

503

*ULTRA HIGH SPEED  
DIGITAL COMPUTER  
FOR SCIENCE AND INDUSTRY*

**E|LIOTT**

# ELLIOTT 503 ULTRA HIGH SPEED DIGITAL COMPUTER FOR SCIENCE AND INDUSTRY

## Introduction

Elliott Brothers have developed the 503 to meet the demand for computers operating at much higher speeds than hitherto without a corresponding increase in cost. This computer will revolutionise the economics of computer usage in several ways

(i) it will handle problems which were formerly more cheaply solved by manual methods.

(ii) it will provide computing facilities for organisations with a large number of individual users. Due to the high speed of the computer, and the simplified programming and operating methods being developed, owners of 503 can run as many as 200 different programmes each day.

(iii) it will tackle the most complex problems arising in science and industry, formerly beyond the scope of small or medium-sized computers.

As an illustration of the advance on currently available computers which the 503 represents, it is interesting to compare it with the 803. The National-Elliott 803 is a small general purpose transistorised computer which is the most popular European

computer ever produced. Yet the 503 is about one hundred times faster than this machine and costs less than twice as much!

## Features of the System

The 503 is a general purpose computer of great speed and flexibility, intended mainly for the solution of technical problems arising in science and industry. It is essentially straightforward in design, but so exceptionally fast that high problem-solving speeds are obtained.

The computer incorporates many features unique among medium-sized data processing systems

- \* 100,000 arithmetic operations per second.
- \* Large magnetic core store.
- \* Time-sharing of peripheral data-transfers.
- \* Fixed and floating point arithmetic.
- \* Direct connection of high-speed input and output equipment.
- \* Compatibility with well-known 803 computer.
- \* Auxiliary magnetic core storage of almost unlimited capacity.
- \* ALGOL Automatic Programming System.

## Basic Computer

The basic 503 forms a powerful and complete computing system in its own right; it has a magnetic core store of 8192 words capacity with a cycle-time of 3.5 microseconds. Each word in the store may be regarded as equivalent to

- (a) a fixed point number of 39 binary digits, equivalent to 11 decimal digits
- (b) a floating-point number using nine binary digits for the exponent and 30 for the mantissa, corresponding to a precision of nine decimal digits
- (c) Five alphanumeric characters, or
- (d) Two single-address instructions.

Input and output for the basic computer is on punched paper tape, read at 1000 characters per second and punched at one hundred characters per second. There are two tape readers and two tape punches. Eight-channel paper tape is normally used on the 503, but the equipment can also handle five-channel paper tape.

The computer is controlled from an electric typewriter which is used for direct input and output.

## Operating Speeds

The basic pulse rate of the 503 is 6.7 megacycles per second.

The computer contains a parallel binary arithmetic unit, and is capable of carrying out 100,000 operations every second.

Typical operation times, inclusive of store access, are as follows

<i>Fixed-point addition</i>	7 microseconds
<i>Floating-point addition</i>	average 20 microseconds
<i>Transfer control</i>	5 microseconds
<i>Fixed-point multiplication</i>	38 to 57 microseconds
<i>Floating-point multiplication</i>	38 to 51 microseconds
<i>Fixed-point division</i>	81 microseconds
<i>Floating-point division</i>	71 microseconds

The time for the inner loop of matrix multiplication routine is 126 microseconds, so that two 50 by 50 matrices can be multiplied together in 16 seconds.

The time required to sort 10,000 items of 10 words each on a 503 with four magnetic tape decks is estimated at 4 minutes.

## Peripheral Equipment

Information may be transferred directly between peripheral devices and any block of consecutive locations in the main store of the computer. Once the transfer has been started it proceeds under the control of the Peripheral Control Unit whilst the computer continues with its programme. "Tag" bits associated with each word in the store of the computer are used to ensure that the computer cannot refer to the block of store involved in a transfer until the new information has arrived, or the old information has been used. However, the computer can refer to the earlier locations of the block whilst the later locations are still involved in the transfer. These arrangements are entirely automatic and need not concern the programmer when writing his programme.

