

# alwac III

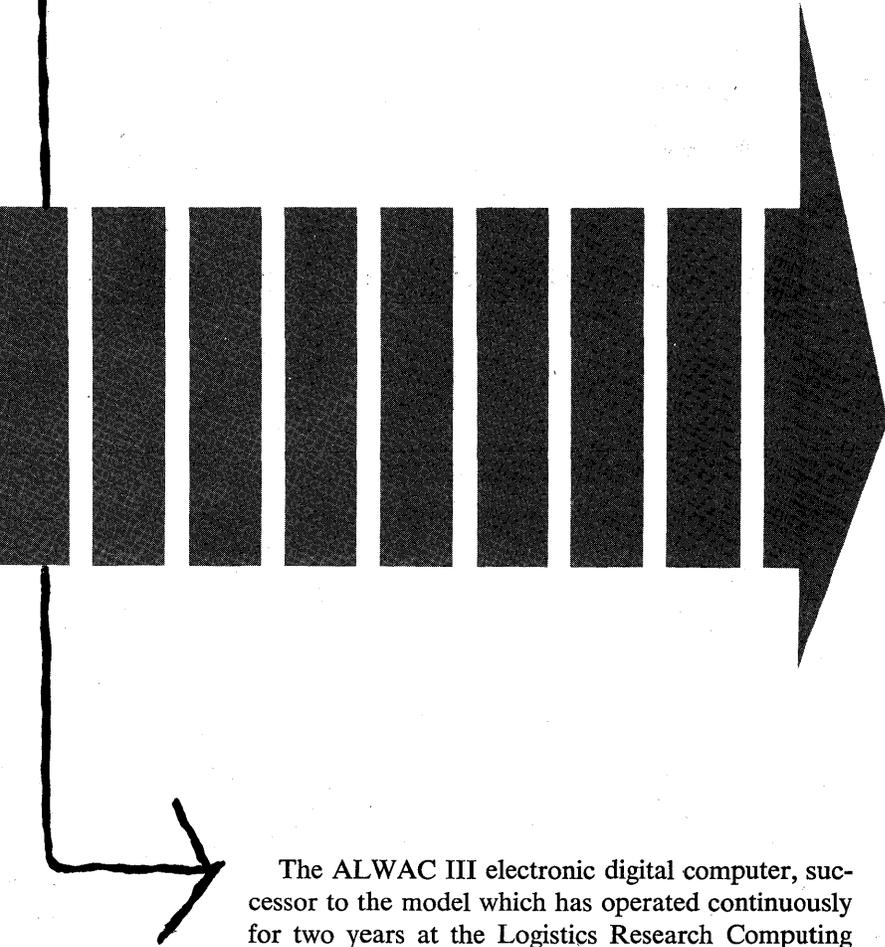
DATA PROCESSING SYSTEMS



LOGISTICS RESEARCH INC.

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# ALWAC III DATA PROCESSING SYSTEMS LOGISTICS RESEARCH INC.



**Automatic Digital Computer  
Punched Card Converter  
Magnetic Tape Storage  
Automatic Typewriter  
Punched Paper Tape**

The ALWAC III electronic digital computer, successor to the model which has operated continuously for two years at the Logistics Research Computing Laboratory, is now available with punched card operation and magnetic tape auxiliary storage. In addition to the convenience of typewriter input and paper tape or typewriter output, which is adequate for some problems, the machine can read or punch cards at the rate of 8,000 alphanumeric characters per minute and read from or record on magnetic tape at the rate of 60,000 characters per minute.

The new model is a fully automatic general purpose computer with an internally stored program. Besides such technical problems as data reduction, trajectory studies, simultaneous equations, matrix inversion, and partial differential equations, this computer can readily handle business problems. With the punched card converter and the magnetic tape system to process large files of information automatically, payroll computation, statistical analyses, cost accounting, and production control problems can be handled at electronic speed. Logistics Research applications engineers, thoroughly trained in problem analysis and with the benefit of the experience of commercial, scientific, and government users of ALWAC, are available to study any problem. A library of standard routines will be made available to purchasers or lessees of ALWAC data processing systems.

