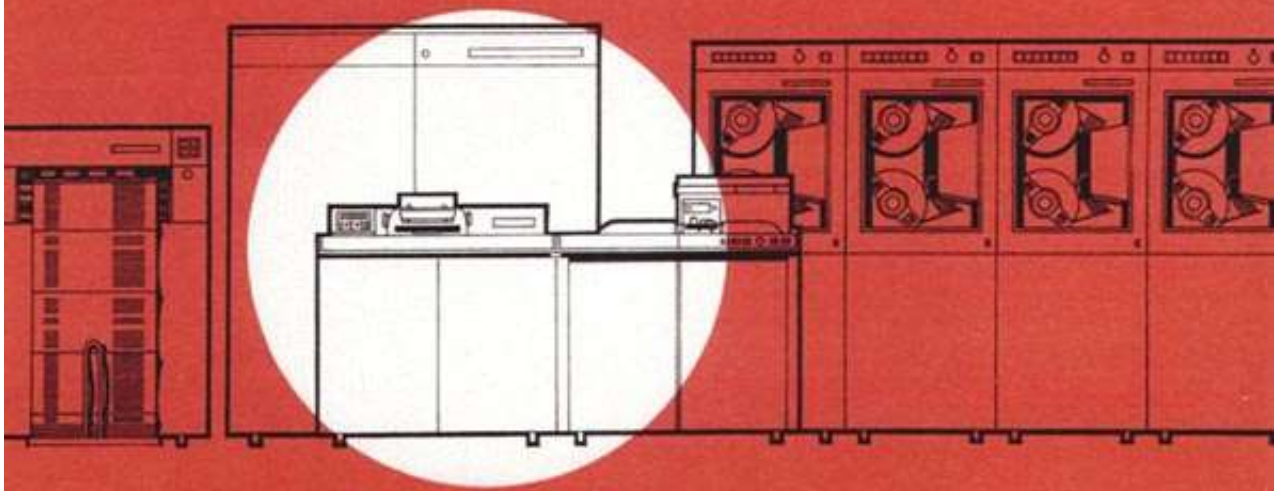
NCR ELLIOTT

4100

Forty-one hundred



Introduction to 4100 Software

4100

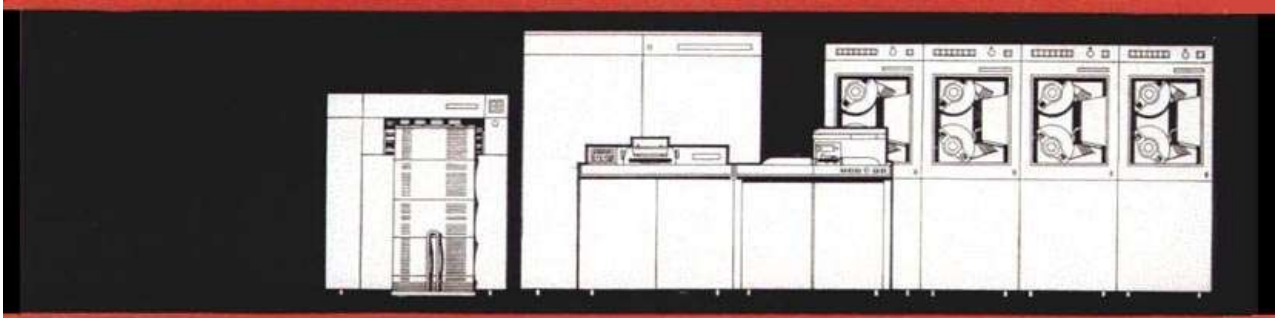
Forty-one hundred

The NCR Elliott 4100 is an up-to-the-minute computer in every way – design, construction, speed, simplicity and power. British designed and built for business, science and real-time computing. No multi-purpose computer is more useful or more efficient.

Specification

Silicon constructed. Over 400 program instructions. Comprehensive software – Algol, Language H, Fortran IV and NEAT 4100 assembler. Standard interface. Large range of peripherals. Processors and peripherals expandable and interchangeable.

The manufacturers reserve the right to alter, without notice, the specification for any equipment described in this leaflet.



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introduction to 4100 software

The modular hardware of the 4100 Data Processing System is supported by a range of modular software that greatly simplifies the writing of efficient programs for both commercial and scientific applications. Appropriate operating systems are constructed for the different hardware configurations giving full and efficient use of the computer and its peripherals.

The software provided includes debugging and testing aids, utility routines and a wide range of programming languages that together provide an efficient means of communicating with the machine.

The programming languages available to users of the 4100 range include:

NEAT Assembly Language.
Language H for commercial programming.
ALGOL and FORTRAN for scientific programming.

ALGOL and FORTRAN for the 4100 conform to the European and proposed international standards for these languages.

Large programs can be operated even on quite small configurations, since programs can be split into segments and held on backing store. The segments are overlaid in core store when required, under the control of the operating system.

The languages available provide an effective approach to programming and a 4100 installation can be brought into full productive use quickly and economically. The higher level languages, Language H, ALGOL and FORTRAN are all problem-oriented, easily read and easily learnt even by the non-professional programmer. Existing programs for other computers can be used virtually unchanged.

4100 NEAT Assembly Language

NEAT is the basic programming language of the 4100 system. It is a symbolic assembly language suitable for all computer applications including scientific, commercial and real time data processing. There are two levels of implementation—the Elementary and the Advanced Assemblers—with upward compatibility between them. Programs written for use with the Elementary Assembler are accepted by the Advanced Assembler. Object programs are run under the control of the Systems Executive.

4100 NEAT Advanced Assembler

The NEAT Advanced Assembler is based on software developed for the NCR 304 and 315 range of machines. Features of the Advanced Assembler are:

Assembler held on magnetic tape or CRAM.
Source program input and object program output on punched tape, punched cards or magnetic media.
Source program listing and cross-referencing to facilitate program debugging.
Clear indication of all source program errors.
Sorting of source program lines makes program correction easy.
Re-assembly masters produced to make recompilation easier.
Sub-routines from a large library inserted automatically in the object program.

NEAT Elementary Assembler

The Elementary Assembler is designed for use with the smaller systems, or systems with a limited range of peripherals (i.e. fewer than three magnetic tapes, no printer, etc.).

Although this system does not have the full facilities offered by the Advanced Assembler, many of the sub-routines included in the Advanced Assembler sub-routine library are available to Elementary Assembler users in the form of punched paper tape source-lines.

The Utility Routines are available to Elementary Assembler users, including debugging and program correction facilities. Both object and source programs are held on punched paper tape.

NEAT System Executive

The System Executive provides a software environment for the running of object programs. It controls:

Interrupt Processing.
Program loading, program to program linking on magnetic tape, and program overlays.
Program 'debugging' facilities under operator intervention.
Operator communications and system control.
Data input/output and peripheral control.

Language H

Developed over several years, Language H achieves a proper balance between the power of expression needed to solve complex data processing problems and the simplicity of approach essential to the efficient use of computers.

Features of Language H are:

- Compact vocabulary and small set of rules for rapid learning.
- Flexible structure to permit ready extension for multi-programming, and mass storage.
- Inherent documentary discipline to permit easy interchange of programs between programmers.
- Automatic segmentation of programs.
- Source programs accepted from punched paper tape or punched cards.
- Independently compiled programs can be held as a library on magnetic tape, with automatic retrieval.
- Detection of source program errors.
- Intermixing of source program and NEAT Assembly Language permitted.
- Efficient control of punched paper tape and punched card input.

Language H has already been successfully applied on the NCR 315 and the NCR Elliott 405 and 803 computers. Its implementation on the NCR Elliott 4100 data processing system makes it possible to transfer programs and programming experience to the new system with a minimum of difficulty or adaptation.

ALGOL

ALGOL is an international programming language designed specifically to meet the requirements of the scientific user. Powerful and flexible, it is easily learnt and applied, and is the accepted language for the publication and interchange of scientific programs.

