APPLICATIONS

Scientific computing

NUMERICAL SYSTEM

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal number system</td>
<td>Binary coded decimal</td>
</tr>
<tr>
<td>Decimal digits per word</td>
<td>10</td>
</tr>
<tr>
<td>Decimal digits per instruction</td>
<td>5</td>
</tr>
<tr>
<td>Instructions per word</td>
<td>2</td>
</tr>
<tr>
<td>Instructions decoded</td>
<td>3/4</td>
</tr>
<tr>
<td>Instructions used</td>
<td>3/4</td>
</tr>
<tr>
<td>Arithmetic system</td>
<td>Fixed point</td>
</tr>
<tr>
<td>Instruction type</td>
<td>One or two address</td>
</tr>
<tr>
<td>Number range</td>
<td>$10^{-9} \leq n \leq 10^9$</td>
</tr>
</tbody>
</table>

Program selection permits one- or two-address modes of operation. The decimal point may be manually set at any desired location. Two address operation is optional for optimum programming.

ARITHMETIC UNIT

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incl. Stor. Access Microsec</td>
<td>176-264</td>
</tr>
<tr>
<td>Excl. Stor. Access Microsec</td>
<td>88-176</td>
</tr>
<tr>
<td>Mult time</td>
<td>4,000</td>
</tr>
<tr>
<td>Div time</td>
<td>6,000</td>
</tr>
<tr>
<td>Vacuum tubes</td>
<td>3,000</td>
</tr>
<tr>
<td>Magnetic cores</td>
<td>320</td>
</tr>
<tr>
<td>Rapid access word registers</td>
<td>2</td>
</tr>
<tr>
<td>Basic pulse repetition rate</td>
<td>125 Kc/sec</td>
</tr>
<tr>
<td>Arithmetic mode</td>
<td>Serial-parallel</td>
</tr>
<tr>
<td>Timing</td>
<td>Synchronous</td>
</tr>
</tbody>
</table>

STORAGE

<table>
<thead>
<tr>
<th>Media</th>
<th>Words</th>
<th>Digits</th>
<th>Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Media</td>
<td>5,300</td>
<td>55,000</td>
<td>8,000(avg)</td>
</tr>
<tr>
<td>Magnetic Drum</td>
<td>100</td>
<td>1,000</td>
<td>88</td>
</tr>
</tbody>
</table>

INPUT

<table>
<thead>
<tr>
<th>Media</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper Tape (Ferranti Photoelectric)</td>
<td>400 char/sec</td>
</tr>
<tr>
<td>Printer</td>
<td>6 char/sec</td>
</tr>
<tr>
<td>Paper Tape</td>
<td>60 char/sec</td>
</tr>
</tbody>
</table>

OUTPUT

<table>
<thead>
<tr>
<th>Media</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tubes</td>
<td>3,000</td>
</tr>
<tr>
<td>Tube types</td>
<td>8</td>
</tr>
</tbody>
</table>

CIRCUIT ELEMENTS ENTIRE SYSTEM

| Crystal diodes                      | 6,000 |
| Magnetic cores                      | 4,700 |
| Separate cabinets                   | 28 standard, 19 in by 7 ft, each. |

Tube types include 6CL6, 5687, 7AK7, 6197, 12AU7, 12AT7, 6BC5, 12BE7.

System is constructed of standard Burroughs pulse control equipment and interconnected with R66CU coaxial cable.

CHECKING FEATURES

Modulo 3 arithmetic check
Modulo 3 check on each word transferred to and from storage.
Forbidden combination multiply and divide check.

POWER, SPACE AND WEIGHT

Power, computer                      | 30 KW, 32 KVA |
Space, computer                      | 400 sq ft area, floor space part of machine |
Capacity, air cond.                   | Blower-exhaust type |
System arranged in form of an almost closed rectangle.

PRODUCTION RECORD

Produced                              | 1 |
Operating                             | 1 |

COST, PRICE AND RENTAL RATE

Approximate cost of basic system $500,000.
Approximate cost of modifications and additions $200,000.

PERSONNEL REQUIREMENTS

Personnel varies with changes in activity of university laboratory.

RELIABILITY AND OPERATING EXPERIENCE

Average error-free running period      | 7 hours/5 hour shift |
Good time                             | 8.5 hours |
Attempted to run time                 | 10 hours |
Operating ratio (Good/Attempted to run) | 0.85 |
Figures based on period May 1953 to November 1956.
Acceptance test December 1955.
Decimal-binary automatic conversion is utilized.

