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Control Data Corporation

CONTROL DATA 160-A

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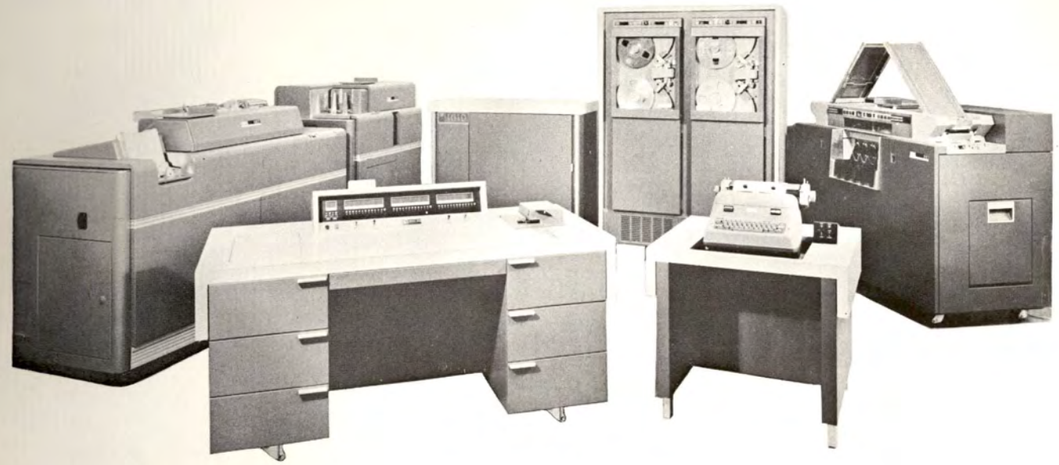
THE 160-A COMPUTER SYSTEM



160-A: LARGE-SCALE COMPUTER FEATURES

Uses the same basic circuits as the Control Data 1604. Includes the following features previously found only in large-scale computers:

- buffered input/output
- interrupt
- expandable memory (8192 to 32,768 words)
- special powerful instructions

160-A: SYSTEM EXPANDABILITY

Can be expanded from a minimum system up to full system capacity—including electric typewriter, magnetic tape system, card reader/punch, and line printer. The Control Data 350 Paper Tape Reader and the Teletype Paper Tape Punch are standard equipment.

160-A: SPECIAL USES

Control Data Satellite Computer System. The 160-A can be used as a satellite computer with direct access to the large-scale 1604.

Microwave Communications. The 160-A can be used to communicate via microwave link with the large-scale 1604 at transmission rates of approximately 1,000,000 bits per second.

160-A: RANGE OF USES

A general-purpose computer, the 160-A can be used for an almost unlimited number of applications. With its buffered input-output, expandable memory, interrupt, high speed, and special powerful instructions, the 160-A can handle a variety of computing applications in

- commercial data processing
- engineering problem solving
- off-line data conversion
- scientific data processing
- real-time data acquisition/data reduction

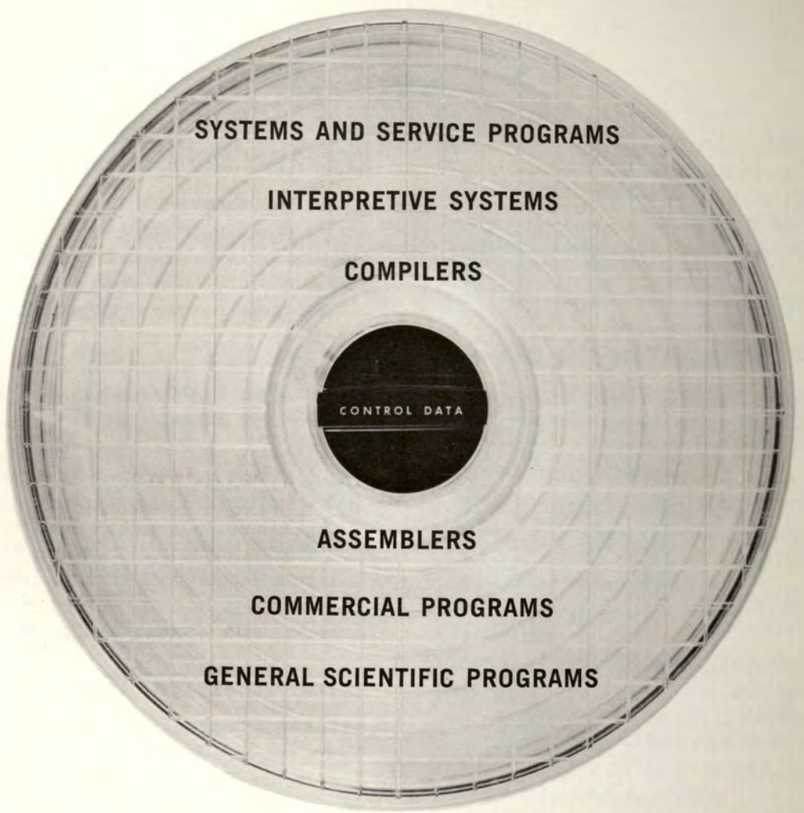
160-A: HIGH-SPEED CIRCUITRY

Using all-transistorized circuitry, the 160-A executes 60,000 instructions per second. Memory cycle time is 6.4 millionths of a second; access time is 2.2 millionths of a second.

160-A: COMPATIBILITY

Programs written for the Control Data 160 can also be used with the 160-A. All peripheral equipment used with the 160 can likewise be used with the 160-A.

CONTROL DATA 160-A PROGRAMMING SYSTEM



With the 160-A Computer, Control Data provides an extensive package of programming aids for many different applications. These are explained on the following pages.

