

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SHENZHEN QIANFENYI INTELLIGENT TECHNOLOGY CO., LTD.
Petitioner

v.

WACOM CO., LTD.,
Patent Owner

DECLARATION OF NABIL J. SARHAN, PH.D.,
IN SUPPORT OF PETITION FOR INTER PARTES REVIEW OF
U.S. PATENT NO. 9,933,866

TABLE OF CONTENTS

I.	Introduction.....	1
II.	Qualifications.....	2
III.	My Understanding of Legal Principles.....	8
IV.	Overview of the '866 Patent.....	15
	A. Brief Background of Prior Art	15
	B. Disclosure of the '866 Patent	18
V.	Challenged Claims.....	19
VI.	Level of Ordinary Skill in the Art	22
VII.	Summary of the Prosecution History	24
VIII.	Claim Construction.....	27
IX.	Teachings of the Prior Art and Applied References.....	29
	A. U.S. Patent Publication No. 20120105362 to Kremin et al. ("Kremin") (Ex. 1005)	30
	B. U.S. Patent No. 6,377,248 to Partow et al. ("Partow") (Ex. 1007).....	32
	C. U.S. Patent Publication No. 20120050207 to Westhues et al. ("Westhues") (Ex. 1006)	33
	D. Known Techniques in Stylus Technology	36
	E. High Voltage	37
	F. Motivations to Combine and Expectation of Success.....	41
X.	First Ground for Invalidity: The Challenged Claims are anticipated by Kremin and/or obvious over Kremin in view of the knowledge of a person having ordinary skill in the art.....	45
XI.	Second Ground for Invalidity: The Challenged Claims are further obvious over Kremin in view of Partow.	45
XII.	Third Ground for Invalidity: The Challenged Claims are anticipated by Westhues and/or obvious over Westhues in view of the knowledge of a person having ordinary skill in the art.....	45
XIII.	Fourth Ground for Invalidity: The Challenged Claims are further obvious over Westhues in view of Kremin.	45
XIV.	Conclusion	46

I. Introduction

I, Nabil J. Sarhan, Ph.D., declare as follows:

1. I have been retained on behalf of Shenzhen Qianfenyi Intelligent Technology Co., Ltd. (hereinafter “Maxeye”) for the above-captioned *inter partes* review proceeding to provide my expert opinions and expert knowledge. I understand that this proceeding involves U.S. Patent No. 9,933,866 (“the ’866 patent”) titled “Active Stylus with High Voltage” by Shahrooz Shahparnia et al., and that the ’866 patent is currently assigned to Wacom Co., Ltd., (“Wacom”). I understand that the present proceedings involve a challenge to the validity of claims 1-7 and 15-16 of the ’866 patent (the “Challenged Claims”).
2. In preparing this declaration, I have reviewed and am familiar with all the references cited herein. I have reviewed and am familiar with the ’866 patent and its file history. I confirm that to the best of my knowledge the accompanying exhibits are true and accurate copies of what they purport to be, and that an expert in the field would reasonably rely on them to formulate opinions such as those set forth in this declaration.
3. The ’866 patent describes techniques related to generating and transmitting high-voltage signals by a stylus. I am familiar with the technology described in the ’866 patent as of its October 17, 2014 filing date and its claimed October 28, 2011 priority date.

4. I have been asked to provide my independent technical review, analysis, insights, and opinions regarding the '866 patent and the references that form the basis for the grounds of rejection set forth in the Petition for *Inter Partes* Review of the '866 patent.

II. Qualifications

5. A copy of my Curriculum Vitae is submitted as Exhibit 1004 in this proceeding. It includes details of my education, employment, and professional credentials. Further experience relevant to styluses, touchscreen devices, and related technologies is discussed below.
6. I am an internationally recognized expert in computer systems and computer networking, with a focus on multimedia applications and multimedia computing and networking, with over twenty years of experience in the field.
7. I graduated from Jordan University of Science and Technology in 1995 with a Bachelor of Science degree in Electrical Engineering. I then obtained Ph.D. and M.S. degrees in Computer Science and Engineering from the Pennsylvania State University (Penn State) in 2003. Both my M.S. thesis and Ph.D. dissertation considered the design of computer systems. Specifically, my Ph.D. dissertation dealt with the design of high-bandwidth I/O systems for multimedia applications.
8. I am an Associate Professor of Electrical and Computer Engineering (ECE) at

Wayne State University and the Director of Wayne State Computer Systems and Deep Learning Research Laboratory. I am the Coordinator of the Interdisciplinary College of Engineering M.S. in AI Program and the Director of the Hardware and System Track. I served as the Graduate Program Director of Electrical and Computer Engineering and the Chair of the College of Engineering Faculty Assembly. I also served as the Director of the Wayne State Multimedia Computing and Networking Research Laboratory in the ECE department for approximately fifteen years. I am chairing the Computer Engineering Area in the ECE department, and I regularly teach undergraduate and graduate courses in computer architecture and computer networks and supervise Ph.D. and M.S. students.

9. I have been regularly teaching the senior-level Computer Architecture course (previously called Computer Organization and Design) since 2003. The course covers microprocessor design, memory hierarchy, and I/O. The I/O aspects include interfacing and communication with peripheral devices. I have also been teaching the Computer Networks and Network Programming course, which includes coverage of all network layers (including the physical layer) and different communication protocols. Additionally, I taught multiple times the Advanced Computer Architecture course, which focuses on the design of parallel computer systems and covers microprocessor design,

memory hierarchy, and I/O. I have recently developed a new mandatory course titled "Object-Oriented Programming for Electrical and Computer Engineering" and led the efforts to modernize the Introduction to Microcomputers course and lab by using ARM-based microcontrollers and the instruction set. Other courses that I taught include Scalable and Secure Internet Services and Architectures, Special Topics on Multimedia, Special Topics on Multimedia Networking, Special Topics on Multimedia Systems and Networks, "Microcomputer Systems and Programming", and "Microprocessor Interfacing Lab". The "Microcomputer Systems and Programming" course covered parallel and serial interfacing. The Microprocessor Interfacing Lab focused on how to connect peripherals to the microprocessor through parallel and serial interfacing and how to program the microprocessor at the assembly language level to interface with such I/O devices.

10. I supervised eight Ph.D. dissertations and four master theses related to computer systems with a focus on multimedia applications and multimedia communication. I am currently supervising two Ph.D. dissertations in these areas of research.
11. I authored more than 60 refereed papers, including those in top journals and conferences in various areas, including computer systems, multimedia,

networking, deep learning, and I/O. Recently, I was awarded (with a collaborator) a grant from the National Science Foundation (NSF) to develop a reconfigurable hardware accelerator chip and system for deep learning and artificial intelligence. The project includes the design of inference-engine chips that are interconnected through PCI Express to build a scalable system supporting large neural models. Three of my other research projects were also sponsored by the NSF. One of these projects was on video streaming (including networking and communication aspects) while another was on the design of a multimedia system, specifically an automated video surveillance system for automatic detection of threats, utilizing wireless communication and cross-layer optimization. Another NSF-sponsored project was on reconfigurable high-performance cluster computing and medical engineering applications. Other research projects were sponsored by Silicon Mechanics and Sun Microsystems. These projects include "High Performance Computing Cluster" and "Sun's Center of Excellence in Open Source Computing and Applications". I am the named inventor on U.S. Patent No. 9,313,463 related to the design of automated video surveillance systems. Other research projects I have been working on are the design of deep-learning systems and chips for seizure prediction and the design of hardware accelerators in the time domain. I served as the Chair of the Interest Group on

Media Streaming of the Institute of Electrical and Electronics Engineering (IEEE) Multimedia Communication Technical Committee and as the Co-Director of the IEEE Multimedia Communication Technical Committee Review Board. I also served as an Associate Editor of the IEEE Transactions on Circuits and Systems for Video Technology. I served as a Guest Editor and Reviewer for prestigious journals and magazines. I have been involved in the organization of numerous international conferences in various capacities, including General Chair, Chair, Technical Program Committee Co-Chair, Publicity Chair, Track Chair, Session Chair, and Technical Program Committee Member. For example, I served as Co-Chair of the Technical Program Committee of ACM SIGMM Workshop on Network and Operating Systems Support for Digital Audio and Video (NOSSDAV) in 2018. I participated as a Panelist in major international conferences.

12. I served as the Chair of the Interest Group on Media Streaming of the Institute of Electrical and Electronics Engineering (IEEE) Multimedia Communication Technical Committee and as the Co-Director of the IEEE Multimedia Communication Technical Committee Review Board. I also served as an Associate Editor of the IEEE Transactions on Circuits and Systems for Video Technology. I served as a Guest Editor and Reviewer for prestigious journals and magazines. I have been involved in the organization of numerous

international conferences in various capacities, including General Chair, Chair, Technical Program Committee Co-Chair, Publicity Chair, Track Chair, Session Chair, and Technical Program Committee Member. For example, I served as Co-Chair of the Technical Program Committee of ACM SIGMM Workshop on Network and Operating Systems Support for Digital Audio and Video (NOSSDAV) in 2018. I participated as a Panelist in major international conferences.

13. I have been extensively involved in internal and international educational reform, review, and accreditation activities. I also served as an external expert in reforming computer science and computer engineering programs and courses. I served as the chair of more than 30 international panels for the review and accreditation of institutions and undergraduate and graduate programs, including "electrical engineering", "electrical and computer engineering", "software engineering", "computer and network engineering", "computer science", and "information technology". I am also a Program Evaluator for ABET Accreditation Board for Engineering and Technology.
14. I received the IEEE SEM Outstanding Professional of the Year Award, the Wayne State University President's Award for Excellence in Teaching, and the College of Engineering Excellence in Teaching Award. I was elevated to a Senior Member of the Institute of Electrical and Electronics Engineers

(IEEE) in 2016.

15. I was inducted into the WSU Academy of Teachers in 2022 for having “a significant impact on the WSU undergraduate learning experience”, practicing “innovative pedagogy”, and demonstrating “instructional excellence”.
16. In the past four years, I have testified twice at trial, including in the matter of ACQIS LLC v. ASUSTeK Computer Inc., et al., and four times at deposition. The ACQIS LLC v. ASUSTeK Computer Inc., et al. case involved computer systems design, interfacing with peripherals, signaling, and communication protocols. The analyzed I/O interconnects included those with low voltage differential signaling (such as PCI Express and USB 3.x) as well as those with other interconnects utilizing single-sided signaling with relatively higher voltage levels (such as PCI).
17. My time is billed at a rate of \$500 per hour in this proceeding. The compensation received from this case is not contingent upon my opinions or performance, the outcome, or any issues involved in or related to the proceeding.

III. My Understanding of Legal Principles

18. I understand that the Petitioner must demonstrate by a preponderance of the evidence that the challenged claims are unpatentable. I understand that the

preponderance of the evidence standard is one characterized as being more likely than not. As each claim is considered a separate invention, I understand that the Petitioner's burden is applicable individually to each claim.

19. I further understand that determining whether a patent claim is unpatentable requires two steps: first, construction of the meaning and scope of the claim (or individual terms of the claim), and second, comparing the properly construed claim to the prior art. A party may assert unpatentability on the basis of anticipation or obviousness.
20. I understand that my analysis requires an understanding of the scope of the '866 patent claims and that the disclosures of the '866 patent and the prior art are judged from the perspective of a person of ordinary skill in the art at the time of the purported invention. For the purposes of this declaration, I have been instructed to consider the time of the purported invention of the '866 patent to be October 28, 2011, the earliest possible priority date for the '866 patent.
21. I understand that during an *inter partes* review, claims of an unexpired patent are to be construed according to their ordinary and customary meaning as would be understood by a person of ordinary skill in the relevant art within the context of the patent record. Unless otherwise noted, I have given the

claim terms their plain and ordinary meaning as understood by a person of ordinary skill in the art at the time of purported invention.

22. I understand that a patent applicant ordinarily claims the structures of its invention directly by reciting such structure in the claims. I understand also that a patent applicant may claim subject matter “as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof.” 35 U.S.C. § 112(f). If a patentee chooses to do so, I understand that the scope of the claim is restricted “to only the structure, materials, or acts described in the specification as corresponding to the claimed function and equivalents thereof.”¹ I understand that the absence of the word “means” in a claim creates a rebuttable presumption that Section 112(f) does not apply.² I also understand, however, that “the presumption can be overcome . . . if the challenger demonstrates that the claim term fails to recite sufficiently definite structure or else recites function without reciting sufficient structure for performing that function.”³
23. I understand that a claim is unpatentable if it is anticipated or obvious. I understand that anticipation of a claim requires that every element of a claim

¹ *Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1347 (Fed. Cir. 2015)

² *Id.* at 1348.

³ *Id.* at 1349 (internal quotations omitted).

is expressly or inherently disclosed in a single prior art reference. I understand that an anticipating reference need not use the exact terms of the claims, but must describe the patented subject matter with sufficient clarity and detail to establish that the claimed subject matter existed in the prior art and that such existence would be recognized by persons of ordinary skill in the field of the purported invention. I also understand that an anticipating reference must enable one of ordinary skill in the art to reduce the purported invention to practice without undue experimentation.

24. I understand that a patent claim is unpatentable if the claimed invention would have been obvious to a person of ordinary skill in the art at the time of the purported invention. This means that even if all of the requirements of the claim cannot be found in a single prior art reference that would anticipate the claim, the claim can still be unpatentable.
25. I understand that an obviousness analysis involves comparing a claim to the prior art to determine whether the claimed invention would have been obvious to a person of ordinary skill in the art at the time of the purported invention in view of the prior art and in light of the general knowledge in the art as a whole. I also understand that obviousness is ultimately a legal conclusion based on underlying facts of four general types, all of which must be considered: (1) the scope and content of the prior art; (2) the level of ordinary skill in the art;

- (3) the differences between the claimed invention and the prior art; and (4) any objective indicia of non-obviousness.
26. I also understand that obviousness may be established by combining or modifying the teachings of the prior art. Specific teachings, suggestions, or motivations to combine any first prior art reference with a second prior art reference can be explicit or implicit, but if relied upon must have existed before the date of purported invention. I understand that prior art references themselves may be one source of a specific teaching or suggestion to combine features of the prior art, but that such suggestions or motivations to combine art may come from the knowledge of a person of ordinary skill in the art. Specifically, a rationale to combine the teachings of references may include logic or common sense available to a person of ordinary skill in the art.
27. I understand that a reference may be relied upon for all that it teaches, including uses beyond its primary purpose. I understand that though a reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, the mere disclosure of alternative designs does not teach away.
28. I further understand that whether there is a reasonable expectation of success from combining references in a particular way is also relevant to the analysis.

I understand there may be a number of rationales that may support a conclusion of obviousness, including:

- Combining prior art elements according to known methods to yield predictable results;
- Substitution of one known element for another to obtain predictable results;
- Use of a known technique to improve similar devices (methods, or products) in the same way;
- Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results;
- “Obvious to try”—choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;
- Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art; and
- Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art teachings to arrive at the claimed invention.

29. I understand that it is not proper to use hindsight to combine references or elements of references to reconstruct the invention using the claims as a guide. My analysis of the prior art is made from the perspective of a person of ordinary skill in the art at the time of the purported invention.
30. I understand that so-called objective indicia may be relevant to the determination of whether a claim is obvious should such evidence be alleged. Such objective indicia can include evidence of commercial success caused by an invention, evidence of a long-felt need that was solved by an invention, evidence that others copied an invention, skepticism or disbelief by those skilled in the art, failure of others, praise of the invention, evidence that an invention achieved a surprising result, or near simultaneous invention by multiple parties. I understand that most of such evidence must have a nexus, or causal relationship to the elements of a claim, in order to be relevant to the obviousness or non-obviousness of the claim. I am unaware of any such objective considerations of non-obviousness having a nexus to the claims at issue in this proceeding.
31. I understand that for a reference to be used to show that a claim is obvious, the reference must be analogous art to the claimed invention. I understand that a reference is analogous to the claimed invention if the reference is from the same field of endeavor as the claimed invention, even if it addresses a different

problem, or if the reference is reasonably pertinent to the problem faced by the inventor, even if it is not in the same field of endeavor as the claimed invention. I understand that a reference is reasonably pertinent based on the problem faced by the inventor as reflected in the specification, either explicitly or implicitly.

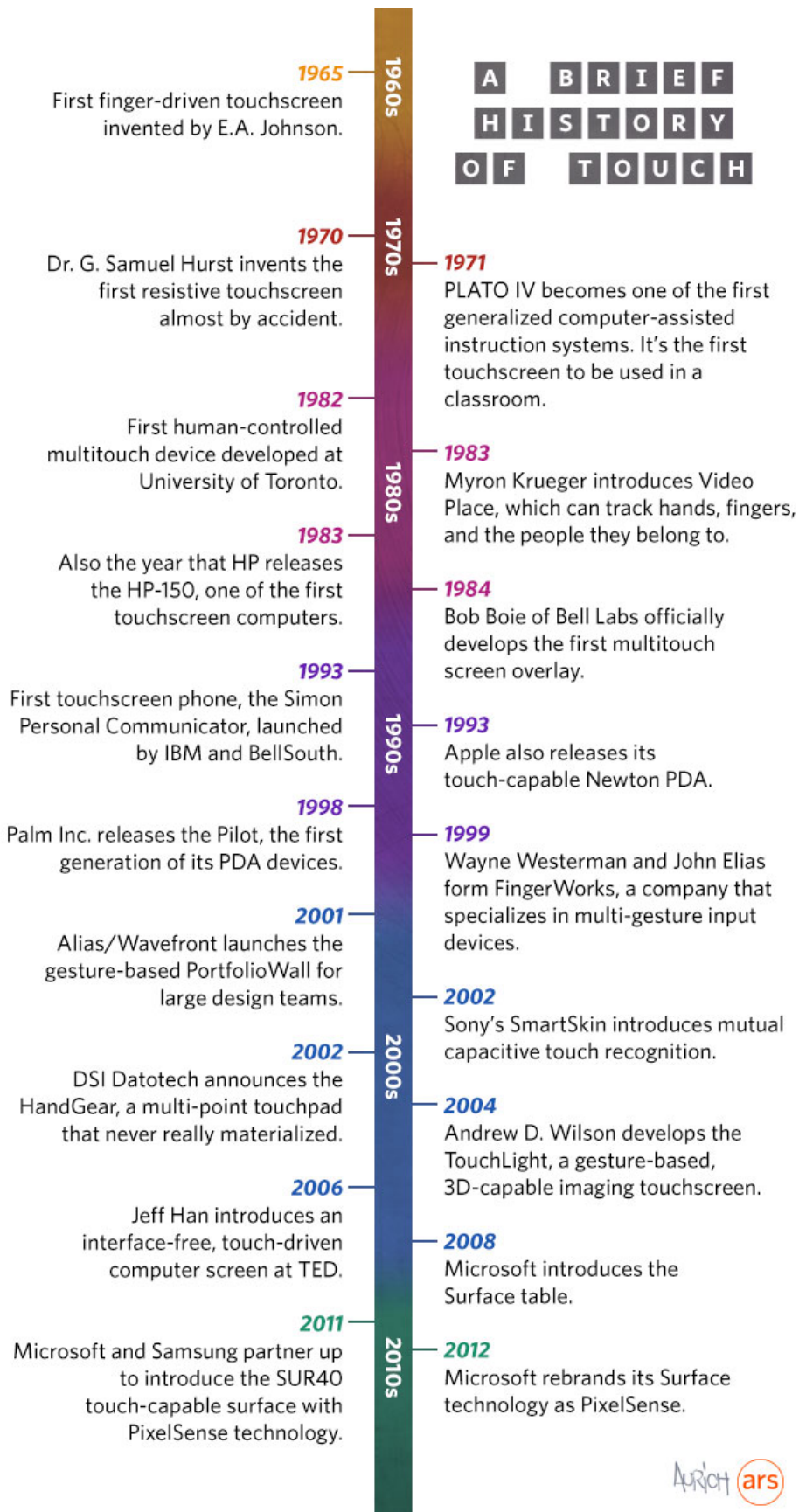
IV. Overview of the '866 Patent

A. Brief Background of Prior Art

32. The '866 Patent describes a purported invention in the field of styluses used with a touch-sensitive device, such as a tablet or a computer screen. These styluses communicate with the touch sensitive device via the touchscreen's electrostatic field.
33. Styluses have been known and used for decades. For example, the "Palm Pilot" product launched nearly three decades ago, in 1996, included a stylus to use with its handheld computing device.
34. Styluses can generally be classified into two types: (1) "passive" styluses, which lack a power source and rely upon contact with the touchscreen for communication, perhaps with the aid of a conductive surface that absorbs some of the touchscreen's electrostatic field using capacitive techniques, and (2) "active" styluses that typically have a power source and use internal electronics to generate electrostatic signals to communicate with the

touchscreen. Active and passive styluses may both use different techniques to communicate with a coupled device, which may include capacitive and/or inductive techniques.

35. Both active and passive styluses have been known for decades. For example, Partow (Ex. 1007) a patent issued in 2002 and filed for in 1999, described an active stylus using a “high-voltage, sinusoidal” signal for communication with a “portable computer.” Ex. 1007 at Abstract, Title.
36. Active and passive styluses can be used with touchscreen devices, such as tablet computers. Touchscreen technology has likewise been known for decades, as illustrated in the below timeline illustrating the development and commercialization of touch technologies, including resistive touchscreens and capacitive touchscreens.



Ex. 1018 (available at <https://arstechnica.com/gadgets/2013/04/from-touch-displays-to-the-surface-a-brief-history-of-touchscreen-technology/>)

B. Disclosure of the '866 Patent

37. The '866 patent is titled "Active Stylus With High Voltage," and it is directed to techniques for transmitting signals wirelessly to a device through a touch sensor of the device, including at least some high-voltage signals. '866 patent, abstract.
38. The '866 patent describes that one or more components of an active stylus may be capable of producing "substantially high voltage," which is defined as "a relatively large potential difference compared to voltages used by an active stylus in normal operation..." '866 patent, 11:43-49. The one or more components may be a transformer or a charge pump. *Id.* For example, voltages used in normal operation may be approximately 1-3 volts, whereas the high voltage may be approximately 10-20 volts. '866 patent, 11:49-54. The high voltage generated at the stylus may be used to power one or more electrodes to transmit signals to a touch-sensitive device. '866 patent, 11:54-61.
39. In an example embodiment, the stylus 20 of the '866 patent is near a touch-sensitive display 54 of a touch-sensitive device 52, and the tip 26 is located a distance D1 away from the touch-sensitive display 54. '866 patent, 11:66-12:2. One or more electrodes in the tip 26 of the stylus 20 receive the high voltage and output high-voltage signals that can be sensed at the touch-

sensitive device 52. '866 patent, 12:3-13. The high-voltage signals transmitted by the stylus of the '866 patent can be used to communicate information about the type of contact, such as for differentiating the stylus from another object (e.g., a user's finger). '866 patent, 12:30-36.

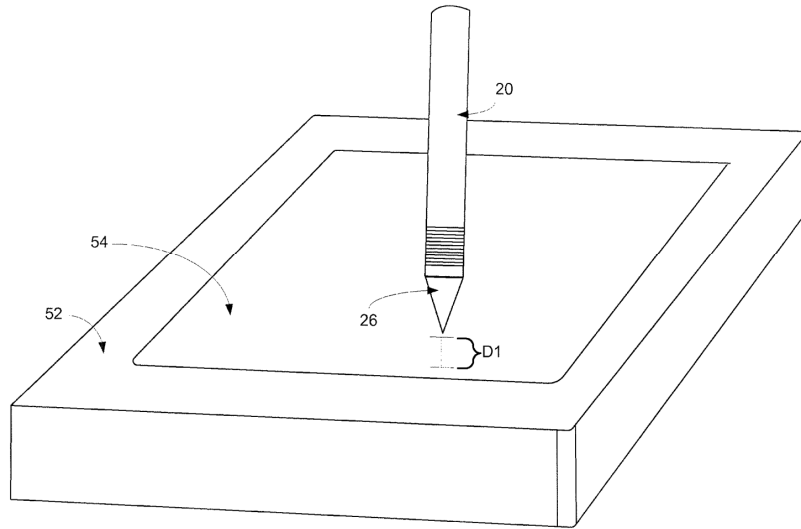


FIG. 6A of '866 Patent (Ex. 1001)

V. Challenged Claims

40. I have listed the challenged claims below, with numbers and letters identifying each element of the claims that are used for clarity throughout the report.

Claim 1

1[pre] – “A stylus comprising:”

1[a] – “one or more electrodes;”

1[b] – “one or more computer-readable non-transitory storage media embodying logic for transmitting signals wirelessly to a device through a

touch sensor of the device, at least some of the signals comprising high-voltage signals associated with a high voltage comprising a relatively large potential difference compared to a voltage within a voltage range of approximately 1 to approximately 3 volts;”

1[c] – “a component operable to convert the voltage of approximately 1 to 3 volts to the high voltage; and”

1[d]– “a stylus tip, one or more of the one or more electrodes being disposed at the stylus tip;”

1[e] – “wherein the high-voltage signals result from the one or more electrodes receiving the high voltage.”