The ALWAC is simple to operate and does not require a specially trained computer staff. The reliable magnetic drum has a capacity of 4,096 words, and each word holds two single-address commands, in which the location of the number to be operated on is specified along with the operation to be performed. Input and output are completely decimal, and alphanumeric information can be handled on all devices in the system.

Once the standard routines for problems have been stored in the computer's magnetic drum memory, the operator simply inserts the data to be operated on from one or a battery of typewriter keyboards or from punched cards. Results are produced automatically as printed page with complete form control, paper tape for later automatic typing, punched cards or magnetic tape files. Paper tape, punched cards, and magnetic tape can of course also be used to automatically insert new routines into the computer as well as to insert data either automatically or at will.

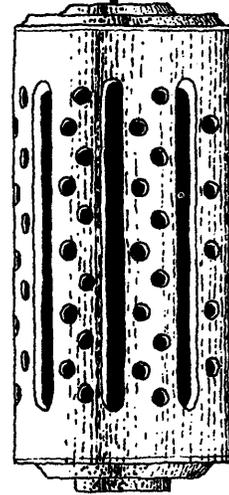
The low price of ALWAC systems and their availability on rental are of particular interest to organizations just entering an electronic data processing program or planning to supplement scientific and engineering computation with some handling of business problems. Training in programming, operation, and maintenance is included with the purchase of an ALWAC system.

## MAGNETIC DRUM MEMORY

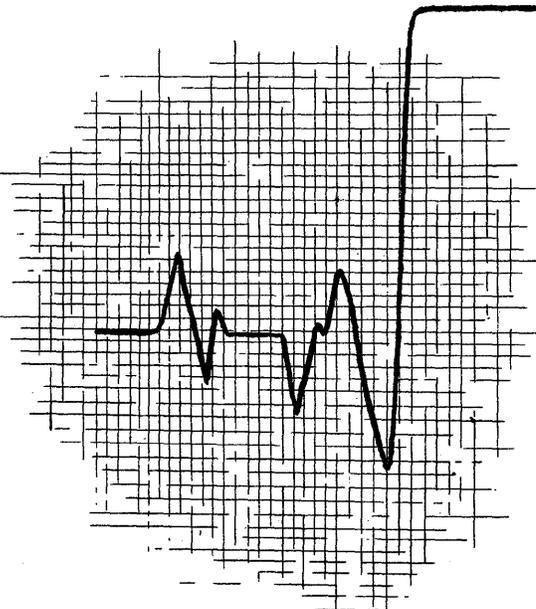
The magnetic drum stores 4,096 words in the form of magnetized spots on its surface (two instructions or one number per word). This amount of storage accommodates 4,096 numbers of nine-decimal-digit length. Each word consists of 33 bits of magnetically recorded information, one of which represents the algebraic sign of numbers. In addition to the 4,096-word main storage, of which 32 words are fast access data storage, the drum has four 32-word channels of fast access storage and four arithmetic registers. The computer is also available with double this amount of storage.

Some instructions which do not require an address for operating data may be packed tighter than two per word. It is sometimes possible to place as many as four commands in one word.

Information recorded on the drum is not destroyed by reading, but remains available to be used over and over again. It may be replaced at any time by recording new information over it.



## SPEED OF OPERATION



The basic operation time for instructions is one millisecond, with an additional eight milliseconds if the operation involves a non-optimum address. Of the 128 words of fast storage there are always eight optimum addresses for any instruction position.

Addition, subtraction, and some other operations—1 millisecond, or, with non-optimum address, 9 milliseconds.

