APPLICATIONS

Scientific calculation; simulation; mathematical research by numerical solution of equations involving simultaneity, complex roots, high order differentials, eigenvalues, eigenvectors, partials, boundary values, calculus of variations.

NUMERICAL SYSTEM

Internal number system: Binary
Binary digits per word: 44 plus sign
Binary digits per instruction: 45
Instructions per word: 1
Instructions decoded: 19
Instructions used: 17
Arithmetic system: Fixed point
Instruction type: Three address
Number range: $0, \pm (2^{-44} \leq n \leq 1-2^{-44})$

A standard machine word contains a sign and 11 decimal or sexadecimal characters.

ARITHMETIC UNIT

Add time (excl. stor. access): 48 Microsec
Mult time (excl. stor. access): 2,208
Div time (excl. stor. access): 2,208
Construction: Diodes and vacuum tubes
Basic pulse repetition rate: 1 Mz/sec
Arithmetic mode: Serial
Timing: Synchronous
Operation: Sequential

STORAGE

Media
Mercury Delay Line (Technitron) Words: 512
Magnetic Drum (ERA) Words: 6,144

Access
Mercury Delay Line (Technitron) Access: 192 (Avg)
Magnetic Drum (ERA) Access: 536

The drum is used as an auxiliary storage. Average access to the first word on a track is 3,400 micro-
sec, and access to the next 31 words is 536 microsec.
The drum storage capacity will be increased to
24,576 words of 48 bits each.

**INPUT**

<table>
<thead>
<tr>
<th>Media</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper Tape (Flexowriter)</td>
<td>10 char/sec</td>
</tr>
<tr>
<td>Keyboard (Flexowriter)</td>
<td>Manual</td>
</tr>
<tr>
<td>Paper Tape (Ferranti)</td>
<td>200 char/sec</td>
</tr>
<tr>
<td>Magnetic Tape</td>
<td>480 char/sec</td>
</tr>
</tbody>
</table>

One character requires 4 bits for decimal or sexadecimal input and 6 bits for alpha-numeric input.

**OUTPUT**

<table>
<thead>
<tr>
<th>Media</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper Tape (Flexowriter)</td>
<td>10 dec dig/sec</td>
</tr>
<tr>
<td>Printed Page (Flexowriter)</td>
<td>10 dec dig/sec</td>
</tr>
<tr>
<td>Oscilloscope</td>
<td>1 dot/432 microsec</td>
</tr>
<tr>
<td>Magnetic Tape</td>
<td>480 char/sec</td>
</tr>
</tbody>
</table>

**CIRCUIT ELEMENTS ENTIRE SYSTEM**

- Tubes: 900
- Tube types: 10
- Crystal diodes: 20,000
- Different plug-in units: 30
- Separate cabinets: 8

Two types of tubes are used in the central computer; other types are used in the drum system, tape units, and input-output stations.

**CHECKING FEATURES**

- Fixed
  - Odd-even parity on mercury storage and drum.
- Optional
  - Odd-even parity on tapes.
  - Automatic transfer summing for drum and tapes.

**POWER, SPACE AND WEIGHT**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Power, computer</td>
<td>25 KW</td>
</tr>
<tr>
<td>Space, computer</td>
<td>260 cu ft 65 sq ft</td>
</tr>
<tr>
<td>Power, air cond.</td>
<td>10 KW</td>
</tr>
<tr>
<td>Space, air cond.</td>
<td>96 cu ft 12 sq ft</td>
</tr>
<tr>
<td>Capacity</td>
<td>10 Tons</td>
</tr>
</tbody>
</table>

**PRODUCTION RECORD**

| Number produced | 1 |
| Number in current operation | 1 |

**PERSONNEL REQUIREMENTS**

- Daily operation: No. of Eng. 3, No. of Tech. 6
- Three 8-hour shifts

Engineers and technicians also do development work.

**RELIABILITY AND OPERATING EXPERIENCE**

- Average error free running period: 16 hours
- Operating ratio: 0.75

The operating ratio is defined as Good Time/Scheduled Time.
The average error free running period is estimated and is based on the longest problem performed.

**ADDITIONAL FEATURES AND REMARKS**

- MAGIC system of automatic programming (utility programs, translation and conversions.)
- Present-address relative instructions
- Base counter (B-box)
- Built for possible expansion of operation.

