QUINN EMANUEL URQUHART & SULLIVAN, LLP
Charles K. Verhoeven (Cal. Bar No. 170151)
charlesverhoeven@quinnemanuel.com
50 California Street, 22nd Floor
San Francisco, California 94111
Telephone: (415) 875-6600
Facsimile: (415) 875-6700

Kevin P.B. Johnson (Cal. Bar No. 177129)
kevinjohnson@quinnemanuel.com
Victoria F. Maroulis (Cal. Bar No. 202603)
victoriamaroulis@quinnemanuel.com
555 Twin Dolphin Drive 5th Floor
Redwood Shores, California 94065
Telephone: (650) 801-5000
Facsimile: (650) 801-5100

Michael T. Zeller (Cal. Bar No. 196417)
michaelzeller@quinnemanuel.com
865 S. Figueroa St., 10th Floor
Los Angeles, California 90017
Telephone: (213) 443-3000
Facsimile: (213) 443-3100

Attorneys for SAMSUNG ELECTRONICS CO., LTD., SAMSUNG ELECTRONICS AMERICA, INC. and SAMSUNG TELECOMMUNICATIONS AMERICA, LLC

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA, SAN JOSE DIVISION

APPLE INC., a California corporation, Plaintiff, vs. SAMSUNG ELECTRONICS CO., LTD., a Korean business entity; SAMSUNG ELECTRONICS AMERICA, INC., a New York corporation; SAMSUNG TELECOMMUNICATIONS AMERICA, LLC, a Delaware limited liability company, Defendants.	CASE NO. 11-cv-01846-LHK **DECLARATION OF BRIAN VON HERZEN, PH.D. IN SUPPORT OF SAMSUNG'S MOTION FOR SUMMARY JUDGMENT**

I, Brian Von Herzen, declare:

1. I am the Chief Executive Officer of Rapid Prototypes, Inc., an electronics consultancy specializing in the research, design and development of commercial electronic products, and have been with the company since 1994. I have been asked to provide an expert declaration on behalf of Samsung Electronics Co. Ltd., Samsung Electronics America, Inc., and Samsung Telecommunications America, LLC (collectively "Samsung") in the above-captioned case.

2. I submit this declaration in support of Samsung's Motion for Summary Judgment. If asked at hearings or trial, I am prepared to testify regarding the matters I discuss in this declaration.

3. I reserve the right to supplement or amend this declaration based on any new information that is relevant to my opinions.

4. I am being compensated for my work in this matter at the rate of $575 per hour plus expenses. My compensation is in no way tied to the outcome of this matter.

I. PROFESSIONAL AND EDUCATIONAL BACKGROUND

5. A detailed record of my education and professional qualifications is attached as Exhibit 1 to my Declaration and summarized below.

6. I received a Bachelor's degree from Princeton University in 1980 in Physics. I received a Master's of Science degree in 1984 and a Ph.D. in 1989 from the California Institute of Technology ("Caltech") in VLSI and Computer Graphics. During and after my graduate studies, part of my research required the design and development of multiple custom integrated circuits. At Caltech, I was awarded a Hertz Foundation Fellowship and a Hughes Foundation Fellowship.

7. From 1992 to 1994 I worked for Synaptics, Inc. in the engineering of electronic circuits for human interface devices such as the TouchPad, which was developed by Synaptics in the 1990's. I have substantial industry experience in the design and manufacture of touch sensing devices, including transparent touchscreens.

8. At Rapid Prototypes, Inc., I specialize in the research, design and development of commercial electronic products. Over the past two decades, I have designed dozens of electronic

systems for several Fortune 500 companies, including human interface devices, signal processing systems, graphics and video processing systems.

9. I am an inventor on approximately a dozen electronics patents and have approximately a dozen additional patents pending.

10. I am a member of the Institute of Electrical and Electronic Engineers (IEEE), and am the author or co-author of published articles related to signal processing and computer graphics. I have given numerous invited seminars at leading conferences and institutions around the world on the topics of digital signal processing, electronic systems engineering, and hardware / software co-design.

II. APPLICABLE LEGAL PRINCIPLES

11. I am informed by counsel that "prior art" includes public information, public knowledge, and public acts that occur before an application for a patent was filed. Prior art includes patents, journals, Internet publications, systems and products.

12. I am further informed by counsel that prior art renders a patent claim invalid by anticipation if the reference discloses each element of the claim, either expressly or inherently, from the point of view of a person of ordinary skill in the art at the time the claimed invention was made. I understand that an element of a claim is inherent if it is necessarily present in an item of prior art.

13. I am further informed by counsel that Section 102 of the Patent Act provides that "[a] person shall be entitled to a patent unless . . . (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or . . . (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States . . . ."

14. I have been informed by counsel that the evidence must be "clear and convincing" for a claim to be found invalid.

15. I understand that a patent claim is invalid if the claim would have been obvious to a person of ordinary skill in the art at the time the patent was filed. I understand that the standard for determining obviousness was clarified by the Supreme Court of the United States in *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 298 (2007).

16. I understand that the obviousness analysis is expansive and flexible. I also understand that a combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results, and that when a patent claims a structure or process already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result. I also understand that in *KSR*, the Supreme Court found that "[w]hen a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability. For the same reason, if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill . . . . a court must ask whether the improvement is more than the predictable use of prior art elements according to their established functions." Further, "it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does."

III. OVERVIEW OF THE '607 PATENT AND THE ASSERTED CLAIMS

17. U.S. Patent 7,663,607 ("the '607 Patent"), titled "Multipoint Touchscreen" was filed on May 6, 2004 and issued on February 16, 2010. The patent has three named inventors: Steve Hotelling, Joshua A. Strickon and Brian Q. Huppi.

18. The '607 Patent relates to a touch panel having a "transparent capacitive sensing medium" configured to detect multiple touches or near touches that occur at the same time and at distinct locations on the touch panel and to produce distinct signals representative of those touches. Generally, the sensing medium includes two layers of conductive traces arranged in grid that are physically separated from each other by an insulator. Monitoring circuitry is connected

to the sensing medium and used to detect multiple touches or near touches that occur at the same time and at distinct locations on the sensing medium.

19. I understand that Apple has dropped claims 1-3, 6, 7, 10 and 11 of the ’607 Patent and is only asserting dependent claim 8. Claim 8 recites “[t]he touch panel as recited in claim 7, further comprising a virtual ground charge amplifier coupled to the touch panel for detecting the touches on the touch panel.” Claim 8 depends from dependent claim 7, which recites “[t]he touch panel as recited in claim 1, wherein the capacitive sensing medium is a mutual capacitance sensing medium.” Claim 7, in turn, depends on independent claim 1, which is reproduced below.

> 1. A touch panel comprising a transparent capacitive sensing medium configured to detect multiple touches or near touches that occur at a same time and at distinct locations in a plane of the touch panel and to produce distinct signals representative of a location of the touches on the plane of the touch panel for each of the multiple touches, wherein the transparent capacitive sensing medium comprises:
>
> a first layer having a plurality of transparent first conductive lines that are electrically isolated from one another; and
>
> a second layer spatially separated from the first layer and having a plurality of transparent second conductive lines that are electrically isolated from one another, the second conductive lines being positioned transverse to the first conductive lines, the intersection of transverse lines being positioned at different locations in the plane of the touch panel, each of the second conductive lines being operatively coupled to capacitive monitoring circuitry;
>
> wherein the capacitive monitoring circuitry is configured to detect changes in charge coupling between the first conductive lines and the second conductive lines.

IV. CLAIM CONSTRUCTION

20. I understand that although the Court has already issued a claim construction order in this case, none of the terms of claim 8 (or claims 1 or 7 from which claim 8 depends) were specifically construed by the Court. I have therefore applied the plain and ordinary meaning as would be understood by one of ordinary skill in that art to all the claim terms below, except where expressly noted.

V. PERSON OF ORDINARY SKILL IN THE ART

21. I am informed by counsel that when analyzing a patent, one does so from the viewpoint of one of ordinary skill in the art at the time of the filing of the patent application. A

person of ordinary skill in the art relevant to the ’607 Patent in May 2004 would have had an undergraduate degree in electrical engineering, physics, computer engineering, or a related field and 2-3 years of work experience with input devices.

VI. THE FINDINGS OF THE INTERNATIONAL TRADE COMMISSION (“ITC”)

22. I understand that Apple has already asserted certain claims of the ’607 Patent against other cellular telephone manufacturers, including Motorola, in the ITC. I also understand that Apple asserted claims 1-7 and 10 of the ’607 Patent against Motorola in Inv. No. 337-TA-750, in the matter of *Certain Mobile Devices and Related Software*. Although dependent claim 8 was not expressly asserted in Inv. No. 337-TA-750, claims 1 and 7, from which claim 8 depends, were both asserted and found by the ITC to be invalid due to prior art. It is my opinion that claim 8, which recites only the trivial and obvious addition of a “virtual ground charge amplifier,” imparts absolutely no novelty or non-obviousness to claims 1 and 7 and is therefore also invalid.

23. More specifically, I understand that ALJ Essex, in his Initial Determination, agreed with the Commission Investigative Staff that claims 1-7 and 10 of the ’607 Patent were invalid based on two, independent grounds. Attached as Exhibit 2 to my Declaration is the Initial Determination (“750 ID”) issued by ALJ Essex. Most notably, ALJ Essex determined that two different prior art bases rendered the ‘607 Patent invalid. (*See* Exhibit 2 at pp. 141-149; 172-177). First, ALJ Essex found the ’607 Patent invalid because it was anticipated by U.S. Patent No. 7,372,455 to Perski et al. (“Perski ’455,” attached as Exhibit 3 to my Declaration). (*Id.* at 145-46). The only claim limitation of claim 1 that Apple argued was missing in Perski ‘455 was the multitouch limitation. (*Id.* at 143). ALJ Essex readily dismissed Apple’s argument, finding that the “method disclosed in Perski ‘455 for detecting multiple touches is *virtually identical* to the disclosure in the ’607 Patent.” (*Id.* at 144 (emphasis added)).

