

1972 to 1973

CMOS LSI circuits for calculators (Sharp and Toshiba)

~ Integrated Circuit ~

Up to this time, the calculator was composed of PMOS LSI, but it was necessary to adopt low power consumption CMOS LSI to realize a calculator that could be operated with a battery for a sufficiently long period of time. Joint development started with Sharp and Toshiba from 1971, and Sharp launched the calculator Elsie Mini, which could operate for 15 hours with three small dry batteries in July 1972, in combination with an LED display device, using one chip CMOS LSI manufactured by Toshiba. Elsie Mate EL-805 was then released in 1973, which could operate for 100 hours with one battery, in combination with a low power consumption multi-digit liquid crystal display. After that, the combination of liquid crystal display device and CMOS LSI became mainstream of calculator, and it evolved from a pocket calculator to a card calculator.

There were challenges to make 1 chip CMOS LSI. It was necessary to overcome the problems such as large chip size of one chip CMOS calculator LSI and high manufacturing cost of CMOS compared to PMOS. Toshiba developed a circuit technology called C²MOS (Clocked CMOS) in 1969. By using this technology, LSI with small number of elements and also in small pattern size could be designed. Furthermore, it had advantages of lower power consumption and faster operating speed than ordinary CMOS, and Toshiba developed a one chip CMOS LSI using C²MOS circuit for Sharp. Still, the chip size of LSI which integrated all the calculator functions on one chip was very large at that time, with the length of a side of about 6 mm, and it was hard to improve the yield at the start of mass production. After that, mass production got on track due to a reduction in chip size and improvement in manufacturing technology, and thereafter, CMOS implementation of other LSIs was accelerated.

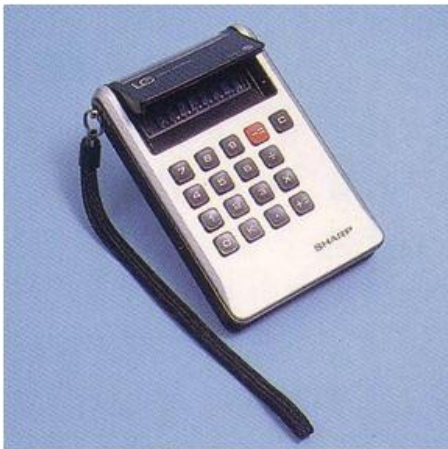


Fig.1: LCD calculator EL-805 from Sharp

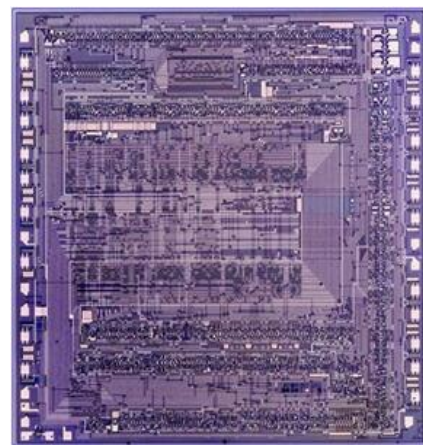


Fig.2: One-chip CMOS LSI for calculator from Toshiba (By courtesy of Toshiba)