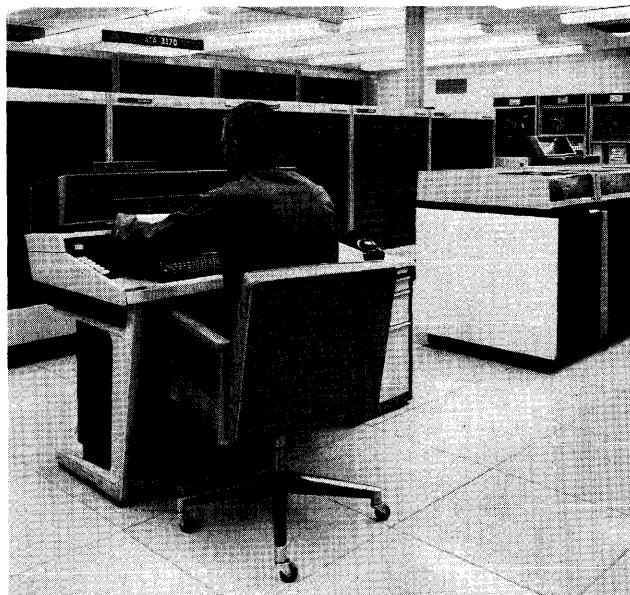# Control Data 3000 Series

The 3170 system is the latest and most attractively priced member of the Control Data 3000 Series. Introduced in 1970, it provides the processing facilities of the faster 3300 and 3500 systems at a considerably lower cost.

MANAGEMENT SUMMARY

The Control Data 3000 Series of medium-scale computer systems has been a mainstay of CDC's large computer product line since May 1964, when initial installations of the 3200 system were made. Though the 3200 has been out of production for several years, four later entries in the same series—the 3100, 3170, 3300, and 3500—are still being actively marketed and are being used effectively in a broad range of applications.

All four of these systems use binary processors with a word length of 24 data bits, and can also be equipped with decimal arithmetic facilities. They are sometimes called the Control Data "Lower 3000 Series" or "3000L Series" to distinguish them from the CDC 3400, 3600, and 3800 systems, which use a 48-bit word length and form the "Upper 3000 Series." The 3400, 3600, and 3800 are no longer in production.

The CDC 3100, a slower and less expensive version of the original 3200, was initially delivered in January 1965. It provides from 8K to 32K words of 1.75-microsecond core storage and facilities for efficient fixed-point binary arithmetic. Floating-point arithmetic and a BCD arithmetic option that facilitates business data processing are available at extra cost. The 3100 mainframe is no longer in production but is available as a "resale product" for either purchase or lease. At its resale purchase price, which is about 40 percent of the original list price, the 3100 mainframe could represent a ▷

The CDC 3100, 3170, 3300, and 3500 are medium-scale systems that offer a broad range of hardware and software facilities. Though their 24-bit word length tends to stamp them as scientific computers, they are also serving effectively in business data processing, communications, and time-sharing environments.

CHARACTERISTICS

MANUFACTURER: Control Data Corporation, 8100 34th Avenue South, Minneapolis, Minnesota 55440.

MODELS: 3100, 3170, 3300, and 3500 Computer Systems.

DATA FORMATS

BASIC UNIT: 24-bit word. Each word is divided into four 6-bit characters. In core storage, an odd parity bit is generated for each of the four characters, so the core word-length is 28 bits. Core storage is addressable either by word or by character position.

FIXED-POINT OPERANDS: One or two 24-bit words in basic binary mode; 1 to 4096 six-bit characters with optional Business Data Processing feature (for 3170, 3300, and 3500 only); 1 to 12 four-bit digits with optional BCD feature (for 3100 only).

FLOATING-POINT OPERANDS: Two words, consisting of 36-bit-plus-sign fraction and 11-bit exponent.

INSTRUCTIONS: 1, 2, or 3 words in length. There are 24 distinct instruction formats. However, most word-oriented instructions are 1 word long and consist of a 6-bit operation code, a 1-bit designator for indirect addressing, a 2-bit index register designator, and a 15-bit memory address. Most of the Business Data Processing instructions (optional for the 3170, 3300, and 3500 only) are 3 words long and specify the memory addresses and lengths of 2 fields.

INTERNAL CODE: 6-bit BCD. (The Business Data Processing feature includes ASCII-to-BCD and BCD-to-ASCII translation instructions.)

MAIN STORAGE

STORAGE TYPE: Magnetic core.

CAPACITY: See table. (If the Multiprogramming option is not present in a 3300 or 3500 system, a maximum of 131,072 words can be used.)

CYCLE TIME: See table.

CHECKING: Parity bit with each 6-bit character is generated during writing and checked during reading.

STORAGE PROTECTION: The Memory Protect feature (standard in the 3170 and 3500) allows two independent areas within a designated 32K block of core storage to the safeguarded against unauthorized alteration. With the Multiprogramming feature, the Page Index defines memory areas where either writing or both reading and ▶

Control Data 3000 Series

▷ sound value for buyers who can accurately predict their long-term computational needs.

The CDC 3150 was introduced in 1967 as a specially-priced, "packaged" configuration of the 3100 system; it is no longer a part of Control Data's standard product line.

The CDC 3300, initially delivered late in 1965, is considerably faster and more flexible than the 3100. It offers from 8K to 262K words of 1.25-microsecond core storage as well as a fast-access Register File (not present in the 3100) that stores 64 words with a 500-nanosecond cycle time. The optional Business Data Processing feature provides 33 instructions that permit convenient processing of variable-length BCD fields—a most unusual and valuable facility in a word-oriented binary computer. The Multiprogramming option provides paging, relocation, and storage protection facilities that enable the 3300 to operate efficiently in time-sharing and other multiaccess environments.

The CDC 3500, announced in September 1967 and delivered in mid-1969, is a considerably faster, integrated-circuit version of the 3300. A 3500 system can include from 32K to 262K words of core storage with a 900-nanosecond cycle time. Floating-point arithmetic is a standard feature, and the Business Data Processing and Multiprogramming facilities are each included in three of the five 3500 processor models.

The CDC 3170, introduced in August 1970, provides full multiprogramming facilities, compatible with those of the faster CDC 3300 and 3500 systems, at a significantly lower price. Rental prices for complete 3170 systems begin at about $15,000 per month. Essentially, the 3170 system combines the powerful processing facilities of the CDC 3300 and 3500 processors with a slower 1.75-microsecond core memory—the same speed as the memory used in the CDC 3100 system. Thus, the 3170 is fully compatible with the 3300 and 3500 and can use all of the same peripheral equipment and software. Multiprogramming hardware, standard in every 3170 Processor, provides paging, relocation, and storage protection facilities.

Rental price differentials between comparable CDC 3170 and 3300 systems average about $5,000 to $6,000 per month. Thus, a company that has been impressed by the capabilities of the CDC 3300 system can now enjoy those capabilities at a substantially lower cost. The overall throughput of a 3170 system is typically about 20 percent lower than that of a 3300 system. And if and when more processing power becomes necessary, the 3170 can readily be field-upgraded to a 3300.

Because of Control Data Corporation's origins and early history, many computer buyers tend to think of it as a company that has little to offer the business-oriented ▷

▶ writing are prohibited when operating in the Program State.

CENTRAL PROCESSORS

INDEX REGISTERS: Three; memory addresses in most (but not all) instructions can be indexed.

INDIRECT ADDRESSING: Possible through multiple levels for most (but not all) instructions. Indexing and indirect addressing can be combined.

INSTRUCTION REPERTOIRE: Standard repertoire consists of approximately 160 instructions, including complete facilities for fixed-point binary arithmetic on 1-word (24-bit) operands. Also included are instructions for addition and subtraction of 2-word (48-bit operands), loading and storing of individual 6-bit characters, and comprehensive logical, testing, and branching facilities.

The Floating Point feature adds facilities for addition, subtraction, multiplication, and division of 2-word floating-point operands, as well as for multiplication and division of 2-word fixed-point operands.

