DATAKEEPER 1000

Ford Instrument Datakeeper 1000 Computing System

MANUFACTURER

Ford Instrument Division of Sperry-Rand Corporation

APPLICATIONS

Manufacturer

Inventory control, machine loading and scheduling, employee time control, reservations. In general, the Datakeeper Computer can be utilized effectively in applications which require the rapid processing of large amounts of random data (Electronic sorting and accumulating).

NUMERICAL SYSTEM

Internal number system	Binary coded decimal
Decimal digits per word	10
Arithmetic system	Fixed point
Instruction type	One address
Number range	0 to $10^{10}-1$

ARITHMETIC UNIT

		Microsec
Add time (exclud. stor. access)		330
Add time (includ. stor. access)		33,000
Construction	Magnetic cores and germanium diodes	
Arithmetic mode	Serial by dec digits and parallel by bits	
Timing	Synchronous	
Operation	Concurrent	

STORAGE

Media	Words	Digits	Microsec Access
Magnetic Drum	1,000	10,000	33,000

INPUT

Media

Remote Transmitters
Keyboard
Tape Reader
Card Reader

Up to 50 remotely located transmitters can be utilized with each computer.

OUTPUT

Media	Speed
Punch Tape	1 dec dig/66 millisec
Visual Display	1 dec dig/132 millisec
Page Printer	1 dec dig/198 millisec

Any "word" on the drum can be displayed at any time by means of the visual display.

CIRCUIT ELEMENTS ENTIRE SYSTEM

Tubes	160
Crystal diodes	664
Magnetic cores	105

CHECKING FEATURES

Power, computer	1.5 KW
Weight, computer	620 lbs.

RELIABILITY AND OPERATING EXPERIENCE

Manufacturer

Average error-free running period 100 hours

INSTALLATIONS

Ford Instrument Company
Division of Sperry-Rand Corporation
Long Island City 1, New York

ADDITIONAL FEATURES AND REMARKS

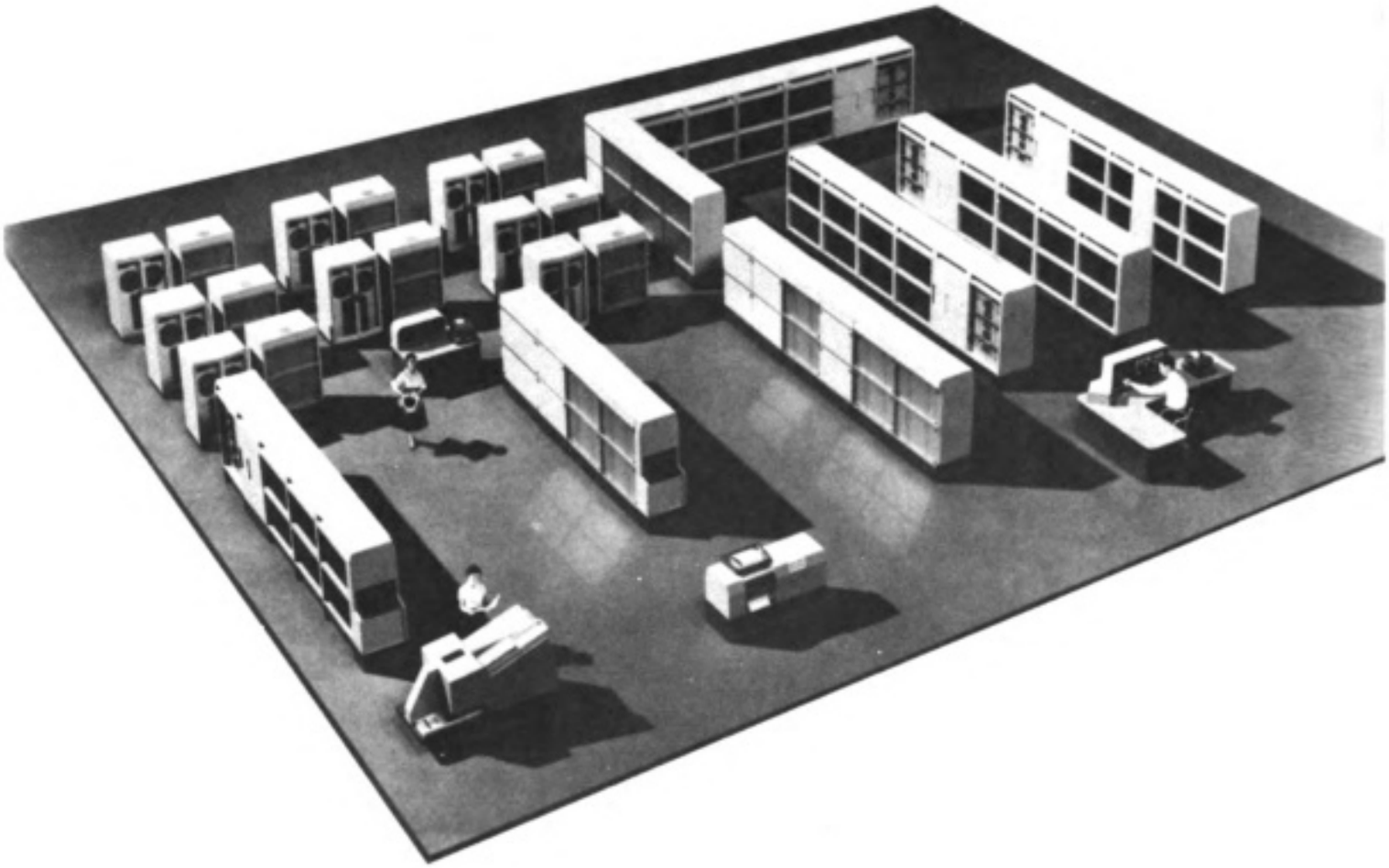
Remote transmission of input
Fixed program
Up to 10 drums can be utilized for increased storage capacity.

DATAMATIC 1000

DATAmatic 1000 Electronic Data Processing System

MANUFACTURER

DATAmatic Corporation



Picture by DATAMATIC Corporation

APPLICATIONS

Commercial (business) and scientific application.

NUMERICAL SYSTEM

Internal number system	Bin coded dec and coded alphanumeric
Decimal digits per word	12
Alphanumeric digits per word	8
Decimal digits per instruction	12
Instructions per word	1
Instructions decoded	1
Arithmetic system	Fixed point
Instruction type	Three address (normal) Four address (subsequence operation)
Number range	0-9, 0-16 and 0-64

Floating point operation may be programmed.

ARITHMETIC UNIT

	Incl. Stor. Access Microsec	Exclud. Stor. Access Microsec
Add time	230.4	58
Mult time	1,008	835
Div time	2,304	2,131
Construction	Vacuum tube amplifiers, crystal diode logic and packaged type construction.	
Rapid access word registers	7	
Arithmetic mode	Serial	
Timing	Synchronous	
Operation	Sequential	

System is primarily sequential. Transfer of information to and from the high speed storage unit is concurrent. The operation times given above under "Including Storage Access" include checking time. The capacity of the accumulator is 11 decimal digits with sign in addition and subtraction or 22 decimal digits with sign in multiplication and division.

Parallel reading and writing of 31 channels on magnetic tape with serial handling of bits comprising each character and word. Access to high speed storage is parallel. Arithmetic operations are serial. Decimal digits are in binary coded decimal, alphanumeric characters are in a six-bit code.

STORAGE

Media	Words	Decimal Digits	Microsec Access
Magnetic Cores	2,000	24,000	12
Magnetic Cores	248	2,976	20
Magnetic Tape		37,200,000/reel	

Description of magnetic tape unit - plastic, 3 inches in width; reel length, 2,700 feet. Magnetizable material is sandwiched between layers of plastic to protect recorded information and increase tape life. Information on tape is recorded across 31 channels. Effective or net information rate is 60,000 decimal digits a second or 40,000 alphanumeric characters a second.
Tape speed is 100 inches a second both forward and reverse.
The maximum number of tape units possible is 100.

INPUT

Media	Speed
Punched Cards	900 cards/min (Input Converter)
Paper Tape	10 char/sec (via Console)
Keyboard	Manual (via Console)
Magnetic Tape	60,000 dec dig/sec (On line tape units)

OUTPUT

Media	Speed
Punched Cards	100/min (Output Converter)
Printing	900 lines/min (Output Converter)
Paper Tape	10 char/sec (via Console)
Magnetic Tape	60,000 dec dig/sec (On line tape units)
Character-at-a-Time	10 char/sec (Console Typewriter)
Paper Tape	Input Converter (available May '58)
Paper Tape	Output Converter (available May '58)

CIRCUIT ELEMENTS ENTIRE SYSTEM

Tubes	3,600
Tube types	Type 6145 and other computer quality types
Crystal diodes	60,000
Magnetic cores	117,000
Transistors	500

The above figures are for the Central Machine.

Separate Cabinets 10 Types (building block units)

Size of installation is dependent on application. Up to 100 magnetic tape units may be used in on-line operation.

CHECKING FEATURES

Fixed
Every word contains checking digits. Transfer weight count check. Arithmetic weight count check. Special circuit checking. Selection and order verification checking.

Optional
Blank column and multiple punch column detection is under control of the operator of the Input Converter.

Other
Marginal checking circuitry included in addition to the above.

POWER, SPACE AND WEIGHT

Power, computer	110 KVA	0.86 PF
Power, air cond.	60 KVA	0.82 PF
Space, computer	550 sq. ft.	
Space, air cond.	Built-in	
Weight, computer	35 Tons	

The above weight and power figures include 10 magnetic tape installations. Space figure excludes aisles and work areas. The total is 4,500 sq. ft.
The clear space to ceiling is 8ft. 3 in.
Recommended floor space 40 by 100 feet (for minimum installation).
Voltage requirements - 208 volts, 3 phase, 60 cycle.
Cooling - air cooling with a total of 75 gpm of cooling water required.
Air conditioning - no requirements of user; proper conditioning requirements integral with machine.
Floor loading - less than 125 pounds per square foot.

PRODUCTION RECORD

In production	2
On order	4
Delivery time	12-18 Months

Four systems are scheduled for production in 1957.
Eight systems are scheduled for 1958.

COST, PRICE AND RENTAL RATE

Approximate cost of basic system $985,000
Approximate cost of additional equipment $600,000
Rental rates of basic system $21,500/Month
Rental rates of additional equipment $12,000/Month

PERSONNEL REQUIREMENTS

Daily Operation	Engineers	Technicians
1-8 Hour shift	1	2
2-8 Hour shifts	2	4
3-8 Hour shifts	3	6

Operators are excluded in the above figures.

FUTURE PLANS

Soon to be announced are:
Paper tape to magnetic tape conversion.
Magnetic to paper tape conversion.
Communication links.
Magnetic ink to magnetic tape conversion.

INSTALLATIONS

The following have ordered systems:
Michigan Hospital Service, Detroit, Michigan
First National Bank of Boston
Minneapolis-Honeywell Regulator Company

ADDITIONAL FEATURES AND REMARKS

Certain features are available or included for satisfying the needs of business:

Sorting Speed	60,000 dec dig/sec
File Scanning Speed	600,000 dec dig/sec
100 Tape Capacity	3.72×10^9 dec dig
Input-Output Speed	60,000 dec dig/sec

Simultaneous reading, writing, and computing.

A typical DATAmatic 1000 system contains the follow-

ing elements:
Input Converter
Magnetic File(s)
File Reference Device
Output Converter
Central Processor
Central Console
Each of these elements is described below.

Input Converter

A transcription device known as the Input Converter (Type 1200) is used to convert source data in the form of punched cards into recorded data on magnetic tape. The Input Converter feeds, translates, edits and arranges format for nine hundred fully punched cards per minute.

In the operation of the converter, the punched cards are loaded into the feeding mechanism in quantities up to 3,000 cards at a time, and are then automatically fed sequentially through three stations. The first two stations are used to read and check data from cards and the information is immediately recorded on magnetic tape. At the third station, a serial number is printed on each card. This number is known as the "continuous sequence number" and is used as an index for filing the cards thus eliminating the time consuming job of arranging source data for future reference.

This automatic number assignment and the comparison reading check are the first two of a series of reliability and accuracy features which are inherent in the DATAmatic system. The input converter operates independently of all other system elements, which means that input, output and central processing can take place simultaneously on separate procedures.

Magnetic Tape

The DATAmatic 1000 uses a three-inch wide magnetic tape of heavy duty construction. There are thirty-one recording channels on the tape which may be used simultaneously. An extraordinary amount of data can be stored on each tape reel of 2,700 feet. Actually, one reel of tape can store 37,200,000 decimal digits of information, which is the equivalent of data that would require 465,000 punched cards. Data on the tape can be erased selectively or totally by controlled programs and the tape can be reused many times for new or changed data.

Since the recording surface of conventional magnetic tape is normally subject to some deterioration from manual handling as well as from contact with the recording head, special techniques have been employed to prevent tape damage. A unique sandwich type construction shields the recording surface between two layers of plastic thus preserving it in handling as well as reducing the amount of friction encountered between the tape and the recording head. This sandwich construction has proved to be so satisfactory that life tests in which the tape has been manually handled freely and passed beneath the recording head over ten million times have failed to show any appreciable signs of corrosion or wear on either the recording head or the tape. Furthermore, no loss of information signals has been encountered.

