

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.
Petitioner

v.

Neodron, Ltd.
Patent Owner

Case No. IPR2020-001287
U.S. Patent No. 9,411,472

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 9,411,472**

TABLE OF CONTENTS

I. INTRODUCTION	1
II. SUMMARY OF THE '472 PATENT.....	1
A. DESCRIPTION OF THE ALLEGED INVENTION OF THE '472 PATENT.....	1
B. PROSECUTION HISTORY OF THE '472 PATENT	5
C. LEVEL OF SKILL OF A PERSON HAVING ORDINARY SKILL IN THE ART	8
III. REQUIREMENTS FOR INTER PARTES REVIEW UNDER 37 C.F.R.	
§ 42.104	9
A. GROUNDS FOR STANDING UNDER 37 C.F.R. § 42.104(A).....	9
B. DISCRETION UNDER 35 U.S.C. § 314(A)	9
C. IDENTIFICATION OF CHALLENGE UNDER 37 C.F.R. § 42.104(B) AND RELIEF REQUESTED.....	14
D. CLAIM CONSTRUCTION UNDER 37 C.F.R. § 42.104(B)(3)	16
IV. THE CHALLENGED CLAIMS OF THE '472 PATENT ARE UNPATENTABLE.....	19
A. <u>GROUND 1</u> : <i>SLEEMAN</i> IN VIEW OF <i>WESTERMAN</i> '787 RENDER CLAIMS 1, 7, 13, 22, AND 23 OBVIOUS.....	19
B. <u>GROUND 2</u> : <i>SLEEMAN</i> IN VIEW OF <i>HOTELLING</i> RENDERS CLAIMS 1, 7, 13, 19, 20, 22, AND 23 OBVIOUS.....	43
C. <u>GROUND 3-4</u> : <i>SLEEMAN</i> , <i>WESTERMAN</i> '787, AND <i>GRIFFIN</i> OR <i>SLEEMAN</i> , <i>HOTELLING</i> , AND <i>GRIFFIN</i> RENDER CLAIMS 5, 6, 11, 12, 17, 18, AND 21 OBVIOUS	52
D. <u>GROUND 5</u> : <i>SLEEMAN</i> , <i>WESTERMAN</i> '787, AND <i>HOTELLING</i> RENDER CLAIMS 19 AND 20 OBVIOUS.....	61
V. CONCLUSION	69
VI. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(A)(1).....	70
A. REAL PARTY-IN-INTEREST	70
B. RELATED MATTERS.....	70
C. LEAD AND BACK-UP COUNSEL.....	70

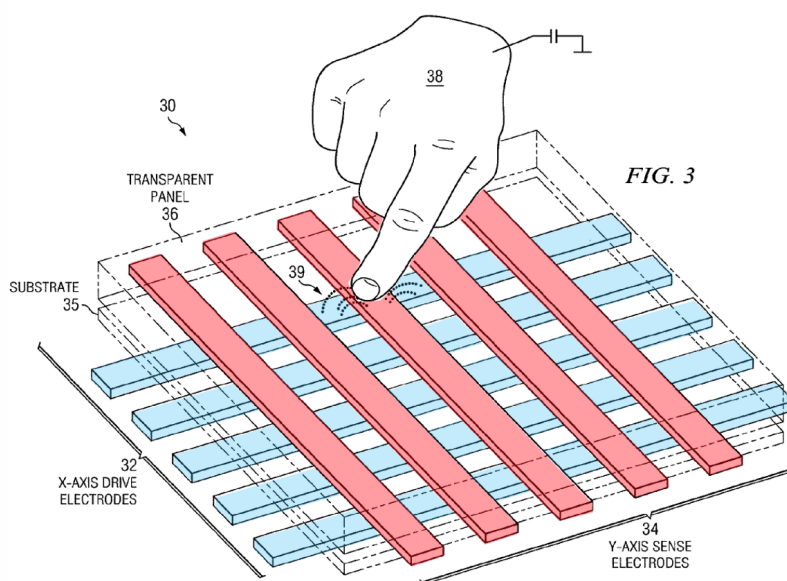
I. INTRODUCTION

Petitioner Apple Inc. requests an *Inter Partes* Review (“IPR”) of claims 1, 5-7, 11-13, and 17-23 of U.S. Patent No. 9,411,472 (“the ’472 Patent”).

II. SUMMARY OF THE ’472 PATENT

A. Description of the alleged invention of the ’472 Patent

The ’472 Patent “generally relates to touch sensors” including “[a] touch sensor . . . utilized by a device such as a tablet computer, personal digital assistant (PDA), smartphone, portable media player, or any other device to detect the presence and location of a touch or the proximity of an object (such as a user’s finger or a stylus) to the device.” ’472 Patent (Ex. 1001), 1:6, 1:60-64. As shown in the figure below, the touch sensor 30 “includes drive electrodes 32 [denoted in blue], sense electrodes 34 [denoted in red], a substrate 35, and a panel 36.” *Id.* at 5:30-32.



Id. at Fig. 3 (annotated).

A controller 12 applies “a pulsed or alternating voltage to drive electrodes 32, which induces a charge on sense electrodes 34.” *Id.* at 5:46-49, Figs. 1, 3. When an object 38 (e.g., the user’s finger) touches or comes in proximity to the sensor, a change in capacitance occurs, which “is sensed by sense electrodes 34 and measured by controller 12.” *Id.* at 5:49-53. The controller 12 determines the position of the touch/proximity “[b]y measuring changes in capacitance throughout an array of sense electrodes 34.” *Id.* at 5:53-57. Thus, this embodiment of touch sensor 30 is a conventional mutual-capacitance sensor. *Najafi Decl.* (Ex. 1003), ¶52.

The ’472 Patent recognizes devices having such capacitive touch sensors “may be utilized in a ‘grounded’ environment (e.g., an environment where the device has a good path to ground)” or “in a ‘floating’ environment (e.g., an environment where the device is not grounded at all or only has a weak path to ground).” ’472 *Patent* (Ex. 1001), 1:64-2:12. The manner in which a user interacts with the device can determine whether the device has a good path to ground or not. For example, if an unplugged “device 20 [is] lying on a surface such as a table while a user is interacting with touchscreen display 22[,]” “device 20 may be considered ‘floating’ since it has no or a weak path to ground.” *Id.* at 5:60-63. That same unplugged “device 20 may be considered ‘grounded’ [with] a strong path to ground” if “held in a user’s hand while a finger on the user’s other hand is touching touchscreen display 22.” *Id.* at 5:65-6:1. Device 20’s grounding status may also be assessed

independently of the user. For example, “device 20 may be considered ‘grounded’ [with] a strong path to ground” if “plugged into a power or synchronization cable.” *Id.*

“FIG. 5A illustrates an example capacitance graph 50a representing” a touch “while device 20 is grounded.” *Id.* at 6:29-32. As shown below, a grounded touch results in “a relatively uniform spike in measured capacitance having a maximum magnitude 54a of approximately 1200.” *Id.* at 6:36-38.

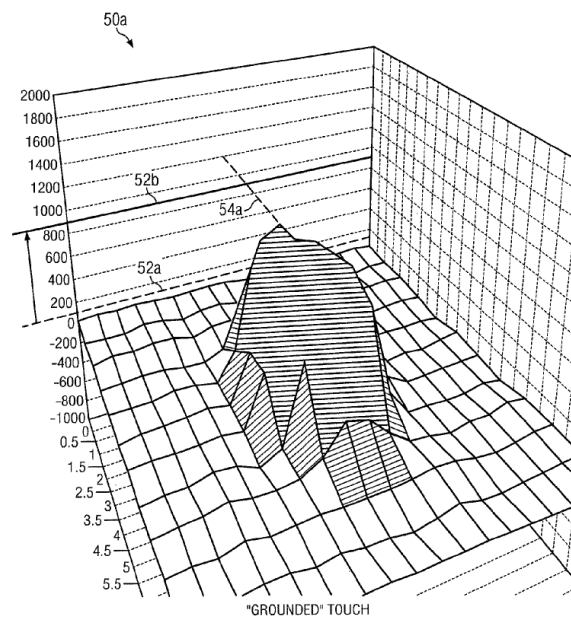


FIG. 5a

Id. at Fig. 5a.

An exemplary floating touch is illustrated below, exhibiting “a non-uniform spike in measured capacitance having a maximum magnitude 54b of approximately 600.” *Id.* at 7:6-15.

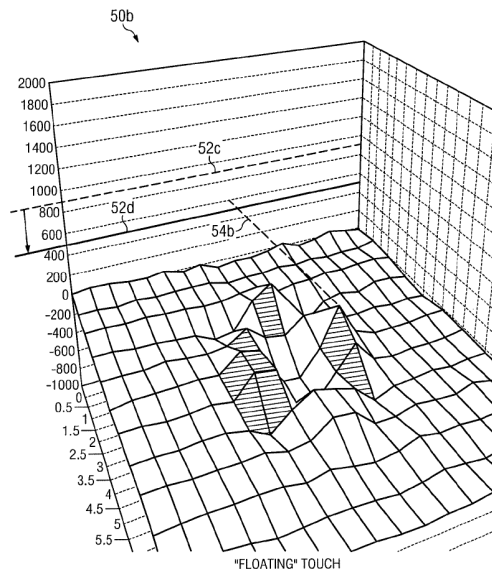


FIG. 5b

Id. at Fig. 5b. As illustrated, “the differences in signals measured by the touch sensor may vary between floating or grounded by up to 30% or more.” *Id.* at 2:12-16.

Per the '472 Patent, conventional “touch sensors are configured with a single touch detection threshold that is used to determine whether an object is touching the touch sensor.” *Id.* at 2:17-19. The threshold is “usually pre-programmed to a fixed value that is a balance between not being too high and therefore not detecting touches in the floating scenario, and not being too low and therefore detecting false touches by picking up noise in the grounded scenario,” but striking the right balance “can be very difficult and often results in touch sensors not accurately detecting touches in all grounding scenarios.” *Id.* at 2:19-27.

To solve this problem, the '472 Patent proposes adjusting the touch detection threshold based on the grounding status of the touch sensor. *Id.* at 2:28-33. Before

determining whether a change in capacitance should be registered as a “touch,” “touch sensor 30 determines the strength of the charge return path between touch sensor 30 and ground 46 in order to determine whether device 20 is grounded or floating” *Id.* at 7:66-8:2, Fig. 7 (step 730). The ’472 Patent describes several ways of determining the strength of the charge return path, including (1) determining if the device is connected, plugged in (*id.* at 8:3-15), (2) determining how close a touch is to an electrode intersection (*id.* at 8:21-26), or (3) “by analyzing the geometry of the shape of one or more capacitance graphs” (*id.* at 9:39-42).

Once the grounding status of the touch sensor is determined, the touch detection threshold may be adjusted. *Id.* at Fig. 7 (step 740). “For example, if touch sensor 30 determines that device 20 is floating, the stored threshold value is adjusted to a value that is a certain percentage of a maximum capacitance magnitude for known floating touches.” *Id.* at 10:11-14. The touch detection threshold is subsequently changed back to the original value after the touch sensor does not detect any interactions within predetermined amount of time. *Id.* at 10:28-36.

B. Prosecution history of the ’472 Patent

The application that resulted in the ’472 Patent was filed on December 8, 2011. ’472 *Patent* (Ex. 1001). U.S. Patent Publication Nos. 2011/0012840 to Hotelling et al. (“*Hotelling*”), 2008/0158146 to Westerman (“*Westerman ’146*”), and

2011/0015889 to Land et al. (“*Land*”) were among the references substantively considered during prosecution of the ’472 Patent.

Hotelling teaches a touch-sensitive device that “can detect its grounded state so that poor grounding can be selectively compensated for in touch signals outputted by the device.” *Hotelling* (Ex. 1010), Abstract, [0038]. Per *Hotelling*, “When a well grounded touch sensitive device receives a touch by an object, such as a user’s fingers, the device’s mutual signal capacitance C_{sig} at the touch location can be properly changed to produce a pixel touch output value indicative of a true touch event.” *Id.* at [0023]. However, a touch event on poorly grounded device produces an “undesirable charge coupling called negative capacitance C_{neg} ” that “cause[s] the pixel touch output value to be in the opposite direction of the intended mutual capacitance change” and “appear[s] to detect less of a touch than is actually present, known as a ‘negative pixel.’” *Id.*

Hotelling teaches “check[ing] one or more parameters which can be indicative of the device’s grounding.” *Id.* at [0018]. For example, the device can check to see if it is receiving power from a power cable or connected to another device via a USB cable. *Id.* at [0025]-[0026]. The device may also determine the grounding state by analyzing “the characteristics of the touch, including the location, orientation, shape, movement, and so on, of the touch image generated by the touch.” *Id.* at [0048]. If poorly grounded, a negative pixel compensation value is calculated or accessed from

a lookup table and then “applied to the touch image to adjust the touch signals, thereby reducing or eliminating any negative pixel effects and providing more accurate touch signals (75). *Id.* at [0059]-[0060].

For the claimed, “determining . . . a grounding status of the touch sensor based on a strength of a charge return path between the touch sensor and a ground,” the Examiner cited *Hotelling’s* “analog value, indicating the degree of grounding.” ’472 *Patent File History* (Ex. 1002), 64 (*citing Hotelling* (Ex. 1010), [0055], [0052], Fig. 7 at step 73). And, for the claimed, “adjust the stored threshold value based on the determined grounding status of the touch sensor,” the Examiner cited *Hotelling’s* negative pixel compensation. *Id.* (*citing Hotelling* (Ex. 1010), [0058]-[0059]). Finding *Hotelling* lacked “determining . . . whether to process the interaction as a touch” by comparing a capacitance reading with the adjusted threshold value, the Examiner cited *Westerman ’146’s* teaching of comparing a measured touch image to a noise threshold and only processing pixels above the noise threshold as touches. *Id.* at 64-65 (*citing Westerman ’146* (Ex. 1005), [0020], Table 1, Fig. 1 at steps 110-130).

Also relevant to the Challenged Claims, *Land* (Ex. 1006) was cited for dependent claim 5’s limitation, “determining that the external object has not touched the touch sensor within a predetermined amount of time; and periodically drift, at a predetermined rate, the stored threshold value back to an original value” *Id.* at 71 (*citing Land’s* “background adjustment rate of every 4 seconds unless a touch

occurs” and reducing/increasing sensor offset by a predetermined number, concluding these teachings are “equivalent to raising or lowering the touch threshold.”).

In response, Applicant amended the independent claims to include a broader variation of the claim 5 limitation. *Id.* at 34-35. Applicant argued “the cited portions of *Land* may disclose a periodic baseline adjustment algorithm, [but] they do not disclose, teach, or suggest a controller that is configured to ‘after adjusting the stored threshold value based on the determined grounding status of the touch sensor: *determine that the external object has not touched the touch sensor within a predetermine amount of time*; and change the stored threshold value *back to an original value*, the original value comprising a value of the stored threshold value *before it was adjusted based on the determined grounding status of the touch sensor[.]*’” *Id.* at 45 (emphasis in original). In response, the Examiner issued a notice of allowance. *Id.* at 13-14.

