



Screen Stars: TXN Leads Race for New Flat Panel Display Technologies

Summary: TXN's Digital Light Processor (DLP) franchise is likely in '04 to double or triple its 1% share of the \$50b flat panel display (FPD) industry, now the third largest consumer end-use market for semis behind PCs (~\$240b) and cellular handsets (~\$70b) and one of the key driving forces behind growth in the consumer electronics business. Thin Film Transistor Liquid Crystal Displays (TFT-LCDs) have ~80% of the market, but plasma displays (from multiple suppliers) and DLPs (exclusively TXN's property) are the fastest growing challengers. The biggest potentially disruptive force in FPDs is INTC, which announced in January its intention to produce Liquid Crystal on Silicon (LCoS) light engines, despite the difficulties a number of talented manufacturers have had achieving efficient large scale production. TXN generates just 5% of its revenues from DLPs (~\$500m in '04) but is now reaping the benefit of a ~\$500m investment in the technology. The top OEMs such as Mitsubishi and Toshiba have introduced DLP-based products in '04, joining Samsung, the world's largest display manufacturer. **TXN is likely to again show 50% DLP revenue growth as a result. INTC, however, faces a long and expensive uphill climb to prove the commercial viability of LCoS.**

TFT-LCD Production Skyrockets. While traditional CRTs are still holding on in the TV market, we expect FPDs to surpass CRTs in the computer display market in '04. There are numerous technical variations of

TFT-LCDs, which operate by a thin film of transistors controlling the amount of light passing through liquid crystals. As many as nine LCD plants are coming online in the next year. This huge increase in capacity will bring precipitous price reductions. Companies such as Samsung that move a significant amount of their production to new seventh generation plants starting in '05 are likely to benefit since these facilities will enable LCD production beyond the current 40 inch screen size threshold.

Plasma Market May Look Better Than It Is. Today's leading alternative to TFT-LCDs are plasma displays, filled with tiny pixels of charged gas. LCDs cannot compete beyond 40 inch screens today, so plasmas have the high-end largely unchallenged, which is unlikely to continue. Plasma displays will remain expensive because they are difficult to make and require special glass. As far as image quality, some consumers complain of image burn-in and early plasmas could only provide their maximum brightness for ~5000 hours. Brightness should be improved this year to ~50,000 hours, or 6 hours/day for 22 years, which is good enough and burn-in is unlikely for consumers since they don't watch the same thing all the time. Still, even with a 20% annual decline in prices through '07, there are other technologies that should be able to provide similar image quality for less cost.

DLP Gaining Traction. The DLP approach

is to take 1.3m microscopic mirrors and use them as an extremely precise light switch in which light is modulated digitally by the tilting of the mirrors in combination with a light source and a spinning color wheel. TXN will introduce its first 1080 line progressive scan high definition product in 2H04, which is the highest image density included in the HDTV standard, and is expected to bring out other improvements improves to the contrast ratio. The failure of Hitachi, Samsung, and Thomson RCA to manufacture LCoS efficiently has been good news for TXN, since all have become its customers for DLPs. Not only have Mitsubishi and Toshiba become new TXN DLP customers in '04 but the contract manufacturers supporting GTW and other new entrants into the display business are also lining up behind DLP. By driving costs down and image quality up, TXN should show strong share and revenue growth.

LCoS Is the Big Unknown. LCoS is another microdisplay that is amplified to cover a larger area. It is a light valve that modulates polarized light. Philips and Sony are the major proponents of LCoS, which also has support from Sanyo, LG, and a number of smaller players like eLCOS and Brilliant. So far, Philips has only shipped LCoS displays in small quantities and has not had much impact on the market. INTC's announcement at CES in January that it was investing heavily in LCoS is the technology's best chance to be commercialized successfully,

yet it is a very high risk endeavor. There may be a market for very high end HDTVs based on LCoS from top tier home theater specialists like Marantz or Bang and Olufson, but the number of consumers who will pay \$10,000 for image quality they could get for \$3,000 is small and wouldn't justify INTC's entry. Unfortunately for INTC, LCoS is not primarily a semiconductor challenge but requires liquid crystal expertise it does not yet have. It may take INTC as long as 18 months to prove it can manufacture LCoS efficiently and secure the OEM support it needs. Further, the concept that LCoS will be cheaper than DLP because it is produced in CMOS (complimentary metal oxide silicon, or standard semiconductor manufacturing methods) instead of MEMs (micro-electrical mechanical devices, the generic term for microscopic components) has yet to be proven.

No End In Sight to Innovation In FPDs. **Electronic Ink,** Organic Light-Emitting Diodes (OLEDs), and Field Emission Displays (FEDs) are also potential candidates for breakthroughs. Electronic Ink is a reflective technology that Philips is commercializing for portable small format displays. OLEDs are an emissive technology that releases energy in the form of light when you pass a current through it. FEDs that use carbon nanotubes could cost a quarter of today's LCDs. These approaches need more time in the minor leagues before getting into the big game. * *

