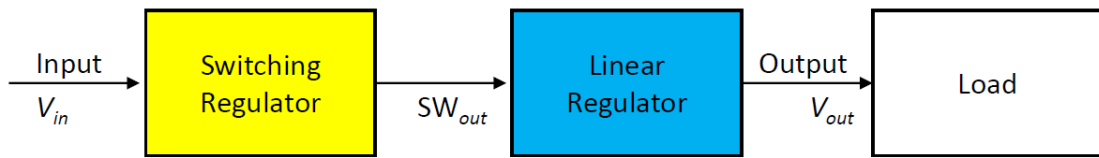
As its name suggests, a switching regulator generates a desired output through the opening and closing of one or more electrical switches. When the switch is closed, current can flow

through the switch to the load, and when the switch is opened, current cannot flow through the switch to the load. How long the switches remain closed or open determines the output voltage supplied to the load. By alternating between opening and closing switches (rather than burning off excess voltage, as in a linear regulator), a step-down switching regulator can produce a lower (i.e., “stepped-down”) output voltage with far better efficiency than a linear regulator—making it an obvious candidate for battery-powered devices. But due in large part to practical limits on the speed at which its switches can be turned on and off, a switching regulator cannot react to changing energy demands of the load almost instantaneously (unlike a linear regulator). The repeated opening and closing of switches also can generate significant noise (also known as “ripple”) in the output voltage of a switching regulator. (Ex. 1 [’366 patent], 2:25-27; Ex. 2 [Choi Rep.] ¶ 48.)

4. Hybrid Regulators

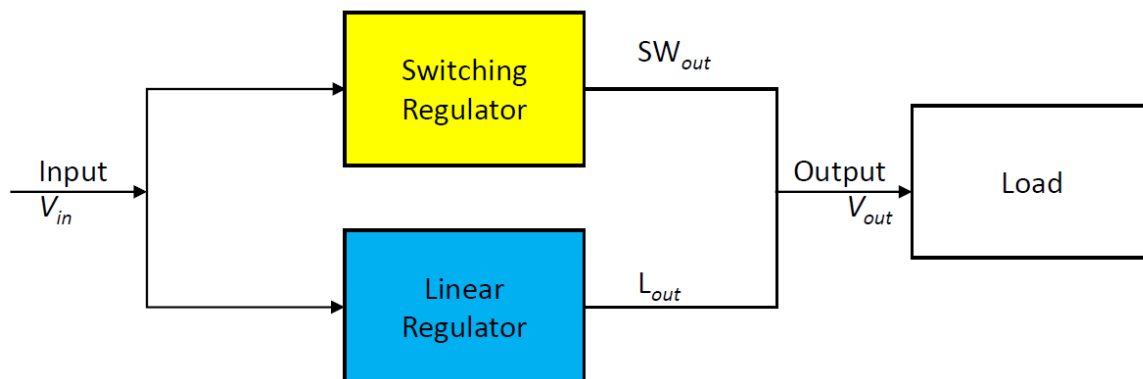
Decades before the ’366 patent, engineers recognized that they could address the tradeoffs between linear regulators (fast and less distortion, but inefficient) and switching regulators (highly efficient, but slower and more distortion) by using both types of regulators in the same power supply. Regulators that include both linear and switching regulators are called “hybrid regulators.” In a hybrid regulator, the linear and switching regulators can be arranged either “in series” (i.e., the output of one regulator is fed to the input of the other regulator) or “in parallel” (i.e., the two regulators receive a common input and provide their output to the same load). (Ex. 1 [’366 patent], 1:30-3:3; Ex. 2 [Choi Rep.] ¶ 49.)

For example, the graphic below shows a basic example of a hybrid voltage regulator with the switching regulator and linear regulator arranged in series:



In this type of configuration, when the speed of variations in power or voltage demands are relatively low, the switching regulator (yellow) can supply the output voltage to the load with reasonable accuracy—by converting the received input voltage (V_{in}) to a lower output voltage (SW_{out}) that is fed to a load (on the right) via the linear regulator (blue). The linear regulator then acts to produce a more precise output to the load, and can also “smooth out” residual noise at the output of the switching regulator without dissipating significant power. Conversely, when the speed of variations in power or voltage demands are relatively high, the output of the switching regulator may not be able to react fast enough to meet those rapidly changing demands. In that case, the linear regulator would have to further reduce the voltage received from the switching regulator to the desired level by dissipating enough power as heat to make up for the difference. The ’366 patent admits that “in series” configurations such as these were known in the prior art. (Ex. 1 [’366 patent], 2:39-3:3; Ex. 2 [Choi Rep.] ¶¶ 50-51.)

An example hybrid regulator with switching and linear regulators connected in parallel is shown below:



In this configuration, the switching regulator (yellow) and the linear regulator (blue) both receive the same input voltage (V_{in}), and the combined output of the switching regulator (SW_{out}) and linear regulator (L_{out}) is supplied to the load as V_{out} . In this arrangement, the switching regulator supplies most of the power during normal operation, but the hybrid regulator also can react quickly to changing energy demands from the load by using the linear regulator to rapidly and independently supply added power to the load when necessary. (Ex. 2 [Choi Rep.] ¶¶ 52-53.)

B. Alleged “Problem” In The Prior Art

As described in the “Background” section of the ’366 patent, different cellular standards require mobile devices (such as cell phones) to transmit their radio frequency (RF) signals at different frequency “bandwidths” and at different power levels (the level of which can influence how far the RF signal travels through the air).³ For example, a relatively early second-generation (2G) cellular standard called GSM requires mobile devices to transmit their communications at a relatively low bandwidth, but always at maximum power levels. By contrast, later cellular standards, such as EDGE, CDMA, and WCDMA, require mobile devices to transmit at higher bandwidths, without necessarily transmitting at maximum power at all times. (Ex. 1 [’366 patent], 1:60-2:18.)

The ’366 patent explains that prior art mobile devices could use linear regulators and switching regulators to implement the requirements dictated by different cellular standards—noting, as detailed above, that (i) a linear regulator could obtain “high bandwidth,” but the “efficiency is low” (*id.*, 2:13-18, Figs. 3A, 3B (“conventional” use of linear regulators)); and (ii) a switching regulator could obtain “very high” efficiency, but was slower to respond to changes in demand due to switching (*id.*, 2:19-38, Figs. 4A, 4B (“conventional” use of switching

³ As discussed further below in connection with the ’700 patent, mobile devices typically use components called power amplifiers to increase power levels of outgoing RF transmissions.

regulators)). The '366 patent also refers to a prior art patent that disclosed a hybrid DC-DC converter that achieved “high efficiency” by connecting switching and linear regulators in series. (*Id.*, 2:39-3:3.) Notably, the '366 patent does not discuss any of the plentiful prior art in which linear and switching regulators also were configured in a parallel arrangement.

C. Alleged “Solution” Of The '366 Patent

The '366 patent discloses a hybrid voltage regulator with a “switch mode part” (e.g., a switching regulator) and a “linear mode part” (e.g., a linear regulator) connected “in parallel,” as shown in the preferred embodiment of Figure 5 below:

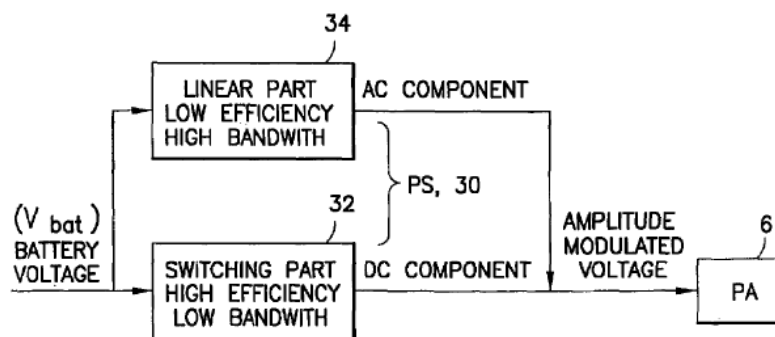


FIG.5

A battery (not shown) supplies a voltage (V_{bat}) to both linear part 34 and switching part 32, and the outputs of the linear and switching parts are combined into an “amplitude modulated voltage” signal (a type of signal used to transmit information in RF systems) that is supplied to the load, power amplifier (PA) 6. The patent explains that the switching part “processes preferably the majority of the power with high efficiency but low bandwidth,” and the linear part “preferably processes a smaller part of the required power with less efficiency but with high bandwidth.” (*Id.*, 5:64-6:2.) According to the inventors, “[t]he result is a power supply that has the required bandwidth and an efficiency somewhat lower than that of a purely switching power supply but still significantly higher than that of the purely linear regulator.” (*Id.*, 6:2-6.)

D. Relevant Aspects Of The File History

As filed in the '366 patent application, the broad wording of the original claims suggested that the inventors believed they were the first to conceive of the idea to connect a switching regulator and linear regulator in parallel, and to use the more efficient switching regulator to provide the majority of output power, and the faster linear regulator to respond to rapid changes in output voltage demands:

1. A DC-DC converter, comprising:

a switch mode part for coupling between a DC source and a load, the switch mode part providing x amount of output power; and

a linear mode part coupled in parallel with the switch mode part between the same or a different DC source and the load, the linear mode part providing y amount of output power, where x is preferably greater than y, and the ratio of x to y may be optimized for particular application constraints,

where the linear mode part exhibits a faster response time to a required change in output voltage than the switch mode part.

(Ex. 3 ['366 Application] at 34.) Not surprisingly, the Examiner rejected those broad claims in view of the prior art. (Ex. 5 [9/10/08 Office Action] at 3.)

After the applicants narrowed their claims, the examiner again rejected them in view of prior art. (Ex. 5 [5/6/09 Office Action] at 2.) In response, the applicant again amended claim 1, this time to add a new requirement for the switch mode part to “be switchable between a slave mode controlled by the linear mode part and a master mode”:

1. (Currently Amended) A DC-DC converter, comprising:

a switch mode part between a DC source and a load, the switch mode part is configured to provide providing x amount of output power; and

a linear mode part in parallel with the switch mode part between the same or a different DC source and the load, the linear mode part configured to provide providing y amount of output power, where x is greater than y, and the ratio of x to y is optimized for particular application constraints,

where the linear mode part exhibits a faster response time to a required change in output voltage than the switch mode part, where the linear mode part compensates at least in part for load variations, wherein the switch mode part is configured to be switchable between a slave mode controlled by the linear mode part and a master mode.

(Ex. 4 [8/7/09 Amendment] at 2.) In so doing, the applicants made clear that they were limiting the scope of revised claim 1 to the specific master/slave arrangements shown in Figures 27B and 30B of their specification:

Claim 1 has been amended ***to incorporate the subject matter*** from Figures 27B (part SW1⁴), page 26, lines 23-27, and 30B (part S1), page 27, lines 19-25.⁵

(*Id.* at 7.)⁶

The '366 specification explains that the incorporated embodiment of Figure 27B is operable in two modes: a WCDMA mode and a GSM/EDGE mode. As shown below, when switch SW2 (at the top) is set to “WCDMA,” the combined output of linear regulator 102 (in

⁴ The reference to switch “SW1” in this passage appears to be an error. Switch SW2 is what makes the switching mode part “switchable between a slave mode controlled by the linear mode part and a master mode.” (Ex. 1 [’366 patent], 17:14-18.)

⁵ Page 26, lines 23-27 of the application correspond to column 17, lines 14-18 of the issued patent, and page 27, lines 19-25 of the application correspond to column 17, lines 52-61 of the issued patent.

⁶ Throughout this brief, all bold/italics emphasis is added, unless otherwise noted.

blue) and switching regulator 100 (in yellow) are fed to WCDMA power amplifier 104B (in purple), as shown by the path highlighted in red:

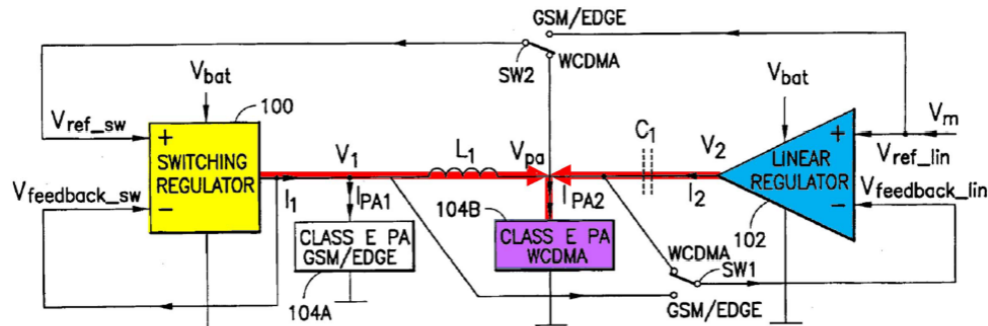


FIG.27B

The specification explains that, when Figure 27B is operated in WCDMA mode, “the linear regulator is the master and the switching regulator is the slave”—because, as shown below by the path in red, the output voltage of the linear regulator (V_2) also is sent across switch SW2 and used to drive the reference signal of the switching regulator (V_{ref_sw}):

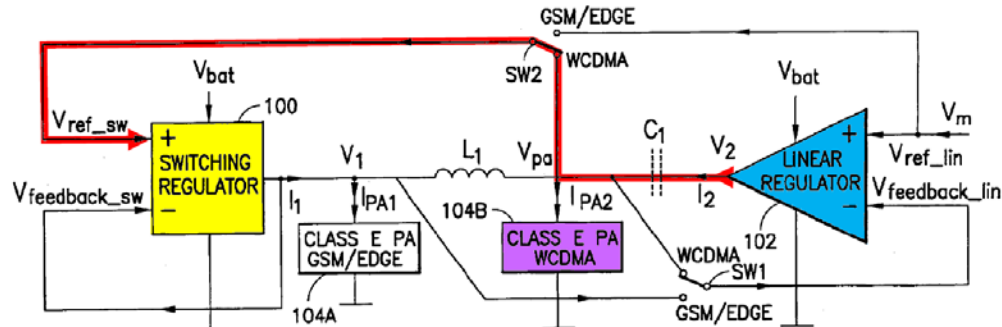


FIG.27B

(*Id.*, 5:27-35 (“[I]n FIG. 27B the linear regulator is the master and the switching regulator is the slave (in the WCDMA mode only).”); *id.*, 17:14-20 (“In the embodiment shown in FIG. 27B the switching regulator 100 is connected as a ‘slave’ for the WCDMA case (both SW1 and SW2 are in the WCDMA position), and receives its V_{ref_sw} signal via SW2 from the output of the linear regulator 102.”).)

By contrast, when switch SW2 is set to “GSM/EDGE,” the output of the linear regulator 102 (in blue) and switching regulator 11 (in yellow) is fed to GSM/EDGE power amplifier 104A (in orange), as shown by the path below in red:

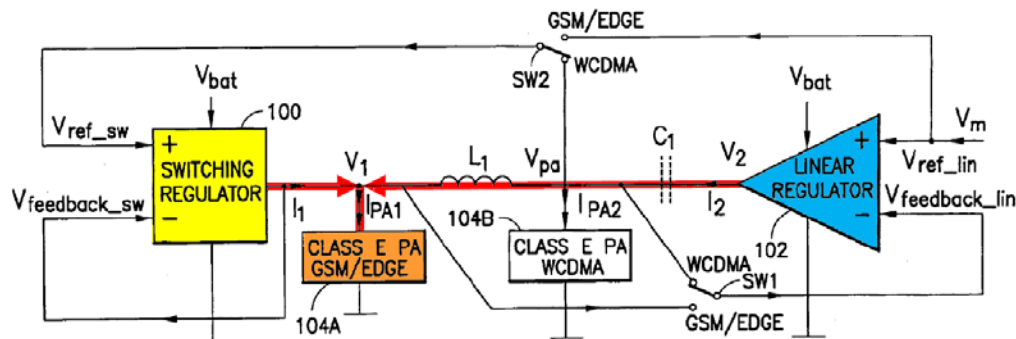


FIG.27B

As shown below, in this mode for Figure 27B, the patent describes the switching regulator as a “master” only when **both regulators** use the **same input voltage signal** (V_m) to drive their respective reference signals (V_{ref_sw} for switching regulator 100, and V_{ref_lin} for linear regulator 102), as illustrated by the path in red below:

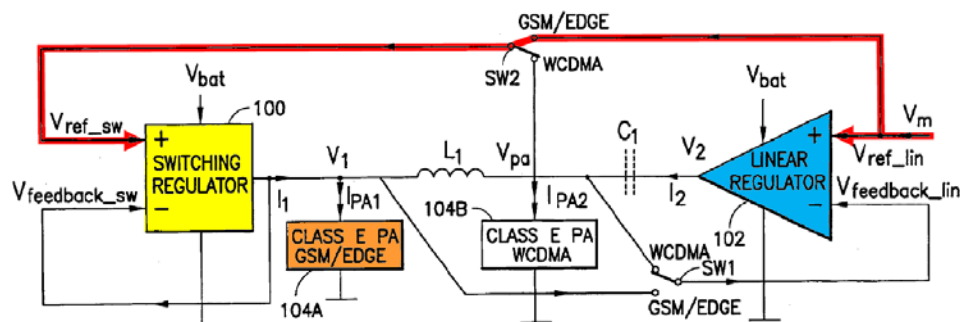


FIG.27B

(*Id.*, 17:18-20 (“In the GSM/EDGE mode (both SW1 and SW2 are in the GSM/EDGE position) the configuration and operating considerations are as described above for FIG. 27A.”); *id.*, 5:27-33 (“[In] FIG. 27A both the switching regulator and the linear regulator are masters.”).) There is no mode disclosed for Figure 27B in which the switching regulator is a master and the linear

regulator is a slave, or in which the switching regulator is a master, but uses a reference signal different from the reference signal used by the linear regulator.

The same holds true for Figure 30B, the other embodiment that the '366 applicants incorporated into the asserted claims via amendment during prosecution (which adds a CDMA mode). In that embodiment, as shown below, when switch S1 is set to "WCDMA," switching regulator 100 (in yellow) operates as a slave to linear regulator 102A (in blue)—because, as shown by the red path, the output of linear regulator 102A drives the reference signal (V_{ref_sw}) of switching regulator 100:

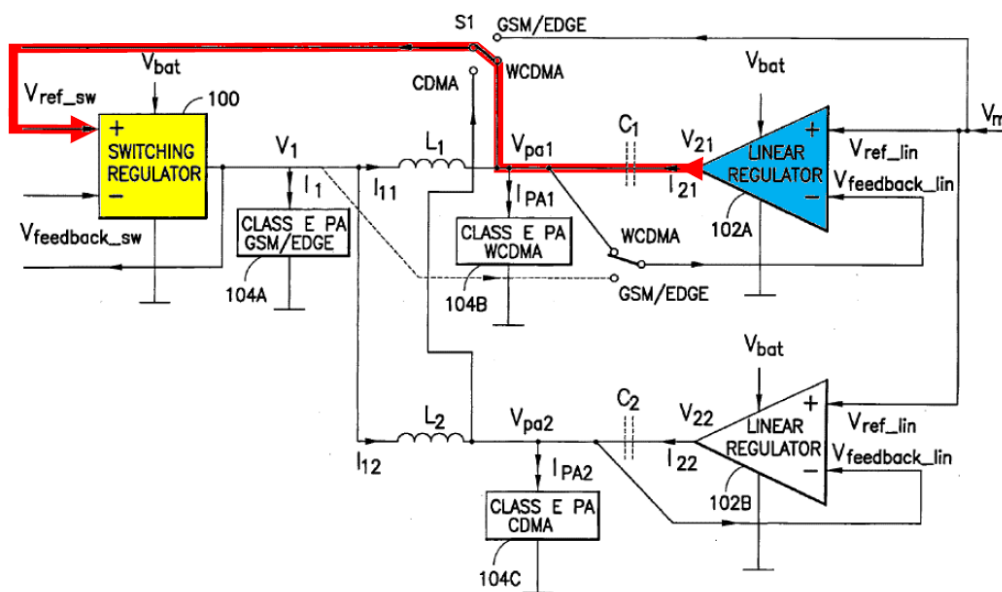


FIG.30B

And as depicted below, when switch S1 is set to "CDMA," switching regulator 100 (in yellow) operates as a slave to linear regulator 102B (in blue)—because, as shown by the red path, the output of linear regulator 102B is used to drive the reference signal (V_{ref_sw}) of switching regulator 100:

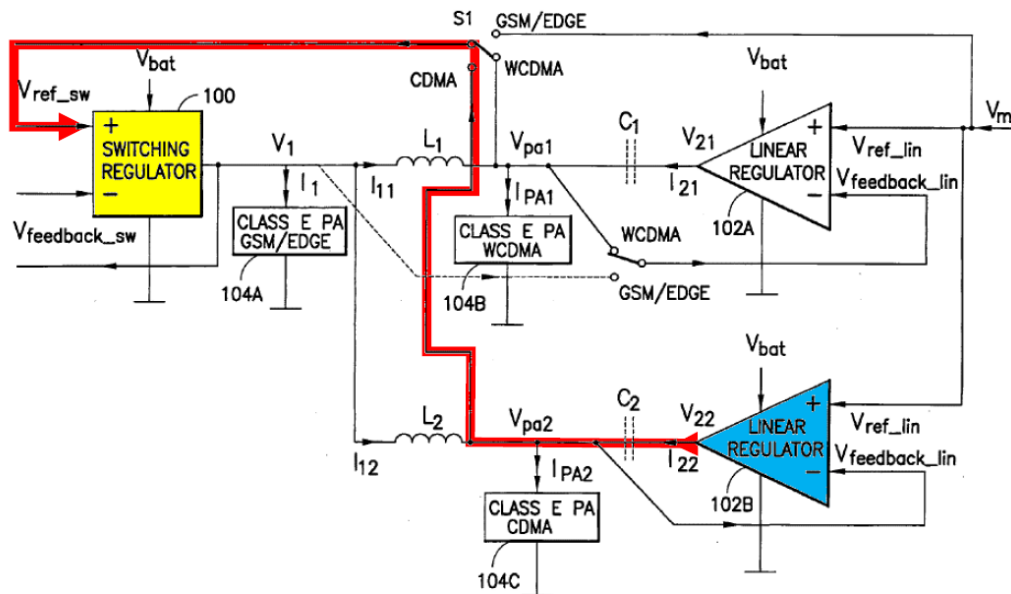


FIG. 30B

(*Id.*, 5:56-59 (“[I]n FIG. 30B . . . the switching regulator is the slave (in the WCDMA and CDMA modes only).”); *id.*, 17:53-61 (“[I]n FIG. 30B the switching regulator 100 is connected as a ‘slave’ in only the WCDMA and CDMA modes of operation, where its reference voltage is the output of the linear regulator 102A or 102B as selected by the three pole switch S1 according to the currently active system (WCDMA or CDMA).”).)

Similar to Figure 27B, there is no mode disclosed in connection with Figure 30B in which the switching regulator is the master and the linear regulator is the slave. Instead, the switching regulator is only described as a “master” when the **same voltage signal** (V_m) is used to drive the reference signal for **both regulators**, as shown by the red path below:

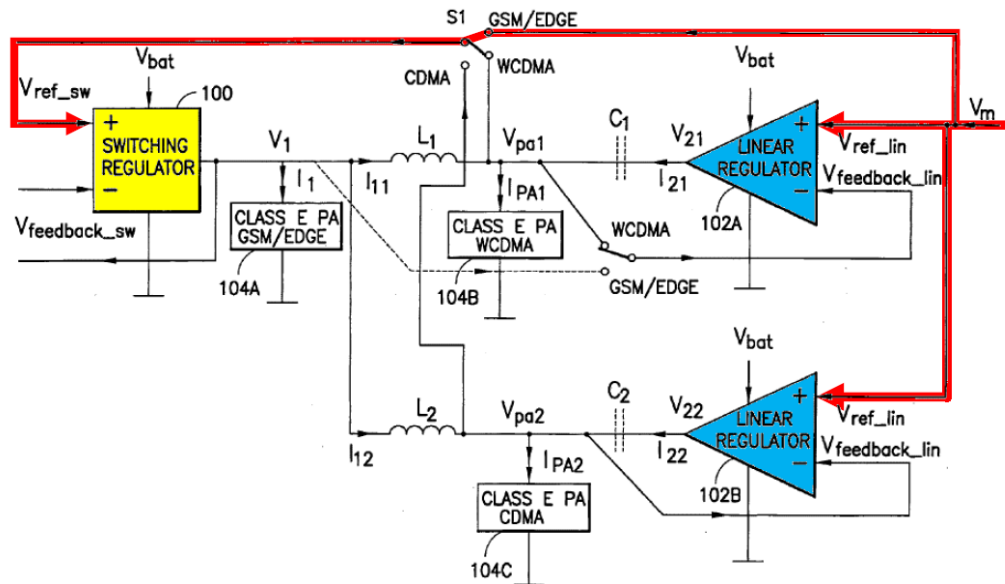


FIG.30B

(*Id.*, 17:53-61 (“In the GSM/EDGE mode the switching regulator 100 receives its V_{ref_sw} input, via S1, from the V_m input, and thus functions as in FIG. 30A.”); *id.*, 5:55-56 (“[I]n FIG. 30A the switching regulator and each of the linear regulators are masters.”); *id.*, 17:52-53 (“In FIG. 30A the switching regulator 100 and both linear regulators 102A, 102B are connected as ‘masters.’”).)

E. Level Of Ordinary Skill In The Art

At the time the '366 patent was filed, a person of ordinary skill in the art would have had (1) a Master of Science degree in Electrical Engineering or related discipline, and two to three years of experience in radio frequency (RF) circuit design or power supply design, (2) a Bachelor of Science degree in Electrical Engineering or related discipline, and three to four years of experience in RF circuit design or power supply design, or (3) equivalent educational and professional experience. (Ex. 2 [Choi Rep.] ¶ 30.)

