# High SNR and High Frame Rate Analog Front-End ICs with Active Stylus for Capacitive Touch Screen Panels

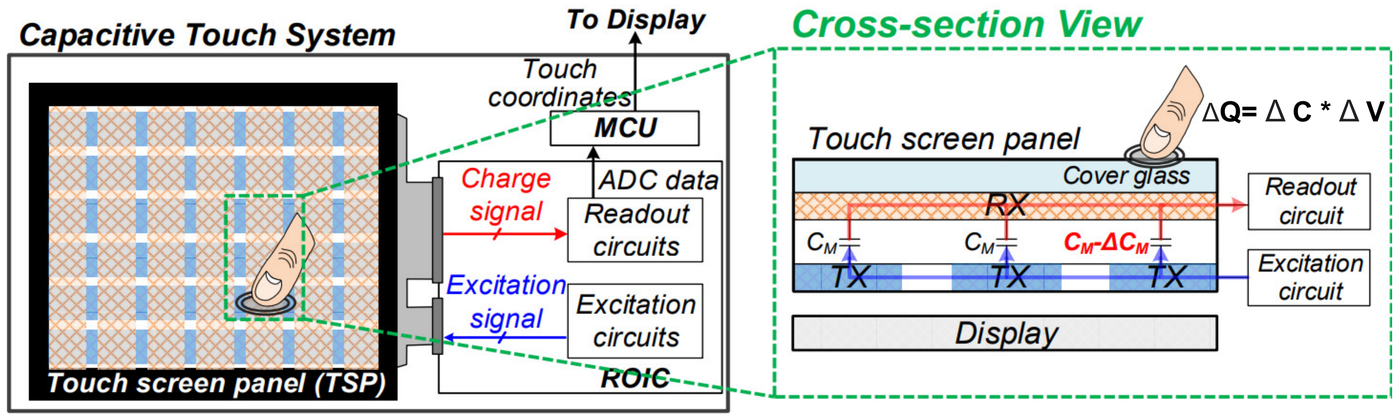
Young Chae Son[1], Jae-sung An[2]
Tech University of Korea, South Korea[1], TU Delft, The Netherlands[2]

## Operating Principles

| | High SNR | Low SNR |
|---|---|---|
| Touch | Touched Point → Extracted Touch Points | Touched Point → Extracted Touch Points |

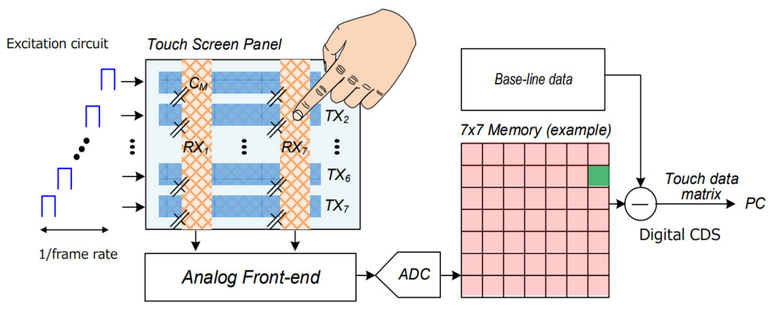
| | High Frame Rate | Low Frame Rate |
|---|---|---|
| Line Drawing | Line Drawing → Extracted Line Drawing | Line Drawing → Extracted Line Drawing |

Need for High SNR and High Frame




- Presence of finger changes mutual capacitance between TX and RX electrodes
- ROIC drives the TX electrodes with excitation signals
- ROIC senses and digitizes resulting charge displacement, which is proportional to capacitance

