IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF WISCONSIN

NOKIA CORPORATION, Plaintiff, v. APPLE INC., Defendant.	
APPLE INC., Counterclaim-Plaintiff, v. NOKIA CORPORATION and NOKIA INC., Counterclaim-Defendants.	CIVIL ACTION NO. 10-CV-249

DECLARATION OF PATRICK FAY

1. My name is Dr. Patrick Fay. I have personal knowledge of the information set forth herein, and I could and would competently testify thereto if called as a witness.

2. I have been retained by the law firm of Wilmer Cutler Pickering Hale and Dorr LLP as an expert on behalf of defendant Apple Inc. ("Apple") in this action for patent infringement brought by Nokia Corporation against Apple.

3. I understand that in this action, Nokia has accused Apple of infringing U.S. Patent No. 5,752,172, entitled "Distributed Transmitter Output Power Control Circuit and Method for a Radio Telephone" ("the '172 patent"). I understand that Nokia has accused Apple of infringement of claims 1 and 2 of the '172 patent.

4. I understand that in this action, Nokia also has accused Apple of infringing U.S.

Patent No. 7,532,680, entitled "Multi-Mode Radio Frequency Transmitter" ("the '680 patent"). I understand that Nokia has accused Apple of infringement of claims 1-31 of the '680 patent.

5. I hold a Bachelor of Science degree in electrical engineering (1991) from the University of Notre Dame, a Master of Science degree in electrical engineering (1993) from the University of Illinois, and a Ph. D. degree in electrical engineering (1996) from the University of Illinois. I am a Senior Member of the Institute of Electrical and Electronics Engineers (IEEE), a Member of Eta Kappa Nu and Tau Beta Pi, a Member of the IEEE Electron Device Society, a Member of the IEEE Microwave Theory and Techniques Society, and a member of the IEEE Lasers and Electro-Optics Society. I am a named inventor on three U.S. patents.

6. I have done work with all aspects of amplifier technology during my career. As a result, I am familiar with the manner in which amplifiers amplify signals and in which the gains of various types of amplifiers are adjusted.

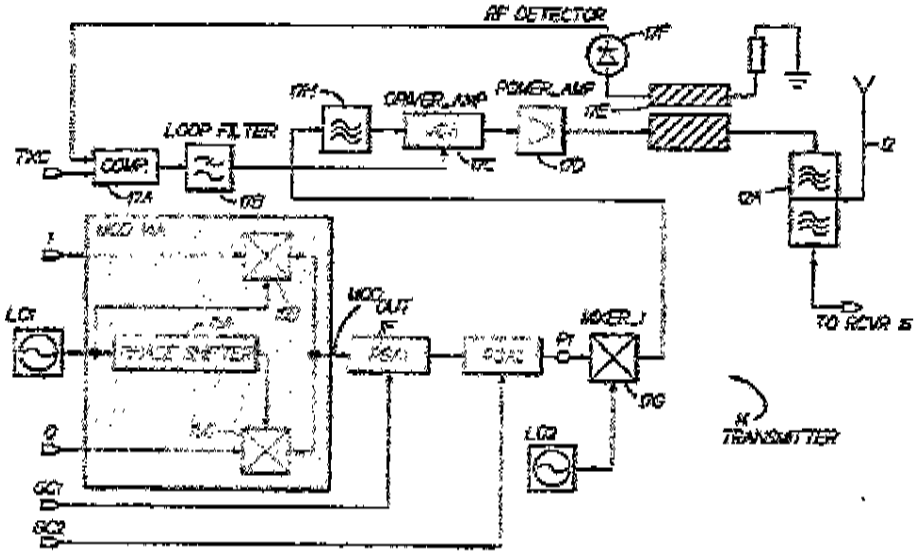
7. A copy of my current curriculum vitae is attached hereto as Exhibit A.

8. Based on my experience in the field of amplifier technology and my professional background, I am very familiar with the art of amplifier technology, including the technology described in the '172 and '680 patents.

9. In the preparation of this declaration I reviewed the '172 patent, which was filed on August 16, 1996, and the '680 patent, which was filed on December 27, 2005, and is based on a prior application filed on September 3, 2003.