F. Disputed Claim Terms

The parties and the Staff dispute the meaning of four terms appearing in claims 1 and 17 of the '366 patent, which are set forth below (disputed terms are emphasized):

1. A DC-DC converter, comprising:

a switch mode part between a DC source and a load, the switch mode part is configured to provide x amount of output power; and

a linear mode part in parallel with the switch mode part between the same or a different DC source and the load, the linear mode part configured to provide y amount of output power, where x is greater than y, and ***the ratio of x to y is optimized for particular application constraints***,

where the linear mode part exhibits a faster response time to a required change in output voltage than the switch mode part, where the linear mode part compensates at least in part for load variations, wherein the switch mode part is configured to be switchable between ***a slave mode controlled by the linear mode part*** and a ***master mode***.

17. A DC-DC converter as in claim 1, where the linear mode part is ***effectively slaved*** to operation of the switch mode part to source or sink current.

(Ex. 1 ['366 patent], claims 1, 17.)

1. **“the ratio of x to y is optimized for particular application constraints” (claim 1)**

Apple's Construction	Nokia's Construction	Staff's Construction
Indefinite	“the ratio of x to y is adjusted to different levels to satisfy the constraints of a given application”	“the ratio of x to y is adjusted to obtain acceptable performance for an intended application's RF system specifics” For example, such RF system specifics include the spectrum of RF envelope, amplitude of high frequency AC components, etc.

The parties and Staff dispute whether the phrase “the ratio of x to y is optimized for particular application constraints” is indefinite, as Apple contends, or should be construed to

have one of the different meanings that Nokia and the Staff propose. Apple’s construction should be adopted because the patent provides no objective bounds for a person of ordinary skill to determine (i) when the specified “x to y” ratio has been “optimized” or not—a subjective determination that can vary significantly from person to person, and (ii) what “particular application constraints” are and which ones supposedly fall within the claims. By contrast, Nokia and the Staff (i) improperly read “optimized” out of the claim, either by re-writing “optimized” as just “adjusted,” or by injecting an equally indefinite “acceptable performance” standard, and (ii) do nothing to cure the indefiniteness of the “particular application constraints” portion of the limitation.

a. **The Disputed Phrase Is Indefinite.**

In *Nautilus, Inc. v. Biosig Instruments, Inc.*, the Supreme Court held that “a patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with **reasonable certainty**, those skilled in the art about the scope of the invention.” 134 S. Ct. 2120, 2124 (2014). Claim terms lack “reasonable certainty” under *Nautilus* if the intrinsic record fails to provide “**objective boundaries** for those of skill in the art” to understand the full scope of the claims. *Interval Licensing LLC v. AOL, Inc.*, 766 F.3d 1364, 1371, 1374 (Fed. Cir. 2014) (finding phrase “unobtrusive manner that does not distract a user” indefinite because it failed to provide reasonable certainty as to scope of invention given the lack of “objective boundaries” to apply for that limitation).

That is precisely the case here. As detailed below, the requirement for the ratio of “x to y” to be “optimized for particular application constraints” is indefinite for two independent reasons: (i) the patent does not provide any objective criteria that would allow one of ordinary skill to assess whether their circuit is “optimized” or not—thus leaving that determination to the

varying subjective beliefs of different individuals; and (ii) nor does the patent provide the objective bounds of what it means by “particular application constraints.”

i. **The ’366 Patent Fails To Provide Any Objective Criteria For Determining Whether The Claimed Ratio Is “Optimized.”**

Claim 1 states that “x” refers to the “amount of output power” provided by the switch mode part of the claimed hybrid regulator, and “y” refers to the “amount of output power” provided by the linear mode part of the same regulator. But nothing in the claim itself explains when “the ratio of x to y is **optimized**” (or not optimized).

Nor does the ’366 specification provide any such guidance. Rather, the specification only states that (i) it is “generally . . . desirable” for “x” to be higher than “y” (a separate claim requirement), (ii) it is preferable to “maximize the ratio of x to the total power,” (iii) the “actual ratio” will depend on a variety of “factors and considerations”; (iv) “this relationship between the power processed by the switching part . . . and the linear part . . . is **not** to be considered as a limitation of the preferred embodiments,” and (v) in some cases, “the relationship $x > y$ **does not apply at all.**” (Ex. 1 [’366 patent], 6:15-24, 6:35-37.) Nothing in these generic and conflicting disclosures provides a person of ordinary skill with **any objective criteria** to use when attempting to assess whether the ratio of x to y has reached the point that it is “optimized” within the meaning of the asserted claims. (Ex. 2 [Choi Rep.] ¶ 56.)

That lack of disclosure is even more problematic given the highly subjective nature of determining whether something is “optimized”—which can vary significantly depending on the **subjective goals** of a particular circuit designer. See *Interval Licensing*, 766 F.3d at 1370-74 (finding term “unobtrusive manner” a “term of degree” that was “purely subjective,” even where specification provided an example, because without more, “a skilled artisan is left to wonder what other forms of display are unobtrusive and non-distracting . . . thus leaving the skilled

artisan to consult the ‘unpredictable vagaries of any one person’s opinion’”); *Datamize, LLC v. Plumtree Software, Inc.*, 417 F.3d 1342, 1350-51 (Fed. Cir. 2005) (finding term “aesthetically pleasing” indefinite where the patent failed to provide “a workable objective standard” because “the meaning of the claim language would depend on the unpredictable vagaries of any one person’s opinion”). For example:

- A first engineer may view an “optimized” hybrid regulator as one that maximizes energy efficiency, and thus may decide to use the switching part all the time (i.e., a ratio where x is 100 and y is 0)—but this design would react slowly to changing energy demands of the load;
- A second engineer may believe that an “optimized” hybrid regulator should be able to respond faster to changing demands of the load, and thus may choose a design that uses the linear mode part to provide 25% of the power to the load (e.g., a ratio where x is 75% and y is 25%)—but compared with the first engineer’s design, this configuration would be somewhat inefficient and wasteful of energy due to the increased use of the linear regulator; and
- A third engineer may view an “optimized” hybrid regulator as one that responds even faster to respond to load demands changes, and therefore uses the linear mode part to provide 49% of the power and switching mode part to provide only 51% of the power (e.g., a ratio where x is 51% and y is 49%)—but this design is even less efficient than the previous two designs.

The patent fails to provide any metrics, guidelines, or other objective boundaries that would allow a person of ordinary skill to determine, even for this basic example, whether any of the three circuit design configurations is “optimized” within the meaning of the asserted claims. Are any of these three examples “optimized,” as that term is used in the claims of the ’366

patent? Are all three? Are none? The '366 patent simply does not provide enough guidance to a potential competitor to be able to make this determination. (Ex. 2 [Choi Rep.] ¶¶ 57-58.)

The patent also fails to explain how to weigh the many other potential factors beyond efficiency and speed that circuit designers might view differently in making such a determination (e.g., component cost, distortion tolerances, circuit complexity and size, circuit reliability, intended uses of the DC-DC converter, and, especially for mass-market consumer devices, quality and consistency in high-volume manufacturing). (*Id.* ¶ 58.)

For example, a switching regulator could be designed to more quickly compensate for changing energy demands of the load, which would allow less use of the linear regulator and increase overall efficiency of the hybrid regulator (i.e., the switching regulator portion of the hybrid regulator could efficiently supply more of the overall power than a slower switching regulator could). However, a faster switching regulator could be more expensive to implement because, for example, it uses higher performance switches. One engineer may choose to use the more expensive, faster switching regulator and consider the ratio between the switching and linear regulators “optimized.” Another engineer may use a cheaper, slower switching regulator that will require more use of the linear regulator, but still consider the ratio “optimized” because it is cheaper to implement. The '366 patent provides no guidance that would allow a person of ordinary skill in the art to determine in which of these designs (if any) the ratio of x to y has been “optimized” for a “particular application constraint.” (*Id.* ¶ 59.)

The same uncertainty would exist even with respect to engineers who might be seeking to achieve the **same** overall design goals. For example, if four different designers all seek to design a hybrid regulator with relatively high efficiency, one might decide to use the more efficient switching part to provide 85% of power, while the other three designers might decide to use the

same switching part to provide 88%, 93%, and 95% of the power, respectively. The patent never explains how to determine which of these possible ratios, if any, are “optimized” and which ones are not. (*Id.* ¶ 60.)

In sum, this lack of disclosure renders the term “optimized” indefinite because a person of ordinary skill cannot determine with reasonable certainty when a particular ratio of x to y is “optimized,” and when it is not, within the context of the claims. *See Nautilus*, 134 S. Ct. at 2124; *Interval Licensing*, 766 F.3d at 1374.

In fact, multiple courts have found similar “optimize” terms indefinite where, like here, a patent failed to provide sufficient objective criteria. *See, e.g., In re TR Labs Patent Litig.*, No. CIV. A. 09-3883-PGS, 2014 WL 3500596, at *4-*5 (D.N.J. July 14, 2014) (finding term “optimizes demand served” indefinite because the specification just provided “an optimization strategy” that “may” be pursued, without identifying how various possible considerations “are to be weighed and balanced in a way that optimizes demand served”); *Optimum Processing Solutions, LLC. v. AMD*, No. 09-cv-1098, at *2, *38 (N.D. Ga. July 10, 2012) (finding terms “optimized” and “optimum manner” indefinite), *adopted by* No. 09-cv-1098 (N.D. Ga. Aug. 24, 2012) (attached as Exhibit 13).

For example, in *Optimum Processing Solutions*, the plaintiff proposed to construe the term “optimized” as “the carrying out of a procedure to maximize or minimize a performance index of the procedure.” *Id.* at *11. In rejecting that construction and finding the term indefinite, the court noted that—like here— the specification used the term “optimized,” but did not “define or clarify” what it meant, and also did not “explain, add details, give examples of or otherwise indicate with respect to what metric, characteristic, or ‘performance index’ the elements may be optimized.” *Id.* at *12, *18; *id.* at *23, *34-*35 (finding “a number of different

performance indices, or combination of them” could be used to “optimize” something, including “time, power consumption, chip area, and cost,” and the existence of “multiple potential metrics for optimization” underscored “the concern that a person of ordinary skill in the art would not be able to determine whether or not an element is ‘optimized’ within the meaning of [the plaintiff’s] proposed claim construction”).

The same result applies here, for the reasons above. Therefore, as used in the asserted claims, the term “optimized” should be found indefinite.

ii. The ’366 Patent Fails To Provide Objective Criteria To Determine Whether Something Is A “Particular Application Constraint.”

The phrase “the ratio of x to y is optimized for particular application constraints” also is indefinite for a separate reason: the patent fails to specify what types of “particular application constraints” fall within the scope of the claims, or even what constitutes a covered “application” or what renders something about such an application a “constraint.” Because none of this terminology is defined or otherwise explained in the ’366 patent, a person of ordinary skill is left to guess as to which “particular” types of “applications” and “constraints” are covered by the claims, and which ones are not. Therefore, the limitation “the ratio of x to y is optimized for particular application constraints” is indefinite for this reason as well. (Ex. 2 [Choi Rep.] ¶ 68.) See 35 U.S.C. § 112(b) (claims must “particularly point[] out and distinctly claim[] the subject matter which the inventor ... regards as the invention”).

b. Nokia’s And The Staff’s Proposed Constructions Are Wrong And Themselves Indefinite.

Nokia and the Staff contend that the disputed phrase is not indefinite. But their inability to agree on a supposed construction only reinforces Apple’s position that persons of ordinary

skill cannot ascertain the meaning of that claim language with reasonable certainty. Nor is either construction justified in view of the *Markman* record.

First, Nokia proposes to construe the disputed claim language to mean “the ratio of x to y is adjusted to different levels to satisfy the constraints of a given application.” But nothing in the patent or file history supports Nokia’s effort to rewrite the “optimized” element of claim 1 to require something that is merely “adjusted to different levels.” Nokia also lacks any record support for its attempt to introduce the undefined concept as to whether different levels “satisfy the constraints of a given application”—which also is indefinite given that different persons of skill may subjectively disagree as to whether something is “satisfied,” and the patent provides no objective criteria to resolve that dispute. Nokia also does nothing to resolve the indefiniteness of the phrase “particular application construction”; its proposed construction simply rearranges the order of the words, without making any attempt to construe them. (Ex. 2 [Choi Rep.] ¶ 63.)

Second, the Staff proposes to construe the disputed phrase to mean “the ratio of x to y is adjusted to obtain acceptable performance for an intended application’s RF system specifics.” But nothing in the *Markman* record equates something that is “optimized” with something that is merely just “acceptable.” The term “acceptable performance” does appear in the specification, but just once in the following sentence: “In GSM/EDGE, and assuming that **acceptable performance** can be obtained, the linear regulator 102 may be disabled and only the switching regulator 100 is used.” (Ex. 1 [’366 patent], 17:2-4.) Nothing in that sentence purports to define “optimized” as merely involving “acceptable performance.” Indeed, the sentence is describing an example in which the linear regulator **is not even used** (i.e., it is “**disabled**”)—unlike the asserted claims which require x and y power from the linear mode part **and** switch mode part.

The Staff’s “adjusted to obtain acceptable performance” construction also is itself indefinite. The patent provides no guidance as to when a particular ratio might result in objectively “acceptable performance” and when it would not—leaving persons of ordinary skill to speculate in accordance with their own varying subjective views. Because performance “acceptable” to one person may be wholly unacceptable to another, the lack of objective criteria is fatal to the Staff’s proposed construction. *See Interval Licensing*, 766 F.3d at 1370-71; *Datamize*, 417 F.3d at 1350-51. (Ex. 2 [Choi Rep.] ¶ 64.)

Finally, the Staff’s construction simply repeats the term “application,” without providing any meaning or other guidance as to what that term supposedly covers. Its construction also defines “constraints” as limited to “RF system specifics,” even though (i) nothing in the intrinsic record purports to define “constraints” in that manner, (ii) the phrase “RF system specifics” is itself undefined and not explained in the patent, and (iii) claim 1 does not contain any limitation specific to RF devices, and instead is directed to **any kind** of DC-DC converter found in **any kind** of device (“A DC-DC converter, comprising . . .”).

2. “slave mode controlled by the linear mode part” (claims 1, 13)

Apple’s Construction	Nokia’s Construction	Staff’s Construction
“mode in which the reference signal of the switch mode part is the output of the linear mode part”	“mode in which an output from the linear mode part is used as a reference signal for the switch mode part”	“mode in which the output from the linear mode part is a reference signal for the switch mode part”

As noted above, claim 1 requires the switch mode part to be switchable between two different modes: “a slave mode controlled by the linear mode part” and “a master mode.” The parties and Staff appear to agree that the switch mode part is operating in the claimed slave mode when it uses a certain output from the linear mode part as its reference signal. However, they disagree about whether that output from the linear mode part must be a single output (i.e., “**the**

output”), as Apple and the Staff contend, or can be multiple outputs (i.e., “**an** output”), as Nokia alone contends. They also disagree about whether the output from the linear mode part must be used as a single reference signal for the switch mode part (i.e., “**the** reference signal”), as Apple contends, or can be used as one of several reference signals (i.e., “**a** reference signal”), as Nokia and the Staff contend.

Because Apple’s proposed construction is derived nearly verbatim from the patent’s own words—in describing the two embodiments to which the applicants limited their claims during prosecution to overcome prior art—it should be adopted.

a. **Apple’s Proposed Construction Should Be Adopted.**

Apple’s proposed construction of the “slave mode” limitation should be adopted for the following reasons.

First, the term “slave mode” does not have any particular or well-understood meaning in the context of hybrid regulators. (Ex. 2 [Choi Rep.] ¶ 65.) Indeed, the parties and Staff all appear to agree on this issue.

Second, as noted above, during prosecution of the ’366 patent, the applicants twice amended claim 1 in response to prior art rejections, including to add a new limitation requiring the claimed switch mode part to “be switchable between a slave mode controlled by the linear mode part and a master mode”:

1. (Currently Amended) A DC-DC converter, comprising:

a switch mode part between a DC source and a load, the switch mode part is configured to provide ~~providing~~ x amount of output power; and

a linear mode part in parallel with the switch mode part between the same or a different DC source and the load, the linear mode part configured to provide ~~providing~~ y amount of output power, where x is greater than y, and the ratio of x to y is optimized for particular application constraints,

where the linear mode part exhibits a faster response time to a required change in output voltage than the switch mode part, where the linear mode part compensates at least in part for load variations, wherein the switch mode part is configured to be switchable between a slave mode controlled by the linear mode part and a master mode.

(Ex. 4 [8/7/09 Amendment] at 2.) In making that amendment, the applicants represented to the Patent Office that “***Claim 1 has been amended to incorporate the subject matter from Figures 27B (part SW1), page 26, lines 23-27, and 30B (part S1), page 27, lines 19-25.***” (*Id.* at 7.) As such, the scope of the master/slave limitations added to claim 1 must be interpreted in view of the embodiments found in Figures 27B and 30B and the cited portions of the specification. See *TMC Fuel Injection Sys., LLC. v. Ford Motor Co.*, No. 2016-2122, 2017 U.S. App. LEXIS 5266, at *5 (Fed. Cir. Mar. 27, 2017) (“Prosecution history disclaimer applies when a patentee makes statements during prosecution that would cause ‘a competitor [to] reasonably conclude that the applicant clearly and unmistakably limited’ the scope of the claims.” (quoting *Uship Intellectual Props., LLC v. United States*, 714 F.3d 1311, 1316 (Fed. Cir. 2013))).

In both covered embodiments, the inventors expressly defined the switch mode part as “slave” to the linear mode part ***only*** when ***the*** reference signal (singular) of the switch mode part is ***the*** output (singular) of the linear mode part—just as Apple has proposed to define that term here. For example, in connection with Figure 27B, the specification expressly states that the

switch mode part is a “slave” to the linear mode part when the switch mode part receives “*its*” reference signal (singular) from “*the* output of the linear regulator”:

In the embodiment shown in FIG. 27B ***the switching regulator 100 is connected as a ‘slave’ for the WCDMA case*** (both SW1 and SW2 are in the WCDMA position), ***and receives its V_{ref_sw} signal via SW2 from the output of the linear regulator 102.***

(Ex. 1 [’366 patent], 17:14-18; *id.*, 5:33-35 (“[I]n FIG. 27B . . . the ***switching regulator is the slave*** (in the WCDMA mode only)”). Consistent with that textual disclosure—which the applicants expressly incorporated into claim 1—when in slave mode (i.e., switch SW2 is set to WCDMA), Figure 27B only shows a ***single*** output from linear regulator 102 (in blue), and switching regulator 100 (in yellow) uses that single output as its ***sole*** reference single (V_{ref_sw}):

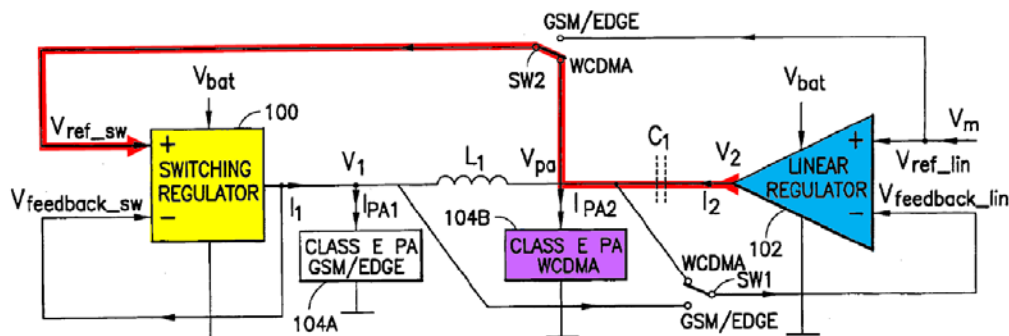


FIG. 27B

(*Id.*, Fig. 27B.)

Similarly, for the incorporated embodiment described in connection with Figure 30B, the specification again defines the switch mode part as acting as a “slave” to the linear mode part when the switch mode part receives “*its*” reference signal (singular) from “*the* output of the linear regulator” (singular):

[I]n FIG. 30B the ***switching regulator 100 is connected as a ‘slave’*** in only the WCDMA and CDMA modes of operation, ***where its reference voltage is the output of the linear regulator 102A or 102B*** as selected by the three pole switch S1 according to the currently active system (WCDMA or CDMA).

(Ex. 1 [’366 patent], 17:53-58; *id.*, 5:56-59 (“[I]n FIG. 30B . . . the **switching regulator is the slave** (in the WCDMA and CDMA modes only).”). Consistent with that disclosure, Figure 30B only shows (i) a **single** output from linear regulator 102A if S1 is set to WCDMA, and a **single** reference signal (V_{ref_sw}) based on that single output used by switching regulator 100, as shown by the red path, and (ii) a **single** output from linear regulator 102B if S1 is set to CDMA, and a **single** reference signal (V_{ref_sw}) based on that single output used by switching regulator 100, as shown by the purple path:

During WCDMA or CDMA operation, switch “S1” connects the output of one of the linear regulator to the reference signal of the switching regulator so that the switching regulator operates in “slave mode”

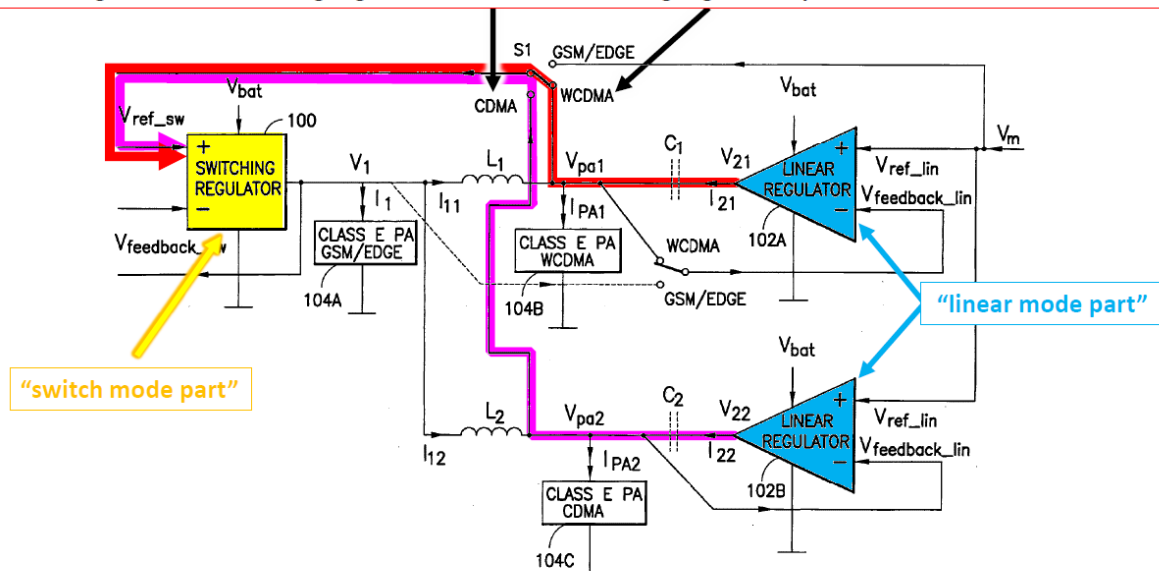


FIG.30B

Thus, in every slave mode described in connection with Figure 30B, the switching regulator receives **its single** reference signal (V_{ref_sw}) from **the single** output of one of the two linear regulators (V_{21} or V_{22}).

At bottom, there is no disclosure in connection with Figures 27B or 30B in which, during slave mode, the linear regulator has multiple outputs or the switching regulator uses multiple reference signals. Instead, the patent repeatedly and consistently describes those embodiments as involving a single linear regulator output used as a single switching regulator reference signal.

Accordingly, because the applicants amended claim 1 during prosecution to add the “slave mode” requirement—which they limited to the slave modes disclosed in connection with Figures 27B and 30B—and because the specification expressly defines the switch mode part in those embodiments as “slave” to the linear mode part when the switch mode part takes “*the* output” from the linear mode part and uses it as “*its* reference” signal, that stated definition controls—just as Apple has proposed (“mode in which the reference signal of the switch mode part is the output of the linear mode part”).

b. Nokia’s and the Staff’s Proposed Constructions Are Incorrect.

Nokia and the Staff should not be permitted to broaden the inventor’s narrowing of the claims during prosecution to cover other possible (and non-incorporated) modes in which a linear regulator might have multiple outputs (as Nokia alone argues), or in which a switching regulator might use multiple reference signals (as Nokia and the Staff argue)—neither of which is disclosed as part of the claimed “slave mode” in connection with Figures 27B or 30B, as discussed above. *See Phillips v. AWH Corp.*, 415 F.3d 1303, 1316 (Fed. Cir. 2005) (en banc) (“[T]he inventor’s lexicography governs.”); *see also id.* at 1317 (“[T]he prosecution history can often inform the meaning of the claim language by demonstrating how the inventor understood the invention and whether the inventor limited the invention in the course of prosecution, making the claim scope narrower than it would otherwise be.”); *PODS, Inc. v. Porta Stor, Inc.*, 484 F.3d 1359, 1368 (Fed. Cir. 2007) (holding claims limited to a “singular rectangular-shaped frame” where patentee limited claims to that shape during prosecution, and thus had “surrendered any claim to a frame that was not rectangular or four-sided”).⁷

⁷ Indeed, *none* of the figures in the specification show a hybrid regulator with a linear mode part that has multiple outputs, or a switch mode part that has multiple reference signals. Each switch mode part has a single reference signal that is provided by a single output of one or more linear mode parts.

3. “master mode” (claims 1, 4)

Apple’s Construction	Nokia’s Construction	Staff’s Construction
“mode in which the linear mode part and the switch mode part use the same reference signal”	“mode in which a modulating signal is used as a reference signal for the switch mode part”	“mode in which the switch mode part has as a reference signal a modulating signal”

As noted above, claim 1 requires the switch mode part to be switchable between a “slave mode” and a “master mode.” The parties agree that whether the claimed switch mode part is operating in a “master mode” turns on the identity of the reference signal used by the switch mode part. But they disagree as to the required identity of that reference signal—i.e., whether it must be the *same reference signal used by the linear mode part*, as Apple contends, or whether it can be *any reference signal* derived from *any source*, as long as it is a “modulating signal,” as Nokia and the Staff contend. As detailed below, the portions of the specification incorporated into the claims during prosecution make clear that Apple’s proposed construction is correct.

a. Apple’s Proposed Construction Should Be Adopted.