Claim 2

“The stylus of claim 1, wherein the component is a transformer.”

Claim 3

“The stylus of claim 1, wherein the high voltage comprises a voltage within the voltage range of approximately 10 to approximately 20 volts.”

Claim 4

“The stylus of claim 1, wherein the high-voltage signals identify a location of the stylus relative to the touch sensor of the device.”

Claim 5

“The stylus of claim 1, wherein, when the stylus is in contact with or in the

proximity of the touch sensor of the device, the high-voltage signals are used to simulate or distinguish:

contact by an object other than the stylus with the device; or
a presence of the object near the touch sensor of the device.”

Claim 6

“The stylus of claim 5, wherein the object is least a part of a human hand.”

Claim 7

“The stylus of claim 5, wherein the high-voltage signals are based on a voltage used by at least a portion of the touch sensor of the device.”

Claim 15

15[pre] – “One or more non-transitory computer-readable storage media embodying logic that is operable when executed to:”

15[a] – “transmit electromagnetic signals from a stylus to a device through a touch sensor of the device, at least some of the electromagnetic signals comprising high-voltage signals associated with a high voltage comprising a relatively large potential difference compared to a voltage within a voltage range of approximately 1 to approximately 3 volts, the stylus comprising:”

15[a1] – “one or more electrodes for wirelessly transmitting the signals to the device;”

15[a2] – “a component operable to convert the voltage of approximately 1 to

3 volts to the high voltage; and”

15[a3] – “a stylus tip, one or more of the one or more electrodes being disposed at the stylus tip;”

15[a4] – “wherein the high-voltage signals result from the one or more electrodes receiving the high voltage.”

Claim 16

“The media of claim 15, wherein the component is a transformer.”

VI. Level of Ordinary Skill in the Art

41. I understand that several factors are relevant to determining the level of ordinary skill in the art at the time of the claimed invention. I understand that those factors include: (1) the educational level of the inventor(s); (2) type of problems encountered in the art; (3) prior art solutions to those problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) educational level of active workers in the field.
42. The art of the '866 patent relates to active styluses that may communicate with devices including touch sensors.
43. The inventors of the '866 patent are Shahrooz Shahparnia, Kishore Sundara-Rajan, Yassar Ali, and Izhar Bentov. At least some of the inventors have

advanced degrees (e.g., master's degrees or higher) in electrical or computer engineering disciplines, including Mr. Shahparnia⁴ and Mr. Sundara-Rajan⁵.

44. The types of problems encountered in the art include providing styluses with various functionalities that are easily and conveniently enabled by a user, providing reliable communication between a stylus and a device, and providing styluses that are easy to use.
45. Innovations are made incrementally because stylus-type input devices are not new, and various ways of designing and using a stylus are known in the art. The sophistication of styluses can vary, from simple passive styluses to more sophisticated active styluses, which may have various functionalities and sophisticated electronic and/or computerized components.
46. Besides the inventors of the '866 patent, I am familiar with others who work in the relevant field, including inventors of patents in the same field of endeavor. Based on my familiarity, I am aware that workers in the field

⁴ Ex. 1008 (available for download at <https://www.linkedin.com/in/shahrooz-shahparnia-6596183/>)

⁵ Ex. 1009 (available for download at <https://www.linkedin.com/in/ksrajan/>)

commonly have a degree in electrical or computer engineering⁶, or the like, which may also include computer science⁷.

47. After considering the factors mentioned above, and based on the disclosure of the '866 patent, a person of ordinary skill in the art at the relevant time would have had at least a four-year bachelor's degree in computer engineering, electrical engineering, or similar, and at least two years of experience working with computing systems and their interaction/communication with other devices, or an advanced degree in computer engineering, electrical engineering, or the like.

VII. Summary of the Prosecution History

48. The patent application that issued as the '866 patent was filed on October 17, 2014 as a continuation of U.S. Patent Application No. 13/362,830 (issued as U.S. Patent No. 8,866,767), filed on January 31, 2012. Ex. 1001, p. 1. The '866 patent claims priority to U.S. Provisional Application No. 61/553,114, filed on October 28, 2011. *Id.* A preliminary amendment was filed with the application, which cancelled original claims 1-20 and substituted new claims 21-40. Ex. 1002, pp. 244-251.

⁶ Ex. 1011 (available for download at <https://www.linkedin.com/in/westerma/>)

⁷ Ex. 1010 (available for download at <https://www.linkedin.com/in/hrvojebenko/>)

49. In a first office action, all claims were rejected. Ex. 1002, pp. 200-206. Independent claims 21, 28, and 35 (corresponding to issued claims 1, 8, and 15) were rejected under 35 U.S.C. § 112 as indefinite because the recitation of “a relatively large potential difference compared to a voltage within a range of approximately 1 to approximately 3 volts” was found to be vague, and because “approximately 1 to approximately 3 volts” was found to be unclear. *Id.* Additionally, claims 21, 23-28, 30-35, and 37-40 were rejected as obvious over U.S. Patent Publication No. 20120327041 to Harley et al. (“Harley”) and U.S. Patent No. 5,657,053 to Files et al. (“Files”), and claims 22, 29, and 36 were rejected as obvious over Harley, Files, and U.S. Patent Publication No. 20100315384 to Hargreaves et al. *Id.*
50. In a second office action, the previous Section 112 rejections were withdrawn. Ex. 1002, pp. 171-177. The second office action again asserted Section 103 rejections over Harley and Files, and over Harley, Files, and Hargreaves. *Id.* In renewing the Section 103 rejections, the second office action rejected an argument by the applicant that Harley combined with Files did not establish obviousness of features related to transmitting *electromagnetic* signals. Ex. 1002, pp. 184-194.
51. In a third office action, the examiner rejected amended claims under both Sections 112 and 103. Ex. 1002, pp. 142-148. The Section 112 rejections

related to enablement of a claim limitation regarding “high-voltage signals generated at least in part by a high voltage.” *Id.* The Section 103 rejections were as to obviousness of claims 21, 23-28, 30-35, and 37-40 over Harley and U.S. Patent Publication No. 20140049478 to Brunet et al., and obviousness of claims 22, 29, and 36 over Harley, Brunet, and Hargreaves. *Id.* The applicant attempted to overcome the Section 112 and 103 rejections without claim amendments. Ex. 1002, pp. 126-138.

52. In a fourth office action, the examiner withdrew the enablement rejections. Ex. 1002, pp. 114-121. Additionally, the examiner asserted new Section 112 rejections of claims 21-40 because the examiner argued that “[i]t is not clear how a signal can be created by a high voltage” – in other words, the signal itself cannot be ***created by*** a high voltage. *Id.* Additionally, the examiner rejected claims 21, 23-27, 35, and 38 as obvious over Harley and Brunet, and the examiner rejected claims 22 and 36 as obvious over Harley, Brunet, and Hargreaves. *Id.* The examiner found claims 37, 39, and 40 to be allowable, if rewritten in independent form and amended to overcome the Section 112 rejections. *Id.*
53. In a fifth office action, the examiner asserted similar Section 112 rejections to those stated in the fourth office action. Ex. 1002, pp. 76-83. Additionally, the examiner rejected claims 21, 23-27, 35, and 38 as obvious over Harley and

Brunet, and the examiner rejected claims 22 and 36 as obvious over Harley, Brunet, and Hargreaves. *Id.* The examiner found claims 37, 39, and 40 to be allowable, if rewritten in independent form and amended to overcome the Section 112 rejections, and the examiner found claims 28-34 to be allowable, if amended to overcome the Section 112 rejections. *Id.*

54. For reasons that are not clear in the record, a sixth office action was issued, even though apparently no response to the fifth office action had apparently been submitted. Ex. 1002, pp. 68-71. This office action restated the Section 112 rejections and found that claims 21-40 would be allowable if amended to overcome the Section 112 rejections. *Id.* After amending the claims to address the Section 112 rejections, the claims were allowed in a Notice of Allowance dated November 20, 2017 and a corrected Notice of Allowance dated November 29, 2017. Ex. 1002, pp. 37-38, 43-47, & 57-65.

VIII. Claim Construction

55. I understand that during an *inter partes* review, claims of an unexpired patent are to be construed according to their ordinary and customary meaning as would be understood by a person of ordinary skill in the relevant art within the context of the patent record.

§112(f) Means Plus Function – “component operable to convert the voltage”

56. It is my understanding that when a term is defined by its function, rather than

by recited structure, material, or acts, then that term is a means plus function term. A key inquiry is whether a person of ordinary skill in the art would understand the term to have sufficiently definite meaning as the name for a known structure, materials, or acts, or a known category of structures, materials, or acts.

57. In the present case, claim 1 recites “a component operable to convert the voltage of approximately 1 to 3 volts to the high voltage.” It is my opinion that a person of ordinary skill in the art would not understand this feature as the name for structure, materials, or acts, or a known category of structures, materials, or acts. It is my understanding that this claim term would be interpreted as a means-plus-function term, which covers the structure, material, or acts and any equivalents thereof which the patent’s specification describes as corresponding to the functions recited in the claims.
58. The term “component” is a non-structural generic placeholder, and the limitation recited in claim 1 specifies that the “component” serves the function of converting a voltage of approximately 1 to 3 volts to a high voltage. Turning to the specification of the ’866 patent, the corresponding structure that serves this function is described as “a transformer or charge pump...” Ex. 1001, 11:43-54. Accordingly, a person of ordinary skill in the art would understand that the “component” of claim 1 is a means-plus-function

limitation, with the corresponding structure being a transformer or a charge pump.

Plain and Ordinary Meaning

59. It is my opinion that all other terms in the '866 patent claims would have been provided their plain and ordinary meaning as would have been understood by a person of ordinary skill in the art in light of the '866 patent specification.

IX. Teachings of the Prior Art and Applied References

60. This analysis relies primarily on three pieces of prior art as shown in the table below. Each of the prior art references identified herein is from the field of stylus-type input devices and/or is reasonably pertinent to the particular problem with which the inventors were concerned.

Reference	Inventor	Publication Date
U.S. Patent Publication No. 20120105362 (Ex. 1005)	Viktor Kremin et al.	May 3, 2012 (priority date of October 28, 2010)
U.S. Patent No. 6,377,248 (Ex. 1007)	Tony S. Partow et al.	April 23, 2002
U.S. Patent Publication No. 20120050207 (Ex. 1006)	Jonathan Westhues et al.	March 1, 2012 (filed August 30, 2010)

61. Kremin and Westhues were not before the examiner during the prosecution of the '866 patent. While Partow is listed on the face of the '866 patent (Ex. 1001), the file history does not contain any substantive analysis of Partow

relative to the claims of the '866 patent, and Partow was not applied in any claim rejections in the application that issued as the '866 patent. *See* Ex. 1002.

A. U.S. Patent Publication No. 20120105362 to Kremin et al. (“Kremin”) (Ex. 1005)

62. Kremin is titled “Synchronizing a Stylus With a Capacitive Sense Array” and was filed on August 19, 2011, claiming priority to multiple provisional applications filed on October 28, 2010. Ex. 1005, p. 1. Kremin was published on May 3, 2012. *Id.*
63. The technology disclosed in Kremin relates to synchronizing a stylus to a capacitive sense array. Ex. 1005, ¶ [0048]. In an embodiment, a synchronization signal 899 is transmitted to a stylus 850, as illustrated in FIG. 8 below, and the stylus 850 generates a signal 898 based on the synchronization signal 899. *Id.* at ¶ [0083]. Synchronization between the host 805 and the stylus 850 enables communication between the stylus and the host. *Id.* at ¶ [0086]. The stylus 850 of Kremin includes a booster 870, which boosts a battery voltage delivered to the tip driver 890, allowing the tip driver 890 amplify a received signal to a higher voltage. *Id.* at ¶¶ [0081] & [0084]. A high-voltage signal allows the stylus 850 to be detected while hovering and allows for faster and more robust detection by the host. *Id.*

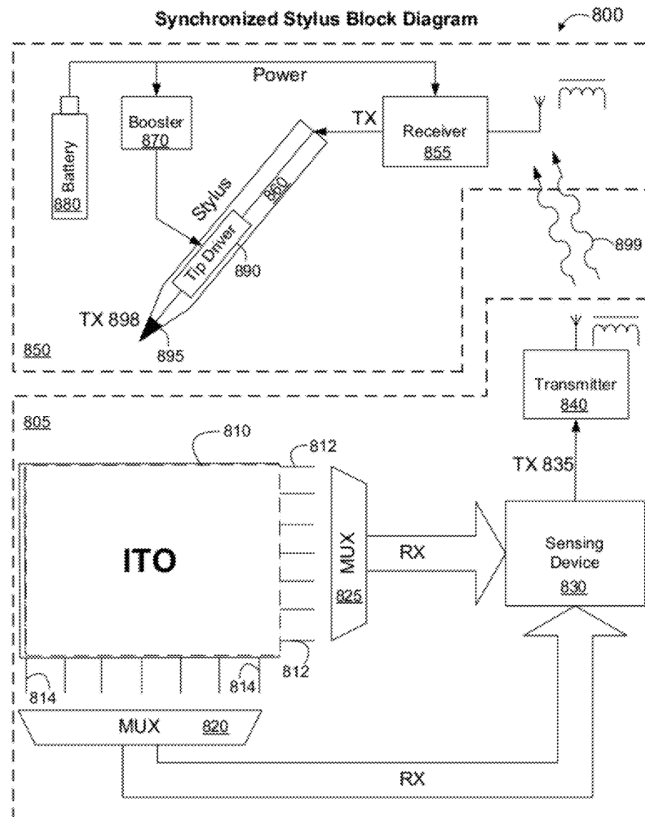


FIG. 8 of Kremin (Ex. 1005)

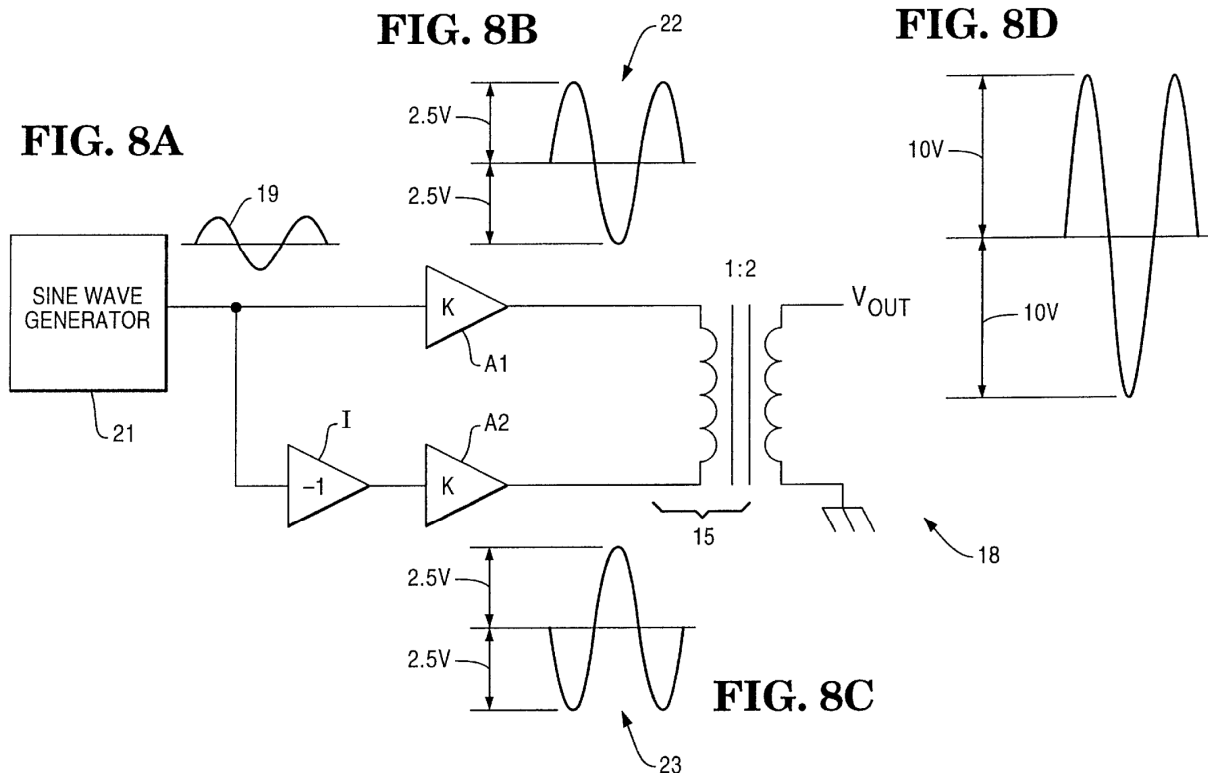
64. The technology disclosed in Kremin allows for multi-touch and simultaneous input signals, including simultaneous use of a stylus and touch object (e.g., a finger). Ex. 1005, ¶ [0003]. Kremin describes that high-voltage signals allow for, and distinguish between, simultaneous use of a stylus 330 and touch object 340. *Id.* at ¶¶ [0024], [0051], [0086]. Kremin further discloses how, for example, a stylus and palm contacting a device may both produce transmit signals but are distinguishable by relative strength of the stylus signal, as compared to the signal generated by a palm. *Id.* at ¶ [0102]. This encompasses distinguishing between the stylus and passive touch objects. *Id.* at ¶¶ [00102],

[00103]. Additionally or alternatively, Kremin describes that the stylus signal amplitude, frequency, phase, or the like may be the same as or similar to the signal utilized for finger sensing by the touch screen controller. *Id.* at ¶ [0076].

B. U.S. Patent No. 6,377,248 to Partow et al. (“Partow”) (Ex. 1007)

65. Partow is titled “High Voltage Stylus for Portable Computer” and was filed on September 30, 1999. Ex. 1007, p. 1. Partow issued as a patent on April 23, 2002. *Id.*
66. The technology disclosed in Partow relates to a stylus for use with a digitizing pad, which may comprise a transparent overlay on a display of a portable computer. Ex. 1007, 1:4-6. Partow describes as background that prior art styluses were configured to produce a signal that induces a current, which causes a voltage to be generated indicative of the size of the respective current. *Id.* at 1:12-17. Processing circuitry receives the voltage signals and computes the position of the stylus signal. *Id.* at 1:17-19. Partow describes that the signal generated by the stylus should be relatively large, so that the stylus signal can be differentiated from noise. *Id.* at 1:47-51. However, the size of the signal may be limited due to various constraints, such as the size of the stylus and available battery power. *Id.* at 1:52-57.
67. To generate the high-voltage signal, a first amplifier A1 receives a sine wave from a sine-wave generator and a second amplifier A2 receives an inverted

sine wave (i.e., the generated sine wave having been inverted by the inverter I). *Id.* at 2:51-58. The two amplifiers A1 and A2 feed the primary winding 15 of a transformer 18, each amplifier outputting a sine wave that is 5 volts peak-to-peak. *Id.* at 2:53-60. The transformer 18 outputs a wave that is 20 volts peak-to-peak. Partow, 2:60-62. The output of the transformer 18 is applied to the tip of the stylus. *Id.* at 3:28-29.



FIGS. 8A-8C of Partow (Ex. 1007)

C. U.S. Patent Publication No. 20120050207 to Westhues et al. ("Westhues") (Ex. 1006)

68. Westhues is titled "Localizing an Electrostatic Stylus Within a Capacitive Touch Sensor" and was filed on August 30, 2010. Ex. 1006, p. 1. Westhues

was published on March 1, 2012. *Id.*

69. The technology disclosed in Westhues relates to an active stylus configured to receive a signal from a matrix of a capacitive touch sensor to measure a first position of the stylus along a first axis, and to transmit a signal to the matrix of the capacitive touch sensor to indicate a second position of the stylus along a second axis. Ex. 1006, Abstract.
70. The stylus of Westhues includes an electrode 370 coupled to a transmit/receive switch 360, which is coupled to a current receiver 340 and a voltage transmitter 350. *Id.* at ¶ [0050]. The transmit/receive switch 360 enables multiplexing of the current in the current receiver 340 and the voltage in the voltage transmitter 350 onto the electrode 370 in the stylus 300. *Id.* at ¶ [0051]. The transmit/receive switch 360 can allow a high voltage (e.g., around 100 V) output to be applied to the electrode 370 in the transmit mode, and to receive a small current signal (e.g., around 1 uA) from the electrode 370 in the receive mode. *Id.*

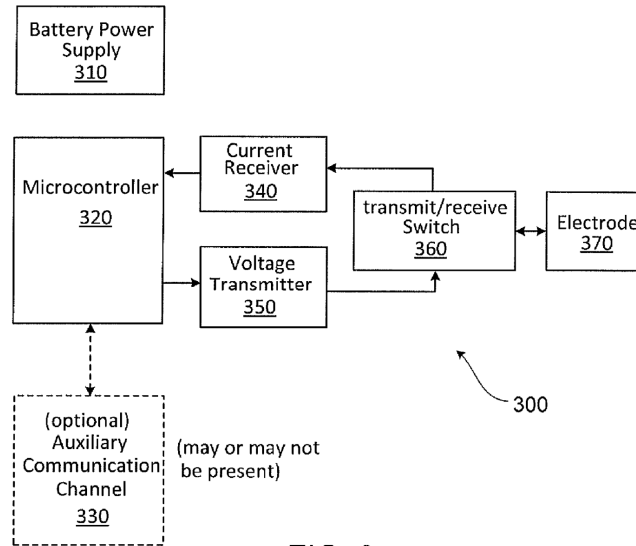


FIG. 3

FIG. 3 of Westhues (Ex. 1006)

71. FIG. 4 of Westhues illustrates an example circuit 400 for transmitting a large voltage and receiving a small current. *Id.* at ¶ [0055]. The illustrated transmit/receive circuit uses a battery voltage (e.g., which may be three volts) and generates a high voltage (e.g., which may be ~100 volts). *Id.* at ¶ [0056]. The high voltage is generated using the transformer L2 and applied to the node TP1, where the electrode of the stylus connects. *Id.* at ¶¶ [0055]-[0056].

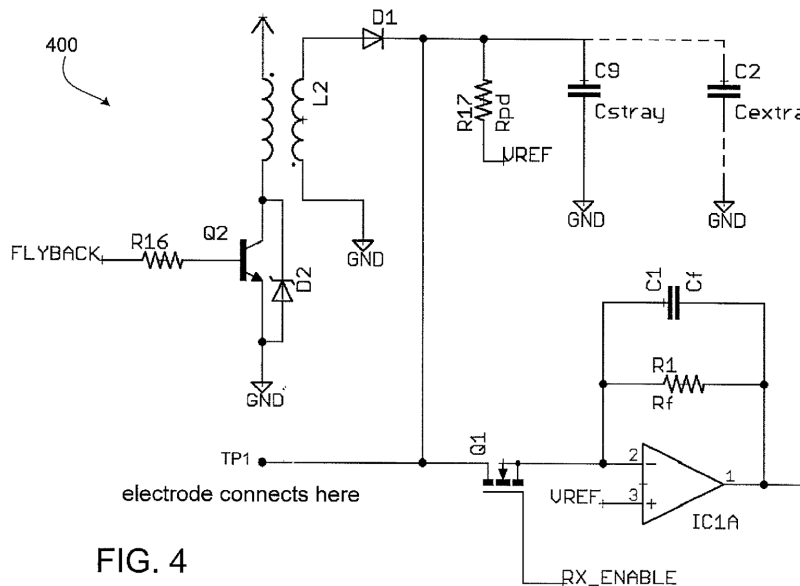


FIG. 4

FIG. 4 of Westhues (Ex. 1006)

D. Known Techniques in Stylus Technology

72. As of the earliest possible priority date of the '866 patent, a person of ordinary skill in the art would have been familiar with a wide variety of techniques and components for implementing a stylus for use with a touch-sensitive device. Simple, passive styluses were well known, which may use capacitive techniques, at least a portion of which includes a conductive surface that can absorb some of a touchscreen's electrostatic field, which registers as a touch at the touch-sensitive device. A person of ordinary skill in the art also would have been familiar with resistive touchscreens, which may detect a touch when pressure is applied to a first sheet causing the first sheet to come into contact with a second sheet. A person of ordinary skill would have known of simple styluses that could be used to apply pressure to a resistive touchscreen

as well.

73. Moreover, as of the earliest possible priority date of the '866 patent, a person of ordinary skill would have been familiar with active stylus technologies. Active styluses may have their own power sources, and may communicate richer information to a device, such as switch data, pressure data, orientation information, and so forth. A contemporaneous example is the HTC Scribe, which was a pressure-sensitive stylus that offered highlighting and erasing functionality using buttons, among other functionalities.⁸ Other examples include active styluses disclosed in the references discussed herein.

E. High Voltage

74. As of the earliest possible priority date for the '866 patent, a person of ordinary skill would have been familiar with high-voltage techniques in the context of styluses. For example, as discussed above, Partow was issued in 2002 and recognized the desirability of a stylus that generates a high-voltage signal, so that the signal can be differentiated from noise. Ex. 1007, 1:41-51.