The Business Data Processing (BDP) feature, available for the 3170, 3300, and 3500, adds facilities for convenient processing of variable-length fields composed of 6-bit BCD characters. Included are 33 instructions for adding, subtracting, moving, editing, searching, comparing, converting, translating, packing, and unpacking character-oriented fields. BCD multiplication and division, however, are performed by standard subroutines rather than by hardware instructions. The BDP feature includes six types of format conversions: BCD to binary, binary to BCD, BCD to 8-bit ASCII, ASCII to BCD, 6-bit numeric to 4-bit (pack), and 4-bit to 6-bit (unpack).

The BCD feature, available for the 3100, provides 9 instructions for adding, subtracting, loading, storing, shifting, and testing fields consisting of 1 to 12 four-bit BCD digits.

INSTRUCTION TIMES: See table.

MULTIPROGRAMMING: The Multiprogramming feature, standard in the 3170 and optional in the 3300 and 3500 Processors, provides paging and relocation facilities for efficient operation in multiprogramming and time-sharing modes. Core memory is divided into 2048-word pages, each of which can in turn be divided into four partial pages. Program segments can be assigned to noncontiguous pages and partial pages. The Page Index File, a core matrix consisting of sixty-four 24-bit registers, enables the program to obtain the physical address of any required page or partial page and provides storage protection.

INPUT/OUTPUT CONTROL

I/O CHANNELS: The basic 3100 Processor includes two 12-bit channels. Either two more 12-bit channels or a single 24-bit channel can be added.

A 3170 system can have two, four, or six channels. In each case, half the channels are 12-bit channels and the other half are 24-bit channels.

A 3300 system can have a maximum of eight channels, up to four of which may be 24-bit channels.

A 3500 system can have up to eight channels, each of which can operate in either the 12-bit or 24-bit mode. ▶

Control Data 3000 Series

CHARACTERISTICS OF THE 3000 SERIES PROCESSORS

	3100	3170	3300	3500
MAIN STORAGE				
Cycle time, microseconds/word	1.75	1.75	1.25	0.90
Words fetched per cycle	1	1	1	1
Minimum capacity, 24-bit words	8,192	49,152	8,192	32,768
Maximum capacity, 24-bit words	32,768	131,072	262,144	262,144
PROCESSOR				
Processor Model No.	3114	3174	3304	3504 or 3514
Add time, microseconds (5-digit decimal fields)	16.1*	?	24.6*	7.37
Add time, microseconds (24-bit binary fields)	3.50	3.25	2.75	1.40
Add time, microseconds (48-bit binary fields)	5.20	4.75	4.00	2.00
Add time, microseconds (floating point)	15.4*	6.9 to 8.3*	6.93*	2.65
Processor features:				
Business Data Processing	not avail.**	optional	optional	optional
Floating Point	optional	optional	optional	standard
Register File	not avail.	standard	standard	standard
Memory Protect	optional	standard	optional	standard
Multiprogramming	not avail.	standard	optional	optional
CHANNELS				
Max. No. of I/O channels	4	6	8	8
Max. No. of peripheral controllers per channel	8	8	8	8

* With optional hardware feature.

** BCD feature provides more limited decimal arithmetic capabilities.

user. In fact, the Business Data Processing feature gives the 3170, 3300, and 3500 systems unusually strong internal processing capabilities for business applications. Moreover, the 3000 Series now includes a wide array of useful software facilities and an unusually large assortment of mass storage, input/output, and communications equipment. Thus, buyers of medium-scale systems for business as well as scientific workloads should take a hard look at the Control Data line before placing their orders.

The 3000 Series systems are well suited for use in real-time and communications-oriented environments, and Control Data offers a broad selection of associated special-purpose hardware. There are three data communications controllers, several analog/digital conversion controllers, a remote batch terminal, remote and local CRT display terminals, graphic subsystems which provide vector-oriented CRT displays and light pen input, and a "satellite coupler" that interconnects two Control Data computers. The 3000 Series has been an especially popular choice among Wall Street brokerage firms for on-line message switching and accounting functions.

CONFIGURATION RULES: Each 3000 Series I/O channel can accommodate up to eight peripheral controllers. Twelve-bit channels are usually used for low- and medium-speed peripheral devices, while 24-bit channels are used for high-speed disk and drum units.

SIMULTANEOUS OPERATIONS: One input or output operation on each installed I/O channel can occur simultaneously with computing.

I/O INTERFERENCE: The 12-bit channels require two memory references for each 24-bit word of I/O data transferred to or from core storage. The 24-bit channels require only one memory reference per word.

MASS STORAGE

813 & 814 DISK FILES: These units provide fairly large-capacity random-access storage on non-interchangeable disks. No longer in production, they are now available on a resale basis. Model 813 uses 36 disks (64 data recording surfaces) and stores up to 133 million 6-bit characters. Model 814 has 72 disks (128 data recording surfaces) and stores up to 266 million characters. In both models, the disks are equally divided between two side-by-side vertical spindles. Model 813 has one comb-type access mechanism, while Model 814 has two independent ones. Four read/write heads serve each recording surface. Up to 1.05

Control Data 3000 Series

Compatibility within the 3000 Series is fairly high but not complete. The 3170, 3300, and 3500 processors, when equipped with the same optional facilities, are fully program-compatible with one another. Although the 3100 lacks some instructions which are present in the 3300 and 3500, its basic instruction set is upward-compatible with the larger models. However, the BCD arithmetic option for the 3100 uses instructions and data formats which are completely different from those of the Business Data Processing feature for the 3170, 3300, and 3500. Most of the Control Data software can be used on any of the four systems; the principal exception is the top-of-the-line MASTER Operating System, which can be used only on 3170, 3300, and 3500 systems that include the Muliprogramming feature.

There is no machine-level program compatibility between these "Lower 3000 Series" systems and the 48-bit "Upper 3000 Series" models (i.e., the CDC 3400, 3600, and 3800), although all of these systems use the same peripheral equipment, the same external data codes, and similar COBOL and FORTRAN source languages.

Compatibility with the widely-used IBM System/360 and System/370 equipment and software is very limited. The IBM systems use 8-bit EBCDIC characters and 32-bit words, whereas the CDC 3000 Series uses 6-bit BCD characters and 24-bit words. To help bridge the resulting compatibility gap, Control Data offers a number of 9-track magnetic tape units in addition to the 7-track units which are used in most 3000 Series installations. The cause of inter-system compatibility is further aided by the ANSI COBOL and FORTRAN compilers which CDC now offers for the 3000 Series.

Since January 1970, Control Data's pricing has been unbundled to a greater degree than that of any other major computer builder. Separate charges are imposed for technical support, educational courses, equipment maintenance, and all software released after January 1, 1970. Traditionally, most of Control Data's customers have been relatively sophisticated, self-sufficient organizations that do not require a great deal of manufacturer support, and these users have not been greatly affected by the new support policy. There can be little doubt, however, that Control Data's chances for increased penetration of the business data processing market have been hampered by the unbundling move.

The 3000 Series must now be regarded as a "mature" computer family. Very few significant new hardware or software facilities have been added to the line during the last two years, and the 3100 mainframe and numerous peripheral devices are no longer in production. Control Data's recent development efforts have been heavily concentrated upon the larger Cyber 70 computers and the forthcoming 8000 Series. Nonetheless, the 3000 Series continues to provide users of medium-scale computers with an impressive array of hardware and software facili-

million characters can be read or written at each position of each access mechanism. Each data surface has 256 tracks, and each track holds up to 8192 characters in 256-character sectors. Average head movement time is 70 milliseconds, average rotational delay is 25.7 milliseconds, and data transfer rate is 196,000 char/sec. The 3234 Controller connects up to eight 813 or four 814 Disk Files to one or two I/O channels (but can control only one data transfer operation at a time).

