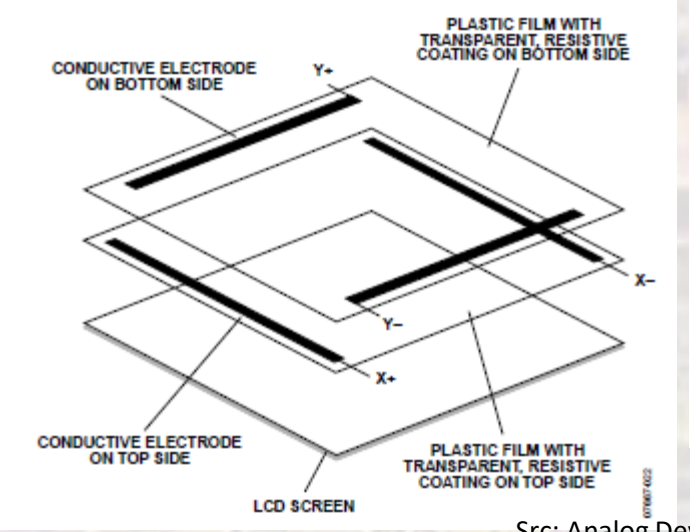
Touch Screens

Touch Screens

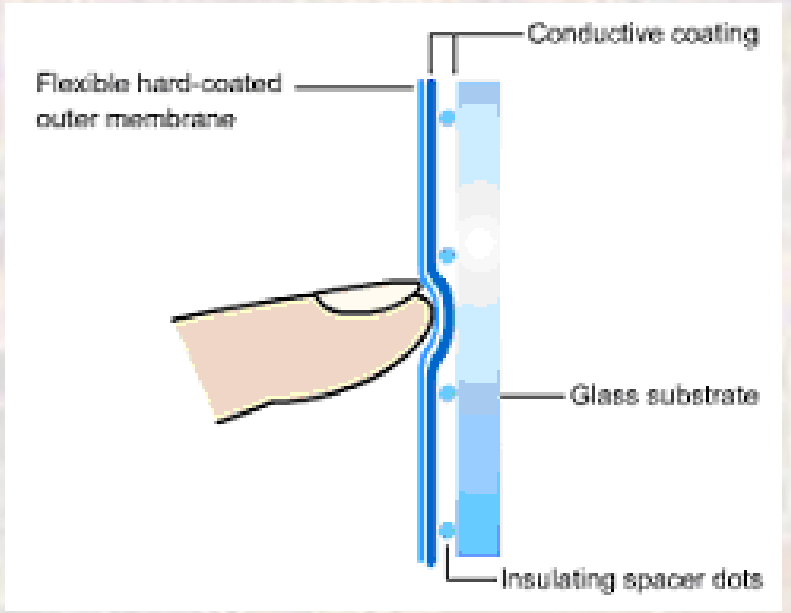
- Technologies
  - Resistive
  - Capacitive
  - Optical
  - Surface wave

Touch Screens

- Resistive Touch – 4 wire
  - 2 layers of resistive material
  - 1 with connections at top/bottom
  - 1 with connections at sides
  - Separated by air/spacers



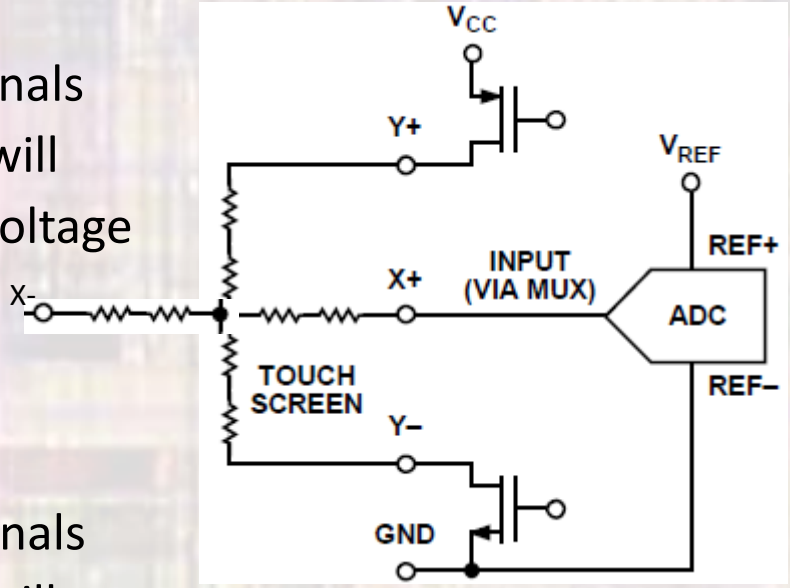
Src: Analog Devices



Src: ELO

Touch Screens

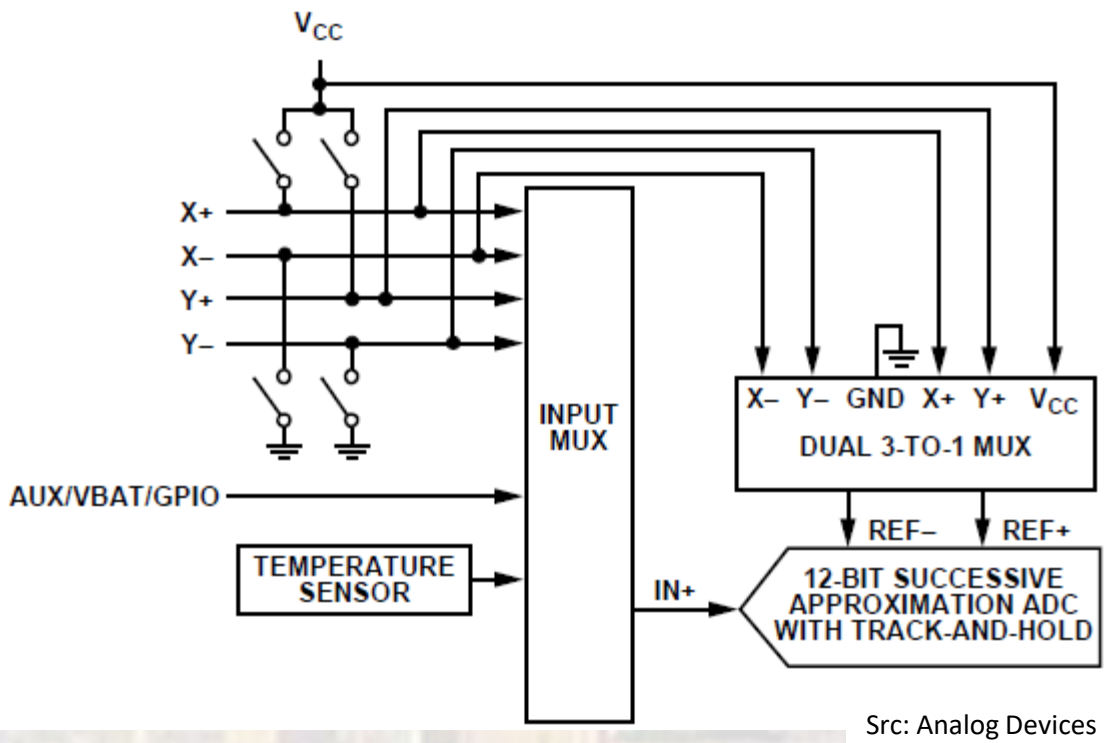
- Resistive Touch – 4 wire
  - Measure Y position
    - Place a voltage across Y terminals
    - Where touched, X+ terminal will measure relative voltage
  - Measure X position
    - Place a voltage across X terminals
    - Where touched, Y+ terminal will measure relative voltage