**INSTALLATIONS**

University of Michigan
Engineering Research Institute
Willow Run Research Center
Ypsilanti, Michigan
MINIAC C, II

MANUFACTURER

Marchant Calculators, Incorporated

APPLICATIONS

The Atlantic Refining Company
Scientific and engineering. The Model II and the Model C are identical in most respects.

NUMERICAL SYSTEM

<table>
<thead>
<tr>
<th>Internal number system</th>
<th>Model C</th>
<th>Model II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digits per word</td>
<td>Bin coded dec</td>
<td>Bin coded and Hexa dec</td>
</tr>
<tr>
<td>Digits per instruction</td>
<td>10 decimal</td>
<td>10 decimal</td>
</tr>
<tr>
<td>Instructions per word</td>
<td>20 binary</td>
<td>10 decimal</td>
</tr>
<tr>
<td>Instructions decoded</td>
<td>67</td>
<td>71</td>
</tr>
<tr>
<td>Arithmetic system</td>
<td>Fixed point</td>
<td>Fixed point</td>
</tr>
<tr>
<td>Instruction type</td>
<td>One address</td>
<td>One address</td>
</tr>
<tr>
<td>Number range</td>
<td>-1 &lt; n &lt; +1</td>
<td></td>
</tr>
</tbody>
</table>

The 67 instructions include 30 add, subtract and compare commands. The machine addresses are octal. There are binary and decimal addition commands.

ARITHMETIC UNIT

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Microsec</td>
<td>Microsec</td>
</tr>
<tr>
<td>Add time</td>
<td>11,200</td>
<td>21,200</td>
</tr>
<tr>
<td>Malt time</td>
<td>24,300</td>
<td>41,400</td>
</tr>
<tr>
<td>Div time</td>
<td>25,600</td>
<td>43,200</td>
</tr>
<tr>
<td>Construction</td>
<td>Vacuum tubes</td>
<td></td>
</tr>
<tr>
<td>Basic pulse repetition rate</td>
<td>300 K/sec</td>
<td></td>
</tr>
<tr>
<td>Arithmetic mode</td>
<td>Serial</td>
<td></td>
</tr>
<tr>
<td>Timing</td>
<td>Synchronous (clocking channels on the drum)</td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>Sequential</td>
<td></td>
</tr>
</tbody>
</table>

The add time, excluding storage access, given above, is equivalent to 3 word times. The operand and instruction times are included in all the above values.

STORAGE

<table>
<thead>
<tr>
<th></th>
<th>Microsec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Media</td>
<td>Words</td>
</tr>
<tr>
<td>Magnetic drum</td>
<td>4,096</td>
</tr>
<tr>
<td>256 words</td>
<td>2,500 microsec average access, is optional</td>
</tr>
</tbody>
</table>
INPUT

<table>
<thead>
<tr>
<th>Media</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper Tape (Flexowriter)</td>
<td>600 char/min (6 channel tape)</td>
</tr>
<tr>
<td>Keyboard</td>
<td>Manual</td>
</tr>
</tbody>
</table>

Loading 4,096 instructions would take approximately 70 minutes.

OUTPUT

<table>
<thead>
<tr>
<th>Media</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper Tape (Flexowriter)</td>
<td>600 dig/min</td>
</tr>
</tbody>
</table>

Spare Flexowriter can also be used for the separate preparation of data and programs.

CIRCUIT ELEMENTS ENTIRE SYSTEM

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tubes</td>
<td>850</td>
</tr>
<tr>
<td>Tube types</td>
<td>7</td>
</tr>
<tr>
<td>Crystal diodes</td>
<td>2,000</td>
</tr>
<tr>
<td>Separate cabinets</td>
<td>1</td>
</tr>
</tbody>
</table>

There are 75 types of plug-ins at $10 each.
50% of the machine uses 7 types of plug-ins.
The major types of tubes are the 5963, 5687, 12BH7, 12AT7, 5965, 5915, 2DE1.
A cold water supply and a desk for the Flexowriter is included.

CHECKING FEATURES

Timing circuits
Twenty jacks for applying marginal voltages

POWER, SPACE AND WEIGHT

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Power, computer</td>
<td>5 KW, 220 volt</td>
</tr>
<tr>
<td>Space, computer</td>
<td>91 cu ft, 20 sq ft</td>
</tr>
<tr>
<td>Space, air cond.</td>
<td>Dimensions 4.5 x 4.5 x 4.5 ft plus desk</td>
</tr>
<tr>
<td>Weight, computer</td>
<td>2,000 lbs</td>
</tr>
<tr>
<td>Capacity, air cond.</td>
<td>2 Tons</td>
</tr>
</tbody>
</table>

Designed for cooling by water between 60° and 65°F.