Kremin (Ex. 1005)

⁸ Ex. 1012 (available at <https://web.archive.org/web/20110216170350/http://www.pcpro.co.uk/blogs/2011/02/15/htc-flyer-review-first-look/>; archived as of February 16, 2011); Ex. 1013 (available at <https://web.archive.org/web/20110521024609/https://www.techradar.com/news/mobile-computing/htc-scribe-will-change-the-way-you-use-tablets-955427>; archived as of May 21, 2011)

75. As discussed above, the stylus 850 of Kremin includes a booster 870, which boosts a battery voltage delivered to the tip driver 890, allowing the tip driver 890 amplify a received signal to a higher voltage. Ex. 1005, ¶¶ [0081] & [0084]. A high-voltage signal allows the stylus 850 to be detected while hovering and allows for faster and more robust detection by the host. *Id.*

Westhues (Ex. 1006)

76. As discussed above, the stylus of Westhues includes a circuit as illustrated in FIG. 4 of Westhues, which is used to transmit a high-voltage signal using a battery voltage. Ex. 1006, ¶¶ [0055]-[0056]. For example, the battery voltage may be approximately three volts, while the high voltage may be approximately 100 volts. *Id.* The high-voltage signals of Westhues are used in relation to localizing the stylus along a matrix of a capacitive touch sensor. *Id.* at Abstract.

U.S. Patent Publication No. 20100170726 to Yeh (“Yeh”)

77. Prior art reference Yeh also discusses high-voltage techniques related to styluses. Yeh is titled “Electronic Stylus, Capacitive Touchpad Module, and Apparatus for Touch Input” and was filed on January 4, 2010, claiming priority to a provisional application filed on January 6, 2009. Yeh was published on July 8, 2010.
78. Yeh discloses a stylus that emits an “excitation signal” (Srf of FIG. 5) to

change a charging/discharging waveform in a trace of a capacitive touchpad module, so that an effect similar to a “finger down” to the capacitive touchpad module is obtained. Yeh, ¶ [0043]. To generate the excitation signal Srf, a boost circuit 3204 boosts a battery voltage VD to provide a boosted voltage Vboost, which is fed to a quartz oscillator 3202. *Id.* at ¶ [0046]. The boosted voltage Vboost would be understood as a high voltage, relative to the battery voltage VD. A person of ordinary skill in the art would have known of such high-voltage techniques in relation to styluses, and a person of ordinary skill in the art would have known how to generate high-voltage signals to be transmitted by a stylus.

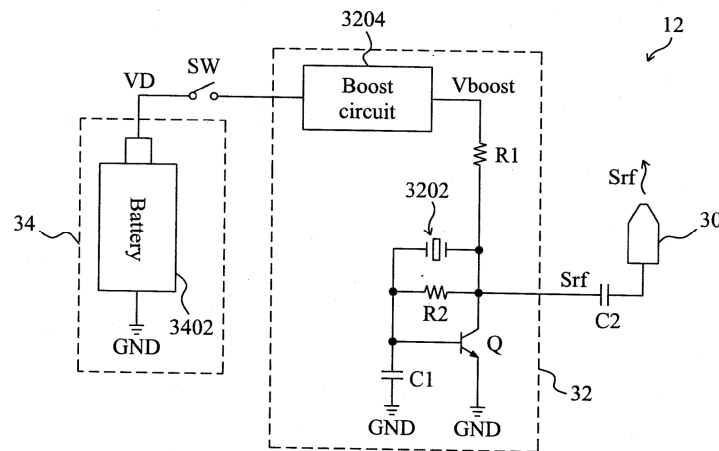


FIG. 5 of Yeh

U.S. Patent No. 8,766,954 to Vuppu et al. (“Vuppu”) (Ex. 1017)

79. Prior art reference Vuppu also discusses high-voltage techniques related to styluses, and specifically operations performed by a stylus in relation to a

signal received from a host device. Ex. 1017 at Abstract. Vuppu is titled “Active Stylus For Use With Touch-Sensitive Interfaces and Corresponding Method” and was filed on December 21, 2010. *Id.* at p. 1.

80. The stylus of Vuppu receives signals through a compound tip including electrodes, and an active circuit in the stylus detects an electric field variation emanating from a touch-sensitive surface. *Id.* at 3:3-41. The active circuit applies a gain to the detected field variations, which may include, for example, inverting a received signal, amplifying a received signal, non-inverting a received signal, or non-amplifying a received signal. *Id.* at 3:42-49. A person of ordinary skill in the art (POSITA) would appreciate that amplification, as in Vuppu, would be used to transmit a higher voltage signal. Additionally, Vuppu illustrates that it was known in the art to use a stylus to modify the voltage of a signal received from a host device, such as by performing amplification or inversion of the signal.

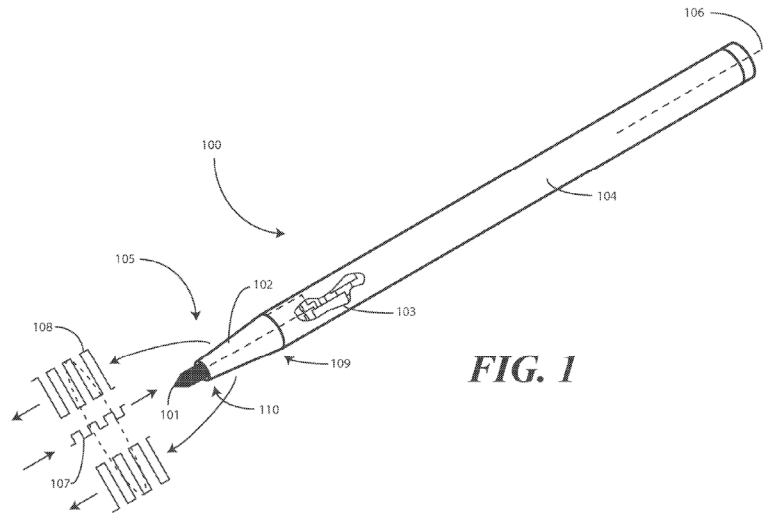


FIG. 1

FIG. 1 of Vuppu (Ex. 1017)

F. Motivations to Combine and Expectation of Success

81. While certain aspects of stylus technology, such as active stylus technology, may involve at least moderately sophisticated electrical and/or computerized technologies, a person of ordinary skill in the art nonetheless would be able to combine various features of stylus-type input devices with at least a reasonable expectation of success and to achieve predictable results. For example, a person of ordinary skill in the art would have known how to incorporate various components and features within an active stylus device, such as buttons/switches, various other kinds of sensors, computer-readable media, processing components, one or multiple electrodes or other means for wireless signal transmission, and so forth. Additionally, a person of ordinary skill in the art would have been able to apply various techniques for generating a high voltage, such as techniques using a transformer, including techniques

that are based on a voltage received from a host device. Moreover, in computer systems and computer devices, it is common for a POSITA to combine features that would result in better performance, efficiency, improved specifications, and/or better acceptance by customers. As discussed above, a person of ordinary skill in this art would have a relatively high level of knowledge and skill. For example, it is common for an inventor in this field to have at least a master's degree in computer engineering, electrical engineering, or the like, or a bachelor's degree with multiple years of experience. Accordingly, it would be well within the abilities of a person of ordinary skill in the art to combine known techniques in the art in various ways to achieve predictable results.

82. For example, a POSITA would be motivated to combine Kremin and Partow. As discussed my Appendix A, Kremin and Partow discuss similar technologies and solve similar problems related to using a stylus with a high voltage for interacting with touch screens. Partow in particular focuses primarily on how to generate a high voltage and how designs related to high-voltage features can be adapted for different situations. *See* Appx. A. A POSITA implementing a stylus as disclosed in Kremin would, thus, benefit from the detailed disclosure of Partow, and would be motivated to modify Kremin based on Partow for the obvious benefit of providing additional ways

to generate a high voltage in a stylus. *Id.*; *see also* Ex. 1007 (Partow) at 1:67-2:64.

83. Higher voltage has several advantages, including improved detection of the stylus by the touch-sensitive device, even while the stylus is not in direct physical contact with the device, better ability to differentiate the signal from noise, and allowing faster and more robust detection by the device. A POSITA would have been motivated to so modify the stylus of Kremin for the obvious benefit of more easily producing a boosted voltage. *See* Ex. 1007 (Partow) at 1:67-2:64.
84. In addition, Partow specifically discloses how the system can be modified as the circumstances require, including the factors contributing to the value of the output voltage. It contains an entire section titled “Important Considerations” that discusses several examples with different voltage levels. *See* Ex. 1007 (Partow) at 1:35-4, cols. 3-6. The analysis in Appendix A discusses example disclosures in Partow upon which a POSITA may rely when modifying the stylus of Kremin.
85. To provide another example, a POSITA would be motivated to combine Westhues and Kremin. Westhues and Kremin discuss similar technologies and solve similar problems related to using a stylus with a high voltage for interacting with touch screens, and both references discuss, for example,

determining the position of a stylus. While both references discuss high-voltage techniques, Westhues discusses an example high voltage of 100 volts (Ex. 1006, ¶ [0051]), whereas Kremin specifies an example high voltage of 10-20 volts while still implementing high-voltage features, such as hover detection (Kremin, ¶ [0084]). A POSITA implementing a stylus as disclosed in Westhues would, thus, benefit from the disclosure of Kremin, and would be motivated to modify Westhues based on Kremin for one or more obvious benefits, such as decreasing power consumption while still implementing high-voltage techniques. *See* Appx. B.

86. Reduced power consumption has the obvious benefit of increasing the battery life of the stylus. For example, while the high-voltage signal of Westhues may use a voltage of, e.g., 100 volts (Ex. 1006, ¶ [0051]), Kremin describes embodiments that can perform hover detection using a high-voltage signal with a voltage of, e.g., 10-20 volts (Ex. 1005, ¶ [0084]). A POSITA would appreciate that the 10-20 volt range used for the high-voltage signal of Kremin would have various advantages, such as decreased power consumption, while retaining the high-voltage features. A POSITA, thus, would benefit from the disclosure of Kremin and use the disclosed techniques in the stylus of Westhues. This task would have been routine and well within a POSITA's skill. The analysis in Appendix B discusses example disclosures in Kremin

upon which a POSITA may rely when modifying the stylus of Westhues.

X. First Ground for Invalidity: The Challenged Claims are anticipated by Kremin and/or obvious over Kremin in view of the knowledge of a person having ordinary skill in the art.

87. It is my opinion that all Challenged Claims are anticipated over Kremin or obvious over Kremin in view of the knowledge of a person having ordinary skill in the art. Appendix A is a claim chart detailing my invalidity analysis in relation to Kremin on both anticipation and obviousness grounds.

XI. Second Ground for Invalidity: The Challenged Claims are further obvious over Kremin in view of Partow.

88. It is my opinion that all Challenged Claims are further obvious over Kremin in view of Partow. Appendix A further details my invalidity analysis on obviousness grounds over Kremin as modified by Partow, including the rationale and motivation to combine Kremin and Partow.

XII. Third Ground for Invalidity: The Challenged Claims are anticipated by Westhues and/or obvious over Westhues in view of the knowledge of a person having ordinary skill in the art.

89. It is my opinion that all Challenged Claims are anticipated over Westhues or obvious over Westhues in view of the knowledge of a person having ordinary skill in the art. Appendix B is a claim chart detailing my invalidity analysis in relation to Westhues on both anticipation and obviousness grounds.

XIII. Fourth Ground for Invalidity: The Challenged Claims are further obvious over Westhues in view of Kremin.

90. It is my opinion that the Challenged Claims are further obvious over Westhues

in view of Kremin. Appendix B further details my invalidity analysis on obviousness grounds over Westhues as modified by Kremin, including the rationale and motivation to combine Westhues and Kremin.

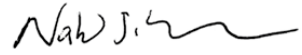
XIV. Conclusion

In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

91. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed this 29th day of August, 2025.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Nabil J. Sarhan", with a stylized flourish at the end.

Nabil J. Sarhan, Ph.D.

Appendix A

U.S. Patent No. 9,933,866 Invalidity Chart – Anticipation and obviousness over Kremin alone and in view of Partow

U.S. Patent Publication No. 20120105362 to Kremin et al. (“Kremin”) (Ex. 1005) (published May 3, 2012; priority date October 28, 2010) either expressly, implicitly, or inherently anticipates the challenged claims of U.S. Patent No. 9,933,866 (“’866 Patent”) (Ex. 1001) under 35 U.S.C. § 102 and/or renders those claims obvious under 35 U.S.C. § 103 in view of the knowledge of a person of ordinary skill in the art (“POSITA”). Alternatively, Kremin renders the challenged claims obvious further in view of U.S. Patent No. 6,377,248 to Partow et al. (“Partow”) (Ex. 1007) (issued April 23, 2002). The chart below sets forth my analysis regarding anticipation and obviousness of the challenged claims on each of these alternative bases.

Both Kremin and Partow describe similar technologies and solve similar problems. Both disclose a stylus employing high voltage for interacting with touch screens/sensors and disclose methods for determining the touch position. A POSITA would have been motivated to modify the technology of Kremin based on Partow for the obvious benefit of providing additional ways to generate a high voltage in styluses, Partow, 1:67– 2:64. One advantage of higher voltage is improved detection of the stylus by the touch-sensitive device, even while the stylus is not in direct physical contact with the device. *Id.* Other advantages of using a relatively higher voltage is that it helps to differentiate the signal from noise, and allows for faster and more robust detection by the device.

Kremin discloses a system and method for tracking a stylus on a capacitive sense array, the system comprising the capacitive sense array configured to detect a presence of the stylus, a processing device to generate a synchronization signal, and a transmitter to transmit the synchronization signal to the stylus to synchronize the stylus to the capacitive sense array. Kremin at ABSTRACT. Kremin also discloses that the “[t]he booster 870 boosts the battery voltage delivered to the tip driver 890, allowing the tip driver 890 to amplify the TX signal 835 to a higher voltage (e.g., 10-20V)”. Kremin ¶ [0084].

Similarly, Partow’s invention concerns a stylus for producing a high-voltage signal for an electrostatic digitizing pad, where the high voltage is obtained by applying a sine wave to one lead of the primary of a transformer, and applying the inverse of the sine wave to the other lead of the primary. The secondary of the transformer produces the high voltage, which is developed into a signal which is applied to the digitizing pad. Partow at ABSTRACT.

Accordingly, Partow focuses primarily on how to generate a high voltage and provides more detailed disclosure about this aspect and how the design can be changed to meet different situations. A POSITA would benefit from this detailed disclosure and its great flexibility and use it in the system disclosed by Kremin. This task would have been routine and well within the skills of a POSITA.

Claim 1

1[pre] A stylus comprising:

Example Disclosures in Prior Art

To the extent the preamble is limiting, Kremin discloses an electronic system 300 having a processing device 310 for detecting a presence of a touch object 340 and a stylus 330. Kremin ¶ [0051]. Kremin discloses a stylus. See, e.g., Kremin at Abstract (“A system and method for tracking a *stylus*...”) (emphasis added).

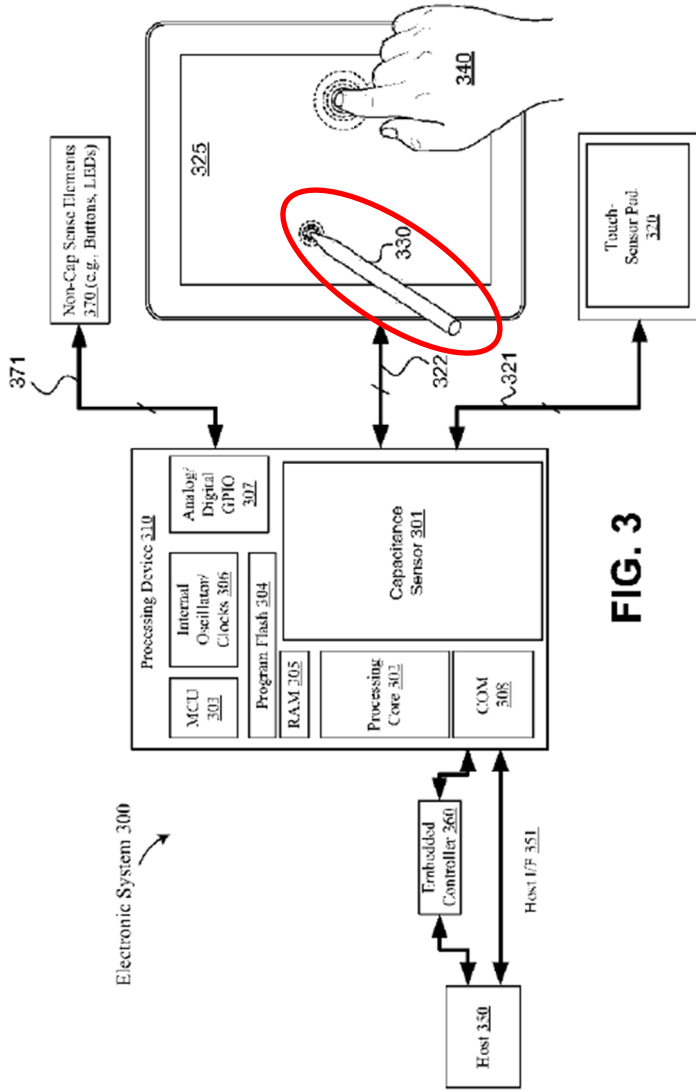


FIG. 3

FIG. 3 of Kremin

As another example, the component 850 of FIG. 8 of Kremin is a stylus synchronized to a host device 805. Ex. 1005, ¶ [0080].

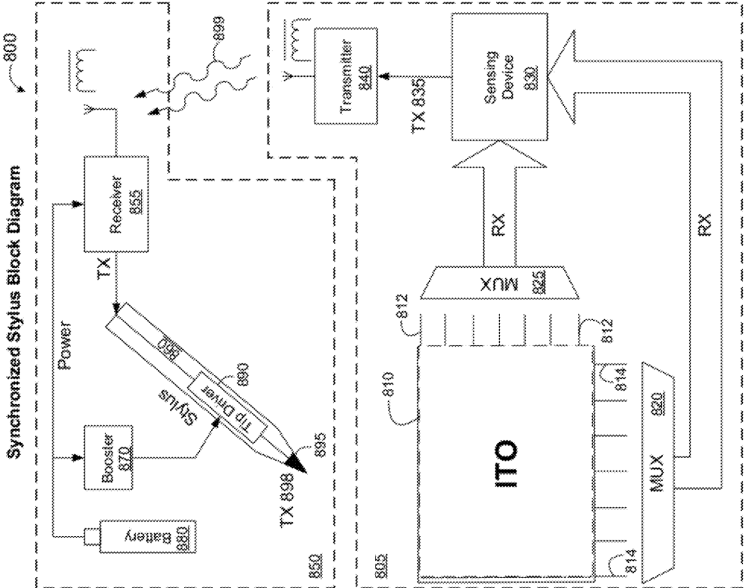
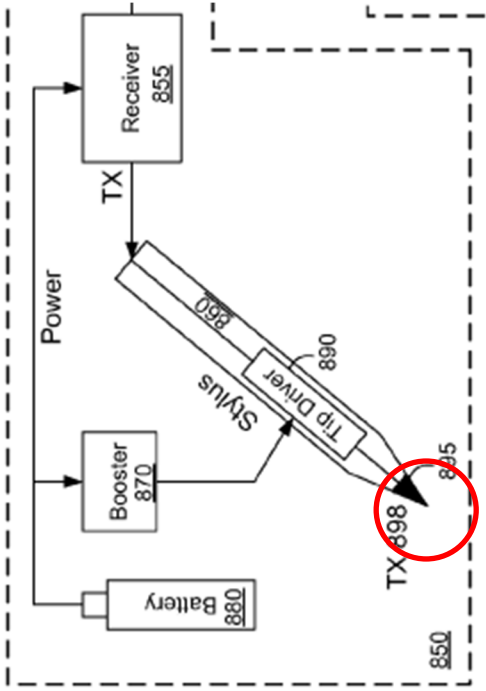


FIG. 8 of Kremin

1[a] one or more electrodes;

The stylus 850 of Kremin contains a stylus tip 895 by which the amplified stylus transmit signal is capacitively coupled to the capacitive sense array. Kremin Claim 6, ¶ [0085]. Capacitive coupling is a transfer of electric signals that inherently requires a pairing of electrodes¹. A POSITA would understand that the tip 895 must comprise an electrode, which was commonplace for styluses of this kind before the '866 patent. A POSITA would appreciate that an electrode could be understood as a conductor that establishes electrical contact with a nonmetallic component of a circuit². An electrode may serve as the conductive element that creates (or senses) changes in the electric field between two objects. For the disclosed active stylus to perform capacitive coupling, a POSITA would understand that the tip of the electrode must be conductive and must receive the (high voltage) signal of the stylus so that "capacitive" coupling with the touch screen can be achieved. A POSITA would know that an electrode is required, as it is the conventional way to provide this functionality. US Patent 8,928,635 B2 1:59-2:1 and WO 2012/033619 A2 at Abstract, 28:15-29:8, Fig. 11A, Claim 1, Claim 8, Claim 12, and Claim 14. Limitation 1[a] is, therefore, inherently disclosed in Kremin. Additionally, even if limitation 1[a] were not inherent in Kremin, it would be obvious to a POSITA to include an electrode based on the disclosure of Kremin and the knowledge of a POSITA, and no undue experimentation is required for a POSITA to know that an electrode would be needed, as it is the conventional way to provide this functionality. As of the earliest possible priority date for the '866 Patent, electrodes had been known for decades, and a POSITA would have known of and used one or more electrodes to perform the foregoing functions. Moreover, active styluses are known to have electrodes at the tip. See, e.g., US Patent 8,928,635 B2 at ABSTRACT, FIG. 3, 1:58-2:1, and Claim 15, U.S. Patent Publication No. 20120050207 ¶[0050], U.S. Patent No. 8,766,954 at 3:3-17, and WO 2012/033619 A2 at Abstract, 28:15-29:8, Fig. 11A, Claim 1, Claim 8, Claim 12, and Claim 14. As an example, active styluses that employ capacitive coupling act as a drive and/or a sense element in a capacitive touch system. US Patent 8,928,635 B2 1:58-59. Unlike conventional passive styluses which work passively by blocking electric field lines between the drive and sense electrodes of a capacitive touch sensor panel, these active styluses usually act either act as a drive electrode to create an electric field between the drive electrode and the sense lines of a mutual capacitive touch sensor panel, or as a sense electrode for sensing capacitively coupled signals from one or more stimulated drive rows and columns of the touch sensor panel or both. US Patent 8,928,635 B2 1:59-2:1. These active styluses can significantly improve stylus sensing on a mutual capacitive touch sensor panel without incurring significant additional cost. US Patent 8,928,635 B2 2:3-5.



Claim 1	Example Disclosures in Prior Art
	And in describing the position tracking system for the stylus, Kremin discloses that the row 660 and column 640 electrodes in the sense array are capacitively coupled to the stylus 680, detecting the charge coupled at the contact point 695 with the stylus—this is inherently only possible if there is electrode in the stylus, as well. Kremin ¶ [0073]. Accordingly, Kremin inherently discloses (and further renders obvious) limitation 1[a]. FIG. 6 of Kremin

¹ Capacitive coupling, also called electrostatic coupling, is “[t]he association of two or more circuits with one another by means of mutual capacitance between them”. See, *e.g.*, Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 96 (Ex. 1015).

² See *e.g.*, Merriam-Webster Dictionary: <https://www.merriam-webster.com/dictionary/electrode> (Ex. 1014). See, also, Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 239 (Ex. 1015) for the definition of an electrode.

Claim 1	Example Disclosures in Prior Art
1 b one or more computer-readable non-transitory storage media embodying logic for transmitting signals wirelessly to a device through a touch sensor of the device, at least some of the signals comprising high-voltage signals associated with a high voltage comprising a relatively large potential difference compared to a voltage within a voltage range of approximately 1 to approximately 3 volts;	Kremin discloses that embodiments of the systems and methods can be implemented using instructions stored on a computer-readable medium. Kremin ¶ [0140]. Additionally, Kremin discloses a stylus with a microcontroller block, including CPU. “FIG. 13 is a block diagram illustrating one embodiment of a stylus 1300 for synchronizing and modulating additional data into a stylus transmit signal 898. The stylus 1300 includes a receiver 855, microcontroller block 1305, voltage booster 870, battery 880, tip driver 890, actuator 893, stylus tip 895, voltage divider 1310, and force sensor 1360. In one embodiment, the microcontroller block 1305 includes ADC 1320, CPU core 1330, buttons 1340 and 1341, synchronization and modulation.” Kremin ¶ [0104] (emphasis added). “Embodiments of the present invention, described herein, include various operations. These operations may be performed by hardware components, software, firmware, or a combination thereof.” ¶[0139]. A POSITA would understand that a microcontroller will also include both volatile and nonvolatile memory to store the programs to be executed and associated data. A microcontroller can be defined as follows “[a] complete microprocessor system on a chip. Includes on-chip the CPU, local RAM , local ROM or EPROM , clock and control circuits, and serial and parallel IO ports that can be programmed for various control functions” ³³ (emphasis added).

³ Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 470 (Ex. 1015).

