ICL System Ten 320

MANAGEMENT SUMMARY

Introduced in January 1980, the System Ten 320 represents a bid by ICL to become a major supplier of business data processing systems in the United States. The System Ten 320 is the third major new product introduced in the United States by ICL, Inc., since this subsidiary of International Computers Ltd., Great Britain, assumed control and ownership of the Singer Business Machines operation in 1976. Prior to 1976 earlier System Ten processors were manufactured and sold by Singer Business Machines both as a general purpose computer and a point of sale backroom system. Since ICL acquired the System Ten Rights in 1976, it has installed over 2000 enhanced System Ten 220 processors worldwide.

The System Ten 320 maintains the same architectural and system concepts as the original System Ten. The System Ten 320 is designed to give the individual departments control of their own records and the processing of those records—plus shared access to a central data bank.

Features of the System Ten 320 include:

- As many as 20 independent jobs can be processed at the same time, with multiprogramming controlled by the hardware rather than by software.
- A System Ten 320 can include up to 200,000 characters of semiconductor memory, and up to 320 million characters of on-line disk storage.
- Video Display Units (VDU's), printers and other peripheral devices are connected to the central processor via simple two-wire bit serial asynchronous lines and can be located at distances up to 2,000 feet away.

The System Ten 320 processor makes use of large scale integration (LSI) in its circuitry, and utilizes semiconductor random access memory (RAM) with a cycle time of 2.2 ➢

The System Ten Model 320 processor is a 6-bit CPU designed to handle both batch processing and real-time operations. Up to 20 jobs can run simultaneously under hardware control.

MAIN MEMORY: 60K to 200K 6-bit characters.
DISK CAPACITY: 20 to 320 megabytes.
WORKSTATIONS: A maximum of 20 recommended; physical limitation is 200 devices.
PRINTERS: 60 cps to 600 lpm.
OTHER I/O: Magnetic tape; Point of Sale Terminals; earlier System Ten peripherals (card readers/punches, paper tape punch) can also be attached.

CHARACTERISTICS

MANUFACTURER: International Computers, Inc., 415 East Airport Freeway, Irving, Texas 75062. Telephone (214) 258-8525.

International Computers, Inc. is a division of International Computers Limited, London, England.

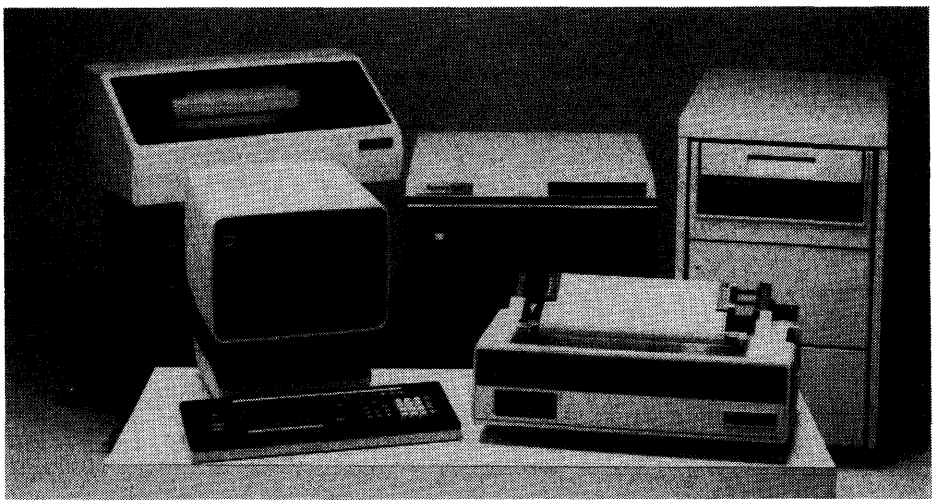
MODEL: System Ten 320.

DATE ANNOUNCED: January 1980.

DATA FORMATS

BASIC UNIT: 6-bit character. Each character position in storage can represent one alphanumeric character or one BCD digit.

FIXED-POINT OPERANDS: Can range from one to ten characters for arithmetic operations, or up to 100 characters for move, edit, and exchange operations. Arithmetic result fields can be up to 20 characters long. Operand lengths are ➢



The System Ten Model 320 shown here includes a wide range of the standard peripheral units available. The Model 320 processor is flanked by a 300 lpm, 132 column printer and a 20 megabyte cartridge disk. The CRT shown is the Model 85 Display Unit and the adjacent printer is the 180 cps, matrix serial model.