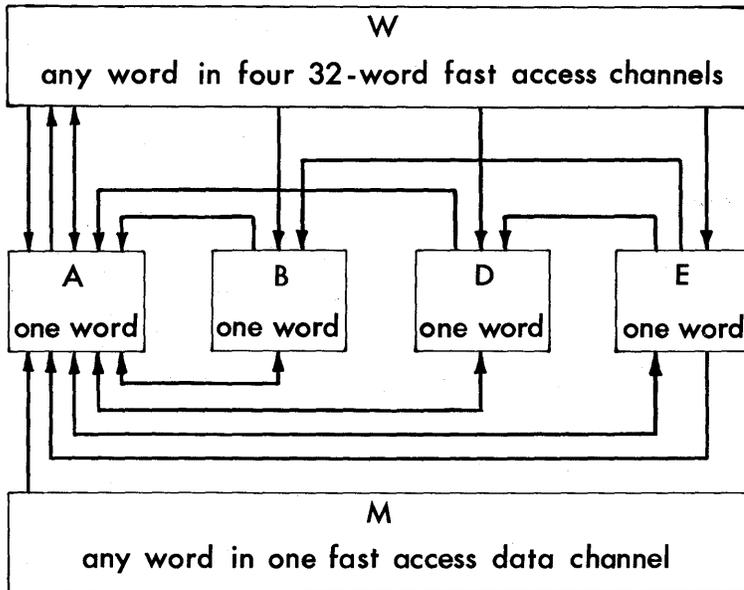
Shift instructions—minimum 1 millisecond, maximum 17 milliseconds.

Multiplication or division without address or with an optimum address—17 milliseconds. If address is not optimum, 25 milliseconds.

Thirty-two-word block transfers to and from main memory—minimum 80 milliseconds, maximum 96 milliseconds.

Input and output instructions—must wait for feedback or timing signals from input-output device.

## PROGRAMMING



In the diagram, A, B, and D are computing registers, E is an automatic tally and test-for-jump register, W is any one of the 128 words in the four fast-access channels, and M is any word in one of the main-memory channels (00) which is used to store data for fast access.

Each of these registers is capable of storing one word.

Each order and each address is represented by two characters. For example, suppose we wish to multiply 9975.00 by .04 and divide the product by 12. If 9975.00 is in storage location 40, .04 is in location 42, and 12 is in location 44, the resulting code would be:

```
40 40 Copy word 40 (9975.00) to the B register.
e6 42 Multiply the B register by word 42 (.04).
ea 44 Divide double length AB by word 44 (12).
30 — Exchange A and B (remainder and quotient);
      quotient now in A.
48 40 Copy the A register into word 40. (Replaces
      the 9975.00 in 40 with the result, 33.2500)
```

The ALWAC incorporates an extremely simple and convenient method of operating subroutines, and subroutines may be permanently stored or called in automatically as needed.

## SUMMARY OF INSTRUCTIONS

### MODIFY ACCUMULATOR

Eleven instructions to clear, round off, obtain absolute value, change sign, complement, perform regular shifts and floating point shifts.

### COPY AND EXCHANGE

Twenty-two instructions to exchange, copy, or extract between fast storage and the arithmetic registers, in various combinations.

### ARITHMETIC OPERATIONS

Fourteen instructions to add and subtract in all algebraic combinations, add and subtract double length, multiply and divide both with and without accumulating.