821-1 & 821-2 DATA FILES: These units provide large-capacity random-access storage on non-interchangeable disks. Model 821-1 uses 36 disks (64-data recording surfaces) and stores up to 419 million 6-bit characters. Model 821-2 has 72 disks (128 data recording surfaces) and stores up to 838 million characters. In both models, the disks are equally divided between two side-by-side vertical spindles. Model 821-1 has one comb-type access mechanism, while Model 821-2 has two independent ones. Up to 838,400 characters can be read or written at each position of each access mechanism. Each data surface has 512 tracks, and each track holds up to 12,800 characters in 640-character sectors. Average head movement time is 80 milliseconds, average rotational delay is 17 milliseconds, and data transfer rate is 420,000 char/sec. The 3553-2 Controller connects up to eight 821-1 or four 821-2 Data Files to one or two I/O channels. The Dual Access Option permits the use of two 3553-2 Controllers, allowing simultaneous data transfer operations on any two disk file access mechanisms.

841 MULTIPLE DISK DRIVE: Provides large-capacity random-access storage in interchangeable 11-disk packs which are physically compatible with the IBM 2316 Disk Pack (though the recording format differs from that of the IBM 2314 Direct Access Storage Facility). Available in six models: 841-3 (three on-line drives plus one spare) through 841-8 (eight on-line drives plus one spare). Each drive stores up to 35.84 million 6-bit characters and has a comb-type access mechanism that can read or write up to 179,200 characters in each of its 200 positions. Each track holds up to 8960 characters in 640-character sectors. Average head movement time is 75 milliseconds, average rotational delay is 12.5 milliseconds, and data transfer rate is 420,000 char/sec. The 3553-2 Controller connects an 841 subsystem to one or two I/O channels. The Dual Access Option permits the use of two 3553-2 Controllers, allowing simultaneous data transfer operations on any two drives.

853 & 854 DISK STORAGE DRIVES: These units provide random-access storage in interchangeable 6-disk packs which are physically compatible with the IBM 1316 Disk Pack (though the recording formats differ from that of the IBM 2311 Disk Storage Drive). No longer in production, they are now available on a resale basis. Each drive holds one disk pack at a time and has a comb-type access mechanism that can read or write up to 40,960 characters (10 tracks) at each position. Each track holds 4096 characters in 256-character sectors. Model 853 has 100 data tracks on each recording surface and stores up to 4.1 million 6-bit characters per pack. Model 854 has 200 data tracks on each recording surface and stores up to 8.2 million characters per pack. For both models, average head movement time is 95 milliseconds, average rotational delay is 12.5 milliseconds, and average data transfer rate is 208,000 char/sec. The 3234 Controller connects up to eight 853 and/or 854 Drives to one or two I/O channels (but can control only one data transfer operation at a time).

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This business-oriented Control Data 3500 configuration features the 915 Page Reader (at left rear).

▷ ties at attractive prices. And the effectiveness of these systems has been convincingly demonstrated through more than eight years of field experience in a wide range of business, scientific, communications, and real-time applications. □

▶ **863 DRUM STORAGE:** Provides high-performance random-access storage using fixed read/write heads. No longer in production, but available on a resale basis. Stores up to 4.19 million 6-bit characters. Reads and records 13 tracks (12 data plus 1 parity) in parallel. Data is addressable by individual 12-bit byte. Average access time is 17 milliseconds. Data transfer rate can range from 62,500 to 2,000,000 char/sec, depending upon the interface factor selected. The 3637 Controller connects up to eight 863 and/or 865 Drums to one or two I/O channels (but can control only one data transfer operation at a time).

865 DRUM STORAGE: Provides high-performance random-access storage using fixed read/write heads. Stores up to 8.38 million 6-bit characters. Reads and records 4 tracks in parallel. Data is addressable by 256-character sector. Average access time is 17 milliseconds, and data transfer rate is fixed at 1,000,000 char/sec. The 3637 Controller connects up to eight 863 and/or 865 Drums to one or two I/O channels (but can control only one data transfer operation at a time).

INPUT/OUTPUT UNITS

604 MAGNETIC TAPE TRANSPORT: Reads and records data on 1/2-inch tape in 7-track IBM-compatible format, in either even-parity BCD mode or odd-parity binary mode. Can read in both forward and reverse directions. Data transfer rates are 15,000, 41,700, and 60,000 char/sec at densities of 200, 556, and 800 bpi, respectively. Tape speed is 75 inches per second. Single and dual-channel controllers are available for up to 8 tape drives

(see price list). No longer in production, the 604 is now available on a resale basis.

607 MAGNETIC TAPE TRANSPORT: Reads and records data on 1/2-inch tape in 7-track IBM-compatible format, in either even-parity BCD mode or odd-parity binary mode. Can read in both forward and reverse directions. Data transfer rates are 30,000, 83,300, and 120,000 char/sec at densities of 200, 556, and 800 bpi, respectively. Tape speed is 150 inches per second. Five different controllers are available: 1x4, 1x8, 2x8, 3x8, and 4x16. (For each model, the first figure denotes the maximum number of I/O channels and the second denotes the maximum number of tape drives that can be connected to the controller.) No longer in production, the 607 is now available on a resale basis.

608 MAGNETIC TAPE TRANSPORT: Reads and records data on 1/2-inch tape in 7-track IBM-compatible format, in either even-parity BCD mode or odd-parity binary mode. Can read in both forward and reverse directions. Data transfer rates are 7,500, 20,800, and 30,000 char/sec at densities of 200, 556, and 800 bpi, respectively. Tape speed is 37.5 inches per second. The single-channel 3128 Controller accommodates up to 8 tape drives.

609 MAGNETIC TAPE TRANSPORT: Reads and records data on 1/2-inch tape in 9-track IBM-compatible format. Data transfer rate is 30,000 char/sec at the single recording density of 800 bpi. Tape speed is 37.5 inches per second. The 3121 Controller permits a maximum of 2 tape drives to be connected to a single I/O channel with reading in the forward direction only.

650 SERIES MAGNETIC TAPE TRANSPORTS: These units read and record data on 1/2-inch tape in 7- or 9-track IBM-compatible formats, in either even-parity BCD mode or odd-parity binary mode. They can read in both the forward and reverse directions. Up to 8 tape transports can be connected to either a single or dual-channel controller (model 3518 or 3528, respectively). ▶

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Eight different transports are available, with the following recording modes, tape speeds, recording densities, and data transfer rates:

Model 657-1: 7 tracks; 37.5 ips; 200/556/800 bpi; 7,500/20,800/30,000 char/sec.

Model 657-2: 7 tracks; 75 ips; 200/556/800 bpi; 15,000/41,700/60,000 char/sec.

Model 657-3: 7 tracks; 112.5 ips; 200/556/800 bpi; 22,500/62,500/90,000 char/sec.

Model 657-4: 7 tracks; 150 ips; 200/556/800 bpi; 30,000/83,300/120,000 char/sec.

Model 659-1: 9 tracks; 37.5 ips; 800/1600 bpi; 30,000/60,000 char/sec.

Model 659-2: 9 tracks; 75 ips; 800/1600 bpi; 60,000/120,000 char/sec.

Model 659-3: 9 tracks; 112.5 ips; 800/1600 bpi; 90,000/180,000 char/sec.

Model 659-4: 9 tracks; 150 ips; 800/1600 bpi; 120,000/240,000 char/sec.

405 CARD READER: Reads standard 80-column cards photoelectrically at up to 1200 cpm; can also read 51-column cards at up to 1600 cpm. Reads both Hollerith-coded and binary cards. Has a 4000-card input hopper, a 4000-card primary stacker, and a 240-card secondary stacker. The 3447 and 3649 Controllers connect a single card reader to one or two I/O channels, respectively. Each controller contains a full-card buffer.

415 CARD PUNCH: Punches standard 80-column cards, in either Hollerith or binary format, at up to 250 cpm. Has a 1200-card input hopper and a 1500-card output stacker. The 3446 and 3644 Controllers connect a single card punch to one or two I/O channels, respectively. Each controller contains a full-card buffer.