Magnetic File

The Magnetic File (Type 1100) handles magnetic tape for five principal functions:
Record data on magnetic tape from the input converter
Read data from magnetic tape to the output converter
Read data from magnetic tape to the File Reference Device
Transfer data to the Central Processor
Record data from the Central Processor

Volume of transactions and complexity of operations govern the number of Magnetic Files used in a DATAmatic system. The "building block" plan is followed. For moderate sized installations only a few units are needed - but for very large, multiple application installations, as many as 100 Magnetic Files with a capacity of billions of digits can be actively engaged in a single system. A single Magnetic File is capable of reading or recording as many as 60,000 decimal digits or 40,000 alphanumeric characters per second. This is not a peak reading rate but a rate of continuous information flow which can actually be realized. Magnetic tape moves under the reading - recording head at 100 inches per second and can be scanned while the tape is moving in either direction.

File Reference Device

Any Magnetic File can be referred to or interrogated without disturbing the rest of the system by means of an auxiliary unit known as the File Reference Device (Type 1150). This unit is used to control a particular Magnetic File from which it is desired to extract specific information such as, account number, work order or item cost. The record or any desired portion of it is printed out by means of the File Reference Device's self-contained printer.

Output Converter

The Output Converter (Type 1300) has two principal functions, both of which are associated with the transfer of data from the Magnetic Files. These are:
Conversion of magnetic recordings to printed records and reports
Conversion of magnetic recordings to standard punched cards

In both functions the output is edited and format is governed automatically by the converter, this feature eliminates many conventional central processor operations usually needed to condition data for output.

Punched card output will be achieved at the rate of 6,000 cards per hour. Two speeds of electro-mechanical printed output will be available, which are:
150 lines of 120 characters maximum per minute
600 to 900 lines of 120 characters maximum per minute

Central Processor

The Central Processor performs two principal functions, which are:
Automatic Sequential Control of Processing Operations
Data Manipulation, (Sorting, Merging, Automatic Operations)

Physically, it contains the electronic elements and circuitry for carrying out, at high speeds, the stored programs. The fast and reliable internal memory system is composed of magnetic cores with a capacity of 24,000 decimal digits. Four 62 - word buffers are provided for efficient input and output. Access to memory is in parallel and time for reading a word is approximately 10 microseconds.

Searching for items on tape may be accomplished automatically under Central Processor control with the scan being performed on as many as ten magnetic tapes simultaneously. This scanning is performed under the control of standard machine instructions and at the rate of as much as 600,000 decimal digits per second. The availability of buffer storage makes possible the performance of searching while other central machine operations are in progress.

The Processor is especially designed for high-speed sorting, merging and file maintenance. Some examples of sorting speeds are:
Sort - 60,000 decimal digits per second (equivalent of 750 fully punched cards per second)
Merge - 60,000 decimal digits per second
File Search - 600,000 decimal digits per second

Central Console

The supervision and master control of the System is exercised through the Central Console (Type 1090).

This unit also enables the operator to communicate directly with any element of the system under contrd of the Processor when required for diagnostic purposes, and receive printed answers to any interrogation of the machine. Under normal operation the Central Console permits monitoring of the machine. It monitors the condition of key components in the system and permits the location of potential trouble before it actually occurs.

Building Blocks

Each unit in the DATAmatic 1000 System is an individual "building block". Enough building blocks are integrated into a system to handle the requirements of the records being processed. However, if the work load increases or new applications are developed, additional units can be added. Conversely, if the work load should diminish, units may be removed from the system.

This building block principle is followed within system units which are constructed of small individual packages which contain a limited number of components. These packages may be plugged into the system or removed as required. Consequently, when there is an indication on the Central Console of some component weakening, the package containing the declining component can simply be removed and replaced with a spare package.

Services

The DATAmatic Corporation provides the following services to prospective customers and users at no charge:

Assistance in feasibility surveys and application analysis.

Training schools for programmers and coders.

Instruction manuals including routines for automatic programming.

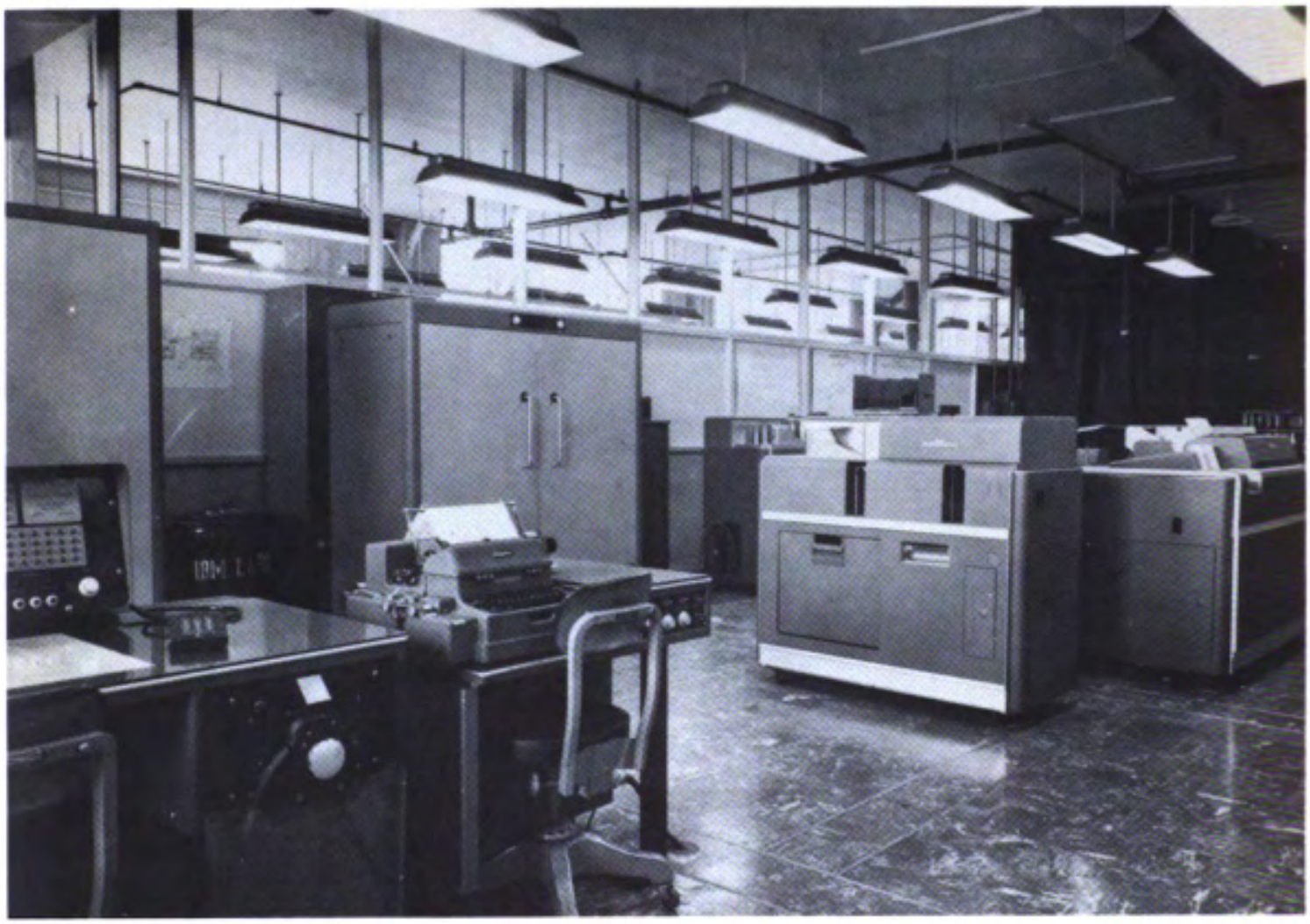
Field service on leased equipment.

If the user elects to purchase equipment outright, his maintenance personnel will be trained at the DATAmatic factory, or service contracts will be arranged. Fully tested magnetic tape is stocked at the factory and sold to users as needed.

DATATRON

DATATRON Electronic Data Processing System

ElectroData Division
Burroughs Corporation



Picture by Wright-Patterson Air Force Base, Ohio

APPLICATIONS

Manufacturer
Designed specifically to cope with the full range of electronic computing problems in the fields of business, industry, science and government.

Government Sample
Naval Air Test Center
Technical and scientific data processing.
Naval Ordnance Laboratory, Corona, California
Missile evaluation-data processing.
Ordnance Tank - Automotive Command
Engineering.
U. S. Navy Hydrographic Office
Scientific computations in oceanography, navigation, etc. and business applications in inventory control, cost accounting, etc.
Wright-Patterson Air Force Base
Scientific.

Industrial Sample
American Bosch-Arma Corporation
Systems analysis, systems design and data reduction.
California Research Corporation
Problems arising from petroleum research and development.
JPL - California Institute of Technology
80% scientific calculations and 20% data processing.
Magnolia Petroleum Company
Application of applied mathematics to petroleum exploration and production research.
Nuclear Development Corporation of America
General purpose scientific computation.
Princeton Computation Center - Electronic Associates, Incorporated
Service computation.
Socony Mobil Oil Company, Incorporated
Technical, scientific, operations research.
Southern California Co-operative Wind Tunnel
Wind tunnel data reduction and related problems. Prime application is to provide on-line data reduction on a real time basis. The computer input can be taken directly from the wind tunnel output equipment

Picture by Naval Ordnance Laboratory, Corona, California

without resorting to any form of manual intervention or temporary storage media.

Great Lakes Pipe Line Company
50% business, 50% scientific.

NUMERICAL SYSTEM

Manufacturer
Internal number system Binary coded decimal
Decimal digits per word 10 plus sign
Decimal digits per instruction 2 to 10
Instructions per word One
Instructions decoded 83
Arithmetic system Floating and fixed point arithmetic units. The floating point control is a separate unit which can be purchased with Datatron depending on application. Fixed point arithmetic incorporated in central computer.
Instruction type One address

Number range Computer $+(1-10^{-10})$ to $-(1-10^{-10})$
Floating point unit $10^{-51} \leqslant N < 10^{49}$

Government Sample
Naval Air Test Center
Floating point control on order.

Naval Ordnance Laboratory, Corona, California
Floating point control on order.

U. S. Navy Hydrographic Office
2 instruction digits, 4 address digits, 1 breakpoint digit, 3 extra digits. No floating point. Convenient scaling command makes floating point programing quite easy.

Wright-Patterson Air Force Base
Floating point subroutine.

Industrial Sample
American Bosch-Arma Corporation
Has floating point.

JPL - California Institute of Technology
Fixed point.

Magnolia Petroleum Company
Floating point on order.

Nuclear Development Corporation
Fixed point.

ARITHMETIC UNIT

	Manufacturer	Microsec
(1)	Add (exclud. stor. access)	169 or 338
(2)	Add (includ. stor. access)	1,019 or 1,188
(3)	Mult (exclud. stor. access)	8,450 (mean)
(4)	Mult (includ. stor. access)	9,300 (mean)
(5)	Div (exclud. stor. access)	11,830 (mean)
(6)	Div (includ. stor. access)	12,680 (mean)

Construction Vacuum tubes and condenser-diodes
Rapid access word registers 6
Basic pulse repetition rate 142 Kc
Arithmetic mode Series parallel
Timing Synchronous
Operation Sequential

Additions per digit in division equal the value of

Picture by ElectroData - General Insurance Company of America

quotient digit plus 2. Additions per digit in multiplication equal value of accumulator digit (multiplier).

Government Sample

Naval Air Test Center

Operation time including storage access time is considered the average time required using high speed loops for access of command, operand and actual operation time. Operation times are, given in order as above (1) 170, (2) 2,500, (3) 1,376-16,856, (4) 10,800, (5) 1,850-20,210, and (6) 14,000.

Ordnance Tank - Automotive Command

The average operation times, on the basis of 4 word and 40 word-times are, respectively (1) 190, (2) 1,040, (3) 6,500, (4) 2,540, (5) 10,000, (6) 11,040. Binary information is handled in parallel and decimal information is handled serially. Arithmetic unit construction requires 1,157 tubes and 3,800 crystal diodes.

U. S. Navy Hydrographic Office

When including order access and operand access, operation times, respectively, are (1) 500, (2) 2,200, (3) 9,000 aver., (4) 10,700, (5) 13,000 aver., (6) 14,700. The adder is serial. Words are transferred in parallel.

Industrial Sample

American Bosch-Arma Corporation

Random average operation time is 1,600 microseconds.

Nuclear Development Corporation

Operation time excluding storage access time is, respectively, (1) 170, (3) 1,376-16,856, (5) 1,850-20,210. Times are given for multiplication (and division) by zero to multiplication (and division) by 9,999,999,999.

Princeton Computation Center - Electronic Associates, Incorporated

Operation times are given as, respectively, (1) 170, (2) 2,000, (3) 1,376-16,856, (4) 8,500, (5) 1,850-20,000, (6) 10,100.

