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System Assembly Rule

For EETI PCAP solution



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-	2014/07/17	Update EETI document form.
-	2014/08/11	Re-arrange chapters and add FPC tail descriptions.
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Introduction

Capacitive touch technology is sensitive to environment. A stable and reliable touch performance needs a good combination of touch sensor design, firmware tuning, system assembly and environmental interferences consideration.

The fundamental characteristic to a PCAP touch solution is the stray capacitance, which is mainly come from the gap between the touch sensor and LCD. The humidity and temperature change will also affect stray capacitance.

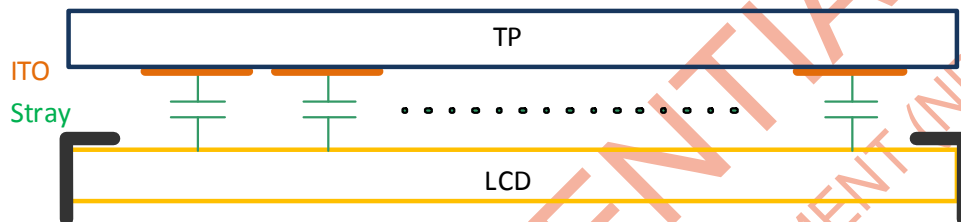


Figure 0. Gap between TP and LCD provide a basic reference stray

In order to optimize the touch performance with EETI PCAP solution, the system integrators must follow this guide for system integration.

1 Bonding

The bonding method decides the most parts of stray capacitance in a touch system. There are two touch sensor and LCD bonding methods, **air bonding** and **direct bonding**.

1.1 Active Area Mapping

Before going to bonding method, the first rule of bonding is the active area mapping. In order to keep all the sensing and driving channels to have similar stray capacitance, the ITO sensing pattern of sensing channels close to the edge must not overlap with LCD metal frame or other conductive parts. Overlapping with LCD metal frame or conductive parts (with and without ground) may cause significant signal difference between the center area and the edge area, and degrade the touch performance and interference immunity.

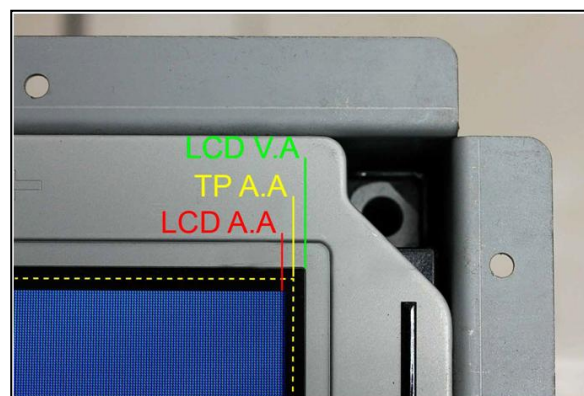


Figure 1-1. ITO should not overlap with metal frame

1.2 Air Bonding

Air bonding is to separate touch sensor and LCD by air gap. There will be a gap between the touch sensor and the LCD. When using air bonding process, the target is to make system integrator must be careful about:

- **Newton Ring**

Sensors with thin cover glass might be deflected or bended when finger pressed. Due to the optical reflection, such deflection may cause Newton ring if without any treatment.

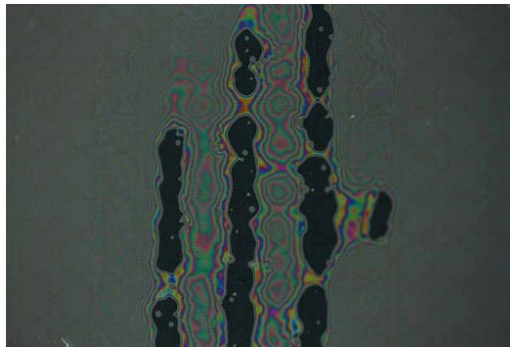


Figure 1-2. Newton Ring after sensor bending.

- **Signal Distortion**

The stray capacitance will change due to such deflection. eGalaxTouch solution may tolerate the stray capacitance change in a continuous way, but not if it is in an irregular or sporadic way.

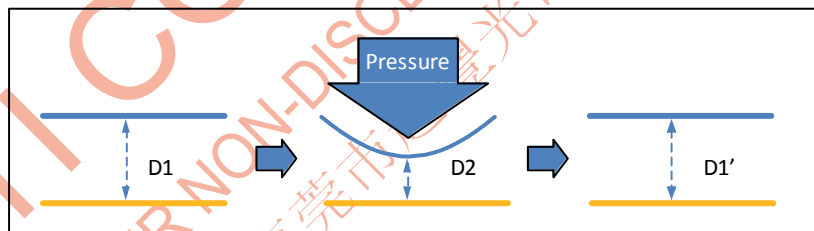


Figure 1-3. Touch sensor deformation should recover to initial state after release pressure.