Apple’s proposed construction should be adopted for the following reasons.

First, no party contends that the term “master mode” has a specific or well-understood meaning in the context of hybrid regulators. (Ex. 2 [Choi Rep.] ¶ 66.) Thus, the meaning of that term turns on how the inventors used it in the specification. *See World Class Tech. Corp. v. Ormco Corp.*, 769 F.3d 1120, 1124 (Fed. Cir. 2014) (noting where “the claim language leaves uncertainty” and fails to provide “an unambiguous, clear” meaning of a term, “we turn to the specification to resolve the uncertainty”); *Sunovion Pharms., Inc. v. Teva Pharms. USA, Inc.*, 731 F.3d 1271, 1276-77 (Fed. Cir. 2013) (explaining court was “[t]urning therefore to the intrinsic record of the patent” because the disputed term had “no plain or ordinary meaning”);

Phillips, 415 F.3d at 1315-16 (“[I]n case of doubt or ambiguity it is proper in all cases to refer back to the descriptive portions of the specification to aid in solving the doubt or in ascertaining the true intent and meaning of the language employed in the claims” (quoting *Bates v. Coe*, 98 U.S. 31, 38 (1878))).

Second, the intrinsic record here demonstrates that the inventors defined the “master mode” of claim 1 as limited to situations in which the switch mode part uses the same reference signal used by the linear mode part. Specifically, as explained above in connection with the “slave mode” limitation, during prosecution of the ’366 patent, the applicants added the “master mode” requirement to claim 1 via amendment (to overcome prior art objections), along with a representation that the scope of that mode was limited to the embodiments shown in Figures 27B and 30B. (Ex. 4 [8/7/09 Amendment] at 2, 7 (“Claim 1 has been amended to incorporate the subject matter from Figures 27B (part SW1), page 26, lines 23-27, and 30B (part S1), page 27, lines 19-25.”).) See *TMC Fuel Injection Sys.*, 2017 U.S. App. LEXIS 5266, at *5.

For Figure 27B, the specification describes and shows only one type of master mode: i.e., when switch SW2 is in the GSM/EDGE position, the switching regulator (in red) is in “master mode” because, as shown by the red path, its reference signal (V_m) is the **same reference signal used by the linear regulator** (in blue), which also is a “master”:

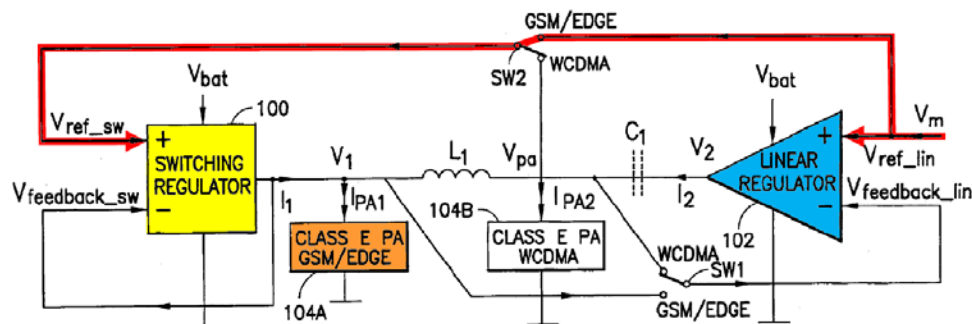


FIG.27B

(Ex. 1 [’366 patent], Fig. 27B; *id.*, 17:18-20 (“In the GSM/EDGE mode (both SW1 and SW2 are in the GSM/EDGE position) the configuration and operating considerations are as described above for FIG. 27A.”); *id.*, 17:1-2 (“In FIG. 27A **both regulators 104A, 104B are connected as ‘masters’.**”); *id.*, 5:32-33 (“[I]n FIG. 27A **both the switching regulator and the linear regulator are masters . . .**”). There is no disclosure of a “master” mode in connection with Figure 27B in which the switching regulator uses a reference signal that is anything other than the same reference signal used by linear regulator.

The same is true for Figure 30B, which also describes just one way in which the switch mode part can operate in a “master mode”: when switch SW2 is in the GSM/EDGE position, the switching regulator (in red) is a “master” **only** when its reference signal (V_m) is the **same reference signal used by the linear regulators** (in blue), such that all are “masters”:

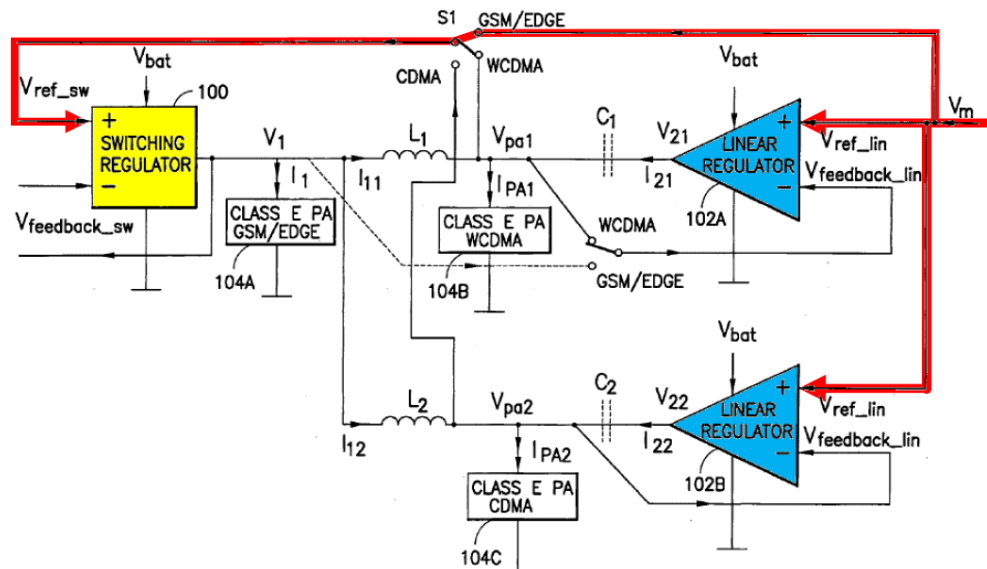


FIG.30B

(Ex. 1 [’366 patent], Fig. 30B; *id.*, 17:58-61 (“In the GSM/EDGE mode the switching regulator 100 receives its V_{ref_sw} input, via S1, from the V_m input, and thus functions **as in FIG. 30A.**”); *id.*, 17:52-53 (“In FIG. 30A **the switching regulator 100 and both linear regulators 102A, 102B are connected as ‘masters’ . . .**”); *id.*, 5:55-56 (“[I]n FIG. 30A **the switching regulator and**

each of the linear regulators are masters . . .”).) Again, there is no disclosure of any mode for Figure 30B in which the switch mode part operates as a master and uses a reference signal other than the reference signal shared with the linear mode part.

In sum, because the applicant expressly limited the added “master mode” limitation to the portions of the specification discussing the embodiments of Figures 27B and 30B, and because the specification defines the switch mode part in those disclosures as a “master” only when it receives the same reference signal received by the linear mode part, that lexicography controls. Therefore, the term “master mode” should be construed to mean “mode in which the linear mode part and the switch mode part use the same reference signal.” *See Phillips*, 415 F.3d at 1316 (“[T]he inventor’s lexicography governs.”).

b. Nokia’s And The Staff’s Proposed Construction Is Incorrect.

Nokia and the Staff propose to construe “master mode” such that the limitation would be met if the reference signal used by the switch mode part is “*a* modulating signal”—of *any* kind and from *any* source. But as detailed above, that is not what is described in connection with the embodiments depicted in Figures 27B and 30B—which the applicants incorporated into their new claims during prosecution. Nothing in those embodiments limits the reference signal to a particular type of signal, including a “modulating signal.” And *none* of the figures or disclosures of the ’366 patent shows a switch mode part operating in a master mode where its reference signal is anything other than the same reference signal used by the linear regulator. Therefore, Nokia’s and the Staff’s unsupported attempt to re-write the scope of claim 1 should be rejected.

4. “effectively slaved to operation of the switch mode part” (claim 17)

Apple’s Construction	Nokia’s and Staff’s Construction
Indefinite	“configured to use a control signal that is provided to the switch mode part as a reference signal”

The parties dispute whether the term “effectively slaved” (as used in the broader phrase “effectively slaved to operation of the switch mode part”) is indefinite, as Apple contends, or should be construed as “configured to use a control signal that is provided to the switch mode part as a reference signal,” as Nokia and the Staff contend. Because the disputed term has no plain meaning, and because the ’366 patent fails to ascribe any objective bounds that would allow persons of skill to understand the meaning of the term as used in the claim, it is indefinite.

a. **The Disputed Phrase Is Indefinite.**

The term “effectively slaved to operation of the switch mode part” is indefinite for the following reasons.

First, the parties and Staff all appear to agree that the term “effectively slaved” does not have an established plain and ordinary meaning in the field of hybrid regulators. (Ex. 2 [Choi Rep.] ¶ 68.) Accordingly, whether the term has a sufficiently definite meaning turns on how it was used in the context of the intrinsic record. *See Sunovion Pharms.*, 731 F.3d at 1276-77.

Second, nothing in the intrinsic record supplies a sufficiently definite meaning for the term “effectively slaved.” The term appears just once in the patent—only in claim 17—and that claim provides no details about what it means for the linear regulator to be “effectively slaved to operation of the switch mode part” (“17. A DC-DC converter as in claim 1, where the linear mode part is effectively slaved to operation of the switch mode part to source or sink current.”).

Given this lack of disclosure—which fails to provide a person of ordinary skill with any **objective means** to determine when a linear regulator is no longer “slaved” to the switch mode part, and instead is merely “effectively slaved”—the term is indefinite. *See Nautilus*, 134 S. Ct. at 2124 (holding claims are indefinite if persons of ordinary skill cannot ascertain “the scope of the invention” with “reasonable certainty”); *Interval Licensing*, 766 F.3d at 1371, 1374 (requiring “objective boundaries for those of skill in the art” to understand the full scope of the claims).

b. Nokia's And The Staff's Construction Is Incorrect.

Nokia and the Staff propose to construe “effectively slaved to operation of the switch mode part” to mean “configured to use a control signal that is provided to the switch mode part as a reference signal.” But neither contends that is the plain meaning of the phrase, and nothing in the intrinsic record defines the phrase in that or any other manner—which is not surprising given that, as detailed above, the term “effectively slaved” only appears in claim 17.

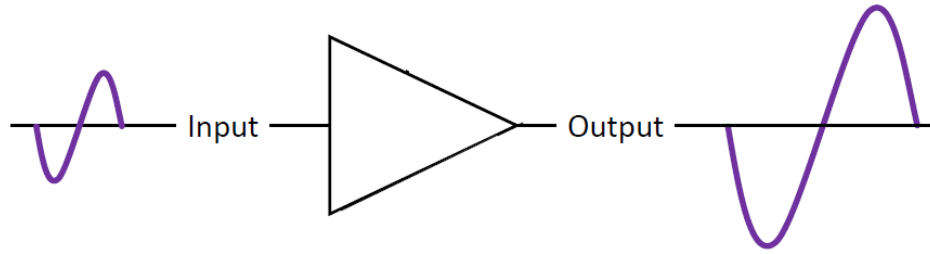
III. U.S. PATENT NO. 6,480,700 (“THE ’700 PATENT”)

The ’700 patent, which issued on November 12, 2002, is titled “Apparatus, and Associated Method, for Operating a Communication Device at Reduced Level of Current Consumption.” In general, the patent purports to disclose a way to save battery life in a radio communication device by reducing the amount of bias current supplied to a two-stage power amplifier.

A. Technology Background

1. Power Amplifiers

A “power amplifier” is an electronic component that accepts an input signal and, ideally, produces an output signal that is an exact replica of the input signal, but with proportionately greater power. The ’700 patent is directed to a specific type of amplifier called an “RF power amplifier,” which takes an RF (radio frequency) input signal at a certain power level (such as the signal that carries voice data for a cellular phone call) and produces an output signal of a greater RF power level. RF signals can be visualized as rapidly oscillating waves where the signal amplitude represents the signal power. For example, as shown below, the input signal on the left is fed to an amplifier (represented by the triangle), which amplifies the signal to produce a higher amplitude output power signal shown on the right:



(Ex. 2 [Choi Rep.] ¶ 69.)

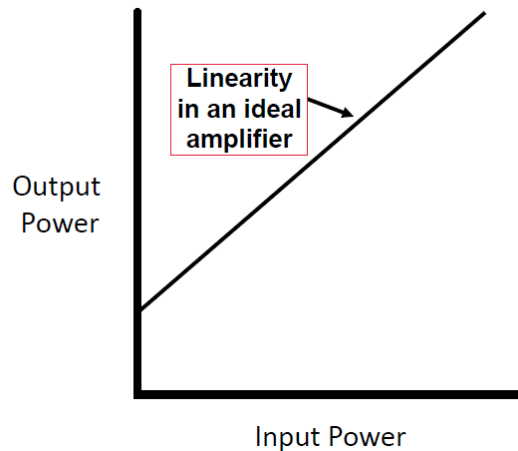
A power amplifier can be implemented in a single stage (i.e., the signal is amplified in one step) or in multiple stages (i.e., the signal is amplified over a series of steps, each of which incrementally increases the power of the signal). Multi-stage amplifiers, which were known for decades in the prior art, allow for greater output power levels to be achieved, especially at high frequencies where a single stage typically cannot sufficiently amplify a signal. Additionally, multi-stage amplifiers can provide circuit designers with more control over how a signal is amplified at different points in the amplification process. (*Id.* ¶ 70.)

2. **Gain / Linearity**

The ratio of the output signal to the input signal is known as “gain” (represented in equations with the symbol “A”). For example, an amplifier that increases the voltage of an input signal will produce “voltage gain” (A_V), which is calculated by dividing the voltage amplitude in the output signal by the voltage amplitude in the original input signal ($A_V = V_{out} / V_{in}$); e.g., if an amplifier receives an input signal of 0.5 volts and outputs a signal of 5 volts (a ratio of 5 to 0.5), the amplifier has a gain of 10. Circuit designers also can use an amplifier to produce “current gain” (A_I), which is the ratio between the output signal current amplitude and the input signal current amplitude ($A_I = I_{out} / I_{in}$). The “power gain” (A_P) takes into account the aggregate current and voltage (and therefore, the power) in the input and output signals. (Ex. 2 [Choi Rep.] ¶ 71.)

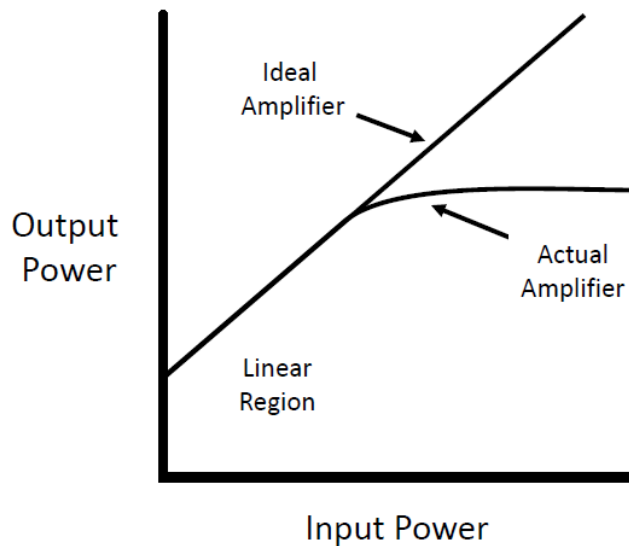
In an ideal amplifier, the gain will remain constant regardless of the level of the input, such that, if a power amplifier has a gain of 10, its output power always will be 10 times greater

than the power of any input signal (e.g., if the input is .1 watts, the output will be 1.0 watts, and if the input is 10 watts, the output will be 100 watts). This relationship between output power and input power in an ideal amplifier is shown below:



In the context of amplifiers, “linearity” refers to a relationship between the input signal and amplified output signal that can be represented in a straight line, the slope of which is constant and, mathematically, is equal to the amplifier’s gain. Thus, in the figure above, the gain shown is “linear” because the output/input ratio maintains a consistent and proportional relationship across all input and output power levels. (*Id.* ¶¶ 72-73.)

In practice, however, power amplifiers typically only produce a linear gain over a limited range of input power (known as the “linear region” or “linear operation”). For example, as shown below, the output power of an actual amplifier will diverge from the theoretical output power of an ideal amplifier as input power increases—and will eventually level out at maximum output power of the amplifier:



The region where the output power flattens at higher input power levels is known as “saturation.” When a power amplifier is operated at increasingly higher power such that the output power to input power relationship begins to deviate from a straight line, the gain will decrease from a constant value. This effect is shown above, where the rate of change of the output power for a commensurate increase in input power decreases as the input power is increased beyond the linear region. (*Id.* ¶¶ 74-75.)

3. **Bias**

Like other electronic components, a power amplifier may require an input signal at a particular power level to turn on and operate. This is sometimes called the amplifier’s “threshold power” level. To ensure that a power amplifier can amplify signals, including those falling below the threshold power level, circuit designers can apply a DC voltage or current to the amplifier, known as “bias.” The level of bias applied to an amplifier determines its “quiescent operating point,” which refers to the set of characteristics that an amplifier will exhibit when it is turned on and ready to operate (but not amplifying a signal). (*Id.* ¶ 76.)

Bias can be supplied to a power amplifier in different ways. For example, a circuit can be designed such that a source external to the power amplifier supplies the bias that sets the quiescent operating point of the amplifier. A power amplifier also can be designed to use the power of the input signal itself—instead of, or in addition to, bias supplied by an external source—to set the quiescent operating point of the amplifier. (*Id.* ¶ 77.)

A circuit designer can adjust a power amplifier's gain by adjusting the amount of bias applied. An increase in bias generally leads to a commensurate increase in amplifier gain, and a decrease in bias generally leads to a commensurate decrease in amplifier gain. Engineers also can design power amplifiers to allow adjustments to the amount of bias supplied over time as operating conditions or other circumstances change (e.g., if the level of the input signal drops, a higher bias can be applied to maintain a desired signal level). Moreover, because the supply of bias itself requires power, designers wishing to conserve battery power also may choose to turn off or reduce the amount of bias supplied to an amplifier at certain times. (*Id.* ¶ 78.)

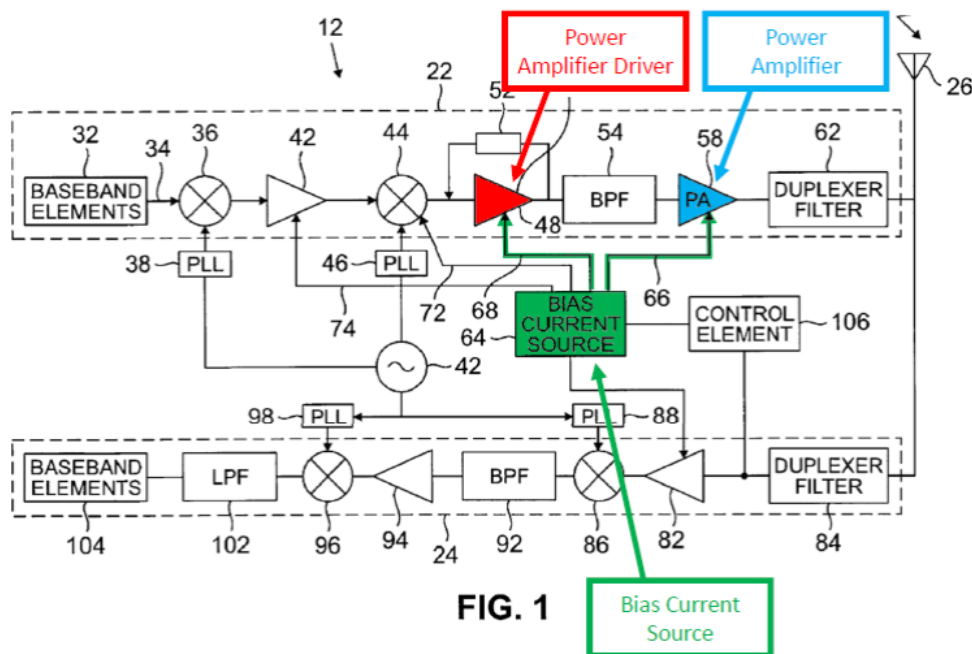
B. Alleged “Problem” In The Prior Art

The '700 patent does not identify any specific problem in the prior art with respect to the biasing of power amplifiers. Instead, the patent simply states that radio communication devices such as cellular phones (referred to by the patent as “mobile stations”) are frequently powered by portable power supplies such as batteries, and that a general need existed to further extend the battery life of these devices by reducing the amount of power consumed. (*E.g.*, Ex. 6 [’700 patent], 2:18-22 (“[A]ny manner by which the level of power consumption required to operate the mobile station can be reduced would increase the time period during which the mobile station can be powered by the portable power supply.”).)

C. Alleged “Solution” Of The ’700 Patent

The ’700 patent purports to extend the battery life of mobile devices by reducing the amount of bias current supplied to a multi-stage power amplifier in certain circumstances. (*E.g.*, *id.*, 1:9-15 (“[T]he present invention relates to apparatus, and an associated method, by which to operate portions of the cellular mobile station, or other communication device, at a desired power level, but at reduced current consumption levels, thereby to reduce power consumption of the device and increase longevity of the portable power supply thereof.”).)

Figure 1 of the ’700 patent shows bias current source 64 (in green) supplying bias current (path also shown in green) to several components, including power amplifier driver 48 (in red) and power amplifier (PA) 58 (in blue):



(*Id.*, Fig. 1.) The patent explains that (i) a generally linear relationship exists between bias and gain when the power signal supplied to an amplifier is relatively low (as shown in Figure 4, below on the left), and (ii) a generally non-linear relationship exists between bias and gain when the power signal supplied to an amplifier is at high levels, such that the ratio between bias and

gain will flatten out as the amplifier achieves saturation (as shown in Figure 3, below on the right):

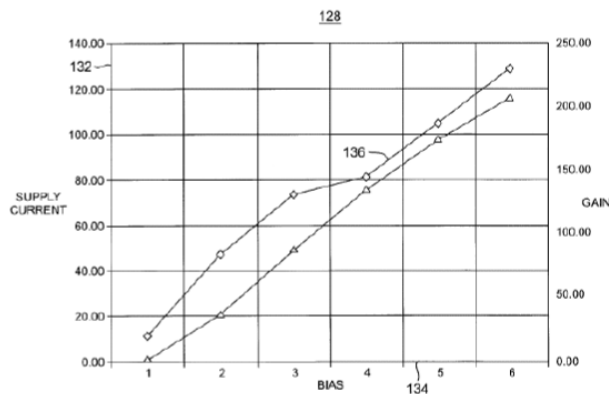


FIG. 4

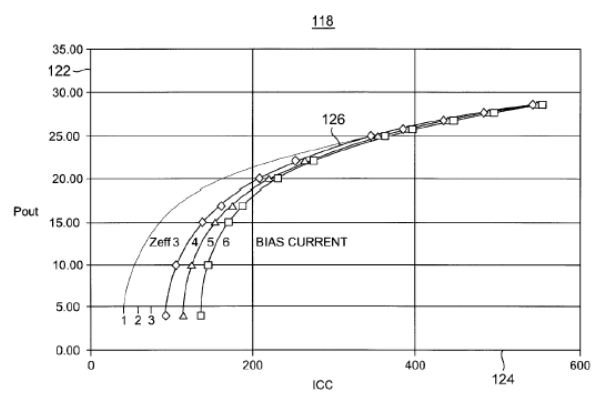


FIG. 3

(*Id.*, Figs. 3, 4; *id.*, 4:39-42 (explaining Figure 3 depicts “the large signal performance of the power amplifier forming a portion of the transmit portion of the mobile station shown in FIG. 1”); *id.*, 8:18-20 (“FIG. 4 illustrates a graphical representation, shown generally at 128, showing the small-signal performance of the power amplifier.”).)

At times when the bias current controls the gain of the power amplifier (as in Figure 4)—which the patent refers to as a “small signal mode”—the power amplifier is biased using external bias current source 66:

When, however, the power amplifier falls out of the large-signal mode due to reduction in the power level of the signal applied thereto, the power amplifier, instead, **enters into a small-signal mode** in which the power amplifier is not self-biased. **When in the small-signal mode, the biasing current applied to the power amplifier on the line 66 controls the gain of the power amplifier.**

(*Id.*, 7:1-7; *id.*, 2:61-3:1 (“When the power level of the transmit signal applied to the power amplifier is reduced beneath a threshold level, the power amplifier no longer remains self-biased. Instead, the power amplifier becomes biased by the biasing current applied thereto, and the gain of the power amplifier, and the transmit signal amplified thereat, is controlled by the level of the

biasing current.”); *id.*, 8:18-20 (“FIG. 4 illustrates a graphical representation . . . showing the small-signal performance of the power amplifier.”).)

By contrast, during periods when the bias current does not control the gain of the power amplifier—which the patent refers to as a “large signal mode”—the amplifier will become “self-biased.” The patent explains that, when self-biased in large signal mode, bias current source 66 is no longer used to control the gain; instead, the input power signal is used to set the quiescent operating point of the amplifier (the specific level of which will vary depending on the specific “construction” of the amplifier):

At such high output level, the power amplifier 58 becomes *self-biased*. That is to say, ***the input power of the transmit signal applied to the power amplifier 58 and the construction of the power amplifier, including device geometries, sets the quiescent operating point of the power amplifier 58*** together with the driver 48.

(*Id.*, 6:54-59;⁸ *id.*, 2:57-61 (“At the maximum output power level, the power level is self-biased. That is to say, the power level of the transmit signal applied to the power amplifier, together with the construction of the amplifier, sets the quiescent operating point thereof.”); *id.*, 8:15-17 (explaining when “the amplifier becomes self-biased, viz., [it] generates essentially the same output power levels independent of the value of the biasing current”).)