C. Level of skill of a person having ordinary skill in the art

A person having ordinary skill in the art (POSITA) at the time of the ’472 Patent would have been a person having at least a bachelor’s degree in electrical engineering, computer engineering, computer science, or a related field, and at least two years of experience in the research, design, development, and/or testing of human-machine interfaces such as touch sensors or other capacitive sensors and the

firmware or system software that govern said interfaces, or the equivalent, with additional education substituting for experience and vice versa. *Najafi Decl.* (Ex. 1003), ¶28.

III. REQUIREMENTS FOR INTER PARTES REVIEW UNDER 37 C.F.R. § 42.104

A. Grounds for standing under 37 C.F.R. § 42.104(a)

Petitioner certifies that the '472 Patent is available for IPR and that the Petitioner is not barred or estopped from requesting IPR challenging the claims of the '472 Patent.

B. Discretion under 35 U.S.C. § 314(a)

1. The *Fintiv*-pertinent “parallel proceeding” is in the district court—the only proceeding with parallel authority to cancel claims

An ITC Investigation does not *parallel* an IPR because the ITC lacks the authority to issue a binding ruling on invalidity. Indeed, the Federal Circuit has long held that rulings at the ITC carry no preclusive effect on other forums. *Texas Instr. Inc. v. Cypress Semiconductor Corp.*, 90 F.3d 1558, 1569 (Fed. Cir. 1996) (explaining section 337’s legislative history shows Congress did not intend decisions of the ITC on patent issues to have preclusive effect on other forums and holding the same); *Tandon Corp. v. United States Int’l Trade Comm’n*, 831 F.2d 1017, 1019, 4 USPQ2d 1283, 1285 (Fed. Cir. 1987). Without the aid of *res judicata*, ITC determinations do not implicate the efficiency concerns *Fintiv* targets.

The Board has expressly recognized this critical distinction, explaining that the “ITC does not have the authority to invalidate a patent in a way that is applicable to other forums, and thus ITC decisions do not preempt issues addressed in an *inter partes* review proceeding.” *Nichia Corp. v. Lighting Science Group Corp.*, IPR2019-01259, Paper 21, *27 (PTAB Jan. 15, 2020). The lack of parallel authority is particularly important when assessing efficiencies. Absent the PTAB cancelling the Challenged Claims, these same invalidity issues will be litigated in the district court *after* the ITC Investigation concludes. *Id.* at 27-28 (noting that, even if the ITC finds the asserted claims invalid, the patent owner may continue to assert the claims at issue in the district court); *see also Renesas Elecs. Corp. v. Broadcom Corp.*, IPR2019-01040, Paper 9, *8 (PTAB Nov. 13, 2019) (noting the ITC decision cannot “resolve” the issues before the Board). Because a district court’s authority to cancel claims—an authority that parallels the PTAB’s in an IPR—may not be exercised until after the ITC Investigation concludes, the Board has repeatedly held that ITC investigations do “not render [an IPR] proceeding duplicative or amount to a waste of the Board’s resources.” *Samsung Elecs. Co., Ltd. v. BitMicro, LLC*, IPR2018-01410, Paper 14, at *18 (PTAB Jan. 23, 2019); *see also 3Shape A/S and 3Shape Inc. v. Align Technology, Inc.*, IPR2020-00223, Paper 12 at *33-34 (PTAB May 26, 2020) (noting the “ITC does not have the power to cancel a patent claim” and concluding no “concerns with efficiency . . . support exercising our authority to

deny institution”); *Wirtgen Am., Inc. v. Caterpillar Paving Prods.*, IPR2018-01202, Paper 10, at *7–10 (PTAB Jan. 8, 2019).

2. **The *Fintiv* factors strongly favor institution**

- (a) *Whether the court granted a stay or evidence exists that one may be granted if a proceeding is instituted.*

Litigation in the Western District of Texas has been stayed pending finality of the ITC investigation. *Neodron Ltd. v. Apple Inc.*, 6-20-cv-00116 (WDTX), Text Order Granting Motion to Stay dated 3/31/2020. While it is unlikely the ITC investigation will be stayed, the efficiency and integrity of the system are best served by instituting review.

- (b) *Proximity of the court’s trial date to the Board’s projected statutory deadline for a final written decision.*

No trial date has been set in the district court, and any theoretical trial date is years away. Accordingly, the Board’s projected statutory deadline for an FWD will long predate any trial, and this factor favors institution.

Even if the Board were to consider the ITC Investigation schedule, this factor favors institution. The currently scheduled ITC hearing is set to conclude on February 22, 2021, but an initial determination is not due until June 18, 2021 and a Final Determination is not due until October 20, 2021. In stark contrast to district court trials that conclude with a jury verdict, ITC evidentiary hearings merely provide each party the opportunity to present evidence for consideration by the ALJ.

An initial decision will not issue until approximately four months later. Further, another four months must pass before a final determination issues. But even this ruling is not appealable (i.e., not final from a procedural standpoint) until after the presidential review period expires—60 days later. 19 U.S.C. § 1137(c); *id.* at (j)(4) (“such determination shall become final on the day after the close of such [presidential review] period or the day on which the President notifies the Commission of his approval, as the case may be”). The stay in the district court will not lift until the ITC determination becomes final, which at its earliest would be December 20, 2021 in this matter.

(c) *Investment in the parallel proceeding by the court and the parties.*

The parallel district court proceedings were stayed shortly after the complaint was served, and the court has invested no substantive efforts into the patentability of the claims at issue. Accordingly, this factor favors institution.

This factor also favors institution even if the ITC Investigation is considered—the ITC panel has yet to hold any *Markman* hearing (currently scheduled on September 14-15, 2020), fact discovery has just opened (set to conclude on October 23, 2020), and expert reports will not be exchanged for another four months.

(d) *Overlap between issues raised in the petition and in the parallel proceeding.*

As noted above, Petitioners have yet to present any invalidity theories before the district court. Accordingly, there is no overlap, and this factor favors institution.

Even if the ITC Investigation were considered, there is insufficient overlap because the ITC will not address the validity of Challenged Claims 5-7, 11-12, or 17-23. Thus, unless the Board institutes this proceeding and considers the merits of these claims, when the district court lifts its stay, the district court will have to independently, and without guidance from the Board or the ITC, consider these issues. Should the Board institute and reach a final written decision, on the other hand, it would simplify or resolve entirely, the invalidity issues before the district court. *See, e.g., Comcast Cable Comm'ns, LLC v. Rovi Guides, Inc.*, IPR2019-00231, Paper 14, *11–12 (PTAB May 20, 2019).

Further, for claims that are at issue in both the ITC and IPR, the ITC will apply a more stringent standard than the PTAB. *Linear Tech. Corp. v. Int'l Trade Comm'n*, 566 F.3d 1049, 1066 (Fed. Cir. 2009); 35 U.S.C. § 316(e).

(e) *Whether the petitioner and the defendant in the parallel proceeding are the same party.*

The parties are the same in both the district court litigation and ITC Investigation. However, members of the Board have noted that the *Fintiv* order addressed only the scenario in which the petitioner is unrelated to a defendant in a

parallel proceeding, finding this should weigh against denying institution, but that the *Fintiv* order “says nothing about situations in which the petitioner is the same as, or is related to, the district court defendant.” *Cisco Sys., Inc. v. Ramot at Tel Aviv Univ. Ltd.*, IPR2020-00122, Paper 15, at *10-11 (PTAB May 15, 2020) (APJ Crumbley, dissenting) (noting that disfavoring a “defendant in the district court” is “contrary to the goal of providing district court litigants an alternative venue to resolve questions of patentability”). This rationale carries the same weight when considering the parties to an ITC Investigation.

(f) *Other circumstances that impact the Board’s exercise of discretion, including the merits.*

As set forth below, the strength of the proposed grounds weighs strongly in favor of institution.

C. Identification of challenge under 37 C.F.R. § 42.104(b) and relief requested

In view of the prior art and evidence presented, claims 1, 5-7, 11-13, and 17-23 (“Challenged Claims”) of the ’472 Patent are unpatentable and should be cancelled. 37 C.F.R. § 42.104(b)(1). Further, based on the prior art references identified below, IPR of the Challenged Claims should be granted. 37 C.F.R. § 42.104(b)(2).

Proposed Grounds of Unpatentability	Exhibits
<u>Ground 1:</u> U.S. Patent Publication No. 2011/0001708 to <i>Sleeman</i> (“ <i>Sleeman</i> ”) in view of U.S. Patent Publication No. 2009/0160787 to Westerman et al. (“ <i>Westerman</i> ’787”) renders claims 1, 7, 13, 22, and 23 obvious under 35 U.S.C. § 103(a).	1007, 1008
<u>Ground 2:</u> <i>Sleeman</i> in view of U.S. Patent Publication No. 2011/0012840 to Hotelling et al. (“ <i>Hotelling</i> ”) renders claims 1, 7, 13, 19, 20, 22, and 23 obvious under 35 U.S.C. § 103(a).	1007, 1008, 1010
<u>Ground 3:</u> <i>Sleeman</i> in view of <i>Westerman</i> ’787 in further view of U.S. Patent Publication No. 2011/0248948 to Griffin et al. (“ <i>Griffin</i> ”) renders claims 5, 6, 11, 12, 17, 18, and 21 obvious under 35 U.S.C. § 103(a).	1007, 1008, 1009
<u>Ground 4:</u> <i>Sleeman</i> in view of <i>Hotelling</i> in further view of <i>Griffin</i> renders claims 5, 6, 11, 12, 17, 18, and 21 obvious under 35 U.S.C. § 103(a).	1007, 1010, 1009
<u>Ground 5:</u> <i>Sleeman</i> in view of <i>Westerman</i> ’787 in further view of <i>Hotelling</i> renders claims 19-20 obvious under 35 U.S.C. § 103(a).	1007, 1008, 1010

Section IV identifies where each element of the Challenged Claims is found in the prior art. 37 C.F.R. § 42.104(b)(4). The exhibit numbers of the supporting evidence relied upon to support the challenges are provided above and the relevance of the evidence to the challenges raised are provided in Section IV. 37 C.F.R. § 42.104(b)(5). Ex. 1001–Ex. 1024 are also attached.

D. Claim construction under 37 C.F.R. § 42.104(b)(3)

In this proceeding, claims are interpreted under the same standard applied by Article III courts (i.e., the *Phillips* standard). *See* 37 C.F.R. § 42.100(b); *see also* 83 Fed. Reg. 197 (Oct. 11, 2018); *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312 (Fed. Cir. 2005) (*en banc*). Under this standard, words in a claim are given their plain meaning, which is the meaning understood by a person of ordinary skill in the art in view of the patent and file history. *Phillips*, 415 F.3d 1303, 1312-13.

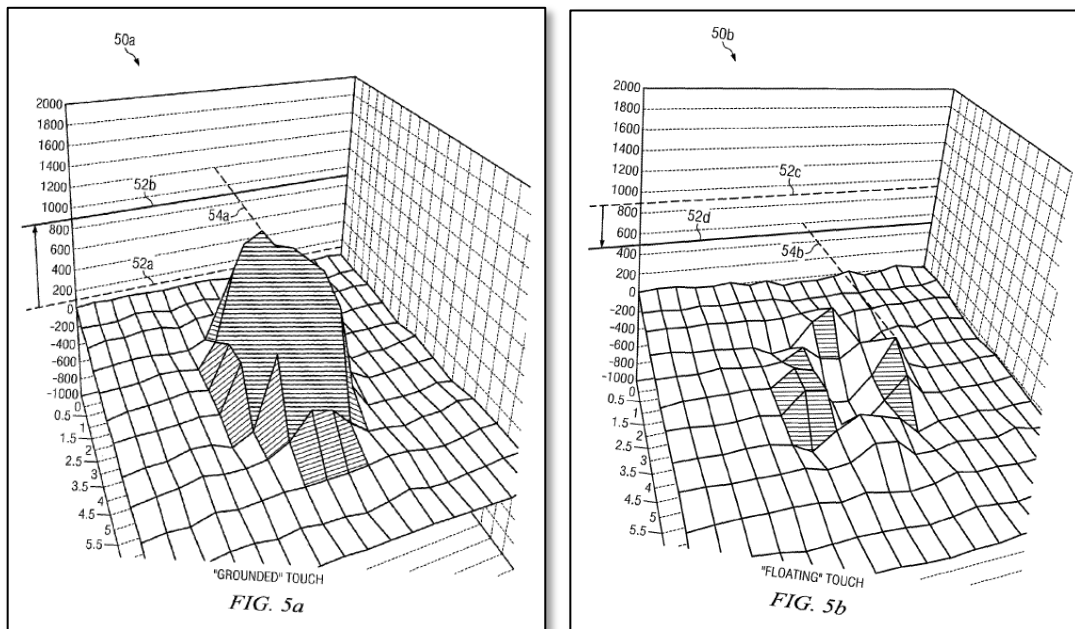
1. Determining the grounding status . . .

Claims 1 and 13 recite the limitation, “determine a grounding status of the touch sensor based on a strength of a charge return path between the touch sensor [/touch-sensitive device] and a ground.” Claim 7 similarly recites, “determining, by the controller, a grounding status of the touch sensor based on a strength of a charge return path between the touch sensor and a ground.”

The '472 Patent describes analyzing different types of data in order to determine the strength of the charge return path between the touch sensor and a ground. *Najafi Decl.* (Ex. 1003), ¶¶59-64. For example, the touch sensor may communicate with device software to determine whether it is physically connected to a power source or another device via a cable. '472 Patent (Ex. 1001), 7:66-8:15. Another method “determin[es] the location in which touch object 38 touched touchscreen display 22 and correlate[es] the location with locations in which sense

electrodes 34 and drive electrodes 32 intersect.” *Id.*, 8:21-26, Figs. 6A-B; *Najafi Decl.* (Ex. 1003), ¶¶60-62 (explaining a touch directly over an electrode intersection, or node, would produce a larger change in capacitance than a touch between nodes and the ’472 Patent uses this fact to assess whether a smaller than expected change in capacitance is experienced for a touch directly over a node).

Finally, the strength of the charge return path may be determined by analyzing the shape capacitance graphs, such as those shown in Figs. 5A-B:



Id., Figs. 5A, 5B, 9:39-61 (describing the same and noting Fig. 5A illustrates a “larger and more concentrated” spike and Fig. 5B illustrates a pattern that is “smaller in magnitude and more dispersed”); *Najafi Decl.* (Ex. 1003), ¶63.

