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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
61/407,907	10/28/2010		220	CD10084P		

CONFIRMATION NO. 6876

60909
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE, CA 95134-1709

FILING RECEIPT



OC000000044575149

Date Mailed: 11/19/2010

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If Required, Foreign Filing License Granted: 11/18/2010

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 61/407,907**

Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No

Title

Stylus with Force Sensing

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page 1 of 3

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	CD10084P
		Application Number	
Title of Invention	Stylus with Force Sensing		
<p>The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.</p> <p>This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.</p>			

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	CD10084P
		Application Number	
Title of Invention	Stylus with Force Sensing		

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Customer Number	60909
Petitioner Shenzhen Qianfenyi Intelligent Technology Co., Ltd.	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	CD10084P
		Application Number	
Title of Invention	Stylus with Force Sensing		
Email Address	larz@cypress.com	<input type="button" value="Add Email"/>	<input type="button" value="Remove Email"/>

Application Information:

Title of the Invention	Stylus with Force Sensing		
Attorney Docket Number	CD10084P	Small Entity Status Claimed	☐
Application Type	Provisional		
Subject Matter	Utility		
Suggested Class (if any)		Sub Class (if any)	
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)		Suggested Figure for Publication (if any)	

Publication Information:

☐	Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☒	Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

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Customer Number	60909		

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	CD10084P
		Application Number	
Title of Invention	Stylus with Force Sensing		

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Application Number	Country ⁱ	Parent Filing Date (YYYY-MM-DD)	Priority Claimed
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Assignee ¹			Remove
If the Assignee is an Organization check here. ☒			
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Phone Number	408-545-7194	Fax Number	408-545-6911
Email Address	larz@cypress.com		
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Signature	/Larry Johnson/		Date (YYYY-MM-DD)	2010-10-28
First Name	Larry	Last Name	Johnson	Registration Number
				56861

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CYPRESS SEMICONDUCTOR INVENTION DISCLOSURE FORM

GENERAL PURPOSE OF INVENTION

The use of stylus with touchscreens is well established, but all existing technologies have disadvantages of cost, performance and/or reliability.

Resistive touchscreens are well suited to the use of a passive stylus. The original Palm Pilots from the mid-1990s were one of the first devices with a resistive touchscreen designed for use with a stylus, and helped to popularize that technology. However, resistive touchscreens have many disadvantages, and are increasingly being replaced by capacitive touchscreens.

Capacitive touchscreens can support the use of a passive stylus, but the minimum stylus tip size (~5mm) that can be supported by current sensing technology is much larger than the pen-like tip (eg 1mm) desired in many applications.

Various tethered active stylus approaches have been deployed for use with capacitive touchscreens, and these are in use in applications such as point-of-sale terminals (eg the signature pad used for credit card transactions in larger retail stores) and other "public" uses. However, the need for cable is a significant drawback for "private" applications such as tablet PCs, Smartphones and "Slates" (such as the iPad). The technology used in tethered applications falls broadly into 2 categories:

- Inductive. In this case, the stylus sensing is implemented largely independently of the finger-sensing capability of the touchscreen. Typically, an AC signal is generated and fed to the tip of the stylus, and sensors behind or around the display receive the signal; the relative magnitude of the received signal at each of the sensors is then used to interpolate the position of the stylus tip.
- Electrostatic. An electrostatic field is generated at the tip of the stylus which is detectable by a self-capacitance touchscreen, as if the stylus tip were larger than it actually is. In effect, the electrostatic field is used to magnify the effective size of the stylus tip as detected by the self-capacitance sensing touchscreen system.

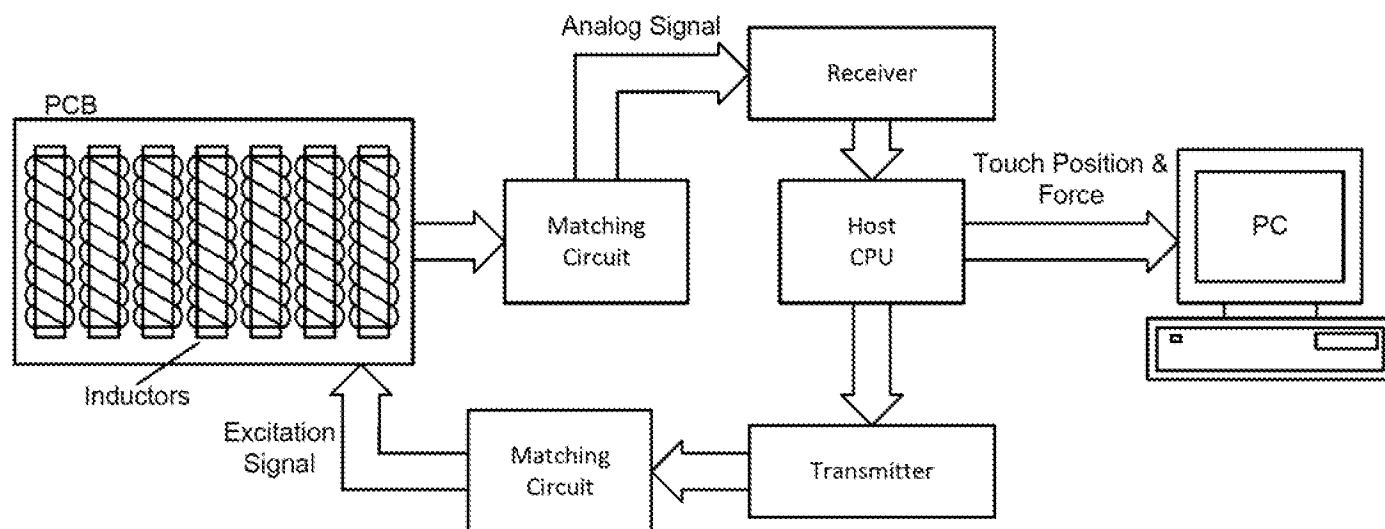
In order to meet the performance requirements demanded by the latest applications, touchscreens are rapidly migrating to mutual capacitance sensing – or a combination of self and mutual capacitance sensing (on which Cypress has patent applications pending).

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PREVIOUS SOLUTIONS

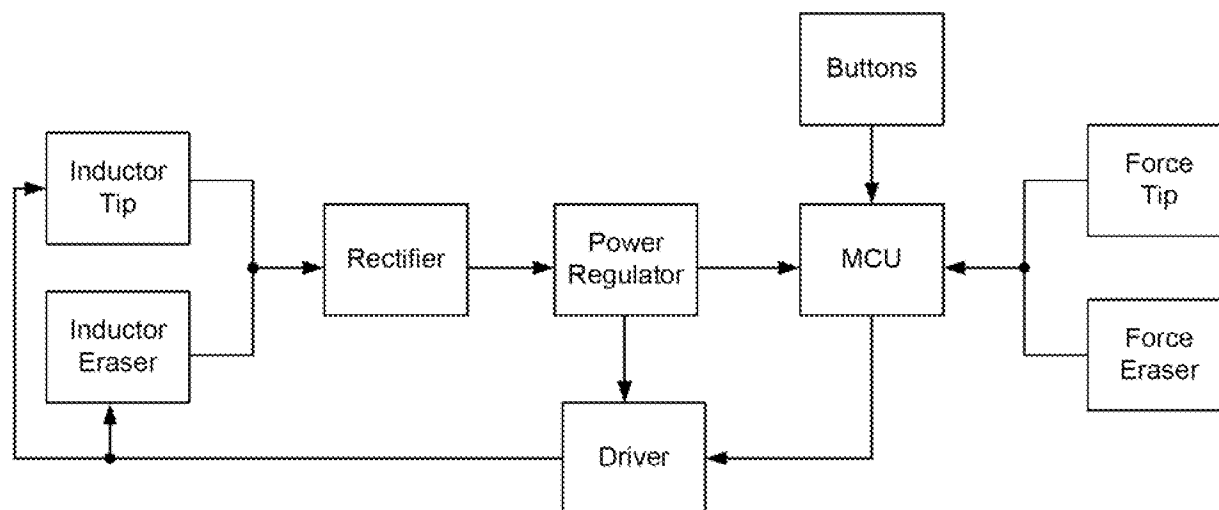
There are two known competitor solutions from Wacom and N-Trig. The Wacom host controller block diagram is shown on Figure 1. The Wacom stylus block diagram is shown on Figure 2.

Figure 1 Wacom Host Block Diagram



The Wacom stylus uses magnetic field for stylus powering and touch position detection. The touch position is calculated based on inductors signals relations. The stylus presence close to some inductors changes its currents. The maximum changes indicate touch position. The inductors are placed behind the screen on the PCB. These inductors are connected to amplifier output and provide the energy for stylus operation. The high frequency carrier are received and on stylus side and is used for self-powering and data transmitting.

Figure 2 Wacom Stylus Block Diagram



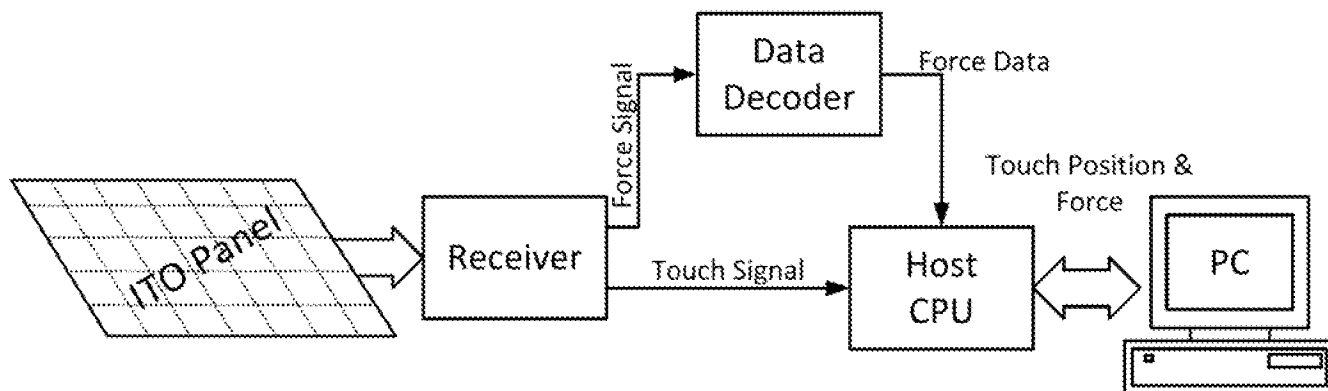
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Energy from the inductors comes to rectifier and power regulator. The regulator output voltage is 3.3V. These voltage feeds to microcontroller and invertors. The microcontroller measures force sensors and buttons states and send it back trough inductor. There are capacitors and jumpers on the board and the inductors are manually tuned to resonance on factory. The two inductors on different stylus edges provide enough power in both drawing and erase modes.

The Wacom solution has serious disadvantages as high power consumption, high EMI radiation, and expensive construction.

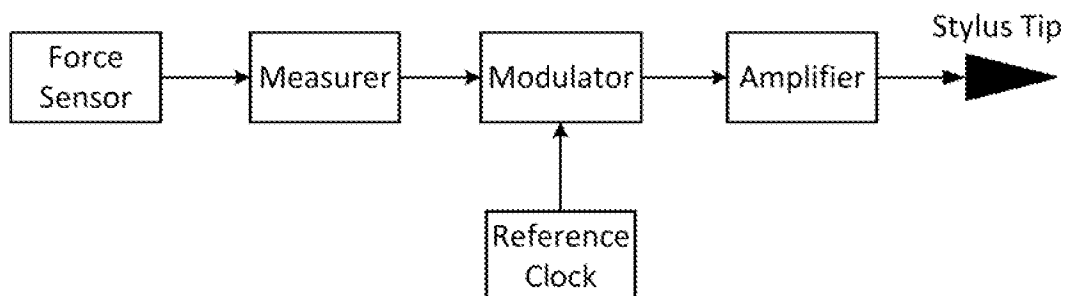
The N-Trig host block diagram is shown on Figure 3. The N-Trig stylus block diagram is shown on Figure 4.