STORAGE

Manufacturer Media	Words	Digits	Microsec Access
Magnetic Drum	4,080	40,800	850
Magnetic Tape	400,000	4,000,000	240,000,000
Data File	2,000,000	20,000,000	24,000,000

4 High-speed 20-word drum loops
4,000-word intermediate-speed main drum memory

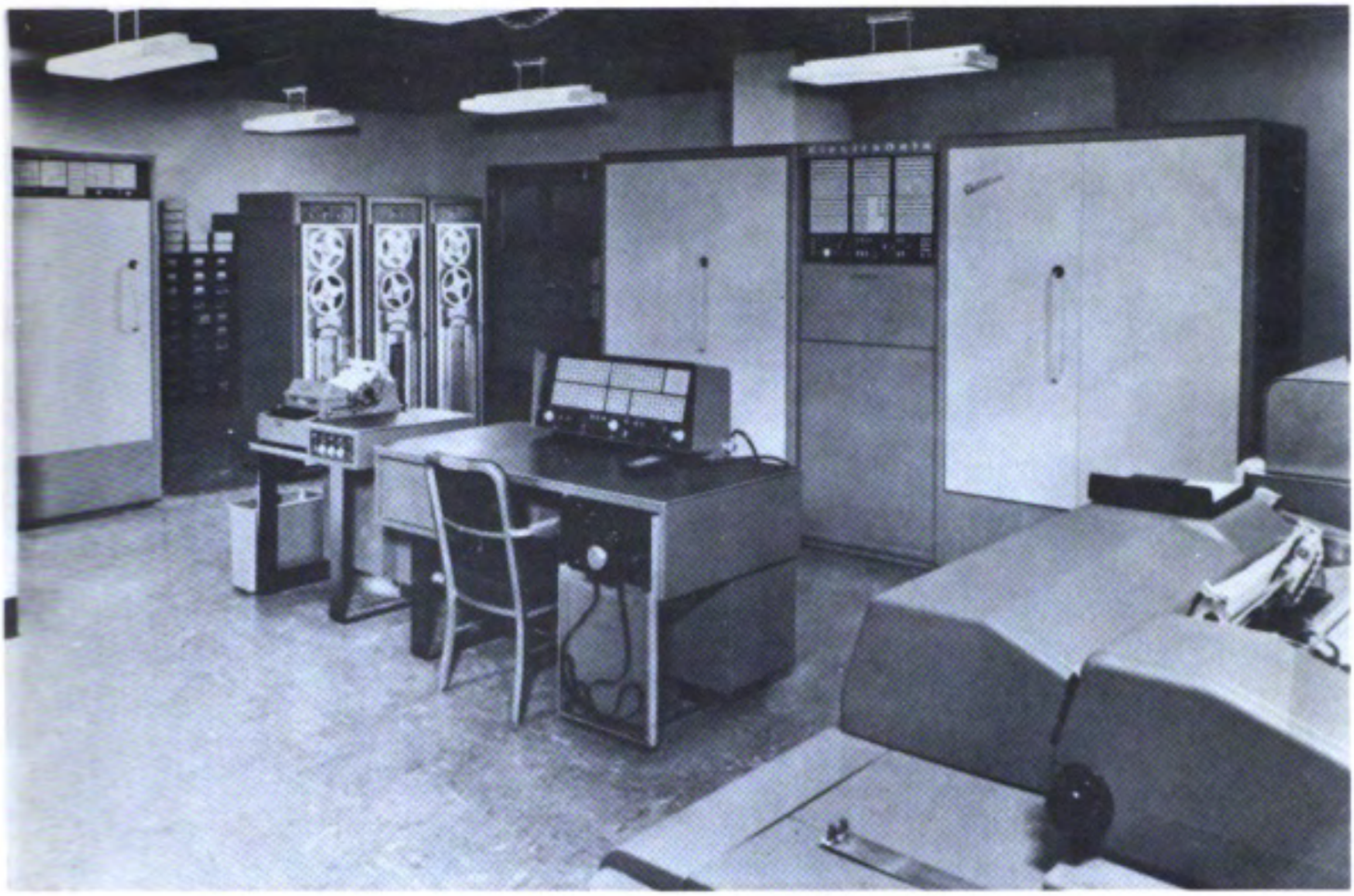
Government Sample

Naval Air Test Center

Up to 10 magnetic tape units can be used. Each unit stores 400,000 10-digit words in addressable blocks of 20 words. Independent block search at 60 in/sec on 2,500 ft. tape is used.

Ordnance Tank - Automotive Command

Magnetic drum main memory access time is 8,500 microseconds average.



Picture by ElectroData - Allstate Insurance Company, Skokie, Illinois

Industrial Sample
Magnolia Petroleum Company
Two magnetic tape transports used.
Nuclear Development Corporation
Installation has 2 tape units.

INPUT

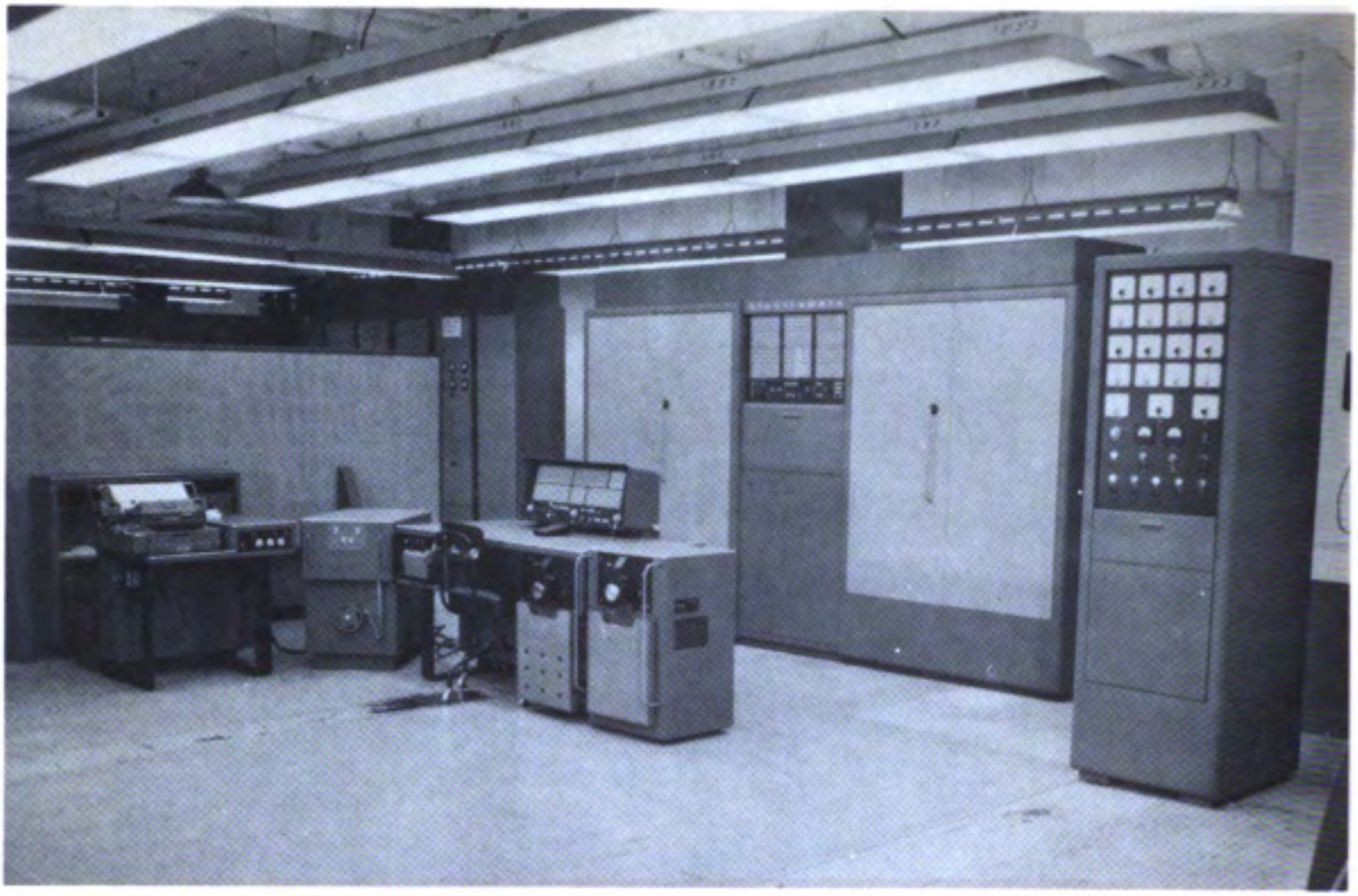
Manufacturer Media	Speed
Paper Tape	540 dig/sec
Keyboard	Manual
Magnetic Tape	6,000 dig/sec
Cards	21,120 dig/min, ea. reader

Up to 7 card readers can be used with DATATRON.
Magnetic tape speed is 46 millisec per block, 20 words/block.
Additional Input Systems in Use:
Government Sample
Naval Ordnance Laboratory, Corona, California
2 Cardatron input units on order.
Ordnance Tank - Automotive Command
Photo and mechanical reader, 540 and 10 char/sec respectively, 6 channel tape.
U. S. Navy Hydrographic Office
IBM 528 200 cpm card reader on order.
Industrial Sample
Magnolia Petroleum Company
Paper tape reader rated excellent. Punched card system seldom used.
Southern California Co-operative Wind Tunnel
IBM 528 Reproducer, 200 c/min normal use is 5 words per card for instructions, 80 columns for wind tunnel data; IBM 517 gang Summary Punch, 100 c/min, on-line reader, 80 columns of data.

OUTPUT

Manufacturer Media	Speed
Electric Typewriter	10 char/sec
Paper Tape	60 dig/sec
Magnetic Tape	6,000 dig/sec
Cards	1,800 char/min

Up to 7 printers may be used with system.
Up to 7 punch card machines may be used at one time.
Additional Output Systems in Use:
Government Sample
Naval Ordnance Laboratory, Corona, California
2 Cardatron output units on order, Tallyplotter at 20 points per second manufactured by Tally Register Company, Seattle, Washington.
U. S. Navy Hydrographic Office
Line printer 150 lines/min. max., Flexowriter 5 or 10 char/sec (half-speed for alphabetic).
Wright-Patterson Air Force Base
407 IBM Tabulator 150 lines/min.
Industrial Sample
Great Lakes Pipe Line Company
Paper tape 60 dig/sec, cards 100 c/min IBM 514,



Picture by Jet Propulsion Laboratory - California Institute of Technology, Pasadena, California

Line Printer 150 lines/min IBM 407.
Magnolia Petroleum Company
IBM 416 Tabulator 150 lines/min.
Socony Mobil Oil Company
IBM 402 Tabulator 100 lines/min.
Southern California Co-operative Wind Tunnel
IBM 528 Reproducer 100 c/min, normal use is 80 digits of output, IBM 416 Numerical Account Machine 150 lines/min, normal use is 80 digits per line.

CIRCUIT ELEMENTS ENTIRE SYSTEM

Manufacturer Central Computer

Tubes	Approx. 1,202
Tube types	Approx. 3,176
Resistors	Approx. 10,000
Tube types	Primarily 5963, 12BH7, 5965 2D21, 5881

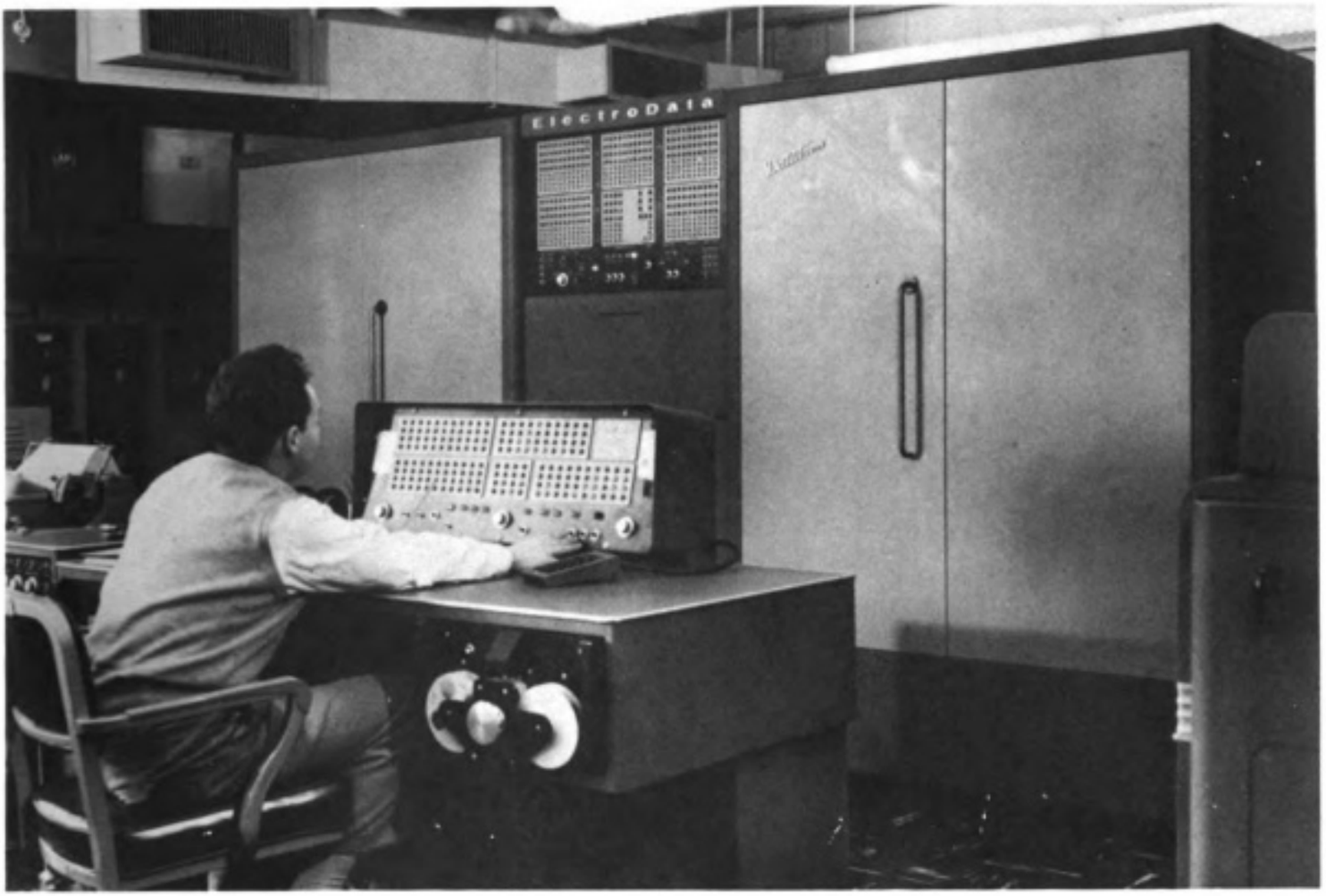
Separate cabinets Maximum 24

Government Sample
Naval Ordnance Laboratory, Corona, California
Complement consists of computer, console, typewriter control, punch card converter, power supply, tape control unit, 2 tape storage units, and Tally Plotter. On order are floating point, additional power supply, 5 Cardatron cabinets (1 Control, 2 Inputs, 2 Outputs), and a Datafile Bin.
Naval Air Test Center

