

Document ID: EDG-002-200206-1

Sensor Design Rule

For EETI PCAP solution



eGalax_eMPIA Technology Inc.

EETI CONFIDENTIAL



For Release Only Under Non-Disclosure Agreement (NDA)


For 東莞市越豐光電有限公司

Trademark Acknowledgments:

I2C is a registered trademark of Philips Electronics.

SPI is a registered trademark of Motorola, Inc.

EETI and EETI logo  and eGalaxTouch® logo  *eGalaxTouch*

and eGalaxWorks® logo  *eGalaxWorks* are trademarks of eGalax_eMPIA Technology Inc.

(C) Copyright by EETI 2000, 2020. All rights reserved.

Printed in Taiwan.

EETI CONFIDENTIAL
RELEASE UNDER NON-DISCLOSURE AGREEMENT (NDA)
FOR 東莞市越豐光電有限公司



eGalax_eMPIA Technology Inc.

11F, No 302, Rueiguang Road, Nei Hu District,

Taipei 114, TAIWAN

T: +886 2 8751 5191

F: +886 2 2797 8808

URL: www.eeti.com

Sales : touch_sales@eeti.com

FAE : touch_fae@eeti.com

Revision History

Document ID	Date	Revision Description
-	2012/11/05	First Publication.
-	2013/05/30	Update 4.Double Routing
-	2014/02/17	1.Matching and Shielding traces , Figure 1-1 (page.4) Add Figure 1-2 (page.4) 2.Pitch of Channels (page.5) 3.Resistance (page.5) 4.Double Routing, Figure 4-1 (page.6) 5.Mutual Capacitance (Cm) , Figure 5-1 (page.7) Figure 6-1, 6-2, 8-1, 9-1 (Page.7~9)
-	2014/03/17	Update 2.Pitch of Channels (page.5)
-	2014/07/17	Update EETI document form.
-	2014/08/14	Update EETI document form.
-	2014/09/03	Add chapter 11. FPC design.
EDG-002-141210-1	2014/12/10	Update chapter 3, 5 & 9 content.
EDG-002-150319-1	2015/03/19	Update chapter 1, 2, 4, 5, 6, 8, 9.
EDG-002-150325-1	2015/03/25	Update chapter 5, 8.
EDG-002-150401-1	2015/04/01	Update chapter 5.
EDG-002-150414-1	2015/04/14	Update chapter 2, 5.
EDG-002-170703-1	2017/07/03	Update Figure 2-1, Figure 6-1, chapter 3
EDG-002-180813-1	2018/08/13	Update chapter 1~11.
EDG-002-200206-1	2020/02/06	Update chapter 3.

Index

Revision History.....	3
Introduction	5
1 What is a Good Sensor for EETI Solution	5
2 Capacitance Matching and Shielding Traces	6
3 Cover Glass Thickness and ITO Pitch	8
4 Resistance.....	9
5 Mutual Capacitance (Cm).....	11
6 Electrodes.....	13
7 ESD Ring(GND Ring)	14
8 TP AA and LCD AA	14
9 Tx and Rx Architecture (For GFF, GG and DITO Type design).....	15
10 Shielding Layer.....	15
11 FPC Design	16

Introduction

In order to optimize the projected capacitive touch sensor to work with eGalaxTouch controller chip, the sensor designer should follow this sensor design rule. Please also consider the visibility and light transmission in pattern design.

1 What is a Good Sensor for EETI Solution

The major factors contributing to a touch sensor are: Cover glass, ITO pitch, ITO pattern, Resistance, Capacitance. Parameters below are suggested for EETI PCAP touch solution, and we will discuss them in the following chapters.

Cover Glass Thickness	ITO Pitch	Tx/Rx Gap	Tx Resistance (Single Route)	Tx Resistance (Double Route)	Rx Resistance (Single Route)	Grid Capacitance(Cm)	RC Constant
< 2mm	5.00mm	0.5mm	<10K Ω	<40K Ω	<30K Ω	< 1pF	<1.3us
3	6.12mm	0.6mm					
4	7.02mm	0.7mm					
5	7.91mm	0.8mm					
6	8.66mm	0.86mm					
7	9.35mm	0.93mm					
8	10.00mm	1.0mm					

2 Capacitance Matching and Shielding Traces

In order to achieve good capacitance matching among channels, all of the metal traces should have the same design. Shielding traces can be added before the first channel and after the last channel in each axis to optimize the capacitance matching. Each shielding trace shall be 0.5mm ~ 1mm away from the active area. Each shielding trace shall be counted as one channel (I/O pin). The Line width and Space width (L/S) of shielding trace should be the same as those of other signal metal traces. The width of signal metal trace and shielding trace shall be **as wide as possible**.

