Brief Introduction of OGS
1. History of Fortrend

• FORTREND Taiwan Scientific Corp. established on 1999.
• The R&D team successfully developed OGS on 2009.
• The Fortrend OGS is one of a kind Touch Panel, in leading technology and performance.
• Since the Fortrend OGS kicked off mass production from 2010; Fortrend has grown up to be a Leading Enterprise at the Capacitive Touch Panel field.
2. Flow Chart of Liquid Diamond layer

Adequate plate Total cleaning → Liquid Diamond Spray → Liquid Diamond Layer Pretreatment

Liquid Diamond Layer Coating → Liquid Diamond coated glass Post treatment → Liquid Diamond coated glass plate packaging
3. Flow chart of OGS process

**One Glass Solution flowchart**

- **Mother Glass** or **Curved Glass**
- **Cutting**
  - CNC Grinding
  - Polishing
- **Ultrasonic cleaning**
- **Chemically Strengthen Glass**
- **Liquid Diamond Treatment**
- **BM**
- **ITO1 Sputter and ITO1 Etching**
- **Isolation Coating**
- **ITO2 Sputter and ITO2 Etching**
- **ASF lamination and FPC Bonding**

*Manufacture multiple layers of ITO*
4. Illustration of Fortrend OGS Touch Panel

* Cut to adequate dimension glass plate, no need for secondary strength with hydrofluoric acid, none hazardous.
* **Apple** request 6 face strengthened glass plate, the Fortrend is a 6 faces strengthen glass plate in use.
* Glass breaking point to be at 80kg; 3 times stronger than Large SHEET Process.
* Unique BM & ISO material developed by Fortrend.
* Cost effective process than others, ¼ compare to others.
* High production yield rate up to 80 %, compare to other’s under 30 %.
* Comparatively low cost of manufacturing facilities only 1 / 10 to others.
* Global Patented protection to partners of Fortrend.
* Fortrend Liquid Diamond layer has Anti-Germ / Self & Easy cleaning / with Blue-Ray & UV reduction / High hardness anti-scratch function. **Apple** request.
* Fortrend can adopt PCTP & Electromagnetic power source and digitizer. The mainstream product needs to adopt up to date features to come.
5.1 Fortrend TP ITO Structure:
no bridge, high yield rate 80% plus
Surface Treatment can add on AS, AG, AF and Liquid Diamond.

5.2 Fortrend OGS structure
5.3 Large glass SHEET OGS TP Issues

A. The Issues of conventional SHEET process
   A.1 The sheet glass is strengthened first
   A.2 The TP ITO schematic processed.
   A.3 Then; large size processed panel to be cut into pieces.

B. Secondary strengthen with hydrofluoric acid
   B.1 Hardened glass plate has issue in edge grinding.
   B.2 Hydrofluoric acid only smoothen the irregular surface, not really harden or strengthen the edge surface, while customer like Apple request for 6 faces strengthen glass plate.
   B.3 Hydrofluoric acid is hazardous to worker and environment.

C. Liquid Diamond layer
   SHEET processed glass plate can not apply Liquid Diamond layer.

D. PCTP & Electromagnetic power source and digitizer
   SHEET processed TP can not adopt the new function onto their product.
5.3.1 Difficulty of Bridge, yield rate 36%

There are 8864 bridges on a piece of 24” TP, any of them fail will cause NG.

Before building the bridges(15um), tiny isolator(20um) need to be produced in advance. And then exposure/develop/etching.
## 6. Comparison Chart of different method

<table>
<thead>
<tr>
<th>Analysis difference of Touch Panel</th>
<th>(1)Glass Strength</th>
<th>2nd Glass Strength Treatment</th>
<th>AR</th>
<th>Stylus</th>
<th>Hovering</th>
<th>Size of limitation</th>
<th>Total Thickness</th>
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<tbody>
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<td>FT OGS</td>
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<td>YES</td>
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<tr>
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<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>Under6&quot;</td>
</tr>
</tbody>
</table>

◆ Total Thickness: Use OGS. IN-Cell or On-Cell are the same.

Total thickness of LCD plus OGS or In-Cell. On-Cell are the same.
7.1 The comparison of OGS/IN-Cell/On-Cell

1. APPLE、Samsung request the On-Cell/In-Cell add on cover glass, thin glass plate for protecting.

On-Cell & In-Cell need to glue on a thin cover glass in protecting the LCM, the thickness will be identical to OGS, the cost shall be raised too.

2. Because On-Cell & In-Cell Touch sensor is Outside or Inside of LCD, there can not be air gap in between the protecting cover glass and LCM. A completely glue bonding is costly and less yield rate.
The transparent OCA is a very good adhesive glue for bonding, but it has a character of produce “ bubble “ in temperature as low as 37°C.