Claim 1	Example Disclosures in Prior Art
	The CPU also includes logic circuitry⁴ to execute programs and control the operation of the stylus, which includes processing input data from various sources (such as battery level, force, buttons, acceleration, etc.) and transferring this data wirelessly. Kremin also describes using various wireless techniques for transmitting signals from a stylus to a host device, such as optical, ultrasonic, inductive, or RF signal transmissions. Kremin, ¶ [0111]. “In an embodiment, the synch mod block 1350 is configured to modulate additional data into the TX signal 835. Some types of additional data that may be modulated into the stylus TX signal 835 include battery data, acceleration data, button data, force data, and other data as would be appreciated by one of ordinary skill in the art having the benefit of this disclosure.” Kremin ¶ [0105]. “In one embodiment, if no modulation of additional data is required on the stylus TX signal 898, the stylus 1300 operates similar to the stylus block 850 of FIG. 8. In particular, the receiver 855 wirelessly receives the TX signal 835, the synch mod block 1350 receives the TX signal 835 from the receiver 855, the tip driver 890 drives or amplifies the TX signal 835, and the stylus tip 895 capacitively couples the amplified stylus TX signal 898 to the sense array 810. In an embodiment, the synch modblock 1350 may be bypassed if no modulation of additional data in the stylus TX signal 898 is required” Kremin ¶ [0106]. “The CPU core 1330 processes the button input data and sends it to the synch mod block 1350. The synch modblock 1350 modulates the button data into the stylus TX signal 835. The tip driver 890, in conjunction with the voltage booster 870, amplifies the modulated stylus TX signal 835 and the stylus tip 895 capacitively couples the modulated stylus TX signal 898 to the sense array 810. In an embodiment, the synch modblock 1350 may modulate one or more other types of additional data into the stylus TX signal 835 in addition to the button data and/or battery data, such as the force data described below.” Kremin ¶ [0108]. “In an embodiment, force sensing is implemented in the stylus 1300. Force sensing provides additional data relating to the stylus tip 895 contact pressure on the sense array 810. The force sensor 1360 detects the force applied to the actuator 893. The measurer 1370 determines the amount of force (e.g., magnitude of force signal) applied to the tip 895. The CPU core 1330 processes the force signal and sends it to the synch modblock 1350. The synch modblock 1350 modulates the force data into the stylus TX signal 835. The tip driver 890, in conjunction with the voltage booster 870, amplifies the modulated stylus TX signal 835 and the stylus tip 895 capacitively couples the modulated stylus TX signal 898 to the sense array 810.” Kremin ¶[0109]. A POSITA reading this limitation would understand that “wirelessly” in the context of this claim means communicating that is not through a hardwired connection. In multiple embodiments, Kremin discloses that the stylus communicates with the touch device using capacitive coupling. Kremin ¶[0011], [0064], [0065], [0066], [0099], [0102], Claim 1, Claim 5, and Claim 16. A POSITA would understand that capacitive coupling would transmit signals without a wired connection (i.e., wirelessly). Kremin also discloses that “[t]he communication channel or link” between the stylus and the host “may be a RF link, Bluetooth link, an optical link, an infrared (IR) link, or other communication channels/links as would be appreciated by one of ordinary skill in the art having the benefit of this disclosure.” <i>Id.</i> ¶ [0093]. Kremin further discloses that “[t]he stylus 1300 may transmit the stylus TX signal 898 using one code, and may transmit the additional data using another code. In an embodiment, the stylus TX signal 898 and additional data may utilize the same frequency or different frequencies. In other embodiments, optical, ultrasonic, inductive, or RF signal transmissions may be utilized to transfer the additional data from the stylus 1300 to the sensing device 830. For example, additional data may be wirelessly coupled from the stylus 1300 to the sensing device 830. It should be noted that additional hardware, such as antennas and/or amplifiers, may be required to transmit the additional data to the sensing device 830. Such embodiments would be known by those of ordinary skill in the art with the benefit of this disclosure.” <i>Id.</i> ¶ [0111]. See also <i>Id.</i> ¶ [0012] and Fig. 2B describing a prior art system with RF communication between the stylus and the sense array.

⁴ “Central processing unit -Also called central processor; abbreviated CPU. 1. The part of a computer system that contains the main storage, arithmetic unit, and special register groups. Performs arithmetic operations, controls

Claim 1	Example Disclosures in Prior Art
	Additionally, Kremin discloses that “[a] high voltage stylus TX Signal 898 may enable the host device 805 to detect the stylus 850 when it is “hovering,” or in close proximity to the capacitive sense array 810, but not physically touching an overlay disposed over the capacitive sense array 810”. Kremin ¶ [0084]. Kremin also discloses that “[a] high voltage stylus TX signal 898 may also provide for faster and more robust detection by the sensing device 830”. Kremin ¶ [0084]. Besides, Kremin discloses that “[t]he higher stylus TX voltage couples more charge to the MC array 400 more quickly, thus reducing the amount of time required to sense each row and column of the sense array 400”. Kremin ¶ [0076]. These are additional examples of wireless transmission disclosed in Kremin. Moreover, Kremin discloses that the “[t]he booster 870 boosts the battery voltage delivered to the tip driver 890, allowing the tip driver 890 to amplify the TX signal 835 to a higher voltage (e.g., 10-20V)”. Kremin ¶ [0084]. The “high-voltage” signal of Kremin allows the stylus to be detected while “hovering” (i.e., without a wired connection and therefore “wirelessly”). <i>Id.</i> The untethered, or “wireless” active stylus 850 of Kremin contains a receiver, 855, a battery 880, a booster 870, a tip driver 890, and a stylus tip 895. Kremin ¶¶ [0079], [0081]. The stylus 850 generates a signal 898 based on a signal 835 received by the receiver 855 from the transmitter 840. <i>Id.</i> ¶ [0083]. The stylus 850 capacitively couples that signal 898 to the device via the stylus tip 895. <i>Id.</i> ¶ [0085]. Kremin further discloses that in one exemplary embodiment, the stylus TX signal 677 ranges from approximately 20-50V”. <i>Id.</i> ¶ [0076]. <i>See also</i> Kremin FIG. 13, FIG 16, ¶¶[0104], ¶[[0107], ¶[[0108], ¶[[0109], [0116] (disclosing a booster and/or high voltage tip driver). <i>See also</i> [0076], [0092]. <i>See also</i> [0085] (discussing “amplified signal”). While the term “high-voltage” is likely indefinite, the ’866 Patent specifically states that a voltage in the range of 10-20V would be “high-voltage.” <i>See</i> ’866 Patent at 11:51-54 & claim 3. To the extent these terms are not indefinite, Kremin discloses a “high-voltage signal” that has a “relatively large potential difference” from the range of 1-3 volts. The signal 835 may be amplified by the booster 870 to a higher voltage signal 898, for example up to 10 to 20 volts, which has a relatively large potential difference compared to a voltage within a voltage range of approximately 1 to 3 volts. <i>Id.</i> ¶ [0084]. The signal 898 is transmitted via the touch sensor stylus tip 895. <i>Id.</i> In some embodiments, the signal can be amplified to a voltage of 20 to 50 volts. <i>Id.</i> ¶ [0048]. The high voltage signal is then capacitively coupled with the sensing device through the tip 895. <i>Id.</i> ¶ [0085].

instruction processing, and provides timing signals and other housekeeping operations. 2. A group of registers and logic that form the **arithmetic/logic unit** plus another group of registers with associated **decoding logic** that form the control unit. Most MOS devices are single-chip CPUs, in that the registers hold as many bits as the word length of the unit. With bit-slice devices, however, central processing units of any bit width can be assembled essentially by connecting the bit-slice parts in parallel. Externally, a bit-slice device will appear to be a coherent single CPU capable of handling words of the desired bit length. 3. That part of a computer system that controls the interpretation and execution of instructions. In general, the CPU contains the following elements: **arithmetic and logic unit (ALU)**, timing and control, accumulator, scratch-pad memory, program counter and address stack, instruction register, and UO control logic. 4. That unit of a computing system that fetches, decodes, and executes programmed instructions and maintains the status of results as the program is executed.” (emphasis added) See Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 107 (Ex. 1015).

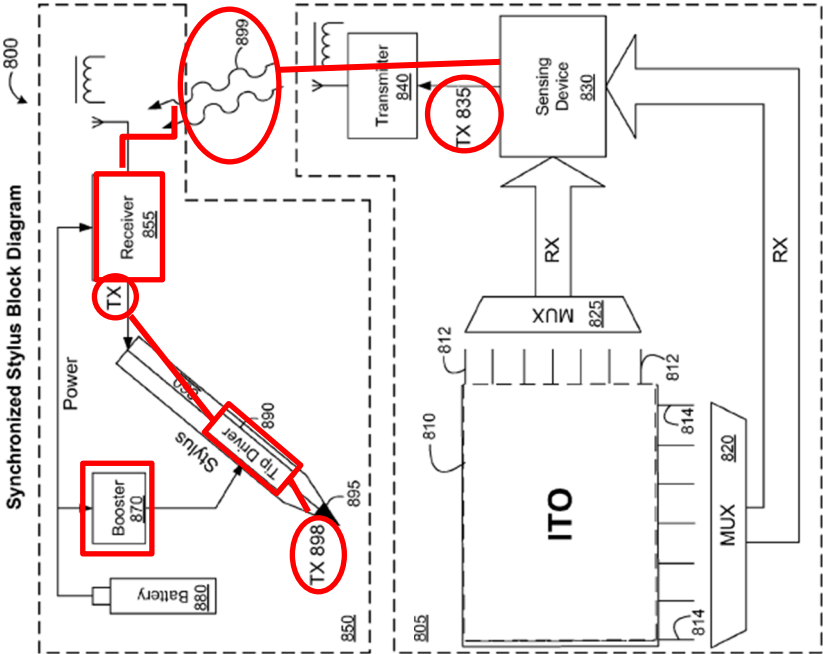


FIG. 8 of Kremin

Claim 1	Example Disclosures in Prior Art
	Not only does Kremin itself disclose this claim limitation, but it discusses that this limitation was already known in the prior art. Furthermore, this claim limitation is obvious based on the prior art disclosed by Kremin. “FIG. 2A is a block diagram illustrating a conventional embodiment of a host device 200 for tracking the position of a touch object. The host device 200 includes an Indium-Tin-Oxide (“ITO”) panel 205, a receiver 210, a data decoder 215, a host CPU 220, and a PC 225. In FIG. 2B, the stylus 250 includes a force sensor 255, a measurer 260, a modulator 265, an amplifier 270, a stylus tip 275, and a reference clock 280. The stylus 250 is typically battery-powered (not illustrated).” See Kremin at [0010]. A POSITA would appreciate that this conventional embodiment also includes this claim limitation.

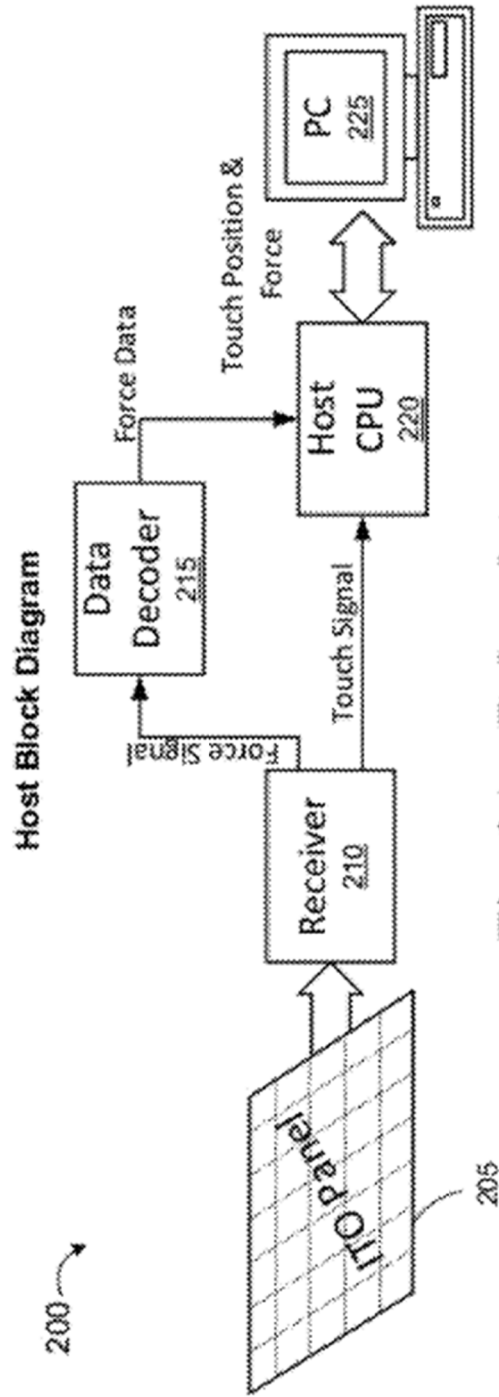


Fig. 2A - Related Art

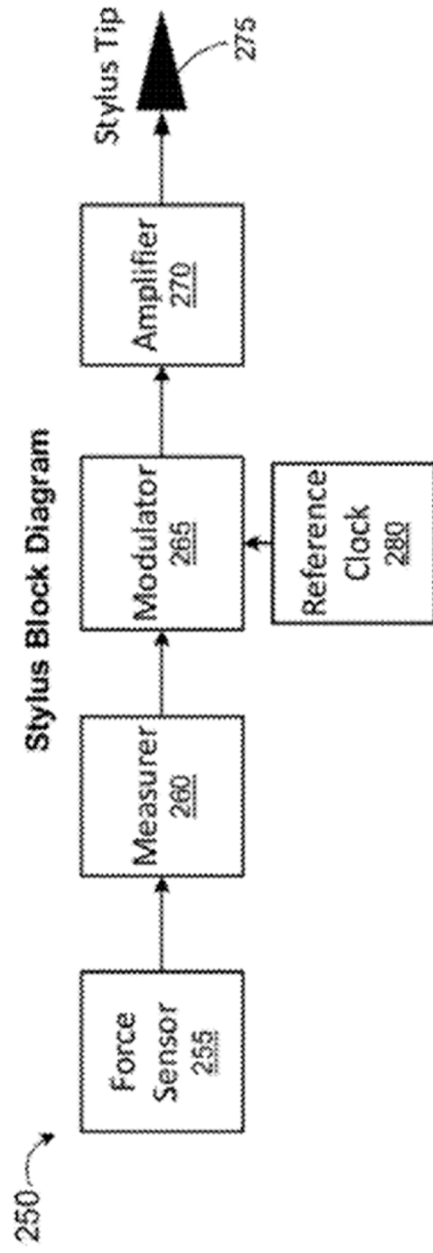
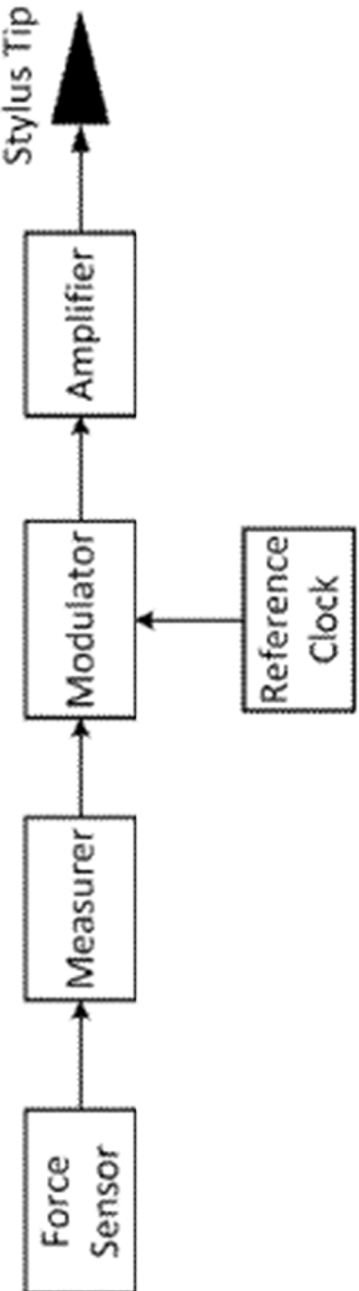


Fig. 2B - Related Art

FIG. 2A and FIG. 2B of Kremin

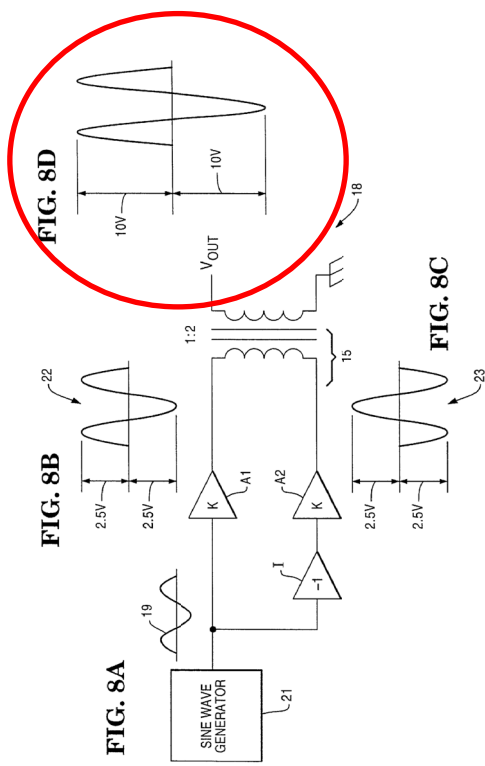
Kremin's Provisional Patent Application (US Provisional application No. 61/407,907 by Kremin et al, titled "SYNCHRONIZING ASTYLUS WITH A CAPACTIVE SENSE ARRAY" and filed on Oct. 28, 2010) (Ex. 1016), which is incorporated by reference at paragraph [0001] of

Claim 1	Example Disclosures in Prior Art
	Kremin, shows the same schematic of Fig. 2B of Kremin, but is labeled as “N-Trig Stylus Block Diagram”. See US Provisional application No. 61/407,907 at 4. N-Trig was referred to as one of the “two known competitor solutions”. See US Provisional application No. 61/407,907 at 3. The amplifier is used to boost the voltage signal. Therefore, the use of amplifiers or other components to increase the voltage signal transmitted by the stylus is already known in the art, even before Kremin itself. The value of the output voltage is a matter of design choice. Figure 4 N-Trig Stylus Block Diagram  <pre> graph LR FS[Force Sensor] --> M[Measurer] M --> Mod[Modulator] RC[Reference Clock] --> Mod Mod --> A[Amplifier] A --> ST[Stylus Tip] </pre> FIG. 4 of Kremin’s Provisional Patent Application (US Provisional application No. 61/407,907) (Ex. 1016) It was further known in the art prior to the effective filing date of the ’866 Patent that the stylus can receive the signal from the touch-sensitive device and then amplify it (i.e., convert it to a higher voltage), or non-amplify it (i.e., keep it at the same voltage level), and then send it back to the touch-sensitive device. See, e.g., U.S. Patent No. 8,766,954 to Vuppu et al. (“Vuppu”) (Ex. 1017) at ABSTRACT, 3:36-49, 3:36-49, and 4:46-60, Claim 14. Amplifying the signal can decrease the size of the stylus tip and improve the precision of the touch. Vuppu at ABSTRACT, 1:27-41, 6:27-36, and 11:65-12:2.

Claim 1

Example Disclosures in Prior Art

To the extent Kremin does not expressly, implicitly, or inherently disclose the substance of limitation 1[b], a POSITA could modify Kremin in view of Partow to meet this limitation. Partow discloses “an improved stylus for a portable digitizing pad, which produces a large position signal.” Partow, 1:65-67. The technology of Partow uses a transformer to output a signal that is “about 20 volts, peak-to-peak.” Partow, 2:51-62. While the term “high-voltage” is likely indefinite, the ‘866 Patent specifically discloses a voltage in the range of 10-20V would be “high-voltage.” See ‘866 Patent at 11:51-54 & claim 3. Further, Partow specifically discloses an embodiment with “a power supply voltage of 3.0 volts” that is fed into a transformer, and the “output of the transformer is 60 volts, zero-to-peak, or 120 volts, peak-to-peak,” Partow at 3:37-46, well in excess of the “high voltage” range discussed on the ‘866 Patent. Accordingly, Partow also discloses “high-voltage signals associated with a high voltage comprising a relatively large potential difference compared to a voltage within a voltage range of approximately 1 to approximately 3 volts” because the output of the technology of Partow (as shown in FIG. 8D) is a high voltage signal, as claimed.



FIGS. 8A-8D of Partow

It would have been obvious to a POSITA to modify the stylus of Kremin to implement the particular way of producing a high-voltage signal disclosed in Partow, and a POSITA would have been motivated to so modify the stylus of Kremin for the obvious benefit of more easily producing a boosted voltage. See Partow, 1:67-2:64. In addition, Partow specifically discloses how the system can be modified as the circumstances require, including the factors contributing to the value of the output voltage. It contains an entire section titled “Important Considerations” that discusses several examples with different voltage levels. See Partow at 1:35-4, cols. 3-6.

1[c] a component operable to convert the voltage of approximately 1 to 3 volts to the high voltage; and

As discussed in my declaration (Ex. 1003), limitation 1[c] is likely a means-plus-function limitation corresponding to a transformer or a charge pump, as disclosed in the '866 patent specification. For the reasons discussed below, the booster of Kremin performs the identical function specified in limitation 1[c] in substantially the same way, and produces substantially the same results as the corresponding element disclosed in the specification. Kremin, therefore, anticipates and renders obvious limitation 1[c] under a means-plus-function analysis. Even if limitation 1[c] were not interpreted as a means-plus-function limitation, Kremin still anticipates and renders obvious limitation 1[c] for the reasons discussed below.

As described above, the stylus 850 of Kremin includes a receiver 855, booster 870, and tip driver 860 connected to a battery 880. The tip driver 890 of Kremin is a powered component containing a booster 870 operable to convert the initial voltage signal 835 to a “high voltage” signal 898 of 10 to 20 volts. Kremin ¶ [0081], [0084]. Kremin discloses a booster 870 to boost a battery voltage (e.g., of 1.5 volts) to allow a tip driver 890 to amplify a TX signal 835 of a host device 805 to a higher voltage (e.g., 10 to 20 volts). Kremin ¶ [0084].

Additional embodiments make this clear: an embodiment to detect force identifies the same voltage booster 870, tip driver 890, and stylus tip 895, with an actuator 893 to receive force sensed by the force sensor 1360. Kremin ¶¶ [00104], [00109].

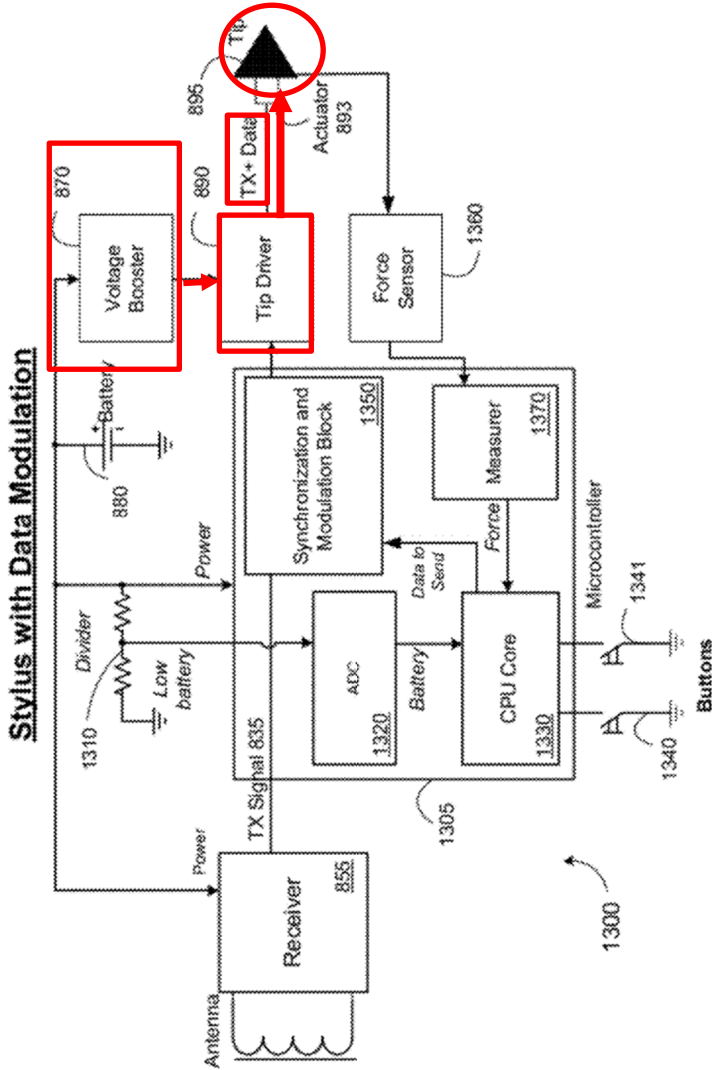


FIG. 13 of Kremin

Claim 1	Example Disclosures in Prior Art
	One embodiment in Kremin describes a process for amplifying the transmit signal to 20 to 50 volts to allow for detection while the stylus tip hovers over the host device. Kremin ¶¶ [0048], [0099]. Kremin therefore discloses limitation 1[c]. To the extent Kremin does not expressly, implicitly, or inherently disclose the substance of limitation 1[c], a POSITA could modify Kremin in view of Partow to meet this limitation. For example, as discussed above, FIGs. 8A through 8D of Partow illustrate generating a high-voltage signal by increasing the voltage of a received signal to a high voltage. Partow, 2:51-62. The component illustrated in these figures would be understood as a component operable to convert the voltage of approximately 1 to 3 volts to the high voltage, as in limitation 1[c]. A person of ordinary skill in the art would appreciate that this feature of Partow can be combined with Kremin. For example, the component of FIGs. 8A-8D of Partow can be implemented as the booster of Kremin.