Figure 3 N-Trig Host Block Diagram



The ITO sensors are connected to the selective receiver. The ITO line with maximum received signal is stylus position. The stylus generates carrier frequency that amplified and supplied to ITO panel via stylus tip. The signal maximum is touch position. The force data are transmitted by carrier frequency modulation. The received signal is decoded on host side and transmits to PC. The stylus is powered from battery.

Figure 4 N-Trig Stylus Block Diagram



The N-Trig solution has advantages as simplicity and potentially robust operation. The disadvantages are special narrow band receiver and RF noise immunity.

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INDICATE THE DISADVANTAGES OF THE OLD TECHNOLOGY

The disadvantages of Wacom technology are:

- High Power Consumption
- Expensive Construction
- High EMI radiation

The disadvantages of N-trig technology are:

- Narrow band receiver required
- Potential RF noise problem

INVENTION DESCRIPTION

The synchronization channel was caused using Indium as receiver for the stylus signals. Indium multi-channel receiver is based on the synchronous detector technique, which requires presence of the reference demodulation signal. This means the demodulator and input signals should be frequency and phase aligned. Indium does not contain the quadrature receiver and does not allow implementing narrow-band receiver in other ways.

If stylus + palm rejection is required for ITO design then stylus should be active. It means that TX signal should be supplied to stylus tip, not to ITO panel. The Cypress chip Indium that is used for ITO panel scanning utilizes complicated TX signal shape. The tethered stylus is old-fashion solution therefore the TX signal should be transmitted to stylus using wireless technology.

There are several ways of TX signal transmitting. It is Radio link or inductive link, optical or ultrasound link. The transmitter modulates high frequency carrier (433MHz, 900MHz, 2.4GHz) by TX signal. The radio receiver on stylus side recovers the TX signal and supply to stylus tip after some amplification. The radio link is simple, robust and well known method with one serious disadvantage only. The receiver consumes a lot of power that limits build-in battery life.

The Inductive coupling between host and stylus allows building low power receiver due to higher than in radio input signal value. The main difference between radio and inductive technology is antenna construction and operation frequency. The inductive coupled stylus typically used lower RFID frequencies that don't require licensing.

The synchronized stylus block diagram is shown on Figure 5. The sensing device listening entire ITO panel and generates one TX signal. This signal goes to transmitter that can be radio, inductive way, optical or any other known communication channel. The received TX signal goes to high voltage tip driver. The one or two cells alkaline batteries voltage is too low for tip driver. Low tip voltage can't provide hover touch. The booster increase voltage up to 10V...20V that provides high stylus touch signal.

Figure 5 Synchronized Stylus Block Diagram

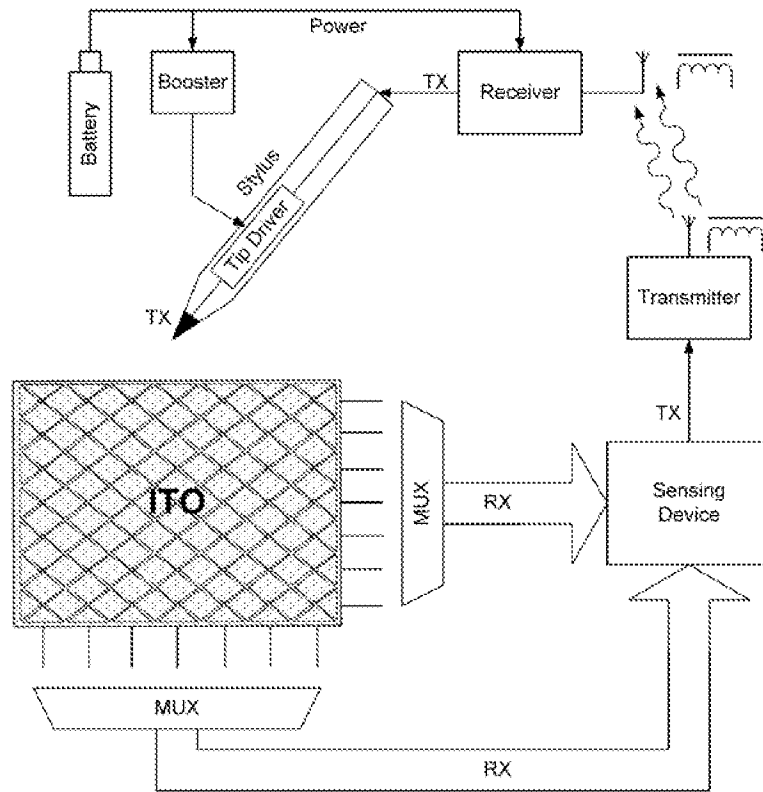
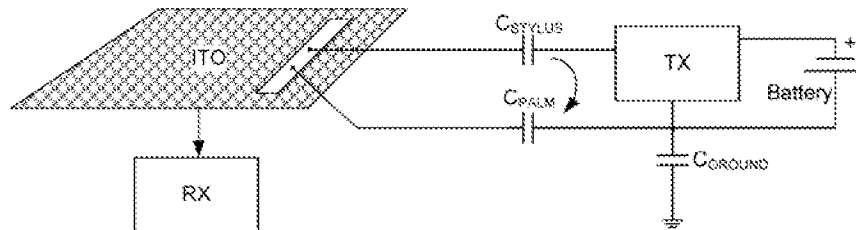


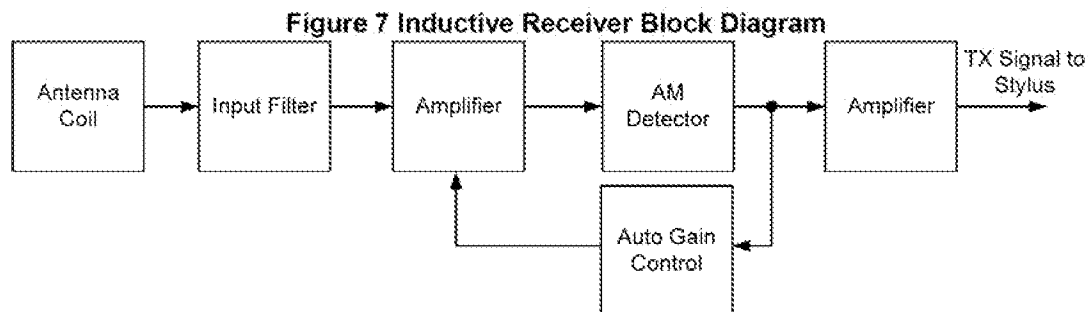
Figure 6 Palm Influence Mechanism



The palm influence is described in Figure 6. The human body is connected to ground via some capacitance C_{ground} . It means that palm is not really grounded and always has some TX potential too. This potential causes small signal changes when hand is on the panel, Figure 5. The capacitance C_{palm} changes when palm is on the panel or in the air. The palm influence in hover mode (in the air) is zero. If palm touch the panel then palm influence depends on C_{stylus} to C_{palm} relation. Physically the palm is much bigger then the stylus so the capacitances relation will be close to zero. It means that the malp influence is close to zero too.

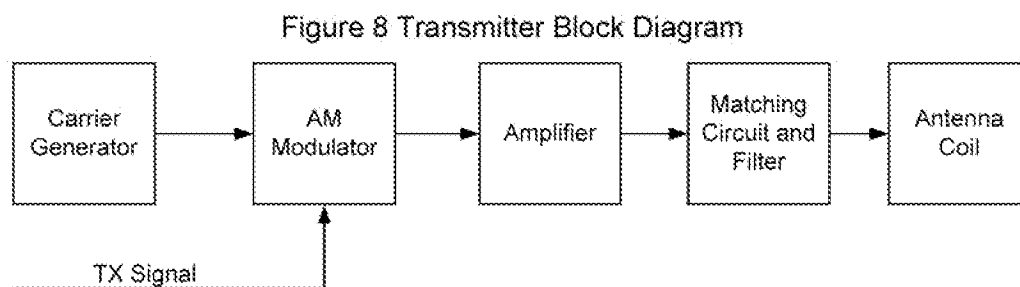
CYPRESS SEMICONDUCTOR INVENTION DISCLOSURE FORM

The Inductive receiver block diagram is shown on Figure 7



The magnetic antenna receives very weak AM modulated signal. This signal is filtered from noise and amplified to level that is enough for amplitude detector. The detected signal is amplified to logical levels and goes to receiver output. Also the detected signal is used for auto gain control loop that provides constant output signal amplitude for wide input signal voltage range.

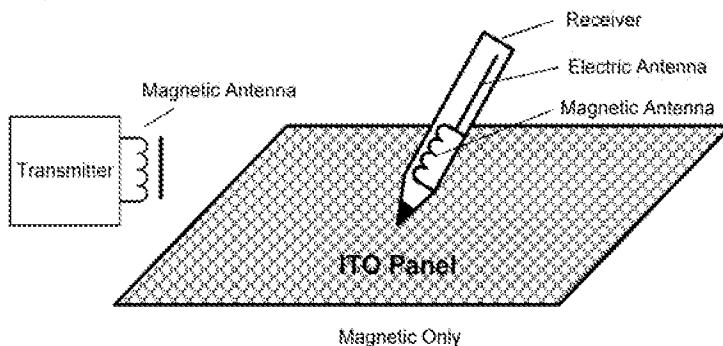
The transmitter Block Diagram is shown on Figure 8.



The oscillator generates carrier frequency much higher than modulated TX signal frequency. The modulated signal is amplified and filtered for unnecessary harmonics removing. And after filtering the Carrier + TX signal going to transmitter coil.

There are different possible Transmitter coil antennas constructions for inductive stylus. First antenna is small inductor the same as on the stylus, Figure 9. It is worsted case. The maximum distance to transmitter is 10cm (4") only. But this is very compact antenna that doesn't require panel reworking.

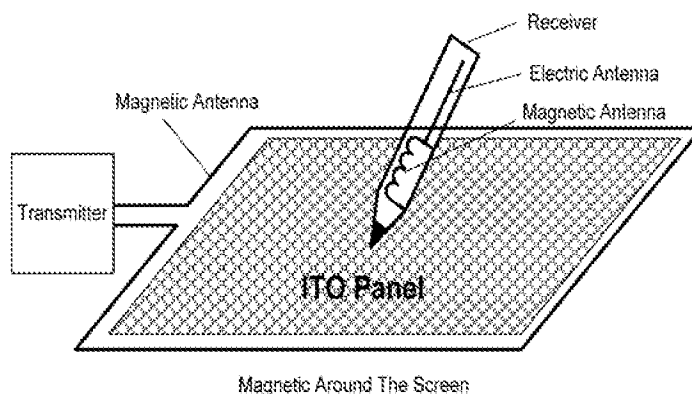
Figure 9 Use Small Coil as Transmitter Antenna



The second antenna is coil around the screen, Figure 10. In this case the stylus to transmitter distance can be up to 20cm (8") that is enough for 15" screens. But antenna signal can affect to RX lines and increase noise. Also, Antenna increases screen border that is disadvantage too.

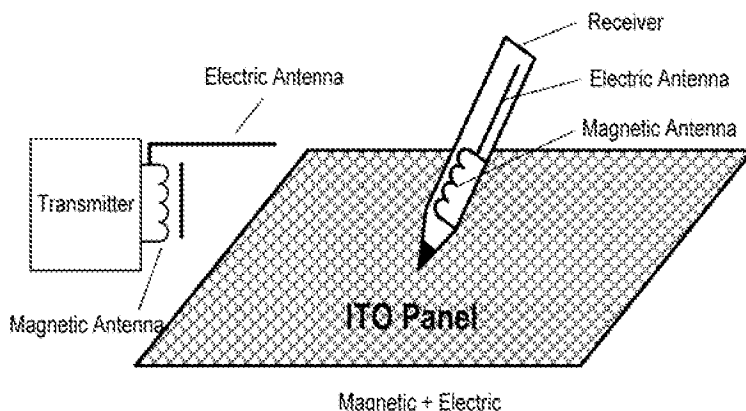
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Figure 10 Use a Coil around the Panel as Antenna



The third antenna is small inductor on the board plus 10cm long wire close to the screen border, Figure 11. The operation distance is the same as in previous case. The electric antenna can be implemented on PCB that doesn't require display construction changes.