ALGOL implementation for British computers was pioneered on the NCR Elliott 803. 4100 ALGOL is based on the 803 system and on that for the Elliott 503, and the wide range of programs developed for these and other machines can be transferred to the 4100 with the minimum of modification.

4100 ALGOL contains the combined language facilities of 803 ALGOL and of full ECMA ALGOL, the Standard subset of ALGOL 60 adopted by the European Computer Manufacturers' Association, and proposed as a draft standard by the International Organization for Standardization.

Features of 4100 ALGOL are:

- Fast compilation.
- Clear indications of all source program errors.
- Run-time checks on arithmetic and array indexing.
- Parts of a program can be written in NEAT Assembly Language.
- Magnetic tape operating system.
- Facilities for segmentation of programs too large to be held entirely in core store.
- Source code input from punched paper tape or punched cards.
- 'Load-and-go' operation of programs.
- Batch processing facilities.
- Operating systems tailored to the different hardware configurations.
- Library scheme for storage of programs on backing store, with automatic retrieval.
- Magnetic tape labelling compatible with commercial formats.

FORTRAN

FORTRAN is a machine-independent language widely used for scientific programming, particularly in the United States. FORTRAN is available on the 4100 and gives the user access to powerful and reliable programs already written for many applications.

4100 FORTRAN is based on the standard version of FORTRAN IV by the American Standards Association and accepted by both the International Organization for Standards and the European Computer Manufacturers' Association.

The language is implemented at two levels. For small configurations with no backing store, ASA FORTRAN is restricted by the exclusion of double length and complex data, and of data statements and block data sub programs. For systems with larger core stores or with magnetic tapes, full ASA FORTRAN is available.

Features of 4100 FORTRAN are:

- Independent compilation of sub programs.
- Fast compilation.
- Compact object code.
- All syntactical source program errors detected.
- Magnetic tape operating system on two handlers.
- Facilities for segmentation of large programs if three handlers available.
- Source programs accepted from punched paper tape or punched cards.
- 'Load-and-go' and batch processing options.
- Mixture of FORTRAN sub programs with NEAT programs.
- Independently compiled programs can be held as a library on magnetic tape, with automatic retrieval.
- Magnetic tape labelling compatible with commercial formats.

Highlights of 4100 Software

- Efficient use of equipment: modular hardware supported by modular software.
- Simplification of programming: problems presented to the computer in the users own language.
- Overlay facilities: large programs can be segmented to run on small configurations.
- Compatibility between machines of different types is provided through the use of high-level languages.
- Software economy: Executives and operating systems tailored to suit the configuration.

The provision of sophisticated software is of vital importance when related to the total investment in a computer system. A computer can only be described as truly productive when it is doing the job of work for which it was originally intended. Positive financial advantages interpreted as savings in man and machine hours will accrue from the use of NCR Elliott software.

4100

Central Processor MODEL 4130

The 4130 central processor is a high-speed, multi-programming unit, fully compatible with the less powerful 4120 processor.

The 4130 processor is compact, self-contained and transportable, so that installation consists only of plugging it into a suitable mains outlet. Since the equipment is fully transistorised and capable of tolerating a wide range of environmental conditions it requires no special air conditioning (although air conditioning may be required for systems using certain peripherals).

The processor operates in parallel on binary words of 24 bits. This word-length is ideal for both commercial and scientific work. Most 4120 standard 'extracode' functions are provided by hardware on the 4130, giving high-speed floating point arithmetic and array indexing for scientific work. Commercial data processing applications can make use of the six-bit character manipulation facilities included in the instruction repertoire.

Instructions are normally of 24 bits in length but certain commonly used instructions are available in a 12-bit format. This allows considerable saving in program storage, particularly for standard software packages. Powerful variations of addressing mode are provided; these cover literal addressing, indirect addressing and B-modification, as well as normal direct addressing.

At present a maximum of 262,144 words of core storage can be attached to the 4130 central processor in four modules of 65,536 words. The processor itself has been designed to take a maximum of 524,288 words.

The first 32,768 words of consecutive store is directly addressable; areas greater than 32,768 words are addressed by modified or indirect addresses or directly with the aid of a 10-bit base register. All 4120 programs can be run unchanged anywhere in the store.

As the address phrase of a direct instruction has a maximum value of 32,767, the contents of the base register, in units of 512 words, can be added, thus enabling any location within the range BASE to BASE + 32,767 to be directly addressed.

There are over 400 orders and variants available, making up a versatile and flexible programming system. Each instruction has a simple mnemonic to ease identification.

A unified approach to all input and output operations has been devised. A standard interface has been implemented for the central processor and all devices in the system, allowing for the interchange of peripherals with the 4120.

The interface is designed to minimise the amount of buffering and control logic required for any peripheral device, and yet permit extremely high data transfer rates. Up to fourteen independent input/output channels are provided. Additional channels are made available when an Autonomous Transfer Unit is fitted.

Each peripheral has an associated control and status word. The former may be sent to the peripherals and specifies to them certain control functions – e.g. rewind tape, do not interrupt, select particular handler. The latter provides the processor with information on the state of the peripheral – e.g. controller busy, end of tape, write permit, etc.

A powerful feature of the standard interface is the program interrupt scheme. Each input/output channel may interrupt on either of two levels, one demanding a more urgent response than the other. Storage of all important registers and determination of which channel has interrupted are done automatically by hardware, allowing a fast response to an interrupt.

The interrupt facilities ensure efficient use of peripherals without waste of central processor time, but where there is a large volume of input and output an optional Autonomous Transfer Unit enables all peripheral transfers to take place autonomously on a cycle-stealing basis.

A multi-programming scheme is provided, allowing any number of programs to be interleaved together, thus making the most efficient use of both peripherals and central processor time. This scheme is supervised by a software executive program, the Program Scheduling Executive (P.S.E.).

Full protection against program interference is given by the use of the 10-bit base register and a 10-bit range register. The former holds the address of the lowest location which can be used by the current program, the latter the address of the highest location allocated to the current program, thus providing hardware protection.

All input/output instructions are trapped and control is transferred to P.S.E., which then ensures that no program has access to peripherals which have been assigned to any other program.

In addition to multi-programming, multi-access working is available on the 4130. Here any number of users may simultaneously be in direct communication, via remote teleprinter consoles, with the central processor for program testing and running purposes. To each individual user the 4130 appears as a 4120.

Comprehensive programming systems, covering all fields of application, are provided, including ALGOL, NEAT 4100 assembly language, Language H and FORTRAN IV.

Components of the Processor

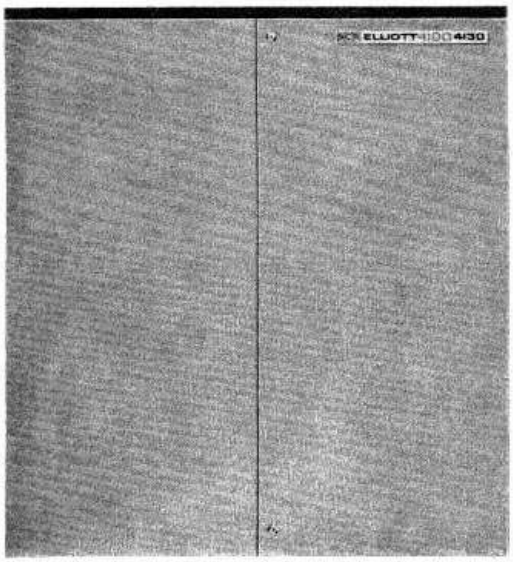
The central processor comprises:

(a) **Main Unit**

This is a self-contained cabinet containing the arithmetic and control units, together with their associated power supplies. Exclusive use of silicon semiconductors and metal oxide film resistors provides tolerance of a wide range of environmental conditions. There is space in the cabinet for the Autonomous Transfer Unit.

