

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. 9,280,220

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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. 9,280,220 (“the ’220 patent”) titled “Pulse- or Frame-Based Communication Using Active Stylus” to Shahrooz Shahparnia et al., and that the ’220 patent is currently assigned to Wacom Co., Ltd. (“Wacom”). I understand that the present proceedings involve a challenge to the validity of claims 1-5, 7-11, and 13-17 of the ’220 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 ’220 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 ’220 patent describes techniques for providing sensor data captured at one or more sensors in or on a stylus through a touch sensor of a device. I am familiar with the technology described in the ’220 patent as of its January 9,

2015 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 '220 patent and the references that form the basis for the grounds set forth in the Petition for *Inter Partes* Review of the '220 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, networking, multimedia, 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 Engineers (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 five times at deposition. That case involved computer systems design, interfacing with peripherals, signaling, and communication protocols.
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 '220 patent claims and that the disclosures of the '220 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 '220 patent to be October 28, 2011, the earliest possible priority date for the '220 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 claim is unpatentable if it is anticipated or obvious. I understand that anticipation of a claim requires that every element of a claim

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.

23. 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 requirements of the claim cannot be found in a single prior art reference that would anticipate the claim, the claim can still be unpatentable.
24. 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.

25. 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.
26. 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.
27. 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.

28. 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.
29. 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.
30. 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.

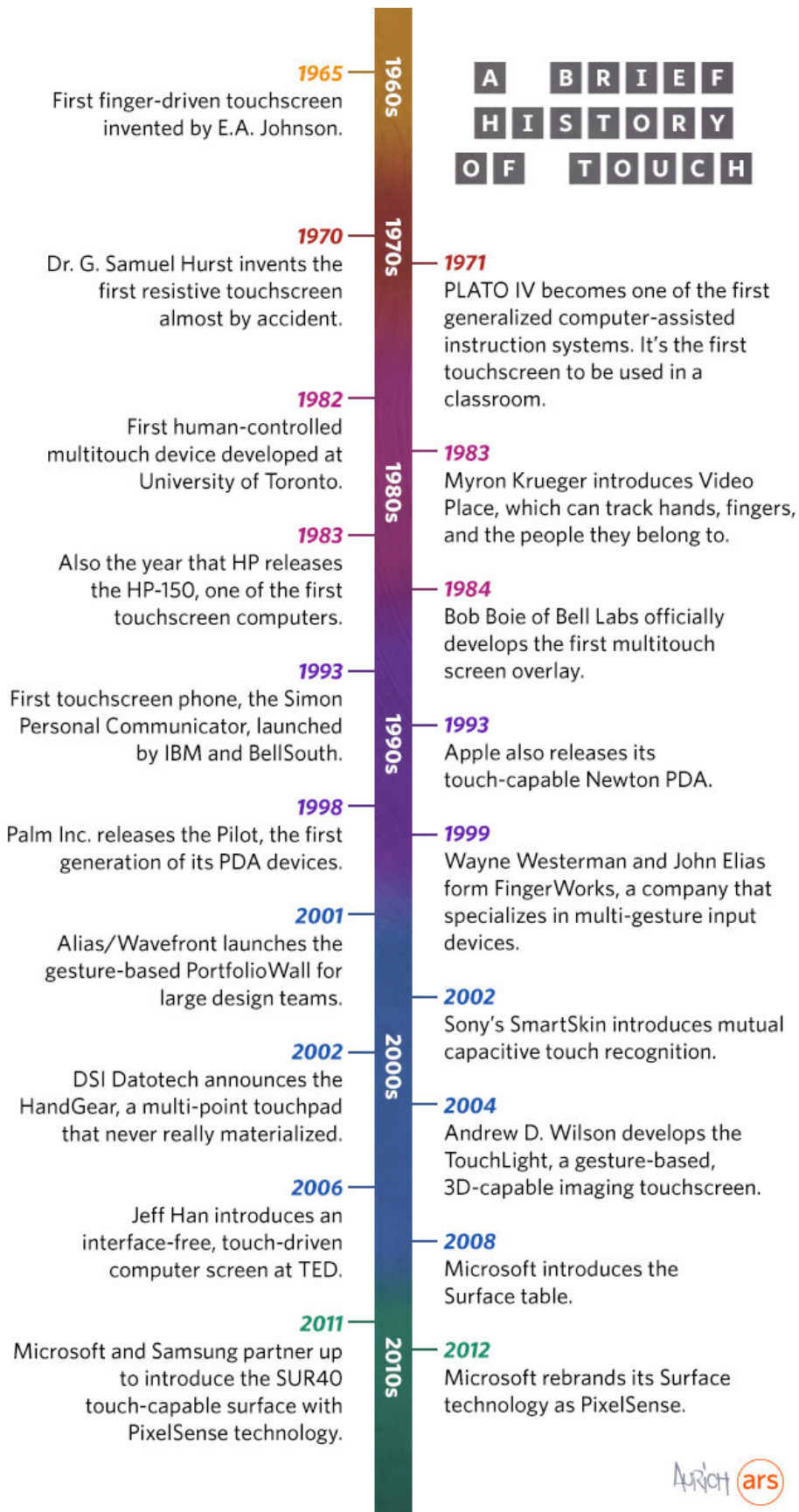
IV. Overview of the '220 Patent

A. Brief Background of the Prior Art

31. The '220 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.
32. 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.
33. 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.

34. Both active and passive styluses have been known for decades. For example, U.S. Patent No. 6,377,248 to Partow (“Partow”), 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.” Partow at Abstract, Title.
35. 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. 1019 (available at <https://arstechnica.com/gadgets/2013/04/from-touch-displays-to-the-surface-a-brief-history-of-touchscreen-technology/>)

B. Disclosure of the '220 Patent

36. The '220 patent is titled “Pulse- or Frame-Based Communication Using Active Stylus,” and it is directed to techniques for receiving, through a touch sensor of a device, sensor data captured using one or more sensors in or on a stylus.
37. The '220 patent describes embodiments of an active stylus, which may include buttons 30 and sliders 32, 34, which can be used to enable or alter functionality of the stylus or a device that receives inputs from the stylus, or for providing feedback to or accepting input from a user. Ex. 1001, 6:20-29. Additionally, the '220 patent describes ridges or grooves 24, which may provide tactile feedback to or accept tactile input from a user. *Id.* at 7:2-9. Other components that may be included in the stylus include audio components 38 for transmitting and receiving audio signals and visual feedback components 36. *Id.* at 7:9-20.

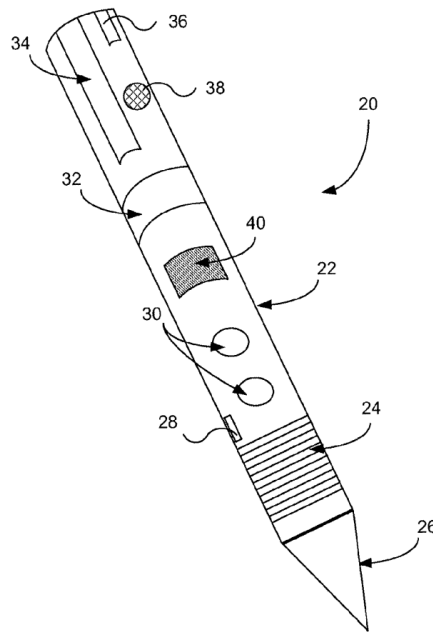


FIG. 2 of '220 Patent (Ex. 1001)

38. A tip 26 of the stylus of the '220 patent may include one or more electrodes configured to communicate data between the stylus and the device. *Id.* at 7:36-41. Additionally, a port 28 may be configured to transfer signals or information between the stylus and the device or a power source. *Id.* at 7:44-51.
39. The '220 patent describes that the stylus may further include a controller 50, memory 44, power source 48, and sensors 42. *Id.* at 7:58-61. These components may be used to provide communication between the stylus and the device, to enable or alter functionality of the stylus or the device, or to provide feedback to or accept input from a user. *Id.* at 8:1-5.

39. The '220 patent describes that the stylus may further include a controller 50, memory 44, power source 48, and sensors 42. *Id.* at 7:58-61. These components may be used to provide communication between the stylus and the device, to enable or alter functionality of the stylus or the device, or to provide feedback to or accept input from a user. *Id.* at 8:1-5.

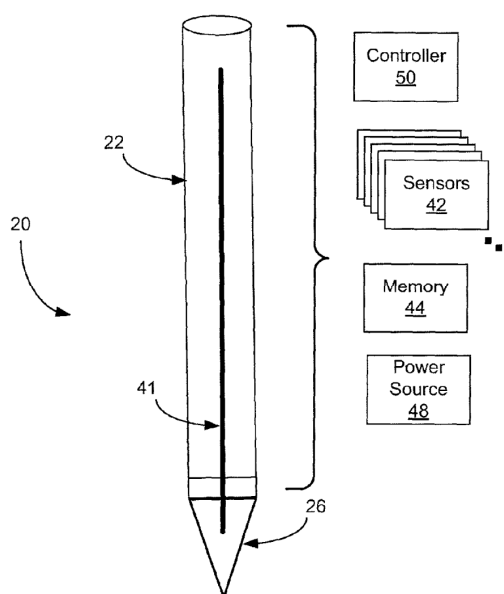


FIG. 3 of '220 Patent (Ex. 1001)

40. The sensors 42 may include touch sensors, gyroscopes, accelerometers, or contact sensors. *Id.* at 8:42-44. The sensors 42 may detect and measure one or more characteristics of the active stylus, such as acceleration, movement, orientation, contact, pressure, force, or vibration. *Id.* at 8:46-49.
41. The '220 patent discloses a method for communicating modulated data between the stylus and the device. *Id.* at 13:51-53. The stylus receives sensor data from the sensors 42. *Id.* at 13:53-54. The stylus waits to receive a carrier signal from the touch controller of the device, and the carrier signal is generated by the touch controller and transmitted to the stylus. *Id.* at 13:55-58. The stylus then modulates the carrier signal to include the sensor data, so that the sensor data can be communicated from the stylus to the touch

controller, and the modulated signal is then communicated. *Id.* at 13:58-63. The touch controller receives the modulated carrier signal including the sensor data, and the touch controller demodulates the carrier signal and extracts the sensor data. *Id.* at 13:64-67.

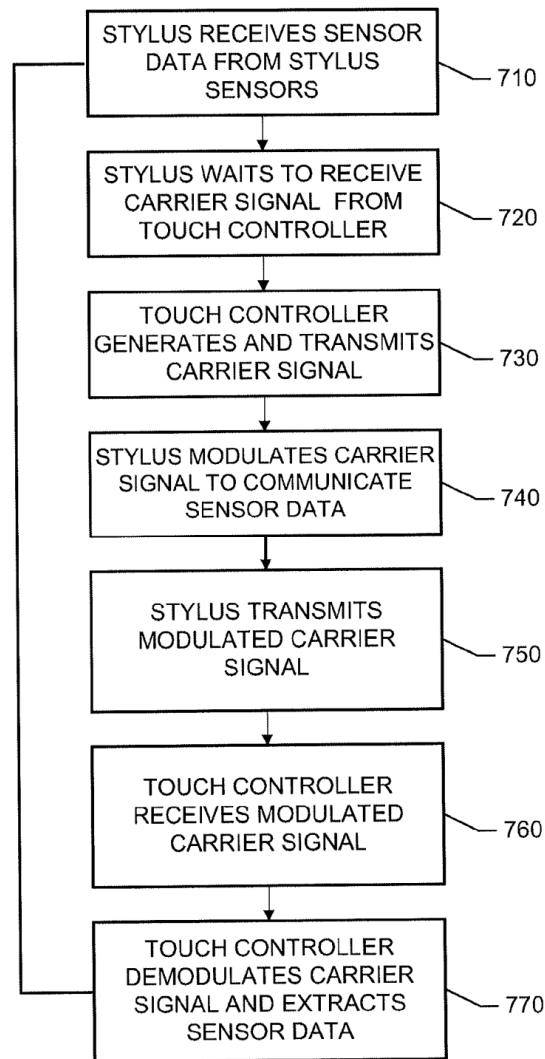


FIG. 7A of '220 Patent (Ex. 1001)

V. Challenged Claims

42. 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 sensors;”

1[b] – “one or more electrodes configured to communicate with a device by receiving signals from and transmitting signals to a touch sensor of the device; and”

1[c] – “one or more computer-readable non-transitory storage media embodying logic that is operable when executed to:”

1[c1] – “receive sensor data from the one or more sensors;”

1[c2] – “receive a first signal generated by the device;”

1[c3] – “generate a second signal by modulating a carrier signal based on the sensor data; and”

1[c4] – “transmit to the device, in response to the first signal, the second signal, the sensor data being obtainable by demodulating the second signal.”

Claim 2

“The stylus of claim 1, wherein the first signal is the carrier signal modulated to generate the second signal.”

Claim 3

“The stylus of claim 1, wherein the second signal is generated using one of:

amplitude modulation; frequency modulation; and phase modulation.”

Claim 4

“The stylus of claim 1, wherein:

the one or more sensors comprise a pressure sensor and a button; and

the sensor data comprises pressure data and button state data.”

Claim 5

“The stylus of claim 1, wherein the sensor data is digital.”

Claim 7

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

7[a] – “receive sensor data from one or more sensors in or on a stylus, the stylus comprising one or more electrodes configured to communicate with a device by receiving signal from and transmitting signals to a touch sensor of the device;”

7[b] – “receive a first signal generated by the device;”

7[c] – “generate a second signal by modulating a carrier signal based on the sensor data; and”

7[d] – “transmit to the device, in response to the first signal, the second signal, the sensor data being obtainable by demodulating the second signal.”

Claim 8

“The media of claim 7, wherein the first signal is the carrier signal modulated to generate the second signal.”

Claim 9

“The media of claim 7, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.”

Claim 10

“The media of claim 7, wherein:

the one or more sensors comprise a pressure sensor and a button; and

the sensor data comprises pressure data and button state data.”

Claim 11

“The media of claim 7, wherein the sensor data is digital.”

Claim 13

13[pre] – “A system comprising:”

13[a] – “a device comprising a touch sensor; and”

13[b] – “a stylus comprising:”

13[b1] – “one or more sensors;”

13[b2] – “one or more electrodes configured to communicate with a device by receiving signals from and transmitting signals to a touch sensor of the device; and”

13[b3] – “one or more computer-readable non-transitory storage media

embodying logic that is operable when executed to:”

13[b3A] – “receive sensor data from the one or more sensors;”

13[b3B] – “receive a first signal generated by the device;”

13[b3C] – “generate a second signal by modulating a carrier signal based on the sensor data; and”

13[b3D] – “transmit to the device, in response to the first signal, the second signal, the device being operable to obtain the sensor data by demodulating the second signal.”

Claim 14

“The system of claim 13, wherein the first signal is the carrier signal modulated to generate the second signal.”

Claim 15

“The system of claim 13, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.”

Claim 16

“The system of claim 13,
wherein: the one or more sensors comprise a pressure sensor and a button; and
the sensor data comprises pressure data and button state data.”

Claim 17

“The system of claim 13, wherein the sensor data is digital.”

VI. Level of Ordinary Skill in the Art

43. 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.
44. The art of the '220 patent relates to active styluses that may communicate with devices including touch sensors.
45. The inventors of the '220 patent are Shahrooz Shahparnia, Vivek Pant, Esat Yilmaz, Vemund Kval Bakken, Kishore Sundara-Rajan, John Stanley Dubery, Martin J. Simmons, and Sherif Hannah. At least some of the inventors have advanced degrees (e.g., master's degrees or higher) in electrical or computer engineering disciplines, including Mr. Shahparnia¹ and Mr. Bakken².
46. The types of problems encountered in the art include providing styluses with various functionalities that are easily and conveniently enabled by a user,

¹ Ex. 1010 (available for download at <https://www.linkedin.com/in/shahrooz-shahparnia-6596183/>)

²Ex. 1011 (available for download at <https://www.linkedin.com/in/vemundbakken/>)

providing reliable communication between a stylus and a device, and providing styluses that are easy to use.

47. 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.
48. Besides the inventors of the '220 patent, I am familiar with other workers 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 commonly have a degree in electrical or computer engineering³, or the like, which may also include computer science⁴.
49. After considering the factors mentioned above, and based on the disclosure of the '220 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

³ Ex. 1012 (available for download at <https://www.linkedin.com/in/westerma/>)

⁴ Ex. 1013 (available for download at <https://www.linkedin.com/in/hrvojebenko/>)

engineering, or the like.

VII. Summary of the Prosecution History

50. The patent application that issued as the '220 patent was filed on January 9, 2015 as a continuation of U.S. Patent Application No. 13/363,043 (issued as U.S. Patent No. 8,933,899), filed on January 31, 2012. Ex. 1002, pp. 163-170. The '220 patent claims priority to U.S. Provisional Application No. 61/553,114, filed on October 28, 2011. *Id.*
51. A preliminary amendment was filed on February 2, 2015, which cancelled the original claims and substituted new claims before examination began. *Id.* at 96-101. No objections or rejections were stated, and the application was allowed on November 2, 2015. The '220 patent issued on March 8, 2016. *Id.* at 28.

VIII. Teachings of the Prior Art and Applied References

52. This analysis relies primarily on six 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(s)	Publication Date
Japanese Patent Publication No. JP 2008-152640 to Kaneko	Susumu Kaneko	July 3, 2008

U.S. Patent Publication No. 20120105362	Viktor Kremin et al.	May 3, 2012 (priority date October 28, 2010)
U.S. Patent No. 8,766,954	Sandeep Vuppu et al.	Issued July 1, 2014 (filed December 21, 2010)
U.S. Patent No. 8,928,635	Jonah A. Harley et al.	January 6, 2015 (filed June 22, 2011)
U.S. Patent No. 8,988,398	Xiang Cao et al.	March 24, 2015 (filed February 11, 2011)
U.S. Patent Publication No. 20100085325	Oliver P. King-Smith et al.	April 8, 2010

53. None of the above prior art references, with the exception of Kremin, were before the examiner during the prosecution of the '220 patent. While Kremin is listed on the face of the '220 patent, nothing in the prosecution history indicates that the examiner substantively considered Kremin, and Kremin was not cited in any rejections of the application that issued as the '220 patent.

A. Japanese Patent Publication No. JP 2008-152640 to Kaneko (“Kaneko”) (Ex. 1005)

54. Kaneko is titled “Coordinate Input Device and Coordinate Input System” and was filed on December 19, 2006. Ex. 1005 at 1. Kaneko was published on July 3, 2008. *Id.*

55. The technology disclosed in Kaneko includes a coordinate input device that detects contact or proximity of an object to a panel using a loop coil unit

around the outer periphery of the panel. Ex. 1005, ¶ [0016]. A sensor matrix unit is arranged on the panel to detect the coordinate position where the object comes into contact or close proximity to the panel. *Id.* A voltage applied to each electrode within the sensor matrix unit is switched sequentially. *Id.* Based on a change in capacitance detected by the sensor matrix unit and/or a change in electric current in the loop coil unit, a computation processing unit detects the coordinate position where the object is in contact or near the panel. *Id.* The disclosed technology can be used to provide inputs using a finger and using a pen. *Id.* at ¶ [0020].

[Fig. 1]

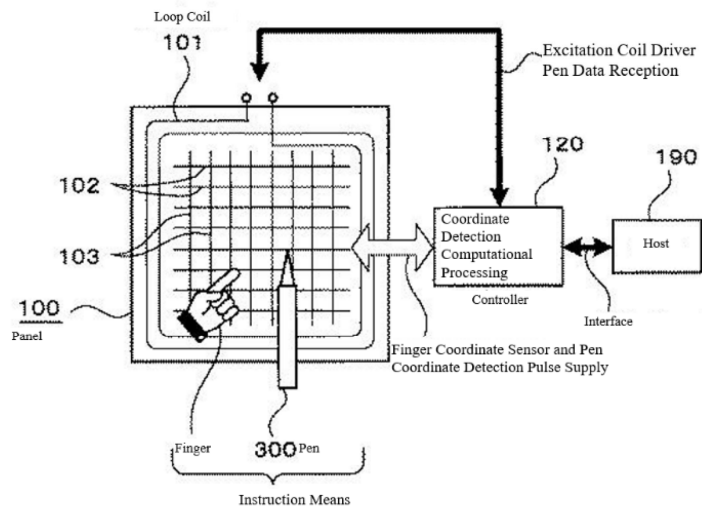


FIG. 1 of Kaneko (Ex. 1005)

56. The stylus of Kaneko includes a LC resonant circuit 310 used to receive signals from and communicate signals to the panel side (i.e., the host device). *Id.* at ¶¶ [0040]-[0041]. For example, the stylus includes a modulation circuit

that performs amplitude modulation to change an electric current through the loop coil on the panel side to transmit data from the stylus. *Id.* The signal is received at the panel side and demodulated to access the transmitted data. *Id.*

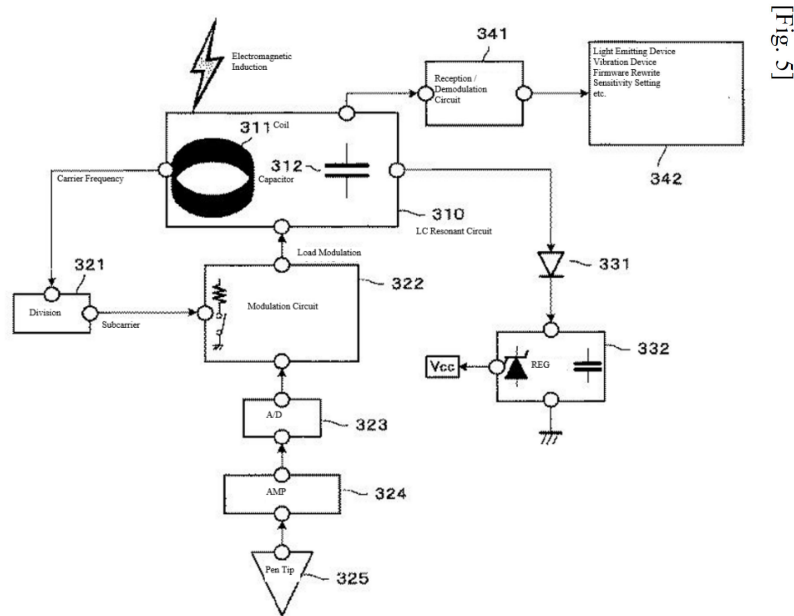


FIG. 5 of Kaneko (Ex. 1005)

57. Disclosed embodiments include sensors for capturing data to be transmitted, such as a pressure detection mechanism to detect pressure. *Id.* at ¶ [0024].

B. U.S. Patent Publication No. 20120105362 to Kremin et al. (“Kremin”) (Ex. 1009)

58. Kremin is titled “Synchronizing a Stylus With a Capacitive Sensor Array” and was filed on August 19, 2011. Ex. 1009 at 1. Kremin claims priority to multiple provisional patent applications filed on October 28, 2010. *Id.*
59. Kremin relates to the field of user interface devices and, in particular, to capacitive sensor devices. Ex. 1009 at ¶ [0002] [TECHNICAL FIELD].
60. The technology disclosed in Kremin includes embodiments of a system in

which a stylus can be detected and tracked by a processing device. *Id.* at ¶¶ [0051]-[0052]. In particular, Kremin discloses a system and method for tracking a stylus on a capacitive sense array. *Id.* at ABSTRACT. 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. *Id.*

61. Kremin also discloses a stylus for synchronizing and modulating data into a stylus transmit signal. *Id.* ¶ [0104]. The data to be modulated and transmitted may include, for example, data received from a force sensor. *Id.* at ¶¶ [0104] & [0109]. A synch mod block modulates the data using various modulation techniques. *Id.* at ¶ [0110].

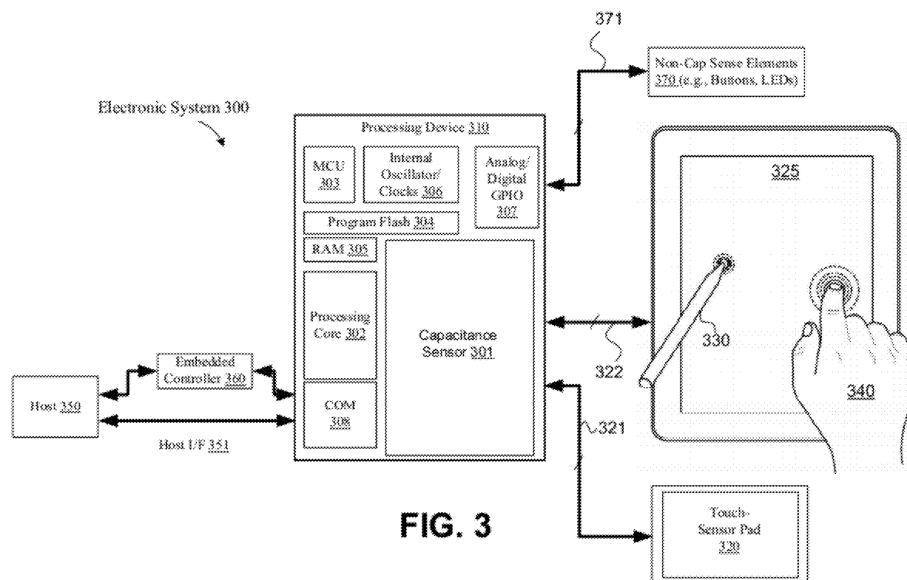


FIG. 3 of Kremin (Ex. 1009)

62. In disclosed embodiments, the stylus of Kremin includes sensors, which may be used to capture and transmit various data, such as force sense data, battery data, acceleration data, and button status data. *Id.* at ¶¶ [0109] & [0113].
63. The stylus of Kremin receives a signal from the sensing device, which is used as a carrier signal to transmit data back to the sensing device. *Id.* at ¶¶ [0085] & [0105]-[0110].

C. U.S. Patent No. 8,766,954 to Vuppu et al. (“Vuppu”) (Ex. 1006)

64. Vuppu is titled “Active Stylus For Use With Touch-Sensitive Interfaces And Corresponding Methods” and was filed on December 21, 2010. Ex. 1006 at 1. Vuppu issued as a patent on July 1, 2014. *Id.*
65. Disclosed embodiments of the stylus of Vuppu include a compound tip 105 having a center electrode 101 and a shroud electrode 102. *Id.* at 3:3-8. The center electrode detects electric field variations, which may emanate from a touch-sensitive surface due to an emitted periodic wave used to detect touch. *Id.* at 3:36-41. The center electrode is also described as a “receive electrode.” *Id.* at 6:1-3. The shroud electrode, also described as a “transmit electrode,” is used to inject a charge into a touch-sensitive interface. *Id.* at 6:3-7. Specifically, an active circuit applies a gain to the detected electric field variations by varying a potential (i.e., a voltage) of the shroud electrode. *Id.* The gain applied to the electric field variations may be, for example, inverting,

non-inverting, amplifying, or non-amplifying. Vuppu, 3:46-49. In some embodiments, a magnitude of the injected charge can be altered proportionally to forces detected by a force sensor, thereby allowing force information to be transmitted in the signal. *Id.* at 6:37-53.

66. In the configuration shown in FIG. 2 of Vuppu, the compound tip of the stylus "sniffs" the electric field variations emitted from the touch sensitive interface through the center electrode. *Id.* at 4:46-48. The active circuit of the stylus then applies the gain, which in one embodiment is inverting and amplifying, and injects charge into the touch-sensitive interface 201 to alter the capacitance formed between the touch-sensitive interface 201 and the compound tip 105. *Id.* at 4:46-53. An advantage offered by the stylus is that the host does not need to be configured with special software or application-specific hardware components to detect the stylus's compound tip. *Id.* at 4:53-56.
67. Amplifying the stylus transmit signal can decrease the size of the stylus tip and improve the precision of the touch. *Id.* at ABSTRACT, 1:27-41, 6:27-36, and 11:65-12:2.
68. Vuppu employs a simple, active circuit that requires no alteration to the electronic device with which the stylus is used. *Id.* at 10:18-20. Vuppu works with a wide variety of touch sensitive systems, universally with no required

hardware or software alteration in the touch-sensitive system. *Id.* at 10:20-23. Accordingly, Vuppu provides seamless transitions between finger-based input and stylus-based input. *Id.* at 10:23-25. Further, Vuppu employs very few circuit components and can be manufactured robustly and inexpensively. *Id.* at 10:26-28.

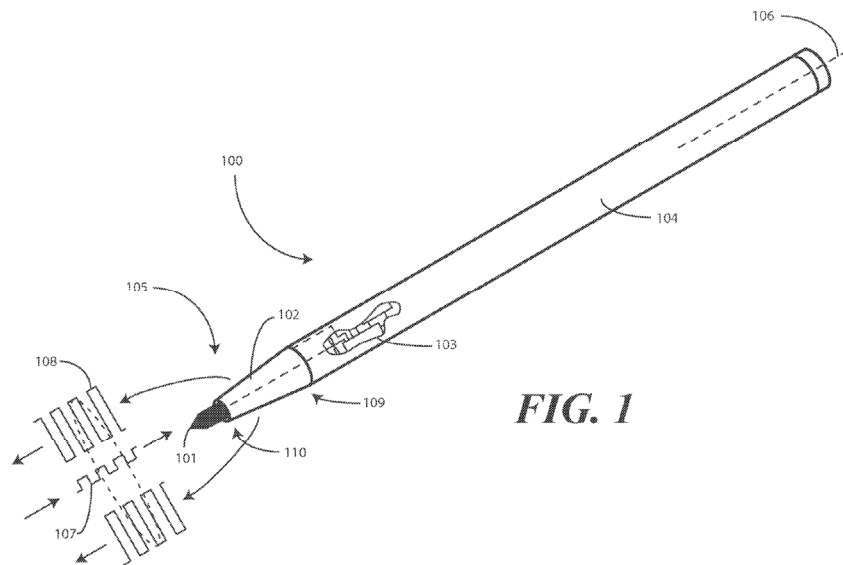


FIG. 1 of Vuppu (Ex. 1006)

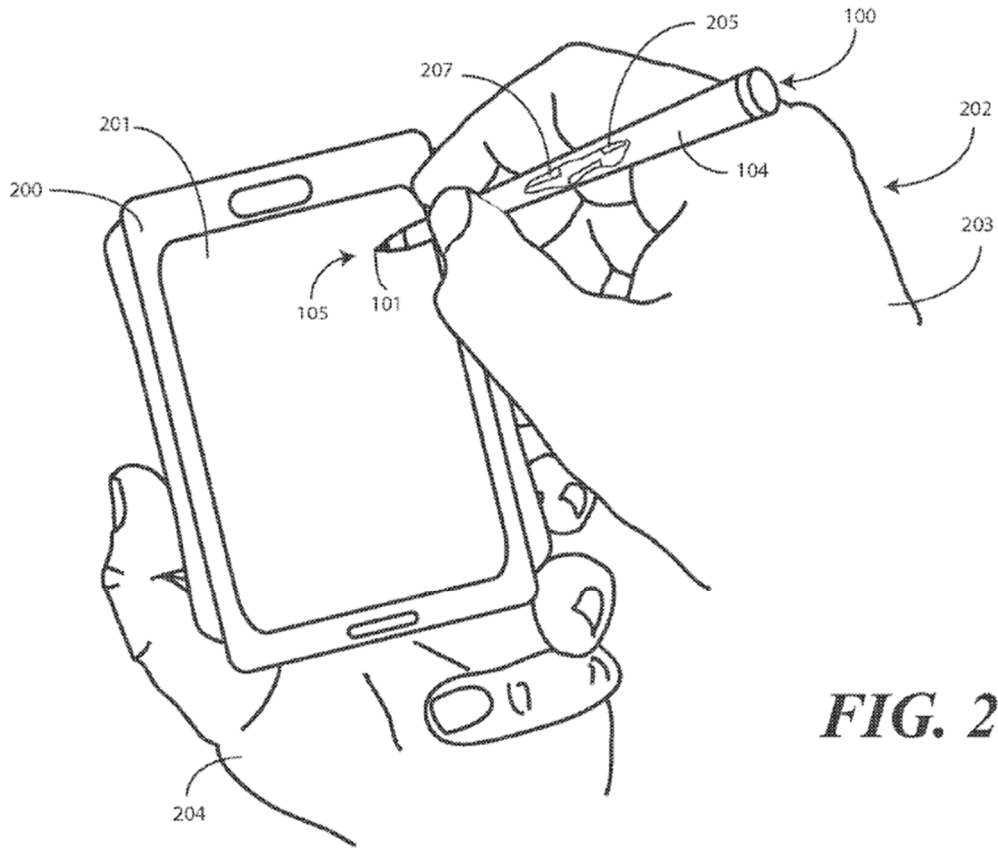


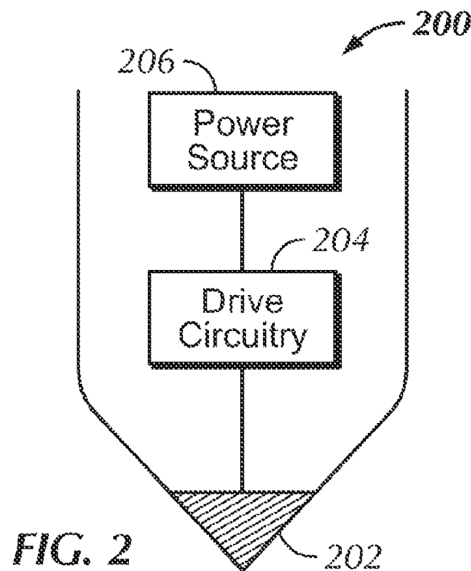
FIG. 2

Figure 2 of Vuppu (Ex. 1006)

D. U.S. Patent No. 8,928,635 to Harley et al. (“Harley”) (Ex. 1021)

69. Harley is titled “Active Stylus” and was filed on June 22, 2011. Ex. 1021 at 1. Harley issued as a patent on January 6, 2015. *Id.*
70. Harley discloses an active stylus that can act as a drive element, a sense element, or both in a capacitive touch system. Ex. 1021 at 1:58-59. For example, disclosed embodiments can create an electric field between a drive electrode of the active stylus and sense lines of a mutual capacitance touch sensor. *Id.* at 1:59-66. And disclosed embodiments can act as a sense electrode

for sensing capacitively coupled signals from stimulate drive rows and columns of the touch sensor panel. *Id.* at 1:66-2:1. An example stylus 200 is illustrated in FIG. 2 of Harley. *Id.* at 4:54-55. The stylus 200 includes drive circuitry 204 coupled to an electrode 202, which function together to generate and transmit a stimulus signal. *Id.* at 4:55-59. The drive circuitry 204 is connected to a power source 206. *Id.* at 4:66-5:1.



71.

FIG. 2 of Harley (Ex. 1021)

E. U.S. Patent No. 8,988,398 to Cao et al. (“Cao”) (Ex. 1007)

72. Cao is titled “Multi-Touch Input Device With Orientation Sensing” and was filed on February 11, 2011. Ex. 1007 at 1. Cao issued as a patent on March 24, 2015. *Id.*
73. The technology disclosed in Cao relates to a multi-touch orientation sensing

input device, which may be in the form of a stylus or pen. *Id.* at 3:59-64. The input device of Cao includes various sensors, such as a compass, gyroscope, and accelerometers included in an inertial measurement unit. *Id.* at 4:30-35. The inertial measurement unit is used to detect and report orientation and movement of the input device. *Id.* The orientation information can be used, for example, to enable different functions of the input device. Cao, 1:20-30.

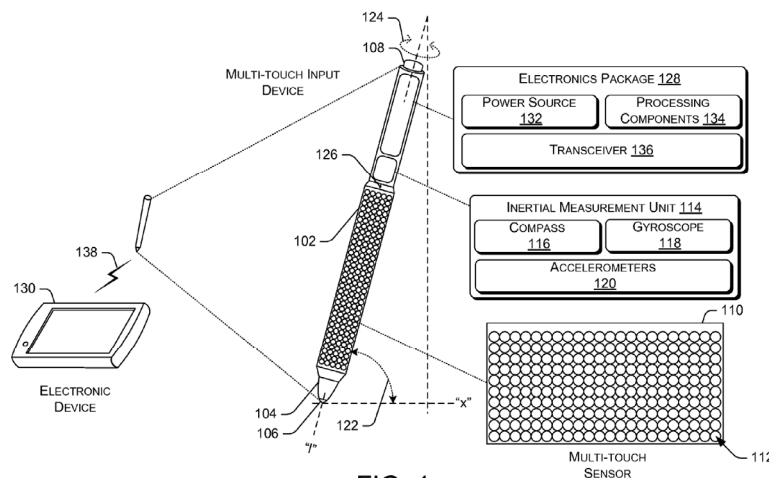


FIG. 1

FIG. 1 of Cao (Ex. 1007)

F. U.S. Patent Publication No. 20100085325 to King-Smith et al. (“King-Smith”) (Ex. 1008)

74. King-Smith is titled “Combination Touch and Transducer Input System and Method” and was published on April 8, 2010. Ex. 1008 at 1.
75. The technology disclosed in King-Smith relates to a transducer, which may be a stylus, configured to transmit digital data to a sensor having an array of electrodes. *Id.* at Abstract. For example, pressure data, switch status data, or

transducer ID data can be encoded and communicated to the sensor. *Id.* at ¶ [0063]. In disclosed embodiments, a microcontroller unit (MCU) of the transducer encodes the digital data using frequency shifts, amplitude shifts, or phase shifts. *Id.* The sensor receives the digital data, and the digital data is decoded. *Id.* Suitable encoding techniques include Frequency-Shift Keying (FSK), Amplitude-Shift Keying (ASK), Phase-Shift Keying (PSK), or Quadrature Amplitude Modulation (QAM). *Id.* at ¶ [0112].

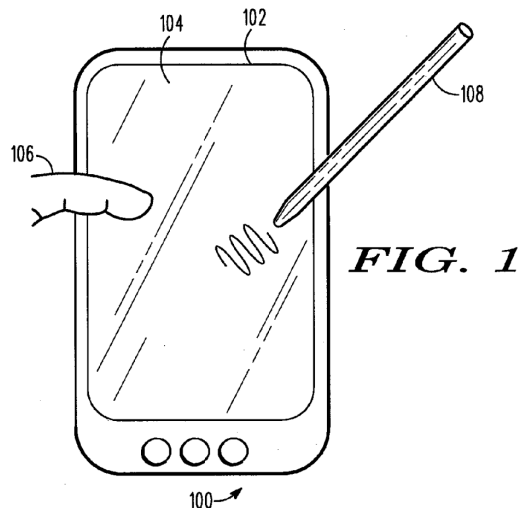


FIG. 1 of King-Smith (Ex. 1008)

G. Known Techniques in Stylus Technology

76. As of the earliest possible priority date of the '220 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.

77. Moreover, as of the earliest possible priority date of the '220 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.⁵ Other examples include active styluses disclosed in the references discussed herein.

H. Sensors and Sensor Data

78. As of the earliest possible priority date for the '220 patent, a person of

⁵ Ex. 1014 (available for download at <https://web.archive.org/web/20110216170350/http://www.pcpro.co.uk/blogs/2011/02/15/htc-flyer-review-first-look/>); Ex. 1015 (available for download at <https://web.archive.org/web/20110521024609/https://www.techradar.com/news/mobile-computing/htc-scribe-will-change-the-way-you-use-tablets-955427>)

ordinary skill would have been familiar with the inclusion of various sensors in a stylus-type input device, as well as various techniques for capturing and communicating data from the sensors (e.g., using various modulation techniques).

Cao (Ex. 1007)

79. The technology disclosed in Cao relates to capturing data from sensors in a stylus-type input device and conveying the sensor data to another device. For example, as discussed above, the input device of Cao includes an inertial measurement unit 114, which may include a compass, a gyroscope, and one or more accelerometers that are used to determine orientation data for the input device and provide different functionalities for the input device based on the orientation data. *See* Ex. 1007 at 1:20-30 & 4:30-52. Data from the input device of Cao is communicated to a separate electronic device (e.g., using wireless or wired connections), and the electronic device may perform operations based on the data, such as to enable different functionalities based on orientation information. *See Id.* at 5:34-39 & 10:15-23.

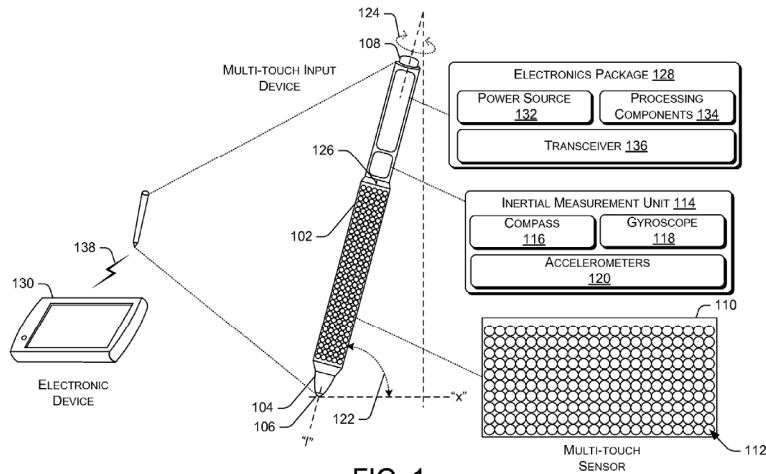


FIG. 1

FIG. 1 of Cao (Ex. 1007)

Kremin (Ex. 1009)

80. In a further example, Kremin describes a stylus for use with a capacitive sense array. Ex. 1009 at Abstract. The stylus of Kremin may include a force sensor and an accelerometer. *Id.* at ¶¶ [0104] & [0109]. The stylus may modulate various data into a signal outputted by the stylus, which may include battery data, acceleration data, button data, or force data. *Id.* at ¶ [0105].

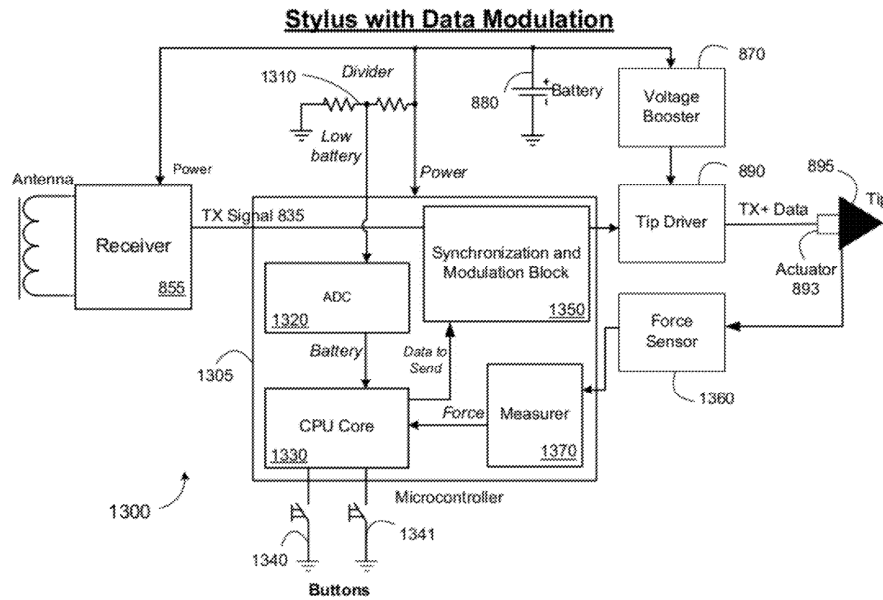


FIG. 13 of Kremin (Ex. 1009)

U.S. Patent Publication No. 20100051356 to Stern et al. (“Stern”)

81. In a further example, Stern discloses a “pressure sensitive stylus” with a movable tip that recedes within a housing responsive to an applied pressure and an optical sensor to sense displacement of the tip and provide an output. Stern, Abstract. The output of the sensor is used to encode a signal for transmission, which may also include additional encoded information, such as switch state information. Stern, 8:1-12.