3691 PAPER TAPE READER/PUNCH: Consists of a Control Data 350 Reader, a Teletype BRPE-11 Punch, and an integrated controller. Reads 5-, 7-, or 8-level tape at up to 350 char/sec and punches it at up to 120 char/sec. Connects to one I/O channel.

3694 PAPER TAPE READER/PUNCH: Consists of a reader, punch, and integrated controller. Reads 5-, 7-, or 8-level tape at up to 1000 char/sec and punches it at up to 120 char/sec. Includes tape spooling mechanisms. Connects to two I/O channels.

501 LINE PRINTER: Prints up to 1000 lpm when the character set is confined to any 48 consecutive characters on the rotating print drum. When all 64 characacters are used, the printing speed is 800 lpm. Has 136 print positions and an 8-channel vertical format control tape. The 3256 and 3659 Controllers connect a single printer to one or two I/O channels, respectively. Each controller contains a full-line buffer. The 501 Printer is no longer in production and has been largely superseded by the 512-1 Printer (below).

505 LINE PRINTER: Prints up to 500 lpm using a 64-character rotating print drum. Has 136 print positions and an 8-channel vertical format control tape. The buffered 3256 and 3659 Controllers connect a single printer to one or two I/O channels, respectively. The 505 Printer is no longer in production, but available on a resale basis.

512-1 LINE PRINTER: Uses a 48- or 64-character horizontal "train" of engraved type slugs. Rated printing speed is 1200 lpm with the 48-character trains. Has 136 print positions. Four different interchangeable train cartridges are available: the 48-character IBM AN and HN arrangements, the 64-character CDC 501 Line Printer set, and a 64-character ASCII subset. Other character sets are available on special order. The 3555-1 Controller includes a full-line buffer and connects one printer to a single I/O channel.

3254 LINE PRINTER: Prints up to 300 lpm using a 64-character rotating print drum. Has 136 print positions and an 8-channel vertical format control tape. Includes an integrated single-channel controller. The 3254 Model 1, which uses a modified standard Gothic font, is offered on a resale basis, while the 3254 Model 2 OCR Printer, which uses the stylized ASCSOCR font plus Rabinow special characters, is still in production at this writing.

3293 INCREMENTAL PLOTTER: Consists of a single-channel controller and a Calcomp Model 565 drum-type digital plotter. Plots up to 300 0.01-inch steps per second on a chart 12 inches wide and 120 feet long.

915 PAGE READER: Optically reads alphanumeric data from typed or printed documents at an instantaneous reading rate of 370 characters per second. Reads the 26 upper-case letters, 10 numerals, and 26 special symbols of the American Standard Character Set for Optical Character Recognition. Can read any number of lines, spaced at up to 6 lines per inch, from documents 4.5 to 12 inches in width and 2.5 to 14 inches in length, or from continous fanfold forms. Has two output stackers, each capable of holding a 2.5-inch stack of documents. The 3195 Controller includes a 160-character buffer and connects one page reader to a single I/O channel.

243 GRAPHICS SUBSYSTEM: Consists of a display console with a 21-inch CRT, integrated controller with 4096 twelve-bit words of core memory, light pen, alphanumeric and function keyboards, and 3000 Series interface. The controller contains processing logic that enables it to execute many display subroutines without interrupting the host computer. The 248 Memory Expansion feature provides 4096 or 8192 additional words of core memory. Feature 10182 expands the symbol set from 64 to 128 characters, while Feature 60094 allows CDC 8000 Series peripheral devices to be connected for increased I/O and storage capabilities. The subsystem connects to a 12-bit 3000 Series I/O channel.

274 DIGIGRAPHICS CONSOLE: Consists of a vector-oriented, 22-inch, flat-face CRT with character generator and light pen. Alphanumeric and function keyboards are optional The screen has a 4096-by-4096 raster and can display up to 2000 inches of curves or up to 1800 characters of any size or font. The 274 Console connects to a 12-bit 3000 Series I/O channel via a 3344 Digigraphics Controller, which can include 4K, 8K, 16K, or 32K words of buffer memory.

3291 SINGLE-STATION ENTRY/DISPLAY: Connects directly to a 12-bit 3000 Series I/O channel and consists of a typewriter-style keyboard, CRT with a 6-by-8-inch display area, and integrated 1000-character buffer. Display consists of 20 lines of 50 characters each. Display character set has 64 symbols.

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3387 ANALOG/DIGITAL INTERFACE CONTROLLER: Connects to a 12-bit or 24-bit 3000 Series I/O channel and controls various members of the CDC 1500 product family. These units, in turn, permit direct wire connections between the computer system and a wide variety of customer devices using both digital and analog techniques.

3682 SATELLITE COUPLER: Permits direct communication between two 3000 Series computers (or, when used with a 3681 Data Channel Converter, between a 3000 Series computer and a Control Data 160, 160-A, or 8090 computer). Acts as a 12-bit-wide data path between two I/O channels in the two separate computers. To transfer data, one channel must perform a Write operation while the other executes a corresponding Read operation.

8271D TRANSFER SWITCH: Permits manual switching of a peripheral controller between two I/O channels. Requires a 3270A or 3270B Transfer Switch Controller, which handles up to four or eight 8271D Switches, respectively.

COMMUNICATION DEVICES

3316-1 MULTIPLEXER CONTROLLER: Permits real-time communications between a 3100, 3170, or 3300 computer and a large network of communication lines. Through appropriate configurations of terminal units (one for each line), 304 Communications Multiplexers (one for every 16 lines), and 303 Communications Expansion Units (one for every eight 304 CM's), a 3316-1 can control up to 512 low-speed lines. When both low- and high-speed lines are used, the maximum line capacity of the 3316-1 is correspondingly reduced as a function of the system I/O transfer rate. The 3316-1 requires a dedicated 12-bit I/O channel and has direct access to core storage. It interrupts the processor only when an entire message has been transmitted or an operational problem has occurred. An optional feature permits two 3000 Series computers and two 3316-1 Multiplexers to communicate with the same group of lines. (NOTE: The 3516-1 Multiplexer Controller performs similar functions in Control Data 3500 systems.)

3266 COMMUNICATION TERMINAL CONTROLLER: Interconnects a 3000 Series I/O channel with up to 16 full-duplex or 32 simplex communication lines. A plug-in data set adapter or terminal unit must be installed in the 3266 to interface with each line and perform the necessary format and speed conversions. A dozen different adapters and terminal units are available to accommodate a fairly broad range of terminal equipment and transmission facilities. Designed for low-volume communications traffic, the 3266 requires processor monitoring on a character-by-character basis. Up to eight 3266 Controllers can be connected to a single I/O channel. No longer in production, the 3266 is now available on a resale basis.

3275 DATA SET CONTROLLER: Provides an interface between a 3000 Series I/O channel and a Bell System 201A, 201B, or 300 Series Data Set or equivalent. This permits half-duplex data communications, usually with another similarly-equipped Control Data computer, at speeds of 2000 to 40,800 bits per second over appropriate common-carrier lines. A 12-bit cyclic code word is appended to each data record to permit detection of most transmission errors. No longer in production, the 3275 is now available on a resale basis.

211 DISPLAY/ENTRY STATION: Permits input via a typewriter-style keyboard and output via a 6-by-8-inch CRT display. Standard display format consists of 20 lines of 50 characters each; an optional format provides thirteen 80-characters lines. Display character set consists of 64 symbols. Special edit features are optional. The associated 218 Output Station provides typewriter output at 15.5 characters per second. These units can be connected to a 3000 Series computer either directly, via cables, or remotely, via communication links. The 3290 Local Display Controller provides storage and control logic for any combination of up to 12 cable-connected 211 and 218 stations. For remote use, the 216 Remote Display Controller interfaces any combination of up to twelve 211 and 218 stations to a Bell System 201A/B Data Set or equivalent.

214 REMOTE ENTRY/DISPLAY STATION: A self-contained display terminal consisting of a typewriter-style keyboard, CRT with a 6-by-8-inch display area, and integrated controller. Standard display format consists of 20 lines of 50 characters each; an optional format provides thirteen 80-character lines. Display character set consists of 64 symbols. Connects to a Bell System 201A/B Data Set or equivalent and an appropriate communications link to the computer.

