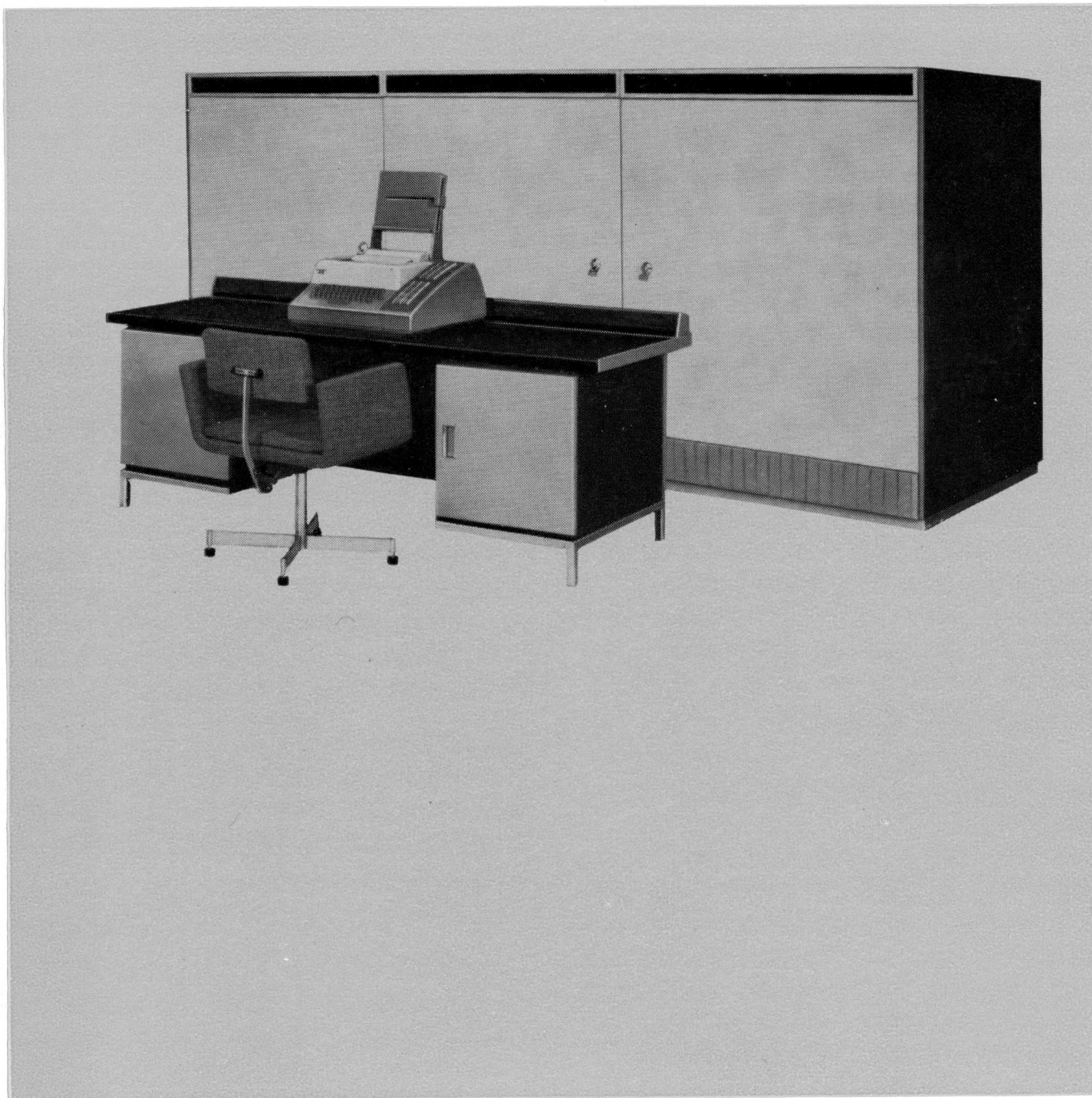**I·C·T**

I.C.T 1900 SERIES

CENTRAL PROCESSORS
1904
1905

DESCRIPTION

The I.C.T 1904 is in the middle of the 1900 series of compatible Central Processors providing throughput of approximately two and a half times that of the I.C.T 1903.

