

FERRANTI MARK I*

MANUFACTURER

Ferranti Computer Mark I*

Ferranti Limited
Manchester, England



Picture by Ferranti Electric, Inc., 30 Rockefeller Plaza, New York 20, N.Y. and the Ministry of Supply, UK.

APPLICATIONS

Scientific calculation

NUMERICAL SYSTEM

Internal number system	Binary
Binary digits per word	40
Binary digits per instruction	20
Instructions per word	2
Instructions decoded	32
Instructions used	30 - 32
Arithmetic system	Fixed point
Instruction type	One address

Shift and standardized instructions provided, which facilitate floating point arithmetic.

Number range $-2 \leq n < 2$

ARITHMETIC UNIT

	Time	Microsec
Add (Includ. Stor. Access)		1,200
Mult (Includ. Stor. Access)		2,160
Construction	Vacuum tubes, CRT, and magnetic drum.	
Basic pulse repetition rate	100 Kc/sec	
Arithmetic mode	Serial	
Timing	Synchronous	
Operation	Sequential	

The input-output may be either sequential or concurrent. There is a built in multiplier, but no built in divider. The machine normally operates on long (40-bit) words, with short (20-bit) words forming instructions and B-lines. A manual facility switches-in either 40 - or 20 - bit accumulator operation.

STORAGE

Media	Words	Digits	Microsec Access
Electrostatic (CRT)	768	15,360	
Magnetic Drum	32,768	655,360	31,200

The CRT stores 768 20-bit words. The magnetic drum has 256 tracks and revolves at 1,924 RPM.

INPUT

Media	Speed
Paper Tape	200 char/sec

Five hole tape is used. One character consists of 5 bits.

OUTPUT

Media	Speed
Teleprinter	7 char/sec
Tape Punch	25 char/sec
Parallel Printer	150 lines/min

The parallel printer line consists of 64 alphanumeric characters, with 92 printing positions on each line. The remaining positions print spaces, the locations of which are pre-set by a plugboard.

CIRCUIT ELEMENTS ENTIRE SYSTEM

Tubes	3,300
Crystal diodes	1,000
Tube types	
6AL5 (Double diodes)	1,500
EP50, 5591 (Pentodes)	1,500
12AT7 (Double triodes)	220
Sundries	80
Separate cabinets	2 (excluding power supplies and air conditioners.)

CHECKING FEATURES

Optional
Check facilities for transfers between drum and CRT storage.

POWER, SPACE AND WEIGHT

Power, computer	26 KW
Space, computer	4,000 cu. ft., 600 sq. ft.
Weight, computer	10,000 lbs.

Air conditioner is built-in.

PRODUCTION RECORD

Produced	9
Operating	8
Delivery time	In stock

The figures include two machines of an earlier Mark I design.

COST, PRICE AND RENTAL RATE

Approximate cost of basic system \$400,000 f.o.b., New York, N. Y.

PERSONNEL REQUIREMENTS

Manufacturer	Engineers
Daily Operation	
1-8 Hour shift	2
2-8 Hour shifts	3
3-8 Hour shifts	4

The number of engineers specified above are based on a 5-day work week and allow time off due to vacations, illness, etc.

RELIABILITY AND OPERATING EXPERIENCE

Manufacturer	
Average error-free running period	44.97 hours
Good time	1799 hours
Attempted to run time	1859 hours
Operating ratio (Good/Attempted to run)	0.968

The above figures are based on the operation of one Mark I* system for the twelve months immediately following installation. The longest continuous period of operation without unscheduled maintenance was 165 hours of machine time.

FUTURE PLANS

Manufacturer
A magnetic tape storage unit has been developed for attachment to existing Mark I* systems. This unit uses 35 mm film base tape and provides storage for approximately 900 blocks of 2560 bits each. Control circuits are provided to locate any block according to instructions received from the computer.

