

# SEAC

Standards Electronic Automatic Computer  
General Purpose Scientific Calculator

## MANUFACTURER

National Bureau of Standards  
U. S. Department of Commerce



Picture by National Bureau of Standards

### APPLICATIONS

General data processing, scientific calculation and engineering development.

### ARITHMETIC UNIT

Internal number system	Binary
Binary digits per word	44 plus sign
Binary digits per instruction	45
Instructions per word	1
Instructions decoded	16
Instructions used	16
Arithmetic system	Fixed Point
Instruction type	Three or four address
Number range	- (4 - 2 <sup>-42</sup> ) to + (4 - 2 <sup>-42</sup> )

### NUMERICAL SYSTEM

	Incl. Stor. Access Microsec	Exclud. Stor. Access Microsec
Add time	192 - 1,540	48
Mult time	2,300 - 3,600	2,112
Div time	2,300 - 3,600	2,112
Construction	Germanium diodes, delay lines, pulse transformers	
Rapid access word registers		3
Basic pulse repetition rate		1 Megacycle/sec
Arithmetic mode	Serial	
Timing	Synchronous	
Operation	Sequential	



Picture by National Bureau of Standards

### STORAGE

Media	Words	Digits	Microsec Access
Acoustic (Mercury)	1,024	49,152	216 (avg)
Electrostatic (CRT)	1,024	49,152	12
Magnetic Tape	24,000	$52 \times 24 \times 10^3$	bits/ unit

Ampex or Potter units store  $6 \times 10^5$  words/unit or  $48 \times 6 \times 10^5$  bits/unit. Magnetic tape speed is 60 feet/sec. Average effective access time to electrostatic storage is 60 microsec. Acoustic and electrostatic storage may be used together in computation.

### INPUT

Media	Speed
Keyboard (Flexowriter)	Manual (Max 10 char/sec)
Paper Tape (Flexowriter)	10 Char/sec
Paper Tape (Potter)	150/600 char/sec (Photoelectric)
Magnetic Wire (Pierce)	65 words/sec (New unit)
Magnetic Tape	135 words/sec (Single Channel)
Magnetic Tape	4,500 words/sec (Multichannel)
Punched Card	330 char/sec

### OUTPUT

Media	Speed
Printer (Flexowriter)	10 char/sec
Paper Tape (Flexowriter)	10 char/sec
Paper Tape (Teletype)	58 char/sec
Paper Tape (Soroban)	240 char/sec
Magnetic Wire (Pierce)	65 words/sec
Magnetic Tape	135 words/sec
Magnetic Tape	4,500 words/sec

### CIRCUIT ELEMENTS ENTIRE SYSTEM

Tubes	2,229
Tube types	34
Crystal diodes	23,271
Magnetic cores	783
Transistors	3
Separate cabinets	29

6AN5 and 6AK5 used permanently. Magnetic cores used in delay lines.

### CHECKING FEATURES

Fixed  
Parity check for acoustic storage.  
Parity check for electrostatic storage.

## POWER, SPACE AND WEIGHT

Power, computer	24 KVA
Power, air cond.	5.76 KW 7.2 KVA 0.80 PF
Space, computer	680 cu. ft. 85 sq. ft.
Space, air cond.	77 cu. ft. 17 sq. ft.
Weight, computer	3,000 lbs. (Central Machine)
Weight, Air cond.	1,500 lbs.

Dimensions of computer are 5 x 17 ft. Air conditioner measures 77 x 31 x 56 inches. Floor space for computer control console, memories and auxiliaries is 1,386 sq. ft. Floor space for air conditioner and power supplies is 225 sq. ft.

## PRODUCTION RECORD

Produced	1
Operating	1

## PERSONNEL REQUIREMENTS

Daily Operation	Engineers	Tech and Operators
3-8 Hour shifts	5	7

Approximately 30 mathematician-coders operate the machine. The engineering staff spends approximately one half of their time on engineering development of machine modifications and new auxiliary equipment.

## RELIABILITY AND OPERATING EXPERIENCE

Average error-free running period	3 hours
Good time	4,877 hours
Attempted to run time	5,786 hours
Operating ratio (Good/Attempted to run)	0.83
Figures based on period	26 Aug. 55 to 14 Sept. 56
Acceptance test	May 1950

The above figures are for system reliability and include the SEAC and all its auxiliary equipments.

## INSTALLATIONS

National Bureau of Standards  
U. S. Department of Commerce, Washington 25, D. C.