Independent claims 1, 7, and 13 do not specify how the strength of a charge return path between the touch sensor and a ground is to be determined (*Najafi Decl.*

(Ex. 1003), ¶65) and should, accordingly, be interpreted broadly enough to capture analyzing any of the data described above. Indeed, several dependent claims confirm that the independent claim language must be broad enough to capture analyzing different types of data. For example, claim 15 is directed to the second method, requiring a grounding status determination that assesses whether the “external object has touched the touch sensor at a location that at least partially covers a particular one of the nodes.” Claim 19 targets the third method, requiring a grounding status determination that “analyz[es] shapes of one or more capacitance graphs.” Accordingly, claim 13’s limitation, “determine a grounding status of the touch sensor based on a strength of a charge return path between the touch-sensitive device and a ground,”¹ must be broad enough to capture analyzing the types of data recited in claims 15 and 19, each of which depend from 13.

Consistent with a conclusion that the determining the strength of a charge return path must be broad enough to capture analyzing disparate types of data, the Examiner set forth the following broad interpretation during prosecution:

[A]pplicant does not define “strength of a charge return path” therefore Examiner broadly construes “strength of a charge return path” as the results of an analysis of data to determine a grounding status . . .

¹ Independent claims 1 and 7 include nearly identical language.

'472 Patent File History (Ex. 1002), 212.

For these reasons, Petitioner proposes “determin[ing . . .] a grounding status of the touch sensor based on a strength of a charge return path between the touch sensor and a ground” should be construed to at least include “analyze [/analyzing] data indicative of the touch sensor’s grounding state.” *Najafi Decl.* (Ex. 1003), ¶68.

IV. THE CHALLENGED CLAIMS OF THE '472 PATENT ARE UNPATENTABLE

A. Ground 1: Sleeman in view of *Westerman* '787 render claims 1, 7, 13, 22, and 23 obvious

Sleeman published on January 6, 2011, which predates the '472 Patent's priority date of December 8, 2011 by more than eleven months. *Sleeman* (Ex. 1007). *Sleeman* was not cited or considered during prosecution of the '472 Patent. *Supra*, Section II.B. Although *Sleeman* and the '472 Patent were originally assigned to Atmel Corporation, *Sleeman* qualifies as prior art to the '472 Patent under at least 35 U.S.C. § 102(a) because it represents the work of another. *In re Katz*, 687 F.2d 450, 454 (C.C.P.A. 1982). Whether a reference is the work of “another” turns on “whether the portions of the reference relied on as prior art, and the subject matter of the claims in question, represent the work of a common inventive entity.” *EmeraChem Holdings, LLC v. Volkswagen Grp. of Am., Inc.*, 859 F.3d 1341, 1345 (Fed. Cir. 2017) (quoting *Riverwood Int'l Corp.*, 324 F.3d at 1356). Here, *Sleeman* and the '472 Patent have completely different inventive entities – the sole inventor

of *Sleeman* is Peter Sleeman and the '472 Patent names Martin John Simmons, Darren Golbourn and Daniel Pickett. *Sleeman* (Ex. 1007); '472 Patent (Ex. 1001). Therefore, *Sleeman* qualifies as the work of another under § 102(a). Petitioner also notes the prior art exclusion under § 103(c) applies only to prior art under § 102(e), (f), or (g), and not § 102(a). 35 U.S.C. § 103(c)(1).

The '472 Patent “generally relates to touch sensors” where “a touch sensor encompasses a touch screen.” '472 Patent (Ex. 1001), 1:6, 1:26-28. Likewise, the Challenged Claims are directed generally toward touch sensors/touch-sensitive devices. *Id.* at 12:28 (claim 1 reciting “a touch sensor”), 13:38 (claim 7 reciting a method relating to touch sensor operation), 14:44 (claim 13 reciting a “touch-sensitive device”). *Sleeman* is similarly directed to “a touchscreen 110 having a plurality of sensor nodes 115.” *Sleeman* (Ex. 1007), [0015]. Therefore, *Sleeman* is in the same field of endeavor and is analogous to the claimed invention of the '472 Patent. *Sleeman* is also reasonably pertinent to the problem addressed by the '472 Patent inventor. Namely, both the claimed invention of the '472 and *Sleeman* are directed to adjusting a detection threshold based on characteristics of a user's interaction with the touch sensor. Compare '472 Patent (Ex. 1001), Claim 1 (“adjust the stored threshold value based on the determined grounding status of the touch sensor”) with *Sleeman* (Ex. 1007), [0022] (teaching a detect threshold may be

adjusted based on detected signatures of a touch). For this additional reason, *Sleeman* is analogous to the claimed invention of the '472 Patent.

Westerman '787 was published on June 25, 2009 and qualifies as prior art to the '472 Patent under 35 U.S.C. § 102(b) (pre-AIA). *Westerman* '787 (Ex. 1008). Although other disclosures by the same inventor were considered during prosecution of the '472 Patent, the *Westerman* '787 disclosure was neither cited nor considered. *Westerman* '787 describes “multi-touch sensor panels that utilize an array of capacitive sensors (pixels) to detect and localize touch events.” *Id.* at [0001]. *Westerman* '787 is therefore in the same field of endeavor and analogous to the claimed invention of the '472 Patent.

Westerman '787's touch sensor includes drive lines 100 “driven by stimulation signals from drive circuits 102,” which form “a mutual capacitance 105 . . . between drive lines 100 and sense lines 104 (e.g. columns) at their crossing points” and “charge from the drive lines can be coupled onto the sense lines, where charge amplifiers 106 detect the charge and generate touch output values indicative of the amount of touch detected at a particular pixel.” *Id.* at [0028].

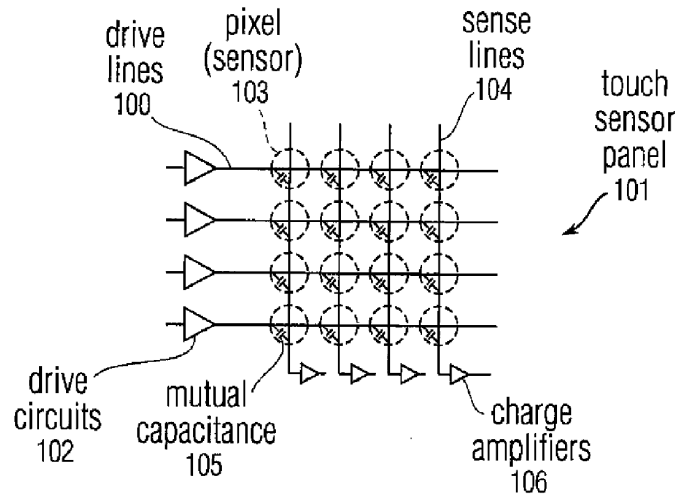


Fig. 1a

Id. at Fig. 1a.

In a grounded scenario, the amount of charge coupled onto the sense line C_{sig} is reduced because some of the charge is shunted to ground through the grounded finger (depicted as grounded plate 214 in the figure below):

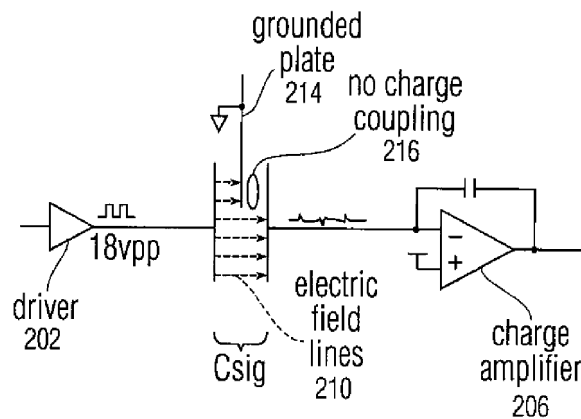


Fig. 2a

Id. at Fig. 2a, [0030] (“Grounded plate 214 can block some of the electric field lines 210 flowing from the left plate to the right plate. Because blocked electric field lines

210 can be shunted to ground through the grounded finger, virtually no charge is coupled through to the sense column (see 216) for the blocked electric field lines 210.”); *Najafi Decl.* (Ex. 1003), ¶83.

However, in an ungrounded scenario, the “[t]he finger attenuates the amount of charge coupled onto the sense line, but some charge is still coupled through” resulting in less of a change in capacitance. *Westerman '787* (Ex. 1008), [0031].

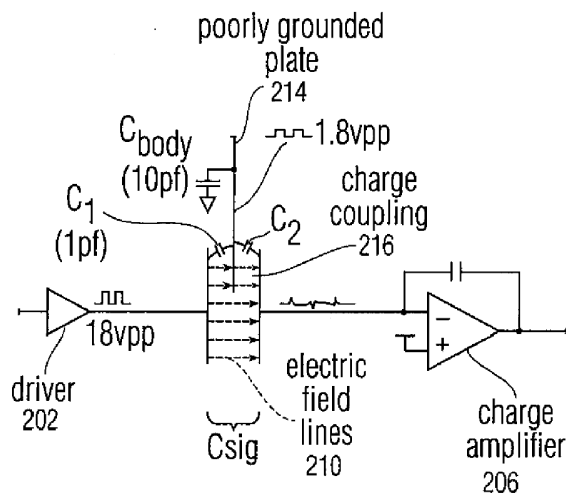


Fig. 2b

Id. at Fig. 2b; *Najafi Decl.* (Ex. 1003), ¶84.

Westerman '787 describes methods of recognizing and then compensating for poor grounding conditions. *Westerman '787* (Ex. 1008), [0053]. Therefore, *Westerman '787* is also reasonably pertinent to the problem addressed by the '472 Patent inventor and is analogous to the claimed invention of the '472 Patent for this reason as well.

1. Claim 1

1. A touch sensor comprising:

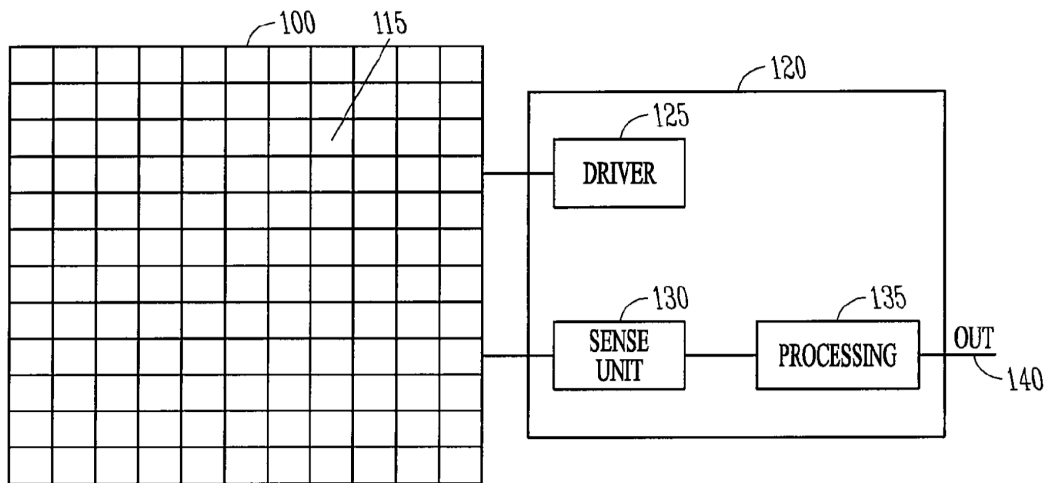
To the extent the preamble is limiting, *Sleeman* teaches “a touchscreen 110 having a plurality of sensor nodes 115 to provide signals from the plurality of nodes about a first touch of an array of touch screen sensor nodes 115.” *Sleeman* (Ex. 1007), [0015]. The ’472 Patent expressly teaches that “a touch sensor encompasses a touch screen . . .” ’472 Patent (Ex. 1001), 1:26-28.

[1(a)] a plurality of sense electrodes; and

Sleeman’s touchscreen includes “a plurality of sensor nodes 115 to provide signals from the plurality of nodes about a first touch of an array of touch screen sensor nodes 115.” *Sleeman* (Ex. 1007), [0015]. “[A] driver 125 [] drives the touchscreen with electrical pulses” and [w]hen a finger or stylus or other device is touching the screen, the transfer of charge responsive to the touch may be received from one or more nodes, such as at a sense unit 130 that may measure the transferred charge at each node to determine whether or not a touch has occurred at each node.” *Id.* at [0016], [0023] (“In one embodiment, the nodes are pulsed with electrical signals in order to access the capacitance of each node, and the signature is comprised of change of capacitance for each node.”).

A POSITA would have understood that *Sleeman* is describing a mutual capacitance touch sensor because only mutual capacitance sensors include drivers

that drive the sensor with electrical pulses and are able to uniquely measure the capacitance of each node (i.e., the intersection of drive and sense electrodes). *Najafi Decl.* (Ex. 1003), ¶¶69-71, ¶¶47-49, ¶92. Because mutual capacitance sensors always include one layer of drive electrodes and one layer of sense electrodes, a POSITA would have understood *Sleeman* expressly discloses “a plurality of sense electrodes” coupled to sense unit 130, which are depicted as either the horizontal or vertical lines in Figure 1. *Id.* at ¶¶47-49, ¶¶92-93.



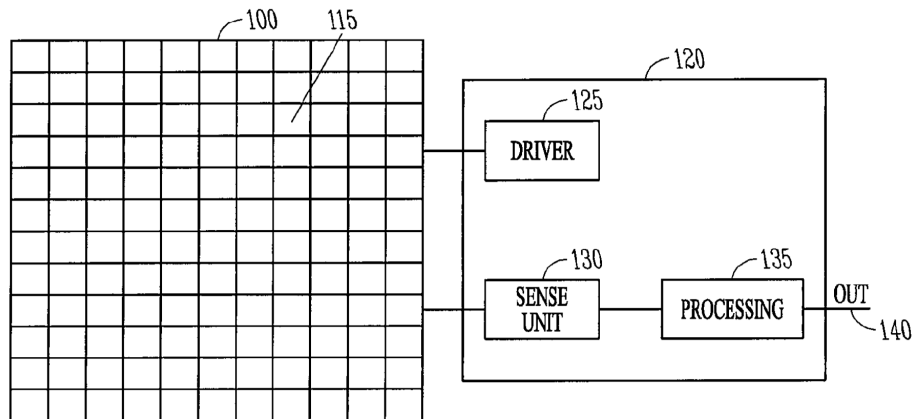
Sleeman (Ex. 1007), Fig. 1.

To the extent the Board finds *Sleeman* does not expressly disclose a plurality of sense electrodes, a POSITA would have understood *Sleeman*'s touch sensor necessarily includes a plurality of sense electrodes that enable sense unit 130 to measure the transferred charge at each node. *Najafi Decl.* (Ex. 1003), ¶94. A POSITA would have understood that when *Sleeman*'s drive electrodes are pulsed by

driver 125, they capacitively couple with the sense electrodes coupled to sense unit 130 forming mutual capacitance at the intersecting points (i.e., nodes 115). *Id.* at ¶94, ¶48. Because the sense unit 130 must be coupled to sense electrodes in order to measure a change in capacitance, a POSITA would also have understood *Sleeman*, if not expressly, inherently discloses a plurality of sense electrodes. *Id.* at ¶94.