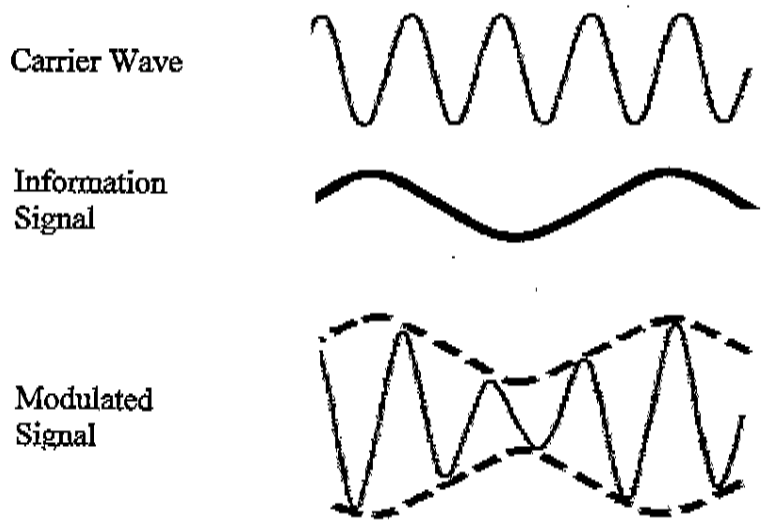
10. The '172 patent describes a transmitter circuit for a mobile device, such as a cellular telephone. (*See, e.g.*, '172 patent, Abstract; Col. 1:6-9.) The transmitter generates an RF signal that an antenna transmits to a network. As acknowledged in the background section of the '172 patent, transmitters with "modulators," "variable gain driver amplifiers," and "power

amplifiers" were known and used prior to August 16, 1996. (*See, e.g.*, '172 Patent, Col. 1:24-26.) The patent focuses on adding one or more "programmable gain amplifiers" (PGA1 and PGA2 in Figure 1 below) after the modulator (MOD 14A), but prior to the variable gain driver amplifier (VGA 17C) and power amplifier (POWER AMP 17D):



('172 Patent, Fig. 1 (highlighting added).)

11. A transmitter cannot directly transmit speech or data "over the air" to a network. Instead, it must first place the speech or data signal on a "carrier wave," which "carries" this information to a network base station. The modulator performs this function by modifying, or "modulating," the carrier wave based on the speech or data information to produce a modulated signal that can be transmitted to the network:



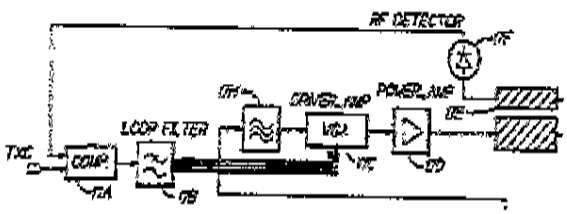
As shown in the diagram above, the carrier wave cycles between peaks and valleys at a particular frequency. In the example above, the amplitude is modulated, but in general the modulator may adjust the height of the peaks and valleys, the instantaneous frequency, or timing (or phase) of the carrier wave, or combinations of these, based on the speech or data signal to create the modulated signal.

12. Modulators operate with relatively low power signals in order to conserve power and battery life, and to minimize non-idealities such as noise, distortion, and interference within the transmitter. The transmitter accordingly must increase, or "amplify," the strength of the modulated signal before transmitting it to the network base station so that the signal will be strong enough to reach the base station. The power amplifier is the last amplifier in the transmitter and increases the strength of the signal so that it can reach the base station.

13. The power required to transmit the modulated signal from the transmitter to the base station varies depending on factors such as the distance between the mobile telephone and the base station. (*See, e.g.*, '172 Patent, Col. 1:18-23.) When a telephone is far away from the base station, it typically needs to transmit the modulated signal with more power to ensure that it

is properly received by the base station. Conversely, when it is close to the base station, it can transmit the signal with less power. Some conventional transmitters accordingly included a variable gain driver amplifier between the modulator and the power amplifier to adjust the strength of the modulated signal, to account for these variations, before supplying the signal to the power amplifier for transmission. (*See, e.g.*, '172 Patent, Col. 1:24-26.)