INSTALLATIONS

Instituto Nazionale del Calcolo
Rome, Italy

Armament Research and Development Establishment
Fort Halstead, England

Royal Dutch Shell Laboratories
Amsterdam, Holland

Atomic Weapons Research Establishment
Aldermaston, England

A.V. Roe Aircraft Company
Manchester, England

ADDITIONAL FEATURES AND REMARKS

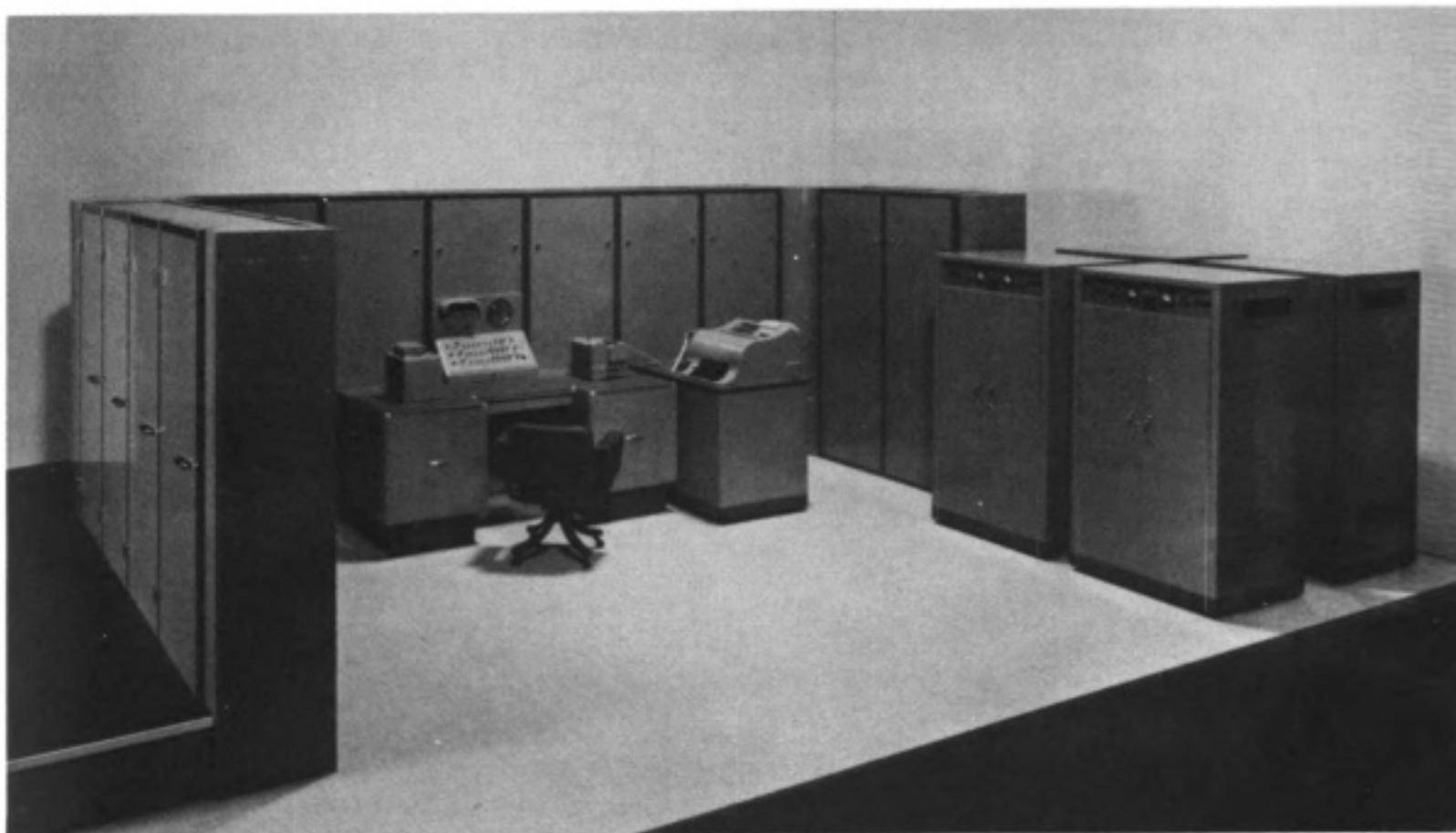
Manufacturer
Seven B-lines are provided to facilitate instruction modification and counting operations. Each B-line has a 20-bit capacity.