200 USER TERMINAL: Consists primarily of a 217-2 Entry/Display Station, which is similar to the 214 described above. The 217-2 can be used alone or with the addition of a 333-cpm card reader (Model 224-2) and/or either a 300 lpm printer (Model 222-1 or 222-2) or a 15.5-char/sec output typewriter (Model 218-1). Can be used effectively in either batch or conversational mode. The terminal can be connected to the computer via a voice-grade line in either a party-line or dialed network arrangement. Data is transmitted at up to 4800 bits per second. The optional line printer has a 63-character set and either 80 or 136 print positions. No longer in production, the 200 User Terminal is now available on a resale basis.

SOFTWARE

OPERATING SYSTEMS: The three principal operating systems for the 3000 Series computers, in order of increasing power and complexity, are Real-Time SCOPE, MSOS, and MASTER. In addition, Control Data offers a conversational time-sharing system called KRONOS III. The facilities provided by each of these systems are summarized in the following paragraphs.

REAL-TIME SCOPE: A tape-oriented operating system that requires at least 16K words of core storage plus 3 magnetic tape units, console typewriter, card reader and printer (or other suitable input and output devices), and 2 I/O channels. It permits independent operation of a foreground program and a background program in separate paritions. Programs in the background partition can be processed in stacked-job fashion. The foreground program may be a real-time or communications-oriented routine.

Real-Time SCOPE is built around a resident monitor program that controls interrupt processing, switching between programs, and I/O operations. Other routines, called in from a library tape when required, handle job sequencing, program loading, debugging, library maintenance, and data transcription.

Real-Time SCOPE permits one or two I/O channels to be designated as real-time channels, with all I/O operations on these channels controlled by the user's own coding.

Control Data 3000 Series
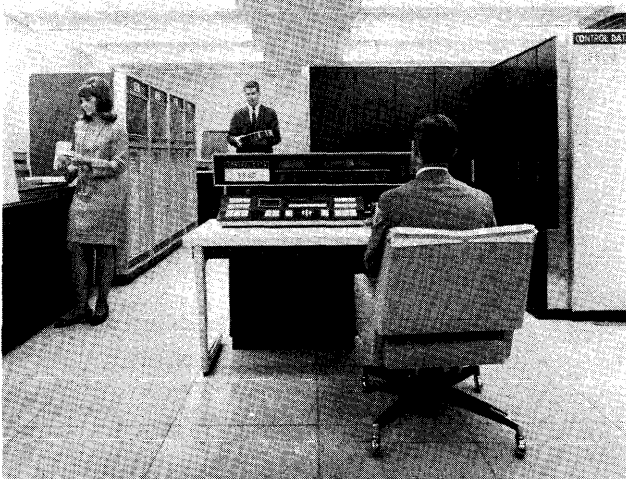
Console and mainframe of the 3500 system, largest member of the 3000 Series.

▶ The SCOPE I/O control system handles all I/O operations on the remaining data channels. In general, SCOPE does not allow foreground and background programs to share the same equipment, except that both types of programs may reference the same disk or drum unit.

MASS STORAGE OPERATING SYSTEM: MSOS is a disk-oriented operating system whose facilities are otherwise similar to those of Real-Time SCOPE. It is designed around a resident monitor program that controls interrupt processing, switching between programs, and I/O operations. Other routines, called in from a disk library file when required, handle job sequencing, program loading, debugging, library maintenance, and data transcriptions. MSOS requires at least 16,384 words of core storage plus 2 disk drives, console typewriter, card reader and printer (or other suitable I/O devices), and 2 I/O channels. Concurrent foreground/background processing requires at least 32K words or core storage, and 4 or more I/O channels are desirable for improved performance.

MSOS, like Real-Time SCOPE, can handle stacked-job processing of background programs concurrently with a single foreground program. The foreground program is normally a special-purpose program that requires control either at discrete intervals of time or when certain I/O-dependent conditions arise (e.g., a real-time or communications-oriented program).

MSOS input/output control facilities consist of a Central Input/Output system (CIO) and a Mass Storage Input/Output system (MSIO). The functions of both systems are called by means of macro-instructions in assembly-language programs. MSIO permits mass storage files to be processed in either sequential or random fashion. The MSIO routines read and write fixed-length or variable-length records. allocate storage space for files, create device and file labels, provide single or double buffering, and handle blocking and unblocking of logical records. Related utility routines create and maintain file and label directories. MSIO also includes checkpoint and restart facilities.

MASTER: The MASTER Operating System takes advantage of the Multiprogramming hardware for the Control Data 3170, 3300, and 3500 systems to provide flexible facilities for multiprogrammed, multiaccess operation. It can process at least four active jobs concurrently, with

the total number limited mainly by the available equipment resources.

MASTER requires a 3170, 3300, or 3500 system with the Multiprogramming feature, at least 65K words of core storage, 12 million characters of disk and/or drum storage, card reader, printer, 1 magnetic tape unit, and 2 I/O channels. Most configurations include 4 to 8 magnetic tape units and additional core storage, I/O channels, printers, and display stations, although none of these items are required.

MASTER's principal functions include: (1) loading, linking, and execution of programs from disk libraries or user-defined files; (2) allocation of programs to contiguous or noncontiguous pages of core storage; (3) protection of programs and files through a combination of hardware and software facilities; (4) control of input/output operations through a centralized, file-oriented I/O control system; (5) servicing of all interrupt conditions; (6) scheduling of job initiation; (7) coordination of operator/system communication; (8) provision of standard error recovery procedures; (9) provision of file maintenance routines and debugging aids; (10) accumulation of job accounting information.

The user assigns one of five priority classes to each job. These classes, from highest to lowest, are Emergency, Background, Special, Input/Output, and Compute. Whenever possible, MASTER loads and initiates a new job. The job selection criteria include job class, equipment requirements, availability of equipment resources, and length of time each job has been waiting. Emergency jobs are initiated immediately, and lower-priority jobs are suspended if necessary to make room for the emergency jobs. Except when emergency jobs are being processed, MASTER attempts to keep at least one job from each of the four other classes active at all times.

The Mass Storage Input/Output System (MSIO) operates under MASTER to provide basic file-oriented I/O control facilities for both mass storage and magnetic tape units. It can handle both fixed-length and variable-length records.

LISA (Linked Index Sequential Access) is a mass storage file management system that can be used with either the MASTER or MSOS operating system. It provides a set of routines that create and maintain disk or drum files, allowing random storage and retrieval of records by their keys as well as sequential processing of the records in a file. Two or more levels of indexing are used for random processing. Each primary index entry points to a block of secondary index entries, and each secondary index entry contains the key and the physical address of the first record in a data block. The LISA routines can be called from the library by COBOL ENTER verbs, FORTRAN CALL statements, or COMPASS macros and calling sequences.

RESPOND is a file-oriented package, usable with either the MASTER or MSOS operating system, that provides an interface between a 3000 Series system and multiple users at remote terminals. Users at either display stations or teletypewriters can create and maintain files and submit jobs for batch processing. A straightforward command language enables remote users to: (1) open new mass storage files and release unneeded files; (2) enter data records into files and save them for future use; (3) display or print specific records stored in previously created files; (4) delete or replace existing records; and (5) submit a job for batch processing by including standard MASTER or MSOS job control statements. ▶

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► EXPORT/IMPORT provides a remote job submission capability for 3000 Series systems. It consists of a set of routines which operate in connection with RESPOND and the MASTER operating system. Commands entered via the keyboard of a 200 User Terminal permit remote entry of jobs in the form of punched card decks and printing of the resulting output files either at the 200 User Terminal which entered the job, at another remote terminal, or at the central computer site. Voice-grade communications facilities are used.