According to the ’700 patent, this approach can reduce power consumption and extend battery life—by allowing power amplifier 58, when self-biased in large signal mode, to avoid having to use bias supplied by bias current source 64. (*Id.*, 3:1-6 (“Advantageous use of the operation of the power amplifier is made to control current consumption of the power amplifier as the biasing current applied to the power amplifier can be reduced without affecting the output

⁸ The phrase “the construction of the power amplifier” in this statement refers to, at least, the matching networks, the transistor(s) within the amplifier, the biasing circuits, and potentially other components. The term “device geometries” in this statement refers to, at least, the size of the transistor(s) within the amplifier. (Ex. 2 [Choi Rep.] ¶ 81 n.4.)

power level of the transmit signal, once amplified, when the amplifier is self-biased to be operable in a self-biased mode.”).)

D. Level Of Ordinary Skill In The Art

At the time the ’700 patent was filed, a person of ordinary skill in the art would have had (1) a Master of Science degree in Electrical Engineering or related discipline, and two to three years of experience in RF circuit design or power amplifier design, (2) a Bachelor of Science degree in Electrical Engineering or related discipline, and three to four years of experience in RF circuit design or power amplifier design, or (3) equivalent educational and professional experience. (Ex. 2 [Choi Rep.] ¶ 32.)

E. Disputed Claim Terms

Apple, Nokia, and the Staff dispute the meaning of four terms from the ’700 patent, which appear in claims 1 and 16 as set forth below (disputed terms are emphasized):

1. In a radio device operable in a radio communication system to communicate radio-frequency communication signals, an improvement of apparatus for operating the radio device at selected radio characteristics, said apparatus comprising:

a first amplifier element coupled to receive a first radio frequency signal, said first amplifier based [sic] by a first-bias current signal of a first selectable biasing level, said first amplifier element generating a first amplified radio frequency signal exhibiting a first level of linearity, the first level of linearity responsive to the first-bias current signal; and

a second amplifier element coupled to receive **indications of the first amplified radio frequency signal** generated by said first amplifier element, said second amplifier element selectably operable in a **large-signal mode** and in a **small signal mode**, said second amplifier operated in the **large-signal mode** when the **indications of the first amplified radio frequency signal** applied thereto is at least as great as a threshold value such that, when operated in the **large-signal mode**, **said second amplifier become self-biased** at a fixed gain level.

16. In a method for communicating with a radio device operable in a radio communication system to communicate radio-frequency communication

signals, an improvement of a method for operating the radio device at selected radio characteristics, said method comprising:

providing a first radio frequency signal to a first amplifier element biased by a first-bias current signal of a first selectable biasing level;

generating a first amplified radio frequency signal exhibiting a first level of linearity, the first level of linearity responsive to the first-bias current signal; and

providing ***indications of the first amplified radio frequency signal*** to a second amplifier element selectably operable in a ***large-signal mode*** and in a ***small-signal mode***, the second amplifier operated in the ***large-signal mode*** when the ***indications of the first amplified radio frequency signal*** applied thereto is at least as great as a threshold value such that, when operated in the ***large-signal mode, the second amplifier becomes self-biased*** at a fixed gain level.

1. “said second amplifier become [sic] self-biased” (claim 1); “the second amplifier becomes self-biased” (claim 16)⁹

Apple’s Construction	Nokia’s and Staff’s Construction
“the input power of the transmit signal applied to the second amplifier and the construction of the second amplifier sets the quiescent operating point of the second amplifier”	“[said/the] second amplifier element generates essentially the same output power levels independent of the value of an applied bias current signal”

The parties and Staff agree that the claim language “said second amplifier become [sic] self-biased” and “the second amplifier becomes self-biased” should be construed in accordance with the inventors’ lexicography set forth in the specification. They disagree, however, as to which statements in the specification provide the controlling definition. Apple’s construction correctly uses the express definition from the specification that describes ***how the amplifier becomes self-biased***, as claimed, while Nokia and the Staff incorrectly rely on a statement that merely describes the amplifier’s ***output*** after it becomes self-biased (i.e., the result).

⁹ Claim 1 recites “said second amplifier become [sic] self-biased,” while claim 16 recites “the second amplifier becomes self-biased.” The parties and Staff agree that both phrases should be construed to have the same meaning.

a. **Apple's Proposed Construction Should Be Adopted.**

Claims 1 and 16 require “a second amplifier element” that is “selectably operable” in two different modes: a “large-signal mode” and “a small signal mode.” When operated in a large signal mode, the claims further require the “second amplifier” to “become[] ***self-biased*** at a fixed gain level.” (Ex. 6 [’700 patent], claims 1, 16.)

The parties and Staff appear to agree that, as used in the claims of the ’700 patent, the term “self-biased” does not have an established plain and ordinary meaning. Instead, in their specification, the ’700 inventors repeatedly and consistently defined how the second amplifier element becomes “self-biased”: i.e., by having the amplifier use the input RF signal to be amplified (and the amplifier’s own internal circuitry) to set the quiescent operating point of the amplifier, rather than by using the bias received from an external bias source (as occurs in small signal mode when the amplifier is not self-biased):

At such high output level, the power amplifier 58 becomes ***self-biased***. ***That is to say, the input power of the transmit signal applied to the power amplifier 58 and the construction of the power amplifier, including device geometries, sets the quiescent operating point of the power amplifier 58*** together with the driver 48.

(*Id.*, 6:54-59.)

At the maximum output power level, the power level is ***self-biased***. ***That is to say, the power level of the transmit signal applied to the power amplifier, together with the construction of the amplifier, sets the quiescent operating point thereof.***

(*Id.*, 2:54-61 (“Summary of the Invention” section); *see id.*, 2:61-3:1 (“When the power level of the transmit signal applied to the power amplifier is reduced beneath a threshold level, the power amplifier ***no longer remains self-biased***. ***Instead, the power amplifier becomes biased by the biasing current applied thereto***, and the gain of the power amplifier, and the transmit signal amplified thereat, is controlled by the level of the biasing current.”).)

Through their use of the phrase “[T]he power amplifier 58 **becomes self-biased. That is to say . . .**,”¹⁰ the inventors indicated their intent to define the term “self-biased” with the language that follows—which is the near verbatim language contained in Apple’s proposed construction.

Apple’s Construction	Specification Language
“the input power of the transmit signal applied to the second amplifier and the construction of the second amplifier sets the quiescent operating point of the second amplifier”	“That is to say, the input power of the transmit signal applied to the power amplifier 58 and the construction of the power amplifier, including device geometries, sets the quiescent operating point of the power amplifier 58 together with the driver 48.” (<i>Id.</i>, 6:54-59.) “That is to say, the power level of the transmit signal applied to the power amplifier, together with the construction of the amplifier, sets the quiescent operating point thereof.” (<i>Id.</i>, 2:54-61)

That lexicography controls. *See Trading Techs. Int’l, Inc. v. eSpeed, Inc.*, 595 F.3d 1340, 1353 (Fed. Cir. 2010) (quoting the specification’s statement that “[t]he values in the price column are static; **that is**, they do not normally change positions unless a re-centering command is received” as defining the claim term “static”); *SkinMedica, Inc. v. Histogen Inc.*, 727 F.3d 1187, 1200 (Fed. Cir. 2013) (“In a specification, a patentee’s ‘use of “i.e.,” signals an intent to define the word to which it refers.’” (quoting *Edwards Lifesciences v. Cook Inc.*, 582 F.3d 1322, 1334 (Fed. Cir. 2009))); *see also Phillips*, 415 F.3d at 1316 (“[T]he inventor’s lexicography governs.”).

Apple’s proposed construction also is consistent with other portions of the specification in which the inventors explained that an amplifier “of the present invention” may not be biased

¹⁰ The Latin phrase “i.e.” literally means “that is to say.” (Ex. 11 [Dictionary of Modern English Usage] at 253 (“i.e. means that is to say”); Ex. 12 [New Oxford American Dictionary] at 840 (“i.e. ... that is to say”).)

with an external biasing current under certain conditions. (Ex. 6 ['700 patent], 8:28-35 (in connection with Figure 4, describing “an embodiment of the present invention” where a decision is made “to select **whether to bias the amplifier 82 with a biasing current**”); *id.*, 8:36-50 (in connection with Figure 5, describing “an embodiment of the present invention” in which “[a] determination is made . . . **as whether or not to bias the amplifier 82**”); *id.*, 3:52-60 (explaining “[i]f the ratio is greater than a selected threshold . . . **the biasing current is not applied to the low noise amplifier**”); *see also id.*, claim 20 (“selecting whether to bias the receive-circuit amplifier”).) *See Verizon Servs. Corp. v. Vonage Holdings Corp.*, 503 F.3d 1295, 1308 (Fed. Cir. 2007) (“When a patent thus describes the features of the ‘present invention’ as a whole, this description limits the scope of the invention.”).

Apple’s proposed construction also is consistent with the stated purpose of the alleged invention: to reduce battery consumption. Having the second power amplifier set its quiescent operating point by using the input power signal (and the amplifier’s own circuitry)—rather than by using bias supplied from an external bias source—is the precise way in which the patent claims to reduce the overall amount of power consumed by that amplifier. (Ex. 6 ['700 patent], 3:1-6 (“Advantageous use of the operation of the power amplifier is made to control current consumption of the power amplifier as the biasing current applied to the power amplifier can be reduced without affecting the output power level of the transmit signal, once amplified, when the amplifier is self-biased to be operable in a self-biased mode.”).) *See World Class Tech.*, 769 F.3d at 1124 (rejecting construction that “would not serve the sole stated purpose” of the claimed invention); *Osram GmbH v. Int’l Trade Comm’n*, 505 F.3d 1351, 1358 (Fed. Cir. 2007) (considering “the **purposes of the invention**” in construing claim term).

As such, the terms “said second amplifier become [sic] self-biased” (claim 1) and “the second amplifier becomes self-biased” (claim 16) should be construed to mean “the input power of the transmit signal applied to the second amplifier and the construction of the second amplifier sets the quiescent operating point of the second amplifier,” just as defined by the inventors.

b. Nokia And The Staff Rely On The Wrong Statement In The Specification.

In support of their proposed construction, Nokia and the Staff rely on the following statement in the '700 specification:

FIG. 3 illustrates a graphical representation, shown generally at 118, in which the power output, scaled along the ordinate axis 112, is plotted as a function of current I_{cc} 124. The resultant plot 126 indicates that ***the amplifier becomes self-biased, viz., generates essentially the same output power levels independent of the value of the biasing current.***

(Ex. 6 ['700 patent], 8:12-17.) But unlike the specification statements cited above in support of Apple's position—in which the inventors expressly defined how the amplifier becomes self-biased—this statement merely describes what happens to the **output power** of the amplifier **after** the amplifier becomes self-biased, as shown in the “resultant plot” of Figure 3. In other words, it describes the result of self-biasing, and not how the amplifier “becomes self-biased,” as the claim language requires. (Ex. 2 [Choi Rep.] ¶¶ 81-82.) Their proposed construction also does not even use the actual language that the inventors used to describe that resulting output (i.e., the patent refers to “the value of the biasing current,” and not “an applied bias current signal,” as Nokia and the Staff propose).¹¹

¹¹ To the extent the ALJ determines that the inventors defined the term “self-biased” in **both** the sections cited by Apple **and** in the sections cited by Nokia and the Staff, Apple would not object to a construction that combines their constructions: i.e., “the input power of the transmit signal applied to the second amplifier and the construction of the second amplifier sets the quiescent operating point of the second amplifier, and the second amplifier generates essentially the same output power levels independent of the value of the biasing current.”

2. “small signal mode” / “small-signal mode” (claims 1, 2-4, 16)¹²

Apple’s and Staff’s Construction	Nokia’s Construction
“mode in which the bias current controls the gain of the second amplifier element”	“mode in which the gain of the second amplifier element is responsive to an applied bias current signal”

The parties dispute whether the term “small signal mode” should be construed as a mode in which the bias current “**controls**” the gain of the second amplifier element, as Apple and the Staff contend, or whether it is a mode in which the gain must merely be “**responsive**” in some unspecified way to “an applied bias current signal,” as Nokia contends. Because Apple’s and the Staff’s proposed construction is supported by the claims, specification, and understanding of persons of ordinary skill in the art, and uses the inventors’ own words, it should be adopted.

a. **Apple’s And The Staff’s Construction Should Be Adopted.**

Claims 1 and 16 require the second amplifier element to be “selectably operable in a large-signal mode and in a small signal mode.” The claims therefore require that the second amplifier operate in two distinct modes: (1) a small signal mode, and (2) a large signal mode. And the specification confirms that the claimed “small signal mode” is a mode in which the external bias current “controls the gain of the second amplifier element” (unlike in large signal mode when the amplifier is “self-biased”):

When, however, the power amplifier ***falls out of the large-signal mode*** due to reduction in the power level of the signal applied thereto, the power amplifier, instead, ***enters into a small-signal mode*** in which the power amplifier is ***not self-biased***. ***When in the small-signal mode, the biasing current applied to the power amplifier on the line 66 controls the gain of the power amplifier.***

(Ex. 6 [’700 patent], 7:1-7; *id.*, 2:61-3:1 (“When the power level of the transmit signal applied to the power amplifier is ***reduced beneath a threshold level, the power amplifier no longer***

¹² Claims 1-6 and 10 require a “small signal mode,” while claim 16 requires a “small-signal mode.” The parties and Staff agree both terms should be construed to have the same meaning.

remains self-biased. Instead, *the power amplifier becomes biased by the biasing current applied thereto*, and *the gain of the power amplifier*, and the transmit signal amplified thereat, *is controlled by the level of the biasing current*.”); *id.*, 8:18-20 (“FIG. 4 illustrates a graphical representation . . . showing the small-signal performance of the power amplifier.”).)

The disclosure in the specification also is consistent with the understanding of persons of ordinary skill in the art. As explained by Dr. David Choi, who has considerable experience in the field of power amplifiers, including as used in RF devices, a “small signal mode” was typically understood at the time the ’700 patent was filed to refer to a mode where the amplifier is operating in its linear region without distortion from an input signal. A person of ordinary skill in the art would have understood that in this linear region of operation, the bias current controls the gain of the amplifier. (Ex. 2 [Choi Rep.] ¶¶ 84-86.)

Consistent with that disclosure, the terms “small signal mode” and “small-signal mode” should be construed to mean a “mode in which the bias current controls the gain of the second amplifier element.”

b. Nokia’s Proposed Construction Is Incorrect.

Nokia alone proposes to construe “small signal mode” as “mode in which the gain of the second amplifier element is responsive to an applied bias current signal.” But the patent never states that the gain is merely “responsive” to an applied bias current when in small signal mode. Instead, as described above, the patent consistently states that gain must be **controlled** by the bias current when the amplifier is in small signal mode. (*Id.* ¶ 87.)

3. “large-signal mode” (claims 1, 16)

Apple’s Construction	Nokia’s Construction	Staff’s Construction
“mode in which the bias current does not control the gain of the second amplifier	Construction of this term is unnecessary because it is expressly defined by the	“Construction of this term is unnecessary. If construction is required, however, this

element”	claim itself. Alternatively: “mode in which the amplifier element is self-biased at a fixed gain level”	term should be construed consistent with the definition provided in the claim language itself. Alternatively: “mode in which the amplifier element is self-biased at a fixed gain level.”
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The parties and Staff dispute whether the term “large-signal mode” should be construed as a mode in which the bias current “does not control the gain of the second amplifier element,” as Apple contends, whether the term requires no construction, as Nokia and the Staff contend, or whether it means a “mode in which the amplifier element is self-biased at a fixed gain level,” as Nokia and the Staff alternatively contend. Apple’s proposed construction is supported by the claims and specification, and therefore should be adopted—unlike Nokia’s and the Staff’s proposed constructions, which find no support in the intrinsic record and would render other portions of the claim meaningless.

a. **Apple’s Proposed Construction Should Be Adopted.**

As noted above, the claims of the ’700 patent require two distinct modes for the second power amplifier: a “small signal mode” and a “large signal mode.” As also noted above, the intrinsic and extrinsic evidence makes clear that the term “small signal mode” refers to a “mode in which the bias current controls the gain of the second amplifier element.” The patent makes equally clear that “large-signal mode” simply refers to a mode in which the inverse is true—i.e., when an amplifier is operating in small signal mode, the bias current controls the gain of the amplifier, and when it is operating in large-signal mode, the bias current no longer controls the gain of the amplifier (because the amplifier is self-biased):

Eventually, the power amplifier 58 *falls out of the large-signal, self biased mode*, and the gain of the amplifier 58 *becomes dependent upon the level of the biasing current applied thereto*.

(Ex. 6 [’700 patent], 7:52-56; *id.*, 6:66-7:7 (explaining in large signal mode a power amplifier is “self-biased,” but “[w]hen . . . the power amplifier falls out of the large-signal mode due to reduction in the power level of the signal applied thereto, the power amplifier, instead, enters into a small-signal mode in which the power amplifier is not self-biased . . . [and] the biasing current applied to the power amplifier on the line 66 controls the gain of the power amplifier.”).)

Apple’s construction also is consistent with portions of the ’700 specification explaining that, when an amplifier is self-biased in large signal mode, its gain remains “**fixed**”—i.e., the bias current cannot be used to control the gain, unlike in small signal mode. (*Id.*, 6:59-62 (“For so long as the power amplifier is operated in a manner such that the amplifier remains self-biased, the **gain** of the amplifier remains **fixed**.”). According to the patent, this is what allows the amplifier to become self-biased when the amplifier is in large signal mode—by having the amplifier use the input RF signal to self-bias (rather than using bias from an external bias source), an external bias current will not control the amplifier’s gain:

Advantageous use of the operation of the power amplifier is made to control current consumption of the power amplifier as ***the biasing current applied to the power amplifier can be reduced without affecting the output power level of the transmit signal***, once amplified, when the amplifier is self-biased to be operable in a self-biased mode.

(*Id.*, 3:1-6.)

Accordingly, the term “large signal mode” should be construed to mean ““mode in which the bias current does not control the gain of the second amplifier element.”

b. Nokia And The Staff’s Proposed Constructions Are Incorrect.

Nokia and the Staff contend that the term “large signal mode” requires no construction “because it is expressly defined by the claim itself”—a position initially taken only by the Staff, and that Nokia only adopted a few days ago. As shown below, however, nothing in claim 1 or claim 16 purports to define that term, which only appears in the last element of each claim:

a second amplifier element coupled to receive indications of the first amplified radio frequency signal generated by said first amplifier element, said second amplifier element selectably operable in a **large-signal mode** and in a small signal mode, said second amplifier operated in the **large-signal mode** when the indications of the first amplified radio frequency signal applied thereto is at least as great as a threshold value such that, when operated in the **large-signal mode**, said second amplifier become self-biased at a fixed gain level.

(Ex. 6 [’700 patent], claim 1.)

providing indications of the first amplified radio frequency signal to a second amplifier element selectably operable in a large-signal mode and in a small-signal mode, the second amplifier operated in the large-signal mode when the indications of the first amplified radio frequency signal applied thereto is at least as great as a threshold value such that, when operated in the large-signal mode, the second amplifier becomes self-biased at a fixed gain level.

(*Id.*, claim 16.) As shown above, those claims never state what a “large signal mode” actually is; instead, they merely describe what must happen within the scope of the claim “**when**” the mode is operated (“when the indications of the first amplified radio frequency signal applied thereto is at least as great as a threshold value such that . . . , the second amplifier becomes self-biased at a fixed gain level.”).

Nokia and the Staff alternatively propose to construe “large signal mode” to mean “mode in which the amplifier element is self-biased at a fixed gain level.” That argument fails for at least the following three reasons.

First, Nokia and the Staff’s construction simply incorporates the last portion of the limitation (“said second amplifier become[s] self-biased at a fixed gain level”) into the term “large-signal mode”—which is a separate limitation. As shown below, that construction cannot be correct inasmuch as, if inserted into the claim, it would render the last element of claim 1 superfluous and nonsensical:

a second amplifier element coupled to receive indications of the first amplified radio frequency signal generated by said first amplifier element,

said second amplifier 55 element selectably operable in a **[mode in which the amplifier element is self-biased at a fixed gain level]** and in a small signal mode, said second amplifier operated in the **[mode in which the amplifier element is self-biased at a fixed gain level]** when the indications of the first amplified radio frequency signal applied thereto is at least as great as a threshold value such that, **when 60 operated in the [mode in which the amplifier element is self-biased at a fixed gain level], said second amplifier become self-biased at a fixed gain level.**

(*Id.*, claim 1.) *See Aristocrat Techs. Australia Pty Ltd. v. Int’l Game Tech.*, 709 F.3d 1348, 1357-58 (Fed. Cir. 2013) (rejecting construction that “would render the ‘identifying prize’ step superfluous” (citation omitted)); *Digital-Vending Servs. Int’l, LLC v. Univ. of Phoenix, Inc.*, 672 F.3d 1270, 1275 (Fed. Cir. 2012) (“In *Phillips*, this court reinforced the importance of construing claim terms in light of the surrounding claim language, such that words in a claim are not rendered superfluous.”).

Second, although the ’700 patent discloses a relationship between a “large signal mode” and an amplifier that is “self-biased at a fixed gain level,” the claims contain both terms, and treats them **separately**. Because different terms are presumed to have different meanings, the term “large-signal mode” should be construed to mean something beyond the separate limitations requiring the amplifier to “become self-biased at a fixed gain level.” *See CAE Screenplates, Inc. v. Heinrich Fiedler GmbH & Co. KG*, 224 F.3d 1308, 1317 (Fed. Cir. 2000) (“[W]e must presume that the use of these different terms in the claims connotes different meanings.”); *Innova/Pure Water, Inc. v. Safari Water Filtration Sys., Inc.*, 381 F.3d 1111, 1119 (Fed. Cir. 2004) (“[A]ll claim terms are presumed to have meaning . . .”).

Finally, nothing in Nokia’s and the Staff’s proposed construction expressly states that, when operating in “large-signal mode,” the applied bias current does not control the gain of the amplifier. Therefore, unless Apple’s construction is adopted, Nokia and/or the Staff may attempt to argue later that, an amplifier could be operating in **both** small- and large-signal mode when

bias current is controlling the amplifier's gain—even though the specification makes clear that can only occur when the amplifier is operating in small signal mode.

4. **“indications of the first amplified radio frequency signal” (claims 1, 2, 16)**

Apple's Construction	Nokia's Construction	Staff's Construction
Indefinite	Plain and ordinary meaning Alternatively: “the first amplified radio frequency signal as subjected to further signal processing”	“the first amplified radio frequency signal as subjected to further signal processing” For example, such further signal processing may include filtering, as disclosed in the specification.

The parties dispute whether the term “indications of the first amplified radio frequency signal” is indefinite, as Apple contends, or means “the first amplified radio frequency signal as subjected to further signal processing,” as Nokia and the Staff contend. Because the patent does not provide a person of ordinary skill with any objective basis to determine with reasonable certainty when something is an “indication” (or not an “indication”) of the first amplified radio signal, the term is indefinite. Indeed, that Nokia itself has now proposed two different supposed “plain and ordinary” meanings for this term only reinforces its indefiniteness.

a. **The Disputed Term Is Indefinite.**

As detailed below, the intrinsic record fails to provide any objective criteria or other guidance that would allow a person of ordinary skill in the art to determine with reasonable certainty what qualifies as an “indication” of the claimed first amplified radio frequency signal.

First, as used in the '700 patent, the term “indications” does not have an established plain and ordinary meaning with respect to an RF signal. (Ex. 2 [Choi Rep.] ¶ 95.) At least the Staff appears to agree.

Second, nor do the claims furnish any meaning for the term. Claims 1 and 16 state only that the “indications” are “of the first amplified radio frequency signal,” and that the second amplifier element is operated in a large signal mode “when the indications of the first amplified radio frequency signal applied thereto are at least as great as a threshold value.” Nothing in this disclosure specifies what the “indications” might be, or how a person of ordinary skill could determine when such “indications” exist (or do not exist).

Third, the specification also fails to provide any of the required objective criteria. The term “indications” appears only twice in the specification—and even then, it largely just mirrors the generic language of the claims:

A second amplifier element is coupled to receive **indications of the first amplifier radio frequency signal** generated by the first amplifier element. The second amplifier element is operated in the large signal mode when the **indications of the first amplified radio frequency signal** applied thereto is at least as great as a threshold value such that, when operated in the large signal mode, the second amplifier element becomes self-biased at fixed gain level.

(Ex. 6 [’700 patent], 4:11-21.) Again, nothing in that disclosure provides an ordinarily-skilled artisan with any objective basis to ascertain whether something is an “indication” of a signal or not an “indication.” (Ex. 2 [Choi Rep.] ¶ 95.)

Finally, through its own conduct, Nokia has confirmed that the term “indications” is indefinite. Initially, Nokia asserted that, as used in the asserted claims, “indications” has a “plain and ordinary meaning,” which Nokia defined as “**something** that serves to indicate.” (Ex. 7 [Nokia Initial Constructions] at Ex. C at 6.) But “something” means a “thing” that is “**undetermined or unspecified**.” (Ex. 9 [Am. Heritage College Dictionary] at 1297 (“Something ... An **undetermined** or **unspecified** thing”); Ex. 10 [Merriam-Webster’s Collegiate Dictionary] at 1120] (“something ... some **indeterminate** or **unspecified** thing”).) A “indeterminate” or “unspecified” thing is hardly a thing that is definite.

Nokia later reversed course and adopted the different construction that the Staff has proposed—now calling that the “plain and ordinary meaning” instead. That construction is wrong as well, for the reasons as discussed below. But in any event, that the owner of the ’700 patent could not settle on the meaning of “indications” only reinforces the indefinite nature of the term. *See Tech. Innovations, LLC v. Amazon.com, Inc.*, 35 F. Supp. 3d 613, 620 n.8 (D. Del. 2014) (finding indefiniteness and noting patent owner’s “inconsistency” in construing claim was “incompatible with the public notice function” of patents).

b. Nokia And The Staff’s Construction Should Be Rejected.

Having shifted positions, Nokia now supports the Staff’s proposal to construe the phrase “indications of the first amplified radio frequency signal” to mean “the first amplified radio frequency signal as subjected to further signal processing” (the Staff’s construction further states “For example, such further signal processing may include filtering, as disclosed in the specification.”) That construction should be rejected for multiple reasons.