24. Second, ALJ Essex found the ’607 Patent invalid in view of the Sony Smartskin paper (“Smartskin,” attached as Exhibit 4 to my Declaration). (*Id.* at 172-73). Although the Commission Investigative Staff determined that Smartskin anticipated all the asserted claims, ALJ Essex found that anticipation in view of Smartskin was an “extremely close call.” (*Id.* at 147

(emphasis in original)). While falling slightly short of finding anticipation in view of Smartskin, ALJ Essex did easily find that Smartskin rendered all the asserted claims of the ’607 Patent obvious, either by itself or in conjunction with Japanese Patent Application Pub. No. 2002-342033A to Rekimoto (“Rekimoto”), the same author of the Smartskin paper. (*Id.* at 172-76).

25. I have reviewed the 750 ID and agree with ALJ Essex and the Commission Investigative Staff that Perski ‘455 anticipates claims 1-7 and 10 of the ’607 Patent. I also agree with the Commission Investigative Staff that Smartskin anticipates claims 1-7 and 10. With respect to ALJ Essex’s obviousness determination, I further agree that if Smartskin does not anticipate claims 1-7 and 10, it most certainly renders all the claims obvious, either by itself or in view of Rekimoto.

26. I understand that the full Commission decided to review the 750 ID and affirmed the ALJ’s determination of no violation of the Tariff Act. (*See* Notice of Commission Decision issued March 16, 2012, attached as Exhibit 5 to my Declaration). I understand that the Commission decided not to review the anticipation determination in view of Perski ‘455 and therefore that ground of invalidity was affirmed and made final. I also understand that the Commission decided to review the obviousness determination in view of Smartskin, and on review, slightly modified the reasoning contained in the Initial Determination but otherwise affirmed the ALJ’s obviousness determination. (*Id.* at 3). Importantly, with respect to the obviousness finding in view of Smartskin, the Commission noted that “Motorola has demonstrated by clear and convincing evidence that the asserted claims of the ’607 Patent are invalid under 35 U.S.C. § 103.” (*Id*).

27. On March 28, 2012, I understand that the Commission issued its Opinion reviewing just the obviousness determination in view of Smartskin. (*See* the Commission Opinion, attached as Exhibit 6 to my Declaration). I have reviewed the Commission Opinion and agree with its conclusions. In connection with the obviousness finding in view of Smartskin, I agree with ALJ Essex, the Commission Investigative Staff, and the full Commission that “Smartskin provides the

reason to combine the use of transparent electrodes made of materials such as ITO with the mutual-capacitance sensor for detecting multiple touches on the sensor surface." (*Id.* at 7-8). I further agree with the Commission that Smartskin provides one of ordinary skill with a "reasonable expectation of success" under the Supreme Court's rationale in *KSR Int'l Co. v. Teleflex Inc*. (*Id.*). Namely, I agree that the use of transparent ITO electrodes was extremely well known far in advance of the '607 Patent filing and that using transparent ITO electrodes in the sensor described in Smartskin would "do[] no more than yield predictable results." (*Id.* at 10). I further disagree with Apple's contention that the sensors described in Smartskin and the '607 Patent are different in any material respect, and in any event find this comparison irrelevant to my obviousness determination for the same reasons articulated by the Commission in its Opinion. (*Id.* at 12-14).

VII. THE "VIRTUAL GROUND CHARGE AMPLIFIER" OF CLAIM 8 IS A COMMON "INTEGRATOR" CIRCUIT FOUND IN MANY APPLICATIONS INCLUDING TOUCHSCREENS OVER A DECADE BEFORE THE '607 PATENT WAS FILED

28. As I mentioned above, it is my understanding that claim 8 was not asserted at the ITC against Motorola. Claims 1 and 7, from which claim 8 depends, were asserted and found invalid. It is my opinion that the addition of such a commonplace piece of circuitry (*i.e.*, a "virtual ground charge amplifier") to the touchscreen of claims 1 and 7 cannot and does not impart any novelty, non-obviousness, or inventiveness whatsoever to the claimed invention. This well-known circuit is a simple operational amplifier "integrator" that performs the mathematical operation of integration. Moreover, this piece of circuitry is found in numerous prior art references, including textbooks, IEEE articles, and university physics experiments, which reinforces my opinion that the claimed charge amplifier is a trivial and obvious addition to the touchscreen recited in claims 1 and 7.

29. Operational amplifiers, or op-amps, are among the most widely used electronic devices today, being used in a vast array of consumer, industrial, and scientific devices. They can range from just a

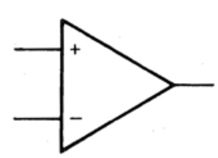


Figure 4.1

few cents to produce and are typically packaged as components or used as elements of more complex integrated circuits. Op-amps have two inputs—an inverting (negative) input and a non-inverting (positive) input—and a single output. Figure 4.1, taken from a popular textbook, shows the common representation of an op-amp. (*See* P. Horowitz and W. Hill, "The Art of Electronics," (2nd edition, 1989), p. 176, attached as Exhibit 7 to my Declaration).

30. In its infringement contentions, I understand that Apple did not identify what circuitry constituted the claimed "virtual ground charge amplifier" of claim 8 and rather merely stated that "the specific circuit elements performing this function will be identified in discovery." (*See* Exhibit 17 to Apple's Disclosure of Asserted Claims & Infringement Contentions, attached as Exhibit 8 to my Declaration). This failure of Apple to disclose what precise circuitry it believed constituted the claimed "virtual ground charge amplifier" rendered claim 8 ambiguous because, in my opinion, a "virtual ground charge amplifier" is not a term of art. [redacted]

31. [redacted] This definition is consistent with FIG. 13 of the specification of the '607 Patent which shows an example of a "filter," which has been reproduced below. As described below, such a basic, ubiquitous circuit does not add any inventiveness whatsoever to the invention described in the '607 Patent. The use of such an operational amplifier in the configuration shown in FIG. 13 is simple op-amp "integrator" that responds to changes in input voltage over time. As explained in more detail below, this precise circuitry was extremely well known in the field of electronics generally and in the field of capacitive touch screen specifically and used to filter out parasitic, or unwanted, charge coupling.

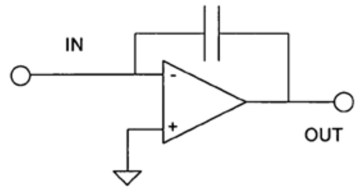


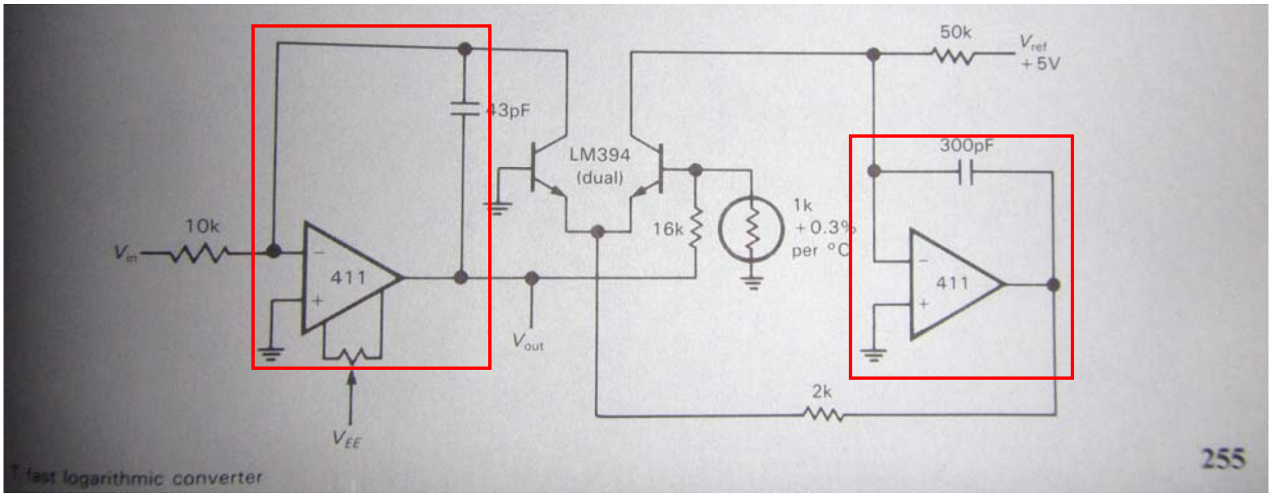
FIG. 13

32. [redacted]

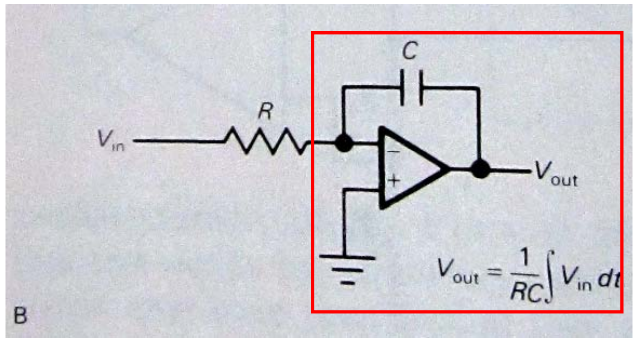
33. [redacted]