Example Disclosures in Prior Art	
Claim 1	
1[e] wherein the high-voltage signals result from the one or more electrodes receiving the high voltage.	As described above, Kremin states that the tip driver 890 drives or amplifies (with booster 870) the transmit signal 835, and the stylus tip 895 capacitively couples the amplified stylus transmit signal 898 to the device's sense array 810. Kremin ¶¶ [0085], [0106]-[0107]. Kremin makes clear throughout that the signal passes through the tip driver 890, is amplified, and then sent to the stylus tip. <i>Id.</i> Accordingly, Kremin discloses limitation 1[e].

Claim 2	Example Disclosures in Prior Art
The stylus of claim 1, wherein the component is a transformer.	Considering Kremin’s design and inclusion of a powered 880 booster 870 in a tip driver 870, it would have been obvious to a POSITA that the voltage booster 870 coupled with the tip driver 890 used to generate the boosted voltage 898 could comprise a transformer. See Kremin ¶¶ [0081], [0084]. The use of a transformer to “boost” voltage was well-known in the art decades before the effective filing date of the ’866 Patent. The transformer is one of a few main basic components that can boost voltage, and it would be the first or second choice that would come to a POSITA’s mind⁵. The main devices to boost the voltage are transformers, amplifiers, and charge pumps. No undue experimentation is needed by a POSITA to determine the component to use for boosting the voltage, especially if this component is the main or at least one of the main components used for this purpose. To the extent Kremin does not expressly, implicitly, or inherently disclose the substance of Claim 2, a POSITA could modify Kremin in view of Partow to meet this limitation. As discussed above, Partow discloses technologies for producing “a large position signal” (i.e., a high-voltage signal) in a stylus. Partow, 1:65-67. To produce the large position signal, the technology of Partow uses a transformer, such as the transformer 18 shown in FIGs. 8A-8D of Partow. Partow’s description of a transformer would easily provide further technical descriptions that a POSITA would incorporate into Kremin’s existing design to more easily boost voltage. FIGs. 8A-8D of Partow

⁵ A Booster can be defined as “[a] device inserted into a line (or cable) to increase the voltage. Boosting generators are also used to raise the level of a dc line. **Transformers are usually employed to boost ac voltages**” (emphasis added). Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 80 (Ex. 1015).

Claim 3	Example Disclosures in Prior Art
The stylus of claim 1, wherein the high voltage comprises a voltage within the voltage range of approximately 10 to approximately 20 volts.	To the extent claim 3 is not indefinite, Kremin discloses a “high-voltage signal” that is within the range of 10 to 20 volts. As discussed above, the stylus 850 of Kremin includes a tip driver 890 with voltage booster 870 coupled to a battery 880. Kremin describes an embodiment with a high voltage stylus transmit signal 898 within a voltage range of 10 to 20 volts. Kremin ¶ [0084]. The high-voltage signal of Kremin allows the stylus to be detected while “hovering” (i.e., without a wired connection and therefore “wirelessly”). <i>Id.</i> Kremin accordingly discloses claim 3. Claim 3 is further obvious over Kremin in view of the knowledge of a POSITA and in view of Partow. The high-voltage signal of Partow shown in FIG. 8D above has a peak-to-peak voltage of 20 volts (and a zero-to-peak voltage of 10 volts). Partow, 2:60-62. Accordingly, even if claim 3 were not disclosed in Kremin, a POSITA would know to implement claim 3 based on Partow in combination with Kremin.
Claim 4	Example Disclosures in Prior Art
The stylus of claim 1, wherein the high-voltage signals identify a location of the stylus relative to the touch sensor of the device.	The high-voltage signal of Kremin is used to locate the stylus relative to the capacitive sense array of the host device. Kremin, ¶ [0085]. Kremin discloses that the high voltage stylus signal allows for robust detection of the stylus location, as well as detection while hovering over but not physically touching a sensing device (i.e., without a wired connection and therefore “wirelessly”). Kremin ¶ [0084]. Kremin therefore discloses claim 4. Specifically, Kremin discloses that “[a] high voltage stylus TX Signal 898 may enable the host device 805 to detect the stylus 850 when it is “hovering,” or in close proximity to the capacitive sense array 810, but not physically touching an overlay disposed over the capacitive sense array 810”. Kremin ¶ [0084]. Kremin also discloses that “[a] high voltage stylus TX signal 898 may also provide for faster and more robust detection by the sensing device 830”. Kremin ¶ [0084]. “FIG. 20 is flow diagram of one embodiment of a method of tracking the position of a passive touch object and a stylus on a capacitive sense array”. Kremin ¶[0046]. “FIG. 21 is flow diagram of one embodiment of a method of tracking the position of a stylus that is contacting or hovering over a capacitive sense array”. Kremin ¶[0047].

Fig. 20

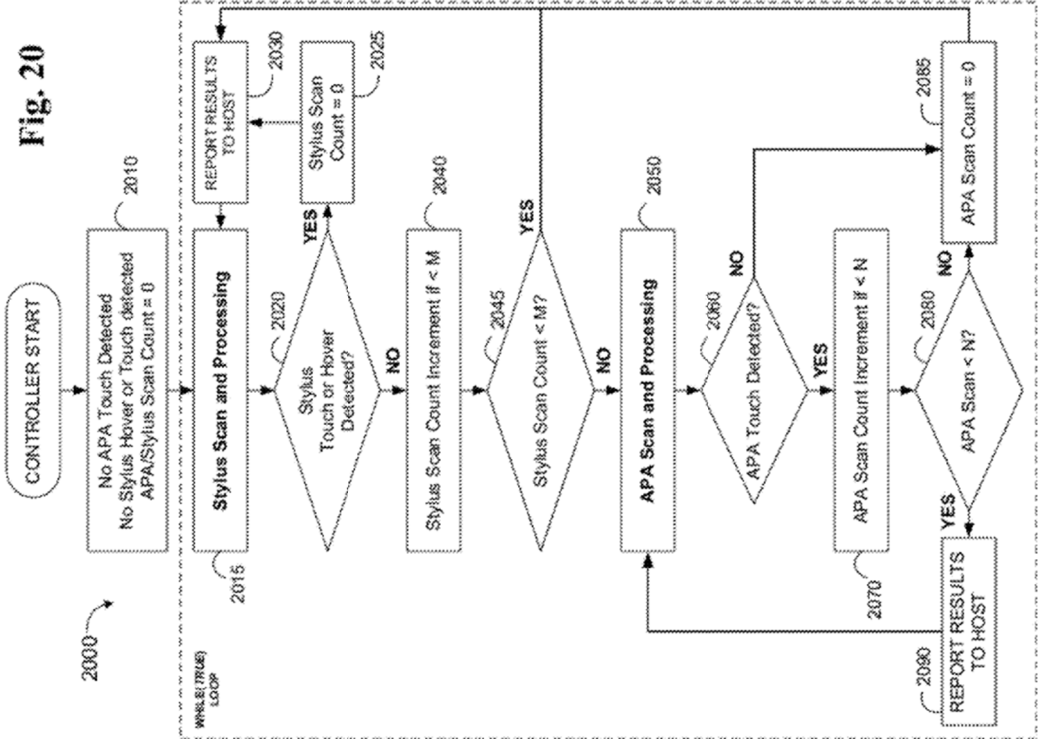


FIG. 20 of Kremin

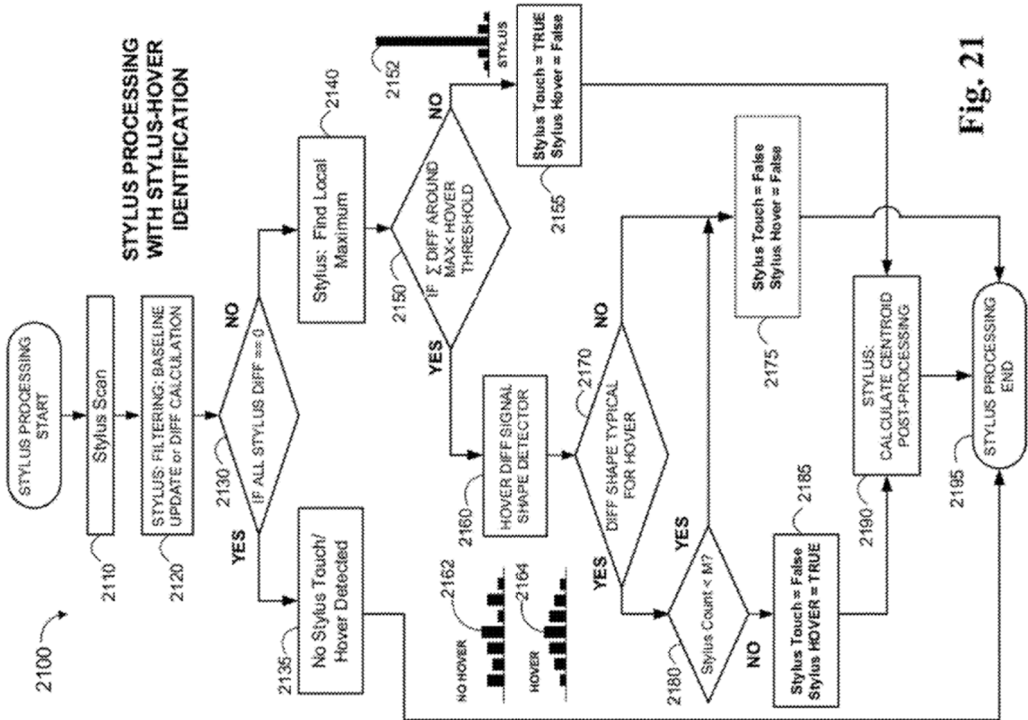


FIG. 21 of Kremin

Claim 5	Example Disclosures in Prior Art
The stylus of claim 1, wherein, when the stylus is in contact with or in the proximity of the touch sensor of the device, the high-voltage signals are used to simulate or distinguish: contact by an object other than the stylus with the device; or a presence of the object near the touch sensor of the device.	Kremin’s stylus design emphasizes allowing for multi-touch and simultaneous input signals, including simultaneous use of a stylus and touch object. Kremin ¶ [0003]. Kremin’s use of high voltage signals allows for, and distinguishes between, simultaneous use of a stylus 330 and touch object 340. Kremin ¶¶ [0024], [0051], [0086]. Kremin further discloses how, for example, a stylus and palm contacting a device will both produce transmit signals but are distinguishable by the strong voltage of the stylus tip transmit signal, as opposed to the voltage of a palm or other contacting devices. Kremin ¶ [0102]. This encompasses <i>distinguishing</i> between contact by the stylus and passive touch objects when the stylus is in contact with or in proximity of the device. Kremin ¶¶ [0102], [0103]. Specifically, Kremin discloses that “when touching the ITO panel 1210, the capacitive influence of the palm depends on the magnitude of C palm 1250 and C stylus 1230. The human body is connected to ground return path via some finite capacitance C ground2 1260. It means that palm is not really grounded and always has some TX potential too. This potential may cause small signal changes when hand is on the panel due capacitive coupling with panel. The stylus tip TX signal is much stronger than palm TX signal. It allows us to separate stylus and palm touches by signal level threshold without problems.” Kremin ¶ [0102]. FIG. 3 of Kremin is “a block diagram illustrating one embodiment of an electronic system having a processing device for detecting a presence of a touch object and a stylus”. Kremin ¶ [0018]. FIG. 12A of Kremin is “a diagram illustrating the electrical effect of a stylus and palm simultaneously contacting an ITO panel”. Kremin ¶ [0032].

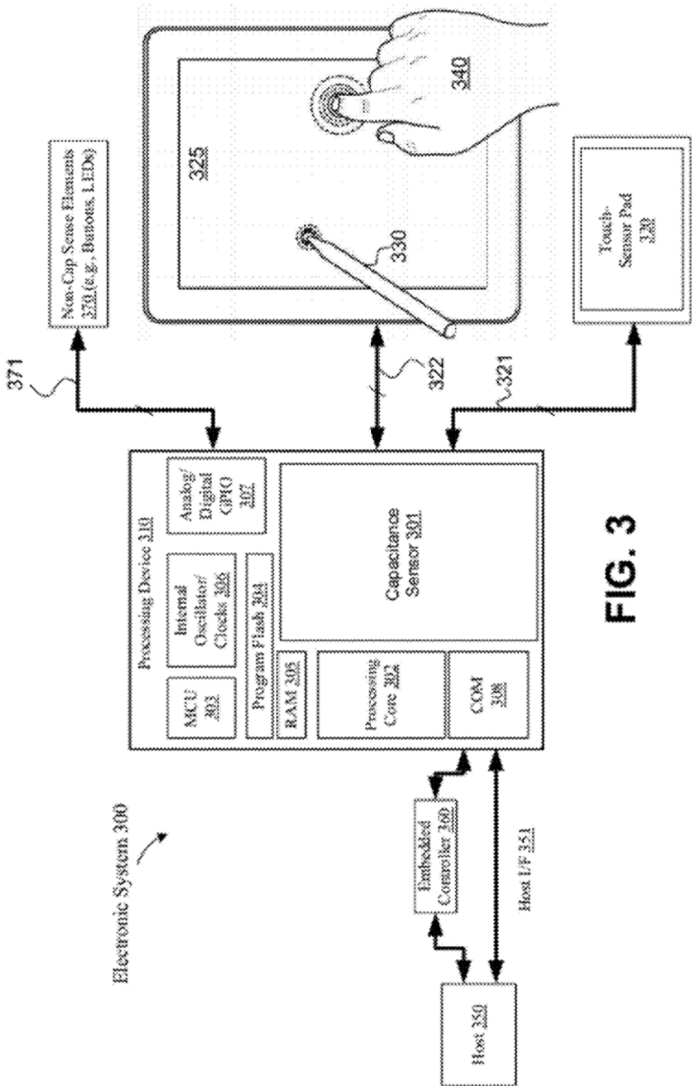


FIG. 3

FIG. 3 of Kremin

Claim 5	Example Disclosures in Prior Art
	FIG. 12A (left) and 12B (right) of Kremin As described above, high-voltage signals allow for detection while the stylus tip hovers over the host device. Kremin ¶ [0048], [0084], [0099]. The stylus’s presence can therefore be detected and contact with the device can be simulated while the stylus is hovering—i.e., in proximity to the device—rather than while it is contacting the device directly. Kremin further describes an embodiment in which “the stylus signal amplitude, frequency, phase, etc., may be the same or similar to that which is utilized for finger sensing by the touch screen controller”. Kremin ¶ [0076]. Accordingly, a stylus may <i>simulate</i> finger sensing (or that of passive touch devices), which would be understood as simulating contact by another object or the presence of another object when the stylus is in contact with or in the proximity of the touch sensor of the device. Kremin therefore discloses claim 5.

Claim 6	Example Disclosures in Prior Art
The stylus of claim 5, wherein the object is least a part of a human hand.	As discussed above, the technology of Kremin can be used both to simulate a touch by a user’s finger and to distinguish the touch of a user’s palm or finger. Kremin ¶ [0024], [0051], [0076], [0086], [00102]–[00103]. The user’s palm is, in particular, is a heavy focus of Kremin and seen in Figures 12A and 12B. Accordingly, Kremin discloses claim 6.

stylus tip then capacitively couples the amplified transmit signal to the touch sensor of the device. *Id.* The amplified transmit signal, now high voltage, is accordingly based on the voltage used by the touch sensor.

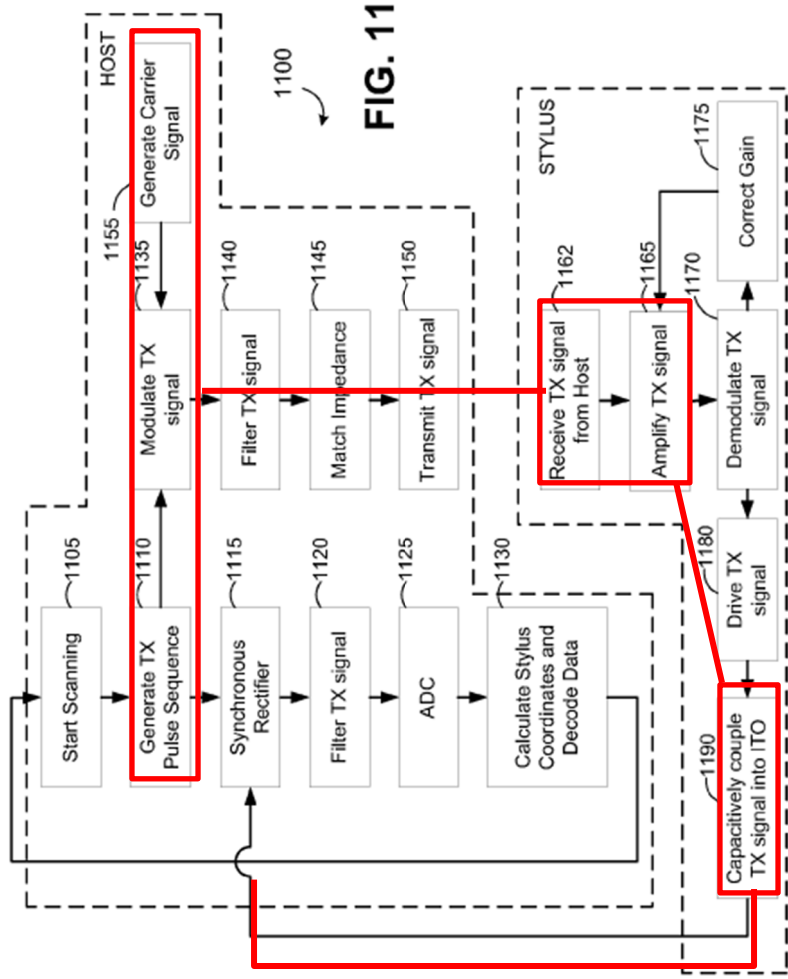


FIG. 11 of Kremin

This is iterated in Kremin’s explanation of palm rejection technology: the palm is not stimulated by the transmit signal that originated from the transmit drive circuit of the touch screen controller/touch sensor, so the device is able to differentiate between the stylus and a hand, because it can recognize the signal it created. Kremin ¶ [00103]. Specifically, Kremin states the following: “Thus, a palm (i.e., a passive touch object) would not interfere with stylus position tracking in a noticeable way because the palm would not be stimulated by the TX signal originating from the TX drive circuit of the touch screen controller (e.g., TX drive circuit 610 of touch screen controller 605, or sensing device 830 of host 805). It should be noted that the palm has much smaller stylus TX signal propagation as compared to the stylus tip”. Kremin ¶ [00103].

Claim 7	Example Disclosures in Prior Art
	As discussed above with reference Claim 1, Kremin discloses that “[a] high voltage stylus TX Signal 898 may enable the host device 805 to detect the stylus 850 when it is “hovering,” or in close proximity to the capacitive sense array 810, but not physically touching an overlay disposed over the capacitive sense array 810”. Kremin ¶ [0084]. The stylus 850 capacitively couples that signal 898 to the device via the stylus tip 895. Id. ¶ [0085]. In each of the foregoing embodiments, a POSITA would appreciate that transmit signals are necessarily based on a voltage signal used by at least a portion of the touch sensor of the device, because they are generated from the touch sensor of the device. It was also known in the art prior to the effective filing date of the ’866 Patent that the stylus can receive the signal from the touch-sensitive device, invert it (i.e., convert to opposite polarity), non-invert it (i.e., keep it with the same polarity), amplify it (i.e., convert it to a higher voltage), or non-amplify it (i.e., keep it at the same voltage level), and then send it back to the touch-sensitive device. <i>See, e.g.,</i> Vuppu at ABSTRACT, 3: 36-49, 3:36-49, and 4:46-60, Claim 14. Amplifying the signal can decrease the size of the stylus tip and improve the precision of the touch, while inverting can help in the differentiation from the finger touch. Vuppu at ABSTRACT, 1:27-41, 6:27-36, and 11:65-12:2. Therefore, it would have been obvious to a POSITA to implement claim 7 based on Kremin and the knowledge of a POSITA. Kremin therefore discloses claim 7.
Claim 15	Example Disclosures in Prior Art
15[pre] One or more non-transitory computer-readable storage media embodying logic that is operable when executed to:	To the extent the preamble is limiting, Kremin specifically describes embodiments that may be implemented as a computer program product on a computer-readable medium. Kremin ¶ [00140]. See discussion of limitation 1[b] above.

15[a] transmit electromagnetic signals from a stylus to a device through a touch sensor of the device, at least some of the electromagnetic signals comprising high-voltage signals associated with a high voltage comprising a relatively large potential difference compared to a voltage within a voltage range of approximately 1 to approximately 3 volts, the stylus comprising:	The terms “high voltage” and “relatively large potential difference” are likely indefinite for the reasons discussed above. See limitation 1[b]. The stylus 850 of Kremin contains a receiver, 855, a battery 880, a booster 870, a tip driver 890, and a stylus tip 895. Kremin ¶¶ [0079], [0081]. The stylus 850 generates a signal 898 based on a signal 835 received by the receiver 855 from the transmitter 840. <i>Id.</i> ¶ [0083]. The stylus 850 capacitively couples that signal 898 to the device via the stylus tip 895. <i>Id.</i> ¶ [0085]. The signal 835 may be amplified by the booster 870 to a higher voltage signal 898, for example up to 10 to 20 volts, which has a relatively large potential difference compared to a voltage within a voltage range of approximately 1 to 3 volts. <i>Id.</i> ¶ [0084]. Accordingly, the transmit signal of Kremin is a high-voltage signal associated with a high voltage. Additionally, a POSITA would appreciate that the transmit signal of Kremin is an electromagnetic signal, as that term is used in the ’866 patent. For example, a POSITA would appreciate that capacitive coupling utilizes the electric field variations, which also generate magnetic fields, as governed by Maxwell’s Equations (specifically Ampère-Maxwell law). The unifying theory of electricity and magnetism is described by Maxwell’s equations, which show that electric fields and magnetic fields are not separate phenomena but are interlinked. A POSITA would, therefore, appreciate that signals transmitted using capacitive coupling are electromagnetic signals. Additionally, even if the transmit signal were not understood as an electromagnetic signal, Kremin also discloses that “[t]he communication channel or link” between the stylus and the host “may be a RF link, Bluetooth link, an optical link, an infrared (IR) link, or other communication channels/links as would be appreciated by one of ordinary skill in the art having the benefit of this disclosure.” <i>Id.</i> ¶ [0093]. Kremin also discloses that “[t]he stylus 1300 may transmit the stylus TX signal 898 using one code, and may transmit the additional data using another code. In an embodiment, the stylus TX signal 898 and additional data may utilize the same frequency or different frequencies. In other embodiments, optical, ultrasonic, inductive, or RF signal transmissions may be utilized to transfer the additional data from the stylus 1300 to the sensing device 830. For example, additional data may be wirelessly coupled from the stylus 1300 to the sensing device 830. It should be noted that additional hardware, such as antennas and/or amplifiers, may be required to transmit the additional data to the sensing device 830. Such embodiments would be known by those of ordinary skill in the art with the benefit of this disclosure.” <i>Id.</i> ¶ [0111]. See also <i>Id.</i> ¶ [0012] and Fig. 2B describing a prior art system with RF communication between the stylus and the sense array. RF (including Bluetooth) signals would also be understood as electromagnetic signals, as that term is used in the ’866 patent. Kremin therefore discloses and renders obvious limitation 15[a].
--	---

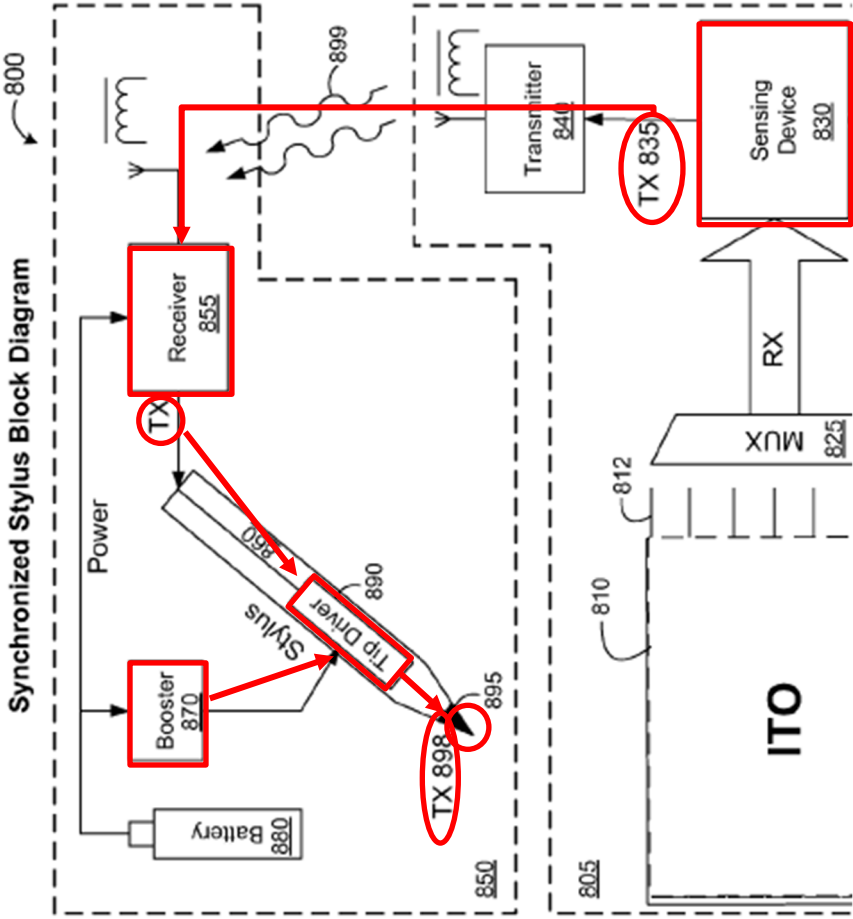
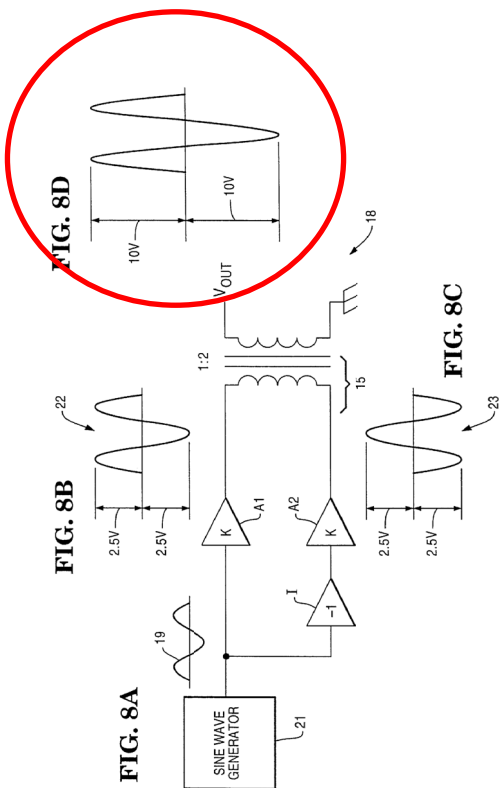


FIG. 8 of Kremin

To the extent Kremin does not expressly, implicitly, or inherently disclose the substance of limitation 15[a], a POSITA could modify Kremin in view of Partow to meet this limitation.