INSTALLATIONS

Wayne University
Computational Laboratory
Detroit 1, Michigan
UDEC II III
Unitized Digital Electronic Computer
Model II (Modified to Model III)

APPLICATIONS
Scientific and commercial

NUMERICAL SYSTEM
Internal number system  Excess-three bin coded dec
Decimal digits per word  9 plus sign digit
Decimal digits per instruction  5
Instructions per word  2
Instructions decoded  40
Instructions used  32
Arithmetic system  Fixed point
Instruction type  One address
Number range  Movable decimal point

Two address word possible if second instruction in each word is unconditional transfer. Each instruction is one half word, i.e. 5 digits. Of these, 3 digits specify address and 2 digits the command.

MANUFACTURER
Burroughs Corporation
Electronic Instruments Division

ARITHMETIC UNIT
Add time (exclud. stor. access)  680 microsec
Mult time (exclud. stor. access)  30,000 microsec
Div time (exclud. stor. access)  50,000 microsec
Construction  Vacuum tubes
Basic pulse repetition rate  125 Kc/sec
Arithmetic mode  Serial parallel
Timing  Synchronous
Operation  Sequential

STORAGE

<table>
<thead>
<tr>
<th>Media</th>
<th>Words</th>
<th>Microsec Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetic Core</td>
<td>1,000</td>
<td>20/5 digits</td>
</tr>
<tr>
<td>Magnetic Drum</td>
<td>10,000</td>
<td>8,500 (Avg)</td>
</tr>
</tbody>
</table>

53,000 decimal digits total drum storage. Drum information contained in blocks of 200 words for transfer to and from core storage.
INPUT

<table>
<thead>
<tr>
<th>Media</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper Tape (Ferranti Photoelectric)</td>
<td>120 char/sec</td>
</tr>
<tr>
<td>Paper Tape (Potter magnetic tape handler modified for photoelectric input)</td>
<td>Magnetic Tape (Potter)</td>
</tr>
</tbody>
</table>

OUTPUT

<table>
<thead>
<tr>
<th>Media</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper Tape (Teletype) (2)</td>
<td>60 char/sec (5-level)</td>
</tr>
<tr>
<td>Paper Tape (Teletype)</td>
<td>60 char/sec (7-level)</td>
</tr>
<tr>
<td>Magnetic Tape (Potter)</td>
<td></td>
</tr>
</tbody>
</table>

CIRCUIT ELEMENTS ENTIRE SYSTEM

Tubes 3,000
Machine consists of Burroughs Pulse Control Equipment, approximately 600 units in all.

CHECKING FEATURES

Fixed
Transfer check modulo 3
Overflow, halt, and multiplication-division alarms.

POWER, SPACE AND WEIGHT

Power, computer 33 kW
Space, computer 51 racks
Capacity, air cond. 15 Tons

PRODUCTION RECORD

Number produced 2 (Incl UDEC I)
Number in current operation 2
Delivery time 6 Months

UDEC I located at Wayne University, Detroit, Michigan
UDEC II III located at Burroughs Corporation, Philadelphia, Pennsylvania

COST, PRICE AND RENTAL RATE

Approximate price of basic system $200,000 (UDEC II)
Additional equipment $100,000

PERSONNEL REQUIREMENTS

Daily Operation Engineers Tech or Operators
One 8-hour shift 1 3
Two 8-hour shifts 2 4

RELIABILITY AND OPERATING EXPERIENCE

Average error free running period 6 hours
Operating ratio 0.85
Acceptance test October 1953

INSTALLATIONS

Wayne University (UDEC I)
Computational Laboratory
Detroit 1, Michigan
Burroughs Corporation
Electronic Instruments Division
1209 Vine Street
Philadelphia, Pennsylvania

ADDITIONAL FEATURES AND REMARKS

Special instructions:
Four B-boxes
Overflow transfer instruction
Complete format control
Transfer on special character
Logical sum and product
Single and double register shift instructions
Buffered input-output for photoreaders and teletype punches.
Provision for additional equipment and modification of logic.

Burroughs UDEC III is a general modification of UDEC II. UDEC III will consist of Burroughs pulse control equipment which has been used in UDEC II. The basic flexibility of this equipment provides for a maximum of modification with respect to special instructions and special input-output equipment which must be added as required. In addition to this, the flexibility also provides for a modernization of the machine with the advancement of the art.

When all plans for the modification of UDEC II are complete, the system will be designated UDEC III. The changeover is scheduled to take place in the Spring of 1957. Accordingly, UDEC II will then cease to exist. At the present time, UDEC II is in operation.
APPLICATIONS

Government Sample
U. S. Naval Training Device Center
Real time simulation of flight for pilot training. This system is based on studies conducted by the
Moore School of Electrical Engineering and sponsored by the USNTDC. The computing system described is a
preliminary design. A contract for development was
awarded to Sylvania Electric Products, Inc.,
Electronic Systems Division, Waltham, Mass. for
development and fabrication. The purpose of the
computer is to simulate Navy and Air Force type
operational flight trainers, which at present
utilize analog computers. It is intended to be a
research tool upon which exhaustive mathematical
investigations relative to flight simulation and
pilot training will be conducted.