MULTIPLE ACCESS RETRIEVAL SYSTEM (MARS-III) is a data management system that operates under the MASTER operating system. It facilitates the creation and maintenance of a common data base serving a variety of application programs. MARS-III provides both batch-mode and on-line inquiry and report generation facilities. Multiple users at remote terminals can communicate with the system by means of a special query language that includes conditional and Boolean expressions as well as arithmetic operators. MARS-III handles processing in both random and sequential access modes, and can retrieve and update either individual data elements or full records. Data security provisions are offered at the element, file, and terminal levels. MARS-III requires at least 65K words of system core storage, four magnetic tape drives for sorts and utility functions, the Business Data Processing hardware, and enough mass storage to hold all the user's data files.

KRONOS III: A dedicated time-sharing system for the larger 3000 Series computers, KRONOS III can service up to 48 active users at remote terminals. A scheduling algorithm allocates computer processing time and resources among all the conversational-mode users, and a background executive permits deferred program execution and controls a random-access file system. KRONOS III runs on a 3170, 3300, or 3500 system with at least 65K words of core storage, two 12-bit and two 24-bit I/O channels, Floating-Point and Multiprogramming hardware, one 863 Drum, one 813 Disk File, two magnetic tape units, a console typewriter, a Teletype Model 33 or 35 ASR supervisory teletypewriter, a 3316-1 Multiplexer Controller, and appropriate communications facilities. It can simultaneously handle up to 48 Teletype-compatible terminal devices operating at 110 bits/second.

Programming languages available under KRONOS III are conversational BASIC, batch and interactive FORTRAN, CAL, NELIAC, and assembly language. Other KRONOS III facilities include a Text Editor that facilitates development and modification of programs and data files, a Debug routine for loading and debugging assembly-language programs, and an Applications Library that contains data management, scientific, engineering, mathematical, and statistical routines.

COBOL: Control Data offers several COBOL compilers for the 3000 Series. By far the most advanced is ANSI COBOL Version 2, which can be used with the MSOS or MASTER operating system. It implements all of the functional modules of the American National Standard COBOL language at the highest level. Thus, it includes facilities for sorting, report writing, random-access files, libraries, and segmentation. In addition, ANSI COBOL Version 2 includes the following extensions: identifier series in arithmetic statements, READ INTO, WRITE FROM, File Name Series in USE, RENAMING, ADD without TO or GIVING, and OPEN INPUT-OUTPUT. The optional Business Data Processing hardware is required for both compilation and execution.

Several other COBOL compilers with less powerful language facilities are available for use with the Real-Time SCOPE, MSOS, and MASTER operating systems. All are based on the COBOL-61 language, and one provides mass storage facilities.

FORTRAN: Control Data's top-level ANS FORTRAN compilers, available for use with the MSOS or MASTER operating system, provide all the facilities of the American National Standard FORTRAN language and allow compilation and execution using mass storage devices.

Three other FORTRAN compilers are currently in use with 3000 Series systems: FORTRAN-32, a tape-oriented compiler that operates under Real-Time SCOPE, and two Mass Storage FORTRAN compilers that operate under MSOS and MASTER. All three compilers use essentially the same language, which incorporates the features of USA Standard FORTRAN plus numerous extensions.

Among the significant FORTRAN language extensions are the following: (1) mixed-mode arithmetic permits operands of the real, integer, character, and nonstandard types to be freely combined; (2) eight-character names are permitted; (3) an ENTRY statement permits multiple entries to a subprogram; (4) octal constants can be indicated by the use of a trailing B; (5) FORMAT statements may specify conversions of type O (internal binary to octal) or type R (internal BCD to alphanumeric characters); (6) facilities are included for manipulating bits or partial words; (7) ENCODE and DECODE statements transfer data from one area of storage to another while performing specified format conversions; (8) BUFFER IN and BUFFER OUT statements transmit physical records to or from core storage in buffered fashion without the use of format lists.

ALGOL: The ALGOL compiler for the 3000 Series computers is based on a compiler developed by Regnecentralen of Denmark for the GEIR computer. It provides a nearly complete implementation of the ALGOL-60 language (including such features as recursion and general call-by-name), plus comprehensive input/output pro- ►
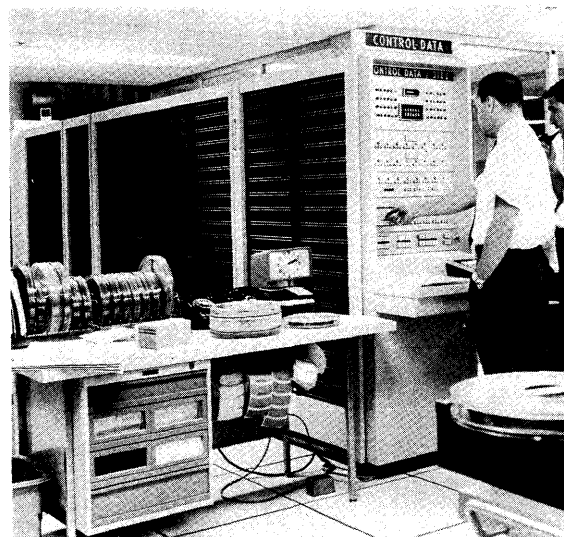
The 3114 Processor, key component of the Control Data 3100 system, is now offered on a resale basis at about 40 percent of its original purchase price.

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▶ cedures and both compile-time and object-time diagnostics. The compiler can generate either complete programs or self-contained procedures which can later be incorporated into programs. The ALGOL compiler operates under the MSOS or MASTER operating system.

COMPASS: The standard symbolic assembly language for the 3000 Series computers, COMPASS (sometimes called COMPASS-33) permits efficient use of all their hardware resources. COMPASS assemblers are available for use with the Real-time SCOPE, MSOS, and MASTER operating systems. (An earlier and somewhat less powerful assembler called COMPASS-32 can be used with Tape and Disk SCOPE.) COMPASS/RTS and COMPASS/MSOS have identical external characteristics, whereas COMPASS/MASTER differs in its control cards, listing format, diagnostics, and a few instructions. Each operating system provides input/output and interrupt facilities which can be accessed through brief calling sequences in COMPASS programs.

COMPASS provides all the facilities that might reasonably be expected in a third-generation assembler, including both programmer-defined and library macro-instruction facilities. The values of address fields can be represented by constants, symbolic addresses, literals, and certain arithmetic expressions. Data areas can be "preloaded" with specified values at the time a program is loaded. Common areas can be designated to permit communication among subprograms written in COMPASS and in other languages. Subprograms can be linked through the use of external symbols and entry points. Conditional assembly facilities permit selective assembly of code sequences based on tests performed at assembly time. Numerous pseudo-instructions provide control of the assembly process and the resulting listings.

UTILITY ROUTINES: Routines to handle basic diagnostic, data transcription, and library maintenance operations are offered for use with each of the 3000 Series operating systems. The Simultaneous Peripheral Processor (SIPP) controls the concurrent execution of several data transcription functions.

Generalized sort/merge routines using both magnetic tape and disk units are available. A Report Generator facilitates the preparation of programs which produce reports from a single input file. A Data Processing Package (DPP) contains routines which facilitate business programming by performing move, compare, edit, multiply, and divide operations on BCD fields, as well as a General-Purpose Input/Output (GPIO) system that performs open, read, write, and close operations on sequential files.

APPLICATION PROGRAMS: A modest assortment of programs for specific applications is available for the 3000 Series. Among the principal ones are:

    PERT/Time
    PERT/Cost
    Regina-I (linear programming)
    ADAPT (numerical control)
    Digigraphics Control Package
    PROFITS (on-line manufacturing control system)
    Brokerage Control System
    SAINT (IBM 1401/1460 simulator)

PRICING

EQUIPMENT: The following systems are representative of the types of 3000 Series configurations that are commonly used and are supported by standard Control Data

software. All necessary controllers are included in the indicated prices, and the quoted rentals include equipment maintenance.

