TPK remains the leading touch-panel maker globally, but we expect its fundamentals to deteriorate further in 2014 due primarily to fiercer competition, and thus initiate coverage with a Sell (5) rating.

**Investment case**

TPK is facing fiercer competition in all its business segments: smartphones, tablets, and notebooks.

For 2014, we forecast a 43% YoY fall in EPS and a decline in ROE to 12.3% (from close to 37% in 2012).

Market earnings expectations still look too high; initiating with Sell rating and target price of TWD170, implying 22% downside.

**Catalysts**

**Smartphones/tablets:** losing ground. TPK is losing orders in Google and Amazon tablets, and we think its share of orders for the iPad and iPad mini could fall to 50-55% in 2H13 (vs. 60-70% in 1H13), as rivals are pricing aggressively and their production yield rates are catching up fast with TPK’s. Its touch-on-lens (TOL) solution for smartphones is struggling to win enough orders to offset a shortfall from phasing out orders for the iPhone 4S. Thus, we forecast TPK’s smartphones/tablets revenue (80%+ of its 2013E revenue) to decline by 18% YoY in 2014.

**Notebook PCs (NBs): fierce contest ahead.** As competitors are cutting prices sharply and customers are becoming more willing to accept low-cost commoditised products, we forecast TPK’s market share in touch NBs to fall to 25-30% in 2H13, from 65%+ in 1H13. In 2014, we expect stiffer pricing competition on a supply-demand imbalance, and forecast its ASP to fall by 25% YoY and its market-share to erode to 32% (vs. 45% in 2013E and 87% in 2012).

Refocus on mid-range segment not an instant remedy. TPK plans to provide lower-cost touch modules for NBs in 4Q13 and for smartphones in 2Q14. We think this should broaden its addressable market but are concerned about potential margin pressure in the transition period. Also, we believe Apple is unlikely to adopt its new solutions in 2014.

**Tough 2013, even tougher 2014.** Due to intensifying competition and pricing pressure, for 2014 we forecast TPK’s operating margin to contract to 6.3% (vs. 8-12% in 2012-13E), its EPS to decline by 43% YoY (~23% YoY for 2013E), and its ROE to fall to 12.3% (close to 37% in 2012).

**Valuation**

We set a six-month target price of TWD170, based on a 9x 2014E PER (30% discount to TPK’s past-three-year trading average of 13x) to reflect the deteriorating fundamentals we see. Our 2014E EPS is 41% below the Bloomberg consensus.

**Risks**

These would be higher touch adoption in NBs, and Apple taking up TPK’s TOL or silver nanowire solution.

### How do we justify our view?

**Notebook PCs (NBs): fierce contest ahead.** As competitors are cutting prices sharply and customers are becoming more willing to accept low-cost commoditised products, we forecast TPK’s market share in touch NBs to fall to 25-30% in 2H13, from 65%+ in 1H13. In 2014, we expect stiffer pricing competition on a supply-demand imbalance, and forecast its ASP to fall by 25% YoY and its market-share to erode to 32% (vs. 45% in 2013E and 87% in 2012).

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Growth outlook

After a strong 2011 and a moderate 2012, we forecast TPK to see declines of 9% YoY in sales and 23% YoY in EPS for 2013, driven mainly by weak end demand in high-end mobile devices and a lower touch penetration rate in NB PCs compared with market expectations. For 2014, due to likely fiercer competition and intensifying pricing pressure, we forecast TPK’s operating-profit margin to decline to 6.3% (vs. 8-12% in 2012-13), its EPS to fall by 43% YoY, and its ROE to come down to 12.3% (from nearly 37% in 2012).

Valuation

Our six-month target price of TWD170 is based on a 2014E PER of 9x. Our target multiple is set at a 30% discount to TPK’s past-three-year trading average of 13x to reflect the deterioration we expect in its fundamentals. We believe the stock’s current trading PER of 11.5x for 2014E is unjustified given the sharp earnings declines we forecast for 2013 and 2014.

We think PER is the most appropriate way to evaluate downstream tech companies like TPK. We recognise flaws with this method, such as a lack of insight into the long-term business outlook and a mismatch between earnings/cash flow. Still, we consider PER a straightforward, intuitive, and accurate way to predict a tech company’s earnings power, at least near-term.

Earnings revisions

The 2013-14 Bloomberg consensus EPS forecasts for TPK have been trending down since late-2Q13. We attribute this to the company’s lacklustre order growth in smartphones and tablets, lower-than-expected touch penetration rate in touch NBs, and rising competition with other touch-panel makers in Asia.

Our 2014 EPS forecast is 41% below the Bloomberg consensus, which we believe reflects the deteriorating fundamentals we see for the company in 2014. We expect the consensus forecast to be cut further given severe competition and pricing pressure we envisage in the coming quarters.
Key assumptions

- Profit and loss (TWDm)


Small-sized (3.5" - 7") touch panel shipment (1000 unit) 23,800.0 35,983.4 60,800.0 107,100.0 121,271.9 72,640.3 50,283.1 46,150.0

Mid-sized (7"-10") touch panel shipment (1000 unit) 0.0 0.0 12,635.8 40,618.0 62,200.0 49,278.0 51,147.4 59,042.1

Large-sized (larger than 10.1") touch panel shipment (1000 unit) 0.0 0.0 0.0 120.0 143,372.0 173,659.0 140,550.0 142,500.0


Mobile Phone Lens Revenues 12,942 18,709 40,554 90,077 83,630 61,806 41,440 31,255

DSC Lens Revenues 0 0 19,045 52,840 76,753 65,078 62,481 65,787

Other Revenue 0 0 0 455 13,277 31,576 36,628 44,958

Total Revenue 12,942 18,709 59,599 143,372 173,659 158,460 140,550 142,000

COGS (11,188) (14,473) (49,582) (119,179) (144,042) (134,390) (120,732) (121,978)


Other op.expenses (539) (639) (1,574) (3,491) (4,645) (3,855) (3,862) (3,976)

Operating profit 492 2,612 6,232 16,324 20,211 13,057 8,784 8,662

Net interest inc./(exp.) 0 0 0 0 0 0 0 0

Assoc/forex/extraord./others 32 18 (228) (1,676) (340) 952 574 626

Pre-tax profit 394 2,564 5,933 14,381 19,658 13,008 8,165 8,069

Tax (5) (254) (1,185) (3,153) (5,299) (1,756) (1,674) (1,654)

Net profit (reported) 388 2,317 4,742 11,128 14,359 11,252 6,491 6,415

Net profit (adjusted) 388 2,317 4,742 11,128 11,252 6,491 6,415 6,415

EPS (reported) (TWD) 1.730 10.566 17.704 37.815 43.379 33.332 18.925 18.691

EPS (adjusted) (TWD) 1.730 10.566 17.704 37.815 43.379 33.332 18.925 18.691

EPS (adjusted fully-diluted) (TWD) 1.730 10.566 17.704 37.815 43.379 33.332 18.925 18.691

Net cash from operations 1,622 2,538 8,069 19,636 9,585 17,505 14,491 14,244

Capex (1,746) (1,247) (12,983) (28,522) (11,563) (25,000) (12,000) (10,000)

Change in cash 10 1,109 3,893 4,819 12,850 (7,603) (2,554) 1,371

Free cash flow 76 1,291 (4,914) (8,886) (1,605) (7,808) 2,491 4,244

Source: FactSet, Daiwa forecasters
Company profile

TPK, established in 2003, specialises in providing touch-enabled user interface solutions for small- and mid-sized displays from the making and selling of cover glass, touch sensors, modules and display laminations. The company was listed on the main board of the Taiwan Stock Exchange in October 2010.