PRODUCTION RECORD

Produced 1 Model C and 1 Model II
Operating 1 Model C and 1 Model II
Delivery time 6 Months

COST, PRICE AND RENTAL RATE

Approximate cost of basic system $85,000
Approximate cost of Flexowriter $2,950
Approximate cost of Spare Flexowriter $2,950

PERSONNEL REQUIREMENTS

<table>
<thead>
<tr>
<th>Daily Operation</th>
<th>Engineers</th>
<th>Tech and Operators</th>
</tr>
</thead>
<tbody>
<tr>
<td>One 8-Hour shift</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Two 8-Hour shifts</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Three 8-Hour shifts</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

RELIABILITY AND OPERATING EXPERIENCE

Atlantic Refining Company, Philadelphia - Model C
Average error-free running period 12 hours (50% of 8 hour days are perfect)

Good time 403
Attempted to run 443
Operating ratio (Good/Attempted to run) 0.91

Figures based on period 20 July 1956 to 11 October 1956
Acceptance test 17 October 1956
Preventive maintenance scheduled is 2 hours/week.

Atlantic Refining Company, Dallas - Model II
Average error-free running period 5-10 hours

Good time 1,137 hours
Attempted to run 1,382 hours
Operating ratio (Good/Attempted to run) 0.76

Picture by The Atlantic Refining Company, Incorporated, Philadelphia, Pennsylvania

Figures based on period January 1956 to November 1956
Acceptance test 1 March 1955

FUTURE PLANS

Atlantic Refining Company, Philadelphia
Optical tape reader
Magnetic tape
Atlantic Refining Company, Dallas
Optical tape input is partially completed, operation to begin in 1957.
Incorporation of a Moseley system, to have the following items:
Tape Translator
X-Y Recorder
Character Printer
Curve Follower

INSTALLATIONS

Model C:
Atlantic Refining Company
260 South Broad Street
Philadelphia 1, Pennsylvania
Model II
Atlantic Refining Company
Research and Development Laboratory
4500 W. Mockingbird Lane
Dallas, Texas

ADDITIONAL FEATURES AND REMARKS

Atlantic Refining Company, Philadelphia
Fast access loop
B-box
Minimum size, general purpose computer
MOBIDIC
Mobile Digital Computer

MANUFACTURER
Electronic Systems Division, Sylvania Electric Products, Incorporated

APPLICATIONS
Manufacturer
Military field use.

NUMERICAL SYSTEM

- Internal number system: Binary
- Binary digits per word: 36
- Binary digits per instruction: 6
- Instructions per word: 1
- Arithmetic system: Fixed point
- Instruction type: One address
- Number range: \((-1 \cdot 2^{-36}) \text{ to } + (1 \cdot 2^{36})\)
- Expandable word length and double precision.

ARITHMETIC UNIT

<table>
<thead>
<tr>
<th>Operation</th>
<th>Microsec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add (includ. stor. access)</td>
<td>16</td>
</tr>
<tr>
<td>Mult (includ. stor. access)</td>
<td>50</td>
</tr>
<tr>
<td>Div (includ. stor. access)</td>
<td>150</td>
</tr>
</tbody>
</table>

CONSTRUCTION

- Transistors: 4,096
- Words: 36
- Microsec Access: 8

STORAGE

- Media: Magnetic Core
- Words: 4,096
- Digits: 36
- Access: 8

The machine is capable of accepting a magnetic drum. Additional magnetic core storage units may be added if desirable.

INPUT

The system is to be equipped with paper and magnetic tape and electric typewriter input media.

OUTPUT

The system is to be equipped with paper and magnetic tape and electric typewriter output media.

Picture by Electronic Systems Division, Sylvania Electric Products, Incorporated
CHECKING FEATURES
Parity check on storage unit. Marginal check on all circuits. Overflow check in arithmetic unit.

POWER, SPACE AND WEIGHT
The complete computer, including air conditioning and console will be mounted in a standard military trailer.

PRODUCTION RECORD
| In production | 1 |
| On order      | 1 |
| Delivery time | 36 months |

RELIABILITY AND OPERATING EXPERIENCE
Manufacturer
Designed for extremely high reliability under battlefield conditions.