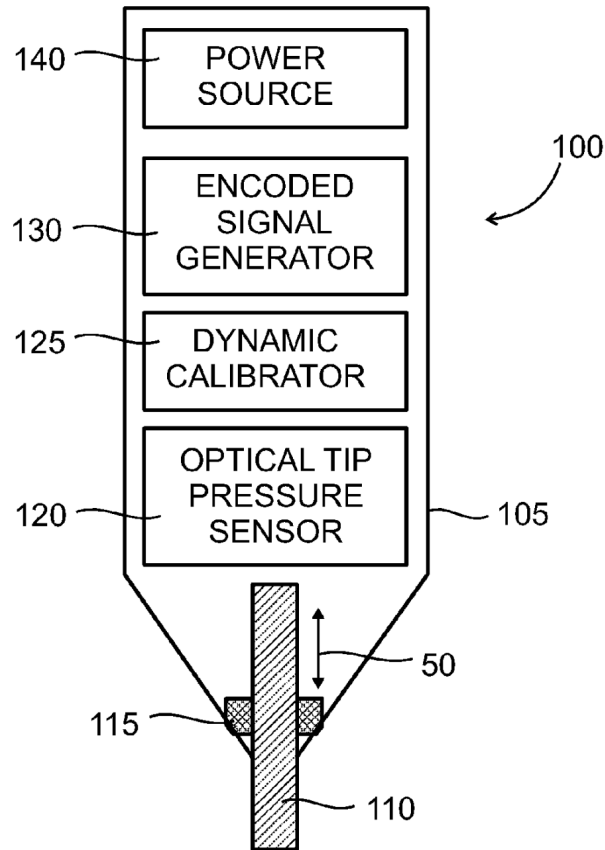


FIG. 1A of Stern

82. Based on the foregoing, it was well known in the art as of the earliest possible priority date for the '220 patent to include various sensors in a stylus-type input device and to implement various techniques for modulating sensor data. *See, e.g., Stern, 6:63-7:3 & Ex. 1008 at 26:1-8.*

I. Motivations to Combine and Expectation of Success

83. 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 (POSITA) 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 POSITA 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, and so forth. Additionally, a POSITA would have been able to implement various communication protocols for transmitting data to and from an active stylus. As discussed above, a POSITA 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. Accordingly, it would be well within the abilities of a POSITA to combine known techniques in the art in various ways to achieve predictable results.

84. For example, a POSITA would be motivated to combine Kaneko and Vuppu. As discussed in my Appendix A1, Kaneko and Vuppu describe similar technologies and address similar problems. Both describe devices in the form of a stylus used to provide inputs to a touch sensor of a device, and both describe techniques for communicating signals from a stylus to a touchscreen device and vice versa. *See* Appx. A1. Kaneko describes that the stylus includes an electric field sensor at the pen tip to detect the strength of an electric field received from the touchscreen device. Ex. 1005 at ¶ [0024]. Vuppu describes

that the stylus includes a compound tip that includes a center electrode and a shroud electrode. Ex. 1006 at 3:3-8. The center electrode detects electric field variations (e.g., a periodic wave transmitted by a touch-sensitive device), while a potential of the shroud electrode is changed using an active circuit to enable the compound tip to emit electric field variations to be detected by the touch-sensitive device. *Id.* at 3:36-41 & 3:50-61.

85. It would be obvious for a POSITA to modify the stylus of Kaneko based on Vuppu to receive and transmit signals using a compound tip having electrodes. For example, the center electrode of Vuppu can be implemented as the electric field sensor of the stylus of Kaneko, and a shroud electrode as in Vuppu can be added to the stylus of Kaneko to allow the modified stylus to transmit signals to the touchscreen device using the compound tip.
86. A POSITA would be motivated to combine Kaneko based on Vuppu to enable an easier, more efficient, and seamless detection of the finger touch. A POSITA would understand that amplification and inversion when applied to the stylus transmit signal would help in discriminating the stylus touch from the finger touch without the need to have the complicated approach in Kaneko, which employs two drastically different mechanisms for detecting the stylus touch and the finger touch and uses a switching process to switch between these two mechanisms. Ex. 1005 at ¶¶[0025], [0051]-[0057], and Figure 11.

In contrast, Vuppu employs a simple, active circuit that requires no alteration to the electronic device with which the stylus is used. Ex. 1006 10:18-20. Vuppu works with a wide variety of touch sensitive systems, universally with no required hardware or software alteration in the touch-sensitive system. *Id.* at 10:20-23. Accordingly, Vuppu provides seamless transitions between finger-based input and stylus-based input. *Id.* at 10:23-25. Further, Vuppu employs very few circuit components and can be manufactured robustly and inexpensively. *Id.* at 10:26-28.

87. Additionally, a POSITA would appreciate that modifying the stylus of Kaneko based on Vuppu would enable the production of a strong signal by a stylus, which is easy for a touch-sensitive device to detect, while simplifying the overall touch detection approach. *See Id.* at 2:40-54. Thus, modifying the stylus of Kaneko based on Vuppu to transmit signals using a compound tip having electrodes would improve the detection of the position of the stylus. In particular, the use of capacitive coupling for sending a signal to the touch-sensitive device employing the embodiments in Vuppu can help improve the detection of the stylus position. A POSITA would understand that amplifying the stylus transmit signal can decrease the size of the stylus tip and improve the precision of the touch. *Id.* at ABSTRACT, 1:27-41, 6:27-36, and 11:65-12:2. It is also known in the art that sending a high voltage signal by the stylus

via capacitive coupling to the touch sensor can enable the host device to detect the stylus when it is hovering or in close proximity to the capacitive sense array, but not physically touching an overlay disposed over the capacitive sense array. U.S. Patent Publication No. 20120105362, ¶ [0084]. It is also known in the art that a high voltage stylus transmit signal can also provide for faster and more robust detection by the sensing device. U.S. Patent Publication No. 20120105362, ¶[0084].

88. In this combination, capacitive coupling is used for the touch/hovering detection, while electromagnetic induction is used for powering the stylus and sending other data, including pressure data. As discussed above, a POSITA would understand this combination would better cultivate the benefits of both capacitive coupling and electromagnetic induction. It would be well within the capabilities of a POSITA to modify the stylus of Kaneko based on Vuppu
89. As a further example, a POSITA would be motivated to further modify the Kaneko based on Cao and/or King-Smith. As discussed in my Appendix A2, Kaneko and Cao describe similar technologies and address similar problems. Both describe devices in the form of a stylus (alternatively referred to as an “electronic pen” or a “digital pen” in some examples) used to provide inputs to a touch sensor of a device, and both describe styluses that include sensors. *See* Appx. A2. A POSITA would have been motivated to modify the

technology Kaneko based on Cao for the obvious benefit of capturing richer sensor data, which can be used to determine orientation of the stylus to enable different functions of the stylus. *See, e.g.*, Ex. 1007 1:20-51.

90. Additionally, Kaneko and King-Smith also describe similar technologies and address similar problems. Similar to Kaneko, King-Smith describes a stylus (provided as an example of a “transducer”) used to provide inputs to a touch sensor of a device, and it describes that the stylus transmits digital data, including pen pressure data and switch status data. *See, e.g.*, Ex. 1008 at Abstract. According to the technology of King-smith, a “combination touch and transducer input system” is provided such that user input can be provided using a finger, a stylus, or both. *Id.* The technology of King-Smith provides both a “touch mode” and a “transducer mode,” which may both use capacitive techniques. *See, e.g., Id.* at ¶¶ [0007] & [0020]. A POSITA implementing the stylus of Kaneko would benefit from the disclosure of King-Smith, for example, because King-Smith discloses additional techniques (e.g., capacitive techniques) for detecting both a stylus and a user’s touch, and King-Smith discloses additional modulation techniques for encoding digital data. *See, e.g., Id.* at ¶¶ [0020] & [0112]. A POSITA would have been motivated to modify the technology of Kaneko based on King-Smith for the obvious benefit of improved communication of data using different kinds of modulation of the

signal. *Id.* at ¶ [0010].

91. As a further example, a POSITA would be motivated to modify Kaneko in view of Harley. As discussed in my Appendix A3, Kaneko and Harley describe similar technologies and address similar problems. Both describe communication between a stylus and a touch sensor of a device through capacitive coupling, and both describe synchronization and modulation/demodulation of data. Kaneko describes that the stylus includes an electric field sensor at the pen tip to detect the strength of an electric field received from the touchscreen device. Ex. 1005, ¶[0024]. Similarly, Harley discloses an electrode at the tip of the stylus. Ex. 1021 at Abstract. The stylus of Harley includes powered circuitry coupled to the electrode, and the stylus is configured for capacitively coupling with a touch sensor panel via the electrode. *Id.* The powered circuitry may include drive circuitry to output a drive voltage at the electrode and/or sense circuitry to sense a voltage received at the electrode. *Id.* In other words, the electrode of Kaneko is used for receiving a signal via capacitive coupling, whereas the electrode of Harley is used for both transmitting and receiving a signal. A POSITA would have been motivated to modify the technology of Kaneko based on Harley for one or more obvious benefits, such as simplifying the stylus design and/or reducing costs. For example, while Kaneko uses capacitive coupling to receive data

from the touch sensor and induction for other types of communication, a POSITA would have been motivated to modify the stylus of Kaneko to use capacitive coupling for **both** transmitting and receiving, as in Harley. This modification would result in a simpler and less costly design because fewer components would be needed to achieve similar functionality.

92. Additionally, a POSITA would be motivated to modify Kremin in view of Harley. As discussed in my Appendix B2, Kremin and Harley describe similar technologies and address similar problems. Both describe styluses used to communicate with a touch sensor of a device, and both use capacitive coupling, synchronization, and modulation/demodulation. Ex. 1003, Appx. B2. Kremin discloses a stylus for synchronizing and modulating data into a stylus transmit signal. Ex. 1009, ¶[0104]. The data to be modulated and transmitted may include, for example, data received from a force sensor. *Id.* at ¶[0104]&[0109]. A synch mod block modulates the data using various modulation techniques. *Id.* at ¶[0110]. Similarly, Harley describes a stylus that can act as a drive and/or sense element in a capacitive touch system. Ex. 1021 at 1:5-7. The stylus of Harley includes an electrode at its tip and powered circuitry coupled to the electrode and configured for capacitively coupling the electrode with a capacitive touch sensor panel. Ex. 1021 at Abstract. The powered circuitry can include drive circuitry configured to output a drive

voltage at the electrode and/or sense circuitry configured to sense a voltage received at the electrode. *Id.* A POSITA would have been motivated to modify the technology of Kremin based on Harley for one or more obvious benefits, such as implementing a simplified design and saving costs. While the stylus of Kremin uses capacitive coupling for sending data to the touch sensor/host, Kremin discloses, in an embodiment, inductive coupling to send data from the touch sensor/host to the stylus⁶. By contrast, Harley use capacitive coupling for both sending and receiving data. A POSITA would modify the stylus of Kremin to use capacitive coupling for both sending and receiving signals, and this modification would result in a simpler and less costly implementation.

IX. First Ground for Invalidity: The Challenged Claims are obvious over Kaneko in view of Vuppu and the knowledge of a person having ordinary skill in the art.

93. It is my opinion that all Challenged Claims are obvious over Kaneko in view of Vuppu and the knowledge of a person having ordinary skill in the art.

⁶ Kremin contemplates different methods for communication from the host device to the stylus. For example, Kremin discloses that in an embodiment, the system further includes a transmitter to wirelessly transmit the synchronization signal from the processing device to the stylus. Kremin ¶ [0048]. In some embodiments, the transmitter may include a magnetic antenna to inductively transmit the synchronization signal to the stylus where the antenna is disposed around the outer edges of the capacitance sense array. *Id.* See also Kremin ¶ [0090]. See also FIG. 13 and limitations 1[c2] and 1[c3] below. A POSITA would understand that wireless transmission includes capacitive coupling, where no physical wires are used. As discussed above, capacitive coupling requires the use of an electrode at the tip. Thus, a POSITA would understand the disclosure in Kremin alone to contemplate one or more electrodes in the stylus to receive and transmit signals.

Appendix A1 is a claim chart detailing my invalidity analysis in relation to Kaneko and Vuppu, including the rationale and motivation to combine the references.

X. Second Ground for Invalidity: The Challenged Claims are further obvious over Kaneko in view of Vuppu, Cao, and/or King-Smith.

94. It is my opinion that all Challenged Claims are further obvious over Kaneko in view of Vuppu, Cao, and/or King-Smith. Appendix A2 further details my invalidity analysis on obviousness grounds over Kaneko as modified by Vuppu, Cao, and/or King-Smith, including the rationale and motivation to combine the references.

XI. Third Ground for Invalidity: The Challenged Claims are further obvious over Kaneko in view of Harley.

95. It is my opinion that all Challenged Claims are further obvious over Kaneko in view of Harley. Appendix A3 further details my invalidity analysis on obviousness grounds over Kaneko in view of Harley, including the rationale and motivation to combine the references.

XII. Fourth Ground for Invalidity: The Challenged Claims are further obvious over Kaneko in view of Harley, Cao, and/or King-Smith.

96. It is my opinion that all Challenged Claims are further obvious over Kaneko in view of Harley, Cao, and/or King-Smith. Appendix A4 further details my invalidity analysis on obviousness grounds over Kaneko as modified by Harley, Cao, and/or King-Smith, including the rationale and motivation to

combine the references.

XIII. Fifth 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.

97. 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 B1 is a claim chart detailing my invalidity analysis in relation to Kremin on both anticipation and obviousness grounds.

XIV. Sixth Ground for Invalidity: The Challenged Claims are further obvious over Kremin in view of Harley.

98. It is my opinion that all Challenged Claims are further obvious over Kremin in view of Harley. Appendix B2 further details my invalidity analysis on obviousness grounds over Kremin as modified by Harley, including the rationale and motivation for combining the references.

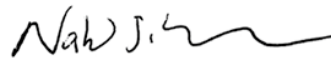
XV. Conclusion

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.

99. 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 17th day of September, 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 A1

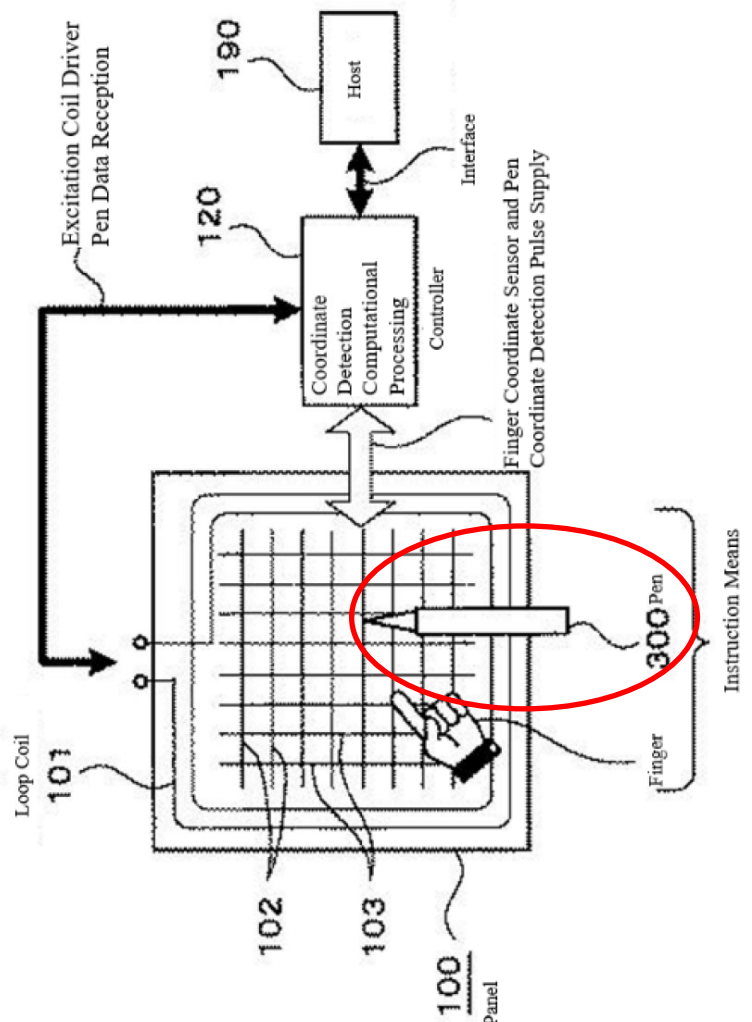
U.S. Patent No. 9,280,220 Invalidity Chart – Obviousness over Kaneko in view of Vuppu

The challenged claims of U.S. Patent No. 9,280,220 (“’220 Patent”) (Ex. 1001) are obvious under 35 U.S.C. § 103 over Japanese Patent Publication No. JP 2008-152640 to Kaneko (“Kaneko”) (Ex. 1005) (published July 3, 2008) and U.S. Patent No. 8,766,954 to Vuppu et al. (“Vuppu”) (Ex. 1006) (issued July 1, 2014; filed December 21, 2010) as set forth in the chart below.

Kaneko and Vuppu describe similar technologies and address similar problems. Both describe devices in the form of a stylus used to provide inputs to a touch sensor of a device, and both describe techniques for communicating signals from a stylus to a touchscreen device and vice versa.

Kaneko describes that the stylus includes an electric field sensor at the pen tip to detect the strength of an electric field received from the touchscreen device. Kaneko, ¶ [0024]. Vuppu describes that the stylus includes a compound tip that includes a center electrode and a shroud electrode. Vuppu, 3:3-8. The center electrode of the stylus detects electric field variations (e.g., a periodic wave transmitted by a touch-sensitive device), while a potential of the shroud electrode is changed using an active circuit to enable the compound tip to emit electric field variations to be detected by the touch-sensitive device. Vuppu, 3:36-41 & 3:50-61. The active circuit of the stylus is configured to apply again to the detected electric field variations. Vuppu, 3:42-43. The gain applied to the electric field variations may be, for example, inverting, non-inverting, amplifying, or non-amplifying. Vuppu, 3:46-49. In the configuration shown in FIG. 2 of Vuppu, the compound tip of the stylus “sniffs” the electric field variations emitted from the touch sensitive interface through the center electrode. Vuppu, 4:46-48. The active circuit of the stylus then applies the gain, which in one embodiment is inverting and amplifying, and injects charge into the touch-sensitive interface 201 to alter the capacitance formed between the touch-sensitive interface 201 and the compound tip 105. Vuppu, 4:46-53. An advantage offered by the stylus is that the host does not need to be configured with special software or application-specific hardware components to detect the stylus's compound tip. Vuppu, 4:53-56.

It would be obvious for a person of ordinary skill in the art to modify the stylus of Kaneko based on Vuppu to receive and transmit signals using a compound tip having electrodes. For example, the center electrode of Vuppu can be implemented as the electric field sensor of the stylus of Kaneko, and a shroud electrode as in Vuppu can be added to the stylus of Kaneko to allow the modified stylus to transmit signals to the touchscreen device using the compound tip. A person of ordinary skill in the art would be motivated to combine Kaneko based on Vuppu to enable an easier, more efficient, and seamless detection of the finger touch. A person of ordinary skill in the art would understand that amplification and inversion when applied to the stylus transmit signal would help in discriminating the stylus touch from the finger touch without the need to have the complicated approaches in Kaneko, which employs two drastically different mechanisms for detecting the stylus touch and the finger touch and uses a switching process to switch between these two mechanisms. Kaneko ¶¶[0025], [0051]-[0057], and Figure 11. In contrast, Vuppu employs a simple, active circuit that requires no alteration to the electronic device with which the stylus is used. Vuppu, 10:18-20. Vuppu works with a wide variety of touch sensitive systems, universally with no required hardware or software alteration in the touch-sensitive system. Vuppu, 10:20-23. Accordingly, Vuppu provides seamless transitions between finger-based input and stylus-based input. Vuppu, 10:23-25. Further, Vuppu employs very few circuit components and can be manufactured robustly and inexpensively. Vuppu, 10:26-28. Additionally, a person of ordinary skill in the art would appreciate that modifying the stylus of Kaneko based on Vuppu would enable the production of a strong signal by a stylus, which is easy for a touch-sensitive device to detect, while simplifying the overall touch detection approach. See Vuppu, 2:40-54. A person of ordinary skill in the art would understand that amplifying the stylus transmit 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. It is also known in the art that sending a high voltage signal by the stylus via capacitive coupling to the touch sensor can enable the host device to detect the stylus when it is hovering or in close proximity to the capacitive sense array, but not physically touching an overlay disposed over the capacitive sense array. U.S. Patent Publication No. 20120105362, ¶ [0084]. It is also known in the art that a high voltage stylus transmit signal can also provide for faster and more robust detection by the sensing device. U.S. Patent Publication No. 20120105362, ¶ [0084]. In this combination, capacitive coupling is used for the touch/hovering detection, while electromagnetic induction is used for powering the stylus and sending other data, including pressure data. As discussed above, a person of ordinary skill in the art would understand this combination would better cultivate the benefits of both capacitive coupling and electromagnetic induction. It would be well within the capabilities of a person of ordinary skill in the art to modify the stylus of Kaneko based on Vuppu, and a person of ordinary skill in the art would have a reasonable chance of success in doing so.

<p>Claim 1</p> <p>1[pre] A stylus comprising:</p>	<p>Example Disclosures in Prior Art</p> <p>To the extent the preamble is considered limiting, Kaneko discloses an electronic pen 300 used as an input means to a panel 100. Kaneko, Figure 1 & ¶ [0020], [0024], and [0040]. The electronic pen of Kaneko is a stylus.</p> <p>[Fig. 1]</p>  <p>Figure 1 of Kaneko</p>
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Example Disclosures in Prior Art	
Claim 1	<p>The electronic pen of Kaneko includes, for example, an electric field sensor. Kaneko, ¶ [0024]. Kaneko describes that an electric field sensor at the pen tip detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form, the intensity data is sent to the modulation circuit. <i>Id.</i> The modulation circuit modulates the LC resonance voltage to generate a counter magnetic field. <i>Id.</i> This generated counter magnetic field alters the electric current flowing in loop coil 101 on the panel side. <i>Id.</i> The signal provided from the electronic pen to the panel side is used to communicate data. Kaneko, ¶ [0041]. The electronic pen of Kaneko also includes sensors, such as “a pressure detection mechanism to detect pressure according to usage.” Kaneko, ¶ [0024]. A person of ordinary skill in the art would appreciate that detecting pressure would be performed using one or more sensors. Moreover, the electronic pen of Kaneko includes mechanical switches assigned for functions like clicks. A person of ordinary skill in the art would appreciate that detecting user clicks would be performed using one or more sensors. Therefore, a person of ordinary skill would appreciate that Kaneko discloses limitation 1[a] based on at least the foregoing disclosures.</p>
1[b] one or more electrodes configured to communicate with a device by receiving signals from and transmitting signals to a touch sensor of the device; and	<p>The electronic pen of Kaneko includes an electric field sensor at the tip of the electronic pen. Kaneko, ¶ [0024]. A signal is provided to the electronic pen via the electric field sensor and from a loop coil 101, and the electronic pen generates a counter magnetic field to communicate data to the panel side. Kaneko, ¶¶ [0024] and [0040]. A conductive material, such as metal or conductive resin, is arranged at the pen tip 325 to detect the electric field from the conductive film pattern on the panel side. Kaneko, ¶ [0044]. Based on this, a person of ordinary skill in the art would appreciate that the electronic pen of Kaneko includes “one or more electrodes configured to communicate with a device”. A person of ordinary skill in the art would appreciate that an electrode could be understood as a conductor that establishes electrical contact with a nonmetallic component of a circuit. <i>See</i> Ex. 1020. An electrode may serve as the conductive element that creates or senses changes in the electric field between two objects. The electric field sensor of Kaneko would, therefore, be understood as “one or more electrodes” as in limitation 1[b]. Moreover, Kaneko discloses the use of capacitive coupling between the touch panel and the electronic pen Kaneko, ¶¶ [0031] and [0016]. Capacitive coupling is a transfer of electric signals that inherently requires a pairing of electrodes by proximity. A person of ordinary skill in the art would understand that the tip must comprise an electrode. No undue experimentation is required for a person of ordinary skill in the art 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 ’220 Patent, electrodes had been known for decades, and a person of ordinary skill in the art 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. <i>See, e.g.,</i> US Patent 8,928,635 B2 at ABSTRACT, FIG. 3, 1:58-2:1, and Claim 15, U.S. Patent Publication No. 20120050207 ¶[0050], and Vuppu (Ex. 1006) at 3:3-17. 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.</p>

Claim 1	Example Disclosures in Prior Art
	<div data-bbox="378 1163 407 1244" data-label="Caption"> <p>[Fig. 6]</p> </div> <div data-bbox="418 782 909 1193" data-label="Diagram"> </div> <div data-bbox="924 889 958 1155" data-label="Caption"> <p>Figure 6 of Kaneko</p> </div> <div data-bbox="995 118 1141 1943" data-label="Text"> <p>To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation 1[b], it would be obvious to a person of ordinary skill in the art to modify Kaneko in view of the knowledge of a person of ordinary skill in the art to implement limitation 1[b]. For example, as discussed above, it was known to include an electrode in the tip of a stylus, and it would be obvious to a person of ordinary skill in the art that the electrode can be used for transmitting signals, receiving signals, or both. See, e.g., US Patent 8,928,635 B2 1:58-2:1.</p> </div>

Claim 1	Example Disclosures in Prior Art
	<p>Alternatively, limitation 1[b] would be obvious to a person of ordinary skill in the art in view of Kaneko and Vuppu. The stylus of Vuppu includes a compound tip having a center electrode (e.g., 101 of FIG. 1), which is used to detect electric field variations (i.e., to receive signals from the touch sensor) and a shroud electrode (e.g., 102 of FIG. 1), which is used with an active circuit to enable the compound tip to emit electric field variations (i.e., to transmit signals to the touch sensor). Vuppu, 3:3-8, 3:36-41, & 3:50-61. Vuppu discloses that the shroud electrode may function as “a transmit electrode.” Vuppu, 6:3-7. The technology of Vuppu enables the stylus to apply a positive or negative gain to a received signal to inject charge into a touch-sensitive display, which may provide a stronger signal that is easy for the touch-sensitive display to detect. Vuppu, 2:48-54. In particular, the active circuit of the stylus is configured to apply again to the detected electric field variations. Vuppu, 3:42-43. The gain applied to the electric field variations may be, for example, inverting, non-inverting, amplifying, or non-amplifying. Vuppu, 3:46-49. In the configuration shown in FIG. 2 of Vuppu, the compound tip of the stylus “sniffs” the electric field variations emitted from the touch sensitive interface through the center electrode. Vuppu, 4:46-48. The active circuit of the stylus then applies the gain, which in one embodiment is inverting and amplifying, and injects charge into the touch-sensitive interface 201 to alter the capacitance formed between the touch-sensitive interface 201 and the compound tip 105. Vuppu, 4:46-53. An advantage offered by the stylus is that the host does not need to be configured with special software or application-specific hardware components to detect the stylus's compound tip. Vuppu, 4:53-56.</p>

Claim 1	Example Disclosures in Prior Art
	<p>Vuppu, therefore, discloses limitation 1[b]. It would be obvious for a person of ordinary skill in the art to modify the stylus of Kaneko based on Vuppu to receive and transmit signals using a compound tip having electrodes. For example, the center electrode of Vuppu can be implemented as the electric field sensor of the stylus of Kaneko, and a shroud electrode as in Vuppu can be added to the stylus of Kaneko to allow the modified stylus to transmit signals to the touchscreen device using the compound tip. A person of ordinary skill in the art would be motivated to combine Kaneko based on Vuppu to enable an easier, more efficient, and seamless detection of the finger touch. A person of ordinary skill in the art would understand that amplification and inversion when applied to the stylus transmit signal would help in discriminating the stylus touch from the finger touch without the need to have the complicated approach in Kaneko, which employs two drastically different mechanisms for detecting the stylus touch and the finger touch and uses a switching process to switch between these two mechanisms. Kaneko ¶¶[0025], [0051]-[0057], and Figure 11. In contrast, Vuppu employs a simple, active circuit that requires no alteration to the electronic device with which the stylus is used. Vuppu, 10:18-20. Vuppu works with a wide variety of touch sensitive systems, universally with no required hardware or software alteration in the touch-sensitive system. Vuppu, 10:20-23. Accordingly, Vuppu provides seamless transitions between finger-based input and stylus-based input. Vuppu, 10:23-25. Further, Vuppu employs very few circuit components and can be manufactured robustly and inexpensively. Vuppu, 10:26-28. Additionally, a person of ordinary skill in the art would appreciate that modifying the stylus of Kaneko based on Vuppu would enable the production of a strong signal by a stylus, which is easy for a touch-sensitive device to detect, while simplifying the overall touch detection approach. See Vuppu, 2:40-54. A person of ordinary skill in the art would understand that amplifying the stylus transmit 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. It is also known in the art that sending a high voltage signal by the stylus via capacitive coupling to the touch sensor can enable the host device to detect the stylus when it is hovering or in close proximity to the capacitive sense array, but not physically touching an overlay disposed over the capacitive sense array. U.S. Patent Publication No. 20120105362, ¶ [0084]. It is also known in the art that a high voltage stylus transmit signal can also provide for faster and more robust detection by the sensing device. U.S. Patent Publication No. 20120105362, ¶ [0084]. In this combination, capacitive coupling is used for the touch/hovering detection, while electromagnetic induction is used for powering the stylus and sending other data, including pressure data. As discussed above, a person of ordinary skill in the art would understand this combination would better cultivate the benefits of both capacitive coupling and electromagnetic induction. It would be well within the capabilities of a person of ordinary skill in the art to modify the stylus of Kaneko based on Vuppu, and a person of ordinary skill in the art would have a reasonable chance of success in doing so.</p>

Claim 1

Example Disclosures in Prior Art

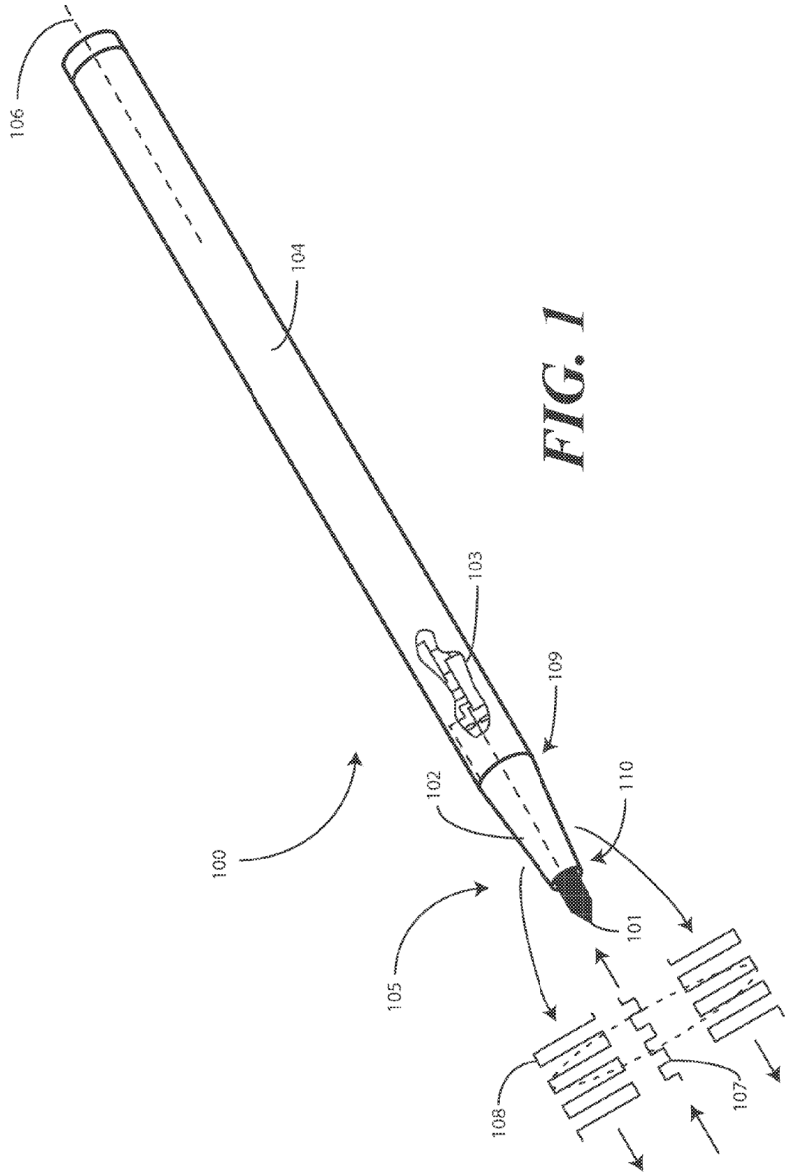


Figure 1 of Vuppu

Claim 1

Example Disclosures in Prior Art

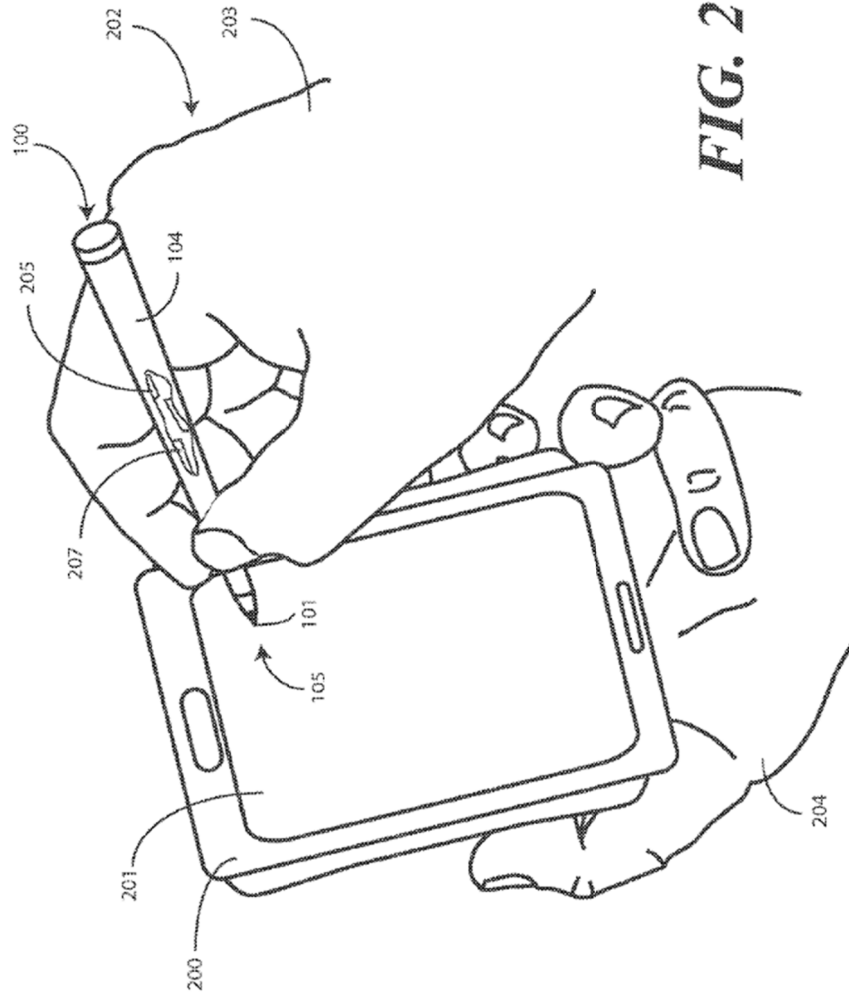


Figure 2 of Vuppu

<p>1[c] one or more computer-readable non-transitory storage media embodying logic that is operable when executed to:</p>	<p>Kaneko discloses various operations performed at the electronic pen, such as modulating a LC resonance circuit 310 by a modulation circuit 322 to change electric current flow through a loop coil 101 on the panel side. Kaneko, ¶ [0041]. The electronic pen is thus used to transmit data to the controller on the panel side, where the signal is demodulated to receive the data. <i>Id.</i> A person of ordinary skill in the art would appreciate that the electronic pen of Kaneko includes limitation 1[c] to store instructions for performing operations performed at the electronic pen. Moreover, Kaneko explicitly states in the context of the touch panel that “[b]y being able to send data (commands) to the pen, functionalities such as reading pen-specific information, setting sensitivity settings, firmware updates, and potentially enabling features like vibration via a vibration device or light notifications (e.g., through LEDs) triggered by commands sent from the controller side can be realized, providing a wireless pen that utilizes bidirectional data transmission”. Kaneko ¶ [0050]. Thus, the electronic pen of Kaneko includes firmware, which is system software¹ that is used to control the operation of the pen. The firmware is necessarily stored in persistent memory² and requires a central processing unit (CPU) to be executed, as any other program, and such a CPU will include logic³. Kaneko also explicitly mentions that “as shown in Fig. 5, signals received by the LC resonant circuit 310 of the electronic pen are demodulated by the reception/demodulation circuit 341, and the demodulated data is supplied to the processing unit 342 within the electronic pen to execute the corresponding processing. Kaneko ¶ [0050]. A person of ordinary skill in the art would understand that such a processing unit that can be used to execute corresponding processing will include a CPU. Furthermore, the “sensitivity settings” shown in Figure 5 of Kaneko will necessarily require being stored in a computer-readable non-transitory storage media. See also Kaneko ¶ [0050].</p>
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¹ Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 286 (Ex. 1016).

² Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 286 (Ex. 1016).

³ Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 107 (Ex. 1016).

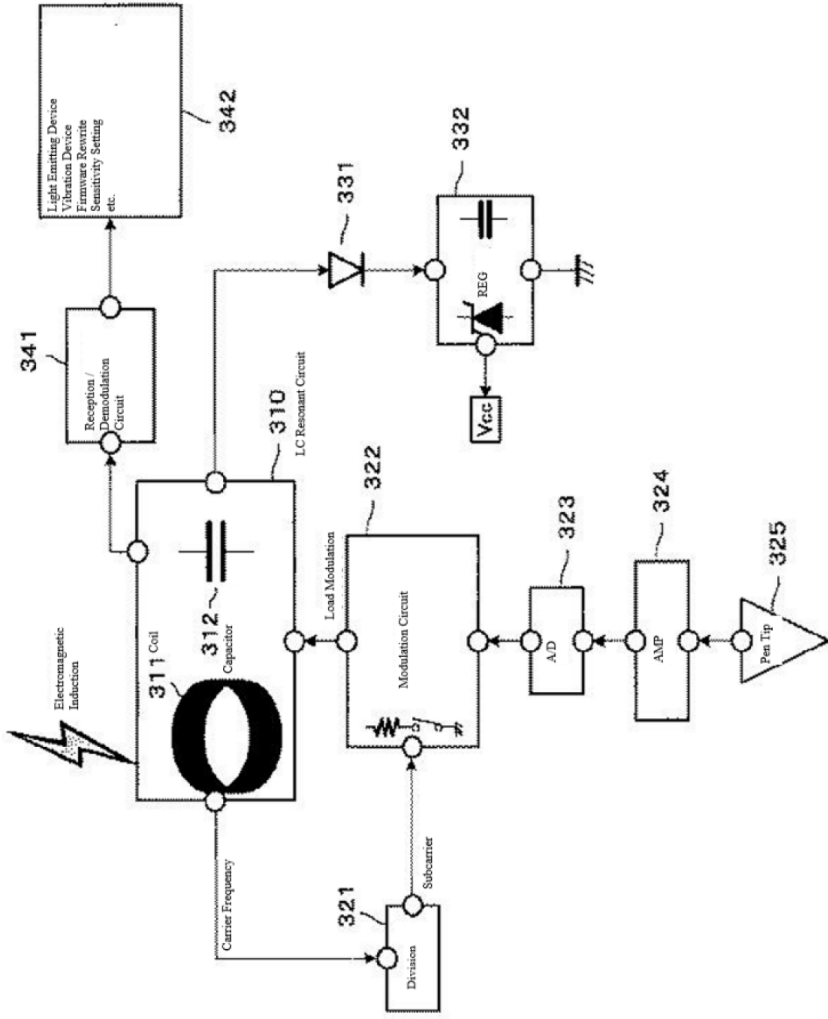
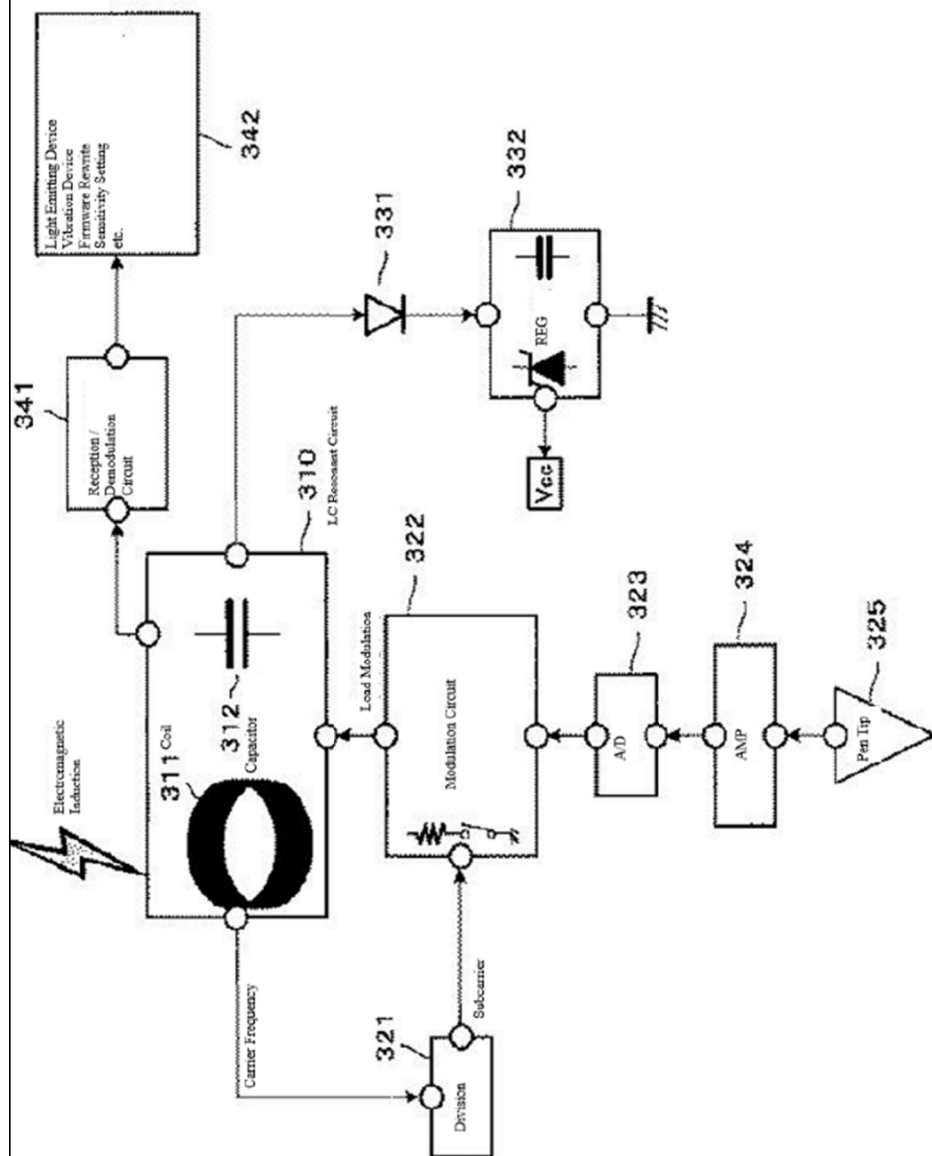


