

## An Island-based EMI Solution Guide for Mobile Hand Held Devices

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The Hawaiian Islands are beautiful. So is a “Hawaii” based set of solutions for EMI issues common to the new Mobile Hand Held (MHH) devices.

The Hawaiian Islands have three “Big” islands that are visited most often. The mobile handheld device (MHH) has three “Big Design Islands” that are most commonly visited for next generation improvement. The “Big” MHH islands most visited in the journey to next generation devices include projected Capacitive (PROCAP) touch sensors; faster processor to allow increased device functionality and speed; and antenna optimization to ensure connectivity on any island.

To ensure a timely design solution to meet each of the design goals, it is imperative that the design engineer understands that each of the above desires is dependant upon a robust EMI set of solutions.

### **Projected capacitive touch sensor display**

Step one begins with the projected capacitive (PROCAP) touch display. This type of display interface is selected for many reasons, including multi-touch capability, speed, sensitivity and overall functionality.

An effective PROCAP sensor can face many integration challenges since it is a “conductive circuit” that can appear to look like an antenna, be in close proximity to other electrical devices and be near metal surfaces that can all impact the sensor's performance.

Solutions to optimize the PROCAP sensor include the integration of three key material sets:

**1. Unpatterned Transparent Conductors (UTC).** To reduce the affect of internal device generated EMI noise that can impact the PROCAP sensor, the use of Second Generation Unpatterned Transparent Conductors (SG-UTC) for EMI Shielding is recommended.

The SG-UTC films are placed between the display and the PROCAP sensor because this is the common EMI noise source direction. These SG-UTC films are a transparent PET film with a conductive coating that has been optimized not only for EMI shielding, but color, haze and reflection characteristics. Many SG-UTCs are designed to offer excellent performance for PROCAP sensor designs and can offer a range of EMI shielding and transparency performance to allow optimization of the overall display for PROCAP sensor performance and transparency.

### **2. PROCAP sensor E-field normalization and guard layer for PROCAP**

**sensor optimization.** Patterned transparent conductor (PTC) films or the SG-UTC films can offer “E-field normalization” of the PROCAP sensor by using the SG-PTC or SG-UTC film in the display stack near the PROCAP sensor. The Second Generation PTC films can also be used in the PROCAP sensor to replace the current generation of Indium Tin Oxide (ITO) based sensor designs.

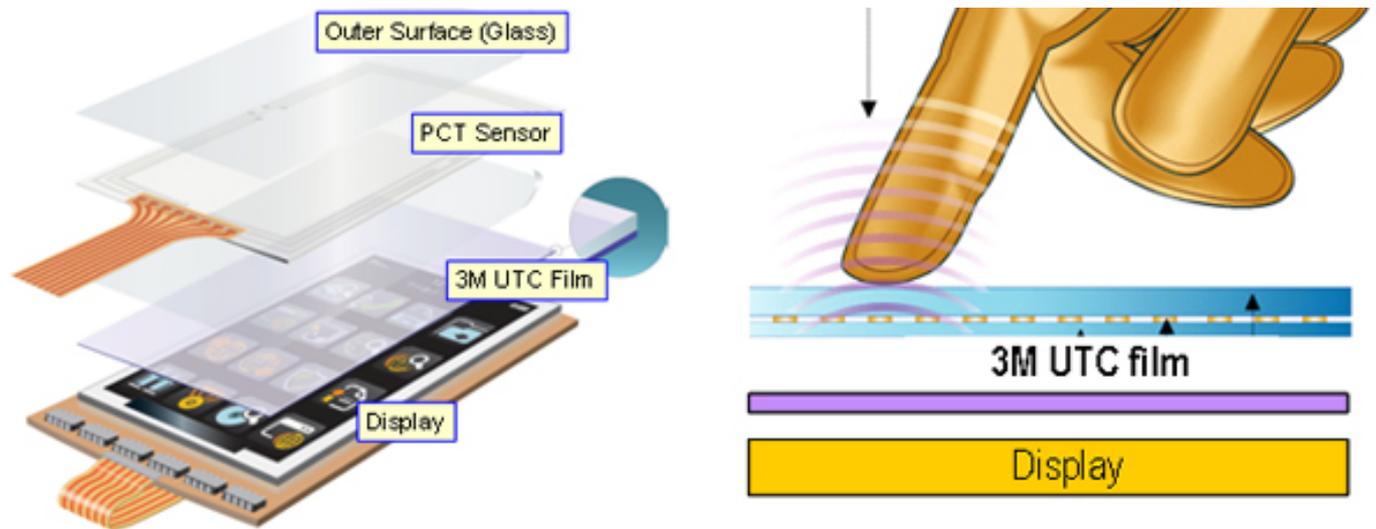
The SG-PTC or SG-UTC films can act as PROCAP sensor “E-field normalization” or “Guard” layer films. Since the PROCAP sensor can have areas that are “electrically far or near” from other conducting surfaces (metal frame, bezel edges) the capacitance or inductance can vary across the PROCAP sensor. The SG-UTC or SG-PTC can be used as an “E-field normalization” film or “Guard” layer that modestly interacts with the PROCAP sensor array and unifies circuit performance across the sensor, much like metal layers are used near flat flex cables to influence circuit impedance levels to optimize performance. With reduced variability of the PROCAP sensor due to “environmental capacitance or inductance”, the PROCAP sensor can have improved response & sensitivity along with a more simplified software and hardware integration.