14. In the '172 patent, the variable gain driver amplifier adjusts the magnitude of the modulated signal based on a feedback loop which varies the "gain" of the amplifier. This feedback loop, or "power control loop" (shown in Figure 3 below), compares the actual strength of the modulated signal output from the power amplifier with the desired strength, and generates a gain control signal (highlighted in red) based on this comparison:



(*See* '172 Patent, Fig. 3.).

15. In particular, the power control loop contains an RF detector 17F and a comparator 17A. The detector 17F detects the actual power of the modulated signal output from the power amplifier 17D, and the comparator 17A determines the difference between the actual power of the signal and the desired power (represented by the signal TXC). (*See, e.g.*, '172 Patent, Col. 4:13-26.) The power control loop also includes a filter 17B, which operates in conjunction with the comparator 17A, to condition the gain control signal (highlighted in red in the figure above) to change the gain of the amplifier 17C, which in turn, changes the magnitude of the signal that the amplifier 17C outputs. Specifically, when the actual power of the signal at the output is less than the desired power, the comparator 17A and filter 17B output a gain control

signal to gradually increase the gain over a continuous range of values until the desired output power equals the actual output power. (*See, e.g.*, '172 Patent, Col. 4:13-18). On other hand, when the actual power is greater than the desired power, the gain control signal gradually decreases the gain over a continuous range of values until the actual and desired powers are equal. (*Id.*)

16. The background section of the '172 patent states that conventional transmitters, which use a single variable gain amplifier between the modulator and the power amplifier, are "not an optimum solution" because the variable gain amplifier must be designed to precisely adjust the magnitude of the modulated signals over a large dynamic range (e.g., up to 60 dB). (*See, e.g.*, '172 Patent, Col. 1:23-34.) The '172 patent describes a transmitter that includes one or more "programmable gain amplifiers" after the modulator, but prior to and in addition to the variable gain driver amplifier and the power amplifier. (*See, e.g.*, '172 Patent, Fig. 3; Col. 1:60-67; Claims 1-15.) The programmable gain amplifiers have a gain that is set, or "programmed," in discrete "steps" (*e.g.*, at 1 dB intervals). (*See, e.g.*, '172 Patent, col. 2:47-53; 4:36-42; 4:66-5:5).

17. The gain of the programmable gain amplifiers can be programmed to compensate for factors such as component tolerance variations due to, for example, variations during the manufacturing process of the transmitter components. (*See, e.g.*,'172 Patent, Col. 2:47-53; 4:36-48; Col. 4:63-5:5). Since the programmable gain amplifiers adjust the magnitude of the signal before it is input to the variable gain driver amplifier, the variable gain driver amplifier can operate over a smaller dynamic range (e.g., up to 40-45 dB). (*See, e.g.*, '172 Patent, Col. 6:20-24; 6:24-7:9).

18. The claim language and specification of the '172 patent describe, to one of

ordinary skill in the art, that the "variable gain driver amplifier" and "programmable gain amplifier" are separate components, with separate functions. All of the claims require both a "variable gain driver amplifier" and a "programmable gain amplifier." (*See, e.g.*, '172 Patent, Col. 7:16-10:4.) The specification explains that each operates differently. The "variable gain driver amplifier" adjusts the magnitude of the modulated signal based on a "power control loop," and accordingly, its gain varies over a continuous range of values. (*See, e.g.*, '172 Patent, Fig. 3; Col. 4:13-18). The "programmable gain amplifiers," in contrast, adjust the gain in set "steps" (e.g., at 1 dB intervals). (*See, e.g.*,'172 Patent, Col. 2:47-53; 4:36-42; 4:63-5:5).

19. The '172 specification also explains that the variable gain driver amplifier performs a "power ramping" function, which further confirms to one of ordinary skill in the art that its gain can be varied over a continuous range of values. (*See, e.g.*, '172 Patent, Col. 1:26-30; 4:32-34; 6:65-67). Thus, a person of ordinary skill in the art would understand that the "variable gain driver amplifier" has a gain that can be varied "over a continuous range of values." The "programmable gain amplifier," in contrast, has a gain that is programmed to be varied in set "steps" or intervals (e.g., in 1 dB intervals).

