Thirty Years of Liquid Crystal Display

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This year, 2003, marks an important milestone in the history of LCDs—it has been 30 years since Sharp first began mass production of LCDs. This year also marks the 50th anniversary of the start of television broadcasts in Japan, and the 50th year since Sharp introduced TV sets to the market, and hence holds deep significance for Sharp Corporation as a company.

The fact that the history of the LCD industry began with their use as displays in electronic calculators is well known. Liquid crystal substances themselves were discovered years ago in the 19th century. A long period followed in which they were not used industrially, but were treated only as the subject of academic research.

In 1968, Radio Corporation of America (RCA) announced a prototype LCD, but it was Sharp that plunged into research and first commercialized the LCD in 1973 as the ideal display for electronic calculators, which were then the focus of fierce competition to develop models with thinner profiles, more compact size, and lower power consumption. The first LCD was a monochrome device, a simple alphanumeric display consisting only of segment electrodes. Users subsequently began to demand thinner, more compact electronic calculators, and thinner, smaller LCDs with lower costs have advanced considerably since then.

In 1986, the development of STN technology led to successfully increasing the size of the LCD screen to 10 inches on the diagonal. The information capacity of displays also increased, making it possible to manipulate document text on the screen. Utilizing this display in stand-alone word processors, which were the "stars" among the office equipment of the time, proved to be hit, and we achieved a breakthrough in using LCDs to replace the monochrome CRTs then used in word processors. Adopting them for use in notebook PCs engendered a

whole new market for notebook PCs, and from this market emerged new requests for color-capable displays, higher resolutions, and larger sizes. These demands hastened the development and production of amorphous TFT LCDs.

Mass production of amorphous TFT LCDs began with 3-inch models, but in 1988, Sharp announced a prototype 14-inch LCD TV which was an unprecedented size at the time. This development planted the dream of "LCDs becoming the flat-screen TVs of the future" in the hearts of many people.

Amorphous TFT LCDs were welcomed in the marketplace as displays for PCs that process information in the form of text, graphics and still images. In the latter half of the 1990s, advances in mass-production techniques prompted larger screen sizes, higher resolutions, and lower costs. As a result, LCD applications also began to expand from simply being embedded in notebook PCs, to the market for PC monitors replacing conventional CRTs. In 2002, the percentage of PC screens based on LCDs is close to 50%.

In addition, Sharp endeavored to create unique, "one-of-a-kind" products that make use of LCDs, and came out with a group of products premised on LCDs, including the Viewcam, Zaurus, mobile phones, game devices, and more. These products generated new demand for LCDs, demonstrating an upward, synergistic spiral effect that, in turn, fosters the development of new LCD technologies.

Then, with the debut of the AQUOS LCD TV introduced in January 2001, it became clear that TVs were moving in the direction of switching from CRTs to LCDs. The consciousness of consumers changed with the 37-inch LCD TV model introduced last fall, and the notion that even 40-inch LCD TVs are on the horizon is swelling. By taking advantage of digital BS and terrestrial digital broadcasting and the deployment of new infrastructure, I believe that the diffusion of LCD TVs will be wider and faster than ever imagined.

On the other hand, demand continues strong for higher resolutions, lower power consumption and more compact sizes in product areas that use small- and medium-format LCDs, such as mobile phones, PDAs like the Zaurus, mini-notebook PCs, Viewcams, and others. In response, we started mass production of System LCDs that employ CG Silicon technology beginning in October of last year.

With System LCDs, functional peripheral components, particularly driver ICs, can be formed on the same glass substrate as the display, something extremely difficult to do with amorphous silicon or poly-crystalline silicon. The application of System LCDs to small and medium formats has many advantages, including higher definition, extremely low power consumption, higher performance (multiple display resolutions based on multiple drivers), higher reliability, and lower costs.

Last autumn, we announced a new technology that enabled us to develop a prototype CG Silicon LCD panel with an integrated Z80® CPU. This announcement was a good indication of the level of achievement of our current technology, and while it is not expected to lead to business immediately, it points to an entirely new area of semiconductor technology. In the future, our desire is to see it used to make ultra-thin computers and ultra-thin TVs a reality.

We have also successfully developed technology to render 3D stereoscopic images, long a dream for displays, by stacking two LCDs to generate the 3D effect, and have introduced it first for use in mobile phones.

In this light, looking back over the 30 years of LCDs, one can say that Sharp has grown its business based on a "spiral strategy of devices and products" in which we develop unique, "one-of-a-kind" LCD technologies and then come out with "one-of-a-kind" products that make use of them. We are now on the threshold of an era of pervasive digital networking, and LCDs will continue to increase in importance as a result. Sharp will also continue to take up the challenge of developing one-of-a-kind technologies and creating one-of-a-kind products based on its spiral strategy of devices and products, focusing on large-format LCDs, System LCDs, 3D LCDs, and more, and remains committed to playing a vital role in the further development of LCDs.