Partow discloses “an improved stylus for a portable digitizing pad, which produces a large position signal.” Partow, 1:65-67. Specifically, the technology of Partow uses a transformer to output a signal that is “about 20 volts, peak-to-peak.” Partow, 2:51-62. While the term “high-voltage” is indefinite, the ’866 Patent specifically states that a voltage in the range of 10-20V would be “high-voltage.” See ’866 Patent at 11:51-54 & claim 3. Further, Partow specifically discloses an embodiment with “a power supply voltage of 3.0 volts” that is fed into a transformer, and the “output of the transformer is 60 volts, zero-to-peak, or 120 volts, peak-to-peak,” Partow at 3:37-46, well in excess of the “high voltage” range discussed on the ’866 Patent. Accordingly, Partow also discloses “high-voltage signals associated with a high voltage comprising a relatively large potential difference compared to a voltage within a voltage range of approximately 1 to approximately 3 volts”

because the output of the technology of Partow (as shown in FIG. 8D) is a high voltage signal, as claimed.



FIGS. 8A-8D of Partow

Claim 15	Example Disclosures in Prior Art
15[a1] one or more electrodes for wirelessly transmitting the signals to the device;	See limitations 1[a] and 1[b] above. The stylus 850 of Kremin contains a stylus tip 895 by which the amplified stylus transmit signal is capacitively coupled to the capacitive sense array. Kremin Claim 6, ¶ [0085]. Capacitive coupling is a transfer of electric signals that inherently requires a pairing of electrodes—a POSITA would understand that the tip 895 must comprise an electrode, which was commonplace for styluses of this kind before the '866 patent. The diagram illustrates a stylus system. A battery (880) is connected to a transmitter (TX 855) and a booster (870). The TX 855 is connected to a stylus (860) through a tip driver (890). Inside the stylus, there is a TX 898 and a tip (895). The tip (895) is shown in contact with a sense array (850). The entire system is enclosed in a dashed box labeled 850. FIG. 8 of Kremin And in describing the position tracking system for the stylus, Kremin discloses that the row 660 and column 640 electrodes in the sense array are capacitively coupled to the stylus 680, detecting the charge coupled at the contact point 695 with the stylus—this is inherently only possible if there is electrode in the stylus tip. Kremin ¶ [0073]. The high-voltage signal of Kremin allows the stylus to be detected while “hovering” (i.e., without a wired connection and thus wirelessly). Kremin ¶ [0084]. Kremin also discloses that “[t]he communication channel or link” between the stylus and the host “may be a RF link, Bluetooth link, an optical link, an infrared (IR) link, or other communication channels/links as would be appreciated by one of ordinary skill in the art having the benefit of this disclosure.” <i>Id.</i> ¶ [0093]. Kremin further discloses that “[t]he stylus 1300 may transmit the stylus TX signal 898 using one code, and may transmit the additional data using another code. In an embodiment, the stylus TX signal 898 and additional data may utilize the same frequency or different frequencies. In other embodiments, optical, ultrasonic, inductive, or RF signal transmissions may be utilized to transfer the additional data from the stylus 1300 to the sensing device 830. For example, additional data may be wirelessly coupled from the stylus 1300 to the sensing device 830. It should be noted that additional hardware, such as antennas and/or amplifiers, may be required to transmit the additional data to the sensing device 830. Such embodiments would be known by those of ordinary skill in the art with the benefit of this disclosure.” <i>Id.</i> ¶ [0111]. See also <i>Id.</i> ¶ [0012] and Fig. 2B describing a prior art system with RF communication between the stylus and the sense array. Kremin accordingly discloses limitation 15[a1].

15[a2] a component operable to convert the voltage of approximately 1 to 3 volts to the high voltage; and

See limitation 1[c]. As described above, the stylus 850 of Kremlin includes a receiver 855, booster 870, and tip driver 860 connected to a battery 880. The tip driver 890 of Kremlin is a powered component containing a booster 870 operable to convert the initial voltage signal 835 to a high voltage signal 898 of 10 to 20 volts. Kremlin ¶ [0081], [0084]. Kremlin discloses a booster 870 to boost a battery voltage (e.g., of 1.5 volts) to allow a tip driver 890 to amplify a TX signal 835 of a host device 805 to a higher voltage (e.g., 10 to 20 volts). Kremlin ¶ [0084].

Additional embodiments make this clear: an embodiment to detect force identifies the same voltage booster 870, tip driver 890, and stylus tip 895, with an actuator 893 to receive force sensed by the force sensor 1360. Kremin ¶¶ [00104], [00109].

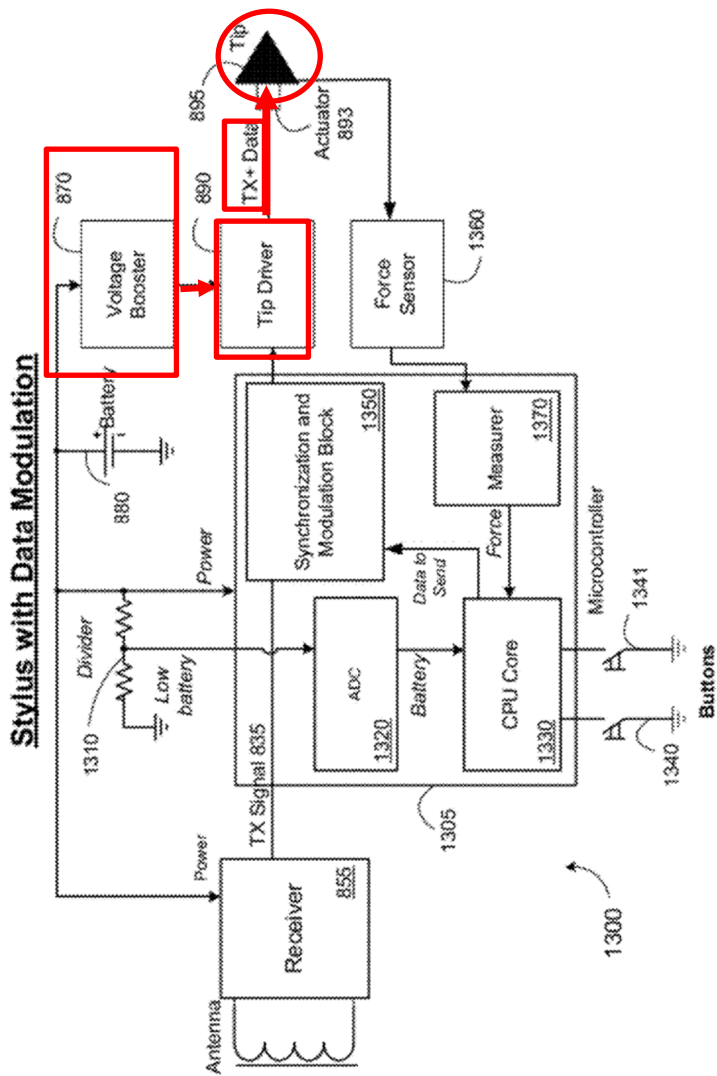


FIG. 13 of Kremin

One embodiment in Kremin describes a process for amplifying the transmit signal to 20 to 50 volts to allow for detection while the stylus tip hovers over the host device. Kremin ¶ [0048], [0099]. Kremin therefore discloses limitation **15a21**.

To the extent Kremlin does not expressly, implicitly, or inherently disclose the substance of claim 15, a POSITA could modify Kremlin in view of Partow to meet this limitation.

As discussed above, the technology of Partow produces “a large position signal” (i.e., a high-voltage signal). Partow 1:65-67. The technology

Appendix B

U.S. Patent No 9,933,866 Invalidity Chart – Anticipation and obviousness over Westhues alone and in view of Kremin

U.S. Patent Publication No. 20120050207 to Westhues et al. (“Westhues”) (Ex. 1006) (published March 1, 2012; filed August 30, 2010) either expressly, implicitly, or inherently anticipates the challenged claims of U.S. Patent No. 9,933,866 (“’866 Patent”) (Ex. 1001) under 35 U.S.C. § 102 and/or renders those claims obvious under 35 U.S.C. § 103 in view of the knowledge of a person of ordinary skill in the art (“POSITA”). Alternatively, Westhues renders the challenged claims obvious further in view of U.S. Patent Publication No. 20120105362 to Kremin et al. (“Kremin”) (Ex. 1005) (published May 3, 2012; priority date October 28, 2010). The chart below sets forth my analysis regarding anticipation and obviousness of the challenged claims on each of these alternative bases.

Both Westhues and Kremin describe similar technologies and solve similar problems. Both disclose a stylus employing high voltage for interacting with touch screens/sensors and disclose methods for determining the touch position. Westhues’s invention concerns methods, systems, and apparatuses related to capacitive touch sensors, such as a fine-pointed, active stylus, where the stylus is configured to receive a signal from the capacitive touch sensor for synchronizing a time base of the stylus with the capacitive touch sensor, to receive a signal from a matrix of the capacitive touch sensor to measure a first position along one axis, and to transmit a signal from the single electrode of the stylus to the matrix to indicate a second position of the stylus along another axis of the matrix. Westhues at ABSTRACT.

Similarly, Kremin discloses a system and method for tracking a stylus on a capacitive sense array, where the system comprises the capacitive sense array configured to detect a presence of the stylus, a processing device to generate a synchronization signal, and a transmitter to transmit the synchronization signal to the stylus to synchronize the stylus to the capacitive sense array. Kremin at ABSTRACT. Kremin also discloses that the “[t]he booster 870 boosts the battery voltage delivered to the tip driver 890, allowing the tip driver 890 to amplify the TX signal 835 to a higher voltage (e.g., 10-20V)”. Kremin ¶ [0084].

A POSITA would have been motivated to modify the technology of Westhues based on Kremin for one or more obvious benefits, such as reduced power consumption. Reduced power consumption has the obvious benefit of increasing the battery life of the stylus. For example, while the high-voltage signal of Westhues may use a voltage of, e.g., 100 volts (Westhues, ¶ [0051]), Kremin describes embodiments that can perform hover detection using a high-voltage signal with a voltage of, e.g., 10-20 volts (Kremin, ¶ [0084]). A POSITA would appreciate that the 10-20 volt range used for the high-voltage signal of Kremin would have various advantages, such as decreased power consumption, while retaining the high-voltage features. A POSITA, thus, would benefit from the disclosure of Kremin and use the disclosed techniques in the stylus of Westhues. This task would have been routine and well within a POSITA’s skill. The below analysis discusses example disclosures in Kremin upon which a POSITA may rely when modifying the stylus of Westhues.

Additional discussion of the disclosure of Kremin relative to the challenged claims is included in Appendix A, which is incorporated herein by reference for any purpose and as to all claim limitations to further show obviousness of the challenged claims in view of Westhues and Kremin.

Claim 1	Example Disclosures in Prior Art
1[pre] A stylus comprising:	To the extent the preamble is limiting, Westhues discloses “<i>an active stylus 100</i>, which is in close proximity to conductive rows and columns in a matrix 160, and which has a conductive body 110, and a thin metal wire forming its tip 120.” Westhues, ¶ [0038] (emphasis added). The diagram illustrates a stylus 100 positioned above a matrix 160. The stylus consists of a main conductive body 110 and a thin metal wire tip 120. At the end of the wire is a non-conductive body 130, which allows an electric field to escape, represented by curved lines 140. The matrix 160 is shown as a series of horizontal and vertical lines representing conductive rows and columns. The electric field lines 140 are concentrated between the tip of the stylus and the matrix. Labels 150 and 160 point to the matrix structure. FIG. 1 of Westhues

Claim 1	Example Disclosures in Prior Art
1[a] one or more electrodes;	Westhues discloses that the stylus includes <i>an electrode 370</i> coupled to a transmit/receive switch 360. Westhues, ¶ [0050]. Westhues discloses limitation 1 [a]. <pre> graph TD 310[Battery Power Supply 310] --> 320[Microcontroller 320] 320 --> 340[Current Receiver 340] 320 --> 350[Voltage Transmitter 350] 340 --> 360[transmit/receive Switch 360] 350 --> 360 360 --> 370[Electrode 370] 320 -.-> 330["(optional) Auxiliary Communication Channel 330"] 330 -.-> 330_note["(may or may not be present)"] subgraph 300 [300] 310 320 340 350 360 370 330 end </pre> FIG. 3 FIG. 3 of Westhues (annotated)

1[b] one or more computer-readable non-transitory storage media embodying logic for transmitting signals wirelessly to a device through a touch sensor of the device, at least some of the signals comprising high-voltage signals associated with a high voltage comprising a relatively large potential difference compared to a voltage within a voltage range of approximately 1 to approximately 3 volts;	Westhues discloses that disclosed embodiments can be implemented as instructions “encoded on <i>computer storage medium</i> for execution by, or to control the operation of, data processing apparatus.” Westhues, ¶ [0063] (emphasis added). Additionally, Westhues discloses that the active stylus can include a microcontroller coupled to the receiver and the transmitter circuits, where the microcontroller can be configured to compute coordinate positions of the active stylus with respect to the locations on the capacitive touch sensor, and to report at least some of the coordinate positions from the active stylus. Westhues ¶ [0006], FIG 3, and claims 20-22, 36, and 42. Westhues also discloses control software that utilizes the existing hardware. Westhues ¶ [0046]. It further discloses that “[i]n operation, the microcontroller 320 sequences the process, where the software in the microcontroller 320 is responsible at least for maintaining the sense of time, for computing the coordinates, computing the interpolation, and reporting the coordinates back to the matrix, and so on”. Westhues ¶ [0051]. A POSITA would understand that a microcontroller includes a CPU to execute program instructions as well as both volatile and nonvolatile memory to store the programs to be executed and associated data. A microcontroller can be defined as follows “[a] complete microprocessor system on a chip. Includes on-chip the CPU, local RAM, local ROM or EPR0M, clock and control circuits, and serial and parallel IO ports that can be programmed for various control functions”¹ (emphasis added). The CPU also includes logic circuitry² to execute programs and control the operation of the stylus, including computing the coordinate positions. Westhues, therefore, discloses “one or more computer-readable non-transitory storage media embodying logic,” as in limitation 1[b].
--	--

¹ Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 470 (Ex. 1015).

² “Central processing unit -Also called central processor; abbreviated CPU. 1. The part of a computer system that contains the main storage, arithmetic unit, and special register groups. Performs arithmetic operations, controls instruction processing, and provides timing signals and other housekeeping operations. 2. A group of registers and logic that form the **arithmetic/logic unit** plus another group of registers with associated **decoding logic** that form the control unit. Most MOS devices are single-chip CPUs, in that the registers hold as many bits as the word length of the unit. With bit-slice devices, however, central processing units of any bit width can be assembled essentially by connecting the bit-slice parts in parallel. Externally, a bit-slice device will appear to be a coherent single CPU capable of handling words of the desired bit length. 3. That part of a computer system that controls the interpretation and execution of instructions. In general, the CPU contains the following elements: **arithmetic and logic unit (ALU)**, timing and control, accumulator, scratch-pad memory, program counter and address stack, instruction register, and UO control logic. 4. That unit of a computing system that fetches, decodes, and executes programmed instructions and maintains the status of results as the program is executed.” (emphasis added) See Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 107 (Ex. 1015).

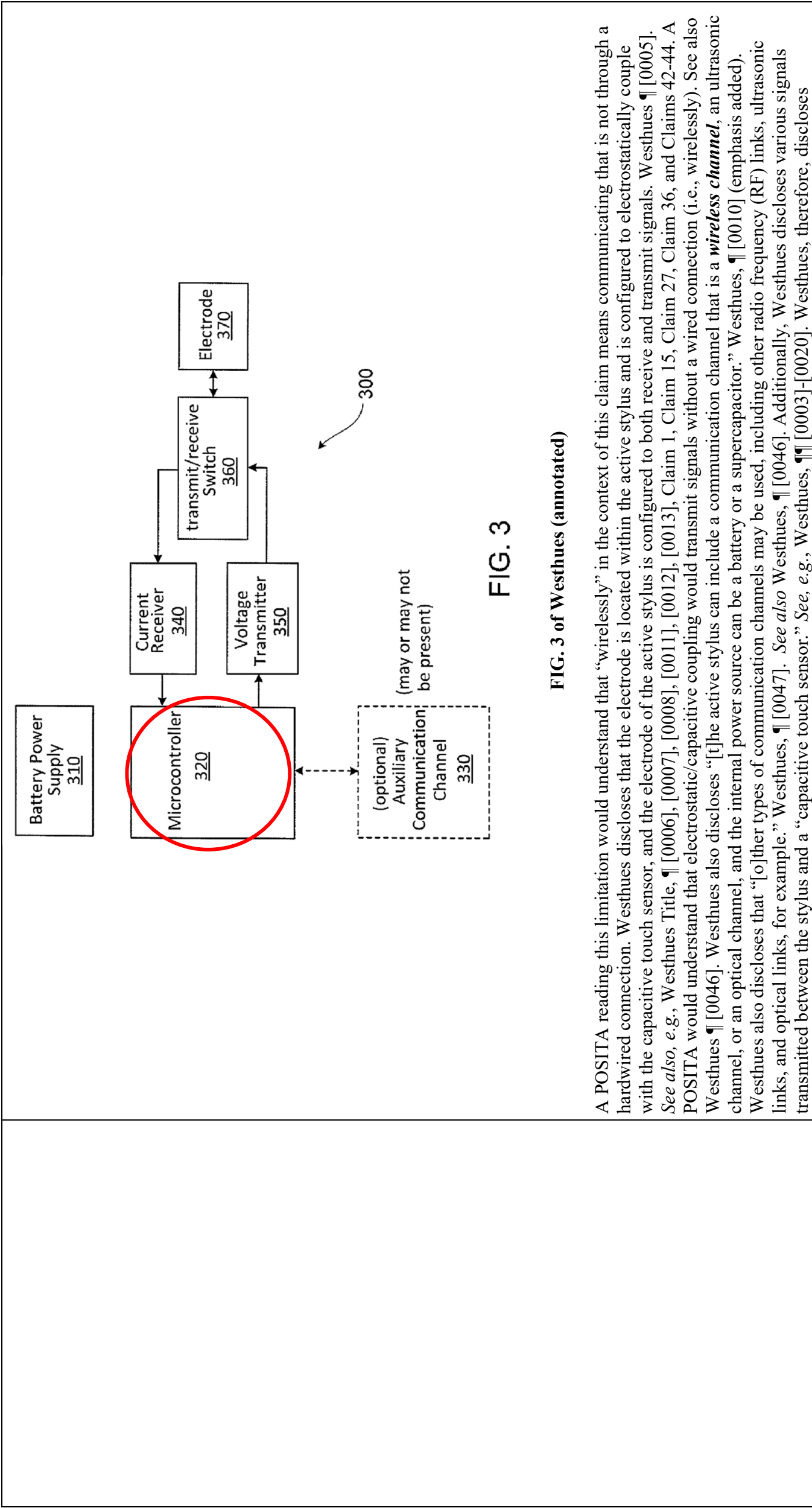


FIG. 3 of Westhues (annotated)

A POSITA reading this limitation would understand that “wirelessly” in the context of this claim means communicating that is not through a hardwired connection. Westhues discloses that the electrode is located within the active stylus and is configured to electrostatically couple with the capacitive touch sensor, and the electrode of the active stylus is configured to both receive and transmit signals. Westhues ¶ [0005]. See *also, e.g.*, Westhues Title, ¶ [0006], [0007], [0008], [0011], [0012], [0013], Claim 1, Claim 15, Claim 27, Claim 36, and Claims 42-44. A POSITA would understand that electrostatic/capacitive coupling would transmit signals without a wired connection (i.e., wirelessly). See also Westhues ¶ [0046]. Westhues also discloses “[t]he active stylus can include a communication channel that is a **wireless channel**, an ultrasonic channel, or an optical channel, and the internal power source can be a battery or a supercapacitor.” Westhues, ¶ [0010] (emphasis added). Westhues also discloses that “[o]ther types of communication channels may be used, including other radio frequency (RF) links, ultrasonic links, and optical links, for example.” Westhues, ¶ [0047]. See *also* Westhues, ¶ [0046]. Additionally, Westhues discloses various signals transmitted between the stylus and a “capacitive touch sensor.” See, *e.g.*, Westhues, ¶ [0003]-[0020]. Westhues, therefore, discloses

“transmitting signals wirelessly to a device through a touch sensor of the device,” as in limitation 1[b].

To the extent these terms are not indefinite, Westhues discloses a “high-voltage signal” that has a “relatively large potential difference” from the range of 1-3 volts. Specifically, Westhues discloses that a transmit/receive switch 360 included in the stylus “can *allow a high voltage (e.g., around 100 V) output to be applied to the electrode 370 in the transmit mode*, and to receive a small current signal (e.g., around 1 uA) from the electrode 370 in the receive mode.” Westhues, ¶ [0051] (emphasis added). Additionally, Westhues discloses that “the transmit/receive circuit *uses a battery voltage (e.g., approximately 3 V) and generates a high voltage at ~100V (delivering tens of microamps of current at a maximum)*, and a receiver can be placed on the same node.” Westhues, ¶ [0056] (emphasis added). “In FIG. 4, the transmit/receive circuit uses a battery voltage (e.g., approximately 3V) and generates a high voltage at ~100V (delivering tens of microamps of current at a maximum), and a receiver can be placed on the same node”. Westhues, ¶ [0056] It would be appreciated that the “high voltage” of Westhues meets all requirements of limitation 1[b] regarding “at least some of the signals comprising high-voltage signals associated with a high voltage comprising a relatively large potential difference compared to a voltage within a voltage range of approximately 1 to approximately 3 volts.” For example, the “high voltage” of approximately 100 V, as in Westhues, would be understood by a POSITA as being used to transmit “high-voltage signals,” as claimed, and the “high voltage” of Westhues has a relatively large potential difference compared to a voltage in a range of approximately 1 to approximately 3 volts.