Figure 5 of Kaneko

Claim 1	Example Disclosures in Prior Art
<p>1[c1] receive sensor data from the one or more sensors;</p>	<p>As discussed in limitation 1[a] above, the electronic pen of Kaneko includes, for example, an electric field sensor. Kaneko, ¶ [0024] Kaneko describes that an electric field sensor at the pen tip detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form, the intensity data is sent to the modulation circuit. <i>Id.</i> The modulation circuit modulates the LC resonance voltage to generate a counter magnetic field. <i>Id.</i> This generated counter magnetic field alters the electric current flowing in loop coil 101 on the panel side. <i>Id.</i> In particular, Kaneko describes that an electric field sensor at the pen tip detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form, the intensity data is sent to the modulation circuit. Kaneko, ¶ [0024]. Specifically, Kaneko provides the following details in relation to Figure 1.</p> <p>By placing the electronic pen within the alternating magnetic field generated by loop coil 101, power is supplied to the electronic pen via electromagnetic induction, driving the internal circuit of the pen. Alternating or pulse voltage is then sequentially applied to the matrix pattern. The electric field sensor at the pen tip detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form, the intensity data is sent to the modulation circuit. The modulation circuit amplitude-modulates (load modulation) the LC resonance voltage to generate a counter magnetic field. This generated counter magnetic field alters the electric current flowing in loop coil 101 on the panel side. By demodulating this change in electric current, the intensity data sent from the pen is obtained. Based on the received electric field strength distribution, interpolation processing for the pen coordinates is performed, and the pen coordinate data is output from controller 120 to host 190. <i>Id.</i></p> <p>See also Kaneko, ¶ [0055]. Therefore, detecting the electric field variations through the electric field sensor effectively enables the overall system to sense and detect the coordinate of the pen position. The signal provided from the electronic pen to the panel side is used to communicate data. Kaneko, ¶ [0041].</p> <p>The electronic pen of Kaneko also includes sensors, such as “a pressure detection mechanism to detect pressure according to usage.” Kaneko, ¶ [0024]. A person of ordinary skill in the art would appreciate that detecting pressure would be performed using one or more sensors. Moreover, the electronic pen of Kaneko includes mechanical switches assigned for functions like clicks. A person of ordinary skill in the art would appreciate that detecting user clicks would be performed using one or more sensors.</p> <p>Therefore, a person of ordinary skill would appreciate that Kaneko discloses limitation 1[c1] based on at least the foregoing disclosures.</p> <p>To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation 1[c1], a person of ordinary skill would understand how to modify Kaneko to meet this limitation based on such person’s knowledge and Kaneko. For example, while Kaneko does not expressly state that the detected pressure is received by the modulation circuit, it would be obvious to a POSITA that pressure data would be received at the modulation circuit to be communicated to the panel side. Kaneko discloses that the LC resonant circuit is amplitude modulated by the modulation circuit, which changes the current flowing through the loop coil on the panel side, thus enabling transmission of data from the stylus to the controller. Kaneko, ¶ [0041]. Kaneko does not limit the kinds of data that can be transmitted according to these techniques, and it would be obvious to a POSITA that the transmitted data would include data collected using the pressure detection mechanism.</p>

<p>1[c2] receive a first signal generated by the device;</p>	<p>Figure 5 of Kaneko shows that the electronic pen receives a signal from the touch panel through electromagnetic induction, and then it detects the carrier frequency of the received signal, modulates this carrier signal based on the data to be sent by the pen, and subsequently transmits the output of the modulation process to the touch panel. Specifically, Kaneko discloses that “[t]he modulation circuit 322 receives a signal obtained by dividing the carrier frequency detected by the LC resonant circuit 310 using the frequency divider 321”. Kaneko, ¶ [0045]. It also discloses that “[b]y changing the electric current flowing through the loop coil 101, this electric current change is detected on the panel side and converted to voltage by a detection resistor, enabling demodulation into the desired data for transmission of data from the electronic pen to the controller”. <i>Id.</i> In relation to Figure 5, Kaneko describes that an electric field sensor at the pen tip 325 detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form using an analog-to-digital converter 323, the intensity data is sent to the modulation circuit 322. Kaneko, ¶ [0024], [0045]. Kaneko also provides the following details in relation to Figure 1.</p> <p>The detailed structure will be described later. An alternating electric current is passed through the loop coil 101, which is positioned as a loop antenna around the outer periphery of electrodes 102 and 103 forming the matrix pattern. By placing the electronic pen within the alternating magnetic field generated by loop coil 101, power is supplied to the electronic pen via electromagnetic induction, driving the internal circuit of the pen. Alternating or pulse voltage is then sequentially applied to the matrix pattern. The electric field sensor at the pen tip detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form, the intensity data is sent to the modulation circuit. The modulation circuit amplitude-modulates (load modulation) the LC resonance voltage to generate a counter magnetic field. This generated counter magnetic field alters the electric current flowing in loop coil 101 on the panel side. By demodulating this change in electric current, the intensity data sent from the pen is obtained. Based on the received electric field strength distribution, interpolation processing for the pen coordinates is performed, and the pen coordinate data is output from controller 120 to host 190. <i>Id.</i></p> <p>See also Kaneko, ¶ [0055].</p>
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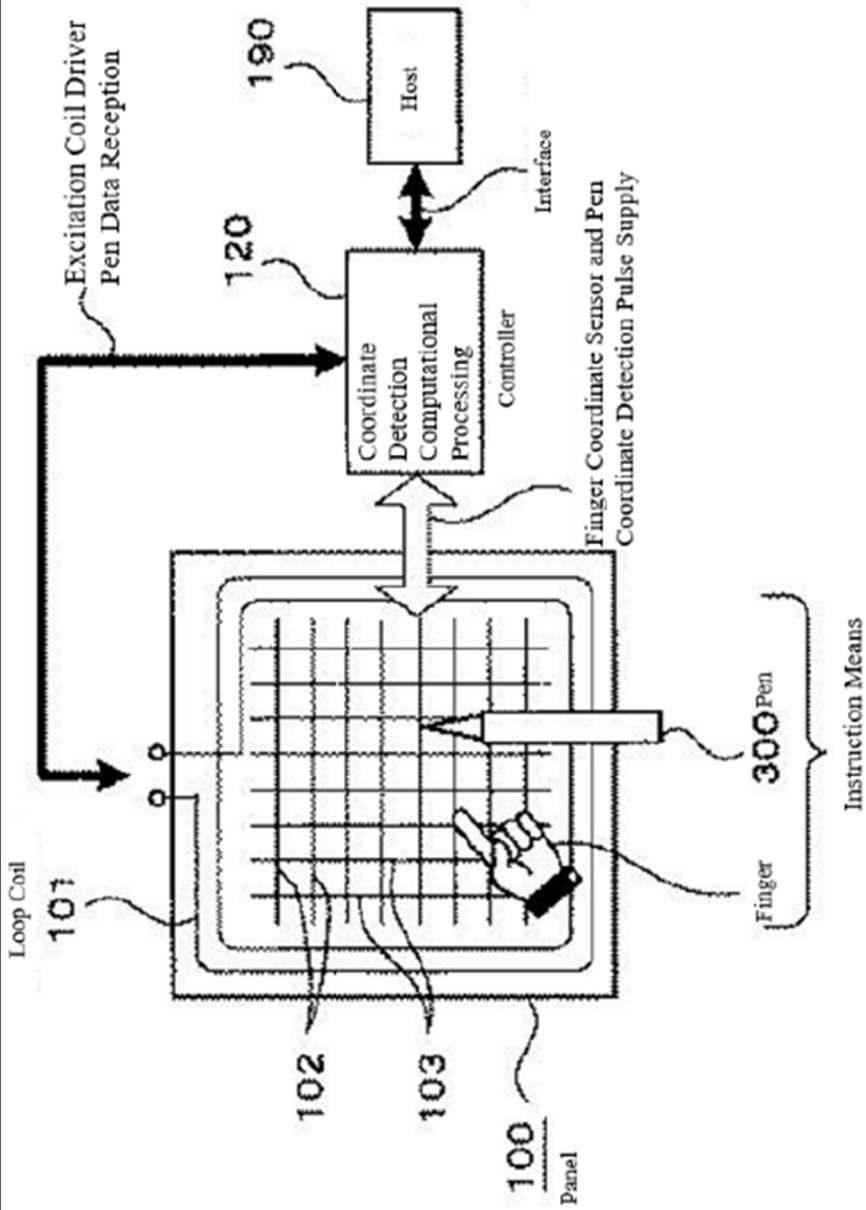


Electronic Pan Outline Block Diagram

Figure 5 of Kaneko

Claim 1

Example Disclosures in Prior Art



Simple Block Diagram
Figure 1 of Kaneko

The stylus of Kaneko therefore receives “a first signal generated by the device.”

Claim 1	Example Disclosures in Prior Art
<p>1[c3] generate a second signal by modulating a carrier signal based on the sensor data; and</p>	<p>Modulation can be defined as the “process of modifying some characteristic of a wave (called a carrier) so that it varies in step with the instantaneous value of another wave (called a modulating wave or signal)”, where “[t]he carrier can be a direct current, an alternating current (provided its frequency is above the highest frequency component in the modulating wave), or a series of regularly repeating, uniform pulses called a pulse chain (provided their repetition rate is at least twice that of the highest frequency to be transmitted)”⁴. It can also be defined as “[t]he controlled variation of frequency, phase, and/or amplitude of a carrier wave of any frequency in order to transmit a message”⁵. It can further be defined as “[t]he process, or results of the process, whereby some characteristic of one signal is varied in accordance with another signal”, where “[t]he modulated signal is called the carrier and may be modulated in three fundamental ways: by varying the amplitude (amplitude modulation) by varying the frequency (frequency modulation) or by varying the phase (phase modulation)”⁶. Modulation can further be defined as “a process through which an information-bearing message (i.e., modulating) signal is used to modify (i.e., modulate) some parameter (e.g., amplitude, frequency, phase) of a periodic (such as a high-frequency sinusoidal) signal known as a carrier wave, individually or in combination, to produce the modulated signal for transmission”⁷.</p> <p>As discussed above with reference to limitation 1[c2], the modulation circuit 322 of Kaneko receives a signal obtained by dividing the carrier frequency detected by the LC resonant circuit 310 using a frequency divider 321. Kaneko, ¶ [0041]. See also Figure 5 of Kaneko. Moreover, Kaneko discloses that an excitation frequency provided from the panel side serves as a carrier. Kaneko, ¶ [0037]. The modulation circuit 322 of Kaneko modulates the LC resonance circuit 310 to change electric current flow through a loop coil 101 on the panel side to transmit data. Kaneko, ¶ [0041].</p> <p>As discussed earlier with reference to limitations 1[a] and 1[c1] above, the electronic pen of Kaneko also includes an electric field sensor. Kaneko, ¶ [0024]. The electric field sensor at the pen tip detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form, the intensity data is sent to the modulation circuit. <i>Id.</i> The modulation circuit modulates the LC resonance voltage to generate a counter magnetic field. <i>Id.</i> As shown in Figure 5 of Kaneko, the sensed electric field variations are ultimately sent to the modulation circuit 322 for transmission to the panel/host. In particular, Kaneko describes that an electric field sensor at the pen tip detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form, the intensity data is sent to the modulation circuit. Kaneko, ¶ [0024]. Kaneko also provides the following details in relation to Figure 1.</p>

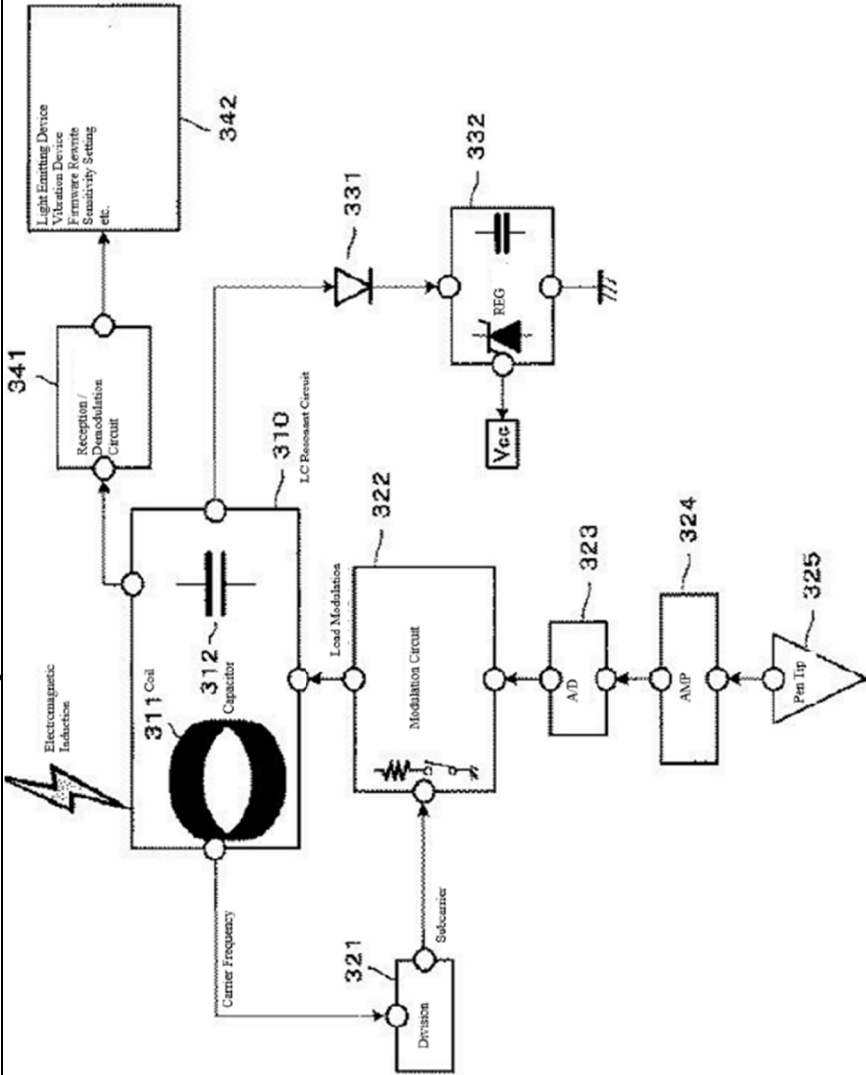
⁴ Rudolf F. Graf Boston. MODERN DICTIONARY OF ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, pages 479-480 [Ex. 1016].

⁵ Rudolf F. Graf Boston. MODERN DICTIONARY OF ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 480 [Ex. 1016].

⁶ Rudolf F. Graf Boston. MODERN DICTIONARY OF ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 480 [Ex. 1016].

⁷ Ali Grami. Introduction to Digital Communications. Copyright © 2016 Elsevier Inc, page 34 [Ex. 1018].

Claim 1	Example Disclosures in Prior Art
	<p>By placing the electronic pen within the alternating magnetic field generated by loop coil 101, power is supplied to the electronic pen via electromagnetic induction, driving the internal circuit of the pen. Alternating or pulse voltage is then sequentially applied to the matrix pattern. The electric field sensor at the pen tip detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form, the intensity data is sent to the modulation circuit. The modulation circuit amplitude-modulates (load modulation) the LC resonance voltage to generate a counter magnetic field. This generated counter magnetic field alters the electric current flowing in loop coil 101 on the panel side. By demodulating this change in electric current, the intensity data sent from the pen is obtained. Based on the received electric field strength distribution, interpolation processing for the pen coordinates is performed, and the pen coordinate data is output from controller 120 to host 190. <i>Id.</i></p> <p>See also Kaneko, ¶ [0055]. Therefore, detecting the electric field variations through the electric field sensor enables the overall system to effectively sense and detect the coordinate of the pen position.</p> <p>Moreover, as discussed above, it would be appreciated that the data transmitted by the stylus of Kaneko may include other sensor data, such as the pressure data. Kaneko discloses that the electronic pen includes a “pressure detection mechanism to detect pressure according to usage”. While Kaneko does not explicitly state that the pressure data is transferred through the modulation circuit 322, a person of ordinary skill in the art would understand that the embodiment shown in Figure 5 can be used to transmit this data as well because (1) this pressure data must be transmitted to the panel/host side somehow, (2) there is no other embodiment that shows a different way to transfer this data, (3) and it would be wasteful in terms of cost, integration, and power consumption to include additional circuitry to do so. A stylus transfers pressure data to enable more precise and natural input, particularly for tasks like drawing, handwriting, and graphic design.</p> <p>Therefore, the stylus of Kaneko transmits the data by generating “a second signal by modulating a carrier signal based on the sensor data,” as in limitation 1[c3].</p>

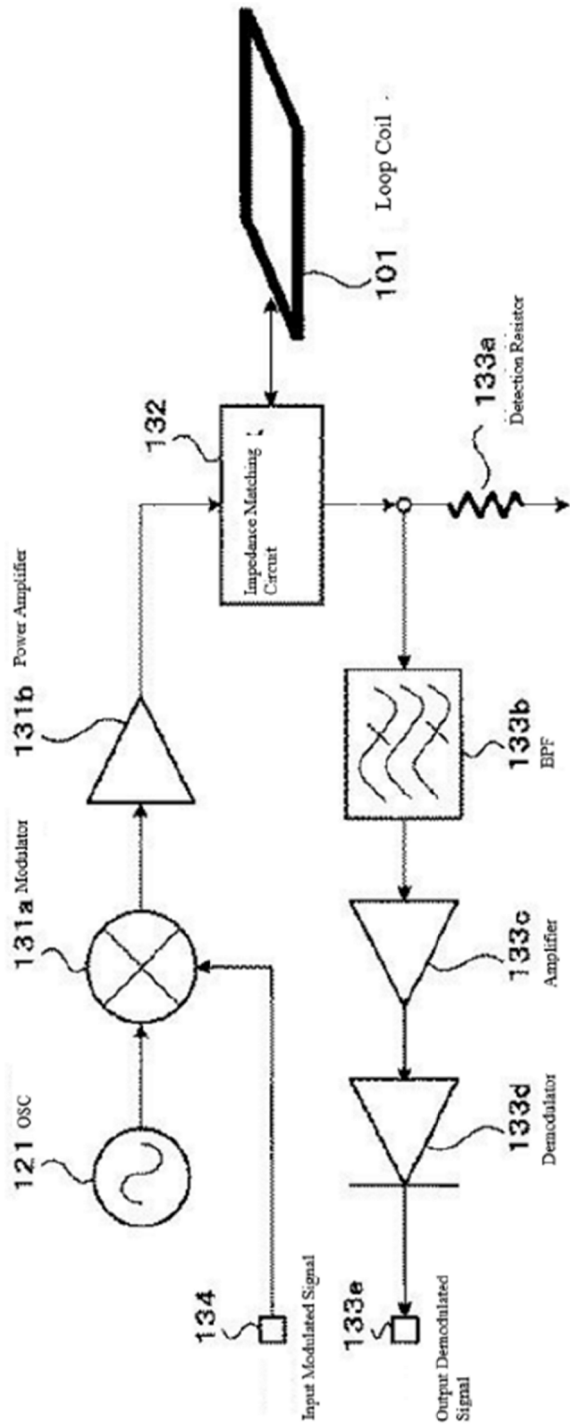


Electronic Pressure Block Diagram

Figure 5 of Kaneko

To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation 1[c3], a person of ordinary skill would understand how to modify Kaneko to meet this limitation based on such person's knowledge and Kaneko. For example, as discussed above with reference to limitation 1[c1], while Kaneko does not expressly state that data from the pressure detection mechanism is used to modulate the carrier signal, a person of ordinary skill in the art would appreciate that this operation is inherent in Kaneko, or alternatively that it would be obvious to modulate data from the pressure detection mechanism into the signal to be communicated to the panel side.

<p>Claim 1</p>	<p>Example Disclosures in Prior Art</p>
<p>1[c4] transmit to the device, in response to the first signal, the second signal, the sensor data being obtainable by demodulating the second signal.</p>	<p>As discussed above with reference to limitations 1[c2] and 1[c3], the modulation circuit 322 of Kaneko modulates the LC resonance circuit 310 to change electric current flow through a loop coil 101 on the panel side to transmit data. Kaneko, ¶ [0041]. The electric current change is detected on the panel side and converted to voltage by a detection resistor, enabling demodulation into received data. <i>Id.</i> As discussed with reference to limitation 1[c3] above, the stylus of Kaneko generates the second signal using a carrier signal provided by the panel side and performing modulation to transmit data from the stylus to the panel side, which may include sensor data. Figure 4 of Kaneko shows an example configuration of the transmission and reception section 130. Kaneko, ¶ [0038]. At the controller side of the touch panel/host, “[t]he impedance matching circuit 132 is connected to a detection resistor 133a for receiving signals, and the received signal obtained at this detection resistor 133a is sent through a bandpass filter 133b and an amplifier 133c to a demodulator 133d, from which the demodulated signal from 133d is output as a received signal at output terminal 133e. Kaneko, ¶ [0039]. Kaneko also discloses that “[t]he transmission and reception processing unit 130 is also equipped with a receiving circuit 133, which detects data regarding the strength of the electric field from the electronic pen and performs demodulation of the received function within that receiving circuit 133” and that “[t]he detected data and demodulated data are sent to the pen coordinate/function calculation unit 129”. Kaneko, ¶ [0037]. It also discloses that “[i]n the pen coordinate/function calculation unit 129, the supplied data and the clock provided from the frequency divider 123 are used to detect the coordinate position (or a nearby position) where the electronic pen contacts the panel” and that “[t]he data of the detected coordinate position is sent to the host 190 via interface 141”. <i>Id.</i></p>



Controller Side Transmission and Reception Circuit Configuration

Figure 4 of Kaneko

Therefore, the stylus of Kaneko transmits the second signal to the device in response to the first signal – that is, the second signal is provided by processing the signal received from the device. The sensor data is obtainable by demodulating the second signal. Kaneko, therefore, discloses limitation 1[c4].

To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation 1[c4], a person of ordinary skill would understand how to modify Kaneko to meet this limitation based on such person’s knowledge and Kaneko. For example, as discussed above with reference to limitation 1[c1], while Kaneko does not expressly state that data from the pressure detection mechanism is used to modulate the carrier signal an then will be demodulated, a person of ordinary skill in the art would appreciate that this operation is inherent in Kaneko, or alternatively that it would be obvious to modulate data from the pressure detection mechanism into the signal to be communicated to the panel side.

Claim 2	Example Disclosures in Prior Art
2. The stylus of claim 1, wherein the first signal is the carrier signal modulated to generate the second signal.	As discussed above with reference to limitations 1[a], 1[c2] and 1[c3], Kaneko describes that an electric field sensor at the pen tip detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form, the intensity data is sent to the modulation circuit. Kaneko, ¶ [0024]. The modulation circuit 322 of Kaneko receives a signal obtained by dividing the carrier frequency detected by the LC resonant circuit 310 using a frequency divider 321. Kaneko, ¶ [0041]. Moreover, Kaneko discloses that an excitation frequency provided from the panel side serves as a carrier. Kaneko, ¶ [0037]. The modulation circuit 322 of Kaneko modulates the LC resonance circuit 310 to change electric current flow through a loop coil 101 on the panel side to transmit data. Kaneko, ¶ [0041]. Based on this, the carrier signal of Kaneko is “the first signal,” as claimed, which is modulated to generate the second signal.

Claim 3	Example Disclosures in Prior Art
3. The stylus of claim 1, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.	<p><i>See limitation 1[c3] above.</i> Kaneko discloses the LC resonant circuit 310 is amplitude modulated by the modulation circuit 322. Kaneko, ¶ [0041]. It would, therefore, be appreciated that the stylus of Kaneko generates the “second signal” using at least “amplitude modulation,” as in claim 3. Kaneko further discloses that the disclosed technology can use various modulation techniques, such as “frequency, phase, and amplitude modulation.” Kaneko, ¶ [0049]. While the discussion of frequency and phase modulation is in the context of sending data from “the controller side to the electronic pen,” it would be appreciated that these modulation techniques can likewise be implemented at the stylus. Moreover, amplitude modulation, frequency modulation, and phase modulation are the three fundamental ways to perform modulation⁸. As an example, a notable textbook states that “[w]e have three distinct modulation categories: amplitude modulation (AM), frequency modulation (FM), and phase modulation (PM)⁹. Modulation can even be defined as “[t]he controlled variation of frequency, phase, and/or amplitude of a carrier wave of any frequency in order to transmit a message”¹⁰. It can also be defined as “a process through which an information-bearing message (i.e., modulating) signal is used to modify (i.e., modulate) some parameter (e.g., amplitude, frequency, phase) of a periodic (such as a high-frequency sinusoidal) signal known as a carrier wave, individually or in combination, to produce the modulated signal for transmission”¹¹. This “is similar to when a musician modulates a tone by varying its volume (amplitude), its timing (phase), and its pitch (frequency)”¹². A person of ordinary skill in the art would understand that modulation is generally performed by one of these three fundamental ways and would naturally turn to use one of these ways to perform modulation.</p>

⁸ Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 480 (Ex. 1016).

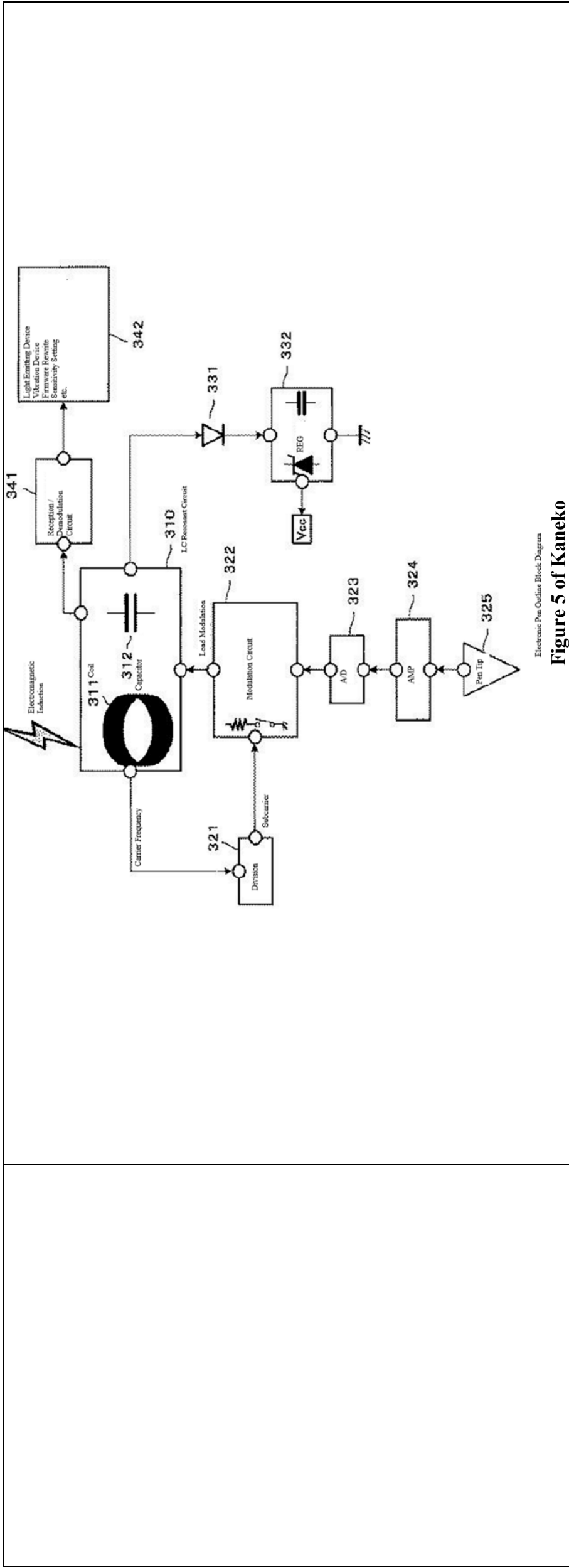
⁹ Ali Grami. Introduction to Digital Communications. Copyright © 2016 Elsevier Inc, page 35 (Ex. 1018).

¹⁰ Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 480 (Ex. 1016).

¹¹ Ali Grami. Introduction to Digital Communications. Copyright © 2016 Elsevier Inc, page 34 (Ex. 1018).

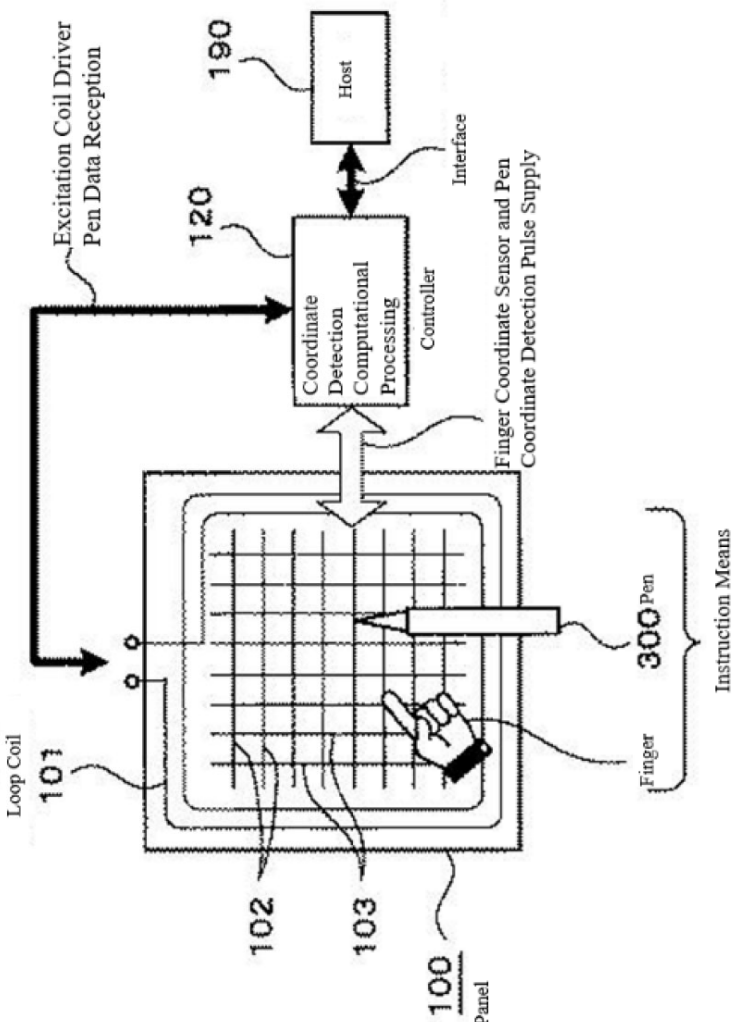
¹² Ali Grami. Introduction to Digital Communications. Copyright © 2016 Elsevier Inc, page 34 (Ex. 1018).

	<p>To the extent Kaneko does not expressly, implicitly, or inherently disclose the limitations of claim 3, a person of ordinary skill would understand how to modify Kaneko to meet these limitations based on such person’s knowledge and Kaneko. For example, even if it is not inherent that frequency and phase modulation can be performed at the stylus of Kaneko, it would nonetheless be obvious to a person of ordinary skill in the art to modify the stylus of Kaneko to perform these kinds of modulation based on the explicit disclosure in paragraph [0049] regarding frequency and phase modulation. It would, accordingly, be obvious based on Kaneko alone to generate the “second signal” using any of amplitude modulation, frequency modulation, phase modulation, or combinations thereof.</p>
<p>Claim 4</p> <p>4. The stylus of claim 1, wherein: the one or more sensors comprise a pressure sensor and a button; and the sensor data comprises pressure data and button state data.</p>	<p>Example Disclosures in Prior Art</p> <p>As discussed with reference to limitation 1[a] above, the electronic pen of Kaneko includes sensors, such as “a pressure detection mechanism to detect pressure according to usage.” Kaneko, ¶ [0024]. Additionally, the electronic pen of Kaneko includes switches for assigned functions, such as for clicking. <i>Id.</i> Kaneko, therefore, discloses one or more sensors comprising “a pressure sensor and a button.” Furthermore, it would be appreciated that the sensor data transmitted by the stylus of Kaneko comprises “pressure data and button state data,” as in claim 4. As discussed above with reference to limitations 1[c1], 1[c2], 1[c3], and 1[c4], it would be obvious to a person of ordinary skill in the art that the transmitted data would include data collected using the pressure detection mechanism – that is, “pressure data.” Additionally, the disclosure in Kaneko regarding functions of the switches relates to, for example, “clicking” – that is, detecting whether a switch has been actuated to register a “click.” A person of ordinary skill in the art would appreciate that the switches of Kaneko may be buttons, and that the registering of a “click” would involve transmitting data regarding a state of the button to enable a feature associated with “clicking.” While Kaneko does not explicitly state that the pressure and clicking data are transferred through the modulation circuit 322, a person of ordinary skill in the art would understand that the embodiment shown in Figure 5 can be used to transmit this data as well because (1) this pressure and clicking data must be transmitted to the panel/host side somehow, (2) there is no other embodiment that shows a different way to transfer these types of data, (3) and it would be wasteful in terms of cost, integration, and power consumption to include additional circuitry to do so.</p>
<p>Claim 5</p> <p>5. The stylus of claim 1, wherein the sensor data is digital.</p>	<p>Example Disclosures in Prior Art</p> <p>Kaneko discloses digitizing at the electronic pen using an analog-to-digital converter 323, and Kaneko discloses that a digital processing configuration is preferred to reduce the effects of noise. Kaneko, ¶¶ [0024], [0045], and [0047]. Specifically, Kaneko describes that the electric field sensor of the stylus detects a signal and converts it “to digital form.” <i>Id.</i> As discussed above, this signal is then used to generate the second signal and transmit data from the stylus to the panel side. See also Figure 5 of Kaneko. Furthermore, since Kaneko explicitly discloses digitizing at least the sensed electric field variations, a person of ordinary skill in the art would understand that all other sensor data must be handled in the same way so that they can be encoded in the transmit signal of the electronic pen. It would, therefore, be appreciated that the stylus of Kaneko implements the feature “wherein the sensor data is digital.”</p>



Claim 7		Example Disclosures in Prior Art
7[pre] One or more computer-readable non-transitory storage media embodying logic that is operable when executed to:		See limitation 1[c] above.
	7[a] receive sensor data from one or more sensors in or on a stylus, the stylus comprising one or more electrodes configured to communicate with a device by receiving signal from and transmitting signals to a touch sensor of the device;	See limitations 1[b] and 1[c1] above.

Claim 7		Example Disclosures in Prior Art
7[b]	receive a first signal generated by the device;	See limitation 1[c2] above.
7[c]	generate a second signal by modulating a carrier signal based on the sensor data; and	See limitation 1[c3] above.
7[d]	transmit to the device, in response to the first signal, the second signal, the sensor data being obtainable by demodulating the second signal.	See limitation 1[c4].
Claim 8		Example Disclosures in Prior Art
8.	The media of claim 7, wherein the first signal is the carrier signal modulated to generate the second signal.	See claim 2 above.
Claim 9		Example Disclosures in Prior Art
9.	The media of claim 7, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.	See claim 3 above.
Claim 10		Example Disclosures in Prior Art
10.	The media of claim 7, wherein: the one or more sensors comprise a pressure sensor and a button; and the sensor data comprises pressure data and button state data.	See claim 4 above.
Claim 11		Example Disclosures in Prior Art
11.	The media of claim 7, wherein the sensor data is digital.	See claim 5 above.

Claim 13	Example Disclosures in Prior Art
<p>13[pre] A system comprising:</p>	<p>To the extent the preamble is considered limiting, Kaneko discloses an electronic pen 300 used as an input means to a panel 100. Kaneko, Figure 1 and ¶¶ [0020], [0024], and [0040]. The panel 100 uses a controller unit 120 to detect inputs and provide coordinate information to a host 190. Kaneko, ¶¶ [0031], [0037]. Based on at least the foregoing disclosure, it would be appreciated that Kaneko discloses a system.</p> <p style="text-align: center;">[Fig. 1]</p>  <p style="text-align: center;">Figure 1 of Kaneko</p> <p>The panel 100 of Kaneko includes and input detection part that detects a coordinate position touched on the panel. Kaneko, ¶ [0020]. The panel 100 of Kaneko would be understood as comprising a touch sensor included in a device.</p>
<p>13[a] a device comprising a touch sensor; and</p>	<p><i>See limitation 1[pre].</i></p>
<p>13[b] a stylus comprising:</p>	<p><i>See limitation 1[a].</i></p>
<p>13[b1] one or more sensors;</p>	

Claim 13	Example Disclosures in Prior Art
13[b2] one or more electrodes configured to communicate with a device by receiving signals from and transmitting signals to a touch sensor of the device; and	<i>See limitation 1[b].</i>
13[b3] one or more computer-readable non-transitory storage media embodying logic that is operable when executed to:	<i>See limitation 1[c].</i>
13[b3A] receive sensor data from the one or more sensors;	<i>See limitation 1[c1].</i>
13[b3B] receive a first signal generated by the device;	<i>See limitation 1[c2].</i>
13[b3C] generate a second signal by modulating a carrier signal based on the sensor data; and	<i>See limitation 1[c3].</i>
13[b3D] transmit to the device, in response to the first signal, the second signal, the device being operable to obtain the sensor data by demodulating the second signal.	<i>See limitation 1[c4].</i>
Claim 14	Example Disclosures in Prior Art
14. The system of claim 13, wherein the first signal is the carrier signal modulated to generate the second signal.	<i>See claim 2 above.</i>
Claim 15	Example Disclosures in Prior Art
15. The system of claim 13, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.	<i>See claim 3 above.</i>
Claim 16	Example Disclosures in Prior Art

16. The system of claim 13, wherein: the one or more sensors comprise a pressure sensor and a button; and the sensor data comprises pressure data and button state data.	See claim 4 above.
Claim 17	
17. The system of claim 13, wherein the sensor data is digital.	See claim 5 above.

Example Disclosures in Prior Art

Appendix A2

U.S. Patent No. 9,280,220 Invalidity Chart – Obviousness over Kaneko, Cao, and/or King-Smith

Japanese Patent Publication No. JP 2008-152640 to Kaneko (“Kaneko”) (Ex. 1005) (published July 3, 2008) renders obvious the challenged claims of U.S. Patent No. 9,280,220 (“’220 Patent”) (Ex. 1001) under 35 U.S.C. § 103 in view of U.S. Patent No. 8,766,954 to Vuppu et al. (“Vuppu”) (Ex. 1006) (issued July 1, 2014; filed December 21, 2010), U.S. Patent No. 8,988,398 to Cao et al. (“Cao”) (Ex. 1007) (issued March 24, 2015; filed February 11, 2011), and/or U.S. Patent Publication No. 20100085325 to King-Smith et al. (“King-Smith”) (Ex. 1008) (published April 8, 2010) as set forth in the chart below.

As discussed in Appendix A1, all limitations of the challenged claims are obvious in view of Kaneko and Vuppu, and Appendix A1 is incorporated herein for all purposes. The below analysis is provided to further show that limitations of the claims are also disclosed in Cao and/or King-Smith.

Kaneko and Cao describe similar technologies and address similar problems. Both describe devices in the form of a stylus (alternatively referred to as an “electronic pen” or a “digital pen” in some examples) used to provide inputs to a touch sensor of a device, and both describe styluses that include sensors.

A person of ordinary skill in the art would have been motivated to modify the technology Kaneko based on Cao for the obvious benefit of capturing richer sensor data, which can be used to determine orientation of the stylus to enable different functions of the stylus. *See, e.g.*, Cao, 1:20-51.

In the typical use case disclosed in Kaneko, the stylus (referred to as an “electronic pen”) uses an LC resonant circuit to communicate via a loop coil of a device, while finger detection is performed using a matrix of electrodes. *See, e.g.*, Kaneko, ¶¶ [0020]-[0024]. The stylus of Kaneko includes a “pressure detection mechanism” to detect a pressure and a modulation circuit that performs amplitude modulation to generate a counter magnetic field for communication back to the host device. *Id.*

Cao discloses that the stylus (referred to as an “input device” which “may be shaped like a stylus or pen”) can be detected using a proximity sensor and according to different detection techniques or combinations of detection techniques, including “electromagnetic induction sensing” or capacitive touch sensing, among other techniques. *See, e.g.*, Cao, 3:61-66 & 6:6-15. The stylus of Cao includes various sensors, such as a compass, a gyroscope, and one or more accelerometers included in an inertial measurement unit, which can be used to detect and report orientation and movement. Cao, 4:30-52. A person of ordinary skill in the art implementing the stylus of Kaneko would benefit from the disclosure of Cao, for example, because Cao discloses a range of detection techniques, including both inductive and capacitive techniques for detecting and communicating with a stylus, and the stylus of Cao can be used to capture richer sensor data. It would be well within the capabilities of a person of ordinary skill in the art to modify the stylus of Kaneko based on Cao. It would be well within the capabilities of a person of ordinary skill in the art to modify the stylus of Kaneko based on Cao, and a person of ordinary skill in the art would have a reasonable chance of success in doing so.

Kaneko and King-Smith also describe similar technologies and address similar problems. Similar to Kaneko, King-Smith describes a stylus (provided as an example of a “transducer”) used to provide inputs to a touch sensor of a device, and it describes that the stylus transmits digital data, including pen pressure data and switch status data. *See, e.g.*, King-Smith, Abstract. According to the technology of King-Smith, a “combination touch and transducer input system” is provided such that user input can be provided using a finger, a stylus, or both. *Id.* The technology of King-Smith provides both a “touch mode” and a “transducer mode,” which may both use capacitive techniques. *See, e.g.*, King-Smith, ¶¶ [0007] & [0020]. A person of ordinary skill in the art implementing the stylus of Kaneko would benefit from the disclosure of King-Smith, for example, because King-Smith discloses additional techniques (e.g., capacitive techniques) for detecting both a stylus and a user’s touch, and King-Smith discloses additional modulation techniques for encoding digital data. *See, e.g.*, King-Smith, ¶¶ [0020] & [0112].

A person of ordinary skill in the art would have been motivated to modify the technology of Kaneko based on King-Smith for the obvious benefit of improved communication of data using

different kinds of modulation of the signal. King-Smith, ¶ [0010]. It would be well within the capabilities of a person of ordinary skill in the art to modify the stylus of Kaneko based on King-Smith, and a person of ordinary skill in the art would have a reasonable chance of success in doing so.