[1(b)] a controller communicatively coupled to the plurality of sense electrodes, the controller configured to:

Sleeman's touchscreen sensor includes “[a] controller 120 . . . communicatively coupled to the touchscreen sensor nodes 115 to receive the signals . . .” *Sleeman* (Ex. 1007), [0015].



Id. at Fig. 1.

[1(b)(i)] receive a plurality of signals from the plurality of sense electrodes associated with an interaction with the touch sensor by an external object, the plurality of signals indicative of an amount of capacitance between the touch sensor and the external object;

Sleeman's controller 120 receives the signals from the plurality of nodes 115 associated with an interaction with the touchscreen sensor by an external object. *Id.* at [0015]. The signals may be indicative of “a change in capacitance caused by a touch.” *Id.* at [0016], [0023]. “The greater the contact of a touch with a node, the greater the change detected in the central nodes, up to some maximum possible change . . .” *Id.* at [0023].

The '472 Patent similarly detects “a change in capacitance at a capacitive node” to detect a touch. '472 *Patent* (Ex. 1001), 3:44-49. Accordingly, “a change in capacitance caused by a touch” falls within the scope of “an amount of capacitance between the touch sensor and the external object.”

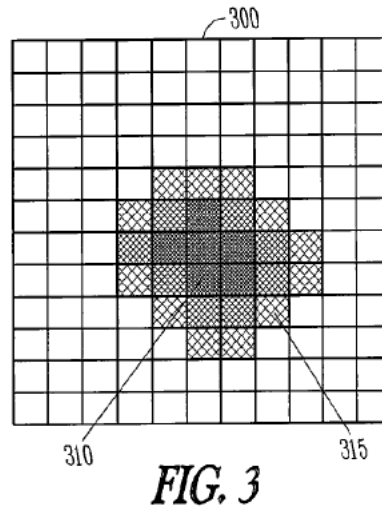
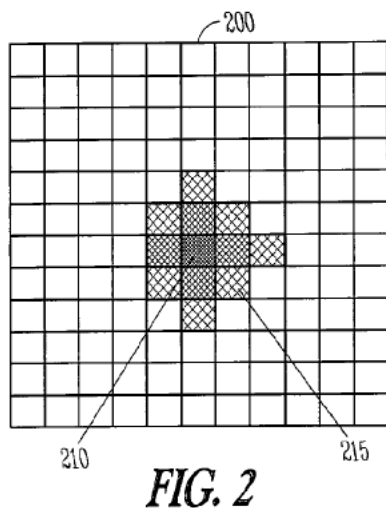
[1(b)(ii)] access a stored threshold value, the threshold value indicating a threshold magnitude of capacitance;

Sleeman's controller accesses an “internal” (i.e., “stored”) “detection threshold” value that represents a magnitude of “capacitance change” so that it may be modified upon entering detect mode. *Sleeman* (Ex. 1007), [0022] (describing “modify[ing] an internal detection threshold for entering the detect mode”), [0023] (noting the “detection threshold may [] be set to a capacitance change . . . , looking at the strongest signals present across all nodes measured.”); *see also id.* at [0025],

[0027], Fig. 7 (steps 720, 730) (describing stored normal and stylus thresholds that are compared to capacitance measurements); *Najafi Decl.* (Ex. 1003), ¶96 (explaining a POSITA would have understood *Sleeman*'s internal threshold value must necessarily be stored and accessed by the controller in order to be modified).

[1(b)(iii)] determine a grounding status of the touch sensor based on a strength of a charge return path between the touch sensor and a ground;

Sleeman's controller determines what type of object is in contact with the touch sensor by analyzing "touch signatures generated at each node responsive to different types of touches." *Sleeman* (Ex. 1007), [0019]. As depicted below, FIG. 2 "illustrates a shape of a small finger touch signature" and Fig. 3 depicts "a larger finger touch." *Id.* at [0019]-[0020].



Id. at Figs. 2-3; see also *id.* at Fig. 4.

Sleeman's controller analyzes the size and intensity/strength of these signatures to determine the type of external object and changes the detection

threshold accordingly. *Id.* at [0022] (“Once the shape of the signature is determined, controller 120 may . . . based on the type of signature, modify an internal detection threshold for entering the detect mode.”); *see also Najafi Decl.* (Ex. 1003), ¶¶72-77, ¶97. Thus, the controller adjusts the detection threshold based on the determined touch signature in order to better detect touches from objects that generate weaker capacitance signals. *Najafi Decl.* (Ex. 1003), ¶77. *Sleeman* also contemplates “a multiple touch situation . . . when a second touching object separated from the first touching object is used at the same time as the first touching object.” *Sleeman* (Ex. 1007), [0026]. In this scenario, the controller localizes sets of nodes associated with each touch, implements “independent detect modes” for each touch. *Id.* at Fig. 6.

Sleeman, however, does not account for the known problem that poor grounding can distort the touch signatures. For example, *Westerman* ’787 teaches that poor grounding reduces the effect of a touch causing a less of a change in the capacitance. *Westerman* ’787 (Ex. 1008), [0031], [0037], Fig. 2b; *see also, Najafi Decl.* (Ex. 1003), ¶¶82-88, ¶98. As discussed above, *Westerman* ’787 teaches an ungrounded touch causes “[t]he finger [to] attenuate[] the amount of charge coupled onto the sense line, but some charge is still coupled through.” *Westerman* ’787 (Ex. 1008), [0031].

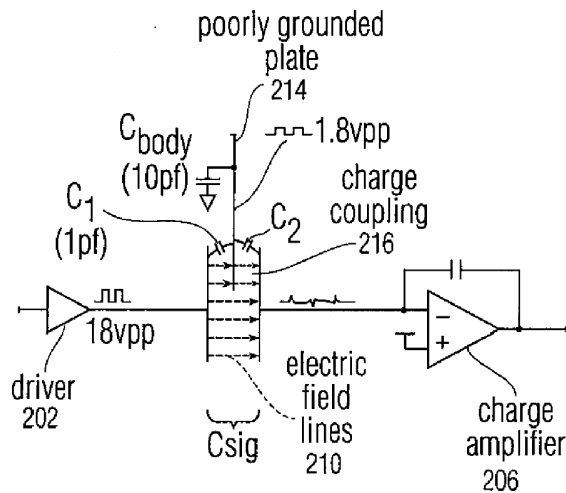
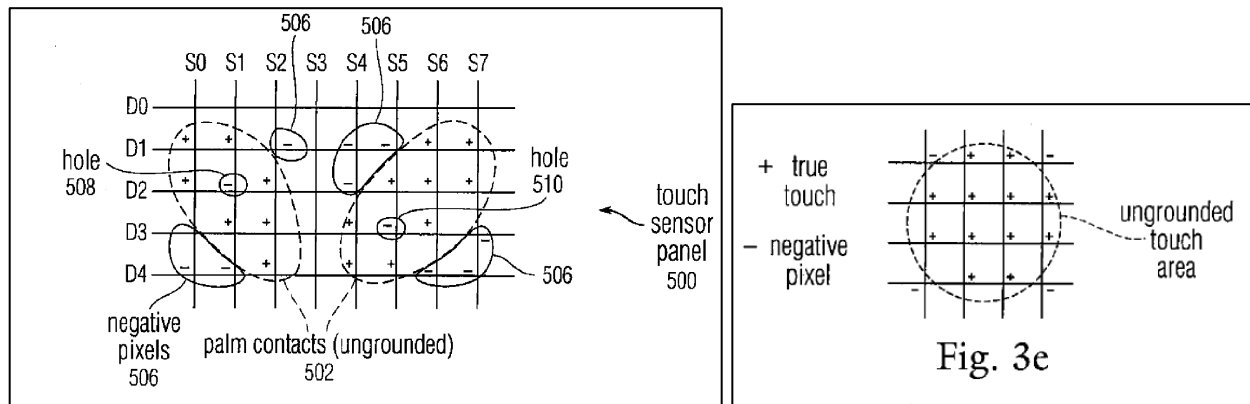


Fig. 2b

Westerman '787 (Ex. 1008), Fig. 2b, *see also, id.*, Fig. 2a; *Najafi Decl.* (Ex. 1003), ¶¶83-84. Since more charge is coupled through to the sense electrode in an ungrounded scenario than in a grounded scenario, “the effect of a finger touch is reduced.” *Westerman* '787 (Ex. 1008), [0031]; *Najafi Decl.* (Ex. 1003), ¶85 (opining poor grounding causes less of a change in capacitance).

Poor grounding “can weaken not only the pixels being touched, but can also weaken adjacent pixels not being touched and located in the drive line being stimulated, to the point where they produce output readings indicative of a negative touch” and “this problem is made worse if there are multiple pixels being touched along the drive line being stimulated, because now even more charge can be coupled onto other sense lines being simultaneously touched.” *Westerman* ’787 (Ex. 1008), [0037], Fig. 3b; *see also id.* at [0006]. As a result, “these distorted readings . . . can

appear more negative than they should.” *Id.* at [0027]. Examples of such distorted readings are depicted in the following figures:



Id. at Fig. 5b (depicting distortions resulting from multiple touches), Fig. 3e (depicting distortions resulting from a single touch).

To identify this phenomenon, *Westerman* '787 determines the grounding status by “comput[ing] the ratio of pixels with positive touch output values to pixels having negative touch output values. The smaller the value, the more negative pixels exist, which is likely to mean an ungrounded palm.” *Id.* at [0053]. As discussed in Section III.C, “determine a grounding status of the touch sensor based on a strength of a charge return path between the touch sensor and a ground” should be construed to at least include “analyze data indicative of the touch sensor’s grounding state.” The '472 Patent expressly discloses multiple embodiments where the grounding status is determined by analyzing capacitance changes resulting from a touch. '472 Patent (Ex. 1001), 8:21-10:14, Figs. 5A-B. Like these embodiments, *Westerman* '787 analyzes capacitance changes resulting from a touch to obtain positive to

negative pixel ratio indicative of the sensor's grounding state. *Najafi Decl.* (Ex. 1003), ¶100.

In the event PO argues *Westerman* '787 is concerned with the grounding state of the user, rather than the grounding state of the touch sensor, the '472 Patent makes clear no such distinction exists. Indeed, the '472 Patent expressly teaches that the manner in which a user interacts with the device can determine whether the device itself has a good path to ground or not. For example, if an unplugged "device 20 [is] lying on a surface such as a table while a user is interacting with touchscreen display 22[,]" "device 20 may be considered 'floating' since it has no or a weak path to ground." '472 Patent (Ex. 1001), 5:60-63. That same unplugged "device 20 may be considered 'grounded' [with] a strong path to ground" if "held in a user's hand while a finger on the user's other hand is touching touchscreen display 22." *Id.* at 5:65-6:1. *Westerman* '787 describes identical floating and grounded scenarios. *Westerman* '787 (Ex. 1008), [0030-0031] (describing a "floating" state that results from a user having "touched the touch sensor panel surface without picking up the device" and a grounded state that results from the user "touching a bezel, backside, etc. of a device that includes the touch sensor panel," e.g., holding the device while using it). Also, like the '472 Patent, *Westerman* '787 teaches that the grounding state impacts the capacitance changes resulting from a touch. *Compare id.* at [0006] ("distorted readings (so called 'negative pixels') that can be produced when two or

more simultaneous touch events are generated by the same poorly grounded object on a touch sensor panel”) *with* ’472 Patent (Ex. 1001), 1:64-2:16 (noting “the differences in signals measured by the touch sensor may vary between floating or grounded by up to 30% or more”). Accordingly, a POSITA would have understood that, although *Westerman* ’787 makes reference to the grounding status of the user’s finger (*see, e.g., Westerman* ’787 (Ex. 1008), [0027], [0030-0031]), the reference does in fact determine “the grounding status of the touch sensor” as that phrase is used in the ’472 Patent. *Najafi Decl.* (Ex. 1003), ¶100. Other teachings in the art also confirm that a user’s interaction with the device (e.g., holding the device vs. using the device on a table) determines the grounding status of the device itself. *See, e.g., Hotelling* (Ex. 1010), [0034] (describing an embodiment that senses what the device is touching, noting that “**a proximate human surface can be an indication that the device 30 is** being held by a user or resting in the user’s lap and therefore **grounded**” and that “**a proximate wood surface can be an indication that the device 30 is** resting on a table top and therefore likely **poorly grounded**”) (emphasis added).

A POSITA would have understood that *Sleeman*’s touch sensor would have suffered from the same distortions caused by poor grounding conditions, which would have hindered the controller’s ability to reliably recognize touches. *Najafi Decl.* (Ex. 1003), ¶101. Indeed, *Westerman* ’787 teaches a similar mutual capacitive

touch sensor to *Sleeman*, “having an array of sensors 103 that can be formed from a plurality of drive lines 100 and a plurality of sense lines 104.” *Westerman* ’787 (Ex. 1008), [0028]. Also like *Sleeman*, *Westerman* ’787’s sensor includes drive circuits 102 that stimulate drive lines 100 such that “charge from the drive lines can be coupled onto the sense lines, where charge amplifiers 106 detect the charge and generate touch output values indicative of the amount of touch detected at a particular pixel.” *Id.*

Because poor grounding conditions would have made the capacitance signals to appear lower than expected, *Sleeman*’s touch signature analysis would have been less reliable resulting in legitimate touching going undetected by the controller. *Najafi Decl.* (Ex. 1003), ¶101. In an ungrounded touch scenario involving two fingers, for example, the negative pixel effect described in *Westerman* ’787 would cause their respective changes in capacitance to be lower than expected due to distortions caused by poor grounding. *Id.* at ¶101. In such a scenario, if the negative pixel effect, due to poor grounding is not accommodated, legitimate touches may not exceed the detection threshold and go undetected. *Id.*

Sleeman teaches adjusting the touch detection threshold to account for less intense change in capacitance signals caused by touches from different types of external objects including small fingers and styluses. *Id.* at ¶102. Based on the teachings of *Westerman* ’787, a POSITA would have been motivated to determine

the grounding status of *Sleeman*'s touch sensor so that it could determine when poor grounding conditions are present and lower the detection threshold accordingly. *Id.* This modification would have predictably enabled *Sleeman*'s controller to recognize the occurrence of a touch event despite poor grounding, and, properly adjust the detection threshold in order to more reliably detect legitimate touches. *Id.* at ¶103.

