FAIRCHILD PLANAR PROGRESS REPORT



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The Planar process and extensions of its technology have a potential still being explored.

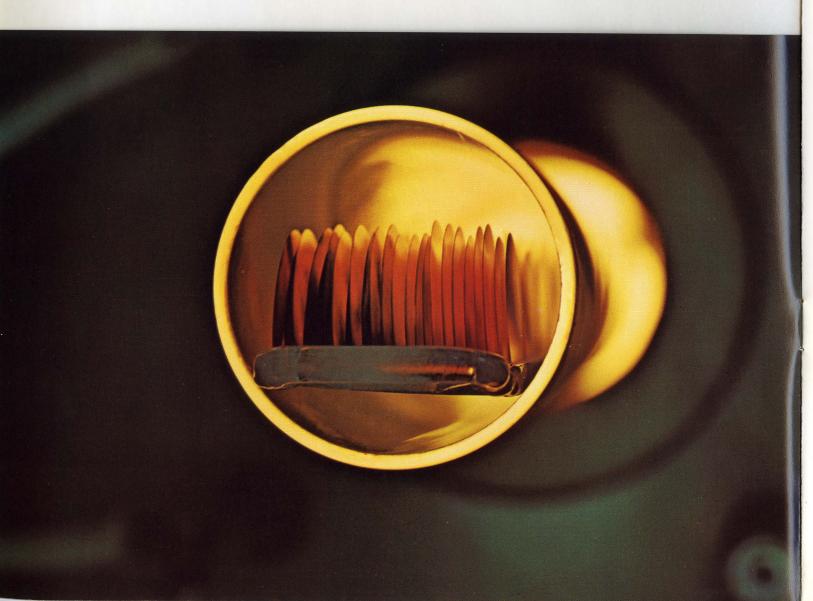
WAFER RECEIVES INTEGRAL SURFACE OF SILICON DIOXIDE

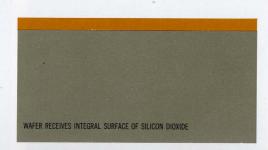
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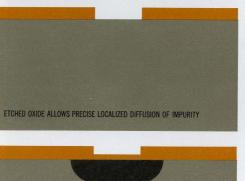
FAIRCHILD PLANAR PROGRESS REPORT





The advantages of the Planar process are derived from the first diffusion. Silicon wafers—from which diodes, transistors or microcircuits will be manufacturedare placed in an oxidizing atmosphere at 1200°C. A hard, silicon dioxide surface formed on the wafer is the key to Planar construction. It passivates the surface of the device and prevents contamination and associated parameter drift. It insulates the surface of the device and allows direct deposition of metal without electrical interference. As successive mask/etch/diffusion steps are performed, the wafer assumes the electrical characteristics gained from precisely controlled variations in collector, base, and emitter areas and junction perimeters. The Planar process assures uniformity, stability, and reliability. Important in simple devices, it is the key to production capability in complex integrated circuitry.

Uniformity: Diffusion of as many as two thousand individual dice in a typical wafer and hundreds of wafers in the same batch diffusion is coupled with the controlled timing, atmosphere and temperature of Fairchild Planar processing to produce devices of outstanding uniformity and optimum specifications with high yields.



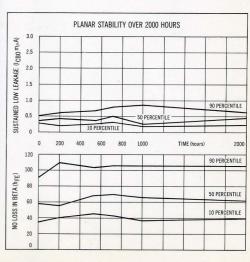






Stability: The performance graphs illustrate the stability of Fairchild Planar devices over two thousand hours.

Reliability: The integral silicon dioxide surface of every Planar device is the key to Planar reliability. Each junction is formed beneath the oxide, thus never exposed to surface contaminants, microscopic particles or atmospheric variables which can cause degradation in devices with exposed junctions. Providing a large lead-attach area with electrically small devices permits the use of larger diameter lead wires and more reliable lead bonding in Micro-Planar devices.