Industrial Sample
University of Pennsylvania, Moore School of
Electrical Engineering
Operational flight trainers and real-time control
problems.

NUMERICAL SYSTEM

Moore School of Electrical Engineering
Internal number system Binary
Binary digits per word 20 plus sign plus parity
check bit
Binary digits per instruction 19 plus parity check
Instructions per word 1
Instructions decoded 28
Arithmetic system Fixed point
Instruction type One address
Number range \((1 - 2^{-20})\) to \((1 - 2^{-20})\)

ARITHMETIC UNIT

Exclu. Stor. Access Microsec
Add time 5
Mult time 10
Div time 105
Construction-Vacuum tubes and crystal diodes
Arithmetic mode Sequential - parallel
Timing Synchronous
Operation Sequential

The system utilizes sequential-parallel operation
using serial synchronous circuits. Construction
of the arithmetic unit is similar to the SEAC
System. Employs W. E. type 40K A tube. Some
transistors are used. A 5 phase clock source is
used.

STORAGE

<table>
<thead>
<tr>
<th>Media</th>
<th>Words</th>
<th>Microsec</th>
<th>Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetic Core</td>
<td>4189</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

The storage system consists of two separate units:
4,994 number words and 4,995 instruction words.

Both units require an access time of 5 microseconds
while the arithmetic unit is operating on the
previous instruction.

INPUT

Manufacturer
Media Speed
Punched Cards 750 words/min
Gray Code Shaft Converters 10 microseconds
Switches Manual

U. S. Naval Training Device Center
Punched cards are used only at start of simulation.
The switches are sensed in 5 microseconds. 64
switches are used as discrete inputs. Analog and
discrete inputs are initiated by pilots' controls
and certain flight instructor inputs.

OUTPUT

Manufacturer
Media Speed
Binary Printer 2,000 lines/sec

U. S. Naval Training Devices Center
Printer - Teledirect paper 2,000 words/sec
64 Analog
24 Discrete

Analog and discrete outputs provide voltages to
actuate pilots' instruments and indicators.

CIRCUIT ELEMENTS ENTIRE SYSTEM

<table>
<thead>
<tr>
<th>Tubes</th>
<th>1,800</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tube types</td>
<td>3</td>
</tr>
<tr>
<td>Crystal diodes</td>
<td>20,000</td>
</tr>
<tr>
<td>Magnetic cores</td>
<td>180,224</td>
</tr>
<tr>
<td>Transistors</td>
<td>500</td>
</tr>
</tbody>
</table>

Above figures are approximate. A tube type utilized
is the 40K A.

Separate cabinets 6 (not including A-D
conversion equipment)

CHECKING FEATURES

U. S. Naval Training Devices Center
Fixed
Parity, marginal, overflow, unused order type
Optional
Slow computation switch and one cycle operation for
program check and calibration.

POWER, SPACE AND WEIGHT

Power, Computer 10 kW
Capacity, air cond. 10 Ton

Above power requirement is estimated.
PRODUCTION RECORD

Produced 0
In production 1
Delivery time 30 Months

U. S. Naval Training Devices Center
Prototype version due January 1959.

PERSONNEL REQUIREMENTS

U. S. Naval Training Devices Center
One pilot trainee, one flight instructor, one
computer operator (engineer), 3 - 4 technicians
(maintenance, calibration) etc.

FUTURE PLANS

U. S. Naval Training Devices Center
Future models to be transistorized and possibly
mobilized. Has possibility of simulating more
than one cockpit simultaneously.

INSTALLATIONS

University of Pennsylvania, Moore School of
Engineering, 200 South 33rd Street, Philadelphia 4,
Pennsylvania

ADDITIONAL FEATURES AND REMARKS

Manufacturer
Ultra high speed is achieved through a novel logical
structure. System includes an interval timer of
great flexibility for real-time simulation.

U. S. Naval Training Devices Center
Real time simulation of many different types of
flight trainers. Solves complete aerodynamic and
engine equations in flight and on ground. Eighty-
eight inputs and outputs (analog and discrete).
Relative address register. Will actuate two
different aircraft cockpits.
APPLICATIONS

Manufacturer
Universal Automatic Computer Model I

Government Sample
Army Map Service
Geodetic, cartographic and photogrammetric computations.

Bureau of the Census
Two computers are utilized for statistical data processing.

New York Naval Shipyards
The shipyard utilizes the Bureau of Ships' computer at the David Taylor Model Basin for the following applications:

Random numbers were generated to facilitate statistical experimental design associated with an investigation of the holding strength of various screw fasteners in several types of wood suitable for decking under several experimental conditions.

Univac saved several hundred man-hours which would have been required for manual solution of the problem. Univac aided in insuring independence among lists of random numbers which would have been difficult in manual solution.