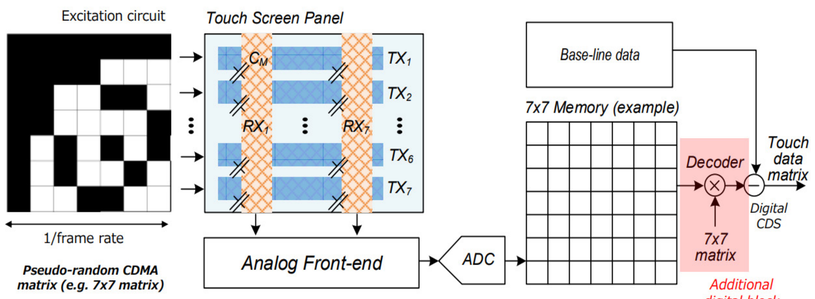
### Sequential Driving Method




: 1 data contains 1 cell information

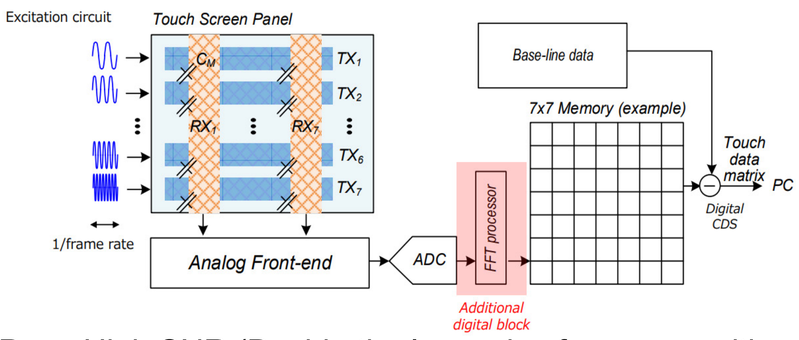
- Pros: Simple driving scheme
- Cons: Low frame rate
@ large number of TX electrode

### CDMA driving method




- Pros: High SNR, Low supplies can be used
- Cons: Low frame rate
@ large number of TX electrode
Complexity of digital block↑
(Additional decoder)

### Multiple Freq. driving method



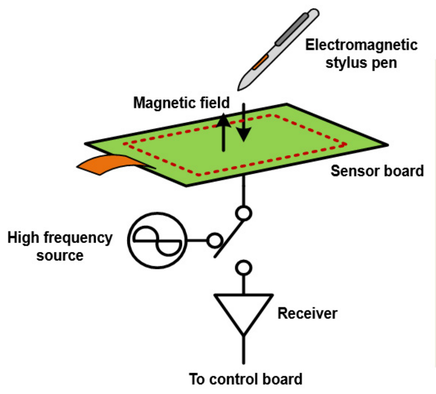

Pros: High SNR,(Decide the low-noise frequency with FFT processor), High Frame rate,
Low supplies can be used
Cons: complexity of digital block ↑
(Additional FFT processor)