(b) **Control Box**

This consists of a series of lamps illustrating the most important features of the state of the computer at any given time, a loudspeaker with volume control, and several control buttons and switches.



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Power requirements	50 c/s ± 1 c/s single phase 230 ± 10 volts.
Consumption	2 kVA
Operating conditions	Temperature 0–50 °C. Relative humidity 5–95%
Dimensions	5 ft. 10 in. × 2 ft. 2 in. × 5 ft. 3 in.
Weight	1000 lb.
Word length	24 bits
Instruction code	12 or 24 bits
Operation	Parallel
Addressing mode	Direct literal, indirect and B-modified
System compatibility	Standard interface
Program languages	ALGOL, NEAT 4100 assembly language, Language H, FORTRAN IV.
Registers accessible by program	Main accumulator Reserve accumulator Sequence control register Count register Conditions register Mantissa register (2 words) Exponent register Base register Range register

Typical Instructions Available

LD	Load operand to main accumulator
ADD	Add operand to main accumulator
MULM	Double-length multiplication
GET	Shift the operand one character left cyclicly and replace the least significant character of the main accumulator by the least significant character of the operand.
SBL	Shift double-length accumulator left (shift both registers left)
SMLC	Shift main accumulator one character left cyclicly
J	Unconditional jump
JN	Jump if negative
JZ	Jump if zero
DKJN	Decrease count register by 1. Jump if negative
COMP	Compare main accumulator with operand Set conditions register accordingly
FA	Add to floating point accumulator
FM	Multiply floating point accumulator
FMOD	Modulus of floating point accumulator

4100

Line Printers MODELS 4258 and 4259

These low-cost line printers are available for use with the Elliott 4100 computer. Both models are buffered and have maximum speeds of 300 and 1250 lines respectively.

Their repertoire is basically similar to the ISO/ECMA code with 56 characters on model 4258 and 64 on model 4259. Both models have space and tab control characters. Up to 160 characters per line may be printed and the tab facility, together with a fast paper slew, allows full utilization of the line printer's speed.

Printed forms from 3½in to 20in wide can be accommodated, and up to six legible copies produced from a single impression. A simple control governs the even, powerful hammer intensity, to provide a clean, firm print impression even where the maximum number of copies is produced.

Vertical format is controlled by the program in conjunction with an easily changed loop of Mylar tape.

The basic mechanisms of these printers have been thoroughly tested and proven. They represent fine value at their respective speeds of operation.

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MODEL 4255

Lines per minute	300
Print character repertoire	64
Lines per inch	6 or 8
Characters per inch	10
Characters per line	80 or 120 or 136 or 160
Paper feed	18 in per second
Dimensions	4 ft 6 in × 4 ft 0 in × 2 ft 6 in
Weight	1,500 lb
Power requirements	230 ± 10% volts, 50 Hz ± 2%
Power consumption	1.5 KVA

MODEL 4259

Lines per minute	1,250
Print character repertoire	64
Lines per inch	6 or 8
Characters per inch	10
Characters per line	120 or 132 or 160
Paper feed	27.5 in per second
Dimensions	4 ft 6 in × 4 ft 8 in × 2 ft 6 in
Weight	1,650 lb
Power requirements	230 ± 10% volts, 50 Hz ± 2%
Power consumption	2.9 KVA

4100

Magnetic Tape Storage

MODELS 4268, 4269, 4270 and 4271

Where the immediate access storage of the 4100 requires extension, serial backing storage can be provided by connecting, through one standard interface socket, a cluster of magnetic tapes consisting of a master controller (which includes one magnetic tape handler) and up to seven slaves.

The system allows only one handler to be obeying the controller at one time, but any number of rewinds, which occur off-line, can be carried out concurrently with a read, write, erase or backspace operation.

There is a choice of two units offering respectively transfer rates of 33,300 and 12,000 characters per second. With the faster tape units the recording density is 556 characters per inch; with the slower, 200 characters per inch.

Industry-compatible, variable-length records can be written or read, up to a maximum of 2,047 alphanumeric characters per record; the inter-record gap is ¾ in. Data parity is checked on reading in two ways – laterally on each character and longitudinally on each block. Parity bits are inserted on writing to the tape. A read-after-write check occurs automatically.

An erase instruction causes a 4 in. increase in inter-record gap. Tape may be backed. A 'write lockout' prevents writing on to master files. The magnetic tape units incorporate internal air filters to maintain minimum dust content within the handler cabinet; however, the external atmosphere should be filtered and kept in a specified temperature range.

The magnetic tape units offer the 4100 user the benefits of magnetic tape storage at exceptionally low cost. They are compatible with other magnetic tape systems and are compactly engineered to ensure maximum reliability.

12 Kcs. Magnetic Tape

Model 4268 master controller, including one slave handler.
Model 4269 slave handler unit.
Handlers per controller: 8 (max.).
Tape speed 60 in. per sec.
Packing density 200 characters per inch.
Rewind speed 250 in. per sec.
Inter record gap $\frac{3}{4}$ in.
Recording method – NRZ.
Tape length 2,400 ft.
Single tape capacity 5,350,000 characters.
Number of tracks: 7

Dimensions	*Master*	*Slave*
Height	5 ft. 3 in.	5 ft. 3 in.
Width	4 ft. 0 in.	2 ft. 0 in.
Depth	1 ft. 7 in.	1 ft. 7 in.

Weight 850 lb. (Model 4268)
325 lb. (Model 4269)
Power requirements 230 ± 10% volts 50 c/s
Power consumption 1.2 KVA (Model 4268)
0.7 KVA (Model 4269)

33 Kcs. Magnetic Tape

Model 4270 master controller, including one slave handler.
Handlers per controller: 8 (max.).
Model 4271
Tape speed 60 in. per second.
Packing density 200 or 556 bits per inch.
Rewind time 250 in. per second.
Inter record gap $\frac{3}{4}$ in.
Recording method – NRZ.
Tape length 2,400 ft.
Single tape capacity 13 million characters.
Number of tracks: 7

Dimensions	*Master*	*Slave*
Height	5 ft. 3 in.	5 ft. 3 in.
Width	4 ft. 0 in.	2 ft. 0 in.
Depth	1 ft. 7 in.	1 ft. 7 in.

(A second handler can be housed in the master cabinet.)
Weight 850 lb. (Model 4270)
325 lb. (Model 4271)
Power requirements 230 ± 10% volts 50 c/s
Power consumption 1.2 KVA (Model 4270)
0.7 KVA (Model 4271)

Environmental Conditions
The magnetic tape system will operate in the following conditions: Temperature 20° C - 30° C. Relative humidity 20% 60% without condensation. Air filtration efficiency 95% @ 5 micron particle size.

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Paper Tape Station MODEL 4210

The paper tape station is a compact unit equipped with either one or two Model 4213 readers and either one or two Model 4214 punches. It contains the associated logic and power supplies for these devices, including control keys and lamps.

Paper Tape Reader

MODEL 4213

The reader has a nominal speed of 1,000 characters per second and can stop on a single character. Reading is done photo-electrically and the device is temperature-compensated.

The reader accommodates all standard paper tape sizes with 5, 6, 7 or 8 channels (plus sprocket hole). A brake release bar is used for inserting and positioning tape and allows instant adjustment for different tape widths.

An 8-bit buffer is provided to increase efficiency and to reduce brake wear.

The paper tape station contains the associated logic, power, control keys and an OFF-LINE lamp.

Paper Tape Punch

MODEL 4214

The punch has a nominal speed of 110 characters per second and perforates 5, 6, 7 or 8 channel codes (plus sprocket hole).

All standard paper tape sizes are accommodated and an adjustable guide is fitted.

An 8-bit buffer is provided to increase efficiency and to avoid timing problems.

The paper tape station contains the associated logic, power, control keys and an OFF-LINE lamp.