ICL System Ten 320

microseconds. Its outstanding feature is its ability to control 20-way multiprogramming at the hardware level. This is achieved by a round-robin time slicing technique that divides the processor's computational power among the various programs (users) which are competing for its attention at any given moment. For the majority of applications, this time-slicing of user instruction execution times is masked by the inherent slow speed nature of I/O operations, thereby giving the effect that each user is on a dedicated single computer system.

Main memory in the System Ten 320 can be physically divided into up to 20 fixed partitions, each ranging from 1,000 to 80,000 characters in size. Each partition holds one program at a time and is serviced by a single Input/Output Channel (IOC), to which up to ten slow-speed peripheral devices can be connected. A single File Access Channel (FAC), available to the programs in all the partitions, is used for disk drives and magnetic tape units. I/O operations on the Input/Output Channels are overlapped with one another and with computation, but an I/O operation on the File Access Channel causes computation to be temporarily suspended. A common memory area, selectable from 1,000 to 80,000 characters, is used as a mailbox area between partitions or to hold a program common to more than one partition.

Central processor time is automatically allocated, in software programmed time "slices," to each partition containing an active program. If a program is unable to use any or all of the processor time allocated to it during a given slice (e.g., because it is awaiting completion of an I/O operation), control is automatically transferred to the program in the next partition. This hardware-controlled multiprogramming technique eliminates the need for a complex software control system thus making more memory available to users for applications programs. Certain programming conventions must be carefully observed, however, especially in the case of references to the common core memory area and the File Access Channel, which are shared by all partitions.

The System Ten 320 offers a wide assortment of peripheral equipment. ICL manufactures its own video display unit and purchases disk drives from Control Data, tape drives from Ampex, and printers from Centronics.

The Model 85 Video Display Unit (VDU) provides keyboard input to and visual output from a System Ten processor located up to 2,000 feet away. It is a buffered unit with a standard typewriter keyboard and numeric keypad, silent operation, and editing and formatting features. The addition of a low cost matrix serial printer offers each user the ability for hard copy output. High speed printers can also be added and shared among users.

Communications adapters enable a System Ten 320 to communicate effectively with another System Ten, with a larger computer, or with remote VDU/printer terminals.

System Ten 320 processors can perform local batch processing operations in addition to editing the input and output from a remote central computer.

specified either explicitly or implicitly by the referencing instructions.

FLOATING-POINT OPERANDS: No facility for floating-point arithmetic is provided.

INSTRUCTIONS: Each instruction word is ten characters long, and the address of its leftmost character must be a multiple of ten. The instruction format includes a four-bit operations code and two four-digit decimal addresses, each with an index register designator.

INTERNAL CODE: Six-bit subset of ASCII. The six bits of each System Ten character code correspond to ASCII bits 1, 2, 3, 4, 5, and 7, ruling out the use of lower-case letters and most of the ASCII control codes. The System Ten input/output channels automatically perform 6-bit/8-bit code conversions by adding (during output) or deleting (during input) ASCII bit 6 and a parity bit from each character.

MAIN STORAGE

STORAGE TYPE: Semiconductor RAM.

CYCLE TIME: 2.2 microseconds per character.

CAPACITY: 60,000 to 200,000 characters, in 60,000 character modules.

CHECKING: None.

STORAGE PROTECTION: Provided by hardware. Each program can access only the data stored within its own partition and in a common memory area. Physical partitioning is accomplished by wiring. A System Ten 320 can have up to 20 partitions, each with dedicated reserve memory. A common area of at least 1,000 characters must also be established. The first 300 characters of common memory are protected from alteration by programs and are used to hold program status information about each partition.

CENTRAL PROCESSOR

INDEX REGISTERS: Three for each partition. Either or both addresses of most instructions can be indexed. Single or double indexing adds 18 or 35 microseconds, respectively, to the instruction time.

INDIRECT ADDRESSING: Single level adds 25 microseconds per instruction.

INSTRUCTION REPERTOIRE: 15 instructions, including addition, subtraction, multiplication, division, comparison, editing, and movement of variable-length fields. All arithmetic is performed in fixed-point decimal mode, using instructions of the 2-address, memory to memory type.

INSTRUCTION TIMINGS: Average for two-address operations on five-digit decimal fields:

Add/Subtract	**80.3 microseconds**
Multiply:	**324.0 microseconds**
Divide	**746.0 microseconds**
Move:	**61.0 microseconds**

PHYSICAL SPECIFICATIONS: The Model 320 processor is housed in a cabinet that stands 26 inches wide, 29.5 inches high, and 27 inches deep. Power requirement is a 115 volts AC, single phase, 60 Hz circuit.