INSTALLATIONS
Mobile. Presently located at Electronic Systems Division, Sylvania Electric Products, Incorporated, Waltham, Massachusetts

ADDITIONAL FEATURES AND REMARKS
Mobile and ruggedized for military use
Expandable word length
Expandable memory capacity
Expandable input-output capacity.
MODAC 404
Mountain Systems Digital Automatic Computer

MANUFACTURER
Airborne Instruments Laboratory, Incorporated (Parent)
Mountain Systems, Incorporated

APPLICATIONS
Statistical and business data processing, accounting, coding and controls.

NUMERICAL SYSTEM
Internal number system  Binary coded decimal
Decimal digits per word  6
Decimal digits per instruction  2
Instructions decoded  8
Arithmetic system Fixed point
Instruction type One Address
Number range 0 to 999,999

Programming system is designed for special application. Operations include addition, subtraction, unit entry, bulk entry and transfer.

ARITHMETIC UNIT

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Add time</td>
<td>25,000</td>
<td>240</td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic pulse repetition rate</td>
<td>150 Kc/sec</td>
<td></td>
</tr>
<tr>
<td>Arithmetic mode</td>
<td>Serial</td>
<td>Asynchronous</td>
</tr>
<tr>
<td>Timing</td>
<td></td>
<td>Sequential</td>
</tr>
<tr>
<td>Operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The addition time given above is for the addition of two 6-digit decimal numbers.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

STORAGE

<table>
<thead>
<tr>
<th>Storage Media</th>
<th>Words</th>
<th>Digits</th>
<th>Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetic Drum</td>
<td>20,000</td>
<td>120,000</td>
<td>25,000</td>
</tr>
</tbody>
</table>

Access time given above is average. System stores 500,000 binary digits in 50 milliseconds access time.
INPUT

<table>
<thead>
<tr>
<th>Media</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper Tape</td>
<td>200 char/sec</td>
</tr>
<tr>
<td>Punched Cards (Rem. Rand Tab)</td>
<td>4 cards/sec</td>
</tr>
</tbody>
</table>

OUTPUT

<table>
<thead>
<tr>
<th>Media</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper Tape</td>
<td>200 char/sec</td>
</tr>
<tr>
<td>Punched Cards (Rem. Rand Tab)</td>
<td>4 cards/sec</td>
</tr>
</tbody>
</table>

CIRCUIT ELEMENTS ENTIRE SYSTEM

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tubes</td>
<td>1,000 (approx.)</td>
</tr>
<tr>
<td>Tube types</td>
<td>3 (major)</td>
</tr>
<tr>
<td>Crystal diodes</td>
<td>2,000 (approx.)</td>
</tr>
<tr>
<td>Separate cabinets</td>
<td>1</td>
</tr>
</tbody>
</table>

CHECKING FEATURES

Address check.

POWER, SPACE AND WEIGHT

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Power, computer</td>
<td>3 KW</td>
</tr>
<tr>
<td>Space, computer</td>
<td>120 cu ft, 20 sq ft</td>
</tr>
<tr>
<td>Weight, computer</td>
<td>1,500 lbs.</td>
</tr>
</tbody>
</table>

PRODUCTION RECORD

Reader's Digest Association
Produced: 1
Operating: 1
Delivery time: 9 Months

COST, PRICE AND RENTAL RATE

Reader's Digest Association
Approximate cost of basic system $100,000.

PERSONNEL REQUIREMENTS

Reader's Digest Association
Daily Operation Engineers: 0, Tech and Operators: 1
One 8-hour shift

RELIABILITY AND OPERATING EXPERIENCE

Reader's Digest Association
Good time: 6,000 hours
Attempted to run time: 6,188 hours
Operating ratio (Good/Attempted to run): 0.97
Figures based on period September 1955 to January 1957
Acceptance test September 1954
Additional features include external programming, dual entry to memory with single address and an address check.
MODAC 410
Mountain Systems Digital Automatic Computer Model 410

MANUFACTURER
Airborne Instruments Laboratory, Incorporated (Parent)
Mountain Systems Incorporated

APPLICATIONS
Business Data Processing

NUMERICAL SYSTEM
Internal number system  Decimal - Excess 3
Decimal digits per word  10
Arithmetic system  Fixed point
Instruction type  One address
Number range  0 to 10 decimal digits
Program is stored internally and on tape.

