WHIRLWIND I

The Whirlwind Computer

MANUFACTURER

Massachusetts Institute of Technology, Digital Computer Laboratory

Picture by Massachusetts Institute of Technology, Digital Computer Laboratory

APPLICATIONS

Manufacturer
Scientific and engineering computation. The research reported in this computing system description was sponsored by the Office of Naval Research.

NUMERICAL SYSTEM

Binary digits per word	16
Binary digits per instruction	16
Instructions per word	1
Instructions decoded	32
Instructions used	29
Arithmetic system	Fixed point
Instruction type	One address
Number range	$2^{-15}-1$ to $1-2^{-15}$

ARITHMETIC UNIT

	Includ. Stor. Access Microsec	Exclud. Stor. Access Microsec
Add time	15	8
Mult time	34	23.5
Div time	64	57

Construction	Vacuum tubes
Basic pulse repetition rate	1 Megacycle/sec
Arithmetic mode	Parallel
Timing	Synchronous
Operation	Concurrent

STORAGE

Media	Words	Microsec Access
Magnetic Core	6,144	1
Two Magnetic Drums	36,848	8,300
Five Magnetic Tapes	125,000/tape	
Toggle Switch	32	1
Flip-flop	5	1

A word consists of 16 digits plus a parity digit. Read-rewrite time is 7 microseconds. Drum access time is average value. Magnetic tape packing is 210 words/inch.

INPUT

Media	Speed
Ferranti Photo Reader	200 lines/sec
Mechanical Tape Reader	14 lines/sec
Magnetic Tape	30 in/sec

The Ferranti photoelectric paper tape reader is normally used for input.

OUTPUT

Media	Speed
Magnetic Tape	188 char/sec
Oscilloscope-camera	200 char/sec
Flexowriter	10 char/sec

Magnetic tape is normally used for delayed Flexowriter output.

CIRCUIT ELEMENTS ENTIRE SYSTEM

Tubes	7,850
Tube types	40
Crystal diodes	14,000
Magnetic cores	104,448

Of the 7,850 envelopes, there are 9,950 cathodes. The cores are used in core memory only. Of the 40 tube types, 16 are used in the power supplies only.

CHECKING FEATURES

Fixed

Arithmetic element checks, parity checks of core memory and magnetic drums, and information transfer checks.

Optional

Marginal checking is done one hour daily to determine if any computer circuits have deteriorated during the past 24 hours.

POWER, SPACE AND WEIGHT

Power, computer	160 KVA	
Power, air cond.	130 KVA	
Space, computer	4,400 cu. ft.	625 sq. ft.
Spece, air cond.	4,200 cu. ft.	525 sq. ft.
Weight, computer	20,000 lbs.	
Weight, air cond.	16,000 lbs.	
Capacity, air cond.	132 Tons	

PRODUCTION RECORD

Produced	1
Operating	1

PERSONNEL REQUIREMENTS

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

RELIABILITY AND OPERATING EXPERIENCE

Average error-free running period 19.4 hours
Good time 3,172.3 hours
Attempted to run time 3,237.9 hours
Operating ratio (Good/Attempted to run) 0.98
Figures based on period 15 May 1956 to 24 Sep 1956
Acceptance test 1950

INSTALLATIONS

Digital Computer Laboratory, Massachusetts Institute of Technology, Cambridge 39, Massachusetts