Claim 1		Example Disclosures in Prior Art	
1[pre] A stylus comprising: 1[a] one or more sensors;		Kaneko discloses limitation 1[pre] for the reasons discussed in Appendix A1.	
		Kaneko discloses limitation 1[a] for the reasons discussed in Appendix A1.	
		<p>Even if limitation 1[a] were not disclosed in Kaneko, a person of ordinary skill in the art could modify Kaneko in view of Cao to meet this limitation.</p> <p>For example, Cao discloses an input device 102 (i.e., a stylus) that includes an inertial measurement unit 114, which may comprise a compass, a gyroscope, and one or more accelerometers, which are sensors. Cao, 3:59-4:35.</p> <div data-bbox="711 612 1185 1403"><p>FIG. 1</p><p>FIG. 1 of Cao</p></div> <p>It would have been obvious to modify the stylus of Kaneko to include the sensors of Cao, and a person of ordinary skill would have been motivated to so modify the stylus of Kaneko for the obvious benefit of capturing richer sensor data, which can be used to determine orientation of the stylus to enable different functions of the stylus. <i>See, e.g.,</i> Cao, 1:20-51.</p>	

Claim 1	Example Disclosures in Prior Art
1[b] one or more electrodes configured to communicate with a device by receiving signals from and transmitting signals to a touch sensor of the device; and	Limitation 1[b] is obvious for the reasons discussed in Appendix A1, and limitation 1[b] is further obvious in view of Kaneko and Vuppu for the reasons discussed in Appendix A1.
1[c] one or more computer-readable non-transitory storage media embodying logic that is operable when executed to:	<p>Limitation 1[c] is obvious for the reasons discussed in Appendix A1.</p> <p>To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation 1[c], a person of ordinary skill could modify Kaneko in view of Cao to meet this limitation. For example, Cao discloses that software included in processing components 134 of an input device may be stored in a memory, which may comprise computer-readable media. Cao, 5:12-15.</p>
1[c1] receive sensor data from the one or more sensors;	<p>Limitation 1[c1] is obvious for the reasons discussed in Appendix A1.</p> <p>To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation 1[c1], a person of ordinary skill could modify Kaneko in view of Cao to meet this limitation.</p>
	<p>For example, the input device 102 of Cao includes the inertial measurement unit 114, which may comprise a compass, a gyroscope, and one or more accelerometers, which are sensors. Cao, 3:59-4:35. The inertial measurement unit 114 is used to measure and output a pitch or tilt angle of the input device 102. Cao, 4:35-37. The data collected using the inertial measurement unit 114 is, therefore, sensor data that is received by a component in the stylus of Cao.</p>

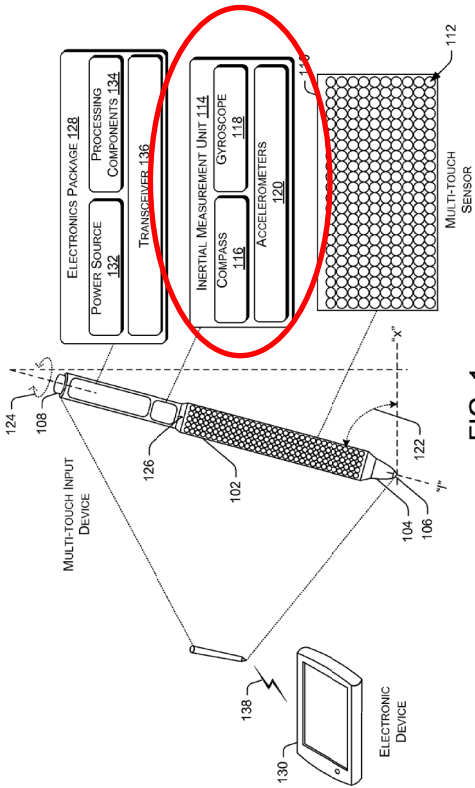


FIG. 1

Claim 1	Example Disclosures in Prior Art Figure 1 of Cao
	<p>It would have been obvious to modify the stylus of Kaneko to include the sensors of Cao, and a person of ordinary skill would have been motivated to so modify the stylus of Kaneko for the obvious benefit of capturing richer sensor data, which can be used to determine orientation of the stylus to enable different functions of the stylus. <i>See, e.g.,</i> Cao, 1:20-51.</p>
1[c2] receive a first signal generated by the device;	<p>Limitation 1[c2] is obvious for the reasons discussed in Appendix A1.</p>
1[c3] generate a second signal by modulating a carrier signal based on the sensor data; and	<p>Limitation 1[c3] is obvious for the reasons discussed on Appendix A1.</p> <p>To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation 1[c3], a person of ordinary skill could modify Kaneko in view of Cao to meet this limitation.</p> <p>For example, Cao discloses passing output data of the inertial measurement unit to the electronic device. Cao, 4:55-57.</p> <p>It would have been obvious to modify the stylus of Kaneko to pass the output data to the electronic device as in Cao, and a person of ordinary skill would have been motivated to so modify the stylus of Kaneko for the obvious benefit of capturing richer sensor data, which can be used to determine orientation of the stylus to enable different functions of the stylus. <i>See, e.g.,</i> Cao, 1:20-51.</p>
1[c4] transmit to the device, in response to the first signal, the second signal, the sensor data being obtainable by demodulating the second signal.	<p>Limitation 1[c4] is obvious for the reasons discussed in Appendix A1.</p> <p>To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation 1[c4], a person of ordinary skill could modify Kaneko in view of Cao to meet this limitation.</p> <p>For example, Cao discloses passing output data of the inertial measurement unit to the electronic device. Cao, 4:55-57.</p> <p>It would have been obvious to modify the stylus of Kaneko pass the output data to the electronic device as in Cao, and a person of ordinary skill would have been motivated to so modify the stylus of Kaneko for the obvious benefit of capturing richer sensor data, which can be used to determine orientation of the stylus to enable different functions of the stylus. <i>See, e.g.,</i> Cao, 1:20-51</p>
Claim 2	Example Disclosures in Prior Art

2. The stylus of claim 1, wherein the first signal is the carrier signal modulated to generate the second signal.	See discussion of claim 2 at Appendix A1.
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Example Disclosures in Prior Art	
<p>Claim 3</p> <p>3. The stylus of claim 1, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.</p>	<p>Claim 3 is obvious and/or in view of Kaneko and Vuppu for the reasons discussed in Appendix A1.</p> <p>Alternatively, a person of ordinary skill could modify Kaneko in view of King-Smith to meet these limitations.</p> <p>King-Smith discloses a transducer, which may be a stylus, configured to selectively generate an electric field at multiple frequencies and to encode digital data in frequency shifts of the electric field. King-Smith, ¶ [0010]. King-Smith further describes that “any other digital modulation technique may be used to encode digital data, including Amplitude-Shift Keying (ASK) technique, Phase-Shift Keying (PSK) technique, and Quadrature Amplitude Modulation (QAM) technique.” <i>Id.</i> Therefore, King-Smith discloses generating a signal using amplitude modulation, frequency modulation, and phase modulation. It would have been obvious to modify the technology of Kaneko to implement various kinds of modulation, as in King-Smith, and a person of ordinary skill would have been motivated to so modify the stylus of Kaneko for the obvious benefit of improved communication of data using different kinds of modulation of the signal. <i>See id.</i></p>

Example Disclosures in Prior Art	
<p>Claim 4</p> <p>4. The stylus of claim 1, wherein: the one or more sensors comprise a pressure sensor and a button; and the sensor data comprises pressure data and button state data.</p>	<p>Claim 4 is obvious and Vuppu for the reasons discussed in Appendix A1.</p> <p>To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation the limitations of claim 4, a person of ordinary skill could modify Kaneko in view of Cao to meet these limitations.</p> <p>For example, Cao discloses that the input device may include a retractable tip that activates a pressure switch housed in the input device. Cao, 3:64-66. The pressure switch outputs a signal when sufficient pressure actuates the switch. Cao, 3:66-67. Cao further discloses that the body of the input device can have at least one button, which may be a clickable button to activate a pressure switch. Cao, 4:1-4. Accordingly, Cao discloses a pressure sensor and a button, as well as sensor data comprising pressure data and button state data.</p>

Claim 5	Example Disclosures in Prior Art
<p>5. The stylus of claim 1, wherein the sensor data is digital.</p>	<p>Claim 5 is obvious and Vuppu for the reasons discussed in Appendix A1.</p> <p>To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation the limitations of claim 5, a person of ordinary skill could modify Kaneko in view of Cao to meet this limitation.</p> <p>For example, Cao discloses “digital data” in relation to data outputted by the inertial measurement unit. Cao, 5:1-9. Cao, therefore, also discloses “wherein the sensor data is digital.”</p>
Claim 7	Example Disclosures in Prior Art
<p>7[pre] One or more computer-readable non-transitory storage media embodying logic that is operable when executed to:</p>	<p><i>See limitation 1[c] above.</i></p>
<p>7[a] receive sensor data from one or more sensors in or on a stylus, the stylus comprising one or more electrodes configured to communicate with a device by receiving signal from and transmitting signals to a touch sensor of the device;</p>	<p><i>See limitations 1[b] and 1[c1] above.</i></p>
<p>7[b] receive a first signal generated by the device;</p>	<p><i>See limitation 1[c2] above.</i></p>
<p>7[c] generate a second signal by modulating a carrier signal based on the sensor data; and</p>	<p><i>See limitation 1[c3] above.</i></p>
<p>7[d] transmit to the device, in response to the first signal, the second signal, the sensor data being obtainable by demodulating the second signal.</p>	<p><i>See limitation 1[c4].</i></p>

Claim 8	Example Disclosures in Prior Art
8. The media of claim 7, wherein the first signal is the carrier signal modulated to generate the second signal.	<i>See claim 2 above.</i>
Claim 9	Example Disclosures in Prior Art
9. The media of claim 7, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.	<i>See claim 3 above.</i>
Claim 10	Example Disclosures in Prior Art
10. The media of claim 7, wherein: the one or more sensors comprise a pressure sensor and a button; and the sensor data comprises pressure data and button state data.	<i>See claim 4 above.</i>
Claim 11	Example Disclosures in Prior Art
11. The media of claim 7, wherein the sensor data is digital.	<i>See claim 5 above.</i>
Claim 13	Example Disclosures in Prior Art
13[pre] A system comprising:	Limitation 13[pre] is obvious for the reasons discussed in Appendix A1.
13[a] a device comprising a touch sensor; and	Limitation 13[a] is obvious for the reasons discussed in Appendix A1.
13[b] a stylus comprising:	<i>See limitation 1[pre].</i>
13[b1] one or more sensors;	<i>See limitation 1[a].</i>
13[b2] one or more electrodes configured to communicate with a device by receiving signals from and transmitting signals to a touch sensor of the device; and	<i>See limitation 1[b].</i>

Claim 13	Example Disclosures in Prior Art
13[b3] one or more computer-readable non-transitory storage media embodying logic that is operable when executed to:	<i>See limitation 1[c].</i>
13[b3A] receive sensor data from the one or more sensors;	<i>See limitation 1[c1].</i>
13[b3B] receive a first signal generated by the device;	<i>See limitation 1[c2].</i>
13[b3C] generate a second signal by modulating a carrier signal based on the sensor data; and	<i>See limitation 1[c3].</i>
13[b3D] transmit to the device, in response to the first signal, the second signal, the device being operable to obtain the sensor data by demodulating the second signal.	<i>See limitation 1[c4].</i>
Claim 14	Example Disclosures in Prior Art
14. The system of claim 13, wherein the first signal is the carrier signal modulated to generate the second signal.	<i>See claim 2 above.</i>
Claim 15	Example Disclosures in Prior Art
15. The system of claim 13, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.	<i>See claim 3 above.</i>
Claim 16	Example Disclosures in Prior Art

16. The system of claim 13, wherein: the one or more sensors comprise a pressure sensor and a button; and the sensor data comprises pressure data and button state data.	<i>See claim 4 above.</i>
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Example Disclosures in Prior Art	
17. The system of claim 13, wherein the sensor data is digital.	<i>See claim 5 above.</i>

Appendix A3

U.S. Patent No. 9,280,220 Invalidity Chart – Obviousness over Kaneko in view of Harley

Japanese Patent Publication No. JP 2008-152640 to Kaneko (“Kaneko”) (Ex. 1005) (published July 3, 2008) renders obvious the challenged claims of U.S. Patent No. 9,280,220 (“’220 Patent”) (Ex. 1001) under 35 U.S.C. § 103 in view of U.S. Patent No US 8,928,635 B2 to Harley et al. (“Harley”) (Ex. 1021) (issued January 6, 2015; filed June 22, 2011), as set forth in the chart below.

Kaneko and Harley describe similar technologies and address similar problems. Both describe devices in the form of a stylus used to communicate with a touch sensor of a device, and both describe techniques for communicating signals from a stylus to a touchscreen device and vice versa. Additionally, both employ capacitive coupling for communication, and both disclose synchronization between the stylus and touch sensor and modulation/demodulation of data. Furthermore, both of them disclose how the location of the stylus can be determined.

Kaneko provides a coordinate input device that enables both finger and pen inputs with high accuracy and high functionality. Kaneko at Abstract. It describes that the stylus includes an electric field sensor at the pen tip to detect the strength of an electric field received from the touchscreen device. Kaneko, ¶ [0024]. Kaneko discloses various operations performed at the electronic pen, such as modulating a LC resonance circuit by a modulation circuit to change electric current flow through a loop coil 101 on the panel side. Kaneko, ¶ [0041]. The electronic pen is thus used to transmit data to the controller on the panel side, where the signal is demodulated to receive the data. *Id*

Similarly, Harley relates generally to touch sensing, and more particularly, to providing a stylus that can act as a drive and/or sense element in a capacitive touch system. Harley 1:5-7 (FIELD). It discloses an active stylus, where the stylus includes an electrode at a tip of the stylus and powered circuitry coupled to the electrode and configured for capacitively coupling the electrode with a capacitive touch sensor panel. Harley at Abstract. The powered circuitry can further include drive circuitry configured to output a drive voltage at the electrode and/or sense circuitry configured to sense a voltage received at the electrode. *Id*. Harley also discloses synchronization between the stylus and the touch sensor. *Id*. 6:47-7:26, Claim 6. It also discloses modulation/demodulation of data. *Id*. 7:4-26. 9:40-67, Claim 1, Claim 4, Claim 13, Claim 15, and Claim 16. In one embodiment, where the stylus acts as a drive electrode, a capacitive touch sensor panel can detect charge coupled into sense lines on the panel by the stimulus from the stylus and determine the location of the stylus on its surface. *Id*. 5:6-19.

A person of ordinary skill in the art would have been motivated to modify the technology of Kaneko based on Harley so that the stylus can use capacitive coupling for both sending and receiving all data to be communicated. This combination greatly simplifies the design and reduces the cost. While Kaneko uses capacitive coupling by stylus to receive selected data from the touch sensor/host, it discloses, in an embodiment, the use of electromagnetic induction/coupling for other types of communication. A person of ordinary skill in the art would have been motivated to use capacitive coupling for both ways of communication, as in Harley, for the obvious benefits of reducing cost and simplifying the implementation. Electromagnetic coupling requires dedicated coils in the touch sensor/touch screen instead of relying only on the standard capacitive touch layers in the case of capacitive coupling. The coils make the touch sensor more complex to manufacture, thereby further increasing the cost. It would be well within the capabilities of a person of ordinary skill in the art to modify the stylus and touch sensor of Kaneko based on Harley, and a person of ordinary skill in the art would have a reasonable chance of success in doing so.

Example Disclosures in Prior Art	
Claim 1	To the extent the preamble is considered limiting, Kaneko discloses an electronic pen 300 used as an input means to a panel 100. Kaneko, Figure 1 & ¶¶ [0020], [0024], and [0040]. The electronic pen of Kaneko is a stylus.

[Fig. 1]

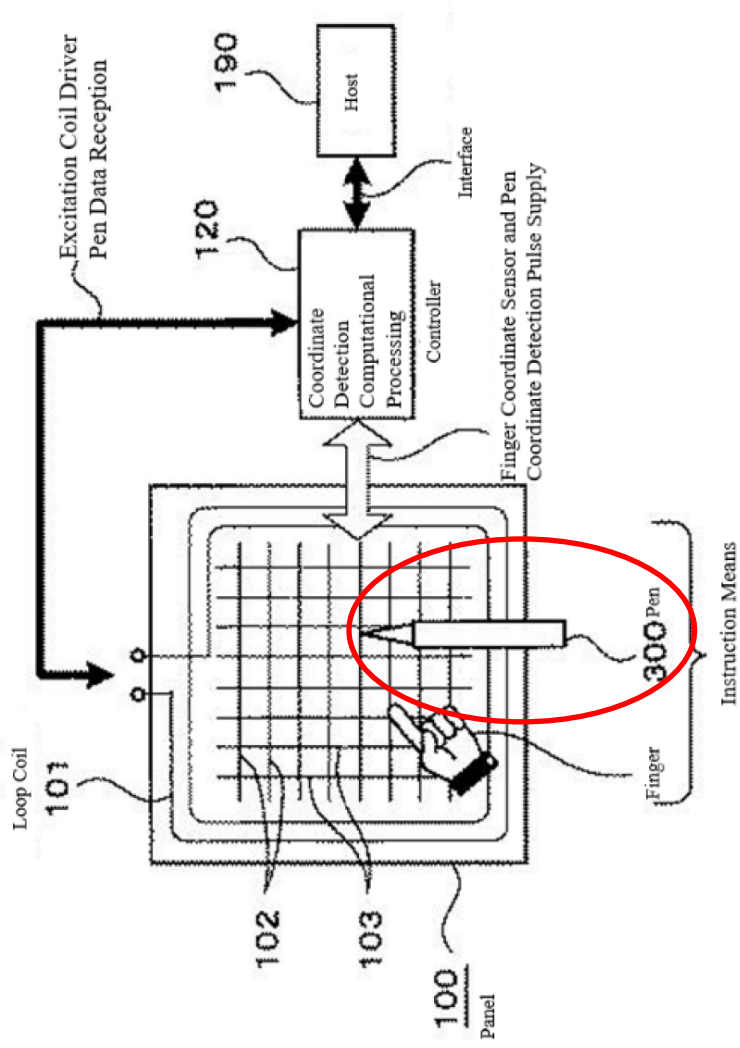


Figure 1 of Kaneko

Example Disclosures in Prior Art	
Claim 1	<p>The electronic pen of Kaneko includes, for example, an electric field sensor. Kaneko, ¶ [0024]. Kaneko describes that an electric field sensor at the pen tip detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form, the intensity data is sent to the modulation circuit. <i>Id.</i> The modulation circuit modulates the LC resonance voltage to generate a counter magnetic field. <i>Id.</i> This generated counter magnetic field alters the electric current flowing in loop coil 101 on the panel side. <i>Id.</i> The signal provided from the electronic pen to the panel side is used to communicate data. Kaneko, ¶ [0041]. The electronic pen of Kaneko also includes sensors, such as “a pressure detection mechanism to detect pressure according to usage.” Kaneko, ¶ [0024]. A person of ordinary skill in the art would appreciate that detecting pressure would be performed using one or more sensors. Moreover, the electronic pen of Kaneko includes mechanical switches assigned for functions like clicks. A person of ordinary skill in the art would appreciate that detecting user clicks would be performed using one or more sensors. Therefore, a person of ordinary skill would appreciate that Kaneko discloses limitation 1[a] based on at least the foregoing disclosures.</p>
1[b] one or more electrodes configured to communicate with a device by receiving signals from and transmitting signals to a touch sensor of the device; and	<p>The electronic pen of Kaneko includes an electric field sensor at the tip of the electronic pen. Kaneko, ¶ [0024]. A signal is provided to the electronic pen via the electric field sensor and from a loop coil 101, and the electronic pen generates a counter magnetic field to communicate data to the panel side. Kaneko, ¶¶ [0024] and [0040]. A conductive material, such as metal or conductive resin, is arranged at the pen tip 325 to detect the electric field from the conductive film pattern on the panel side. Kaneko, ¶ [0044]. Based on this, a person of ordinary skill in the art would appreciate that the electronic pen of Kaneko includes “one or more electrodes configured to communicate with a device”. A person of ordinary skill in the art would appreciate that an electrode could be understood as a conductor that establishes electrical contact with a nonmetallic component of a circuit. <i>See</i> Ex. 1020. An electrode may serve as the conductive element that creates or senses changes in the electric field between two objects. The electric field sensor of Kaneko would, therefore, be understood as “one or more electrodes” as in limitation 1[b]. Moreover, Kaneko discloses the use of capacitive coupling between the touch panel and the electronic pen. Kaneko, ¶¶ [0031] and [0016]. Capacitive coupling is a transfer of electric signals that inherently requires a pairing of electrodes by proximity. A person of ordinary skill in the art would understand that the tip must comprise an electrode. No undue experimentation is required for a person of ordinary skill in the art 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 ’220 Patent, electrodes had been known for decades, and a person of ordinary skill in the art 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. <i>See, e.g.,</i> Harley at ABSTRACT, FIG. 3, 1:58-2:1, and Claim 15, U.S. Patent Publication No. 20120050207 ¶[0050], and U.S. Patent No. 8,766,954 (Ex. 1006) at 3:3-17. As an example, active styluses that employ capacitive coupling act as a drive and/or a sense element in a capacitive touch system. Harley 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. <i>Id.</i> 1:59-2:1. These active styluses can significantly improve stylus sensing on a mutual capacitive touch sensor panel without incurring significant additional cost. <i>Id.</i> 2:3-5.</p>

Claim 1	Example Disclosures in Prior Art
	<div data-bbox="378 1166 407 1244" data-label="Caption"> <p>[Fig. 6]</p> </div> <div data-bbox="418 784 909 1193" data-label="Diagram"> <p>The diagram illustrates a stylus tip assembly. It consists of an amplifier (AMP) labeled 324, which is connected to a block labeled 326. This block 326 is further connected to a stylus tip assembly labeled 327. The tip assembly includes a conductive material (325) and a pen tip (327). The conductive material is shown as a dashed outline, indicating its internal structure. The pen tip is shown as a solid outline, indicating its external shape. The entire assembly is connected to a ground symbol.</p> </div> <div data-bbox="924 889 956 1155" data-label="Caption"> <p>Figure 6 of Kaneko</p> </div> <div data-bbox="997 118 1177 1943" data-label="Text"> <p>To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation 1[b], it would be obvious to a person of ordinary skill in the art to modify Kaneko in view of the knowledge of a person of ordinary skill in the art to implement limitation 1[b]. For example, as discussed above, it was known to include an electrode in the tip of a stylus, and it would be obvious to a person of ordinary skill in the art that the electrode can be used for transmitting signals, receiving signals, or both. See, <i>e.g.</i>, U.S. Patent No. 8,766,954 3:36-41 & 3:50-61 and Harley 1:58-2:1.</p> </div>

Claim 1	Example Disclosures in Prior Art
	<p>Alternatively, limitation 1[b] would be obvious to a person of ordinary skill in the art in view of Kaneko and Harley. Harley discloses one or more electrodes to perform the foregoing functions. Harley at ABSTRACT, FIG. 3, 1:58-2:1, and Claim 15. It discloses an active stylus, where the stylus includes an electrode at a tip of the stylus and powered circuitry coupled to the electrode and configured for capacitively coupling the electrode with a capacitive touch sensor panel. <i>Id.</i> at Abstract. The powered circuitry can further include drive circuitry configured to output a drive voltage at the electrode and/or sense circuitry configured to sense a voltage received at the electrode. <i>Id.</i> Specifically, Figure 2 of Harley illustrates an exemplary active stylus for use with a capacitive touch sensor panel according to various embodiments. Figure 3 of Harley illustrates exemplary drive circuitry of the active stylus of Figure 2 according to various embodiments. Harley clarifies that the disclosed active stylus can significantly improve stylus sensing on a mutual capacitive touch sensor panel without incurring significant additional cost compared with passive styluses. <i>Id.</i> 2:3-5. A person of ordinary skill in the art would have been motivated to modify the technology of Kaneko based on Harley so that the stylus can use capacitive coupling for both sending and receiving all data to be communicated. This combination greatly simplifies the design and reduces the cost. While Kaneko uses capacitive coupling by stylus to receive data from the touch sensor/host, it discloses, in an embodiment, the use of electromagnetic induction/coupling for other types of communication. See, e.g., Figure 5 of Kaneko, which is discussed in limitations 1[c], 1[c1], 1[c2], and 1[c3] below. A person of ordinary skill in the art would have been motivated to use capacitive coupling for both ways of communication, as in Harley, for the obvious benefits of reducing cost and simplifying the implementation. Electromagnetic induction/coupling requires dedicated coils in the touch sensor/touch screen instead of relying only on the standard capacitive touch layers in the case of capacitive coupling. These coils make the touch sensor more complex to manufacture, thereby further increasing the cost. It would be well within the capabilities of a person of ordinary skill in the art to modify the stylus and touch sensor of Kaneko based on Harley, and a person of ordinary skill in the art would have a reasonable chance of success in doing so. Although this combination may require the use of a battery within the stylus, a person of ordinary skill in the art would understand that it is one of a small number of design choices and is an excellent tradeoff considering the achieved simplicity of design and reduced cost.</p>

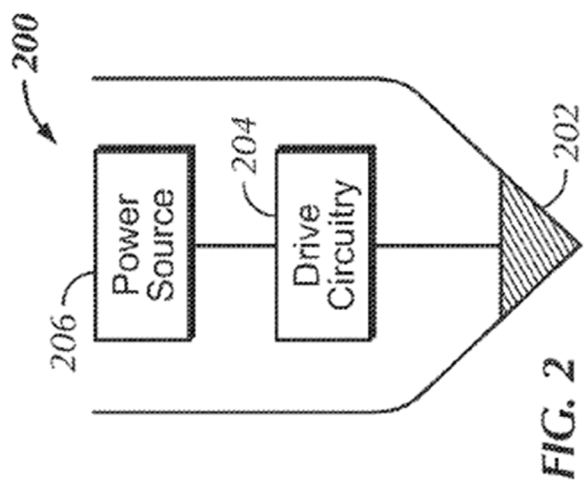


Figure 2 of Harley

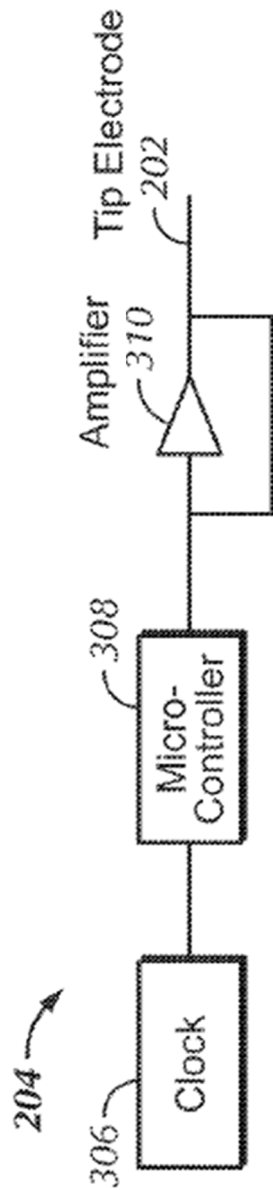


Figure 3 of Harley

Claim 1	Example Disclosures in Prior Art

1[c] one or more computer-readable non-transitory storage media embodying logic that is operable when executed to:	<p>Kaneko discloses various operations performed at the electronic pen, such as modulating a LC resonance circuit 310 by a modulation circuit 322 to change electric current flow through a loop coil 101 on the panel side. Kaneko, ¶ [0041]. The electronic pen is thus used to transmit data to the controller on the panel side, where the signal is demodulated to receive the data. <i>Id.</i> A person of ordinary skill in the art would appreciate that the electronic pen of Kaneko includes limitation 1[c] to store instructions for performing operations performed at the electronic pen. Moreover, Kaneko explicitly states in the context of the touch panel that “[b]y being able to send data (commands) to the pen, functionalities such as reading pen-specific information, setting sensitivity settings, firmware updates, and potentially enabling features like vibration via a vibration device or light notifications (e.g., through LEDs) triggered by commands sent from the controller side can be realized, providing a wireless pen that utilizes bidirectional data transmission”. Kaneko ¶ [0050]. Thus, the electronic pen of Kaneko includes firmware, which is system software¹ that is used to control the operation of the pen. The firmware is necessarily stored in persistent memory² and requires a central processing unit (CPU) to be executed, as any other program, and such a CPU will include logic³. Kaneko also explicitly mentions that “as shown in Fig. 5, signals received by the LC resonant circuit 310 of the electronic pen are demodulated by the reception/demodulation circuit 341, and the demodulated data is supplied to the processing unit 342 within the electronic pen to execute the corresponding processing. Kaneko ¶ [0050]. A person of ordinary skill in the art would understand that such a processing unit that can be used to execute corresponding processing will include a CPU. Furthermore, the “sensitivity settings” shown in Figure 5 of Kaneko will necessarily require being stored in a computer-readable non-transitory storage media. See also Kaneko ¶ [0050].</p>
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¹ Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 286 (Ex. 1016).
² Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 286 (Ex. 1016).
³ Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 107 (Ex. 1016).

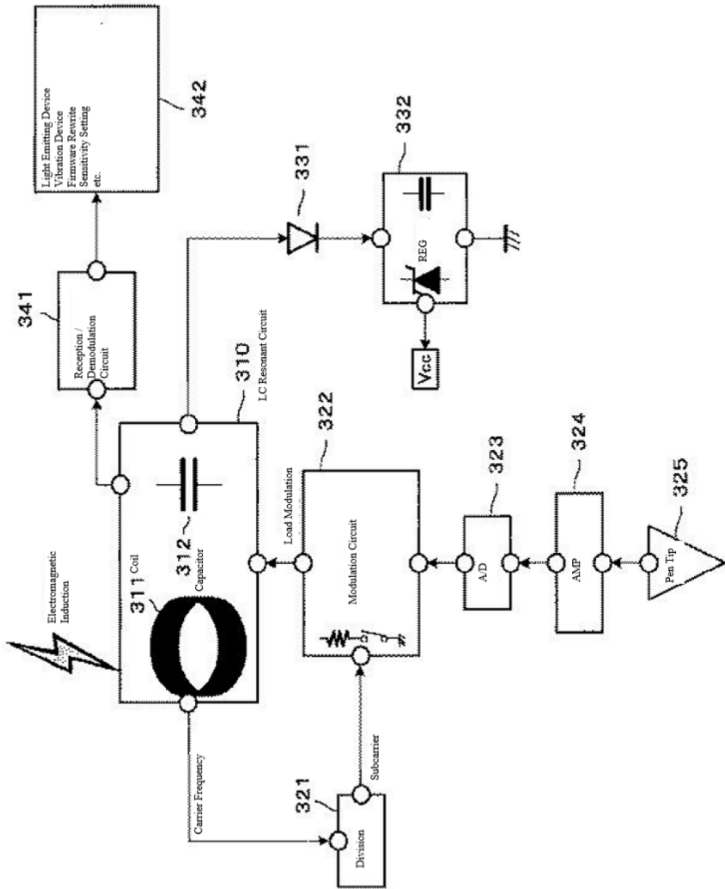
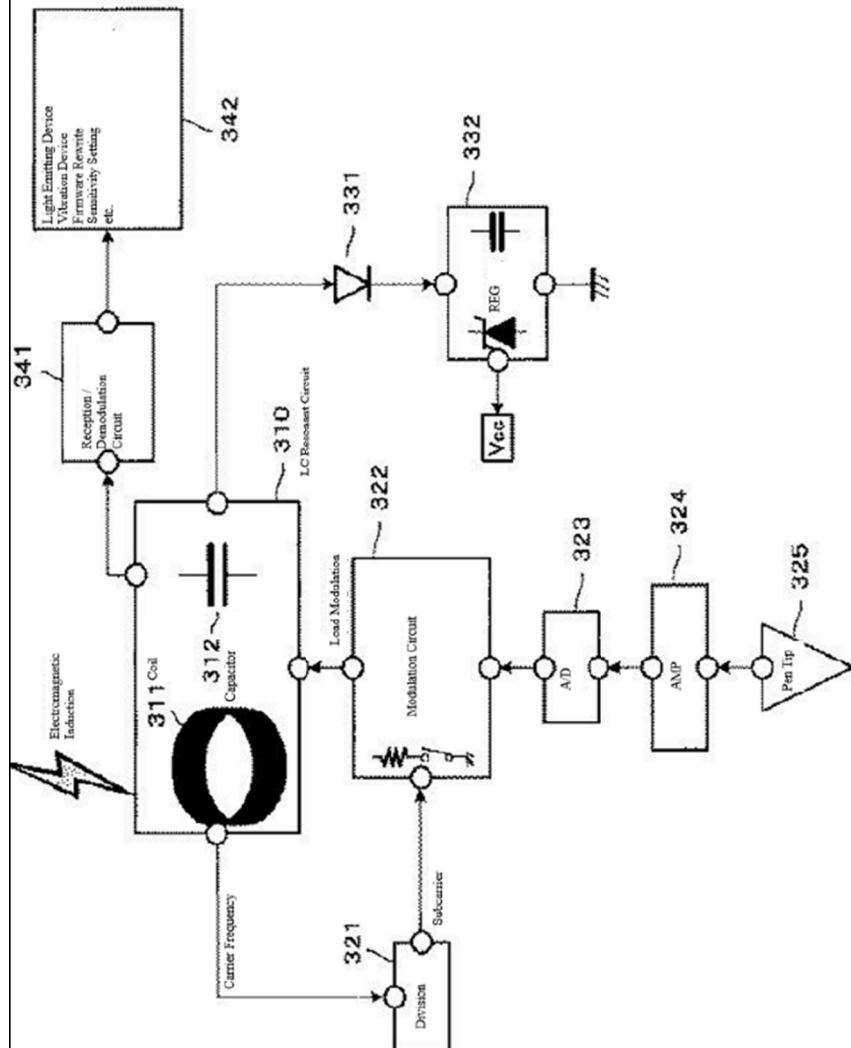


Figure 5 of Kaneko

<p>1[c1] receive sensor data from the one or more sensors;</p>	<p>As discussed in limitation 1[a] above, the electronic pen of Kaneko includes, for example, an electric field sensor. Kaneko, ¶ [0024] Kaneko describes that an electric field sensor at the pen tip detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form, the intensity data is sent to the modulation circuit. <i>Id.</i> The modulation circuit modulates the LC resonance voltage to generate a counter magnetic field. <i>Id.</i> This generated counter magnetic field alters the electric current flowing in loop coil 101 on the panel side. <i>Id.</i> In particular, Kaneko describes that an electric field sensor at the pen tip detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form, the intensity data is sent to the modulation circuit. Kaneko, ¶ [0024]. Specifically, Kaneko provides the following details in relation to Figure 1.</p> <p>By placing the electronic pen within the alternating magnetic field generated by loop coil 101, power is supplied to the electronic pen via electromagnetic induction, driving the internal circuit of the pen. Alternating or pulse voltage is then sequentially applied to the matrix pattern. The electric field sensor at the pen tip detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form, the intensity data is sent to the modulation circuit. The modulation circuit amplitude-modulates (load modulation) the LC resonance voltage to generate a counter magnetic field. This generated counter magnetic field alters the electric current flowing in loop coil 101 on the panel side. By demodulating this change in electric current, the intensity data sent from the pen is obtained. Based on the received electric field strength distribution, interpolation processing for the pen coordinates is performed, and the pen coordinate data is output from controller 120 to host 190. <i>Id.</i></p> <p>See also Kaneko, ¶ [0055]. Therefore, detecting the electric field variations through the electric field sensor effectively enables the overall system to sense and detect the coordinate of the pen position. The signal provided from the electronic pen to the panel side is used to communicate data. Kaneko, ¶ [0041].</p> <p>The electronic pen of Kaneko also includes sensors, such as “a pressure detection mechanism to detect pressure according to usage.” Kaneko, ¶ [0024]. A person of ordinary skill in the art would appreciate that detecting pressure would be performed using one or more sensors. Moreover, the electronic pen of Kaneko includes mechanical switches assigned for functions like clicks. A person of ordinary skill in the art would appreciate that detecting user clicks would be performed using one or more sensors.</p> <p>Therefore, a person of ordinary skill would appreciate that Kaneko discloses limitation 1[c1] based on at least the foregoing disclosures.</p> <p>To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation 1[c1], a person of ordinary skill would understand how to modify Kaneko to meet this limitation based on such person’s knowledge and Kaneko. For example, while Kaneko does not expressly state that the detected pressure is received by the modulation circuit, it would be obvious to a POSITA that pressure data would be received at the modulation circuit to be communicated to the panel side. Kaneko discloses that the LC resonant circuit is amplitude modulated by the modulation circuit, which changes the current flowing through the loop coil on the panel side, thus enabling transmission of data from the stylus to the controller. Kaneko, ¶ [0041]. Kaneko does not limit the kinds of data that can be transmitted according to these techniques, and it would be obvious to a POSITA that the transmitted data would include data collected using the pressure detection mechanism.</p>
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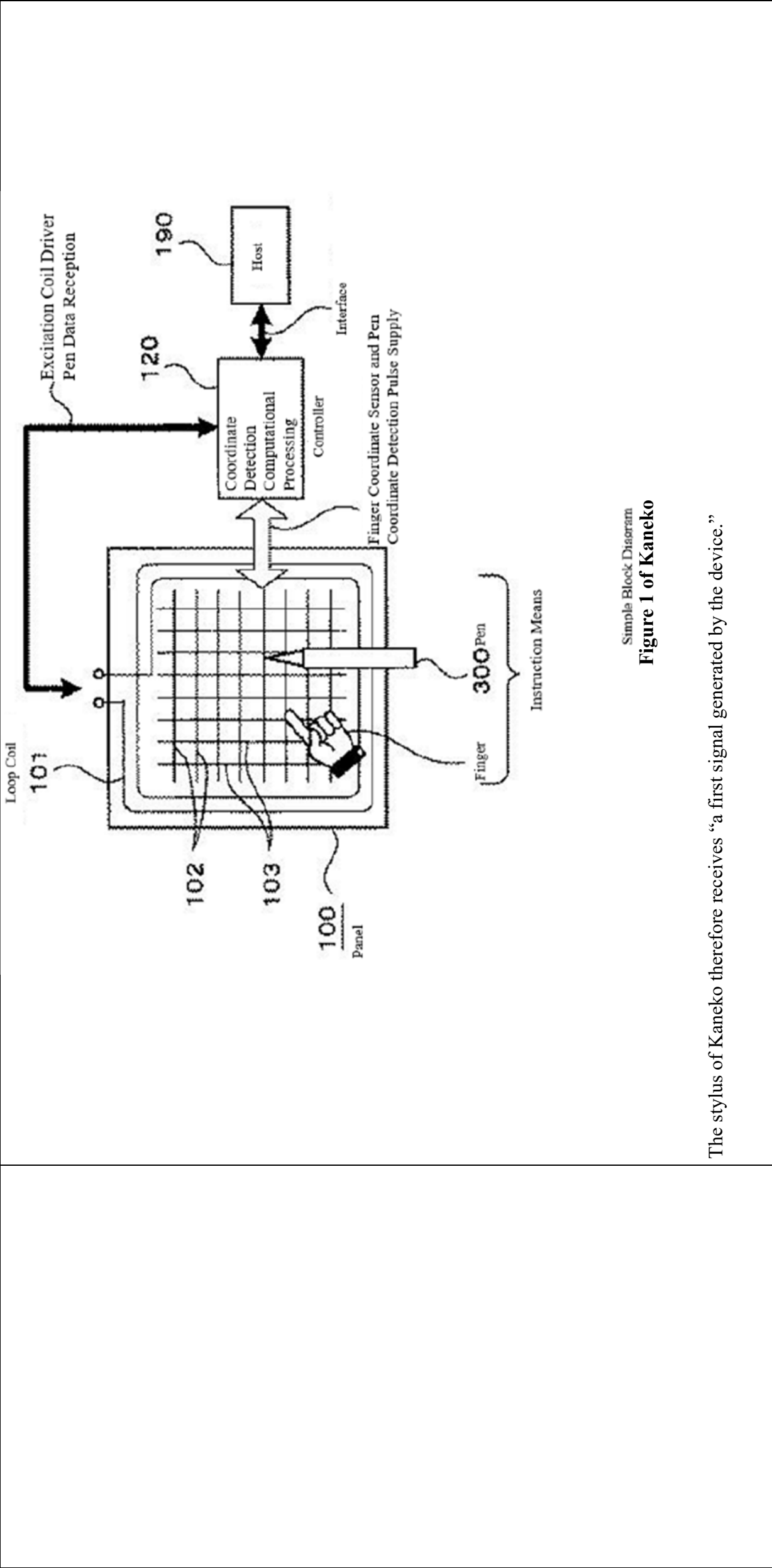
<p>1[c2] receive a first signal generated by the device;</p>	<p>Figure 5 of Kaneko shows that the electronic pen receives a signal from the touch panel through electromagnetic induction, and then it detects the carrier frequency of the received signal, modulates this carrier signal based on the data to be sent by the pen, and subsequently transmits the output of the modulation process to the touch panel. Specifically, Kaneko discloses that “[t]he modulation circuit 322 receives a signal obtained by dividing the carrier frequency detected by the LC resonant circuit 310 using the frequency divider 321”. Kaneko, ¶ [0045]. It also discloses that “[b]y changing the electric current flowing through the loop coil 101, this electric current change is detected on the panel side and converted to voltage by a detection resistor, enabling demodulation into the desired data for transmission of data from the electronic pen to the controller”. <i>Id.</i> In relation to Figure 5, Kaneko describes that an electric field sensor at the pen tip 325 detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form using an analog-to-digital converter 323, the intensity data is sent to the modulation circuit 322. Kaneko, ¶ [0024], [0045]. Kaneko also provides the following details in relation to Figure 1.</p> <p>The detailed structure will be described later. An alternating electric current is passed through the loop coil 101, which is positioned as a loop antenna around the outer periphery of electrodes 102 and 103 forming the matrix pattern. By placing the electronic pen within the alternating magnetic field generated by loop coil 101, power is supplied to the electronic pen via electromagnetic induction, driving the internal circuit of the pen. Alternating or pulse voltage is then sequentially applied to the matrix pattern. The electric field sensor at the pen tip detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form, the intensity data is sent to the modulation circuit. The modulation circuit amplitude-modulates (load modulation) the LC resonance voltage to generate a counter magnetic field. This generated counter magnetic field alters the electric current flowing in loop coil 101 on the panel side. By demodulating this change in electric current, the intensity data sent from the pen is obtained. Based on the received electric field strength distribution, interpolation processing for the pen coordinates is performed, and the pen coordinate data is output from controller 120 to host 190. <i>Id.</i></p> <p>See also Kaneko, ¶ [0055].</p>
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Electronic PDA Online Block Diagram
Figure 5 of Kaneko

Claim 1

Example Disclosures in Prior Art



Simple Block Diagram
Figure 1 of Kaneko

The stylus of Kaneko therefore receives “a first signal generated by the device.”

Claim 1	Example Disclosures in Prior Art
<p>1[c3] generate a second signal by modulating a carrier signal based on the sensor data; and</p>	<p>Modulation can be defined as the “process of modifying some characteristic of a wave (called a carrier) so that it varies in step with the instantaneous value of another wave (called a modulating wave or signal)”, where “[t]he carrier can be a direct current, an alternating current (provided its frequency is above the highest frequency component in the modulating wave), or a series of regularly repeating, uniform pulses called a pulse chain (provided their repetition rate is at least twice that of the highest frequency to be transmitted)”⁴. It can also be defined as “[t]he controlled variation of frequency, phase, and/or amplitude of a carrier wave of any frequency in order to transmit a message”⁵. It can further be defined as “[t]he process, or results of the process, whereby some characteristic of one signal is varied in accordance with another signal”, where “[t]he modulated signal is called the carrier and may be modulated in three fundamental ways: by varying the amplitude (amplitude modulation) by varying the frequency (frequency modulation) or by varying the phase (phase modulation)”⁶. Modulation can further be defined as “a process through which an information-bearing message (i.e., modulating) signal is used to modify (i.e., modulate) some parameter (e.g., amplitude, frequency, phase) of a periodic (such as a high-frequency sinusoidal) signal known as a carrier wave, individually or in combination, to produce the modulated signal for transmission”⁷.</p> <p>As discussed above with reference to limitation 1[c2], the modulation circuit 322 of Kaneko receives a signal obtained by dividing the carrier frequency detected by the LC resonant circuit 310 using a frequency divider 321. Kaneko, ¶ [0041]. See also Figure 5 of Kaneko. Moreover, Kaneko discloses that an excitation frequency provided from the panel side serves as a carrier. Kaneko, ¶ [0037]. The modulation circuit 322 of Kaneko modulates the LC resonance circuit 310 to change electric current flow through a loop coil 101 on the panel side to transmit data. Kaneko, ¶ [0041].</p> <p>As discussed earlier with reference to limitations 1[a] and 1[c1] above, the electronic pen of Kaneko also includes an electric field sensor. Kaneko, ¶ [0024]. The electric field sensor at the pen tip detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form, the intensity data is sent to the modulation circuit. <i>Id.</i> The modulation circuit modulates the LC resonance voltage to generate a counter magnetic field. <i>Id.</i> As shown in Figure 5 of Kaneko, the sensed electric field variations are ultimately sent to the modulation circuit 322 for transmission to the panel/host. In particular, Kaneko describes that an electric field sensor at the pen tip detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form, the intensity data is sent to the modulation circuit. Kaneko, ¶ [0024]. Kaneko also provides the following details in relation to Figure 1.</p>

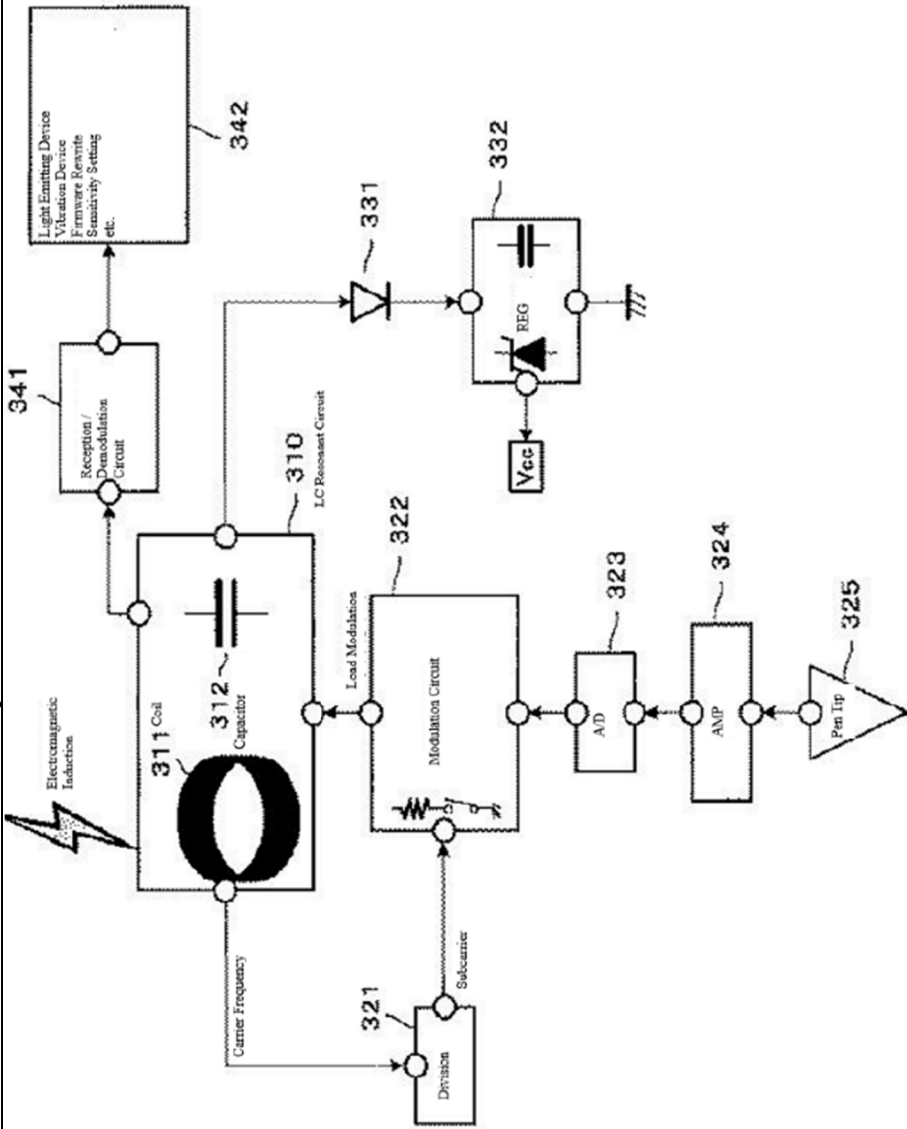
⁴ Rudolf F. Graf Boston. MODERN DICTIONARY OF ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, pages 479-480 [Ex. 1016].