Figure 11 Use Electric and Magnetic Antennas



THE ITO PANEL USAGE FOR THE SYNCHRONIZATION SIGNAL CAPACITIVE TRANSMISSION

The typical operation frequencies for the ITO panel are 100...500kHz. The ITO panel could be used for the higher frequency signals transmission between stylus and host device using capacitive coupling between stylus and panel, no additional magnetic antenna is needed.

The following options could be identified:

- Use ITO panel electrodes for the capacitive high-frequency modulated carrier signal transmission from host to stylus.
- Use ITO panel electrodes for the capacitive coupling the high-frequency modulated carrier signal from stylus to host.

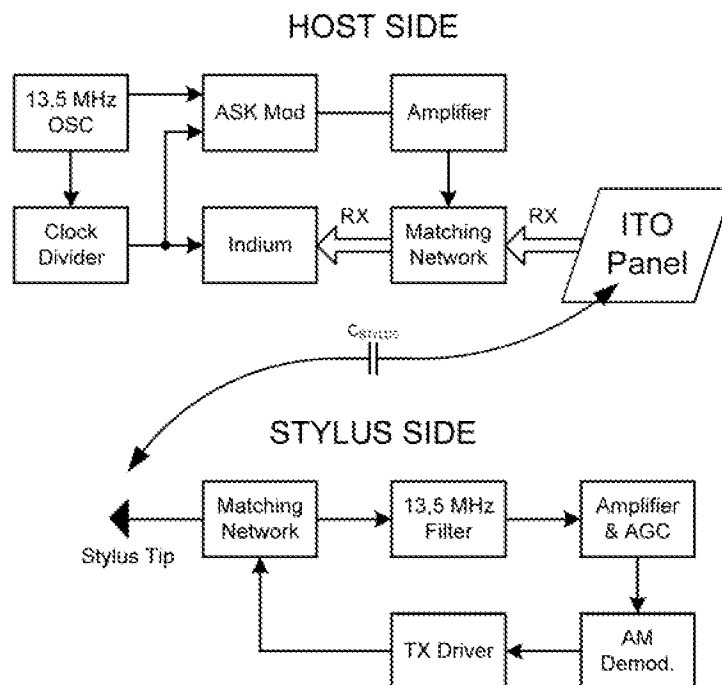
In the first option the ASK or FSK modulated high-frequency carrier signal (e.g. 13.56MHz) is supplied to ITO panel electrodes and is sensed by the stylus, see Figure 12. The ITO panel attenuates the high-frequency signal, but this attenuation is compensated by high signal amplification at stylus side.

The 13.56MHz carrier signal is useful via several reasons:

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- This is standard RFID signal, no licensing is required worldwide.
- The TX panel operation frequency could be obtained by division this signal, providing complete carrier noise suppression of the Indium receiver channel.
- The stylus tip and metal stylus case are working as electric field antenna.

Figure 12. Transferring the Synchronization Signal from Host to Stylus with High-Frequency Carrier

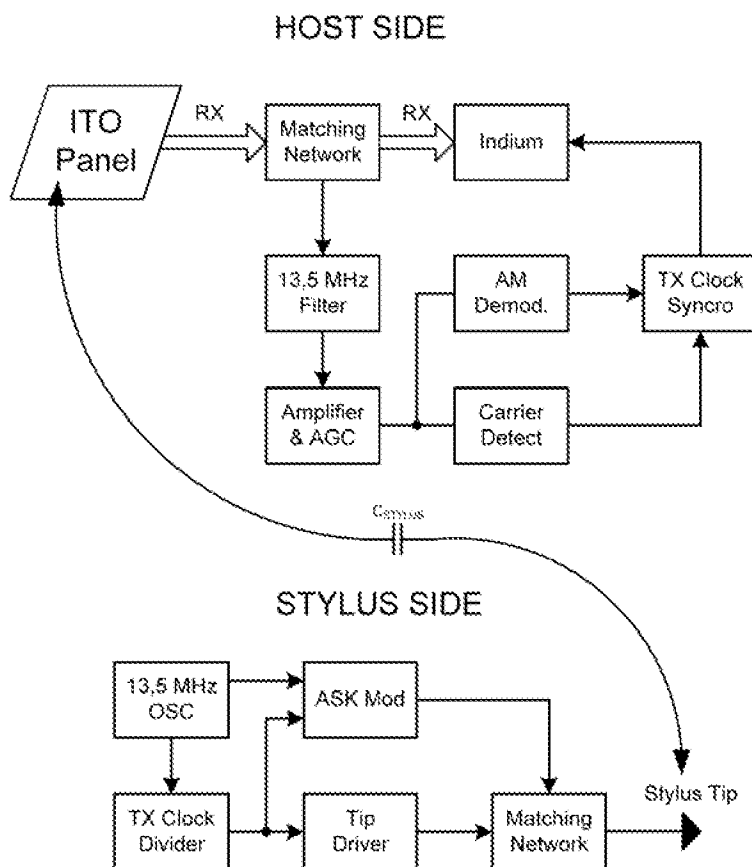


In the second option stylus acts as master and sends the high-frequency carrier signal to host, see Figure 13 together with TX signal. This is reverse synchronization channel implementation of the previous option. The ITO panel operation frequency could be formed by division the high-frequency carrier signal to provide full suppression of the carrier signal by the Indium receiver channel. In this case the carrier frequency noise is suppressed completely and has no influence on the receiver operation.

The ITO panel attenuates the high-frequency signal from stylus, but this attenuation should be compensated by using the gain at the carrier receiver side.

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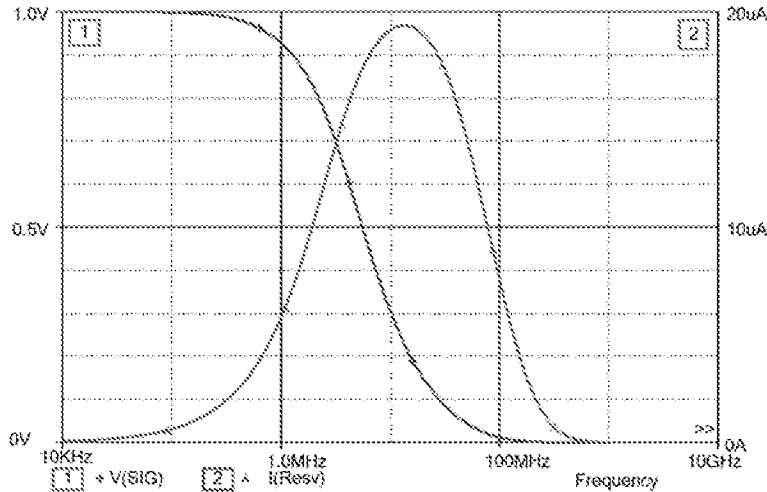
Figure 13. Transferring the Synchronization Signal from Stylus to Host with High-Frequency Carrier



It is interesting to investigate the ITO panel practical possibilities to handle the high-frequency signals. Taking into account we should not satisfy full panel recharge condition longer, much higher frequency signals could be supplied to the ITO Panel. Figure 14 shows the panel-to-stylus gain-frequency characteristics. The simulation results were obtained by driving whole row and column electrodes at same time and sensing the stylus current in the middle of panel. This reflects the worse case attenuation condition. The ITO panel was considered with double routing. The stylus current has been sensed using 1 pF capacitor.

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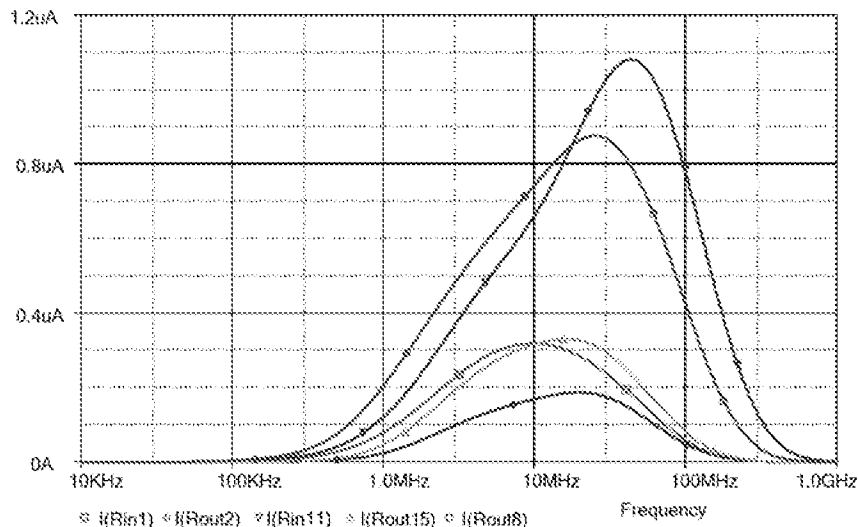
Figure 14. Panel Voltage (Pink) and Stylus Current (Yellow) when Whole Panel is Driven At Same Time



As visible from Figure 14, the peak stylus current happens around 10MHz and values are easy to be detected by using the low-cost receiver circuits.

It is interesting to investigate ITO panel properties to conduct the high frequency signal from stylus to host. For this configuration evaluation the 1V carrier signal is supplied in the panel center via 1pF capacitor and carrier current is sensed from the different panel electrodes, Figure 15. As visible from Figure 15, the stylus signal is much more attenuated (values below 1uA), so this method requires more amplification than in the previous case. So, the method of the carrier signal transmission from host to stylus is preferred. It's another advantage is absence the high-frequency oscillator circuits at the stylus, resulting the longer battery life.

Figure 15. Panel Current when Stylus Injects the 1V Carrier Signal vs. Carrier Frequency



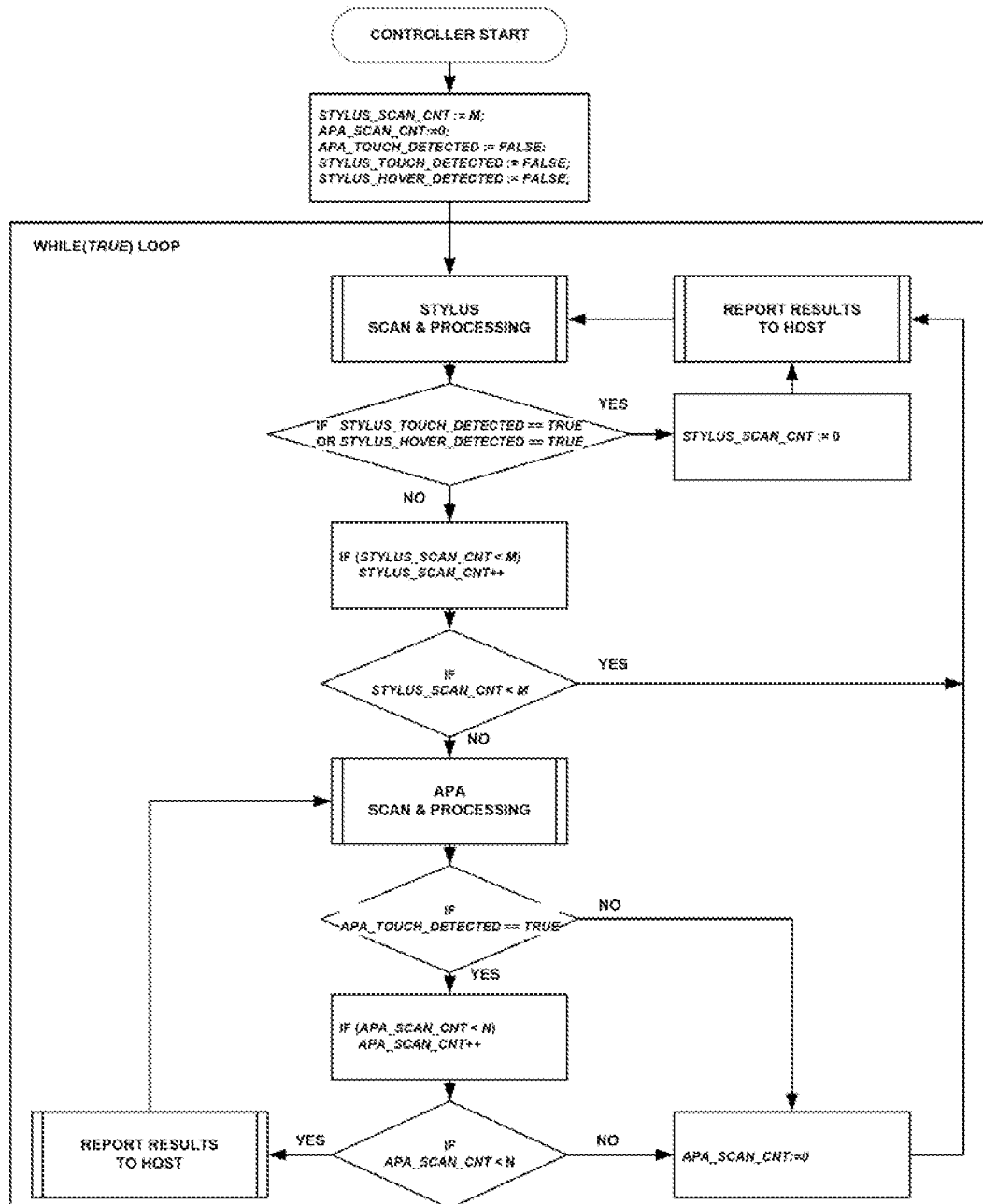
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SCANNING AND STYLUS DETECTION ALGORITHMS

When stylus signal is physically measured then host CPU needs to processed data. Also, regular finger needs to be processed too and FW should switch between finger and stylus. The possible data processing algorithms are bellow.