First, the asserted claims require a comparison between “*the indications* of the first amplified radio frequency signal”—i.e., something other than the signal itself—and “a **threshold value**.” But Nokia’s and the Staff’s proposed construction would require re-writing the claims to require a comparison between *the signal itself* (as processed) and the threshold value. (Ex. 2 [Choi Rep.] ¶ 96.) That attempt to rewrite the claims is improper. *See Helmsderfer v. Bobrick Washroom Equip., Inc.*, 527 F.3d 1379, 1383 (Fed. Cir. 2008) (“Courts cannot rewrite claim language.”).

Second, nothing in the ’700 patent equates “indications” with “further signal processing,” including filtering. (Ex. 2 [Choi Rep.] ¶ 96.) Rather, as noted above, the specification only generically uses the term “indications” when parroting the claim language. It would be error to construe a term to mean something that the patent itself does not attribute to the term. *See*

Honeywell Int’l, Inc. v. Int’l Trade Comm’n, 341 F.3d 1332, 1340-41 (Fed. Cir. 2003) (rejecting proposed construction because it “import[ed] a limitation that [wa]s . . . outside the bounds of the claims, the written description, and the prosecution history,” and instead finding limitation indefinite).

Finally, Nokia’s and the Staff’s proposed construction is itself indefinite. Because the patent does not equate “indications” with any type of “further signal processing”—or even use the phrase “further signal processing”—a person of ordinary skill in the art has no reasonable basis from which ascertain when “the first amplified radio frequency signal” is still the original signal and when it becomes something different through “further . . . processing.” (Ex. 2 [Choi Rep.] ¶¶ 96-98.)

For example, the patent says nothing about whether an amplified RF signal that is merely sampled or measured in some way has been subject to “further signal processing,” even though the signal itself may remain the same. As another example, if a “first amplified radio signal” were “further . . . process[ed]” to be the **opposite** of the “first amplified radio frequency signal,” processed in a way that makes it **as different as possible** from the “first amplified radio frequency signal,” or even sent to and returned from a different device, it is unclear whether any of those signals would still be “indications of the first amplified radio signal,” and if so, whether there is any way to “process” the first amplified radio frequency signal such that it would not be an indication of itself. The patent does not say. (*Id.* ¶ 97.)

IV. U.S. PATENT NO. 9,473,602 (“THE ’602 PATENT”)

The ’602 patent, which claims priority to March 29, 2006, is entitled “Portable Electronic Device.” In general, the patent purports to improve over the “squeezed” appearance of a prior art flip phone via a different flip-phone design in which (i) a tubular-shaped housing has holes cut

out for components (e.g., keypad, display, and camera), (ii) the battery and printed circuit board (PCB) are arranged side-by-side, and (iii) the user input (or keypad) is located directly above and next to the battery and PCB. According to the named inventor, this specific arrangement helps “maintain aesthetic balance” and is desirable because it “allow[s] added thickness.”

A. Technology Background

1. Handheld Electronic Device Housings

Before the claimed March 2006 priority date of the '602 patent, handheld electronic devices such as personal data assistants (PDAs), mobile phones, and music players were ubiquitous. (Ex. 15 [Expert Report of Charles Mauro Regarding Claim Construction of U.S. Patent No. 9,473,602 (“Mauro Rep.”) ¶ 24.]) These devices had different types of housings, including one-piece seamless housings that could be shaped like a tube; two-piece housings with front and back pieces; and housings made of three or more pieces, including doors for battery access. (*Id.*) Examples of these housing types are shown below:



One-Piece Housing—iPod mini (2004)



Two-Piece Housing—Ericsson T65 (2001)



Three-Piece Housing—Nokia 1100 (2003)

(*Id.* ¶ 24.)

As of March 2006, one of the most common cell phone designs was the “flip phone,” which, as shown below, has two housings—one on top and one on bottom—each of which could be made of multiple pieces:



Motorola RAZR v3 (2004)

(*Id.* ¶ 25.)

Before March 2006, electronic device housings were made using a variety of different well-known manufacturing techniques including: (i) extrusion, i.e., forcing solid material through a die to form a one-piece product with a seamless surface, and then punching or cutting out holes as needed (Ex. 14 [’602 patent], 3:33-36, 4:57-60, 6:5-12); (ii) injection molding, i.e., injecting material into a mold; (iii) stamping a piece of metal into shape; and (iv) machining by cutting and removing material from a slab, just to name a few. (Ex. 15 [Mauro Rep.] ¶ 26.)

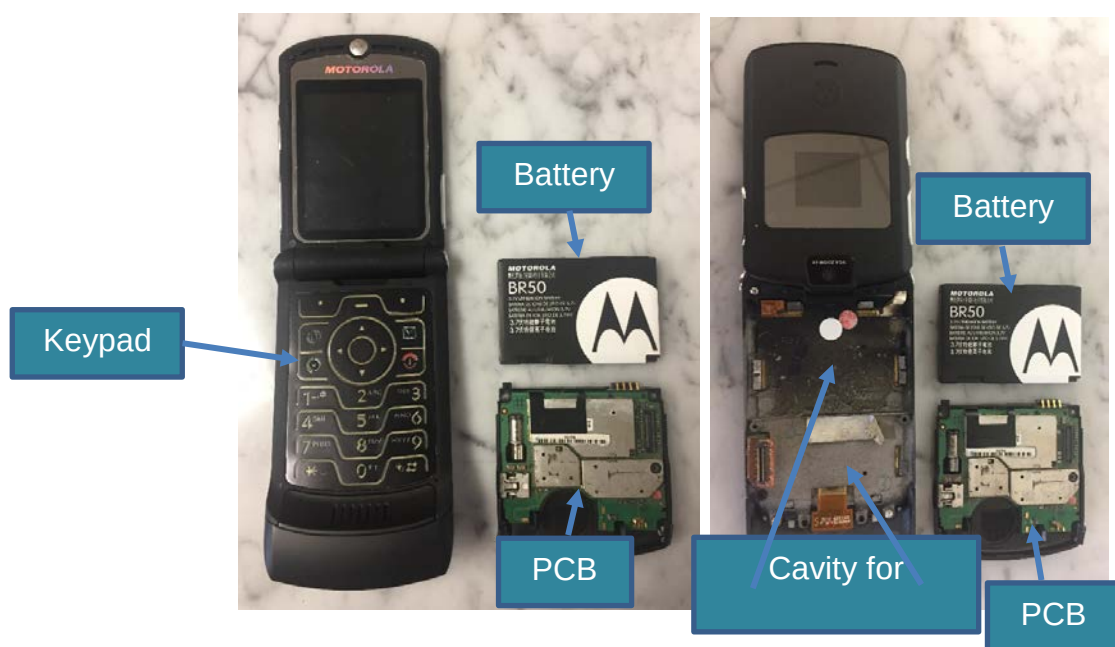
2. Arrangement Of Device Components

Before March 2006, electronic devices also typically had at least three main components: (i) a battery; (ii) a PCB containing the basic elements of a memory and a processor; and (iii) a user input mechanism such as a keypad that allowed the user to enter commands. These devices also frequently contained other components as well, including, for example, cameras and one or more transceivers located on the PCB (for devices with wireless capabilities, such as cellular,

Bluetooth, and Wi-Fi). The '602 patent does not claim to invent any of these components. (Ex. 14 ['602 patent], 1:23-34, 1:65-2:5; (Ex. 15 [Mauro Rep.] ¶¶ 28, 32-35.)

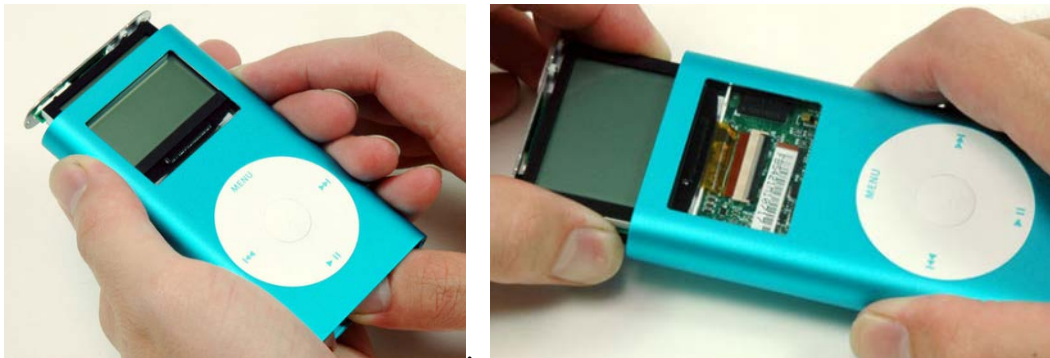
These electronic device components could be arranged in different ways depending on the specific design goals for the product. For example, designs were often constrained by the size, shape, and thickness of the battery, which typically occupied a substantial portion of the small interior space. Stacking the battery on top of the PCB could help meet a design goal for a narrower phone, or placing the battery and PCB side-by-side could help meet a design goal for a thinner phone. In both arrangements, the keypad or other user input was typically located above the battery and PCB. (Ex. 15 [Mauro Rep.] ¶ 29.)

One example of the side-by-side battery and PCB arrangement was the popular Motorola RAZR prior art flip phone, which the '602 patent describes as an “[u]ltra-thin” phone. (Ex. 14 ['602 patent], 1:23-34; Ex. 15 [Mauro Rep.] ¶ 29.) A disassembled Motorola RAZR v3 with PCB and battery, both of which fit side-by-side under the keypad, is shown below:



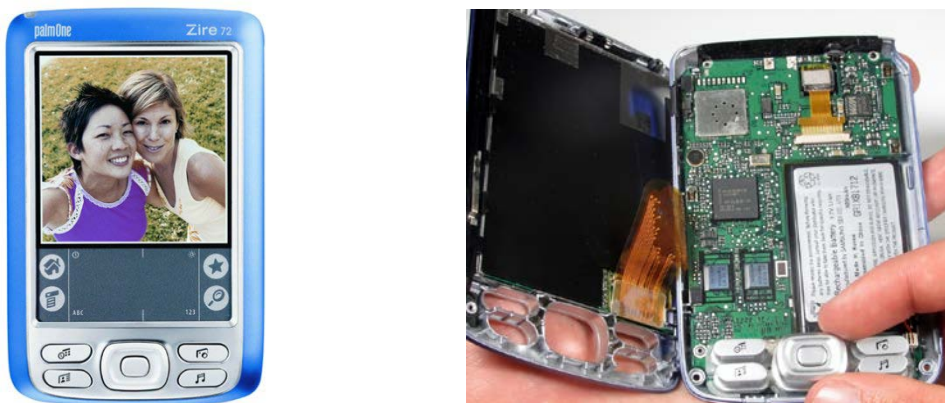
(Ex. 15 [Mauro Rep.] ¶ 29.)

The type of housing dictates the way in which components are placed inside the device during manufacturing. For example, when using a **one-piece housing**, the components slide in through an opening in the top or bottom, and end caps are used to close the top and bottom, as shown below:



(Id. ¶ 30.)

For devices with a **two-piece housing**, such as front and back pieces, the components are simply placed inside one piece, and the other piece of the housing is placed over them, as shown below:



(Id. ¶ 31.)

B. The Alleged “Problem” In The Prior Art

In the Background of the Invention section of the '602 patent, the named inventor claimed that a need existed for a new device design arising from the emergence of an “[u]ltra

thin telephone” that “pioneer[ed] a new approach in mechanical architecture for flip-phone designs.” (Ex. 14 [’602 patent], 1:23-25.) The ’602 patent explains that the “[p]riority for these products is mechanical thinness,” and discusses examples such as the Motorola RAZR flip phone that “has a thickness of about 0.54 inch,” and “[c]andy-bar shaped mobile phones [that] can have smaller thicknesses, such as the Motorola SLIVR and the Motorola SCALPEL with a thickness of about 0.25 inch.” (*Id.*, 1:23-34 (identifying Motorola RAZR, Motorola [RAZR] V3, Motorola [RAZR] V3x, Samsung SCH-V740, NEC L).) A photograph of the Motorola RAZR V3 is shown below:



As shown in the first two images, the top half of the RAZR is smaller than the bottom half. And as shown in the third image, when closed, the top half is designed to fit into the recess for the keypad in the bottom half of the phone. The result is a thin phone, even when closed. (Ex. 15 [Mauro Rep.] ¶ 34.)

The ’602 patent criticizes the prioritization of “mechanical thinness” as “allowing the feature set and industrial design to be adjusted to suit this [thinness] goal,” which, in the case of the RAZR, resulted in a supposed “squeezed” appearance. (Ex. 14 [’602 patent], 1:25-28, 1:38.) The patent purports to improve upon flip phones like the RAZR with an “ultrathin fold product” that nevertheless “allow[s] added thickness:”

There is a desire for an architecture for ***an ultrathin fold product***, such as a flip-phone style of mobile telephone, which ***can maintain aesthetic balance in proportions***, and ***allow added thickness to avoid a “squeezed” appearance*** as seen with the RAZR™ mobile telephone.

(*Id.*, 1:35-39.) The claimed invention of the '602 patent thus sacrifices at least some thinness in favor of “aesthetic balance in proportions.” (*Id.*; Ex. 15 [Mauro Rep.] ¶ 35.)

C. Nokia’s Alleged “Solution”

The '602 patent purports to achieve the dual goals of ultra-thinness and added thickness through two main features of the claimed electronic device: by using (i) tubular housing members; and (ii) a side-by-side arrangement of the battery and PCB containing the processor, memory, and transceiver:

One of the features of the invention is the use of ***tubular members to form the major housing components*** of the first and second sections of the flip-phones. The ***tubular housing members*** provide ***an increased strength*** than conventional housing designs. This allows the reduction in side of the housing components versus conventional housing components and, thus, ***a reduction in the thickness*** 24 of the telephone. ***In addition, the side-by-side positioning of the battery/engine can further allow a reduction in thickness*** of the handset versus conventional stacked battery/engine handsets.

(Ex. 14 ['602 patent], 5:61-6:4.)

Figure 5 of the '602 patent shows a side view of the claimed flip phone in a closed configuration:

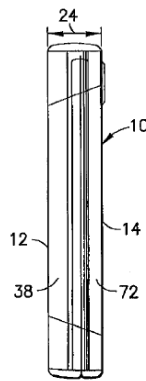
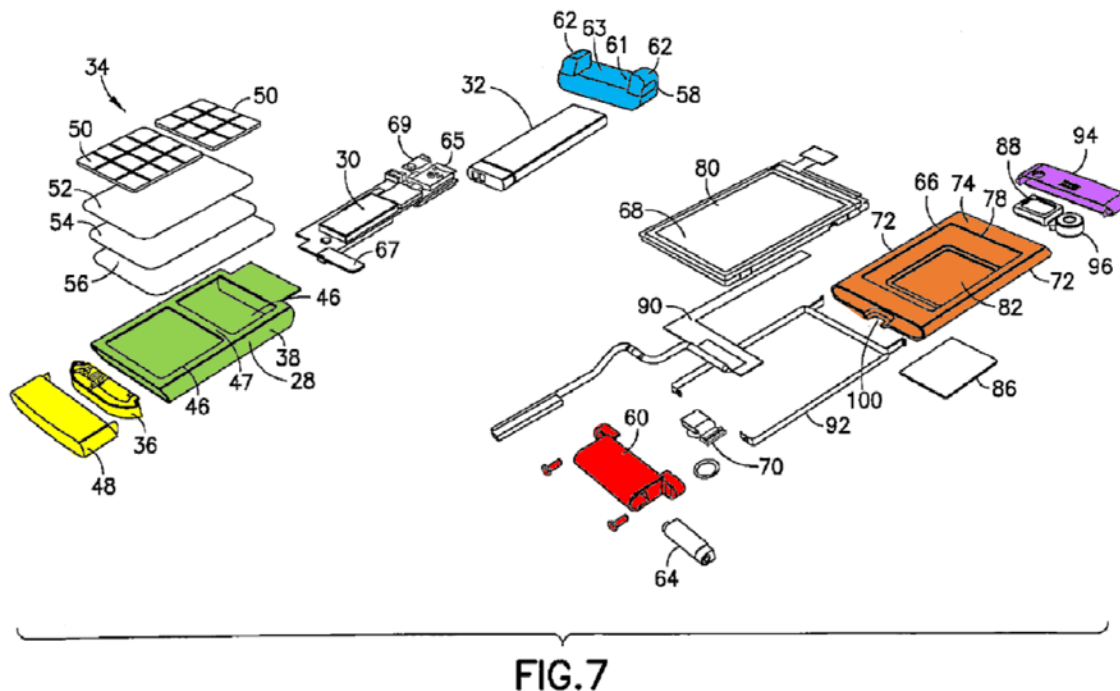


FIG.5

(*Id.*, Fig. 5, 2:28, 3:19-23.) The patent explains that “thickness 24” can be “about only 15 mm,” or 0.59 inches, which is slightly thicker than the Motorola RAZR. (*Id.*, 3:26-27.) Like the RAZR, the flip phone has two sections—a top section 12 and a bottom section 14. But unlike the RAZR, the top section does not fit into a recess in the bottom section; instead, the two sections are the same length: “when the two sections 12, 14 are closed, the telephone 10 has a block shape with grooves along the joints at the lateral sides, but with the ends of the sections 12, 14 being at the same bottom end of the closed shape.” (*Id.*, 3:19-23.) Moreover, each housing has a “substantially uniform thickness” along its entire length. (*Id.*, 3:16-18.)

Figure 7 of the '602 patent, annotated below, shows an exploded view of the claimed device and provides “details of how the small thickness 24 of about only 15 mm in a flip-phone design can be accomplished”:

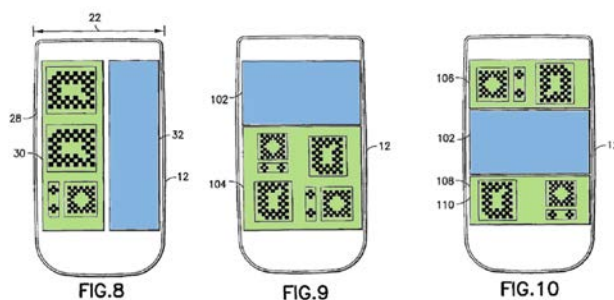


(*Id.*, 3:24-27, Fig. 7.) The first section 12 (in green) “generally comprises a first housing member 28,” which “comprises a one-piece tubular member.” (*Id.*, 3:27-32.) Similarly, the second section 14 (in orange) “generally comprises a second housing member 66,” which

“preferably comprises a one-piece member having a general tubular shape.” (*Id.*, 4:52-55.) Both housing members are preferably made of metal, and “could be formed from an extruded member with holes punched into it after it is extruded.” (*Id.*, 3:30-36, 4:54-60.) The front side of first housing member 28 has holes 46 for user input 34 (*id.*, 3:39-41), and the front side of second housing member 66 has a hole 78 for display module 68 (*id.*, 4:62-65).

Tubular housing member 28 encloses the components by “form[ing] a majority of opposite exterior lateral sides 38 and a rear side 40 of the first section 12 (except at top and bottom ends 42, 44 of the first section)” and a “front side.” (*Id.*, 3:36-39.) Tubular housing member 66 is described similarly. (*Id.*, 4:60-62 (“form[ing] portions of opposite exterior lateral sides 72, a front side 74 and a rear side 76 of the second section 14”).) The ’602 patent explains that “[b]ecause of the tubular shape” of the housing members, the members have “substantially open top and bottom apertures.” (*Id.*, 3:41-44, 5:3-6.) The battery and other components “can be inserted and removed through the hinge end” (at second hinge member 60). (*Id.*, 6:5-12.) The tubular housing apertures are then covered at the top and bottom, as shown in annotated Figure 7: antenna cover 48 (in yellow) and first hinge member 58 (in blue) close the ends of the first housing 28, and speaker cover 94 (in purple) and second hinge member 60 (in red) close the ends of the second housing 66. (*Id.*, 3:45-47, 4:12-15, 4:37-38, 5:9-14.)

The ’602 patent also describes several arrangements of the battery and PCB, which the patent calls the “engine section.” (*Id.*, 1:66-2:1 (describing “an engine section comprising a printed circuit board, a transceiver, a processor and a memory”).) For example, in Figures 8, 9, and 10 below, the battery (in blue) is arranged side-by-side with the engine section (in green):



(*Id.*, Figs. 8-10, 3:65-4:10, 5:26-39.)

Consistent with the purported “desire” for “an ***ultrathin fold product***, such as a flip-phone style of mobile telephone,” the only embodiment of the purported invention described or shown in the ’602 patent is a flip phone. (*Id.*, 1:35-36, Figs. 1-6.)

D. The Asserted ’602 Claims

Nokia has asserted 24 of the ’602 patent’s 36 claims, including independent claims 1, 15, and 22.¹³ Claim 1 and its dependent claims recite a “portable electronic device.” Claim 1 is set forth below, with the disputed term emphasized in bold/italics:

1. A portable electronic device comprising:
 - a one piece ***housing forming enclosed exterior lateral sides and a rear side***;
 - a cut out in the rear side of said housing;
 - a camera located in said housing and extending to said cut out at said rear side;
 - an engine section comprising a printed circuit board, a transceiver, a processor and a memory;
 - a user input section located above the engine section and a battery, wherein the user input section is located adjacent the battery and the engine section;
 - wherein the battery and engine section are housed in the housing and the user input is located in an opening between said exterior lateral sides of said one piece housing of the portable electronic device.

¹³ Nokia asserts claims 1, 6-15, 17, 18, 22, and 27-36 of the ’602 patent.

Claim 15 and its dependent claims are directed to a “housing for a portable electronic device.” Claim 15 is set forth below with the disputed term emphasized in bold/italics:

15. A housing for a portable electronic device comprising:
- a one piece ***housing forming enclosed exterior lateral sides and a rear side***;
 - a cut out in the rear side of said housing, said cut out configured to receive at least part of a camera;
 - wherein the housing is configured to receive a battery and an engine section,
 - wherein a user input is located in an opening between said exterior lateral sides of said one piece housing of the portable electronic device,
 - wherein the battery and engine section are configured to be housed in the housing such that the user input section is located above the engine section and the battery, and
 - wherein the user input section is located adjacent the battery and the engine section.

Claim 22 and its dependent claims recite a “mobile phone.” Claim 22 is set forth below with the disputed term emphasized in bold/italics:

22. A mobile phone comprising:
- a one piece ***housing*** of the mobile phone ***forming enclosed exterior lateral sides and a rear side*** of the mobile phone;
 - a cut out in the rear side of said housing;
 - a camera located in said housing and extending to said cut out at said rear side;
 - an engine section comprising a printed circuit board, a transceiver, a processor and a memory;
 - a user input section located above the engine section and a battery, wherein the user input section is located adjacent the battery and the engine section;
 - wherein the battery and engine section are housed in the housing and the user input is located in an opening between said exterior lateral sides of said one piece housing of the mobile phone.

E. Level Of Ordinary Skill In The Art

For the '602 patent, a person of ordinary skill in the art would have at least a Bachelor's degree in industrial design or equivalent industry experience, and two years of work experience in the design of mobile electronics and an understanding of the history of industrial or product design trends and manufacturing technology in small handheld electronic devices.

Nokia contends that a person of ordinary skill in the art would have “either (1) a bachelor of science in industrial design or mechanical engineering and three years of experience designing cellular phones or (2) a master of science in industrial design or mechanical engineering with two years of experience in designing cellular phones.” This definition is incorrect for at least two reasons.

First, the '602 patent is not limited to cellular phones. The patent is titled “Portable Electronic Device,” and the claims are directed to a “portable electronic device” in claim 1 and a “housing” for a portable electronic device in claim 15. Portable electronic devices include cellular phones, but also include personal digital assistants and music players, among other devices. A person of ordinary skill in the art could therefore have sufficient skills and experience in the design of a variety of portable electronic devices, not just cellular phones. (Ex. 15 [Mauro Rep.] ¶ 22.)

Second, a master's degree or three years of experience is not required. The '602 claims are directed to a well-known form of housing and a simple arrangement of basic components, and do not contain any detail about the components that would require any specific connections or design of the components. At most, an understanding of the patent requires knowledge of the driving factors behind the visual design of handheld electronics, which an industrial designer with two years of relevance experience would know well. (*Id.* ¶ 23.)

F. Disputed Claim Term

1. **“housing forming enclosed exterior lateral sides and a rear side”;
“housing . . . forming enclosed exterior lateral sides and a rear side”
(claims 1, 15, 22)**

Apple’s Construction	Nokia’s Construction	Staff’s Construction
Tubular housing	Construction of this term is unnecessary. If construction is required, however, this term should be construed consistent with its plain and ordinary meaning, which is the claim language itself. Alternatively: “member that houses forming enclosed exterior lateral sides and a rear side”	Construction of this term is unnecessary. If construction is required, however, this term should be construed consistent with its plain and ordinary meaning, which is the claim language itself. Alternatively: “member that houses forming enclosed exterior lateral sides and a rear side”

The primary dispute with respect to the term “housing . . . forming enclosed exterior lateral sides and a rear side” is whether it should be construed consistent with the ’602 patent’s express description of the “features of the invention,” as Apple proposes, or should instead be broadened to encompass Nokia’s and the Staff’s purported “plain and ordinary meaning,” which would apparently cover any type of housing, including those in the prior art that the patent claims to improve upon. The specification—which describes the tubular “housing” as a feature of “the invention” and core element of every disclosed example—as well as the plain language of the disputed term, confirm that Apple’s construction is correct.

(a) Apple’s Proposed Construction Should Be Adopted.

As detailed below, the ’602 specification repeatedly makes clear that the term “housing . . . forming enclosed exterior lateral sides and a rear side” is intended to mean “tubular housing,” just as Apple has proposed.

First, the ’602 patent describes the use of a tubular structure of the housing as “one of the features of the invention:”

One of the features of the invention is the use of tubular members to form the major housing components of the first and second sections of the flip-phones. ***The tubular housing members provide an increased strength*** than conventional housing designs. This allows the reduction in side [sic] of the housing components versus conventional housing components and, thus, a reduction in the thickness 24 of the telephone.

