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DESK TOP COMPUTERS



New generation... What they work

Thinking Computers? Think Small

They're everywhere—simple-to-operate, desk-top electronic calculating instruments

By MELVIN WHITMER

AS RECENTLY AS 15 YEARS AGO, ACCORDING to the American Federation of Information Processing Societies (AFIPS), there were fewer than 25 computers at work in all of the US. That number has grown today to well over 35,000, and the AFIPS predicts that by 1975 there will be more than 85,000—representing an annual investment of \$30 billion.

Understandably, the greatest increase—because of their lower initial cost—will come in the area of compact and desk-type computers. Though physically small, many of this new generation of time-savers are capable of a wider range of computations than some of the huge multi-rack installations of a decade or so ago.

Strictly speaking, the subject of this article is a hybrid. An electromechanical calculator, or adding machine, can perform only simple operations. A true computer has large-capacity memory banks and can be programed, or instructed, to "learn" a long and intricate series of computations. A desk-top computer can do more than an adding machine but less than a true computer. It is becoming a popular item with many businesses, and will be used so much in the future it will open many job opportunities. Electronics technicians will be needed to service these computers.

In all but a few isolated instances, factory-service opportunities include

extensive training programs for technicians with a good technical background. Factory-trained technicians service and repair computer hardware directly for the factory or for local franchised distributors of the equipment.

Although service during warranty will be performed by the factory or by its authorized distributors, most manufacturers later will encourage in-plant electronics personnel to perform all routine computer maintenance. Service information and short training courses will be made available to the personnel of qualified plants. Many users obviously will have to add technicians to their existing staffs when complex computer equipment becomes a significant part of the company's office equipment.

Manufacturers of desk-top computers agree, however, that independent industrial-service organizations will be unable to enter the field of desk-top computers. Few, indeed, would want to. Sales and service functions of this magnitude are best performed under factory direction. Service information, therefore, seldom will be available to independents.

Personnel requirements

It's hard to generalize about what talents and training are required for factory-service work. Each manufacturer has his own employment standards. Very few require applicants to hold degrees for field and shop work—high school and an interest in electronics generally are

minimum requirements. Technical-school graduates should have no trouble being accepted as trainees in any manufacturer's sales and service department. Experience in office-machine servicing is most desirable, but an electronics technician with this type of background is rare indeed. The market is wide open, and most companies are expanding their sales and service staffs for the time when their electronic calculators become part of every corporation's office-machine budget.

Integrated circuitry is largely responsible for stuffing a useful measure of large-computer capability into a small package. And some manufacturers use interchangeable printed-circuit cards to hold several IC's at one time. These modules are stacked compactly in a holder or "bin."

The capabilities of a typical desk-top computer reach far beyond those of mechanical calculators or adding machines. Operations include adding, subtracting, multiplying, dividing, working with powers and roots, logarithms, factorials, and trigonometric functions. These and other capabilities of small computers will add efficiency to business offices and engineering departments. Full-scale data-handling systems won't become obsolete, of course, but only those problems requiring very complex processing will be sent to the central computer.

Simple problems, or preliminary steps in a more complex program, will be



Sage 1 (Dero Research & Development) has 20-digit register.



IME-86 has 7 registers to store various parts of a problem.



Canon 161 is a self-contained unit with Nixie-tube display and integrated circuits.



Operators (+, -, etc.) are printed in red on paper tape of Monroe's Epic 3000.



SCM's COGITO 240 SR has 31 keys for insertion, selection, and storage control.

accomplished with the desk-top computer. This elimination of trivial tasks will greatly increase the usefulness of the central computer. Since operating a small computer is similar to operating a mechanical calculator, it's a job easily assigned to non-technically trained employees.

An integrated circuit deposited and etched on a chip of silicon or other semiconductor material performs the same function as a conventional multicomponent stage. Resistors, diodes, capacitors and transistors that normally would be used to build a typical transistorized stage are replaced by small areas of deposited metallic oxides.

The circuit shown in Fig. 1-a is the equivalent of that constructed on a single integrated-circuit chip. In operation the circuit establishes two stable conditions: The first occurs when Q1 and Q2 are conducting; the second, when Q3 and Q4 are conducting. Input pulses are applied to S_c or R_c . Clock pulses—which synchronize the advance of data through the computer—are applied at connector C. Outputs are obtained from R_D , Q, S_D , or \bar{Q} and differ primarily in current-output characteristics. Outputs R_D and S_D vary about 1.5 volts, based upon the

stable condition. Outputs Q and \bar{Q} vary about 3.5 volts, at a higher impedance than that available at R_D and S_D .