The solution of simultaneous equations represents approximately ten per cent of the work in a pipe stress problem. Six by six matrices are solved by desk calculators and those of a higher order are solved by an analog computer.

Computations of standard deviation, arithmetic averages, were requested. Comparisons of computing methods showed manual methods would take 80 hours and Univac 1 hour.

X-ray spectroscopy computations were requested. This included the computation of wave lengths by continuously substituting values from an extremely large range of variables.

Requests for a continuous sequential regression analysis representing life testing were made. Also due to the many environmental variables factorial analysis was requested to control experimental
conditions.
David Taylor Model Basin
Mathematical and data processing.
Industrial Sample
Consolidated Edison Company
Customer billing and accounting.
E. I. du Pont de Nemours and Company
General engineering, scientific and commercial.
The Franklin Institute
Computing center activity.
Franklin Life Insurance Company
Insurance data processing.
General Electric Company Appliance and TV Receiver
Division
Business data processing.
New York University, BSC Computing Facility
Scientific and data handling problems.
Pacific Mutual Life Insurance Company
Business: Data processing of ordinary life insurance
work on a daily cycle basis.
University of California Radiation Laboratory
Research and services in mathematical sciences and
weapons development.

**NUMERICAL SYSTEM**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal number system</td>
<td>Binary coded decimal</td>
</tr>
<tr>
<td>Decimal digits per word</td>
<td>12 (11 plus sign)</td>
</tr>
<tr>
<td>Decimal digits per instruction</td>
<td>6</td>
</tr>
<tr>
<td>Instructions per word</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructions decoded</td>
<td>63</td>
</tr>
<tr>
<td>Instructions used</td>
<td>45</td>
</tr>
<tr>
<td>Arithmetic system</td>
<td>Fixed point</td>
</tr>
<tr>
<td>Instruction type</td>
<td>One address</td>
</tr>
<tr>
<td>Number range</td>
<td>Between -1 and +1</td>
</tr>
</tbody>
</table>

Floating point is performed by sub-routines supplied with the computer. The decimal point occurs at the right of the sign digit.

**ARITHMETIC UNIT**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incl. Stor. Access</td>
<td>Microsec 525</td>
</tr>
<tr>
<td>Excl. Stor. Access</td>
<td>Microsec 282.6</td>
</tr>
<tr>
<td>Add time</td>
<td>2,150</td>
</tr>
<tr>
<td>Mult time</td>
<td>3,950</td>
</tr>
<tr>
<td>Div time</td>
<td>5,000 vacuum tubes</td>
</tr>
<tr>
<td>Construction</td>
<td>3,707.6</td>
</tr>
<tr>
<td>Rapid access word registers</td>
<td>4</td>
</tr>
<tr>
<td>Basic pulse repetition rate</td>
<td>2.25 M/sec</td>
</tr>
<tr>
<td>Arithmetic mode</td>
<td>Synchronous</td>
</tr>
<tr>
<td>Timing</td>
<td>Sequential</td>
</tr>
<tr>
<td>Operation</td>
<td></td>
</tr>
</tbody>
</table>

The minimum storage access time is 40.4 microseconds.
The maximum storage access time 40.4 microseconds.
STORAGE

<table>
<thead>
<tr>
<th>Media</th>
<th>Words</th>
<th>Digits</th>
<th>Microsec Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustic Delay Line</td>
<td>1,000</td>
<td>12,000</td>
<td>40.4 to 404</td>
</tr>
</tbody>
</table>

The acoustic medium is mercury. If average access time is 5 word times, the average access time would be 202 microseconds.

Industrial Sample

The Franklin Life Insurance Company

The read-out from storage is serial. Therefore, access time is 1 word time plus latency time, which can be as high as 9 word times, so if the average latency time is assumed to be 5 word times (202 microseconds) plus 1 word read-out time (40.4 microseconds), average access is 242.4 microseconds.

Author's note: Perhaps a realistic random access time, taken over a large number of storage cycles, would be a statistical average of 1 word time plus 4-1/2 word times or 222.2 microseconds, or the arithmetic mean obtained from the minimum and maximum access times. However, the 222.2 microseconds would not represent any real access time for a given word in storage.