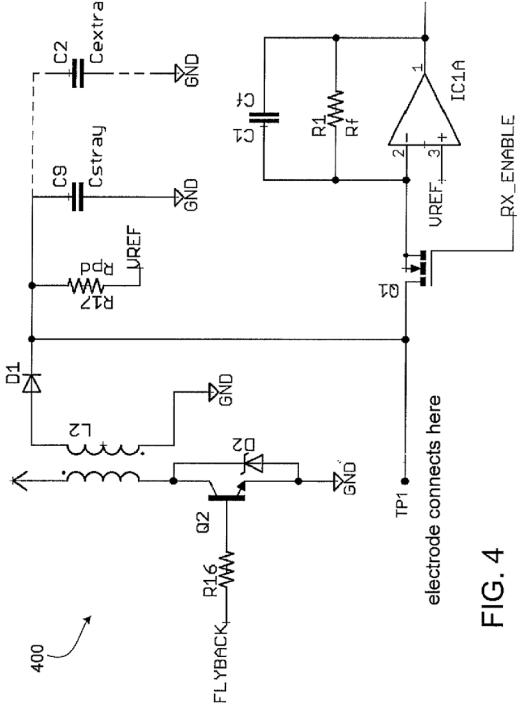
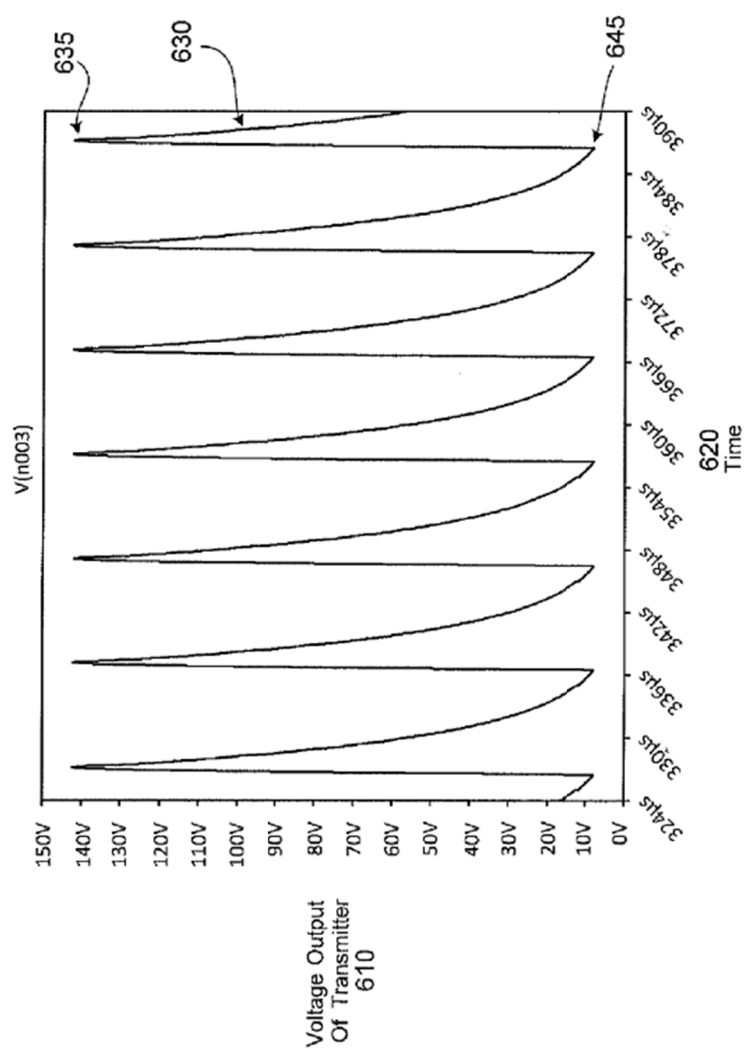


FIG. 4 of Westhues

FIG. 6 of Westhues depicts a diagram with an example of the Voltage output of the transmitter versus time. Westhues, ¶ [0029].



Output of transmitter, with $V_{in} = 3\text{ V}$, $C_{stray} = 7\text{ pF}$, $R_{pd} = 100\text{ k}$, $L_{pri} = 200\text{ uH}$, $L_{sec} = 10\text{ mH}$ (for 1:7 turns ratio)

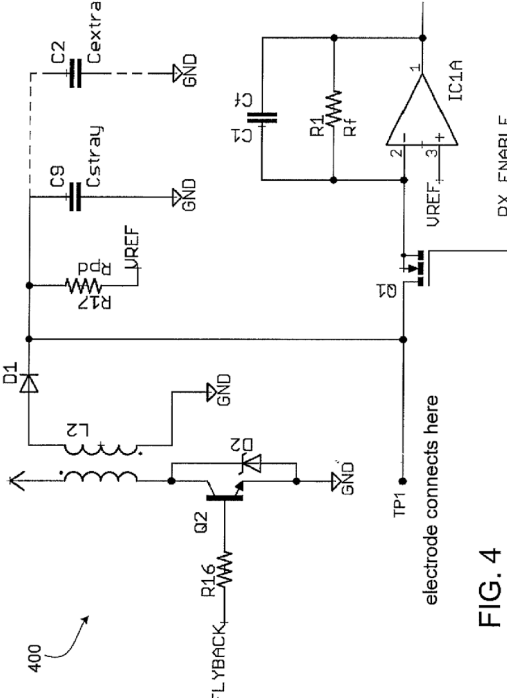
FIG. 6

FIG. 6 of Westhues

To the extent Westhues does not expressly, implicitly, or inherently disclose the substance of limitation **1[b]**, one of ordinary skill in the art could modify Westhues in view of Kremin to meet this limitation.

Kremin discloses a booster 870 to boost a battery voltage (e.g., of 1.5 volts) to allow a tip driver 890 to amplify a TX signal 835 of a host device 805 to a higher voltage (e.g., 10 to 20 volts). Kremin ¶ [0084]. Kremin further discloses wireless communication using the disclosed stylus. Kremin ¶ [0079], [0081], & [0084]-[0085]. Kremin discloses a “high-voltage signal” that has a “relatively large potential difference” from the range of 1-3 volts, as in limitation **1[b]**. The signal 835 may be amplified by the booster 870 to a higher voltage signal 898, for example up to 10 to 20 volts, which has a relatively large potential difference compared to a voltage within a voltage range of approximately 1 to 3 volts. *Id.* ¶ [0084]. The signal 898 is transmitted via the touch sensor stylus tip 895. *Id.* In some embodiments, the signal can be amplified

Claim 1	Example Disclosures in Prior Art
	to a voltage of 20 to 50 volts. <i>Id.</i> ¶ [0048]. The high voltage signal is then capacitively coupled with the sensing device through the tip 895. <i>Id.</i> ¶ [0085]. The diagram, titled "Synchronized Stylus Block Diagram", illustrates a system for a stylus (890) interacting with an ITO layer (810). The stylus (890) includes a tip driver (890) and a tip (895). A transmitter (840) is connected to the tip driver (890) and a receiver (855). The receiver (855) is connected to a booster (870) and a battery (880). The transmitter (840) is connected to a sensing device (830). The sensing device (830) is connected to a multiplexer (MUX 825) and a receiver (RX). The ITO layer (810) is connected to a multiplexer (MUX 820) and a receiver (RX). The diagram also shows a stylus (890) with a tip driver (890) and a tip (895). The tip driver (890) is connected to a transmitter (840) and a receiver (855). The transmitter (840) is connected to a sensing device (830). The sensing device (830) is connected to a multiplexer (MUX 825) and a receiver (RX). The ITO layer (810) is connected to a multiplexer (MUX 820) and a receiver (RX). The diagram also shows a stylus (890) with a tip driver (890) and a tip (895). The tip driver (890) is connected to a transmitter (840) and a receiver (855). The transmitter (840) is connected to a sensing device (830). The sensing device (830) is connected to a multiplexer (MUX 825) and a receiver (RX). The ITO layer (810) is connected to a multiplexer (MUX 820) and a receiver (RX). FIG. 8 of Kremin (annotated) It would be obvious to a person of ordinary skill in the art to modify Westhues to implement techniques disclosed in Kremin, and a person of ordinary skill in the art would have been motivated to so modify Westhues for one or more obvious benefits. For example, while the high-voltage signal of Westhues may use a voltage of, e.g., 100 volts (Westhues, ¶ [0051]), Kremin describes embodiments that can perform hover detection using a high-voltage signal with a voltage of, e.g., 10-20 volts (Kremin, ¶ [0084]). A person of ordinary skill in the art would appreciate that the 10-20 volt range used for the high-voltage signal of Kremin would have various advantages, such as decreased power consumption, while still implementing high-voltage features. Other obvious benefits that would motivate a person of ordinary skill in the art to modify Westhues based on Kremin include the ability to simulate and/or distinguish between the stylus and a passive touch object, such as a finger or hand, as further discussed below with reference to claim 5.

Claim 1	Example Disclosures in Prior Art
1[c] a component operable to convert the voltage of approximately 1 to 3 volts to the high voltage; and	As discussed in my declaration, limitation 1[c] is likely a means-plus-function limitation corresponding to a transformer or a charge pump, as disclosed in the '866 patent specification. For the reasons discussed below, the illustrated circuit of Westhues (which includes a transformer) performs the identical function specified in limitation 1[c] in substantially the same way, and produces substantially the same results as the corresponding element disclosed in the specification. Westhues, therefore, anticipates and renders obvious limitation 1[c] under a means-plus-function analysis. Even if limitation 1[c] were not interpreted as a means-plus-function limitation, Westhues still anticipates and renders obvious limitation 1[c] for the reasons discussed below. FIG. 4 of Westhues illustrates a transmit/receive circuit that “uses a battery voltage (e.g., approximately 3 V) and generates a high voltage at ~100V (delivering tens of microamps of current at a maximum).” Westhues, ¶ [0056].  FIG. 4 FIG. 4 of Westhues “The high voltage can be generated using a flyback circuit, similar to the flyback circuit used to excite a cathode ray tube display, or used in a switch-mode power supply. The flyback circuit includes the transformer L2, which stores energy. Energy may flow into the first or primary winding of L2, be stored as a magnetic field, within the core of L2, and then flow out of the core of L2, through the secondary winding of L2. The voltage may be transformed according to the turns ratio of the transformer L2, and according to the timings of the applied signals. The energy flowing out through the secondary winding of L2 may flow into the stray capacitance at the output through D1, and develop the high voltage across that stray capacitance.” Westhues, ¶ [0056]. It would be appreciated that at least a portion of the circuit illustrated in FIG. 4 of Westhues is “a component operable to convert the voltage of approximately 1 to 3 volts to the high voltage,” as in limitation 1[c]. For example, the transformer L2 of Westhues would be understood as at least a portion of a component operable to convert the voltage of approximately 1 to 3 volts to the high voltage.

Claim 1	Example Disclosures in Prior Art
	To the extent Westhues does not expressly, implicitly, or inherently disclose the substance of limitation 1[c], one of ordinary skill in the art could modify Westhues in view of Kremin to meet this limitation. For example, the booster 870 of Kremin, which is discussed above, would also be understood as “a component operable to convert the voltage of approximately 1 to 3 volts to the high voltage,” as in limitation 1[c] for the reasons discussed in Appendix A. It would have been obvious to a person of ordinary skill in the art to implement the booster 870 of Kremin in the stylus of Westhues. An example of such an implementation could produce a high-voltage signal in the range of 10 to 20 volts, as disclosed in Kremin, rather than the ~100 volts disclosed in Westhues, for one or more obvious benefits, such as reduced power consumption.
1[d] a stylus tip, one or more of the one or more electrodes being disposed at the stylus tip;	Westhues discloses that the stylus includes “a <i>tip</i> that is configured to interact with the matrix of the capacitive touch sensor.” Westhues, ¶ [0006] (emphasis added). For example, FIG. 1 of Westhues illustrates “a thin metal wire forming [a] tip 120” of the stylus, which is used to transmit the signal. Westhues, ¶ [0038]. Westhues, therefore, discloses “a stylus tip,” as in limitation 1[d]. FIG. 1 of Westhues To transmit the high-voltage signal, the “transmit/receive switch 360 can allow a high voltage (e.g., around 100 V) output to be applied to the <i>electrode 370</i> in the transmit mode, and to receive a small current signal (e.g., around 1 uA) from the electrode 370 in the receive mode.” Westhues, ¶ [0051] (emphasis added). “A cathode of diode D1 is coupled to node TP1 where the electrode connects.” Westhues, ¶ [0056]. It would be appreciated that the electrode of Westhues is “one or more of the one or more electrodes being disposed at the stylus tip,” as in limitation 1[d].

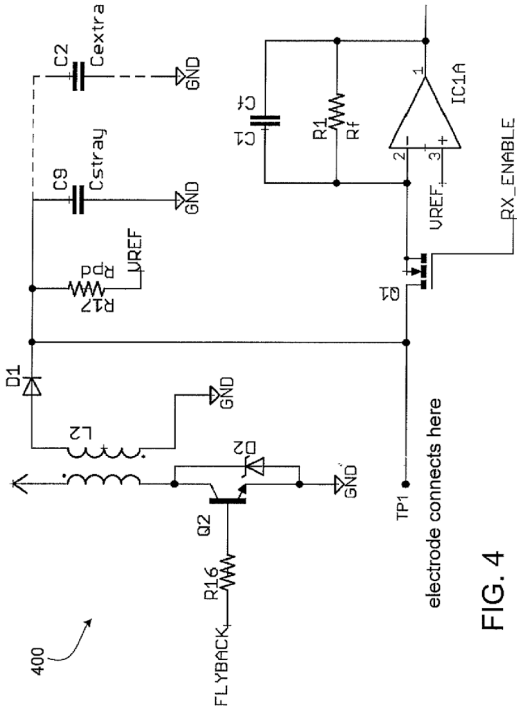


FIG. 4

FIG. 4 of Westhues

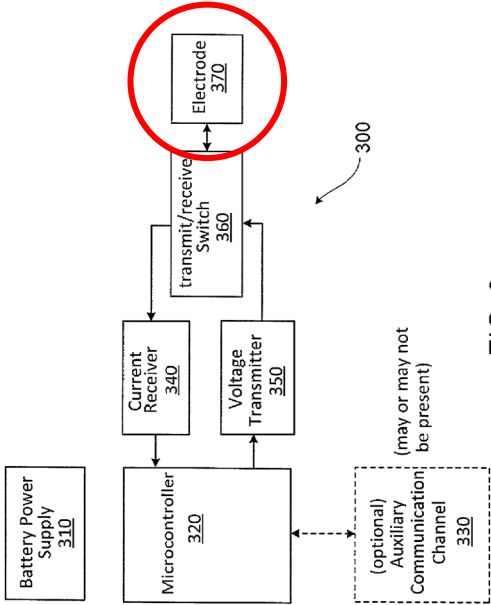


FIG. 3

FIG. 3 of Westhues (annotated)

Example Disclosures in Prior Art	
Claim 1	As discussed above, FIG. 4 of Westhues illustrates a transmit/receive circuit that “uses a battery voltage (e.g., approximately 3 V) and generates a high voltage at ~100V (delivering tens of microamps of current at a maximum).” Westhues, ¶ [0056]. For the reasons discussed above, this circuit is used to transmit high-voltage signals as claimed. FIG. 4 illustrates that “[t]he energy flowing out through the secondary winding of [transformer] L2 may flow into the stray capacitance at the output through [diode] D1, and develop the high voltage across that stray capacitance.” Westhues, ¶ [0056]. “A cathode of diode D1 is coupled to node TP1 <i>where the electrode connects</i>.” Westhues, ¶ [0056] (emphasis added). In other words, the electrode of Westhues receives the high voltage, provided using the transformer, via the node TP1. As discussed above, the electrode is disposed in the tip and used to transmit the high-voltage signals. Therefore, Westhues discloses “wherein the high-voltage signals result from the one or more electrodes receiving the high voltage,” as in limitation 1[e].

Claim 2	Example Disclosures in Prior Art
The stylus of claim 1, wherein the component is a transformer.	As discussed above with reference to limitation 1[c], FIG. 4 of Westhues illustrates a circuit used to generate the high voltage, at least a portion of which is the claimed “component operable to convert the voltage of approximately 1 to 3 volts to the high voltage,” as claimed. The illustrated circuit includes “<i>transformer L2</i>,” which is used to provide the high voltage. Westhues, ¶¶ [0055]-[0060]. “The high voltage can be generated using a flyback circuit, similar to the flyback circuit used to excite a cathode ray tube display, or used in a switch-mode power supply. The flyback circuit includes the transformer L2, which stores energy. Energy may flow into the first or primary winding of L2, be stored as a magnetic field, within the core of L2, and then flow out of the core of L2, through the secondary winding of L2. The voltage may be transformed according to the turns ratio of the transformer L2, and according to the timings of the applied signals.” Westhues, ¶ [0056]. Westhues, therefore, discloses claim 2.

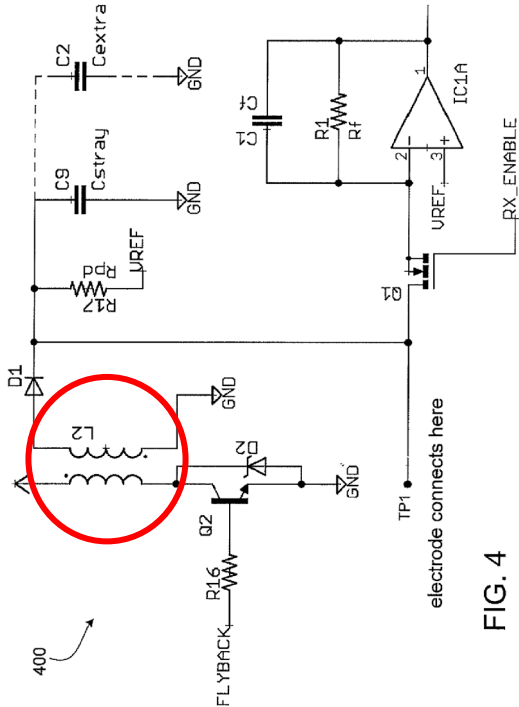


FIG. 4

FIG. 4 of Westhues (annotated)

Claim 3	Example Disclosures in Prior Art
The stylus of claim 1, wherein the high voltage comprises a voltage within the voltage range of approximately 10 to approximately 20 volts.	To the extent these terms are not indefinite, it would be appreciated that these features are at least inherent in Westhues. While specific examples in Westhues discuss a high voltage of approximately 100 volts (Westhues, ¶¶ [0051] & [0056]), these examples are non-limiting (Westhues, ¶¶ [0070] & [0072]). Accordingly, a person of ordinary skill in the art would appreciate that a voltage range of approximately 10 to approximately 20 volts would be contemplated by Westhues, and this particular voltage range would be merely a design choice that does not involve any inventive step. It would be well within the knowledge of a person of ordinary skill in the art to generate a high-voltage signal in this range. Additionally or alternatively, it would be obvious to implement the feature “wherein the high voltage comprises a voltage within the voltage range of approximately 10 to approximately 20 volts” in view of Westhues and the knowledge of a person of ordinary skill in the art and/or in view of Kremin. For example, even if claim 3 were not inherent in Westhues, it would be obvious to a POSITA to modify the stylus of Westhues to use this specific voltage range and a POSITA would understand that the specific high voltage used would be merely a matter of design choice. A POSITA would also understand that decreasing the voltage would significantly decrease power consumption and thus improve the battery life of the stylus. Additionally, Kremin describes a high-voltage signal that can be, for example, 10 to 20 volts. Kremin, ¶ [0084]. It would have been obvious to a person of ordinary skill in the art to implement the booster 870 of Kremin in the stylus of Westhues. An example of such an implementation could produce a high-voltage signal in the range of 10 to 20 volts, as disclosed in Kremin, rather than the ~100 volts disclosed in Westhues, for one or more obvious benefits, such as reduced power consumption.
Claim 4	Example Disclosures in Prior Art
The stylus of claim 1, wherein the high-voltage signals identify a location of the stylus relative to the touch sensor of the device.	Westhues includes much disclosure on identifying the location of the stylus relative to the touch sensor. For example, Westhues describes that the disclosed stylus transmits signals “to localize itself among the rows and receives to localize itself among the columns,” and uses these localizations to perform interpolation “to determine a more exact location in the touch sensor.” Westhues, ¶ [0042]. Westhues also discloses that “[t]he active stylus is configured to receive a signal from a matrix of the capacitive touch sensor to measure a first position along one axis, and transmit a signal from the single electrode of the stylus to the matrix to indicate a second position of the stylus along another axis of the matrix. The stylus can transmit the received signal to report the first position of the stylus”. Westhues at ABSTRACT. Claim 1 of Westhues claims “[a] method for using an active stylus to enable determination of a two-dimensional position of the active stylus relative to a capacitive touch sensor, wherein the capacitive touch sensor has a two-dimensional matrix of conductors configured as a first array of conductors arranged in rows and a second array of conductors arranged in columns, and wherein the active stylus has an electrode and active components”. Westhues, therefore, discloses “wherein the high-voltage signals identify a location of the stylus relative to the touch sensor of the device,” as in claim 4. To the extent Westhues does not expressly, implicitly, or inherently disclose the substance of claim 4, one of ordinary skill in the art could modify Westhues in view of Kremin to meet this limitation.

For example, Kremin describes that the high voltage stylus signal 898 allows for robust detection of the stylus 850 location, as well as detection while hovering over but not physically touching a sensing device. Kremin ¶ [0084]. “FIG. 20 is flow diagram of one embodiment of a method of tracking the position of a passive touch object and a stylus on a capacitive sense array”. Kremin ¶[0046]. “FIG. 21 is flow diagram of one embodiment of a method of tracking the position of a stylus that is contacting or hovering over a capacitive sense array”. Kremin ¶[0047].

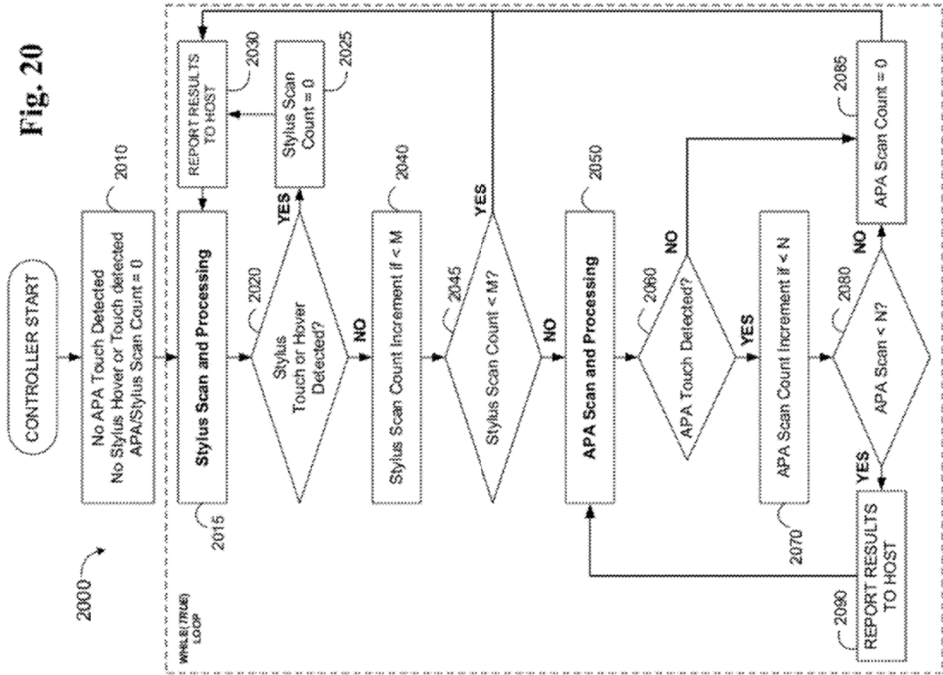


FIG. 20 of Kremin

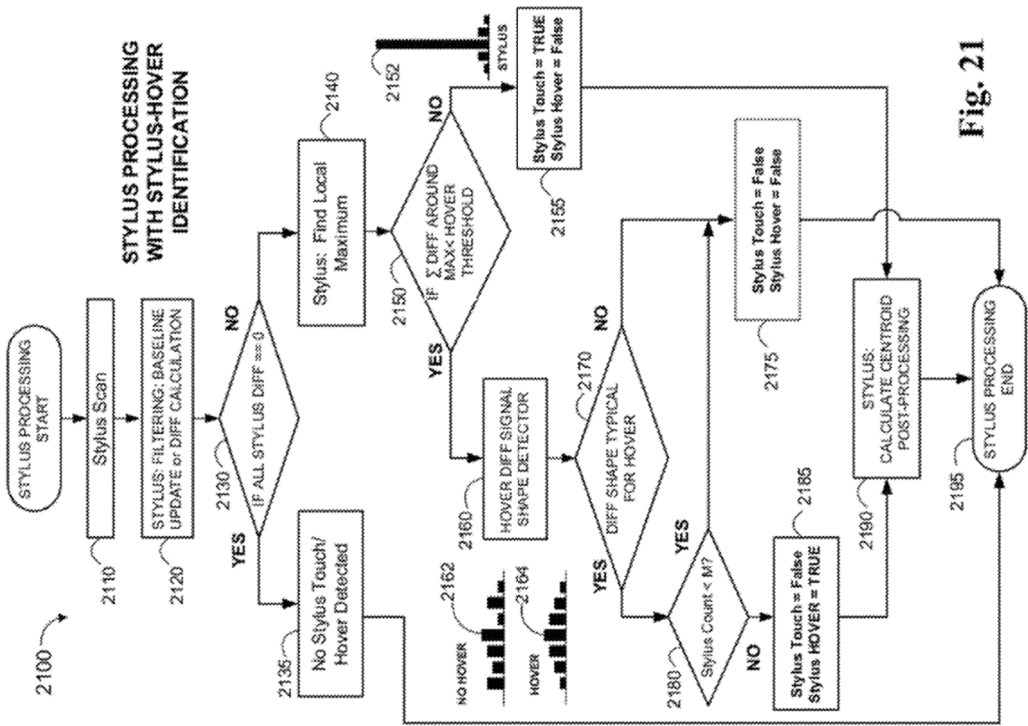


FIG. 21 of Kremin

Kremin, therefore, also discloses claim 4, and it would be obvious to a person of ordinary skill in the art to use the high-voltage signal of Westhues to identify a location of the stylus relative to the touch sensor of the device, as further disclosed in Kremin.