- **Sensor Damage**

The sensor coating may still be damaged due to direct contact with LCD, even with protection layer.

- **Moisture**

The moisture must not enter the gap between touch sensor and LCD in integration process. eGalaxTouch firmware allows slow stray capacitance change in a limited variation; if the variation in stray capacitance becomes too much, the signal change will be too large to be compensated by firmware.

- **Adhesive Tape and Gasket**

Some adhesive foam tape can be easily deformed with external force, the gap between touch sensor and LCD cannot be fixed, and thus stray capacitance will not be stable. (Thermal stress is prohibited in sensor lamination). Please select adhesive tape or gasket that holds touch sensor firmly and causes no air gap change is preferred.

1.3 Optical/ Direct Bonding

Fully lamination like Optical/direct bonding helps to keep the stray capacitance stable. However, system integrators need to consider the Flatness of lamination. As lamination thickness could affect stray capacitance, it must be applied evenly and leveled to minimize the variation in stray capacitance between sensing channels.

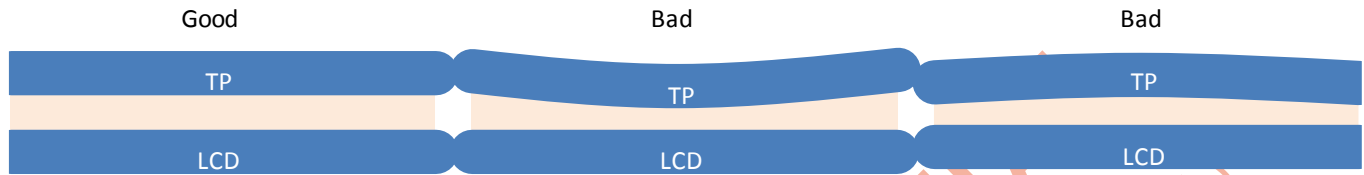


Figure 1-4. Flatness of lamination

2 Mechanical Supporting

If the touch sensor is not fixed or well supported, the gap between itself and LCD might be easily adjusted unintentionally, resulting in stray capacitance variation and touch malfunction. The touch sensor should be fixed with good supported to keep the gap and position between itself and LCD fixed to avoid significant stray capacitance change. The touch system needs a stable LCM supporting frame or skeleton. Such supporting frame or skeleton must not be deformed by any external force. With plastic or flexible frame or skeleton, the stray capacitance might fluctuate because of the unfixable gap between touch sensor and LCD, therefore plastic or flexible frame is not preferred. If plastic frame is needed, shielding layer or optical/direct bonding must be adopted. In addition, because most plastic is not conductive, plastic supporting frame is not preferred for mobile device with capacitive touch.

3 GND

eGalaxTouch solution needs to work in environment with stable stray capacitance. In order to minimize the variation in stray capacitance, all conductive mechanical parts must not be floating. Intermittent floating any conductive part around the touch sensor may cause significant stray capacitance change and abnormal touch function. It is recommended to keep all conductive parts having same electrical potential as the GND of the touch controller module.

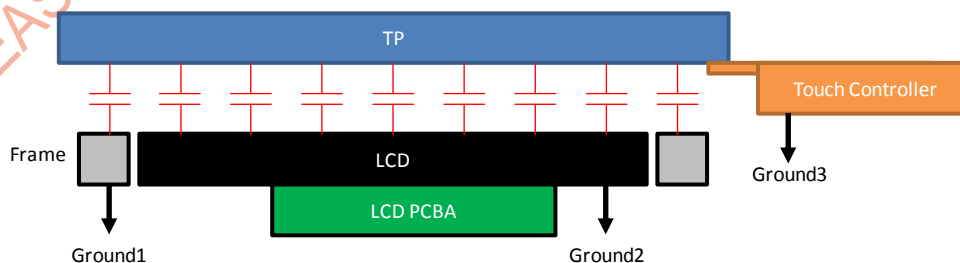


Figure 3-1. GND1, GND2 and GND3 should be connected together to have the same ground

Please fix and ground touch controller by screws. Please not using a conductive adhesive tape or ground line to fix and ground touch controller.

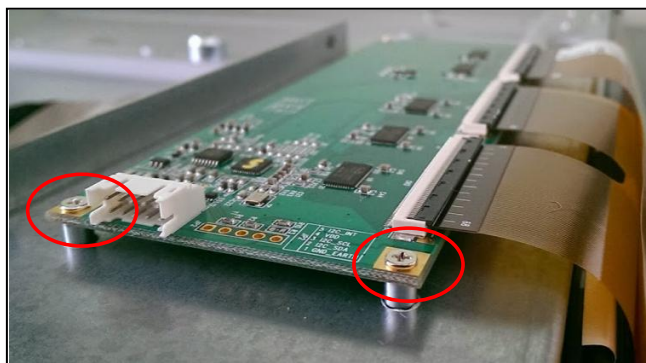


Figure 3-2. Use screw to fix controller to provide a stable ground condition.