---

**Balance sheet (TWDm)**

| Year       | Cash & short-term investment | Inventory | Accounts receivable | Other current assets | Total current assets | Fixed assets | Goodwill & intangibles | Other non-current assets | Total assets | Short-term debt | Accounts payable | Other current liabilities | Total current liabilities | Fixed assets | Goodwill & intangibles | Other non-current assets | Total assets | Share capital | Reserves/R.E./others | Shareholders' equity | EV | Net debt/(cash) | BVPS (TWD) | ROCE | ROIC | Net interest cover | Net dividend payout | Free cash flow yield | Current ratio (x) | Net interest cover (x) | Net dividend payout | Free cash flow yield |
|------------|----------------------------|-----------|---------------------|----------------------|----------------------|---------------|------------------------|------------------------|----------------|---------------|-----------------|--------------------------|------------------------|--------------|------------------------|------------------------|----------------|-------------|-------------------|----------------|----------------|----------------|----------------|----------------|-------------------|----------------|-----------------|
Bruising battles to come

As it faces stiffer competition in all its business segments, we believe TPK will encounter a tough 2014, for which we forecast its EPS to fall by more than 40% YoY and its ROE to decline back to a low-teens level.

Company background

Established in 2003, TPK is the inventor and world’s leading producer of glass-based projected capacitive-type touch panels. The company’s shares were listed on the main board of the Taiwan Stock Exchange in October 2010.

Based in Taipei and with most of its sites located in Xiamen, the company has sought to become a ‘one-stop shop’ for touch-panel solutions (cover glass, touch sensors, touch modules, and touch display lamination).

TPK is the world’s leading producer of glass-based projected capacitive-type touch panels, with a market share of 25% in terms of revenue for 2012. (We describe this touch solution in Appendix II of this report.) The company supplies touch modules and touch displays to most of the top-tier handset and tablet makers, including Apple, Amazon, Google, Sony, Blackberry, HTC, and LGE.

Initiating with Sell rating

We initiate coverage on TPK with a Sell (5) rating and a six-month target price of TWD170, based on a 9x PER applied to our 2014 EPS forecast. Our analysis reveals that TPK faces intensifying competition, along with an unfavourable industry trend of the market for high-end mobile devices becoming saturated, and a slower global penetration rate of touch NBs than the market has been expecting. These trends suggest to us that the company is entering a very challenging period for its business.

TPK’s largest client is Apple, which contributed about 60% to its total revenue for 2012. TPK started shipping glass-type touch panels for Apple’s iPhone in 2007 and has also been the major touch-panel supplier for Apple’s iPad since its launch in early 2010. TPK enjoyed a 110% CAGR in total revenue during 2009-12, driven by the strong secular growth of the iPhone and iPad. TPK faced a challenge to its order flow and revenue stream when Apple adopted the in-cell touch solution developed by some of TPK’s competitors (Sharp/ LG Display [LGD] and Japan Display) for the iPhone 5 in 2H12. However, TPK seemed to manage this well by diversifying into non-Apple brands to offset the initial negative impact from a lack of new iPhone orders, and delivered solid revenue growth of 21% YoY for 2012. TPK’s revenue exposure to Apple declined to 60% in 2012, from 80% in 2011.

We believe TPK’s fundamentals have been facing major challenges since the middle of this year, and we expect this to be even more the case in 2014.

For smartphones, impacted by decelerating industry growth in the high-end segment, TPK’s high-end touch solution – touch-on-lens (TOL) – is struggling to win volume orders to offset the shortfall from phasing out orders for the iPhone 4S (15% of its total revenue for 2013E on our forecasts). TPK is also facing greater competition in tablets. Our market research suggests that, in addition to losing orders now in Google and Amazon tablets, TPK’s share of orders for the iPad and iPad mini could decline to 50-55% in 2H13 (from 60-70% in 1H13), as its competitors have adopted aggressive pricing and their production yield rates are catching up fast with TPK’s. As such, we forecast TPK’s revenue from smartphones and tablets (which we expect to exceed 80% of its total revenue in 2013) to decline by 18% YoY in 2014.

NBs should be the only bright spot for the company next year, on the back of NBs’ increasing adoption of touch displays. However, we do not expect this trend to be strong enough to offset the order and revenue...
shortfall we foresee from smartphones and tablets, as we believe TPK is also losing its leading edge in the NB segment.

Factoring in the above segmental trends, we forecast TPK’s revenue to decline by 8.8% YoY for 2013 and by 11.3% YoY for 2014. Given we also envisage lower economies of scale and gross-profit margin compression due to pricing pressure, we forecast the company’s operating-profit margin to contract to 6.3% in 2014 (from 8-12% in 2012-13E), and its EPS to decline by 23% in 2013 and 43% YoY in 2014. We project its ROE to contract to 12.3% in 2014, from nearly 37% in 2012.

Smartphones and tablets – losing ground

Smartphones: likely to struggle in the post-iPhone era

Smartphones are the main product contributor for TPK, with its touch solutions for smartphones accounting for 48% of its total revenue for 2012. After its major customer, Apple, switched to using the in-cell solution (supplied by Sharp, LGD and Japan Display) for the iPhone 5 in 2H12, TPK has been promoting actively its proprietary one glass solution, TOL, in the market, and targeting the high-end smartphone segment.

TOL has various merits compared with some competing touch solutions, such as a better touch performance, thinner/lighter form factor, and greater flexibility to customise. However, as the high-end smartphone segment is becoming saturated and there is increasing margin pressure across smartphone brands, despite TOL’s advantages, it has so far been adopted by only a limited number of models of major brands due to cost concerns. The ASP of TOL is 15-20% higher or even more so compared to other competing solutions (glass/film/film [G/F/F] and one-glass solution [OGS]), based on our estimates.

As a result, we forecast TPK’s revenue from smartphones to decline by 26% YoY in 2013 and 33% YoY in 2014.

Tablets – competition is catching up

Apple is TPK’s largest customer in the tablet segment (we forecast the iPad and iPad mini to account for 60% of its tablet revenue for 2013). Thanks to its superior execution and faster production yield rate ramp-up capability compared with its peers, TPK has so far been the major touch supplier for Apple’s iPad and iPad mini, with a 60-70% share of orders.

But the competitive dynamics are changing. GIS, a subsidiary of Hon Hai (Apple’s major EMS partner), has been aggressively gaining iPad/iPad mini orders this year. Our market research indicates GIS is likely to secure 45-50% of orders for the widely expected iPad Air in 4Q13, and is likely to land a similar share of orders for the next-generation iPad mini, backed by an
aggressive pricing strategy and fast ramp-up in its production yield, given only limited upgrades to the specifications of the panels.

In total, we forecast TPK’s share of orders for the iPad/iPad mini could decline to 52% in 2014, from 65% in 2012 and 63% we expect in 2013. Such a loss of orders would likely offset the majority of growth expected in total production volume for the iPad/iPad mini in 2014E, on our estimates. For 2014, we forecast TPK’s revenue from the iPad/iPad mini to grow by only 5% YoY, despite 20%-plus YoY growth we project in the total production volume for Apple’s iPad/iPad mini.

Competition is also intensifying in the non-Apple tablet segment. Similar to the smartphone segment, tablet brand vendors are becoming more aggressive in launching their low-end and mid-range models in anticipation of relatively slow growth in the high-end segment. Because of this shift in strategy, tablet brand vendors are increasingly focusing on the cost of touch modules, rather than the quality of panels, presenting an opportunity for emerging tier-two module makers which tend to be aggressive in pricing their offerings.

In our view, this development poses a risk to TPK, the industry leader specialising in premium products. Our market research indicates TPK is unwilling to compete on price and, in turn, is losing its share of orders for non-Apple tablets such as Amazon’s Kindle Fire and Google’s Nexus 7.

