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## Will Tessera's 'Smart Module' Gamble Pay Off?

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SAN JOSE, Calif. -- With little or no fanfare, Tessera Technologies Inc. has accomplished a rare feat: It is one of the few intellectual-property (IP) chip companies that is making money.

But many wonder if Tessera's luck will eventually run out. Still others ponder if the San Jose-based company will rebound from a false start in its new and fledgling growth engine: imaging and optics. In this segment, it is taking a bold gamble by attempting to shake-up the CMOS image-sensor component/packaging supply chain, where OEMs are scrambling to cut costs for a new class of camera-based cell phones and smartphones.

Indeed, Tessera faces many challenges. The company's main IP business--chip-scale packaging (CSP)--could see many of its existing contracts and patents expire in the distant future. It prevailed in a recent complaint with the U.S. International Trade Commission (ITC), but it remains unclear just how it will realize any payments in a complex case that has chip makers and OEMs reeling.

Realizing that it needed a new engine for growth, Tessera has embarked on a bold but little-understood strategy that could pay huge dividends--or may simply fall flat. Since 2005, it has acquired five separate companies in the imaging and optics arena. Call it Tessera's big gamble: It hopes to replicate success in DRAM IP, by assembling the pieces to boost the imaging quality and functionality for camera-based handsets, a market that is projected to grow from 987 million units in 2010 to 1.17 billion units in 2011, according to Barclays Capital.

But the company has already seen a slight setback for its Imaging and Optics division, which develops wafer-level packaging for CMOS image sensors, wafer-level optics for camera modules, smart optics technology and embedded image enhancement IP.

The unit also claims to have the industry's most viable 3-D technology based on thru-silicon-via (TSV) technology. Also in the works is a silent air iconic cooling technology for notebook PCs and other products.

Citing a fall in capital equipment spending, the Imaging and Optics group is projected to exit the year with about \$12 million in sales for 2009, significantly down from \$23 million in sales last year, according to Barclays Capital. The forecast is down from projections earlier this year, when Barclays predicted that the group would realize \$30 million sales for 2009.

In response, Tessera disagreed. Imaging and Optics revenue are expected to be \$31.7 million in 2009, according to Tessera. The \$12 million figure cited is only for the "Products & Services portion of our Imaging & Optics business," the company said.

The group missed its forecast in other respects. At one time, the Imaging and Optics division projected that its sales would hit \$100 million by 2010, said Hans Mosesmann, an analyst with Raymond James. Considered one of the company's "secrets for its long term success," the group has now pushed out those ambitious \$100 million sales targets to 2011, Mosesmann said.

Clearly, Tessera "jumped the gun" in terms of its projections for the group, he said. "It may take time" before it generates significant revenue in that group.

One of the problems is a micro-optic lens technology, which is developed and sold for off-axis applications in semiconductor lithography tools, as well as other markets. The fab tool market has been horrible in 2009, which has impacted Tessera's bottom line.

"This business was hit," said Mike Bereziuk, executive vice president of the Imaging and Optics division. "It's recovering, but there's a long ways to go."

Bereziuk indicated that many of Tessera's IP licensees in the arena will shortly ramp their products, especially mass-market camera phones. In other words, the unit expects to see higher royalty streams in 2010, he said.

The ultimate goal of the fledging group is to provide the IP for a new class of camera-based handsets, based on "image capture and video" technologies, he told *EE Times* in a recent interview at the company's headquarters here.

### **New forecasts**

"Tessera's chip-scale packaging (CSP) technology remains the key driver of Tessera's royalty stream, with DRAM likely the major contributor," said C.J. Muse, an analyst with Barclays Capital, in a report. The "longer term focus (is) on emerging growth opportunities in Imaging and Optics. That said, outside of some upfront licensing fees, Tessera has not seen much Imaging and Optics royalty streams to speak of."

Some licensees will begin to ramp in 1Q 2010 and beyond, he said. But it remains to be seen if Tessera can replicate its glory in the arena. In 1990, the company was founded as a manufacturer of IC-packaging, but it eventually moved towards an IP model. It devised the so-called Tessera Compliant Chip (TCC) technology, a newfangled CSP scheme.

Today, the company boasts the who's who in terms of licensees. It is pushing its CSP IP into wireless and NAND, but its claim to fame is DRAM. "On this front, management indicated that their CSP technology is scalable to (greater than) 2.5-GHz DDR3; and with DDR3 likely remaining mainstream well beyond 2013, this will continue to be a solid contributor to Tessera's top/bottom-line for many years," Muse said. "Management also indicated that they are working on solutions for DDR4 as well, though this has yet to enter production."