Please fix Tx/ Rx FPC tail in a touch system, it should not move freely, the unstable FPC can cause unexpected signal interference.

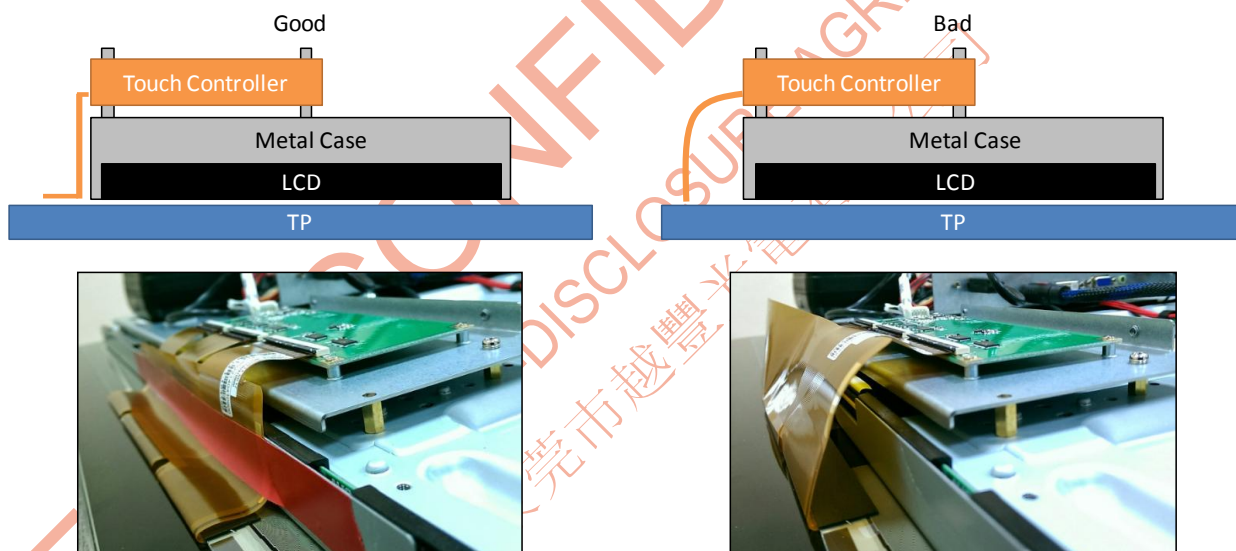


Figure 3-3. FPC Tail should be fixed.

Please arrange Tx/ Rx FPC tail tidy, if it is intended to overlap Tx/ Rx tail by some mechanical / interference purpose, please overlap them in a right angle, other angle may cause signal interference between Tx and Rx FPC tail.

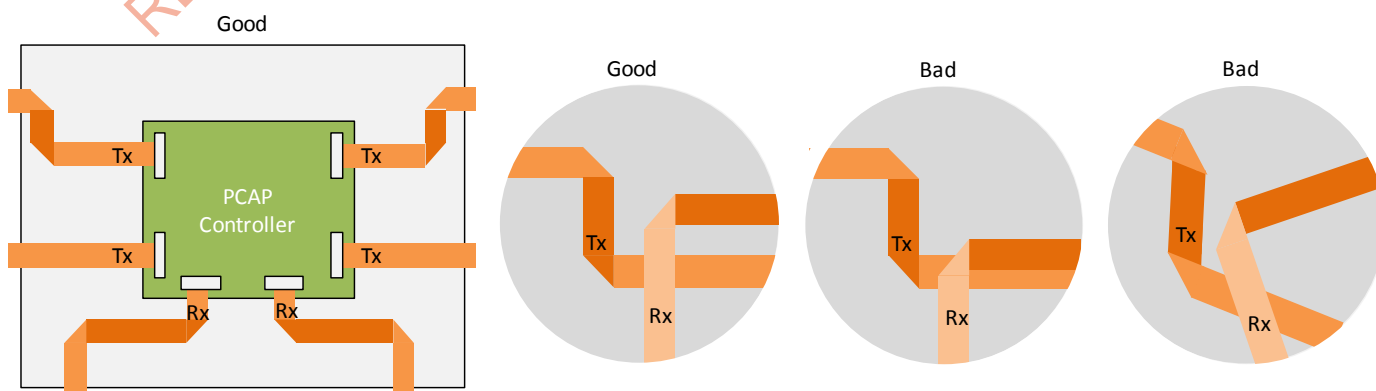


Figure 3-4. Tx/ Rx FPC tail overlap condition.