CONTROL DATA CORPORATION

COMPUTER DIVISION • MINNEAPOLIS, MINNESOTA

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COMPILERS AND ASSEMBLERS

OSAP. A two-pass symbolic assembly program providing the programmer with a versatile, machine-oriented language for logical and data processing problems. Use of mnemonic operation codes and symbolic operands relieves the programmer of the more tedious *housekeeping* chores.

Alternate versions of OSAP are available for expanded equipment configurations which provide one- or two-pass assembly and improved efficiency.

FLAP. A two-pass symbolic assembly program for the 160-A, FLAP is used in preparing programs to be operated by INTERFOR, which is described below. Programs residing completely in memory are assembled in a *single* pass. This assembler is compatible with CODAP, a symbolic program for the large-scale 1604 Computer . . . thus facilitating the transition from small to large-scale computers with minimum reprogramming.

INTERPRETIVE SYSTEMS

INTERFOR. Provides more powerful arithmetic and logical functions by simulating many commands taken from the large-scale 1604. Also provides for debugging of many 1604 Programs on the more economical 160-A. This provision is especially important to users having access to 1604 Computers, or when the 160-A is used as a Satellite Computer to the 1604.

CALINT. A complete arithmetic interpretive system for the 160-A Computer, CALINT provides a simple, basic, user-oriented language for small business and scientific applications. CALINT includes many of the commonly used subroutines and requires only a simple calling sequence to append additional, often-used subroutines.

BCK. A decimal arithmetic package used as the basis for more complex programs to be run on the 160-A, BCK provides a unique binary encoding that permits nine decimal digits to be stored in only three computer storage locations. Arithmetic manipulations are performed on three, six, or nine decimal digits as specified by the programmer. Conversion of binary-coded decimal (BCD) quantities are performed with unusual speed and convenience. BCK can also be conveniently integrated into the user's own programming systems.



SYSTEMS AND SERVICE PROGRAMS

Off-Line Processing. A full-scale off-line system—i. e., card-to-magnetic tape or magnetic tape-to-printer or punch— is built around the 160-A Computer when it is used as a control device to

- drive a 120 print-position printer at 500 or 1000 lpm
- control a card reader, reading mixed binary or BCD decks at 650 or 1300 cpm (routines for slower card readers are also available)
- punch 80-column cards in either binary or BCD modes at 100 cpm

SATELLITE. The 160-A is used in the Satellite Computer System to perform pre- and post-processing of data from the 1604 Computer. In this System, the 160-A Satellite Computer shares tape units with the 1604; memory-to-memory data transfer is direct and bi-directional between computers.

Visual Display Device Programs. These enable display data to be written on plotters or on CTR displays. These programs generate character displays or provide point or continuous plots on such devices.

Service Routines. These routines have been written for the following:

- complete group of machine diagnostic programs
- duplication and verification of paper tapes
- dump selected portions of memory in a variety of code formats
- paper tape input routines to: load paper tapes in a variety of code formats and punch levels

Magnetic Tape Handling Programs. These programs will read or write magnetic tapes in BCD or binary modes. Transfer rates are either 15 KC or 30 KC character rates.

GENERAL SCIENTIFIC AND COMMERCIAL PROGRAMS

Mathematical Subroutings. Performs sort-merge on BCD for calculating the following functions in various ranges of precision:

- sine x
- tangent x
- arcsine x
- series expansion
- square root of x
- cosine x
- arctangent x
- arccosine x
- exponential (2^x, e^x, 10^x)
- log to the base 2

Generalized Sort-Merge. Performs sort-merge on BCD information, using four tape handlers or more.

Matrix Algebra Package. Contains the matrix operations of add, subtract, and multiply . . . as well as the routines for matrix inversion, determinant evaluation, and solution of systems of simultaneous linear equations.

Integration and Interpolation Programs. These enable the programmer to perform simple integration, solve systems of differential equations, and perform an algebraic interpolation in two or three dimensions.

Polynomial Equation Solvers. These are programs written for finding solutions of polynomial equations with real coefficients.

Set of Statistical Routines. These have been written for the usual regression and correlation analysis.

Conversion Programs. These programs are used to

- convert from BCD to binary
- convert from binary to BCD
- convert from flex code to binary and vice versa

160-A SPECIAL FEATURES

Buffered Input-Output

Input-output operations are carried out independent of the main computer program. When the transfer of input or output data is required, the main computer program is used *only* to initiate an automatic cycle which buffers data to and from the computer memory. The main computer program then continues . . . while the actual buffering of data is carried out *independently and automatically*.

Interrupt

The 160-A periodically senses the input-output channels for the presence of an interrupt signal. When an interrupt is detected, the program jumps to an interrupt sequence in memory . . . which includes the instructions necessary to return to the main program at the proper place. An interrupt is not recognized during a non-buffered input-output operation.

Powerful Instructions

Included in the 160-A repertoire of 91 instructions are special instructions usually found in computers much larger than the 160-A. Some of these are:

- **STORE CONTENTS OF P** – which gives the programmer the option of storing the address of the instruction which is currently being executed.
- **RETURN JUMP** – only one instruction is required to store the return address in the subroutine and at the same time jump to the entrance of a subroutine.
- **KEY CONTROL STOPS AND JUMPS** – provide optional operator-initiated sequence controls.

Expandable Memory

The 160-A basic memory consists of 8192 words of magnetic core storage contained within the desk-size cabinet. Additional external memory modules of 8192 words each can be added up to a maximum of 24,576 . . . for a total memory capacity of 32,768 words. The internally stored program switches from one memory module of 8192 words to another, depending upon the addressing mode.

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