### BLOCK TRANSFER

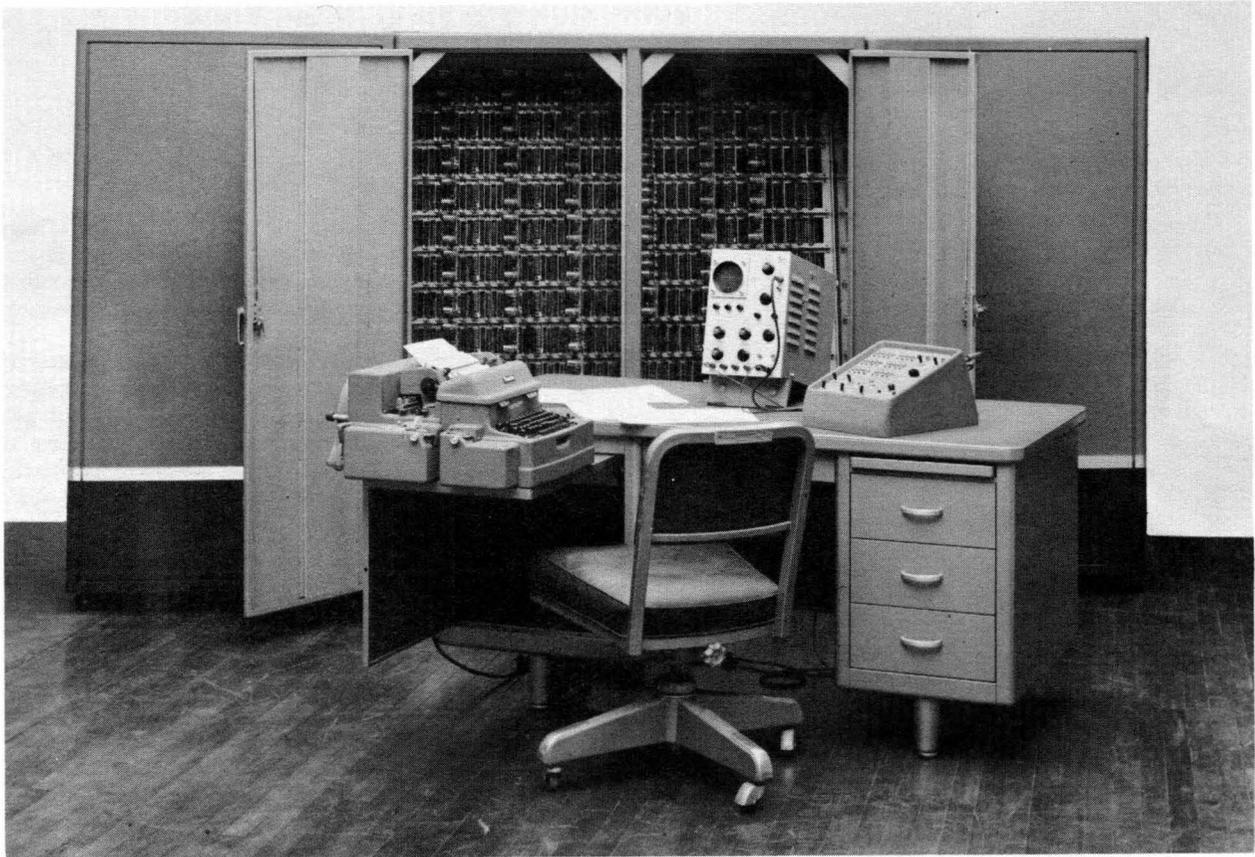
Eight instructions to transfer a block of 32 words between main memory and fast storage.

### TRANSFER CONTROL

Nine instructions to transfer control (jump) either unconditionally or depending on overflow, breakpoint switch settings, counting, comparison, A register negative and not zero, or A register not zero.

### INPUT-OUTPUT

Seventeen instructions to control typewriter (decimal, alphanumeric, and hexadecimal), paper tape, punched cards, and magnetic tape.