34. This observation is completely consistent with my own opinion. Charge amplifiers in the configuration shown in FIG. 13 of the ’607 Patent were extremely well known as “integrators” far in advance of the invention described in the ’607 Patent. These charge amplifiers were prevalent in the consumer electronics industry and were used in many devices ranging from CCD cameras to DRAM memory. A popular textbook shows the *exact same*

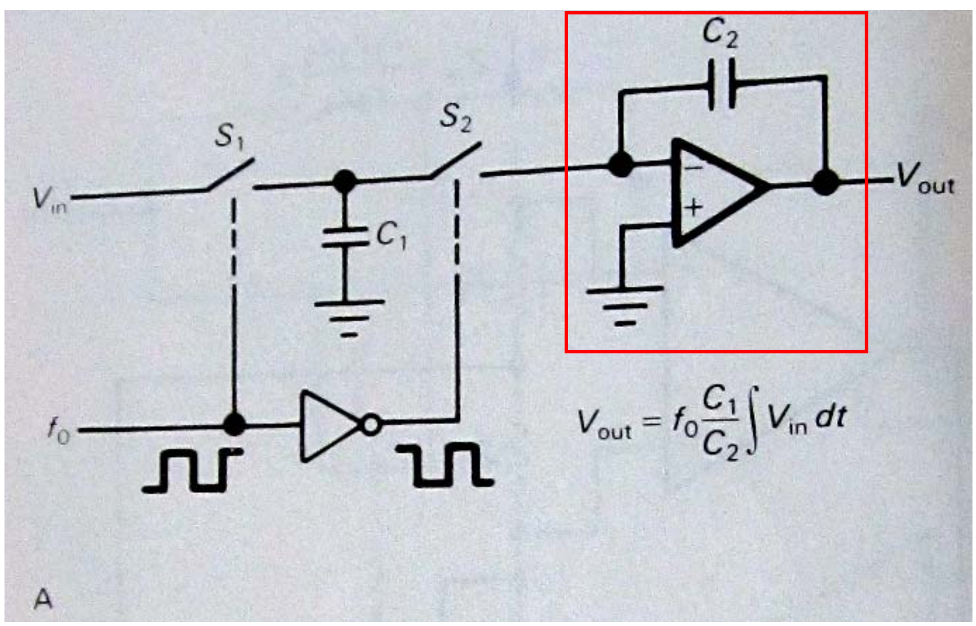
arrangement in numerous circuit examples, for instance, as the fast logarithmic converter (Example T) on page 255 of the Horowitz and Hill textbook. (*See* Exhibit 7).



35. Both instances of the "411" operational amplifier in the figure above comprise the exact same "virtual ground charge amplifier" circuit shown in FIG. 13 of the '607 patent. The left example above grounds the positive input of the amplifier, just as in FIG. 13 of the '607 Patent, causing the negative input to maintain a "virtual ground," using a 43 pF feedback capacitor on the negative input. The right example above also grounds the positive input, also just as in FIG. 13 of the '607 Patent, causing the negative input to maintain a "virtual ground," using a 300 pF feedback capacitor on the negative input. Both of these operational amplifiers are configured as "virtual ground charge amplifiers" and are depicted clearly in the 1989 university textbook. Additional examples of this configuration of a virtual ground charge amplifier can be found on pages 277, 278 and 282 of the same textbook. (*See* Exhibit 7). In particular, the conventional "integrator" of Figure 5.25B in the textbook (reproduced below) shows the *exact same* configuration of a virtual ground charge amplifier as shown in FIG. 13 of the '607 Patent. This figure appears in Chapter 5, titled "Active Filters and Oscillators" as an example of a common and well-known circuit element that can be used in many applications. (Exhibit 7).



36. This conventional "integrator" is in the *exact same* configuration as the "virtual ground charge amplifier" shown in FIG. 13 of the '607 Patent. In addition, the "integrator" of Figure 5.25A of the same textbook also shows the *exact same* configuration of the virtual ground charge amplifier shown in FIG. 13 of the '607 patent. (Exhibit 7). Figure 5.25A is given in the textbook as another common example of a charge "integrator," this time a switched-capacitor type of integrator. (Exhibit 7).



37. The use of these "virtual ground charge amplifiers" as filter elements was also extremely well known for at least a decade prior to the filing of the '607 Patent. For example, the same textbook provides several examples of various filters that use the same operational amplifier configuration.

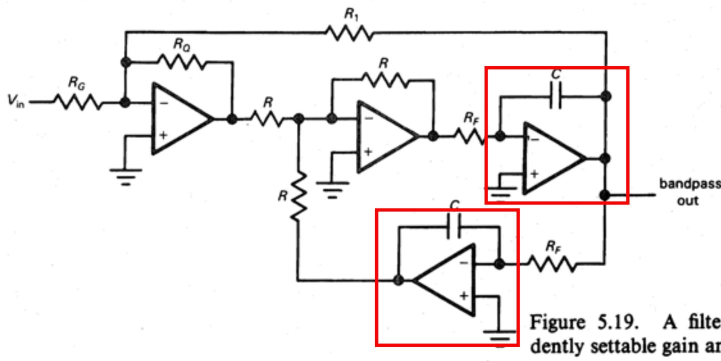


Figure 5.19. A filter with independently settable gain and *Q*.

38. As shown in Figure 5.19 above, the filter depicted in the popular electronics textbook from 1989 shows two operational amplifiers in a "virtual ground charge amplifier" configuration. These two amplifiers are in the *exact same* configuration as shown in FIG. 13 of the '607 Patent. Other examples of various filters with this same configuration can be found throughout Chapter 5, entitled "Active Filters and Oscillators." (*See, e.g.*, Figure 5.20 of Exhibit 7). As such, this textbook provides ample motivation for one of ordinary skill in the art to incorporate the "integrator" or filter elements described therein into any filtering application in order to reduce stray signals or noise.

39. These "virtual ground charge amplifier" circuits were all in common usage well before the invention described in the '607 Patent. I therefore agree with Dr. Maharbiz that circuit designers would choose a virtual ground charge amplifier rather than any other operational amplifier for this type of application, since it has a high input impedance and maintains virtual ground on the input electrodes, which can reduce, or filter, noise base on the impedance of the feedback circuit. It would have been obvious to any circuit designer at the time the '607 Patent was filed to include such an amplifier, as evidenced by the widespread use of this exact same amplifier in numerous applications in the 1989 university textbook as shown above.

40. Yet another example of this well-known circuit configuration is taken from University of Colorado's Physics 3330 curriculum, Experiment 5, Fall 1999, where the second figure on page 2 (Figure 5.2) shows a simple current integrator in the *exact same* configuration shown in FIG. 13 of the '607 Patent, complete with grounded positive input and feedback

capacitor from the output to the negative input. The figure is reproduced below (also *available at* http://www.colorado.edu/physics/phys3330/PDF/Experiment5.pdf).

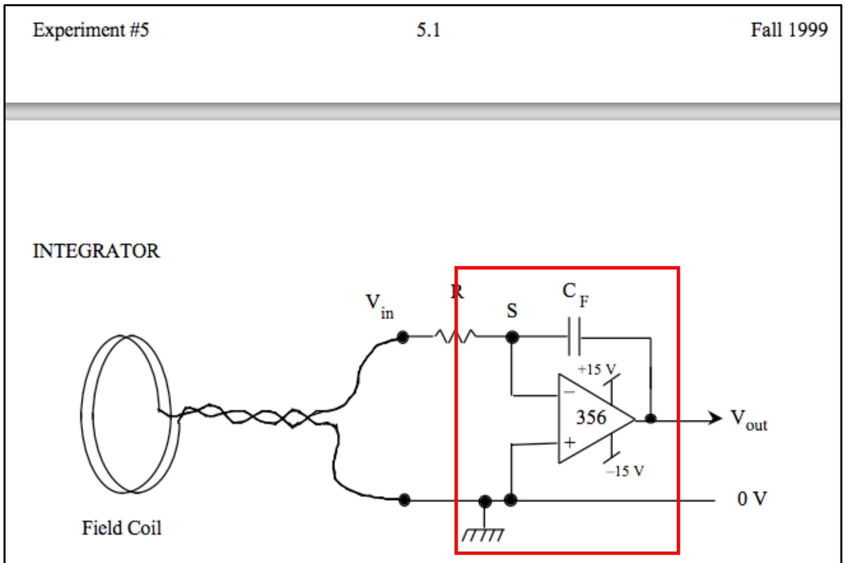
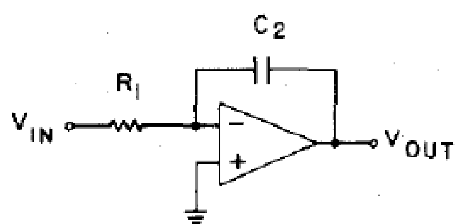


Figure 5.2 Integrator

41. Such "virtual ground charge amplifiers" were also commonly used for dynamic memory circuits and for camera sensor circuits. The charge amplifier integrates the current on the input wire over time to produce an output proportional to the integrated current (namely charge) on the input. When a memory cell is read, the charge present on the capacitor of the memory location is placed on the memory read bus. The change in charge is then sensed at the edge of the memory array using a charge amplifier that measures the change in charge on the input to the charge amplifier. This circuit has been in standard practice for decades, and was adapted in more recent decades to CMOS camera sensors such as those present in cellular telephones and digital cameras today. The light reaching each pixel of the CMOS camera sensor places a charge on that pixel. The pixels are read out to a bus, where the charge amplifiers at the edge of the bus commonly measure the charge associated with that row or column using a charge amplifier to increase the magnitude of the charge signal on the bus. Like a memory array or an image sensor array, touch sensor arrays use the same configuration of row and column lines and the same configuration of charge amplifiers. Amplifying signals from array lines using such charge

amplifiers was in standard practice well before the time of the invention described in the ’607 Patent.