Tubes	1,500
Tube types	14
Crystal diodes	3,500

CHECKING FEATURES

Manufacturer
Fixed
DATATRON automatically stops upon the appearance of an unanticipated overflow. An alarm light is turned on and computation is stopped by a forbidden combination (binary-coded decimal digits 10 through 15) in the A, B, D and R registers, the address register, control counter, and shift counter. Inspection of the registers on the control panel indicates the failure location. An alarm stops the computer if the storage cell counted does not contain all zeros at the start of each drum revolution. This prevents information from being recorded on or read from incorrect locations on the drum.
An audible alarm indicates excessive rise in exhaust air temperature in the computer cabinet. After a preset interval, up to 15 minutes, DC voltage will be shut off if the temperature stays at or above a predetermined level.
Optional
The marginal voltage test panel facilitates selective lowering of voltages in registers and control section which, in conjunction with test routines, can detect marginal components before they give trouble in actual operation. Supervisory test panel on front of computer has extensive controls and



Picture by Arthur D. Little, Cambridge, Massachusetts

check features, including access to any flip-flop for manual setting, substitution of manual or low frequency pulse operation for the drum clock, and a switch panel which allows maintenance personnel to force abnormal register behavior and to inhibit certain normal checking functions for diagnostic purposes.
Contents of all registers are displayed simultaneously at all times.
Checking features in use:

Government Sample

Naval Air Test Center
Forbidden combination, word storage position check, selective voltage marginal checking panels, tape parity, tape search, read-write check, defective tape check.

Naval Ordnance Laboratory, Corona, California
Standard Datatron checks.

Ordnance Tank - Automotive Command
Marginal check panel providing means to vary filament and bias voltages, with switching arrangements to isolate to selected circuit groups; test oscillator for frequency variation allows asynchronous operation; switches for checking of selected operations; diagnostic routines.

U. S. Navy Hydrographic Office
Stop on forbidden combination (binary coded decimal digit greater than 9) anywhere in arithmetic unit.

Wright-Patterson Air Force Base
Forbidden combination, sector alarm, parity check on tapes, overflow, tape summing devices, break-point.

Industrial Sample

JPL - California Institute of Technology
Automatic stop on unallowed binary coded digits greater than 9.

Nuclear Development Corporation of America
Forbidden combination, word storage position check, selective voltage marginal checking panels, tape parity, tape search, read-write check, defective tape check.

POWER, SPACE AND WEIGHT

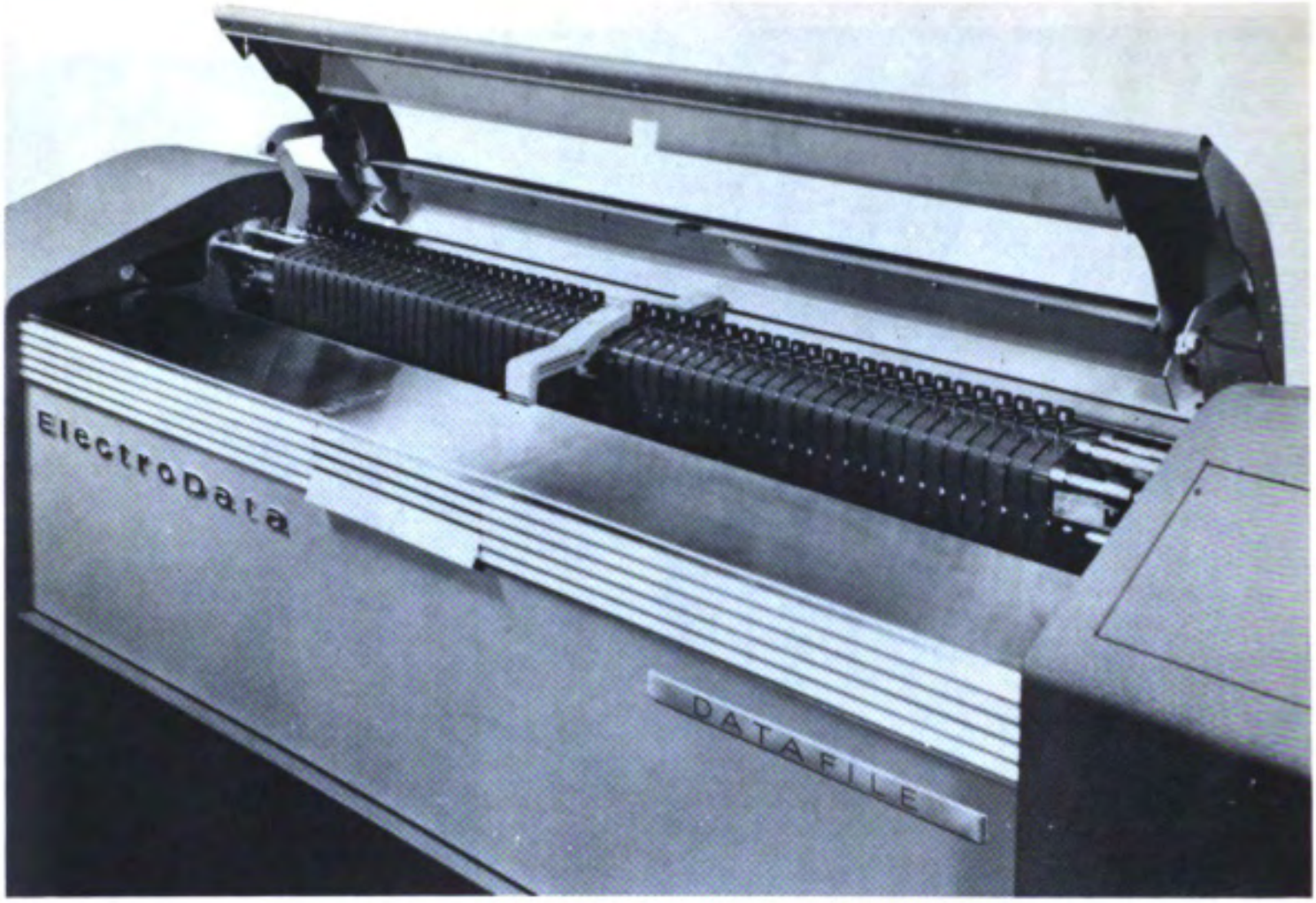
Manufacturer

Power, computer	16.5KVA	
Space, computer	181 ft.^{3}	28 ft.^{2}
Weight, computer	3,175 lbs.	

Amount of air conditioning depends upon size of computer system installed. For every 12,000 BTU/hr. generated by the system one ton of refrigeration is recommended. Environmental conditions should also be taken into consideration.

Government Sample

Naval Air Test Center
The computer requires 29.1 KVA (including M-G set, console, and tape control), 182 cu. ft., 28 sq. ft.; measures 144 by 28 by 78 inches, and weighs 3,440 lbs. The air conditioner requires 9.7 KW; 142.4 cu. ft.; 17.7 sq. ft.; measures 82-1/4 by 31 by 96-9/16 inches; weighs 2,400 lbs. and has a 10-Ton capacity. The weight of the system, including output devices,



Picture by ElectroData Corporation, Pasadena, California

tape control and tape unit, power control and voltage regulator, but not the motor-generator or air conditioner is about 6,100 lbs. The same equipment uses about 70 sq. ft. of floor area and is housed in a room of 437 sq. ft.

U. S. Navy Hydrographic Office
Installed in room 26 by 40 ft.

Wright-Patterson Air Force Base
Computer power factor 0.9, 16.04 KVA, requires total space of 10,500 cu. ft., 750 sq. ft., and weighs 7,358 lbs. Air conditioner requires 12.433 KVA, p.f. 0.9, requires total 2,100 cu. ft., 150 sq. ft., weighs 6,000 lbs. and has a capacity of 15-Tons.

Industrial Sample

California Research Corporation
Capacity of air-conditioner is 7-Tons.

Princeton Computation Center
Computer power 37 KVA, air conditioner 32 KVA, capacity of air conditioner 17-Tons.

Socony Mobil Oil Company
Standard 10-Ton Carrier "Weathermaker" air conditioning unit takes care of computer and building heat load.

PRODUCTION RECORD

Manufacturer

Produced	48
In production	20
Operating	48
On order	30
Delivery time	6 to 12 Months, depending on system ordered.

COST, PRICE AND RENTAL RATE

Manufacturer
The information listed is for general guidance in selecting DATATRON electronic data processing machines. A variety of systems may be assembled, incorporating punched card or perforated tape input, punched card, perforated tape, typewriter or tabulating machine output, and auxiliary high-capacity storage in the form of magnetic tapes. All prices are subject to change without notice. Under the ElectroData lease plan the DATATRON computer may be combined with various accessory equipment to provide alternate means of input-output, and various capacities of auxiliary storage. All rentals are subject to change without notice and all equipment is leased only as part of data processing system.

Unit	Price	Rental Rate Dollars/Month
DATATRON Digital Computer Model 205	$135,000	$3,900

Includes cabinet, plug-ins, and 12-inch magnetic drum with read-write heads for 4,080-word memory. Also includes Magnetic-Electronic Power Supply and Power Control Units.

Control Consoles
All consoles, of standard office-desk size, contain

the decimal keyboard, displays of the computer registers, and computer and system controls. In all consoles, the right desk-drawer position will accommodate a Photoelectric Reader.

Photoelectric Reader: Reads a 6-hole code from Flexowriter tape at the rate of about 540 decimal digits per second.

High Speed Tape Punch: Perforates paper tape under control of the computer at the rate of 60 decimal digits per second. It is mounted in a separate cabinet and connected to the console by a single cable.

Control Console Model 403 $7,050 $230

The 403 Console is the basic unit, neither the Photoelectric Reader nor the High Speed Punch are included.

Control Console Model 406 $14,210 $490

The 406 Console includes both the Photoelectric Reader and the High Speed Punch.

Control Console Model 409 $11,230 $362

The 409 Console includes a Photoelectric Reader.

Consolette Model 405 $1,980 $70

Table-top unit, contains decimal keyboard, essential controls and indicators of full console, but does not include neon-lamp displays of the registers.

Typewriter Control Model 446 $4,560 $137

Usable with all Consoles, the 446 includes the stand which supports the Flexowriter and contains external format control equipment and a relay translator.

Modified Flexowriter
Model 458 $3,135 $95

Incorporates the correct code for alphanumeric print-out under computer control; both a Tape Punch and a Tape Reader are attached to the Flexowriter. The Tape Reader may be used for slow input to the computer.

Tape Perforator and
Verifier Model 454 $3,790 $133

Includes a decimal keyboard, tape perforator, and tape reader. Used to prepare, verify, or automatically duplicate numeric perforated tape.

Numeric Code Converter
Model 460 $3,680 $110

Provides conversion, digit by digit, from one punched paper tape code to another. Includes a motorized tape reader, motorized tape punch, and two matrix cards (ElectroData to Teletype and Teletype to ElectroData code). Matrix card prices for other codes will be quoted separately on request.

External Switching and Output
Selector Model 420 $4,375 $155

Permits the 500 Punched Card Converter to operate with either an IBM tabulator or summary punch as selected by computer programming.

External Switching
Model 421 $2,890 $105

Provides selective switching to eight external sources as directed by the computer program. Includes computer conversion kit and external relay closures, but does not include the Output Selector Unit for use with the 500 Punched Card Converter.

Punched Card Converter
Model 500 $18,625 $567

Permits use, under computer control, of an IBM summary punch as input and an IBM tabulator or gang punch as output.