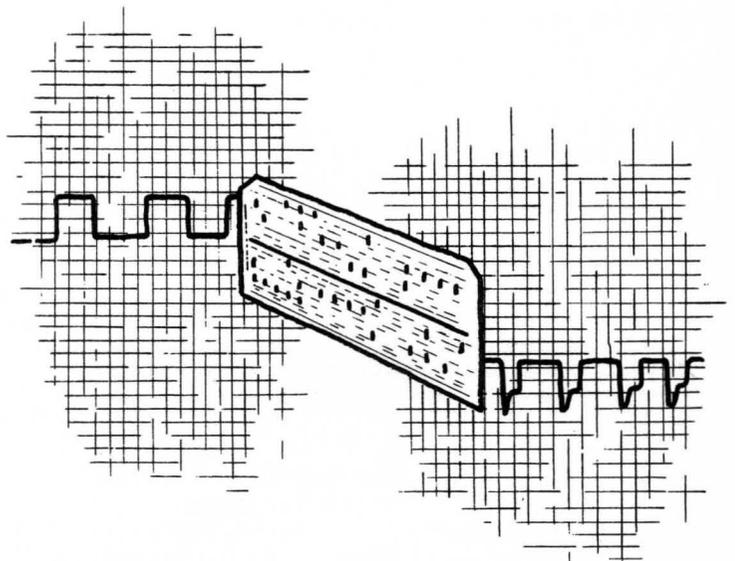
## INPUT-OUTPUT

The ALWAC punched card converter enables the computer to read or punch all 80 alphanumeric characters on a card. Cards containing ten numbers of eight decimal digits each can be handled at the rate of 100 cards per minute. More than ten numbers of various lengths shorter than eight digits can be handled on one card.

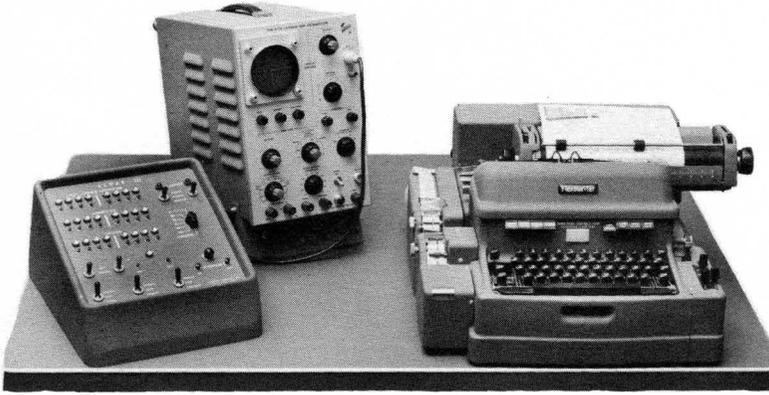
Since the converter has some arithmetic circuits of its own, computing and card handling may proceed during more than 90 per cent of the time while the summary punch is being operated at top speed.

When numbers and instructions have once been stored on magnetic tape from one of the fast access working channels of the drum, the tape may be used to bring in or take out information at the rate of 7,500 words—more than the capacity of the drum—per minute.

Automatic typing, punched paper tape, or both, with algebraic sign, alphanumeric characters, and complete control of the form of the printed page are produced by the typewriter system.



## CONTROLS AND INDICATORS



By means of a compact control panel the ALWAC provides complete information for operation, checking of new routines, and preventive maintenance checks.

Entire routines can be carried out step by step for inspection of storage and arithmetic register contents, or instructions can be inspected without being carried out, under the operator's control. During step-by-step operation, the instruction about to be carried out, the address, if any, to which it refers, and the address of the next instruction to be carried out are displayed in three banks of lights. Each digit of the two-digit instruction codes and addresses is displayed in four lights easily read by summing the values of the lights that are on; the values are 8, 4, 2, and 1.

Automatic breakpoints for checking purposes in routines are provided by two conditional-jump switches.

Alarms and function indicators are operated by a number of built-in reliability checks.

## PHYSICAL CHARACTERISTICS

Three separable but unified cabinets finished in gray and black wrinkle and mounted on ball-bearing swivel casters house the magnetic drum memory, the power supply, and the arithmetic and control elements. All are 29 inches deep and 66½ inches high.

	Width	Approximate Weight
Memory	47 inches	600 pounds
Power Supply	34 inches	900 pounds
Arithmetic and Control Section	55½ inches	600 pounds

The punched card converter and the magnetic tape unit are housed in separate cabinets.