The following peripheral devices are currently being offered on the 503:

*Backing magnetic core store in units of 16,384 words.*

*Magnetic Film Units (maximum eight).*

*Magnetic Tape Units (maximum sixteen).*

*High Speed Line Printer.*

*Punched Card Reader.*

*Punched Card Punch.*

An interrupt system is provided in the computer. On interrupt the contents of all the special registers are stored away and the computer transfers control to another programme. This facility is used to deal with programme and other error conditions such as floating-point overflow, and to control the computer from the typewriter keyboard. It may also be used, in conjunction with standard programmes provided by Elliott Brothers, to enable information to be transferred between one peripheral device and another simultaneously with the operation of an independent programme. In this way the computer may be translating an autocode programme whilst the results of the previous job are being printed on the line printer from magnetic tape.

### **Checking and Reliability**

The 503 computer is designed in such a way as to achieve extremely high reliability. The smaller 503 systems are run without a resident engineer and Elliotts provide a comprehensive maintenance service. All the circuits of the 503 are fully transistorised, and the store is a ferrite core matrix, so that there are no mechanical moving parts other than input and output devices. Experience gained in the

803 and in military computing systems has enabled Elliotts to design a computer as reliable as the simpler and slower 803.

A parity check bit is used with every word in both the main and backing core stores. Extensive checks are included on the correct functioning of all peripheral devices. A parity check is used with every character read or punched on paper tape. An automatic error interrupt occurs on the detection of errors caused by malfunctioning of equipment or by certain faults in programming.

### **Compatibility with 803**

The 503 is entirely compatible with the well-known National-Elliott 803 computer: the word length and instruction code of the two machines is the same.

This compatibility has the following advantages:

(a) *The extensive library of programmes already developed for the 803 is immediately available for the faster machine*

(b) *Potential 503 users may test their programmes immediately on the 803*

(c) *803 users may exchange their computer for a 503 if the former machine becomes overloaded without having to reprogramme their work—a task which would prove extremely formidable*

(d) *A central research establishment may install a 503 computer with 803 computers at each of its out-stations. Users of the 803's may run their larger problems on 503 after testing them on their own machine.*

## Programming Systems

The basic code of the computer is a single address system with one (double length) accumulator and two instructions per word. There are 64 different functions including add-into-store and similar operations. Each of the 8192 locations of the main store may be used as an index register, thus greatly simplifying the programming of complex problems.

The programming systems in use on the 803 computer, including the Mark 3 Autocode and the Matrix Interpretive Scheme, will be immediately available on the 503.

A symbolic assembly programme for machine code programmers, including facilities for calling in sub-routines by name, is being developed, and will be available with the first 503 computers.

Work is well advanced on an ALGOL automatic programming system for 503.

ALGOL "statements" are written in a natural way and are very easy to understand.

Examples:

```
acceleration:=a-32.18×sin(theta+1);  
if a=b and x < epsilon then y:=(1-exp(x))/x  
    else y:=-1;  
for i:=1 step 1 until N do sum:=sum+A[i];
```

ALGOL 60 is a programming language developed by an international committee of experts in Automatic Programming, and it has been designed not only to simplify the programming of extremely complex problems, but also to make the programming of every-day problems as easy as possible for the occasional user.

Since the publication of the ALGOL report, a large number of programmes written in ALGOL by leading specialists in the field of computing methods have appeared in mathematical and computing journals. The Elliott ALGOL translator will make such programmes available to all users of the Elliott 503 and 803 computers. It will also enable a 503 installation to draw its staff from the widening body of programmers who are familiar with ALGOL, and who have developed an appreciation for its great power and simplicity.

*Other Computers by Elliott Brothers*

*National-Elliott 803 Small General Purpose Computer*

*Elliott 502 Real Time Data Processing System*



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***Pioneers of the first decade—now leaders of the second decade***

Eleven years' experience in the design and application of automatic digital computers places Elliott in a leading position among European computer manufacturers with more than 150 sales to date. From the first experimental trials recording and analysis machine in 1950 to the revolutionary 503 of 1961, Elliott have been proud to maintain a distinguished record of significant achievement.

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The information given in this leaflet is subject to alteration as additions and improvements to the equipment described are made.

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