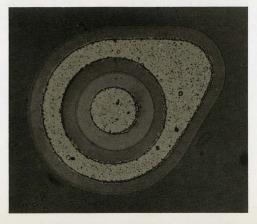
Planar Diodes exhibit a combination of electrical characteristics which cannot be duplicated through any other manufacturing technique: Fast switching speeds, high conductance, low capacitance, low leakage and high reverse voltages have been optimized in three basic diode types which encompass the specifications of a wide variety of competitive devices. From the basic diode types, FD 1, FD 2, and FD 3, Fairchild is able to ship to every major diode application. The uniformity and stability of these diodes has made them ideally suited to applications requiring matched pairs and quads. Combining Planar and epitaxial techniques has extended the range of diodes into very high conductance types. The new Adam package, featuring hermetic glass-to-metal seals and allsoldered connections, is available with all Fairchild Planar diodes where the application calls for miniaturization.

Transistors: With the introduction of the Silicon Planar 2N709, Fairchild broke the germanium speed barrier and there is no type of transistor available which cannot be made and made better through Planar processing. Planar and Planar epitaxial transistors have an exceptional combination of speed, power and lowsaturation resistance. The stability, uniformity and reliability of Fairchild Planar devices dominate the application of all types of transistor—general purpose, amplifiers and switches. Amplifiers: high voltage, small signal, RF, VHF, UHF and power. Switches: high speed, high current, saturating and non-saturating. The

precise control of the process which enabled Fairchild to produce these devices has also enabled the company to introduce similar types for industrial-commercial applications and to enter the entertainment market with a competitive edge—silicon's high performance at prices competitive to germanium.

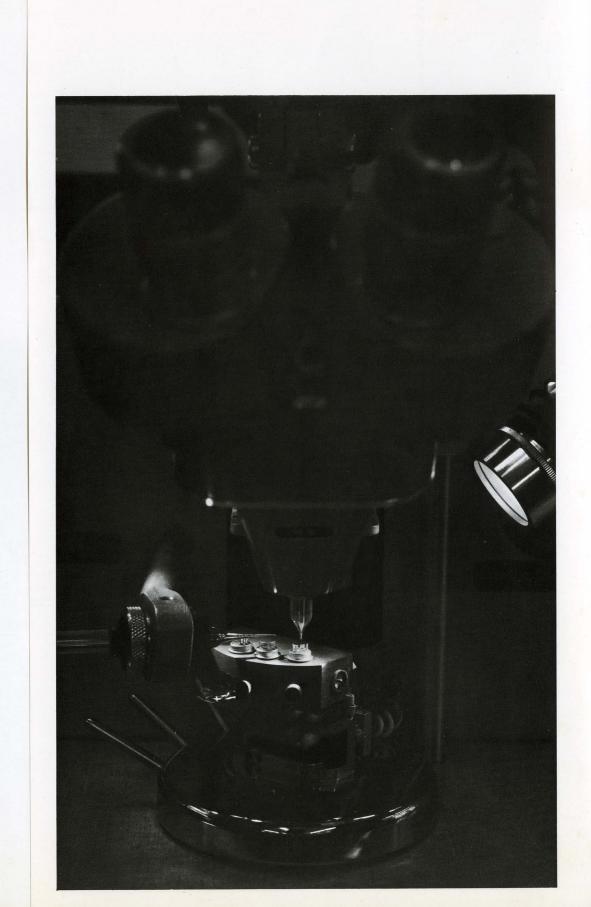
Epitaxial techniques have been combined with the Planar process wherever it has offered an advantage in device performance. Particularly where higher currents are the object, and the combination of the two techniques has enabled Fairchild to produce small, high speed devices which still have the capability of handling high currents.











Geometries: Within the framework of the Planar process, the geometry or pattern of the diffusions and hence the junctions can be manipulated significantly, thus altering the electrical characteristics of the device. The original Planar transistors had the familiar 'teardrop' configuration shown on the previous page. The interdigitated geometry common to power devices and Fairchild's new 'trident' geometry feature long emitter-periphery to emitter-area ratio which results in good high current performance and low capacitance with high operating speeds and frequencies.