(Ex. 14 ['602 patent], 5:61-6:1.) By equating “the invention” with the use of “tubular members to form the major housing components,” the inventors expressly limited the scope of the “housing” limitation to a tubular structure. *See Verizon Servs.*, 503 F.3d at 1308 (“When a patent . . . describes the features of the ‘present invention’ as whole, this description limits the scope of the invention”); *Praxair, Inc. v. ATMI, Inc.*, 543 F.3d 1306, 1324 (Fed. Cir. 2008) (“The claims of the patent must be read in light of the specification’s consistent emphasis on this fundamental feature of the invention.”); *Honeywell Int’l, Inc. v. ITT Indus., Inc.*, 452 F.3d 1312, 1318 (Fed. Cir. 2006) (affirming construction of “fuel injection system component” as the specific “fuel filter” component where the “written description refers to the fuel filter as ‘this invention’ or ‘the present invention’”); *Trs. of Columbia Univ. v. Symantec Corp.*, 811 F.3d 1359, 1365 (Fed. Cir. 2016) (affirming construction of “byte sequence feature” as limited to “machine code instructions” because “machine code instructions” were described as the very thing that made the claim term “useful and informative”).

Second, other portions of the specification point to the tubular shape of the housing as the very design feature that supposedly overcame the described aesthetic and structural “problems” with flip phones then on the market—by allowing designers to build a thin mobile device with “substantially uniform thickness” and “increased strength” over conventional designs, but without appearing “squeezed.” (*E.g.*, Ex. 14 ['602 patent], Abstract (“The first section has a user input section and a first tubular housing member The second tubular housing member forms a majority of opposite exterior lateral sides.”), 3:16-18; *id.*, 5:61-6:1 (describing how

“increased strength” from tubular shape allows designers to use “reduc[ed] in si[z]e” housing components, which enables “a reduction in the thickness of the telephone”).) Indeed, tubular housing is the **only design** that the ’602 patent teaches to accomplish its dual goals of an “ultrathin fold product” that nevertheless “allow[s] added thickness.” (*Id.*, 1:35-39; Ex. 15 [Mauro Rep.] ¶ 37.)

Where, as here, a feature of the sole embodiment is described as the “essence of the claimed invention,” that too limits the scope of the claims to that feature. *Secure Web Conference Corp. v. Microsoft Corp.*, 640 Fed. Appx. 910, 914-15 (Fed. Cir. 2016) (although “mindful not to limit claims to preferred embodiments,” adopting construction based on figures that “depict the essence of the claimed invention rather than a preferred embodiment”) (emphasis omitted); *see also Toro Co. v. White Consol. Indus.*, 199 F.3d 1295, 1300-01 (Fed. Cir. 1999) (construing claim to require particular configuration where specification described its importance and did not disclose others).

Third, the remaining portions of the ’602 specification further confirm Apple’s proposed construction—by consistently and exclusively describing the claimed “housing” as “tubular”:

- “The first section has a user input section and a first **tubular housing member** The second section has a display and a second **tubular housing member**. . . . The first **tubular housing member** at least partially houses the user input section. The second **tubular housing member** at least partially houses the display.” (’602 patent, Abstract, *see also id.*, 1:53-64.)
- “The first **housing member** 28 generally comprises a one-piece **tubular** member. In a preferred embodiment, the **tubular** member is comprises [sic] of metal, such as aluminum for example. In one type of embodiment, the **tubular** metal member could be formed from an extruded member with holes punched into it after it is extruded.” (*Id.*, 3:30-35.)
- “Because of the **tubular shape** of the first **housing member** 28, the **first housing member** 28 **has substantially open top and bottom apertures**, which are slanted in the embodiment shown.” (*Id.*, 3:41-44.)
- “The second **housing member** 66 preferably comprises a one-piece member having a general **tubular shape**. In a preferred embodiment, the **tubular** member is comprises

[sic] of metal, such as aluminum for example. In one type of embodiment, the **tubular** metal member could be formed from an extruded member with holes punched into it after extrusion.” (*Id.*, 4:54-60.)

- “Because of the **tubular shape** of the second **housing member** 66, the second **housing member** 66 has substantially open top and bottom apertures, which are slanted in the embodiment shown.” (*Id.*, 5:3-6.)
- “The camera 70 is **housed** at an exterior side of the portable electronic device by a junction 98 of a cutout portion 99 of the second hinge member 60 and a cutout portion 100 of the second **tubular housing member** 66.” (*Id.*, 5:16-19.)
- “The components 112, 114, 116 are **housed** in a one-piece metal **tubular housing member** 118.” (*Id.*, 5:43-45.)
- “FIG. 12 shows an embodiment similar to FIG. 11. However, in this embodiment the battery 126 is thinner and wider than the battery 112. The **tubular housing member** 128 is thinner and wider than the **tubular housing member** 118. FIG. 13 shows another alternate embodiment. In this embodiment the battery 130 is about half the width of the **tubular housing member** 132.” (*Id.*, 5:49-55.)

Similarly, **all** the figures in the specification show **only** a “tubular” housing. For example, Figures 1 through 10 show a flip phone consisting of two “tubular members” and a connecting hinge. (*Id.*, Figs. 1-10.) And Figures 11, 12, and 13 show a different arrangement of the components inside a housing member, all described as “tubular.” (*Id.*, Figs. 11-13.)¹⁴

For example, the ’602 patent’s description of Figure 7 explains how the “housing” “form[s] enclosed exterior lateral sides and a rear side,” just as the claims require.¹⁵ And Figure

¹⁴ The ’602 patent describes forming the housing component(s) from an extrusion manufacturing process. (*Id.*, 3:33-36 (“In one type of embodiment, the tubular metal member could be formed from an **extruded** member with holes punched into it after it is **extruded**.”); *id.*, 4:57-60 (same); *id.*, 6:8-11 (“The housing of a fold phone can be **extruded** in one material. Extruding a housing in one material and having a user exchangeable battery (and cards) through a hinge end can be provided.”); *id.*, 7:28-29 (“A housing according to claim 15 wherein the one piece housing has been **extruded**.”).) This process is one way to manufacture tubular forms. (Ex. 15 [Mauro Rep.] ¶ 26.)

¹⁵ The other housing embodiments vary only insofar as the materials that may be used (e.g., aluminum or other metals) and the manufacturing procedures that may be employed (e.g., extrude the member and punch holes after the extrusion). (*Id.*, 3:32-36.)

7 itself shows the housings of the device (e.g., housing members 28 and 66) as long, hollow tubes with openings at the top and bottom:

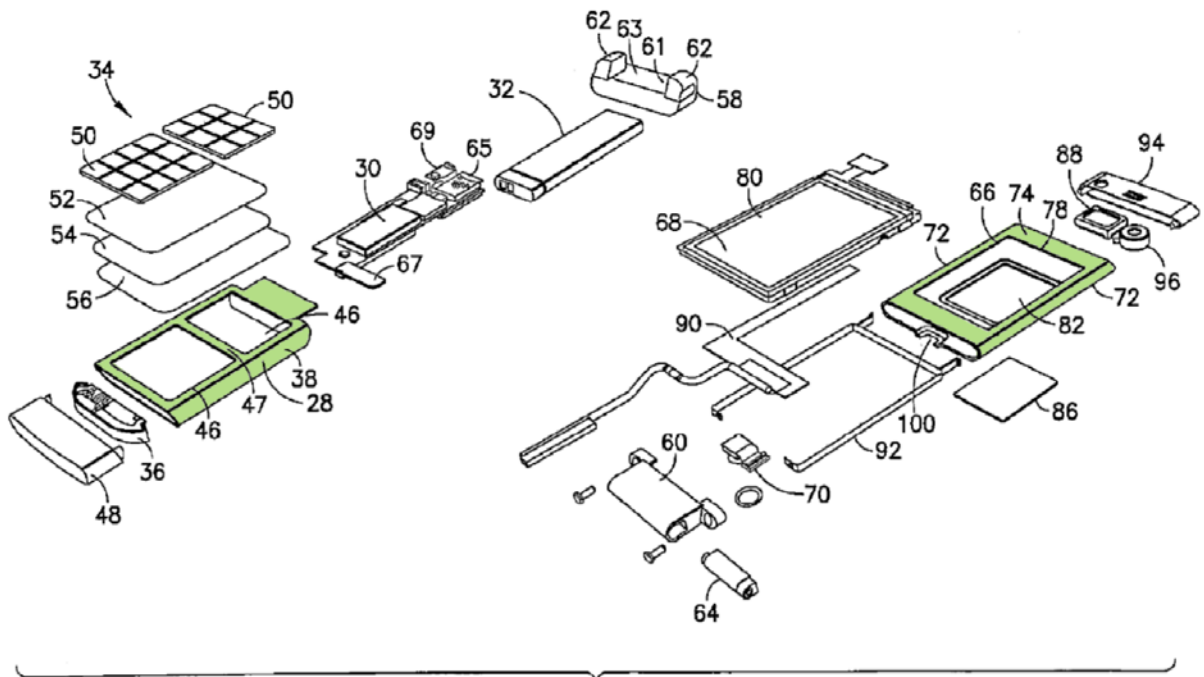


FIG.7

(Ex. 14 ['602 patent], Fig. 7.)

The specification describes each housing shown in Figure 7 in a manner consistent with Apple's proposed construction of the claimed "housing ... forming enclosed lateral sides and a rear side." Taking the example of "housing member 28," the patent explains that it comprises:

- "a one-piece **tubular** member" (*id.*, 3:31-32);
- which "forms a majority of opposite **exterior lateral sides 38 and a rear side 40** of the first section 12" (*id.*, 3:36-38);
- with a "**front side** of the first housing member 28" (*id.*, 3:39-40); and

- “substantially open **top and bottom apertures**” (*id.*, 3:43-44).¹⁶

These are the hallmarks of a tubular shape. (Ex. 15 [Mauro Rep.] ¶¶ 39-48.)

This repeated, consistent, and exclusive description of the claimed “housing . . . forming enclosed exterior lateral sides and a rear side” as **tubular**—without any suggestion that any non-tubular housing may be used to achieve the goals of the invention—only reinforces that Apple’s proposed construction should be adopted. See *CSP Techs, Inc. v. Sud-Chemie AG*, 643 F. App’x 953, 955-57 (Fed. Cir. 2010), *cert. denied*, 137 S. Ct. 376 (2016) (affirming construction of “upper housing portion” as limited to two-piece device because “the specification . . . use[d] the term ‘upper housing portion’ consistently and exclusively in the context of the disclosed two-piece embodiment”); *VirnetX, Inc. v. Cisco Sys., Inc.*, 767 F.3d 1308, 1318 (Fed. Cir. 2014) (“The fact that anonymity is ‘repeatedly and consistently’ used to characterize the invention strongly suggests that it should be read as part of the claim.”); *Eon-Net v. Flagstar Bancorp*, 653 F.3d 1314, 1321 (Fed. Cir. 2011) (construing terms consistent with how the “written description repeatedly and consistently defines the invention”); *Secure Web Conference Corp.*, 640 Fed. Appx. at 914 (construing “security device” as limited to a stand-alone device separate from the microprocessor device where “the specification describe[d] specific advantages gained from separating the security device from the microprocessor-based device, but also . . . never once suggest[ed] embedding the security device within the microprocessor based device”). Indeed,

¹⁶ The specification explains that the front side contains “holes” in which the user input section or keypad is placed. (*Id.*, 3:39-41 (“The front side of the first housing member 28 has holes 46 therethrough for portions of the user input section 34 to be located in the holes.”).) The specification further explains that the apertures at the bottom and top of the tube are covered by the first hinge member 58 and antenna cover 48. (*Id.*, 3:45-47, 4:12-15.) As Figure 7 makes clear, therefore, the tubular housing of the claimed device wraps around the device, may have holes punched into its front surface, and has openings at the top and bottom for “end caps.” (Ex. 15 [Mauro Rep.] ¶ 45.)

the '602 patent purports to improve upon and teaches away from non-tubular housings. (Ex. 14 ['602 patent], 1:18-39.)

Finally, Apple's proposed construction is consistent with the plain meaning of the claim, which requires a "one piece housing . . . forming enclosed exterior lateral sides and a rear side." A person of ordinary skill in the art as of March 29, 2006 (the earliest date to which the '602 patent claims priority),¹⁷ would understand that a "one-piece" housing can only function if it encloses the components of the device on all sides—just as a tubular housing does, as the '602 patent itself confirms. (*Id.*, 3:30-32, 4:54-55, 5:43-45 (describing term "one-piece" consistently and exclusively as a one piece **tubular** member: the "first housing member 28 generally comprises a one-piece tubular member," the "second housing member 66 preferably comprises a one-piece member having a general tubular shape," and the components shown in Figure 11 "are housed in a one-piece metal tubular housing member 118"); Ex. 15 [Mauro Rep.] ¶¶ 36, 39, 47; Ex. 16 [McGraw-Hill Dictionary of Scientific and Technical Terms] at 1015 ("housing" defined as "a case or enclosure to cover and protect a structure or a mechanical device").)

(b) Nokia And The Staff's Proposed "Plain And Ordinary Meaning" Is Both Unclear And Incorrect.

Nokia and the Staff assert that no construction is needed, and that the term "housing . . . forming enclosed exterior lateral sides and a rear side" should be given a purported "plain and

¹⁷ As the patent makes clear, and Nokia agrees, the relevant field is industrial design. (*E.g.*, Ex. 14 ['602 patent], 1:23-25 ("Ultra thin telephone products have emerged in the market, pioneering a new approach in **mechanical architecture for flip-phone designs** (also known a clam-shell handset)."); *id.*, 1:25-27 ("Priority for these products is mechanical thinness, allowing the feature set and **industrial design** to be adjusted to suit this goal."); *id.*, 3:15-19 ("As seen with reference to FIG. 3, the **design** shown has a substantially uniform thickness lower section 12 and a substantially uniform thickness upper section 14 along their entire lengths except for at the hinge 16."); *id.*, 3:24-27 ("Referring also to FIG. 7, there is shown an exploded perspective view of the telephone 10 for details of how the small thickness 24 of about only 15 mm in a **flip-phone design** can be accomplished."); *id.*, 5:63-65 ("The tubular housing members provide an increased strength than conventional **housing designs**."))

ordinary meaning,” which they articulate as a “member that houses forming enclosed exterior lateral sides and a rear side.” That construction is wrong for the reasons discussed above. It also complicates the language of the term without providing any guidance as to its meaning. As Apple understands this proposed construction, it suggests a “member that houses, which forms enclosed exterior lateral sides and a rear side”—which adds nothing to the claim besides confusion.

Moreover, as discussed above, the ’602 patent purports to distinguish the claimed invention from the many mobile phone designs already on the market—by emphasizing its tubular housing structure. Yet, under Nokia’s and the Staff’s construction, any one-piece housing component would arguably satisfy the claim, including in the very prior art devices Nokia claimed to improve upon (because each has at least a partial enclosure on the lateral and rear sides). (Ex. 15 [Mauro Rep.] ¶ 48.) That result would be improper. *See SciMed Life Sys., Inc. v. Advanced Cardiovascular Sys., Inc.*, 242 F.3d 1337, 1343 (Fed. Cir. 2001) (affirming “that the claims should not be read so broadly as to encompass the distinguished prior art structure”); *Koepnick Med. & Educ. Research Found., L.L.C. v. Alcon Labs., Inc.*, 347 F. Supp. 2d 731, 741-42 (D. Ariz. 2004), *aff’d*, 162 F. App’x 967 (Fed. Cir. 2005) (rejecting construction under which “the patent would be invalidated by the wealth of prior art,” including that described in the patent); *Personalized Media Commc’ns, LLC v. Apple, Inc.*, 2016 WL 6299860, at *8 (E.D. Tex. Oct. 26, 2016) (rejecting construction “so broad as it would cover the prior art . . . which [plaintiff] contended in prosecution, and now still contends, did not allow” claimed feature).

V. U.S. PATENT NO. 8,036,619 (“THE ’619 PATENT”)

The ’619 patent, entitled “Oscillator Having Controllable Bias Modes and Power Consumption,” claims priority to September 26, 2001. The patent is directed to a component called a “voltage controlled oscillator” (VCO) that generates a “local oscillator” (LO) signal that radio frequency (RF) communication devices use to receive and transmit wireless signals. The specification describes a way of varying the power consumption of the VCO and the quality of the LO signal by tuning two key parameters. According to the patent, this allows VCOs to be used in “dual mode” cellular phones that can operate with two different cellular systems.

A. Technology Background

1. Cellular Systems / Channel Access Methods

In a cellular system, one or more network base stations (the towers sometimes visible along roads and on top of buildings) communicate wirelessly with one or more user devices, such as cellular phones (sometimes called “mobile stations”). As the ’619 patent admits, many different cellular systems were known in the prior art, including second-generation (2G) standards such as the Global System for Mobile Communications (GSM), and third-generation (3G) standards such as Wideband Code Division Multiple Access (WCDMA). Each of these cellular standards specifies different requirements that user devices must follow to communicate over the network. (Ex. 17 [’619 patent], 1:41-51; Ex. 18 [Woods Rep.] ¶ 64.)

To operate on a cellular system, a cellular phone must be configured to operate on that specific type of system. “Single mode” cellular phones, which have existed since at least the 1970s, can operate with only one cellular system. (Ex. 17 [’619 patent] 1:41-45; Ex. 18 [Woods Rep.] ¶ 31.) By contrast, “dual mode” cellular phones, which had emerged at least by the mid-1990s, can operate with two different cellular systems. (Ex. 17 [’619 patent], 1:45-49; Ex. 18

[Woods Rep.] ¶ 31.) The '619 patent concedes that the prior art included cellular phones “operable with different cellular networks.” (*Id.*, 1:52-56; Ex. 18 [Woods Rep.] ¶¶ 31, 57.)

The word “mode” (as used in the terms “single mode” and “dual mode”) refers to an “access mode” (also known as a “channel access method”), which is the process that a cellular system requires devices to use to “access” a channel on the system. Before the '619 patent, various channel access methods enabled multiple cellular phones to use the same cellular system at the same time. Examples included Frequency Division Multiple Access (FDMA) channel access methods (which assign different users different frequencies in a communication channel), Time Division Multiple Access (TDMA) channel access methods (which divide a common communication channel between different users based on time), and Code Division Multiple Access (CDMA) channel access methods (which use codes to allow users to share the same channel frequencies at the same time). (Ex. 18 [Woods Rep.] ¶¶ 30-33.)

Although a cellular standard will specify the channel access methods that a cellular phone must use to access the cellular system, cellular standards often do not specify many details about how the specified channel access method must be implemented—leaving those details instead to phone designers. In that case, as long as the cellular phone complies with the “access rules” of the specified channel access method (as specified by the standard), the designer can determine the way individual radio components in the cellular phone operate, as well as what other features to include in the phone. (*Id.* ¶ 25.)

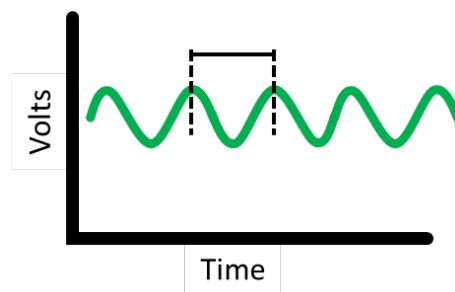
As the '619 patent explains, for example, a cellular phone could be designed to operate certain radio components only when needed during an active conversation (i.e., a “conversation mode”) and to disable those components when not needed (i.e., a “receive/idle mode”). (Ex. 17 [’619 patent], 2:6-12.) Alternatively, the cellular phone’s radio components could be active at all

times for operational simplicity. Yet another design option is a “sleep mode” to save power when the device is neither transmitting nor receiving. None of these operational characteristics is governed by channel access methods. (Ex. 18 [Woods Rep.] ¶ 36.)

Likewise, channel access methods typically do not dictate the use of particular circuit designs in a cellular phone. That said, however, certain types of components are needed for the radio portion of the cellular phone to operate, including an oscillator circuit such as a VCO (described further below). Indeed, the '619 patent itself explains how it was known in the prior art that “[a] local oscillator (LO) signal **is required** for receiving and transmitting in a wireless (RF) communication device, such as a cellular telephone,” and that “[a] voltage controlled oscillator (VCO) is typically used in a phase-locked loop to generate the LO signal.” (Ex. 17 ['619 patent], 1:22-26.)

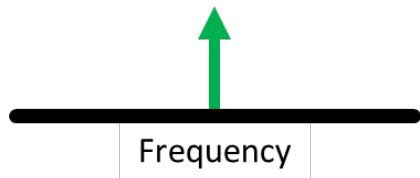
2. Voltage Controlled Oscillators

A VCO, like other types of oscillators, is an electrical circuit that provides an oscillating voltage signal at a particular frequency. Like a pendulum in a clock that swings back and forth, the voltage of a VCO signal cycles between two voltage values. This repeating cycle can be illustrated as a sine wave, like the one shown below:



One cycle is illustrated within the dashed lines, and the number of cycles per second defines the signal's frequency, expressed in Hertz (Hz). (Ex. 18 [Woods Rep.] ¶ 38.)

The frequency components of a signal can also be represented by plotting those components on a frequency axis, as shown below:



In this basic example, the oscillator frequency has only one frequency component, shown as a single upward arrow. If more than one frequency component were present in the oscillator signal, each frequency component would have its own line along the frequency axis. Lower frequencies will appear on the left side of the frequency axis, and higher frequencies will appear on the right side of the axis. (*Id.*)

Oscillating signals are used to transmit information by radio frequency. Specifically, the oscillating signal is used to convert information from its naturally occurring frequency range (e.g., a voice signal at 0-4 kHz) into signals in the much higher radio frequency range (e.g., 925-960 MHz). In other words, these oscillating signals provide a “carrier” for the information in the radio frequency spectrum. (*Id.* ¶ 40.)

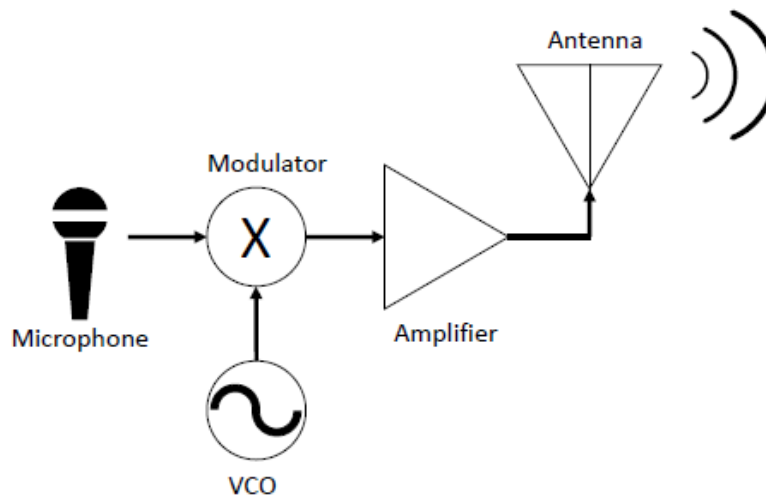
As the name “voltage controlled oscillator” implies, the frequency of the oscillating signal produced by a VCO is controlled by a voltage signal. When used in an RF device like a cellular phone, changing the voltage supplied to the VCO (via a voltage control signal) allows the device to change the frequency that the phone uses to transmit and receive its wireless communications—akin to tuning an FM radio to a particular radio channel. The claimed invention of the ’619 patent does not concern this voltage control signal. (*Id.* ¶ 29.)

To prevent its signal from decaying over time, a VCO must consume power (such as the power supplied by a battery in a cellular phone). This power consumption of oscillators was

well understood before the '619 patent, and it is simply characterized by multiplying the magnitude of the oscillator's voltage supply (called "Vcc" in the '619 patent) by the oscillator's current consumption (a measure of the amount of electricity flowing into the oscillator circuit). Another voltage signal, called a bias voltage ("Vbias" in the '619 patent), controls the oscillator's current consumption. (Ex. 17 ['619 patent], 2:23-30; Ex. 18 [Woods Rep.] ¶¶ 42-43.)

3. Effect Of Phase Noise In Local Oscillator Signals

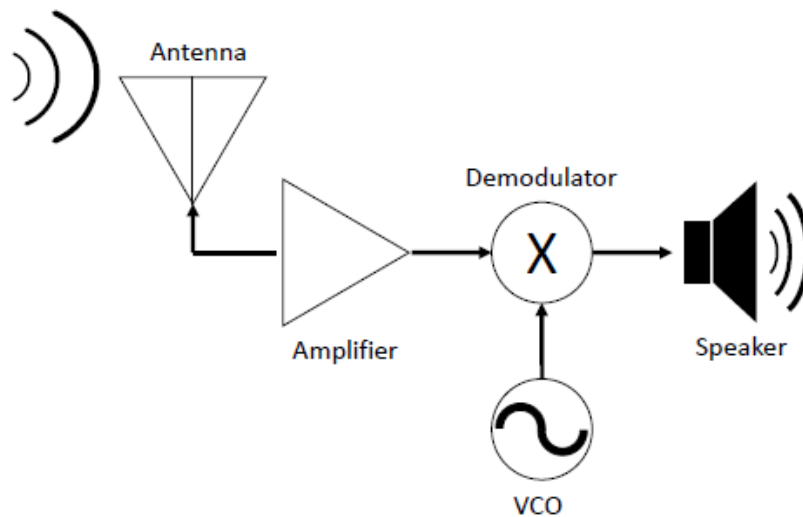
Before the alleged invention of the '619 patent, it was commonplace for RF devices to use VCOs in their radio transmitter, receiver, and/or transceiver circuitry. (Ex. 18 [Woods Rep.] ¶ 44.) A simplified radio transmitter, shown below, shows a VCO in the context of a wireless device (e.g., a cellular telephone):



As a user speaks into the microphone of the cellular phone (on the left), the microphone captures her voice as an electrical signal in the voice frequency band of 0-4 kHz. This voice signal is then passed to a component called a "modulator." Meanwhile, a VCO generates an oscillating signal in the RF band at the desired frequency that corresponds to the user's cellular network (e.g., 900 MHz). This oscillating signal is also passed to the modulator, which

“encodes” the voice signal (received from the microphone) onto the carrier signal (received from the VCO) and passes it to an amplifier (triangle symbol on the right). The amplifier boosts the power of the now radio-encoded signal and transmits it through an antenna. (*Id.* ¶ 46.)