FERRANTI MERCURY

MANUFACTURER

Ferranti Electric, Inc. Mercury Computer

Ferranti Limited
Manchester, England



Picture by Ferranti Electric, Inc., 30 Rockefeller Plaza, New York 20, N. Y., and the Ministry of Supply, UK

APPLICATIONS

Scientific calculation

NUMERICAL SYSTEM

Internal number system Binary
 Binary digits per word 10 or 40
 Binary digits per instruction 20
 Instructions per word 2 per long word
 Instructions decoded 64
 Instructions used 64

Arithmetic system
 Floating point for 40-bit numerical calculations
 Fixed point for 10-bit operation

Instruction type One address
 Addresses may refer either to short or to long words.

Number range 2^{-256} to 2^{+256}

Numbers may be positive or negative

ARITHMETIC UNIT

Time	Microsec
Add (Includ. stor. access)	180
Mult (Includ. stor. access)	300
Div (Includ. stor. access)	3,500
Construction	Vacuum tubes, condenser - diodes, magnetic cores and magnetic drum.
Rapid access word registers	8
Basic pulse repetition rate	1 Mc/sec
Arithmetic mode	Serial
Timing	Synchronous
Operation	Sequential, parallel storage

Operation times given above for addition and multiplication are for 40-bit floating point numbers. Divide time is for 40-bit numbers by program. For floating point numbers, characteristic has 30 bits and exponent has 10-bits. Transfer times including

access are 120 microseconds for 40 - bit words and 60 microseconds for 10-bit words. All organizing instructions, including addition or subtraction of 10 - bit words, take 60 microseconds, including access time.

STORAGE

Media	Words	Digits	Microsec Access
Magnetic Cores	1,024	40 bits/word	Rapid
Magnetic Drums	16,384	40 bits/word	8,000

There is also a 40 - bit accumulator and 7 immediate access B-registers of 10 bits each constructed of magnetic cores.

INPUT

Media	Speed
Paper Tape	200 Char/sec

OUTPUT

Media	Speed
Paper Tape Punch	25 char/sec
Teleprinter	6.7 char/sec

CIRCUIT ELEMENTS ENTIRE SYSTEM

Tubes	1,500
Tube types	2
Crystal diodes	3,000
Magnetic cores	42,000

The computer will permit several possible layouts. It is made of three bays of cabinets which can form a U or an L plan. There is a power supply cabinet, two drum cabinets and a desk.

CHECKING FEATURES

Fixed

Parity check on core and drum storage.

Optional

Parity check at input and output on decimal digits.

POWER, SPACE AND WEIGHT

Power, computer	40 KVA
Power, air cond.	15 KVA
Space, computer	216 cu. ft., 36 sq. ft.
Weight, computer	2,500 lbs.

Heat dissipation is by totally inclosed forced air circulation, with Freon refrigeration system. Heat finally exhausted by evaporator - condenser or water cooling.

PRODUCTION RECORD

Produced	0
In production	5
Operating	0
On order	12
Delivery time	15 months

Of the 12 orders, 8 are firm and 4 are unconfirmed orders.

COST, PRICE AND RENTAL RATE

Approximate cost of basic system \$400,000

FUTURE PLANS

A new factory has been acquired and full-scale production will be achieved early in 1957.

Magnetic tape and punched card attachments are under development.

ADDITIONAL FEATURES AND REMARKS

The address part of an instruction can be modified by any of 7 B-registers of 10 bits each.