INPUT/OUTPUT CONTROL

I/O CHANNELS: Every System Ten processor includes a single File Access Channel (FAC) and can be equipped with from one to 20 Input/Output Channels (IOC's).

ICL System Ten 320

PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION & SPEED	MANUFACTURER
MAGNETIC TAPE EQUIPMENT		
Model 45-8	9-track, 800/1600 bpi, NRZI or PE, IBM-compatible, 10.5-inch reels, 20,000 cps, 25 ips	Ampex
PRINTERS		
Model 61-1	Matrix Serial Printer; 132 print positions, 5x7 dot matrix, 64-character set, bi-directional, 60 cps	Centronics
Model 61-2/3	Matrix Serial Printer; 132 print positions, 7x7 dot matrix, 64-character set, bi-directional, 120/180 cps	Centronics
Model 62-1/2/3/4	Line Printer; 132 positions, 64-character set, 75/150/300/600 lpm	Centronics
TERMINALS		
Model 85	Video Display Unit; 24 lines by 80 characters, 64-character set, 2700 cps, 10-key numeric keypad and standard alphanumeric keyboard, 9x7 dot matrix; connects to an IOC	ICL
Model 81	Remote Display Unit; 24 lines by 80 characters, 64-character set, 10-key numeric keypad and standard typewriter keyboard; provides connections for a Model 61 Matrix Serial Printer; connects to CPU via standard synchronous modem	ICL

A version of the System Ten 320, the 310, is also offered as part of the ICL 9500 Retail Point of Sale System. The primary partition peripheral devices in this application are the ICl 9500 series Point of Sale terminals.

The System Ten is marketed on a partially bundled basis. Technical support and the Disk Management Facility software are included in the equipment prices, but educational courses and applications packages are separately priced. Application programs are offered on the basis of license fees plus charges for any necessary modifications to the basic routines. In installations where ICL does all the programming on a turnkey basis, ICL claims the programming cost is typically about 30% of the total hardware cost.

Software support for the System Ten 320 includes the Disk Management Facility II, a set of support programs used to create and maintain files; the Logical Input/Output Control System, a set of subroutines that handle file and record I/O operations; utility routines; COBOL, RPG, and an assembler; and a number of application packages.

Target markets for the System Ten 320 include General Purpose Billing/Accounting Applications, Retail Vertical Market areas such as Home Improvement Centers, Department Stores, and specialized areas such as manufacturing. The architecture lends itself best to applications requiring multiple users.

ICL believes in system integrity and hardware reliability. The System Ten 320 offers the minicomputer user multiprogramming benefits with few software overhead constraints.□

SIMULTANEOUS I/O OPERATIONS: The IOC's operate on an interrupt basis, so their operations are overlapped with one another and with computing in other partitions. However, computing is suspended whenever an I/O operation is in progress on the FAC, which is used for all magnetic tape and disk I/O operations.

I/O DATA RATES: Data is transmitted between the IOC's and the associated peripherals in bit-serial fashion at up to 3,000 characters/second. The FAC accommodates data rates up to 454,000 characters/second.

CONFIGURATION RULES

Maximum configuration parameters for a System Ten 320 are as follows:

- **Up to 200,000 characters of main memory**
- **Up to 320 million characters of on-line disk storage**
- **Up to 200 low-speed peripheral devices (workstations, printers, card readers/punches, and paper tape readers/punches)**
- **Up to 4 9-track magnetic tape drives**

WORKSTATIONS: Up to ten low-speed peripheral devices (workstations, printers, card units, etc.) can be connected via an IOC. One IOC is dedicated to each memory partition. ICL recommends a maximum of twenty workstations on line to the System Ten 320.

MASS STORAGE: Up to four disk drives can be connected to the File Access Channel (FAC) via the MDC 5 Disk Controller. The maximum disk storage capacity is 320 million characters. Model 46 and 47 disk drives can be intermixed on the system.

MAGNETIC TAPE UNITS: Up to four magnetic tape units can be connected to the FAC via a control unit.

PRINTERS: See WORKSTATIONS above.

ICL System Ten 320

MASS STORAGE

MODEL 46 SERIES DISK DRIVES: Fixed/removable units with 10 million characters of removable storage and fixed disk capacities of 10, 30, or 50 million characters. The units use a voice coil access mechanism with one read/write head serving each 10 million character recording surface. Each surface has 800 data tracks divided into 125 sectors, each capable of holding 100 eight-bit characters of data. Each disk read or write instruction transfers one 100 character record. Average head movement time is 30 milliseconds, average rotational delay is 8.33 milliseconds, and data transfer rate is 450,000 characters per second. The Model 46 Series Disk Drives are manufactured by Control Data Corporation.