⁵ Rudolf F. Graf Boston. MODERN DICTIONARY OF ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 480 [Ex. 1016].

⁶ Rudolf F. Graf Boston. MODERN DICTIONARY OF ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 480 [Ex. 1016].

⁷ Ali Grami. Introduction to Digital Communications. Copyright © 2016 Elsevier Inc, page 34 [Ex. 1018].

Claim 1	Example Disclosures in Prior Art
	<p>By placing the electronic pen within the alternating magnetic field generated by loop coil 101, power is supplied to the electronic pen via electromagnetic induction, driving the internal circuit of the pen. Alternating or pulse voltage is then sequentially applied to the matrix pattern. The electric field sensor at the pen tip detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form, the intensity data is sent to the modulation circuit. The modulation circuit amplitude-modulates (load modulation) the LC resonance voltage to generate a counter magnetic field. This generated counter magnetic field alters the electric current flowing in loop coil 101 on the panel side. By demodulating this change in electric current, the intensity data sent from the pen is obtained. Based on the received electric field strength distribution, interpolation processing for the pen coordinates is performed, and the pen coordinate data is output from controller 120 to host 190. <i>Id.</i></p> <p>See also Kaneko, ¶ [0055]. Therefore, detecting the electric field variations through the electric field sensor enables the overall system to effectively sense and detect the coordinate of the pen position.</p> <p>Moreover, as discussed above, it would be appreciated that the data transmitted by the stylus of Kaneko may include other sensor data, such as the pressure data. Kaneko discloses that the electronic pen includes a “pressure detection mechanism to detect pressure according to usage”. While Kaneko does not explicitly state that the pressure data is transferred through the modulation circuit 322, a person of ordinary skill in the art would understand that the embodiment shown in Figure 5 can be used to transmit this data as well because (1) this pressure data must be transmitted to the panel/host side somehow, (2) there is no other embodiment that shows a different way to transfer this data, (3) and it would be wasteful in terms of cost, integration, and power consumption to include additional circuitry to do so. A stylus transfers pressure data to enable more precise and natural input, particularly for tasks like drawing, handwriting, and graphic design.</p> <p>Therefore, the stylus of Kaneko transmits the data by generating “a second signal by modulating a carrier signal based on the sensor data,” as in limitation 1[c3].</p>



Electronic Pen Outline Block Diagram

Figure 5 of Kaneko

To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation 1[c3], a person of ordinary skill would understand how to modify Kaneko to meet this limitation based on such person's knowledge and Kaneko. For example, as discussed above with reference to limitation 1[c1], while Kaneko does not expressly state that data from the pressure detection mechanism is used to modulate the carrier signal, a person of ordinary skill in the art would appreciate that this operation is inherent in Kaneko, or alternatively that it would be obvious to modulate data from the pressure detection mechanism into the signal to be communicated to the panel side.

Claim 1	Example Disclosures in Prior Art
<p>1[c4] transmit to the device, in response to the first signal, the second signal, the sensor data being obtainable by demodulating the second signal.</p>	<p>As discussed above with reference to limitations 1[c2] and 1[c3], the modulation circuit 322 of Kaneko modulates the LC resonance circuit 310 to change electric current flow through a loop coil 101 on the panel side to transmit data. Kaneko, ¶ [0041]. The electric current change is detected on the panel side and converted to voltage by a detection resistor, enabling demodulation into received data. <i>Id.</i> As discussed with reference to limitation 1[c3] above, the stylus of Kaneko generates the second signal using a carrier signal provided by the panel side and performing modulation to transmit data from the stylus to the panel side, which may include sensor data. Figure 4 of Kaneko shows an example configuration of the transmission and reception section 130. Kaneko, ¶ [0038]. At the controller side of the touch panel/host, “[t]he impedance matching circuit 132 is connected to a detection resistor 133a for receiving signals, and the received signal obtained at this detection resistor 133a is sent through a bandpass filter 133b and an amplifier 133c to a demodulator 133d, from which the demodulated signal from 133d is output as a received signal at output terminal 133e. Kaneko, ¶ [0039]. Kaneko also discloses that “[t]he transmission and reception processing unit 130 is also equipped with a receiving circuit 133, which detects data regarding the strength of the electric field from the electronic pen and performs demodulation of the received function within that receiving circuit 133” and that “[t]he detected data and demodulated data are sent to the pen coordinate/function calculation unit 129”. Kaneko, ¶ [0037]. It also discloses that “[i]n the pen coordinate/function calculation unit 129, the supplied data and the clock provided from the frequency divider 123 are used to detect the coordinate position (or a nearby position) where the electronic pen contacts the panel” and that “[t]he data of the detected coordinate position is sent to the host 190 via interface 141”. <i>Id.</i></p>

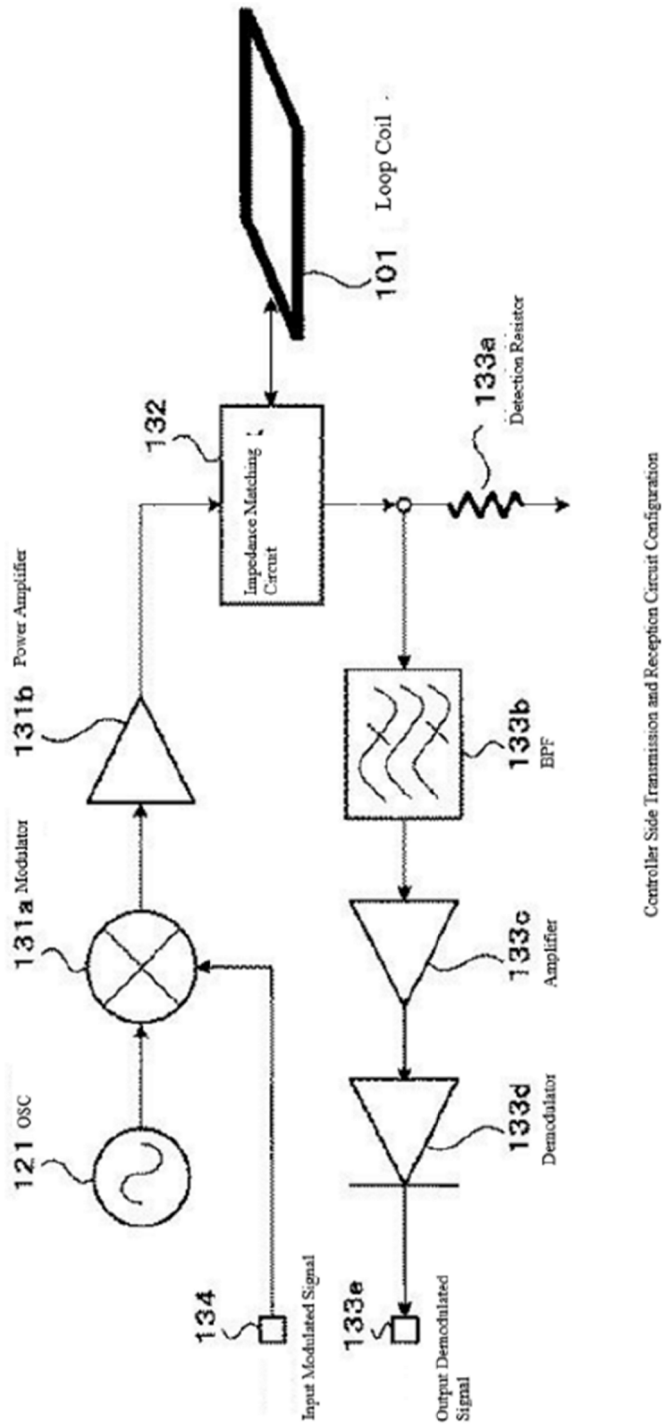


Figure 4 of Kaneko

Therefore, the stylus of Kaneko transmits the second signal to the device in response to the first signal – that is, the second signal is provided by processing the signal received from the device. The sensor data is obtainable by demodulating the second signal. Kaneko, therefore, discloses limitation 1[c4].

To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation 1[c4], a person of ordinary skill would understand how to modify Kaneko to meet this limitation based on such person’s knowledge and Kaneko. For example, as discussed above with reference to limitation 1[c1], while Kaneko does not expressly state that data from the pressure detection mechanism is used to modulate the carrier signal an then will be demodulated, a person of ordinary skill in the art would appreciate that this operation is inherent in Kaneko, or alternatively that it would be obvious to modulate data from the pressure detection mechanism into the signal to be communicated to the panel side.

Claim 2	Example Disclosures in Prior Art
2. The stylus of claim 1, wherein the first signal is the carrier signal modulated to generate the second signal.	As discussed above with reference to limitations 1[a], 1[c2] and 1[c3], Kaneko describes that an electric field sensor at the pen tip detects the strength of the electric field generated around the matrix pattern, and after converting this detected signal to digital form, the intensity data is sent to the modulation circuit. Kaneko, ¶ [0024]. The modulation circuit 322 of Kaneko receives a signal obtained by dividing the carrier frequency detected by the LC resonant circuit 310 using a frequency divider 321. Kaneko, ¶ [0041]. Moreover, Kaneko discloses that an excitation frequency provided from the panel side serves as a carrier. Kaneko, ¶ [0037]. The modulation circuit 322 of Kaneko modulates the LC resonance circuit 310 to change electric current flow through a loop coil 101 on the panel side to transmit data. Kaneko, ¶ [0041]. Based on this, the carrier signal of Kaneko is “the first signal,” as claimed, which is modulated to generate the second signal.

Claim 3	Example Disclosures in Prior Art
3. The stylus of claim 1, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.	<p><i>See limitation 1[c3] above.</i> Kaneko discloses the LC resonant circuit 310 is amplitude modulated by the modulation circuit 322. Kaneko, ¶ [0041]. It would, therefore, be appreciated that the stylus of Kaneko generates the “second signal” using at least “amplitude modulation,” as in claim 3. Kaneko further discloses that the disclosed technology can use various modulation techniques, such as “frequency, phase, and amplitude modulation.” Kaneko, ¶ [0049]. While the discussion of frequency and phase modulation is in the context of sending data from “the controller side to the electronic pen,” it would be appreciated that these modulation techniques can likewise be implemented at the stylus. Moreover, amplitude modulation, frequency modulation, and phase modulation are the three fundamental ways to perform modulation⁸. As an example, a notable textbook states that “[w]e have three distinct modulation categories: amplitude modulation (AM), frequency modulation (FM), and phase modulation (PM)⁹. Modulation can even be defined as “[t]he controlled variation of frequency, phase, and/or amplitude of a carrier wave of any frequency in order to transmit a message”¹⁰. It can also be defined as “a process through which an information-bearing message (i.e., modulating) signal is used to modify (i.e., modulate) some parameter (e.g., amplitude, frequency, phase) of a periodic (such as a high-frequency sinusoidal) signal known as a carrier wave, individually or in combination, to produce the modulated signal for transmission”¹¹. This “is similar to when a musician modulates a tone by varying its volume (amplitude), its timing (phase), and its pitch (frequency)”¹². A person of ordinary skill in the art would understand that modulation is generally performed by one of these three fundamental ways and would naturally turn to use one of these ways to perform modulation.</p>

⁸ Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 480 (Ex. 1016).

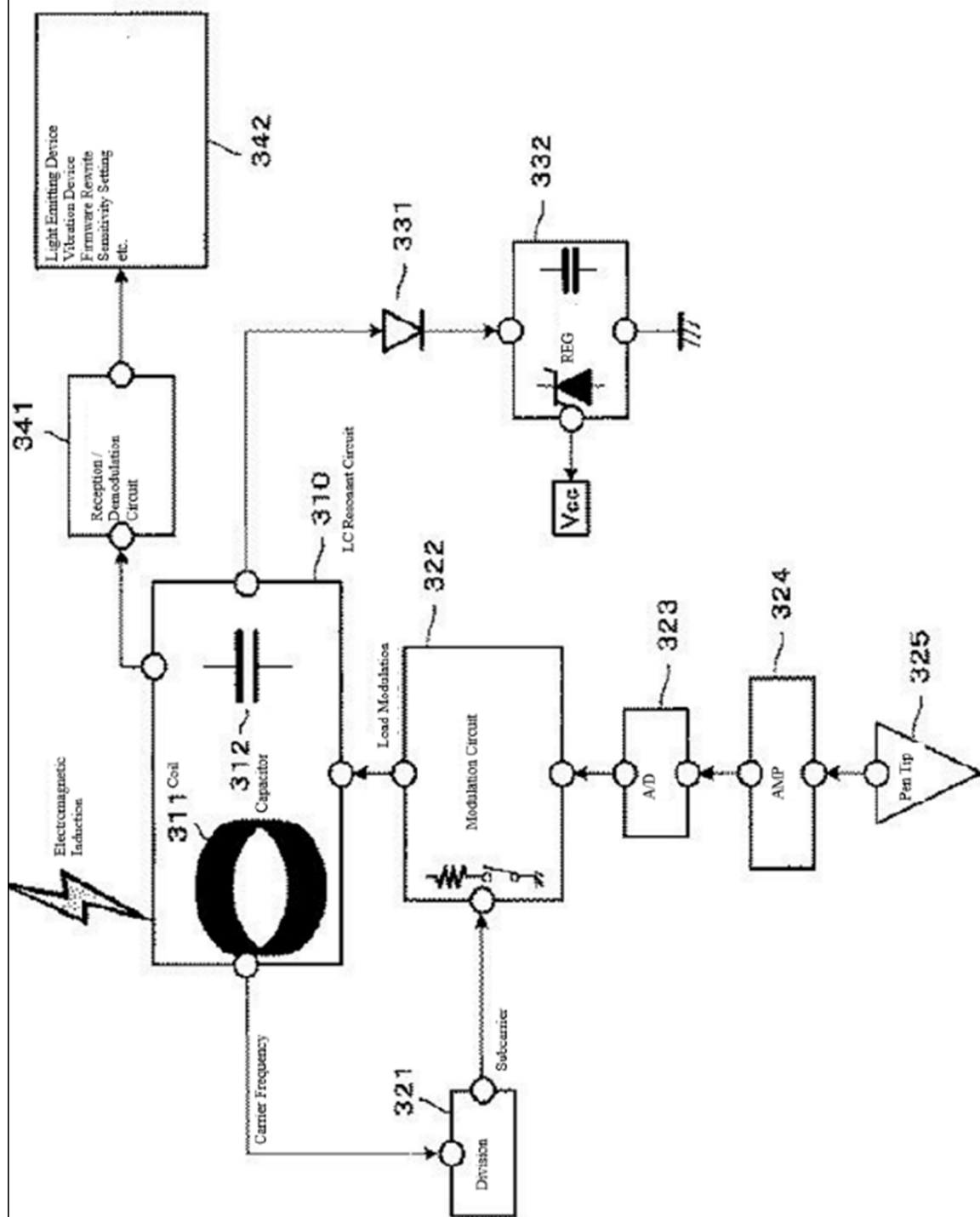
⁹ Ali Grami. Introduction to Digital Communications. Copyright © 2016 Elsevier Inc, page 35 (Ex. 1018).

¹⁰ Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 480 (Ex. 1016).

¹¹ Ali Grami. Introduction to Digital Communications. Copyright © 2016 Elsevier Inc, page 34 (Ex. 1018).

¹² Ali Grami. Introduction to Digital Communications. Copyright © 2016 Elsevier Inc, page 34 (Ex. 1018).

	<p>To the extent Kaneko does not expressly, implicitly, or inherently disclose the limitations of claim 3, a person of ordinary skill would understand how to modify Kaneko to meet these limitations based on such person’s knowledge and Kaneko. For example, even if it is not inherent that frequency and phase modulation can be performed at the stylus of Kaneko, it would nonetheless be obvious to a person of ordinary skill in the art to modify the stylus of Kaneko to perform these kinds of modulation based on the explicit disclosure in paragraph [0049] regarding frequency and phase modulation. It would, accordingly, be obvious based on Kaneko alone to generate the “second signal” using any of amplitude modulation, frequency modulation, phase modulation, or combinations thereof.</p>
<p>Claim 4</p> <p>4. The stylus of claim 1, wherein: the one or more sensors comprise a pressure sensor and a button; and the sensor data comprises pressure data and button state data.</p>	<p>Example Disclosures in Prior Art</p> <p>As discussed with reference to limitation 1[a] above, the electronic pen of Kaneko includes sensors, such as “a pressure detection mechanism to detect pressure according to usage.” Kaneko, ¶ [0024]. Additionally, the electronic pen of Kaneko includes switches for assigned functions, such as for clicking. <i>Id.</i> Kaneko, therefore, discloses one or more sensors comprising “a pressure sensor and a button.” Furthermore, it would be appreciated that the sensor data transmitted by the stylus of Kaneko comprises “pressure data and button state data,” as in claim 4. As discussed above with reference to limitations 1[c1], 1[c2], 1[c3], and 1[c4], it would be obvious to a person of ordinary skill in the art that the transmitted data would include data collected using the pressure detection mechanism – that is, “pressure data.” Additionally, the disclosure in Kaneko regarding functions of the switches relates to, for example, “clicking” – that is, detecting whether a switch has been actuated to register a “click.” A person of ordinary skill in the art would appreciate that the switches of Kaneko may be buttons, and that the registering of a “click” would involve transmitting data regarding a state of the button to enable a feature associated with “clicking.” While Kaneko does not explicitly state that the pressure and clicking data are transferred through the modulation circuit 322, a person of ordinary skill in the art would understand that the embodiment shown in Figure 5 can be used to transmit this data as well because (1) this pressure and clicking data must be transmitted to the panel/host side somehow, (2) there is no other embodiment that shows a different way to transfer these types of data, (3) and it would be wasteful in terms of cost, integration, and power consumption to include additional circuitry to do so.</p>
<p>Claim 5</p> <p>5. The stylus of claim 1, wherein the sensor data is digital.</p>	<p>Example Disclosures in Prior Art</p> <p>Kaneko discloses digitizing at the electronic pen using an analog-to-digital converter 323, and Kaneko discloses that a digital processing configuration is preferred to reduce the effects of noise. Kaneko, ¶¶ [0024], [0045], and [0047]. Specifically, Kaneko describes that the electric field sensor of the stylus detects a signal and converts it “to digital form.” <i>Id.</i> As discussed above, this signal is then used to generate the second signal and transmit data from the stylus to the panel side. See also Figure 5 of Kaneko. Furthermore, since Kaneko explicitly discloses digitizing at least the sensed electric field variations, a person of ordinary skill in the art would understand that all other sensor data must be handled in the same way so that they can be encoded in the transmit signal of the electronic pen. It would, therefore, be appreciated that the stylus of Kaneko implements the feature “wherein the sensor data is digital.”</p>

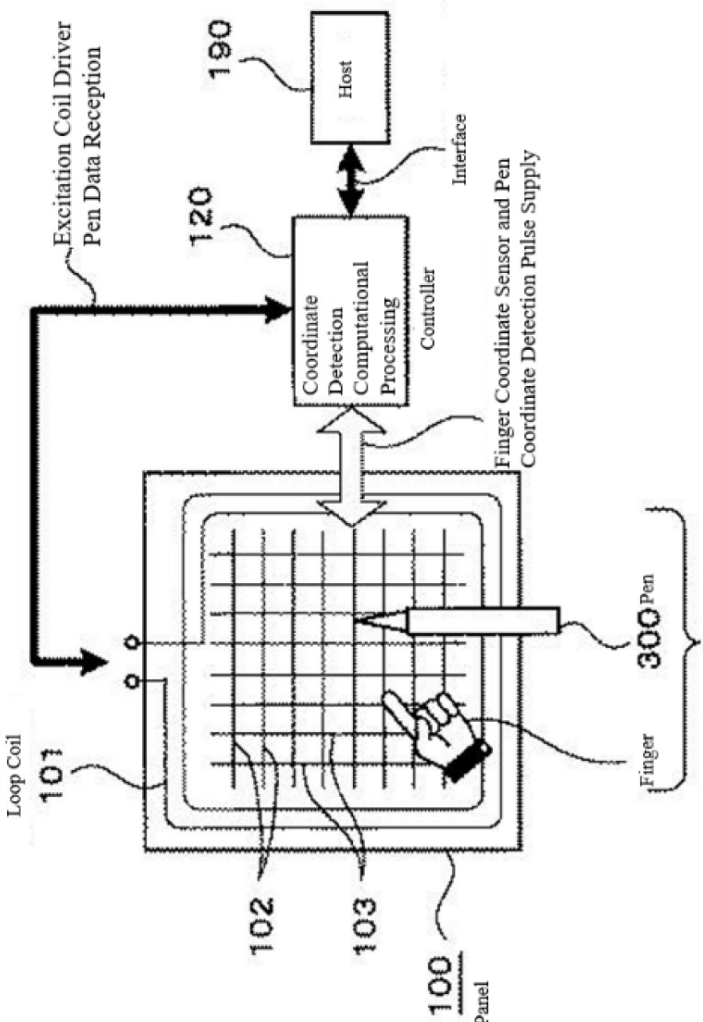


Electronic Pen Outline Block Diagram

Figure 5 of Kaneko

Claim 7	Example Disclosures in Prior Art
7[pre] One or more computer-readable non-transitory storage media embodying logic that is operable when executed to:	See limitation 1[c] above.
7[a] receive sensor data from one or more sensors in or on a stylus, the stylus comprising one or more electrodes configured to communicate with a device by receiving signal from and transmitting signals to a touch sensor of the device;	See limitations 1[b] and 1[c1] above.
7[b] receive a first signal generated by the device;	See limitation 1[c2] above.
7[c] generate a second signal by modulating a carrier signal based on the sensor data; and	See limitation 1[c3] above.
7[d] transmit to the device, in response to the first signal, the second signal, the sensor data being obtainable by demodulating the second signal.	See limitation 1[c4].
Claim 8	Example Disclosures in Prior Art
8. The media of claim 7, wherein the first signal is the carrier signal modulated to generate the second signal.	See claim 2 above.
Claim 9	Example Disclosures in Prior Art
9. The media of claim 7, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.	See claim 3 above.
Claim 10	Example Disclosures in Prior Art

10. The media of claim 7, wherein: the one or more sensors comprise a pressure sensor and a button; and the sensor data comprises pressure data and button state data.	See claim 4 above.
Claim 11	
11. The media of claim 7, wherein the sensor data is digital.	See claim 5 above.

Claim 13	Example Disclosures in Prior Art
<p>13[pre] A system comprising:</p>	<p>To the extent the preamble is considered limiting, Kaneko discloses an electronic pen 300 used as an input means to a panel 100. Kaneko, Figure 1 and ¶¶ [0020], [0024], and [0040]. The panel 100 uses a controller unit 120 to detect inputs and provide coordinate information to a host 190. Kaneko, ¶¶ [0031], [0037]. Based on at least the foregoing disclosure, it would be appreciated that Kaneko discloses a system.</p> <p style="text-align: center;">[Fig. 1]</p>  <p style="text-align: center;">Figure 1 of Kaneko</p> <p>The panel 100 of Kaneko includes and input detection part that detects a coordinate position touched on the panel. Kaneko, ¶ [0020]. The panel 100 of Kaneko would be understood as comprising a touch sensor included in a device.</p>
<p>13[a] a device comprising a touch sensor; and</p>	<p><i>See limitation 1[pre].</i></p>
<p>13[b] a stylus comprising:</p>	<p><i>See limitation 1[a].</i></p>
<p>13[b1] one or more sensors;</p>	

Claim 13	Example Disclosures in Prior Art
13[b2] one or more electrodes configured to communicate with a device by receiving signals from and transmitting signals to a touch sensor of the device; and	<i>See limitation 1[b].</i>
13[b3] one or more computer-readable non-transitory storage media embodying logic that is operable when executed to:	<i>See limitation 1[c].</i>
13[b3A] receive sensor data from the one or more sensors;	<i>See limitation 1[c1].</i>
13[b3B] receive a first signal generated by the device;	<i>See limitation 1[c2].</i>
13[b3C] generate a second signal by modulating a carrier signal based on the sensor data; and	<i>See limitation 1[c3].</i>
13[b3D] transmit to the device, in response to the first signal, the second signal, the device being operable to obtain the sensor data by demodulating the second signal.	<i>See limitation 1[c4].</i>
Claim 14	Example Disclosures in Prior Art
14. The system of claim 13, wherein the first signal is the carrier signal modulated to generate the second signal.	<i>See claim 2 above.</i>
Claim 15	Example Disclosures in Prior Art
15. The system of claim 13, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.	<i>See claim 3 above.</i>
Claim 16	Example Disclosures in Prior Art

16. The system of claim 13, wherein: the one or more sensors comprise a pressure sensor and a button; and the sensor data comprises pressure data and button state data.	See claim 4 above.
Claim 17	
17. The system of claim 13, wherein the sensor data is digital.	See claim 5 above.

Example Disclosures in Prior Art

Appendix A4

U.S. Patent No. 9,280,220 Invalidity Chart – Obviousness over Kaneko, Cao, and/or King-Smith

Japanese Patent Publication No. JP 2008-152640 to Kaneko (“Kaneko”) (Ex. 1005) (published July 3, 2008) renders obvious the challenged claims of U.S. Patent No. 9,280,220 (“’220 Patent”) (Ex. 1001) under 35 U.S.C. § 103 in view U.S. Patent No US 8,928,635 B2 to Harley et al. (“Harley”) (Ex. 1021) (issued January 6, 2015; filed June 22, 2011), U.S. Patent No. 8,988,398 to Cao et al. (“Cao”) (Ex. 1007) (issued March 24, 2015; filed February 11, 2011), and/or U.S. Patent Publication No. 20100085325 to King-Smith et al. (“King-Smith”) (Ex. 1008) (published April 8, 2010) as set forth in the chart below.

As discussed in Appendix A3, all limitations of the challenged claims are obvious in view of Kaneko and Harley, and Appendix A3 is incorporated herein for all purposes. The below analysis is provided to further show that limitations of the claims are also disclosed in Cao and/or King-Smith.

Kaneko and Cao describe similar technologies and address similar problems. Both describe devices in the form of a stylus (alternatively referred to as an “electronic pen” or a “digital pen” in some examples) used to provide inputs to a touch sensor of a device, and both describe styluses that include sensors.

A person of ordinary skill in the art would have been motivated to modify the technology Kaneko based on Cao for the obvious benefit of capturing richer sensor data, which can be used to determine orientation of the stylus to enable different functions of the stylus. *See, e.g.,* Cao, 1:20-51.

In the typical use case disclosed in Kaneko, the stylus (referred to as an “electronic pen”) uses an LC resonant circuit to communicate via a loop coil of a device, while finger detection is performed using a matrix of electrodes. *See, e.g.,* Kaneko, ¶¶ [0020]-[0024]. The stylus of Kaneko includes a “pressure detection mechanism” to detect a pressure and a modulation circuit that performs amplitude modulation to generate a counter magnetic field for communication back to the host device. *Id.*

Cao discloses that the stylus (referred to as an “input device” which “may be shaped like a stylus or pen”) can be detected using a proximity sensor and according to different detection techniques or combinations of detection techniques, including “electromagnetic induction sensing” or capacitive touch sensing, among other techniques. *See, e.g.,* Cao, 3:61-66 & 6:6-15. The stylus of Cao includes various sensors, such as a compass, a gyroscope, and one or more accelerometers included in an inertial measurement unit, which can be used to detect and report orientation and movement. Cao, 4:30-52. A person of ordinary skill in the art implementing the stylus of Kaneko would benefit from the disclosure of Cao, for example, because Cao discloses a range of detection techniques, including both inductive and capacitive techniques for detecting and communicating with a stylus, and the stylus of Cao can be used to capture richer sensor data. It would be well within the capabilities of a person of ordinary skill in the art to modify the stylus of Kaneko based on Cao. It would be well within the capabilities of a person of ordinary skill in the art to modify the stylus of Kaneko based on Cao, and a person of ordinary skill in the art would have a reasonable chance of success in doing so.

Kaneko and King-Smith also describe similar technologies and address similar problems. Similar to Kaneko, King-Smith describes a stylus (provided as an example of a “transducer”) used to provide inputs to a touch sensor of a device, and it describes that the stylus transmits digital data, including pen pressure data and switch status data. *See, e.g.,* King-Smith, Abstract. According to the technology of King-Smith, a “combination touch and transducer input system” is provided such that user input can be provided using a finger, a stylus, or both. *Id.* The technology of King-Smith provides both a “touch mode” and a “transducer mode,” which may both use capacitive techniques. *See, e.g.,* King-Smith, ¶¶ [0007] & [0020]. A person of ordinary skill in the art implementing the stylus of Kaneko would benefit from the disclosure of King-Smith, for example, because King-Smith discloses additional techniques (e.g., capacitive techniques) for detecting both a stylus and a user’s touch, and King-Smith discloses additional modulation techniques for encoding digital data. *See, e.g.,* King-Smith, ¶¶ [0020] & [0112].

A person of ordinary skill in the art would have been motivated to modify the technology of Kaneko based on King-Smith for the obvious benefit of improved communication of data using

different kinds of modulation of the signal. King-Smith, ¶ [0010]. It would be well within the capabilities of a person of ordinary skill in the art to modify the stylus of Kaneko based on King-Smith, and a person of ordinary skill in the art would have a reasonable chance of success in doing so.

Claim 1		Example Disclosures in Prior Art	
1[pre] A stylus comprising: 1[a] one or more sensors;		Kaneko discloses limitation 1[pre] for the reasons discussed in Appendix A3.	
		Kaneko discloses limitation 1[a] for the reasons discussed in Appendix A3.	
		<p>Even if limitation 1[a] were not disclosed in Kaneko, a person of ordinary skill in the art could modify Kaneko in view of Cao to meet this limitation.</p> <p>For example, Cao discloses an input device 102 (i.e., a stylus) that includes an inertial measurement unit 114, which may comprise a compass, a gyroscope, and one or more accelerometers, which are sensors. Cao, 3:59-4:35.</p> <div data-bbox="711 612 1185 1403"><p>FIG. 1</p><p>FIG. 1 of Cao</p></div> <p>It would have been obvious to modify the stylus of Kaneko to include the sensors of Cao, and a person of ordinary skill would have been motivated to so modify the stylus of Kaneko for the obvious benefit of capturing richer sensor data, which can be used to determine orientation of the stylus to enable different functions of the stylus. See, e.g., Cao, 1:20-51.</p>	

Claim 1	Example Disclosures in Prior Art
1[b] one or more electrodes configured to communicate with a device by receiving signals from and transmitting signals to a touch sensor of the device; and	Limitation 1[b] is obvious for the reasons discussed in Appendix A3, and limitation 1[b] is further obvious in view of Kaneko and Harley for the reasons discussed in Appendix A3.
1[c] one or more computer-readable non-transitory storage media embodying logic that is operable when executed to:	<p>Limitation 1[c] is obvious for the reasons discussed in Appendix A3.</p> <p>To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation 1[c], a person of ordinary skill could modify Kaneko in view of Cao to meet this limitation. For example, Cao discloses that software included in processing components 134 of an input device may be stored in a memory, which may comprise computer-readable media. Cao, 5:12-15.</p>
1[c1] receive sensor data from the one or more sensors;	<p>Limitation 1[c1] is obvious for the reasons discussed in Appendix A3.</p> <p>To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation 1[c1], a person of ordinary skill could modify Kaneko in view of Cao to meet this limitation.</p>
	<p>For example, the input device 102 of Cao includes the inertial measurement unit 114, which may comprise a compass, a gyroscope, and one or more accelerometers, which are sensors. Cao, 3:59-4:35. The inertial measurement unit 114 is used to measure and output a pitch or tilt angle of the input device 102. Cao, 4:35-37. The data collected using the inertial measurement unit 114 is, therefore, sensor data that is received by a component in the stylus of Cao.</p>

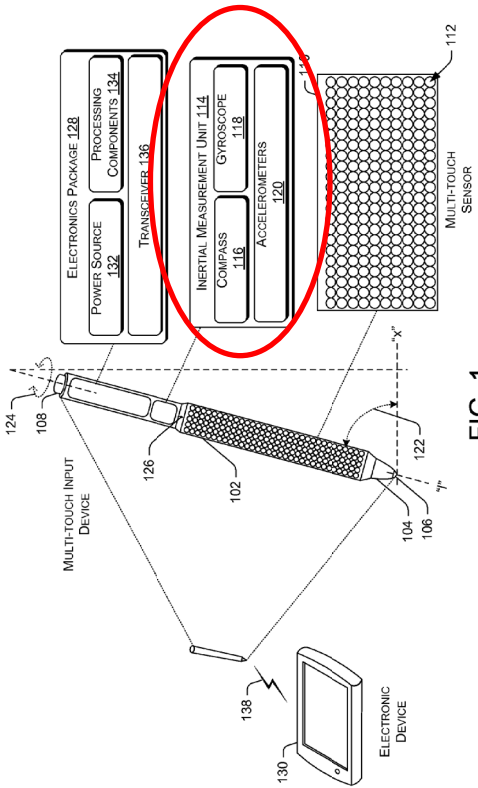


FIG. 1

Claim 1	Example Disclosures in Prior Art Figure 1 of Cao
	<p>It would have been obvious to modify the stylus of Kaneko to include the sensors of Cao, and a person of ordinary skill would have been motivated to so modify the stylus of Kaneko for the obvious benefit of capturing richer sensor data, which can be used to determine orientation of the stylus to enable different functions of the stylus. <i>See, e.g.,</i> Cao, 1:20-51.</p>
1[c2] receive a first signal generated by the device;	<p>Limitation 1[c2] is obvious for the reasons discussed in Appendix A3.</p>
1[c3] generate a second signal by modulating a carrier signal based on the sensor data; and	<p>Limitation 1[c3] is obvious for the reasons discussed on Appendix A3.</p> <p>To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation 1[c3], a person of ordinary skill could modify Kaneko in view of Cao to meet this limitation.</p> <p>For example, Cao discloses passing output data of the inertial measurement unit to the electronic device. Cao, 4:55-57.</p> <p>It would have been obvious to modify the stylus of Kaneko to pass the output data to the electronic device as in Cao, and a person of ordinary skill would have been motivated to so modify the stylus of Kaneko for the obvious benefit of capturing richer sensor data, which can be used to determine orientation of the stylus to enable different functions of the stylus. <i>See, e.g.,</i> Cao, 1:20-51.</p>
1[c4] transmit to the device, in response to the first signal, the second signal, the sensor data being obtainable by demodulating the second signal.	<p>Limitation 1[c4] is obvious for the reasons discussed in Appendix A3.</p> <p>To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation 1[c4], a person of ordinary skill could modify Kaneko in view of Cao to meet this limitation.</p> <p>For example, Cao discloses passing output data of the inertial measurement unit to the electronic device. Cao, 4:55-57.</p> <p>It would have been obvious to modify the stylus of Kaneko pass the output data to the electronic device as in Cao, and a person of ordinary skill would have been motivated to so modify the stylus of Kaneko for the obvious benefit of capturing richer sensor data, which can be used to determine orientation of the stylus to enable different functions of the stylus. <i>See, e.g.,</i> Cao, 1:20-51</p>
Claim 2	Example Disclosures in Prior Art

2. The stylus of claim 1, wherein the first signal is the carrier signal modulated to generate the second signal.	See discussion of claim 2 at Appendix A3.
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Claim 3	Example Disclosures in Prior Art
<p>3. The stylus of claim 1, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.</p>	<p>Claim 3 is obvious for the reasons discussed in Appendix A3.</p> <p>Alternatively, a person of ordinary skill could modify Kaneko in view of King-Smith to meet these limitations.</p> <p>King-Smith discloses a transducer, which may be a stylus, configured to selectively generate an electric field at multiple frequencies and to encode digital data in frequency shifts of the electric field. King-Smith, ¶ [0010]. King-Smith further describes that “any other digital modulation technique may be used to encode digital data, including Amplitude-Shift Keying (ASK) technique, Phase-Shift Keying (PSK) technique, and Quadrature Amplitude Modulation (QAM) technique.” <i>Id.</i> Therefore, King-Smith discloses generating a signal using amplitude modulation, frequency modulation, and phase modulation. It would have been obvious to modify the technology of Kaneko to implement various kinds of modulation, as in King-Smith, and a person of ordinary skill would have been motivated to so modify the stylus of Kaneko for the obvious benefit of improved communication of data using different kinds of modulation of the signal. <i>See id.</i></p>

Claim 4	Example Disclosures in Prior Art
<p>4. The stylus of claim 1, wherein: the one or more sensors comprise a pressure sensor and a button; and the sensor data comprises pressure data and button state data.</p>	<p>Claim 4 is obvious for the reasons discussed in Appendix A3.</p> <p>To the extent Kaneko does not expressly, implicitly, or inherently disclose the limitations of claim 4, a person of ordinary skill could modify Kaneko in view of Cao to meet these limitations.</p> <p>For example, Cao discloses that the input device may include a retractable tip that activates a pressure switch housed in the input device. Cao, 3:64-66. The pressure switch outputs a signal when sufficient pressure actuates the switch. Cao, 3:66-67. Cao further discloses that the body of the input device can have at least one button, which may be a clickable button to activate a pressure switch. Cao, 4:1-4. Accordingly, Cao discloses a pressure sensor and a button, as well as sensor data comprising pressure data and button state data.</p>

Claim 5	Example Disclosures in Prior Art
<p>5. The stylus of claim 1, wherein the sensor data is digital.</p>	<p>Claim 5 is obvious the reasons discussed in Appendix A3.</p> <p>To the extent Kaneko does not expressly, implicitly, or inherently disclose limitation the limitations of claim 5, a person of ordinary skill could modify Kaneko in view of Cao to meet this limitation.</p> <p>For example, Cao discloses “digital data” in relation to data outputted by the inertial measurement unit. Cao, 5:1-9. Cao, therefore, also discloses “wherein the sensor data is digital.”</p>
Claim 7	Example Disclosures in Prior Art
<p>7[pre] One or more computer-readable non-transitory storage media embodying logic that is operable when executed to:</p>	<p><i>See limitation 1[c] above.</i></p>
<p>7[a] receive sensor data from one or more sensors in or on a stylus, the stylus comprising one or more electrodes configured to communicate with a device by receiving signal from and transmitting signals to a touch sensor of the device;</p>	<p><i>See limitations 1[b] and 1[c1] above.</i></p>
<p>7[b] receive a first signal generated by the device;</p>	<p><i>See limitation 1[c2] above.</i></p>
<p>7[c] generate a second signal by modulating a carrier signal based on the sensor data; and</p>	<p><i>See limitation 1[c3] above.</i></p>
<p>7[d] transmit to the device, in response to the first signal, the second signal, the sensor data being obtainable by demodulating the second signal.</p>	<p><i>See limitation 1[c4].</i></p>

Claim 8	Example Disclosures in Prior Art
8. The media of claim 7, wherein the first signal is the carrier signal modulated to generate the second signal.	<i>See claim 2 above.</i>
Claim 9	Example Disclosures in Prior Art
9. The media of claim 7, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.	<i>See claim 3 above.</i>
Claim 10	Example Disclosures in Prior Art
10. The media of claim 7, wherein: the one or more sensors comprise a pressure sensor and a button; and the sensor data comprises pressure data and button state data.	<i>See claim 4 above.</i>
Claim 11	Example Disclosures in Prior Art
11. The media of claim 7, wherein the sensor data is digital.	<i>See claim 5 above.</i>
Claim 13	Example Disclosures in Prior Art
13[pre] A system comprising:	Limitation 13[pre] is obvious for the reasons discussed in Appendix A3.
13[a] a device comprising a touch sensor; and	Limitation 13[a] is obvious for the reasons discussed in Appendix A3.
13[b] a stylus comprising:	<i>See limitation 1[pre].</i>
13[b1] one or more sensors;	<i>See limitation 1[a].</i>
13[b2] one or more electrodes configured to communicate with a device by receiving signals from and transmitting signals to a touch sensor of the device; and	<i>See limitation 1[b].</i>

Claim 13	Example Disclosures in Prior Art
13[b3] one or more computer-readable non-transitory storage media embodying logic that is operable when executed to:	See limitation 1[c].
13[b3A] receive sensor data from the one or more sensors;	See limitation 1[c1].
13[b3B] receive a first signal generated by the device;	See limitation 1[c2].
13[b3C] generate a second signal by modulating a carrier signal based on the sensor data; and	See limitation 1[c3].
13[b3D] transmit to the device, in response to the first signal, the second signal, the device being operable to obtain the sensor data by demodulating the second signal.	See limitation 1[c4].
Claim 14	Example Disclosures in Prior Art
14. The system of claim 13, wherein the first signal is the carrier signal modulated to generate the second signal.	See claim 2 above.
Claim 15	Example Disclosures in Prior Art
15. The system of claim 13, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.	See claim 3 above.
Claim 16	Example Disclosures in Prior Art

16. The system of claim 13, wherein: the one or more sensors comprise a pressure sensor and a button; and the sensor data comprises pressure data and button state data.	<i>See claim 4 above.</i>
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Claim 17	Example Disclosures in Prior Art
17. The system of claim 13, wherein the sensor data is digital.	<i>See claim 5 above.</i>

Appendix B1

U.S. Patent No. 9,280,220 – Anticipation and obviousness over Kremin

U.S. Patent Publication No. 20120105362 to Kremin et al. (“Kremin”) (Ex. 1009) (published May 3, 2012; priority date October 28, 2010) either expressly, implicitly, or inherently anticipates the asserted claims of U.S. Patent No. 9,280,220 (“’220 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. The chart below sets forth my analysis regarding anticipation and obviousness of the challenged claims on each of these alternative bases.

Kremin relates to the field of user interface devices and, in particular, to capacitive sensor devices. Kremin ¶ [0002] [TECHNICAL FIELD]. It discloses a system and method for tracking a stylus on a capacitive sense array. Kremin at ABSTRACT. 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. *Id.* Kremin also discloses a stylus for synchronizing and modulating data into a stylus transmit signal. Kremin, ¶ [0104]. The data to be modulated and transmitted may include, for example, data received from a force sensor. *Id.* at ¶¶ [0104] & [0109]. A synch mod block modulates the data using various modulation techniques. *Id.* at ¶ [0110].

To the extent (if at all) that one or more claim limitations are not expressly, implicitly, or inherently disclosed in Kremin, the challenged claims would nonetheless be obvious to a person of ordinary skill in the art in view of such person’s knowledge.

Claim 1

1[pre] A stylus comprising:

Example Disclosures in Prior Art

To the extent the preamble is considered limiting, Kremin discloses limitation 1[pre]. For example, the system 300 of FIG. 3 of Kremin illustrates a stylus 330, which can be detected and tracked by a processing device 310. Kremin, ¶¶ [0051]-[0052].