Src: Analog Devices

Touch Screens

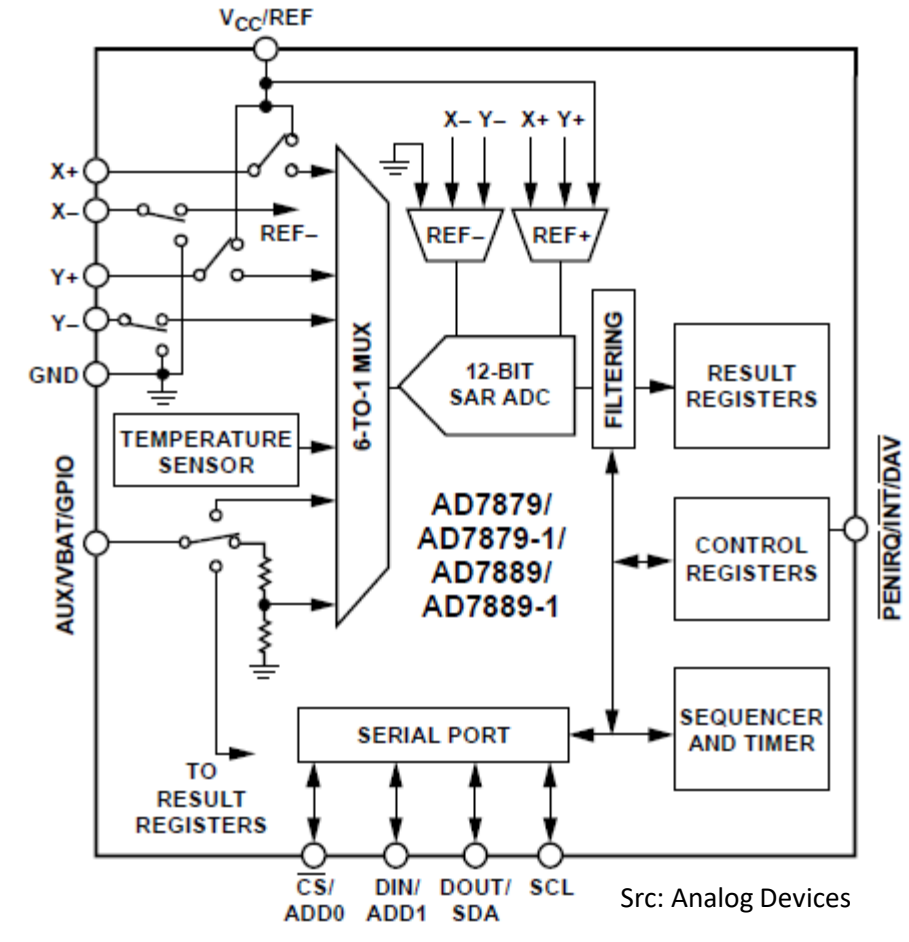
- Resistive Touch – 4 wire



Src: Analog Devices

Touch Screens

- Resistive Touch – 4 wire



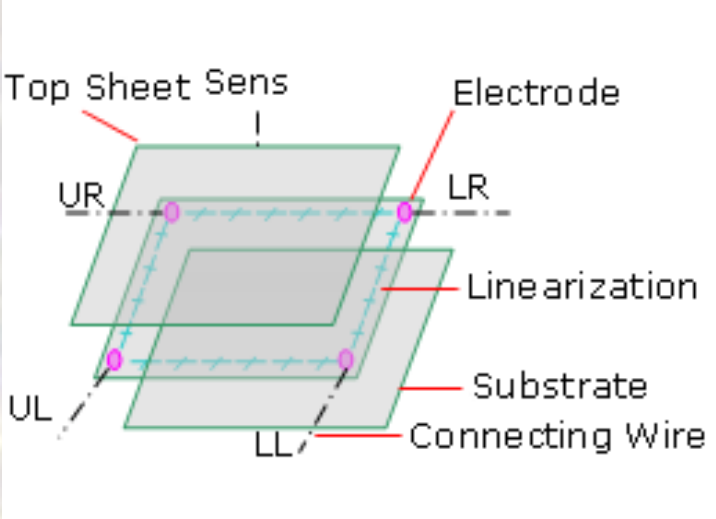
Src: Analog Devices

Touch Screens

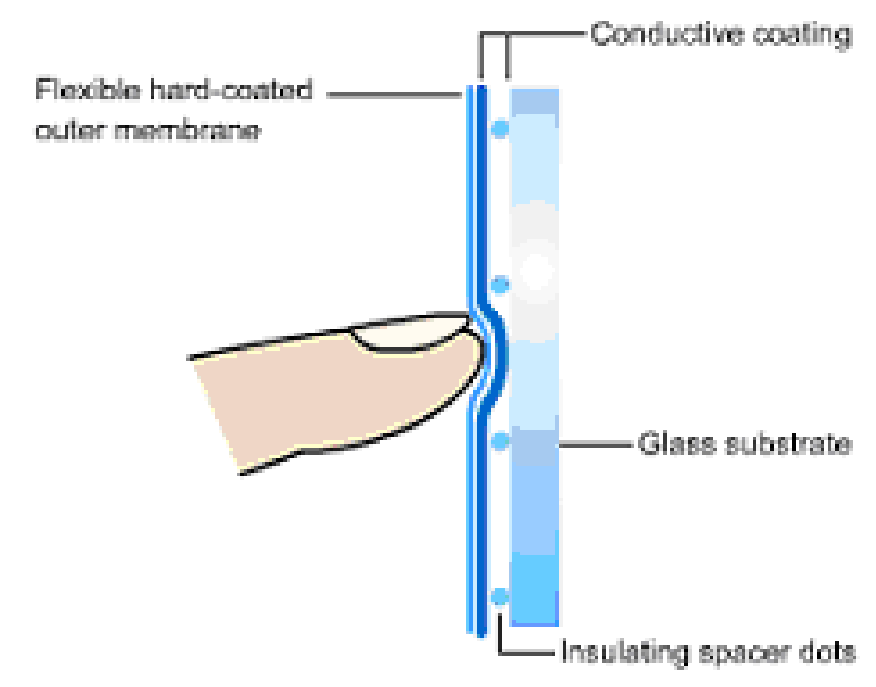
- Resistive Touch – 4 wire
  - Pro
    - Flexible screen material
    - Any material can be used for touch
    - Can be very accurate
  - Con
    - Surface easy to damage
    - Low endurance
    - Limited light transmission
    - SINGLE TOUCH

Touch Screens

- Resistive Touch – 5 wire
  - 1 layer of resistive material
  - 1 with connections at 4 corners
  - 1 layer of conductive material
  - Separated by air/spacers



