CLAIMS

What is claimed is:

1. A method for using an active stylus to enable determination of a two-dimensional position of the active stylus relative to a capacitive touch sensor, wherein the capacitive touch sensor has a two-dimensional matrix of conductors configured as a first array of conductors arranged in rows and a second array of conductors arranged in columns, and wherein the active stylus has an electrode and active components, the method comprising:

receiving a first signal in the active stylus from at least one of the columns in the matrix;

measuring a signal strength of each first signal received from the columns;

using the measured signal strengths to calculate a first position of the active stylus along a first axis of the matrix of the capacitive touch sensor at the active stylus, wherein the active stylus is configured to determine the first position along the first axis of the matrix based on the received first signal;

transmitting the calculated first position of the active stylus along the first axis of the matrix of the capacitive touch sensor in a timeslot allocated for transmitting the calculated first position from the active stylus;

transmitting a second signal from the electrode of the active stylus to at least one of the rows of the matrix to indicate the~~a~~ second position of the active stylus along a second axis of the matrix, wherein the capacitive touch sensor is configured to determine the second position along the second axis of the matrix based on the received second signal, and wherein the capacitive touch sensor is configured to process the transmitted first position and the determined second position to determine the two-dimensional position of the active stylus relative to the capacitive touch sensor,

wherein the electrode is located within the active stylus and is configured to electrostatically couple with the capacitive touch sensor, and

wherein the electrode of the active stylus is configured to both receive and transmit signals.

2. The method of claim 1, further comprising, prior to receiving the first signal in the active stylus or transmitting the second signal, receiving a third signal in the active stylus from the capacitive touch sensor to synchronize a time base of the active stylus with a time base of the capacitive touch sensor.

3. The method of claim 2, wherein the third signal for synchronization is received in the active stylus through a communication channel.

4. The method of claim 3, wherein the communication channel comprises a wireless communication channel, an ultrasonic channel, or an optical channel.

5. The method of claim 2, wherein the communication channel is configured to receive or transmit information related to at least one of the active stylus or the capacitive touch sensor.

6. The method of claim 2, wherein the third signal is received from at least one of the columns in the second ~~first~~ array of conductors ~~columns~~, wherein the third signal is received in the active stylus through the electrode at least at the one column.

7. The method of claim 6, wherein the third signal is received from a pulse that is simultaneously transmitted on multiple columns in the second ~~first~~ array of conductors ~~columns~~.

8. The method of claim 2, wherein the third signal is received once per time frame.

9. The method of claim 8, wherein the time frame comprises a timeslot allocated for the third signal to be received by the stylus.

10. The method of claim 8, wherein the time frame comprises a timeslot allocated for each of the columns to transmit the first signal from the capacitive touch sensor.

11. The method of claim 8, wherein the time frame comprises the~~a~~ timeslot allocated for transmitting the calculated first position from the active stylus, and wherein none of the columns transmit a signal during the timeslot allocated for transmitting the calculated first position from the active stylus.

12. The method of claim 8, wherein the time frame comprises a timeslot allocated for each of multiple active styluses to transmit a respective first position.

13. The method of claim 1, wherein the transmission of the calculated first position from the active stylus is configured to occur through a communication channel.

14. The method of claim 13, wherein the communication channel comprises a wireless channel, an ultrasonic channel, or an optical channel.

15. The method of claim 1, wherein the transmission of the calculated first position from the active stylus is configured to occur through electrostatic coupling of the electrode of the active stylus to the matrix during the timeslot allocated for transmitting the calculated first position, wherein at least one of the rows is configured to receive the calculated first position from the electrode of the active stylus.

16. The method of claim 1, wherein the transmissions of the active stylus are configured to occur simultaneously with multiple transmissions of other active styluses or columns utilizing multiple orthogonal waveforms.

17. The method of claim 1, wherein the transmissions of the active stylus are configured to occur with multiple transmissions of other active styluses or columns utilizing simultaneous multiple frequency-divided signals.

18. The method of claim 1, wherein the transmissions of the active stylus are configured to occur with multiple transmissions of other active styluses or columns utilizing simultaneous multiple code-divided signals.

19. The method of claim 1, further comprising interpolating to compute the first and second positions of the active stylus.

20. The method of claim 1, wherein the active stylus comprises:

a switch coupled with the electrode that is configured for multiplexing a relatively large voltage and a relatively small current, wherein the switch is configured for transmitting a voltage onto the electrode in a transmission mode, and for receiving a current from the electrode in a receiving mode;

a receiver circuit for the current that is coupled to the switch to receive at least part of the current through the switch, from the electrode;

a transmitter circuit for the voltage that is coupled to the switch to transmit at least part of the voltage through the switch, onto the electrode;

a microcontroller coupled to the receiver and the transmitter circuits; and

an internal power source to provide power to at least the microcontroller.