The control logic includes a timer which automatically shuts off the motor approximately 4 seconds after last used. A delay of 1 second before punching is automatically introduced to allow the motor to run up to full speed when the next character is accepted, if the motor has previously been shut off. This reduces paper wear and the risk of oil on the paper tape.

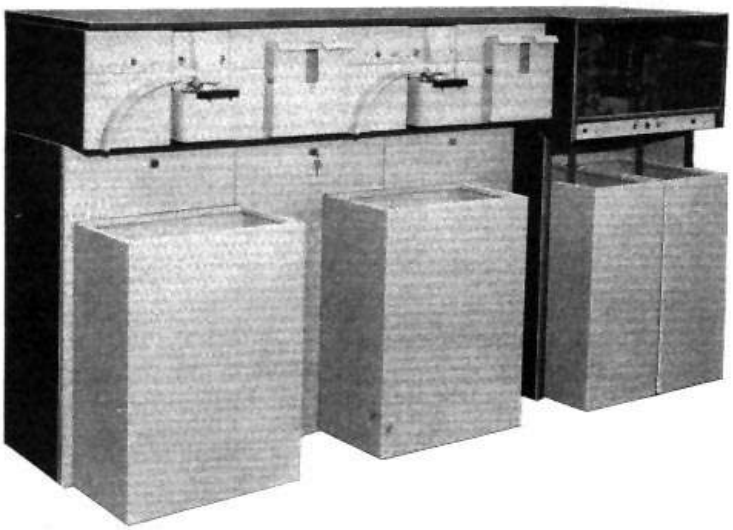
Paper Tape Station

Number of sockets
Two for tape readers and two for tape punches.

Power requirements
230±10% volts 50 c/s.

Power consumption
2 KVA (max.)

Dimensions
Width: 6 ft. 10 in.
Depth: 3 ft. 0 in.
Height: 4 ft. 0 in.
Weight: 806 lb.



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Paper Tape Reader

Tape sizes
Standard paper tape $\frac{11}{16}$ in., $\frac{7}{8}$ in. and 1 in. of specified texture and colours.
Standard 5, 6, 7 and 8 channel (plus sprocket hole) tapes can be used on the same reader.
Guides may be instantly adjusted to suit width of tape inserted.

Speed
1,000 characters per second maximum with stopping time of 0.3 milliseconds.

Dimensions
Width: 6.25 in.
Depth: 10 in.
Height: 9.9 in.
Weight: 17 lb.

Paper Tape Punch

Tape sizes
As for Tape Reader.

Speed
110 characters per second maximum.

Dimensions
Width: 8 in.
Depth: 16.5 in.
Height: 12 in.
Weight: 32 lb.

4100

Control Console MODEL 4222

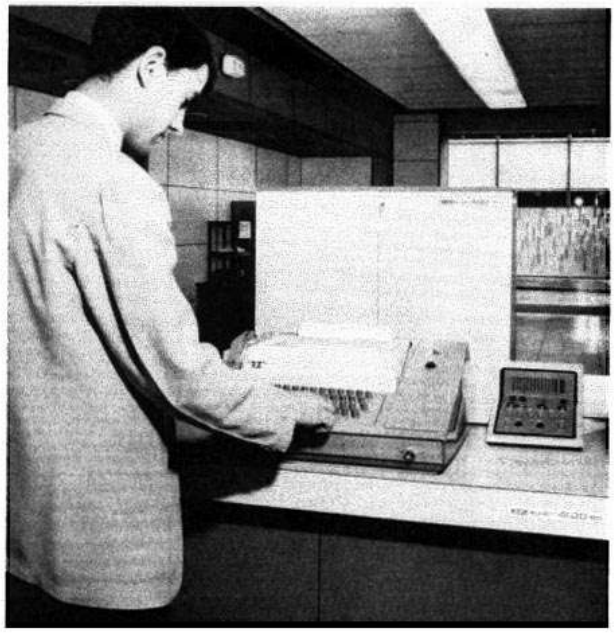
The control console of the 4100 system is designed to simplify the work of controlling the processor and peripheral units and monitoring the processing functions. It consists of a teleprinter and a control panel.

The teleprinter is an integral part of the 4100 system since it provides two-way communication between operator and processor. Employing the moving head, fixed carriage principle, it prints at the rate of 10 characters per second.

As well as producing exceptions reports and program control instructions, the teleprinter provides for input and output of small volumes of data. By using a four bit control word to define 'normal interrupt inhibit', 'normal interrupt permit' and the teleprinter mode (input or output), the programmer has full control over its operation. When normal interrupt occurs data is accepted as soon as it is ready, but when normal interrupt is inhibited, the teleprinter accepts an 'attention interrupt' while the program examines the status word to ascertain the cause of the interrupt.

Reports printed on the teleprinter provide a detailed record of the work carried out by the system and can be filed as a 'computer log'.

The control panel has the minimum number of control switches for efficient operation of the system. Four buttons control the processor, while six sense keys allow the operator to direct the flow of the program. There is also a message key that allows the operator to interrupt the program at any time by causing an 'attention interrupt'.



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Typewriter speed
10 characters per second (maximum)

Printing method
Moving print head, stationary carriage

Paper width
8½ in.

Typing line
69 characters

Character pitch
10 per inch

Dimensions
3 ft 6 in × 2 ft 3 in × 3 ft 0 in

Weight
450 lb

Power requirements
220±10% volts 50 c/s

4100

Central Processor MODEL 4120

The Central Processor is compact, fully self-contained and transportable, so that installation consists only of plugging it into a suitable mains outlet. Since the equipment is fully transistorised and capable of tolerating a wide range of environmental conditions, it requires no special air conditioning, (although air conditioning may be required for systems using certain peripherals).

The Processor operates in parallel on binary words of 24 bits. This word-length is ideal for both commercial and scientific work. Multi-length and floating-point arithmetic features are available for scientific work. Commercial data processing applications can make use of the six-bit character manipulation facilities included in the instruction repertoire.

Instructions are normally of 24 bits in length, but certain commonly used instructions are available in a 12 bit format. This allows considerable saving in program storage, particularly for standard software packages. Powerful variations of addressing mode are provided; these cover literal addressing, indirect addressing and B-modification, as well as normal direct addressing. There are over 400 orders available, making up a versatile and flexible programming system. Each instruction has a simple mnemonic to ease identification. A number of registers are directly accessible to the programmer to permit further program control. Each peripheral has an associated control word and status word: the former may be written to the peripherals and specify to them certain control functions, while the latter provides the processor with information on the state of the peripheral.

A distinctive feature is the provision of a set of "extracode" instructions to perform certain complex functions such as floating-point arithmetic with minimum loss of time and maximum compactness of program storage.

A unified concept for all input and output operations has been devised. A standard electrical interface has been implemented for all devices and the central processor in the system, allowing for the interchange of peripherals.

The interface is designed to minimise the buffering and control logic which is required for any peripheral device, and yet to permit extremely high data transfer rates. Up to 12 independent input/output channels are provided.

A powerful feature of the standard interface is the program interrupt scheme, which ensures maximum utilisation of the peripherals with minimum delay to the central processor.

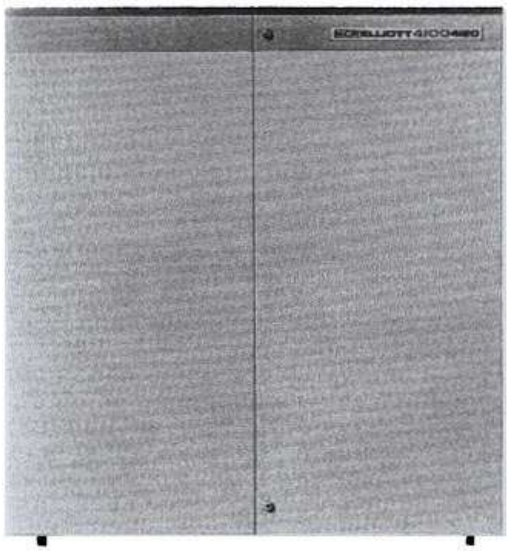
Comprehensive programming systems, covering all fields of applications, are provided, including ALGOL, Symbolic Assembly Program, NEAT, Language H and FORTRAN IV.