20. Similar to the '172 patent, the '680 patent relates to a mobile telephone transmitter having (1) a "modulator" to modulate a carrier signal with an information signal, (2) a "variable gain amplifier" to adjust the power level of the modulated signal before it is input into the power amplifier, and (3) a "power amplifier" to increase the strength of the signal before it is transmitted to the network.

21. When the prior application for the '680 patent was filed on September 4, 2003, the industry was considering a significant change to the relevant telecommunications standards, including the standards defining the technical requirements for modulators. The new standard

included a "dual timeslot system" that alternated between two different forms of modulation: "GMSK" modulation and "8-PSK" modulation.

22. The '680 patent describes changes to the power amplifier made to accommodate this proposed dual timeslot system. More specifically, it describes using a "programmable power amplifier" that can operate as either a "variable gain power amplifier" (for GMSK modulation) or as a "fixed gain power amplifier" (for 8-PSK modulation). (*See, e.g.*, '680 Patent, Col. 1:27-31; 3:32-38.) Fig. 1A below shows the transmitter 10 when the power amplifier 12 is operating as a "variable gain power amplifier" to transmit a GMSK modulated signal:

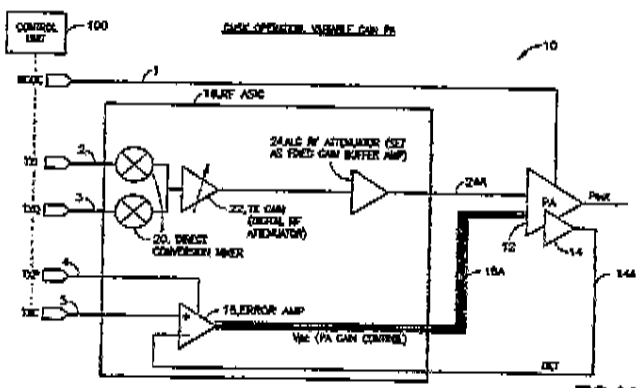


FIG. 1A

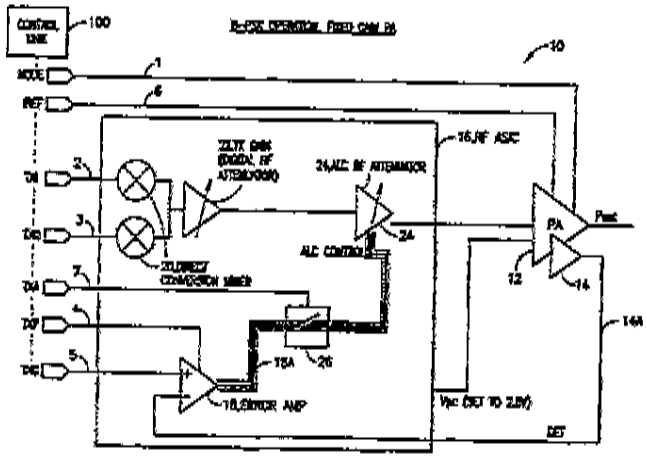
('680 Patent, FIG. 1A).

In this mode, the power amplifier 12 has a gain that is adjusted by a power control loop. This power control loop, like the power control loop in the '172 patent, compares the actual strength of the signal output from the power amplifier with the desired signal strength, and varies the gain of the variable gain power amplifier 12 until the actual and desired power are the same. (*See, e.g.*, '680 Patent, Col. 4:6-12.).

23. More specifically, the power control loop includes an RF detector 14 and an error amplifier 18. The detector 14 outputs a signal (DET) corresponding to the actual power of the signal transmitted from the power amplifier 12, and the error amplifier 18 outputs a gain control

signal (Vpc) (highlighted in red) corresponding to the difference between the actual power and the desired power (represented by the signal TXC) to vary the gain of the amplifier 12 over a continuous range. (See, e.g., '680 Patent, Col. 3:38-41; 3:50-53; 4:6-20).

24. Fig. 1B below shows the transmitter 10 when the power amplifier 12 is operating as a "fixed gain power amplifier" to transmit an 8-PSK modulated signal:



('680 Patent, FIG. 1B).