Multiple Assemblies: A unique advantage of the Planar process is demonstrated in a line of special products—multiple chip devices within a single package. Fairchild has had an established production line making special products for three years. The high yields of the Planar process made multiple assemblies economically feasible. The stability and uniformity of Planar devices makes it technically practicable to combine them with guaranteed matched electrical characteristics. Better thermal tracking between devices in one enclosure, in addition to Planar reliability, assures improved circuit reliability. This product line has helped designers achieve greater circuit performance and reliability especially where it is not economical to develop an integrated circuit for the application, but where reduced size, fewer interconnections and greater reliability are major considerations. The same chips which comprise Fairchild's basic product line are used in the manufacture of multiple assemblies. They are available in hundreds of configurations and in a variety of packages.









Micrologic: Within a year after introducing the Planar process, Fairchild produced the first practical microcircuit—integrating transistors and resistors, plus all the necessary interconnections, in a single, monolithic chip of silicon. A full spectrum of highly developed semiconductor skills was utilized: precision optics and mask-making; the Planar diffusion process; metal-over-oxide; mounting and lead bonding; testing and test equipment design and production.

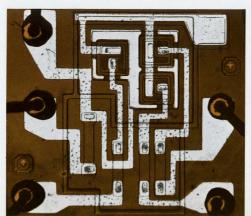
Fairchild's first offering was Micrologic
—six compatible computer building blocks. This family of devices is sufficient to handle all of the logic-function requirements of a digital machine operating at bit rates up to 1 mc; no other components are required in the logic section of such a machine. The result is a smaller machine—requiring less power—which can be designed in less time—and cost far less to manufacture.

Micrologic utilizes modified DCTL (Direct Coupled Transistor Logic) circuitry and is designed to operate in a full military environment over a temperature range of -55° to plus 125° C. Worst-case propagation delay is 50 nanoseconds stage delay over the full temperature range.

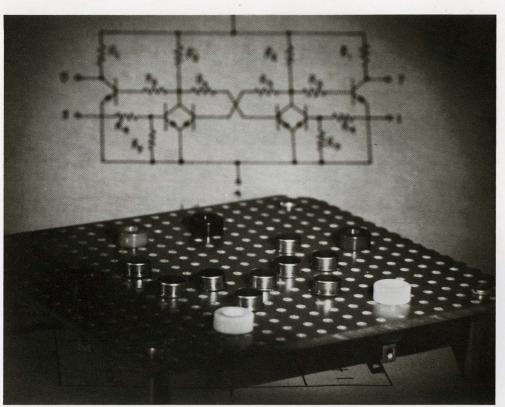
Micrologic, and microcircuitry in general, offers the systems builder major reliability, and cost advantages besides the obvious one of decreased size. Improved reliability stems from many factors: The number of soldered connectors:

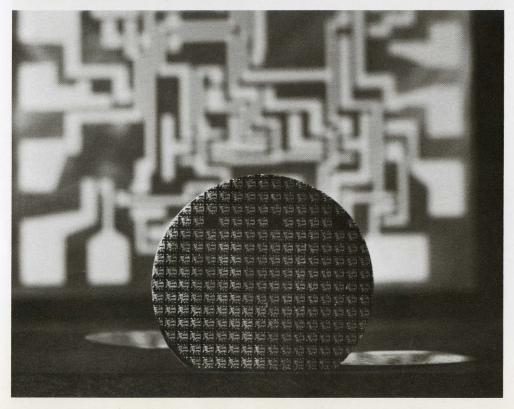
tions may be reduced to one tenth the number required by standard components; power consumption is greatly reduced so less heat is generated; fewer dissimilar materials come into contact.

The improved cost picture stems from the major savings which can be realized in the use of Micrologic as opposed to the best contemporary single layer (printed circuit board) computer packaging techniques. With Micrologic, volume can be cut to one twentieth. Design time is one twentieth to printed circuit masters. The power requirement is one fourth-for equal speed and temperature ranges. Micrologic elements are handled exactly as transistors and can reduce the assembly costs to one tenth! And as the use of Micrologic has extended, the cost of the units versus the production volume relationship has brought the individual unit cost down. In total, these factors are expected to bring the cost of the logic section of a computer down to twenty or thirty percent of present costs. And all of these things are accomplished without sacrificing performance.