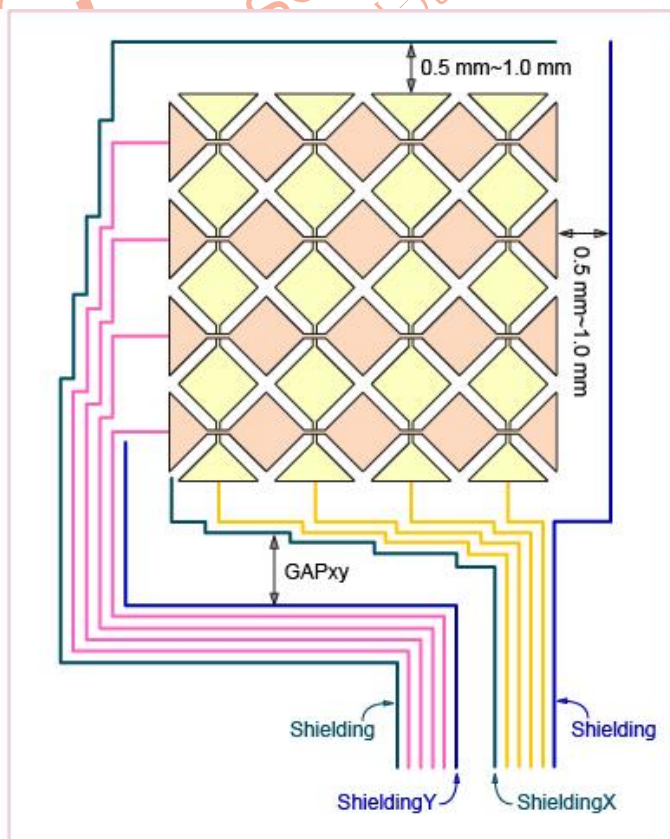
GAPxy, the distance between shielding trace X and shielding trace Y, should be kept as far as possible. GAPxy can be derived from the formula below. Please keep GAPxy as 0.5mm if the calculated one is less than 0.5mm.

$$\text{GAPxy} = \text{Max}(0.5, \text{Shielding length} * 0.01) , \text{unit : mm}$$

For example:

Shielding length	GAPxy
20	0.5
100	1
300	3
400	4
600	6
1000	10

Unit : mm



NOTE: Shielding trace is not GND ring.

Figure 2-1

In order to ensure a similar active area, we recommend ladder shape for trace design.

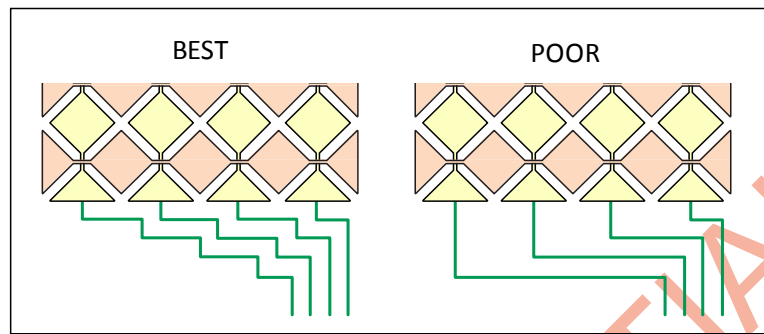


Figure 2-2 .Matching and Shielding Traces

3 Cover Glass Thickness and ITO Pitch

Having smaller sensor pitch will result in better linearity, resolution, and finger separation. However, it also depends on the thickness of cover glass of touch sensor. To meet Win8 logo requirement, the recommended sensor pitch is less than 5.0mm, while the cover glass thickness is less than 2mm. For thicker cover glass application that does not need Win8 logo requirement, the sensor pitch should be bigger. As a rule of thumb, the sensor pitch is recommended as:

$$\frac{5^2}{2} = \frac{P^2}{h}, \quad 5 \leq P \leq 10, \quad 2 \leq h \leq 8$$

unit : mm.

Where,

P is pitch of sensor pattern (Figure 3-1).

h is the thickness of cover glass (Figure 3-2).

NOTE: Win8 logo requires that separation distance be less than 12mm in vertical or horizontal motion, and be less than 15mm in diagonal motion.

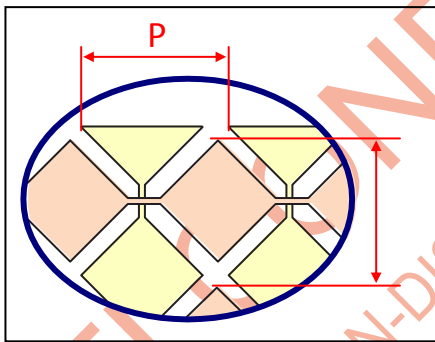


Figure 3-1

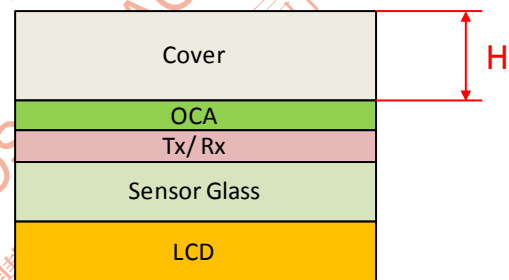


Figure 3-2

For the eGalax active pen TP design, the TP's cover glass thickness must \geq channel pitch * 0.14 .

For example: If the sensor pitch is 5.0mm, the cover glass thickness should be equal to or greater than 0.7mm.

4 Resistance

Having higher resistance will result in higher RC time constant and longer charge/discharge time, causing longer response time.

The resistance is recommended to be kept as low as possible.

EXC7200 series:

Resistance of the Tx and Rx channel needs to be smaller than 15K ohm including metal trace.

EXC7900/EXC3000/EXC31xx/EXC80H100/EXC82H100 series:

Resistance of the Tx channel (Single routing) needs to be smaller than 10K ohm including metal trace.

Resistance of the Tx channel (Double routing) needs to be smaller than 40K ohm including metal trace.

Resistance of the Rx channel needs to be smaller than 30K ohm including metal trace.

EXC80H84/EXC80H46 series:

Resistance of the Tx + Rx channel needs to be smaller than 60K ohm including metal trace for 24" or less.

In order to reduce the resistance of driving stripes, double routing wire trace design is recommended for longer axis (Tx) ; please keep it single routing for the shorter axis(Rx).