A POSITA would have understood this modification would have required minor changes to the controller's firmware and would have predictably resulted in *Sleeman*'s touch sensor recognizing poor grounding conditions so that it could lower the detection threshold to more reliably detect valid touches. *Id.* at ¶103. A POSITA would have also understood that performing a simple computation such as *Westerman* '787's ratio would not have significantly contributed to the computational load of the controller. *Id.* at ¶104. Moreover, configuring *Sleeman*'s controller to determine the grounding status ratio would have further enhanced its ability to reduce the touch detection threshold in situations resulting in weaker capacitance signals including poor grounding conditions. *Id.* Therefore, a POSITA would have understood there would have been a reasonable expectation of success when configuring *Sleeman*'s controller to determine the sensor's grounding status as taught by *Westerman* '787. *Id.*

[1(b)(iv)] adjust the stored threshold value based on the determined grounding status of the touch sensor;

After determining the shape of the touch signature, *Sleeman*’s “controller 120 may . . . **modify an internal detection threshold** for entering the detect mode.” *Sleeman* (Ex. 1007), [0022] (emphasis added), [0026]. For example, “[i]f a stylus shape is detected” or “[i]f a very small finger, such as a child’s finger is detected, the internal detection threshold may also be lowered.” *Id.* *Sleeman* lowers the detection threshold in these instances in order to increase the sensor’s sensitivity to account for weaker signals being received by the controller. *Id.* at Figs. 2-4, [0019]-[0022]; *Najafi Decl.* (Ex. 1003), ¶105.

As discussed above, *Westerman* ’787 teaches the capacitance readings “can appear more negative than they should” under poor grounding conditions. *Westerman* ’787 (Ex. 1008), [0027], [0037]; *Najafi Decl.* (Ex. 1003), ¶106. For the reasons discussed above, *Sleeman*’s touchscreen modified to account for poor grounding conditions pursuant to *Westerman* ’787 would have modified detection threshold(s) to account for poor grounding conditions. *Supra*, Claim 1(b)(iii). Like *Sleeman*’s teaching that a threshold is lowered to account for weaker signals due to a stylus or small finger, a POSITA would have understood that similarly lowering the threshold in response to determining a poor grounding status would have

predictably enabled *Sleeman*'s sensor to more reliably detect touches of poorly grounded external objects. *Najafi Decl.* (Ex. 1003), ¶106.

[1(b)(v)] after adjusting the stored threshold value, determine whether to process the interaction as a touch by the external object based on a comparison of the amount of capacitance with the adjusted threshold value; and

After adjusting the internal detection threshold, *Sleeman*'s controller enters a detect mode where "the controller interprets additional touches with a reduced threshold, as such touches are more likely to not correspond to noise, and be actual touches." *Sleeman* (Ex. 1007), [0022], [0026] ("The controller . . . enters a detect mode as a function of the type of the second touch"). In detect mode, the controller determines whether to process the interaction as a touch by the external object based on a comparison of the measured change in capacitance and reduced threshold. *Id.* at [0003] (noting "[t]he capacitive measurement is compared to the threshold, and if exceeding the threshold, a detect state is entered"), [0025] ("when a stylus touch signature shape is encountered[,] . . . a lowered detection threshold is used to detect further touches"), [0028].

[1(b)(vi)] after adjusting the stored threshold value based on the determined grounding status of the touch sensor: determine that the external object has not touched the touch sensor within a predetermined amount of time; and change the stored threshold value back to an original value, the original value comprising a value of the stored threshold value before it was adjusted based on the determined grounding status of the touch sensor.

As discussed in the preceding sections, *Sleeman* supports touch inputs from multiple different objects and recognizes that the detect threshold should be adjusted for the specific object type interacting with the device. *Sleeman* (Ex. 1007), [0001], [0004], [0019-0021], [0022] (“**Once the shape of the signature is determined, controller 120 may** either enter a detect mode of operation if the touching object is a finger, or **based on the type of signature, modify an internal detection threshold** for entering the detect mode.”) (emphasis added). *Sleeman* further explains that the adjusted threshold should be maintained while in detect mode because subsequent touches are “more likely to not correspond to noise, and be actual touches,” and explains that the modified threshold should revert back to its original value, “**a predetermined amount of time** following the first touch.” *Id.* at [0022], [0025] (emphasis added).

Sleeman also teaches a prior art embodiment where the sensor enters a detect state with a reduced threshold, maintains the reduced threshold as long as touches are detected, and restores the threshold to its original value after exiting the detect state due to removal of touch. *Id.* at [0003] (“In one prior device, . . . [t]he detect state is maintained as long as the measured capacitive changes on the nodes exceed the threshold” and “**[t]he original threshold is restored once the detect state is exited due to removal of the touch.**”) (emphasis added).

A POSITA would have understood that exiting a detect state due to removal of touch necessarily involves determining that the external object has not touched the touch sensor within a predetermined amount of time. *Najafi Decl.* (Ex. 1003), ¶109. This is because mutual capacitance sensors were scanned at predetermined frequencies ranging from ~20-200 Hz. *Id.* (citing *Barrett* (Ex. 1021), 18). Assuming the touch sensor has a scan frequency of 100 Hz, for example, the sensor would be scanned 100 times per second with each scan lasting 10 milliseconds. *Id.* One scan resulting in no capacitance measurements exceeding the adjusted detection threshold would mean that the external object has not touched the sensor for at least 10 milliseconds. *Id.* Thus, determining that no capacitance readings exceeded the adjusted threshold for one scan of the touch sensor means the external object has not touched the touch sensor within the predetermined amount of time it takes to complete one scan of the touchscreen. *Id.* For this reason, a POSITA would have understood *Sleeman's* description of the prior art embodiment inherently teaches determining that the external object has not touched the touch sensor within a predetermined amount of time (i.e., at least one sensor scan) before changing the stored threshold value back to its original value. *Id.*, ¶110.

As set forth above, it would have been obvious to configure *Sleeman's* controller to adjust the threshold based on a determined grounding status. In this scenario, it would also have been obvious to change the threshold back to its original

value once the detect state is exited due to removal of touch per *Sleeman's* prior art embodiment. *Najafi Decl.* (Ex. 1003), ¶111. A POSITA would have understood that using the modified threshold for a predetermined amount of time following the *first* touch may result in the threshold being changed back to its original value while the external object is still touching the sensor in a poorly grounded state. *Id.* Such a reduction in sensor sensitivity while the external object is still interacting with the sensor would, under some circumstances, result in inadvertent non-detections of valid touches. *Id.*

A POSITA would further have understood that adjusting the threshold after touch has been removed as taught by *Sleeman's* prior art embodiment would be a predictable way to avoid this problem and increase the sensor's performance. *Id.* at ¶112. For this reason, a person of ordinary skill would have been motivated to modify *Sleeman's* controller to restore the threshold back to its original value after removal of touch, i.e., after determining the external object has not touched the touch sensor within the predetermined amount of time it takes to complete at least one scan of the touchscreen. *Id.*

A POSITA would have understood this modification would only require a simple change to the controller's firmware. *Id.* at ¶113. Given this and the fact that *Sleeman* acknowledges this arrangement was well known in the art, there would have been a reasonable expectation of success when configuring *Sleeman's*

controller to change the threshold back to its original value after determining the external object has not touched the touchscreen for the predetermined amount of time. *Id.*

2. ***Claim 7***

7. *A method comprising:*

To the extent the preamble is limiting, *Sleeman* teaches “a method of detecting touches . . .” *Sleeman* (Ex. 1007), [0009].

*Claim [7(a)]:*²

Supra at Claims 1 preamble, 1(a), 1(b), and 1(b)(i).

Claim [7(b)]:

Supra, Claim 1(b)(ii).

Claim [7(c)]:

Supra, Claim 1(b)(iii).

Claim [7(d)]:

Supra, Claim 1(b)(iv).

Claim [7(e)]:

Supra, Claim 1(b)(v).

Claim [7(f)]:

Supra, Claim 1(b)(vi).

² Claim language for all limitations in the Challenged Claims is reproduced in the Claim Listing Index at the end of this petition.

3. **Claim 13**

Claim 13[p]:

Supra at Claims 1 preamble, 1(a), 1(b).

Claim [13(a)]:

Supra at Claim 1(b)(i).

Claim [13(b)]

Supra at Claim 1(b)(ii).

Claim [13(c)]:

Supra at Claim 1(b)(iii).

Claim [13(d)]:

Supra at Claim 1(b)(iv).

Claim [13(e)]:

Supra at Claim 1(b)(v).

Claim [13(f)]:

Supra at Claim 1(b)(vi).

4. **Claim 22**

22. The touch sensor of claim 1, wherein:

if the amount of capacitance is greater than the adjusted threshold value, the interaction with the touch sensor by the external object is processed as a touch by the external object; and if the amount of capacitance is less than the adjusted threshold value, the interaction with the touch sensor by the external object is not processed as a touch by the external object.

After adjusting the internal detection threshold, *Sleeman*'s controller enters a detect mode where "the controller interprets additional touches with a reduced

threshold, as such touches are more likely to not correspond to noise, and be actual touches.” *Sleeman* (Ex. 1007), [0022], [0026]. As is well understood in the art, *Sleeman* processes interactions with an external object as a touch when the change in capacitance exceeds the threshold and concludes there has been no touch when the changed capacitance does not exceed the threshold. *Id.*, [0002] (explaining “thresholds may be used to determine whether the touchscreen is being initially touched”), [0003] (teaching “the threshold is a function of the measured capacitance at each node which changes in response to a touch by a finger or stylus” such that “[t]he capacitive measurement is compared to the threshold, and if exceeding the threshold, a detect state is entered”); *see also*, *Najafi Decl.* (Ex. 1003), ¶115.

5. *Claim 23*

Claim 23:

Supra, Claim 1(b)(vi).

B. Ground 2: *Sleeman* in view of *Hotelling* renders claims 1, 7, 13, 19, 20, 22, and 23 obvious

As discussed in Section II.A, the ’472 Patent teaches multiple scenarios that may result in a well-grounded or poorly grounded device. For example, the manner in which a user interacts with the device (e.g., whether holding an unplugged device or not) can determine whether the device has a good path to ground or not. ’472 *Patent* (Ex. 1001), 5:60-6:1. As set forth in Ground 1, identical to certain examples in the ’472 Patent, *Westerman* ’787 teaches determining the grounding status of the

touch sensor based on the user's interaction with the device. However, *Westerman* '787 does not teach determining the grounding status of the touch sensor independently of the user's interaction with the device, e.g., by determining whether the device is plugged in. To the extent PO contends the limitations of independent claims 1, 7, and 13 requiring determination of "a grounding status of the touch sensor based on a strength of a charge return path between the touch sensor [/touch-sensitive device] and a ground" should be construed narrowly to exclude embodiments where grounding status is determined based on an interaction with the touch sensor and user, *Hotelling* teaches this limitation. In other words, Petitioner offers this ground to cover the possibility of a narrow construction that requires determining the grounding status of the touch sensor in isolation.

Hotelling was filed on July 16, 2009 and published on January 20, 2011. *Hotelling* (Ex. 1010). *Hotelling* therefore qualifies as prior art to the '472 Patent under at least 35 U.S.C. §§ 102(a) and (e) (pre-AIA). As discussed above, *Hotelling* was considered during prosecution of the '472 Patent. *Supra*, Section II.B. However, *Hotelling* was not considered in combination with the teachings of *Sleeman*. *Id.* Moreover, Petitioner only relies on *Hotelling* for the "determining grounding status" limitations, which were never disputed by PO during prosecution of the '472 Patent. *Id.*

Hotelling “relates generally to touch sensitive devices and, more particularly, to detecting a grounded state of a touch sensitive device.” *Hotelling* (Ex. 1010), [0001]. *Hotelling* detects the ground state by “monitoring various touch sensitive device parameters indicative of the device’s grounding and determining the grounding based on the monitored parameters’ values.” *Id.* at [0023]. *Hotelling* is therefore in the same field of endeavor and analogous to the claimed invention of the ’472 Patent. *Hotelling* is also reasonably pertinent to the problem faced by the inventors of the ’472 Patent since it discloses monitoring the grounding status of a capacitive touch sensor and applying compensation based on the determined grounding status.

1. *Claim 1*

1. A touch sensor comprising:

To the extent the preamble is limiting, *Sleeman* discloses this limitation. *Supra*, Section IV.A.1 at Claim 1 [Preamble].

[1(a)] a plurality of sense electrodes; and

Sleeman discloses this limitation. *Supra*, Section IV.A.1 at Claim 1(a).

[1(b)] a controller communicatively coupled to the plurality of sense electrodes, the controller configured to:

Sleeman discloses this limitation. *Supra*, Section IV.A.1 at Claim 1(b).

[1(b)(i)] receive a plurality of signals from the plurality of sense electrodes associated with an interaction with the touch sensor by an external object, the

plurality of signals indicative of an amount of capacitance between the touch sensor and the external object;

Sleeman discloses this limitation. *Supra*, Section IV.A.1 at Claim 1(b)(i).

[1(b)(ii)] access a stored threshold value, the threshold value indicating a threshold magnitude of capacitance;

Sleeman discloses this limitation. *Supra*, Section IV.A.1 at Claim 1(b)(i).

[1(b)(iii)] determine a grounding status of the touch sensor based on a strength of a charge return path between the touch sensor and a ground;

As discussed previously, *Sleeman* does not account for the fact that poor grounding conditions can distort the touch signatures. *Hotelling* teaches “when a poorly grounded touch sensitive device receives a touch by an object, such as a user’s fingers, undesirable charge coupling called negative capacitance C_{neg} can be introduced into the device to cause the pixel touch output value to be in the opposite direction of the intended mutual capacitance change.” *Hotelling* (Ex. 1010), [0023]. As a result, “a pixel experiencing touch under poor grounding conditions can appear to **detect less of a touch** than is actually present.” *Id.* (emphasis added). To solve this problem, *Hotelling* “monitor[s] various touch sensitive device parameters indicative of the device’s grounding and determining the grounding based on the monitored parameters’ values.” *Id.* Like the ’472 Patent, *Hotelling* teaches determining the touch sensor’s grounding state by detecting whether or not the device is physically connected to a power source or another device via a cable or dock. *Id.* at [0024]-[0030], Fig. 1. For example, “sensed power can indicate that the

device 10 is plugged into a wall outlet, for example, thereby grounding the device through the wall ground. Therefore, sensing power via the connector port 10a can indicate that the touch sensitive device 10 is grounded.” *Id.* at [0024]. *Hotelling* teaches several advantages to determining the grounding status of a touch sensor including improved accuracy, faster touch sensing, and power savings. *Id.* at [0019].

A POSITA would have understood that *Sleeman*’s touchscreen would have suffered from the same distortions caused by poor grounding conditions, which would have hindered the controller’s ability to analyze the touch signatures and determine the types of external objects. *Najafi Decl.* (Ex. 1003), ¶123. *Hotelling* teaches a similar “mutual capacitance sensor, in which a pair of conductive electrodes can be disposed in close proximity to each other . . . and in which one of the electrodes can be charged (e.g., stimulated with an AC voltage) to form fringing electric fields and a mutual capacitance therebetween.” *Hotelling* (Ex. 1010), [0039].