Cardatron Model 506

Buffer Control Unit and Auxiliary Power Supply.	$31,000	$770
Input Station	$22,500	$560
Output Station (80 character) . .	$26,300	$660
Output Station (120 character). .	$27,550	$690

(maximum number of stations: seven)

Permits simultaneous high-speed communication between standard punched card machines and the 205 Computer. Alphabetic, special, and numeric characters may be intermixed in any manner.

Magnetic Tape Control
Model 543 $25,000 $750

Master control system which provides electronic control for up to 10 Datareader units.

Datareader Model 544 $12,000 $375

Magnetic tape storage unit includes read-write heads and tape drive mechanism and operates under control of 543 Tape Control Unit. Reel type storage accommodates up to 2,500 feet of tape. Capacity: maximum 400,000 ten-digit (decimal) words, addressed in 20-word blocks.

Datafile Model 560 $25,000 $825

Multiple magnetic tapes for data storage under control of the 543 Magnetic Tape Control Unit. Includes drive mechanism for fifty lengths of tape (one hundred logical tapes), partitioned bin, and read-write heads. Tapes are brought out over guide rods and the two recording heads are servo positioned under the selected tape. Up to 12,500 feet of tape in a single Datafile gives a capacity of two million ten-digit words, addressed in 20-word blocks.

Floating Point Control
Model 360 $21,200 $725

Provides automatic floating point arithmetic for the operations of addition, subtraction, multiplication, and division.

Outline of Sale Policy

Guarantee and Installation Policy

Except for expendable items, such as tubes, diodes, fuses, lamps, and neon indicators, all equipment is guaranteed for one year against defective material or workmanship. The purchase of DATATRON data processing machines includes the following: Necessary sets of coding, operational, and maintenance manuals, the services of trained personnel to supervise installation in the purchaser's plant and to conduct operation demonstration, and prescribed training of the purchaser's employees by qualified ElectroData instructors in programming, operation and maintenance procedures and techniques. NOTE: The purchaser may contract for the additional services of a staff of qualified programmers, mathematical analysts and engineers, and for time on the DATATRON system at the ElectroData Computing Center to further improve his specific utilization of the equipment.

Maintenance Service: Maintenance service on a continuing, periodic, or on-call basis is available by contract through a staff of qualified service engineers stationed in major cities across the country.

Terms of Sale: Net 10 days from date of invoice. Prices for machines requiring an operational demonstration are payable 80% upon delivery to a common carrier, 20% upon completion of installation. Prices are F.O.B. factory, Pasadena, California. Handling, shipping, and insurance charges will be borne by the purchaser. Sales, use, or other taxes imposed directly on the sale of ElectroData machines by Federal, State, or local governments will be borne by the purchaser. A standard ElectroData Corporation sales agreement covering all purchase terms is executed at the time of sale.

Outline of Lease Policy

A standard ElectroData Corporation lease agreement covering all leased equipment and terms and incorporating substantially the following provisions, will be executed at the time of leasing: The rental agreement is effective for one year from the date installation of the equipment is complete, and

remains in effect thereafter until terminated by either party upon three months' written notice. ElectroData provides maintenance service as required to keep the machines in good operating condition. The lease price includes personal property tax and insurance coverage on the machines; all additional taxes are paid by the lessee. Transportation costs on machines from and to ElectroData's plant in Pasadena will be paid by lessee. Machines under lease may be purchased at any time at the prices in effect at the time such option is exercised, less a credit of 40% of all rentals paid, up to a maximum of 60% of the purchase price. ElectroData furnishes prescribed training of customer employees in programming, and operating procedures and techniques. NOTE: Additional services of a staff of qualified programmers, mathematical analysts and engineers and time on the DATATRON system at the ElectroData Computing Center to further improve specific utilization of the equipment may be contracted for.

Government Sample

Ordnance Tank - Automotive Command
Basic system $156,000; tape control $25,000; data reader $12,000; tape file $25,000.

U. S. Navy Hydrographic Office
Basic system $135,000; control console $7,050-14,210; Flexowriter and control $7,695; card converter $18,625; magnetic tape control $25,000; magnetic tape transport $12,000; Cardatron $53,500-up. Rental Rate = (Purchase Price + 10%)/36.

Wright-Patterson Air Force Base
Basic system $139,582; additional equipment $74,670 (Magnetic tape and card converter); Rental IBM 407 and 528 $802; additional rental IBM 519, 552, 024, 523, 082 $475.

Industrial Sample

American-Bosch Arma Corporation
Basic system $140,000; all additional equipment in Arma facility $360,000.

Nuclear Development Corporation
Basic system $200,000.

Southern California Co-operative Wind Tunnel
$5,000/month, single shift for computer and input-output equipment; approximately $250/month, single shift, for accessory equipment and tunnel output equipment.

Princeton Computation Center
Basic system cost $200,000, $8,000 per month rental rate basic system and $600 per month additional equipment. System is rented.

PERSONNEL REQUIREMENTS

Manufacturer

ElectroData

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

Engineers are for maintenance only. Tech/Operators are for an average size system.

Government Sample

Naval Air Test Center
One engineer required. A one shift day is sufficient for usual needs. Overtime is scheduled as it is needed. The computer installation is maintained by a full time company maintenance engineer who is on call for emergency service if more than one shift is needed. Because of the recruiting problem, the mathematicians and mathematics aides of data reduction groups write and debug programs and operate the computer for their own work.

Naval Ordnance Laboratory, Corona, California
For three 8-hour shifts, 2 engineers and 5 technicians or operators are used, which includes operation of associated input-output devices. In addition, approximately 10 persons are engaged in programming, etc.

Ordnance Tank - Automotive Command
For one 8-hour shift, 1 engineer and 1 technician used for maintenance.

U. S. Navy Hydrographic Office
One 8-hour shift, 1 engineer, 2-3 technicians.
Two 8-hour shifts, 2 engineers, 3-4 technicians.
Three 8-hour shifts, 3 engineers, 4-5 technicians.

Wright-Patterson Air Force Base
One 8-hour shift, 2 engineers, 1 operator, 9 mathematicians, 3 technicians, 1 secretary. Second shift worked 1/4 year, above personnel split up to cover this shift. WCTEF (Data Processing Section, Facility and Data Branch, Test Engineer Division, Directorate of Flight and All-Weather Testing), works a 2nd shift only when work load is too great for one shift.

Industrial Sample

American Bosch-Arma Corporation
One 8-hour shift, 10 engineers, 3 technicians
Two 8-hour shifts, 15 engineers, 6 technicians
Three 8-hour shifts, 17 engineers, 8 technicians
Personnel engaged in other activities.

California Research Corporation
One 8-hour shift, 6 engineers, 2 technicians.

JPL - California Institute of Technology
Two 8-hour shifts. During day shift, the machine is operated by members of the mathematical staff. Two operators are employed at night. Maintenance is carried out by staff primarily concerned with other engineering development. Time required is about 12% of an engineers time and 20% of a technicians time. There is no night maintenance.

Great Lakes Pipe Line Company
One 8-hour shift, 1 engineer, 2 technicians or operators. Programmers operate equipment at present, however, a computer operator will be used shortly.

Magnolia Petroleum Company
One 8-hour shift, 7 technologists, 3 technicians or operators. 8-hour shift plus overtime.

Nuclear Development Corporation
One 8-hour shift, 1 engineer, 3 technicians
Two 8-hour shifts, 2 engineers, 4 technicians
Three 8-hour shifts, 3 engineers, 5 technicians.

Socony Mobil Oil Company
Two 8-hour shifts, 1 engineer for maintenance, 1 technician per shift, 7 analysts and programmers, 3 non-degree operators, card punchers.

Southern California Co-operative Wind Tunnel
One 8-hour shift, 4 engineers, 1 operator, shift starts between 6:30 AM and 8:00 AM. Second 8-hour shift starts at 4 PM with one engineer and one operator or technician. Totals are 226 hours per week of salaried labor (supervisor and programmer), 96 hours per week of hourly labor, (machine operators). Computing service is provided from 6:30 AM until Midnight, 6 days per week.

RELIABILITY AND OPERATING EXPERIENCE

Manufacturer

ElectroData Division
Average error-free running period greater than 95%, based on customer reports to ElectroData.

Government Sample

Naval Air Test Center
Good time 1,330 hours, attempted to run time 1,400

hours, operating ratio (Good/Attempted to Run) 95%, preceeding figures based on period from 1 February 1956 to 30 September 1956. System passed customer acceptance test 23 January 1956. Scheduled preventive maintenance is 1 hour per day. Down time used to compute operating ratio includes time not available for use as result of failure in any of the equipment including input and output devices.

Naval Ordnance Laboratory, Corona, California
Respectively as above, 53.4 hours, 90 hours, 59.3% from 1 January 1956 to 15 September 1956.

Ordnance Tank - Automotive Command
Respectively 655.5 hours, 680 hours, 96%, 23 July 1956 to 16 November 1956, 23 July 1956.

U. S. Navy Hydrographic Office
Operating ratio 94.3%, based on period from 1 July 1956 to 1 October 1956, acceptance test passed 29 June 1956.

Wright-Patterson Air Force Base
Respectively 1,463.75 hours, 1,964.66 hours, 74.50%, 1 December 1955 to 30 September 1956, acceptance January 1955. Summary of figures: 1,964.66 hours attempted to run, 1,463.75 good problem time, 462.56 hours scheduled preventive maintenance, 38.55 hours unscheduled maintenance, 345.53 hours modification and auxiliary installation time not included in attempted to run time.

Industrial Sample

American Bosch-Arma Corporation
Respectively 109 hours/week, 110 hours/week, 99%, February 1955 to December 1955, acceptance passed February 1955.

California Research Corporation
Respectively 480 hours, 505 hours, 95%, July 1956 to October 1956, 18 July 1956.

JPL - California Institute of Technology
Respectively 2,506 hours, 2,602 hours, 96%, January 1956 to October 1956, August 1955.

Magnolia Petroleum Company
Acceptance passed March 1956. On the average unscheduled maintenance time has been less than 5% out of a total of 6,000 hours of DC time.

Nuclear Development Corporation
Operating ratio is 71%, period from May 1956 to October 1956, acceptance in May 1956, average error free running time is 10 hours.

Socony Mobil Oil Company
Operating ratio is 90%, period from July 1956 to September 1956, acceptance passed on 20 December 1954, average error-free running period is 6 hours (obtained with difficulty).

Southern California Co-operative Wind Tunnel
Respectively 2,850 hours, 3,380 hours including unscheduled maintenance, 84.3%, 1 December 1955 to 31 October 1956, acceptance 4 October 1955. 84.3% of the time demand was placed upon the equipment, production was obtained, or the equipment was capable of producing good output. Records are maintained so as to show preventive maintenance, unscheduled maintenance, including lost time due to equipment failures and assumed good time.

ADDITIONAL FEATURES AND REMARKS

Manufacturer
The automatic address-modification features of the B-register, along with its automatic tally. Automatic editing provided by the format bands on Cardatron buffer drums, as well as freeing of the Computer as soon as information is transferred. This allows input, output, and processing to proceed simultaneously while card machines operate at a maximum rate. Independent search for permanently addressed blocks on magnetic tape, which allows processing of results of previous search while current search is going on. Ability to read from magnetic tape, update information, and write back on the same tape in the same position. Provision of high-speed through quick-access loops, which allows straightforward sequential coding and does not require complicated placement of instructions or data for minimal access.

Government Sample

Naval Air Test Center
The built-in B-register permits easy use of relative addresses for sub-routines and is very convenient for address modification and tallying. The four high speed loops into which blocks of twenty words can be transferred from the main memory, permit nearly all operations to be carried out at high speed. The visual display of the accumulator, operand and command registers is very convenient in code checking. Magnetic tape search is initiated by computer control but is carried out independent of the computer. A command word is made up of a two digit order, a four digit address, a one digit breakpoint or skip digit, three space digits which can be used for a tally and the sign position which is used to control paper tape and B-register modification.

Ordnance Tank - Automotive Command
Automatic coding can be programmed by means of SAC and DOTI routines, Datatron contains a B-register and photo-electric reader used as input device.

U. S. Navy Hydrographic Office
Scaling order, one B-box, paper tape input very fast, accurate, and convenient, addressable magnetic tape blocks are a superb advantage.

Wright-Patterson Air Force Base
System has A, B, D, and R registers and Flexowriter output, theodolite magnetic tape auxiliary input, auxiliary slow speed airborne magnetic tape playback input (Digital).

Industrial Sample

American Bosch-Arma Corporation
Installation has standard 4 high-speed loops, 1 B-box and optional magnetic tapes, floating point and high speed card converting equipment.

JPL - California Institute of Technology
Auxiliary Equipment: (1) Tape preparation unit for preparing, verifying, and duplicating tapes. This unit will also compare two supposedly identical tapes. (2) Punched tape operated word-at-a-time printer operating at a speed of 1.4 words/second with a format controlled both by the computer and by the carriage position of the printer. The computer has been modified to permit punching of tape for direct listing on a Flexowriter without using the ElectroData typewriter control unit.

Nuclear Development Corporation
One 4-digit B-box used for address modification and counting, four 20-word high speed drum loops increases standard drum access time by a factor of 10, floating point obtained by an automatic coding routine, which also supplies mathematical functions.