## Passive Stylus Pen ( w/o battery)

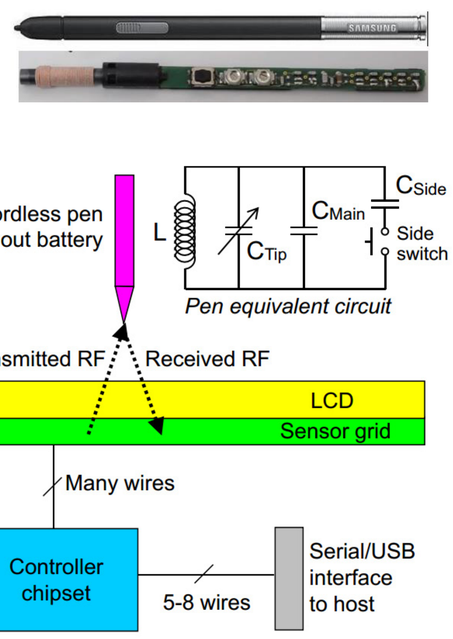
### Electromagnetic

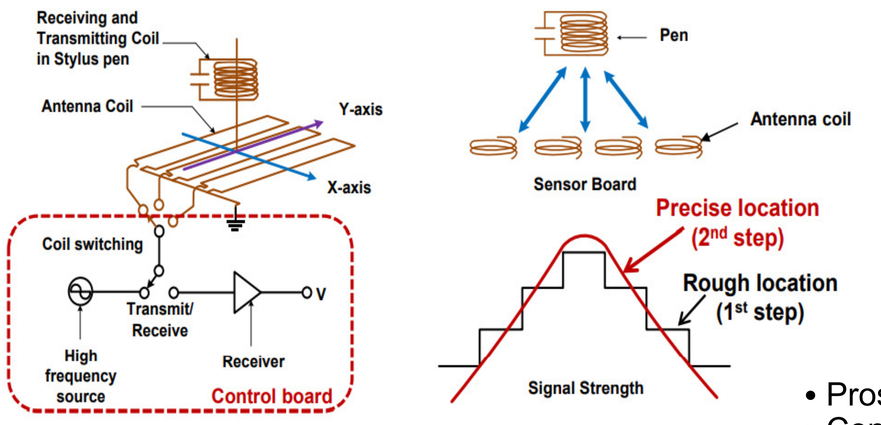


Source: Samsung




< Principle of electromagnetic stylus pen >

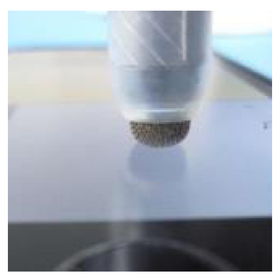


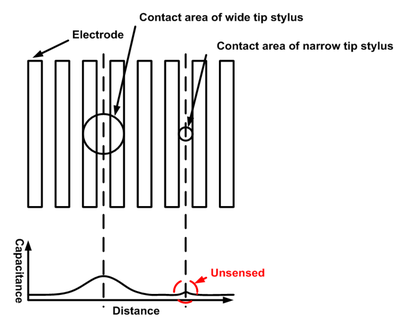

< Sensing operation of control board >

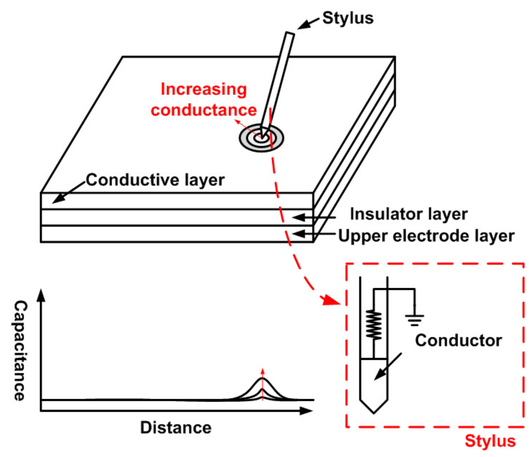
- Pros: No power supply, narrow tip stylus
- Cons: Additional panel(EMR)

### Capacitive



Source: Synaptics




Pros: Simple structure, No power consumption •
Cons: Thick tip, low accuracy

## Active Stylus Pen (w/ battery)

### CDMA driving method



Source: Apple




Active stylus pen for iPad




< Touch/pen sensing system(Apple) >

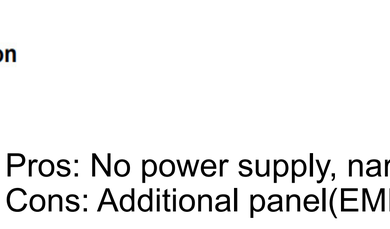
TBPF: touch signal passes through the touch filter
PBPF: stylus signal passes through the stylus filter



Source: Wacom




< Touch/pen sensing system (Wacom) >



< Conceptual diagram of active stylus pen for tilt expression >

→Dual electrodes are used for expressing the tilt angle

- Pros: Various expression, High accuracy & pen pressure
- Cons: Additional battery required for stylus pen, High price

### Multiple Freq. driving method




< Block diagram of the active stylus (top) and
extracted coordinated of the active >stylus (bottom)