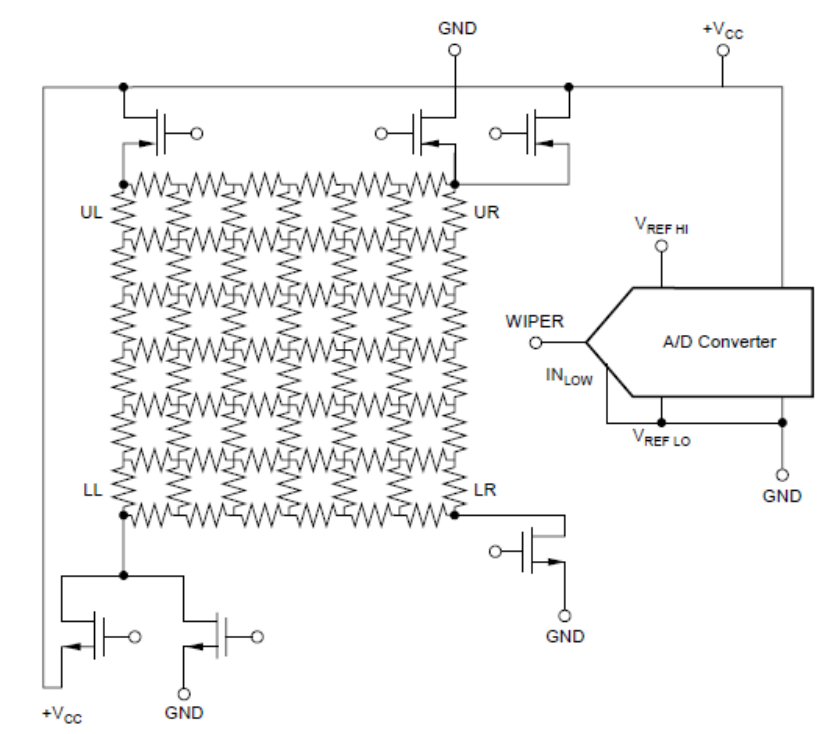
Src: ewinsonic



Src: ELO

Touch Screens

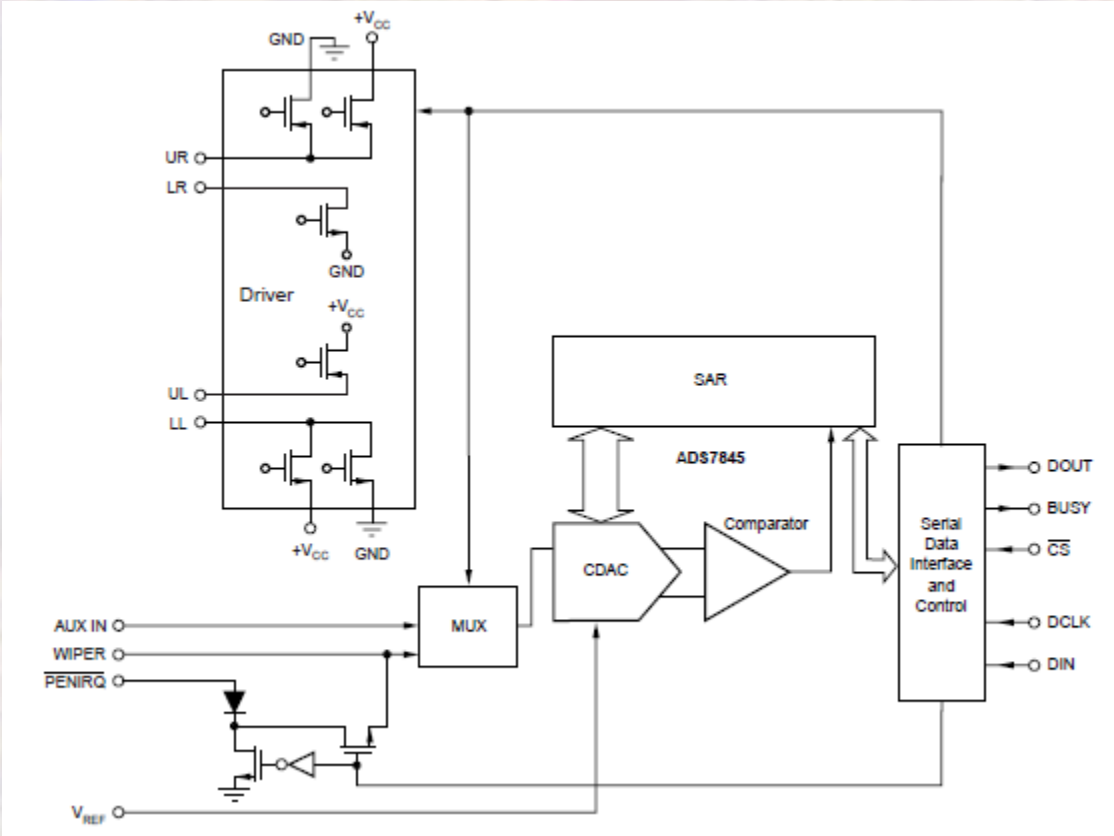
- Resistive Touch – 5 wire
  - Measure Y position
    - LR – gnd, UL - Vdd
    - LL – gnd, UR – Vdd
    - Where touched, wiper terminal will measure relative voltage
  - Measure X position
    - LR – gnd, UL - Vdd
    - LL – Vdd, UR – gnd
    - Where touched, wiper terminal will measure relative voltage



Src: TI

Touch Screens

- Resistive Touch – 5 wire



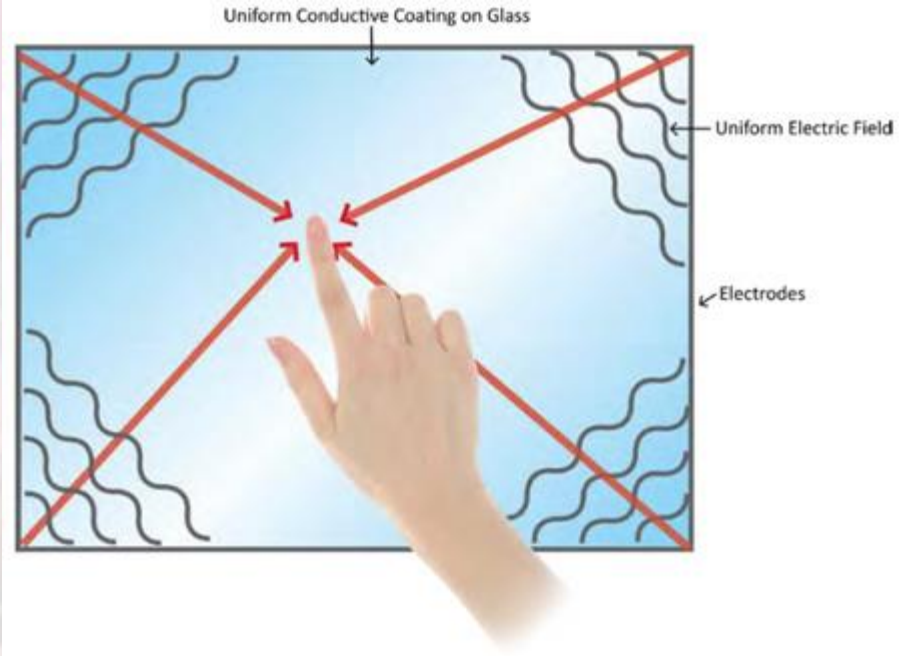
Src: TI

Touch Screens

- Resistive Touch – 5 wire
  - Pro
    - Flexible screen material
    - Any material can be used for touch
    - Can be very accurate
  - Con
    - Surface easy to damage
    - Better but still limited endurance
    - Better light transmission
    - SINGLE TOUCH

Touch Screens

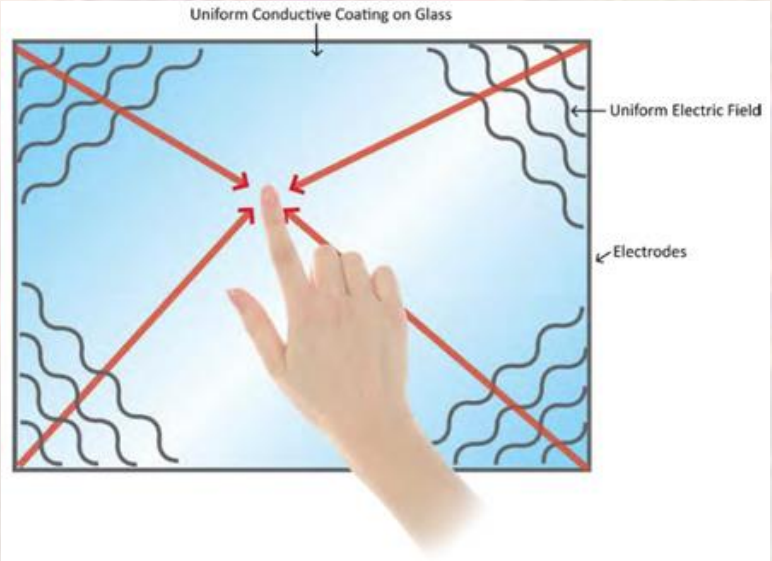
- Surface Capacitive
  - Uniform conductive material
    - On glass
  - Common voltage applied at all 4 corners → uniform electric field



  - When touched, finger modifies the field (creates a capacitor) → current from each corner
  - Calculate position based on relative current values – 1/r

Touch Screens

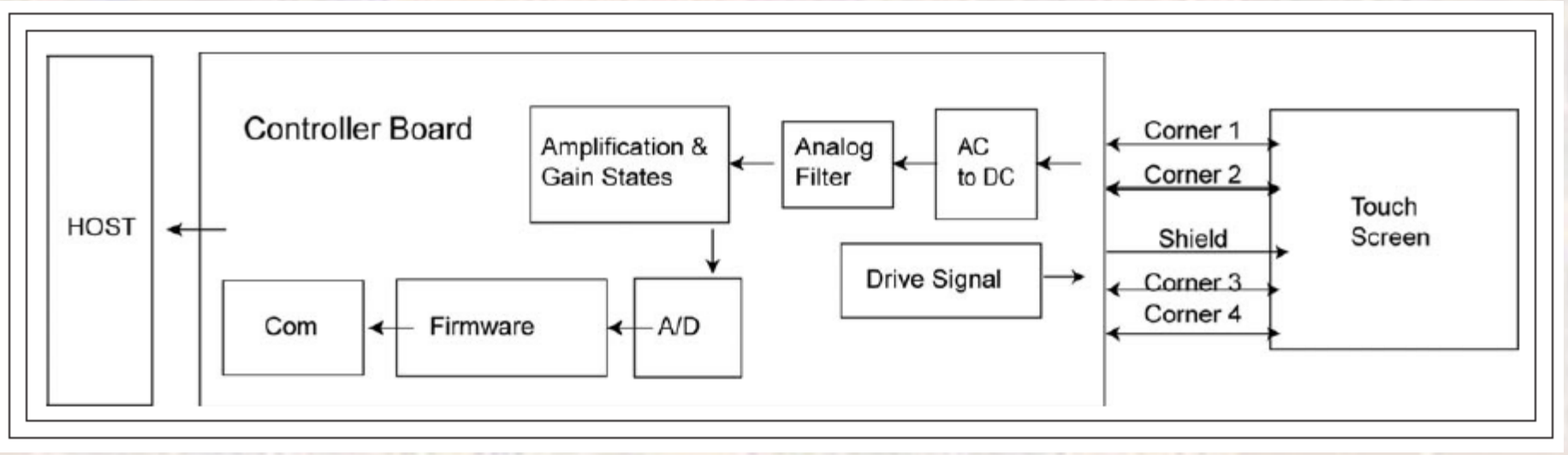
- Surface Capacitive
  - Setup a sine wave on all 4 corners
  - $i = C\, dv/dt$
  - When touched, finger modifies C
    → Δi