Princeton Computation Center
Following features are extremely helpful: B-box, quick access loop, movability of input to memory, addressability of tape storage.

Socony Mobil Oil Company
In addition to standard Datatron features, a Socony innovation consists of a monitoring system responsive to a "flag" digit in the instruction words if the "flag" switch is "ON".

Southern California Co-operative Wind Tunnel
Input-output system is straight numeric. The manufacturer altered their stock computer to allow input

or output of 80 decimal digits plus 30 signs (x - overpunches). The normal is 80 plus 8 signs. Input is selected manually from either an IBM 528 punch or from the punch magnets of the wind tunnel data recording IBM 517 punch, through a direct tie-line. Other features are standard.

FUTURE PLANS

Government Sample

Naval Air Test Center

A floating point unit is on order. Additional magnetic tape storage in the form of an additional Datareader, Model 544, or a Datafile, Model 560, is being considered for use as an input medium for telemetered or airborne digitized test data.

Naval Ordnance Laboratory, Corona, California

Scheduled for delivery in summer of 1957 are a Cardatron with 2 input and 2 output units, Floating Point Unit, Datafile Bin, and additional power supply.

Ordnance Tank - Automotive Command

Tape Control Unit, 2 Magnetic Tape Data Readers, Floating Point Unit and High-Speed Paper Tape Output Punch are to be added. A feasibility study will be made to determine if the Datatron can be integrated with an analog computer.

U. S. Navy Hydrographic Office

Cardatron to be delivered February 1957 and two additional tape (magnetic) units by end of 1957.

Wright-Patterson Air Force Base

A development contract is being sponsored to record digital airborne flight test instrumentation measurements on magnetic tape at a high speed (2,200 samples per second maximum rate or a 100 sample per second per transducer) and play the recorded magnetic tape directly back into the computer. Interest lies in point-to-point and line plotters using card input. Intensive efforts have not been expended in this field to date by Wright-Patterson Air Force Base.

Industrial Sample

Socony Mobil Oil Company

Delivery of Floating Point unit expected in November 1956.

Southern California Co-operative Wind Tunnel

On or about 1 January 1958, an Electrodata Cardatron Input-Output System is to be attached. This will include one input-output station and two output stations. A proposed speed-up of the data output of the wind tunnel will make the system inadequate for real time calculations on a per point cycle. Since the wind tunnel is not a continuous output device, it is intended to provide on-line (without manual intervention) services in primary areas of interest. It is anticipated that real time calculations on a run cycle basis (a run of 20 points) can be provided. The programming system will be one which has data artificially entered by subroutine action whenever the tunnel has data ready and which will automatically link two asynchronous devices (wind tunnel digitizing equipment and the computer). This is possible due to the fact that the higher speed device (the tunnel) periodically stops.

INSTALLATIONS

Southern California Cooperative Wind Tunnel, Pasadena, California.

Allstate Insurance Company, Skokie, Illinois

Jet Propulsion Laboratory, Pasadena, California

American Bosch Arma Corporation, Arma Division (2), Eglin Air Force Base, Florida

U. S. Naval Ordnance Laboratory, Corona, California

Magnolia Petroleum Company, Dallas, Texas

Socony-Mobil Oil Company, Incorporated (2), Paulsboro, New Jersey

Cornell Aeronautical Laboratory (2), Buffalo, New York

Purdue University, Lafayette, Indiana

Edwards Air Base, Edwards, California

Wright Air Development Center, Dayton, Ohio

Dow Chemical Company, Midland, Michigan

National Advisory Committee for Aeronautics (2), Moffett Field, California

Shell Development Company (2), Emeryville, California

General Insurance Company of America, Seattle, Washington

Babcock and Wilcox Company, New York City

Aerojet-General Corporation, Sacramento, California

Arthur D. Little, Incorporated (2), Cambridge, Massachusetts

U. S. Naval Air Station, Patuxent River, Maryland

United Gas Corporation, Shreveport, Louisianna

California Research Corporation, Richmond, California

Convair, Pomona, California

Phillips Petroleum Company, Bartlesville, Oklahoma

University of Dayton, Dayton, Ohio

Canadair Division, General Dynamics Corporation, Montreal, Quebec

McDonnel Aircraft Corporation, St. Louis, Missouri

University of Chicago, Chicago, Illinois

Westinghouse Electric Corporation, Research Laboratory, Pittsburgh, Pennsylvania

Nuclear Development Corporation of America, White Plains, New York

The M. W. Kellogg Company, New York, New York

Detroit Arsenal, Center Line, Michigan

Hydrographic Office, Suitland, Maryland

Sears Roebuck & Company, Chicago, Illinois

Great Lakes Pipe Lines Company, Kansas City, Missouri

The Ohio Oil Company, Denver, Colorado

American Machine & Foundry, Greenwich, Connecticut

California Institute of Technology, Pasadena, California

Babcock and Wilcox Company, Lynchburg, Virginia

Atomic Energy of Canada, Limited, Chalk River, Ontario, Canada

Certified Grocers of California, Limited, Los Angeles, California

General Petroleum Corporation, Los Angeles, California

Melpar, Incorporated, Boston, Massachusetts

The following information was received too late to be included in the above outline:

Edwards Air Force Base, Air Force Flight Test Center

The system is utilized for processing flight test data.

Reliability and operating experience:

Average error-free running period	110 hours
Good time	110 hours
Attempted to run time	120 hours
Operating ratio (Good/Attempted to run)	0.92

Figures based on period 10 September 1956 to December 1956.

Acceptance test May 1955.

National Advisory Committee for Aeronautics, Ames Aeronautical Laboratory, Moffett Field, California

Datatron System No. 107

Price of basic system was $120,000

Price of additional equipment $21,000

One engineer and three technician-operators are required. Programmers do most of the operating.

Reliability and operating experience:

Average error-free running period	12 hours
Good time	131.8 hours
Attempted to run time	328.7 hours
Operating ratio (Good/Attempted to run)	.40

Figures based on period 29 November 1956 to 3 January 1957.

Acceptance test April 1955.

The above figures are not representative for the total period of operation of this system, but are quite representative for the last six months. About 6% of the "attempted to run" time is scheduled maintenance.

Datatron System No. 128

Reliability and operating experience:

Average error-free running period	24 hours
Good time	289 hours
Attempted to run time	358.2 hours
Operating ratio (Good/Attempted to run)	0.81

Figures based on period 29 November 1956 to 3 January 1957.

Acceptance test April 1956.

About 12% of the "attempted to run time" is scheduled maintenance. This time is not included under "good time".

U. S. Department of Interior, Geological Survey, Washington, D. C.

System is used for scientific computing and data processing. "CARDATRON" will be used. The CARDATRON system will increase the speed of the punched cards to 240 cards/min. The present DATATRON system will be modified by the addition of a buffered alphanumeric card handling system, the CARDATRON. Should the need arise, for floating point arithmetic, this could be readily provided. The only other addition which might be required in the forseeable future is the DATAFILE, a quasi-random access magnetic tape file.

Allstate Insurance Company

The system is utilized for the consolidation of statistics and accounting records. A second DATATRON will be used for storing policy holder information for renewal, billing, etc.

One, two and three engineers and two, four and six technician-operators are required for one, two and three 8-hour shifts, respectively.

The operating ratio is 0.97, which allows 3% for scheduled and unscheduled maintenance.

The system was accepted on 15 February 1955.

General Insurance Company of America

Personnel requirements for two 8-hour shifts are two engineers, one technician, and two operators. These requirements are based on current operating status.

Reliability and operating experience:

Average error-free running period	16 hours
Good time	3,568 hours
Attempted to run time	4,123 hours
Operating ratio (Good/Attempted to run)	0.86

Figures based on period 1 February 1956 to 31 December 1956.

Acceptance test 25 January 1956.

It is planned to replace the present punched card converter with an Electrodata CARDATRON in April 1957.

Shell Development Company

Application is in support of chemical and physical research and engineering.

Checking features utilized on system include:

Forbidden B, C, D, combination check
Drum sector count alarm
Overflow stop
Input-output interlocks
Marginal voltage check panel
Variable frequency test facility
State of logical control toggles are displayed.

Reliability and operating experience:

Average error-free running period	20 hours
Good time	3,381 hours
Attempted to run time	3,690 hours
Operating ratio (Good/Attempted to run)	0.92

Figures based on period July 1955 to July 1956.

Acceptance test 8 June 1955.

System has been subjected to three major installations.

United Gas Corporation, Research Department

Application is in the public utility, gas oil industry.

The normal operating day is 13 hours, consisting of an 8 and a 5 hour shift. Two engineers and 3 operators are required. The engineers are on call for trouble during both shifts. They are usually occupied with modifications, and improvements. The operators run routine problems and the mathematicians de-bug programs.

Reliability and operating experience:

Average error-free running period	30-40 hours
Good time	2,630 hours
Attempted to run time	3,888 hours
Operating ratio (Good/Attempted to run)	0.75-0.96 based on weekly data

Figures based on period January 1956 to December 1956.

Acceptance test December 1955.

It is proposed to install an automatic monitor device for printing the register contents as the program is executed. This will be useful in debugging. This will provide a higher speed monitor without the necessity of a stored monitor program.

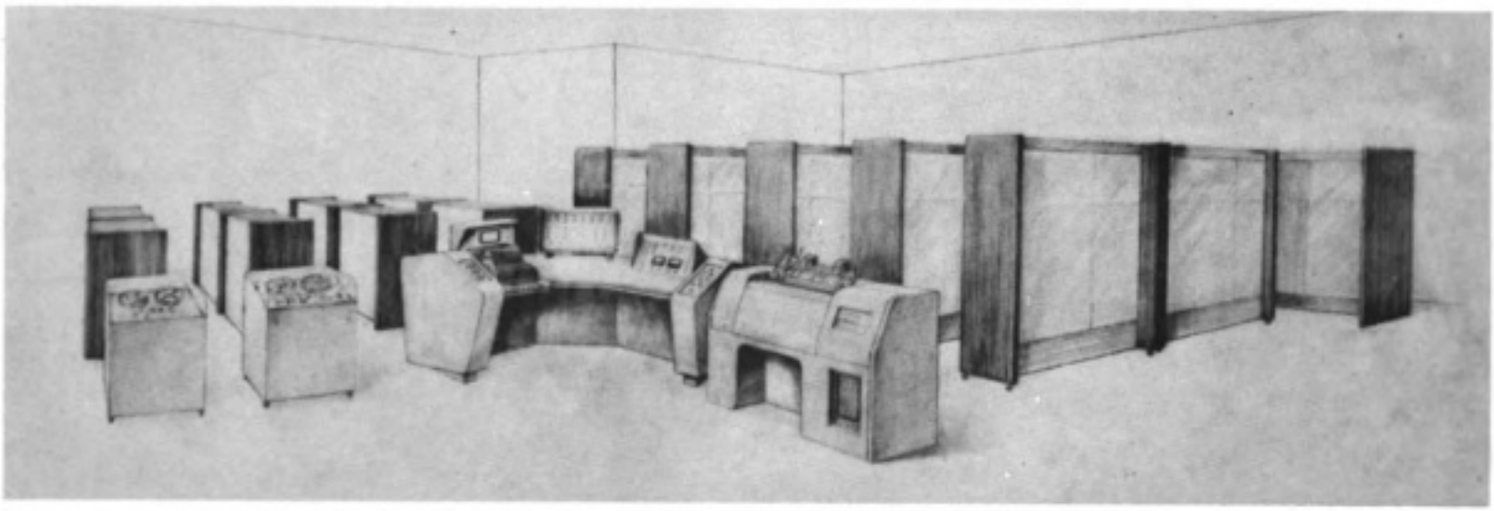
It is also proposed to install an automatic operation control, which will control operations by means of a paper tape master program. This will eliminate the necessity of an operator attending the computer.

DIANA

The Diana Data Processing System

MANUFACTURER

Laboratory for Electronics
Business Machine Division



Picture by Laboratory for Electronics, Business Machine Division

APPLICATIONS

General purpose business applications.

