Resistive Touch

A resistive touch screen is comprised of several transparent, electrically active, and mechanically supporting film layers. To enable the touch screen functionality, two parallel transparent electrically-conductive layers are separated mechanically by micro transparent spacer dots, which creates a thin gap between the two conductive layers. When a force acts upon the top surface of the touch screen, such as a finger press, the two electrically-conductive layers physically come into contact with each other at the location of the pressure (touch). Voltage is constantly applied to one of the electrically conductive layers, so when a touch event occurs, the two layers are electrically connected. The touch screen controller then determines the position of the touch event by measuring the voltage on the x and y axes in one or more quadrants of the touch screen, and compares that to the original voltage applied. The position of a touch can then be determined though use of both the voltage divider law and the known resistance per square of the electrically active film layers.

A resistive touch screen is used in many applications where display interaction is a requirement. Such applications can include, but are not limited to, restaurants, factories, hospitals and military equipment. An advantage of resistive touch technology is low cost, due to design simplicity. In general, resistive touch screens can be the most cost effective option. Another advantage of a resistive touch screen is its reliance on mechanical pressure to register a touch event. This mechanical pressure requirement allows the user to interface with the touch screen using any mechanical method available from finger to glove to stylus. A third advantage of a resistive touch screen is electrical robustness. Due to the intrinsic principals of operation, resistive touch screens are immune to most electrical interference and can be electrically isolated for use in high voltage environments. A disadvantage of a resistive touch screen is the chance for physical damage that could occur if the user applies excessive pressure or sharp instruments in an attempt to register a touch event.

A second disadvantage of a resistive touch screen is poor readability in outdoor applications or direct sunlight. Internal reflections are created due to the many electrically active and mechanically supporting film layers; these reflections obscure the original displayed image.

General Digital has addressed the aforementioned shortcomings of the resistive touch screen with the methods outlined below.

Readability in outdoor applications is enhanced through the use of a circular polarizer integrated into a touch screen assembly. The circular polarizer removes internal reflections—caused by light reflecting off of the electrically active and mechanically supporting film layers—by blocking and absorbing them before they reach the observer. This removal of reflections dramatically increases contrast and, by extension, display readability in bright daylight conditions.
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The risk of physical damage to the front surface is reduced by moving to a glass-film-glass design. The standard hard-coated plastic film front surface of the touch screen is replaced by an antireflective scratch resistant hardened 0.1 mm to 0.3 mm glass overlay. This overlay not only causes the touch screen to be more scratch resistant, but also adds additional strength in heavy impact and/or military applications.

Some advantages of resistive touch screens:

- **Top Surface Glass Thickness:**
  - 0.1mm~0.3mm (chemically strengthened)
  - >7H hardness
  - Scratch resistant
  - Adds additional strength in heavy impact or military applications
- **Top Surface Plastic (ITO Layer):**
  - 100-150 um
- **Bottom ITO Layer (Glass):**
  - 0.7, 1.1, 1.8mm (chemically strengthened)
  - Adds secondary layer of strength in heavy impact or military applications
- **Size Dependent**
- **Stylus or Finger Input Mode**
- **Reflectance (measured per MIL-L-85762A):**
  - Specular: <1.2% at 30 Degrees
  - Diffuse: <0.1% at 30 Degrees
- **Outdoor Readability**
- **Transparency:**
  - 68~72% with compensation of retarder film
- **Operation Force:**
  - Stylus = R0.8mm, normally < 1.5 lbs. (static pressure)
- **Boot Impact:**
  - Perpendicular force of 285 lbs. ±15 lbs.
  - Rectangular contact striking surface (rubber, leather, or equivalent) measuring 1.0 ±0.2 x 0.5 ±0.1 inches
- **Ball Drop Test:**
  - 2 oz. steel ball dropped from 30°, 3 times
- **EMI Micromesh (MIL-STD-461E) can be Added to the Touch Stack Up as an Option**
- **MOPPS Gloves Applicable**
- **Temperature:**
  - Operating: -30° C ~ 70° C
  - Storage: -40° C ~ 80° C
- **Humidity:**
  - Operating: -20%~90% RH
  - Storage: -20%~90% RH
- **Single Touch Point**

While the cost of circular polarized glass-film-glass touch screens can be more expensive than standard resistive touch screens, the additional layer of protection together with the reduction of internal reflections and added robustness for extended temperatures, make the GFG CP an ideal candidate in military, industrial and medical applications.