**TPK: market share among major tablet makers**

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2013E</th>
<th>2014E</th>
</tr>
</thead>
<tbody>
<tr>
<td>(in units)</td>
<td>Total volume</td>
<td>TPK - share</td>
<td>TPK - shipments</td>
</tr>
<tr>
<td>Apple - iPad/iPad mini</td>
<td>66</td>
<td>65%</td>
<td>43.0</td>
</tr>
<tr>
<td>Amazon Kindle Fire</td>
<td>8.5</td>
<td>80%</td>
<td>6.8</td>
</tr>
<tr>
<td>Google Nexus 7</td>
<td>7</td>
<td>50%</td>
<td>3.5</td>
</tr>
<tr>
<td>MSFT surface</td>
<td>2.5</td>
<td>85%</td>
<td>2.1</td>
</tr>
</tbody>
</table>

*Source: Daiwa estimates and forecasts*
**NBs – fierce contest likely ahead**

_Slow touch penetration_

In our view, the market was hoping that Microsoft’s Windows 8, an operating system with a touch-oriented, tile-based interface that was launched in 2H12, would spur the penetration of touch panels in mid-to-large-sized IT products, such as 11-15” NBs. But we think it fair to say that Windows 8 has not drawn sufficient consumer interest to trigger such a change.

Our research in the supply chain indicates that touch adoption (in the NB segment) could reach only 12% in 4Q13, compared with earlier expectations within the market for 20% penetration. We forecast global penetration of touch NBs to improve gradually from 9% in 2013 to 23% in 2014.

■ **Touch NBs: global adoption rate by quarter**

**Over-capacity: a real issue in 2014E**

Although touch panels can be highly customised products, especially those for use in high-end models, NB brand vendors’ greater tolerance for commoditised touch products makes it harder for suppliers to differentiate themselves, in our view. In turn, we believe the industry’s supply/demand outlook is becoming an increasingly important consideration for investors.

On the back of aggressive expansion by TFT-LCD makers and existing touch panel vendors, our supply/demand model points to the industry facing a significant over-supply of modules for touch NBs in 2014E, even factoring in only the capacity plans of glass-type touch panel makers. This imbalance between supply and demand will make pricing competition even fiercer in 2014E, in our view.

■ **Supply and demand analysis: touch panels for NBs in 1H14E**

<table>
<thead>
<tr>
<th>Company</th>
<th>Fab</th>
<th>Substrate size</th>
<th>Substrate capacity (’000 units / m)</th>
<th>Touch panel %</th>
<th>Loading rate (%)</th>
<th>Substrate capacity - Touch (’000 units / m)</th>
<th>Cuts per substrate (14&quot;)</th>
<th>Monthly outputs (14&quot;)</th>
<th>Yield rate% (14&quot;)</th>
<th>Yield-monthly outputs (14&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AU Optronics</td>
<td>5</td>
<td>1100x1300</td>
<td>50 100% 100%</td>
<td>100%</td>
<td>90</td>
<td>1,600</td>
<td>1200</td>
<td>8</td>
<td>50%</td>
<td>760</td>
</tr>
<tr>
<td>Innolux</td>
<td>4.5</td>
<td>730x920</td>
<td>70 100% 100%</td>
<td>100%</td>
<td>80</td>
<td>1,200</td>
<td>1600</td>
<td>8</td>
<td>80%</td>
<td>1200</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
<td>730x920</td>
<td>80 100% 100%</td>
<td>100%</td>
<td>80</td>
<td>1,200</td>
<td>1600</td>
<td>8</td>
<td>80%</td>
<td>1200</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
<td>730x920</td>
<td>40 100% 100%</td>
<td>100%</td>
<td>40</td>
<td>1,200</td>
<td>1600</td>
<td>8</td>
<td>80%</td>
<td>1200</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1100x1300</td>
<td>150 100% 100%</td>
<td>100%</td>
<td>150</td>
<td>1,200</td>
<td>1600</td>
<td>8</td>
<td>80%</td>
<td>1200</td>
</tr>
<tr>
<td>TPK</td>
<td>5.5</td>
<td>1300x1500</td>
<td>100 100% 100%</td>
<td>100%</td>
<td>100</td>
<td>1,200</td>
<td>1600</td>
<td>8</td>
<td>80%</td>
<td>1200</td>
</tr>
<tr>
<td>TPK/Cando</td>
<td>4.5</td>
<td>730x920</td>
<td>80 100% 100%</td>
<td>100%</td>
<td>80</td>
<td>1,200</td>
<td>1600</td>
<td>8</td>
<td>80%</td>
<td>1200</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
<td>730x920</td>
<td>100 100% 100%</td>
<td>100%</td>
<td>100</td>
<td>1,200</td>
<td>1600</td>
<td>8</td>
<td>80%</td>
<td>1200</td>
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<tr>
<td></td>
<td>4.5</td>
<td>730x920</td>
<td>100 100% 100%</td>
<td>100%</td>
<td>100</td>
<td>1,200</td>
<td>1600</td>
<td>8</td>
<td>80%</td>
<td>1200</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
<td>730x920</td>
<td>100 100% 100%</td>
<td>100%</td>
<td>100</td>
<td>1,200</td>
<td>1600</td>
<td>8</td>
<td>80%</td>
<td>1200</td>
</tr>
<tr>
<td>Wintek</td>
<td>3.5</td>
<td>650x750</td>
<td>540 100% 100%</td>
<td>30%</td>
<td>189</td>
<td>1,134</td>
<td>816</td>
<td>6</td>
<td>80%</td>
<td>737</td>
</tr>
<tr>
<td>Hannstouch</td>
<td>5.3</td>
<td>1200x1300</td>
<td>70 30% 100%</td>
<td>100%</td>
<td>21</td>
<td>378</td>
<td>132</td>
<td>18</td>
<td>35%</td>
<td>132.3</td>
</tr>
<tr>
<td>HengHao</td>
<td>4.5</td>
<td>730x920</td>
<td>70 100% 100%</td>
<td>100%</td>
<td>70</td>
<td>560</td>
<td>40%</td>
<td>8</td>
<td>224</td>
<td>560</td>
</tr>
<tr>
<td>LaiBao</td>
<td>5</td>
<td>1100x1300</td>
<td>100 100% 100%</td>
<td>100%</td>
<td>100</td>
<td>1,800</td>
<td>1600</td>
<td>18</td>
<td>58%</td>
<td>1,044</td>
</tr>
</tbody>
</table>

Total supply – touch panels for NB PCs (’000 units/m) 10,002 6,249
Total demand – touch panels for NB PCs (’000 units/m) 3,167

Over-supply (%) 97%

*Source: Companies, Daiwa forecasts*
TPK faces market-share losses, with further pricing pressure to come

TPK was the dominant player in touch NBs in 4Q12, with an 85%-plus market share thanks to its established industry position and limited supply from other players.

But our research in the market indicates that TPK is losing its competitive edge, given NB brands’ greater tolerance for lower-quality touch modules and commoditised products in the face of lukewarm demand for NBs and these companies’ sharper focus on costs. Emerging tier-two touch module vendors are attracting attention from NB brands due to their aggressive pricing strategies.

AUO, arguably the most aggressive LCD panel maker in the touch segment, has been pushing its eTP solution to NB brands since 2Q13. According to our research in the market, eTP, which essentially bundles a TFT-LCD panel with a touch module, has received good feedback from vendors. Although AUO’s eTP is a commoditised product which leaves limited flexibility for product design or LCD panel selection, our research suggests eTP has been adopted by the supply chain for major NB brands (Acer, Dell and HP) due to its attractive ASP, which we estimate is 25-30% lower than for TPK’s solution. AUO is targeting to offer its eTP2 solution, which features a lower-spec module than eTP but has a 5-10% lower ASP, in the low-end and mid-range NB segments in 4Q13.

In addition to LCD panel makers, film-based touch suppliers such as O-Film, J-Touch and Yong Fast are seeking to establish a presence in the touch NB market. Film-based touch makers have had limited exposure to touch NBs in 2013 due to production issues for the G/F/F solution in the segment for mid-to-large touch modules (above 10”).

However, film-based touch suppliers are developing a new film solution, known as metal mesh for touch NBs, which they believe will be more cost efficient and better suited for mid-to-large size applications. If film-based makers can address the quality issues of the metal mesh solution — 1) the ‘moire issue’, where metal lines interfere with the TFT-LCD and become visible, 2) potential oxidation of the silver and copper, and 3) low production yields — we believe competition in the touch NB market will intensify further.