Because poor grounding conditions would have made the sensed capacitance signals to appear lower than they should, *Sleeman*’s system would not have properly accounted for this distortion using its disclosed technique that considers only the size and intensity of a touch signature to determine a proper detection threshold. *Najafi Decl.* (Ex. 1003), ¶124. For example, a touch scenario involving a large finger would normally be assigned a higher detection threshold, but the changes in

capacitance encountered would be lower than expected due to distortions caused by poor grounding. *Id.* In such a scenario, legitimate touches may not exceed the detection threshold and may go undetected. *Id.* For this reason, a POSITA would have been motivated to enable *Sleeman's* controller to determine the sensor's grounding status as taught by *Hotelling*. *Id.* at ¶125. This modification would have predictably enabled *Sleeman's* controller to recognize the occurrence of a touch event despite poor grounding conditions, and, properly adjust the detection threshold in order to more reliably detect legitimate touches. *Id.* Moreover, a POSITA would have been motivated to configure *Sleeman's* controller to determine the grounding status as to achieve the same benefits taught by *Hotelling* including improved accuracy, faster touch sensing, and power savings. *Id.*

A POSITA would have understood this change would have required minor changes to the touch sensitive device's hardware and the controller's firmware and would have predictably resulted in *Sleeman's* touch sensor recognizing poor grounding conditions so that it could lower the detection threshold to more reliably detect valid touches. *Id.* at ¶126. Therefore, a POSITA would have understood there would have been a reasonable expectation of success when configuring *Sleeman's* controller to determine the sensor's grounding status as taught by *Hotelling*. *Id.*

[1(b)(iv)] adjust the stored threshold value based on the determined grounding status of the touch sensor;

After determining the shape of the touch signature, *Sleeman*'s "controller 120 may . . . **modify an internal detection threshold** for entering the detect mode." *Sleeman* (Ex. 1007), [0022] (emphasis added), [0026] (noting "[t]he controller . . . enters a detect mode as a function of the type of the second touch") For example, "[i]f a stylus shape is detected" or "[i]f a very small finger, such as a child's finger is detected, the internal detection threshold may also be lowered" to increase the sensor's sensitivity to account for weaker signals being received by the controller. *Id.*, Figs. 2-4, [0019]-[0022]; *Najafi Decl.* (Ex. 1003), ¶127.

As discussed above, *Hotelling* teaching poor grounding conditions result in the sensor "detect[ing] less of a touch than is actually present." *Hotelling* (Ex. 1010), [0023]. For all of the reasons discussed above, a POSITA would have understood *Sleeman*'s mutual-capacitance touchscreen would experience the same distortions described by *Hotelling* and would have therefore been motivated to lower *Sleeman*'s detection threshold(s) to account for the fact that the received capacitance readings are lower than they should be due to poor grounding conditions. *Supra*, Claim 1(b)(iii). As discussed above, *Sleeman* teaches lowering the threshold to account for weaker signals due to a stylus or small finger contacting the sensor, for example. *Id.* A POSITA would have understood that similarly lowering the threshold in response to determining a poor grounding status would have predictably enabled *Sleeman*'s

sensor to more reliably detect touches of poorly grounded external objects. *Najafi Decl.* (Ex. 1003), ¶128.

[1(b)(v)] after adjusting the stored threshold value, determine whether to process the interaction as a touch by the external object based on a comparison of the amount of capacitance with the adjusted threshold value; and

Sleeman discloses this limitation. *Supra*, Section IV.A.1 at Claim 1(b)(v).

[1(b)(vi)] after adjusting the stored threshold value based on the determined grounding status of the touch sensor: determine that the external object has not touched the touch sensor within a predetermined amount of time; and change the stored threshold value back to an original value, the original value comprising a value of the stored threshold value before it was adjusted based on the determined grounding status of the touch sensor.

Sleeman teaches this limitation. *Supra*, Section IV.A.1 at Claim 1(b)(vi).

2. Claim 7

7. A method comprising:

To the extent the preamble is limiting, *Sleeman* teaches this limitation. *Supra*, Section IV.A.2 at Claim 7 Preamble.

Claim [7(a)]:

Supra, Claims 1 preamble, 1(a), 1(b), and 1(b)(i).

Claim [7(b)]:

Supra, Claim 1(b)(ii).

Claim [7(c)]:

Supra, Claim 1(b)(iii).

Claim [7(d)]:

Supra, Claim 1(b)(iv).

Claim [7(e)]:

Supra, Claim 1(b)(v).

Claim [7(f)]:

Supra, Claim 1(b)(vi).

3. *Claim 13*

Claim 13[p]:

Supra, Claims 1 preamble, 1(a), 1(b).

Claim [13(a)]:

Supra, Claim 1(b)(i).

Claim [13(b)]:

Supra, Claim 1(b)(ii).

Claim [13(c)]:

Supra, Claim 1(b)(iii).

Claim [13(d)]:

Supra, Claim 1(b)(iv).

Claim [13(e)]:

Supra, Claim 1(b)(v).

Claim [13(f)]:

Supra, Claim 1(b)(vi).

4. *Claim 22*

Claim 22:

Sleeman teaches this limitation. *Supra*, Section IV.A.4 at Claim 22.

5. *Claim 23*

Claim 23:

Sleeman teaches this limitation. *Supra*, Section IV.A.5 at Claim 23.

C. **Grounds 3-4: *Sleeman*, *Westerman* '787, and *Griffin* OR *Sleeman*, *Hotelling*, and *Griffin* render claims 5, 6, 11, 12, 17, 18, and 21 obvious**

Griffin was filed on April 8, 2010 and published on October 13, 2011. *Griffin* (Ex. 1009). *Griffin* therefore qualifies as prior art to the '472 Patent under at least 35 U.S.C. §§ 102(a) and (e) (pre-AIA). *Griffin* was not cited or considered during prosecution of the '472 Patent. *Supra*, Section II.B. *Griffin* describes “portable electronic devices having touch-sensitive devices and their control.” *Griffin* (Ex. 1009), [0001]. The touch-sensitive device may be a “touch-sensitive display 118 may be any suitable touch-sensitive display, such as a capacitive. . . . [which] includes a capacitive touch-sensitive overlay 114.” *Id.* at [0022]. *Griffin* is therefore in the same field of endeavor and analogous to the claimed invention of the '472 Patent.

1. *Claim 5*

5. The touch sensor of claim 1, wherein changing the stored threshold value back to the original value comprises periodically drifting, at a predetermined rate, the stored threshold value back to the original value.

The '472 Patent discloses an embodiment where periodically drifting a threshold value back to its original value at a predetermined rate encompasses “periodically adjust[ing] back to initial touch detection threshold 52c of 900 at a

predetermined rate.” ’472 Patent (Ex. 1001), 10:41-46. In one example, the threshold is adjusted once per second, but the ’472 Patent “anticipates any appropriate rate of adjustment.” *Id.* at 10:46-57.

Sleeman teaches changing the stored threshold value back to the original value but does not describe periodically drifting or adjusting, at a predetermined rate, the stored threshold back to the original value. *Griffin* teaches a touch-sensitive display including touch thresholds that are “modifiable and may be based on the values of any number of parameters.” *Griffin* (Ex. 1009), [0033]. *Griffin*’s “touch threshold information may be stored in . . . [an] equation.” *Id.*, [0045]. For example, *Griffin* demonstrates modifying touch thresholds by changing the value linearly over time:

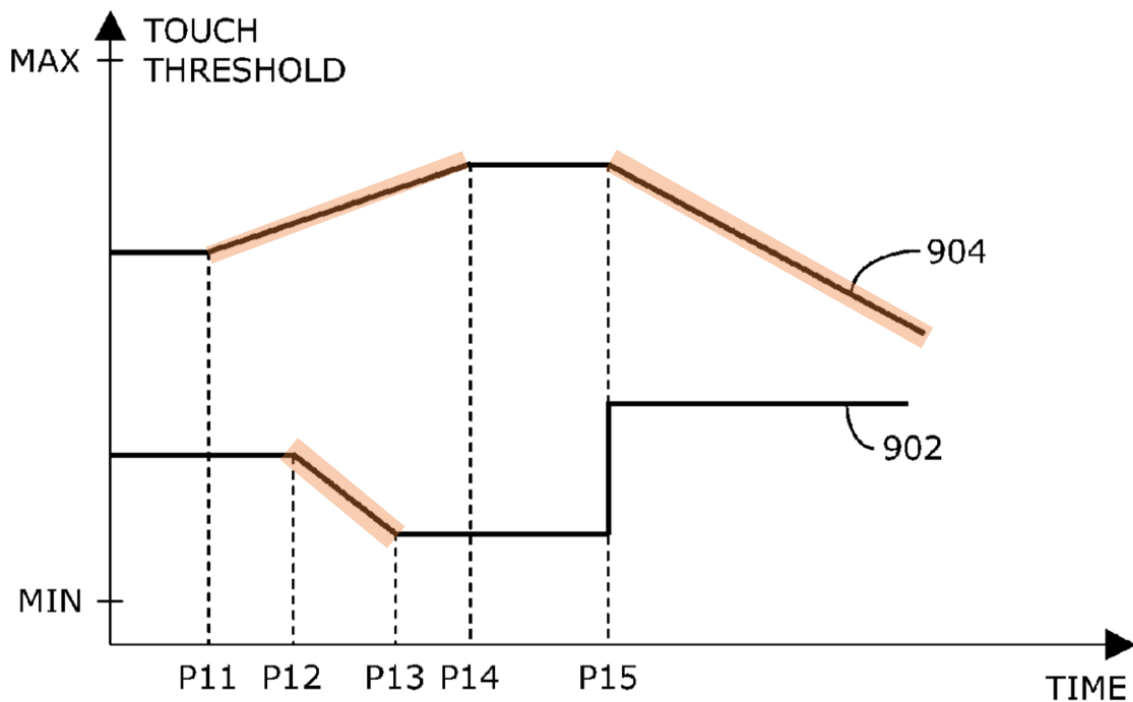


FIG. 9

Id., Fig. 9 (emphasis added); *see also, id.*, [0058] (“When a change in parameter P11 is identified, the upper touch threshold 904 is modified by linearly increasing the upper touch threshold 904 over time . . .”).

A POSITA would have understood that when expressing a threshold value as a linear equation (i.e., $y=mx+b$), the variable x is time, the variable y is the value of the threshold, and the constant m is the rate at which the value of the threshold changes over time (i.e., the slope of the line). *Najafi Decl.* (Ex. 1003), ¶134. Moreover, a POSITA would have understood *Griffin’s* threshold value y is adjusted once for every timestep x , which is consistent with the ’472 Patent’s disclosure of periodically drifting a threshold value back to its original value at a predetermined rate by adjusting the threshold at predetermined timesteps (e.g., one adjustment per second). *Id.* at ¶¶134-136. For these reasons, a POSITA would have understood *Griffin’s* teaching of adjusting the threshold value in accordance with a linear equation is consistent with the ’472 Patent’s description of periodically drifting a threshold value back to its original value at a predetermined rate. *Id.* at ¶136.

It would have been obvious to change *Sleeman’s* stored threshold value back to its original value by periodically drifting it at predetermined rate as taught by *Griffin*. *Id.* at ¶137. A mutual capacitance sensor scans the sensor’s nodes at a frequency of 20-200 Hz, which is much faster than a human user is able to interact with it. *Id.*, ¶137, ¶109. This means even if the external object has not been in

contact with the touch sensor in the amount of time it takes for the controller to complete multiple scans of the nodes, the user may still be interacting with the sensor. *Id.* at ¶137. Assuming the grounding conditions have not changed, and the threshold is raised back to its original value, this may result in a valid touch going undetected. *Id.*

A POSITA would have understood gradually changing the threshold back to its original value at a predetermined rate per *Griffin*'s teachings would accommodate a user who is still interacting with the sensor. *Id.* at ¶138. This would predictably result in making the sensor more robust and less likely to inadvertently miss valid touches. *Id.* For these reasons, a POSITA would have been motivated to change *Sleeman*'s threshold back to its original value by periodically drifting it at a predetermined rate as taught by *Griffin* to achieve the predictable result of a more robust and reliable touch sensor. *Id.*

A POSITA would further have understood this modification would only require a simple change to *Sleeman*'s controller firmware. *Id.* at ¶139. Additionally, this modification would have enhanced *Sleeman*'s ability to reliably detect different types of touches and would have therefore not changed *Sleeman*'s principle of operation or rendered it inoperable for its intended purpose. *Id.* And there would have been a reasonable expectation of success when implementing this modification. *Id.*

2. Claim 6

6. The touch sensor of claim 1, wherein:

[6(a)] adjusting the stored threshold value based on the determined grounding status of the touch sensor comprises replacing the stored threshold value with a new threshold value; and

Sleeman’s controller “modif[ies] an internal detection threshold . . .” *Sleeman* (Ex. 1007), [0022], [0025] (“In one embodiment, an internal detection threshold is set to be more sensitive . . .”). Specifically, *Sleeman* lowers the internal detection threshold under when specific types of external objects are detected. *Id.*, [0022]. A POSITA would have understood modifying a value means changing or altering it, and this understanding coupled with *Sleeman*’s disclosure of lowering the internal threshold value means *Sleeman* discloses replacing the original threshold value with a new, lower value in memory. *Najafi Decl.* (Ex. 1003), ¶¶141-142 (citing definition of “modify” in *Oxford Dictionary* (Ex. 1024)).

For the reasons discussed above, it would have been obvious to enable *Sleeman* to adjust the stored threshold value based on the determined grounding status of the touch sensor. *Supra*, Section **Error! Reference source not found.**, Claim 1(b)(iv). It would have been obvious to a POSITA to replace the stored threshold value with a new threshold value based on the determined grounding status for the same reasons. *Id.*

[6(b)] the stored threshold value is adjusted at a predetermined rate.

As explained above, *Griffin* teaches adjusting the stored threshold value at a predetermined rate using a linear equation. *Supra*, Claim 5. *Griffin* also generally teaches several advantages to such adjustable thresholds including reducing inadvertent user inputs (including unintended calls and text messages) and reducing power consumption. *Griffin* (Ex. 1009), [0033], [0043].

It was well known in the art at the time of the '472 Patent that capacitance changes occur in mutual-capacitance sensors as the user's finger approaches the sensor, but prior to the finger coming into full contact with the sensor. *Najafi Decl.* (Ex. 1003), ¶144 (citing *QT60161 Datasheet* (Ex. 1011), 7). This results in situations where the threshold is lowered prior to the finger making full contact with the sensor making the sensor more sensitive to noise. *Id.* at ¶145. Therefore, a POSITA would have been motivated to lower *Sleeman's* stored threshold value at a predetermined rate as taught by *Griffin* to prevent the threshold from being lowered the full amount prior to the external object making full contact with the sensor. *Id.* This combination of known elements would have predictably resulted in making *Sleeman's* touch sensor more resistant to noise and less susceptible to false touch detections. *Id.*

A POSITA would have understood this modification would only require a simple change to *Sleeman's* controller firmware. *Id.* at ¶146. Additionally, this

modification would have enhanced *Sleeman's* ability to reliably detect different types of touches and would have therefore not changed *Sleeman's* principle of operation or rendered it inoperable for its intended purpose. *Id.* For these reasons, there would have been a reasonable expectation of success when implementing this modification. *Id.*

3. *Claim 11*

Claim 11:

Supra, Claim 5.