42. These types of charge amplifiers were also routinely used to reduce, or filter, parasitic capacitance well over a decade before the ’607 Patent was filed. This use underscores the obviousness of incorporating such a charge amplifier in a capacitive touchscreen where parasitic capacitance is present. Often switched capacitor circuits (like the circuits shown above) provide accurate voltage gain and integration by switching a sampled capacitor onto an op-amp with a capacitor in feedback. One of the earliest of these circuits is the “parasitic-sensitive integrator” developed by the Czech engineer Bedrich Hosticka in 1977—over 25 years prior to the filing date of the ’607 Patent. (*See* B. Hosticka, R. Brodersen and P. Gray, “MOS Sampled Data Recursive Filters Using Switched Capacitor Integrators,” IEEE Journal of Solid State Circuits, Vol SC-12, No. 6, December 1977, attached as Exhibit 11 to my Declaration).



(a)

43. As shown above, Figure 2(a) of the Hosticka paper is identical to the “virtual ground charge amplifier” shown in FIG. 13 of the ’607 Patent. The amplifier shown in the example above has its positive input grounded, just as in FIG. 13 of the ’607 Patent, causing the negative input to maintain a “virtual ground,” using feedback capacitor on the negative input. As explained by Hosticka, Brodersen, and Gray, the use of such a circuit as a type of “switched filter” to reduce noise in the form of parasitic capacitance and was extremely well known in many different applications. (Exhibit 11 at 600, 604). The Hosticka paper gives many other examples of filters also incorporating a “virtual ground charge amplifier,” such as the low-pass filter shown below. (Exhibit 11 at 603).

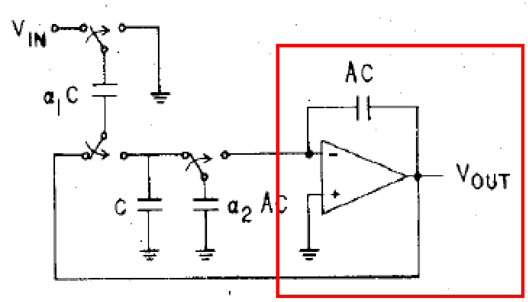
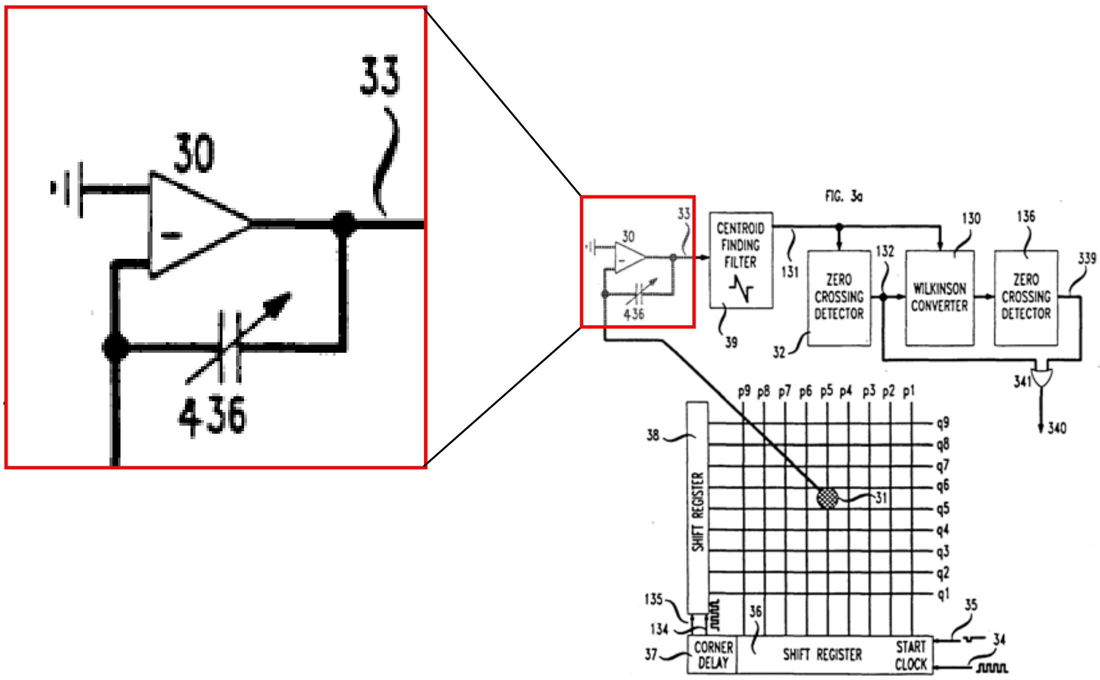


Fig. 5. Version 3 filter which only requires a single amplifier.

44. The circuits shown above were so commonplace that one of ordinary skill in the art at the time of the invention described in the ’607 Patent would have found it obvious to include such a circuit in any detection circuitry subject to parasitic capacitance in order to act as a filter, as taught by Hosticka and the 1979 textbook. The incorporation of such a circuit would be a trivial addition to any capacitive touch sensor that would yield extremely predictable results—namely the filtering of parasitic noise and unwanted charge coupling resulting potentially in more accurate measurements.

45. Virtual ground charge amplifiers were also extremely well known in the touch sensor field many years prior to the invention described in the ’607 Patent. For example, as I referenced in my opening expert report, FIG. 3 of U.S. Patent No. 5,113,041 to Blonder et al. (hereinafter “Blonder,” attached as Exhibit 12 to my Declaration) shows the exact same “virtual ground charge amplifier” *over a decade* before the filing date the ‘607 Patent. Blonder describes a transparent “touch screen” for use with a conductive stylus or human finger, just like the ’607 Patent, and is therefore in the exact same field of art as both Perski and Smartskin. (*See, e.g.,* Exhibit 12 at 14:43-65).

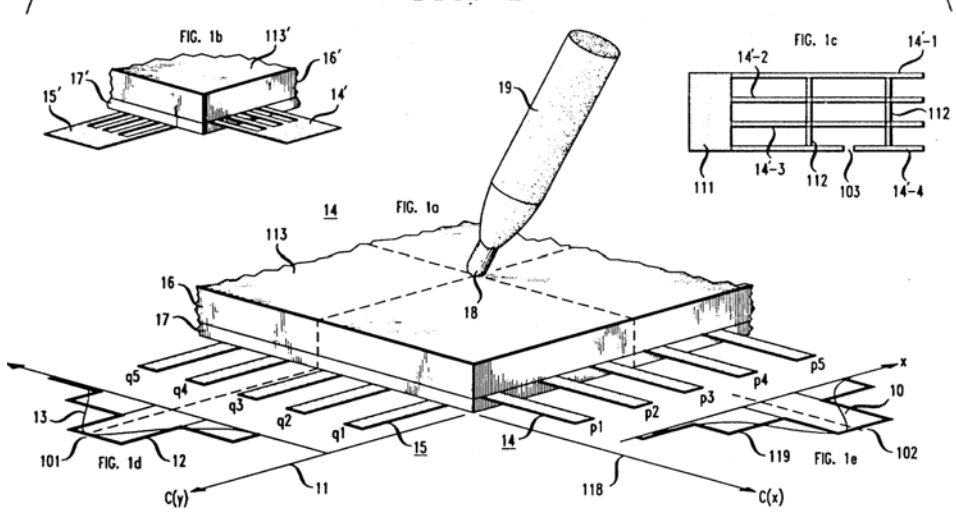


47. The inverting amplifier 30 shown in Blonder is *identical* in every respect to the "virtual ground charge amplifier" shown in FIG. 13 of the '607 Patent. For example, the non-inverting (positive) terminal of the amplifier is tied to ground, and the inverting (negative) terminal is connected to a feedback loop with a capacitor. As such, the amplifier includes the exact same "capacitor designed into a negative feedback loop" that Apple's own expert alleged was required for an operational amplifier to be considered a "virtual ground charge amplifier."

48. In his validity report, Dr. Maharbiz points out misleading and irrelevant distinctions between the touch sensor described in Blonder and the touch sensors described in Perski and Smartskin. (*See* Exhibit 10 at ¶¶ 105-112). He argues that these differences would somehow prevent successful incorporation of the "virtual ground charge amplifier," which is clearly shown in FIG. 3 of Blonder, into the touch sensors of either Perski or Smartskin. These arguments are completely without merit. The capacitive touch sensor design described in Blonder is virtually identical to the touch sensors described in Perski and Smartskin. All three of these capacitive touch sensors utilize two layers of conductive lines in order to detect the touch of a human finger or stylus. The conductive lines in Blonder are even arranged in parallel layers forming an X/Y

grid, just like those in Perski and Smartskin. FIG. 1 of Blonder clearly shows this layered arrangement of conductive lines.

FIG. 1



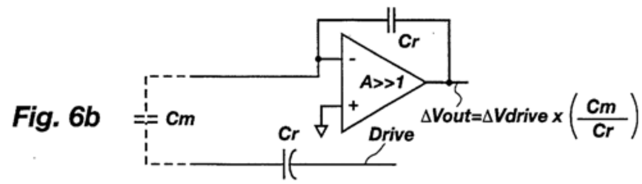
49. Dr. Maharbiz first argues that Blonder applies a "voltage pulse" to the lines, while Smartskin and Perski use AC signals. (*See* Exhibit 10 at ¶ 106). This is an irrelevant distinction. As described above, the "virtual ground charge amplifier" configuration has been used for over a decade in many applications, including use as current integrators and filters. Both AC and pulsed DC signals benefit equally from the use of such a charge amplifier, and the capacitive detection techniques are virtually identical for AC and DC driving signals. Moreover, Blonder itself acknowledged in prior art that "[t]he inputting implement introduces a current *(AC or DC)* onto the tablet, where it is measured." (Blonder at 4:20-22 (emphasis added)). Blonder, therefore, recognized that AC and DC signals were interchangeable and either could be used as the driving signal to detect touches using a capacitive touch screen. In fact, the selection of AC versus DC driving signals is merely an implementation detail well within the purview of one of ordinary skill in the art.