Proposed system solution provides APA touchscreen controllers with detection of signal from active stylus processing of which allows reliable and accurate computation of stylus position on the surface of touchscreen.

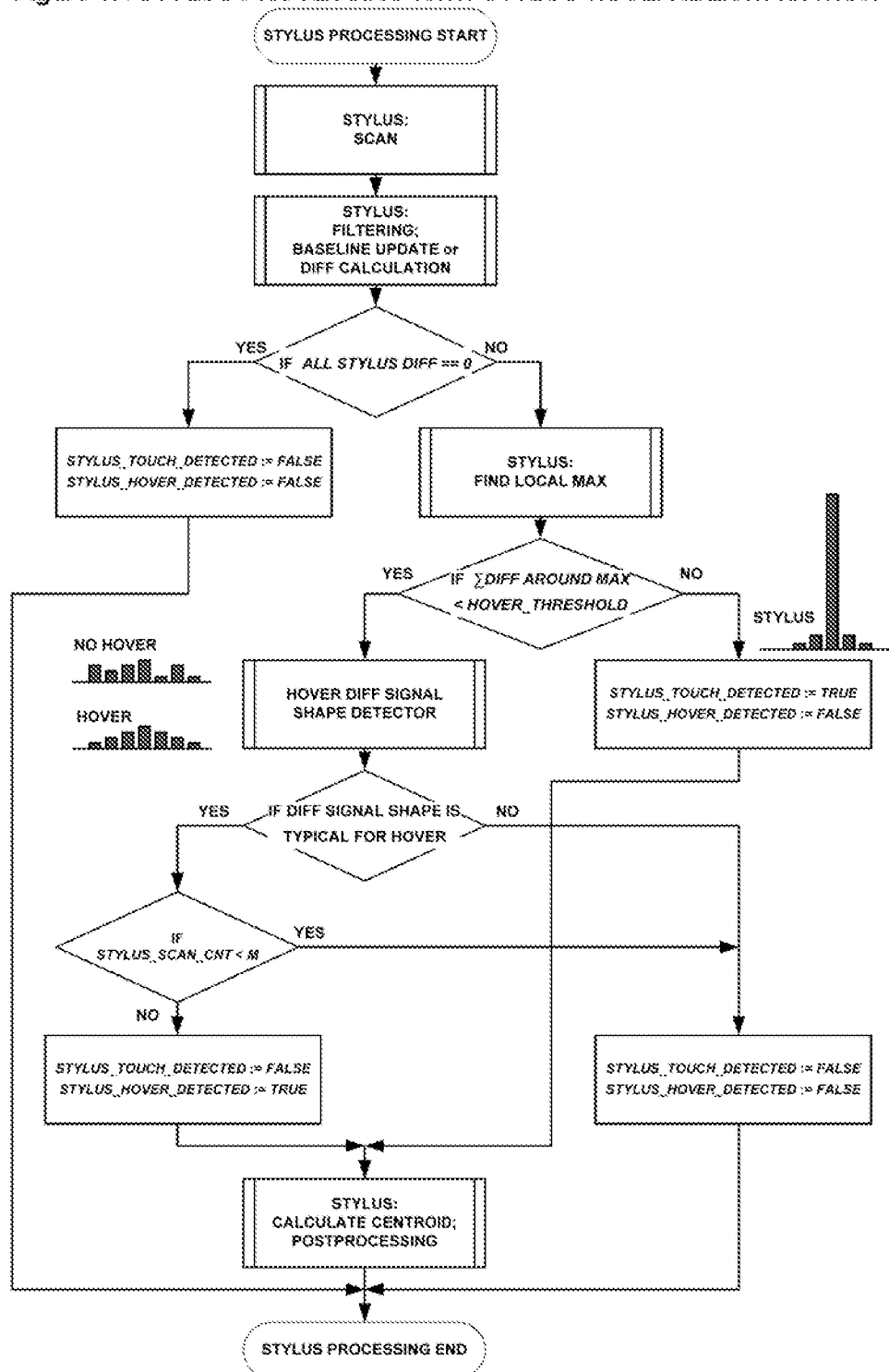
Figure 16 ONE POSSIBLE IMPLEMENTATION OF TOUCHSCREEN SCANNING WITH APA AND STYLUS SUPPORT



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Given solution automatically switches between regular APA scanning mode and stylus scanning mode to provide user interface with more flexibility. Figure 16 shows one possible implementation of capacitive touchscreen scanning that supports finger touch and stylus touch/hover detection as well as position computation of corresponding touch/hover. Figure 17 expands "STYLUS SCAN & PROCESSING" block given in Figure 16.

Figure 17. STYLUS PROCESSING WITH STYLUS-HOVER IDENTIFICATION



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It shows the logic sequence of [STYLUS] - [HOVER] - [NO_STYLUS] - [NO_HOVER] states identification and transition among them. Figure 18 gives one possible implementation of "STYLUS SCAN" block based on CYPRESS controllers (INDIUM and PSoC3). APA mode scanning and processing algorithm is shown on Figure 19. APA particular sensing method is not considered in this application and these operations are given in general form.

Figure 18. ONE EXAMPLE OF STYLUS SCANNING SEQUENCE USING CYPRESS TOUCHSCREEN CONTROLLER

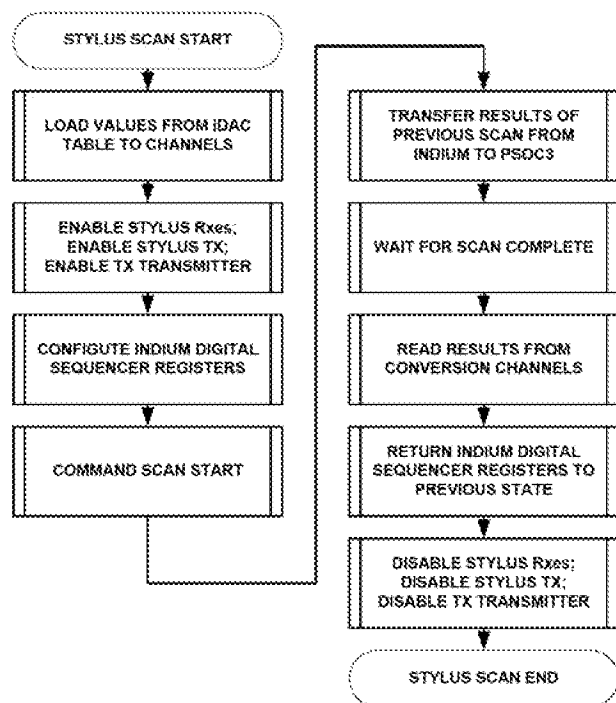
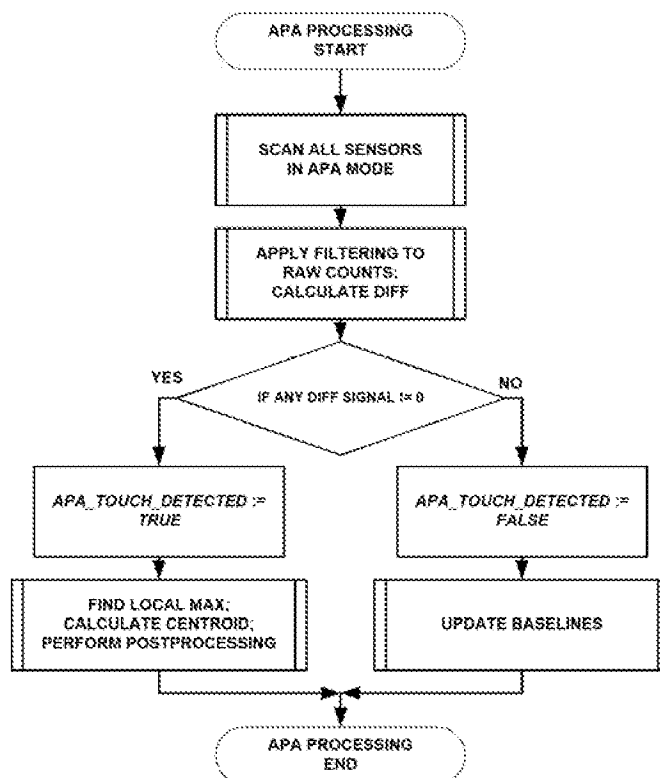


Figure 19 TOUCHSCREEN SCANNING AND DATA PROCESSING IN APA MODE



According to Figure 17 touchscreen controller makes a decision what the current state is ([STYLUS] - [HOVER] - [NO_STYLUS] - [NO_HOVER]) based on two parameters: (A) the sum of DIFF signals around the peak of DIFF signals distribution over the panel and (B) DIFF signals spatial shape (signal gradient). When the sum of DIFF signals around DIFF peak is larger then predefined *HOVER_THRESHOLD* value controller resolves system state as [STYLUS AND NO_HOVER] and starts with post-processing including position calculation. In case when the sum of DIFF signals around DIFF peak is lower than *HOVER_THRESHOLD* value special quantitative parameter is calculated to make decision what system state is [HOVER AND NO_STYLUS] or [NO_STYLUS AND NO_HOVER]. In some applications so-called *HOVER_FACTOR* parameter is used, see SHP IROS 001-57691. And if DIFF signal shape is typical for HOVER controller resolves system state as [HOVER AND NO_STYLUS] otherwise [NO_STYLUS AND NO_HOVER]. Depending on this decision further post-processing is performed.

According to touchscreen scanning algorithm given on Figure 16 stylus operation mode has higher priority than APA mode. Let's consider touchscreen controller operation in following conditions:

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1. Neither finger nor stylus touch panel.
2. Finger only touches panel.
3. [A] Stylus only touches panel. [B] Stylus only touches panel and then put finger. [C] Stylus and finger touch panel and then remove finger.
4. Stylus only touches panel and then remove stylus.
5. Stylus and finger touch panel and then remove stylus.
6. Finger only touches panel and then put stylus.
7. Finger only touches panel and then remove finger.

Touchscreen controller operations for all these cases are depicted on time diagrams of Figure 20

In case (1) touchscreen controller periodically performs Stylus-then-APA scanning this provides fastest first response time when finger or stylus is introduced.

In case (2) controller periodically performs APA scan only. In other words system locks on finger. But since stylus has higher priority than APA, controller should perform stylus scan as well. In given algorithm once per N APA scans stylus scan is performed. N value determines the relation between APA report rate and first stylus response time.

In case (3) only stylus is scanned. Stylus scanning should not be interrupted by introduced or removed finger.