In total, we forecast TPK’s market share in touch NBs could decline to 30%-plus in 2014E, from 85%-plus in 4Q12. Moreover, we estimate TPK could see a 25% YoY decline in the ASP of its NB products in 2014E due to the competitive environment.
Bill of materials for regular NBs, touch NBs and hybrid NBs

(USD) Typical NB Touch NB Remarks Detachable NB Remarks
CPU 45 ~ 210 45 ~ 210
Display 40 ~ 60 40 ~ 60 40 ~ 60
Touch panels 40 ~ 60 40 ~ 60 40 ~ 60
Chipset 36 ~ 44 36 ~ 44 36 ~ 44
HDD 40 ~ 60 40 ~ 60
SSD 60 ~ 100 PC makers prefer SSDs, though machines are likely to have both HD and SSD
60 ~ 100 PC makers prefer SSDs, though machines are likely to have both HD and SSD
DRAM 15 ~ 25 15 ~ 25
Battery 20 ~ 35 20 ~ 35
Casing 30 ~ 45 40 ~ 60 Need two packs
40 ~ 80 Need stronger casing
Optical drive 27 ~ 42 Typically no ODD
Connectors 20 ~ 30 20 ~ 30 20 ~ 35 More connectors
PCB 14 ~ 20 14 ~ 20 15 ~ 30
Power adaptor 6 ~ 7 6 ~ 7 6 ~ 7
Wireless module 4 ~ 6 4 ~ 6 4 ~ 6
Keyboard 4 ~ 6 4 ~ 6 4 ~ 6
Other parts 10 ~ 20 11 ~ 22 Different hinge designs 15 ~ 25 Complex hinge design
Software 30 ~ 80 40 ~ 80 40 ~ 80
Total 381 ~ 680 395 ~ 768 465 ~ 923

Source: Companies, Daiwa
Note: HDD = hard disk drive, SSD = solid state drive, PCB = printed circuit board, ODD = optical disk drive; hybrid NBs = detachable NBs

Refocusing on mid-range segment not an instant remedy

In its 2Q13 results meeting for analysts (6 August 2013), TPK’s management highlighted its plans to refocus on the mid-range segment.

In the NB market, TPK targets to provide a low-cost one-glass solution (OGS) to meet customers’ demand for use in mid-range to low-end NBs. We believe this approach could help TPK to regain some orders in the NB market by broadening its product range; however, the benefits will likely hinge on the ASP for TPK’s low-cost OGS, which is currently 10-15% higher than those of its peers.

For smartphones, TPK intends to offer a silver nanowire (SNW) solution targeting mid-range models with relatively large screens (5-6”). The SNW solution is an alternative to indium tin oxide (ITO) sensors, and is superior in terms of production cost, transparency, conductivity and flexibility. In October this year, TPK announced a strategic alliance with Nissha Printing to co-develop the SNW solution through a joint venture (TPK Film). TPK is targeting to begin mass production of SNW products in 2Q14 with a monthly capacity of 2m units. It believes the ASP of its SNW products could be 15-20% lower than for its existing glass-type products.

We believe the company’s SNW initiative could be a long-term positive for it, further broadening its addressable market and expanding its product offering, provided it can overcome production-yield issues (one major hurdle is the uniformity of coating on the substrate) and bring its solution to the market on schedule.

However, the potential earnings and revenue contributions from SNW in 2014-15 are uncertain, as the cost competitiveness of the technology is unproven relative to competing solutions such as G/F/F and OGS. At the same time, we believe the market is assuming TPK will win orders for these new SNW products from a major US customer in 2014, and our research in the market suggests that this is unlikely.

Comparison of major OGS touch solutions for NBs

<table>
<thead>
<tr>
<th>eTP 1</th>
<th>eTP 2</th>
<th>InnoTouch</th>
<th>UETP</th>
<th>OGS</th>
<th>Lower-cost OGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maker</td>
<td>AUO</td>
<td>AUO</td>
<td>Innolux</td>
<td>LCD Glass</td>
<td>Soda Lime</td>
</tr>
<tr>
<td>Cover glass</td>
<td>Soda Lime</td>
<td>LCD Glass</td>
<td>LCD Glass</td>
<td>Soda Lime</td>
<td>Gorilla</td>
</tr>
<tr>
<td>Bonding</td>
<td>Direct bonding</td>
<td>Direct bonding</td>
<td>Air bonding</td>
<td>Air bonding</td>
<td>Direct bonding</td>
</tr>
<tr>
<td>Fab gen</td>
<td>G5</td>
<td>G5</td>
<td>G4.5</td>
<td>G5</td>
<td>G4.5/6</td>
</tr>
<tr>
<td>SOP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customers</td>
<td>Acer, Lenovo, DELL, HP</td>
<td>Acer, Lenovo</td>
<td>Lenovo</td>
<td>In discussions</td>
<td>Acer, Sony, Asus, Lenovo, Fujitsu</td>
</tr>
<tr>
<td>Not included</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MP schedule</td>
<td>2Q13</td>
<td>4Q13</td>
<td>4Q13</td>
<td>2014</td>
<td>4Q12</td>
</tr>
<tr>
<td>Source: Display Search, Daiwa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: CS = chemical strengthening

Comparison of major OGS touch solutions for NBs

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<td>G5</td>
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<td>In discussions</td>
<td>Acer, Sony, Asus, Lenovo, Fujitsu</td>
</tr>
<tr>
<td>Not included</td>
<td></td>
<td></td>
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<tr>
<td>MP schedule</td>
<td>2Q13</td>
<td>4Q13</td>
<td>4Q13</td>
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<td>4Q12</td>
</tr>
<tr>
<td>Source: Display Search, Daiwa</td>
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<td></td>
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</tbody>
</table>

Note: CS = chemical strengthening

Material comparison: metal mesh vs. silver nanowire

<table>
<thead>
<tr>
<th>Material</th>
<th>Metal Mesh</th>
<th>Silver Nanowire</th>
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</thead>
<tbody>
<tr>
<td>Conductivity</td>
<td>★★★★</td>
<td>★★★★</td>
</tr>
<tr>
<td>Optical transparency</td>
<td>★½</td>
<td>★½</td>
</tr>
<tr>
<td>Availability for flexible display</td>
<td>★★★</td>
<td>★★★</td>
</tr>
<tr>
<td>Cost</td>
<td>★★½</td>
<td>★½</td>
</tr>
<tr>
<td>Mass production capability</td>
<td>★~</td>
<td>★~</td>
</tr>
<tr>
<td>Material supplier</td>
<td>MTNtech, Atmel, Fujifilm, Unipixel</td>
<td>Cambrios</td>
</tr>
<tr>
<td>Module supplier</td>
<td>O-film, J-touch, GIS, Young Fast</td>
<td>TPK (JV), Samsung (JV)</td>
</tr>
<tr>
<td>Target market</td>
<td>Tablet and NBS</td>
<td>Smartphones (5-6”)</td>
</tr>
</tbody>
</table>

Source: Company data, Daiwa
Note: * Neither has entered mass production, so cost remains uncertain
Financial highlights

2014 set to be worse than 2013, with earnings falling 43% and ROE to 12%
Following the 8.8% YoY decline in revenue we expect in 2013E, we forecast TPK's revenue in 2014 to fall by 11.3% YoY, with revenue growth in touch NBs likely to be insufficient to offset the decline in its smartphone/tablet business revenue in the face of heightened competition.

On back of its reduced scale economies and a likely gross-margin squeeze owing to pricing pressure, we forecast TPK's operating margin to decline to 6.3% in 2014 (from 8-12% in 2012-13E) and its EPS to fall 43% YoY (from a 23% YoY decline in 2013E). For 2014, we forecast TPK's ROE to come down to 12.3% (from close to 37% in 2012).

As for margins, we expect TPK's 3Q13 gross margin to be largely flat QoQ at 14%. We forecast its 3Q13 operating margin to contract to 5.3% (from 6.7% in 2Q13), compared with prior guidance for an operating margin of 6%, owing to the reduced revenue base. In all, we forecast TPK to post EPS of TWD3.33 for 3Q13, which would be a three-year low.