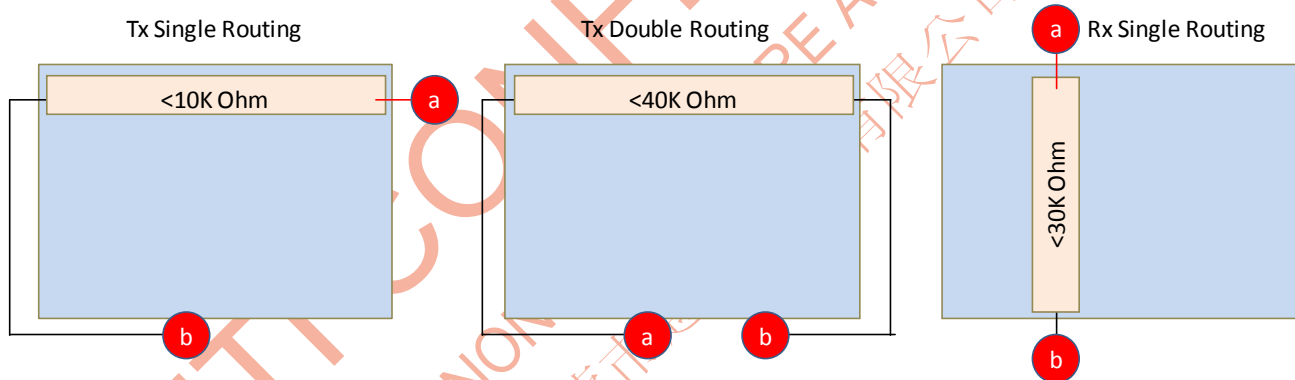


Figure 4-1

However, double routing trace design may cause side effects such as

- ⊙ Unable to detect the open channels
- ⊙ Poor signal uniformity.

NOTE1: It is recommended to apply double routing design to Tx, but Rx double routing is forbidden.

NOTE 2: Firmware is fine-tuned with the provided touch panel samples. Base on the samples, the firmware is able to cover a range of sensor characteristic. The RC characteristic in production must not have large variation to keep similar touch performance.

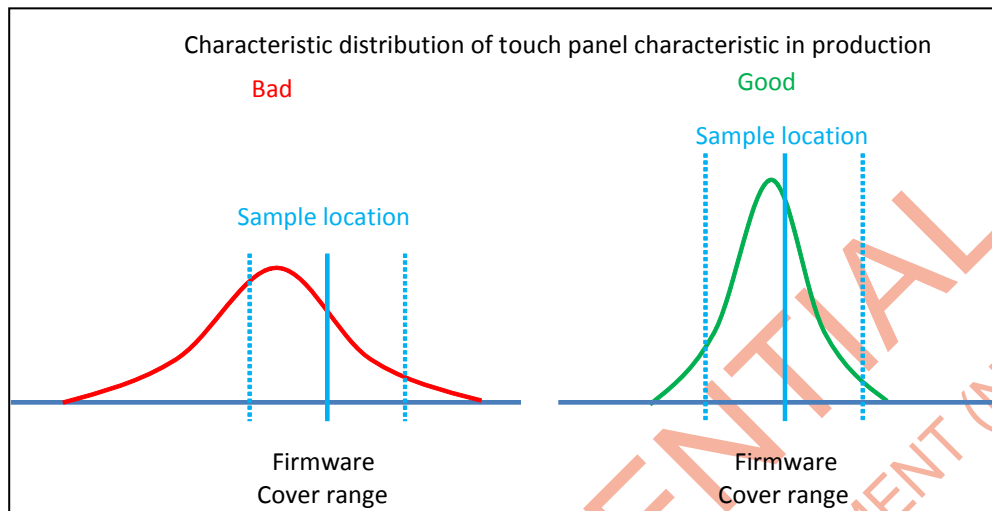


Figure 4-2

Disclaimer: RC numbers provided above are for reference only; EETI does not guarantee any compatibility. Actual performance is dependent on various touch panel characteristics, firmware calibration and full system assembly.

5 Mutual Capacitance (Cm)

The mutual capacitance is formed with C_f and C_o , as picture below:

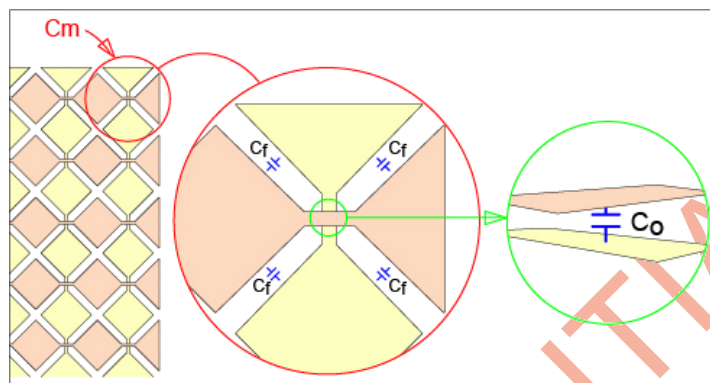


Figure 5-1

Where

C_f refers to fringe capacitance; it changes when TP is touched (ΔC_f)

C_o refers to overlap capacitance; it **does not** change when TP is touched.