Components of the Processor

The Central Processor comprises:—

(a) **Main Unit**
This is a self-contained cabinet mounted on castors for manoeuvrability. It contains the arithmetic and control units, space for 32,768 words of magnetic core storage and the power supplies for logic and control. Exclusive use of silicon semi-conductors and metal oxide film resistors provides tolerance of a wide range of environmental conditions.

(b) **Control Box**
This consists of a series of lamps illustrating the most important features of the state of the computer at any given time, a loud speaker with volume control and several control buttons and switches.



Power requirements	50 c/s single phase 220± 10% volts
Consumption	1.3 KVA
Operating conditions	Temperature 0-50°C
Relative humidity	5-95%
Dimensions	5 ft. 3½ in. × 48½ in. × 2 ft. 2 in.
Weight	1,000 lb.
Word length	24 bits
Instruction Code	12 or 24 bits
Operation	Parallel
Addressing mode	Direct, literal, indirect and B-modified
System compatibility	Standard interface
Program language	Algol, S.A.P., Neat, Language H., Fortran IV
Registers accessible by program	Main accumulator Reserve accumulator Sequence control register Count register Conditions register Normal interrupt word Attention interrupt word

Typical Instructions Available

LD	Load operand to main accumulator
ADD	Add operand to main accumulator
MULM	Double-length multiplication
GET	Shift the operand one character left cyclicly and replace the least significant character of the main accumulator by the least significant character of the operand
SBL	Shift double-length accumulator left
SMLC	Shift M one character left cyclicly
J	Unconditional jump
JN	Jump if negative
JZ	Jump if zero
DKJN	Decrease count register by 1. If it is negative, transfer control
COMP	Compare main accumulator with operand set conditions register accordingly

4100

Introduction

Designed and built in Britain, the NCR Elliott 4100 is a compact, low-cost electronic data processing system that can be put to work in all fields of business, government, industry, science, research and education. With a choice of central processors and stores, it is the first multi-purpose system in its price range to achieve the speed, power and versatility of larger and more expensive computers.

The equipment is entirely modular in design and construction. A standard electrical interface, consisting of simple plug-and-socket connections, is used between the central processor and all peripheral units in the wide range immediately available. This means that the 4100 can be supplied in configurations precisely matched to the needs of individual users, and that the processor and peripherals can be exchanged or expanded whenever the user wishes. It is thus possible for a business or scientific organisation to start with a modest installation and expand it, step by step, into a data processing system of considerable power and capacity.

The standard interface permits high rates of data transfer and also permits powerful 'program interrupt' facilities that operate on two levels and enable the capacities of the processor and peripherals to be utilised fully. There are up to 14 independent input/output channels, each of which accepts either one peripheral or a cluster of peripherals under the control of one master unit.

Central Processor

Two fully compatible central processors, the 4120 and the 4130, are available, incorporating such technological developments as silicon logic elements. The 4130 is the more powerful. Both central processors are self-contained, easily transportable and work satisfactorily without air conditioning or temperature control. Air conditioning may, however, be required for systems incorporating certain peripheral units.

Six-microsecond core store units are available in 8,192 and 16,384 word modules. A maximum of 32,768 words of directly addressable store can be attached. Two-microsecond core store units are available in 16,384, 32,768 and 65,536 word modules. A maximum of 32,768 can be attached to the 4120 central processor but four modules, each of 65,536 giving a maximum store capacity of 262,144 words, can be attached to the 4130.

Word length is 24 bits ideal for both commercial and scientific applications. Automatic double-length working is available. For scientific applications there are multi-length and floating point facilities. Commercial users can take advantage of the six bit character-manipulation facilities incorporated in the instruction repertoire.

The command structure allows for 59 basic instructions, but since most of these have several modes of operation there is an overall repertoire of 400 instructions. Data can be addressed directly, indirectly, in the form of literals, or through a system of address-modification based on relative addresses. Extracode instructions to perform certain frequently required functions amplify the basic machine code.

Input

Punched paper tape (5, 7 or 8 channel codes) at 1,000 characters per second. Standard 80-column punched cards at 400 or 2,000 cards per minute.

Output

Punched paper tape (5, 7 or 8 channel codes) at 100 characters per second. Standard 80-column punched cards at 100 cards per minute. A choice of buffered and unbuffered line printers operating at 300, 600, 1,000 or 1,250 lines per minute. For scientific applications, there is a range of digital incremental plotters and cathode ray tube displays.

Backing Stores

Magnetic tape units with a transfer rate of either 12,000 or 33,300 characters per second. Magnetic card files (CRAM) with a transfer rate of 38,000 characters per second and a capacity per unit of over 16,000,000 characters. Magnetic disc handlers with a transfer rate of 135,000 characters per second and a disc capacity (both sides) of over 1,000,000 characters. A cluster of up to eight magnetic tape, CRAM or magnetic disc handlers can be connected to the central processor through one standard interface channel.

Software

The modular 'hardware' of the 4100 system is matched by an exceptionally wide range of modular 'software'. This enables the user to achieve substantial savings in the cost of developing efficient programs and in the time taken to get the equipment into full operation. Programming aids include NEAT 4100 Elementary and Advanced Assemblers; Algol; Fortran IV; and Language H.

Supporting Services

The 4100 is backed by the combined resources of two companies with many years' experience in all fields of electronic data processing. The comprehensive range of before and after-sale services includes: System investigation; advice on staff selection; advice on site preparation; training courses for operators, programmers and management; and technical maintenance service geared to the user's needs.

★ *Separate brochures, containing full specification data, are available for all units and services mentioned in this introductory leaflet.*

4100

Autonomous Transfer Unit

(Incorporating MODELS 4124, 4125 and 4126)

When the Autonomous Transfer Unit (ATU) is attached to the central processor of a 4100 system, information can be transferred between the main core store and peripheral devices without using the arithmetic unit during the actual transfer. Since information is extracted from and placed into the store by 'stealing' store cycles from the arithmetic unit, these data transfers are interleaved with normal computing.

The ATU consists of:

Model 4124	Store Control Unit (SCU)
Model 4125	Packed Transfer Unit (PTU)
Model 4126	Unpacked Transfer Unit (UTU)

With the 4120 central processor the ATU is housed in a separate cabinet; with the 4130 it is incorporated in the central processor cabinet.

Store Control Unit

The SCU allows the arithmetic unit and three input/output channels to obtain access to the main core store on a cycle-stealing basis. It also allocates priorities to them, channel 1 being given the highest priority and the central processor the lowest.

Through one SCU a maximum of two PTU's and one UTU can be connected, together with the arithmetic unit, to the main store of a 4100 system.

Packed Transfer Unit

Using either of the two channels provided by the SCU, each PTU is connected to up to three peripheral devices via three standard interface sockets. At any moment information can be transferred to and from any one of the three peripherals; it is not possible to interleave repetitive character transfers from two or more peripherals on the same PTU.

This unit enables four six-bit characters to be placed into, or taken from, each consecutive location in a specified block of storage. These transfers take place autonomously.

When a PTU is not transferring information, the peripheral devices connected to it appear to be directly connected to the 4100 system; therefore the central processor can treat the connections as standard peripheral channels.

The PTU's are designed for use with high-speed equipment, giving maximum cumulative transfer capacity of up to 330 kc/s with the 4130 central processor, and up to 250 kc/s with the 4120 central processor. It is recommended for magnetic tapes.