**Capacitive Touch**

A capacitive touch screen operates on the principals of a parallel plate electronic capacitor—two conductors separated by a dielectric layer. The capacitive touch screen consists of an insulator, such as glass, coated with a transparent conductor, such as indium tin oxide (ITO). When charged, this coated insulator creates one plate in the parallel plate capacitor arrangement. The corresponding plate is formed by the environment around the touch sensor. A capacitance is then established that is constantly monitored by the touch controller. Touching the surface of the screen creates a distortion of the screen’s electrostatic field and increases the measureable capacitance. It is this increase in capacitance in a specific area of the touch screen that allows the touch controller to determine the action and position of the touch event.

An advantage of a capacitive touch screen is excellent readability in outdoor applications or direct sunlight. Because of the single layer construction, no internal reflections are present; this dramatically increases contrast and, by extension, display readability in bright daylight conditions. A second
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Advantage of a capacitive touch screen is the zero force requirement to register a touch event. This allows for a more enjoyable and fluid user experience on devices such as kiosks or ATMs. A third advantage of a capacitive touch screen is its mechanical robustness. As it has no moving parts, it is more robust than a resistive touch screen which requires mechanical actuation on a touch event.

Lastly, capacitive touch screens allow multiple touch events on one panel allowing the user to accomplish tasks such as pinch-to-zoom. Unlike a resistive touch screen, one cannot use a capacitive touch screen through most types of electrically insulating material, such as gloves. This disadvantage especially affects usability in consumer electronics, such as touch tablet PCs and capacitive smart phones in cold weather. It can be overcome with a special capacitive stylus, or a special-application glove with an embroidered patch of conductive thread passing through it and contacting the user’s fingertip.

Some advantages of capacitive touch screens:

• Single Finger or Stylus Input
• High Impact
• Scratch Resistant
• No Drift
• Unaffected by Rain or Moisture
• Light Touch to Activate
• Temperature:
  – Operating: -20°C ~ 70°C
  – Storage: -40°C ~ 85°C
• 90% + Transparency
• >7H Hardness

Projected Capacitive Touch
Projected Capacitive Touch (PCT or PCAP) technology is a variant of the aforementioned capacitive touch technology. PCT touch screens are made up of a matrix of rows and columns of conductive material, layered on sheets of glass. This can be done either by embedding micro thin wires between two dielectrics, etching single or multiple conductive layers, such as an ITO, to form a grid pattern of electrodes. A time-varying voltage is applied to this grid to create a uniform electrostatic field, which is measured by the touch controller. When a conductive object, such as a finger, moves into the vicinity of this field, it distorts the field at that point. This change in the electrostatic field is measurable by the touch controller as a change in capacitance. Therefore, this system is able to accurately track touch events and position.

An advantage of a PCT is the ability to produce a more robust solution that is less costly than a comparable resistive touch solution. Additionally, unlike traditional capacitive touch technology, it is possible for a PCT system to sense a passive stylus or gloved fingers that a standard capacitive touch screen would be unable to detect. However, moisture on the surface of the panel, high humidity, or collected dust can interfere with the performance of a PCT system.

Some advantages of Projected Capacitive Touch:

• 2-10 Finger Touches
• 10.4”~42” Display Sizes
• Best Overall Look Similar to Smartphones
• Low Cost
• Winter Gloves, Industrial Heavy Duty Gloves, and Outdoor Gloved Hands Operable (Size Dependent: up to 10.4” Diagonal)
• Works with Water
• Drift-free Coordinates
• Scratch Resistant
• Optional EMI Design
• 85% + Transparency
• -20°C ~ 70°C Operation Temperature
• -40°C ~ 80°C Storage Temperature
• <7H Hardness