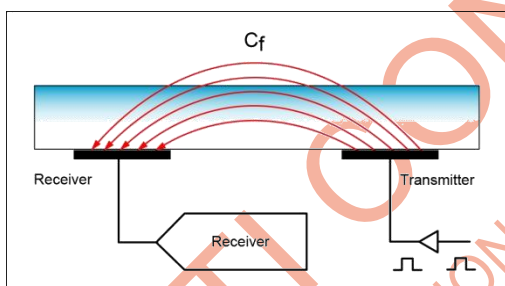


Figure 5-2

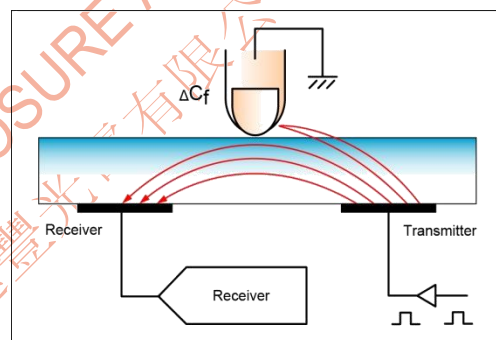


Figure 5-3

Having lower mutual capacitance will have better signal quality and faster touch response. Generally, the mutual capacitance between X and Y should be less than 1pF; for large size TP, this unit cell mutual capacitance should be designed as low as possible to reduce the total capacitance.

Proper fringe gap, the distance between each adjacent X and Y pattern that is suggested to be 500~1000um, can also decrease mutual capacitance and increase SNR. Please follow the table below to design the sensor.

Cover Glass thickness	Sensor Pitch	XY fringe gap
≤ 2	5.00	0.50
3	6.12	0.61
4	7.07	0.70
5	7.91	0.79
6	8.66	0.86
7	9.35	0.93
8	10.00	1.00

Unit : mm

For GG or GFF sensor structure, the lamination tolerance between X layer and Y layer should also be concerned.

For example:

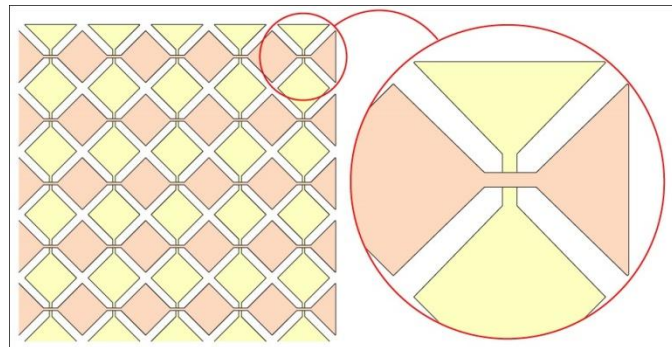


Figure 5-4 Good

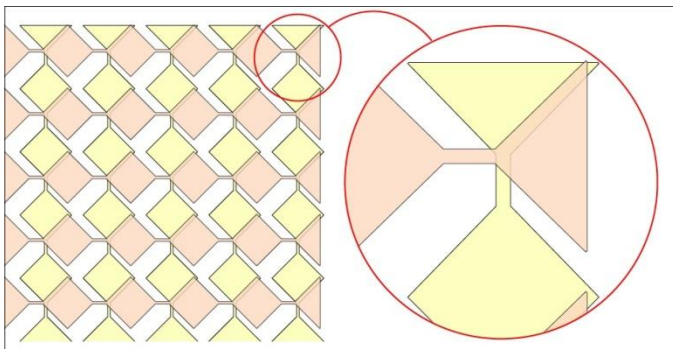


Figure 5-5 NG

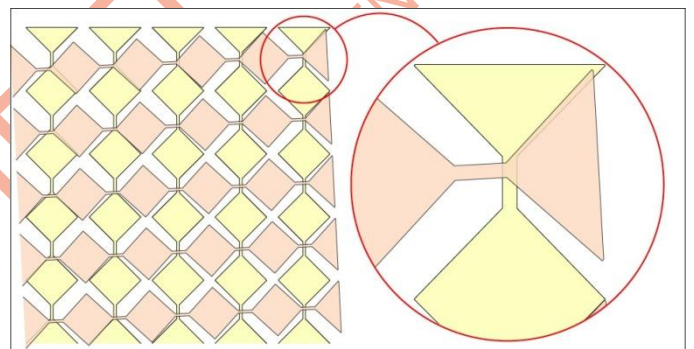


Figure 5-6 NG

EETI suggests $C_m < 1\text{pF}$

$$C_m = C_{xy} / (T_x CH * R_x CH)$$

C_{xy} is the mutual capacitance of X layer and Y layer.