  - Calculate position based on relative current values – 1/r

Touch Screens

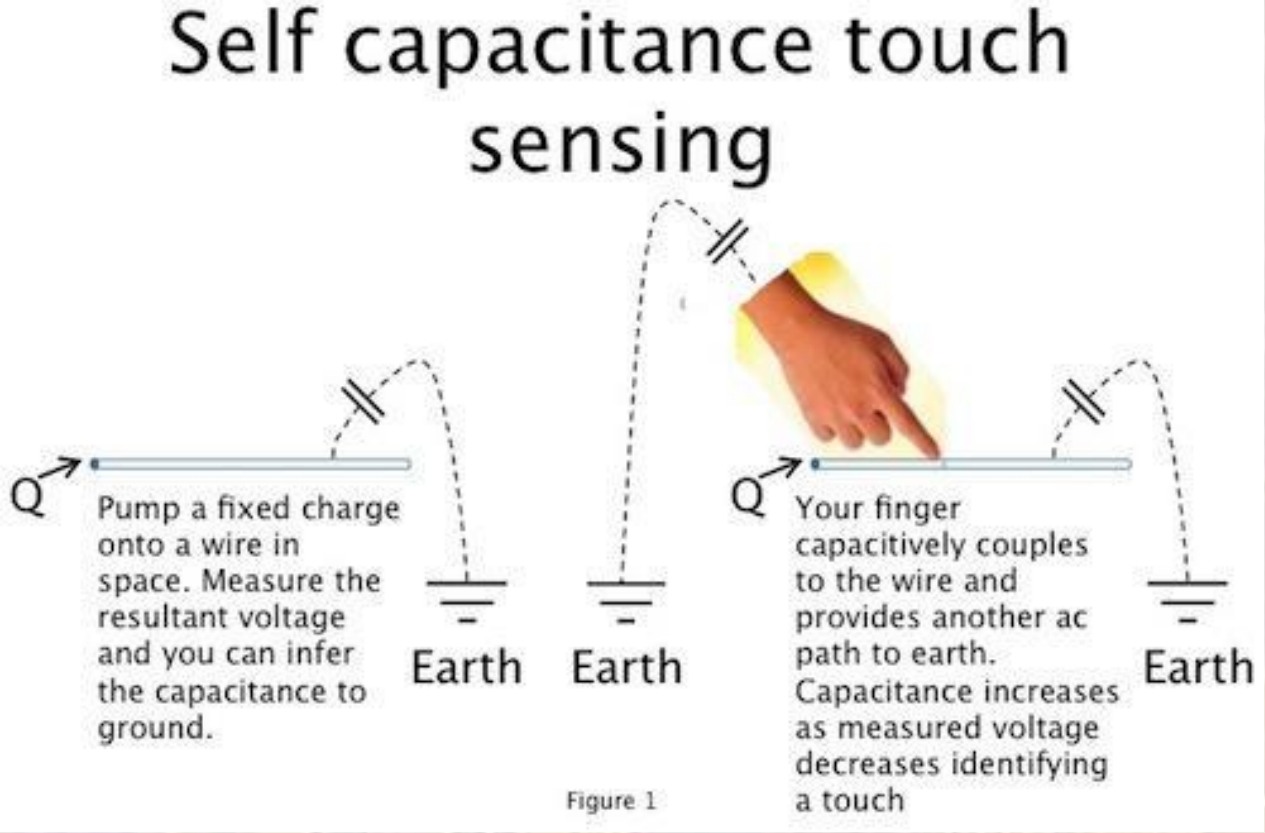
- Surface Capacitive



Src: Information Display

Touch Screens

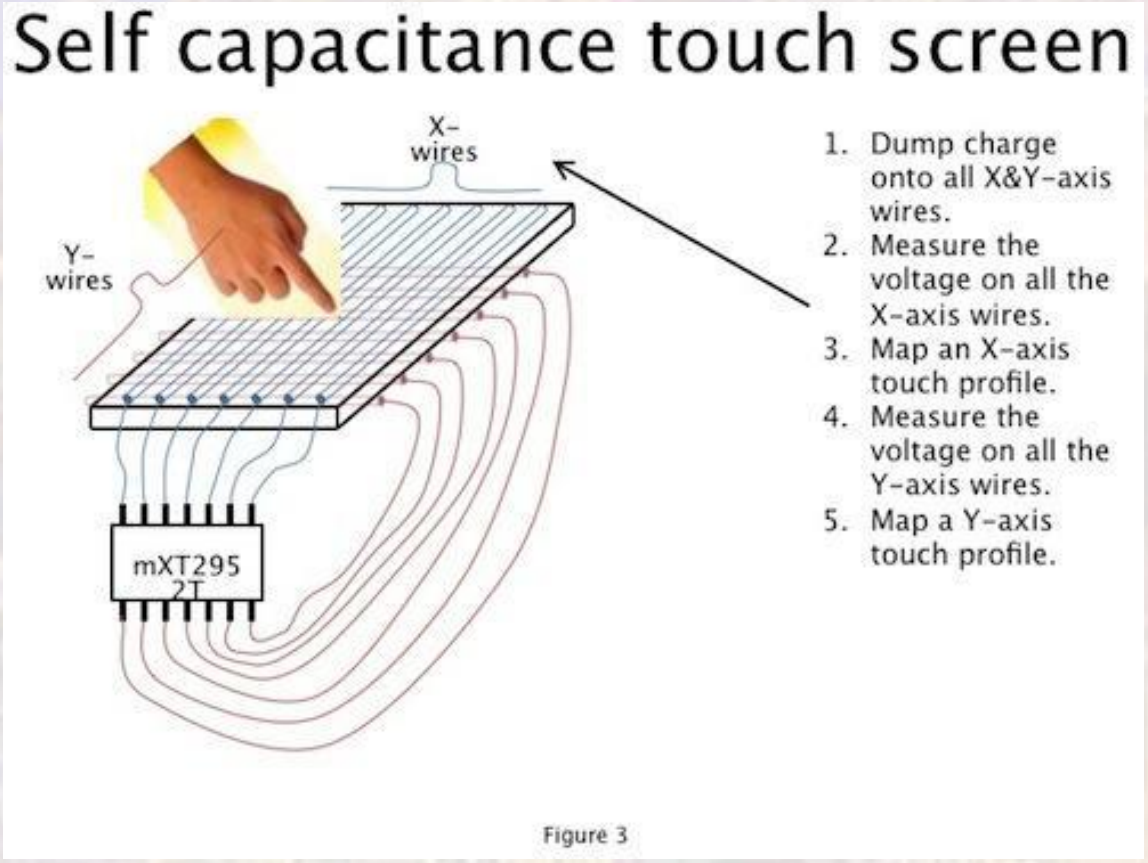
- Projected Capacitive – Self Capacitance