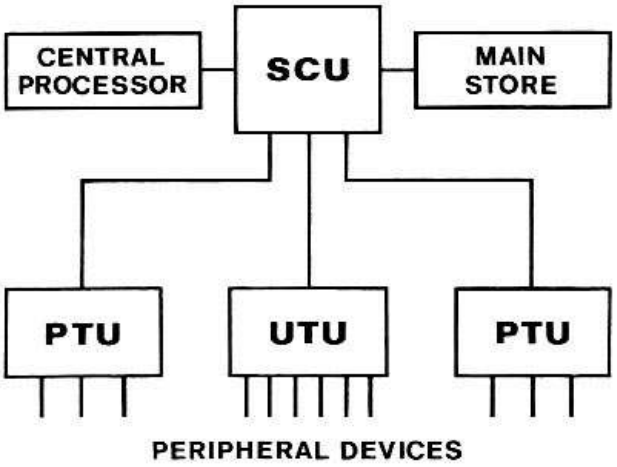
Unpacked Transfer Unit

Using one SCU channel, the UTU provides a highly efficient method of dealing with the 14 standard peripheral device sockets. It thus allows a maximum of 14 peripheral devices to be serviced at one time. Each device is serviced on a strict priority basis, the peripheral channel with the highest number having the highest priority.

One eight-bit character can be placed into, or taken from, each consecutive location in a specified block of storage. These transfers take place autonomously, each being time-interleaved with those from other peripheral devices attached to the UTU.

When a particular peripheral channel is not actually using the UTU it appears to be directly connected to the 4100 system. Therefore the central processor can treat it as a normal peripheral device without interfering with the autonomous transfers to and from other peripherals.

The UTU is designed for medium-speed equipment, such as paper tape or card readers and punches.



[redacted]

Dimensions of cabinet*	Height: 5 ft. 3 in. Width: 5 ft. 10 in. Depth: 2 ft. 2 in.
Weight	800 lb.
Power requirements	230 ± 10% volts, 50 c/s
Power consumption	1.1 KVA (4120) 0.8 KVA (4130)

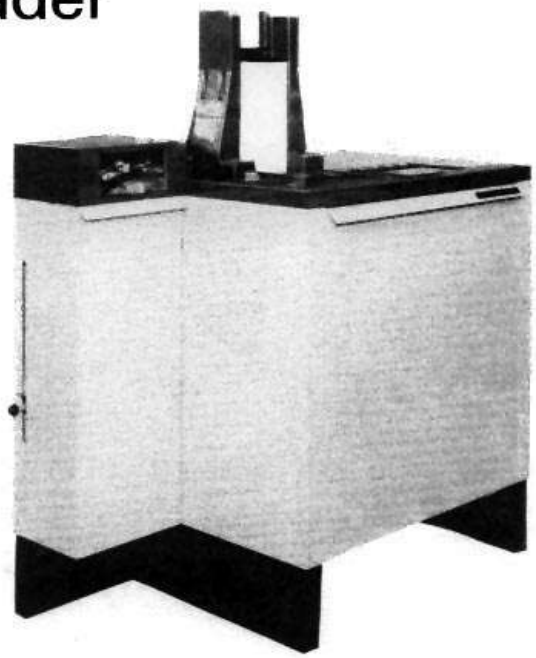
* For 4120 central processor only. With 4130 ATU is housed in central processor cabinet.

4100

Punched Card Reader

MODEL 4241

Punched card input facilities for 80-column cards are provided on the 4100 system by a 400 cards-per-minute reader (Model 4241).
The reader and all associated control logic are housed in a cabinet which also incorporates an operator's control panel and a stacking device for loading cards into a card storage tray. The input magazine holds up to 1,500 cards, and the receiving trays up to 1,800 cards.
Cards are read column by column as they move past a single-read station consisting of 12 photo-transistors.



Technical Specification

Speed 400 cards per minute
Dimensions 3 ft 6 in × 2 ft 3 in × 3 ft 0 in
Weight 450 lb
Power requirements 220 ± 10% volts, 50 c/s
Power consumption 0.5 kVA

The NCR-Elliott 4100 is an up-to-the-minute computer in every way—design, construction, speed, simplicity and power. British designed and built for business, science and real-time computing. No multi-purpose computer is more useful or more efficient.

Silicon constructed. Over 400 program instructions. Comprehensive software – Algol, Language H, Fortran IV and NEAT 4100 assembler. Standard interface. Large range of peripherals. Processor and peripherals expandable and interchangeable.

NCR

NCR
206/216 Marylebone Road, London, NW1. *Tel:* PADdington 7070

ELLIOTT

ELLIOTT-AUTOMATION COMPUTERS LTD.
Scientific Computing Division, Elstree Way, Borehamwood, Herts. *Tel:* ELStree 2040

atalogue 445

A TGA design, printed in England by Publicity Arts Ltd, London, WC2

4100

CRAM (Card Random Access Memory)

provides a flexible and economical magnetic file system. It can be used in the same way as magnetic tapes, discs or drums. Information can be (1) batched and processed sequentially; (2) processed on-line on a random basis; or (3) sorted and selectively recorded, so that the computer can serially process the active records and completely by-pass the inactive records.

CRAM permits multiple types of data to be stored in a single pack of cards. Many routines that require two to eight magnetic tape handlers can be performed on one or two CRAM units. CRAM eliminates the need for separate source and destination handlers, and thus greatly reduces the cost of magnetic file storage.

The system provides fast access to an unprecedented range of information. In a single computer run, information can be sorted, all related records updated, report information generated and stored, additional program information read, and reports printed out.

Unlike magnetic tape systems, CRAM requires no re-winding. Since a CRAM cartridge can be removed and a new one loaded in less than 30 seconds, data stored off-line can be placed on-line as needed.

With the 4100 system a group of up to eight CRAM units can be connected through a controller to one standard interface socket.

The system allows only one CRAM unit to be obeying the controller at one time, but the card drop on one CRAM unit can be carried out concurrently with reading or writing on another unit.

Data is recorded on magnetic cards 3¼ in × 14 in, each containing 56 recording tracks. Each track has a capacity of 1,120 alphanumeric (6 bit) characters. The pack of 256 magnetic cards is housed in a removable cartridge with a total capacity of 16,056,320 alphanumeric characters.

Information is transferred between the processor and a magnetic card at a rate of 38,000 characters per second.

Any card may be selected by program control. Cartridges can be easily and quickly changed without switching off the unit.

Data parity is checked on reading in two ways: (1) on each character and (2) on each track. Parity bits are inserted on writing. A read-after-write check occurs automatically. Data is self-clocking.

Data transfer rate
38,000 alphanumeric (6 bit) characters per second.