On the other end of the cellular phone call, a receiver performs the reverse process to recover the caller’s voice. A simplified radio receiver is shown below:

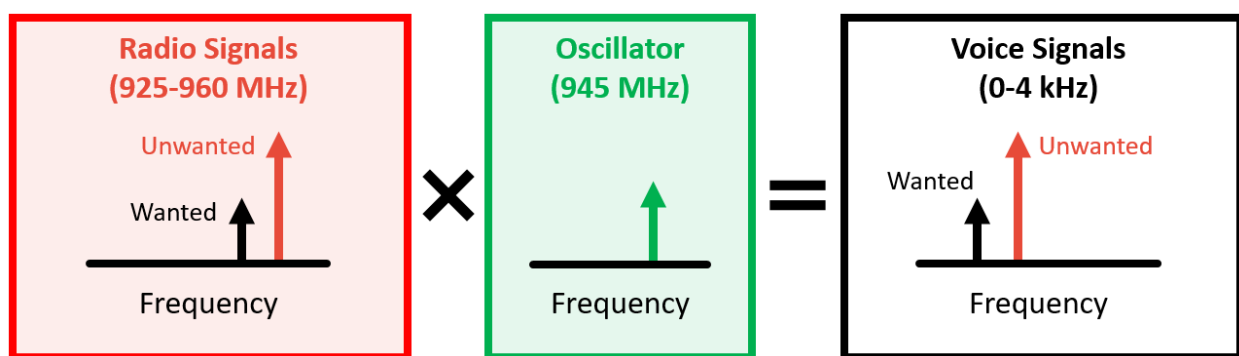


An antenna (on the left) receives the radio signal containing the encoded voice information and passes it to an amplifier (triangle symbol). The amplifier boosts the received radio signal and passes it to a “demodulator.” Again, a VCO in the received cellular phone generates an oscillating signal that matches the carrier frequency of the received signal, and passes the oscillating signal to the demodulator. The demodulator then “decodes” the radio signal by removing the carrier signal components, leaving only the voice signal that had been encoded onto the radio signal. The voice signal is then passed to the cellular phone’s audio system (shown above as a speaker), which recreates the caller’s voice. (*Id.* ¶ 48.)

At any given time, there may be many different kinds of RF signals travelling through the air—some that are intended for a particular user’s cellular phone (e.g., signals representing a voice call involving that device), and others that are not (e.g., signals representing a voice call

involving a different nearby device, or transmissions from other kinds of RF devices such as garage door openers, walkie talkies, satellites, etc.). Some of these unwanted RF signals can interfere with the signal intended for the user’s cellular phone during the demodulation process—particularly those falling within or nearby the frequency range used by the cellular phone. (Ex. 18 [Woods Rep.] ¶¶ 49-50.)

When a demodulator in a cellular phone converts signals from the RF band to the voice frequency band, it may also convert interfering (or unwanted) signals picked up by the receiver. The diagram below, as explained further below, illustrates this phenomenon:



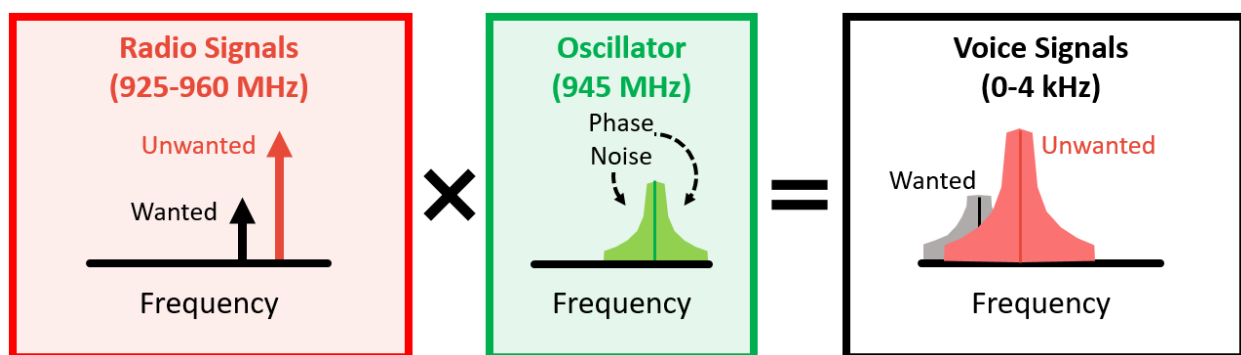
As discussed above, a signal can be represented by plotting its frequency components on a frequency axis. The left panel shows radio signals (wanted signals in black, and unwanted signals in red) far to the right on the frequency axis because their frequency values are relatively high (e.g., 925-960 MHz). Likewise, the oscillator signal (green) in the middle panel is far to the right because its frequency is relatively high as well (e.g., 945 MHz). By contrast, the voice signals shown in the right panel (wanted signals in black, and unwanted signals in red) are far to the left because their frequency values are relatively low (0-4 kHz). (*Id.* ¶ 50.)

The three panels illustrate the demodulation process described above. A demodulator decodes the high-frequency radio signals of the left panel using the oscillator signal of the middle panel to produce the low-frequency voice signals of the right panel. This depiction is an

“ideal” case; an ideal local oscillator signal contains only one frequency (the desired carrier frequency) and will produce a perfect conversion of the wanted and unwanted signals, which the receiver can easily distinguish. (*Id.* ¶ 35.)

In the real world, however, VCOs and the local oscillator signals they produce are not perfect. A real-world oscillator signal has undesired frequency components in addition to the desired carrier frequency component. Thus, the oscillator signal is a distribution of many frequencies rather than a single one. The undesired frequency components are called “phase noise.” (*Id.* ¶¶ 36-37.)

This concept of phase noise is shown in the figures below:

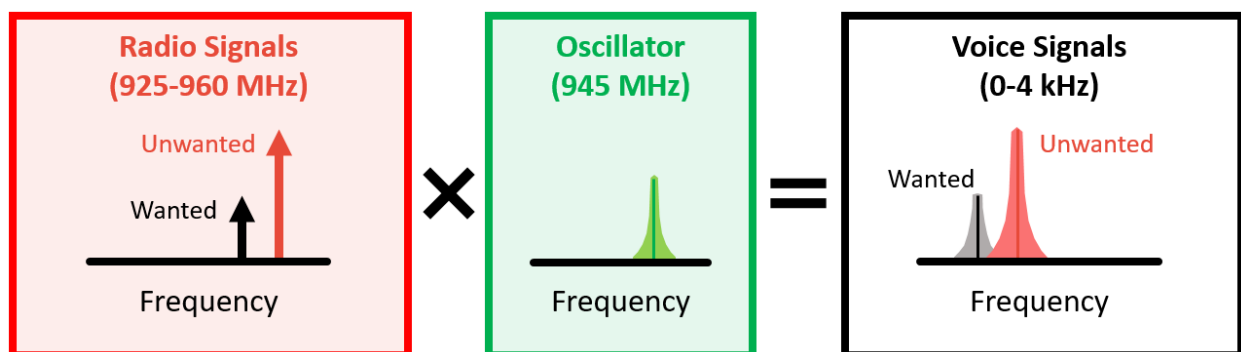


When phase noise is plotted on the frequency axis (shown in the middle panel), the distribution of phase noise frequency components causes the signal to spread to both the left and right of the central carrier signal along the axis. As illustrated in the right panel, this spreading affects the demodulation process and causes the resulting voice signals to spread as well. And when the demodulator uses the “spread-out” oscillator signal to decode the wanted radio signal (shown as having a single frequency component in the left panel), a spread-out voice signal results. The same happens to the unwanted radio signal. (*Id.* ¶¶ 36-37.)

As shown above, because the unwanted interference signal is spread during conversion, it overlaps the frequency range of the wanted information signal. Thus, the RF receiver is unable

to distinguish desired information from unwanted interference, which can distort the user's voice. This problem caused by phase noise in the local oscillator signal was well-known before the '619 patent. (*Id.* ¶ 37.)

It was also known before the '619 patent that increasing the power consumption of the VCO reduced phase noise present in the oscillator signal. A **reduction** in phase noise causes the oscillator signal to spread less along the frequency axis. As shown in the middle panel of the diagram below, although the oscillator signal still shows some spreading, it shows less as compared to the oscillator signal in the diagram immediately above. The diagram below also illustrates the effect on the demodulation process of increasing power consumption and reducing the phase noise of the oscillator signal:



The reduced spreading of the oscillator signals (middle panel) causes the signals decoded using the oscillator signal to spread less (right panel). Because the spreading of the wanted information signal and unwanted interference signal has been reduced (right panel), the overlap between them is reduced. The reduction in overlap between the wanted information signal and unwanted interference signal allows the RF receiver to better distinguish signals from each other, which helps to reduce the harmful results of interference. Because RF circuit designers were aware of the problem of phase noise in oscillator signals, it was commonplace before the '619

patent to design VCOs to avoid unacceptable levels of phase noise based on the expected usage conditions. (*Id.* ¶¶ 38-39.)

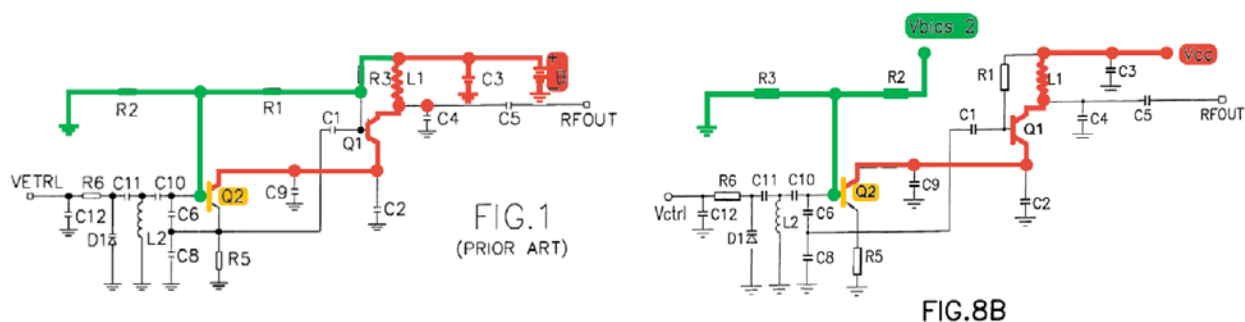
B. The Alleged “Problem” in the Prior Art

The '619 patent recognizes that different prior art cellular systems (e.g., GSM and WCDMA) afforded designers different ways to reduce power consumption, and that different usage conditions placed different demands on the required quality of the VCO signal. (*Id.*, 1:13-18, 1:34-38, 1:41-47.) It also acknowledges that controlling a VCO's current consumption and operating voltage was known in the prior art, along with how to generate a quality VCO signal for a single-mode cellular phone designed for use with one cellular system. (*Id.*, 1:41-45, 1:57-61.) According to the named inventors, however, designers of dual-mode cellular phones only had two options: (i) provide one VCO designed for use with one of the two cellular systems; or (ii) include multiple VCOs, one for each supported cellular system. (*Id.*, 1:45-51.)

C. Nokia's Supposed “Solution”

The '619 patent describes a VCO with adjustable performance and power consumption. Adjustments are made by varying the VCO's operating voltage (V_{cc}) and/or its current consumption control (V_{bias}). These adjustments are made based on RF channel conditions (e.g., a signal-to-noise ratio and/or a received signal strength indicator) and/or an operational mode of the RF communications device (e.g., a conversational mode versus an idle mode). The adjustments to V_{cc} and V_{bias} are also made to “minimize power consumption as a function of an amount of allowable local oscillator phase noise.” (*Id.*, 3:48-51, 3:59-61, 4:4-6, 5:54-6:3, 8:39-52.) The patent does not elaborate as to what amount(s) of local oscillator phase noise are “allowable.”

The '619 patent describes its proposed solution as a minor modification to a known VCO circuit described in an earlier issued patent, U.S. Patent No. 5,926,071 (“the '071 patent”). (*Id.*, 7:46-50 (“FIG. 8A is a more detailed schematic diagram of the VCO 10 of FIG. 3 and FIG. 8B is a more detailed schematic diagram of the VCO 10 of FIG. 4. **Note that these schematic diagrams are based on FIG. 1 of US. Pat. No. 5,926,071.**”).¹⁸ Figure 1 of the prior art '071 patent is shown below (left) next to Figure 8B of the '619 patent, both with annotations:



Like the '071 patent, the '619 patent circuit includes an oscillator transistor Q2 (yellow) coupled to a power supply voltage (red) and a bias voltage network output provided to a control input of the oscillator transistor (green). In the admitted prior art figure, “B” is a battery that is equivalent to the Vcc of Figure 8B. (Ex. 19 ['071 patent], 2:3-5.) The only structural difference between the embodiment shown in Figure 8B of the '619 patent and the circuit of the admitted prior art is the bias network’s (green) voltage feed, Vbias. The '619 patent describes separately controlling Vcc and Vbias to vary the power consumption and phase noise of the VCO based on RF channel conditions and/or an operational mode. (Ex. 17 ['619 patent], claims 1, 7, 18, 20, 31, 46, 60, 79.)

For example, the '619 patent proposes different Vbias settings for two operating modes—one for a conversation mode when operating with a WCDMA cellular system, and one for use

¹⁸ The '071 patent discloses a “basic configuration of a typical prior art voltage controlled oscillator (VCO)” designed to minimize the operating current of the VCO by keeping the operating voltage as low as possible. (Ex. 19 ['071 patent], 1:13-23.)

when operating with a GSM cellular system. (*Id.*, 5:54-64.) The different Vbias settings cause the VCO to consume different amounts of power in the different operating modes. In another example, the levels of Vcc and Vbias are controlled to accommodate changing RF channel conditions. (*Id.*, 6:20-27.) When the channel conditions are favorable and relatively low phase noise is present, the Vcc and Vbias magnitudes are decreased to reduce power consumption. (*Id.*, 6:27-31.) Conversely, if the channel conditions are unfavorable and lower phase noise is required, then Vcc and Vbias are increased to reduce phase noise at the price of higher power consumption. (*Id.*, 6:31-39.)

Alternatively, rather than vary the power consumption and phase noise of the VCO, the '619 patent describes turning off the VCO when it is not needed. (*Id.*, 2:53-56 (“In order to reduce overall power consumption it may be possible to turn off the VCO and possibly also the associated PLL loop, such as when no signal is being received or transmitted.”).)

D. The Asserted '619 Claims

Nokia has asserted 45 of the '619 patent's 83 claims, including independent claims 1, 7, 18, 20, 31, 46, 60, and 79.¹⁹ Claim 1 and its dependent claims recite a “circuit.” Claim 1 is set forth below, with the disputed term emphasized in bold/italics:

1. A circuit comprising:

an oscillator transistor configured to be powered by a power supply voltage (Vcc),

a biasing network having bias voltage outputs configured to receive a control input of said oscillator transistor, said bias voltage network configured to be powered by Vcc, and

circuitry configured to set a magnitude of Vcc as a function of at least one of radio frequency channel conditions or an ***operational***

¹⁹ Nokia asserts claims 1, 3-7, 9-12, 18-21, 23-24, 31, 37-38, 46-51, 53-54, 58-61, 68-74, 76-80, and 82-83 of the '619 patent.

mode of the radio frequency communications device, wherein a value of Vcc is set so as to minimize power consumption as a function of an amount of allowable local oscillator phase noise.

Claim 7 and its dependent claims recite a “circuit.” Claim 7 is set forth below, with the disputed term emphasized in bold/italics:

7. A circuit for comprising:

an oscillator transistor coupled to a power supply voltage (Vcc),

a bias voltage network having bias voltage outputs configured to be provided to a control input of said oscillator transistor, said bias voltage network configured to be provided with a another power supply voltage Vbias, and

circuitry configured to set a magnitude of both Vcc and Vbias as a function of at least one of radio frequency channel conditions or an ***operational mode of a radio frequency communications device***, wherein ***the values of Vcc and Vbias are set so as to minimize power consumption as a function of an amount of allowable local oscillator phase noise.***

Claim 18 and its dependent claims recite an “apparatus.” Claim 18 is set forth below, with the disputed term emphasized in bold/italics:

18. An apparatus, comprising:

an oscillator configured to provide an oscillator signal to at least one of a radio frequency receiver and a radio frequency transmitter that comprise a part of a ***multi-mode communication device***; and

circuitry configured to vary power consumption of said oscillator by changing a value of at least one of a supply voltage (Vcc) and a bias voltage of said oscillator, in response to a ***mode of operation*** of the ***multi-mode communication device***, to adjust a phase noise of the oscillator.

Claim 20 and its dependent claims recite a “method.” Claim 20 is set forth below:

20. A method, comprising:

providing a local oscillator signal to at least one of a radio frequency transmitter and a radio frequency transceiver, and

responsive at least to a signal obtained at least in part from the radio frequency receiver, controlling power consumption of an oscillator that provides the local oscillator signal by changing a value of at least one of a supply voltage and an input bias voltage of the oscillator to adjust a phase noise of the oscillator.

Claim 31 and its dependent claims recite a “method.” Claim 31 is set forth below, with the disputed term emphasized in bold/italics:

31. A method, comprising:

providing a local oscillator signal to at least one of a radio frequency transmitter and a radio frequency receiver; and

responsive at least to a ***mode of operation*** of the device, controlling power consumption of an oscillator that provides the local oscillator signal by changing a value of at least one of a supply voltage and a bias voltage of the oscillator to adjust a phase noise of the oscillator.

Claim 46 and its dependent claims recite a “circuit.” Claim 46 is set forth below, with the disputed term emphasized in bold/italics:

46. A circuit, comprising:

a voltage controlled oscillator configured to provide an oscillator signal to at least one of a radio frequency receiver and a radio frequency transmitter; and

circuitry configured to provide at least a variable supply voltage to said voltage controlled oscillator, ***said variable supply voltage having a magnitude that is controlled to operate said voltage controlled oscillator with a current consumption that is established as a function of a voltage controlled oscillator output signal quality needed for operation in one of a plurality of modes by adjusting the phase noise of the voltage controlled oscillator.***

Claim 60 and its dependent claims recite a “processor.” Claim 60 is set forth below, with the disputed term emphasized in bold/italics:

60. A processor comprising:

while operating under control of software in a ***multi-mode radio frequency device***, execution of the software resulting in processor operations that comprise:

in response to an ***operational mode of the multi-mode radio frequency device***, generating at least one signal that is provided to an oscillator that provides a local oscillator signal; and

in response to the generated at least one signal, changing a value of at least one of a supply voltage and a bias voltage of the oscillator so as to tune phase noise of the voltage controlled oscillator corresponding to the ***operational mode of the multi-mode radio frequency device***.

Claim 79 and its dependent claims recite a “phased locked loop.” Claim 79 is set forth below, with the disputed term emphasized in bold/italics:

79. A phase locked loop comprising:

a voltage controlled oscillator configured to provide a local oscillator signal for at least one of an inphase/quadrature modulator or an inphase/quadrature demodulator, wherein the voltage controlled oscillator comprises:

an oscillator transistor configured to receive a power supply voltage (Vcc), a bias voltage network having bias voltage outputs configured to be provided to a control input of said oscillator transistor, said bias voltage network configured to be provided with a another [sic] power supply voltage (Vbias), and

circuitry configured to vary a magnitude of both Vcc and Vbias as a function of an ***operational mode of a radio frequency communications device***.

E. Level of Ordinary Skill in the Art for the '619 Patent

At the time of the '619 patent's alleged priority date, a person of ordinary skill in the art would have had (1) a Bachelor of Science degree in Electrical Engineering or related discipline, and three to four years of experience in integrated circuit design, (2) a Master of Science degree in Electrical Engineering or related discipline, and two to three years of experience in integrated circuit design, or (3) equivalent educational and professional experience.

Nokia contends that a person of ordinary skill in the art would have “either (1) a bachelor of science in electrical engineering or related field and four years of experience in RF or wireless circuit design or (2) a master of science in electrical engineering or related field with two years of experience in RF or wireless circuit design.” This proposed definition is incorrect. The use of VCO circuits is not limited to RF or wireless circuit designs. Rather, VCOs were part of clocking circuits in integrated circuit (IC) designs long before the ’619 patent. (Ex. 18 [Woods Rep.] ¶ 29.) Thus, when implementing a VCO in an RF device, a designer would not have limited herself to RF devices or wireless devices only, but would also have looked to IC design in general for issues involving phase noise and power consumption control. (*Id.*)

F. Disputed Claim Terms

1. **“operational mode of [a/the] radio frequency communications device” (claims 1, 4-7, 10-12, 60, 79, 83); “mode of operation” (claims 18, 21, 23, 24, 31, 37, 38, 68-74, 76, 77); “one of [a/the] plurality of modes” (claims 46-51)**

“operational mode of [a/the] radio frequency communications device”²⁰		
Apple’s Construction	Nokia’s Construction	Staff’s Construction
Plain meaning; no construction required Alternatively: “A way in which the radio frequency communications device operates”	“air interface of [a/the] radio frequency communications device (e.g., GSM, CDMA, WCDMA)”	“cellular system of [a/the] radio frequency communications device” Examples of such cellular systems include GSM, CDMA, WCDMA, TDMA, etc.
“mode of operation”		
Apple’s Construction	Nokia’s Construction	Staff’s Construction

²⁰ As used in dependent claims 4-6, 10-12, and 83, the term “operational mode” refers back to the term “operational mode of [a/the] radio frequency communications device” as used in independent claims 1, 7, and 79. Further, the term “mode of operation,” as used in claims 68-74 and 76-77, refers back to the term “operational mode of the multi-mode radio frequency device” as used in independent claim 60.

Plain meaning; no construction required Alternatively: “A way of operating”	“air interface (e.g., GSM, CDMA, WCDMA)”	“cellular system” Examples of such cellular systems include GSM, CDMA, WCDMA, TDMA, etc.
“one of [a/the] plurality of modes”		
Apple’s Construction	Nokia’s Construction	Staff’s Construction
Plain meaning no construction required Alternatively: “One of a plurality of ways of operating”	“one of at least two air interfaces (e.g., GSM, CDMA, WCDMA)”	“one of at least two cellular systems” Examples of such cellular systems include GSM, CDMA, WCDMA, TDMA, etc.

The primary dispute centers around whether the terms “operational mode of [a/the] radio frequency communications device,” “mode of operation,” and “one of a plurality of modes” should be construed to have their plain meaning as used in the ’619 patent—i.e., as “a way in which the radio frequency communications device operates,” “a way of operating,” and “one of a plurality of ways of operating,” respectively—as Apple contends, or whether they should be limited to a set of “air interfaces” or “cellular systems,” as Nokia and the Staff propose. Apple’s construction should be adopted because it covers **all** the various operating modes described in the ’619 patent, including those unrelated to air interfaces and cellular standards. By contrast, Nokia’s and the Staff’s proposed constructions would improperly narrow the claim in a manner that excludes these disclosed embodiments.

a. **Apple’s Proposed Construction Should Be Adopted.**

The intrinsic record confirms that, as used in the asserted claims, the named inventors intended to use the disputed terms in accordance with their plain and ordinary meaning: i.e., as “a way in which the radio frequency communications device operates” (for “operational mode of [a/the] radio frequency communications device”), as “a way of operating” (for “mode of

operation”), and as “one of a plurality of ways of operating” (for “one of [a/the] plurality of modes”).

First, the plain language of the claims confirms Apple’s position. The relevant claim limitations require the oscillator circuitry in an RF device to be capable of adjusting its power and/or phase noise characteristic “as a function of” either the RF channel conditions or the operational mode of the device—without placing **any limits** on the specific types of covered operational modes:

- “circuitry configured to set a magnitude of Vcc as a function of at least one of radio frequency channel conditions or an **operational mode** of the radio frequency communications device” (claim 1);
- “circuitry configured to set a magnitude of both Vcc and Vbias as a function of at least one of radio frequency channel conditions or an **operational mode** of a radio frequency communications device” (claim 7);
- “circuitry configured to vary power consumption . . . in response to a **mode of operation**” (claim 18);
- “providing a local oscillator signal . . . responsive at least to a **mode of operation** of the device” (claim 31);
- “a voltage controlled oscillator output signal quality needed for operation in **one of a plurality of modes**” (claim 46);
- “changing a value of at least one of a supply voltage and a bias voltage of the oscillator so as to tune phase noise of the voltage controlled oscillator corresponding to the **operational mode**” (claim 60);
- “circuitry configured to vary a magnitude of both Vcc and Vbias as a function of an **operational mode** of a radio frequency communications device” (claim 79).

The breadth of those limitations is further reinforced by multiple dependent claims that list various operational modes—some that are specific to cellular standards, and others that are not. For example, dependent claims 52 and 75 both refer to “a multi-media mode” as a type of operational mode. (Ex. 17 [’619 patent], claim 52 (“The circuit in claim 46, **where one of the plurality of modes comprises a multi-media mode.**”); *id.*, claim 75 (“The processor as in claim

60, where ***the current mode of operation comprises a multi-media mode.***”).) A person of ordinary skill in the art would understand the operational mode required by these claims is a mode involving more than one type of media (e.g., text, audio, graphics, animation, and full-motion video)—which has nothing to do with the specific cellular standard or air interface used. (Ex. 18 [Woods Rep.] ¶ 60; Ex. 20 [IEEE Dictionary] at 713 (“multimedia: A form of hypermedia consisting of a combination of two or more forms of the following: text, audio, graphics, animation, and full-motion video.”); Ex. 21 [Newton’s Telecom Dictionary] at 554 (“Multimedia is the combination of multiple forms of media in the communication of information. Multimedia enables people to communicate using integrated media: audio, video, text, graphics, fax, and telephony”); Ex. 22 [Dictionary of Communications Technology] at 348 (“multimedia: A term used to reference the combination of two or more media types, such as text and video.”).)