50. Dr. Maharbiz then argues that the "virtual ground charge amplifier" shown in FIG. 3 of Blonder is not actually "coupled to the touch panel for detecting touches." (Exhibit 10 at ¶ 107). This again is incorrect, as the stylus clearly makes contact with the touch panel, creating an electrical coupling with the conductive traces of the touch panel. This is what allows the touch

detection to take place. Blonder is clear that "[a] voltage pulse on a nearby strip *couples* through stylus tip 31 to the amplifier input producing a corresponding voltage pulse at output node 33." (Blonder at 9:32-35). Dr. Maharbiz's coupling argument is therefore completely without merit.

51. Finally, Dr. Maharbiz alleges that "[t]he capacitor at issue in Blonder is used for *force* sensing, not *position* sensing." (Exhibit 10 at ¶¶ 110-111). He then alleges that one skilled in the art would not combine an amplifier circuit in a force sensing stylus with a position sensing sensor, like those described in Perski and Smartskin. (Exhibit 10 at ¶¶ 110-111). This argument again is misleading. Blonder describes both position sensing *and* force sensing embodiments. While Dr. Maharbiz is correct that FIG. 4a of Blonder does describe a force sensing embodiment, "virtual ground charge amplifier" 30 is part of the FIG. 3 embodiment, not the FIG. 4a embodiment. Blonder is clear that in some embodiments "position information *may be supplemented* e.g. by stylus-to-tablet spacing and/or, if in contact, *by force*," but Blonder is primarily concerned with *position* sensing. (Bonder at 4:68–5:1). As such, it is my opinion that any distinction made between force sensing and position sensing is misplaced.

52. In any event, Blonder is just one example of many touch sensors that use such a "virtual ground charge amplifier" configuration to detect touches using a capacitive touch sensor. Another example is shown in U.S. Patent No. 5,565,658 to Gerpheide et al. (hereinafter "Gerpheide '658," attached as Exhibit 13 to my Declaration). Gerpheide '658 issued in 1996—8 years before the '607 Patent was filed. I understand that Gerpheide '658 was even included and charted in Samsung's preliminary invalidity contentions in an obviousness combination with U.S. Patent No. 5,305,017 also to Gerpheide et al. (hereinafter "Gerpheide '017," attached as Exhibit 14 to my Declaration). (*See* Exhibit R-2 to Samsung's Patent Local Rule 3-3 and 3-4 Disclosures, attached as Exhibit 15 to my Declaration). Gerpheide '658, like Blonder, is directed to a capacitive touch sensor. Gerpheide '658, in FIG. 6B, shows a "virtual ground charge amplifier" as its "capacitive measuring element" connected to the touch panel.



53. Once again, this amplifier is in precisely the same configuration as shown in FIG. 13 of the ’607 Patent. The non-inverting (positive) terminal of the amplifier is tied to ground, and the inverting (negative) terminal is connected to a feedback loop with a capacitor. As such, the amplifier includes the exact same “capacitor designed into a negative feedback loop” that Apple’s own expert alleged was required for an operational amplifier to be considered a “virtual ground charge amplifier.” There can be no doubt that Gerpheide ’658 clearly shows a “virtual ground charge amplifier” coupled to the touch panel for detecting touches.

54. Gerpheide ’658 provides the motivation to incorporate the virtual ground charge amplifier of FIG. 6b shown above into any capacitive touch sensor. For example, Gerpheide ’658 teaches that FIG. 6b represents a “preferred alternative” for the capacitive measurement element shown in the prior figures. (Gerpheide ’658 at 7:46-54). Gerpheide ’658 also expressly mentions that these configurations “represent different implementations known in the art for low pass filter elements, such as switched capacitor integrators and filters, high-order analog filters, and digital filters.” (*Id.* at 8:15-19). As such, it would be readily apparent to one of ordinary skill in the art to incorporate the virtual ground charge amplifier of FIG. 6b into any capacitive touch sensing application, including the touch sensors described in Perski and Smartskin, in order to filter unwanted charge coupling and detect only charge coupling due to the presence of a finger touch.

55. As yet another example, Gerpheide ’017, which I understand was also included and charted in Samsung’s preliminary invalidity contentions, also discloses the claimed “virtual ground charge amplifier.” Gerpheide ’017 issued in 1994—a *decade* before the ’607 Patent was filed. Gerpheide ’017 was identified and referenced in my opening expert report with respect to claim 7, from which claim 8 depends. I cited Gerpheide ’017 for its description of a mutual capacitive touch sensor (*see* ¶¶ 111 and 112 of my Corrected Opening Report, attached as Exhibit 16 to my Declaration). In particular, I cited column 9, line 62 through column 12, line 13 in my

opening report. (*Id.* at ¶ 112). These columns describe the exact same "virtual ground charge amplifier" shown in FIG. 13 of the '607 Patent.

56. For example, Gerpheide '017 describes a "differential charge amplifier" which maintains its inputs to "virtual ground" in order to detect mutual capacitance. This is yet another clear example of the claimed "virtual ground charge amplifier" recited in claim 8 of the '607 patent. As shown in the excerpt below, differential charge amplifier 560 is a virtual ground charge amplifier because it is a charge amplifier whose inputs are maintained at "virtual ground," the precise definition provided by Brian Huppi, an inventor of the '607 Patent.

> Wires RP **250** and RN **270** connect the positive and negative halves of the row VDE to non-inverting and inverting inputs, respectively, of a differential charge amplifier **560**. Differential charge amplifier **560** maintains RP and RN at an AC virtual ground so that the AC voltage across each mutual capacitance 500 or 520 is −F and the AC voltage across each mutual capacitance **490** or **510** is +F. The amount of charge coupled onto RP is F*M(C<n>,R<p>)−F*M(C<p>,R<p>). The amount onto RN is F*M(C<n>,R<n>)−F*M(C<p>,R<n>).
>
> The charge amplifier **560** produces an AC differential output voltage, Vo, equal to a gain factor, G, times the charge coupled onto RP minus that on RN. This yields the following relationship:
>
> $$Vo=(F*G)*\{M(C<n>,R<p>)-M(C<p>,R<p>)+M(C<p>,R<n>)-M(C<n>,R<n>)\}=L(C,R).$$
>
> Vo is the balance between C and R, denoted herein as L(C,R). Both G and the magnitude of F are constant scale factors. The product (F*G) is the scale factor, Kfg, in the above definition of the balance, L.

(Gerpheide '017 at 11:41-64).

57. These examples of numerous prior art references each disclosing a "virtual ground charge amplifier" used in connection with a capacitive touch sensor confirm my opinion that this charge amplifier configuration was extremely well known and commonly used in the design of capacitive touch screens for at least 10 years prior to the filing date of '607 Patent. In my opinion, such a feature cannot and does not contribute any inventiveness to the touch panel described and claimed in the '607 Patent.

VIII. <u>INVALIDITY OF CLAIM 8</u>

58. Apple does not deny that almost all of the limitations of claims 1 and 7, from which claim 8 depends, are shown by each of the Perski '455 and Smartskin references. (*See* Exhibit

10). I understand that Apple's arguments are virtually identical to those made in the ITC. Namely, the only limitation of claims 1 and 7 Apple alleges is missing from the Perski '455 reference is the multi-touch limitation. (*Id.* at ¶¶ 72-91). The only limitation of claims 1 and 7 Apple alleges is missing in the Smartskin reference is the "transparent sensing medium" limitation. (*Id.* at ¶¶ 165-181). Apple also alleges that neither reference discloses the "virtual ground charge amplifier" recited in claim 8.

59. In my opinion, Apple's expert makes illogical and completely unsupported distinctions between asserted claim 8 of the '607 Patent and the Perski '455 and Smartskin references. These distinctions, which I understand to be legally irrelevant, cannot withstand even the most superficial scrutiny. It is my opinion, therefore, that both Perski '455 and Smartskin clearly disclose or render obvious each and every limitation found in claim 8 and this claim is therefore invalid. Attached as Exhibit 17 to my Declaration is a claim chart showing in detail where each and every limitation is found in, or rendered obvious by, the references. Exhibit 17 is supported by the deposition transcripts of Brian Q. Huppi (attached as Exhibit 9 to my Declaration), Joshua Strickon (attached as Exhibit 18 to my Declaration), Shawn P. Day (attached as Exhibit 19 to my Declaration), and Steven Hotelling (attached as Exhibit 20 to my Declaration).

A. Perski '455

1. The Multi-touch Limitation

60. Apple's only response to the Perski '455 reference with respect to claims 1 and 7 is that Perski '455 requires the detection of both a finger and a stylus and thus cannot form a "true multitouch design." (Exhibit 10 at ¶¶ 77-79). This argument is without merit. For all the reasons below, Perski '455 clearly and unambiguously discloses this limitation.