To enhance the PROCAP sensor design to reduce variability and improve sensitivity, the Second Generation PTC (SG-PTC) can be considered for the PROCAP sensor design. The SG-PTC film is patterned per a PROCAP sensor X-Y grid design and offers the potential for lower resistance traces along with excellent transparency versus comparative ITO sensor designs. The SG-PTC sensor design could offer a lower RC time constant, thereby enabling a faster sensor, particularly in displays sizes of 8" or more. Some SG-PTCs can also offer improved flexibility and narrower interconnect width versus a typical ITO based touch sensor.

The SG-UTC and SG-PTC films also can offer Electro-Static Discharge (ESD) reduction for the display. The edges or perimeter of a design can allow ESD to spark paste a bezel edge and enter the device leading to potential ESD damage. The SG-PTC or SG-UTC films are below the bezel, but in front of the display and other electronics and could offer a path for the ESD to travel versus the more sensitive electronics of the device.

### **3. EMI shielding or EMI absorbers used to reduce internal EMI noise**

**sources.** EMI Shielding foil, such as the a Copper foil tape could be used to minimize EMI noise leakage. In addition, and often a better solution is the use of EMI absorbers, such as those offered by 3M, to lower the EMI noise levels of a device. Absorbers are good solutions to reduce the EMI noise from a chip or signal line. The absorber converts the EMI energy to a negligible amount of heat as they reduce the EMI energy from the source. Some absorbers are supplied with an adhesive backing so each of application is assured.



**Typical projected capacitive touch sensor with UTC Film in a display stack assembly.**

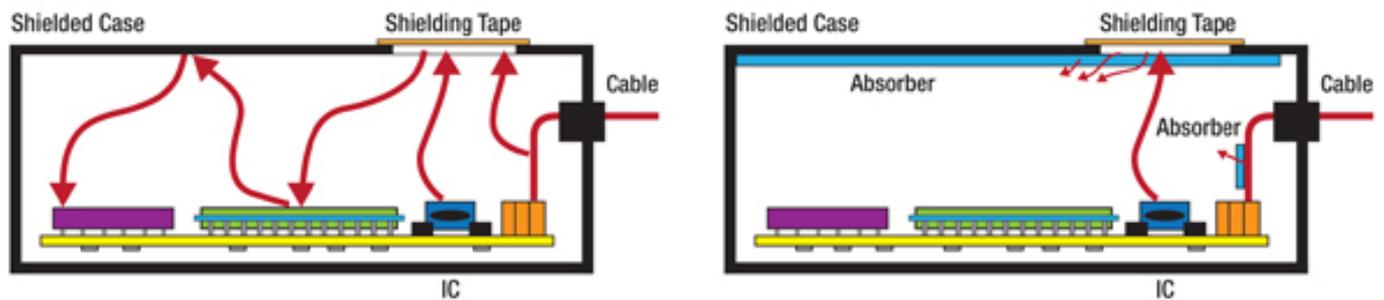
## **Faster Processor**

To achieve the full benefit of the faster processor, it is key that the engineer understands what the speed will bring:

- A faster processor means higher frequencies leading to overall lower signal to noise (s/n) ratios
- Lower s/n ratio means that EMI noise levels must be reduced, or error rates will increase

A lower EMI environment can be accomplished with improved EMI reflective shielding materials- such as the latest generation of copper foil tapes or the new generation of conductive fabric solutions that are laminated with a conductive adhesive that allow for improved conformability, puncture resistance and ease of use.