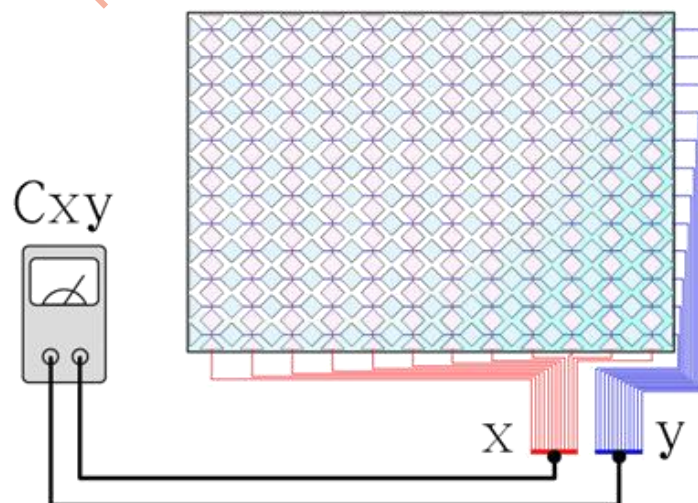
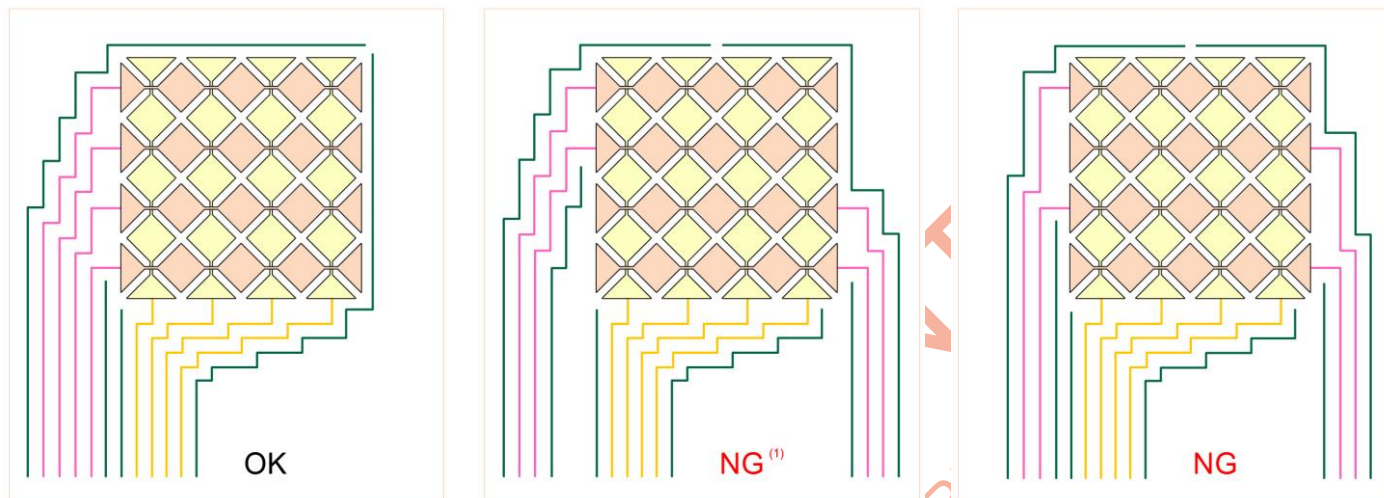


Figure 5-7

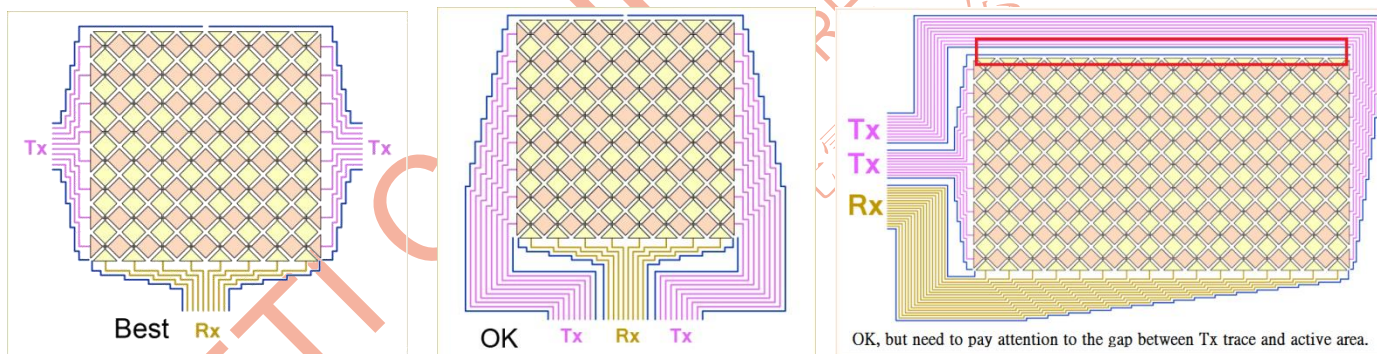
6 Electrodes

All electrodes should be on the same side. Please refer to the following patterns:

Single routing design:



Tx double routing design:



Ways to design for narrow bezels:

1. Reduce the number of channel. (Wide pitch design)
2. Choose EXC80H84/EXC80H46 to support Tx half type.

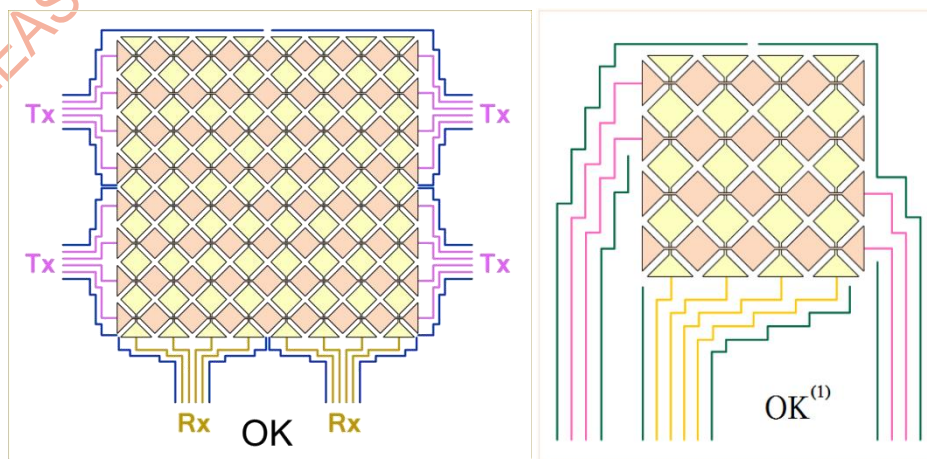


Figure 6-1

Note1: EXC80H84/EXC80H46 supports this type.

7 ESD Ring(GND Ring)

Keep the GND ring at least 1.0mm away from the shielding trace so as to avoid ESD jumping into the shielding trace from the GND ring, otherwise the traces will be easily damaged.