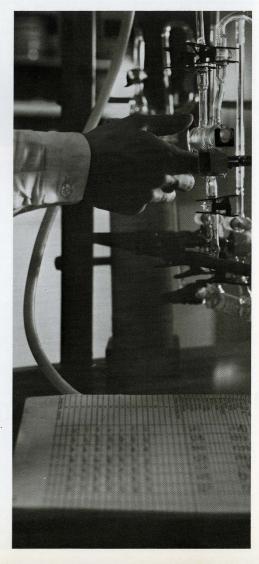




Custom Microcircuitry is a natural outgrowth of Fairchild's standard Micrologic product line. It derives from the development of successful, standard production microcircuits and the inherent flexibility of the Planar process. Within the broad framework of custom microcircuitry, there are two distinct groups-production circuits and Research and Development circuits. In designing custom microcircuits, the basic elements from which the designer works are discrete components, packaged separately and individually characterized with complete electrical data. The transistors, diodes, resistors and capacitors are available with complete specifications and breadboard for the designer to assemble an electrical mock-up of the circuit ultimately to be produced as a single silicon chip. When the design and specifications have been thoroughly proven, Fairchild begins its production cycle. The finished microcircuits - delivered in twelve weeks from acceptance of the schematic - are mass produced according to standard Fairchild procedure. This includes subjecting samples of each batch to a comprehensive quality assurance program. Fairchild also designs and builds special electrical equipment for inspecting the finished units. The custom microcircuits are manufactured in the same manner as Fairchild's Micrologic product line; the designer benefits from the advantages of having his own design built in microcircuitry and has the assurance of Fairchild's successful two years' experience in volume microcircuit production. The same equipment, the same highly skilled personnel and the same unique processes are employed.

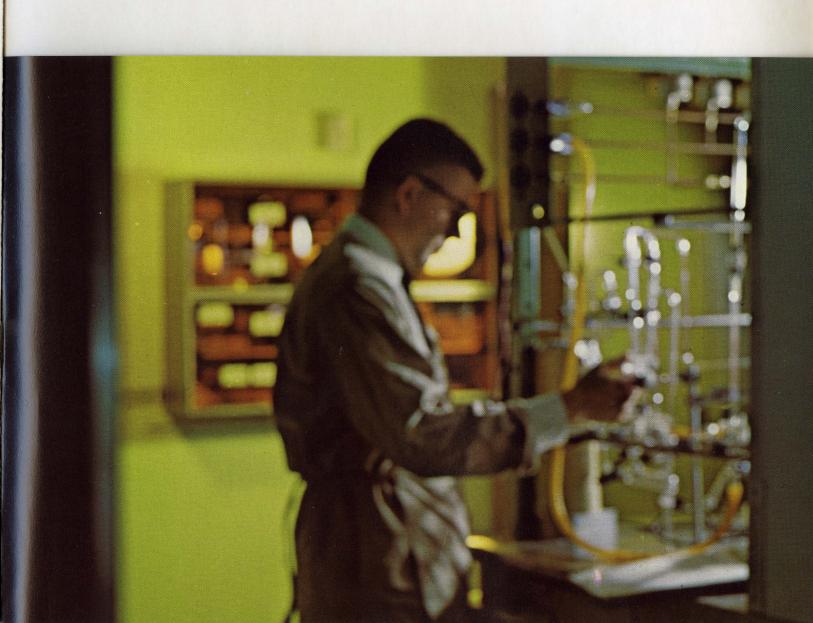
FAIRCHILD SEMICONDUCTOR

Fairchild is now extending microcircuitry techniques to include the integration of NPN, PNP and field effect transistors within a single substrate. The technologies are in hand enabling Fairchild to produce microcircuits with operational and functional characteristics unattainable with the use of discrete components. Ultimately, these new devices will hold a relationship to present transistors similar to that which transistors now hold to vacuum tubes. The marriage of thin film and Planar epitaxial technologies in an integrated device is a technique which allows the fabrication of circuits in smaller devices, resulting in lower systems cost and improved systems reliability. Circuits of this type have the potential of greater switching speeds, frequencies and operation at higher currents—all with greater packaging densities. These are State-of-the-Art integrated circuits, a direct outgrowth of Fairchild's Planar process, the process which has brought about true versatility and economic practicality in silicon.



FAIRCHILD SEMICONDUCTOR . A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

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