3170 TAPE/DISK MASTER SYSTEM: Consists of 3174-3 Business Processor with Business Data Processing and multiprogramming hardware, 65K words (262K characters) of core storage, four I/O channels, 841-3 Multiple Disk Drive with three on-line drives, three 657-1 Magnetic Tape Transports (30KC), 512-1 Line Printer (1200 lpm), 405 Card Reader (1200 cpm), 415 Card Punch (250 cpm), and all necessary controllers. Monthly rental and purchase prices are approximately $16,800 and $676,000, respectively.

3500 TAPE/DISK SYSTEM: Consists of 3514-4 General Purpose Processor with Floating-Point, Business Data Processing, and Multiprogramming hardware, 131K words (524K characters) of core storage, six I/O channels, 841-8 Multiple Disk Drive with eight drives, eight 659-4 Magnetic Tape Transports (240KB) with dual-channel controller. 512-1 Line Printer (1200 lpm), 405 Card Reader (1200 cpm), and 415 Card Punch (250 cpm). Monthly rental and purchase prices are approximately $42,800 and $1,763,000, respectively.

SOFTWARE: All Control Data software released after January 1, 1970, is separately licensed and priced to domestic commercial customers. Software released prior to that date is generally offered at no additional charge. Each separately priced product is licensed for a minimum of one year, and the license agreement can be terminated upon 90 days' notice thereafter Each software license includes one machine-readable copy of the software itself and one copy of the associated documentation. The price list that follows shows the initial fees and monthly royalties for specific 3000 Series software products.

SUPPORT: The services of Control Data consultants, systems analysts, and programmers are available to 3000 Series users on a separately priced basis through CDC's Professional Services Divisions. Hourly rates vary with the service classification and the volume of services utilized.

EDUCATION: All customer education and training courses (other than sales-oriented seminars and presentations) are provided by the Control Data Education Institutes and are separately priced. Most user-oriented 3000 Series courses range from 2 to 5 days in length and cost from $105 to $300 per student.

CONTRACT TERMS: The standard 3000 Series rental contract permits unlimited use of the equipment. There are no extra-use charges. Control Data maintenance service is separately priced.

LONG-TERM LEASES: The new Commercial Credit/ Control Data Computer Leasing Program offers flexible leases for 3- to 7-year periods. The basic lease plan covers a 3-year term, allows unlimited use, includes liberal substitution and add-on privileges, and is cancellable after 24 months upon 90 days' notice. The base 3-year lease price for a 3304-3 Business Data Processor, for example, is $4,164 per month, or 7.6 percent lower than the standard 1-year monthly rental. Additional discounts from the base 3-year lease price are offered for longer lease terms (up to 7 years), for extensions of the non-cancellable periods, for waiver of substitution privileges, and for payment of each year's rental in advance. ■

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Rental (1-year lease)**
PROCESSORS AND MAIN STORAGE				
3114	Computer Module (includes console and two 3106 Channels)*	45,000	224	3,790
3113	Storage Module; 16,384 words*	35,600	144	2,515
3119	Storage Module; 8,192 words*	46,640	124	1,235
3106	Communication Channel; 12-bit*	4,920	31	105
3107	Communication Channel; 24-bit*	7,500	49	175
Options for 3114 processor:				
10018	Floating Point*	16,450	27	880
10019	BCD Arithmetic*	7,250	33	335
10020	General Purpose Arithmetic (Floating Point plus BCD)*	18,775	38	1,160
10123	Memory Protect*	2,500	0	160
3174-1	Basic Processor (includes Multiprogramming hardware and console)	128,000	330	3,130
3174-2	Scientific Processor (Basic Processor plus Floating Point hardware)	140,800	368	3,445
3174-3	Business Processor (Basic Processor plus Business Data Processing hardware)	140,800	427	3,445
3174-4	General Purpose Processor (Basic Processor plus Floating Point and Business Data Processing hardware)	153,000	465	3,760
3177-2	Channel Module (one 12-bit and one 24-bit channel)	12,470	92	285
3177-4	Channel Module (two 12-bit and two 24-bit channels)	24,800	184	565
3177-6	Channel Module (three 12-bit and three 24-bit channels)	37,000	276	840
3172	Magnetic Core Storage (for 3170 system):			
	49,152 words	118,400	535	2,890
	65,536 words	134,400	713	3,285
	81,920 words	176,000	891	4,305
	98,304 words	217,600	1,070	5,315
	114,688 words	259,200	1,248	6,330
	131,072 words	301,000	1,426	7,350
3304	Basic Processor (includes console)	172,780	195	4,495
3304-2	Business Data Processor (includes BDP instructions and console)	185,500	292	4,505
3310	Floating Point Module	33,390	38	870
3311	Multiprogramming Module	38,150	135	945
3306	Communication Channel; 12-bit	6,150	38	130
3307	Communication Channel; 24-bit	9,435	54	225
3309	Storage Module; 8,192 words	55,650	135	1,380
3302	System Storage (for 3300 system):			
	16,384 words	95,930	179	2,430
	32,768 words	172,780	357	4,340
	49,152 words	259,170	535	6,510
	65,536 words	307,400	713	7,635
	81,920 words	384,250	891	9,430
	98,304 words	434,600	1,070	10,570
	114,688 words	506,470	1,248	12,270
	131,072 words	554,380	1,426	13,345
	147,456 words	622,435	1,604	14,950
	163,840 words	667,800	1,782	15,965
	180,224 words	731,930	1,961	16,855
	196,608 words	774,860	2,139	18,430
	212,992 words	835,280	2,317	19,880
	229,376 words	875,560	2,495	20,790
	245,760 words	932,800	2,673	22,140
	262,144 words	970,960	2,852	22,995
3504-1	Processor (includes BDP, Multiprogramming, and console; not in production)	400,000	918	8,715
3514-1	Basic Processor (includes console)	279,800	875	6,825
3514-2	BDP Processor (includes BDP and console)	339,200	945	7,560
3514-3	Multiprogramming Processor (includes Multiprogramming and console)	364,640	962	8,440
3514-4	General Purpose Processor (includes BDP, Multiprogramming, and console)	424,000	999	8,913
3507-1	Communication Channel	12,720	44	305
3502	System Storage (for 3500 system):			
	32,768 words	160,000	405	3,895
	65,536 words	265,000	810	6,525
	98,304 words	355,000	1,215	8,630
	131,072 words	440,000	1,620	10,630
	163,840 words	525,000	2,025	12,580
	196,608 words	605,000	2,430	14,475
	229,376 words	687,000	2,835	16,315
	262,144 words	760,000	3,240	18,105

*Not in new production; offered as Resale Product.
**Rental prices do not include equipment maintenance.