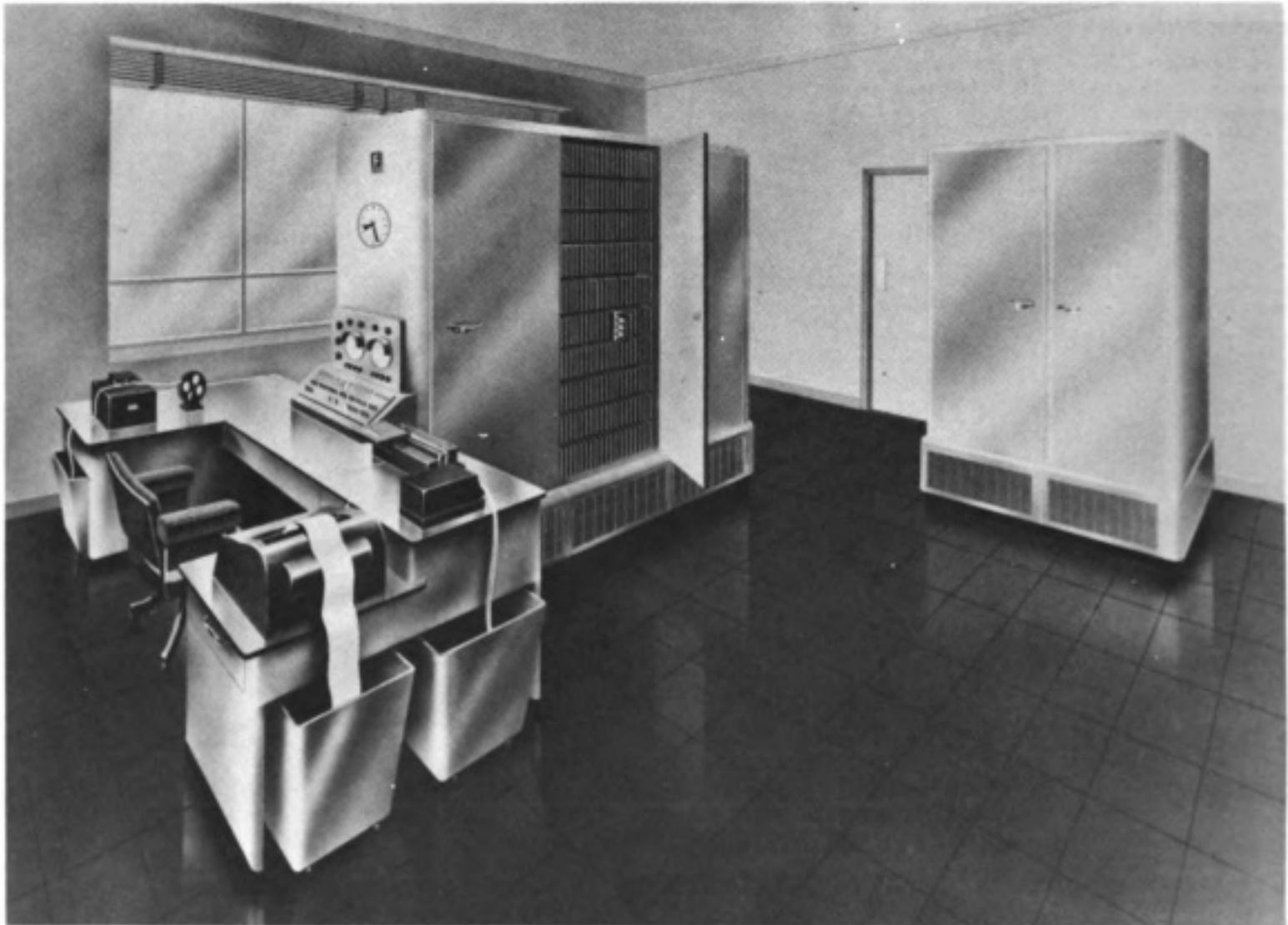
Standard sub-routines are available.

FERRANTI PEGASUS

MANUFACTURER

Ferranti Electric Incorporated Pegasus Computer

Ferranti Limited
Manchester, England



Picture by Ferranti Electric, Incorporated, 30 Rockefeller Plaza, New York 20, New York

APPLICATIONS

Scientific calculation for applications in scientific research, industry and administration.

NUMERICAL SYSTEM

Internal number system	Binary
Binary digits per word	39
Binary digits per instruction	19
Instructions per word	2
Instructions decoded	64
Instructions used	48
Arithmetic system	Fixed point
Instruction type	Modified two address
Number range	$-1 \leq n < 1$

Certain instructions facilitate floating point operations. The instructions are a modified two address type and not a "one-plus-one" type.

ARITHMETIC UNIT

	Time	Microsec
Add (Includ. stor. access)		315
Mult (Includ. stor. access)		2,000
Div (Includ. stor. access)		5,500
Construction	Vacuum tubes, magnetic drum and magnetostrictive delay lines.	
Rapid access word registers	55	
Basic pulse repetition rate	333 Kc/sec	
Arithmetic mode	Serial	
Timing	Synchronous	
Operation	Sequential	

There are 7 accumulators each with full arithmetical and logical facilities, each usable as a B-register for modifying and counting. Also, there are 48 ordinary registers each with arithmetic and logical facilities. All these registers have rapid access.