The touch action start from the finger tip comes close to the sensor, bubble causes air gap in between and dumb the sensitive.

The bubbles may start to produce in the usage hours, the heat comes from LED back light source, in the beginning; it may not has bubbles, but in the long run, the OCA glue is the source of issues.

Touch sensor within the LCD also make low yield rate and high cost.
7.3 Detail illustration of IN-Cell

ON-Cell: Touch sensor is on top of LCD glass

The ON-Cell sensor made on the top side of the LCD glass, must have a cover glass in protection of the sensor face, again; the OCA glue is a must be item.

The transparent OCA glue has the character of producing bubble during usage and heated by LCD back light, the bubbles as an air gap in between finger tip and sensor, cause issue and dumb the touch action.

Touch sensor on top of the LCD also make low yield rate and high cost.
7.4 Detail illustration of FT OGS TP

Fortrend OGS TP : Touch sensor underneath touch glass

Fortrend OGS TP can be attached to LCD module by DSA (Double Side Adhesive) band, easy to use with less cost, no bubble issue.

The Fortrend OGS TP has the sensor made just attached to the beneath side of glass, when bonding to LCD, the OCA glue does not sit in between the finger tip and sensor face, even if bubbles produced by heat, the touch act does not be influenced by the bubbles within OCA layer.

Fortrend TP stand alone to LCD module, high yield rate and low cost.
7.5 The comparison of OGS/IN-Cell/On-Cell

The Shortcoming feature of On-Cell & In-Cell
Which OGS there is not !!

The Advantage feature of On-Cell & In-Cell
Which OGS has them all !!

OGS technology is matured, cost effective to In-Cell & On-Cell.

The mainstream of Touch Panel is OGS !
8. Reasons for Using OGS

- On-Cell, In-Cell and OGS all just require one piece of glass; the same material.
- As On-Cell and In-Cell touch has the surface hardness 2.5H only (LCD glass), it’s necessary to have cover lens and it has to be fully bonded; which is expensive in cost and low in yield rate.
- OGS requires only one glass so does not require full-bonding.
- The techniques to produce On-Cell and In-Cell are difficult with low yield rates hence are only capable for manufacture <5” touch panel with 50% yield rate. For >5”, it would take another 3 to 5 years to be ready.
- FORTREND OGS Touch Panel has Liquid Diamond layer in value add.

* There will be PCTP & Electromagnetic power function to come in the future, which the others will not be able to adopt these features.

OGS technology is matured hence its cost is lower than In-Cell and On-Cell and thus will become the mainstream of future touch panel.”
# 9.1 The Market trend of the Touch Panel

The mainstream analysis report all indicates the following data: OGS grows in the Smart Phone market.

## Smart Phone market

<table>
<thead>
<tr>
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<td>Add-on type (GG, G1F, GFF)</td>
<td>70%</td>
<td>62%</td>
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<tr>
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<tr>
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## Laptop Touch Screen market

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<td>18%</td>
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## Tablet PC Touch Screen market

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<td>3%</td>
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</table>

*Source: DisplaySearch, KDB Daewoo Securities Research*
9.2 Projective Capacitive Touch Panel Market share analysis

The Projective Capacitive Touch Panel Market share:
From the year 2012 / 69.5%, estimated a booming growth to 2015 / 81.5%, the other type comparatively reduced.

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<td>Projected Capacitive</td>
<td>36.3%</td>
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<td>69.5%</td>
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<td>80.1%</td>
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<td>IR/Optical</td>
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<td>Surface Capacitive</td>
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<tr>
<td>Total</td>
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</table>

Source: DisplayBank
We remain optimistic about the growth of touch screens for uses in smart phones and tablet PCs. This year, we project shipments of smart phones and tablet PCs to reach 1.1bn units (+32% YoY), with shipment area expanding 39% YoY to 8,580km². The smart phone- and tablet PC-use touchscreen market is forecast to jump 31% YoY to US$16.4bn, or W18tr. Traditional PC manufacturers are likely to adopt touchscreens full swing starting this year. Indeed, Intel made touchscreens a required specification for all 3rd generation Ultrabooks (to be released this year). We project the touchscreen market to grow at a CAGR of 104% until end-2016, as 40% of laptop computers (89mn units) and 39% of desktop computers (56mn units) are expected to adopt touchscreens.
9.4 Smartphone Touch Screen market breakdown (by technology)

In 2012, add-on technology was used in 62% of smart phones shipped, while on-cell, in-cell, and OGS accounted for 13%, 8%, and 3%, respectively. The on-cell type was adopted in most of SEC’s OLED smart phone models, while the in-cell type was first introduced in the iPhone 5. Going forward, the percentage of add-on adoption is expected to fall steadily, while the figures for OGS and on-cell, which do not require module lamination, should continue to climb.