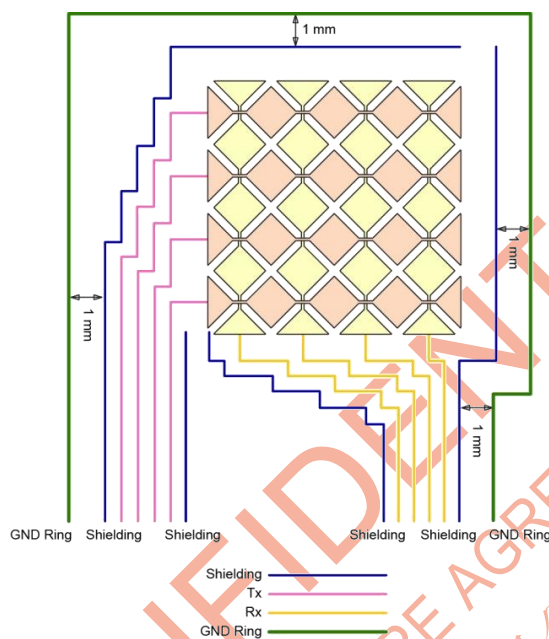
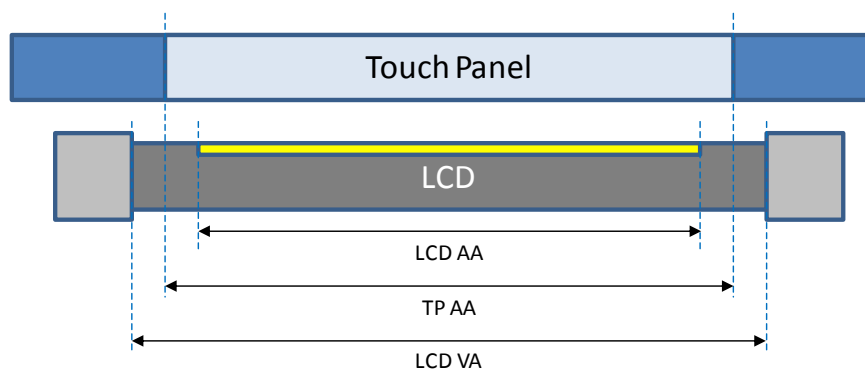
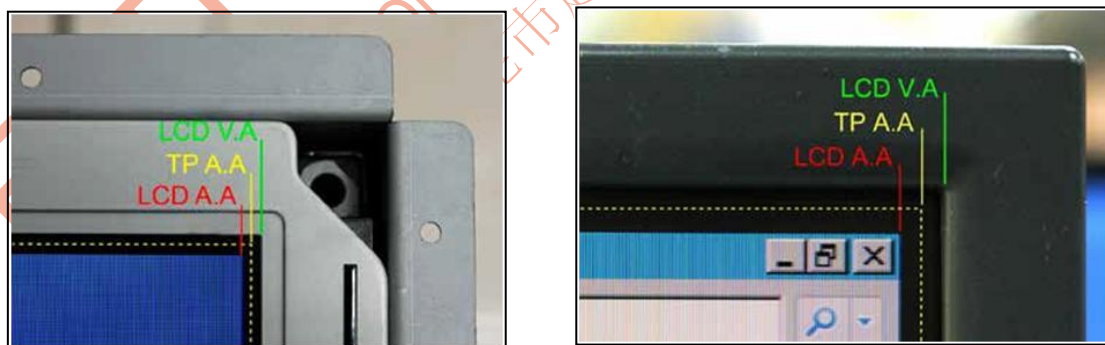


Figure 7-1

8 TP AA and LCD AA

TP AA can be the same as LCD AA, or larger than LCD AA to cover sensor installation tolerance during bounding procedure, but it must not be larger than LCD VA metal frame.



$$\text{LCD AA} + 2 * (\text{Installation Tolerance}) \leq \text{TP AA} \leq \text{LCD VA} - 2 * (\text{Installation Tolerance})$$

Figure 8-1

9 Tx and Rx Architecture (For GFF, GG and DITO Type design)

Put Tx at top side and Rx at bottom side.

For GFF type, the suggested thickness of OCA is 50~200 μm ; 125 μm is preferred.

For DITO type, the suggested thickness of OCR is 200~300 μm ; 250 μm is preferred.

Suggested thickness of sensor glass for DITO is 0.5~1.1mm.

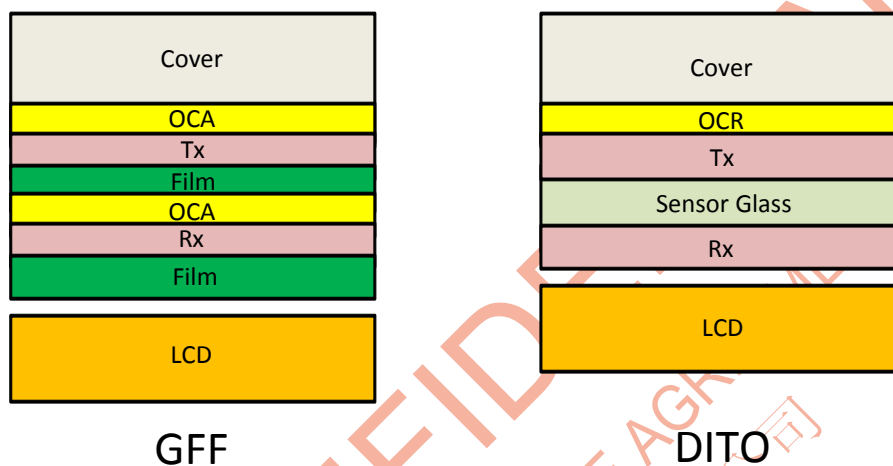


Figure 9-1

10 Shielding Layer

Shielding layer is not necessary. If the TP maker intends to add a shielding layer, please connect shielding layer to the controller ground. A floating shielding layer may cause unexpected touch issue.