It is a multi-purpose digital processor to which a wide range of input, output, storage and communications devices can be attached. The system is designed to allow easy growth from the smaller systems in the range. Thus, all programs written for smaller I.C.T 1900 systems will work unchanged and with increased efficiency on 1904. A smaller processor can be replaced by a 1904, and a 1904 replaced by a larger processor on site.

Peripheral units are attached via I.C.T Standard Interface and are therefore interchangeable with all systems in the range.

Alternatively a 1905 processor can be specified to provide floating-point facilities by built in circuits. Very high calculating speeds are thus available.

- Multi-programming under automatic control of executive
- Processor time automatically allocated for maximum productivity
- Simultaneous operation of peripheral devices
- Reservation system prevents interprogram interference
- Programming compatability throughout the 1900 series

CENTRAL PROCESSORS
1904
1905

Multi-programming

The processor incorporates facilities for multi-programming whereby a number of programs may be run concurrently. Up to four main programs may be run at once with no risk of mutual interference. This multi-programming system is entirely automatic, and the programmer does not have to consider it when writing his programs. If he so desires, the programmer may incorporate into a main program up to two sub-programs which will then participate independently in the automatic multi-programming system, concurrently with the other main programs in the system.

Executive

Executive is the name given to a program which when the computer is in normal use, is always present in the core store, and which controls all other programs that are in the system at any time. The main functions performed by Executive are:

1. Interpretation and execution of the operator's commands to the system, and provision of information for the operator concerning normal program running incidents, and peripheral devices that need attention.

2. Allocation of the time of the central processor among the programs in the system according to given priorities so as to achieve maximum utilization of the central processor and of the peripheral devices.

3. Allocation of peripheral devices to programs that are entered into the system, and the control of data transfers to and from peripheral devices.

4. Monitoring of program and peripheral device performance.

Operation

Systems utilizing 1904 and 1905 processors are controlled by means of messages entered by the operator on a typewriter directly connected to the processor. In addition, pre-punched messages may be entered via a card reader or a paper-tape reader. Executive takes the actions requested, and when necessary will type out messages for the information or action of the operator. This provides a permanent printed record of the sequence of operational events. Facilities for automatic sequencing of jobs are also available.

High Speed Store

A 1904/5 Processor may be supplied with a core store of 8,192, 16,384 or 32,768 words. The store in an initial installation may be later expanded on site up to the maximum when required. The cycle time is 2 microseconds. All store operations are subject to a parity check.

Store Reservation

Each program is allotted an appropriate area within the core store. While executing program instructions the central processor is allowed to use only those parts of the store which are reserved for that program. Whenever the Executive causes the central processor to start obeying a different program the reservation settings are changed to those appropriate for that program. Thus each program, including those under test, is prevented from interfering with any others that may be running in the machine.

Peripheral Transfers

All transfers of data to or from peripheral devices are carried out by program entries to Executive, which has direct control of all devices. Before initiating the transfer, Executive checks that the store locations requested are within the area reserved for the program that issued the request. Once initiated the transfers proceed autonomously so that any number of transfers may be in progress simultaneously.

The central processor is caused to 'hestitate' when necessary to allow a single character or word to be transferred between the core store and the peripheral units. The normal hesitation time is 6 micro-seconds. Internal processing therefore proceeds at a slightly reduced rate while peripheral transfers are in progress. Completion of a transfer causes a signal to the Executive and any program held waiting for that transfer is allowed to proceed. Transfers which fail accuracy controls are automatically repeated a pre-determined number of times before operator intervention is requested, if the peripheral devices permit automatic repositioning of the medium e.g. magnetic tape decks or card punches. On other devices a failure is notified to the operator immediately.