In this mode, the power amplifier 12 has a gain that is "fixed," so it cannot adjust the magnitude of the modulated signal with a variable gain. The power amplifier 12 accordingly must be used with a variable gain RF attenuator 24 that is capable of adjusting the magnitude of the signal based on, for example, varying distances between the mobile telephone and the base station. (*See, e.g.*, '680 Patent, Col. 3:47-50; 4:6-12.).

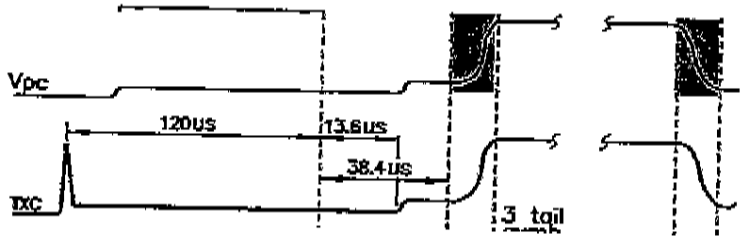
25. In more detail, the error amplifier 18 outputs a gain control signal (ALC control) (highlighted in red) based on the difference between the actual output power (represented by the signal (DET) from the detector 14) and the desired output power (represented by the signal TXC). (See, e.g., '680 Patent, Col. 3:47-50; 3:59-63; 4:6-20).

26. Although the terminology is similar, the "programmable power amplifier" of the '680 patent is a different component than the "programmable gain amplifier" of the '172 patent.

The "programmable power amplifier" is a power amplifier, that can be programmed to operate in different operational modes (*i.e.*, a variable gain mode and a fixed gain mode), and that functions to increase the strength of the modulated signal before it is transmitted to the network. The "programmable gain amplifier" is an amplifier, whose gain can be programmed, and that functions to amplify the modulated signal before it is input to the power amplifier. In other words, in the programmable power amplifier, the operational mode of the power amplifier is programmed, whereas in a programmable gain amplifier, the actual value of the gain is programmed.

27. As with the '172 patent, the '680 patent claim language and specification explain that the "variable gain" power amplifier, amplifier, and circuit are components whose gain can be varied over a continuous range. A person of ordinary skill in the art would understand that the "variable gain" amplifier, power amplifier, or circuit has a gain that can be varied over a continuous range of values. As noted above, the specification discloses that the gain of these components is adjusted based on the disclosed "power control loops," further confirming that they have a gain that can be varied over a continuous range.

28. Fig. 3A further shows that, when the power amplifier 12 is operating as a "variable gain power amplifier," its gain is varied over a continuous range of values:



('680 Patent, FIG. 3A).

The above excerpt from the figure illustrates the "output power ramping" feature of the power amplifier 12 when it is operating in the "variable gain" mode. The portions of the figure

highlighted in red show the gain control signal (Vpc) "ramping up" and "ramping down" the gain of power amplifier 12 by increasing and decreasing the gain over a continuous range of values.

29. In particular, the transmitter 10 disclosed in the '680 patent transmits modulated signals in "time slots," and the power amplifier 12 is switched between the fixed and variable gain modes during the "guard period" between adjacent time slots. (*See, e.g.,* '680 Patent, Col. 2:57-60; 4:12-17). As noted in the patent, smoothly ramping the output power down, switching the operational mode of the power amplifier 12, and then smoothly ramping the power back up during the guard period enables the transmitter 10 to avoid transmitting unwanted power transients and spikes during the guard period. (*See, e.g.,*'680 Patent, Col. 2:34-35; 2:57-60; 4:29-33.) When the power amplifier 12 operates in the "variable gain" mode, the output power is smoothly ramped down (and up) by continuously decreasing (and increasing) the gain control signal (Vpc) to continuously increase (and decrease) the gain of the amplifier 12 over a range of values. (*See, e.g.,*'680 Patent, Col. 4:6-12; 4:32-5:23).

30. I was asked to consider, based on my experience and my review of the '680 patent, whether the phrase "variable gain" would connote a particular structure to a person skilled in the art. In my opinion, this does not connote structure to a person skilled in the art of the technology of the '680 patent, but rather describes only a function. This is true today, and it was true as of September 4, 2003.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct to the best of my knowledge and belief.

Executed on December 17, 2010 in South Bend, IN.

Patrick Fay, Ph.D.