Here's the big question: How long will Tessera's revenue steam last in DRAM? "As for questions regarding the existing DRAM licensing contracts, where patents begin to expire in the next couple of years, Tessera still holds additional patents, trade secrets and 'know how' for DRAM CSP that extend well beyond 2012, including the '106 patent used in the ITC DRAM case, which expires in 2014," Muse said.

In 2007, Tessera filed a complaint with the ITC, charging that various DRAM makers and others infringed upon its patents. In a blow to the company, the ITC recently issued an initial determination, finding Tessera's asserted patents are valid, but not infringed by the respondents. The ITC can affirm, modify or reverse the decision, which is due Dec. 29. The respondents in the DRAM ITC action include Acer, Centon, Elpida, Kingston, Nanya, Powerchip, ProMOS, Ramaxel, Smart Modular and TwinMOS.

Tessera gained a more favorable ruling in another high-profile case. In May, the ITC ruled that the ATI division of Advanced Micro Devices, Freescale, Spansion, STMicroelectronics and Qualcomm infringe two patents of Tessera. The ITC issued a limited exclusion order banning the companies from importing into the U.S. chips that use fine-pitch BGA packages described in the patents.

The ban on imports into the U.S. of a broad range of chips using fine-pitch BGA packages potentially has far reaching impact. But it is still difficult to gauge the impact of the ruling or even find out exactly which chips it covers. The case highlights the difficulties electronics companies face dealing with a rising tide of patent enforcement issues.

Amid its legal battles, Tessera is still seeing a decent growth despite the downturn. Revenues for the three months ended June 30, were \$62.3 million as compared to \$56.3 million for the three months ended June 29, an increase of 11 percent.

CSP---or micro-electronics--revenues for the three months were \$55.6 million as compared to \$49.3 million for the three months ended June 29, 2008. For the unit, operating income for the three months ended June 30, 2009 and June 29, 2008, was \$40.0 million and \$21.8 million, respectively, which represented an increase of 84 percent.

Imaging and optics revenues for the three months ended June 30, were \$6.6 million as compared to \$7.0 million for the three months ended June 29, 2008, a decrease of 5 percent. Imaging and optics revenues for the six months ended June 30, 2009 were \$14.7 million as compared to \$17.6 million for the six months ended June 29, 2008, a decrease of \$3.0 million, or 17 percent.

In that unit, operating loss for the three months ended June 30, 2009 and June 29, 2008 was \$11.4 million and \$9.7 million, respectively, which represented an increased loss of \$1.7 million, or 17 percent. Operating loss for the six months ended June 30, 2009 and June 29, 2008 was \$22.0 million and \$14.9 million, respectively, which represented an increased loss of \$7.1 million, or 47 percent.

Last month, Tessera raised its third quarter 2009 revenue guidance to range between \$65.0-to-\$66.0 million. Third quarter 2009 micro-electronics (CSP) revenue, all of which will be royalty and license related, is now expected to range between \$58.0-to-\$59.0 million. Prior guidance, announced on Aug. 4, was for third quarter to range between \$60.0-to-\$62.0 million and micro-electronics revenue to range between \$54.0-to-\$56.0 million.

It is raised its imaging and optics revenue to be approximately \$7.0 million, of which approximately \$4 million will be royalties and license fees. Prior guidance, given on Aug. 4, was imaging and optics revenue of \$6.0 million, of which approximately \$3.0 million was royalties and license fees.

### **Acquire or bust**

The company's sales in imaging and optics "are modest," said James' Mosesmann. (Tessera's IP licensees) "are not household names. But all it takes is a couple of big OEMs to (realize some) significant volumes."

There is also a new mindset at Tessera, which is seeking to "monetize" the technology, he added. The analyst was referring to a move made last year, when Tessera chairman, president and chief executive, Bruce McWilliams, transitioned to a new role as chief strategy officer. Henry Nothhaft, then vice chairman of the board, became president and chief executive. McWilliams remained chairman.

Tessera also believes it has the pieces in imaging and optics to pay dividends-- finally. It began to assemble the pieces in 2005, when Tessera purchased certain assets of Shellcase Ltd., a provider of wafer- level image sensor packaging technology.