Looking to 4Q13, typically the peak quarter for sales and during which we expect a raft of product launches (iPad Air, Amazon’s Kindle Fires, and Microsoft Surface), we forecast TPK to see revenue growth of 40% QoQ. We also expect a mild recovery in TPK’s operating margin – to 7.0%, from 5.3% in 3Q13E – on the back of enhanced operating leverage (but well off the average of 11.5% over 2011-12). Still, given aggressive pricing competition, we believe TPK’s NB volume may be flat QoQ, if not down QoQ, which would likely fall short of the market’s expectation for QoQ growth in the peak fourth quarter. In total, we forecast 4Q13 EPS of TWD6.2, well below the Bloomberg consensus forecast of TWD8.8.

No equity financing planned in the near term
According to the management, TPK has no equity-raising planned for the foreseeable future. We forecast the company’s net debt-to-equity ratio to reach 59.2% in 2013 and 62.7% in 2014, but we see only a limited possibility of TPK proceeding with equity financing as it has sufficient available banking facilities (TWD99.9bn as of 30 June 2013, according to the company).

3Q13 results preview and 4Q13 outlook
Owing to delays in the launch of new products, together with lower shipments in the smartphone segment, TPK’s preliminary sales for 3Q13 totalled TWD29.5bn, down 23% QoQ and undershooting its guidance for a 15-20% QoQ contraction.
Valuation and recommendation

Initiating with Sell rating

We initiate coverage of TPK with a Sell (5) rating. We expect the company to have a disappointing 2H13 and 2014, given a challenging operating environment caused by severe competition, near saturation of high-end mobile devices, and relatively slow penetration of touch solutions in the NB PC segment.

We have a six-month target price of TWD170, based on our 2014E EPS and assigning of PER of 9x, representing a 30% discount to the stock’s past-three-year average multiple of 13x to reflect the deteriorating fundamentals we see for the company heading into 2014. The stock is currently trading at a 11.5x 2014E PER, which we consider unattractive given the weak earnings we expect next year.

Our 2014 EPS forecast is 41% below that of the Bloomberg consensus. We expect the consensus to revise down its earnings forecasts as it recognises that TPK’s profitability will likely fall short of expectations in 2H13, which would put the share price under downward pressure in the coming months.

Investment risks

The major upside risk to our rating and target price would be higher-than-expected adoption of touch solutions in NBs. Given the inherent operating leverage in TPK’s business model, if this scenario were to occur, we could see a meaningful impact on the company’s operating margin (in the next column we have provided EPS sensitivity tables). Based on our market research, we do not think that the adoption rate will increase dramatically. If the adoption rate were to increase sharply, it would likely be related to vendors cutting their prices, leading to further margin pressure on TPK.

Another risk to our call would be if TPK’s major customer, Apple, were to adopt the company’s proprietary touch solutions: TOL and SNW. However, based on our market research in the Apple supply chain, we think that TPK’s proprietary touch solutions are still not mature enough. Hence, over the next six months, we see a low probability of this scenario occurring.

EPS sensitivity analysis

Our assumptions on changes in TPK’s ASP and gross margin are key variables in our earnings forecasts. We show below a sensitivity analysis of how such changes would affect our forecasts of 2013 and 2014 EPS.

TPK: sensitivity of 2013E EPS to changes in ASP and gross margin

<table>
<thead>
<tr>
<th>EPS (TWD) 2013E</th>
<th>% change of ASP assumption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-12.0%</td>
</tr>
<tr>
<td>13.2%</td>
<td>19.4</td>
</tr>
<tr>
<td>13.1%</td>
<td>21.2</td>
</tr>
<tr>
<td>14.2%</td>
<td>23.1</td>
</tr>
<tr>
<td>15.7%</td>
<td>28.6</td>
</tr>
<tr>
<td>16.2%</td>
<td>30.4</td>
</tr>
<tr>
<td>16.7%</td>
<td>32.3</td>
</tr>
<tr>
<td>17.2%</td>
<td>34.1</td>
</tr>
</tbody>
</table>

Source: Daiwa estimates and forecasts

Note: columns and rows in blue represent our base-case assumptions in our earnings model.
Note 2: Other assumptions: 1) 70% of opex is fixed and 30% is variable (in proportion to sales growth or contraction), 2) non-operating gain/loss (interest income/expense, forex gain/loss, etc.) and tax rate are held unchanged in this sensitivity analysis.

TPK: sensitivity of 2014E EPS to changes in ASP and gross margin

<table>
<thead>
<tr>
<th>EPS (TWD) 2014E</th>
<th>% change of ASP assumption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-12.0%</td>
</tr>
<tr>
<td>12.1%</td>
<td>8.1</td>
</tr>
<tr>
<td>12.9%</td>
<td>9.6</td>
</tr>
<tr>
<td>13.1%</td>
<td>11.1</td>
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<tr>
<td>13.6%</td>
<td>12.5</td>
</tr>
<tr>
<td>14.1%</td>
<td>14.1</td>
</tr>
<tr>
<td>14.6%</td>
<td>15.6</td>
</tr>
<tr>
<td>15.1%</td>
<td>17.1</td>
</tr>
<tr>
<td>15.6%</td>
<td>18.6</td>
</tr>
<tr>
<td>16.1%</td>
<td>20.1</td>
</tr>
</tbody>
</table>

Source: Daiwa estimates and forecasts

Note: columns and rows in blue represent our base-case assumptions in our earnings model.
Note 2: Other assumptions: 1) 70% of opex is fixed and 30% is variable (in proportion to sales growth or contraction), 2) non-operating gain/loss (interest income/expense, forex gain/loss, etc.) and tax rate are held unchanged in this sensitivity analysis.
TPK: one-year forward PER bands

Source: TEJ, Daiwa forecasts

TPK: one-year forward PBR bands

Source: TEJ, Daiwa forecasts

TPK: share price vs. net profit YoY change

Source: TEJ, Company Data
Note: operating profit YoY change for 3Q13E is based on Daiwa forecasts

TPK: share price vs. operating profit YoY change

Source: TEJ, Company Data
Note: operating profit YoY change for 3Q13E is based on Daiwa forecasts

TPK: adjusted shareholding of foreign institutional investors

Source: TEJ, Company Data
Note: For foreign issuers like TPK, major shareholders’ and manager’s holdings are included in the holding by foreign institutional investors (FINI). We deduct those shares from our estimate of the FINI holding.
When a report covers six or more subject companies please access important disclosures for Daiwa Capital Markets Hong Kong Limited at http://www.daiwacm.com/hk/research_disclaimer.html or contact your investment representative or Daiwa Capital Markets Hong Kong Limited at Level 26, One Pacific Place, 88 Queensway, Hong Kong.
## Company profile

### Management team

TPK’s management team has considerable experience in the touch-panel industry. Chairman and founder Michael Chiang was previously the chairman and president of Taiwan Video and Monitor Corporation; Tom Sun, the company’s CEO, was the chief representative for Motorola in the China region before joining TPK in 2007.