INPUT

<table>
<thead>
<tr>
<th>Media</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetic Tape (UNISERVO I)</td>
<td>12,800 char/sec</td>
</tr>
<tr>
<td>Keyboard</td>
<td></td>
</tr>
<tr>
<td>Unityper II Verifier</td>
<td></td>
</tr>
<tr>
<td>80 Column Card-to-</td>
<td></td>
</tr>
<tr>
<td>Tape Converter</td>
<td></td>
</tr>
<tr>
<td>90 Column Card-to-</td>
<td></td>
</tr>
<tr>
<td>Tape Converter</td>
<td></td>
</tr>
<tr>
<td>Paper Tape to</td>
<td></td>
</tr>
<tr>
<td>Magnetic Tape</td>
<td></td>
</tr>
<tr>
<td>Converter</td>
<td></td>
</tr>
<tr>
<td>Magnetic Tape to</td>
<td></td>
</tr>
<tr>
<td>Magnetic Tape</td>
<td></td>
</tr>
<tr>
<td>Transrecorder</td>
<td></td>
</tr>
</tbody>
</table>

Manual

Keypunching 50 char/in density
Keypunching Verifies Unityper II recording

240 char/min. 120 char/in. density

240 char/min. 120 char/in. density

200 char/sec. 5, 6 or 7 channel code

90 char/sec. Speed dependent upon communication facilities

Government Sample

Army Map Service

The packing density may be 20, 50 or 128 pulses/in on 7 channels. The keyboard may be used to "type" information directly into storage. Auxiliary (off-line) equipment includes 2 Unitypers-Model I, 5 Unitypers-Model II and 6 IBM keypunches. A card to tape converter is available by co-operative arrangement with a nearby government agency.
Industrial Sample
The Franklin Life Insurance Company
A read-in requires the use of the main computer for
3,500 microseconds. At the end of this time, the
main computer is released and the read-in continues
into the I-tank, a 720-digit auxiliary storage ex-
clusive of the main storage. Transfer from the
I-tank to main storage is performed during this time
of 3,500 microseconds, during which the previous
block of information is read into the I-tank.
University of California Radiation Laboratory
Unityper I records at 20 char/in. and is "loop
controlled". Unityper II records at 50 char/in.
and printed copy is produced simultaneously.

OUTPUT

<table>
<thead>
<tr>
<th>Media</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNISERVO I</td>
<td>12,800 char/sec</td>
</tr>
<tr>
<td>Printing Unit</td>
<td>10 in/sec</td>
</tr>
<tr>
<td>Uniprinter</td>
<td>10 char/sec</td>
</tr>
<tr>
<td>High Speed Printer</td>
<td>600 lines/min</td>
</tr>
<tr>
<td>Tape-to-Card Converter</td>
<td>120 cards/min</td>
</tr>
<tr>
<td>Magnetic Tape to Paper</td>
<td>50 char/sec</td>
</tr>
<tr>
<td>Tape Converter</td>
<td>90 char/sec</td>
</tr>
<tr>
<td>Magnetic Tape to</td>
<td></td>
</tr>
<tr>
<td>Transrecorder</td>
<td></td>
</tr>
</tbody>
</table>

| Density                |                |
| 20 char/in             |
| 150 char/line          |
| (maximum)              |

Text continues...

Government Sample
Army Map Service
Magnetic tape, 100 in/sec, 20 or 128 pulses/in.
Printer (typewriter) 12 char/sec, direct printing
from storage. Auxiliary (off-line) equipment
includes 4 Uniprinters, 1 high speed printer and 1
Electro-ploter on order from the Benson-Lehner
Corporation.

Industrial Sample
The Franklin Life Insurance Company
A write requires the use of the main computer for
3,500 microseconds, at which time the main computer
is released for further computation, as the write
continues from an auxiliary 720 digit storage
exclusive of the main storage, called the O-tank.

University of California Radiation Laboratory
Output equipment using magnetic tape input:
Uniprinter 10-11 char/sec converts recording on
magnetic tape to desired printed format. High Speed
Printer 600 lines/min, adjustable to 200 and 400 if
desired; 120 char/line; 150 char/line is maximum
when there is repetition of characters.

CIRCUIT ELEMENTS ENTIRE SYSTEM

<table>
<thead>
<tr>
<th>Tubes</th>
<th>5,200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>15</td>
</tr>
<tr>
<td>Crystal diodes</td>
<td>18,000</td>
</tr>
</tbody>
</table>
Picture by the E. I. du Pont de Nemours and Company

Separate cabinets 15

The separate cabinets are included in the Central Computer, the Supervisory Control, the Power Supply and eleven Uniservos. The above figures are approximate and do not include input-output devices.

Government Sample
Army Map Service
The tube types used throughout the entire system include the 25L6, 6AK5, 7AK7, 6AQ6, 6BE6, 6BN7, 6X5, 6AK7, 28117, B07, 809B, 2050, 5545, 5651, 5687, 6AL5, 6AK5, 6AQ6, 5V4, 5R4, 4D32, 3023, 8008. The system includes the Computer, Power Supply, Supervisory Control, Printer and 6 Uniservos.

Industrial Sample
The Franklin Life Insurance Company
Approximately 50% of the tube complement are 25L6's. Each of ten Uniservos (tape handlers) are separate and interchangeable.

CHECKING FEATURES

Fixed
Duplicate circuitry for checking results of computation and comparison
Odd-even pulse
Read-in and read-out pulse check on the 720-digit auxiliary storage.
Three minute interval pulse check.
Automatic re-read provides for reading a block from the tape again when the first reading indicates an error. Marginal checking causes weak tubes to fail during scheduled maintenance instead of during production time.