In case (4) after stylus removing stylus scan is still performed during M following scans. This is caused by nature of hand text entry. During stylus writing stylus tip is placed on panel then lifted over the panel and then placed again. So when stylus is lifted stylus scan is still performed and lock on stylus happens immediately if stylus tip is placed on panel again. Note stylus->hover transition is blocked because hover has worse accuracy than stylus. If during M cycles stylus is not placed controller perform sequence from case (1).

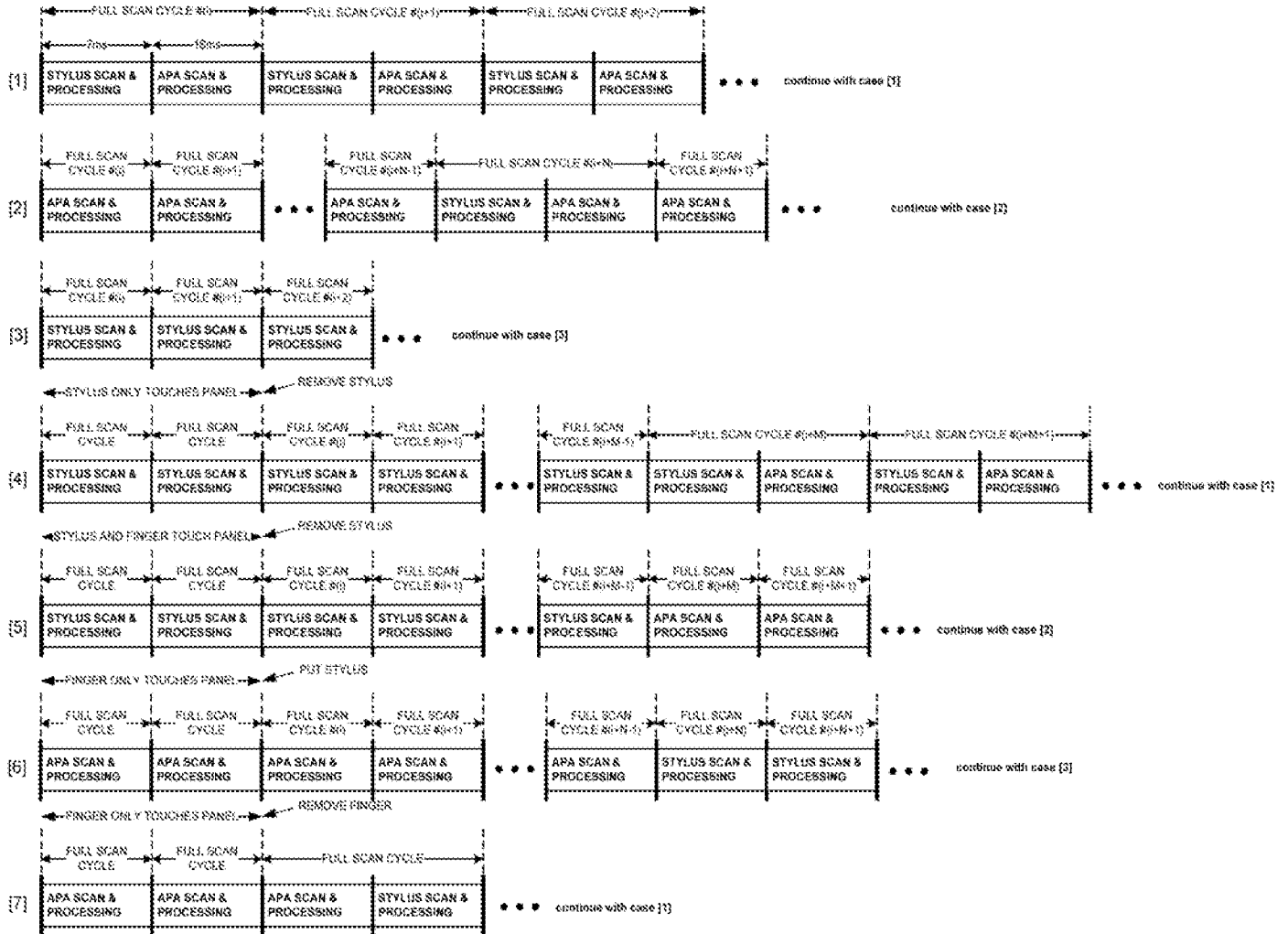
Case (5) is very close to (4) with one difference that after stylus removing system locks on finger and controller perform operations according to case (2).

In case (6) after stylus is placed on the panel N APA mode cycles is performed and then system locks on stylus. Operations continue according to case (3).

Case (7) shows transition from case (2) to case (1).

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Figure 20 TIMING DIAGRAMS OF DIFFERENT OPERATING MODES

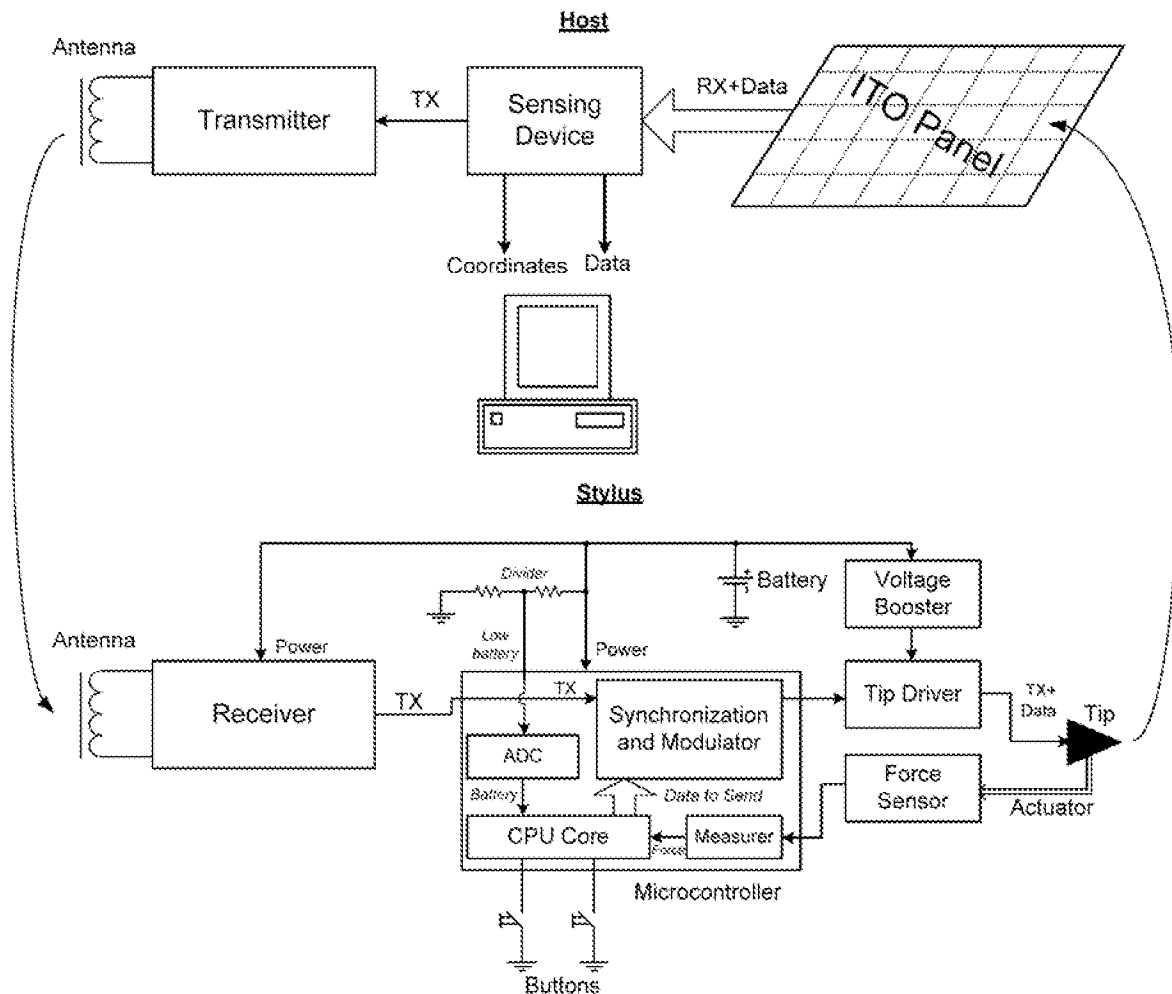


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SYNCHRONIZED CAPACITIVE STYLUS WITH DATA TRANSMITTING

The previously described stylus provides touch position recognition only and doesn't provide reverse channel from stylus to host. Many customers asking for a stylus with force sending. It means that CPU on stylus should measure it and send data to host. The way of reverse channel realization is described below. The stylus with force sensing is shown on Figure 21

Figure 21 Stylus with Force Sensing Block Diagram

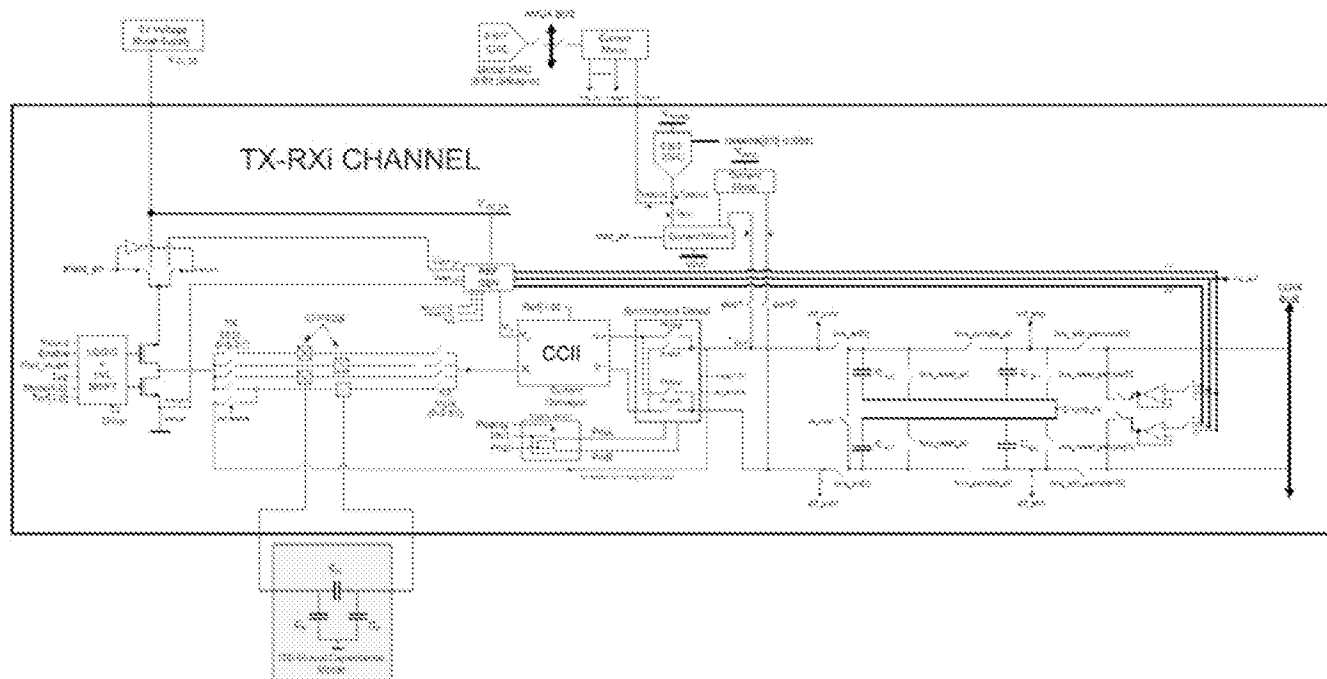


The stylus design have force sensor, low battery indicator and buttons scanning features. Data is transmitted trough ITO panel and received and decoded on Host side. The receiver and transmitter is the same as at previously described stylus. Now we have modulator that changes the tip signal parameters according to data that needs to be transmitted. The Modulator detailed block diagram is shown on Figure 25.