Data capacity for the Model 46 Series is as follows:

Model 46-1— 10 million character removable
10 million character fixed
Model 46-2— 10 million character removable
30 million character fixed
Model 46-3— 10 million character removable
50 million character fixed

MODEL 47 SERIES DISK DRIVES: These larger capacity units provide removable disk packs with formatted data capacities of 40, 80, and 160 million characters for the Models 47-1, 47-2, and 47-3, respectively. The Model 47 uses a voice coil actuator mechanism similar to the mechanism used on the Model 46. The Model 47-3 is limited to two physical units per system or 320 million characters total capacity. The Model 47 disk pack is made up of 5 disks of which three are used in recording and two serve as protective disks. Of the six recording surfaces provided by the three recording disks, data is stored on four surfaces, one surface is not used, and the sixth is used for head positioning. The Model 47-1 and 47-3 each have 800 tracks per surface while the Model 47-2 has 400. Each track is 125 sectors with each sector containing 100 characters of data. Average head movement time is 30 milliseconds, average rotational delay is 8.33 milliseconds, and data transfer rate is 450,000 characters per second. The Model 47 Series Disk Drives are manufactured by Control Data Corporation.

INPUT/OUTPUT UNITS

Earlier System Ten peripheral units are compatible to the System Ten 320, including the Model 30/31 Card Readers, the Model 35 Card Punch, the Model 60 Paper Tape Reader, the Model 65 Paper Tape Punch, the Model 50 Series Line Printers, and the Model 80/82 Video Display Units.

For the current I/O units available, see Peripherals/Terminals table.

COMMUNICATIONS CONTROL

SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA): Enables a System Ten 320 processor to communicate with either another similarly-equipped System Ten or a larger computer over a single leased or dialed voice-grade line. Data is transmitted in synchronous mode at 1200, 2000, 2400, 3600, 4800, or 9600 bits per second, depending upon the type of line and modem employed. ICL states that the SCA will enable a System Ten to communicate with any other major computer system using ASCII.

The SCA includes a "dial out" capability that enables it to initiate calls over a dialed line. Each SCA replaces two physically adjacent IOCs and is associated with one specific main memory partition. The SCA operates in much the same manner as a regular IOC. Computing in other partitions is overlapped with SCA data transmission or reception. No other peripheral devices can be connected to an SCA partition, and other partitions cannot address the SCA directly. Therefore, data to be sent or received by the SCA must be passed through the common memory region or must originate via a FAC (disk or tape) unit.

ASYNCHRONOUS COMMUNICATIONS ADAPTER (ACA): Enables a Sytem Ten 320 processor to communicate with either local or remote terminals in asynchronous mode at 150, 300, 600, 1200, or 1800 bits per second. The ACA permits communication with a variety of terminals that meet the EIA RS-232B/C and CCITT-V.24 interface standard, including ICL POS Data Collectors, which are used in retail stores to collect and transmit point-of-sale information. Transmission is in seven-bit ASCII code using a ten-bit character structure.

Each ACA handles a single line; either leased or dialed voice-grade lines and Bell System Series 202 modems or equivalent can be used. An automatic "dialed out" capability is optional. Up to 10 ACA's can be installed in a System Ten processor; each ACA replaces two physically adjacent IOCs.

ASYNCHRONOUS TERMINAL ADAPTER (ATA): Enables a System Ten 320 processor to communicate with either local or remote terminals in asynchronous mode at 110, 150, 200, or 300 bits per second. Permits communication with a variety of terminals that meet the EIA RS-232B/C interface standard. Transmission is in seven-bit ASCII code using a ten- or eleven-bit character structure. Each ATA handles a single terminal or line. For local use, at distances up to 50 feet, the ATA connects directly to the terminal. For remote use, either leased or dialed telephone lines and Bell System Series 103 modems or equivalent can be used. An automatic "dial out" capability is optional. Up to 20 ATA's can be installed in a System Ten processor. Each ATA replaces one standard IOC or two adjacent channels if the automatic dialing option is included.

SOFTWARE

OPERATING SYSTEM: ICL does not offer an operating system for the System Ten, since many of its normal functions are performed at the hardware level. In order to facilitate the management of programs and data files stored on disk packs, ICL offers the Disk Management Facility II.