NUMERICAL SYSTEM

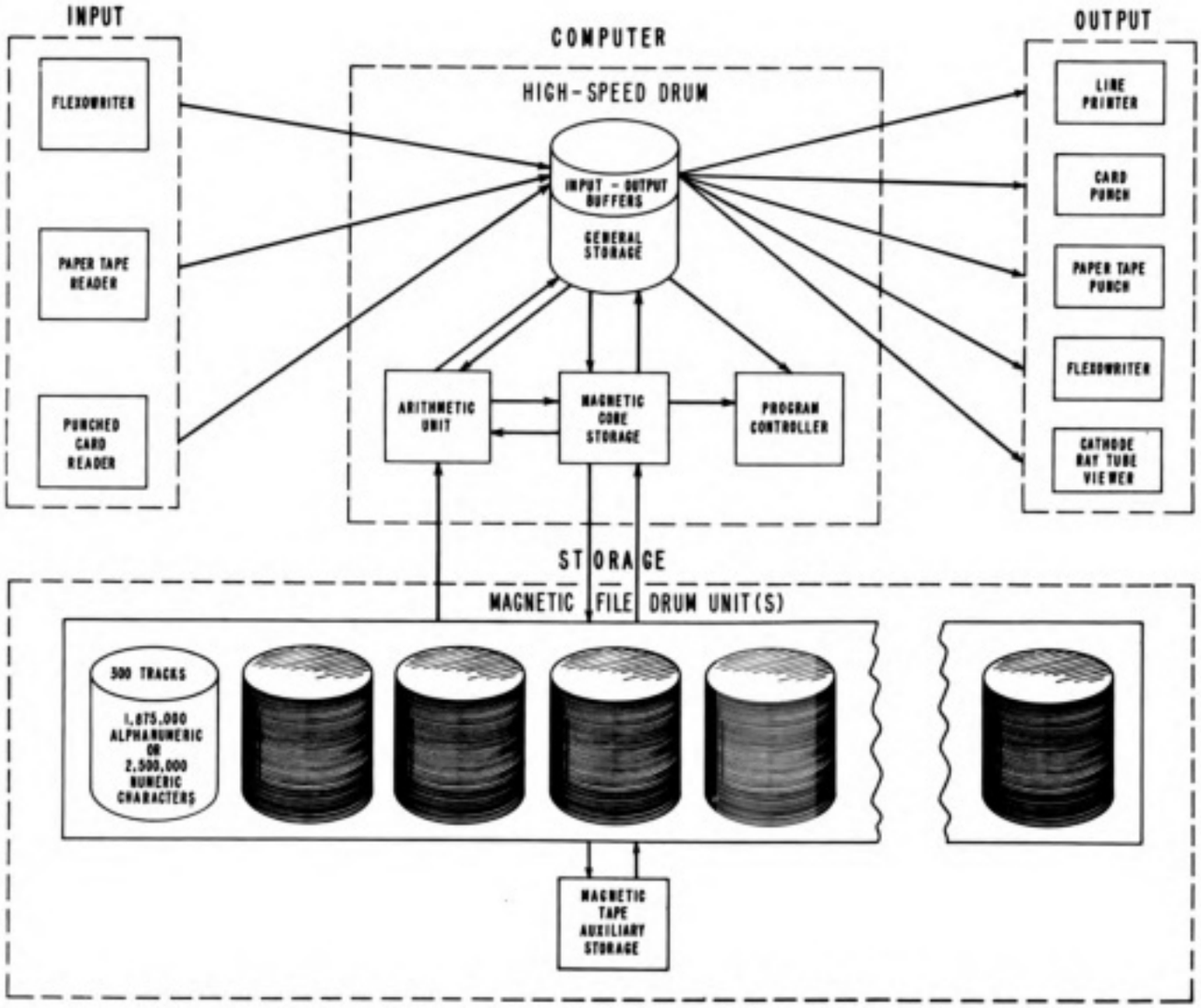
Internal number system	Binary coded decimal
Decimal digits per word	Variable word and block length
Decimal digits per instruction	10
Instructions per word	1
Instructions decoded	19
Instructions used	19
Arithmetic system	Fixed point
Instruction type	Two address: Source and destination
Number range Alphanumeric:	0 to 99 char/word
Numerical for computation:	Up to 12 places

ARITHMETIC UNIT

	Incl. Stor. Access Microsec	Exclud. Stor. Access Microsec
Add time	560	186
Mult time	3,137	2,577
Div time	4,830	4,270

Construction	Magnetic cores
Basic pulse repetition rate	150 Kc/sec
Arithmetic mode	Parallel
Timing	Synchronous for all components except file drums Asynchronous for file drums only
Operation	Sequential and concurrent

The operation times given above for addition and multiplication are for the number 999,999 as operands. The divide time is for a 5 digit quotient. Computer operations are mainly sequential. Input-output operations are concurrent with computation. The arithmetic unit may also work concurrently with non-arithmetic operations. Non-arithmetic operations



Picture by Laboratory for Electronics, Business Machine Division

may be performed concurrently during the last 113 microseconds of the addition time, during the last 2,265 microseconds of multiplication, and during the last 3,966 microseconds of division.

The arithmetic unit consists of the product, multiplier, and multiplicand registers. These registers are 13 digits in length, with character position 0 holding the sign and character position 12 holding the most significant character.

Since the system is capable of handling British sterling notation, the adder, which is part of the arithmetic unit, operates in a scale of 12 unless digit d of the addition, subtraction, multiplication, and round instructions is a zero. In this case, scale of 10 operation is specified. Multiplication is accomplished by halving the multiplier and doubling the multiplicand, with the contents of the multiplicand register being added to the contents of the product register each time the number in the multiplier is odd. On the whole, this method of multiplication is faster than one involving successive additions. Division is accomplished by repeated subtraction of the divisor from the dividend, with the dividend initially in the multiplicand register and the divisor in the multiplier register. The quotient appears in the multiplicand register and the remainder in the product register.

STORAGE

Media	Words	Characters	Microsec Access(Avg)
Magnetic Core	Variable	200-10,000	34
Hi-Speed Drum	Variable	58,500	11,000
File Drums	Variable	$(1.875\text{-}625)\times10^6$	197,000
Magnetic Tape	Must be first transferred to drum		

Access times given above include drum switching. The high speed drum rotates at a speed of 100 revolutions per second, recording is performed in parallel and includes 6,000 characters of input-output buffers.

The file drum rotates at 3 revolutions per second, recording is serial. Each file drum has a capacity of 15×10^6 bits. Characters may be alphanumeric or numeric only. The magnetic file drum is the bulk storage medium. It is 15 inches in diameter by 15 inches long, having a capacity of 1,875,000 alphanumeric characters or 2,500,000 numeric characters. Any number of these file drums (up to a maximum of 330) can be used in a given installation, and regardless of how many are used, the average random access time to any part of the entire file remains one-sixth of a second. For intermediate and buffer storage a single high-speed drum is used, having a capacity of 58,500 alphanumeric characters and an average random access time of 10 milliseconds. Internal working storage (OAST) consists of from

200 to 10,000 characters of magnetic core storage with an average access time of 34 microseconds. In addition, there are twelve transfer registers, each with magnetic core storage for 10 alphanumeric characters.

Since the storage capacity of the magnetic file drums and of OAST is scalable, a user need acquire only the capacity required by his application. This factor, together with a choice of the type and quantity of input and output devices, provides a flexible system that can be tailored to the individual requirements of any given application.

File drums are grouped into units of from one to 33 drums per unit (actually, from 300 to 10,000 tracks per unit, which, at 300 tracks per drum, would be a maximum of 33-1/3 drums per file drum unit). The maximum number of file drum units in a given installation is 10. Both the number of file drums per unit and the number of units are determined by the requirements of the application for which the system is intended.

Each file drum unit contains its own reading and writing mechanism and track selection devices. In locating a record in a file drum unit the computer must first select the proper track by placing the track number in the track address register. The track number may be wholly contained in the record number (tag), or it may be found on an index track which relates record numbers to the appropriate track numbers.

Transfers from a file drum unit can be in the form of a block transfer to OAST, or a word or character transfer to the arithmetic unit or one of the transfer registers. Multiple-block transfers to OAST are also possible, provided OAST is large enough.

Information can be transferred from one file drum unit to another, a track at a time. If the installation includes a magnetic tape unit, information can also be transferred from a file drum unit to tape, a track at a time.

Information can be written on the file drum in only three ways: by a block transfer from OAST, by a track transfer from another file drum unit, or by a track transfer from magnetic tape. During track transfers in either direction, the computer may perform other operations which do not require the use of the drums. The time required for a track transfer is 0.6 second. One drum, therefore, can be loaded or unloaded in three minutes.

On the file drums, information is stored in serial by bit fashion. On the magnetic tape it is stored in parallel by bit, serial by character fashion.

The high speed drum serves as an intermediate speed general storage for the computer and in addition contains the input-output buffers. This drum sets the system pulse repetition frequency of 150 kc by means of an engraved clock track. A second clock track is used in locating sectors on the drum. This sector clock track has 20 equal divisions which are used to locate the 20 sectors of any given band. The use of bands (adjacent tracks in groups of 7) permits parallel by bit handling of characters and a 150 kc character frequency. The capacity of this drum can be specified for each system arrangement.

MAGNETIC CORE STORAGE (OAST, TRANSFER REGISTERS)

OAST has a maximum size of 10,000 characters arranged into 100 sectors of 10 decades per sector, 10 characters per decade. Its minimum size is two sectors or 200 characters. Information is located by sector, decade, and character position, or by sector and word number. Data is handled in parallel by bit, serial by character fashion at a character frequency of 150 kc. The maximum access time to any character is 9 bit times or 60.3 microseconds (the time required to move from the first to the last character in a decade).

Information recorded in OAST wipes out the previous characters, while that read from OAST is retained in storage by recirculation of the characters. In a single-block transfer to OAST, the most significant character of the block transferred is placed in the zero position of the decade addressed. In a multiple-block transfer to OAST, the most significant character of the first block transferred is placed in the zero position of the decade addressed; following blocks are written densely. The number of blocks to be transferred is specified in the instruction.

INPUT

Media	Speed
Paper Tape	60-300 dig/sec
Punched Cards	100-500 cards/min
Typewriter	Manual

Special

Many different types of input-output equipment may be used simultaneously, each working concurrently with the others and with the computer.

Information to be processed or stored can be entered into the system in a number of different ways: via punched paper tape, punched cards, direct keyboard or in certain cases, via magnetic tape. Output can be via punched paper tape, punched cards, line printer, direct typewriter cathode ray tube viewer, or in certain cases, magnetic tape. The magnetic tape input and output units are more in the nature of drum loading and unloading devices; they are used chiefly to store information to which random access is not currently required, or to provide duplicate storage for security purposes.

OUTPUT

Media	Speed	
Paper Tape	60 dig/sec	
Line Printer	150 lines/min	BTM Type 7082
Punched Cards	100 cards/min	

Special devices include any type of on-line input-output equipment such as keyboards, window machines, etc.

CIRCUIT ELEMENTS ENTIRE SYSTEM

Tubes	1,300
Tube types	8
Crystal diodes	62,000
Magnetic cores	15,000
Separate cabinets	14

Above information is based on the Chase-Manhattan Bank, New York computer. These figures will vary, depending upon the size of the system.

CHECKING FEATURES

Fixed

Single bit errors are detected in all information and control paths except in the arithmetic unit. This includes input-output paths, and all data on the addressed file drum track.

Optional

Dual (parallel) arithmetic unit. If the dual arithmetic unit is not included, arithmetic operations can be checked by program.

POWER, SPACE AND WEIGHT

Power, computer	55 KW, 52 KVA, 0.92 PF, 208 V, 60 cycle, 3 phase, 4 wire
Power, air cond.	230V, 60 cycle, 1 phase, 3 wire
Space, computer	800-1,500 sq. ft., max. width 29 in., max. height 75 in.
Weight, computer	18,000 lbs., 200 lbs/sq. ft. max. loading
Capacity, air cond.	20 Tons

PRODUCTION RECORD

In production	2
On order	2
Delivery time	18 Months

First installation will be in the Chase-Manhattan Bank, New York during the latter part of 1957.

COST, PRICE AND RENTAL RATE

Approximate cost of basic system $450,000.
Approximate cost of additional equipment $15,000 to $1,000,000.
Rental rates of basic system $11,250/month, including 3 shift operation and 1 shift maintenance.
Rental rates of additional equipment $375-$25,000/month.

The basic system includes computer with 4 File Drums (7,500,000 characters), 1,000 characters of core storage, 300 digit/sec paper tape reader, and 150 lines/min printer. Additional 15,000,000 bit file drums cost $15,000 each.