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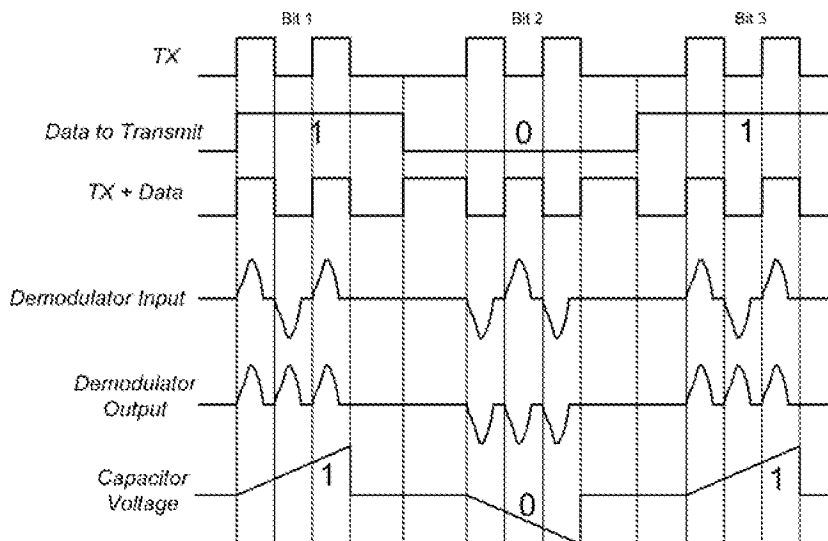
The demodulation process is based on scanning device (Indium) synchronous rectifier nature, Figure 23. The TX signal from Stylus causes I_{X1} current pulses. These pulses goes trough current conveyor CCI to synchronous rectifier that is realized using two capacitors C_{INT} and two switches. These switches operate synchronously with TX driver at PHI1 and PHI2 polarities and convert current pulses to constant voltage V_{OUTX} . This voltage measures by ADC and is our stylus signal.

Figure 22 Scanning Device Internals



The demodulating process is illustrated on Figure 23. The TX pulses after modulator are inverted or non-inverted depends on data bits. These pulses goes trough the ITO panel and created current conveyor input current spikes. The synchronous detector output consist on rectifier spikes that are positive or negative. So, the integrator capacitor C_{INT} voltage is positive or negative too that represents data bits.

Figure 23 Demodulation Process, Indium Inside

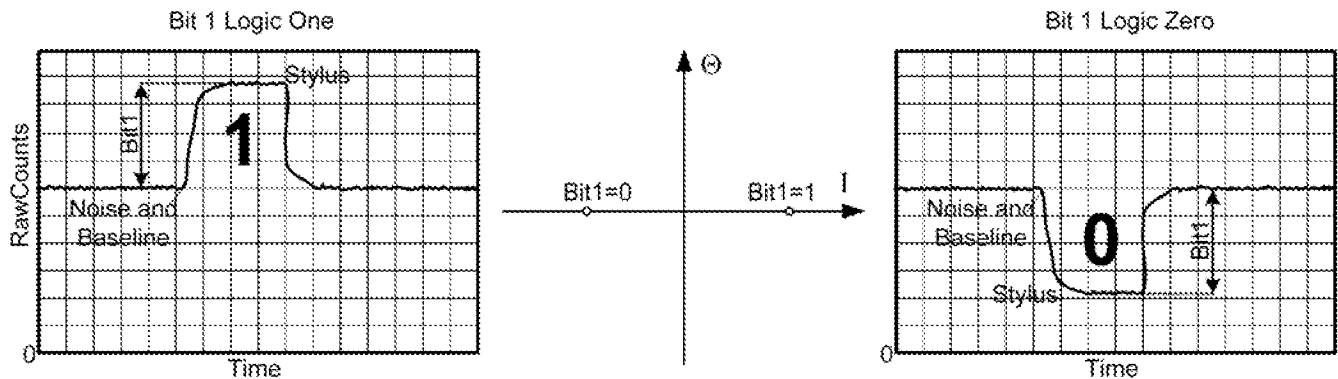


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The FW analyzes Capacitor voltage change direction and decode data bits. It is simple procedure that compares voltage with predefined thresholds and set or clear bits according to this.

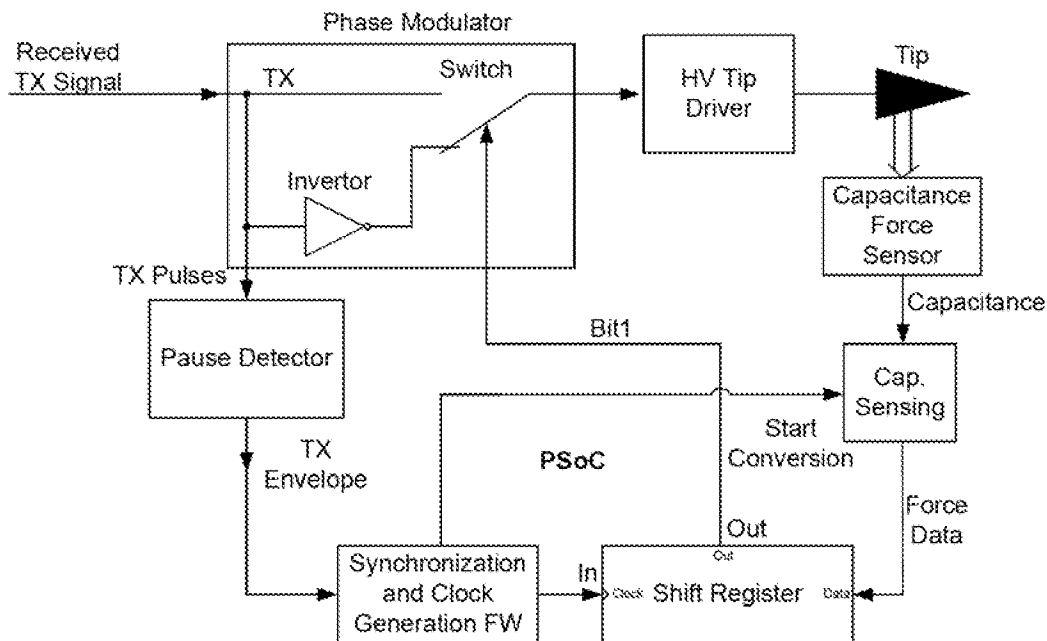
The TX signal phase modulation is used to transmit data from stylus to host. It is based on TX signal inversion/non-inversion on stylus side called BPSK. If not inverted signal is applied to the stylus tip then raw data goes up. If inverted signal is applied to stylus tip then raw data goes down. In both cases the signal has the same value but different polarity, Figure 24. The polarity changes can indicates is button pressed or not, or consist force data bits.

Figure 24 Modulated Raw Counts



The received TX pulses go to Amplitude Detector Figure 25 and to stylus tip driver via switch. This switch is used to select inverted or non-inverted TX signal. The switch is driven by shift register output. Shift register consist on Data that should be transmitted. It can be force, battery voltage or any other Data. The special synchronization and clock generation algorithm in FW generates clocks pulses synchronously with TX signal.

Figure 25 Modulator Detailed Block Diagram



Also it is possible to transmit more than one bit at a time. The quadrature-amplitude modulation can be easily realized as additional phase shift on TX/4 time, Figure 26. The two bits Bit1 and Bit2 are transmitted in the same time. If additional Tx/4 delay are applied to TX signal then resulting signal

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amplitude on demodulator output will be two times lower compare to TX signal without delay, Figure 27, .Checking the received signal amplitudes relations we can easily decode the data.

Figure 26 Quadrature Modulator Block Diagram

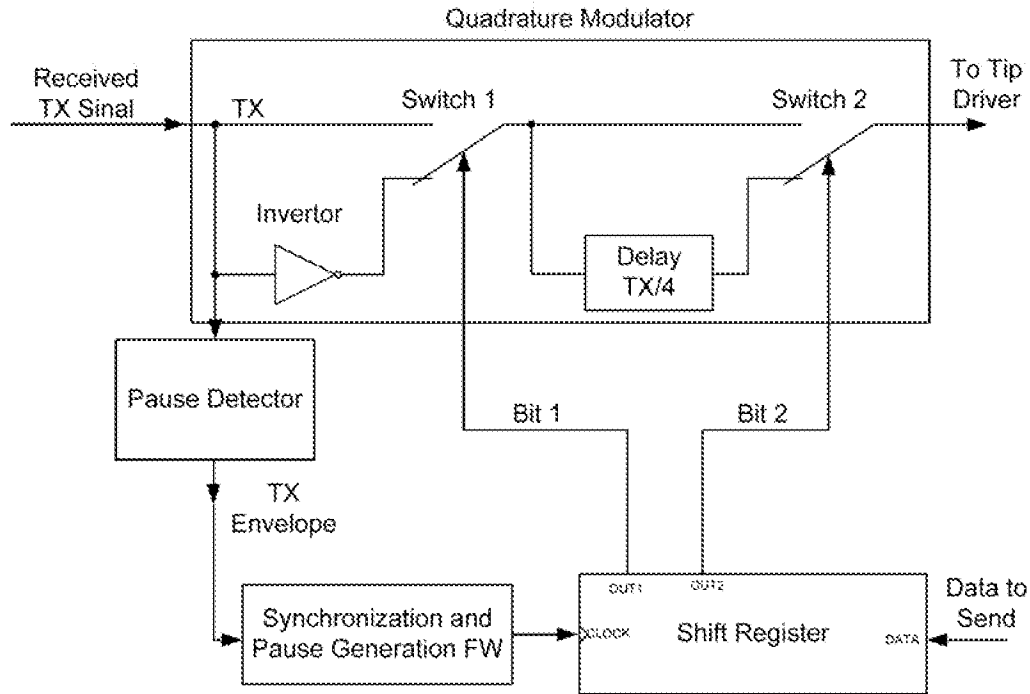
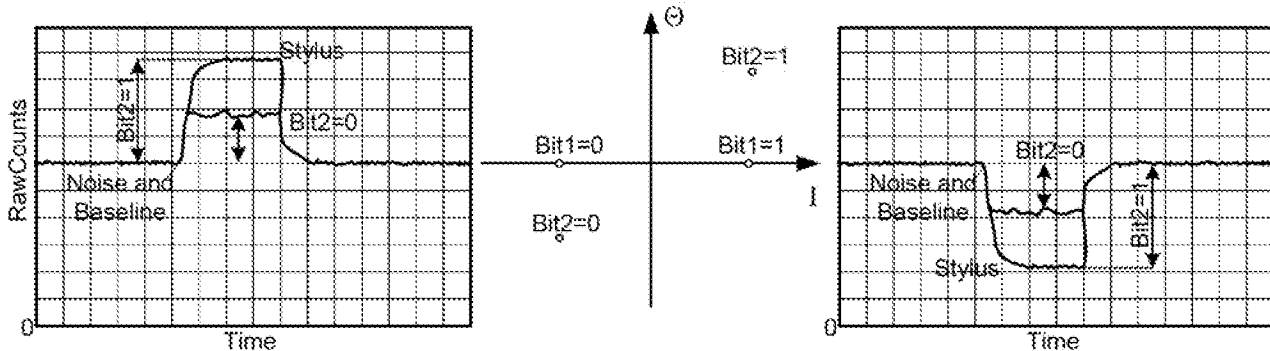


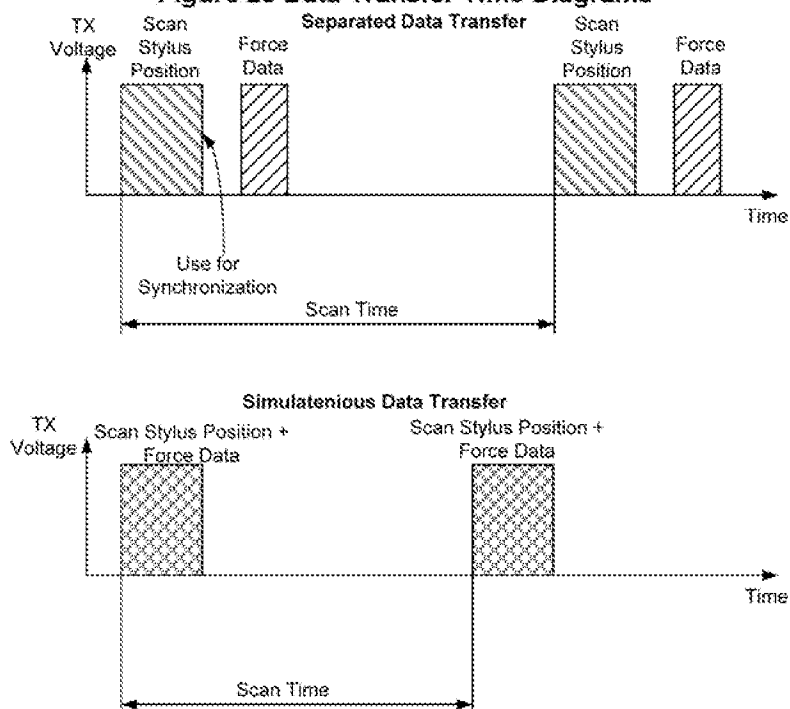
Figure 27 Modulated Raw Counts by Quadrature modulator



The data can be transmitter separated in time from the TX signal or simultaneously with TX, Figure 28. The first way is easy for realization and provides fast data transmitting rate. The end of stylus position scanning can be used for synchronization that provides robust data transfer with low bit rate. But separated data transfer have serious disadvantage as Scan time penalty. The separated data pack required some time that increase total scanning time.