The *Disk Management Facility II* (DMF II) consists of a group of system support programs, used to create and maintain files, and a set of Logical Input/Output Control System (LIOCS) subroutines, called by macro-instructions, which handle file and record I/O operations in user programs. Records are organized in "linked sequential" fashion, with the last six characters of each 10-character sector containing the disk address of the next logical sector. The normal access mode is linked sequential, but random and direct accessing is possible through creation and use of an index to the linked sequential file.

DMF II is an enhancement to the Singer DMF I which offers additional flexibility in data base creation, program independence, and expanded access methods and logical operations.

LANGUAGES: ICL offers an assembler, report program generator (RPG), and COBOL for use on the System Ten 320.

Assembler II converts programs coded in symbolic language into executable machine language. Available to the programmer are macro definition and expansion; conditional assembly; assembly-time variables, statements, and functions; an extended set of instruction mnemonics; literals; relocatable object code; a symbol cross-reference listing that gives 'where set' and 'where used'; assemble-and-execute capability; additional assembler control statements; and finally, disk storage of assembler work files, including the symbol table.

ICL System Ten 320

The *System Ten RPG2* facilitates the coding of programs to produce formatted reports and files. The programmer, using four different types of preprinted specification sheets, prepares a set of specifications that describe the form of the input data, the calculations to be performed, and the format of the desired output. These specifications are entered via a terminal. The RPG compiler then generates a machine-language object program to perform the specified functions. The specification sheet and language facilities of System Ten RPG are quite similar to those of the IBM Report Program Generators. RPG compilation requires a 9K memory partition, one or more disk drives, and a terminal. A line printer is required unless the program listing is to be directed to a Video Display Unit.

The *COBOL* compiler offered by ICL provides characteristics such as data base facilities, interactive video displays, and enhanced structured programming. The COBOL compiler is a subset of ANSI 74 (Nucleus 1) and offers complete access to all DMF II files.

UTILITIES: A number of utility routine packages are available to assist users in programming and implementation of their systems:

- Loading routines for storing, relocating, and linking programs in memory;
- Media routines for reading, punching, duplicating, verifying, sequencing, identifying, listing, and converting punched cards and paper tape;
- Program debugging routines for performing memory dumps (in interpretive or machine-language form) and program traces;
- General service routings for handling input/output, common calculation procedures, etc.; and
- A Sort/Merge Generator for disk-oriented systems only.

APPLICATION PROGRAMS: ICL offers a variety of major application packages including:

The *System Ten Accounting and Reporting System (STARS II)* consists of order processing, accounts receivable, inventory control, sales analysis, accounts payable, and general ledger modules. Each module consists of a number of application programs which are designed to facilitate the entry of information and the processing and reporting functions. The inventory control, accounts receivable, accounts payable, and general ledger modules may be installed individually since each is self-contained. Similarly, the order processing, inventory control, and accounts receivable modules can be installed as a stand-alone order processing system. Each STARS II module offers comprehensive capabilities in its own application area.

The *SAFES* package has been designed to provide a computerized factory management system which includes work-in-progress monitoring and extended requirements planning over 52 weekly periods.

All data is input to the system by a video terminal and is simultaneously displayed so that it can be checked and corrected before the computer updates any files. Similarly, information already stored in the system can be queried by using the keyboard and displayed on the screen in formatted, easy-to-read layouts.

When information is requested, it can be accessed directly with no necessity to search through files for the relevant data. The system uses a 'database' technique for organizing the files, where pointers are maintained between related records, even if they exist in different master files.

The Extended SAFES system is a collection of modules which includes Bill of Materials, Costing, Inventory Control, Extended Requirements Planning, and Work-in-Progress. In order to simplify the installation of the SAFES system it is possible to install each module individually.

Prosper Ten is a financial modeling and business planning package from ICL for users which enables accountants, economists, and managers without computer experience to produce tailor-made models of their organization's activities. Using Prosper Ten for financial modeling adds greater management control of the business, by offering speed, simplicity, and freedom from tedious time consuming routines. Financial models are being used in many different ways. Some of these applications are budgetary control, new product analysis, consolidation of accounts, production planning, sensitivity analysis, capital investment appraisal, cash flow analysis and forecasting, and buy versus lease comparisons.

PRICING

POLICY: System Ten Model 320 computers are available for purchase or third party leasing contracts.

Technical support is provided for normal installations, with additional services being billed to the user. ICL separately charges for its three-week course that teaches computer fundamentals and System Ten programming.