Picture by Ferranti Electric, Incorporated, 30 Rockefeller Plaza, New York 20, New York

STORAGE

	Words	Digits	Microsec Access
Magnetostrictive Delay Lines	55	39/word	Rapid
Magnetic Drum	4,608	40/word	8,000

Drum rotates at 3,750 RPM. The rapid access storage consists of 55 magnetostrictive delay lines, each holding one word. The main storage is a magnetic drum with a revolution time of 16 milliseconds. Words may be transferred between drum and delay lines either one at a time or in blocks of eight words. The additional bit in a word on the drum is for parity check.

INPUT

Media	Speed
Paper Tape	200 char/sec

5 hole tape is used. 5 bits are required for each character. A self-checking code is used. There is a provision for a multiplicity of input devices, e.g. magnetic tape, punched card, etc.

OUTPUT

Media	Speed
Paper Tape	25 char/sec
Page Teleprinter	

There is provision for a multiplicity of output devices, e.g. magnetic tape, punched card, high speed printer.

CIRCUIT ELEMENTS ENTIRE SYSTEM

Tubes	1,300
Crystal diodes	10,000

The logical circuits use only one type of tube. The remainder of the computer, excluding the power supply, uses four types of tubes. 75% of the plug-in units are of 5 types.

CHECKING FEATURES

Fixed
Drum storage is checked by parity digit.

Optional
There is an overflow indicator. The code used on the input-output tapes is semi-automatically checked.

POWER, SPACE AND WEIGHT

Power, computer 12 KW
Space, computer 250 cu. ft., 60 sq. ft.
Weight, computer 2,560 lbs.

Cooling is accomplished by fans venting to the room, but a refrigeration system is offered as an optional extra. The dimensions above include control desk and power unit. The computer proper has a floor area of 20 sq. ft. and a volume of 137 cu. ft. and dissipates 8 KW.

PRODUCTION RECORD

Produced	3
In production	6
Operating	1
On order	22
Delivery time	12 Months

Of the 22 orders, 14 are confirmed and 8 are unconfirmed orders.

COST, PRICE AND RENTAL RATE

Approximate cost of basic system \$200,000 f.o.b., New York, New York

PERSONNEL REQUIREMENTS

One technician or operator is required for each 8 hour shift. One engineer on call.

RELIABILITY AND OPERATING EXPERIENCE

Manufacturer	
Good time	241 hours
Attempted to run time	247 hours
Operating ratio (Good/Attempted to run)	0.976

The first Ferranti Pegasus computer has been used for engineering development, as well as for computation. The above figures, for the last ten weeks of 1956, can only be regarded as an indication of what the operating ratio is likely to be.

FUTURE PLANS

A new factory has been acquired and full scale production will be achieved early in 1957. Magnetic tape and punched card attachments are under development.

INSTALLATIONS

Ferranti Computer Center
21 Portland Place
London, England

Sir W. G. Armstrong Whitworth Aircraft, Ltd.
Coventry, Warwickshire, England

Hawker Aircraft, Ltd.
Kingston, Surrey, England

ADDITIONAL FEATURES AND REMARKS

Programming is expedited through the use of 7 accumulators, which may be selected by the second address in an instruction, and may also be used as B - boxes and counters.

Minimum access programming is not required. In designing the order code, particular attention has been given to those orders that are used for internal organization. This helps the programmer and increases the effective speed.

Basic programmer can be provided.