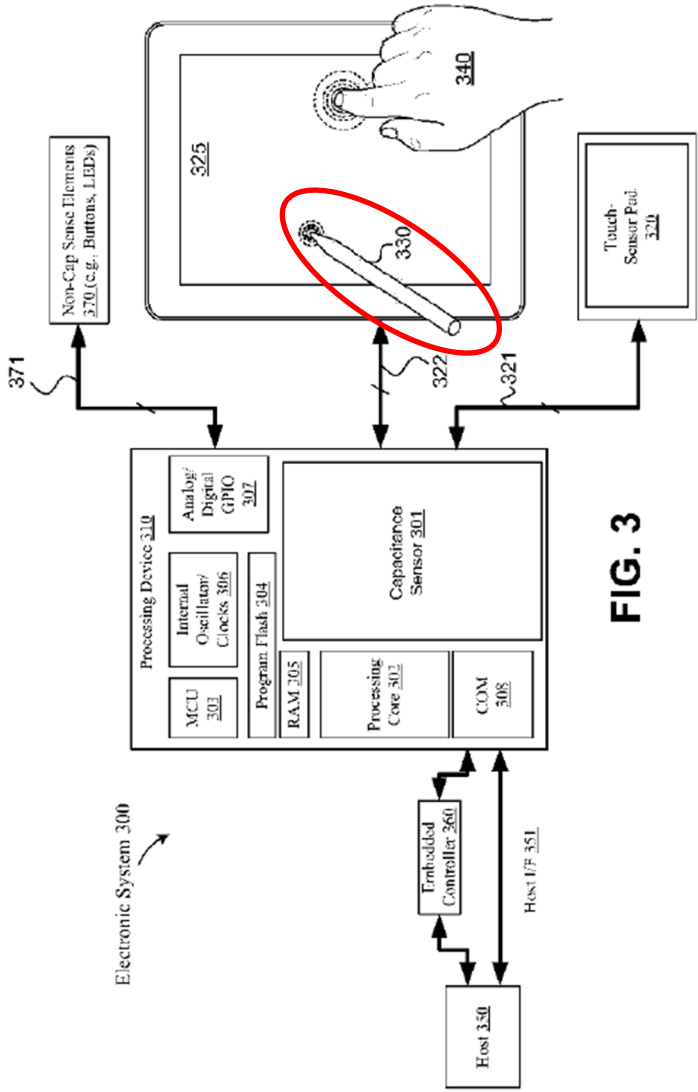


FIG. 3

FIG. 3 of Kremin

1[a] one or more sensors;	<p>Kremin discloses and claims multiple types of sensors in multiple embodiments, including the use of sensors to capture force sense data, battery data, acceleration data, and button status data. Kremin at Claims 1–4, ¶ [0105], [0108]. For example, Kremin discloses that “[s]ome 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]. Moreover, Kremin describes a force sensor 1360 that may be either a passive sensor or an active sensor within the stylus, and a motion sensor to detect motion of the stylus. Kremin at Claims 2-3, 11–13, ¶ [00109]. Kremin further discloses an embodiment that includes a microcontroller block 1305 with buttons 1340, 1341, from which pushes are detected adding additional functionality such as a “left click” and “right click” function. <i>Id.</i> ¶¶ [00105], [00108]. A person of ordinary skill in the art would appreciate that a button is a kind of a sensor, which can output a value such as a binary value. Claim 4 of the ‘220 Patent itself recites that the one or more sensors may comprise “a button.” Kremin describes the buttons themselves as being mechanical, electrical, capacitive, or other types known by one of ordinary skill in the art. <i>Id.</i> ¶ [00108]. A person of ordinary skill in the art would understand that capacitive detection, and a capacitive “button,” requires a capacitive sensor—a type of sensor. <i>Id.</i> ¶ [00108]. Similarly, Kremin discloses an embodiment wherein the orientation or acceleration of the stylus may be detected by an accelerometer—an inertial sensor that measures a change in velocity of an object over time. <i>Id.</i> ¶ [00109]. A person of ordinary skill in the art would recognize an accelerometer as a sensor which senses movement to measure acceleration. Kremin therefore discloses not only an embodiment with a force sensor but an embodiment with multiple sensors, including a force sensor, a motion sensor, buttons (which may be capacitive sense buttons), and an accelerometer/inertial sensor. Accordingly, Kremin discloses limitation 1[a].</p>
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Stylus with Data Modulation

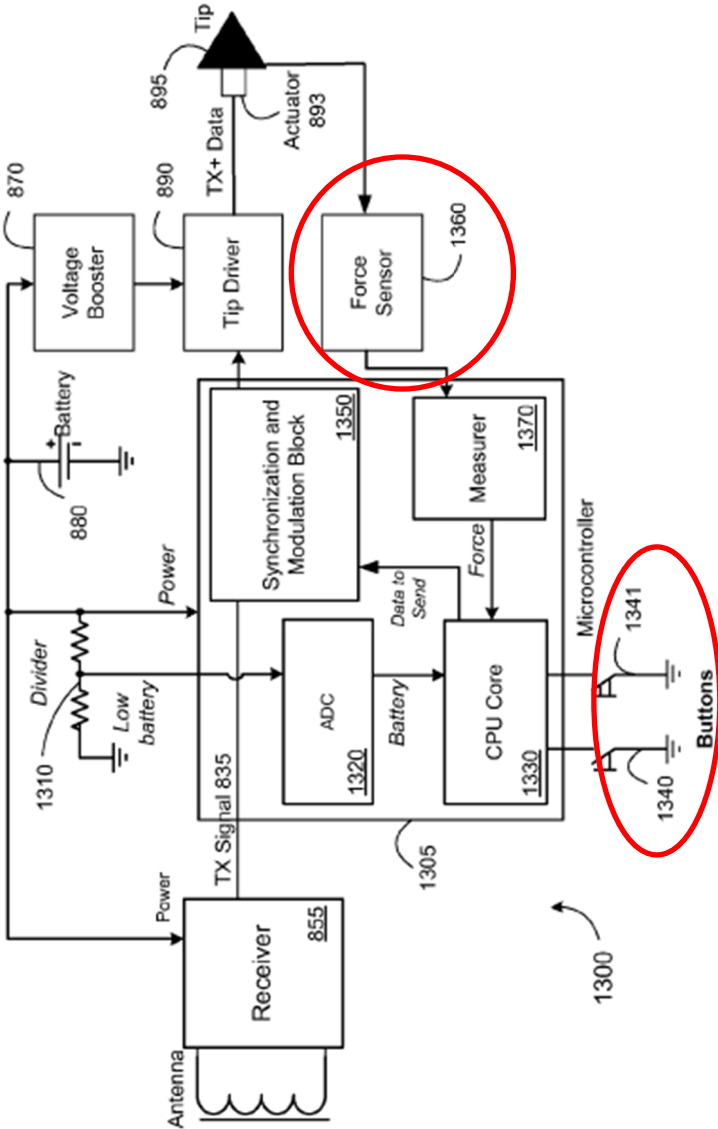


FIG. 13 of Kremin

Claim 1	Example Disclosures in Prior Art
<p>1[h] one or more electrodes configured to communicate with a device by receiving signals from and transmitting signals to a touch sensor of the device; and</p>	<p>The stylus 850 of Kremin contains a stylus tip 895 by which the stylus transmit signal is capacitively coupled to the capacitive sense array. See Kremin Claim 6, ¶ [0085]. See also FIG. 8 of Kremin. Capacitive coupling is a transfer of electric signals that inherently requires a pairing of electrodes by proximity¹. A person of ordinary skill in the art would understand that the tip 895 must comprise an electrode, as it is the conventional way to provide the capacitive coupling functionality with the sense array. 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, Claim 14. A person of ordinary skill in the art would appreciate that an electrode could be understood as a conductor that establishes electrical contact with a nonmetallic component of a circuit². Therefore, an electrode may serve as the conductive element that creates (or senses) changes in the electric field between two objects. As of the earliest possible priority date for the '220 Patent, electrodes had been known for decades, and a person of ordinary skill in the art 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.</p>

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. 1016).

² See e.g., Merriam-Webster Dictionary: <https://www.merriam-webster.com/dictionary/electrode> (Ex. 1020). See, also, Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 239 (Ex. 1016). See also Id. at page 239 for the definition of an electrode.

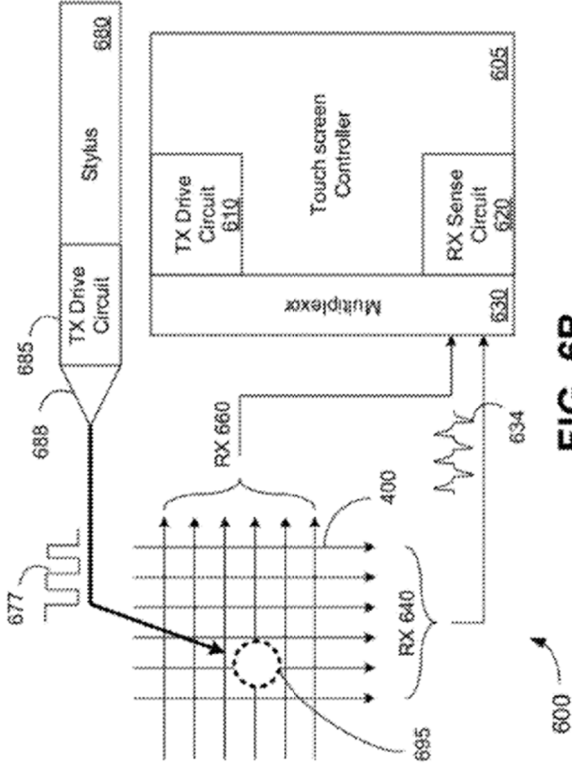
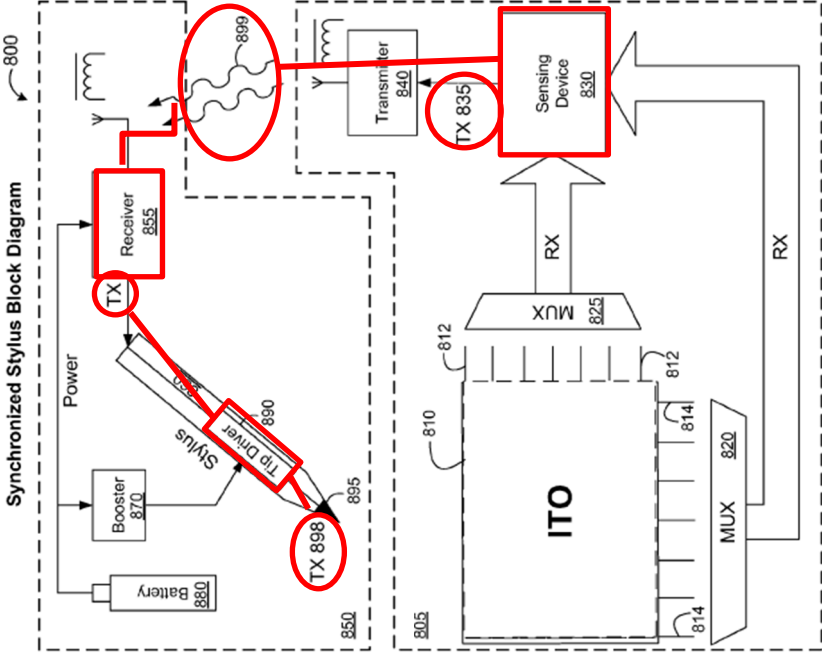


FIG. 6B
FIG. 6 B of Kremin

Kremin further discloses that the stylus 850 communicates with the device through an initial signal 835 that goes through a transmitter 840 and is sent as signal 899 to the stylus receiver 855; 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 touch sense array 810. Kremin ¶¶ [0082]–[0085]. A person of ordinary skill in the art would understand that capacitively coupling the amplified stylus transmit signal 898 to the device's touch sense array 810 requires the use of an electrode.

Claim 1	Example Disclosures in Prior Art
	<p>To the extent Kremin does not expressly, implicitly, or inherently disclose limitation 1[b], it would be obvious to a person of ordinary skill in the art to modify Kremin in view of the knowledge of a person of ordinary skill in the art to implement limitation 1[b]. For example, as discussed above, it was known to include an electrode in the tip of a stylus, and it would be obvious to a person of ordinary skill in the art that the electrode can be used for transmitting signals, receiving signals, or both. See, <i>e.g.</i>, U.S. Patent No. 8,766,954 3:36-41 & 3:50-61 and U.S. Patent No US 8,928,635 B2 1:58-2:1.</p>
<p>1[c] one or more computer-readable non-transitory storage media embodying logic that is operable when executed to:</p>	<p>A person of ordinary skill in the art would appreciate that the stylus 850 of Kremin includes at least one computer-readable non-transitory storage medium (e.g., memory) containing the necessary logic to control the operations of the stylus, such as operations of the receiver, tip driver, and booster, and ultimately the process by which the stylus receives, processes, and transmits signals. 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 person of ordinary skill in the art 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”³ (emphasis added).</p>

³ Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 470 (Ex. 1016).

<p>Claim 1</p>	<div data-bbox="131 94 992 1951"> <p style="text-align: center;">Example Disclosures in Prior Art</p>  <p>The diagram, titled "Synchronized Stylus Block Diagram", illustrates a system 800. A stylus 890 is shown with a tip driver 899 and a tip 898. The tip driver 899 is connected to a transmitter TX 898. The tip 898 is connected to a receiver RX 895. The receiver RX 895 is connected to a receiver 855. The transmitter TX 898 is connected to a transmitter 840. The receiver 855 is connected to a sensing device 830. The transmitter 840 is connected to a sensing device 830. The sensing device 830 is connected to an ITO layer 810. The ITO layer 810 is connected to a multiplexer MUX 825. The multiplexer MUX 825 is connected to a multiplexer MUX 820. The multiplexer MUX 820 is connected to a receiver RX. The system 800 also includes a battery 880, a booster 870, and a tip driver 899. The tip driver 899 is connected to the tip 898. The tip 898 is connected to the receiver RX 895. The receiver RX 895 is connected to the receiver 855. The receiver 855 is connected to the sensing device 830. The sensing device 830 is connected to the ITO layer 810. The ITO layer 810 is connected to the multiplexer MUX 825. The multiplexer MUX 825 is connected to the multiplexer MUX 820. The multiplexer MUX 820 is connected to the receiver RX. The system 800 also includes a battery 880, a booster 870, and a tip driver 899. The tip driver 899 is connected to the tip 898. The tip 898 is connected to the receiver RX 895. The receiver RX 895 is connected to the receiver 855. The receiver 855 is connected to the sensing device 830. The sensing device 830 is connected to the ITO layer 810. The ITO layer 810 is connected to the multiplexer MUX 825. The multiplexer MUX 825 is connected to the multiplexer MUX 820. The multiplexer MUX 820 is connected to the receiver RX.</p> </div> <div data-bbox="992 94 1297 1951"> <p style="text-align: center;">FIG. 8 of Kremin</p> <p>Kremin further discloses an embodiment with a CPU (central processing unit) core 1330 to process signals such as force data detected from a force sensor 1360 and send it to a modulator which then sends it to a tip driver 890. Kremin ¶¶ [00107]–[00109]. A person of ordinary skill in the art would understand that a CPU contains at least two elements, a control unit and an arithmetic-logic unit where the control unit contains circuitry to direct the system to execute stored instructions and the arithmetic-logic unit executes all arithmetic and logical operations⁴. The CPU includes logic circuitry 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, as disclosed in Kremin. Kremin, ¶ [0111], [0105], [0106], [0108], [0109].</p> </div>
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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 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

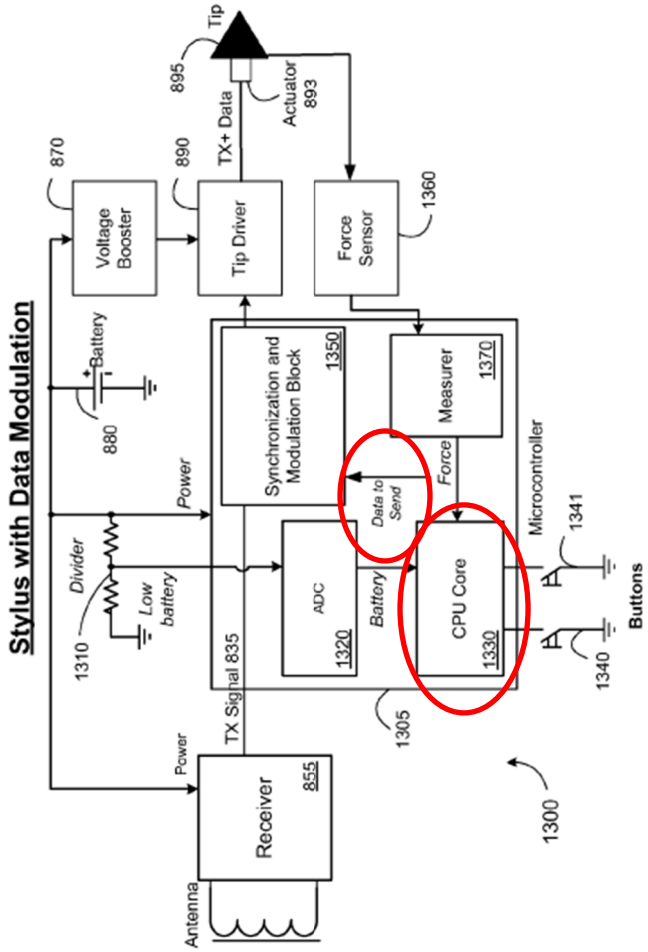


FIG. 13 of Kremin

Lastly, Kremin discloses that embodiments may be implemented in a manner that includes instructions stored on a computer-readable medium. Kremin ¶ [00140]. The instructions may be used to program a processor to perform the described operations. *Id.* Kremin lists a non-exhaustive variety of computer readable storage media, including random-access memory; such storage is “non-transitory,” or unchanging. *Id.* A person of ordinary skill in the art would understand the storage media described by Kremin as computer-readable non-transitory storage media, and would understand that instructions are operable logic to control the operations of the stylus. Accordingly, Kremin fully discloses limitation 1[c].

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. 1016).

Example Disclosures in Prior Art	
Claim 1	<p>As described above, in an embodiment the CPU core 1330 of Kremin is coupled with the force sensor 1360 and measurer 1370, which then processes the force signal or other signal to send it to the synch mod block 1350 to be converted to a signal. Kremin ¶ [00109]. The CPU core 1330 may also be connected to the buttons (which may be capacitive sensors by definition as discussed above with reference to limitation 1[a]), and it processes the button input data. As discussed with reference to limitation 1[a] above, Kremin discloses and claims multiple types of sensors in multiple embodiments, including the use of sensors to capture force sense data, battery data, acceleration data, and button status data. Kremin at Claims 1–4, ¶ [0105], [0108]. The stylus is therefore receiving sensor data from the one or more sensors. See also limitations 1[a] and 1[c] above. Accordingly, Kremin discloses limitation 1[c].</p>

<p>1[c2] receive a first signal generated by the device;</p>	<p>Kremin describes multiple embodiments in which the high-voltage signal of the stylus is generated by amplifying a signal originating from the sensing device. This aligns with the embodiment in FIG. 8 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]. More specifically, Kremin discloses that in an embodiment, the transmitter 840 of the host device (including the sensing device) wirelessly couples the TX signal 835 to the receiver 855 of the stylus. Kremin ¶ [0082]. In one embodiment, the transmitter 840 inductively couples the TX signal 835 to the receiver 855. <i>Id.</i> In other embodiments, the transmitter may wirelessly couple the TX signal 835 in a variety of ways including radio frequency, optical, ultrasound, and other mediums that would be appreciated by one of ordinary in the art. <i>Id.</i> The receiver 855 receives TX signal 899 from the transmitter 840 and couples demodulated TX signal to the stylus 850. <i>Id.</i> Other disclosures in Kremin contemplate different methods for communication from the host device to the stylus. For example, Kremin discloses that in an embodiment, the system further includes a transmitter to wirelessly transmit the synchronization signal from the processing device to the stylus. Kremin ¶ [0048]. In some embodiments, the transmitter may include a magnetic antenna to inductively transmit the synchronization signal to the stylus where the antenna is disposed around the outer edges of the capacitance sense array. <i>Id.</i> See also Kremin ¶ [0090]. A person of ordinary skill in the art would understand that wireless transmission includes capacitive coupling and other methods of communication where no physical wires are used.</p>
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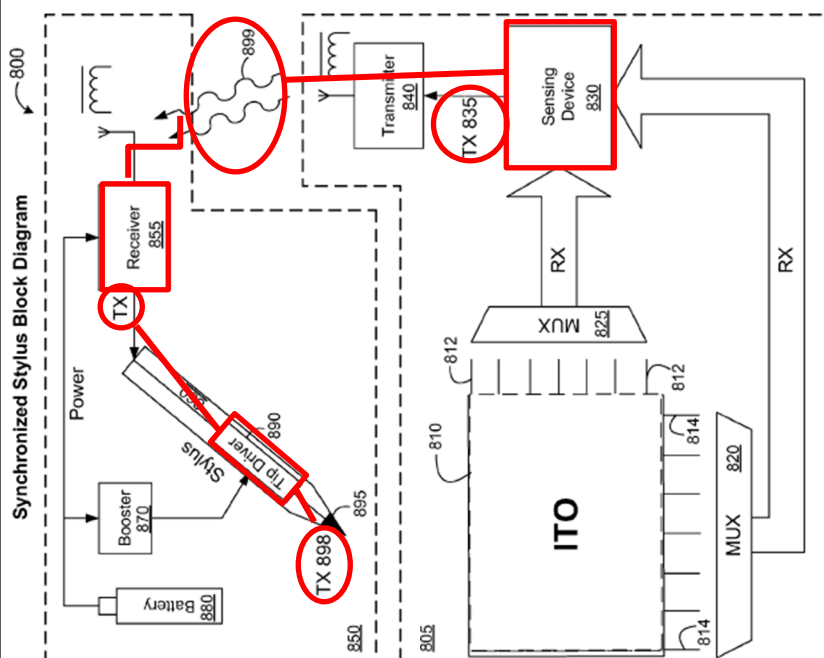


FIG. 8 of Kremin

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. Kremin, ¶ [0098]. The sensing device generates a TX pulse sequence (block 1110). In an embodiment, the TX pulse sequence is a pulse train of TX signals. *Id.* At block 1155, the carrier generator generates a carrier signal (e.g., 13.56 MHz RFID carrier frequency). *Id.* The AM modulator modulates the carrier signal (block 1135) with the TX pulse sequence generated at block 1110. *Id.* In other embodiments, the host device may implement other modulation schemes, as described in conjunction with FIG. 9A. *Id.* A band pass filter filters the modulated TX signal (block 1140). *Id.* At block 1145, a matching network matches the impedance of the filter and antenna, and the transmit block wirelessly transmits the modulated TX signal to the stylus (block 1150). *Id.* The receiver block of the stylus wirelessly receives the modulated TX signal from the host device (block 1162). Kremin, ¶ [0099]. The amplifier block amplifies the modulated TX signal (block 1165), and the AM demodulator removes the carrier frequency from the TX signal (block 1170). *Id.*

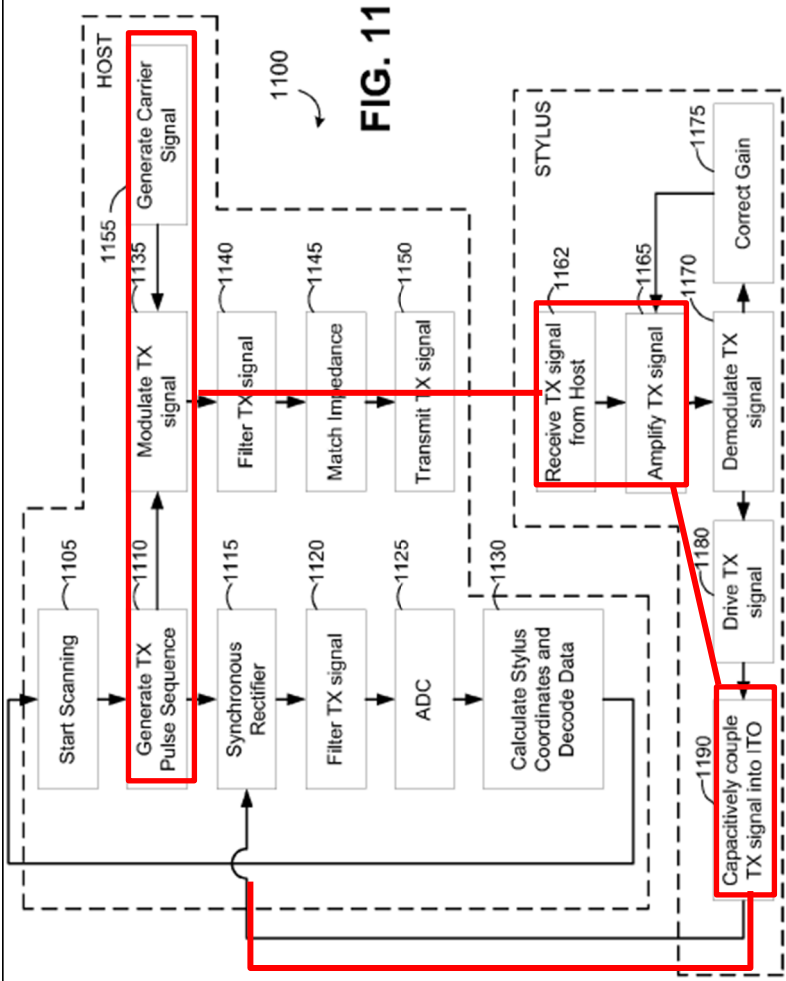


FIG. 11 of Kremin

As yet another example, Figure 13 of Kremin further shows that the stylus receives a signal from the touch screen device, and then it modulates it and transmits it. Specifically, this figure is a block diagram illustrating one embodiment of a stylus 1300 for synchronizing and modulating additional data into a stylus transmit signal 898. Kremin, ¶ [0104]. 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. *Id.* In one embodiment, the microcontroller block 1305 includes ADC 1320, CPU core 1330, buttons 1340 and 1341, synchronization and modulation block (“synch mod block”) 1350, and measurer 1370. *Id.* In an embodiment, the synch mod block 1350 is configured to modulate additional data into the TX signal 835. Kremin, ¶ [0105]. Kremin discloses that 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. *Id.* 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. Kremin, ¶ [0106]. 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. *Id.*

Stylus with Data Modulation

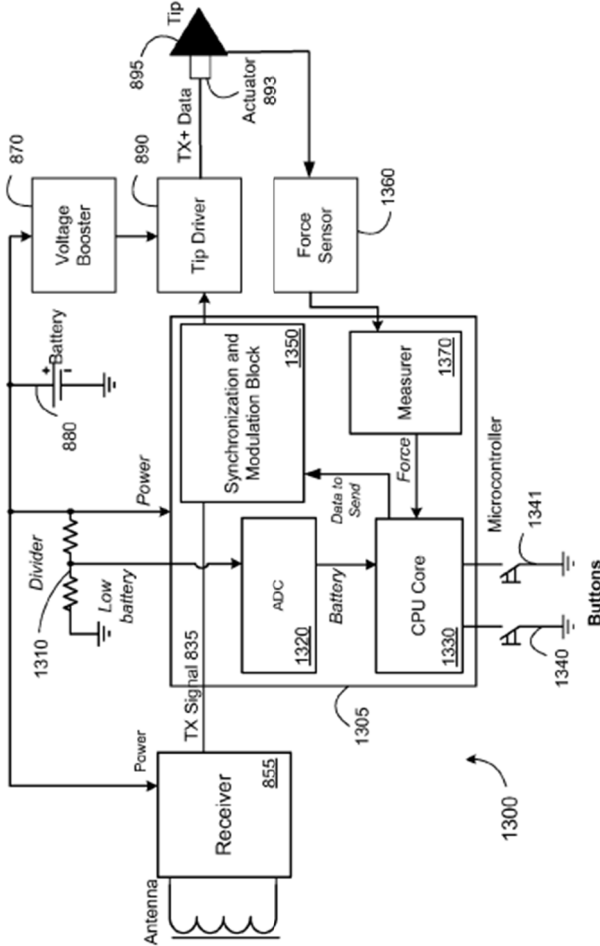


FIG. 13 of Kremin

Additionally, 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].

Therefore, Kremin discloses limitation 1[c2].

Claim 1	Example Disclosures in Prior Art
<p>1[c3] generate a second signal by modulating a carrier signal based on the sensor data; and</p>	<p>Modulation can be defined as the “process of modifying some characteristic of a wave (called a carrier) so that it varies in step with the instantaneous value of another wave (called a modulating wave or signal)”, where “[t]he carrier can be a direct current, an alternating current (provided its frequency is above the highest frequency component in the modulating wave), or a series of regularly repeating, uniform pulses called a pulse chain (provided their repetition rate is at least twice that of the highest frequency to be transmitted)”⁵. Alternatively, it can be defined as “[t]he controlled variation of frequency, phase, and/or amplitude of a carrier wave of any frequency in order to transmit a message”⁶. It can further be defined as “[t]he process, or results of the process, whereby some characteristic of one signal is varied in accordance with another signal”, where “[t]he modulated signal is called the carrier and may be modulated in three fundamental ways: by varying the amplitude (amplitude modulation) by varying the frequency (frequency modulation) or by varying the phase (phase modulation)”⁷. Modulation can further be defined as “a process through which an information-bearing message (i.e., modulating) signal is used to modify (i.e., modulate) some parameter (e.g., amplitude, frequency, phase) of a periodic (such as a high-frequency sinusoidal) signal known as a carrier wave, individually or in combination, to produce the modulated signal for transmission”⁸. This “is similar to when a musician modulates a tone by varying its volume (amplitude), its timing (phase), and its pitch (frequency)”⁹. Thus, modulation varies a carrier signal based on the data to be transmitted and thus by necessity involves using a carrier signal.</p> <p>See the discussion in limitation 1[c2] above. As described, the stylus 850 in Kremin contains a receiver 855 that receives a signal 835, 899 generated from the sensing device 830. Kremin at Claims 1, 6, 7, ¶ [0085].</p> <p>Figure 8 of Kremin initially shows an embodiment with no modulation performed by the stylus. 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. Kremin, ¶ [0106].</p> <p>Figure 13 of Kremin then shows that the stylus receives a signal from the sense device, and then it modulates data into it and transmits it to the sense device. Specifically, this figure “is a block diagram illustrating one embodiment of a stylus 1300 for synchronizing and modulating additional data into a stylus transmit signal 898”. Kremin, ¶ [0104]. 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. <i>Id.</i> In one embodiment, the microcontroller block 1305 includes ADC 1320, CPU core 1330, buttons 1340 and 1341, synchronization and modulation block (“synch mod block”) 1350, and measurer 1370. <i>Id.</i> In an embodiment, the synch mod block 1350 is configured to modulate additional data into the TX signal 835. Kremin, ¶ [0105]. Kremin discloses that 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. <i>Id.</i> A person of ordinary skill in the art would understand from this disclosure that the data received from the sense device is used as a carrier signal.</p>

⁵ Rudolf F. Graf Boston. MODERN DICTIONARY OF ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, pages 479-480 (Ex. 1016).

⁶ Rudolf F. Graf Boston. MODERN DICTIONARY OF ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 480 (Ex. 1016).

⁷ Rudolf F. Graf Boston. MODERN DICTIONARY OF ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 480 (Ex. 1016).

⁸ Ali Grami. Introduction to Digital Communications. Copyright © 2016 Elsevier Inc, page 34 (Ex. 1018).

⁹ Ali Grami. Introduction to Digital Communications. Copyright © 2016 Elsevier Inc, page 34 (Ex. 1018).

Claim 1	Example Disclosures in Prior Art
	<p>Figure 14 of Kremin further illustrates a modulation process (and a later demodulation process) on a data stream, according to an embodiment of the invention. Kremin ¶ [0112]. The modulation process 1405 includes TX data signal 1410, data-to-transmit signal 1420, and TX+Data signal 1430. Kremin describes an embodiment where a modulated transmit signal 1430 is sent from the stylus, incorporating the transmit data signal 1410 embodied as the stylus's transmit data signal and additional data 1420 embodied as force, button, and other data from the stylus. <i>Id.</i> ¶ [00113]. The modulated signal 1430 combining the transmit signal and data signal is transmitted from the stylus to the device, either via capacitive coupling between the tip 895 and the device's sense array or through other wireless means from the stylus 850 to the sensing device 830. <i>Id.</i> The signal 1430 arrives at a demodulator block 1435. <i>Id.</i> ¶ [00114].</p>

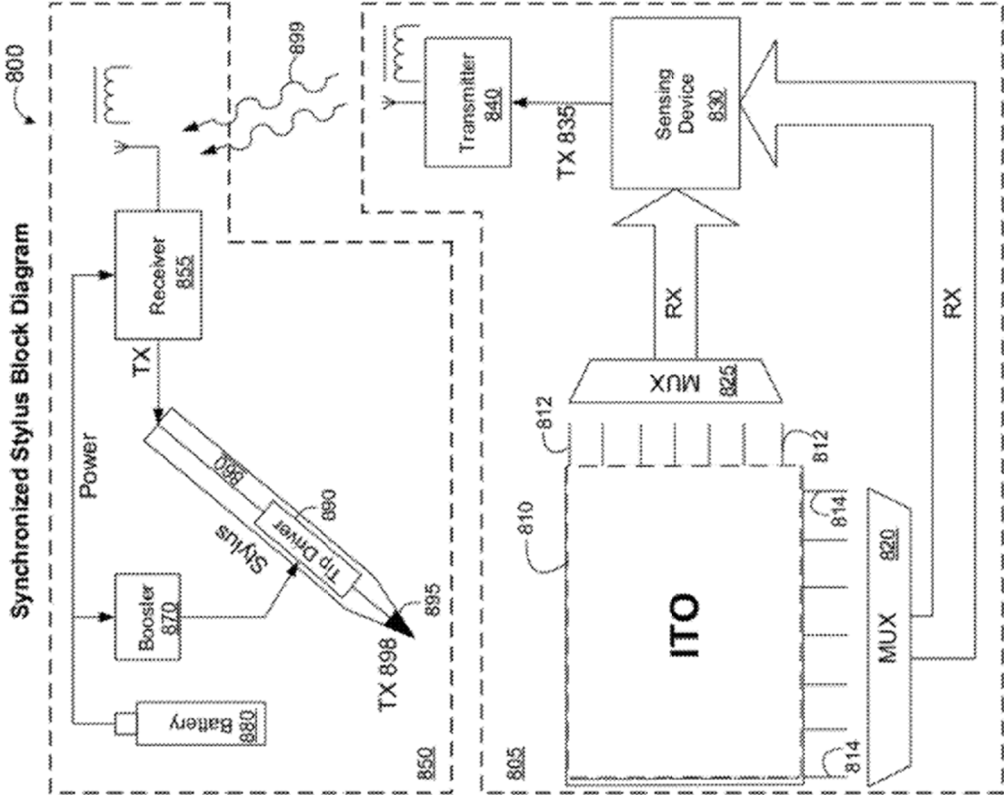


FIG. 8 of Kremin

Stylus with Data Modulation

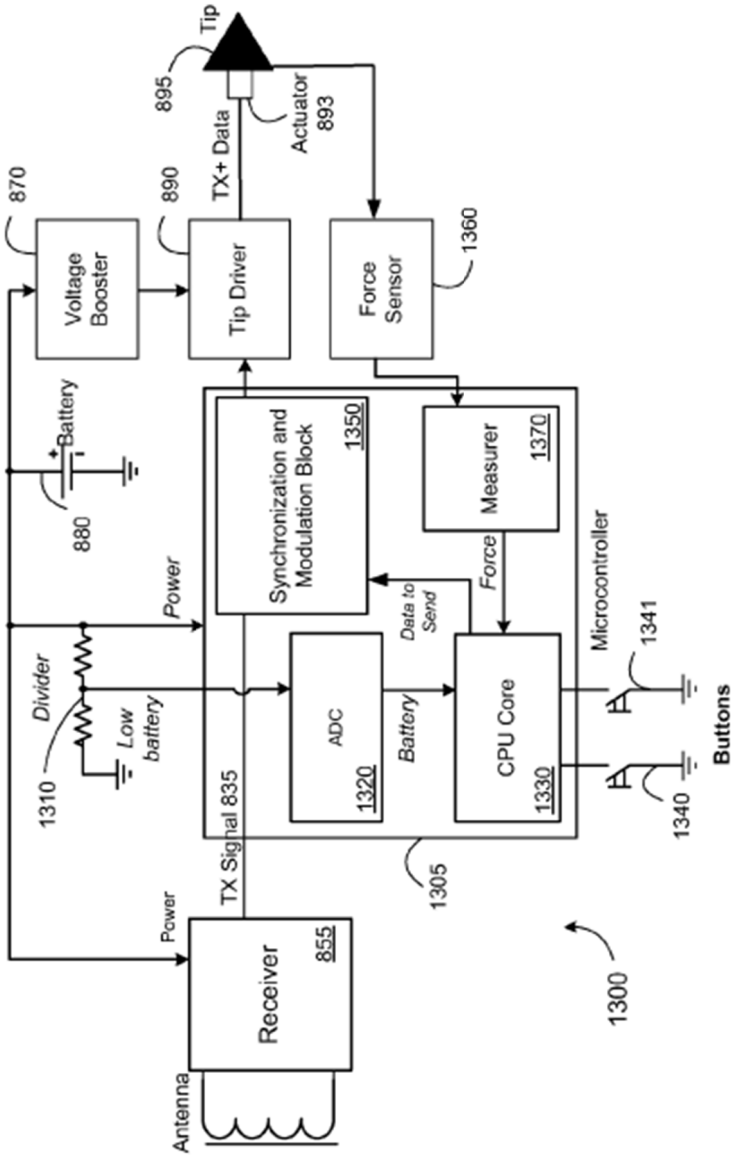


FIG. 13 of Kremin

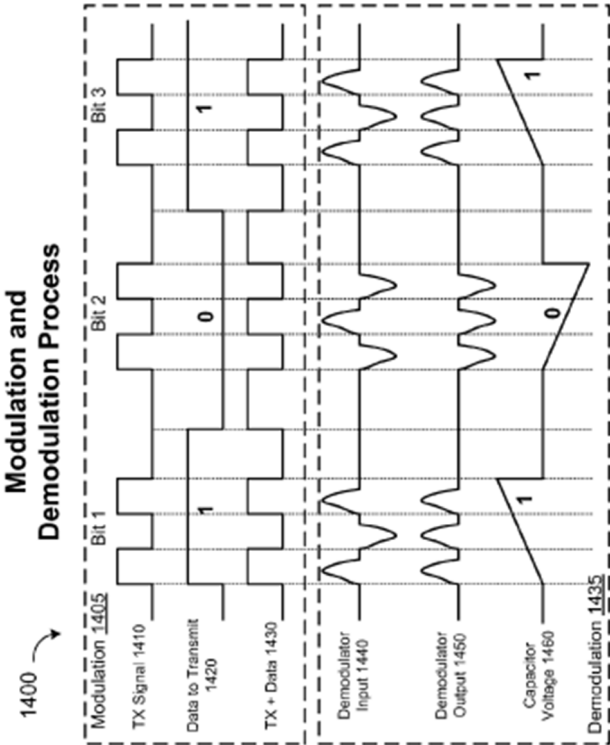


FIG. 14 of Kremin

Claim 1	Example Disclosures in Prior Art
	<p>Although the embodiment shown in Figure 13 does not explicitly use the term “carrier signal”, modulation by necessity involves the use of a carrier signal, as discussed earlier. Furthermore, the disclosure of Kremin relating to the transmission in the opposite direction (i.e., from the host including its sense device to the stylus) explicitly shows the modulation employs a carrier signal. Figure 9A of Kremin shows a block diagram illustrating one embodiment of transmitter 900 configured to transmit a TX signal 915 from a host device 805 to a stylus 850. Kremin, ¶[0087]. The transmitter 900 comprises a carrier generator 910, an amplitude modulation (AM) modulator 920, an amplifier 930, a matching circuit and filter 940, and antenna coil 945. <i>Id.</i> In an embodiment, the carrier generator 910 is a local oscillator that generates a predetermined carrier frequency, where the carrier generator may utilize a ring oscillator, a relaxation oscillator, a crystal oscillator, etc., or other oscillators that would be known by one of ordinary skill in the art. Kremin, ¶[0088]. The carrier frequency may be significantly higher than the TX signal 915. <i>Id.</i> In one embodiment, the carrier generator 910 generates a carrier frequency of 13.56 MHz (radio-frequency identification (RFID) standard), whereas the TX signal 915 frequency may be approximately 100 kHz to 500 kHz. <i>Id.</i> In an embodiment, the TX signal 915 may be generated by frequency dividing the carrier signal or by a separate oscillator circuit. In another embodiment, a circuit within the processing device 310 of Figure 3 generates the TX signal 915. <i>Id.</i> According to one embodiment, the AM modulator 920 receives the carrier frequency from the carrier generator 910 and modulates its amplitude with the TX signal 915. Kremin, ¶[0089]. In one embodiment, the synchronization signal 899 is modulated with the carrier frequency from the carrier generator 910. <i>Id.</i> Kremin further discloses that “[a]lthough amplitude shift-keying (ASK) is described herein, other types of modulation schemes may be used (e.g., frequency shift keying (“FSK”), phase-shift keying (“PSK”), binary phase shift keying (“BPSK”)) and would be known by one of ordinary skill in the art. <i>Id.</i> In one embodiment, the transmitter 900 modulates the TX signal 915 with an RF carrier wave (e.g., 433 MHz, 900 MHz, or 2.4 GHz). In another embodiment, the transmitter 900 utilizes an inductive link to inductively couple the lower frequency RFID modulated carrier wave (modulated TX signal 925) to the inductive receiver 950. Kremin ¶[0090]. Inductively coupling an RFID carrier frequency generally consumes less power than an RF carrier wave and may provide longer battery life in the stylus. <i>Id.</i> In some embodiments, using an RFID carrier frequency may provide significant advantages. <i>Id.</i> In one embodiment, the RFID carrier frequency is frequency divided to generate the TX signal 915, thus providing good noise suppression at the receiver block. <i>Id.</i> Some types of sensor data that may be modulated into the stylus TX signal 835 include battery charge 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. <i>Id.</i> ¶ [00106]–[00109]. As an example, in the embodiment of FIG. 11, a transmit signal 1110 is generated by the sensing device, which is wirelessly transmitted to the stylus 1150. Kremin, ¶ [0098]. The sensing device generates a TX pulse sequence (block 1110). In an embodiment, the TX pulse sequence is a pulse train of TX signals. <i>Id.</i> At block 1155, the carrier generator generates a carrier signal (e.g., 13.56 MHz RFID carrier frequency). <i>Id.</i> The AM modulator modulates the carrier signal (block 1135) with the TX pulse sequence generated at block 1110. <i>Id.</i> In other embodiments, the host device may implement other modulation schemes, as described in conjunction with FIG. 9A. <i>Id.</i> A band pass filter filters the modulated TX signal (block 1140). <i>Id.</i> At block 1145, a matching network matches the impedance of the filter and antenna, and the transmit block wirelessly transmits the modulated TX signal to the stylus (block 1150). <i>Id.</i> The receiver block of the stylus wirelessly receives the modulated TX signal from the host device (block 1162). Kremin, ¶ [0099]. The amplifier block amplifies the modulated TX signal (block 1165), and the AM demodulator removes the carrier frequency from the TX signal (block 1170). <i>Id.</i></p>

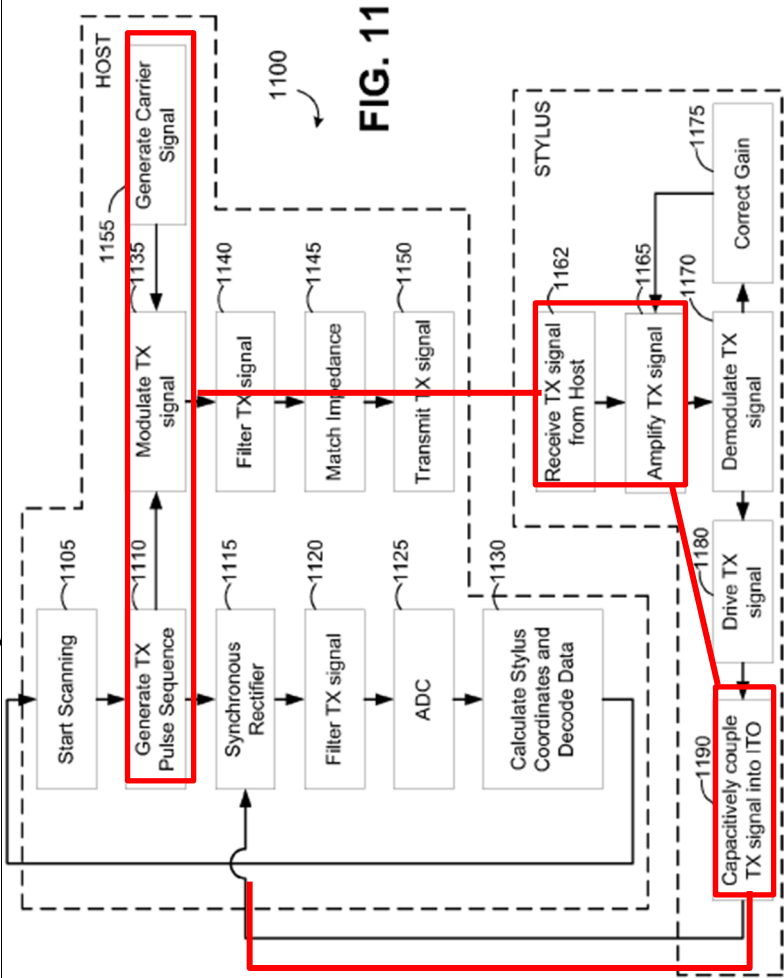


FIG. 11 of Kremin

Kremin describes an embodiment where the synch mod block 1350 (in Figure 13) modulates by a non-exhaustive list of modulation schemes, including frequency modulation (“FM”), frequency-shift keying (“FSK”), amplitude modulation (AM), amplitude-shift keying (ASK), on-off keying (“OOK”), pulse position modulation, phase modulation (“PM”), Manchester encoding, direct sequence spread spectrum (“DSSS”), or other modulation schemes that would be appreciated by one of ordinary skill in the art. *Id.* ¶ [0110]. Kremin also discloses that “PM modulation may further include binary phase shift keying (“BPSK) or quadrature phase shift keying (“QPSK) encoding schemes which are further discussed below with respect to FIGS 15-18”. *Id.* ¶ [0115]. Kremin states that binary phase shift keying is one of several preferred modulation schemes for adding additional data to a signal and describes its benefits in signal-to-noise ratio and reiterates that other modulation schemes may be used as would be known by a person of ordinary skill in the art with the benefit of that disclosure. *Id.* ¶ [0115]. Figure 15C of Kremin uses as an example the encoding of button data by binary phase shift keying, where the button is pressed 1570 or not pressed 1580”. *Id.* ¶ [0115].