11 FPC Design

To improve the ability against noise interfering, please follow the following design rules for FPC.

- a. The Rx channels need to be allocated evenly on Rx ICs. Please allocate at least 15 Rx channels in each Rx IC for EXC3000 series.

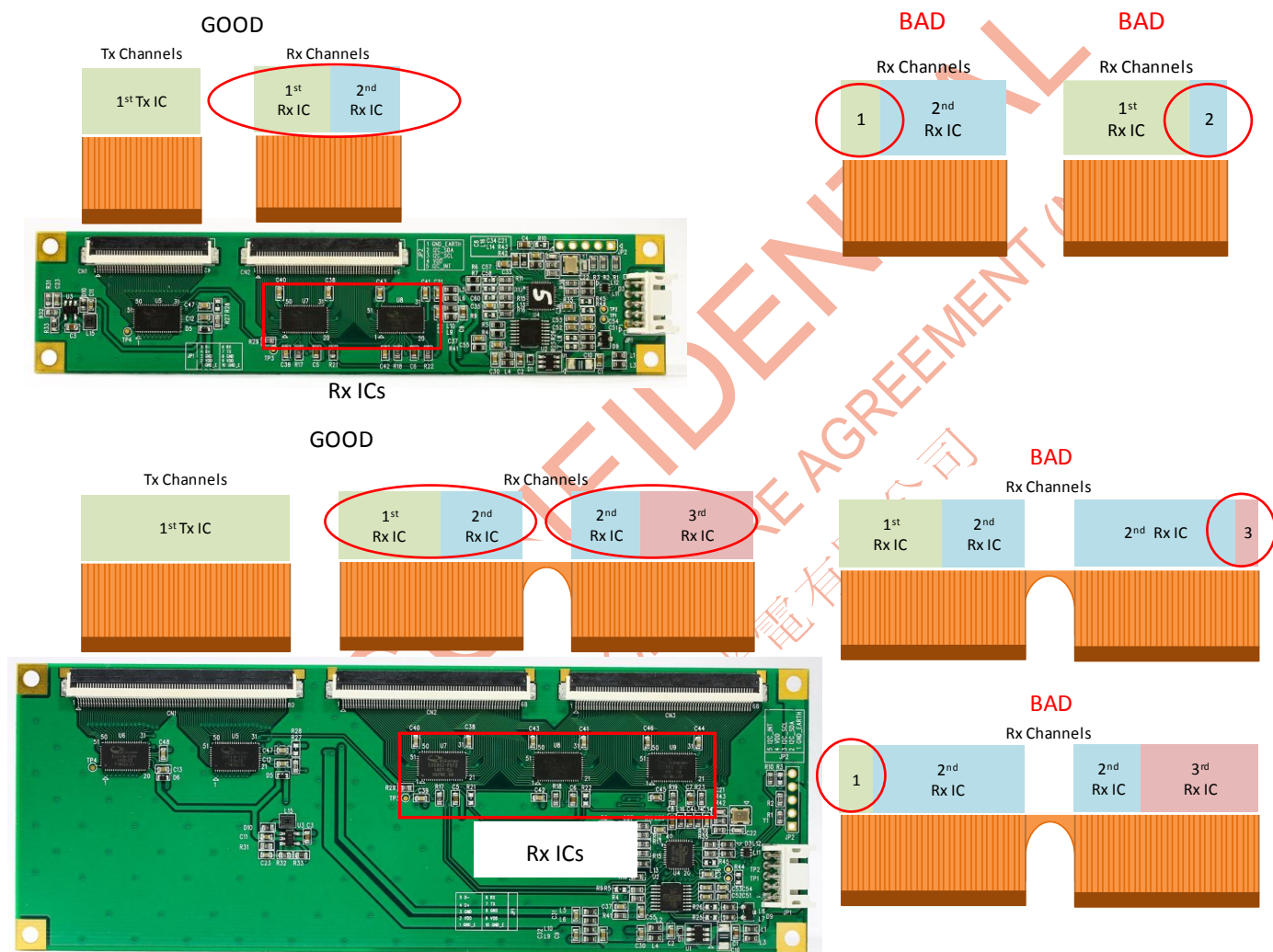


Figure 11-1

- b. Shielding trace is needed at the boundary of tail, and should be connected to IC.

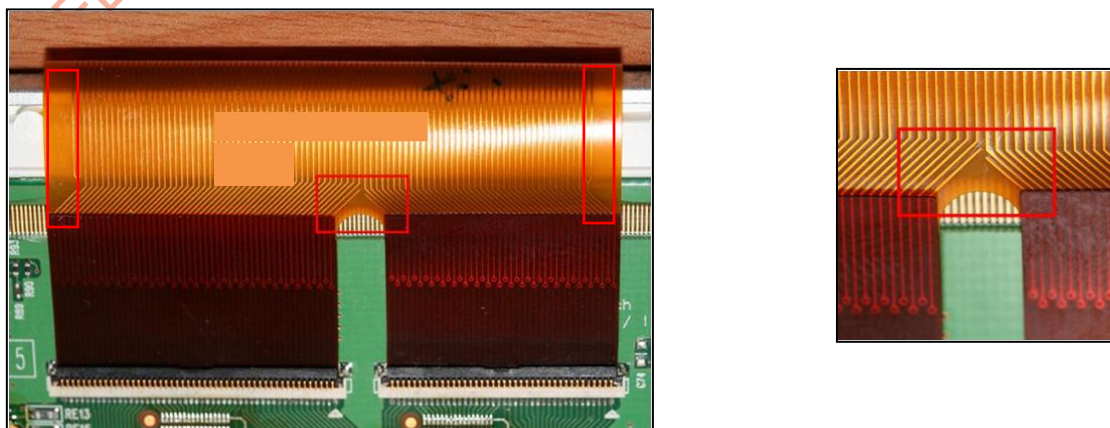


Figure 11-2

- c. Traces need to be matching in distance. (The following figures are NG.)