4. *Claim 12*

Claim 12[p]:

Supra, Section IV.A at Claim 7.

Claim [12(a)]:

Supra, Claim 6(a).

Claim [12(b)]:

Supra, Claim 6(b).

5. *Claim 17*

Claim 17:

Supra, Claim 5.

6. *Claim 18*

Claim 18[p]:

Supra, at Claim 13.

Claim [18(a)]:

Supra, Claim 6(a).

Claim [18(b)]:

Supra, Claim 6(b).

7. *Claim 21*

21. The touch sensor of claim 1, wherein the stored threshold value is adjusted after a predetermined number of interactions with the touch sensor by the external object.

Griffin teaches a touch-sensitive display including a touch threshold that is “modifiable and may be based on the values of any number of parameters.” *Griffin* (Ex. 1009), [0033]. For example, **“[t]he touch threshold may be modified based on the rate of detected touches, also referred to herein as the touch rate, e.g., how often touches occur or the number of touches in a period of time.”** *Id.* at [0044] (emphasis added). *Griffin* further explains, “when the touch rate is high, the touch threshold may be decreased, to reduce the user’s effort to trigger functions, such as when typing on a virtual keyboard 604. When the touch rate is low, the touch threshold may be increased, resulting in more deliberate touches to meet the threshold, such as when selecting the “DELETE” virtual button 602.” *Id.*

A POSITA would have understood *Griffin*’s teaching of modifying a touch threshold based on the number of touches in a period of time qualifies as the claimed adjustment of a threshold value “after a predetermined number of interactions with the touch sensor by the external object.” *Najafi Decl.* (Ex. 1003), ¶¶147-148. As

explained by *Griffin*, the touch rate is “the number of touches in a period of time,” (*Griffin* (Ex. 1009), [0044]) and a POSITA would recognize distinguishing a “high” touch rate or a “low” touch rate would be made by comparing the number of touch interactions in a period of time with a predetermined “high” or “low” number of interactions. *Id.*

It would have been obvious to configure *Sleeman*’s touchscreen to modify the threshold based on the touch rate as taught by *Griffin*. *Id.* at ¶149. As demonstrated by *Griffin*, adjusting detection thresholds based on the number of touch interactions detected in a specified period of time was a well-known way to improve usability of touch sensors. *Id.* As taught by *Griffin*, a high number of interactions may indicate the user is attempting to type on a virtual keyboard so the threshold may be advantageously reduced to make typing easier for the user. *Id.* In contrast, if a small number of interactions are detected in a period of time, then the threshold may be advantageously increased to prevent unintended interactions from being processed as legitimate inputs by the user. *Id.* Thus, a POSITA would have been motivated to improve similar touch sensors in the same way in order to achieve the same usability improvements. *Id.*

Additionally, there would have been a reasonable expectation of success when modifying *Sleeman*’s touch sensor in this way. *Id.* at ¶150. The proposed modification would have required only the straightforward addition of software to

modify the threshold based on the touch rate as taught by *Griffin*. *Id.* (concluding implementing this functionality would have been well within the abilities of a POSITA).

D. Ground 5: Sleeman, Westerman '787, and Hotelling render claims 19 and 20 obvious

1. Claim 19

19. The touch-sensitive device of claim 13, wherein determining the grounding status of the touch sensor based on the strength of the charge return path between the touch sensor and ground comprises analyzing shapes of one or more capacitance graphs.

Sleeman teaches deciding whether to modify the detection threshold based on “**a signature shape** generated from signals received from the nodes.” *Sleeman* (Ex. 1007), [0024] (emphasis added). As shown in the figures below, signature shapes are represented by two dimensional arrays denoting the size of the touch (i.e., how many nodes are in contact with the external object) and intensity (i.e., magnitude) of the capacitance signals where darker shading indicates a stronger capacitance signal:

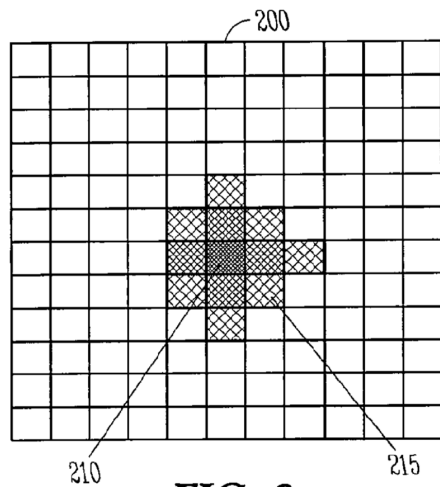


FIG. 2

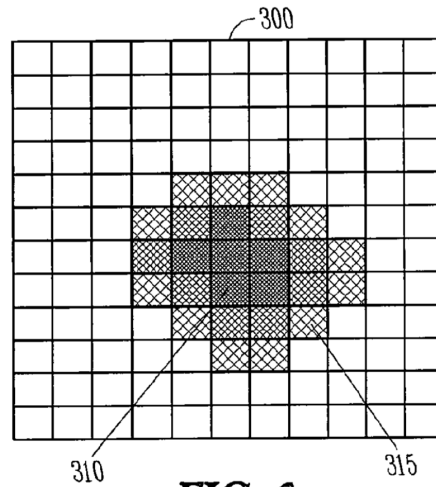


FIG. 3

Id. at Figs. 2-3; *see also, id.* at Fig. 4, [0019]-[0021], [0029]; *Najafi Decl.* (Ex. 1003), ¶151.

A POSITA would have understood *Sleeman's* arrays are similar to the capacitance graphs described in the '472 Patent, except *Sleeman* denotes the magnitude of the capacitance signal by using darker shading for higher magnitude changes in capacitance instead of a three-dimensional graph. *Najafi Decl.* (Ex. 1003), ¶152.

Westerman '787 recognizes differences in the shapes contained in capacitance graphs of grounded and floating touches, but does not expressly analyze these shapes to identify whether the sensor is grounded or floating:

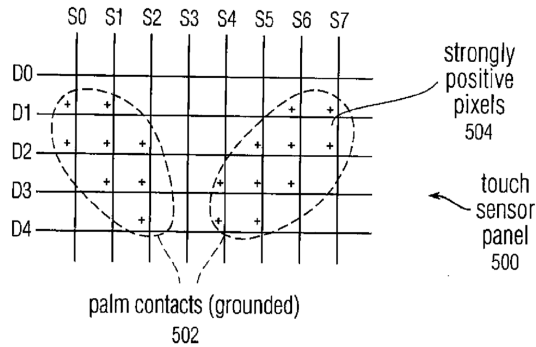


Fig. 5a

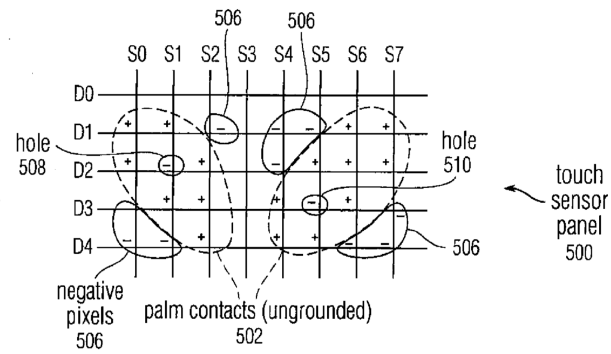


Fig. 5b

Westerman '787 (Ex. 1008), Figs. 5a-b.

Hotelling goes one step further and expressly suggests determining whether a touch sensor is grounded by analyzing a “touch image” representing “the characteristics of the touch, including the location, orientation, **shape**, movement, and so on.” *Hotelling* (Ex. 1010), [0048] (emphasis added), [0050] (“Accordingly, sensing a touch image having this thumb configuration can be an indication that the touch sensitive device is being held and therefore grounded.”). *Hotelling* also recognizes “[t]he ability to detect how well grounded a touch sensitive device is can advantageously provide more accurate and faster touch sensing” as well as provide power savings and enable the device to “more robustly adapt to various grounding conditions.” *Id.* at [0019].

Based on the teachings of *Hotelling*, it would have been obvious to a POSITA to enable *Sleeman*’s controller to determine the grounding status of the touch sensor based on the strength of the charge return path between the touch sensor and ground

by analyzing shapes of one or more capacitance graphs. *Najafi Decl.* (Ex. 1003), ¶157. Given *Sleeman* already analyzes capacitance arrays for the purpose of adjusting the threshold, a POSITA would have been motivated to configure *Sleeman* to also analyze capacitance arrays to determine the grounding status of the sensor. *Id.*

A POSITA would have understood this modification would have predictably provided power savings benefits as well as enabled *Sleeman*'s touchscreen to provide more robust sensing performance as recognized by *Hotelling*. *Id.* at ¶158. Therefore, a person having ordinary skill in the art would have been motivated to improve similar touch sensitive devices in the same way. *Id.*

Additionally, a POSITA would have understood this modification would have required minimal changes to the firmware on *Sleeman*'s controller since it is merely an extension of existing functionality. *Id.* at ¶159. Therefore, there would have been a reasonable expectation of success when configuring *Sleeman*'s touchscreen in this way. *Id.*

2. *Claim 20*

20. The touch-sensitive device of claim 19,

Supra, Claim 19.

[20(a)] wherein analyzing shapes of one or more capacitance graphs comprises: comparing a capacitance graph derived from plurality of signals indicative of an amount of capacitance between the touch-sensitive device and an external object

with a plurality of stored capacitance graphs, the stored capacitance graphs comprising:

As discussed above, *Sleeman* teaches using capacitance arrays/graphs, such as those illustrated in Figures 2-4, to determine whether the detection threshold should be adjusted. *Supra*, Claim 19. In particular, *Sleeman* teaches, “An array with signal weighting may be used in one embodiment and **compared to known arrays** to determine the type of touch corresponding to the signals received.” *Sleeman* (Ex. 1007), [0029] (emphasis added). Therefore, *Sleeman* teaches storing capacitance arrays corresponding to touches from different types of external objects.

For the reasons discussed above with regard to claim 19, it would have been obvious to a POSITA to enable *Sleeman* to analyze the signature shapes of these capacitance arrays/graphs in order to also determine the grounding status of the sensor. *Supra*, Claim 19. Therefore, it would have also been obvious to store capacitance arrays corresponding to different grounding conditions for the same reasons. *Id.*; *Najafi Decl.* (Ex. 1003), ¶160.

[20(a)(i)] a grounded capacitance graph indicative of a typical touch when the touch-sensitive device is grounded; and

Westerman '787 teaches the following exemplary capacitance graph representing a grounded touch:

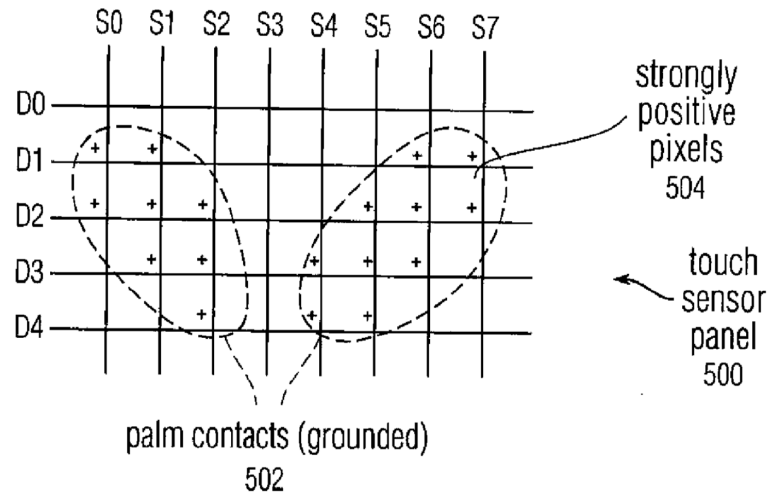


Fig. 5a

Westerman '787 (Ex. 1008), Fig. 5a.

FIG. 5a illustrates an exemplary touch sensor panel 500 with palms 502 of a grounded user touching the panel. In this instance, the pixels 504 being touched can appear strongly positive (large output indicative of touch), and because the palms are grounded, little or no charge can be coupled onto other sense lines, and the negative pixel effect can be insignificant.

Id., [0045].

It would have been obvious to a POSITA to enable *Sleeman* to store a similar capacitance array indicative of a typical touch when the touch-sensitive device is grounded for the same reasons as discussed above with regard to the previous limitation. *Supra*, Claim 20(a); *see also Najafi Decl.* (Ex. 1003), ¶162. As discussed above, *Sleeman* already teaches storing capacitance arrays for the purpose of

determining what type of external object is in contact with the sensor. *Id.* Therefore, there would have been a reasonable expectation of success when modifying *Sleeman*'s controller to also store capacitance arrays representing grounded touches. *Najafi Decl.* (Ex. 1003), ¶163.

[20(a)(ii)] a floating capacitance graph indicative of a typical touch when the touch-sensitive device is floating;

Westerman '787 teaches the following exemplary capacitance graph representing a floating touch:

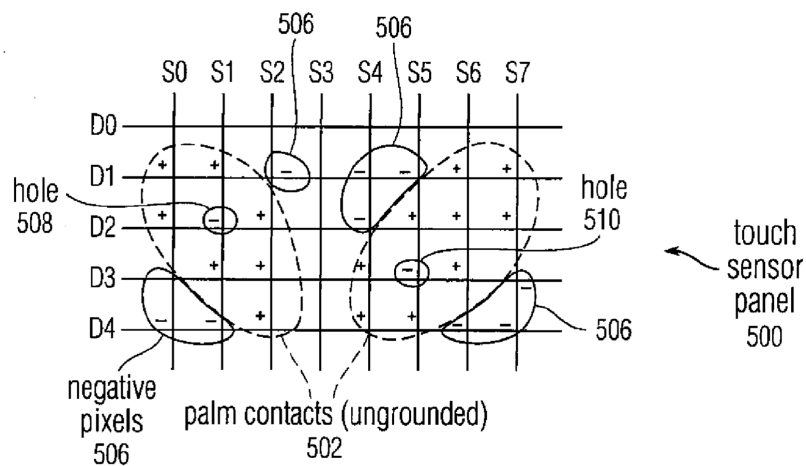


Fig. 5b

Westerman '787 (Ex. 1008), Fig. 5b.

FIG. 5b illustrates an exemplary touch sensor panel 500 with palms 502 of an ungrounded user touching the panel. In this instance, in addition to strongly negative or at least weakened pixels 506 in the corner areas just outside the touch regions, negative or weakened pixels 508 and 510 (holes) can form within the palm areas 502, where

a relatively large number of drive lines and sense lines are being simultaneously touched.

Id., [0046].