Src: Design News

Touch Screens

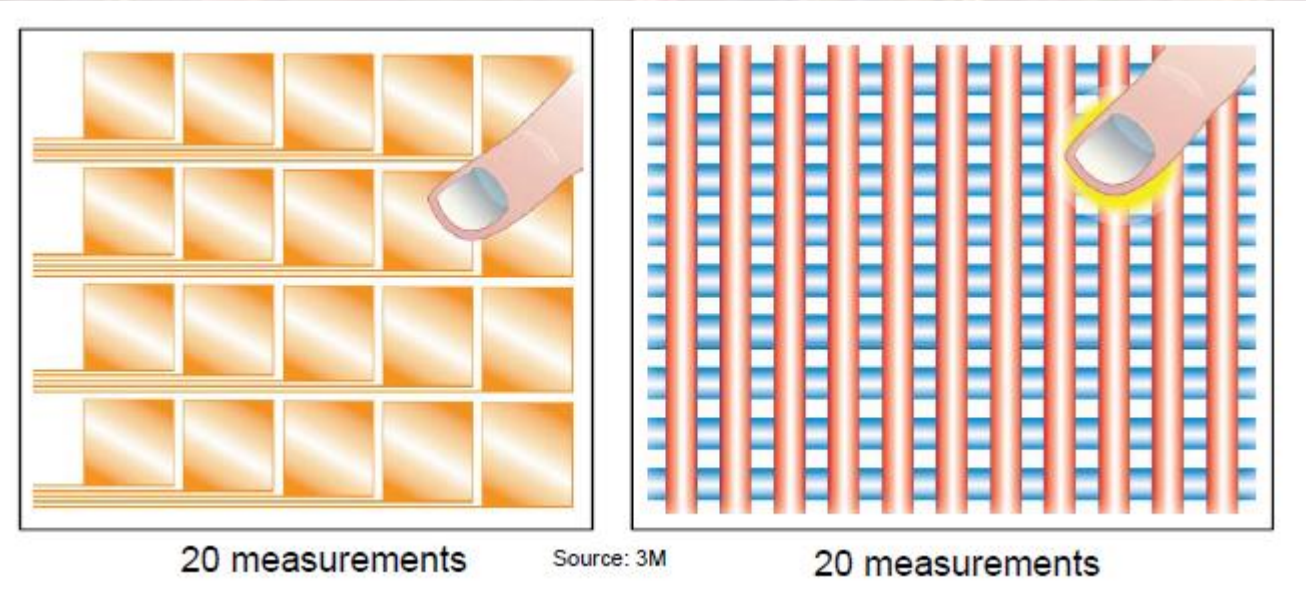
- Projected Capacitive – Self Capacitance



Src: Design News

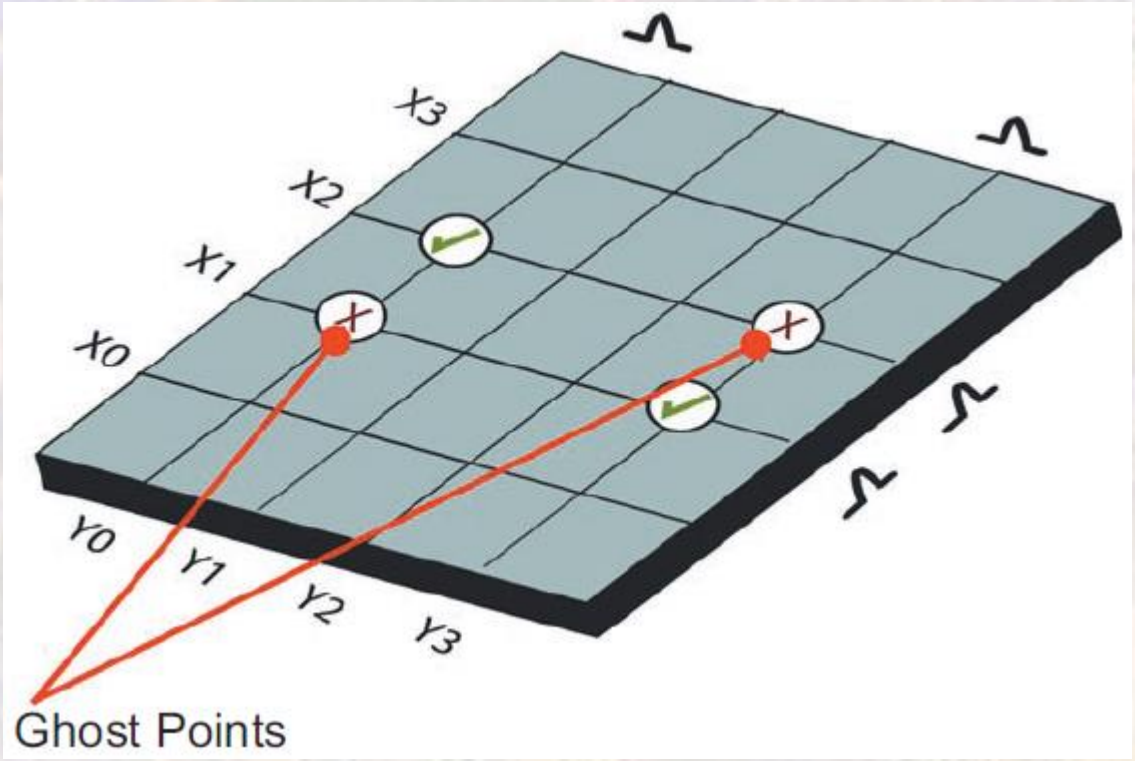
Touch Screens

- Projected Capacitive – Self Capacitance



Touch Screens

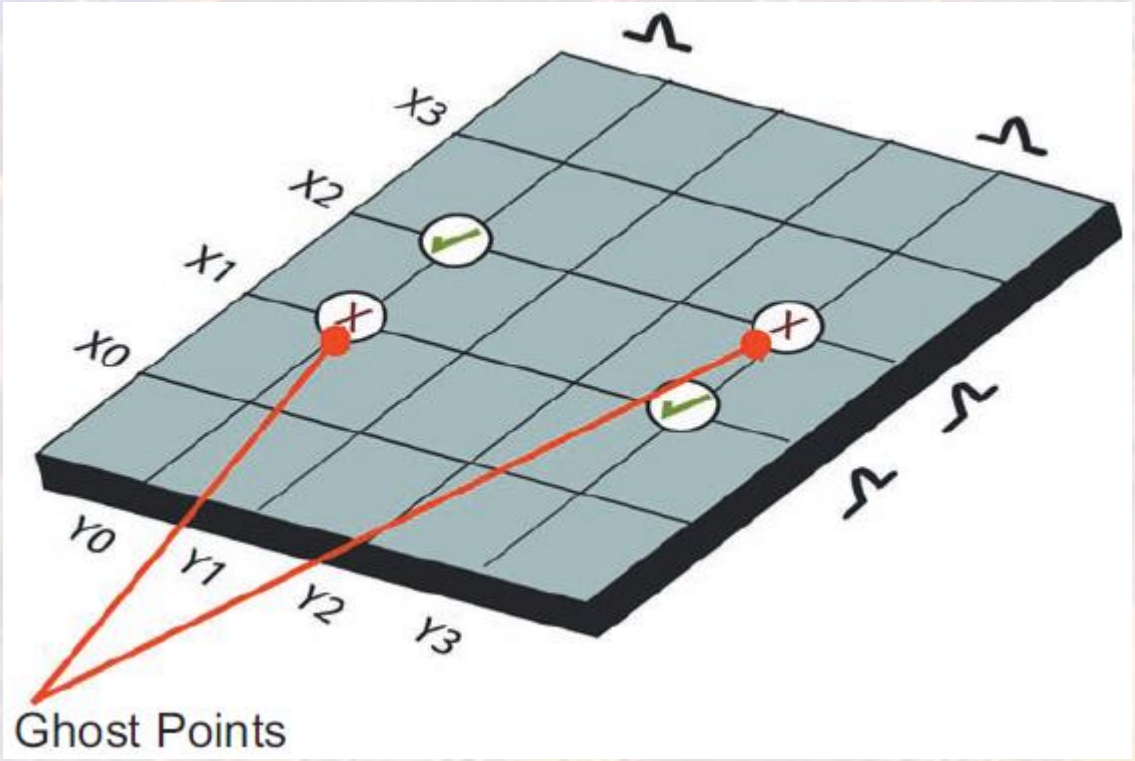
- Projected Capacitive – Self Capacitance
  - Single Touch only