61. Initially, I note the claim 8 does not require a "true multitouch design." Rather, the preamble[1] of claim 1 merely requires the sensing medium to be "configured to detect multiple touches or near touches that occur at a same time and at distinct locations in a plane of a touch panel." Perski '455 plainly *and expressly* discloses this limitation. For example, Perski '455

[1] Both parties agree that the preamble of claim 1 is limiting.

discloses that “[t]he goal of the finger detection algorithm…is to recognize all of the sensor matrix junctions that transfer signals due to external finger touch. It should be noted that this algorithm is preferably able to detect more than one finger touch at the same time.” (Perski ’455 at 14:15-19).

62. In fact, upon closer inspection, the preferred touch detection algorithm disclosed in Perski ’455 is *identical* to that disclosed in the ’607 Patent itself. Both detection algorithms drive one “drive” line at a time and sense on all intersecting “sense” lines. This allows the detection circuitry of both Perski ’455 and the ’607 Patent “to recognize all of the sensor matrix junctions,” and this is what allows for the recognition of multiple simultaneous touches. (*Id.*).

Multi-touch Limitation	Perski ’455	’607 Patent
“configured to detect multiple touches or near touches that occur at a same time and at distinct locations in a plane of a touch panel” (Claim 1)	“The goal of the finger detection algorithm…is to recognize all of the sensor matrix junctions that transfer signals due to external finger touch. It should be noted that this algorithm is preferably able to detect ***more than one finger touch at the same time***. A number of procedures for detection are possible. The most simple and direct approach is to ***provide a signal to each one of the matrix lines in one of the matrix axes, one line at a time, and to read the signal in turn at each one of the matrix lines on the orthogonal axis***…. The junctions that are being touched are the ones connecting the conductor that is currently being energized and the conductors which exhibit an output signal.” (14:15-43).	“***When driven, the charge on the driving line capacitively couples to the intersecting sensing lines through the nodes and the capacitive sensing circuit senses all of the sensing lines in parallel***. Thereafter, ***the next driving line is driven, and the charge on the next driving line capacitively couples to the intersecting sensing lines through the nodes and the capacitive sensing circuit senses all of the sensing lines in parallel***. This happens sequential until all the lines have been driven.” (13:38-46 (reference numerals omitted))

63. As shown in the table above, both the Perski ’455 detection algorithm and the detection algorithm disclosed in the ’607 Patent drive a signal on one drive line at a time until all drive lines have been scanned. After driving each line, all the orthogonal intersecting lines on the other axis are sensed. All sense lines that exhibit an output signal are the lines currently being

touched. This detection algorithm allows for the independent recognition of all junctions in the grid of traces (all X/Y intersection locations), much like a grid coordinate system. This capability is what permits the "true multitouch" recognition. There is absolutely no difference between the detection algorithm disclosed in Perski '455 and the detection algorithm disclosed in the '607 Patent. It is thus my opinion that the detection algorithm used in Perski '455 clearly is able to "detect[ing] multiple touches or near touches that occur at a same time and at distinct locations in a plane of a touch panel."

64. In his validity report, Apple's expert also alleges that "Perski's need for both the stylus and finger touch capability [] led to specific weaknesses in Perski's design." (Exhibit 14 at ¶ 79). This is plainly incorrect. The ability of the touch sensor in Perski '455 to detect both finger and stylus touches is completely irrelevant to the invalidity analysis. First, Perski '455 is clear that the "[d]etection of finger touch and EM stylus is *independent* and can be performed simultaneously *or at different times*. It is left to the *discretion of the user* whether to…implement a detector for *one kind of interaction alone (i.e., finger touch or EM stylus) or to allow the detection of both kinds of interactions*." (Perski '455 at 8:49-55 (emphasis added)). As such, Perski '455 clearly supports solely detecting finger touches, solely detecting an EM stylus, or both forms of detection simultaneously. Second, the ability to detect a finger in addition to a stylus is not prohibited anywhere in claims 1, 7, or 8, so I understand this distinction to be completely irrelevant to my invalidity determination.

65. Rather, all that is required is a sensing medium "configured to detect multiple touches or near touches that occur at a same time and at distinct locations in a plane of a touch panel." This is the only limitation Apple alleges is missing from Perski '455. (Exhibit 10 at ¶¶ 72-91). In my view, Perski '455 shows this feature clearly and unambiguously. There is simply no other possible interpretation of the plain disclosure of Perski '455.

66. Apple's expert seems to admit that Perski '455 does in fact show the ability to detect multiple touches at the same time, but that this ability "was ancillary to the primary purpose of Perski's device." (Exhibit 14 at ¶ 81). This argument has no merit because the "primary purpose" of Perski is legally irrelevant for my invalidity determination. Rather, Perski '455

expressly discloses a transparent sensing medium configured to detect multiple touches at the same time and therefore anticipates this limitation.

67. Apple's expert again seems to admit that Perski '455 meets this limitation when he states "[t]hus, on its face, the Perski references do not disclose or claim multi-finger sensing embodiments in the precise manner that is set forth in the '607 Patent." (*Id.*). Once again, I find this reasoning fatally flawed. First, I understand that is not legally relevant to my invalidity determination what is *claimed* in Perski '455. Rather, I understand that a prior art reference is prior art for all that it discloses anywhere in the reference, whether claimed or unclaimed. Second, there is no requirement I am aware of that a prior art reference must disclose the "precise manner" of sensing set forth in a patent in order to invalidate that patent. Rather, I understand that only each and every limitation of the claims must be disclosed or rendered obvious in order to invalidate a patent. Perski '455 clearly does this. Third, as described above, Perski '455 does in fact describe the exact same detection algorithm disclosed in the '607 Patent; therefore, in my opinion, Perski '455 does in fact disclose the "precise manner" of detection set forth in the '607 Patent.

68. Finally, Apple argues that Perski '455 would not have enabled a working touch panel configured to detect multiple touches. (*Id.* ¶ 82). Apple seems to suggest that when Perski's touch panel is placed over a display, parasitic (or unwanted) variable capacitance coupling would occur "between the display and the sensor and between the environment and the sensor" rendering reliable multitouch detection impossible. (*Id.*). This reasoning is flawed and extremely speculative for several reasons.

69. First, Perski '455 expressly teaches that its sensor is "substantially transparent and suitable for location over a display screen." (Perski '455 at 3:39-40). To suggest that Perski's sensor would somehow not function as described when positioned over a display is completely contrary to the express disclosure of Perski itself and completely unsupported. In fact, *all of Perski's touch sensor embodiments are positioned over a display*. For example, Perski '455 states: "present embodiments comprise a digitizer that allows finger clicks and movement detection on *flat panel displays*, in such a way that the same sensing infrastructure can be used for

electromagnetic (EM) stylus detection. The digitizer is designed to work in conjunction with a patterned transparent conductive foil system, which allows for detecting the location of an electro magnetic stylus on top of an *electronic display surface*." (*Id.* at 8:9-16).

70. Second, all touchscreens positioned over a display would experience some degree of unwanted, or parasitic, coupling. This is inevitable due to interference caused by the display itself. Parasitic coupling will not make multitouch detection unreliable, as suggested by Apple's expert, especially if techniques are used to reduce the unwanted coupling.

71. Third, Apple's own expert admits that "[w]ithout a proper compensation method, these variations in parasitic capacitance across the traces would generate spurious signals…so that reliable multitouch is not possible." (Exhibit 14 at ¶ 85). What Apple's expert fails to mention is that Perski '455 discloses several different compensation methods to account for this parasitic capacitance. For example, Perski '455 teaches that "[i]n a preferred embodiment, the detector actually learns the amount of parasitic current transfer for each individual junction and *subtracts this value from the sampled signals*." (Perski '455 at 14:11-14). As such, Perski '455 describes a method of completely removing virtually all parasitic capacitance by subtracting it out from its measurements. In addition, Perski '455 discloses a sophisticated "mapping solution" to eliminate virtually all of the parasitic capacitance. Perski '455 explains that "[s]uch a mapping process is used in the preferred embodiment of the present invention in order to solve the problem of steady noises injected by the panel display. The same method can be used in the same and other embodiments of the present invention in order to solve any type of steady noise problem." (*Id.* at 21:46-53). As such, Perski '455 discloses several compensation methods that adequately deal with unwanted charge coupling and other sources of noise.

72. Fourth, "reliable multitouch" is not required by any claim of the '607 Patent, as Apple's expert seems to imply. Rather, as described above, only the detection of multiple touches at the same time and at distinct location is required. The transparent touch sensor described by Perski '455 is fully enabled and would certainly detect multiple touches at the same time and at distinct locations, as required by asserted claim 8. Whether or not the sensor described in Perski '455 can perform "reliable multitouch" is irrelevant. In any event, as I

explained above, Perski ’455 provides several mechanisms for combating parasitic capacitance and therefore can reliably detect multiple touches at the same time.

73. For all these reasons, it is my opinion that the touch sensor described in Perski ‘455 does not suffer from disabling parasitic capacitance problems that would render multitouch unreliable. Apple’s suggestions otherwise are highly speculative and completely unsupported. Rather, the express disclosure of Perski ’455 is unambiguous: the touch sensor described in Perski ’455 is configured “to detect more than one finger touch at the same time” and hence discloses this limitation. (Perski ’455 at 14:15-19).

2. <u>The Virtual Ground Charge Amplifier Limitation</u>

74. When I submitted my opening report, I was uncertain of the precise definition of a “virtual ground charge amplifier.” I relied in part on my interpretation of this term in light of the specification of the ’607 Patent as well as the disposition testimony of Brian Huppi, one of the inventor’s of the ’607 Patent. According to Mr. Huppi, Mr. Huppi a “virtual ground charge amplifier” is merely an “operational amplifier [] that was configured such that it held the inputs to be at the same potential as ground.” (Exhibit 9 at 96:19-97:9). With this definition in mind, I cited to at least operational amplifier 74 of FIG. 5 of Perski ‘455 as the claimed “virtual ground charge amplifier.”