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michael Chiang</td>
<td>Chairman</td>
<td>Prior to founding TPK, Mr. Chiang was the chairman and president of Taiwan Video and Monitor Corporation. He holds a Bachelor’s degree in Business Administration from Fu Jen Catholic University.</td>
</tr>
<tr>
<td>Tom Sun</td>
<td>CEO</td>
<td>Mr. Sun held several positions at Motorola for over 20 years and was the chief representative for Motorola in the China region before taking the CEO position at TPK in 2007. He has a Master's degree in Industrial Engineering from Illinois State University, US.</td>
</tr>
<tr>
<td>Micro Kuo</td>
<td>COO</td>
<td>Mr. Kuo became Chief Operating Officer at TPK in 2011. He was the general manager of LiteOn Technology Corporation in 2009. Mr. Kuo holds a Bachelor’s degree in science from New Mexico State University, US.</td>
</tr>
<tr>
<td>Eric Chang</td>
<td>Senior VP</td>
<td>Mr. Chang was employed at eTurboTouch China and GVC prior to joining TPK in 2004. He has also been a director of Greetec Precision Solution Corp. since 2009. Mr. Chang received a Master's degree in mechanical engineering from the University of Science and Technology.</td>
</tr>
<tr>
<td>Ann Wu</td>
<td>Senior VP</td>
<td>Ms. Wu was CEO at both Taiwan Video and Monitor Corporation and Fiege Goth Corporation prior to joining TPK in 2005. She has a Bachelor’s degree in accounting from Tunghai University.</td>
</tr>
<tr>
<td>Freddie Liu</td>
<td>CFO</td>
<td>Mr. Liu served as vice-president at Citibank and was formerly the CFO at TASE Group. He holds an MBA from the University of Michigan.</td>
</tr>
</tbody>
</table>

Source: Company Data

### Sales mix

TPK’s produces touch modules and touch displays (touch modules featuring lamination of the LCD panel). Touch modules have higher gross margins (~20%) than touch displays (~12%), as touch displays incorporate relatively high-ASP panels and the associated costs are passed through to customers.

TPK’s profitability can fluctuate due to changes in the company’s product mix. In 2Q13, touch modules accounted for 31% of the company’s total revenue, with touch displays making up the remainder.

### Shareholding structure

After Balda AG, the largest shareholder in TPK upon the company’s listing, sold down all of its stake over the past two years, Max Gain Management became the major shareholder, with a 7.7% stake, followed by Capable Way Investment (7.0%) and company founder Michael Chiang (5.3%). Collectively, Michael Chiang and his family are the major shareholders, with a 24% holding.

<table>
<thead>
<tr>
<th>Holder Name</th>
<th>Holding %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Gain Management Ltd.</td>
<td>7.67</td>
</tr>
<tr>
<td>Capable Way Investments Ltd.</td>
<td>7.03</td>
</tr>
<tr>
<td>Chiang Ch’ao Jui</td>
<td>5.29</td>
</tr>
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<td>High Focus Holdings Ltd.</td>
<td>4.03</td>
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<tr>
<td>GIC</td>
<td>3.10</td>
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<tr>
<td>Blackrock (Saudi Arabia Central Bank)</td>
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<tr>
<td>Fidelity Fund</td>
<td>2.29</td>
</tr>
<tr>
<td>New Labor Pension Fund</td>
<td>1.65</td>
</tr>
<tr>
<td>Appollo Forum Ltd.</td>
<td>1.63</td>
</tr>
<tr>
<td>Fan Jia De Development Fund</td>
<td>1.61</td>
</tr>
</tbody>
</table>

Source: TEJ, Company

Note: as at 17 October 2013; entities shaded in blue are related to founder Michael Chiang
TPK: organisational structure

Source: Company Data, Daiwa
Appendix I: the touch panel supply chain

### Capacitive touch panel supply chain

**Raw Material**
- Glass Substrate
  - Corning (GLW)
  - Asahi (5301 JP)
  - NKG (6214 JP)
  - NHT (NL)
- ITO Target
  - ULVAC (6728 JP)
  - Nippon Mining (5016 JP)
  - Miitsu (4183 JP)

**ITO Glass/Touch Sensor**
- ITO Glass/Touch sensor
  - AVCT (8077 TT)
  - AIMOcre (3615 TT)
  - G-Tech (3149 TT)
  - Wintek (2384 TT)
  - TPK (3673 TT)
  - Cando (8056 TT)
  - HannsTouch (3049 TT)
  - Truly (732 HK)
  - Laibao (002106 CH)
  - AUO (2409 TT)
  - Innolux (3481 TT)

**Flexible PCB**
- Career (6153 TT)
- Flexium (6269 TT)
- NGI MFG

**Lamination Process**
- Sensing Material
  - Synaptics (SYNA)
  - 3M (MMM)
  - Elo (TEL)
- Controller IC
  - Elan (2458 TT)
  - Synaptics (SYNA)
  - Broadcom (BRCM)
  - Cypress (CY)
  - Allia (3770 JP)
  - EETI (3506 TT)
  - Wacom (6727 JP)
  - Mottak (099049 XQ)
  - Avail (4TML)

**Touch Module/Touch Panel**
- Touch Module/Panel
  - TPK (3673 TT)
  - Winflex (2384 TT)
  - Mitsu (4183 TT)
  - HannsTouch (3049 TT)
  - Truly (732 HK)
  - Laibao (002106 CH)
  - AUO (2409 TT)
  - GBS (Not-listed)
  - Hon Hai (600133 CH)
  - Nissha Printing (7915 JP)
- TFL LCD
  - AUO (2409 TT)
  - Samsung (005930 KS)
  - LGD (034220 KS)
  - Innolux (3481 TT)

**Touch Display**
- EMS/ODM
  - Hon Hai (2317 TT)
  - Pegatron (4068 TT)
  - Quanta (2382 TT)

### RAW MATERIAL
- PET Film
  - Sumitomo (4005 JP)
  - Toray (3402 JP)

**ITO Film/Touch Sensor**
- ITO Film/Touch sensor
  - Nito Denko (6888 JP)
  - Taijin (3401 JP)
  - Ohk & Co (3051 JP)
  - O-Film (032456 CH)
  - Fujifilm (4901 JP)
  - Nissha Printing (7915 JP)

**Flexible PCB**
- Flexfilm PCB
  - Corning's Gorilla (GLW)
  - Fujikura (6216 JP)
  - Leta One (Not-listed)
  - O-Film (002456 CH)

**Cover Glass**
- Corning's Gorilla (GLW)
- Fujikura (6216 JP)
- Leta One (Not-listed)

**Touch Module/Touch Panel**
- Touch Module/Panel
  - Young Fast (3622 TT)
  - J-Touch (3485 TT)
  - Nissha Printing (7915 JP)
  - S-Mac (097780 KS)
  - Iljin Display (020760 KS)
  - Digit Systems (091580 KS)
  - ETL (094190 KS)
  - O-Film (002456 CH)
  - TPK (3673 TT)
  - GIS (Not-listed)

Source: Company Data, Daiwa Capital Markets
Appendix II: the technology of projective capacitive touch solutions

Projective capacitive touch structures – glass type vs. film type

The projective capacitive (p-cap) touch solution is the most widely adopted touch technology by far, thanks to its greater durability, higher transmittance and lower cost compared with solutions such as resistive, surface acoustic wave (SAW), and optical imaging.

P-cap touch solutions feature one of two types of structure: glass type and film type. A glass-type structure typically consists of a glass substrate (deposited with ITO [indium tin oxide] sensors) laminated with cover glass on the top and then laminated onto a TFT-LCD display (G/G solution). In a film-type structure, the glass substrate is replaced with two PET films (G/F/F solution).

Although a glass-type structure is heavier and thicker than a film-type structure, it is superior in durability, sensitivity, and light transmittance. Moreover, film is more sensitive than glass to changes in temperature, and can create ripples that compromise touch sensitivity.

Theoretically, a film-type structure should be around 20% cheaper than the glass-type structure; in practice, however, the pricing gap narrows when the panel becomes larger, as the greater resistance of film makes it hard to improve the production yield when the panel size increases.

TPK and Wintek dominate the glass-type segment, while Ofilm and Youngfast are the major players in the film-type segment.

<table>
<thead>
<tr>
<th>Capacitive touch type: comparison of structure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Glass-type</strong></td>
</tr>
<tr>
<td>Weight</td>
</tr>
<tr>
<td>Thickness</td>
</tr>
<tr>
<td>Durability</td>
</tr>
<tr>
<td>Surface</td>
</tr>
<tr>
<td>Transmittance</td>
</tr>
<tr>
<td>Design</td>
</tr>
<tr>
<td>Lamination process</td>
</tr>
<tr>
<td>Target market</td>
</tr>
</tbody>
</table>

Source: Display Search, Daiwa

Single-glass solution

With mobile devices incorporating thinner and lighter designs, the single-glass solution (SGS) has emerged as an alternative to the traditional G/G solution. Unlike the G/G or G/F/F solutions, SGS omits the sensor glass by integrating the touch sensor up to the cover glass with an ITO coating and patterning.