ARITHMETIC UNIT
Add time (exclu. stor. access)  600 Microsec
Mlt time (exclu. stor. access)  7,000
Div time (exclu. stor. access)  7,000
Construction  Vacuum tubes, magnetic elements and diodes
Number of rapid access word registers  50
Basic pulse repetition rate  150 Kc/sec
Arithmetic mode  Serial
Timing  Asynchronous
Operation  Sequential
Computer is serial with buffer storage.

STORAGE
Media  Words  Microsec  Access
Magnetic Drum  5,000  7,500

50,000 decimal digits stored.
Buffer storage in magnetic cores.

INPUT
Media  Speed
Punched Tape  400 char/sec
Punched Cards  600 cards/min

OUTPUT
Media  Speed
Punched Tape  60 char/sec
Punched Cards  600 cards/min

CIRCUIT ELEMENTS ENTIRE SYSTEM
Tubes  600
Tube types  3
Crystal diodes  3,000
Magnetic elements  1,000

Number of different plug in units  5
Number of separate cabinets  2

CHECKING FEATURES
Number checks
Address checks
Odd number check

POWER, SPACE AND WEIGHT
Power, computer  4 KW
Space, computer  40 cu ft, 20 sq ft
Weight, computer  1,000 lbs

PRODUCTION RECORD
Produced  1
In operation  1
Delivery time  10 Months

COST, PRICE AND RENTAL RATE
Approximate cost of basic system $120,000.
Price includes input and output equipment described.
Other equipment dependent upon specific application.

PERSONNEL REQUIREMENTS
One operator required during operation.

INSTALLATIONS
Readers Digest Association, Incorporated
Condensed Book Club
Pleasantville, New York

ADDITIONAL FEATURES AND REMARKS
Special translator or converter feature reads an abbreviation on a punched card, looks up corresponding code from a list of 5,000 and punches a code number into the same card at a reading and punching rate of 500 per minute.
High speed tallying feature performs 1,440,000 unit additions per hour into selected registers.
Transactions, from a total of 4,000 categories, can be read at random and added to an appropriate one of 4,000 registers.
APPLICATIONS

Reader's Digest Association, Incorporated
Large scale translation, statistical processing and
general purpose computation.

NUMERICAL SYSTEM

Internal number system

Binary coded decimal
and alphanumeric

Decimal digits per word
6
Decimal digits per instruction
2
Arithmetic system

Instructions decoded
12
Relation to other

Fixed point

A single address (for
genereal purpose

Instruction type
applications)

ARITHMETIC UNIT


Add time
8,000 288
Multiply
8,000 8,000
Divide
8,000 8,000

Construction

Vacuum tubes and magnetic cores

Arithmetic mode

Serial

Timing

Asynchronous

Operation

Sequential

The multiply and divide times given above include
re-record time.

OUTPUT

Media
Punched Card
Paper Tape

Speed
360 cards/min
20 char/sec

Punched cards are used for translation and paper
tape for reports.

CIRCUIT ELEMENTS ENTIRE SYSTEM

Tubes
2,000 (approx)
Tube types
3 (major)
Crystal diodes
3,000 (approx)
Magnetic cores
396

CHECKING FEATURES

Odd-even checks on numerical calculations are used.

POWER, SPACE AND WEIGHT

Power, computer
5 kW
Space, computer
240 cu ft, 40 sq ft
Weight, computer
3,000 lbs

PRODUCTION RECORD

Produced
1
Operating
1
Delivery time
12 Months

COST, PRICE AND RENTAL RATE

Approximate cost of basic system $150,000.

PERSONNEL REQUIREMENTS

Daily Operation Engineers Tech and Operators

One 8-hour shift 0 2

RELIABILITY AND OPERATING EXPERIENCE

Acceptance test October 1956.

INSTALLATIONS

Reader's Digest Association, Incorporated
Condensed Book Club
Pleasantville, New York

MODAC 414
Mountain Systems Digital Automatic Computer Model 414

MANUFACTURER
Airborne Instruments Laboratory, Incorporated (Parent)
Mountain Systems, Incorporated

STOREAGE

Media
Magnetic Drum
Magnetic Drum
Magnetic Cores

Words
6,000
4
2

Characters
36,000
24
12

Access
8,000
376
288

INPUT

Media
Punched Cards
Paper Tape

Speed
360 cards/min

Paper Tape is used for report programming and
testing.