If a set pulse is applied to R_c , then Q1 and Q2 are driven into conduction by resultant decrease in base current for Q3 and Q4. The first input pulse at S_c reverses the stable state, cutting off Q1 and Q2 and driving Q3 and Q4 into conduction. A clock pulse will then produce outputs (negative pulses) at S_D and Q.

Microelectronic circuits formed in metal-oxide-semiconductor (MOS) chips often replace as many as 200 standard components; a complete 10-digit counter, for example, can be built into an MOS chip. This greatly reduces the size of the computer without sacrificing problem-solving ability.

Servicing MOS circuitry requires some understanding of the computer layout, a visual inspection for open or shorted printed-circuit paths, voltage tests and finally, replacement of the defective unit. Most computer manufacturers use some form of modular design to facilitate plug-in repairs. The defective plug-in board module may then be returned to the manufacturer's central-repair station for detailed analysis and for repair, when that is possible. Alterna-

tively, the digits may appear on Nixie tubes or a CRT.

The block diagram of a typical small computer is shown in Fig. 2. Keyboard output is fed to the control unit. From the control unit, input data pass to the "learn" or storage sections. The mathematic unit may accept data from the storage register or from the keyboard input (through control unit). Steps, operators and solutions are fed to the printer control circuits, then imprinted on the tape.

A computer like this may "learn" 24 or 48 steps, depending upon the model selected, and there are eight storage registers. The learn feature is the next best thing in computer capability to a completely stored program. Several steps can be stored in a program memory when a problem is repetitive. Working with progressions (1, 7, 13, 19, etc.) and factorials (17 x 16 x 15 x—etc.) could be tedious if done manually. The program memory learns a few basic steps and the operator then activates an automatic sequence.

Desk-top computers defined

All categories of computers are achieving a far greater component den-

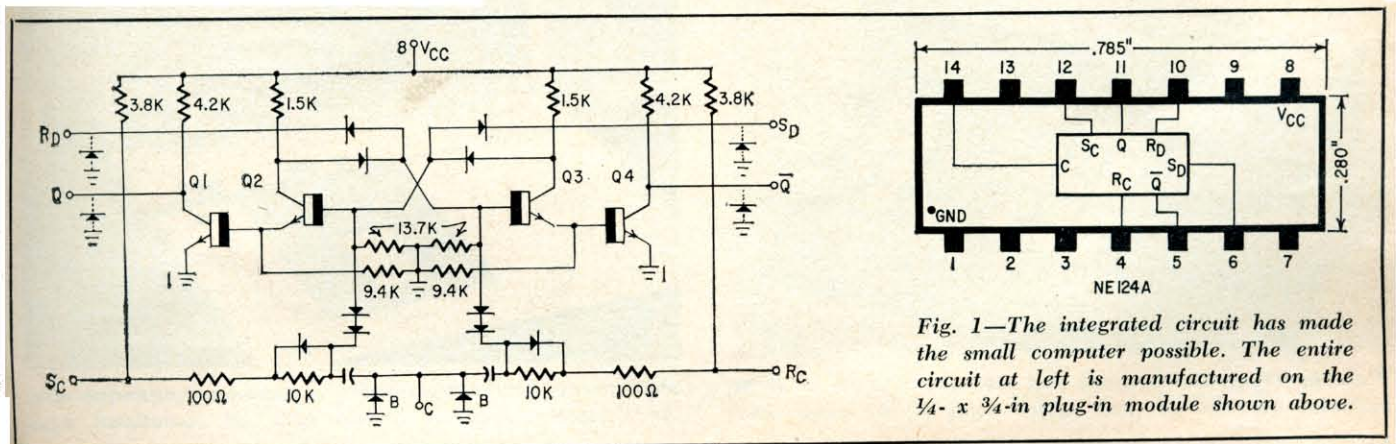


Fig. 1—The integrated circuit has made the small computer possible. The entire circuit at left is manufactured on the 1/4- x 3/4-in plug-in module shown above.