Government Sample
Army Map Service
Fixed
Trouble shooting and indicating checks on this system include:
DC fault test and locator
Primary alarm circuits
Audio check
Mercury tank heater monitor
Storage checker
Checking circuits
Marginal check
Function table checker and neon bank
Duplicate arithmetic circuits
Optional
Test bench and various test equipments
2 modifications for checking purposes
AOC voltage monitor either by meter or scope
Every character has an odd number of pulses. Odd-even checkers on input and output buffers and in other circuits within the machine. Other automatic internal checking features also included.

David Taylor Model Basin
Checking summarized as parity, comparison and counting.
Industrial Sample
The Franklin Institute and University of California Radiation Laboratory
Parity check throughout system, character count on each block of input and output, and parallel computing.

The Franklin Life Insurance Company
No programmed checks are used in normal operation, except during maintenance time, because of the comprehensive hardware checking circuits mentioned above.
Odd-even check of each decimal digit transferred within main computer and of digits coming from or going to magnetic tape.
Duplicated circuits of all arithmetic operations and most control functions.

POWERSPACE AND WEIGHT

<table>
<thead>
<tr>
<th>Power, computer</th>
<th>81 kW, 90 KVA, 0.96 PF, 124.5 KVA with 10 Uniservos and power supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space, computer</td>
<td>943 cu. ft., 16 ft. by 22 ft.</td>
</tr>
<tr>
<td>Space, air cond.</td>
<td>Height: 8 ft, 6-9/16 in.</td>
</tr>
<tr>
<td></td>
<td>Width: 14 ft, 3-3/8 in.</td>
</tr>
<tr>
<td></td>
<td>Depth: 7 ft, 10 in.</td>
</tr>
<tr>
<td>Weight, computer</td>
<td>16,686 lbs.</td>
</tr>
<tr>
<td>Capacity, air cond.</td>
<td>35 Tons</td>
</tr>
</tbody>
</table>

The choice of air conditioner is optional with customer. A closed chilled-air system cools the Central Computer Group and heavy auxiliaries. Chilled water must be supplied at a temperature from 45° to 50° with controls to the Power Supply and the Central Computer. The Central Computer and Power Supply Unit require 35 Tons of refrigeration.

Government Sample
Army Map Service
Total requirement is 125 KVA, 3 input stabilizers are used.
Computer requires 1,400 sq. ft., high speed printer 400 sq. ft.

Weights are:
- Computer 10,000 lbs.
- Power Supply 4,500 lbs.
- Supervisory Control 445 lbs.
- Printer and typer 444 lbs.
- Uniservos, each 450 lbs.

Computer generates 314,000 BTU/hour.
Power Supply generates 98,000 BTU/hour.

David Taylor Model Basin
Installation requires 124.5 KVA, utilizes 1,000 sq. ft., and weighs 29,055 lbs., and is air conditioned at 50 Tons.

Industrial Sample
The Franklin Institute
The air conditioner has a 100-Ton capacity. The computer occupies 4,000 sq. ft. and the air conditioner 150 sq. ft.
The Franklin Life Insurance Company
Installation requires 120 kW, 150 KVA, 0.924 PF, 9,600 cu. ft., 1,200 sq. ft., weighs 125,500 lbs. All of the 60 Ton air conditioner is not required for the central computer.
University of California Radiation Laboratory
A 35-Ton air conditioner of the evaporative type is used.

**PRODUCTION RECORD**

**COST, PRICE AND RENTAL RATE**

**Description** | **Monthly Rental** | **Outright Sale Price**
---|---|---
1 Shift - 5 day week P. O. B. Factory | **UNIVAC I Central** | $13,990.00 | $750,000.00
Computer with Power Supply & Supervisory Control Desk | **UNIVAC I Central** | $13,990.00 | $750,000.00
**UNISERVO I** | 320.00 | 18,000.00
**UNIPRINTER** | 390.00 | 22,000.00
**UNITYPER II** | 90.00 | 4,500.00
**VERIFIER** | NOT CURRENTLY AVAILABLE | |
**HIGH SPEED PRINTER** | 3,300.00 | 185,000.00
**CARD-TO-TAPE UNIT** | 2,500.00 | 142,100.00
(47 Character Code) | |
**CARD-TO-TAPE UNIT** | 2,500.00 | 142,100.00
(36 Character Code) | |
**TAPE-TO-CARD UNIT** | 2,500.00 | 130,000.00
**PERFORATED TAPE-TO-MAGNETIC TAPE (PAM)** | 1,500.00 | 108,000.00
**Converter** | 1,500.00 | 90,000.00
**MAGNETIC TAPE-TO-PERFORATED TAPE (MTP) Converter** | 1,500.00 | 90,000.00

Prices quoted above subject to change without notice. Rental charges include maintenance service, spare parts and test equipment. Separate maintenance contract and maintenance advisory service contract available to purchasers of UNIVAC Systems.