4 EMI

In order to reduce Electromagnetic interference (EMI) strength, the COF design may have a metal plate in the back side, please make the metal plate ground with the system.

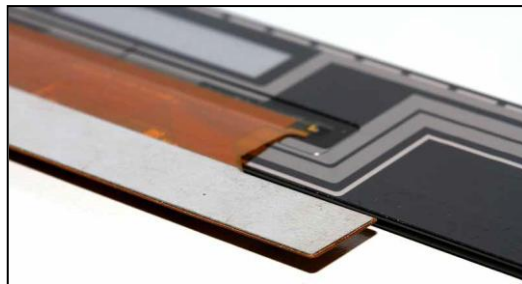


Figure 3-1. The metal plate in the back side of COF

5 ESD

In order to enhance the ESD immunity, the system integrator should prevent the ESD path from coupling to touch sensing, driving circuit. In addition, it needs a well prepared ESD path for the electro-static discharge to prevent the system from being damaged.

Since the entire semiconductor parts are ESD sensitive devices, operator should not touch or contact the parts on the controller board to avoid damaged due to ESD. Operators in manufacture or assembly line should be very careful about ESD protection and not touch the parts on the controller board to avoid ESD damaged.

6 EMC

Capacitive touch technology is sensitive to interference noise. The touch system including, touch sensor sensing ITO, wire traces, and FPC connections must be kept far away from any noise source like power inverter, power inductor...etc, to minimize the noise interference. Below are commonly seen noise sources in system integration:

6.1 LCD Noise

LCD is one of the main noise sources in a touch system. In order to minimize the noise level, the system integrators need to:

- **Larger Gap Between Touch Sensor and LCD**

Bigger gap could help to reduce the noise coupling intensity.

- **Follow eGalaxTouch Sensor Design Rule**

All sensing channels must not be placed overlapping with LCD metal frame and other conductive materials, please refer to EETI document: **EDG-002-PCAP_Sensor_Design_Rule**.

6.2 System Interference

Any signal with frequency less than 1MHz may interfere with the touch system. The touch sensor, wire traces, and FPC connections must be kept far away from noise sources like power inverter, power coil, and other circuits which may cause interference.

6.3 Power Noise

System power noise is also one of the main noise sources to touch system. Some power adaptors may cause big noise and couple to system ground, and interfere with touch system. To minimize such noise interference, the system integrators shall choose a suitable power adaptor. Some power adaptors may induce wide band frequency noise from KHz to hundred KHz. EETI PCAP solutions support frequency hopping, yet, if the noise induced from power adaptors fall in the range of available frequencies, the controller may not be able to find a suitable working frequency.

For more information about EMC, please refer to EETI document: **EDG-008-PCAP_EMC**

7 Lid Close/ Keyboard Affection

Stray capacitance also comes from keyboard when notebook lid is closed. In order to prevent IC getting wrong stray, we have a TP_EN pin for host to control IC's touch enable or disable function. When notebook lid is closed, the TP_EN should be logic '0' (Disable touch function); When notebook lid is open, the TP_EN should be logic '1' (Enable touch function).

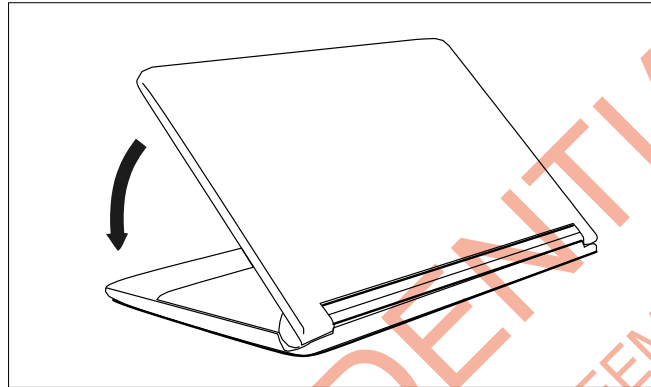


Figure 7-1 Disable/ Power off touch controller when lid closed.

8 Hardware Calibration

There are variations in sensor process and system assembly process which cause signal variation from one system to another. It causes signal saturated, controller cannot detect the signal and touch function become abnormal. Variation in components may also affect signal detection. In order to compensate the system offset and variation, the hardware calibration function is needed for offset canceling among systems. Hardware calibration can also increase the tolerance for touch sensor. If there are some light defects in the sensor, controller can compensate abnormal RC characteristic on these location to provide stable touch function.

Hardware calibration will be executed during fine-tune process, firmware update process and the sensor test process. In order to store latest system offset, it is necessary to run sensor test in each production stage and complete system.

If the system offset is different to the original condition, the hardware calibration data becomes unreliable. To correct the system offset, to run hardware calibration once again is required.



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