Claim 1	Example Disclosures in Prior Art
	<p>One example of modulation described in Kremin is binary phase shift keying, with 180 degree shifts, <i>id.</i> ¶ [0115], which may include or be illustrated as waveforms mirroring the wave pulse 1500 as shown in Figure 15A of Kremin. Figure 15B is a waveform illustrating a stylus TX signal utilizing a one-bit BPSK modulation scheme, according to an embodiment of the invention. <i>Id.</i> ¶ [0037]. Figure 15C is a graph illustrating polar coordinates and phase relationships for a one-bit BPSK modulation scheme, according to an embodiment of the invention. <i>Id.</i> ¶ [0038]. Figure 16 is a block diagram illustrating a modulator block for implementing a one-bit BPSK modulation scheme for adding force sense data to a stylus TX signal, according to an embodiment of the invention. <i>Id.</i> ¶ [0039]. Figure 17A is a waveform illustrating a stylus TX signal utilizing a two-bit, quadrature phase shift keyed (“QPSK”) modulation scheme, according to an embodiment of the invention. <i>Id.</i> ¶ [0040]. Figure 17B is a waveform illustrating a stylus TX signal utilizing a two-bit quadrature phase shift keyed (“QPSK”) modulation scheme, according to an embodiment of the invention. <i>Id.</i> ¶ [0041]. Figure 17C is a graph illustrating polar coordinates and phase relationships for a two-bit QPSK modulation scheme, according to an embodiment of the invention. <i>Id.</i> ¶ [0042]. Figure 18 is a block diagram illustrating a modulator block for implementing a two-bit QPSK modulation scheme for adding additional data to a stylus TX signal, according to an embodiment of the invention. <i>Id.</i> ¶ [0043].</p>

Fig. 15A

Bit 1 Logic One

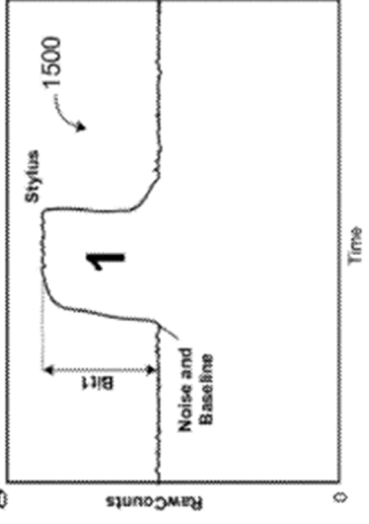


Fig. 15B

Bit 1 Logic Zero

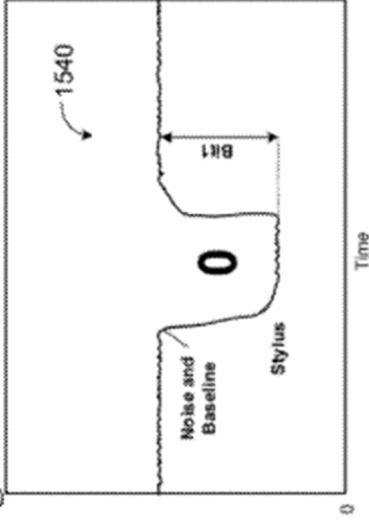


Fig. 15C

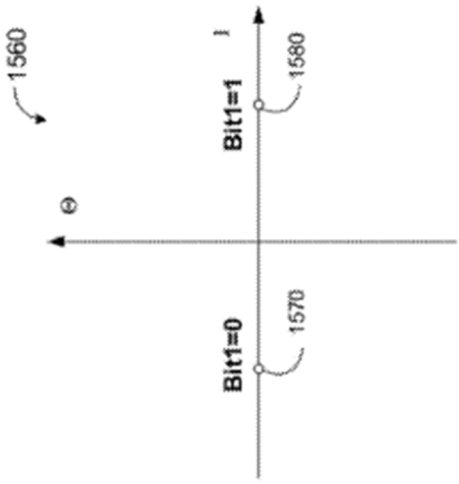


FIG. 15 of Kremin

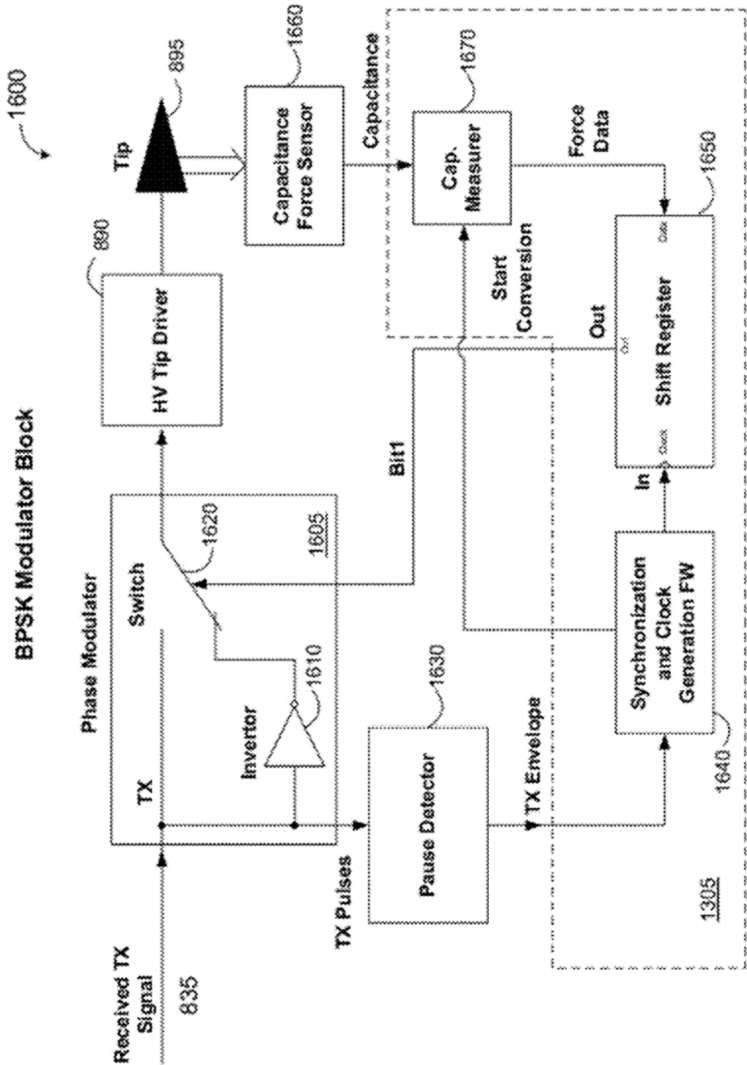


FIG. 16 of Kremin

Fig. 17A

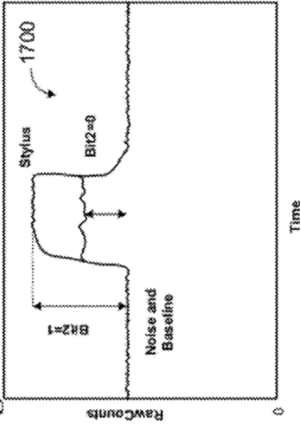


Fig. 17B

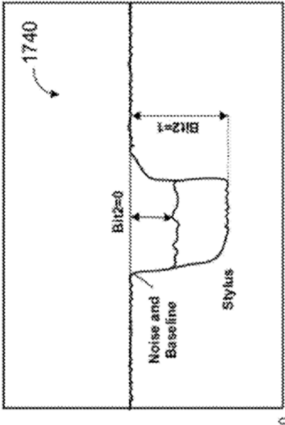


Fig. 17C

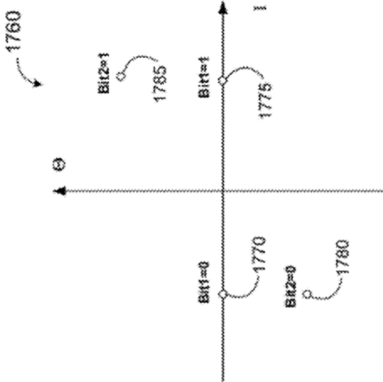


Figure 17 of Kremin

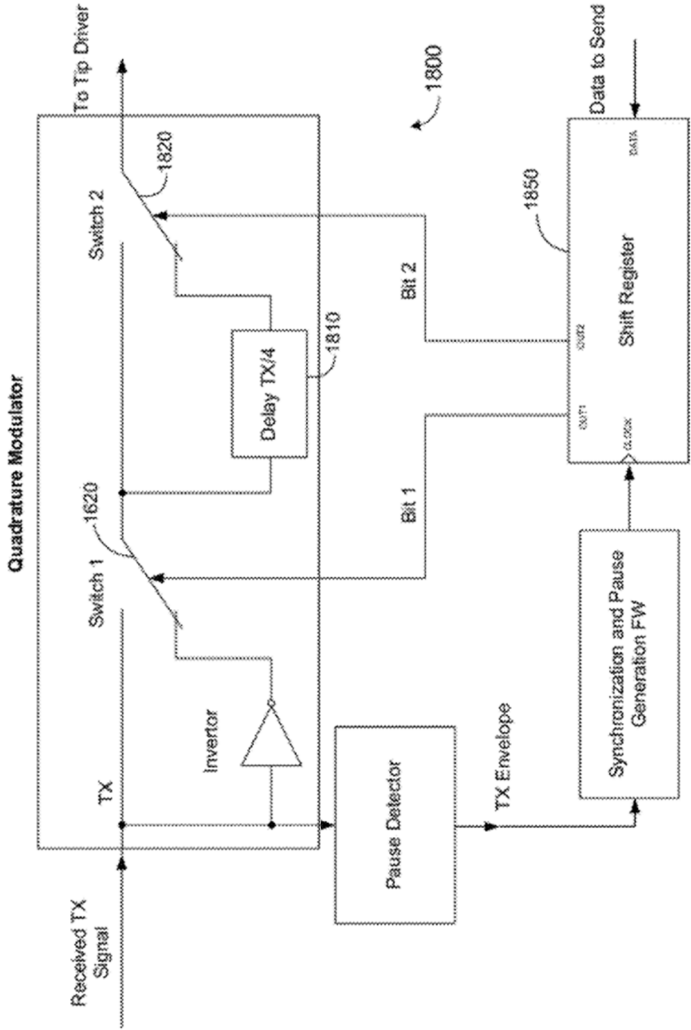


FIG. 18 of Kremin

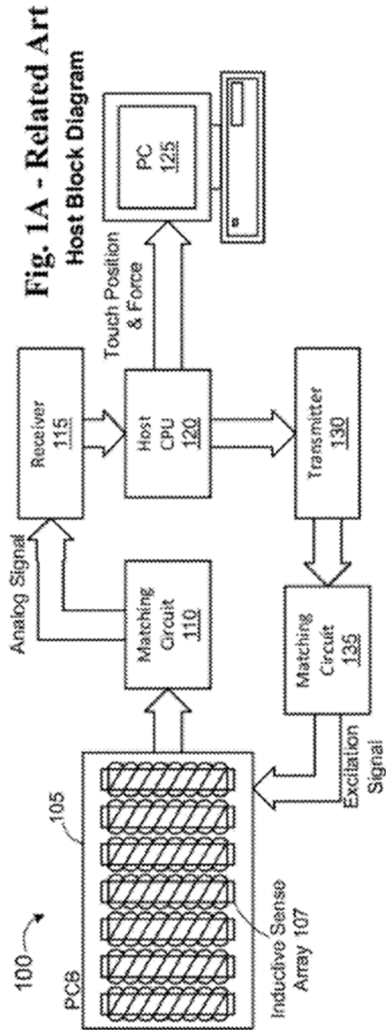
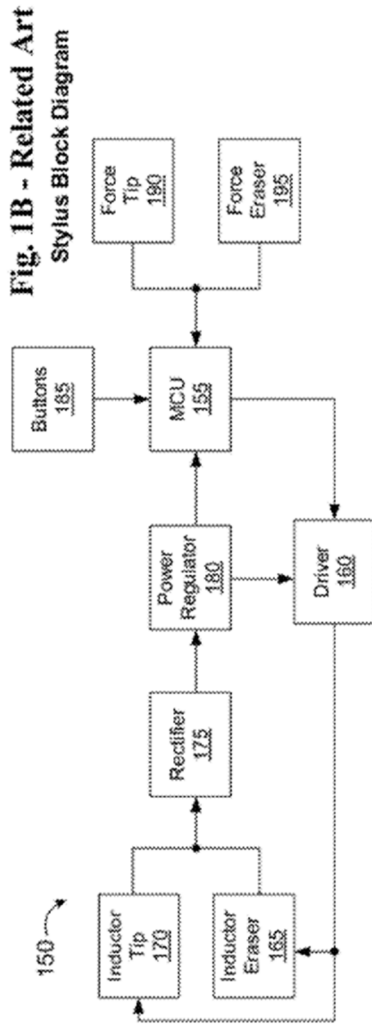
Additionally, this limitation is known in art prior to Kremin. In particular, Kremin discloses the following in relation to Figure 1A (“Related Art”: “Host Block Diagram”) and 1B (“Related Art”: “Stylus Block Diagram”).

The host CPU 120 sends a high frequency **carrier signal** to the stylus 150 via an amplifier (not shown), a transmitter 130, an impedance matching circuit 135, and the inductive sense array 107. The stylus 150 receives and **utilizes the high frequency carrier signal for self-powering and data transmission**. In operation, the stylus 150 rectifies (rectifier 175) and regulates (power regulator 180) the **carrier signal** and feeds the resultant signal to the MCU 155 and driver 160. The MCU 155 measures force sensors (force tip 190 and force eraser 195) and button states (button(s) 185) and couples the resultant data signal to the driver 160. The driver 160 drives the inductor tip 170 and inductor eraser 165, which inductively couples the stylus 150 to the inductive sense array 107. *Id.* ¶ [00008] (emphasis added)

Claim 1

Example Disclosures in Prior Art

Stylus 150 sensing is implemented largely independent of the finger-sensing capability of the touch screen. As described above, stylus tracking requires generating an alter native current (AC) signal by the inductive sense array 107 and inductively coupling the AC signal to the tip of the stylus 150. The inductive sense array 107, located behind the touch screen, in turn receives the stylus signal and the Host CPU 120 interpolates the position of the stylus tip (inductor tip 170) based on the relative magnitude of the received stylus signals at each of the inductive sensors of the inductive sense array 107. While inductive sensing may be reliable, inductive stylus tracking solutions exhibit serious commercial disadvantages including high power consumption, high electromagnetic interference (EMI), high manufacturing costs, and heavy construction. Furthermore, retro fitting an existing touch sensor (passive touch object sensor) to include independent stylus tracking would require an additional PCB 105 layer to incorporate the inductive sense array 107. *Id.* ¶ [000009]



FIGs. 1A and 1B of Kremin

Claim 1	Example Disclosures in Prior Art
	<p>A Person of ordinary skill in the art would understand from this disclosure that the stylus modulates its transmitted signal based on the carrier signal received from the host device. 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 incorporate by reference at paragraph [0001] of Kremin, shows the same schematics of Figures 1A and 1B of Kremin, but is labeled as “Wacom Host Block Diagram” and “Wacom Stylus Block Diagram”. See US Provisional application No. 61/407,907 at 2. Wacom here refers to a prior-art stylus product by Wacom. <i>Id.</i></p> <p>Kremin also discloses the following in relation to Figure 2A (“Related Art”: “Host Block Diagram”) and 2B (“Related Art”: “Stylus Block Diagram”).</p> <p>In operation, the stylus 250 generates, amplifies, and couples a signal from the stylus tip 275 to the ITO panel 205 via capacitive coupling. The ITO panel 205 functions as an antenna and receives the signal from the stylus 250 as described below with respect to FIG. 2B. The selective receiver 210 demodulates the signal and couples a touch position signal to the host CPU 220 and a force data signal to the data decoder 215. The data decoder 215 extracts the force data and couples it to the host CPU 220. The host CPU 220 calculates the stylus touch position based on the relative maximum amplitude of the stylus signal detected on the ITO lines of ITO panel 205. The host CPU 220 further determines the force applied to the stylus based on the force data. The host CPU 220 is controlled by the PC 225. Kremin ¶ [0011].</p> <p>FIG. 2B is a block diagram illustrating a conventional embodiment of an active stylus used in a system for tracking the position of a touch object on an RF sense array. The measurer 260 of stylus 250 measures the force induced on the force sensor 255 and the modulator 265 modulates the resultant force data with a carrier frequency, provided by the reference clock 280. The amplifier 270 amplifies the modulated signal and transmits the modulated carrier frequency from the stylus tip 275. As described above, the host 200 decodes the modulated carrier signal and transmits the result to the PC 225. While an RF sense array solution may offer cost savings and a reduced component count, they require special narrow band receivers on the host 200 and are subject to RF noise and interference. Consequently, conventional touch panel Solutions may have significant disadvantages in cost, performance, applicability, and reliability. Kremin ¶ [0012] (emphasis added).</p>

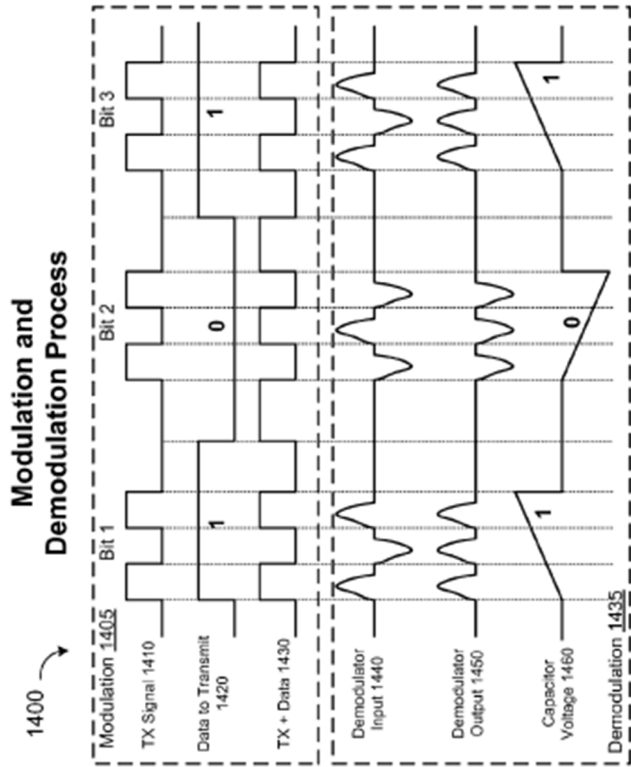
<p>Claim 1</p>	<p>Example Disclosures in Prior Art</p>
	<div data-bbox="224 602 505 1424"> <p>Host Block Diagram</p> </div> <div data-bbox="513 865 542 1155"> <p>Fig. 2A - Related Art</p> </div> <div data-bbox="573 666 824 1403"> <p>Stylus Block Diagram</p> </div> <div data-bbox="841 865 870 1155"> <p>Fig. 2B - Related Art</p> </div> <div data-bbox="899 811 928 1190"> <p>FIGs. 2A and 2B of Kremin</p> </div> <p>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. 1017), which is incorporate by reference at paragraph [0001] of Kremin, shows the same schematics of Figures 2A and 2B of Kremin, but is labeled as “N-Trig Host Block Diagram” and “N-Trig Stylus Block Diagram”. See US Provisional application No. 61/407,907 at 4. N-Trig here refers to a prior-art stylus product by N-Trig. <i>Id.</i></p> <p>Kremin therefore fully discloses limitation 1[c3].</p>
<p>1[c4] transmit to the device, in response to the first signal, the second signal, the sensor data being obtainable by demodulating the second signal.</p>	<p>As described above, the stylus 850 in Kremin contains a receiver 855 that receives a signal 835, 899 generated from the sensing device 830. Kremin ¶ [0085]. In an embodiment, the synch mod block 1350 is configured to modulate additional data into the carrier’s TX signal 835, incorporating the sensor data. <i>Id.</i> ¶ [00105]. The stylus 850 contains a stylus tip 895 through which the stylus transmit signal 898 is capacitively coupled to the capacitive sense array. <i>Id.</i> Claim 6, ¶ [0085]. See limitation 1[c3] above.</p>

Claim 1

Example Disclosures in Prior Art

Figure 14 of Kremin is a timing diagram 1400 illustrating a modulation and demodulation process on a data stream, according to an embodiment of the invention. Kremin ¶ [0112]. Timing diagram 1400 includes a modulation process 1405 and demodulation process 1435. *Id.* The modulation process 1405 includes TX data signal 1410, data-to-transmit signal 1420, and TX+Data signal 1430. The demodulation process 1435 includes demodulator input signal 1440, demodulator output signal 1450, and capacitor voltage 1460. *Id.* Kremin describes an embodiment where a modulated transmit signal 1430 is sent from the stylus, incorporating the transmit data signal 1410 embodied as the stylus's transmit data signal and additional data 1420 embodied as force, button, and other data from the stylus. *Id.* ¶ [00113]. The modulated signal 1430 combining the transmit signal and data signal is transmitted from the stylus to the device, either via capacitive coupling between the tip 895 and the device's sense array or through other wireless means from the stylus 850 to the sensing device 830. *Id.* The signal 1430 arrives at a demodulator block 1435. *Id.* ¶ [00114]. In one embodiment, the received signal arrives to the device as current spikes 1440, which are demodulated into a signal 1450 that is further processed into decoded data corresponding to the additional data 1420 (e.g., sensor data). *Id.*

Kremin therefore discloses that the second signal is transmitted responsive to the first signal and sends the sensor data through that second signal, obtainable through demodulation; Kremin discloses limitation 1[c4].



Claim 2	Example Disclosures in Prior Art
<p>2. The stylus of claim 1, wherein the first signal is the carrier signal modulated to generate the second signal.</p>	<p>See limitation 1[c3] above. Figure 13 of Kremin shows that the stylus receives a signal from the sense device, and then it modulates data into it and transmits it to the sense device. Specifically, this figure “is a block diagram illustrating one embodiment of a stylus 1300 for synchronizing and modulating additional data into a stylus transmit signal 898”. Kremin, ¶ [0104]. 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. <i>Id.</i> In one embodiment, the microcontroller block 1305 includes ADC 1320, CPU core 1330, buttons 1340 and 1341, synchronization and modulation block (“synch mod block”) 1350, and measurer 1370. <i>Id.</i> In an embodiment, the synch mod block 1350 is configured to modulate additional data into the TX signal 835. Kremin, ¶ [0105]. Kremin discloses that 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. <i>Id.</i> A person of ordinary skill in the art would understand from this disclosure that the data received from the sense device is used as a carrier signal. Specifically, a person of ordinary skill in the art would understand that the modulation is achieved by modifying the characteristic of the carrier signal received from the sense device so that it varies with the instantaneous value of the data to be transmitted by the stylus (e.g., force data, etc.)¹⁰.</p> <p>Based on at least the foregoing disclosures, it would be appreciated that Kremin discloses “wherein the first signal is the carrier signal modulated to generate the second signal,” as in claim 2.</p>

¹⁰ See, e.g., the definition of the term modulation in Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, pages 479-480 (Ex. 1016).

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Claim 3	Example Disclosures in Prior Art
3. The stylus of claim 1, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.	See limitation 1[c3]. As described above, Kremin describes an embodiment where the synch mod block 1350 (in Figure 13) modulates by a non-exhaustive list of modulation schemes, including frequency modulation (“FM”), frequency-shift keying (“FSK”), amplitude modulation (AM), amplitude-shift keying (ASK), on-off keying (“OOK”), pulse position modulation, phase modulation (“PM), Manchester encoding, direct sequence spread spectrum (“DSSS), or other modulation schemes that would be appreciated by one of ordinary skill in the art. Kremin. ¶ [0110]. Kremin also discloses that “PM modulation may further include binary phase shift keying (“BPSK) or quadrature phase shift keying (“QPSK) encoding schemes which are further discussed below with respect to FIGS 15-18”. <i>Id.</i> ¶ [0115]. Other modulation schemes, including modulation by amplitude modulation, frequency modulation, and phase modulation, are claimed in Claims 4 and 14. Kremin ¶ [00110], Claims 4, 14. Accordingly, Kremin discloses Claim 3. Moreover, amplitude modulation, frequency modulation, and phase modulation are the three fundamental ways to perform modulation ¹¹ .

Claim 4	Example Disclosures in Prior Art
4. The stylus of claim 1, wherein: the one or more sensors comprise a pressure sensor and a button; and the sensor data comprises pressure data and button state data.	Kremin discloses and claims multiple types of sensors in multiple embodiments, including force sense data, battery data, acceleration data, and button status data. <i>See, e.g.</i> , Kremin at ¶ [0109] & Claims 1–4. Kremin discloses and claims a force sensor 1360 to detect the force applied to the stylus via the actuator 893 and tip 895, measured by the measurer 1370. Kremin at Claims 2-3, 11–13, ¶ [00109]. Kremin further discloses an embodiment includes a microcontroller block 1305 with buttons 1340, 1341, from which pushes are detected adding additional functionality such as a “left click” and “right click” function. <i>Id.</i> ¶¶ [00105], [00108]. Kremin therefore discloses a stylus where the specific sensors are force/pressure sensors and a button—a pair specifically illustrated in Figure 13. The additional data to be modulated into the signal is force data and button data, routed through the CPU core 1330 and sent to the synch mod block 1350. <i>Id.</i> ¶¶ [00105], [00109]. Figures 19A and 19B further describe how pairs of sensor data may be transmitted together or separately. <i>Id.</i> ¶¶ [0044]–[0045]. Kremin discloses claim 4.

¹¹ Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 480 (Ex. 1016); Ali Grami. Introduction to Digital Communications. Copyright © 2016 Elsevier Inc, page 35 (Ex. 1018).

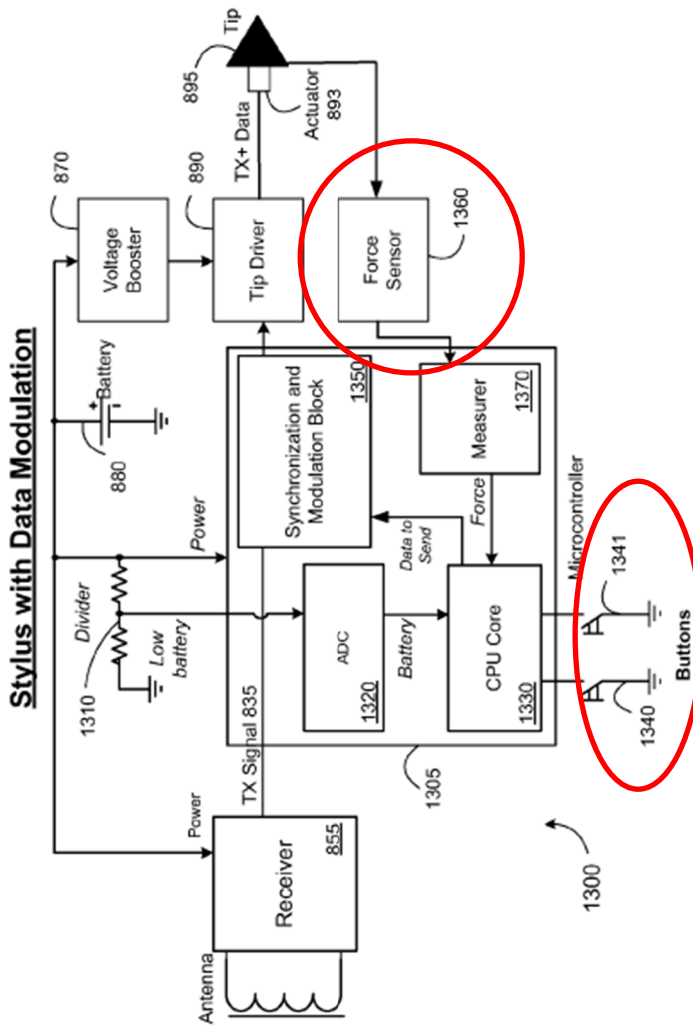


FIG. 13 of Kremin

Claim 5

5. The stylus of claim 1, wherein the sensor data is digital.

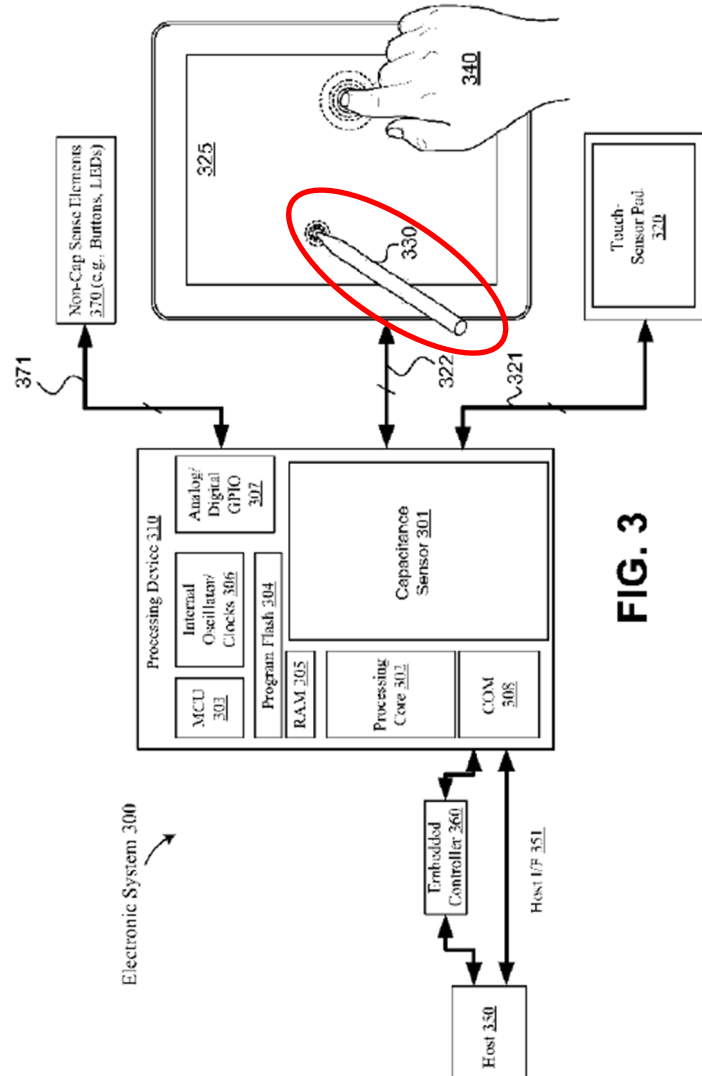
Example Disclosures in Prior Art

As discussed above, Kremin discloses and claims multiple types of sensors in multiple embodiments, including force sense data, battery data, acceleration data, and button status data. *See, e.g.*, Kremin at ¶ [0109] & Claims 1–4. Kremin discloses and claims a force sensor 1360 that may be either a passive sensor or an active sensor within the stylus, and a motion sensor to detect motion of the stylus. Kremin at Claims 2–3, 11–13, ¶ [0109]. Kremin further discloses that other methods may be used to quantitatively determine and digitize a force applied to stylus, and a person of ordinary skill in the art would accordingly appreciate that the force measurements are necessarily digitized when output as sensor data. *Id.*

Additionally, the data from the buttons 1341 and force sensor 1360 redirect through the CPU core 1330. A person of ordinary skill in the art would understand that to do so, the data would need to be digitized: a CPU can only process digital data, that is, binary discrete values of 0s and 1s. A CPU cannot process analog data, which is continuous. Accordingly, all sensor data must be digital by nature. Where it is not digital, an analog-to-digital converter (ADC) 1320 is necessary, as depicted in Figure 13, which would result in sensor data being digital.

	<p>Kremin specifically claims a stylus including ADC for representing battery status, as embodied in Figure 13. Kremin Claim 8, ¶ [00100]. Specifically, it discloses an embodiment where voltage indicating battery status is processed by the ADC and turned into digital data to be processed by the CPU 1330. <i>Id.</i> ¶¶ [00107]. A person of ordinary skill in the art would appreciate that unless specified as analog, many of these forms of information—force data, battery level, etc.—are either already digital or would need to be adapted in the ADC to be processed by the CPU, which is a necessary step before the data can be modulated into a signal.</p> <div data-bbox="370 572 974 1473"> <p>Stylus with Data Modulation</p> </div> <p>FIG. 13 of Kremin</p> <p>Furthermore, since Kremin explicitly discloses digitizing at least the force and battery data, a person of ordinary skill in the art would understand that all other sensor data must be handled in the same way so that they can be encoded in the stylus transmit signal. Kremin at ¶ [0109].</p>
<p>Claim 7</p> <p>7[pre] One or more computer-readable non-transitory storage media embodying logic that is operable when executed to:</p>	<p>Example Disclosures in Prior Art</p> <p>See limitation 1[c] above.</p>

Claim 7		Example Disclosures in Prior Art
7[a] receive sensor data from one or more sensors in or on a stylus, the stylus comprising one or more electrodes configured to communicate with a device by receiving signal from and transmitting signals to a touch sensor of the device;		See limitations 1[b] and 1[c1] above.
7[b] receive a first signal generated by the device;		See limitation 1[c2] above.
7[c] generate a second signal by modulating a carrier signal based on the sensor data; and		See limitation 1[c3] above.
7[d] transmit to the device, in response to the first signal, the second signal, the sensor data being obtainable by demodulating the second signal.		See limitation 1[c4].
Claim 8		Example Disclosures in Prior Art
8. The media of claim 7, wherein the first signal is the carrier signal modulated to generate the second signal.		See claim 2 above.
Claim 9		Example Disclosures in Prior Art
9. The media of claim 7, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.		See claim 3 above.
Claim 10		Example Disclosures in Prior Art

<p>10. The media of claim 7, wherein: the one or more sensors comprise a pressure sensor and a button; and the sensor data comprises pressure data and button state data.</p>	<p>See claim 4 above.</p>
<p>Claim 11</p> <p>11. The media of claim 7, wherein the sensor data is digital.</p>	<p>Example Disclosures in Prior Art</p> <p>See claim 5 above.</p>
<p>Claim 13</p> <p>13[pre] A system comprising:</p>	<p>Example Disclosures in Prior Art</p> <p>To the extent the preamble is considered limiting, Kremin discloses an electronic system 300 having a processing device 310, touch screen 325, and touch sensor pad 320 for detecting the presence of a touch object 340 and a stylus 330, laid out in Figure 3. Kremin ¶ [0051]. Kremin discloses 13[pre].</p>  <p>FIG. 3</p> <p>FIG. 3 of Kremin</p>

Claim 13		Example Disclosures in Prior Art
13[a]	a device comprising a touch sensor; and	As shown in Figure 3 above, the device of the system 300 of Kremin includes a touch screen 325 with a touch sensor pad 320. Kremin ¶ [0051].
13[b]	a stylus comprising:	See limitation 1[pre] above.
13[b1]	one or more sensors;	See limitation 1[a] above.
13[b2]	one or more electrodes configured to communicate with a device by receiving signals from and transmitting signals to a touch sensor of the device; and	See limitation 1[b].
13[b3]	one or more computer-readable non-transitory storage media embodying logic that is operable when executed to:	See limitation 1[c] above.
13[b3A]	receive sensor data from the one or more sensors;	See limitation 1[c1] above.
13[b3B]	receive a first signal generated by the device;	See limitation 1[c2].
13[b3C]	generate a second signal by modulating a carrier signal based on the sensor data; and	See limitation 1[c3] above.
13[b3D]	transmit to the device, in response to the first signal, the second signal, the device being operable to obtain the sensor data by demodulating the second signal.	See limitation 1[c4] above.
Claim 14		Example Disclosures in Prior Art
14.	The system of claim 13, wherein the first signal is the carrier signal modulated to generate the second signal.	See claim 2 above.
Claim 15		Example Disclosures in Prior Art

15. The system of claim 13, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.	See claim 3 above.
Example Disclosures in Prior Art	
16. The system of claim 13, wherein: the one or more sensors comprise a pressure sensor and a button; and the sensor data comprises pressure data and button state data.	See claim 4 above.
Example Disclosures in Prior Art	
17. The system of claim 13, wherein the sensor data is digital.	See claim 5 above.

Appendix B2

U.S. Patent No. 9,280,220 – Obviousness over Kremin in view of Harley

U.S. Patent Publication No. 20120105362 to Kremin et al. (“Kremin”) (Ex. 1009) (published May 3, 2012; priority date October 28, 2010) renders the challenged claims of U.S. Patent No. 9,280,220 (“’220 Patent”) (Ex. 1001) obvious under 35 U.S.C. § 103 in view of U.S. Patent No US 8,928,635 B2 to Harley et al. (“Harley”) (Ex. 1021) (issued January 6, 2015; filed June 22, 2011). The chart below sets forth my analysis regarding obviousness of the challenged claims on this basis.

Both Kremin and Harley describe similar technologies and address similar problems. Both describe active styluses used to communicate with a touch sensor of a device, and both employ capacitive coupling for communication and both disclose synchronization between the stylus and touch sensor and modulation/demodulation of data. Furthermore, both of them disclose how the location of the stylus can be determined.

Kremin relates to the field of user interface devices and, in particular, to capacitive sensor devices. Kremin ¶ [0002] [TECHNICAL FIELD]. It discloses a system and method for tracking a stylus on a capacitive sense array. Kremin at ABSTRACT. 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. *Id.* Kremin also discloses a stylus for synchronizing and modulating data into a stylus transmit signal. Kremin, ¶ [0104]. The data to be modulated and transmitted may include, for example, data received from a force sensor. *Id.* at ¶¶ [0104] & [0109]. A synch mod block modulates the data using various modulation techniques. *Id.* at ¶ [0110].

Similarly, Harley relates generally to touch sensing, and more particularly, to providing a stylus that can act as a drive and/or sense element in a capacitive touch system. Harley 1:5-7 (FIELD). It discloses an active stylus, where the stylus includes an electrode at a tip of the stylus and powered circuitry coupled to the electrode and configured for capacitively coupling the electrode with a capacitive touch sensor panel. Harley at Abstract. The powered circuitry can further include drive circuitry configured to output a drive voltage at the electrode and/or sense circuitry configured to sense a voltage received at the electrode. *Id.* Harley also discloses synchronization between the stylus and the touch sensor. *Id.* 6:47-7:26, Claim 6. It also discloses modulation/demodulation of data. *Id.* 7:4-26. 9:40-67, Claim 1, Claim 4, Claim 13, Claim 15, and Claim 16. In one embodiment, where the stylus acts as a drive electrode, a capacitive touch sensor panel can detect charge coupled into sense lines on the panel by the stimulus from the stylus and determine the location of the stylus on its surface. *Id.* 5:6-19.

A person of ordinary skill in the art would have been motivated to modify the technology of Kremin based on Harley so that the stylus can use capacitive coupling for both sending and receiving data. While Kremin uses capacitive coupling for sending data from the stylus to the touch sensor/host, in an embodiment, Kremin discloses the use of inductive coupling to send data from the touch sensor/host to the stylus¹. A person of ordinary skill in the art would have been motivated to use capacitive coupling for both ways of communication, as in Harley, for the obvious benefits of reducing cost and simplifying the implementation. Inductive coupling requires dedicated coils in the touch sensor/touch screen instead of relying only on the standard capacitive touch layers in the case of capacitive coupling. The magnetic coils make the touch sensor more complex to manufacture, thereby further increasing the cost. It would be well within the capabilities of a person of ordinary skill in the art to modify the stylus and touch sensor of Kremin based on Harley, and a person of ordinary skill in the art would have a reasonable chance of success in doing so.

¹ Kremin contemplates different methods for communication from the host device to the stylus. For example, Kremin discloses that in an embodiment, the system further includes a transmitter to wirelessly transmit the synchronization signal from the processing device to the stylus. Kremin ¶ [0048]. In some embodiments, the transmitter may include a magnetic antenna to inductively transmit the synchronization signal to the stylus where the antenna is disposed around the outer edges of the capacitance sense array. *Id.* See also Kremin ¶ [0090]. See also FIG. 13 and limitations 1[c2] and 1[c3] below. A person of ordinary skill in the art would understand that wireless transmission includes capacitive coupling, where no physical wires are used. As discussed above, capacitive coupling requires the use of an electrode at the tip. Thus, a person of ordinary skill in the art would understand the disclosure in Kremin alone to contemplate one or more electrodes in the stylus to receive and transmit signals.

Claim 1

1[pre] A stylus comprising:

Example Disclosures in Prior Art

To the extent the preamble is considered limiting, Kremin discloses limitation 1[pre]. For example, the system 300 of FIG. 3 of Kremin illustrates a stylus 330, which can be detected and tracked by a processing device 310. Kremin, ¶¶ [0051]-[0052].