Src: Stanford

Touch Screens

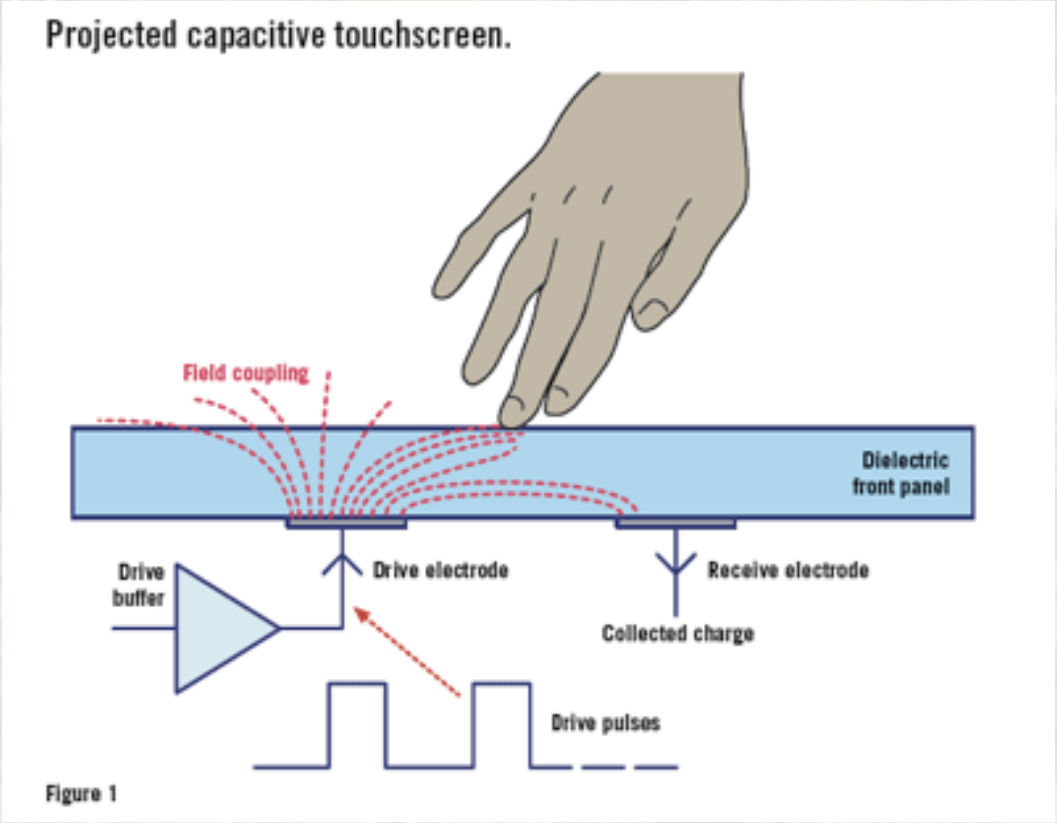
- Projected Capacitive – Self Capacitance
  - With SW can do 2 touch swipes (pinch, expand)



Src: Stanford

Touch Screens

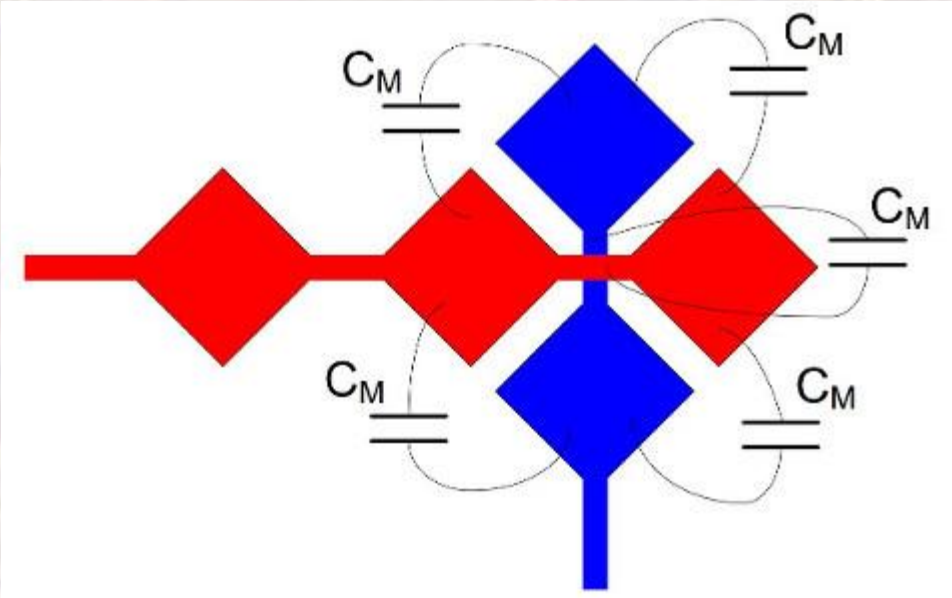
- Projected Capacitive – Mutual Capacitance
  - Reduce the apparent capacitance



Src: Embedded Design

Touch Screens

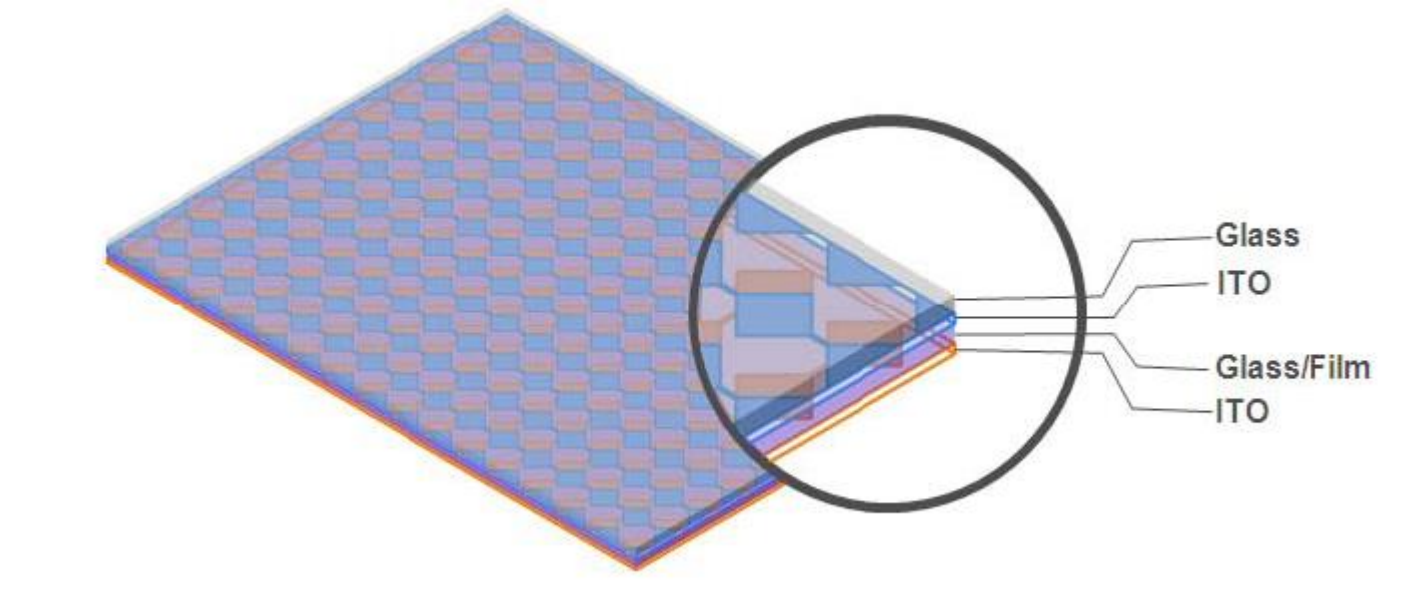
- Projected Capacitive – Mutual Capacitance
  - Single intersection – 2 layer ITO