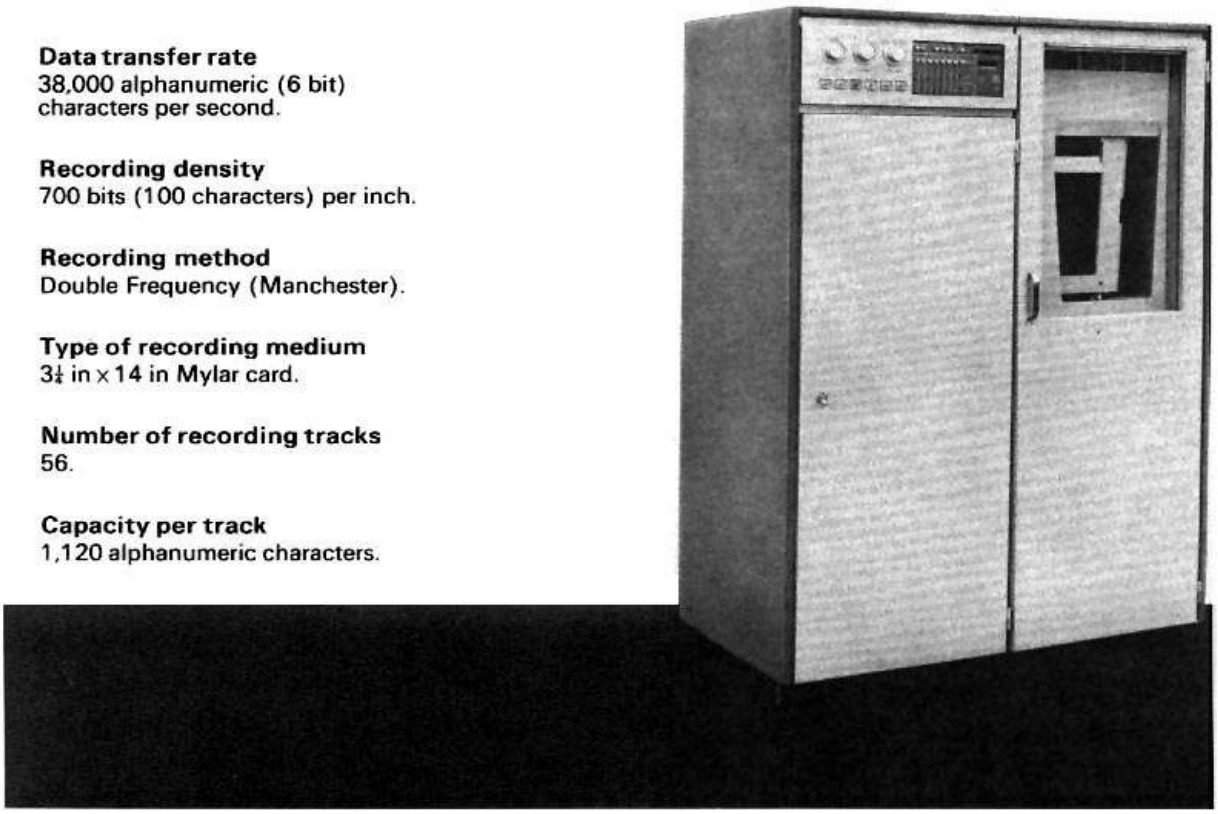
Recording density
700 bits (100 characters) per inch.

Recording method
Double Frequency (Manchester).

Type of recording medium
3¼ in × 14 in Mylar card.

Number of recording tracks
56.

Capacity per track
1,120 alphanumeric characters.



Number of cards per cartridge
256.

Capacity per cartridge
16,056,320 alphanumeric (6 bit) characters.

Dimensions
43 in × 24 in × 60 in.

Weight
800 lb.

Power requirements
415 ± 10% volts, 50/cs 3-phase.

Power consumption
4.5 KVA.

4100

2 μ sec. Core Store Units

MODELS 4330, 4340, and 4345

Both the 4120 and 4130 central processors can be attached by standard interface to ferrite core stores with a basic read/write cycle of 2 microseconds. The following units are available:

Model 4330	16,384 words	each word of 24 bits
Model 4340	32,768 words	
Model 4345	65,536 words	

The largest of these units (Model 4345) can be used only with the 4130 processor.

The maximum store capacity with the 4120 processor is 32,768 words, all directly addressable and housed, with the necessary power supplies, in a single cabinet.

The maximum store capacity with the 4130 processor is 262,144 words, all of which are directly addressable. Up to 65,536 words, together with the necessary power supplies, can be housed in a single cabinet; therefore the full 262,144 words requires four cabinets.

Technical Specification

Typical Operational Times (±10%)

	4120 Processor	4130 Processor
Addition (fixed point)	5.6 microseconds	4.5 microseconds
Multiplication (fixed point)	60.6 microseconds	15 microseconds
Division (fixed point)	61.7 microseconds	24 microseconds
Shift (single length)	5.0 +1.1N microseconds (where N is the number of shifts)	5.5 +.75$\frac{N}{4}$ microseconds
Shift (double length)	5.0 +2.2N microseconds	5.5 +.75$\frac{N}{4}$ microseconds
Collate	5.6 microseconds	4.5 microseconds
Addition (floating point)	199 microseconds	15 microseconds (Average times)
Multiplication (floating point)	400 microseconds	40 microseconds (Average times)
Division (floating point)	411 microseconds	70 microseconds (Average times)

Dimensions of cabinet h. 5 ft. 3 in. w. 5 ft. 10 in. d. 2 ft. 2 in.

Power requirements 230 ±10 volts, 50 ±1 c/s

Power consumption

Model 4330	3 kVA
Model 4340	4 kVA
Model 4345	6 kVA

Weight

4330	1,000 lb.
4340	1,150 lb.
4345	1,250 lb.

NCR

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206/216 Marylebone Road, London NW1. *Tel:* PADdington 7070

ELLIOTT

ELLIOTT-AUTOMATION COMPUTERS LTD.
Elstree Way, Borehamwood, Herts. *Tel:* ELStree 2040

Catalogue 449/9.66

A TGA design, printed in England by Publicity Arts Ltd, London

4100

6 μ sec. Core Store Units

MODELS 4320 and 4325

The 4120 and 4130 central processors can be attached by standard interface to ferrite core stores with a basic read/write cycle of 6 microseconds.

The stores are available in units of 8,192 words (Model 4320) and 16,384 words (Model 4325). A word consists of 24 bits.

Each processor requires a minimum of 8,192 words. This capacity can be expanded up to a maximum of 32,768 words, all of which are directly addressable. The store can be composed of up to four modules.

With the 4120 central processor, the full 32,768 words of store is housed in the central processor cabinet, although an additional power cabinet is required for stores larger than 16,384 words. With the 4130 central processor, the store requires a separate cabinet, but this is capable of housing the full 32,768 words.

Technical Specification

Typical Operational Times (±10%)

	4120 Processor	4130 Processor	
Addition (fixed point)	12 microseconds	12 microseconds	
Multiplication (fixed point)	67 microseconds	22 microseconds	
Division (fixed point)	68.1 microseconds	29 microseconds	
Shift (single length)	8.2 + 1.1N microseconds (where N is the number of shifts)	$6.5 + .75\frac{N}{4}$ microseconds	
Shift (double length)	8.2 + 2.2N microseconds	$6.5 + .75\frac{N}{4}$ microseconds	
Collate	12 microseconds	12 microseconds	
Addition (floating point)	365 microseconds	25 microseconds	Average times
Multiplication (floating point)	619 microseconds	50 microseconds	
Division (floating point)	630 microseconds	81 microseconds	

Dimensions of cabinet (4130 only) h. 5 ft. 3 in. w. 4 ft. 8 in. d. 2 ft. 2 in.
Weight (max. storage fitted) 700 lbs.
Power consumption 2.0. KVA (max.)
Power requirements 230 ± 10 volts, 50 ± 1 c/s

The manufacturers reserve the right to alter, without notice, the specification for any equipment described in this leaflet.

NCR

NCR
206/216 Marylebone Road, London NW1. *Tel:* PADdington 7070

ELLIOTT **ELLIOTT-AUTOMATION COMPUTERS LTD.**
Elstree Way, Borehamwood, Herts. *Tel:* ELStree 2040

Catalogue 451/9.66

A TGA design, printed in England by Publicity Arts Ltd, London W

4100

Card Punch

MODEL 4246

Punched card output facilities for 80-column cards are provided on the 4100 system by a 100 cards per minute punch (Model 4246).

This unit punches at a speed of up to 160 columns per second on standard 80-column rectangular-hole cards. The card punching rate rises from 100 cards per minute where all 80 columns are punched to 310 cards per minute where only the first column on each card is punched.

The input hopper holds up to 1,000 cards, and can be replenished during the punching operation.

The unit contains both a punch station, where punching takes place, and a sensing station where each card is checked immediately after it has been punched, thus providing full check-punch facilities.

Each card is incrementally stepped through as many columns as the processor indicates. As soon as the last column has been punched the card is ejected into the output stacker, which also holds up to 1,000 cards.