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Rental (1-year lease)**
MASS STORAGE				
813	Disk File; 133 million chars.*	55,000	503	3,105
814	Disk File; 266 million chars.*	90,000	638	5,110
821-1	Data File; 419 million chars.	148,400	525	2,750
821-2	Data File; 838 million chars.	275,600	898	5,120
841	Multiple Disk Drives:			
	841-3; 3 on-line drives	92,220	303	1,865
	841-4; 4 on-line drives	118,720	357	2,425
	841-5; 5 on-line drives	143,100	411	2,935
	841-6; 6 on-line drives	165,360	465	3,395
	841-7; 7 on-line drives	185,500	519	3,800
	841-8; 8 on-line drives	203,520	573	4,150
853	Disk Storage Drive; 4.1 million chars.*	7,500	52	315
854	Disk Storage Drive; 8.2 million chars.*	10,000	78	470
863	Drum Storage; 4.19 million chars.*	80,000	432	2,445
865	Drum Storage; 8.38 million chars.	153,700	454	2,530
3234	Disk Storage Controller (for 813, 814, 853 and/or 854)*	16,500	71	495
3553-2	Mass Storage Controller (for 821 or 841)	39,220	152	770
3637	Drum Storage Controller (for 863 and/or 865)*	18,000	146	1,060
10163	Dual Access Option (for 821 or 841)	5,300	17	115
INPUT/OUTPUT UNITS				
604	Magnetic Tape Transport; 15/41.7/60 KC*	13,500	141	520
607	Magnetic Tape Transport; 30/83.3/120 KC*	20,000	162	805
608	Magnetic Tape Transport; 7.5/20.8/30 KC	16,430	114	290
609	Magnetic Tape Transport; 30 KC	16,430	114	290
657-1	Magnetic Tape Transport; 7.5/20,8/30 KC	17,890	76	320
657-2	Magnetic Tape Transport; 15/41.7/60 KC	29,150	125	430
657-3	Magnetic Tape Transport; 22.5/62.5/90 KC	36,970	146	670
657-4	Magnetic Tape Transport; 30/83.4/120 KC	46,640	157	810
659-1	Magnetic Tape Transport; 30/60 KC	18,550	87	325
659-2	Magnetic Tape Transport; 60/120 KC	26,235	119	460
659-3	Magnetic Tape Transport; 90/180 KC	38,160	157	685
659-4	Magnetic Tape Transport; 120/240 KC	43,885	168	810
3228	Magnetic Tape Controller; 1x4; for 604 or 607*	13,500	71	400
3229	Magnetic Tape Controller; 1x8; for 604 or 607*	16,500	81	580
3423	Magnetic Tape Controller; 2x8; for 604 or 607*	26,900	173	1,345
3624	Magnetic Tape Controller; 4x16; for 607 only*	206,170	411	3,870
3625	Magnetic Tape Controller; 3x8; for 607 only*	133,560	270	2,395
3121	Magnetic Tape Controller; 1x2; for 609 only*	9,800	71	375
3128	Magnetic Tape Controller; 1x8; for 608 only*	10,950	71	350
3518-1	Magnetic Tape Controller; 1x8; for 657 drives only	32,860	152	560
3518-2	Magnetic Tape Controller; 1x8; for 657 and/or 659 drives at 200, 556, or 800 bpi only			
3518-3	Magnetic Tape Controller; 1x8; for 657 and/or 659 drives at 200, 556, 800, or 1600 bpi	46,640	195	855
3528-1	Magnetic Tape Controller; 2x8; for 657 drives only	53,000	303	1,065
3528-2	Magnetic Tape Controller; 2x8; for 657 and/or 659 drives at 200, 556, or 800 bpi only	61,480	308	1,160
3528-3	Magnetic Tape Controller; 2x8; for 657 and/or 659 drives at 200, 556, 800, or 1600 bpi	69,960	314	1,260
405	Card Reader; 1200 cpm	24,910	71	370
3447	Card Reader Controller; single channel	12,720	60	190
3649	Card Reader Controller; dual channel	18,020	44	315
415	Card Punch; 250 cpm	20,140	65	260
3446	Card Punch Controller; single channel	24,380	71	430
3644	Card Punch Controller; dual channel	36,040	103	640
3691	Paper Tape Reader/Punch; 350/120 cps	13,250	135	210
3694	Paper Tape Reader/Punch; 1200/120 cps	30,740	276	445
501	Line Printer; 1000 lpm*	27,500	260	700
505	Line Printer; 500 lpm*	20,350	227	480
512-1	Line Printer; 1200 lpm	47,700	243	780
595	Train Cartridge (for 512-1)	3,180	0	105
3254	Line Printer with Controller; 300 lpm*	22,500	195	775
3256	Line Printer Controller; single channel; for 501 or 505*	11,500	65	500
3659	Line Printer Controller; dual channel; for 501 or 505*	17,000	92	685
3555-1	Line Printer Controller; for 512-1	28,620	49	605
3293	Incremental Plotter	10,070	92	225
915	Page Reader (OCR)	89,040	486	1,915
3195	Page Reader Controller	20,670	31	485

*Not in new production; offered as Resale Product.
**Rental prices do not include equipment maintenance.

JANUARY 1973

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Rental (1-year lease)**
INPUT/OUTPUT UNITS (cont)				
243	Graphics Subsystem	53,000	373	1,515
248-1	Memory Expansion (4K words, for 243)	4,800	27	165
248-2	Memory Expansion (8K words, for 243)	7,200	54	230
10182	Symbol Set Expansion (for 243)	3,600	0	115
274	Digigraphics Console	38,000	108	1,040
3344	Digigraphics Controller (for 274):			
	With 4K-word buffer memory	32,000	222	960
	With 8K-word buffer memory	36,000	260	1,190
	with 12K-word buffer memory	42,900	297	1,415
	With 16K-word buffer memory	49,900	335	1,645
3291	Single-Station Entry/Display	8,000	44	355
3682	Satellite Coupler*	6,750	27	170
8271D	Transfer Switch*	2,200	9	74
3270A	Transfer Switch Controller (for 4 switches)*	3,500	11	99
3270B	Transfer Switch Controller (for 8 switches)*	4,500	27	145
COMMUNICATIONS EQUIPMENT				
3275	Data Set Controller*	16,000	65	365
3266	Communication Terminal Controller*	7,800	60	275
3316-1	Multiplexer Controller	29,150	92	640
3516-1	Multiplexer Controller (for 3500 system)	35,000	160	715
303-1	Communications Expansion Unit*	1,300	13	56
304-1	Communications Multiplexer*	8,000	60	375
211·	Display/Entry Station:			
	Without Edit Features	2,300	30	70
	With Edit Features	2,500	32	78
218	Output Station	5,700	38	190
216	Remote Display Controller:			
	Without Edit Features	9,500	100	330
	With Edit Features	9,700	100	350
3290	Local Terminal Controller:			
	Without Edit Features	9,500	100	340
	With Edit Features	9,700	100	360
214	Remote Display/Entry Station	4,200	44	140
217-2	Remote Entry/Display Station*	4,750	44	250
218-1	Output Station*	4,000	27	255
224-2	Terminal Card Reader; 300 cpm	5,250	38	110
222-1	Terminal Line Printer; 80 positions*	25,440	168	465
222-2	Terminal Line Printer: 136 positions*	11,550	195	390

*Not in new production; offered as a Resale Product.
**Rental prices do not include equipment maintenance.

SOFTWARE PRICES

		Initial Fee	Monthly Royalty
MASTER SOFTWARE			
C302-01	MASTER 3 Package, including Compass-33, MS FORTRAN 3, MS COBOL 3, ALGOL 1, Respond/Export/Import 1, LISA 1, etc.	2,000	400
C302-02	ANSI FORTRAN 1	0	0
C302-03	ANSI FORTRAN 2	500	100
C302-04	PERT Package 2 (PERT/Time & PERT/Cost)	0	0
C302-05	Tape Sort/Merge 3	0	50
C302-06	Mass Storage Sort/Merge 2	0	50
C302-07	MARK IV Graphics 1	0	0
C302-08	L-SORT 1	0	50
C302-09	MARS III 1	500	300
C302-11	ANSI COBOL 2	500	100
C302-12	L-SORT 2	0	75
C032-15	On-Line Control Subsystem	300	50
C302-16	PROFITS 1	75	75
C302-19	Mass Storage Sort 3	0	50
MSOS SOFTWARE			
C204-01	MSOS 4 Package, including Compass 3, MS FORTRAN 4, MS COBOL 4, MS Sort/Merge 3, Tape Sort/Merge 2, ALGOL 1, Respond 1, LISA 1, PERT/Time 2, PERT/Cost 2, ADAPT 1, etc.	0	0
C204-04	ANSI FORTRAN 1	0	0
C204-05	Seismic DP Subsystem 1	0	100
C204-06	ANSI COBOL 2	0	100
C204-07	Respond/Export/Import 1	0	0
C204-08	On-Line Control Subsystem	300	50
C204-09	PROFITS 1	0	50
KRONOS III SOFTWARE			
C501-01	KRONOS III Version 1 Package, including BASIC, FORTRAN, FTN, EDIT, DEBUG, GO, and Assemble.	2,000	500
C501-02	Application Package 1; includes CAL 1, NELIAC 1, and User Library 1.	0	0

NOTE: The Real-Time SCOPE Operating System and all related software facilities are available at no additional charge.