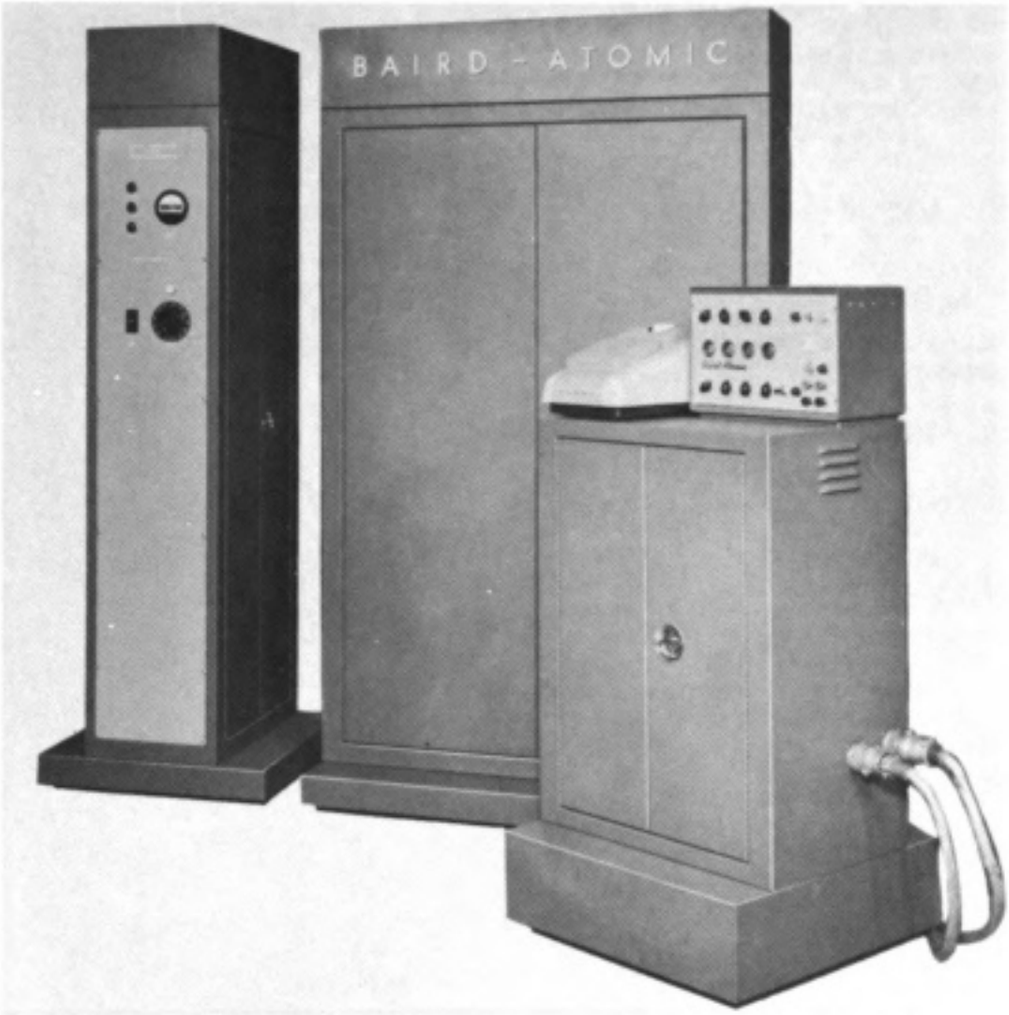
ADDITIONAL FEATURES AND REMARKS

Large random access storage with ability to handle several remote input-output stations concurrently, makes DIANA ideal for on-line or multiple access applications. Inputs do not need to be batched or presorted, and may be posted in some cases at a 20,000 per hour rate. DIANA's ability to both select certain records and sort them by any classification at a rate of speed compatible to the output printer rate makes DIANA ideal for exception reporting.

DIGITAL CORRELATOR 580

Baird-Atomic Model 580 Digital Correlator

Baird-Atomic, Incorporated



Picture by Baird Associates-Atomic Instrument Company

APPLICATIONS

Special purpose system for the automatic statistical analysis of data taken during radio propagation studies.

NUMERICAL SYSTEM

Internal number system	Binary
Binary digits per word	18
Instructions per word	Wired program
Arithmetic system	Fixed point
Number range	
Input	0 to 128 (Binary notation)
Output	0 to 8,191 (Decimal notation)

No instructions are necessary since the program is completely wired-in.

ARITHMETIC UNIT

Add time (exclud. stor. access)	5 microsec/dig
Construction	Filamentary subminiature tubes are used extensively when high speed is not required.
Arithmetic mode	Serial
Timing	Synchronous
Operation	Sequential

STORAGE

Media	Words
Magnetic Drum	125

A small, high speed (2,400 RPM) magnetic drum is used both for storage and to provide the sequential access to the words necessary for forming the correlation products.

INPUT

Media	Speed
Seven Bit Signals	150 words/sec, Maximum

The input number represents power level in decibels. The input digits are parallel.

OUTPUT

Media	Speed
Clary Parallel Printer	One 4-digit correlation product per second

CIRCUIT ELEMENTS ENTIRE SYSTEM

Tubes	1,200
Tube types	13
Crystal diodes	1,400
Separate cabinets	3

CHECKING FEATURES

Fixed

Built-in check program periodically checks machine operation.

POWER, SPACE AND WEIGHT

Power, computer	4 KW
Space, computer	96 cu. ft. 16 sq. ft. (total)
	2 cabinets 2 by 2 by 6 ft.
	1 cabinet 2 by 4 by 6 ft.

PRODUCTION RECORD

Produced	1
Operating	1
Delivery time	12 Months, for similar units

COST, PRICE AND RENTAL RATE

Approximate cost of system $67,000.

PERSONNEL REQUIREMENTS

The computer may be operated by a single untrained operator. An engineer or trained technician would be required (part time) for maintenance.

INSTALLATIONS

U. S. Naval Research Laboratories
Washington 25, D. C.

ADDITIONAL FEATURES AND REMARKS

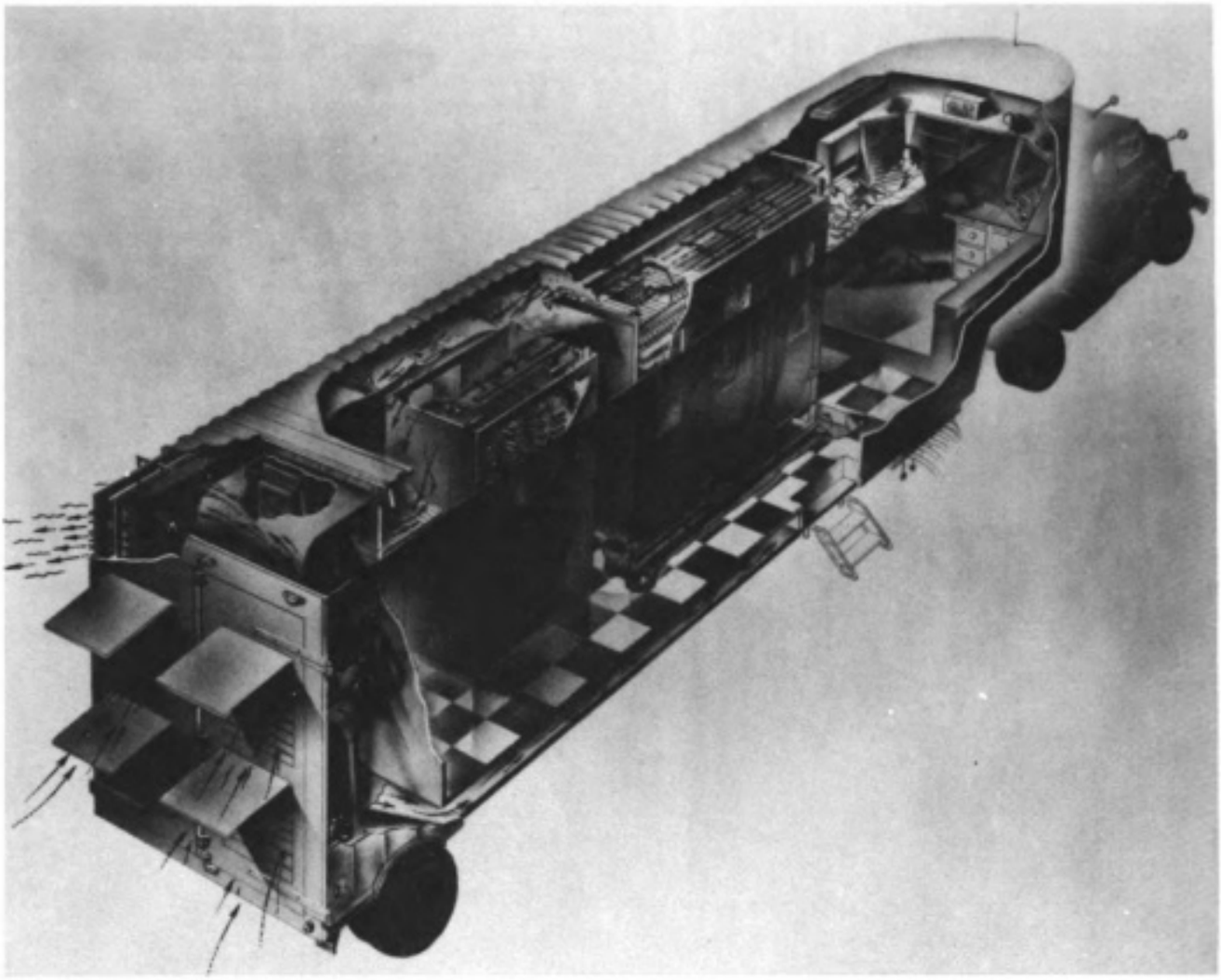
This computer is a special purpose machine designed to compute auto- or cross-correlations of the input data. Correlation sums for shifts of zero through twenty sample intervals are computed simultaneously.

DYSEAC

Second Standards Electronic Automatic Computer

MANUFACTURER

Electronic Computer Laboratory
Data Processing Systems Division
National Bureau of Standards
U. S. Department of Commerce



Picture by National Bureau of Standards

APPLICATIONS

General purpose, simulation, real-time control.

NUMERICAL SYSTEM

Internal number system	Binary
Binary digits per word	45 plus check digit
Binary digits per instruction	45 plus check digit
Instructions per word	1
Instructions decoded	16
Instructions used	16
Arithmetic system	Fixed point
Instruction type	Three address

Number range $-(4 - 2^{-42}) \leqslant n \leqslant (4 - 2^{-42})$

ARITHMETIC UNIT

Time	Incl. Stor. Access Microsec	Excl. Stor. Access Microsec
Add	192 - 1,536	48
Mult	2,304 - 3,648	2,112
Div	2,304 - 3,648	2,112

Construction Diode gates, tube amplifiers, and electrical delay lines

Rapid access word registers 3

Basic pulse repetition rate One megacycle/sec. A four phase clock is used.

Arithmetic mode Serial

Timing Synchronous

Operation Storage and arithmetic processing are serial. Input-output external control are concurrent with arithmetic operations. In addition to the normal complement of operations, the

operations of summation, accumulation, overflow-check, justification, shift, and file are also included.

STORAGE

Media	Words	Digits	Microsec Access
Mercury Delay Line	512	24,576	48-384

There is provision for up to 4,096 words of high speed storage. In addition, the computer has provision for the attachment of many multi-channel magnetic tape or wire units, and a magnetic drum. These would operate concurrently with computation operations.

INPUT

Media	Speed
Keyboard	Manual
Paper Tape Reader	10 char/sec
Magnetic Wire	3,500 dig/sec

Keyboard and punched paper tape reader is a Flexowriter. Alpha-numeric operation is utilized. There is provision for the attachment of a wide variety of input devices that would operate concurrently with computation. There is also a one-word addressable switch memory via a serializer unit.

OUTPUT

Media	Speed
Typewriter (Flexowriter)	10 alphanum char/sec
Paper Tape Punch	60 char/sec
CRT Display Unit	2,000 words/sec
Magnetic Wire	3,500 dig/sec

There is provision for the attachment of a wide variety of output devices that would operate concurrently with computation.

CIRCUIT ELEMENTS ENTIRE SYSTEM

Tubes	900
Tube types	90% are 1 type
Crystal diodes	24,500
Separate cabinets	2

There are 524 tubes in the central computer and 350 in the storage unit. The central computer utilizes 21,500 crystal diodes. The central computer has two basic types of package. One type contains tube amplifiers and diode gates. The other type contains delay lines and diode gates. There are 524 tube packages and 251 delay-line packages.

CHECKING FEATURES

Fixed

Odd - even parity check on storage.

Optional

Automatic program jump or print-outs are optional upon detection of a memory error. Also available for program checking are a wide variety of automonitoring operations for loading and printing out of internal storage locations and substituting new instructional addresses. Each word is checked as it is read from the memory. A real-time clock periodically initiates a storage scan which checks the entire storage.

POWER, SPACE AND WEIGHT

Power, computer	12 KW, 20 KVA
Power, air cond.	35 KVA
Space, computer and storage	270 cu. ft.
Space, air cond.	750 cu. ft.
Capacity, air cond.	18 Tons

There are two trailer vans. Van No. 1 contains the control console, input-output, computer, storage, and 12 Tons of refrigeration capacity. Its internal dimensions are approximately 39 x 7 x 9 feet and weighs about 12 tons. Van No. 2 contains DC power supplies, 6 Tons of refrigeration capacity, and 1,700 cubic feet of spare space. This van also has internal dimensions of 39 x 7 x 9 feet. It weighs 8 tons.

PRODUCTION RECORD

Produced	1
Operating	1

The DYSEAC was designed and constructed by the Electronic Computer Laboratory of the National Bureau of Standards as part of a development program under the sponsorship of the Department of Defense. It was delivered to the Signal Corps in May, 1954.

RELIABILITY AND OPERATING EXPERIENCE

Acceptance test passed in April 1954

ADDITIONAL FEATURES AND REMARKS

For further information on this system see
Transactions of the IRE-PGEC, Vol. EC-3, No. 1 Mar. 1954.
Transactions of the IRE-PGEC, Vol. EC-3, No. 2, June 1954
Journal of the ACM, Vol. 1, No. 2, pp 57-81, April 1954
Proceedings of the IRE, Vol. 41, Oct. 1953, pp 1380-1387.
Circular No. 551 National Bureau of Standards, January 1955.

Two counter-registers are provided for program sequencing. Each counter holds a twelve-binary-digit address. The coder may select the address in either counter as the address of the next instruction to be performed. Also, either counter-register can furnish the base number for relative addresses.

Major design emphasis was placed on versatility of control facilities and on latitude for expansion of the installation. The versatility is achieved by (1) the concurrent input-output property, (2) a self-regulation property which allows the external environment to automatically control the pace of the internal work program, (3) an interruption property which enables the machine to handle unscheduled job assignments which originate externally without advance notice and must be executed as soon as possible, and (4) the preceding three properties acting in concert enable the machine to be employed as a control element in a generalized feedback loop.