Then, in 2006, Tessera purchased Digital Optics Corp., a developer of micro-optical solutions. In 2007, Tessera acquired Eyesquad, a supplier of smart optics technologies, such as digital auto-focus and optical zoom solutions for camera phones and other electronic products.

Last year, Tessera acquired FotoNation, a provider of embedded imaging solutions for digital still camera and mobile phone applications. Principal products encompass technologies for red-eye correction; face tracking; smile and blink detection; as well as other solutions for enhancing digital image quality. FotoNation's technology is embedded in more than two out of three digital still cameras sold today.

In April of 2009, Tessera made its last acquisition by buying certain assets of Israel-based Dblur Technologies Ltd., a developer of software lens technology for cell phone cameras and other imaging applications.

The technologies primarily target the image sensor, via Shellcase in CSP, the lens stack through DigitalOptics, and image quality/image processing, thanks to Eyesquad.

All told, Tessera is trying to turn the camera-phone IP supply chain upside down. The company does not make or sell the CMOS image sensor, but it offers many of the critical packaging and IP technologies for the segment.

One of the key goals is to re-invent the camera module for good reason. Nokia has set a goal to reach a camera module cost of about \$1.00, according to Barclays Capital. Other OEMs are also attempting to drive down the cost of their camera phones.

To achieve that goal, there are complex choices for OEMs. First, a handset camera module includes the image sensor, optical lens, image processor, housing and substrate, according to Barclays Capital.

Traditionally, the image sensor is wirebonded to a PCB substrate. Then the lens barrel is then mounted in its housing on top of the substrate. "A module maker or handset OEM can choose, among other things: 1) whether to package the image sensor using chip scale packaging; chip-on-board, or flip-chip packaging; 2) whether to then mount the sensor on a ceramic substrate or a glass substrate; and 3) whether to use a traditional optical lens stack or a wafer level lens stack," according to the report.

It gets even more complex. "The supply chain in camera phones generally operates as follows: 1) image sensor vendors, image processor vendors, and lens vendors supply their respective components to the camera module maker; and 2) the camera module maker integrates all the components together and ships the complete camera module to the handset OEM," according to the report.

Cost is the key. The image sensor itself makes up 55 percent of the cost of a module. The ASP on a VGA camera module has dropped about 50 percent per year over the last three to four years, and is currently about \$1.50-\$2.00 each, according to the report.

From 2002 to 2007, "image sensor manufacturers were able to shrink the pixel size from 5um to about 1.75um. This enabled smaller, cheaper image sensor chips," according to Barclays. "However, at a certain point, smaller pixels actually raise the camera module cost. This is due to the fact that smaller pixel are less sensitive to light, which lowers the quality of the image. In order to compensate for this effect and maintain the same quality level, module makers must utilize better lens stacks and better image processors, which in turn raises the cost of the module."

### **Smart modules?**

One of the emerging costs is the IC-packaging process. Traditionally, camera module image sensors use chip-on-board (COB) packaging technology. In a rival technology, Tessera offers its Shellcase wafer-level chip scale packaging scheme, said to provide lower costs and better yields.

"Wafer-level packaging (WLP) is an alternative approach where the die are packaged while still in wafer form and the wafer is then singulated to free individually packaged die. WLP has the advantage that the costs of packaging are shared among the good die on the wafer, greatly reducing packaging costs per die," according to a paper from Tessera.

To propel Shellcase technology in the market, Tessera has licensed the technology to several manufacturers: Advanced Wafer Level Packaging, China Wafer Level CSP, Nemotek, as well as Xintec, a joint venture between TSMC and OmniVision.

CSP now accounts for about 40 percent of the image sensor market, according to Barclays. Omnivision uses the Shellcase CSP technology, but others don't. For example, Aptina, the CMOS image sensor spin-off of Micron Technology Inc., uses CSP technology, but not from Shellcase. One of Aptina's biggest handset customers is Motorola.

Two other image sensor players--STMicroelectronics and Toshiba Corp.-- also makes use of CSP, but not from Shellcase. Nokia primarily uses CMOS image sensors from ST and Toshiba, according to the report.

There is still no simple formula for OEMs. "While chip scale packaging for image sensor reduces cost, form factor, and is overall more efficient, several large image sensor vendors including Samsung continue to use COB packaging

because they already have the infrastructure in place, including the associated equipment and an established supply chain," according to Barclays.

"Industry checks suggest that currently CSP packaging is used primarily for sensors with resolutions in the VGA"1.3 MP range, while COB packaging is used for the higher resolution sensors, as CSP packaging is only economical for high-volume packaging needs and higher-resolution image sensors have not yet reached the critical mass," according to the report.