75. I also explained that this operational amplifier 74 of Perski ‘455 inherently carries “Miller capacitance,” which is mathematically identical to a pair of capacitors to ground, providing a virtual ground to the charge amplifier. In my opinion, operational amplifier 74 of Perski ‘455 qualifies as a “virtual ground charge amplifier” under the plain and ordinary meaning of the term.

76. I understand that Apple’s expert now asserts that the claimed “virtual ground charge amplifier” must be in the precise configuration shown in FIG. 13 of the ’607 Patent. Many different prior art references, including the Blonder and two Gerpheide references I described above, show the exact same amplifier configuration shown in FIG. 13 of the ’607 Patent. (*See* ¶¶ 29-57 above). Many of these references predate the filing of the ’607 Patent by *more than 10 years*. Moreover, as discussed above in ¶¶ 29-57, this op-amp configuration is

widely used in all kinds of consumer electronics devices and is even described in many textbooks and university science experiments. Many of the examples I cited above are even in the capacitive touch sensor field and include express descriptions of "virtual ground charge amplifiers" and the reasons for including such circuits in a touch sensor. As such, it is my opinion that even if the Court requires the claimed "virtual ground charge amplifier" to be in the precise configuration shown in FIG. 13 of the '607 Patent, it would have been obvious to one of ordinary skill in the art at the time of the invention of the '607 Patent to include such circuitry in the touch sensor of Perski '455.

77. Such a modification to Perski '455 would have been obvious in order to filter parasitic capacitance and other stray noise. This would allow for only the change in charge coupling due to an eternal finger touch to be measured and detected. For example, Perski '455 itself already acknowledges that there is a certain amount or "parasitic capacitance" associated with the overlapping conductors. Perski '455 then teaches that "[i]n a preferred embodiment, the detector actually learns the amount of parasitic current transfer for each individual junction and subtracts this value from the sampled signals." (Perski '455 at 14:11-14). As such, Perski '455 itself provides the motivation for one of ordinary skill in the art to use the precise amplifier configuration shown in any one of the Blonder reference, the Gerpheide '658 reference, the Gerpheide '017 reference, the numerous textbook references, or the Hosticka article, in order to filter parasitic capacitance and other noises. The addition of such a commonplace circuit to the touch sensor of Perski '455 would have been readily obvious to even the most novice circuit designer.

3. <u>Other Limitations</u>

78. In my rebuttal report regarding non-infringement, it was my opinion that the preamble of claim 1 required the ability to detect *near touches* in addition to actual touches. This requirement, in my opinion, is the result of arguments made by the applicants during prosecution of the '607 Patent. To the extent the Court agrees with my view and to the extent Apple argues that near touches are not detected by the sensor described in Perski '455, it is my opinion that Perski '455 expressly teaches the detection of near touches in addition to actual touches. For

example, Perski ’455 states “[i]n the preferred embodiments of the present invention, the same detector can detect and process signals from an Electro Magnetic Stylus whether it is placed in contact with, *or at a short distance from*, the surface of a flat panel display.” (Perski ’455 at 8:56-65).

79. In my rebuttal report regarding non-infringement, it was also my opinion that the last limitation of claim 1 required driving all of the first conductive lines at the same time and sensing on all the second conductive lines. Because the “first conductive lines” and the “second conductive lines” referred back to the “plurality” of lines, I concluded that more than one (*i.e.*, at least two) lines must be driven simultaneously while sensing on more than one (*i.e.*, at least two) lines. The actual number of lines included in the “first conductive lines” and the “second conductive lines” would depend on how many lines were grouped into the claimed first and second lines, respectively, but at least two must be included in each grouping to fulfill the “plurality” requirement. To the extent the Court agrees with my view and to the extent Apple argues Perski ’455 does not disclose this limitation, it is my opinion that Perski ’455 clearly teaches driving multiple lines simultaneously while sensing on multiple lines. For example, Perski ’455 teaches that “[a] faster approach is to apply the signal to a *group of conductors* on one axis. A group can comprise *any subset including all of the conductors* in that axis, and look for a signal at each one of the conductors on the other axis. Subsequently, an input signal is applied to a *group of lines* on the second axis, and outputs are sought at *each one of the conductors* on the first axis.” (Perski ’455 at 14:44-50). Perski ‘455 unambiguously describes driving a group of multiple lines on one axis while at the same time sensing on all the lines on the other axis and therefore clearly meets this limitation.

80. Because all of the elements of claim 8 are disclosed or rendered obvious by Perski ’455, it is my opinion that Perski ’455 clearly invalidates claim 8 of the ’607 Patent.

B. Smartskin

1. The Transparent Sensing Medium Limitation

81. Apple’s only response to the Smartskin reference with respect to claims 1 and 7 is that Smartskin does not show a “transparent” sensing medium. (Exhibit 14 at ¶¶ 165-176). I

disagree with this allegation. For all the reasons below, Smartskin clearly and unambiguously discloses this limitation.

82. As Apple's expert acknowledged in his report, Smartskin describes two different prototypes. (Exhibit 14 at ¶ 167). Although both prototypes are arguably opaque, in my experience converting either of the two opaque prototypes into a transparent design would have been an easy modification well within the skill of one of ordinary skill at the time the '607 Patent was filed. ITO, or indium tin oxide, is a solid solution that is transparent and colorless in thin layers. ITO is the most widely used transparent conducting oxide and was commonly used in LCD's and flat panel displays well before the '607 Patent was filed. The use of ITO traces in transparent touch screens was extremely well known, as evidenced by the numerous references (like Perski '455 as well as many other references included in Samsung's invalidity contentions) disclosing the use of such transparent electrodes in capacitive touch screens. Converting either opaque sensor prototype into a transparent sensor would involve little more than mounting the electrodes described in Smartskin on transparent dielectric layers and substituting the copper wires with transparent ITO traces. Both of these modifications would have been obvious to one of ordinary skill in the art at the time the '607 Patent was filed. For example, plastic PET transparent films could be used as the substrate to carry the transparent ITO traces. This selection would have been an obvious design choice and is shown in almost all of the transparent touch sensors cited in my opening report, including the capacitive touch sensor of Perski '455. Such a conversion of an opaque capacitive touch sensor into transparent form would yield extremely obvious and predictable results—namely, a touch sensor capable of being used as a *touchscreen* and mounted in front of a display, as already taught by Smartskin itself, as described below.

83. In any event, it is my opinion the Smartskin itself actually discloses the use of transparent electrodes and therefore discloses this limitation without resorting to an obviousness analysis. The two Smartskin prototypes detailed in the Smartskin paper are both adapted for use with a projector that displays information onto the sensors. A user may interact with the displayed information, as shown in Figure 7 below, where a user is able to concatenate two displayed objects using both hands.

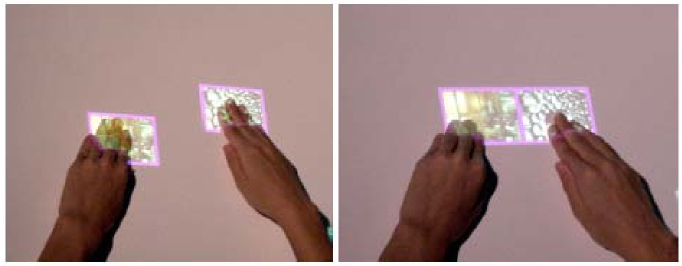


Figure 7: Two-handed operation is used to concatenate two objects.

84. It is clear, therefore, that the touch sensor described in Smartskin is adapted for use with a projection display. Smartskin also includes a section entitled “Use of transparent electrodes” which expressly discloses the use of ITO as a transparent electrode in the design of a Smartskin sensor. (Smartskin at p. 7). As shown below, Smartskin teaches that a “transparent SmartSkin sensor can be obtained by using [] (ITO) or a conductive polymer” and this transparent version of the sensor can be “mounted in front if a flat panel display or on a rear-projection screen.” As such, a fully transparent embodiment of the Smartskin sensor is expressly disclosed within Smartskin itself.

Use of transparent electrodes: A transparent SmartSkin sensor can be obtained by using Indium-Tin Oxide (ITO) or a conductive polymer. This sensor can be mounted in front of a flat panel display or on a rear-projection screen. Because most of today’s flat panel displays rely on active-matrix and transparent electrodes, they can be integrated with SmartSkin electrodes. This possibility suggests that in the future, display devices that will be interactive from the beginning, and will not require “retrofitting” sensor elements into them.

We also want to make transparent tagged objects by combining transparent conductive materials with the use of capacitance tags as shown in Figure 15. This technology will enable creating interface systems such as “DataTiles” [18], a user can interact with the computer via the use of tagged physical objects and hand gestures.

85. Apple’s only response to this express disclosure in Smartskin is that Smartskin doesn’t actually *enable* the use of a transparent sensor, but merely describes one. (Exhibit 14 at ¶ 168). I disagree. The problems identified by Apple’s expert regarding electrical resistance, poor

performance, and thermal and external noise are all specious. In fact, in my experience, none of the alleged problems identified by Apple's expert are actual impediments to making the Smartskin sensor transparent. Numerous other examples of prior art touch sensors were fully transparent, including the touch sensor described in Perski '455; therefore, Apple's arguments are completely without merit.

86. While Apple's expert recites facts about the resistance of copper and ITO, he misses the point. It is not a question of the relative resistance of copper versus ITO. The comparison should be made of the line resistance relative to the input impedance of the charge amplifier. In both cases, the resistance of the copper or ITO lines results in an RC time constant that is very small compared to any human motions or touchpad phenomena. As a result, the distinction between copper and ITO resistance is irrelevant in the context of a charge amplifier that is fast relative to the timescale of human motion on or near a touch sensor.

