effort in the use of microelectronics on a large scale—and in their production and packaging The computer is packaged in a hermetically sealed aluminium chassis with an installation envelope measuring $20\frac{7}{8} \times 10\frac{1}{2} \times 5\frac{5}{8}$ in. It weighs $36\frac{1}{2}$ lb, not including the coolant. It is conduction-cooled by a liquid-cooled chassis. The computer is divided into three sections· memory, logic and input/output, and power supplied

Using microcircuits in high-resolution range counters. L. C DREW, *Electronics*, p. 31 (Nov 1963). High-frequency decade of this counter is a digital microcircuit to save space and power. Snap-off diodes designed into the driver help produce pulse widths of about 2 nanosec at clock rates as high as 250 Mc.

Integrated-circuit oscillator requires few components. H YANAI, T. SUGANO, M YOSHIDA, T. KUROSAWA and I. SAKI, *Electronics*, p. 40 (Dec. 1963). This oscillator represents an ultra-simple circuit that achieves small size through use of integrated-circuit techniques It is versatile and offers economy and reliability at both high and low frequencies. Moreover, it is suitable for f-m applications if designed in a somewhat different form. This redesigning is necessary because the frequency-determining line and the collector portion of the transistor overlap so that a change in voltage on the line changes the collector voltage For f-m use, the frequency determining line must be set off by diffusion isolation.

Packaging flat-pack integrated circuit blocks. H. G. CARTER. *Electron. Packag. and Prod.*, p. 8 (Dec. 1963). Solid-state integrated circuits packaged in a thin flat-pack configuration enjoy a 5·1 volume and weight advantage over the same circuits packaged in the TO-5 transistor can configuration Use of the flat-pack design, however, has been somewhat limited owing to problems of interconnection between the several molecular packages required to mechanize any sub-circuit and the difficulty of transferring heat out of the completed assembly. A packaging plant is described that uses established fabrication techniques in a manner that takes full advantage of the extremely small size of the flat-pack configuration, and provides a direct conduction path for heat removal from the completed module

Optical coupling: new approach to microcircuit interconnections. M. A. GILLEO and J T LAST, *Electronics*, p. 23 (Nov. 1963). A signal carried by light can be transferred between layers without electrical contact or regard to any differences of electric potential. Consequently, in high-speed circuits, coaxial cables or strip lines of small dimensions are not needed and the labour involved is eliminated In addition, reducing the number of external connections which have a lower reliability than the photo-engraved wiring, improves overall system reliability. Optical coupling between integrated circuits is possible because p–n junctions can efficiently convert current to radiation by charge-carrier recombination and reconvert radiation to current by the photovoltaic. In elementary form, an optically coupled circuit comprises two p–n junctions, one transmitting radiation and the other receiving radiation by means of a light pipe of arsenic trisulphide. Although much refinement of detail remains, this method of circuit interconnection can now be used to change the state of a standard, microcircuit flip-flop optically.

SEMICONDUCTOR INTEGRATED CIRCUITS

Integrated semiconductor networks in electromechanical control systems. C. ABBOTT, J. BOHAN, L. HOUSEY and L. REGIS, *Semiconductor Products*, p. 15 (Oct. 1963). The first available integrated circuits were relatively simple digital networks. Linear networks have taken longer to appear because of the increased complexities they introduce. These complexities are of such a nature that they demand a greater degree of co-operation during the design phase between the manufacturer and the customer than other kinds of electronic components. This is indicated in a short review of integrated circuitry as it pertains to digital blocks, to which the steps required for the design and construction of a linear network are compared. A specific linear amplifier is described in detail both with regard to its own technological implications and with regard to the relationship it engendered between the customer and the manufacturer. It is evident that this kind of activity will lead to other integrated circuit blocks of far greater sophistication.

The average conductivity of diffused layers in semiconductors. K. M. BUSEN and G. A. SHIRN, *Solid-State Electron.* **7**, 49–58 (1964). For the determination of the average conductivity σ of diffused layers in semiconductors one must evaluate an expression [equation (1)] where the mobility, μ, as a