In addition to CSPs, Tessera is moving to disrupt another piece of the puzzle. Instead of the traditional lens stack using traditional optics technology, the company is pushing its OptiML wafer level optics (WLO). This allows manufacturers to build thousands of lenses on a single wafer for camera modules, which saves board space and cost.

Using reflow-compatible materials to build the optical elements of the camera module enables it to be efficiently mounted directly onto a phone board, leveraging the same solder reflow process used for assembling other electronics on the same board.

This is still a work in progress. Tessera has completed a VGA-based module based on the technology, with 3-megapixel technology in the works. "Wafer level optics is a relatively newer phenomenon and the technology has yet to be proven on a volume scale," said Barclays' Muse. "As such, wafer level optics currently account for only about 10 percent of the handset camera lens market."

Tessera is also moving forward with another promising technology: The integrated camera module. This is when the module manufacturer integrates the wafer level packaged image sensor with the wafer level optics.

There are issues with that approach. "Note that ST Micro also developed wafer level camera technology internally. The company had traditionally manufactured the image sensor and the image processor, purchased the lens stack externally, and then assembled the entire camera module," according to Barclays.

"And with Nokia--ST's largest camera module customer--pushing for very low-cost modules and wafer level camera technology adoption, ST also began developing wafer level optics. In light of the challenges, checks suggest that the ST's wafer level camera was not reaching the same level of image quality, causing Nokia to become less aggressive in pushing its vendors to adopt a wafer level camera approach," according to the report.

## **The gamble**

But to drive down costs and boost the quality, one of Tessera's licensees, Nemotek Technologie, on Monday announced the availability of its miniaturized wafer-level camera (WLC) for portable applications.

Nemotek Technologie (Sala Al Jadida, Morocco) is said to simplify the manufacturing and supply chain process. Customers work with one source for all wafer-level needs -- from optics packaging assembly to complete camera module testing.

Nemotek Technologie's WLC technology is based on reflow compatible materials. This process uses fewer components during manufacturing, saving time and production costs for customers. Production of customizable WLCs occurs in Nemotek Technologie's certified Class 10 clean room and facility located in Morocco.

Nemotek and China's Q Tech have licensed both Shellcase and OptiML technology. Production at Q Tech is expected to begin in the second half of this year, with royalties likely beginning in first half of next year, according to Barclays.

At least one licensee, Nemotek, is expected to ship its 3-D technology, based on thru-silicon via (TSV) technology.

"Going beyond the Shellcase wafer level chip scale packaging, Tessera introduced its Shellcase MVP solution. Tessera's Micro Via Pad (MVP) technology connects the bond pads and the BGA through a via-through-pad, which consists of a circumferential edge contact through the bond pad," according to Barclays. "While theoretically feasible, TSVs have yet to be employed in mass production due to the high associated capital costs, slow etch rate, and the complex steps necessary."

Still, it remains to be seen if a major OEM will embrace wafer-level camera and MVP technology. Perhaps the company is seeing more gains in another piece of the puzzle: optical image enhancement/smart optics.

This is based on technology from Eyesquad and DBLur. It consists of ultra fast lens and optical zoom IP for the camera phone, among other technologies. Licensees include Toshiba, Samsung and ST.

Royalties are expected to hit in 2010. "Despite the numerous moving parts, we view the smart optics royalty stream segment as the key to Tessera's revenue ramp in 2010 and beyond, given that Tessera receives \$0.10-\$0.15 for every unit shipped integrating smart optics features, as opposed to the \$0.02-\$0.03 royalty for Shellcase and OptiML lens stacks," according to the report.

In recent weeks, Tessera added another piece to the puzzle. Recently, it rolled out its FotoNation FaceRecognition technology, which performs automatic identification of specific human faces in camera equipped mobile devices. "We are seeing increased interest in facial recognition for consumer devices because of the ubiquity of cameras and the variety of benefits that come with knowledge of the identity of the person being captured by the camera," Bereziuk said.

"With the FotoNation FaceRecognition solution, a cell phone camera can automatically tag a photograph containing a specific person's face and email the image directly to a friend or upload it to a social networking site," he said.

Going forward, the signs appear to be bright for the company in CSPs for DRAMs and other devices. The other side of the house? "We have all of the pieces (in place) for smart modules," he added.

Time will tell if the gamble will pay off.

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