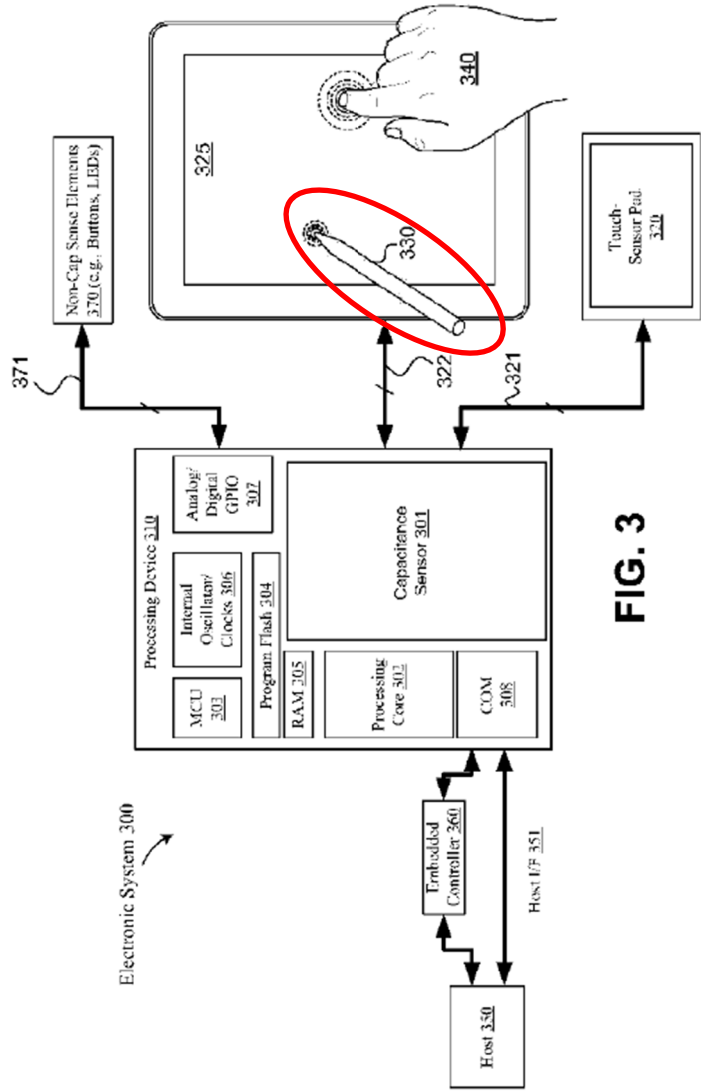


FIG. 3

FIG. 3 of Kremin

1[a] one or more sensors;	<p>Kremin discloses and claims multiple types of sensors in multiple embodiments, including the use of sensors to capture force sense data, battery data, acceleration data, and button status data. Kremin at Claims 1–4, ¶ [0105], [0108]. For example, Kremin discloses that “[s]ome 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]. Moreover, Kremin describes a force sensor 1360 that may be either a passive sensor or an active sensor within the stylus, and a motion sensor to detect motion of the stylus. Kremin at Claims 2-3, 11–13, ¶ [00109]. Kremin further discloses an embodiment that includes a microcontroller block 1305 with buttons 1340, 1341, from which pushes are detected adding additional functionality such as a “left click” and “right click” function. <i>Id.</i> ¶¶ [00105], [00108]. A person of ordinary skill in the art would appreciate that a button is a kind of a sensor, which can output a value such as a binary value. Claim 4 of the ‘220 Patent itself recites that the one or more sensors may comprise “a button.” Kremin describes the buttons themselves as being mechanical, electrical, capacitive, or other types known by one of ordinary skill in the art. <i>Id.</i> ¶ [00108]. A person of ordinary skill in the art would understand that capacitive detection, and a capacitive “button,” requires a capacitive sensor—a type of sensor. <i>Id.</i> ¶ [00108]. Similarly, Kremin discloses an embodiment wherein the orientation or acceleration of the stylus may be detected by an accelerometer—an inertial sensor that measures a change in velocity of an object over time. <i>Id.</i> ¶ [00109]. A person of ordinary skill in the art would recognize an accelerometer as a sensor which senses movement to measure acceleration. Kremin therefore discloses not only an embodiment with a force sensor but an embodiment with multiple sensors, including a force sensor, a motion sensor, buttons (which may be capacitive sense buttons), and an accelerometer/inertial sensor. Accordingly, Kremin discloses limitation 1[a].</p>
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Stylus with Data Modulation

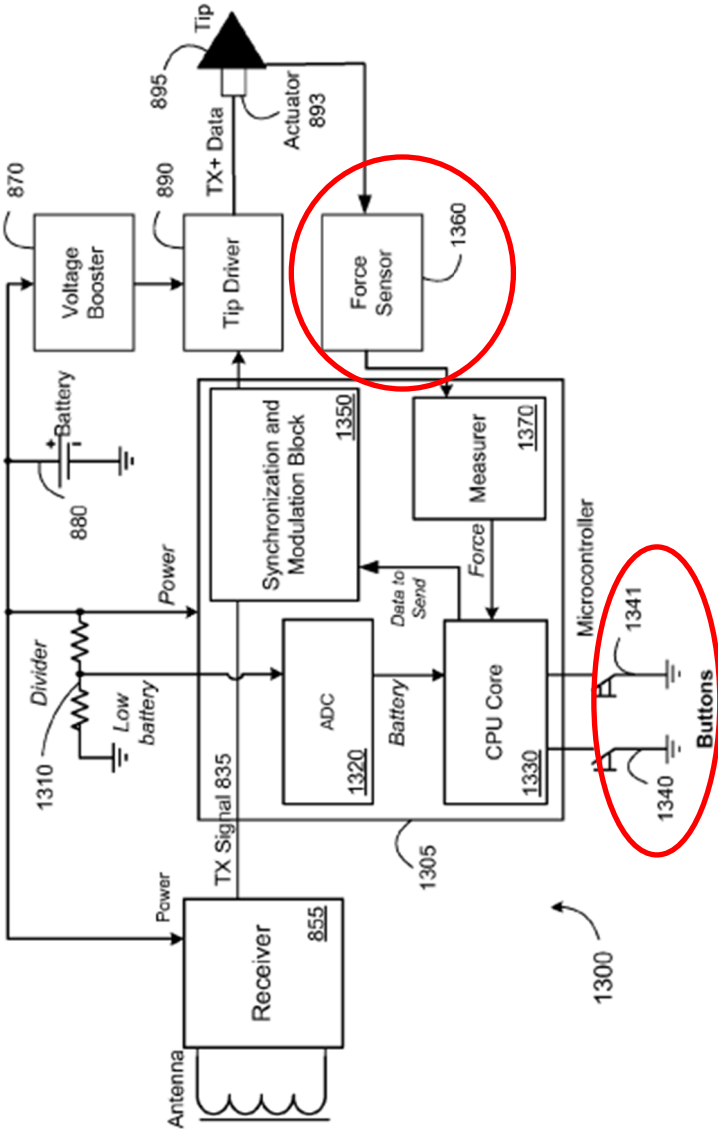


FIG. 13 of Kremin

Example Disclosures in Prior Art	
Claim 1	<p>The stylus 850 of Kremin contains a stylus tip 895 by which the stylus transmit signal is capacitively coupled to the capacitive sense array. Kremin Claim 6, ¶ [0085]. See also FIG. 8 of Kremin. Capacitive coupling is a transfer of electric signals that inherently requires a pairing of electrodes by proximity². A person of ordinary skill in the art would understand that the tip 895 must comprise an electrode, as it is the conventional way to provide the capacitive coupling functionality with the sense array. Harley 1:59-2:1 and WO 2012/033619 A2 at Abstract, 28:15-29:8, Fig. 11A, Claim 1, Claim 8, Claim 12, Claim 14. A person of ordinary skill in the art would appreciate that an electrode could be understood as a conductor that establishes electrical contact with a nonmetallic component of a circuit³. Therefore, an electrode may serve as the conductive element that creates (or senses) changes in the electric field between two objects. As of the earliest possible priority date for the '220 Patent, electrodes had been known for decades, and a person of ordinary skill in the art 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., Harley 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. Harley 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. <i>Id.</i> 1:59-2:1. These active styluses can significantly improve stylus sensing on a mutual capacitive touch sensor panel without incurring significant additional cost. <i>Id.</i> 2:3-5.</p>

² 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. 1016).

³ See e.g., Merriam-Webster Dictionary: <https://www.merriam-webster.com/dictionary/electrode> (Ex. 1020). See, also, Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 239 (Ex. 1016). See also *Id.* at page 239 for the definition of an electrode.

<p>Claim 1</p>	<div data-bbox="133 639 738 1403"> <p>The diagram illustrates a stylus system. At the top, a stylus (680) contains a TX Drive Circuit (685). Below it, a Touch screen Controller (605) includes a TX Drive Circuit (610) and an RX Sense Circuit (620). A grid of electrodes (400) is shown, with a stylus tip (677) and a dashed circle (695) indicating a touch point. A waveform (634) is shown at the bottom, representing a signal. The entire system is labeled 600.</p> </div> <div data-bbox="717 887 787 1158"> <p>FIG. 6B FIG. 6 B of Kremin</p> </div>
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Kremin further discloses that the stylus 850 communicates with the device through an initial signal 835 that goes through a transmitter 840 and is sent as signal 899 to the stylus receiver 855; 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 touch sense array 810. Kremin ¶¶ [0082]–[0085]. A person of ordinary skill in the art would understand that capacitively coupling the amplified stylus transmit signal 898 to the device's touch sense array 810 requires the use of an electrode.

Claim 1

Example Disclosures in Prior Art

Kremin also contemplates different methods for communication from the host device to the stylus. Kremin discloses that in an embodiment, the transmitter 840 of the host device (including the sensing device) wirelessly couples the TX signal 835 to the receiver 855 of the stylus. Kremin ¶ [0082]. In one embodiment, the transmitter 840 inductively couples the TX signal 835 to the receiver 855. *Id.* In other embodiments, the transmitter may wirelessly couple the TX signal 835 in a variety of ways including radio frequency, optical, ultrasound, and other mediums that would be appreciated by one of ordinary in the art. *Id.* The receiver 855 receives TX signal 899 from the transmitter 840 and couples demodulated TX signal to the stylus 850. *Id.* Other disclosures in Kremin further contemplate different methods for communication from the host device to the stylus. For example, Kremin discloses that in an embodiment, the system further includes a transmitter to wirelessly transmit the synchronization signal from the processing device to the stylus. Kremin ¶ [0048]. In some embodiments, the transmitter may include a magnetic antenna to inductively transmit the synchronization signal to the stylus where the antenna is disposed around the outer edges of the capacitance sense array. *Id.* See also Kremin ¶ [0090]. See also FIG. 13 and limitations **1[c2] and 1[c3]** below. A person of ordinary skill in the art would understand that wireless transmission includes capacitive coupling, where no physical wires are used. As discussed above, capacitive coupling requires the use of an electrode at the tip. Thus, a person of ordinary skill in the art would understand the disclosure in Kremin to contemplate one or more electrodes in the stylus to receive and transmit signals.

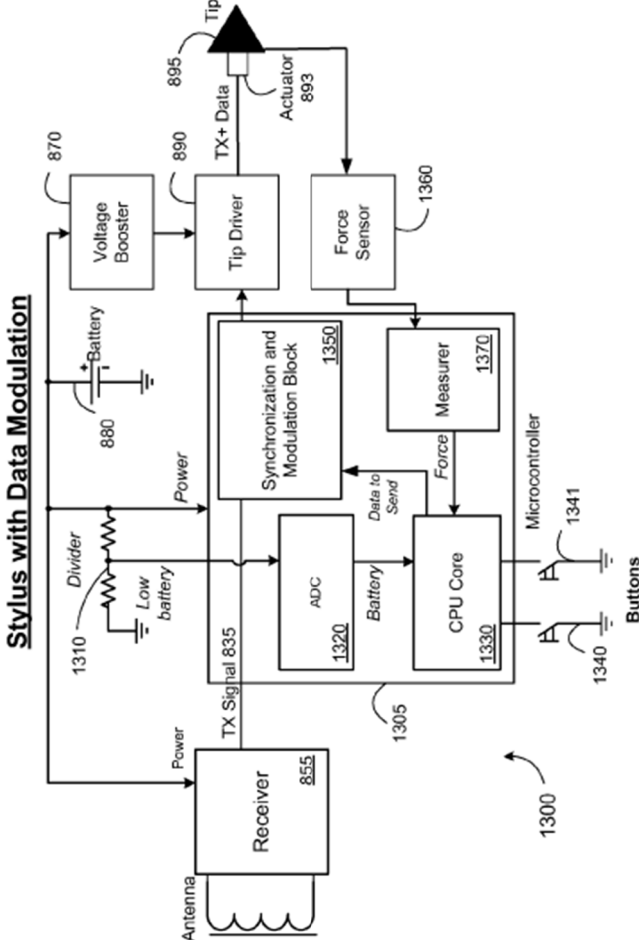


FIG. 13 of Kremin

Claim 1	Example Disclosures in Prior Art
	<p>To the extent Kremin does not expressly, implicitly, or inherently disclose limitation 1[b], it would be obvious to a person of ordinary skill in the art to modify Kremin in view of the knowledge of a person of ordinary skill in the art to implement limitation 1[b]. For example, as discussed above, it was known to include an electrode in the tip of a stylus, and it would be obvious to a person of ordinary skill in the art that the electrode can be used for transmitting signals, receiving signals, or both. See, <i>e.g.</i>, U.S. Patent No. 8,766,954 3:36-41 & 3:50-61 and Harley 1:58-2:1.</p> <p>Alternatively, one of ordinary skill in the art could modify Kremin in view of Harley to meet this limitation. Harley discloses one or more electrodes to perform the foregoing functions. Harley at ABSTRACT, FIG. 3, 1:58-2:1, and Claim 15. It discloses an active stylus, where the stylus includes an electrode at a tip of the stylus and powered circuitry coupled to the electrode and configured for capacitively coupling the electrode with a capacitive touch sensor panel. <i>Id.</i> at Abstract. The powered circuitry can further include drive circuitry configured to output a drive voltage at the electrode and/or sense circuitry configured to sense a voltage received at the electrode. <i>Id.</i> Specifically, Figure 2 of Harley illustrates an exemplary active stylus for use with a capacitive touch sensor panel according to various embodiments. Figure 3 of Harley illustrates exemplary drive circuitry of the active stylus of Figure 2 according to various embodiments. Harley clarifies that the disclosed active stylus can significantly improve stylus sensing on a mutual capacitive touch sensor panel without incurring significant additional cost compared with passive styluses. <i>Id.</i> 2:3-5. A person of ordinary skill in the art would have been motivated to modify the technology of Kremin based on Harley so that the stylus can use capacitive coupling for both sending and receiving data. While Kremin uses capacitive coupling for sending data from the stylus to the touch sensor/host, in an embodiment, Kremin discloses the use of inductive coupling to send data from the touch sensor/host to the stylus. A person of ordinary skill in the art would have been motivated to use capacitive coupling for both ways of communication, as in Harley, for the obvious benefits of reducing cost and simplifying the implementation. Inductive coupling requires dedicated coils in the touch sensor/touch screen instead of relying only on the standard capacitive touch layers in the case of capacitive coupling. The magnetic coils make the touch sensor more complex to manufacture, thereby further increasing the cost. It would be well within the capabilities of a person of ordinary skill in the art to modify the stylus and touch sensor of Kremin based on Harley, and a person of ordinary skill in the art would have a reasonable chance of success in doing so. Although this combination may require the use of a battery within the stylus, a person of ordinary skill in the art would understand that it is one of a small number of design choices and is an excellent tradeoff considering the achieved simplicity of design and reduced cost. Kremin discloses embodiments in which the stylus comprises a battery Kremin ¶¶ [0081, [0084], [0090], [0104], [0105], [0107], [0113], [0123], [0126], Claim 3, and Claim 8.</p>

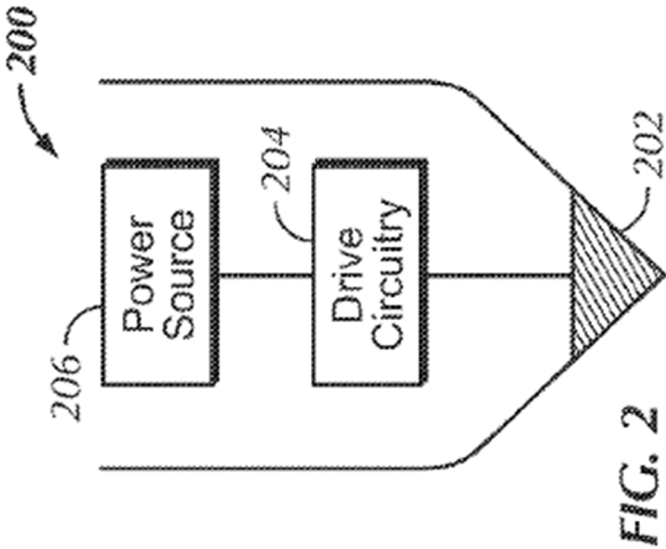


Figure 2 of Harley

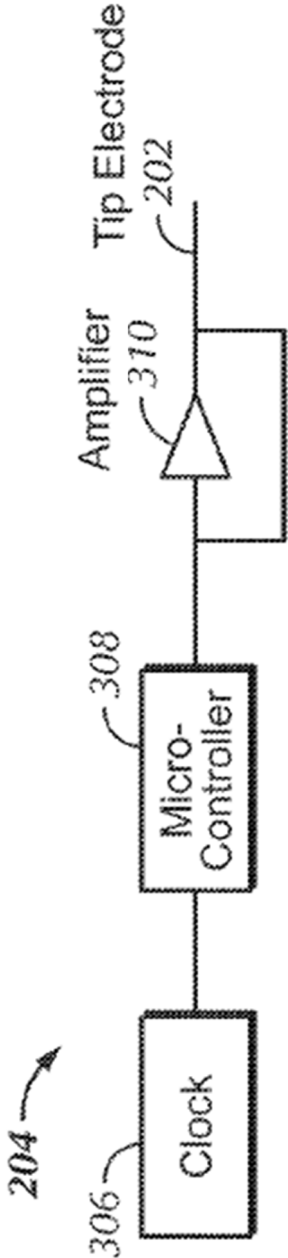


Figure 3 of Harley

Claim 1	Example Disclosures in Prior Art
<p>1[c] one or more computer-readable non-transitory storage media embodying logic that is operable when executed to:</p>	<p>A person of ordinary skill in the art would appreciate that the stylus 850 of Kremin includes at least one computer-readable non-transitory storage medium (e.g., memory) containing the necessary logic to control the operations of the stylus, such as operations of the receiver, tip driver, and booster, and ultimately the process by which the stylus receives, processes, and transmits signals. Kremin ¶ [00140]. Embodiments of the systems and methods can be implemented using instructions stored on a computer-readable medium. Kremin ¶ [00140]. 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 person of ordinary skill in the art 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”⁴ (emphasis added).</p>

⁴ Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 470 [Ex. 1016].

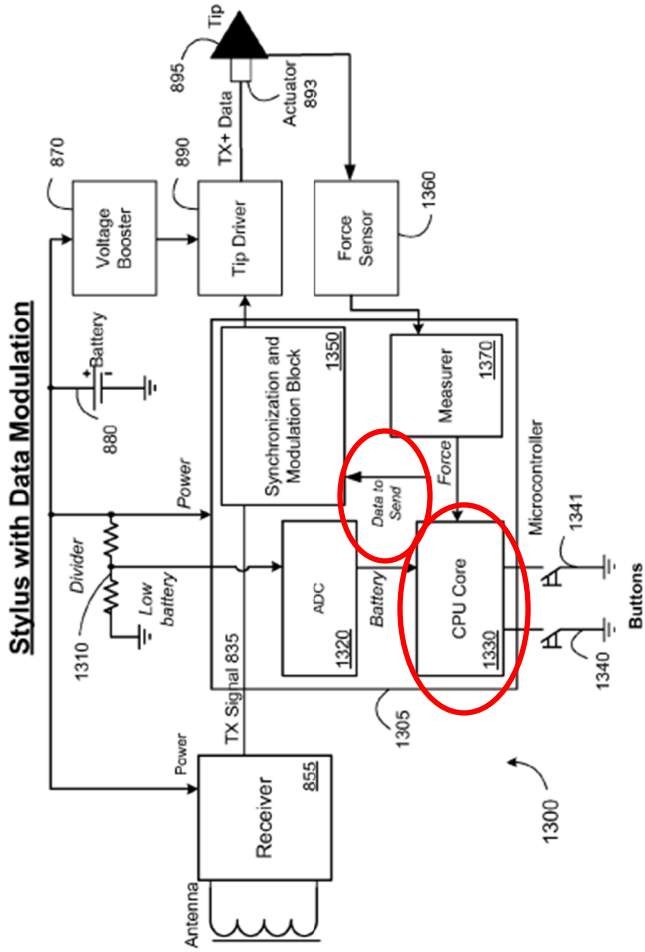


FIG. 13 of Kremin

Lastly, Kremin discloses that embodiments may be implemented in a manner that includes instructions stored on a computer-readable medium. Kremin ¶ [00140]. The instructions may be used to program a processor to perform the described operations. *Id.* Kremin lists a non-exhaustive variety of computer readable storage media, including random-access memory; such storage is “non-transitory,” or unchanging. *Id.* A person of ordinary skill in the art would understand the storage media described by Kremin as computer-readable non-transitory storage media, and would understand that instructions are operable logic to control the operations of the stylus. Accordingly, Kremin fully discloses limitation 1[c].

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. 1016).

Example Disclosures in Prior Art	
Claim 1	As described above, in an embodiment the CPU core 1330 of Kremin is coupled with the force sensor 1360 and measurer 1370, which then processes the force signal or other signal to send it to the synch mod block 1350 to be converted to a signal. Kremin ¶ [00109]. The CPU core 1330 may also be connected to the buttons (which may be capacitive sensors by definition as discussed above with reference to limitation 1[a]), and it processes the button input data. As discussed with reference to limitation 1[a] above, Kremin discloses and claims multiple types of sensors in multiple embodiments, including the use of sensors to capture force sense data, battery data, acceleration data, and button status data. Kremin at Claims 1–4, ¶ [0105], [0108]. The stylus is therefore receiving sensor data from the one or more sensors. See also limitations 1[a] and 1[c] above. Accordingly, Kremin discloses limitation 1[c1].
1[c2] receive a first signal generated by the device;	Kremin describes multiple embodiments in which the high-voltage signal of the stylus is generated by amplifying a signal originating from the sensing device. This aligns with the embodiment in FIG. 8 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].

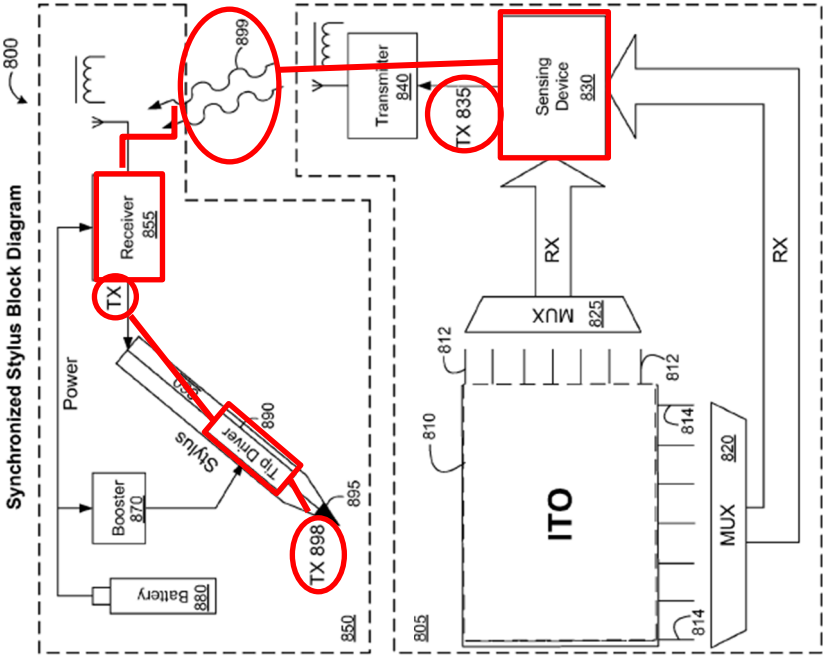


FIG. 8 of Kremin

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. Kremin, ¶ [0098]. The sensing device generates a TX pulse sequence (block 1110). In an embodiment, the TX pulse sequence is a pulse train of TX signals. *Id.* At block 1155, the carrier generator generates a carrier signal (e.g., 13.56 MHz RFID carrier frequency). *Id.* The AM modulator modulates the carrier signal (block 1135) with the TX pulse sequence generated at block 1110. *Id.* In other embodiments, the host device may implement other modulation schemes, as described in conjunction with FIG.9A. *Id.* A band pass filter filters the modulated TX signal (block 1140). *Id.* At block 1145, a matching network matches the impedance of the filter and antenna, and the transmit block wirelessly transmits the modulated TX signal to the stylus (block 1150). *Id.* The receiver block of the stylus wirelessly receives the modulated TX signal from the host device (block 1162). Kremin, ¶ [0099]. The amplifier block amplifies the modulated TX signal (block 1165), and the AM demodulator removes the carrier frequency from the TX signal (block 1170). *Id.*

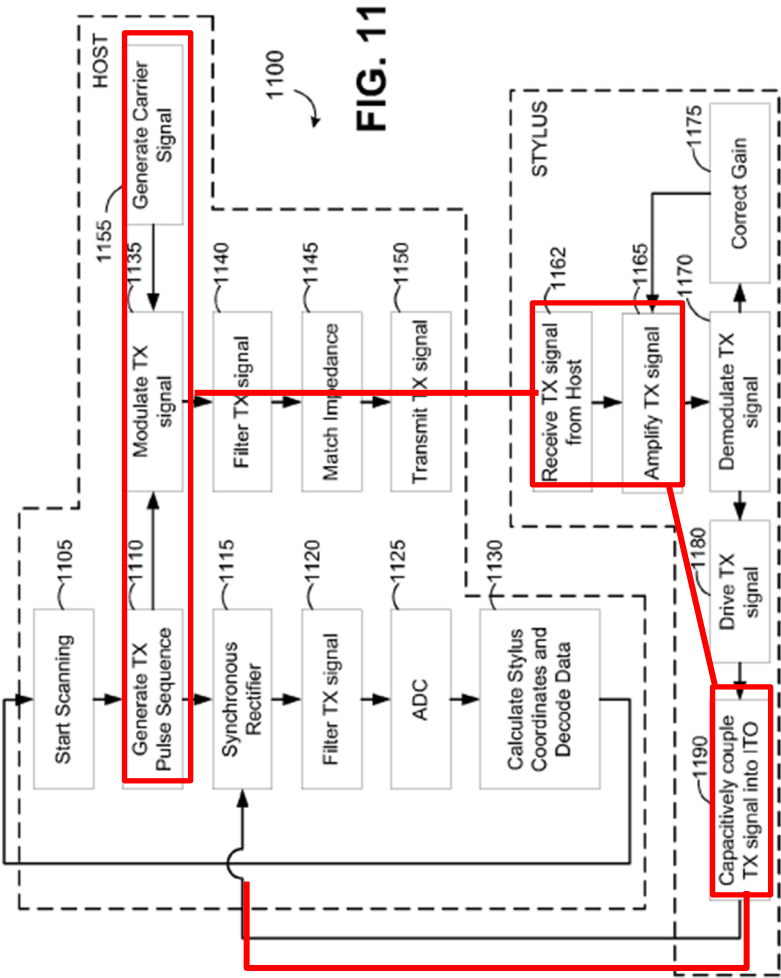


FIG. 11 of Kremin

As yet another example, Figure 13 of Kremin further shows that the stylus receives a signal from the touch screen device, and then it modulates it and transmits it. Specifically, this figure is a block diagram illustrating one embodiment of a stylus 1300 for synchronizing and modulating additional data into a stylus transmit signal 898. Kremin, ¶ [0104]. 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. *Id.* In one embodiment, the microcontroller block 1305 includes ADC 1320, CPU core 1330, buttons 1340 and 1341, synchronization and modulation block (“synch mod block”) 1350, and measurer 1370. *Id.* In an embodiment, the synch mod block 1350 is configured to modulate additional data into the TX signal 835. Kremin, ¶ [0105]. Kremin discloses that 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. *Id.* 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. Kremin, ¶ [0106]. 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. *Id.*

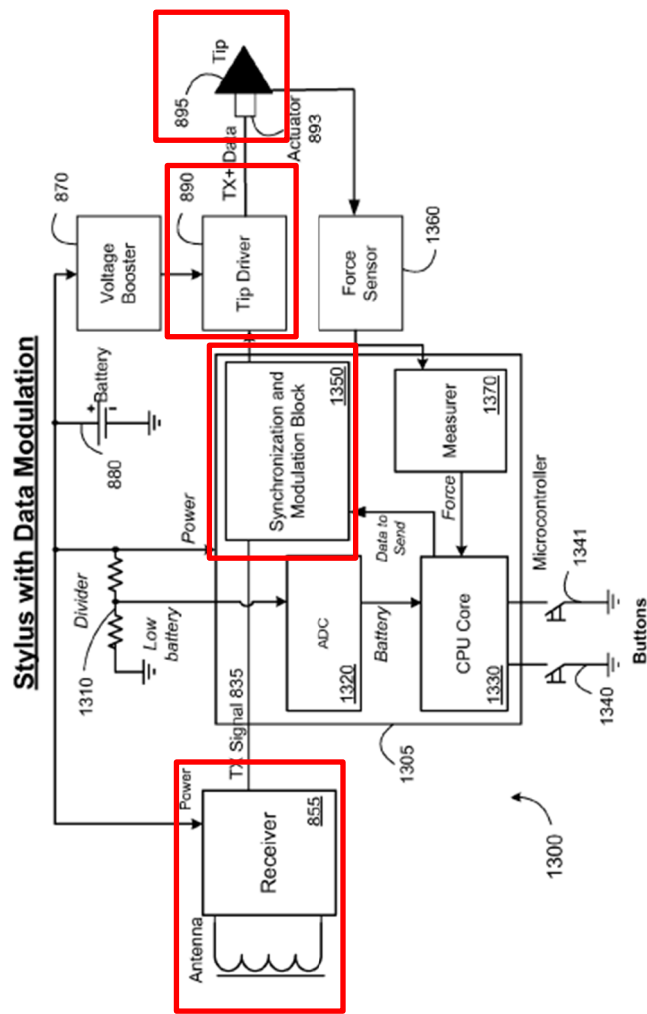


FIG. 13 of Kremin

Additionally, 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].

Therefore, Kremin discloses limitation 1[c2].

Claim 1	Example Disclosures in Prior Art
1[c3] generate a second signal by modulating a carrier signal based on the sensor data; and	Modulation can be defined as the “process of modifying some characteristic of a wave (called a carrier) so that it varies in step with the instantaneous value of another wave (called a modulating wave or signal)”, where “[t]he carrier can be a direct current, an alternating current (provided its frequency is above the highest frequency component in the modulating wave), or a series of regularly repeating, uniform pulses called a pulse chain (provided their repetition rate is at least twice that of the highest frequency to be transmitted)” ⁶ . Alternatively, it can be defined as “[t]he controlled variation of frequency, phase, and/or amplitude of a carrier wave of any frequency in order to transmit a message” ⁷ . It can further be defined as “[t]he process, or results of the process, whereby some characteristic of one signal is varied in accordance with another signal”, where “[t]he modulated signal is called the carrier and may be modulated in three fundamental ways: by varying the amplitude (amplitude modulation) by varying the frequency (frequency modulation) or by varying the phase (phase modulation)” ⁸ . Modulation can further be defined as “a process through which an information-bearing message (i.e., modulating) signal is used to modify (i.e., modulate) some parameter (e.g., amplitude, frequency, phase) of a periodic (such as a high-frequency sinusoidal) signal known as a carrier wave, individually or in combination, to produce the modulated signal for transmission” ⁹ . This “is similar to when a musician modulates a tone by varying its volume (amplitude), its timing (phase), and its pitch (frequency)” ¹⁰ . Thus, modulation varies a carrier signal based on the data to be transmitted and thus by necessity involves using a carrier signal.
1[c4] transmit to the device, in response to the first signal, the second signal, the sensor data being obtainable by demodulating the second signal.	Kremin discloses limitation 1[c3] for the reasons further discussed in Appendix B1.
1[c4] transmit to the device, in response to the first signal, the second signal, the sensor data being obtainable by demodulating the second signal.	Kremin discloses limitation 1[c4] for the reasons discussed in Appendix B1.
Claim 2	Example Disclosures in Prior Art
2. The stylus of claim 1, wherein the first signal is the carrier signal modulated to generate the second signal.	Kremin discloses “wherein the first signal is the carrier signal modulated to generate the second signal,” as in claim 2, for the reasons discussed in Appendix B1.
Claim 3	Example Disclosures in Prior Art

⁶ Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, pages 479-480 (Ex. 1016).

⁷ Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 480 (Ex. 1016).

⁸ Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 480 (Ex. 1016).

⁹ Ali Grami. Introduction to Digital Communications. Copyright © 2016 Elsevier Inc, page 34 (Ex. 1018).

¹⁰ Ali Grami. Introduction to Digital Communications. Copyright © 2016 Elsevier Inc, page 34 (Ex. 1018).

3. The stylus of claim 1, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.	See limitation 1 [c3] and Appendix B1. As described above, Kremin describes an embodiment where the synch mod block 1350 (in Figure 13) modulates by a non-exhaustive list of modulation schemes, including frequency modulation (“FM”), frequency-shift keying (“FSK”), amplitude modulation (AM), amplitude-shift keying (ASK), on-off keying (“OOK”), pulse position modulation, phase modulation (“PM), Manchester encoding, direct sequence spread spectrum (“DSSS), or other modulation schemes that would be appreciated by one of ordinary skill in the art. Kremin. ¶ [0110]. Kremin also discloses that “PM modulation may further include binary phase shift keying (“BPSK) or quadrature phase shift keying (“QPSK) encoding schemes which are further discussed below with respect to FIGS 15-18”. <i>Id.</i> ¶ [0115]. Other modulation schemes, including modulation by amplitude modulation, frequency modulation, and phase modulation, are claimed in Claims 4 and 14. Kremin ¶ [00110], Claims 4, 14. Accordingly, Kremin discloses Claim 3. Moreover, amplitude modulation, frequency modulation, and phase modulation are the three fundamental ways to perform modulation, and a person of ordinary skill in the art would know this” ¹¹ .
Claim 4	
4. The stylus of claim 1, wherein: the one or more sensors comprise a pressure sensor and a button; and the sensor data comprises pressure data and button state data.	Example Disclosures in Prior Art Kremin discloses and claims multiple types of sensors in multiple embodiments, including force sense data, battery data, acceleration data, and button status data. <i>See, e.g.</i> , Kremin at ¶ [0109] & Claims 1–4. Kremin discloses and claims a force sensor 1360 to detect the force applied to the stylus via the actuator 893 and tip 895, measured by the measurer 1370. Kremin at Claims 2-3, 11–13, ¶ [00109]. Kremin further discloses an embodiment includes a microcontroller block 1305 with buttons 1340, 1341, from which pushes are detected adding additional functionality such as a “left click” and “right click” function. <i>Id.</i> ¶¶ [00105], [00108]. Kremin therefore discloses a stylus where the specific sensors are force/pressure sensors and a button—a pair specifically illustrated in Figure 13. The additional data to be modulated into the signal is force data and button data, routed through the CPU core 1330 and sent to the synch mod block 1350. <i>Id.</i> ¶¶ [00105], [00109]. Figures 19A and 19B further describe how pairs of sensor data may be transmitted together or separately. <i>Id.</i> ¶¶ [0044]–[0045]. Kremin discloses claim 4.

¹¹ Rudolf F. Graf Boston. MODERN DICTIONARY of ELECTRONICS, SEVENTH EDITION, REVISED AND UPDATED, Published by Newnes, 1999, page 480 (Ex. 1016); Ali Grami. Introduction to Digital Communications. Copyright © 2016 Elsevier Inc, page 35 (Ex. 1018).

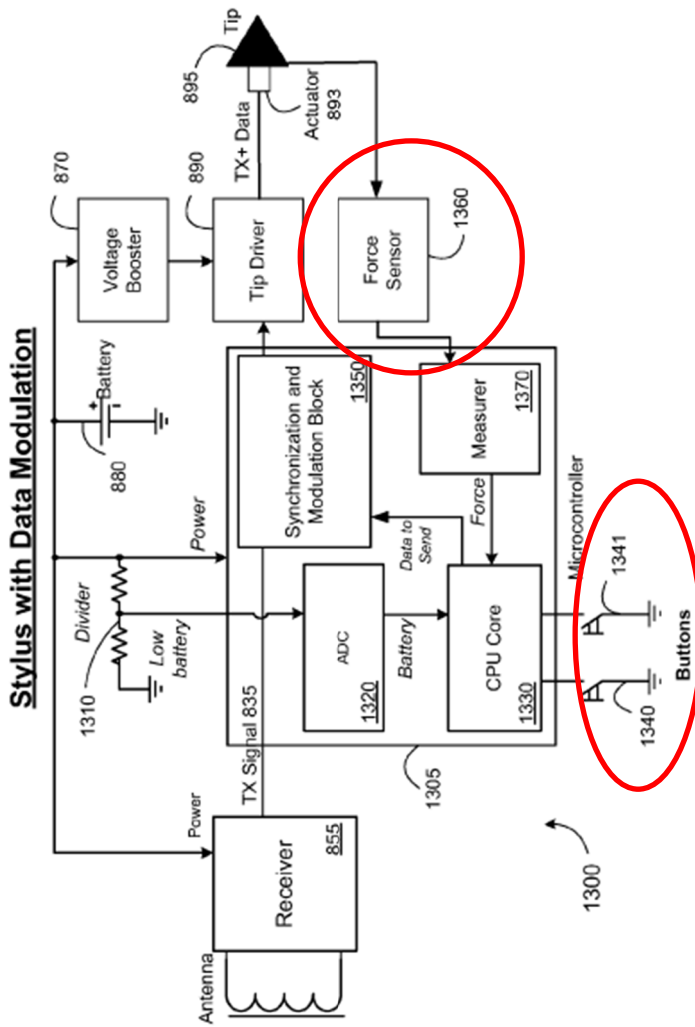


FIG. 13 of Kremin

Claim 5

5. The stylus of claim 1, wherein the sensor data is digital.

Example Disclosures in Prior Art

As discussed above, Kremin discloses and claims multiple types of sensors in multiple embodiments, including force sense data, battery data, acceleration data, and button status data. *See, e.g.*, Kremin at ¶ [0109] & Claims 1–4. Kremin discloses and claims a force sensor 1360 that may be either a passive sensor or an active sensor within the stylus, and a motion sensor to detect motion of the stylus. Kremin at Claims 2-3, 11–13, ¶ [0109]. Kremin further discloses that other methods may be used to quantitatively determine and digitize a force applied to stylus, and a person of ordinary skill in the art would accordingly appreciate that the force measurements are necessarily digitized when output as sensor data. *Id.*

Additionally, the data from the buttons 1341 and force sensor 1360 redirect through the CPU core 1330. A person of ordinary skill in the art would understand that to do so, the data would need to be digitized: a CPU can only process digital data, that is, binary discrete values of 0s and 1s. A CPU cannot process analog data, which is continuous. Accordingly, all sensor data must be digital by nature. Where it is not digital, an analog-to-digital converter (ADC) 1320 is necessary, as depicted in Figure 13, which would result in sensor data being digital.

Kremin specifically claims a stylus including ADC for representing the battery status, as embodied in Figure 13. Kremin Claim 8, ¶ [00100]. Specifically, it discloses an embodiment where voltage indicating battery status is processed by the ADC and turned into digital data to be processed by the CPU 1330. *Id.* ¶¶ [00107]. A person of ordinary skill in the art would appreciate that unless specified as analog, many of these forms of information—force data, battery level, etc.—are either already digital or would need to be adapted in the ADC to be processed by the CPU, which is a necessary step before the data can be modulated into a signal.

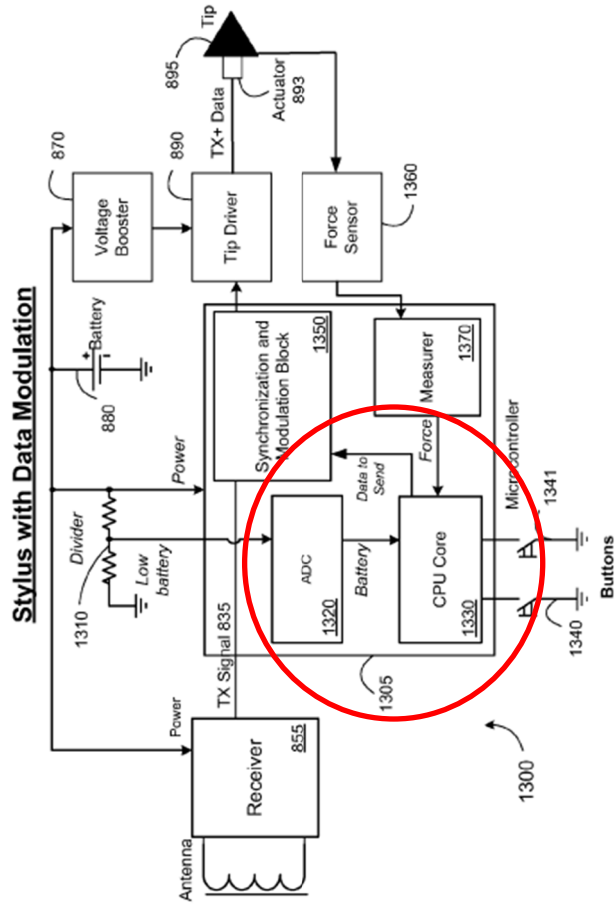


FIG. 13 of Kremin

Furthermore, since Kremin explicitly discloses digitizing at least the force and battery data, a person of ordinary skill in the art would understand that all other sensor data must be handled in the same way so that they can be encoded in the stylus transmit signal. Kremin at ¶ [0109].

	Claim 7
	7[pre] One or more computer-readable non-transitory storage media embodying logic that is operable when executed to:

Claim 7		Example Disclosures in Prior Art
7[a] receive sensor data from one or more sensors in or on a stylus, the stylus comprising one or more electrodes configured to communicate with a device by receiving signal from and transmitting signals to a touch sensor of the device;		See limitations 1[b] and 1[c1] above.
7[b] receive a first signal generated by the device;		See limitation 1[c2] above.
7[c] generate a second signal by modulating a carrier signal based on the sensor data; and		See limitation 1[c3] above.
7[d] transmit to the device, in response to the first signal, the second signal, the sensor data being obtainable by demodulating the second signal.		See limitation 1[c4].

Claim 8		Example Disclosures in Prior Art
8. The media of claim 7, wherein the first signal is the carrier signal modulated to generate the second signal.		See claim 2 above.

Claim 9		Example Disclosures in Prior Art
9. The media of claim 7, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.		See claim 3 above.

Claim 10		Example Disclosures in Prior Art
10. The media of claim 7, wherein: the one or more sensors comprise a pressure sensor and a button; and the sensor data comprises pressure data and button state data.		See claim 4 above.

Claim 11		Example Disclosures in Prior Art
11. The media of claim 7, wherein the sensor data is digital.		See claim 5 above.

Claim 13	Example Disclosures in Prior Art
<p>13[pre] A system comprising:</p>	<p>To the extent the preamble is considered limiting, Kremin discloses an electronic system 300 having a processing device 310, touch screen 325, and touch sensor pad 320 for detecting the presence of a touch object 340 and a stylus 330, laid out in Figure 3. Kremin ¶ [0051]. Kremin discloses 13[pre].</p>
<p>13[a] a device comprising a touch sensor; and</p>	<p>As shown in Figure 3 above, the device of the system 300 of Kremin includes a touch screen 325 with a touch sensor pad 320. Kremin ¶ [0051].</p>
<p>13[b] a stylus comprising:</p>	<p>See limitation 1[pre] above.</p>
<p>13[b1] one or more sensors;</p>	<p>See limitation 1[a] above.</p>
<p>13[b2] one or more electrodes configured to communicate with a device by receiving signals from and transmitting signals to a touch sensor of the device; and</p>	<p>See limitation 1[b].</p>

Claim 13		Example Disclosures in Prior Art
13[b3] one or more computer-readable non-transitory storage media embodying logic that is operable when executed to:		See limitation 1[c] above.
13[b3A] receive sensor data from the one or more sensors;		See limitation 1[c1] above.
13[b3B] receive a first signal generated by the device;		See limitation 1[c2].
13[b3C] generate a second signal by modulating a carrier signal based on the sensor data; and		See limitation 1[c3] above.
13[b3D] transmit to the device, in response to the first signal, the second signal, the device being operable to obtain the sensor data by demodulating the second signal.		See limitation 1[c4] above.
Claim 14		Example Disclosures in Prior Art
14. The system of claim 13, wherein the first signal is the carrier signal modulated to generate the second signal.		
Claim 15		Example Disclosures in Prior Art
15. The system of claim 13, wherein the second signal is generated using one of: amplitude modulation; frequency modulation; and phase modulation.		
Claim 16		Example Disclosures in Prior Art
16. The system of claim 13, wherein:		See claim 4 above.

the one or more sensors comprise a pressure sensor and a button; and the sensor data comprises pressure data and button state data.	
Claim 17	Example Disclosures in Prior Art
17. The system of claim 13, wherein the sensor data is digital.	<i>See claim 5 above.</i>