**Government Sample**

Army Map Service
Approximate price of basic system was $600,000. This price does not reflect present purchase price of similar equipment, as this equipment was purchased by contract negotiated before first machine was built.

Bureau of the Census
$2,500/month for card to tape converter.
$2,500/month for High Speed Printer (Internal Revenue Service)

David Taylor Model Basin

<table>
<thead>
<tr>
<th>Item</th>
<th>Price Paid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic system</td>
<td>$935,000</td>
</tr>
<tr>
<td>Plotter</td>
<td>21,000</td>
</tr>
<tr>
<td>Hi-Speed Printer</td>
<td>185,000</td>
</tr>
<tr>
<td>Card-to-Tape Converter</td>
<td>125,000</td>
</tr>
<tr>
<td>2 Unitypers I</td>
<td>36,000</td>
</tr>
</tbody>
</table>
2 Unprinters 36,000
1 Unityper II 4,000

**Industrial Sample**

The Franklin Institute
Approximate price of basic system was $950,000.
Approximate price of additional equipment $355,000.
Installation cost of $150,000 includes the
construction of a Computation Exhibit as well as the
Computing Center.

The Franklin Life Insurance Company
Approximate cost of basic system was $900,000.
Approximate cost of high speed printer $100,000.

University of California Radiation Laboratory
Approximate cost of basic system was $860,000
Approximate cost of high speed printer 130,000
Approximate cost of Unityper II 5,500

**PERSONNEL REQUIREMENTS**

Manufacturer
The number of engineers, technicians, and operators
required depends upon the equipment complement of the
UNIVAC system and the shift operation.

Government Sample
Army Map Service
Three 8-hour shifts require 2 engineers, 5 technicians
and 6 operators. The total staff is 60 persons,
including programmers, computer and auxiliary equip-
ment operators and maintenance crews.

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**Bureau of the Census**

Two computers are operated on a 168-hour/week basis.
Present staff consists of 5 engineers, 15 electronic
technicians, and 15 operators.

**David Taylor Model Basin**

For three 8-hour shifts, 3 engineers and 11 techni-
cian-operators are required to operate two Univacs
and maintain one.

**Industrial Sample**

The Franklin Institute
One 8-hour shift requires 1 engineer, 4 technicians
and 1 operator.

The Franklin Life Insurance Company
For three 8-hour shifts, 5 days a week, 3 engineers,
4 technician-operators, and 2 non-technical
operators are required.

New York University, AEC Facility
For three 8-hour shifts, 3 to 4 engineers, 13
technicians and operators, and several other categor-
ies of personnel are required, such as typewriter
mechanic, stock supervisor, clerical, etc.

**Pacific Mutual Life Insurance Company**

**Daily Operation**

<table>
<thead>
<tr>
<th>Engineers</th>
<th>Technicians</th>
<th>Operators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

Figures are minimum requirements, based on having
one high speed printer and 15 Unitypers II, in
addition to the 10 Uniservos.
RELIABILITY AND OPERATING EXPERIENCE

Manufacturer
Reliability and operating experience are based on several years records. Using the formula "Available Operating Time" minus "Lost Time" divided by "Scheduled Operating Time", cumulative performance of the UNIVAC I Central Computers averages 93.0% for the past year.

Government Sample
Army Map Service
Good time: 11,952 hrs (115 hrs/week, avg)
Attempted to run time: 13,403 hrs (129 hrs/week, avg)
Operating ratio (Good/Attempted to run): 0.892
Figures based on period 1 January 1955 to 31 December 1956.
Acceptance test: April 1952.
Approximately 22 hrs/week scheduled preventive maintenance is not included. Best 3 month period, July-September 1955, operating ratio was 0.944
Last 6 month period, (July-December 1956), operating ratio was 0.921.

Bureau of the Census
Average error-free running period: Approximately 19 min, average for both computers during 1956.
Good time: 11,361 hours
Attempted to run time: 14,440 hours
Operating ratio (Good/Attempted to run): 0.77
Figures based on period 1 January 1956 to 31 December 1956.
Acceptance test: 2nd computer accepted 4 February 1955.
In addition to the attempted to run time given above, 1,539 hours were scheduled and used for maintenance and engineering changes.

David Taylor Model Basin
Average error-free running period: 8 hours
Figures based on period January 1954 to October 1956
Acceptance test: August 1953.
Average efficiency: 87%
Scheduled production: 112 hours/week.