The major advantages of the SGS include: 1) lower cost (10-20% lower than for the G/G solution, depending on the strength requirements), and 2) greater transparency thanks to the slimmer design and elimination of the glass layer. Compared with in-cell/on-cell technology (detailed below), SGS also offers greater mechanical flexibility for customisation.
We can further divide SGS into two types of products: piece-type (also called cell-type) and sheet-type, where the main difference is the production method (eg, the time at which the glass is cut into pieces). The piece type is widely known as touch on lens (TOL), while the sheet type is known as the one glass solution (OGS).

**Production method: piece-type and sheet type**

![Diagram](https://via.placeholder.com/150)

Source: Display Search, Daiwa

**TOL (touch on lens)**

A touch-panel maker adopting TOL (or piece type) technology cuts the cover glass into pieces, right after finishing the cover-glass production procedure (chemical strengthening, shaping, and printing), before finally going through the ITO process.

This method allows for physically stronger products and affords more flexibility in product design compared with OGS, but it is more expensive and the ITO sputtering process remains a key challenge for most touch panel makers. TPK is currently the only player to offer a TOL solution.

**OGS (one glass solution)**

Compared with TOL, the production process for OGS (or sheet-type panel) is more straightforward: it starts with the cover glass process (chemical strengthening and printing), followed by ITO coating and patterning, and, finally, cutting the sheet into pieces.

Use of OGS entails lower costs, as the ITO sputtering process is performed on a sheet basis rather than a piece basis. However, the end-product is physically weaker and the use of OGS poses some limitations in product design. All things considered, OGS is generally viewed as the better solution for large-size displays like touch NBs, given its lower cost, thinner designs, and lower impedance compared with film-type solutions. The major players in OGS are Wintek and Cando.

---

**Single-glass solution comparison: OGS vs. TOL**

<table>
<thead>
<tr>
<th>Feature</th>
<th>OGS</th>
<th>TOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness</td>
<td>★★★</td>
<td>★★★</td>
</tr>
<tr>
<td>Strength</td>
<td>★</td>
<td>★★☆</td>
</tr>
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<td>Sensitivity</td>
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<td>★</td>
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<td>★</td>
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<td>Mechanical Flexibility</td>
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<td>★</td>
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<tr>
<td>Lead Time</td>
<td>★</td>
<td>★</td>
</tr>
<tr>
<td>Volume flexibility (per month)</td>
<td>★</td>
<td>★</td>
</tr>
<tr>
<td>Mass production capability</td>
<td>★★★</td>
<td>★☆</td>
</tr>
<tr>
<td>Model</td>
<td>Google Nexus 7</td>
<td>Kindle Fire HDX (8.9”)</td>
</tr>
</tbody>
</table>

Source: Daiwa

Overall, we believe TOL is better suited for use in mid-range to high-end smartphones, since it allows for physically stronger products. In comparison, OGS is targeted more at low-end and mid-range products with large screen sizes. The Kindle Fire HDX (8.9”), Amazon’s new flagship tablet, uses the TOL solution, while Google’s Nexus 7 (both old and new models) uses the OGS solution.

**eTP (embedded touch panel)**

TFT-LCD makers recently developed a universal OGS solution for use in NBs. This approach features an embedded touch panel, which refers to a strengthened sensor glass laminated on the TFT-LCD panel.

AU Optronics (AUO) first proposed the eTP solution in late 2012/early 2013. Compared with the conventional OGS solution, for which the sensor glass must be strengthened, in the eTP solution the sensor glass is fully laminated on the LCD display and then customised with a bezel. This approach reduces the cost of strengthening.

Combining the touch panel and LCD display gives TFT-LCD makers better control of the product and allows them to further reduce manufacturing costs. At the same time, the eTP solution can integrate the signals from both layers into one cable and can support edge-to-edge designs which meet Microsoft’s requirements for touch NBs running Windows 8.

AUO’s eTP solution for several screen sizes entered mass production in 2Q13, and we have seen similar designs from other TFT-LCD panel makers. Innolux’s Innotech, which recently entered mass production, can be applied to larger screen sizes for use in all-in-one PCs, while LG Display is believed to be preparing its own solution (UETP) for launch in 2014.
**Cover glass comparison: traditional OGS solution (LHS) vs. ETP solution (RHS)**

Source: Daiwa

**AUO’s eTP exterior: front (LHS) and side views (RHS)**

Source: Display Search, Daiwa

**Major display makers’ OGS solutions for NBs**

<table>
<thead>
<tr>
<th>Maker</th>
<th>eTP 1</th>
<th>eTP 2</th>
<th>InnoTouch</th>
<th>UETP</th>
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<td>Innolux</td>
<td>LGD</td>
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<td>G5</td>
<td>G4.5</td>
<td>G5</td>
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<td>Direct bonding</td>
<td>Air bonding</td>
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<td>No</td>
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<td>No</td>
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<td>4Q13</td>
<td>4Q13</td>
<td>2014</td>
</tr>
<tr>
<td>Major clients</td>
<td>Acer, Lenovo, Dell, HP</td>
<td>Acer, Lenovo</td>
<td>Lenovo</td>
<td>In discussion</td>
</tr>
</tbody>
</table>

Source: Daiwa

**In-cell and on-cell**

Instead of moving the touch sensor to the cover glass, as OGS does, in-cell and on-cell solutions reduce one layer in the touch model by integrating the touch sensor with the LCD module. TFT-LCD makers such as Sharp, LGD, JDI, Samsung and AUO have developed this solution by leveraging their LCD manufacturing capability.

**Structure comparison: OGS vs. in-cell and on-cell**

Source: Company, Daiwa

The major difference between in-cell and on-cell panels is the location of the touch sensor. For in-cell technology, the touch sensor is integrated into the display between the TFT substrate and the colour filter. For on-cell technology, the touch sensor is placed between the colour filter and the polarizer on the top of the encapsulation glass (AMOLED-based).

The in-cell and on-cell solutions also feature thinner and lighter modules, and their costs should decline once production yields improve as technical hurdles such as noise/signal performance and light transmittance are overcome. Still, in-cell and on-cell solutions are inferior to SGS in terms of flexibility and supporting the volumes needed for mass production. As such, though Apple and Samsung Electronics have respectively adopted in-cell and on-cell (AMOLED) technology in their flagship smartphone models, neither solution can yet be considered as a mainstream technology.

**In-cell**

In-cell technology puts the touch sensor layer further beneath the top surface of the display and thus requires very advanced technology in order to enhance the sensitivity and response time. The technology was first used by Apple in its iPhone 5, in 2012, and LG Display, Sharp and Japan Display are currently the major suppliers.

There are three types of in-cell technology available, depending on how the in-cell touch technology display is built: 1) charge-sensing, 2) photo-sensing, and 3) voltage-sensing. Most manufacturers focus on the first two as they offer better touch performance.

**1. Charge sensing**

Charge-sensing technology, or capacitive sensing, is almost indifferent to conventional p-cap touch panel solutions, as the controller IC can measure the change in capacitance caused by the movement of the conductive electrode from a person’s finger, and then detect the location of the finger.
It is in the charge sensing in-cell that vendors place the touch sensor (i.e., the ITO layer) onto the array inside the display module.

**Charge sensing in-cell technology**

The charge sensing in-cell touch solution is not affected by light or the backlight; the touch sensor can detect the capacitance, which is the same as P-cap, whereas other in-cell solutions detect positions by photo or voltage, not by the capacitance. However, there are several disadvantages to using it, including: 1) poor touch performance and a weaker touch signal, 2) the need for a more complicated controller IC, and 3) a less efficient LCD.