<table>
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<tr>
<th>Technology</th>
<th>11</th>
<th>12</th>
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<td>6%</td>
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</tbody>
</table>

Source: DisplaySearch, KDB Daewoo Securities Research
9.5 Laptop Touch Screen market share breakdown (by technology)

Add-on technology was used in 52% of laptops shipped last year, while OGS and other technologies (metal mesh etc.) accounted for 12% and 36%, respectively. However, the percentage of OGS, which started to surge this year, is expected to rise to 83% in 2016. As such, OGS should become a dominant technology for large-sized touchscreen panels. In addition, metal mesh technology is likely to win a certain market share, as it has no limitations with regard to the production of large-sized panels thanks to its low electrical resistance.

<table>
<thead>
<tr>
<th>Technology</th>
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</tbody>
</table>

Source: DisplaySearch, KDB Daewoo Securities Research
9.6 Tablet PC Touch Screen market breakdown (by technology)

As for tablet PCs, the add-on type held the upper hand until last year. Although in-cell, on-cell, and OGS technologies cannot yet be applied to large-sized touch screen production due to yield issues, we believe that their adoption will steadily rise (as has been the case with smart phones).

<table>
<thead>
<tr>
<th>Technology</th>
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<td>18%</td>
<td>28%</td>
<td>33%</td>
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<tr>
<td>Other</td>
<td>3%</td>
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<td>3%</td>
</tr>
</tbody>
</table>

Source: DisplaySearch, KDB Daewoo Securities Research
10. FORTREND OGS Advantage

- The selling price of Fortrend OGS is the cost of others. Our touch panel has lower cost (50% gross profit) than others while bigger panel size has a lower unit cost by inch. Please note that, in market, the bigger panel size sells more expensive in unit inch. Hence, FORTREND has an advantage in NB, PC, LCD, AIO and other new application markets.

- FORTREND touch panel is not constraint by size, while bigger panel size has a higher yield ratio and highly competitive in cost structure.

- FORTREND touch panel material can be any strength level of glass. The strength of our glass is three times stronger than others with better quality.

- We do not have to use the HF to do secondary Glass Strength Treatment, because HF is a severe hazardous, as little as of 1.5 g can kill a people.

- Our team include software design and hardware manufacturing.

- FORTREND OGS touch panel has been in mass production for more than 3 years, therefore related technique, materials and equipments are all matured and ready . and the Windows 8 certificated.

- We have variety of processes patents and developed unique material. FORTREND’s multiple layer structure can be applied on floating touch, pen writing and other features.

- The Liquid Diamond layer technology of Fortrend has been matured, with Anti-Germ / Self clean / Anti-scratch / Blue-Ray & UV & Electrical mega frequency absorb functions, value add features.

- Our cost of equipment is 1/7 to 1/10 of others. Our equipment of annual output value is U.S. Dollar 750 million., but the equipment cost is $ 150 million, the ratio is 5:1.

- FORTREND has patents on touch panel structure featured with short production procedure and high production yield rate. The process is very simple, the engineer or operator needs only two weeks of training to get started.
11. What FORTREND provides more

- FORTREND has a complete R&D Team. With years of experience in Capacitive Touch Panel developing.
- FORTREND offer training session for partner and essential practices.
- FORTREND team provides Software / Firmware and Hardware program.
- FORTREND can provide up to date TP control IC solution
2014 New Product Roadmap

2014/Q2

**Liquid Diamond coating**
Coating Liquid Diamond on the OGS glass
Hardness: 9H
Anti-Scratch /Absorb blue-ray/UV / SAR
Low Contact Angle: Easy and self cleaning
Life time: permanent
Others AS coating with Fluoride element
Temporary function, decay after using.

2014/Q4

**PCTP plus Electromagnetic Volume power battery**
With more functions.
Without additional cost US50 for Electromagnetic.

2015

**PCTP plus DSSC**
It will self-generated power at anytime/anywhere, saving the battery of computer/whole device.

Future

Fortrend will transfer new developed technology / Patents to customers without increase royalties, only charge materials and equipment costs.

While the Large SHEET process can not adopt these function in the future.
13. Co-work Model with FORTREND

- FORTREND provide IP licensing service, training, R&D, MES support and order consigning.
- From bare glass to touch panel procedure, FORTREND can provide complete Turn-key Total Solution. Within 6 moths after contracted, mass production is ready to make profits. The investment can be returned with in 6 month after production.
Join Fortrend
and
Win the Touch Panel market
With
OGS