Because only Apple’s plain meaning constructions would cover such a “multi-media mode”—while Nokia and the Staff would exclude it with their cellular system-based and air interface-based proposals—Apple’s definitions should be adopted for this reason alone. *See Trs. of Columbia Univ.*, 811 F.3d at 1370 (rejecting a construction that would define “the independent claim to exclude material covered by the dependent claim”).

Second, the specification is also consistent with Apple’s proposed construction. As an initial matter, the specification repeatedly uses the terms “operational mode” and “mode of operation,” without ever suggesting an intent to limit or qualify the terms as limited to cellular standards or air interfaces:

- “Circuitry is provided for setting a magnitude of V_{cc} and/or V_{bias} as a function of at least one of RF channel conditions, such as channel conditions determined from a calculation of the (SNR), or ***an operational mode*** of the RF communications device.” (Ex. 17 [’619 patent], Abstract.)

- “Circuitry is provided for setting a magnitude of Vcc and/or Vbias as a function of at least one of RF channel conditions ... or **an operational mode** of the RF communications device.” (*Id.*, 2:30-34.)
- “Using these teachings the MS 100 is enabled to adjust or tune the phase noise of the VCO according to the **mode of operation** of the transceiver, and to thus control the amount of current consumption as a function of the required VCO signal quality.” (*Id.*, 6:35-39.)
- “The teachings of this invention enable one to better optimize the performance of MS 100 for different modes and conditions, and to optimize the power consumption to the current **mode of operation.**” (*Id.*, 7:25-28.)

Nothing in these generic disclosures justifies narrowing the claimed modes of operation to just cellular systems or air interface standards. *See Ottah v. VeriFone Sys., Inc.*, 524 F. App’x 627, 629 (Fed. Cir. 2013) (affirming plain meaning construction where “nothing in the specification suggests that the claim language should be interpreted in a way at variance with its ordinary meaning”); *Teleflex, Inc. v. Ficosa N. Am. Corp.*, 299 F.3d 1313, 1327-28 (Fed. Cir. 2002) (rejecting narrow construction of term where patent was devoid of “clear statements of scope” limiting the term); *Certain Sleep-Disordered Breathing Treatment Sys. & Components Thereof*, Inv. No. 337-TA-890, 2014 WL 279834, Order No. 8, at 8-9 (Jan. 16, 2014) (rejecting narrow construction where term has “an ordinary meaning that is readily apparent”).

In addition, when referring to specific kinds of operational modes, the specification explicitly refers to numerous examples that might be used **in addition to or instead of** those based on the cellular standard or air interface used—including a “multi-media mode,” a “conversation mode,” a “sleep stage or mode,” a “receive/idle mode,” and a “lower power consumption mode”:

- “However, the WCDMA may be only one mode out of two or more in the MS 100, so that the problems introduced by its operation may disappear **when operating in another mode**, such as the TDMA GSM mode, **or in a multi-media mode.**” (Ex. 17 [’619 patent], 7:21-24.)

- “WCDMA-based systems require low VCO power consumption as the VCO 10 must be turned on almost continuously during the **conversation mode or state**.” (*Id.*, 5:62-64.)
- “Also, in conventional usage the VCO has been powered on all the time in the **conversation mode**, while in the **receive/idle mode** the VCO has the fixed bias level” (*Id.*, 2:6-8.)
- “It has been known to calculate the SNR using DSP 116A software for enabling the **sleep stage or mode** of the MS receiver. However, the SNR information is available as well in the **idle mode** and in the **conversation mode**.” (*Id.*, 6:51-54.)
- “When the SNR is found to exceed some threshold, and the VCO 10 cannot be shut off, then Vcc can be reduced, along with Vbias2, to run the VCO 10 in a **lower power consumption mode**.” (*Id.*, 6:27-31.)

It would be error to construe the claims in a manner that excludes these disclosed modes of operation—all of which are independent from the specific cellular standard or air interface used, and some of which (e.g., a “lower power consumption mode”) are directed to the state of the VCO component found within the RF device. See *MBO Labs, Inc. v. Becton, Dickinson & Co.*, 474 F.3d 1323, 1333 (Fed. Cir. 2007) (rejecting construction that would exclude two disclosed embodiments, stating “[a] claim interpretation that excludes a preferred embodiment from the scope of the claim is rarely, if ever, correct” (quoting *On-line Techs., Inc. v. Bodenseewerk Perkin-Elmer GmbH*, 386 F.3d 1133, 1138 (Fed. Cir. 2004))).

In sum, because nothing in the intrinsic record suggests that the named inventors intended for the disputed terms to have anything other than their plain and ordinary meaning, and because that plain meaning covers every example operational modes set forth in the specification, that plain meaning applies here, just as Apple has proposed.

b. Nokia’s And The Staff’s Proposed Constructions Should Be Rejected.

In an apparent attempt to avoid prior art that discloses certain types of operational modes, Nokia proposes to limit the disputed terms to types of “air interfaces,” such as those set forth in

the GSM, CDMA, and WCDMA standards. Similarly, the Staff proposes to limit the “operational mode” terms to “cellular systems,” including GSM, CDMA, and WCDMA.

As noted above, however, nothing in the ’619 patent limits the claims in either manner. As an initial matter, the term “air interface” does not appear anywhere in the patent. Moreover, the patent describes channel access methods such as TDMA, GSM, and CDMA as mere “examples” of operational modes, without ever indicating any intent to limit the asserted claims to those specific operational mode **examples**. (Ex. 17 [’619 patent], 2:36-39 (“The **operational mode can be, for example**, one of a TDMA, burst-type narrow bandwidth mode, or a CDMA, substantially continuous, wider bandwidth mode”).) Therefore, it would be error to limit the claims to those examples. See *Hill-Rom Servs. v. Stryker Corp.*, 755 F.3d 1367, 1371 (Fed. Cir. 2014) (“[W]e do not read limitations from the embodiments in the specification into the claims.”); Ex. 23, *Certain Air Mattress Systems*, Inv. No. 337-TA-971, Order No. 19 at 12 (May 11, 2016) (rejecting “attempts to limit . . . terms to a single embodiment”); *Certain Ink Cartridges & Components Thereof*, Inv. No. 337-TA-565, Final Determination, at *136 (Dec. 2010) (“[U]se of the phrase ‘[f]or example’ shows that elements . . . are exemplary in nature and do not redefine [the term] as limited to the [exemplary] structures.”).

2. **“multi-mode communication device” / “multi-mode device” / “multi-mode radio frequency device” (claims 18-19, 21, 23, 37, 60, 68)**

Apple’s Construction	Nokia’s Construction	Staff’s Construction
Plain meaning; no construction required Alternatively: “A [communication device / device / radio frequency device] that operates with multiple cellular systems”	“communication device capable of operating according to multiple air interfaces (e.g., GSM, CDMA, WCDMA)”	“[communication device/device/radio frequency device] that operates with multiple cellular systems” Examples of such cellular systems include GSM, CDMA, WCDMA, TDMA, etc.

All parties appear to agree that these three disputed “multi-mode” terms refer to RF communication devices that use multiple channel access methods. The parties disagree, however, regarding how best to express that meaning in a construction. Apple’s and the Staff’s construction should be adopted because it is consistent with the plain meaning of the terms, and is grounded in the very language that the named inventors used in describing multi-mode devices.

Specifically, the term “multi-mode device” has a well-understood meaning in the field of RF communication devices: it refers to devices capable of operating with multiple channel access methods, such as TDMA GSM, CDMA, and WCDMA. (Ex. 18 [Woods Rep.] ¶¶ 63-65.)²¹ The ’619 patent confirms that the named inventors intended to use the disputed terms consistent with that ordinary meaning.

For example, the specification discloses “mobile stations” (such as cellular phones) that operate with multiple cellular systems—which it labels “dual and higher mode mobile stations” or “multi-mode” mobile stations. (Ex. 17 [’619 patent], 1:13-18, 1:41-51; Ex. 18 [Woods Rep.] ¶ 66.) Therefore, the patent itself confirms that a “multi-mode” device is a device that operates with multiple cellular systems.

Moreover, when the patent refers to a mobile station that can use different channel access methods, it explains that the device “**operates with**” the specific type of cellular “**system.**” (Ex. 17 [’619 patent], 1:41-48 (“When a mobile station is required to **operate with** only one cellular **system**, such as the Global System for Mobile Communications (GSM) **system** or a wideband code division multiple access (WCDMA) **system**”); *id.*, 2:6-14 (“TDMA-type **system**”); *id.*,

²¹ The ’619 patent expressly states that it is directed to the field of RF communications. (Ex. 17 [’619 patent], 2:21-23 (“Disclosed is an oscillator circuit for use in a local oscillator of an RF communications device that communicates over an RF channel.”).)

4:30-31 (“time-division **system**”); *id.*, 6:4-7 (“**systems** using time division duplex (TDD)”); *id.*, 7:17-20 (“WCDMA **system**”). This is the same verbiage that Apple and the Staff have proposed in their constructions—i.e., “A [communication device / device / radio frequency device] that **operates with multiple cellular systems.**”

Nokia alone proposes to construe the disputed “multi-mode” terms by reference to “air interfaces.” As noted above, however, the words “air interface” do not appear anywhere in the ’619 patent. A proper construction should rest on the words that the named inventors chose to use when writing their patent, rather than importing a new term that is not defined or otherwise discussed in the intrinsic record. Indeed, the Commission has previously rejected the very construction Nokia proposes—“air interface”—where that term was absent from the patent. *See Certain Baseband Processor Chips & Chipsets*, Inv. No. 337-TA-543, USITC Pub. No. 4258, 2011 WL 6175074, at *69-70 (Oct. 10, 2006) (rejecting construction that would narrow the term “wireless communication” to “*air interface protocols*” because “neither the patent or prosecution history uses the term ‘air interface,’ so there is no support to limit the claim to such a narrow interpretation”); *see also Phillips*, 415 F.3d at 1316 (“The construction that stays true to the claim language and most naturally aligns with the patent’s description of the invention will be, in the end, the correct construction.” (citing *Renishaw PLC v. Marposs Societa’ per Azioni*, 158 F.3d 1243, 1250 (Fed. Cir. 1998))).

3. **“a value of Vcc is set so as to minimize power consumption as a function of an amount of allowable local oscillator phase noise” (claims 1); “the values of Vcc and Vbias are set so as to minimize power consumption as a function of an amount of allowable local oscillator phase noise” (claims 7)**

Apple’s Construction	Nokia’s and Staff’s Construction
(claim 1) Indefinite	“a value of Vcc is set at or near the minimum required level according to an amount of allowable local oscillator phase noise”

(claim 7) Indefinite	“the values of Vcc and Vbias are set at or near the minimum required level according to an amount of allowable local oscillator phase noise”
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These claim limitations require setting the value of Vcc or Vbias—the oscillator circuit’s power consumption controls—to minimize power consumption “as a function of an amount of allowable local oscillator phase noise.” The parties’ primary dispute is whether the claim phrase is indefinite, as Apple proposes, or whether it has the meaning that Nokia and the Staff have proposed, which even they do not cast as plain and ordinary meaning. Because the ’619 patent fails to teach what constitutes an “allowable” level of phase noise, this term is indefinite. By contrast, Nokia’s and the Staff’s construction should be rejected because it would alter the claim significantly, without addressing the underlying deficiencies in the term as a whole.

a. **The Disputed Claim Phrase Is Indefinite.**

As noted above, “a patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent . . . fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention.” *Nautilus*, 134 S. Ct. at 2124; *see Interval Licensing*, 766 F.3d at 1371 (holding under *Nautilus* that a claim term is indefinite if the patent fails to provide “objective boundaries for those of skill in the art” to understand the full scope of the claims). Under this controlling standard, the requirement to set the value of the Vcc and/or Vbias so as to minimize power consumption “as a function of an amount of allowable local oscillator phase noise” is indefinite.

The “**allowable** local oscillator phase noise” portion of the limitation is inherently subjective—given that the degree of phase noise that can exist in a system may vary widely, and what constitutes an “allowable” amount of phase noise also can vary significantly among

different engineers.²² For example, (i) one engineer seeking a high quality output may view only the lowest achievable phase noise as “allowable,” (ii) a second engineer willing to sacrifice some signal quality in view of costs or other considerations might view a slightly higher amount of phase noise as “allowable,” and (iii) a third engineer seeking to achieve the lowest cost solution might be willing to treat a phase noise level just below the point at which the oscillator becomes unusable as “allowable.” (*Id.* ¶ 72.)

The patent provides no guidance that would enable persons of ordinary skill to assess with any reasonable certainty which of these phase noise examples (if any) is “allowable” and which ones (if any) are not. Rather, the patent leaves that determination to the discretion of individual circuit designers and their subjective views concerning the many considerations and tradeoffs that can influence the design of a VCO—including component cost, desired power savings, desired margin for error from what amount renders the oscillator unusable, and desired level of performance above the minimum operable level.

Indeed, the ’619 specification only mentions the phrase “allowable phase noise” twice. The first instance simply mirrors the claim language, and thus provides no objective guidance as to what level of phase noise is “allowable” within the scope of the claims. (Ex. 17 [’619 patent], 2:39-41 (“The value of V_{cc} and/or V_{bias} may be set so as to minimize power consumption **as a function of an amount of allowable local oscillator phase noise.**”).) And the second instance uses similar language, with a generic reference at the end to “RF channel quality.” (*Id.*, 2:47-52 (referring to “circuitry coupled between the processor and the VCO for minimizing at least VCO power consumption **as a function of an amount of allowable VCO phase noise for a current**

²² As discussed above, “phase noise” refers to the fluctuations in an oscillator signal’s frequency that causes the desired signal to be obscured by unwanted interference. (Ex. 18 [Woods Rep.] ¶¶ 52-55)

RF channel quality”).) The patent does not define “RF channel quality,” nor does the patent explain how to determine objectively whether an “allowable” amount of phase noise exists with respect to “RF channel quality”—or for any of the many other potential factors that an engineer might consider when assessing a desired level of phase noise.²³

Accordingly, because the disputed phrase uses a subjective term of degree (“allowable”), without disclosing objective criteria that would permit ordinarily-skilled artisans to determine when that level of degree is satisfied, the term is indefinite. See *Interval Licensing*, 766 F.3d at 1373-74 (finding “facially subjective claim language” indefinite where it lacked an “objective boundary”); *GE Lighting Sols., LLC v. Lights of Am., Inc.*, 663 F. App’x 938, 940 (Fed. Cir. 2016) (finding term “elongated” indefinite because the patent provided “no objective means to determine [what is] ‘elongated’ and [what is] not”); *Datamize*, 417 F.3d at 1350-51 (finding “aesthetically pleasing” indefinite because “the meaning of the claim language would depend on the unpredictable vagaries of any one person’s opinion” and the patent failed to provide “a workable objective standard”).

In the end, given the subjective and undefined nature of the term “allowable,” a person of ordinary skill in the art is left with at least the following questions:

- **What** is the test for determining whether a phase noise level is “allowable”?
- **How** precise is the amount of “allowable” phase noise? Is it a single value, a range, or something else? Does the **highest**, the **lowest**, or some **intermediate** level of phase noise that is still “allowable” fall within the scope of the claim?
- **What** is the claimed functional relationship between “allowable” phase noise and power consumption?

²³ The specification also only twice refers to “phase noise” (apart from the two references to “allowable phase noise” discussed above); neither provides any objective guidance about how to determine an “allowable” amount of phase noise. (Ex. 17 [’619 patent], 1:26-29, 6:35-39.)

Because these unanswered questions confirm that a person of ordinary skill would be unable to ascertain the meaning of the disputed claim language with reasonably certainty, the phrase should be found indefinite.

b. Nokia's And The Staff's Construction Is Incorrect.

Nokia and the Staff do not contend that the disputed claim language has any plain and ordinary meaning as used in the claims. Instead, they argue that the disputed phrase should be construed to mean “[a value of V_{cc} is set / the values of V_{cc} and V_{bias} are set] at or near the minimum required level according to an amount of allowable local oscillator phase noise.” That argument fails for the following reasons.

First, the construction leaves intact the ambiguous, subjective phrase “allowable local oscillator phase noise.” As explained above, “allowable” is a purely subjective claim phrase, and the written description provides no objective guidance on how to determine an “allowable” amount of phase noise.

Second, Nokia and the Staff propose to replace “minimize” with “at or near the minimum.” But it is unclear what would be considered sufficiently “near” the minimum—and the patent does not provide any acceptable range of proximity to the purported “minimum.” In addition, “near the minimum” improperly expands the plain meaning of “minimize,” which means “to reduce to the smallest possible amount or degree.” Ex. 24 [Random House Webster's College Dictionary] at 843.)

Third, Nokia's and the Staff's substitution of “required level” for “power consumption” is also unjustified. The term “required level” is itself undefined and disassociated from any objective metric; the specification never discloses a “required level” for a value of V_{cc} or V_{bias} . This is especially problematic because the proposed construction relates two subjective terms—a

“required level” with an “allowable” amount. Thus, one of skill in the art would not know how to calculate the level required. (Ex. 18 [Woods Rep.] ¶¶ 72-76.)

Removing the term “power consumption” also would eliminate the claims’ sole reference to the stated objective of the ’619 patent—decreasing power consumption. (Ex. 17 [’619 patent], 1:34-36, 1:49-51, 2:53, 3:1-3, 6:59-61.) That too would be improper—both by vitiating key elements of the claims, and by construing the claim in a manner inconsistent with the stated purpose of the alleged invention. *See World Class Tech.*, 769 F.3d at 1124 (rejecting construction that “would not serve the sole stated purpose” of the claimed invention); *Osram*, 505 F.3d at 1358 (considering “purposes of the invention” in construing claim term); *Certain Computers & Computer Peripheral Device & Components Thereof*, Inv. No. 337-TA-841, 2012 WL 4829461, Order No. 23, at *37-*38, (Oct. 4, 2012) (rejecting construction, in part, because it excluded key language in the disputed term that effectively “would read out . . . limitations from the claim”).

4. **“said variable supply voltage having a magnitude that is controlled to operate said voltage controlled oscillator with a current consumption that is established as a function of a voltage controlled oscillator output signal quality needed for operation in one of a plurality of modes by adjusting the phase noise of the voltage controlled oscillator” (claim 46)**

Apple’s Construction	Nokia’s and Staff’s Construction
Indefinite	Construction of this term is unnecessary. If construction is required, however, this term should be construed consistent with its plain and ordinary meaning, which is the claim language itself. Alternatively: “said variable supply voltage having a value that is controlled to operate said voltage controlled oscillator with a current consumption that is established according to a voltage controlled oscillator output signal quality needed for operation in one of a plurality of modes (as that term is construed below) by adjusting the phase noise of the voltage controlled oscillator”

The principal dispute is whether the “variable supply voltage” term is indefinite, as Apple contends, or whether the term has the purported “plain and ordinary meaning,” as Nokia and the Staff contend. Because this term includes a “by adjusting the phase noise” limitation that never states what actually must be accomplished **by** that adjustment, and because it requires a “needed” level of signal quality without explaining what objective standard applies to assess what level is “needed,” the term is indefinite. By contrast, Nokia’s and the Staff’s supposed “plain and ordinary meaning” construction would improperly rewrite the limitation, and does nothing to address its multiple levels of indefiniteness.

a. **The Disputed Term Is Indefinite.**

The disputed “variable supply voltage” limitation is indefinite for two independent reasons.

First, the limitation requires a specific configuration in which **something** is accomplished “**by adjusting** the phase noise of the voltage controlled oscillator.” The claim never specifies what that thing might be. The earlier portions of the limitation refer to a “variable supply voltage . . . that is controlled” and “a current consumption that is established.” But the claim does not specify that either feature is “controlled” or “established” “by adjusting the phase noise of the voltage controlled oscillator.” Nor would such a requirement make any sense given that a VCO’s “supply voltage” and “current consumption” are precisely what control the level of phase noise; i.e., neither is controlled by adjusting the phase noise. (Ex. 18 [Woods Rep.] ¶ 79.)

Because those two features are unrelated to the phase noise adjustments in the claim, the “**by adjusting** the phase noise of the voltage controlled oscillator” portion of the claim stands in isolation—leaving a person of skill with no reasonable basis to understand what specifically must occur in response to adjusting the phase noise to satisfy the claim. Because that type of “grammatical gymnastics” (even if the result of an unintentional drafting error) prevents a person

of ordinary skill in the art from ascertaining the full scope of the claim with reasonable certainty, the term is indefinite. *See Allen Eng'g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1349 (Fed. Cir. 2002) (finding claim with “obvious” semantic error was indefinite: “It is not our function to rewrite claims to preserve their validity”); *Andrulis Pharms. Corp. v. Celgene Corp.*, No. CV 13-1644(RGA), 2015 WL 3978578, at *6-*7 (D. Del. June 26, 2015), *aff'd*, 667 F. App'x 775 (Fed. Cir. 2016) (finding term indefinite because of a mismatched antecedent and modifier: “[I]t is not reasonable to use grammatical gymnastics to force ‘enhanced’ to modify ‘combination’ when ‘enhanced’ immediately precedes ‘[therapeutically-effective] amount of thalidomide’ This Court must construe the terms as written—even if the claims are poorly drafted.”) (internal citations and quotation marks omitted).

Second, the disputed limitation is also indefinite because it fails to provide a person of ordinary skill with any objective criteria to determine when the “output signal quality [is] **needed** for operation in one of a plurality of modes.” Claim 46 provides no guidance regarding the level of signal quality that is “needed” within the meaning of the claim. Indeed, the claim does not identify any criteria to make that evaluation, including how high (or low) the signal quality must be. Therefore, persons of ordinary skill are left to their own subjective—and likely differing—views as to whether a particular level of output signal quality is sufficiently “needed” within the meaning of claim 46.²⁴

²⁴ Dependent claim 59 requires “[t]he circuit of claim 46, where the output signal quality comprises an acceptable amount of phase noise.” That added requirement adds no clarity to the scope of “output signal quality needed” for claim 46. Merely referring to an “acceptable” level of phase noise—an inherently subjective limitation that is itself indefinite—tells a person of ordinary skill nothing about any **specific** level or range of phase noise that is “needed,” and nothing about any of the other signal characteristics (beyond the amount of phase noise) that a person of skill might consider in assessing the quality “needed” for an output signal.

Nor does the '619 specification provide any objective clarification as to the required level of output signal quality that is “needed.” The phrase “output signal quality needed for operation in one of a plurality of modes” does not appear in the specification. And the patent only contains the following general discussion directed to the “quality” of a VCO output signal:

- “The **quality of the VCO signal**, for example the phase noise, signal to noise floor, output power and environmental stability) [sic] that is required by the RF system strongly influences the current consumption.” (Ex. 17 ['619 patent], 1:26-29.)
- “Also, different usage conditions and wireless network environments place different demands on the required **quality of the VCO signal**. For example, when no strong interference sources are present a lower **quality VCO signal** may be adequate.” (*Id.*, 1:36-40.)
- “[T]he MS 100 is enabled to adjust or tune the phase noise of the VCO according to the mode of operation of the transceiver, and to thus control the amount of current consumption as a function of the required **VCO signal quality**.” (*Id.*, 6:35-39.)

Nothing in these disclosures purports to define the term “needed” as used in claim 46; they never specify **which**, if any, of the listed signal characteristics are “needed” to fall within the scope of the alleged invention, **what aspects** of any such required characteristics must be assessed to determine whether the quality of the output signal is “needed,” and **what objective metrics** a person of skill should use to make such an assessment. For example, would a signal of barely sufficient quality to permit transmission or reception suffice? Would a very high quality signal for transmitting and receiving suffice? What about signals falling in between those two outer metrics? What about no signal at all? The '619 patent provides no answers to these critical questions. (Ex. 18 [Woods Rep.] ¶¶ 75-76.)

As such, because the patent provides no objective standard for a person of ordinary skill to apply in assessing when output signal quality is “needed” and when it is not “needed,” the disputed limitation is indefinite for this reason as well. See *Halliburton Energy Servs., Inc. v. M-I LLC*, 514 F.3d 1244, 1250 (Fed. Cir. 2008) (finding term “fragile gel” indefinite, even though

the patent provided examples of “fragile gel,” because a person of skill could not determine the full scope of the term with sufficient certainty); *Dow Chem. Co. v. Nova Chem. Corp. (Canada)*, 803 F.3d 620, 634-35 (Fed. Cir. 2015) (holding term “slope of strain hardening coefficient” is indefinite because patent provided no guidance as to what method to use to calculate the slope); *Cayenne Med., Inc. v. Medshape, Inc.*, No. 2:14-cv-0451-HRH, 2016 WL 2606983, at *4 (D. Ariz. May 6, 2016) (holding term “substantially different construction” indefinite, even though the patent provided “some standard” for assessing differences, because “‘some standard’ is not sufficient” to render the term definite).

b. Nokia’s And The Staff’s Constructions Are Incorrect

Nokia and the Staff contend that the “variable supply voltage” limitation should be construed according to its “plain and ordinary meaning,” which they state, in the alternative, as “said variable supply voltage having a value that is controlled to operate said voltage controlled oscillator with a current consumption that is established according to a voltage controlled oscillator output signal quality needed for operation in one of a plurality of modes (as that term is construed below) by adjusting the phase noise of the voltage controlled oscillator.”

That proposed construction fails for several reasons.

First, Nokia and the Staff do not even attempt to make sense of the “by adjusting the phase noise of the voltage controlled oscillator” language—which, as noted above, is not tethered to any other aspect of the limitation. They also do not provide any objective metric to assess when the output signal quality is “needed.” Therefore, the limitation remains indefinite even under their proposed construction.

Second, Nokia and the Staff propose to replace “said variable supply voltage **having a value** that is controlled to operate said voltage controlled oscillator” with “said variable supply

voltage ***having a magnitude*** that is controlled to operate said voltage controlled oscillator.” This attempted rewrite of the claim also does nothing to cure the indefiniteness issues detailed above.

VI. CONCLUSION

For the foregoing reasons, Apple respectfully requests the adoption of its proposed constructions.

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Respectfully submitted,

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