Cards are stacked in the order in which they were punched, and may be removed while the punch is operating. If punching errors are detected, the cards concerned will be offset in the output stacker by half an inch.

Controls are provided on the console for switching off the punch, loading and unloading the punch, and for making the punch off-line to the central processor.

MODEL 4246

Speed	100 cards per minute to 310 cards per minute.
Dimensions	Height 3 ft. 4 in. Width 3 ft. 1½ in. Depth 2 ft. 9 in.
Weight	480 lb.
Power Requirement	230±10% volts, 50 c/s.
Power Consumption	2.4 KVA

4100

Supporting Services

The combined resources of NCR and Elliott-Automation offer purchasers of the 4100 a full range of supporting services. These are not only available during the pre-installation period but continue after the computer is operationally established

The services include:

Customer liaison and installation supervision
Advice on staff selection
Education and technical training
Site planning and engineering services
Programming support and supervision
Project development and progressing
Computor maintenance
Scientific programs and routine library
Contract programmer hire
Computer and punched tape bureau facilities
Software advice

Preliminary Studies
At an early stage in the negotiations trained analysts will visit your organisation to advise you on the applications that can be most profitably implemented.

Installation and Site Preparation
When a 4100 is purchased or rented, a planning engineer provides advice and assistance on the following topics: Site selection, layout of the system; information for engineering, architectural, electrical and air-conditioning drawings; and supervision of the delivery, assembly and connecting-up of the system.

Regular meetings are held to cover the activities of the pre-installation period. This ensures that full progress is maintained and that the purchaser's policy requirements are carried out.

System Programming Development
In the case of commercial installations a Programming Supervisor will guide customers on the definition and specification of programs, and also advise on the use of software. Later, a programmer/analyst will be assigned to the installation for a period equivalent to 12 man-months to assist the customer's staff in writing and testing programs for the first applications. At the installation stage an experienced operator will assist in organising the work and training the operators.

Special arrangements can be made to extend programming help beyond the basic period of 12 man-months.

Program Testing
Programs can be tested and developed on 4100 systems operated by NCR and Elliotts. The customer is allowed free machine time for this purpose equal to three hours per £10,000 value of the computer order.

Education and Training
The courses available include:

1 Appreciation courses for executives wishing to acquire a general knowledge of electronic data processing in general and the 4100 in particular. These are designed for those knowing little or nothing about computers.
2 Programming. Both NCR and Elliotts run courses designed to cover the particular requirements of commercial and scientific users.
3 Operators' Training Courses. Available for the staff of companies which have purchased the 4100, these cover all procedures necessary for the efficient use of the system.

Other specialist courses will be run from time to time on topics of particular interest.

After-sale Liaison
At the time of installation, and on a regular basis thereafter, expert assistance is available on all topics concerned with programming and running the installation.

Users' Group
This is an established organisation for the exchange of programming information by the users of NCR and Elliott equipment. It also arranges visits to installations of general interest and provides a regular forum for the exchange of information.

Maintenance
A country-wide network of maintenance depots – established for the 803 computer – provides users of the 4100 system with both routine and emergency maintenance services.

The service covers routine visits to the customer's site; emergency visits, if required, during agreed hours; and the replacement of components that become defective other than through the customer's negligence. The fee varies with the size of the system and the extent to which it is used.

4100 Library and Technical Manual
With each machine is supplied a complete library of programs and sub-routines covering many applications. This is part of the technical manual, which itself describes all peripheral equipment and provides full engineering information on their construction.

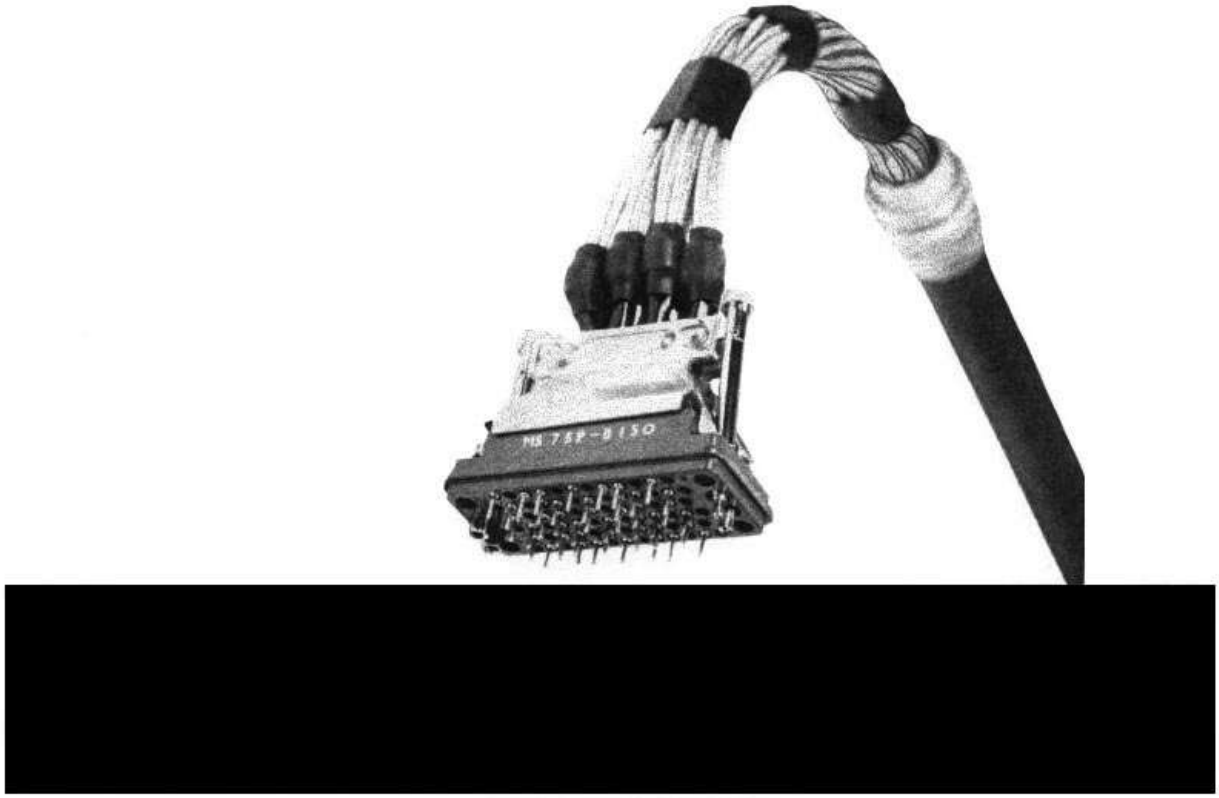
4100

Standard Electrical Interface

The limitations of earlier computers lay in a lack of flexibility and a consequent inability to adapt them to the requirements of a wide number of users. Developments in electronic technology have resulted in a rationalisation of the division between central processor, storage and other peripherals, so that the placing of an accurately defined electrical interface at pre-determined points in a system allows a degree of freedom of exchange which has never existed previously.

The standard electrical interface is employed extensively in the 4100 Data Processing System, both as a store interface to link central processor and storage units and as a peripheral interface to link processor and peripherals. There are up to 12 input/output channels for peripherals on the 4120 processor and to each there may be connected either one peripheral or a controller handling one or more peripherals (e.g. certain units, such as magnetic tapes, may form a cluster to share one channel).

The standard interface consists of a simple plug and socket connection. On each channel 29 lines cross the interface and provide 13 control lines, including a normal interrupt line and an attention interrupt line, plus 16 data lines capable of carrying 8 bits into and 8 bits out of the processor. It is thus possible for all peripherals (or clusters of peripherals) to set up normal and attention interrupts. This provides the basis of a sophisticated scheme of program interruption which operates at two levels for any peripheral and provides a choice of 24 separate and rapidly distinguishable levels of interrupt over the complete system. The result is maximum utilisation of peripheral equipment with minimum delay to the central processor.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