Currently ICL provides full service support in 25 major cities. ICL maintenance policy is to provide 8 hour coverage within 50 miles of sales/service sites at standard rates. Extended coverage is factored up depending on location and type of coverage desired. Standard monthly rates for the 320 System are shown in the Equipment Price Chart. Annual rates would be slightly less.

All ICL standard software is currently available to System Ten users at no extra charge except for the application packages which are offered on a license-fee basis plus modification charges.

Application software prices are competitively priced from $1500 to $20,000 dependent upon the application and degree of training involved. Software customization is also available on an RPQ basis.

Software and applications packages developed on earlier Singer processors are compatible with the System Ten 320 but are not supported by ICL.

EQUIPMENT: Listed below are two typical Sytem Ten 320 configurations.

Entry Level System consists of basic Model 320 processor with 60K characters of semiconductor memory, one input/output channel partition, 20M bytes of disk storage, one Model 85 Video Display Unit, and one 60-cps matrix serial printer. Purchase price is $34,145.

Medium Level System consists of basic Model 320 processor with 120K characters of semiconductor memory, 7 input/output channel partitions, two 80M byte disk drives, 7 Model 85 CRT units, one general purpose synchronous communications channel, and a 600 lpm printer. Purchase price is $76,300. ■

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
SYSTEMS TEN PACKAGED SYSTEMS			
Processor with 60K characters of memory, one IOC, and 20-megabyte cartridge disk system (includes 10-megabyte removable disk and 10-megabyte fixed disk)		$26,800	$190
Processor with 60K characters of memory, one IOC, and 40-megabyte cartridge disk system (includes 10-megabyte removable disk and 30-megabyte fixed disk)		29,800	205
Processor with 60K characters of memory, one IOC, and 60-megabyte cartridge disk system (includes 10-megabyte removable disk and 50-megabyte fixed disk)		32,800	219
Processor with 60K characters of memory, one IOC, and 40-megabyte removable cartridge disk system		31,800	255
Processor with 60K characters of memory, one IOC, and 80-megabyte removable cartridge disk system		38,300	290
Processor with 60K characters of memory, one IOC, and 160-megabyte removable cartridge disk system		42,300	325
60K characters memory increment		2,500	22
MASS STORAGE			
Model 46-1	20-megabyte cartridge disk	9,550	75
Model 46-2	40-megabyte cartridge disk	12,500	90
Model 46-3	60-megabyte cartridge disk	15,500	104
Model 47-1	40-megabyte removable disk	14,500	140
Model 47-2	80-megabyte removable disk	21,000	175
Model 47-3	160-megabyte removable disk	25,000	210
MAGNETIC TAPE EQUIPMENT			
Model 45-8	Magnetic Tape Unit; 9-track, 800 bpi, NRZI	12,500	117
	Magnetic Tape Controller	1,800	15
PRINTERS			
Model 61-1	Matrix Serial Printer; 5x7 dot matrix, 132 positions, 64 character ASCII, bi-directional, 60 cps	4,895	40
Model 61-2	Matrix Serial Printer; 7x7 dot matrix, 132 positions, 64 character ASCII, bi-directional, 120 cps	4,995	50
Model 61-3	Matrix Serial Printer; 7x7 dot matrix, 132 positions, 64 character ASCII, bi-directional, 180 cps	6,200	60
Model 62-1	Line Printer; 132 positions, 64 character ASCII set, 75 lpm	7,800	60
Model 62-2	Same as Model 62-1 except 150 lpm	8,000	75
Model 62-3	Same as Model 62-1 except 300 lpm	9,000	95
Model 62-4	Same as Model 62-1 except 600 lpm	12,000	176
TERMINALS			
Model 85	Video Display Unit; 24 lines by 80 characters, 64-character set, 2700 cps, 10-key numeric keypad and standard alphanumeric keyboard, 9x7 dot matrix	2,800	16
Model 81	Remote Display Unit; 24 lines by 80 characters, 64-character set, 10-key numeric keypad and standard typewriter keyboard; provides connection for Model 61 Matrix Printer	3,900	20
COMMUNICATIONS EQUIPMENT			
Multiple Terminal I/O Channel (MTIOC2)		450	17
Modular Data I/O Channel (MDIOC4)		1,700	17
Synchronous Communications Adapter (SCA)		1,200	17
Asynchronous Terminal Adapter (ATA)		1,100	19
Asynchronous Communications Adapter (ACA)		850	17
Auto Dial Option		400	6
Digital Clock		700	17