21. The method of claim 20, wherein the microcontroller is configured to:

compute coordinate positions of the active stylus with respect to the locations on the capacitive touch sensor, and

report at least some of the coordinate positions from the active stylus.

22. The method of claim 21, wherein the microcontroller is further configured to interpolate to compute the coordinate positions of the active stylus.

23. The method of claim 20, wherein the active stylus further comprises a communication channel, wherein the communication channel comprises a wireless channel, an ultrasonic channel, or an optical channel.

24. The method of claim 20, wherein the internal power source comprises a battery or a supercapacitor.

25. The method of claim 20, wherein the current is on the order of one microamp, and wherein the voltage is on the order of one hundred volts.

26. The method of claim 1, wherein the active stylus comprise a tip that is configured to interact with the matrix of the capacitive touch sensor, wherein the tip of the stylus comprises a force sensor for providing a measurement of force though the stylus.

27. A method for using a capacitive touch sensor to enable determination of a two-dimensional position of an active stylus with respect to the capacitive touch sensor, where the capacitive touch sensor has a two-dimensional matrix of conductors configured as a first array of conductors arranged in rows and a second array of conductors arranged in columns, and where the active stylus has an electrode and active components, the method comprising:

transmitting a first signal from at least one of the columns in the matrix to the active stylus for indicating a first position of the active stylus along a first axis of the matrix of the capacitive touch sensor, wherein the active stylus is configured to determine the first position along the first axis of the matrix based on the transmitted first signal, and wherein the active stylus is configured to communicate the determined first position back to the capacitive touch sensor in a predetermined timeslot allocated for communicating the first position;

receiving a second signal from the electrode of the active stylus at one or more of the rows of the matrix to indicate a second position of the active stylus along a second axis of the matrix, wherein the capacitive touch sensor is configured to

determine the second position along the second axis of the matrix based on the received second signal, and wherein the capacitive touch sensor is further configured to process the communicated first position in the predetermined timeslot and the determined second position to determine the two-dimensional position of the active stylus, and

wherein the capacitive touch sensor is configured to electrostatically couple with the electrode located within the active stylus.

28. The method of claim 27, further comprising, prior to transmitting the first signal or receiving the second signal, transmitting a third signal to the active stylus from the capacitive touch sensor to synchronize a time base of the active stylus with a time base of the capacitive touch sensor.

29. The method of claim 28, wherein the third signal is transmitted from at least one of the columns in the second ~~first~~ array of conductors ~~columns~~ to the active stylus through the electrode.

30. The method of claim 28, wherein the third signal is transmitted with a pulse that is simultaneously transmitted from multiple columns in the second ~~first~~ array of conductors~~columns~~.

31. The method of claim 30, wherein the third signal is transmitted once per time frame.

32. The method of claim 31, wherein the time frame comprises a timeslot allocated for the third signal to be transmitted to the stylus.

33. The method of claim 31, wherein the time frame comprises a timeslot allocated for each of the columns to transmit the first signal from the capacitive touch sensor.

34. The method of claim 31, wherein the time frame comprises a timeslot allocated for each of multiple active styluses to transmit a second signal used to determine that stylus's position along the second axis.

35. The method of claim 27, the method further comprising receiving a calculated first position of the active stylus along the first axis of the matrix of the capacitive touch sensor during the predetermined timeslot allocated for communicating the first position, wherein the receiving of the calculated first position from the active stylus is configured to occur through electrostatic coupling of the electrode of the active stylus to the matrix, wherein at least one of the rows is configured to receive the calculated first position from the electrode of the active stylus during the predetermined timeslot.