Word length

The processor normally operates with words of 24 binary digits. Such a word can be used to represent:-

one instruction

four alpha-numeric characters

a decimal integer in the range —8,388,608 to +8,388,607

a decimal fraction in the range —1.0 to +0.9999999 with accuracy approximately equivalent to seven decimal digits

Two words together may represent a double precision number having an accuracy equivalent to over thirteen decimal digits or a floating-point number.

A number of separate data items may be packed into a word or group of words, and instructions are available to address single characters in the store.

Instruction Code

The first eight core locations assigned to each program are used at the program's accumulators, and can be used

CENTRAL PROCESSORS
1904
1905

for arithmetic and counting. Three of these accumulators may be further used for indexing. Most instructions carry a reference to a core store location and an accumulator. The comprehensive instruction repertoire contains arithmetic, transfer, logical and shifting operations, including multiplication, division and literal operand facilities. There are special provisions for multiple-length arithmetic, conversions between decimal and binary forms of numbers, and character handling.

Floating point
Floating point instructions are available in the 1904 processor by means of sub-routines which are incorporated in Executive when required. There is also available a 1905 processor in which these instructions are carried out by a floating point unit giving greatly increased speeds of floating-point operation.

Input/Output Channels
Peripheral devices are connected to the central processor by means of Input/Output Channels which are located in the processor cabinet. A wide range of peripheral devices to Standard Interface can be attached to the same type of Channel. A Channel can handle a Control or Multiplexor device which can itself handle a number of devices.
A processor can provide for up to eighteen slow peripherals, such as punched card or paper tape devices. Up to five channels for individual or grouped fast peripherals, such as magnetic tape systems or disc stores, may also be added as needed. This figure may in some cases be increased depending on the data rate of the associated peripheral devices.

SPECIFICATION SUMMARY

Data unit 24-bit word
Store size 8,192, 16,384 or 32,768 words
Store cycle time 2 micro-seconds
Store checking One parity bit per word
Multi-programming Up to 4 programs may operate concurrently
Accumulators 8 per program
Index registers 3 per program (uses 3 of the 8 accumulators)
Arithmetic Binary (decimal conversion instructions included)
Addition time 7 micro-seconds
Multiplication time 40 micro-seconds
Division time 44 micro-seconds
Input/Output Channels 18 slow, 5 fast
Peripheral simultaneity Full simultaneity on all peripherals
Processor hesitation time 6 microseconds (minimum) for each word (or character for slow devices) transferred between peripheral device and store.

Floating-point Arithmetic
Both 1904 and 1905 Processors can carry out floating-point arithmetic. In the case of the 1904, floating-point instructions are carried out by subroutines in the Executive program.
A 1905 Central Processor has all the facilities and characteristics of a 1904, plus a Floating-Point Arithmetic Unit which is autonomous. The Central Processor can continue obeying other instructions six microseconds after a floating-point instruction has been initiated. There is a lockout which causes the Central Processor to wait if another floating-point instruction is encountered while the Floating-Point Unit is still busy. The Unit includes a 47-bit floating-point accumulator, and an exponent overflow indicator. The number representation is:

Argument	37 bits plus sign
Exponent	8 bits plus sign

The arithmetic functions may be rounded or unrounded and standardized or unstandardized at the discretion of the user.
Typical times in micro-seconds for the floating-point instructions are:

Add/subtract	13
Multiply	29
Divide	51
Load/store	6/8

PHYSICAL CHARACTERISTICS
The size of the main cabinet depends upon the configuration of peripheral devices and other factors, for example:

	Minimum installation	Large installation
Height	61 inches	61 inches
Depth	34 inches	34 inches
Length	98 inches	194 inches
Weight	2,200 pounds	4,350 pounds

This specification is subject to modification