EMI "reflective" shielding solutions are now being complemented with EMI "absorbing" materials in enclosures that experience near field EMI. These materials act like "acoustic absorber" sealing tiles or carpet in a room that is too loud acoustically. By adding EMI absorbing sheet materials into an EMI environment, the EMI noise is absorbed and reduced, improving the system performance. As a guide, start the initial evaluation with a high performing absorber, maximum thickness and largest area allowed to establish a baseline of potential performance. Some absorbers have high permeability and thus provides excellent performance, while others offer a more economical absorber with a shifted permeability level, so it may meet the required effective performance levels.



**EMI enclosure solutions using only EMI shielding tapes or with EMI absorbers.**

As frequencies rise, the need for reduced device internal electrical bias is needed. Lower contact resistance can reduce bias and improve the Faraday cage performance and seal any leaks via slits or slots established by ground points. Lower electrical bias in a system can minimize internal radiated RF signals generated on the system structures that do radiate and can impact s/n of the data transmitted via a flexible circuit.

Electrically Conductive Adhesive Transfer Tapes (ECATT) can improve device grounding. As the ECATT affects adhesion, grounding resistance level, shock and vibration performance, reliability with environmental aging, EMI shielding in the bond line, rework and surface contact conformance, each application must be optimized for which ECATT product best meets the end user grounding and EMI shielding design goals.

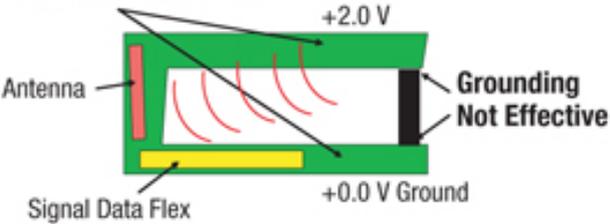
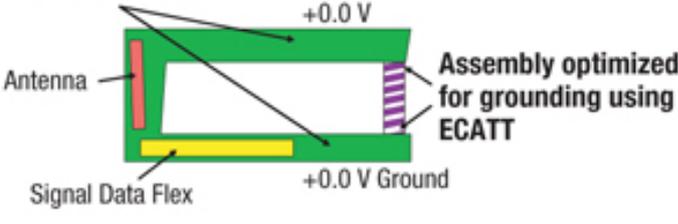
Pictorial Design	Thickness (µm)	Z or XYZ Conductivity (Based on 3M Test Method)	Features, Advantages, and Benefits
	50	Z	Z-Axis, Standard Adhesion Acrylic adhesive, Silver Conductive Filler.
	50	XYZ	XYZ, "Bond Line Gap/Slit" EMI Shielding for High Frequency, Low contact Resistance to Stainless Steel, Improved Contact R conformance.
	66	XYZ	XYZ, Double Coated Aluminum foil, Medium Adhesion Acrylic Adhesive, Nickel Conductive Filler.
	50	XYZ	XYZ, Non-woven Conductive Scrim, Low Contact Resistance to Stainless Steel, Higher Adhesion Acrylic Adhesive.

**An overview of electrically conductive adhesive transfer tape solutions.**

**Antenna performance**

Antennas collect EM energy and deliver it to a device to allow interpretation of the signal. Thus "signal to noise" (s/n) ratio is important for antenna collected data. The internal RF radiated noise of the "device" collected by the antenna can reduce the s/n, so reducing internal device bias is needed. ECATT can offer an effective means to reduce device bias.

## Is Grounding Bias degrading your antennae?

Problem	Solution
<p><b>Electrical Bias Degrades Performance</b></p> <p><b>Internal Device Bias</b></p>  <p>If device is not well grounded, the “bias” voltage in the device acts as a “transmitter” of a signal that the signal line flex, antennae flex, etc. pick up, leading to poor performance.</p>	<p><b>Effectively Ground Device</b></p> <p><b>No Device Bias</b></p>  <p>Device is well grounded so the “bias” voltage in the device is “baseline” and no “RF signal” is emitted.</p>

**Improve antenna performance/sensitivity by reducing device internal electrical bias.**

### Conclusion

The understanding of the three “Big Islands” of MHH design: PROCAP Sensor, Faster Processor, Antenna Optimization and their associated EMI solutions assures a grand time on the big islands with time to do some surfing with the new PROCAP sensor display while playing a high speed video game all the while far from the city.

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