The system operates from standard 110 or 220 volts, 60 cycle, single phase. The basic system including computer and typewriter requires approximately 6 kw of power.

Internal fans provide adequate cooling of the computer at normal room temperature. Temperature should be kept no higher than 80° F. If air conditioning is not used, it is recommended that the computer room have an outside exhaust fan.



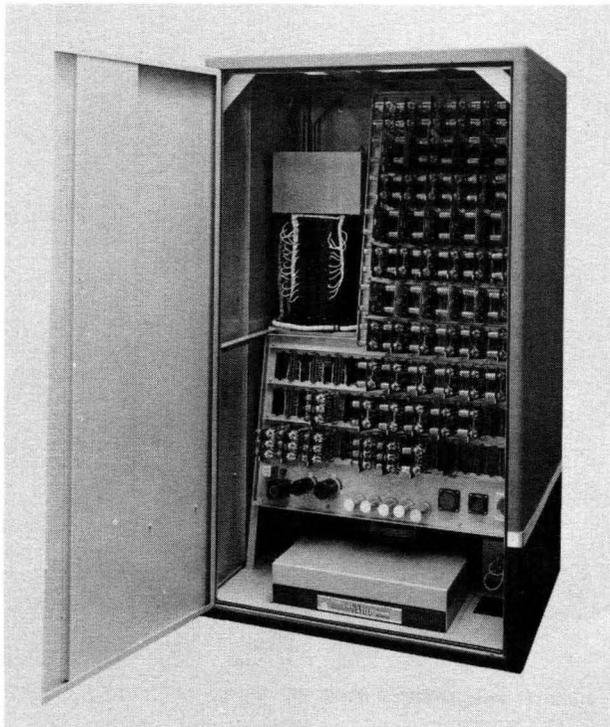
## RELIABILITY

The primary objective in designing the ALWAC was to obtain a computer entirely reliable in its operation at all times with no possibility of losing stored information. This aim has been successfully realized by very conservative use of electrical components, well within their operating ranges, by a simplified method of detecting components whose operation is marginal, and by automatic checking features in various critical computing sequences.

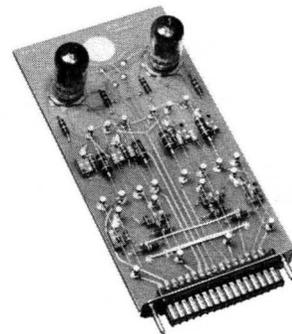
With a clock-pulse rate of only 65 kc and trigger voltage levels of 0 and 15, the ALWAC uses only a small part of the rated capabilities of its tubes and diodes, and the dynamic response characteristics of the circuitry are relatively noncritical. Normal drift in characteristics, therefore, rarely affects the machine's operation.

To simplify preventive maintenance and the insertion of replacements for marginal plug-ins, electronic components are packaged in standardized plug-in units of only a few different types and compact etched circuitry is extensively used. Equipment to test the plug-in units is supplied with the computer. It is a simple matter to check all components in the circuitry in a very short time.

Built-in checks give protection against practically all coding or machine errors, such as unforeseen overflow of an arithmetic register or loss of information in copying from one memory channel to another. Any of these errors will stop the computer and give an alarm, and indicator lights on the control panel will then show which type of error has occurred.



MAGNETIC DRUM MEMORY



FLIP-FLOP PLUG-IN  
(PRINTED CIRCUIT)



DIODE TESTER



PLUG-IN TESTER

LOGISTICS RESEARCH INC. REDONDO BEACH CALIF.

## LOGISTICS APPLICATION ENGINEERING

Experienced Logistics Application Engineers are at your service . . . to survey your data-handling and computational requirements . . . and to show you exactly how ALWAC can serve you. Whether your field is science, business, government, or engineering . . . Logistics can help.