ADDITIONAL FEATURES AND REMARKS

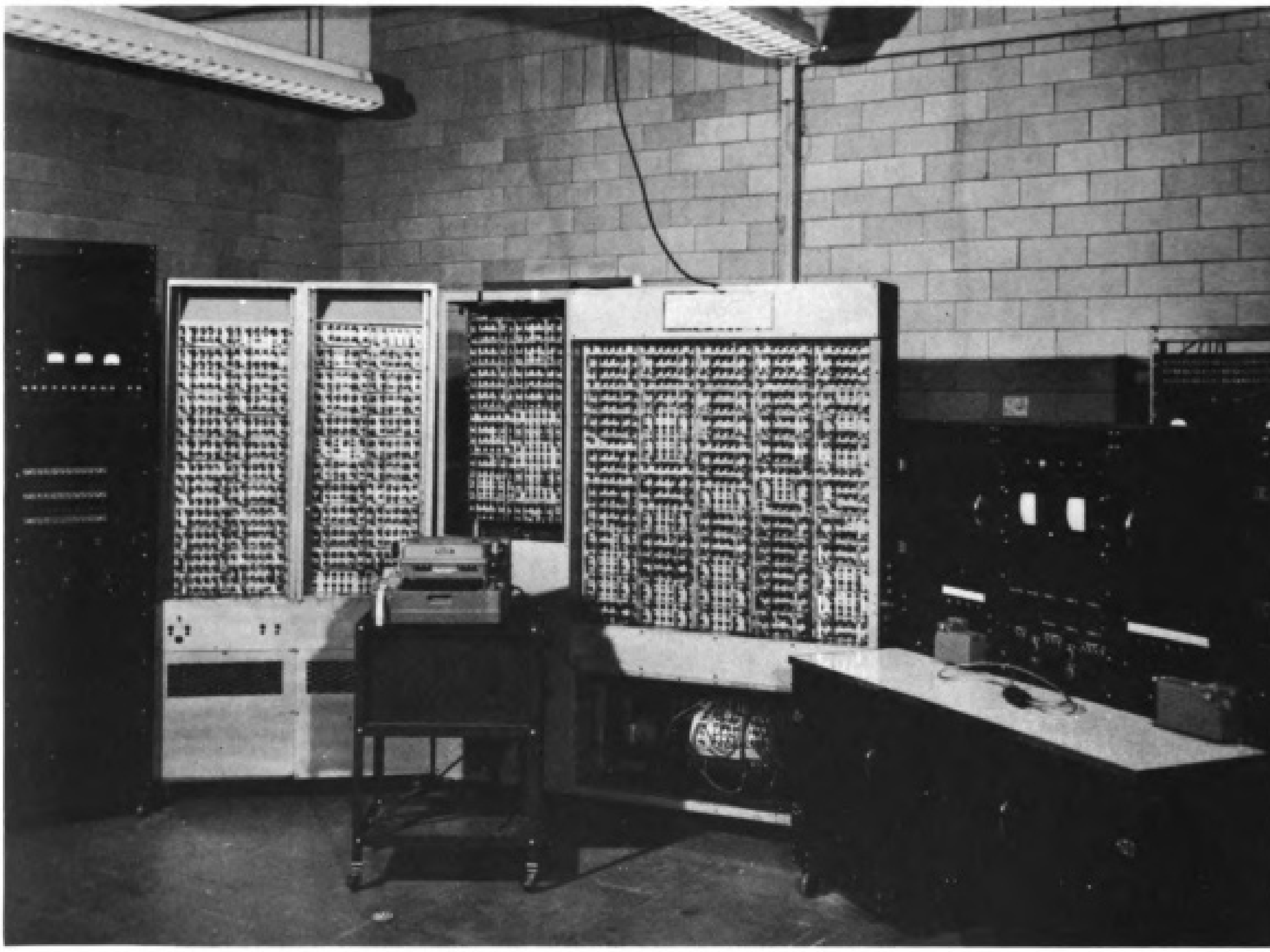
The basic operation code has been supplemented by a comprehensive system of service routines, providing for direct read-in of Flexowriter-coded perforated paper tapes, the logging of each problem on film and paper tape for subsequent processing, assembly during read-in of a suitable set of instructions including interpretive programmed-arithmetic (optional floating point), up to several hundred cycle counters (B-boxes), output routines, error detection, and automatic post mortems.
Routines are normally coded with mnemonic operations, symbolic addresses, relative addresses, program preset parameters, special psuedo-codes, and special control words.
The service routines are stored on magnetic tape and are selected automatically during read-in.

WISC

Wisconsin Integrally Synchronized Computer

MANUFACTURER

College of Engineering
University of Wisconsin



Picture by The University of Wisconsin

APPLICATIONS

General purpose scientific and engineering computation, engineering experimentation and training.

NUMERICAL SYSTEM

Internal number system	Binary
Binary digits per word	50
Binary digits per instruction	50
Instructions per word	1
Instructions decoded	16
Instructions used	16
Arithmetic system	Floating point
Instruction type	Three address
Number range	40 binary digits times $2^{\pm 255}$

ARITHMETIC UNIT

	Includ Stor Access Microsec
Add time	16,700
Mult time	16,700
Div time	16,700

Construction	Vacuum tubes
Rapid access word registers	7
Basic pulse repetition rate	100 Kc/sec
Arithmetic mode	Serial
Timing	Synchronous
Operation	Sequential

Operations are carried out on four instructions simultaneously (Integral Synchronization) resulting in efficient use of access time. Floating point makes efficient use of otherwise long addition time.

STORAGE

Media	Words	Digits	Microsec Access
Magnetic Drum	1,024	51,200	0 - 16,700
Magnetic Drum	4	550	
Magnetic Drum	3	440	

INPUT

Media	Speed
Punched Paper Tape	10 sexadec char/sec
Flexowriter Keyboard	Manual

OUTPUT

Media	Speed
Punched Paper Tape	10 sexadec char/sec
Flexowriter Typewriter	10 sexadec char/sec
Oscilloscope Monitor	

CIRCUIT ELEMENTS ENTIRE SYSTEM

Tubes	1,800
Tube types	3
Crystal diodes	350
Separate cabinets	4

Tube types include 6J6, 12AU7, 6AQ5 and special purpose equivalent. Eight additional tube types are used in power supply and voltage regulating circuits.

POWER, SPACE AND WEIGHT

Power, computer	10 Kw
Space, computer	160 cu. ft. 32 sq. ft.

PRODUCTION RECORD

Produced	1
Operating	1

PERSONNEL REQUIREMENTS

Daily Operation	Engineers
1-8 Hour shift	1

Part time student assistants function as technicians.

INSTALLATIONS

The University of Wisconsin
College of Engineering
Madison 6, Wisconsin

ADDITIONAL FEATURES AND REMARKS

Extract instruction and floating point controls.

Remote control.

Digits in instructions corresponding to the sign of significant digits in numbers are not used in any instruction. Extract instruction is the only instruction which makes use of digits corresponding to exponent in numerical data.

System is financed by the Wisconsin Alumni Research Foundation and the University of Wisconsin, College of Engineering.

Design was governed largely by striving for simplicity of operation.