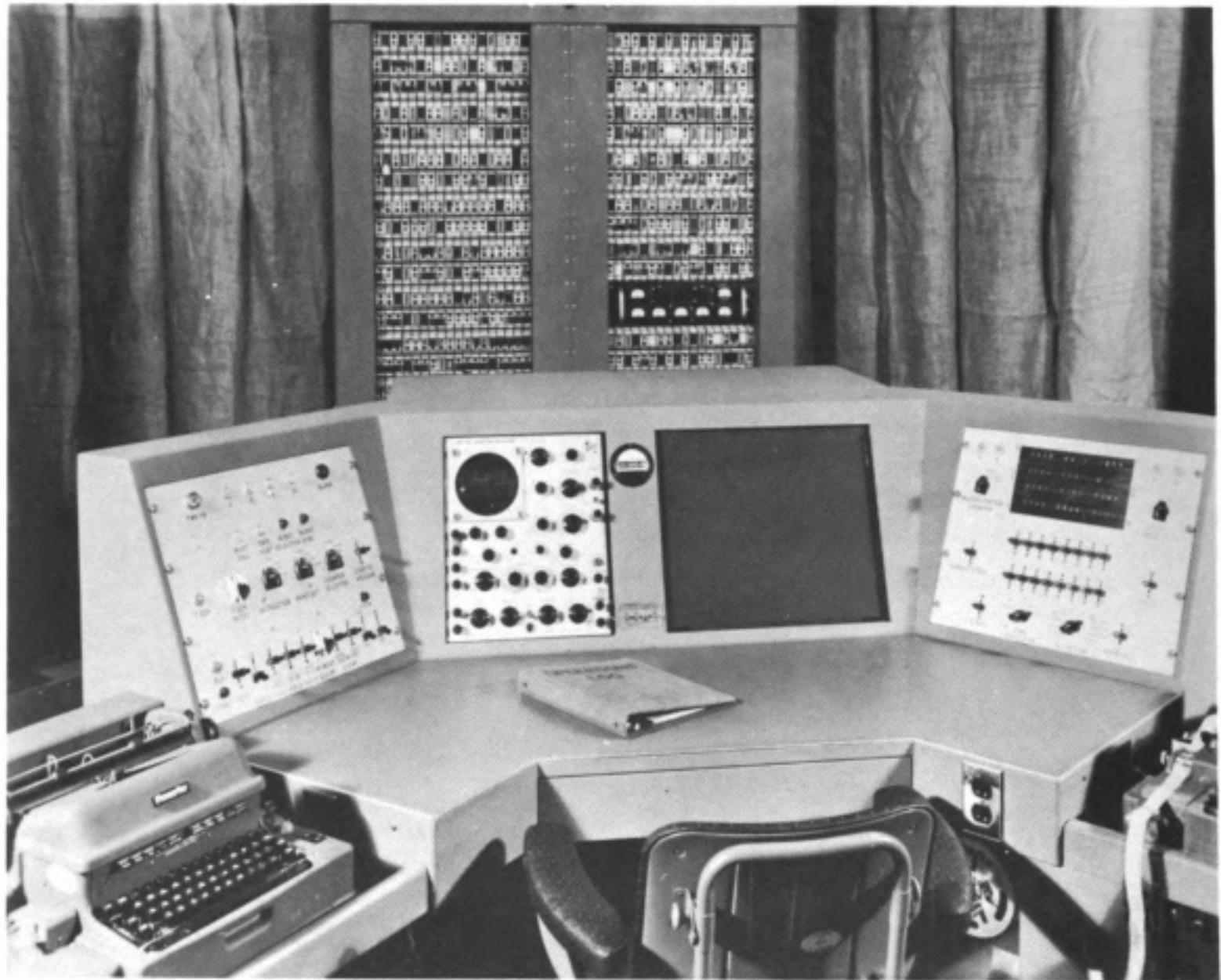
Order code transfers information between the two types of storage.

FLAC I II

Florida Automatic Computers

MANUFACTURER

Original FLAC - Air Force Civil Service
Modifications and redesignation FLAC I - Radio
Corporation of America
FLAC II - Radio Corporation of America, et al.



Picture by RCA Service Company, Incorporated, Patrick Air Force Base

APPLICATIONS

Manufacturer
Data reduction, data processing, and scientific work.

NUMERICAL SYSTEM

Internal number system Binary
 Binary digits per word 44 plus sign
 Binary digits per instruction 44 plus sign
 Instructions per word 1
 Instructions decoded 16 basic commands
 Arithmetic system Fixed point
 Instruction type Three address
 Number range $(1-2^{-44})$ to $-(1-2^{-44})$
 Instruction includes Address Alpha, Beta and Gamma,
 and Control Group and Operation Order.

ARITHMETIC UNIT

	Incl. Stor. Access Microsec	Exclud. Stor. Access Microsec
Add time	240	48
Mult time	2,352	2,112
Div time	2,352	2,112
Construction	2,700 tubes, 22,000 diodes	
Basic pulse repetition rate	1 Megacycle	
Arithmetic mode	Parallel	
Timing	Synchronous	
Operation	Sequential	

System operates on a 48 microsecond minor cycle.
 Storage access includes all transfers. Transfer to
 and from storage register - arithmetic unit is
 serial. Storage register to and from cores is
 parallel, with a 3 microsecond transfer time.