Src Electronic Design

Touch Screens

- Projected Capacitive – Mutual Capacitance
  - Matrix Structure



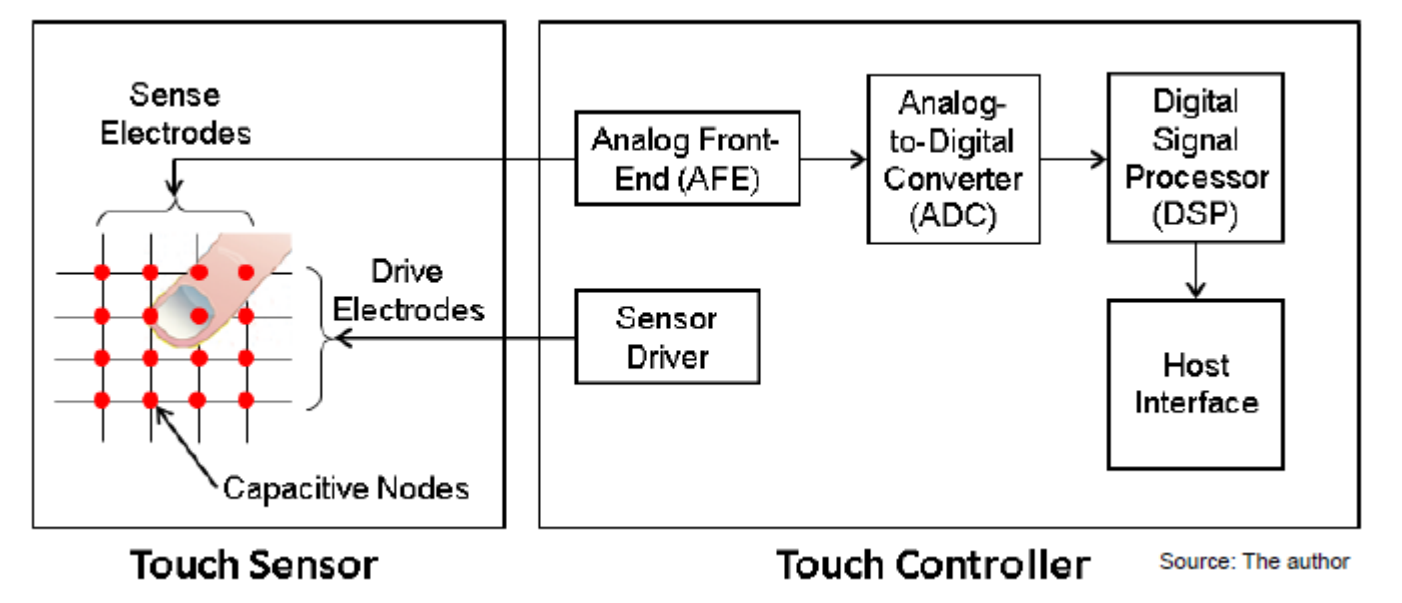
Src: Cypress

Touch Screens

- Projected Capacitive – Mutual Capacitance
  - Matrix Structure
  - Drive 1 row – Scan each column
  - Measure capacitance
  - Provides for multiple touches as each row/column can be detected
  - Operate at a 20 – 200Hz cycle rate

Touch Screens

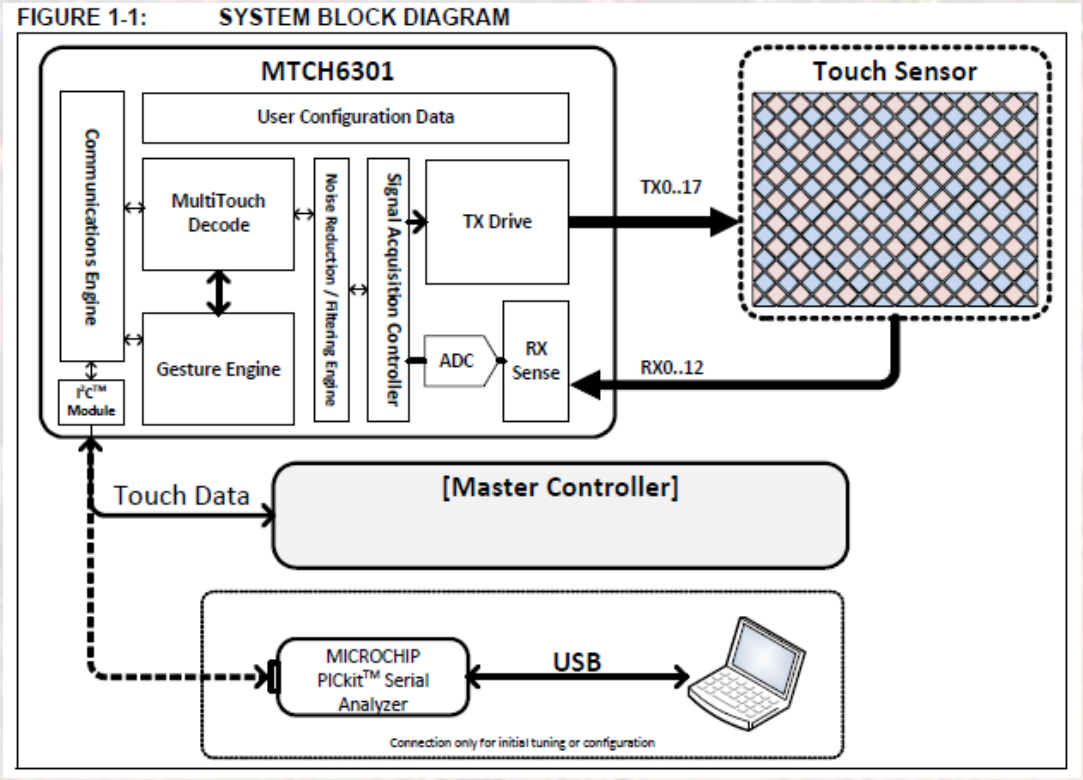
- Projected Capacitive – Mutual Capacitance
  - Controller



