

Late 1990s

Progress in liquid crystal display (LCD) drivers

~ Integrated Circuit ~

In the 1990s, demand for LCD drivers (drivers for liquid crystal displays) increased by the adoption of LCD displays in note PCs, taking advantage of low power consumption, and small and thin form factor. Furthermore, at the end of the 1990s, LCD drivers developed greatly due to miniaturization and implementation of mailing functions of mobile phones and so on. Mounting methods, high-voltage process miniaturization, and colorization of the LCD display contributed to this development.

In the liquid crystal display until the 1980s, the mainstream was segment display and character display by dot matrix, and the segment display products represented by Hitachi's HD44780 which could drive STN (Super Twisted Nematic) liquid crystal in one chip were used for home appliances. On the other hand, in order to enlarge the display area from numerals to dot matrix and further to image display, increase of the number of drive terminals became a problem, where one drive terminal was required for each segment. The liquid crystal display has a structure of applying electric field to the liquid crystal sandwiched between electrodes, and when the number of segment digits or the number of dots to be displayed is increased, the number of outputs for driving the liquid crystal is greatly increased. In the conventional QFP package, only about a few tens of output terminals could be secured for liquid crystal driving, and it was necessary to use a plurality of liquid crystal driving LSIs, and applications of QFP package LCD drivers were limited.

In the 1990s, a TCP (Tape Carrier Package) assembly technology was established and mass-produced, which could realize outputs of several hundred pins in a narrow pitch by mounting a liquid crystal driving LSI on a film, and a large change occurred in liquid crystal applications. By changing QFP packages to a TCP package, it became possible to realize terminal configuration with more than 300 outputs with one TCP package of 48 mm wide film. It was adopted for VGA (640 x 480 dots)/XGA (1024 x 768 dots) display of a notebook PC and a PC monitor. Small-size and multi-terminal assembly became possible by using a TCP package, in which terminals formed by Cu foil on the film and all LSI terminals were crimp connected at one time. 384 pin output was realized in one TCP package, and it was adopted for note PC and PC monitor with XGA display which used 10 - 12 LSIs for one panel. As a result, the demand of LCD drivers reached 1 billion pieces a year.

Liquid crystal display progressed from monochrome display to multi-gradation gray display and color display, and LCD drivers also fulfilled the requirement of high performance/high definition/colorization by fine process while maintaining high breakdown voltage drive. Especially, when TFT (Thin Film Transistor) liquid crystal panel appeared, the display characteristics were greatly improved. Compared to the STN liquid crystal method, the display performance such as contrast and response speed was greatly improved by TFT liquid crystal method in which a transistor driving one pixel (one transistor per

pixel) is formed on the glass. In addition, the LCD drivers came to be separated into a common driver LSI that drives amplitude of 40V, a source driver LSI that drives gray scale data with amplitude of 5V, and a power supply LSI. Among them, the LCD driver that controls the color gradation of colorization was Japan's strong technology, and the demand increased sharply.

As the liquid crystal PC monitor increased, Korean and Taiwanese companies entered the liquid crystal panel business from the second half of 1990, and production of LCD drivers which used to be purchased from Japan also began to rise at the end of the 1990s by Korean and Taiwanese manufacturers.

Meanwhile, due to the rapid increase of mobile phones since the end of the 1990s, LCD drivers grew to a level in which one product category for medium and small liquid crystal display was created. Initially the application was limited to number displays of mobile phones, it then expanded to other applications by the start of short mail service, i-mode service of NTT in 1999, and further the appearance of color display mobile phones, mobile phone equipped with camera and so on, and LCD panels and LCD driver business grew rapidly. In mobile phones, COG (Chip on Glass) assembly which mounts bare chips directly on liquid crystal glass was adopted for compact assembly, and in the 2000s LCD drivers for color liquid crystal displays largely developed. This compact liquid crystal field has grown to over 1 billion pieces per year.

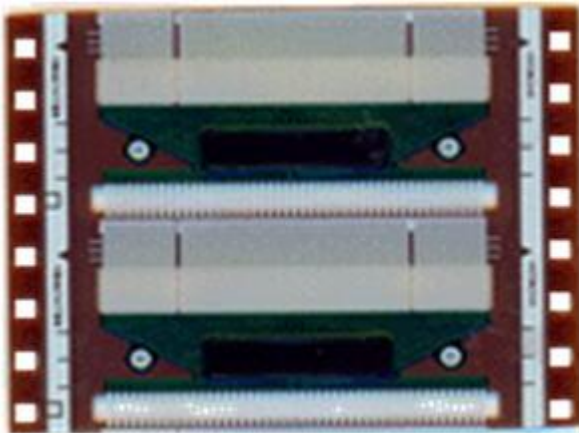


Fig.1: Example of TCP Assembly
(By courtesy of Hitachi)



Fig.2: Example of COG Assembly
(By courtesy of Hitachi)