## ADDITIONAL FEATURES AND REMARKS

System has two counter registers which may be used for program sequencing and address base numbers.  
See DYSEAC



# SWAC

National Bureau of Standards  
Western Automatic Computer

## MANUFACTURER

National Bureau of Standards  
U. S. Department of Commerce



Picture by National Bureau of Standards

### APPLICATIONS

General purpose scientific computation, research in numerical analysis computing methods.

sign. The fourth address controls an optional jump and selects the auxiliary devices.

### NUMERICAL SYSTEM

Internal number system	Binary
Binary digits per word	37 incl. sign
Binary digits per instruction	36
Instructions per word	1
Instructions decoded	13
Instructions used	13
Arithmetic system	Fixed point
Instruction type	Four address
Number range	- $(1 - 2^{-36})$ to $+(1 - 2^{-36})$

Binary point lies between sign and most significant digit. Arithmetic is done with absolute value and

### ARITHMETIC UNIT

	Incl. Stor. Access Microsec	Excl. Stor. Access Microsec
Add time	64	5.3
Mult time	368	296
Div time	Not a logical operation	
Construction	9 tubes/register	
Rapid access word registers	3	
Basic pulse repetition rate	125 Kc/sec	
Arithmetic mode	Parallel	
Timing	Synchronous	
Operation	Sequential	

Auxiliary equipment asynchronous, computer halts and waits for signal. The storage access time includes the 4th address reference. There are 37 parallel registers in the arithmetic unit (three input adders). System uses simultaneous carry and static storage of the addend and the augend. Germanium diodes (semi-conductors) for logical "and" and "or" circuitry.

### STORAGE

Media	Words	Digits	Microsec Access
Electrostatic (CRT)	256	9,984	8
Magnetic Drum	8,192	311,296	17,000

The regeneration time on the electrostatic storage unit is 8 microseconds. The drum access time is given for a 64-word block transfer. The drum transfers in blocks of 64, 32, 16 or 8 words. Average time of transfer for less than a 64 word block is 13,000 microsec.

### INPUT

Media	Speed
Punched Cards (IBM)	240 cards/min
Keyboard	Manual

Eleven words may be punched on each card. The keyboard is adapted for code checking.

### OUTPUT

Media	Speed
Punched Cards	100 cards/min
Tabulator (IBM 402)	80 lines/min
Typewriter	30 words/min

Twenty-four words per card may be punched on output. The tabulator is a decimal output device, printing 72 characters per line.

### CIRCUIT ELEMENTS ENTIRE SYSTEM

Tubes	2,500
Crystal diodes	4,000
Separate cabinets	4

Figures are approximate. The 4 cabinets do not include input-output equipment.

### CHECKING FEATURES

#### Fixed

No interlocks or transfer checks are used.

#### Optional

Parity check on drum transfers is controlled by a toggle switch. Breakpoints may be stored on non-commands to halt machine when loss of control occurs.

### POWER, SPACE AND WEIGHT

Power, computer	30 - 35 KW
Power, air cond	20 HP
Space, computer	System occupies a room 17 x 31 ft.
Capacity, air cond.	Two 10-Ton units and a 5,000 cu. ft./min. fan.

### PRODUCTION RECORD

Produced	1
Operating	1

### COST, PRICE AND RENTAL RATE

Approximate cost of basic system \$400,000  
Rental rates of additional equipment

IBM equipment \$750/month  
The rental charge for use of the computer and auxiliary equipment is \$40/hour. The rental rate does not apply to use of peripheral equipment when not connected to the computer. Such additional use is free.

### PERSONNEL REQUIREMENTS

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

The 3 technical operators are utilized half-time. Undergraduates are hired for technicians, engineers are full time. Programmers are trained as operators of the computer, and are expected to diagnose computer failures as an aid to the maintenance of the system.

### RELIABILITY AND OPERATING EXPERIENCE

Average error-free running period	25 minutes
Good time	796 hours
Attempted to run time	938 hours
Operating ratio (Good/Attempted to run)	0.85
Figures based on period	1 April 56 to 30 June 56
Acceptance test	March 1951

### FUTURE PLANS

It is proposed to replace the electrostatic memory with a magnetic core system, employing non-destructive read-out. Auxiliary equipment to be added includes a high-speed printer, of 600 lines/min., and two magnetic tapes of the Uniservo Type.

A systematic replacement of the selenium power supply rectifiers with silicon is being undertaken. At a longer range, expansion of the memory to a capacity of 16,000 words, all magnetic core, is being planned, but design will not be completed for many months.

### INSTALLATIONS

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Department of Mathematics  
Numerical Analysis Research  
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