Src: Intel – Goeff Walker

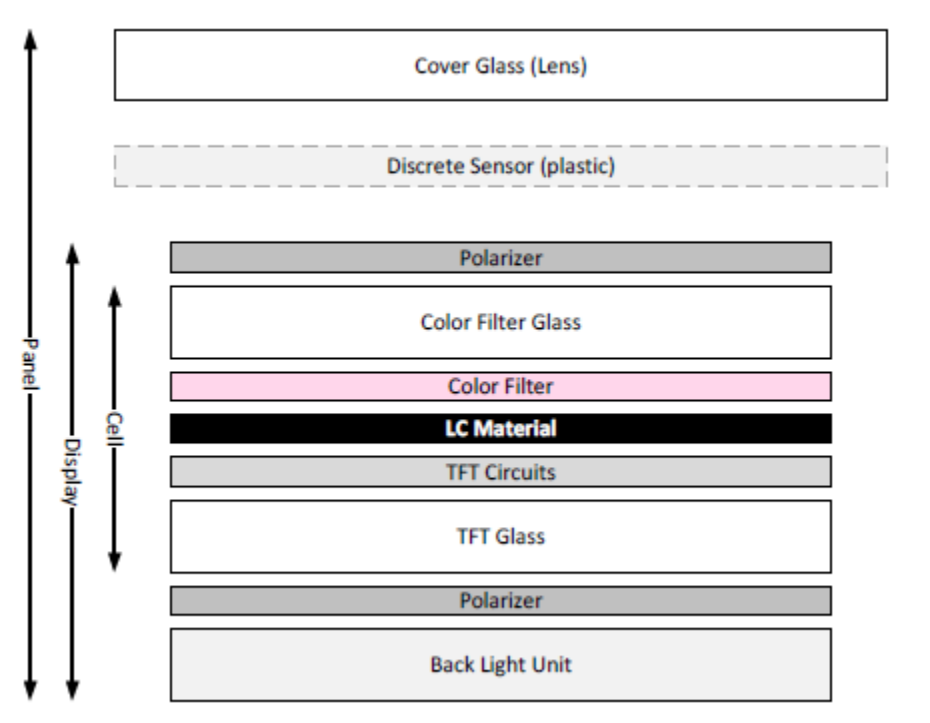
Touch Screens

- Projected Capacitive – Mutual Capacitance
  - Controller



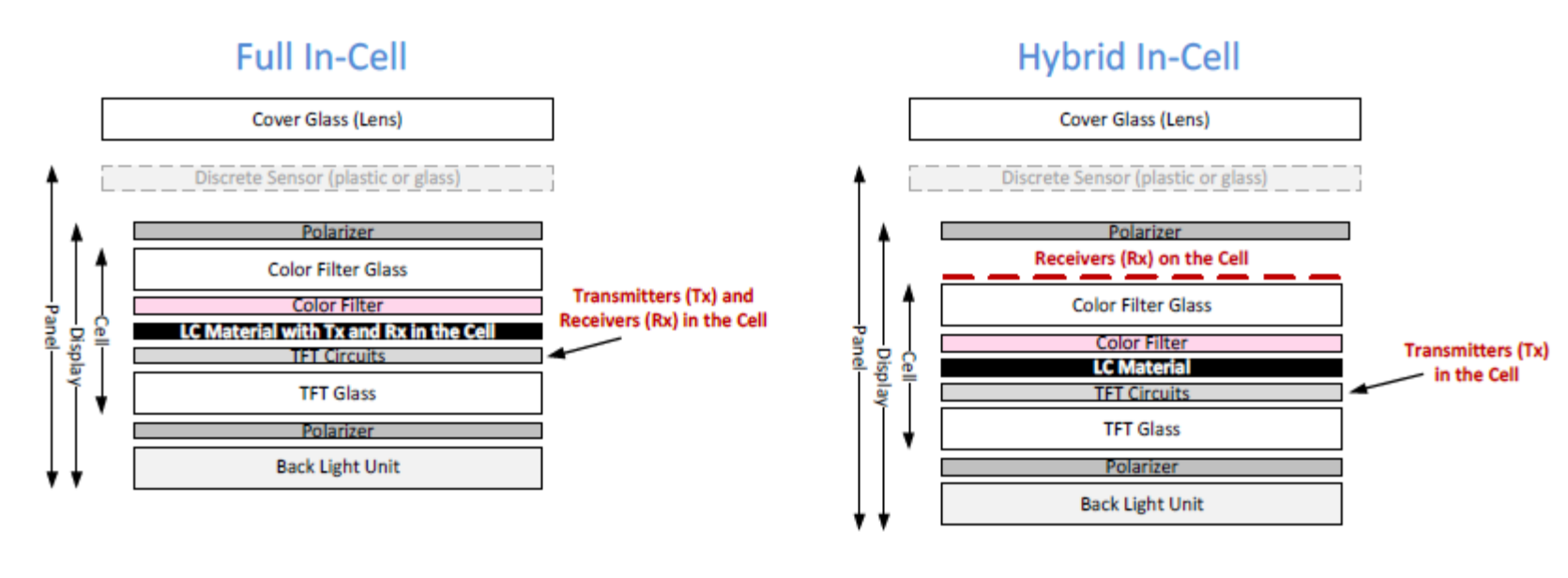
Touch Screens

- Projected Capacitive – Mutual Capacitance
  - On Panel



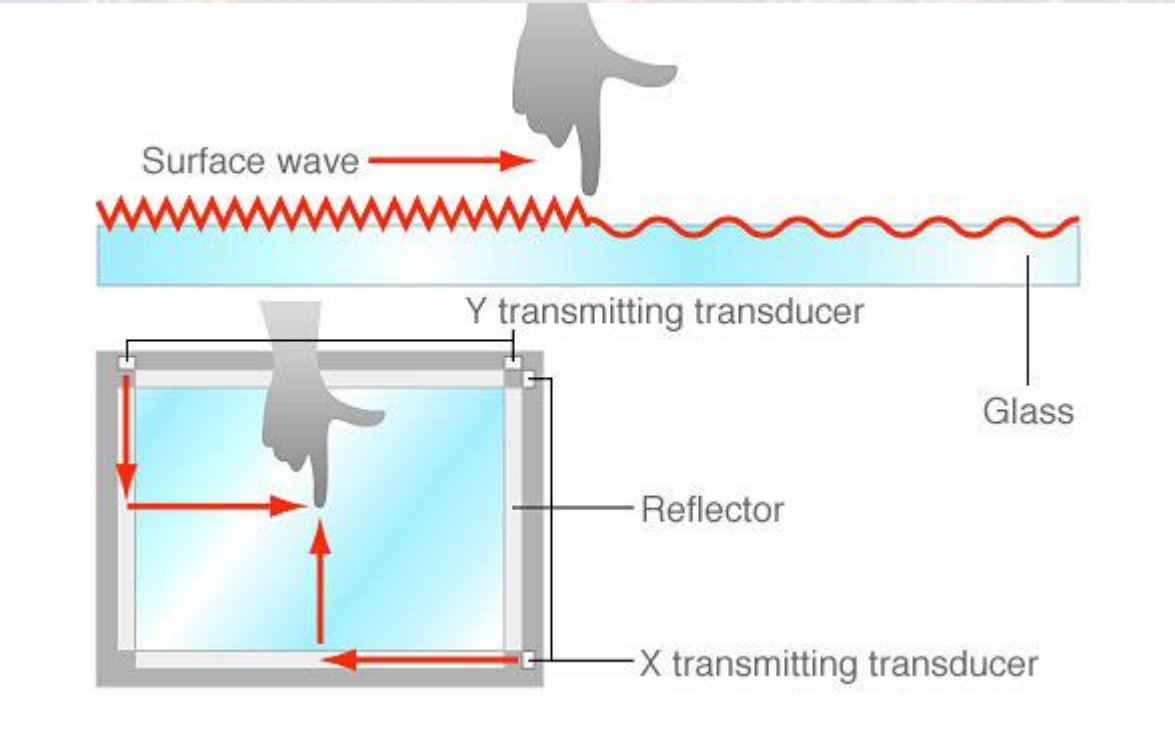
Touch Screens

- Projected Capacitive – Mutual Capacitance
  - In Cell
    - Critical to design as a part of the display – noise, interference



Touch Screens

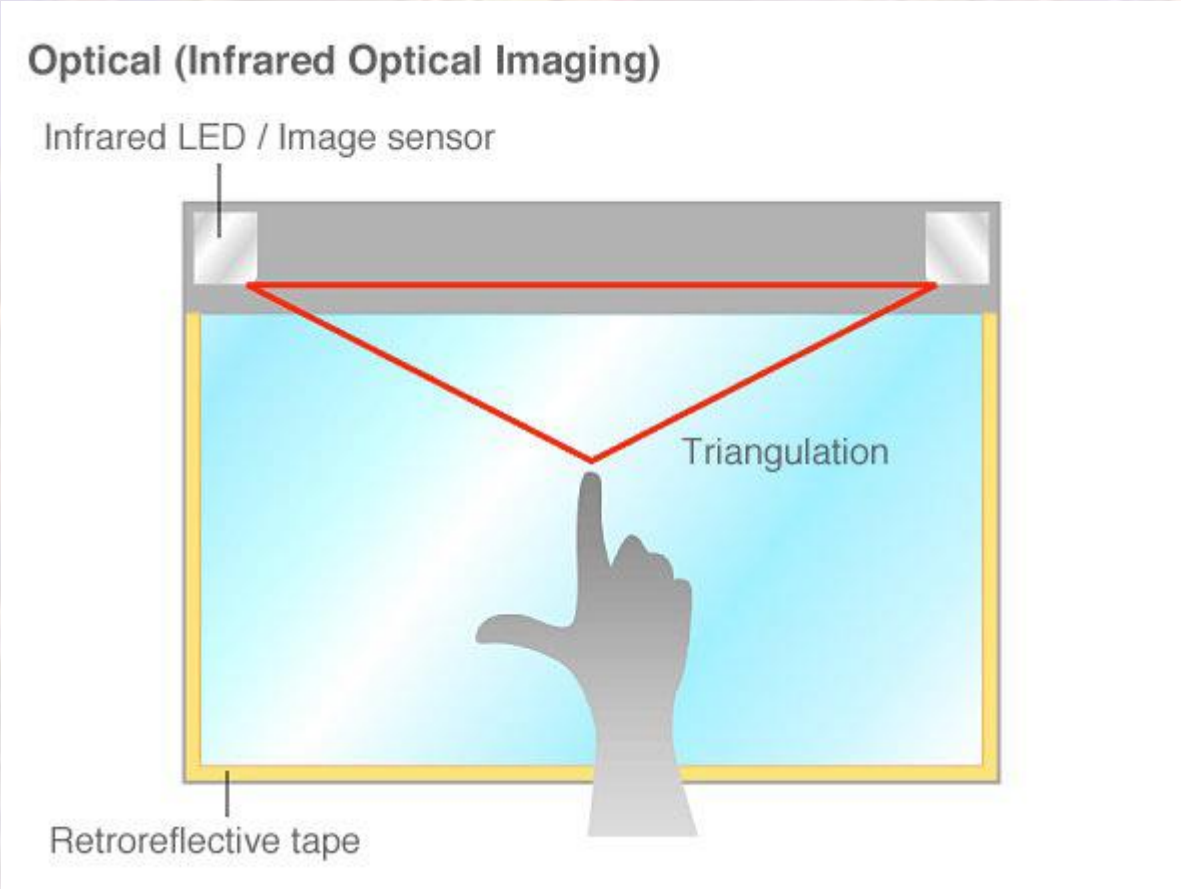
- Surface Acoustic Wave



Src: Touch Screen Basics

Touch Screens

- Infrared



Src: Touch Screen Basics

Touch Screens

- Sensor Comparison

Method	Linearity	Accuracy	Size Scalability	Optical Clarity	Damage Resistant	Multitouch
Infrared	★★★★★	★★★	★★★★★	★★★★★	★★★	Yes (expensive)
Surface Acoustic Wave (SAW)	★★★★	★★★★	★★	★★★	★★★★★	No
Surface Capacitance	★★	★★	★★	★★★★★	★★★★★	No
Resistive	★★★★	★★★★	★★★★	★★	★	Yes (expensive)
Projected Capacitance	★★★★★	★★★★	★★★	★★★★★	★★★★★	Yes

Src: Cypress