~~36. An active stylus configured to operate with a capacitive touch sensor, the active stylus comprising:~~

~~an electrode configured to both receive and transmit signals, and configured to electrostatically couple with the capacitive touch sensor;~~

~~a switch, coupled with the electrode, that is configured to multiplex a relatively large voltage and a relatively small current, wherein the switch is configured to transmit a voltage to the electrode in a transmission mode, and to receive a current from the electrode in a receiving mode;~~

~~means for receiving current from the electrode through the switch, and for transmitting voltage that is coupled through the switch to the electrode;~~

~~a microcontroller coupled to the receiver and the transmitter circuits and configured to determine at least one position of the active stylus with respect to locations on the capacitive touch sensor; and~~

~~an internal power source to provide power to at least the microcontroller.~~

~~37. The active stylus of claim 36, wherein the microcontroller is configured to:~~

~~compute coordinate positions of the active stylus with respect to the locations on the capacitive touch sensor, and~~

~~report at least some of the coordinate positions from the active stylus.~~

~~38. The active stylus of claim 36, wherein the microcontroller is further configured to interpolate when computing the coordinate positions of the active stylus.~~

~~39. The active stylus of claim 36, wherein the active stylus further comprises a communication channel, wherein the communication channel comprises a wireless channel, an ultrasonic channel, or an optical channel.~~

~~40. The active stylus of claim 36, wherein the internal power source comprises a battery or a supercapacitor.~~

~~41. The active stylus of claim 36, wherein the current is on the order of one microamp, and wherein the voltage is on the order of one hundred volts.~~

~~42. An active stylus configured to operate with a capacitive touch sensor, the active stylus comprising:~~

~~an electrode configured to both receive and transmit signals, and configured to electrostatically couple with the capacitive touch sensor;~~

~~a switch, coupled with the electrode, that is configured to multiplex a relatively large voltage and a relatively small current, wherein the switch is configured to transmit a voltage to the electrode in a transmission mode, and to receive a current from the electrode in a receiving mode;~~

~~a receiver circuit for receiving current from the electrode through the switch;~~

~~a transmitter circuit for transmitting voltage that is coupled through the switch to the electrode;~~

~~a microcontroller coupled to the receiver and the transmitter circuits and configured to determine at least one position of the active stylus with respect to locations on the capacitive touch sensor; and~~

~~an internal power source to provide power to at least the microcontroller.~~

3643. A capacitive touch sensor configured to enable determination of a two-dimensional position of an active stylus with respect to the capacitive touch sensor, where the active stylus has an electrode and active components, the capacitive touch sensor comprising:

a two-dimensional matrix of conductors configured to include:

a first array of conductors arranged in rows;

a second array of conductors arranged in columns;

transmitters coupled to the second array of conductors, the transmitters being configured to transmit a first signal from at least one of the columns in the matrix to the active stylus while the active stylus operates in a receive mode, the transmitted first signal processed at the active stylus to determine for indicating a first position of the active stylus along a first axis of the matrix of the capacitive touch sensor; wherein and

the active stylus is configured to determine and communicate to the capacitive touch sensor the first position along the first axis of the matrix in a timeslot allocated for communication of the first position that is determined based on the transmitted first signal; and

receivers coupled to the first array of conductors, the receivers being configured to receive a second signal from the electrode of the active stylus at one or more of the rows of the matrix while the active stylus operates in a transmit mode, the second signal received indicating to indicate a second position of the active stylus along a second axis of the matrix,

wherein:

the capacitive touch sensor is configured to determine the second position along the second axis of the matrix based on the received second signal, and

the capacitive touch sensor is configured to process the first position communicated in the timeslot allocated for communication of the first position and the second position to determine a two-dimensional position of the active stylus relative to the capacitive touch sensor, and

the capacitive touch sensor is configured to electrostatically couple with the electrode located within the active stylus.

3744. A capacitive touch sensor configured to enable determination of a two-dimensional position of an active stylus with respect to the capacitive touch sensor, where the active stylus has an electrode and active components, the capacitive touch sensor comprising:

a two-dimensional matrix of conductors configured to include:

a first array of conductors arranged in rows;

a second array of conductors arranged in columns; and

means for transmitting a first signal from at least one of the columns in the matrix to the active stylus while the active stylus operates in a receive mode to indicate for indicating a first position of the active stylus along a first axis of the matrix of the capacitive touch sensor, and receiving a second signal from the electrode of the active stylus at one or more of the rows of the matrix while the active stylus operates in a transmit mode to indicate a second position of the active stylus along a second axis of the matrix,

wherein:

the active stylus is configured to determine the first position along the first axis of the matrix based on the received first signal and to communicate the first position to the capacitive touch sensor through an auxiliary channel comprising at least one of a wireless communication channel, an ultrasonic channel, and an optical channel,

the capacitive touch sensor is configured to determine the second position along the second axis of the matrix based on the received second signal and to receive the first position communicated through the auxiliary channel, wherein and

the capacitive touch sensor is configured to process the first position received through the auxiliary channel and the determined second position to determine the two-dimensional position of the active stylus, and

the capacitive touch sensor is configured to electrostatically couple with the electrode located within the active stylus.