E. I. du Pont de Nemours and Company
Average error-free running period: 168.6 minutes
Good time: 3,707 hours
(Scheduled minus Down Time minus All Lost Time)
Attempted to run time: 3,895 hours
Operating ratio (Good/Attempted to run): 0.95
Figures based on period 23 December 1955 to 20 December 1956.
Acceptance test: 10 April 1955.
Circuitry for an "I" instruction will be added.
A storage breakpoint feature will also be incorporated.

The UNIVAC I will be converted to a UNIVAC II System
in the near future.

The Franklin Life Insurance Company
In the near future, consideration will be given to
the use of a UNIVAC II or two UNIVAC I Systems.

New York University, AEC Facility
The addition of two new instructions is in progress.
They are a "sorting" instruction and a generalized
comparison instruction.

A number of modifications have been made to
facilitate the engineering trouble shooting and
program debugging.

A high speed digital-to-analog converter and graph
plotter has been constructed and is in use.

Pacific Mutual Life Insurance Company
System to be replaced by UNIVAC II when available.

INSTALLATIONS

Government Sample
Bureau of Census, Department of Commerce,
Washington 25, D. C.

Office of the Air Controller, Headquarters U. S.
Air Force, Washington 25, D. C.

Army Map Service, 6500 Brooks Lane, Washington
16, D. C.

Bureau of Ships, Department of the Navy,
Washington 25, D. C.

Wright Patterson Air Force Base (AMC), Air
Material Command, Dayton, Ohio

Bureau of Census, Federal Office Building No. 3,
Sault, Michigan

University of California, Radiation Laboratory,
Standard, California

Air Material Command, Sacramento, California

Air Material Command, Fort Worth, Texas

Gentilly

Industrial Sample
New York University (AEC), 45 Fourth Avenue,
New York, New York

University of California (AEC), Radiation
Laboratory, 500 P. O. Box 800, Livermore, California

Electronic Computing Center, Remington Rand,
315 Fourth Avenue, New York, New York

General Electric Company, 510 West Liberty Street,
Louisville, Kentucky

Metropolitan Life Insurance Company, One Madison
Avenue, New York 10, New York

United States Steel, National Tube Division,
520 William Penn Place, Pittsburgh, Pennsylvania

E. L. du Pont de Nemours and Company, Louisvile
Building, Wilmington, Delaware

United States Steel, Gary Steel Works, Chicago,
Illinois

Franklin Life Insurance Company, 812 South 6th
Street, Springfield, Illinois

E. R. A., 1900 W. Minnehaha Avenue, St. Paul 4,
Minnesota

Pacific Mutual Life Insurance Company, Box 6050,
Metropolitan Station, Los Angeles 55, California

Westinghouse Electric Company, 3 Gateway, P. O.
Box 2278, Pittsburgh 30, Pennsylvania

Electronic Computing Center, Remington Rand,
2601 Wilshire Blvd., Los Angeles, California

Chesapeake and Ohio Railroad, Terminal Tower
Building, Cleveland 1, Ohio

John Hancock Mutual Life Insurance Company,
200 Berkeley Street, Boston, Massachusetts

Consolidated Edison Company of New York
Metropolitan Life Insurance Company (2)

One Madison Avenue, New York 10, New York

Life and Casualty Insurance Company of Tennessee
Frankfurt Germany, Service Bureau

Sylvania Electric Products, Incorporated, Camillus,
ADDITIONAL FEATURES AND REMARKS

Manufacturer

Library and compiler routines for mathematical and commercial use and service routines for maintenance use are available to customers.

In addition to the checking circuits in the Central Computer, the CARD-TO-TAPE CONVERTER, the TAPE-TO-CARD CONVERTER and the HIGH SPEED PRINTER contain built-in checking features.

Design features which facilitate maintenance include accessibility of chassis through doors in the casework and accessibility of interwiring between chassis from inside.

Simultaneous reading, writing and computation are possible due to built-in buffer units.

UNIVAC may continue to compute while the reading, writing and rewinding operations are being performed.

Industrial Sample

The Franklin Institute

Pivoted tape wipers have been installed on each servo. The wipers feature a gauze roll which exerts a relatively constant force on the tape. The gauze may be changed easily when necessary by merely cutting off the soiled portion.

A function table board neon checking system has been installed. By pressing a button it is possible to quickly determine if any neon on this board have failed.

A new tape ring has been designed. Once inserted in the tape reel it never has to be removed. Positioning of the tape reel when mounting it or at any other time will determine whether it can or cannot be written upon. In conjunction with this, a warning neon has been installed under the servo switch on each servo. This neon lights when a tape can't be written upon. It gives positive proof of this because it indicates to the operator that the no-write micro-switch has been engaged.

The Franklin Life Insurance Company

In addition to the main computer, a high speed printer is maintained by personnel mentioned above. (See PERSONNEL REQUIREMENTS, above). Two additional operators are required for 24 hour operation. The printer is a Remington Rand 600 line/minute unit, utilizing 1,500 vacuum tubes.