Claim 5	Example Disclosures in Prior Art
The stylus of claim 1, wherein, when the stylus is in contact with or in the proximity of the touch sensor of the device, the high-voltage signals are used to simulate or distinguish: contact by an object other than the stylus with the device; or a presence of the object near the touch sensor of the device.	FIG. 2A of Westhues depicts a diagram showing a division of a frame into timeslots with finger touch only. Westhues, ¶ [0024]. FIG. 2B of Westhues depicts a diagram showing a division of a frame into timeslots with finger touch and the stylus. Westhues, ¶ [0025]. With reference to FIG. 2B, Westhues describes techniques for localizing both a finger touch and one or more styluses. Westhues, ¶ [0044]. In contrast to the process for identifying the location of a finger touch, the stylus <i>receives</i> a signal to localize itself among columns of the touch sensor of the device, but <i>transmits</i> a signal to localize itself among rows of the device. Westhues, ¶ [0042]. In an example implementation, a frame 220 includes a timeslot 225 for a synchronization pulse, and “n” timeslots corresponding to a number of columns of the sensor, as well as “m” timeslots corresponding to the number of styluses to be detected. Westhues, ¶ [0044]. A position of the stylus relative to the columns can be calculated at the host device, similar to techniques for detecting a finger touch, but a position of the stylus relative to the columns can instead be calculated within the stylus and transmitted back to the host using the added timeslots. Westhues, ¶ [0045]-[0046]. This is in contrast to localizing a finger, where column and row coordinates are determined at the host side. <i>See id.</i> & FIG. 2A. This would be understood as distinguishing “contact by an object other than the stylus with the device” when the stylus “is in contact with or in the proximity of the touch sensor of the device” using the high-voltage signals, as in claim 5, because Westhues uses distinct techniques for localizing a finger touch and a stylus. See also Westhues, ¶ [0049], including treatment of both stylus and finger touch. Furthermore, a POSITA would understand that the high voltage signal generated by the stylus will provide differentiation from the finger touch.

Claim 5	Example Disclosures in Prior Art
	FIG. 2B Westhues, therefore, meets the limitations of claim 5 for at least these reasons. To the extent Westhues does not expressly, implicitly, or inherently disclose the substance of claim 5, one of ordinary skill in the could modify Westhues in view of Kremin to meet this limitation. For example, Kremin’s stylus design emphasizes allowing for multi-touch and simultaneous input signals, including simultaneous use of a stylus and touch object. Kremin ¶ [0003]. Kremin’s use of high-voltage signals allows for, and distinguishes between, simultaneous use of a stylus 330 and touch object 340. Kremin ¶¶ [0024], [0051], [0086]. Kremin further discloses how, for example, a stylus and palm contacting a device will both produce transmit signals but are distinguishable by the strong voltage of the stylus tip transmit signal, as opposed to the voltage of a palm or other contacting devices. Kremin ¶ [00102]. This encompasses <i>distinguishing</i> between contact by the stylus and passive touch objects when the stylus is in contact with or in the proximity of the touch sensor of the device. Kremin ¶¶ [00102], [00103].

Claim 5

Example Disclosures in Prior Art

FIG. 3 of Kremin is “a block diagram illustrating one embodiment of an electronic system having a processing device for detecting a presence of a touch object and a stylus”. Kremin ¶[0018]. FIG. 12A of Kremin is “a diagram illustrating the electrical effect of a stylus and palm simultaneously contacting an ITO panel”. Kremin ¶[0032].

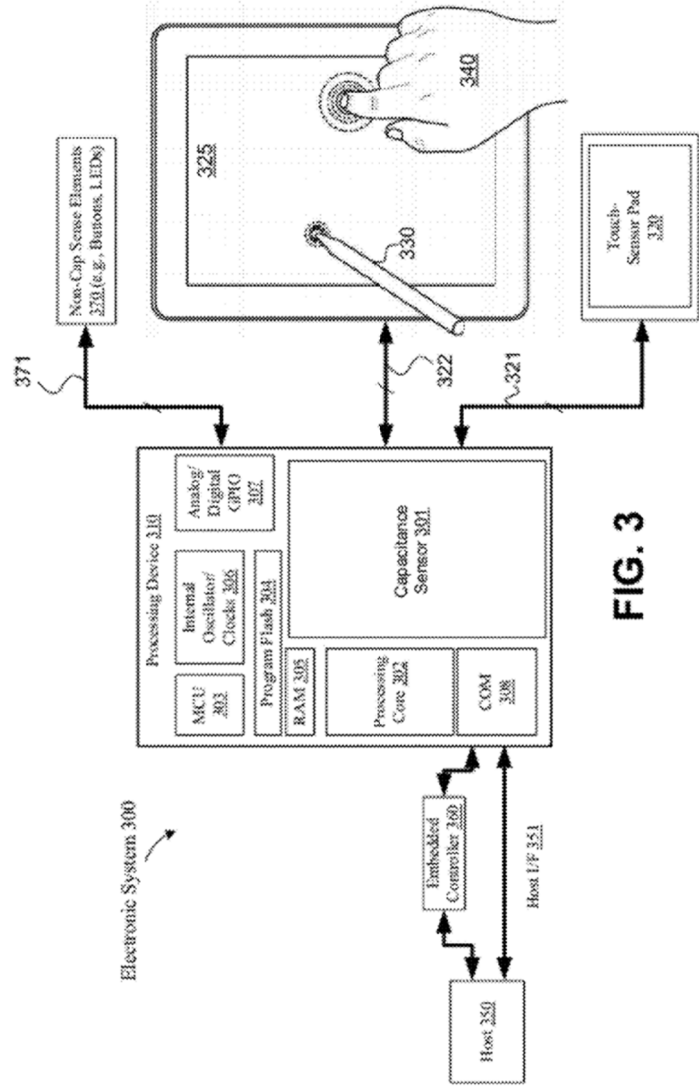


FIG. 3 of Kremin

Claim 5	Example Disclosures in Prior Art
	FIG. 12A (left) and 12B (right) of Kremin As described above, high-voltage signals as in Kremin allow for detection while the stylus tip hovers over the host device. Kremin ¶¶ [0048], [0084], [0099]. The stylus’s presence can therefore be detected and contact with the device can be simulated while the stylus is hovering—i.e., in proximity to the device—rather than while it is contacting the device directly. Kremin further describes an embodiment in which the stylus signal amplitude, frequency, phase, or so on is the same or similar to the signal utilized for finger sensing by the touch screen controller. Kremin ¶ [0076]. Accordingly, a stylus may <i>simulate</i> contact by another object or the presence of another object when the stylus is in contact with or in the proximity of the touch sensor of the device, by using the frequency or phase the device uses to perform finger sensing. Kremin therefore also discloses claim 5. As discussed above, it would be obvious to a person of ordinary skill in the art to modify the technology of Westhues based on Kremin, and a person of ordinary skill in the art would be motivated to so modify Westhues based on Kremin for one or more obvious benefits, including the ability to both simulate and distinguish between a finger touch and a stylus touch.

Claim 6	Example Disclosures in Prior Art
The stylus of claim 5, wherein the object is least a part of a human hand.	As discussed above with reference to claim 5, Westhues at least discloses using distinct techniques for localizing a finger touch and a stylus. A finger is an object that is “at least a part of a human hand.” Westhues, therefore, discloses and/or renders obvious claim 6. To the extent Westhues does not expressly, implicitly, or inherently disclose the substance of claim 6, one of ordinary skill in the art could modify Westhues in view of Kremin to meet this limitation. For example, as discussed above with reference to claim 5, the technology of Kremin can be used both to simulate a touch by a user’s finger and to distinguish the touch of a user’s palm or finger. Kremin ¶¶ [0024], [0051], [0076], [0086], [00102]-[00103]. The user’s palm, in particular, is a heavy focus of Kremin and seen in Figures 12A and 12B. Accordingly, Kremin also discloses claim 6. As discussed above, it would be obvious to a person of ordinary skill in the art to modify the technology of Westhues based on Kremin, and a person of ordinary skill in the art would be motivated to so modify Westhues based on Kremin for one or more obvious benefits, including the ability to both simulate and distinguish between a finger touch and a stylus touch.

Claim 7	Example Disclosures in Prior Art
The stylus of claim 5, wherein the high-voltage signals are based on a voltage used by at least a portion of the touch sensor of the device.	As discussed above with reference to claim 5, Westhues discloses techniques for localizing both a finger touch and one or more styluses. Westhues, ¶ [0044]. In contrast to the process for identifying the location of a finger touch, the stylus <i>receives</i> a signal to localize itself among columns of the touch sensor of the device, but <i>transmits</i> a signal to localize itself among rows of the touch sensor of the device. Westhues, ¶ [0042]. In an example implementation, a frame 220 includes a timeslot 225 for a synchronization pulse, and “n” timeslots corresponding to a number of columns of the sensor, as well as “m” timeslots corresponding to the number of styluses to be detected. Westhues, ¶ [0044]. A position of the stylus relative to the rows can be calculated at the host device, similar to techniques for detecting a finger touch, but a position of the stylus relative to the columns can instead be calculated within the stylus and transmitted back to the host using the added timeslots. Westhues, ¶¶ [0045]-[0046]. Westhues describes that the added timeslot is one “in which none of the columns transmit.” Westhues, ¶ [0042]. “Instead, the stylus transmits the same signal as would have been used to excite a column,” and the position of the stylus on a y axis is determined by looking at the outputs of the receivers attached to each row. <i>Id.</i> It would be appreciated, therefore, that Westhues implements the feature “wherein the high-voltage signals are based on a voltage used by at least a portion of the touch sensor of the device” because the signal transmitted by the stylus is received at the touch sensor and may be “the same signal as would have been used to excite a column.” <i>Id.</i> A person of ordinary skill in the art would understand that the signal would necessarily have characteristics similar to the signal that would otherwise be used to excite the column, such that this signal is at least “based on” a voltage used by columns and/or rows of the touch sensor. To the extent Westhues does not expressly, implicitly, or inherently disclose the substance of claim 7, one of ordinary skill in the art could modify Westhues in view of Kremin to meet this limitation. For example, Kremin describes multiple embodiments in which the high-voltage signal is generated by amplifying a signal originating from the device. This aligns with the embodiment in FIG. 8 of Kremin as well, where the sensing device 830 generates the transmit signal 835, which is sent 899 to the stylus receiver 855 and is amplified to a higher voltage signal 898 by the tip driver 890 via the voltage booster 870. Kremin ¶¶ [0082]-[0085]. The high-voltage signal is then capacitively coupled with the sensing device through the tip 895. <i>Id.</i> ¶ [0085]. The transmit signal 835 may be the same signal as the transmit signal generated and applied to the ITO 810 on the transmit lines 812 (or 814) during finger position tracking. Kremin ¶ [0083].

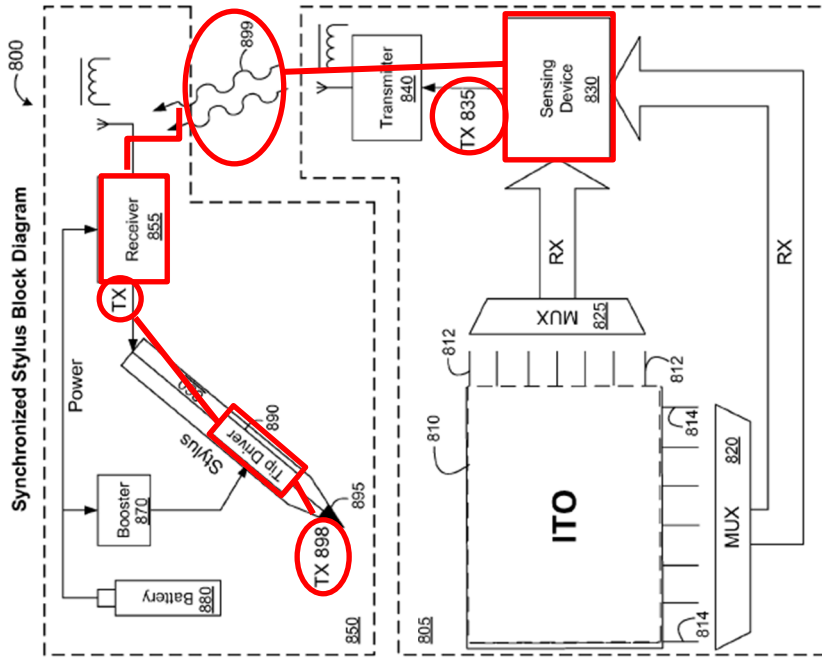


FIG. 8 of Kremin

Similarly, in the embodiment of FIG. 11, a transmit signal 1110 is generated by the sensing device, which is wirelessly transmitted to the stylus 1150; the receiver block of the stylus 1162 receives the signal, which is later amplified by the transit driver 1180 to 20 to 50 volts to improve the capacitive coupling between the stylus and sense array (or touch sensor) of the device 1180. Kremin ¶ [0098]-[00100]. The stylus tip then capacitively couples the amplified transmit signal to the touch sensor of the device. *Id.* The amplified transit signal, now high voltage, is accordingly based on the voltage used by the touch sensor.

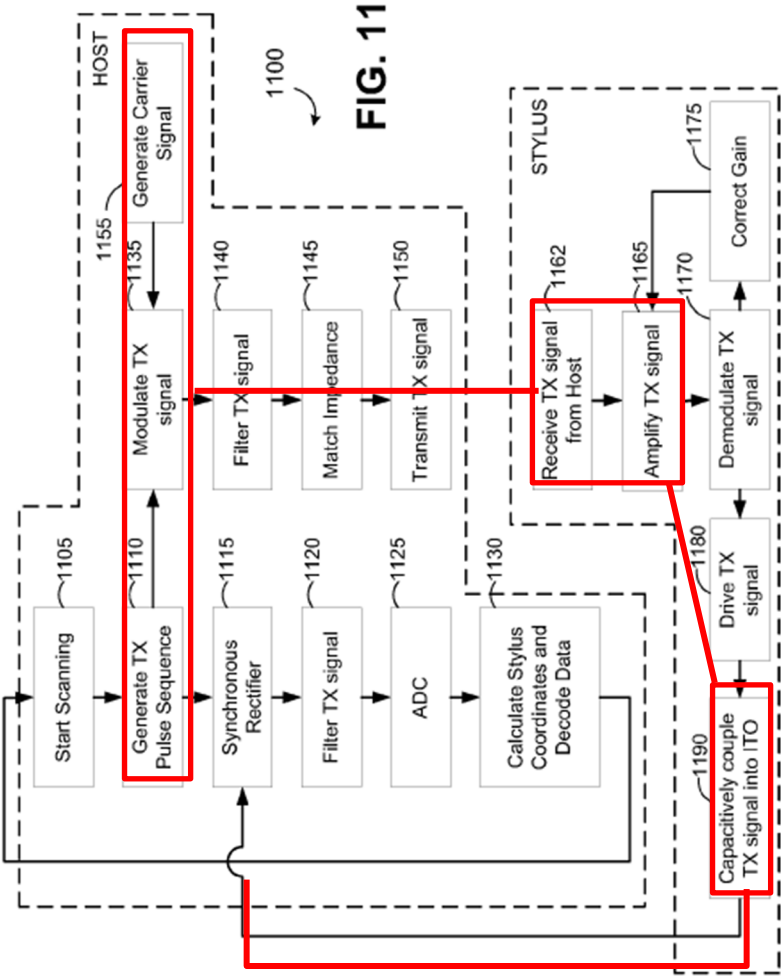


FIG. 11 of Kremin

This is iterated in Kremin’s explanation of palm rejection technology: the palm is not stimulated by the transmit signal that originated from the transmit drive circuit of the touch screen controller/touch sensor, so the device is able to differentiate between the stylus and a hand, because it can recognize the signal it created. Kremin ¶ [00103].

In each of the foregoing embodiments, a person of ordinary skill would appreciate that transmit signals are necessarily based on a voltage used by at least a portion of the touch sensor of the device, because they are generated from the touch sensor of the device. Kremin therefore also discloses claim 7. As discussed above, it would be obvious to a person of ordinary skill in the art to modify the technology of Westhues based on Kremin, and a person of ordinary skill in the art would be motivated to so modify Westhues based on Kremin for one or more obvious benefits, including the ability to both simulate and distinguish between a finger touch and a stylus touch.

Claim 15	Example Disclosures in Prior Art
15[pre] One or more non-transitory computer-readable storage media embodying logic that is operable when executed to:	See limitation 1[b] above.
15[a] transmit electromagnetic signals from a stylus to a device through a touch sensor of the device, at least some of the electromagnetic signals comprising high-voltage signals associated with a high voltage comprising a relatively large potential difference compared to a voltage within a voltage range of approximately 1 to approximately 3 volts, the stylus comprising:	See limitation 1[b] above. Limitation 1[b] differs from limitation 15[a] in that limitation 15[a] specifies transmission of “electromagnetic signals,” but a POSITA would understand that the signals transmitted according to Westhues are electromagnetic, as that term is used in the ‘866 patent. For example, it would be appreciated that electrostatic/capacitive coupling utilizes the electric field variations, which also generate magnetic fields, as governed by Maxwell’s Equations (specifically Ampère-Maxwell law). A POSITA would, therefore, appreciate that signals transmitted using capacitive coupling are electromagnetic signals. The unifying theory of electricity and magnetism is described by Maxwell's equations, which show that electric fields and magnetic fields are not separate phenomena but are interlinked. Additionally, even if signals transmitted via capacitive coupling were not electromagnetic, Westhues further discloses RF signals, which are also electromagnetic signals. Westhues, ¶ [0047]. Westhues therefore discloses limitation 15[a]. Furthermore, limitation 15[a] would be obvious to a POSITA in view of Westhues alone and/or in view of Westhues as modified according to Kremin for the reasons discussed above with reference to limitation 1[b].
15[a1] one or more electrodes for wirelessly transmitting the signals to the device;	See limitations 1[a] and 1[b] above. Specifically, the discussion of limitation 1[a] establishes anticipation of one or more electrodes, and the discussion of limitation 1[b] illustrates that the electrodes are used for wirelessly transmitting signals to the device under anticipation and obviousness analyses.

15[a2] a component operable to convert the voltage of approximately 1 to 3 volts to the high voltage; and

See limitation [1c] above. FIG. 4 of Westhues illustrates a transmit/receive circuit that “uses a battery voltage (e.g., approximately 3 V) and generates a high voltage at ~100V (delivering tens of microamps of current at a maximum)...” Westhues, ¶ [0056].

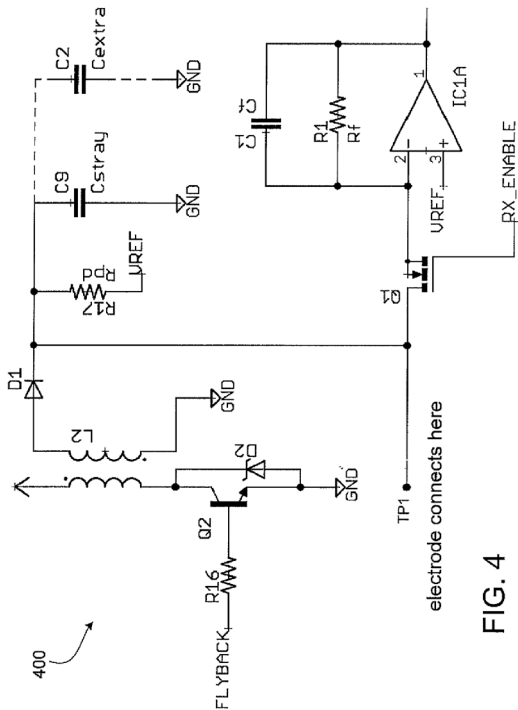


FIG. 4 of Westhues

“The high voltage can be generated using a flyback circuit, similar to the flyback circuit used to excite a cathode ray tube display, or used in a switchmode power supply. The flyback circuit includes the transformer L2, which stores energy. Energy may flow into the first or primary winding of L2, be stored as a magnetic field, within the core of L2, and then flow out of the core of L2, through the secondary winding of L2. The voltage may be transformed according to the turns ratio of the transformer L2, and according to the timings of the applied signals. The energy flowing out through the secondary winding of L2 may flow into the stray capacitance at the output through D1, and develop the high voltage across that stray capacitance.” Westhues, ¶ [0056]. It would be appreciated that at least a portion of the circuit illustrated in FIG. 4 of Westhues is “a component operable to convert the voltage of approximately 1 to 3 volts to the high voltage,” as in limitation **15[a2]**. For example, the transformer L2 of Westhues would be understood as at least a portion of a component operable to convert the voltage of approximately 1 to 3 volts to the high voltage.

To the extent Westhues does not expressly, implicitly, or inherently disclose the substance of limitation **15[a2]**, one of ordinary skill in the art could modify Westhues in view of Kremin to meet this limitation. For example, as described above, the stylus 850 of Kremin includes a receiver 855, booster 870, and tip driver 860 connected to a battery 880. The tip driver 890 of Kremin is a powered component containing a booster 870 operable to convert the initial voltage signal 835 to a high voltage signal 898 of 10 to 20 volts. Kremin ¶ [0081], [0084]. Kremin discloses a booster 870 to boost a battery voltage (e.g., of 1.5 volts) to allow a tip driver 890 to amplify a TX signal 835 of a host device 805 to a higher voltage (e.g., 10 to 20 volts). Kremin ¶ [0084]. Kremin therefore also discloses limitation **15[a2]**. It would be obvious to modify the stylus of Westhues based on Kremin, and a person of ordinary skill in the art would be motivated to so modify the stylus of Westhues for one

Claim 15	Example Disclosures in Prior Art
	or more obvious benefits, as discussed above. For example, a person of ordinary skill in the art would appreciate that the booster 870 of Kremin can be implemented in the stylus of Westhues as the “component operable to convert the voltage of approximately 1 to 3 volts to the high voltage.”
15[a3] a stylus tip, one or more of the one or more electrodes being disposed at the stylus tip;	See limitation 1[a] above. Westhues discloses that the stylus includes “a <i>tip</i> that is configured to interact with the matrix of the capacitive touch sensor.” Westhues, ¶ [0006] (emphasis added). For example, FIG. 1 of Westhues illustrates “a thin metal wire forming [a] tip 120” of the stylus, which is used to transmit the signal. Westhues, ¶ [0038]. Westhues, therefore, discloses “a stylus tip,” as in limitation 15[a3]. FIG. 1 FIG. 1 of Westhues To transmit the high-voltage signal, the “transmit/receive switch 360 can allow a high voltage (e.g., around 100 V) output to be applied to the <i>electrode 370</i> in the transmit mode, and to receive a small current signal (e.g., around 1 uA) from the electrode 370 in the receive mode.” Westhues, ¶ [0051] (emphasis added). “A cathode of diode D1 is coupled to node TP1 where the electrode connects.” Westhues, ¶ [0056]. A person of ordinary skill in the art would appreciate that the electrode of Westhues is disposed at the stylus tip. Accordingly, Westhues discloses “one or more of the one or more electrodes being disposed at the stylus tip,” as in limitation 15[a3].

Claim 15	Example Disclosures in Prior Art
15[a4] wherein the high-voltage signals result from the one or more electrodes receiving the high voltage.	As discussed above, FIG. 4 of Westhues illustrates a transmit/receive circuit that “uses a battery voltage (e.g., approximately 3 V) and generates a high voltage at ~100V (delivering tens of microamps of current at a maximum).” Westhues, ¶ [0056]. For the reasons discussed above, this circuit is used to transmit high-voltage signals as claimed. FIG. 4 illustrates that “[t]he energy flowing out through the secondary winding of [transformer] L2 may flow into the stray capacitance at the output through [diode] D1, and develop the high voltage across that stray capacitance.” Westhues, ¶ [0056]. “A cathode of diode D1 is coupled to node TP1 <i>where the electrode connects</i> .” Westhues, ¶ [0056] (emphasis added). In other words, the electrode of Westhues receives the high voltage, provided using the transformer, via the node TP1. As discussed above, the electrode is disposed in the tip and used to transmit the high-voltage signals. Therefore, Westhues discloses limitation 15[a4].
Claim 16	Example Disclosures in Prior Art
The media of claim 15, wherein the component is a transformer.	See claim 2 above.