In the above diagram, electromagnetic signals from LCD modules may cause interference when measuring capacitance. The touch signal is weakened further, as the touch sensor is located far from the cover glass. In addition, charge-sensing in-cell panels need a more advanced and less power-consuming controller IC, as the LCD is more integrated than in the traditional G/G solution. Finally, the conductive spacer electrodes inside the LCD module lead to a lower aperture ratio, reducing the efficiency of the LCD. These obstacles have slowed the development of charge sensing touch technology.

**2. Photo sensing**

Photo sensing, or light sensing, places photo detectors inside LCD's pixels at the array level. Photo-sensing in-cell technology is a unique solution that detects movement by sensing the shadow of a finger or the reflection of a finger the backlight.

This solution does not need lamination and calibration; however, the photo-sensing technology performs badly in extreme bright/dark environments. Also, there are additional costs involved in replacing expensive photo sensors for the various models on the market.

We believe that photo sensing in-cell technology will be commercialised earlier than other in-cell technologies, but that the makers of this solution still need to overcome the technical and cost issues associated with it before they start mass production.

**3. Voltage sensing**

Voltage sensing in-cell technology works similarly to resistive touch technology. When a person presses the surface of the touch panel with a finger or a stylus, an electric circuit is closed and the voltage returns to zero. This technology measures the voltage range between the open-circuit voltage and the closed-circuit voltage to determine the location of the finger.

Compared with charge-sensing and photo-sensing in-cell technology, this solution uses the simplest controller IC. However, the adoption rate of this technology has been extremely low so far, as it has major drawbacks including: 1) it does not really support multi-touch displays, and 2) it requires finite pressure when pressing the touch panel to function.

**On-cell**

On-cell technology places the touch capacitive sensor on top of the colour filter rather than under the colour filter substrate, as is the case with the in-cell technology.

**On-cell technology: the structure of a TFT-LCD**

Compared with the charge-sensing in-cell technology, the on-cell technology enables a better touch performance as the touch sensor is built above the colour filter instead of below it, and thus is closer to the finger when the latter is pressed on the touch panel's surface. However, the yield rate for on-cell technology remains low and the touch module can be easily damaged during the reverse process used for ITO.
patterning (used to pattern the ITO after patterning the colour filter). Another concern is noise; there is often interference with on-cell technology, between the electromagnetic signals (LCD modules) and touch signals.

AMOLED-based on-cell touch modules, unlike LCD-based module, do not need a colour filter inside the structure and thus the yield rate is higher and the signal-interference problem is not that serious. Samsung introduced the Super AMOLED in 2010 and adopted this technology for its flagship smartphone model, the Galaxy S-series.

### Film-type migration – G1F and GF2

For film-type p-cap touch panels, there are new technologies offering thinner and lighter than the traditional G/F/F solutions: glass on film (G1F) and glass on DITO film (GF2). In the G1F structure, the x-axis touch sensor is coated on the back of the cover glass and coated on the different sides of the ITO film. Both of the solutions emit one film layer and thus enhance the optical performance and touch sensitivity.

Currently, Young Fast is the major provider in Asia of G1F, with this solution used by Microsoft’s Surface tablet. Apple holds the patent on GF2 and uses this technology to produce the iPad mini. However, most film-type touch smartphones and tablets still use the GFF structure given high yield rates and low costs.

### Major touch solutions sensor structure

<table>
<thead>
<tr>
<th>Sensor substrate</th>
<th>GG DITO</th>
<th>GG DITO</th>
<th>OGS</th>
<th>GFF</th>
<th>G1F</th>
<th>GF2</th>
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<td>Substrate #</td>
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<td>Substrate material</td>
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<td>Glass</td>
<td>Glass</td>
<td>Film/film</td>
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<tr>
<td>Y electrode</td>
<td>Glass: top</td>
<td>Glass: top</td>
<td>Glass: bottom</td>
<td>Film #1</td>
<td>Glass: bottom</td>
<td>Film: top</td>
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<td>X electrode</td>
<td>Glass: top</td>
<td>Glass: bottom</td>
<td>Glass: bottom</td>
<td>Film #2</td>
<td>Film: top</td>
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</tr>
</tbody>
</table>

### Major in-cell and on-cell vendors

- AUO
- CMI
- CPT
- LG Display
- NEC
- Samsung
- Seiko-Epson
- Sharp
- Sony
- TMD

Source: Company Data, Daiwa

Source: Display Search, Daiwa
### Major touch solutions: comparison

<table>
<thead>
<tr>
<th></th>
<th>GG</th>
<th>GFF</th>
<th>G1F</th>
<th>GF2</th>
<th>OGS</th>
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</table>

Model: iPad 4, Asus Memo Pad, Microsoft Surface, iPad mini, iPad5, Google Nexus 7, Kindle Fire HDX (8.9’), iPhone 5S, Galaxy S4

Source: Company, Daiwa

### Major touch solutions offered by various companies

<table>
<thead>
<tr>
<th></th>
<th>GG</th>
<th>GFF</th>
<th>G1F</th>
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</table>

Source: Companies, Daiwa
Appendix III: emerging touch-sensor materials beyond ITO

Alternatives to ITO

Currently, ITO remains the most widely used material to make transparent conductive coatings for touch panels. However, ITO-based touch solutions have some disadvantages, such as high material (indium) costs and limited flexibility. As a result, touch-panel makers have been looking for alternatives to ITO. Metal mesh, silver nanowires (SNW), carbon nanotubes, conductive polymers, and graphene are all popular ITO replacements, with the first two the most widely discussed so far.

Metal mesh

In a metal-mesh structure, a circuit line made of silver or copper is printed on the film substrate in a thin structure of about five microns through a roll-to-roll production process.

Metal-mesh touch sensors are superior to conventional ITO touch sensors in several areas. First, the material costs for this solution are about one third of those for ITO sensors. Flexibility is another advantage for metal mesh, as it can be used with soft materials. In addition, metal mesh is more suitable for large-size displays due to lower impedance.

However, metal-mesh touch sensors have not been mass produced due to the ‘Moiré issue’, oxidation, and low yield rates. The Moiré issue is that metal lines are visible on the screen, and this can also reduce the optical performance. The oxidation of silver and copper is another issue, and may shorten the life of the product. Furthermore, the current yield rate of 30-40% drives up the costs.

Film-type touch-module makers such as Young Fast, J-touch and O-film are the major promoters of metal-mesh touch solutions and they expect several tablets and touch NBs to be moved from OGS to this solution. Atmel, MNTech, Unipixel, and Fujifilm are the only players that can provide metal mesh-based films currently. However, film-based touch-module makers such as O-Film are trying to produce their metal-mesh film in-house given that it carries a margin. O-film has said it will have the ability to produce metal-meshed film in-house and offer an integrated touch solution in 3Q13.

Silver nanowire

Another alternative to ITO, SNWs are made of crystalline silver with a diameter of tens of nanometres. Relative to an ITO sensor, this nano-structured inorganic material can produce a transparent conductor coating with a higher optical transparency, a better conductivity and flexibility, and lower production costs. Like ITO, SNW can also be applied to glass, polycarbonate, and PET film.

SNW has a higher transmission level than ITO, which means longer battery life per charge. In addition, silver is a better conductor than indium and thus the amount of material used for the same area can be lower. Unlike ITO, which requires an expensive vacuum application to produce, SNW is applied to a material using a wet chemical solution.

The key issue that needs to be solved is on the supply side. Cambrios, a US-based company, is the only maker of this material currently. TPK has been co-developing a type of SNW material for three years and set up a joint venture, TPK film, with Cambrios in June 2012. TPK then announced a strategic alliance with Nissha Printing on 3 October 2013. According to the agreement, Nissha Printing will invest USD6.25m in TPK film and hold a 25% stake in the company. TPK and Cambrios will hold 65% and 10%, respectively.

Cambrios will offer SNW material, Nissha Printing will contribute its know-how in film and roll-to-roll technology, and TPK film will be dedicated to the production process, such as coating, patterning and die-cutting. Management expects this solution to start mass production in 2Q14 with 2m unit/month.

Source: Cambrios
Daiwa's Asia Pacific Research Directory

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