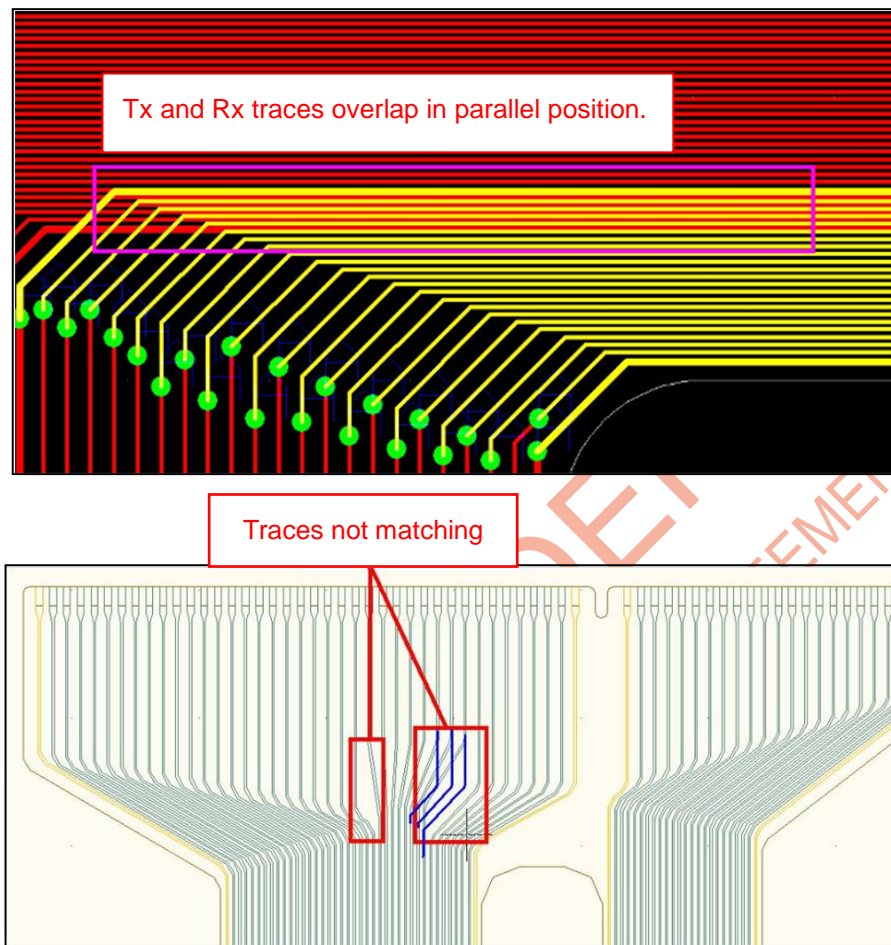


Figure 11-3

- d. If the overlap on traces is inevitable in Tx double routing design, please overlap them in right angle (90°)



Figure 11-4

- e. To prevent FPC peeling issue, we recommend adding dummy bonding pad to enhance FPC reliability.

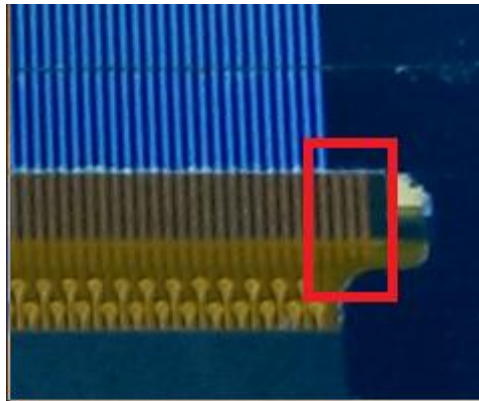


Figure 11-5

EETI CONFIDENTIAL
RELEASE UNDER NON-DISCLOSURE AGREEMENT (NDA)
FOR 東莞市越豐光電有限公司



eGalax_eMPIA Technology Inc.

Headquarters*11F, No 302, Rueiguang Road, Nei Hu District,**Taipei 114, TAIWAN**T: +886 2 8751 5191**F: +886 2 2797 8808***Product Contact**Web Site: www.eeti.comSales: touch_sales@eeti.comFAE: touch_fae@eeti.com

EETI (eGalax_eMPIA Technology Inc.) reserves the right to modify revise or amended this document and/or the content, material, or specification of product at any time without prior notice. EETI takes no responsibility for, and will not be liable for, this document or related information about the suitability or availability being use to the non-EETI's product and using the EETI's product will involve the EETI's software license which including but not limited to source code, program or firmware and is authorized for EETI's product only.

Disclaimer:

UNLESS HAVE THE PRIOR NOTICE BY EETI, EETI DOES NOT RECOMMEND THE USE OF ANY OF ITS PRODUCTS IN MEDICINE, MAINTAIN IN HEALTH, EMERGENCY OR OTHER LIFE SUPPORT APPLICATIONS WHERE THE FAILURE OR MALFUNCTION OF THE PRODUCT CAN REASONABLY BE EXPECTED TO CAUSE FAILURE OF A LIFE-SUPPORT SYSTEM OR TO SIGNIFICANTLY AFFECT ITS SAFETY OR EFFECTIVENESS. EETI Products are not authorized for use in such applications as above, so anyone who violate this will bear strictly at your own risk and make representations of this.