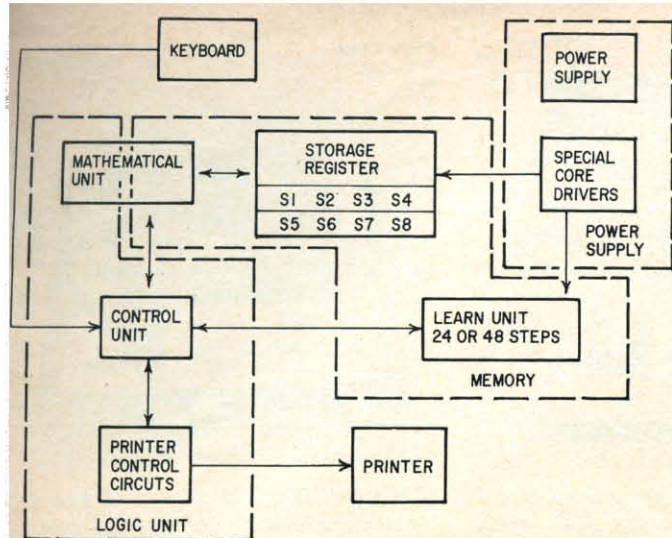


Fig. 2—This block diagram of a typical small computer shows functions used in the learning and calculating processes.



Wyle Scientific calculator uses a cathode-ray-tube display.



This microelectronics calculator by Victor employs 30 MOS (metal-oxide-semiconductor) devices for circuit reliability.

Thinking Computers? Think Small

sity through microcircuit techniques. So, the distinction between desk-top and central computers has to be drawn not only on physical size but on capability as well. A desk-top computer is generally considered to be one that requires no formally prepared stored program entered in a special language. Most desk-top computers are operated like adding machines or mechanical calculators. Problem information is inserted through a digital keyboard or typewriter in much the same sequence as it would be written by hand. When a special program language is required, the computer is properly called a general-purpose digital computer, even though the keyboard or typewriter can be placed on a desk.

Physically, desk-top calculators are either completely self contained or have only a small auxiliary unit that can be mounted under the desk. When the electronic package is built into a desk or console, the computer's computational capacity is usually so large that some form

of preprogramming is necessary. Typewriter, teletype, punched tape or card-reader inputs usually put a computer out of the desk-top class. The exception, of course, would be the addition of one of the above input units to a keyboard-input computer to extend its versatility.

Operation

Since a desk-top calculator seldom requires a stored program, steps to be performed are entered as the computer works the problem. Most small units have storage registers for holding partial solutions or constants. Thus, solving a problem involves step-by-step progression initiated by the operator.

As an example, the sequence of solving a parallel-resistance problem might go like this:

$$\frac{R_1 \times R_2}{R_1 + R_2} = R_t$$

1. Enter value for R1.

2. Add value for R2.
3. Store sum in a register.
4. Enter value for R1.
5. Multiply by value for R2.
6. Divide by sum stored in register.

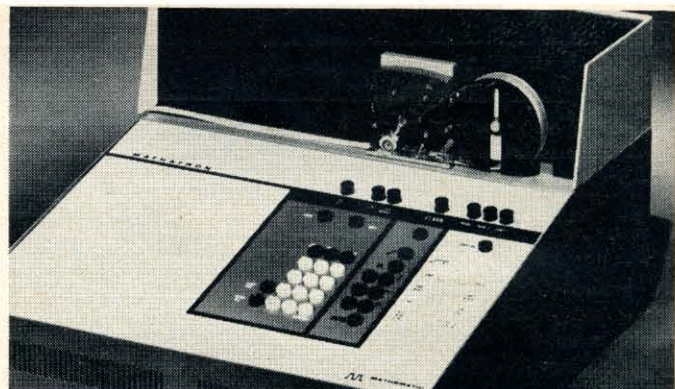
The operator takes the place of the program that is normally stored in a big computer. The 10-digit keyboard is used by most manufacturers for data entry, and additional keys select the function to be performed.

There seems little doubt that desk-top computers will increase in number by the tens of thousands during the next decade. Indeed, some expert observers compare the effect of the "computer revolution" to that of the machine-based technology that sparked and nourished the industrial revolution of the last century. If that is true, and it seems to be, the predictions of the AFIPS may prove to be extremely conservative.

In any case, opportunities for technically trained electronics specialists are certain to grow along with the expanding computer technology. Take a good, hard look at a fascinating field. You well might find yourself a part of it. END



With the Wang 360 you can find the sum of a set of digits and also the sum of their square roots at the same time.



Mathatronics Mathatron supplies a paper-tape answer showing the complete problem solution with all operational signs.