The Planar IC: revolution underestimated

Born in the labs of Fairchild Semiconductor and Texas Instruments in the 1958 time frame, the planar IC finally emerged in 1960; Fairchild shipped it in March 1961. Robert Noyce, the co-founder of Fairchild, and Jack Kilby, an engineer at Texas Instruments, both built early ICs in the lab, and both received patents, which the two companies subsequently cross-licensed. Early recognition of the significance of the IC was underwhelming. But the planar IC became perhaps the single innovation that has had the greatest impact on the high-technology industry and arguably our entire society because electronics underlie advancements in everything from medical procedures to transportation.

EDN's early coverage of the IC explicitly questioned its value. You can read the complete cover story from our Oct 1, 1960, issue, at www.edn.com/060427mtm; we excerpt it here in the sidebar "Micrologic Elements Being Developed." You can see that our editors downplayed the advantages of size that the IC offered. The staff noted that other system elements, such as power sources, dwarfed the size of electronics modules. Therefore, they believed ICs were unnecessary for hot applications of the day, such as spacecraft.

Even Kilby has made it clear that the implications of the IC were underestimated. Years later, he said, "What we didn't realize then was that the integrated circuit would reduce the cost of electronic functions by a factor of a million to one. Nothing had ever done that for anything before."

Fairchild's marketers at the time had clearly zeroed in on computers as the primary application for their "micrologic elements." Based on most historical accounts, however, few realized the impact that these predecessors of the 74xxx family of standard-logic ICs would have in simple combinational- and sequential-logic applications. Still, Fairchild was clearly right in realizing that ICs would be key enablers of computers.

Noyce went on in 1968 to co-found Intel, where the microprocessor was born and nurtured. Noyce oversaw the microprocessor-development project. Even before Intel's birth, Gordon Moore, another co-founder, had stated in 1965 what would become known as Moore's Law. Today, Intel and others continue on the Moore's Law path, and Intel even promises to outpace the law performancewise using dual-processor chips. At a recent meeting with several editors from *EDN*, *Electronic News*, and *Electronic Business*, Stephen Smith, vice president and director of desktop-platform operations at Intel, stated, "IC cost has gone from $5000 to 1 billionth of a cent per transistor over 50 years." EDN

10.01.60

FROM THE VAULT

Micrologic Elements Being Developed

MOUNTAIN VIEW, CALIF.—High-speed, low-power digital computer logic building blocks are under development at Fairchild Semiconductor Corp. To be available early next year, the family of solid-state micrologic elements will handle all the logic-function requirements of a digital machine, no other components being required.

The micrologic elements are made by diffusing planar transistors and resistors into a solid continuum of silicon; element intraconnections are then deposited on the surface. The low cost resulting from batch-processing will mean lower first cost of a computer logic section. It is expected that reliability of the micrologic elements will be at least as good as that of a well-engineered contemporary logic circuit performing the same function.

Micrologic elements will operate at bit rates in excess of 1 mc, a significant advance in the speed of such units. Typical power dissipations of 30 mW per unit will permit high density packaging without extraordinary thermal problems (elements will have a temperature range of −55 to +125°C). The first units will be packaged in eight-lead JEDEC TO-5 transistor cases suitable for printed-circuit-board interconnections, and elements will also be available in the smaller TO-18 packages for welded wire construction. Although these cases do not represent the smallest possible size, they are a convenient compromise between size and ease of interconnection.

Emphasis is placed on the logic function to be performed in both development and use of these building blocks. The following micrologic elements comprise the family: "F" Element - Flip-flop, "B Element - Buffer, "S" Element - Half-shift Register, "H" Element - Half Adder, "G" Element - Gate, "C" Element - Counter Adapter. These are all the building blocks needed for logic functions.

—*EDN*, October 1960, pg 3