Picture by RCA Service Company, Incorporated, Patrick Air Force Base

STORAGE

Media	Words	Microsec Access
Magnetic Core	4,096	3 to storage register
Magnetic Tape Bin	400,000	60×10^6 mean, to any word

Magnetic Tape Bin will be added during second quarter CY-1957.

INPUT

Media	Speed
Paper Tape	300 - 600 char/sec
Magnetic Tape	3 Kc - 250 words/sec
Magnetic Wire	1.2 Kc - 20 words/sec
Flexowriter	10 char/sec - 1 word/sec

There will be three (3) high speed paper tape readers, four (4) magnetic tape handlers, one (1) 60 char/sec reader (to be added in CY-1957), three (3) magnetic wire units. FLAC II will not have Magnetic wire.

OUTPUT

Media	Speed
Punched Tape	60 char/sec; 120 char/sec, 6 and 12 words/sec
Magnetic Tape	3 Kc, 250 words/sec
Flexowriter	60 char/sec, 1 word/sec

Magnetic wire 1.2 Kc, 20 words/sec

There are three (3) paper tape punches at 60 char/sec and two (2) paper tape punches at 120 char/sec. There will be four (4) magnetic tape handlers. High speed input-output selection system can address fifty (50) different input-output units all under control of computer program.

CIRCUIT ELEMENTS ENTIRE SYSTEM

Tubes	2,700
Tube types	21
Crystal diodes	22,000
Magnetic cores	196,608
Switch cores	6,144
Separate cabinets	7

Only 1 type of tube is used in the arithmetic unit. Tube and diode quantities above are approximate. Arithmetic unit utilizes dynamic type circuitry. Storage logic utilizes static type circuitry.

CHECKING FEATURES

Fixed
Modulo 4 parity check to and from storage.
Parity check for each character from bin storage.

POWER, SPACE AND WEIGHT

Power, computer 40 Kw, 50 KVA
Space, computer Installed in room 50 ft x 26 ft
Space, air cond. Installed in basement
Weight, computer 9 Tons
Capacity, air cond. 15 Tons

Motor-generator sets provide power inertia for thyatron supplies.

PRODUCTION RECORD

Produced 1
In production 1
Operating 1
Delivery time 14 Months

FLAC I, now in operation, is the completely modified FLAC. FLAC II is now under construction by commercial firms.

COST, PRICE AND RENTAL RATE

Approximate cost of basic system. Estimated original cost \$500,000, estimated present cost \$750,000. Costs above include new core storage unit, new array of input-output devices, and a new power system.

PERSONNEL REQUIREMENTS

Daily Operation	Engineers	Tech and Operators
1-8 Hour shift	1	2
2-8 Hour shifts	2	4
3-8 Hour shifts	3	6

Other engineering personnel available for technical support during malfunctions.

RELIABILITY AND OPERATING EXPERIENCE

The new FLAC I has recently been placed in operation. Parts are still being added.

FUTURE PLANS

An output buffer storage is planned for permitting computation while punching on paper tape.

1. FLAC II will be identical to FLAC I except that there will be no magnetic wire read-in or out capability.
2. Two (2) 120 character per second paper tape punches are in the process of being added.
3. Four (4) magnetic tape handlers are in the process of being added.
4. One (1) 60 character per second paper tape reader will be added during second quarter CY-1957.
5. Magnetic Tape Bin Memory Unit will be added during second quarter CY-1957.
6. High speed core buffer for punches will be added during the fourth quarter CY-1957.

ADDITIONAL FEATURES AND REMARKS

Complete binary to decimal and decimal to binary number conversion as a basic order - (not a sub-routine).

16 basic orders include a Tally order which permits addresses to be relative to either the control counter or the base counter.

Word counter permits read-in or out from one (1) to FFF (4,096) words with only one (1) instruction. Electronic formatting feature permits output data to contain format characters (column info., zero delete, decimal place, tabulate, carriage return, etc.).

The equipment contains all necessary equipment for marginal checking.

Complete parallel - serial 48 bit shift register for diagnostic purposes.

INSTALLATIONS

Patrick Air Force Base, Florida