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Figure 28 Data Transfer Time Diagrams

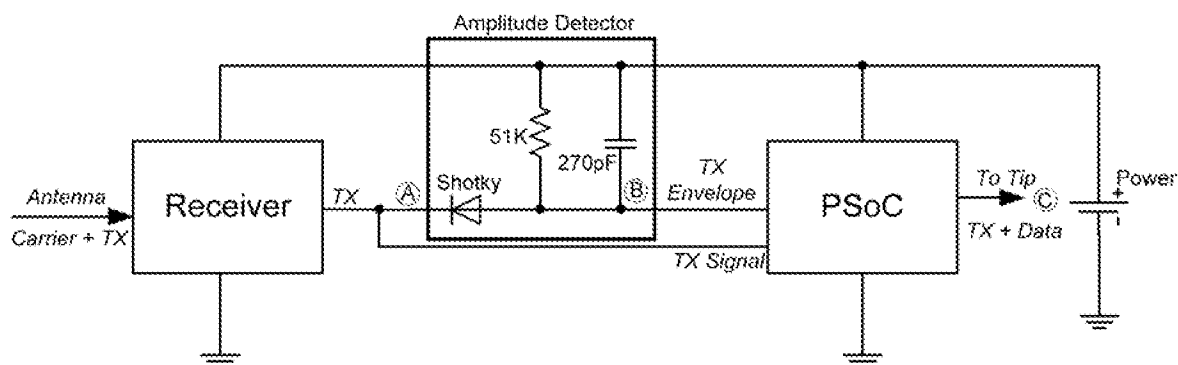


The second method uses the position scan sequence for data transmitting. In this case one bit is transmitted during one scan instead eight or sixteen bits at separated short scans in previous case. It is disadvantage. The advantage is data transmitting without total scan time increasing that can be useful for slow data. The modulation and demodulation process is the same as in Separated data transfer. The difference is in TX pulses that are used for it.

The special short TX pulses are used for data transmitting in Separate mode. These pulses provides enough touch signal for robust bits detection from one side and are doesn't spend much time from other side. The short pulses allows us have a short conversion. Each conversion is one data bit. One long conversion instead a lot of short is used for position detection. It is needed for getting high position resolution and low noise. Therefore one or two bits only can be transferred during this.

The pause detector on Figure 25 is used to get TX signal envelope. The synchronization circuit uses this envelope for clock pulses generation. The pause detector is simple amplitude detector circuit that is shown on Figure 29

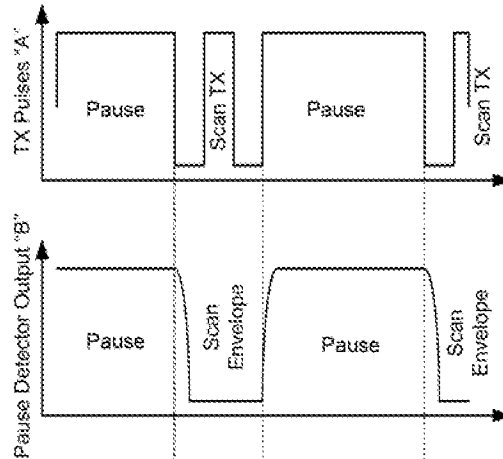
Figure 29 Amplitude Detector and its Connection to Circuit



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The pause detector operation waveforms are shown on Figure 30.

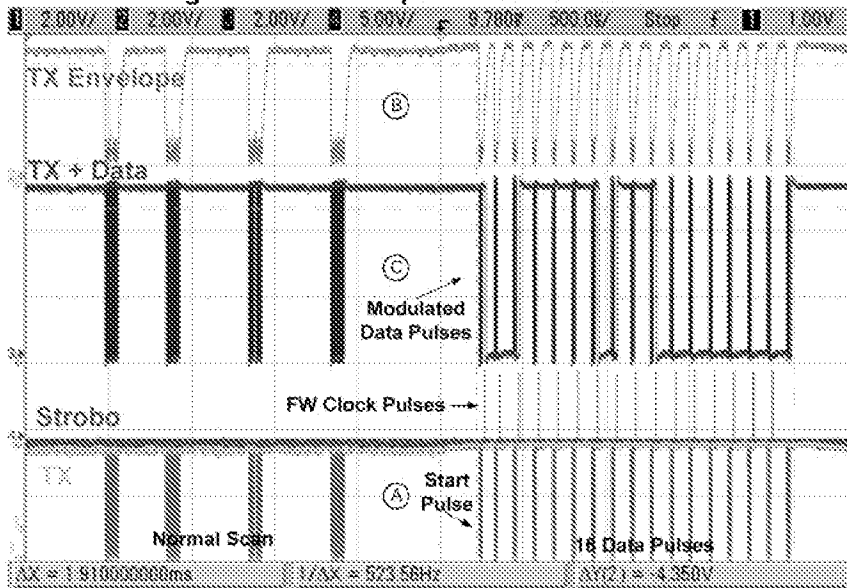
Figure 30 Pause Detector Operation Waveform



The resistor and capacitor creates LPF that removes TX signal carrier and left pulse envelope. This envelope is suitable to use with GPIO for synchronization. When no TX scans sequence then receiver output is high and diode is in non-conductive state. The capacitor is discharged and pause detector output is high. The TX pulses periodically charge the capacitor via diode to ground and moves the output potential close to state.

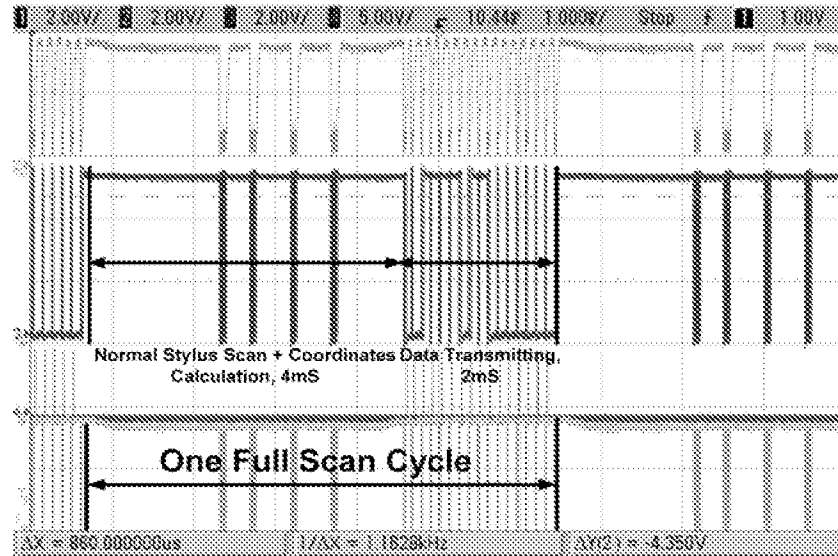
The circuit operation for separated data transfer is illustrated on Figure 31.

Figure 31 Circuit Operation Waveforms



The point "A" yellow is TX signal after receiver. The point "B" green is envelope after pause detector. The point "C" purple showed TX signal after modulation. LSB is first. The modulated data is 000000011011100b or 0xDC. The pink is strobe pulses generated in FW that indicates each bit. The 17 short TX pulses are used for data transfer. One pulse is for synchronization and sixteen for data transfer. Based on amplitude detector signal FW finds each data pulse and sets switch state according to bits that needs to be transferred in this time. All other free time FW spends on normal stylus position calculation and data processing, Figure 32. The total data transmitting time is 2mS.

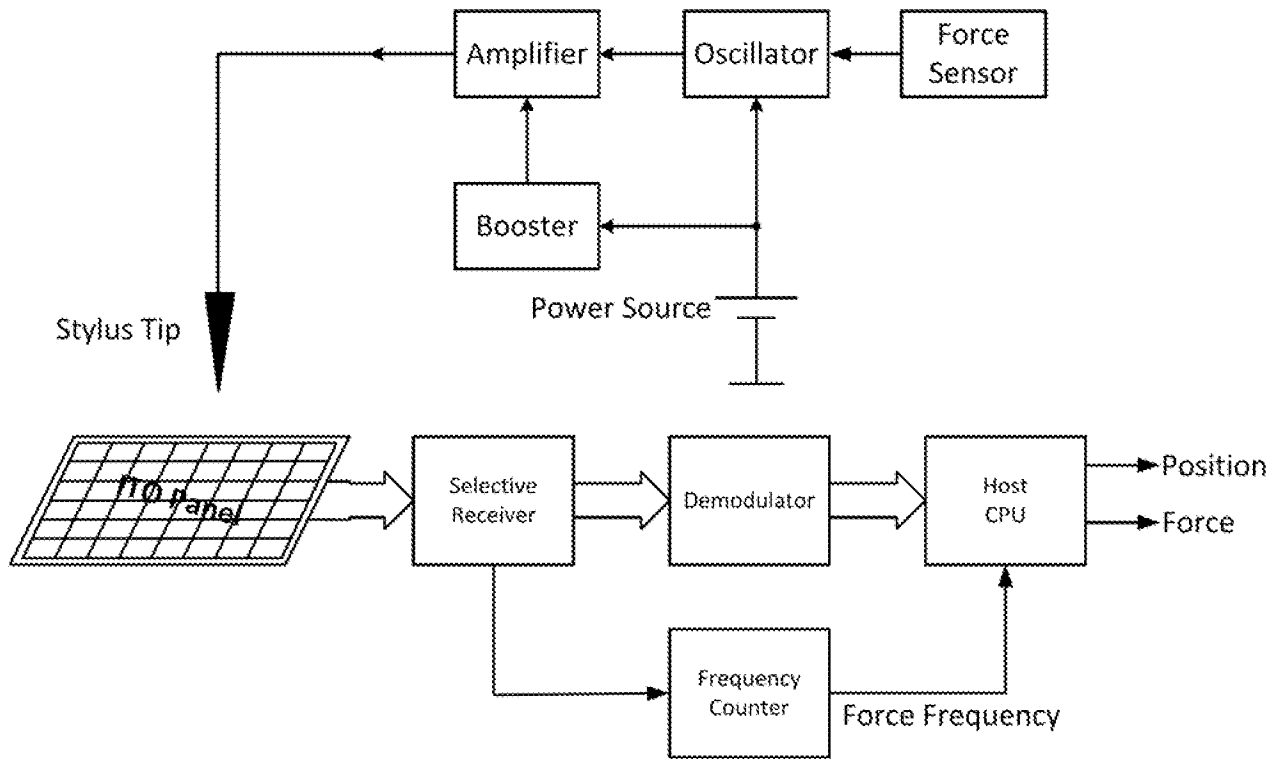
Figure 32 One Full Scan Cycle



UNSYNCHRONIZED STYLUS

The simplest oscillator circuit can be used for unsynchronized stylus and data transmitting realization, Figure 33.