It would have been obvious to enable *Sleeman* to store a similar capacitance array indicative of a typical touch when the touch-sensitive device is floating for the same reasons as discussed above with regard to the previous limitation. *Supra*, Claim 20(a); *see also Najafi Decl.* (Ex. 1003), ¶165. As discussed above, *Sleeman* teaches storing capacitance arrays for the purpose of determining what type of external object is in contact with the sensor. *Id.* Therefore, there would have been a reasonable expectation of success when modifying *Sleeman's* controller to also store capacitance arrays representing floating touches. *Najafi Decl.* (Ex. 1003), ¶166.

[20(b)] determining, based on the comparison, that the touch-sensitive device is grounded if the capacitance graph matches the grounded capacitance graph; and

Sleeman teaches, “An array with signal weighting may be used in one embodiment and compared to known arrays to determine the type of touch corresponding to the signals received.” *Sleeman* (Ex. 1007), [0029] (emphasis added). For the same reasons as discussed above, it would have been obvious to also enable *Sleeman's* controller to determine the device is grounded if the capacitance array matches the stored grounded capacitance graph. *Supra*, Claim 20(a); *see also Najafi Decl.* (Ex. 1003), ¶167.

[20(c)] determining, based on the comparison, that the touch-sensitive device is floating if the capacitance graph matches the floating capacitance graph.

Sleeman teaches, “An array with signal weighting may be used in one embodiment and **compared to known arrays** to determine the type of touch corresponding to the signals received.” *Sleeman* (Ex. 1007), [0029] (emphasis added). For the same reasons as discussed above, it would have been obvious to also enable *Sleeman*’s controller to determine the device is floating if the capacitance array/graph matches the stored floating capacitance graph. *Supra*, Claim 20(a); *see also Najafi Decl.* (Ex. 1003), ¶168.

V. CONCLUSION

For the forgoing reasons, Petitioner respectfully requests *inter partes* review of the Challenged Claims.

Respectfully submitted,

BY: /s/ Adam P. Seitz

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COUNSEL FOR PETITIONER

VI. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(A)(1)

A. Real Party-In-Interest

The Petitioner is the real parties-in-interest. 37 C.F.R. § 42.8(b)(1).

B. Related Matters

Pursuant to 37 C.F.R. § 42.8(b)(2), Petitioner is aware of the following pending patent infringement lawsuits involving the '472 Patent:

- *Capacitive Touch-Controlled Mobile Devices, Computer, and Components Thereof*, 337-TA-1193 (Feb. 13, 2020 ITC)
- *Neodron Ltd. v. Apple Inc.*, 6-20-cv-00116 (Feb. 14, 2020 WDTX)
- *Neodron Ltd. v. LG Electronics, Inc.*, 6-20-cv-00118 (Feb. 14, 2020 WDTX)
- *Neodron Ltd. v. Samsung Electronics Co., Ltd. et al.*, 6-20-cv-00121 (Feb. 14, 2020 WDTX)
- *Neodron Ltd. v. Motorola Mobility LLC*, 3-20-cv-01179 (Feb. 14, 2020 NDCA)
- *Neodron Ltd. v. Cypress Semiconductor Corporation*, 6-20-00523 (June 12, 2020 WDTX)

C. Lead and Back-Up Counsel

Petitioner provides the following designation and service information for lead and back-up counsel. 37 C.F.R. § 42.8(b)(3) and (b)(4).

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CLAIMS LISTING APPENDIX

U.S. Patent No. 9,411,472, Claims 1, 5-7, 11-13, and 17-23

Claim Designation	Claim Language
Claim 1 [Preamble]	1. A touch sensor comprising:
Claim 1(a)	a plurality of sense electrodes; and
Claim 1(b)	a controller communicatively coupled to the plurality of sense electrodes, the controller configured to:
Claim 1(b)(i)	receive a plurality of signals from the plurality of sense electrodes associated with an interaction with the touch sensor by an external object, the plurality of signals indicative of an amount of capacitance between the touch sensor and the external object;
Claim 1(b)(ii)	access a stored threshold value, the threshold value indicating a threshold magnitude of capacitance;
Claim 1(b)(iii)	determine a grounding status of the touch sensor based on a strength of a charge return path between the touch sensor and a ground;
Claim 1(b)(iv)	adjust the stored threshold value based on the determined grounding status of the touch sensor;
Claim 1(b)(v)	after adjusting the stored threshold value, determine whether to process the interaction as a touch by the external object based on a comparison of the amount of capacitance with the adjusted threshold value; and

Claim Designation	Claim Language
Claim 1(b)(vi)	after adjusting the stored threshold value based on the determined grounding status of the touch sensor: determine that the external object has not touched the touch sensor within a predetermined amount of time; and change the stored threshold value back to an original value, the original value comprising a value of the stored threshold value before it was adjusted based on the determined grounding status of the touch sensor.
Claim 5	5. The touch sensor of claim 1, wherein changing the stored threshold value back to the original value comprises periodically drifting, at a predetermined rate, the stored threshold value back to the original value.
Claim 6 [Preamble]	6. The touch sensor of claim 1, wherein:
Claim 6(a)	adjusting the stored threshold value based on the determined grounding status of the touch sensor comprises replacing the stored threshold value with a new threshold value; and
Claim 6(b)	the stored threshold value is adjusted at a predetermined rate.
Claim 7 [Preamble]	7. A method comprising:
Claim 7(a)	receiving, by a controller coupled to a touch sensor, a plurality of signals from a plurality of sense electrodes associated with an interaction with the touch sensor by an external object, the plurality of signals indicative of an amount of capacitance between the touch sensor and the external object;
Claim 7(b)	accessing, by the controller, a stored threshold value, the threshold value indicating a threshold magnitude of capacitance;

Claim Designation	Claim Language
Claim 7(c)	determining, by the controller, a grounding status of the touch sensor based on a strength of a charge return path between the touch sensor and a ground;
Claim 7(d)	adjusting, by the controller, the stored threshold value based on the determined grounding status of the touch sensor;
Claim 7(e)	after adjusting the stored threshold value, determining, by the controller, whether to process the interaction as a touch by the external object based on a comparison of the amount of capacitance with the adjusted threshold value; and
Claim 7(f)	after adjusting the stored threshold value based on the determined grounding status of the touch sensor: determining, by the controller, that the external object has not touched the touch sensor within a predetermined amount of time; and changing, by the controller, the stored threshold value back to an original value, the original value comprising a value of the stored threshold value before it was adjusted based on the determined grounding status of the touch sensor.
Claim 11	11. The method of claim 7, wherein changing the stored threshold value back to the original value comprises periodically drifting, at a predetermined rate, the stored threshold value back to the original value.
Claim 12 [Preamble]	12. The method of claim 7, wherein:
Claim 12(a)	adjusting the stored threshold value based on the determined grounding status of the touch sensor comprises replacing the stored threshold value with a new threshold value; and
Claim 12(b)	the stored threshold value is adjusted at a predetermined rate.

Claim Designation	Claim Language
Claim 13 [Preamble]	13. A touch-sensitive device comprising a controller, the controller communicatively coupled to a plurality of sense electrodes, the controller operable to:
Claim 13(a)	receive a plurality of signals from the plurality of sense electrodes associated with an interaction with the touch sensor by an external object, the plurality of signals indicative of an amount of capacitance between the touch-sensitive device and the external object;
Claim 13(b)	access a stored threshold value, the threshold value indicating a threshold magnitude of capacitance;
Claim 13(c)	determine a grounding status of the touch sensor based on a strength of a charge return path between the touch-sensitive device and a ground;
Claim 13(d)	adjust the stored threshold value based on the determined grounding status of the touch sensor;
Claim 13(e)	after adjusting the stored threshold value, determine whether to process the interaction as a touch by the external object based on a comparison of the amount of capacitance with the adjusted threshold value; and
Claim 13(f)	after adjusting the stored threshold value based on the determined grounding status of the touch sensor: determine that the external object has not touched the touch sensor within a predetermined amount of time; and change the stored threshold value back to an original value, the original value comprising a value of the stored threshold value before it was adjusted based on the determined grounding status of the touch sensor.

Claim Designation	Claim Language
Claim 17	17. The touch-sensitive device of claim 13, wherein changing the stored threshold value back to the original value comprises periodically drifting, at a predetermined rate, the stored threshold value back to the original value.
Claim 18 [Preamble]	18. The touch-sensitive device of claim 13, wherein:
Claim 18(a)	adjusting the stored threshold value determined grounding status of the touch sensor comprises replacing the stored threshold value with a new threshold value; and
Claim 18(b)	the stored threshold value is adjusted at a predetermined rate.
Claim 19	19. The touch-sensitive device of claim 13, wherein determining the grounding status of the touch sensor based on the strength of the charge return path between the touch sensor and ground comprises analyzing shapes of one or more capacitance graphs.
Claim 20 [Preamble]	20. The touch-sensitive device of claim 19,
Claim 20(a)	wherein analyzing shapes of one or more capacitance graphs comprises: comparing a capacitance graph derived from plurality of signals indicative of an amount of capacitance between the touch-sensitive device and an external object with a plurality of stored capacitance graphs, the stored capacitance graphs comprising:
Claim 20(a)(i)	a grounded capacitance graph indicative of a typical touch when the touch-sensitive device is grounded; and
Claim 20(a)(ii)	a floating capacitance graph indicative of a typical touch when the touch-sensitive device is floating;

Claim Designation	Claim Language
Claim 20(b)	determining, based on the comparison, that the touch-sensitive device is grounded if the capacitance graph matches the grounded capacitance graph; and
Claim 20(c)	determining, based on the comparison, that the touch-sensitive device is floating if the capacitance graph matches the floating capacitance graph.
Claim 21	21. The touch sensor of claim 1, wherein the stored threshold value is adjusted after a predetermined number of interactions with the touch sensor by the external object.
Claim 22	22. The touch sensor of claim 1, wherein: if the amount of capacitance is greater than the adjusted threshold value, the interaction with the touch sensor by the external object is processed as a touch by the external object; and if the amount of capacitance is less than the adjusted threshold value, the interaction with the touch sensor by the external object is not processed as a touch by the external object.
Claim 23	23. The touch sensor of claim 1, wherein the stored threshold value is changed back to the original value only if it is determined that the external object has not touched the touch sensor within the predetermined amount of time.

APPENDIX OF EXHIBITS

Exhibit 1001	U.S. Patent No. 9,411,472 to Simmons et al.
Exhibit 1002	File History of U.S. Patent No. 9,411,472
Exhibit 1003	Declaration of Dr. Khalil Najafi (“ <i>Najafi Decl.</i> ”)
Exhibit 1004	Curriculum Vitae of Dr. Khalil Najafi
Exhibit 1005	U.S. Patent Publication No. 2008/0158146 to Westerman (“ <i>Westerman ’146</i> ”)
Exhibit 1006	U.S. Patent Publication No. 2011/0015889 to Land et al. (“ <i>Land</i> ”)
Exhibit 1007	U.S. Patent Publication No. 2011/0001708 to Sleeman (“ <i>Sleeman</i> ”)
Exhibit 1008	U.S. Patent Publication No. 2009/0160787 to Westerman et al. (“ <i>Westerman ’787</i> ”)
Exhibit 1009	U.S. Patent Publication No. 2011/0248948 to Griffin et al. (“ <i>Griffin</i> ”)
Exhibit 1010	U.S. Patent Publication No. 2011/0012840 to Hotelling et al. (“ <i>Hotelling</i> ”)
Exhibit 1011	Quantum Research Group QT60161 Data Sheet (“ <i>QT60161</i> ”)
Exhibit 1012	Affidavit from Chris Butler at the Internet Archive – QT61061
Exhibit 1013	Raphael Wimmer, <i>Capacitive Sensors for Whole Body Interaction</i> , in <i>Whole Body Interaction</i> 121-133 (D. England ed., April 2011) (“ <i>Wimmer</i> ”)
Exhibit 1014	Larry K. Baxter, <i>Capacitive Sensors Designs and Applications</i> , IEEE Press (1997) (“ <i>Baxter</i> ”)
Exhibit 1015	Steve Kolokowsky and Trevor Davis, <i>Touchscreens 101: Understanding Touchscreen Technology and Design</i> , Cypress Semiconductor Corp. (June 2009) (“ <i>Kolokowsky</i> ”)
Exhibit 1016	U.S. Patent No. 3,482,241 to Johnson (“ <i>Johnson</i> ”)
Exhibit 1017	B. Stumpe, <i>A New Principle for X-Y Touch System</i> , CERN (1977) (“ <i>Stumpe</i> ”)
Exhibit 1018	Jeremy White, <i>Multi-Touch Interfaces and Map Navigation</i> , University of Wisconsin-Madison (2009) (“ <i>White</i> ”)
Exhibit 1019	Philip I.S. Lei and Angus K.Y. Wong, <i>The Multiple-Touch User Interface Revolution</i> , IT Pro, IEEE Computer Society 42-49 (January/February 2009)

Exhibit 1020	Becca Hutchinson, Six alumni awarded Presidential Citations for Outstanding Achievement, UDaily, University of Delaware (Oct. 21, 2008, http://www1.udel.edu/udaily/2009/oct/citations102108.html , retrieved June 22, 2020) (“Hutchinson”)
Exhibit 1021	Gary Barrett and Ryomei Omote, <i>Projected-Capacitive Touch Technology</i> , Information Display 26(3):16-21 (March 2010) (“Barrett”)
Exhibit 1022	Kannan Srinivasagam and B. Vibheesh, <i>Differentiating Noise from Real Touch – The Key to Robust Capacitive Sensing</i> , Cypress Semiconductor Corp. (October 2010) (“Srinivasagam”);
Exhibit 1023	Seunghoon Ko et al., <i>Low Noise Capacitive Sensor for Multi-touch Mobile handset’s applications</i> , Proceedings of IEEE Asian Solid-State Circuits Conference (November 8-10, 2010) (“Ko”)
Exhibit 1024	<i>The Compact Oxford English Dictionary</i> (2nd ed. 1999) (“Oxford Dictionary”)

CERTIFICATION OF WORD COUNT

The undersigned certifies pursuant to 37 C.F.R. §42.24 that the foregoing Petition for *Inter Partes* Review, excluding any table of contents, mandatory notices under 37 C.F.R. §42.8, certificates of service or word count, or appendix of exhibits, contains 13,854 words according to the word-processing program used to prepare this document (Microsoft Word).

Dated: August 17, 2020

BY: /s/ Adam P. Seitz
Adam P. Seitz, Reg. No. 52,206

COUNSEL FOR PETITIONER

CERTIFICATE OF SERVICE ON PATENT OWNER
UNDER 37 C.F.R. § 42.105

Pursuant to 37 C.F.R. §§ 42.6(e) and 42.105, the undersigned certifies that on August 17, 2020, a complete and entire copy of this Petition for *Inter Partes* Review including exhibits was provided via Federal Express to the Patent Owner by serving the correspondence address of record for the '472 Patent as listed on PAIR:

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Further, a courtesy copy of this Petition for *Inter Partes* Review was sent via email to Patent Owner's litigation counsel:

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