87. Dr. Maharbiz also exaggerates the effect of line resistance in comparing sheet resistance instead of resistance per unit distance of trace, as would be representative for two identically sized panels, one made from thin copper wires and the other made from wide ITO traces. The copper wires are opaque, so must be made thin to pass a large fraction of light, whereas the wider ITO traces can be made thicker to increase the capacitive pickup of signals. For a 10 cm touchscreen and 1 mm trace pitch, approximately 100 ITO squares can span the touchscreen. The copper traces, on the other hand, must be made narrow enough to not block light, much narrower than the ITO. Allowing for 1% light blockage using copper, the traces would have to be 10 microns wide on a 1000 um pitch. Such a configuration spanning an example 10 cm touchscreen would require ten thousand squares of resistance for the copper, resulting in 4.5 ohms of resistance per trace for copper. Again, using Dr. Maharbiz's figures, 50 ohms per square would result in 5000 ohms for the ITO trace. Even assuming a generous input capacitance of 100 pF, the relevant time constant would be RC = 5000 ohms * 100 pF = 5e-7 seconds = ½ microsecond, more than 1000 times faster than the fastest human motions, which are on millisecond timescales. It was well known to have operational amplifiers with input capacitances well below 100 pF at the time of the invention described in the '607 Patent. In

addition, the traces themselves could be made to have low capacitance as well. The ITO traces are demonstrably fast enough to capture any human motion. It was common knowledge at the time of the invention described in the ’607 Patent that such circuits were practical. Thus, a transparent touchscreen using ITO was well within the purview of an ordinary touch sensor designer at the time of the ’607 Patent invention.

88. Apple’s expert also argues that converting the opaque Smartskin sensor into a transparent sensor would dramatically increase the resistance of the lines and introduce a phase shift. As described above, the resistance of the lines would likely increase by a factor of 1000, not 100,000 as Dr. Maharbiz suggests. Dr. Maharbiz says the 100,000 times sheet resistivity increase “would result in roughly the same amount of increase in the time constant of the system.” I disagree. The time constant of the system is proportional to the resistance of the traces, which are shown in preceding paragraphs to be two orders of magnitude less than the ratio Dr. Maharbiz uses for the copper wires and ITO traces. More importantly, whether the time constant is ½ microsecond for the ITO trances or ½ nanosecond for the copper wires, both timescales are extremely short relative to the millisecond timescales of the fastest human motions.

89. Moreover, Smartskin uses a “lock-in amplifier” to lock in the phase of the system. Not only does the lock-in amplifier accommodate phase shifts, it actually uses phase shifts to achieve its objectives. Thus, I find the comments in Dr. Maharbiz’s report to be unrealistic in suggesting that a working lock-in amplifier detection circuit would be rendered inoperable by the introduction of a phase shift that in an example circuit would measure a fraction of a microsecond. Rather, the lock-in amplifier is designed to accommodate for such a phase shift. The frequencies used by the Smartskin sensor are low compared to the ½ microsecond phase shift timescale. For example, the Smartskin paper discloses 400 KHz frequencies, which is nearly an order of magnitude slower than the typical timescale calculated above for ITO with a high input capacitance amplifier.

90. Dr. Maharbiz also states that “such a large RC might have acted as an inherent low pass filter, preventing the sinusoids of the frequencies described in the Smartskin paper.” Again, this conclusion is specious and unsupported. The 400 KHz sinusoid of the Smartskin sensor

would not be attenuated by an RC time constant that corresponds to a frequency nearly an order of magnitude larger using conservative example values. A 400 KHz sinusoid is not attenuated or blocked by a 2 MHz low-pass filter. Thus, the signal would not be limited for practical values of R and C for the transparent ITO material.

91. Dr. Maharbiz also cites to an increase of noise by a factor of 316, but misses the point that thermal noise is not the driving consideration in this design. In addition, Dr. Maharbiz makes the incorrect assumption that the line resistance is increasing by 100,000 times. For the reasons stated above, the typical copper wire uses 100 times as many squares per unit trace distance than the ITO traces, due to thickness constraints. Thus, the line resistivity is at least two orders of magnitude smaller than the figures indicated by Dr. Maharbiz, resulting in a noise increase of only 31.6 times and not the 316 times suggested by Dr. Maharbiz. The noise of the amplifiers in this example far outweighs the noise of even a large ITO trace. Thermal noise is therefore not the dominant factor in these designs.

92. As a practical matter, the increased resistivity of the ITO would mainly increase the noise at frequencies above the knee frequency of the RC time constant, 2 MHz in the example above. The signals of interest have far lower frequency. It was common practice at the time of the ’607 Patent invention to filter out-of-band noise as required for desired circuit operation. Thus, noise introduced by increased trace resistance could easily be reduced using conventional and well-known filtering techniques.

93. As such, it is my opinion that Smartskin does expressly disclose and fully enable a transparent sensor adapted for use in front of a display. Even if Smartskin did not disclose such an embodiment, it would have been obvious to convert either sensor prototype described in Smartskin into a transparent form so that the sensor could be mounted in front of a display, as taught by Smartskin itself or the Rekimoto reference, which is by the same author.

2. <u>The Virtual Ground Charge Amplifier Limitation</u>

94. For the same reasons described above in connection with Perski ’455, it is my opinion that the addition of a “virtual ground charge amplifier” into the touch sensor of Smartskin would have been a trivial and obvious addition. One of ordinary skill in the art would be

motivated to include such a charge amplifier for the same reasons stated above in connection for Perski ’455. Namely, the addition of such an amplifier configuration could be used as a filter to reduce stray, unwanted charge coupling and potentially improve measurements. Such a modification to the touch sensor of Smartskin would yield extremely predictable results because, as described above, such a charge amplifier configuration was well known and widely used in many filtering applications, including capacitive touch sensors, for over a decade before the filing of the ’607 Patent.

3. <u>Other Limitations</u>

95. In my rebuttal report regarding non-infringement, it was my opinion that the preamble of claim 1 required the ability to detect *near touches* in addition to actual touches. This requirement, in my opinion, is the result of arguments made by the applicants during prosecution of the ’607 Patent. To the extent the Court agrees with my view and to the extent Apple argues that near touches are not detected by the sensor described in Smartskin, it is my opinion that Smartskin expressly teaches the detection of near touches in addition to actual touches. For example, Smartskin states “[w]hen a user’s hand is placed within 5-10 cm from the table, the system recognizes the effect of capacitance change.” (Smartskin at p. 3). Smartskin goes on to explain how “distance estimation” is implemented to determine the relative distance of a hand to the table and even shows (in Figure 5 reproduced below) different visual indications corresponding to varying distances of a finger being away from the table. Smartskin, therefore, clearly detects near touches as well as actual touches.

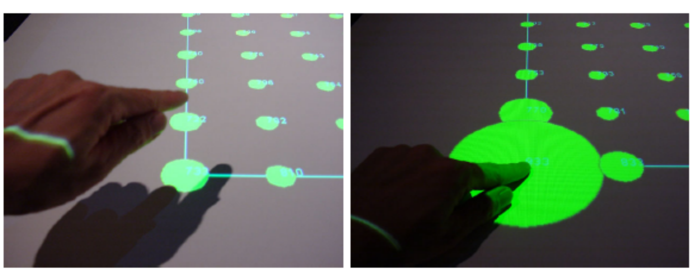


Figure 5: Relationship between distance between hand and sensor and sensed values. The diameter of the circle represents the amplitude of the sensed value.

96. In my rebuttal report regarding non-infringement, it was also my opinion that the last limitation of claim 1 required driving all of the first conductive lines at the same time and sensing on all the second conductive lines. Because the "first conductive lines" and the "second conductive lines" referred back to the "plurality" of lines, I concluded that more than one (*i.e.*, at least two) lines must be driven simultaneously while sensing on more than one (*i.e.*, at least two) lines. The actual number of lines included in the "first conductive lines" and the "second conductive lines" would depend on how many lines were grouped into the claimed first and second lines, respectively, but at least two must be included in each grouping to fulfill the "plurality" requirement. To the extent the Court agrees with my view and to the extent Apple argues Smartskin does not disclose this limitation, it is my opinion that Smartskin clearly teaches driving multiple lines simultaneously while sensing on multiple lines. For example, Smartskin teaches that "[t]he system time-dividing transmitting signal [is] sent to *each of a vertical electrodes* and the system independently measures values from *each of receiver electrodes*." (Smartskin at p. 2). The fact that the transmitted signal is time-divided would indicate that the signal is transmitted to a subset of all the electrodes in one axis while all the electrodes on the other axis are sensed. It is therefore my opinion that Smartskin discloses driving more than one line at the same time while sensing on more than one line. To the extent Smartskin's sensor applies the drive signal only to one electrode at a time, it would have been obvious to use the "faster approach" described in Perski '455 in the Smartskin sensor in order to reduce the number of steps or operations required in order to scan the entire panel. (*See* ¶ 79). This modification to the Smartskin sensor would have been an obvious design choice in order to improve scan speed and efficiency, as taught by Perski '455.

97. Because all of the elements of claim 8 are disclosed or rendered obvious by Smartskin, it is my opinion that Smartksin invalidates claim 8 of the '607 Patent.

IX. CONCLUSION

98. It is my opinion that claim 8 of the '607 Patent is clearly invalid in view of *either* Perski or Smartskin.

I declare under penalty of perjury that the foregoing is true and correct. Executed in Santa Clara County, California on May 17, 2012.

By:

Brian Von Herzen