Figure 33 Unsynchronized Stylus with Free-Running Carrier



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The oscillator generates the carrier that is amplified and supplied to stylus tip. This carrier is received on host side and is used for touch position detection. The force sensor provides the carrier frequency modulation, for example, implementing BPSK, ASK, FSK or using analog modulation, e.g. the output frequency shift is directly proportional to the signal from the force sensor. The same carrier can be modulated for other data transmitting. The method advantages are simultaneous touch position detection and force data transmitting if different operation frequencies are used for the panel scanning and stylus handling. In this case the receiver, which is able handling couple frequencies simultaneously should be used. This implementation requires special receiver development and is not compatible with existing touch sensing chips.

INDICATE ANY ALTERNATE COMPONENT(S) AND/OR METHOD(S) OF CONSTRUCTION.

The alternative implementation options were discussed over document

IF A JOINT INVENTION, INDICATE WHAT CONTRIBUTION WAS MADE BY EACH INVENTOR.

Each inventor has made equal contribution.

DESCRIBE THE FEATURES THAT ARE BELIEVED TO BE NEW.

- The capacitive stylus, which allows utilizing the existing devices, originally designed for the all-points addressable scanning for the stylus signal sensing
- Method of the transmission the synchronization signal between stylus and host using the magnetic or electrostatic antennas
- Method of the transmission the synchronization signal between stylus and host using the ITO panel without usage additional antennas.

Document History Page

Document Title: CYPRESS SEMICONDUCTOR INVENTION DISCLOSURE FORM
Document Number: 27-00030

STATE OPINION OF RELATIVE VALUE OF INVENTION

This invention allowed win multi-million commercial design.

The proposed invention allows provide new class of the multitouch user interface devices, open possibilities to win the new commercial designs.

Claim:

A stylus input device comprising:

- a receiver circuit configured to receive synchronization signals from a transmitter, the synchronization signal for pairing the stylus input device with a stylus input receiving device;
- a force sensor;
- a force sensing circuit for measuring force from the force sensor;
- a tip driver configured to generate a signal at the tip of the stylus input device in response to the synchronization signal; and
- a microcontroller configured to process force and synchronization signals.

CAPACITIVE STYLUS WITH FORCE SENSING

(VICK, OPIR_UKR, RYAN_UKR, DTV)

Brief Summary of Invention:

- The capacitive stylus with force sensing is proposed.
- The stylus synchronization with host is done using either inductive or capacitive coupling.

Key Benefits/Advantages:

- Stylus uses the capacitive coupling between stylus tip and sensing panel for the stylus touch coordinates sensing and for the data transmission.

Motivation:

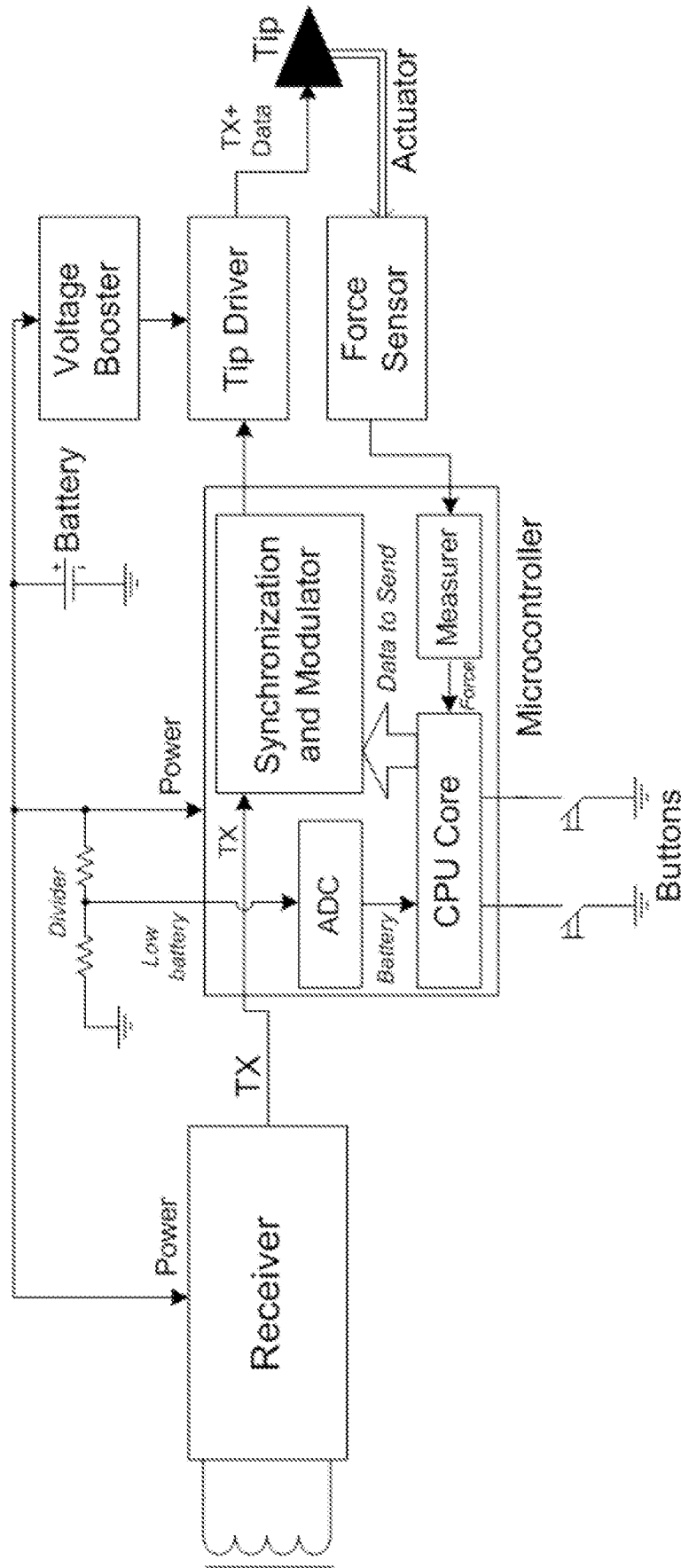
- Capacitive Stylus which works with existing ITO Panels and APA Sensing Circuits.
- Stylus provides the force, battery and buttons sensing.

PRIOR TECHNOLOGY

- Prior technology is based on the inductive position sensing and data communication via inductive coupling between stylus and receiver.
- The inductive coupling requires additional coils, increasing solution complexity and cost.

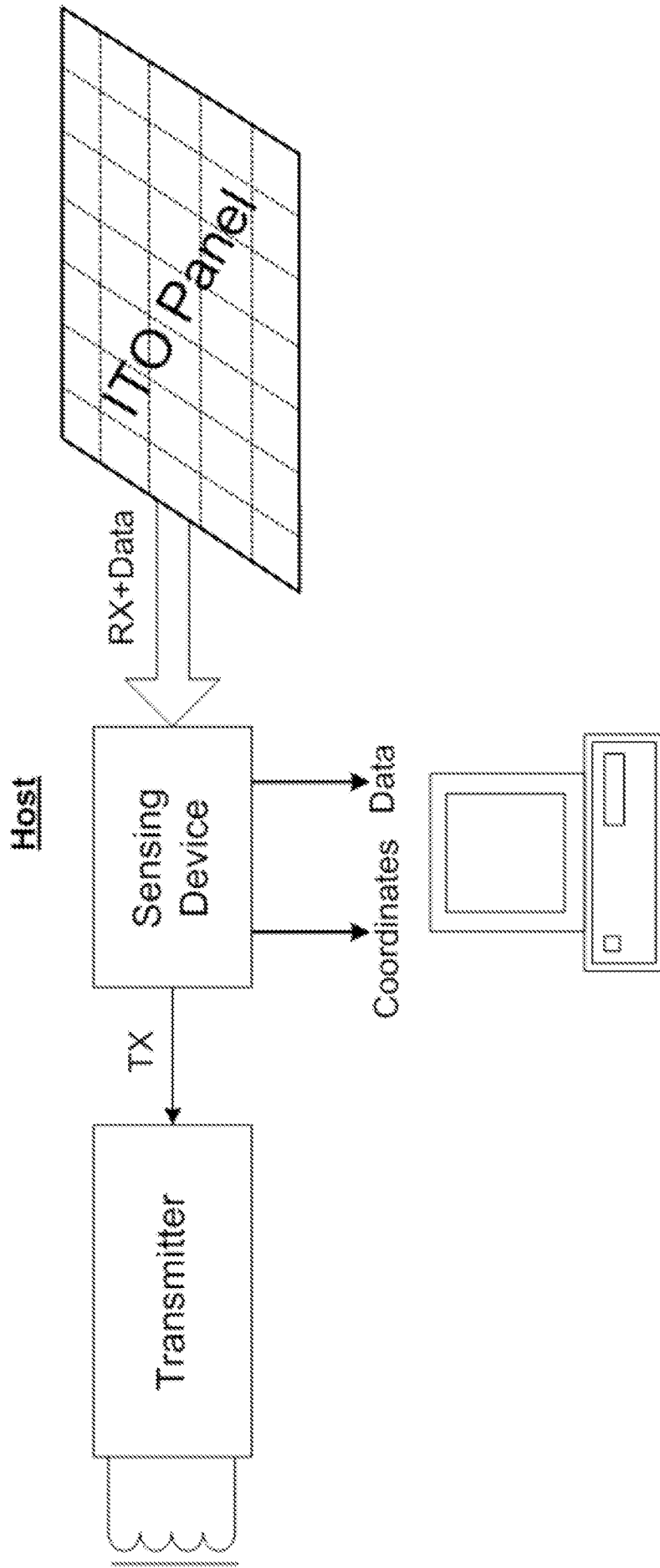
NEW INVENTION

Stylus



- Stylus consists of the receiver of the synchronization signal, modulation system, force sensor, force sensing circuitry, tip driver, microcontroller for the data processing

NEW INVENTION



- Host contains circuitry for the synchronization signal transmission, panel sensing system, data detection system.

SUMMARY OF INVENTIVE ASPECTS

- What is new about your invention?
 - Use stylus tip for force sensor data transfer
 - Use stylus signal modulation for data transfer
 - List new FEATURE 3 (if applicable)
 - Add additional bullets if needed

Why is your invention valuable to the BU and/or Cypress?

- The data transfer can be realized into FW only. It adds value to stylus solution
- The stylus with palm rejection is unique feature that is not realized in our competitors yet

Electronic Patent Application Fee Transmittal

Application Number:

Filing Date:

Title of Invention:

Stylus with Force Sensing

First Named Inventor/Applicant Name:

Victor Kremin

Filer:

Andrew Bateman

Attorney Docket Number:

CD10084P

Filed as Large Entity

Provisional Filing Fees

Description

Fee Code

Quantity

Amount

**Sub-Total in
USD(\$)**

Basic Filing:

Provisional application filing

1005

1

220

220

Pages:

Claims:

Miscellaneous-Filing:

Petition:

Patent-Appeals-and-Interference:

Post-Allowance-and-Post-Issuance:

Extension-of-Time:

Petitioner Shenzhen Qianfenyi Intelligent Technology Co., Ltd.

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Total in USD (\$)				220

Electronic Acknowledgement Receipt

EFS ID:	8728184
Application Number:	61407907
International Application Number:	
Confirmation Number:	6876
Title of Invention:	Stylus with Force Sensing
First Named Inventor/Applicant Name:	Victor Kremin
Customer Number:	60909
Filer:	Andrew Bateman
Filer Authorized By:	
Attorney Docket Number:	CD10084P
Receipt Date:	28-OCT-2010
Filing Date:	
Time Stamp:	23:59:01
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$ 220
RAM confirmation Number	8653
Deposit Account	503781
Authorized User	

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Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

Petitioner Shenzhen Qianmen Intelligent Technology Co., Ltd.

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	CD10084Pappdatasheet.pdf	837022	no	5
			25242dbf68c258c6b723beeb239ad0365925c852		

Warnings:

Information:

2	Specification	CD10084PSpecification10282010.pdf	7828724	no	29
			e0a07bee95c726b61f5e0c92fc4162204e52516e		

Warnings:

Information:

3	Fee Worksheet (PTO-875)	fee-info.pdf	29010	no	2
			56441149f2b6a1b88dc6a16f87d1cb2baa713055		

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National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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