IBM 5110 Computing System

MANAGEMENT SUMMARY

Announced on January 10, 1978, the IBM 5110 Computing System is the big brother to the General Systems Division's 5100 Portable Computer. The 5110 features floppy disk and/or magnetic tape storage and approximately two to three times the internal computing power of the 5100, according to IBM. Like the 5100, the new system is being marketed as a personal computer for the business, engineering, and scientific professional who has a requirement for local computing.

The basic 5110 Computing System consists of a desk-top unit that houses the central processing unit with 16K, 32K, 48K, or 64K bytes of main memory and read-only storage for the language processor, and a typewriter-like keyboard with a 10-key calculator pad and a 1024-character display screen with full screen management and upper and lower case characters.

The 5110 is available in two basic models. Model 1 includes a magnetic tape cartridge drive and can also be equipped with diskette storage. It can store up to 204K bytes per tape cartridge or 1.2 million bytes on a single diskette. Model 2 allows diskette storage only. Up to two 5114 Diskette Units, each housing a maximum of two diskette drives, can be attached to either model of the 5110 for a maximum capacity of 4.8 million bytes of diskette storage. The diskette units can be used in a sequential or direct access mode. When data is written in the standard interchange mode, the diskettes also provide a means of exchanging data with other IBM systems, including the 3741, System/32, System/34, and Series/1. A diskette sort feature is available as an option.

Each of the two basic models of the 5110 is available in 12 submodels, offering the buyer a choice of 16K, 32K, 48K, ▷

IBM's new personal computer, available with high-level BASIC and APL languages, direct-access diskette storage, cartridge tape drives, and an 80- or 120-cps printer, can be programmed to handle a wide range of low-volume commercial and scientific applications. IBM offers 24 models of the 5110, differentiated by their storage media, the amount of main memory they host, and the languages they support. Purchase prices range from $9,875 to $32,925.

CHARACTERISTICS

MANUFACTURER: IBM Corporation, General Systems Division, 875 Johnson Ferry Road N.E., Atlanta, Georgia 30342. Telephone (404) 256-7000.

MODELS: 5110 Model 1 and Model 2.

DATE ANNOUNCED: January 1978.

DATE OF FIRST DELIVERY: February 1978.

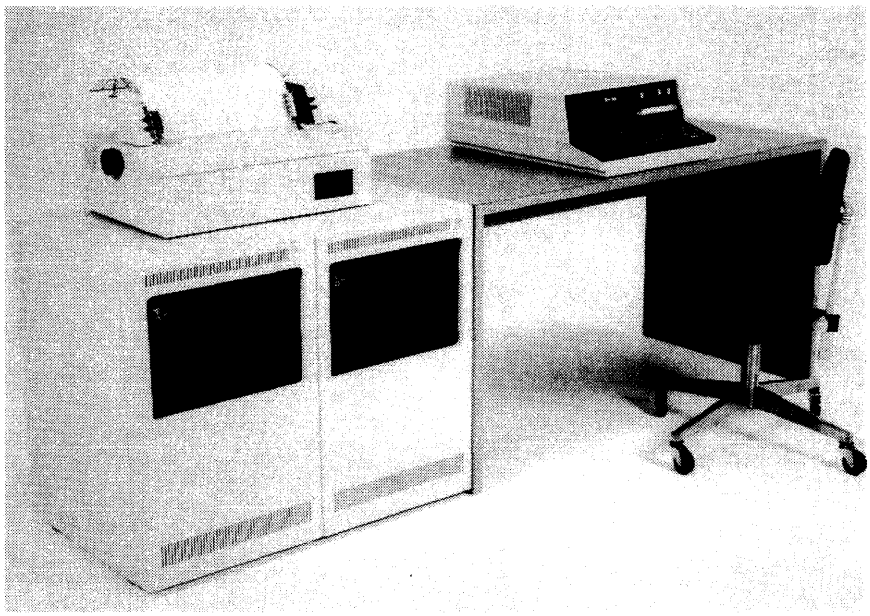
DATA FORMATS

All access to the 5110 is through the BASIC or APL programming languages, implemented in read-only memory. In general, these languages provide specific facilities for numeric integers, floating-point numeric values, numeric arrays, and alphanumeric strings. Instruction formats are, in effect, the BASIC or APL statements themselves. Apparently, the internal structure is based on a 16-bit word.

MAIN STORAGE

Type: MOSFET (Metal-Oxide Semiconductor Field Effect Transistor).

CYCLE TIME: 530 nanoseconds per two-byte access. ▶



The 5110 Computing System shown includes the maximum complement of two 5114 Diskette Units, each housing two diskette drives. Each diskette can store up to 1.2 million characters of information, for a total on-line storage capacity of 4.8 million bytes. The keyboard/display houses the CPU with 16K, 32K, 48K, or 64K bytes of main memory and an optional magnetic tape cartridge unit. Two character printers are available with speeds of 80 and 120 cps, and both have upper and lower case capability.

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or 64K bytes of main memory in conjunction with the BASIC Language Interpreter, the APL Language Interpreter, or both.

An optional Serial I/O feature permits connecting a wide range of peripheral devices available from sources other than IBM. The 5110 also offers an optional Parallel I/O adapter which provides the capability to attach up to 14 IEEE 488-1975 compatible devices such as laboratory instruments, plotters, and printers.

Also available for attachment to the 5110 are a new model of the IBM 5106 Auxiliary Tape Unit for Model 1 users desiring additional tape capacity, and two new models of the IBM 5103 Printer. The 5103 Models 11 and 12 are bidirectional printers capable of printing 80 and 120 characters per second, respectively, in upper and lower case.

The new system offers a choice of either asynchronous and/or bisynchronous communications. The bisynchronous capability permits emulation of either an IBM 3741 or 2770 at speeds up to 4800 bps. In asynchronous mode, the 5110 emulates a 2741 terminal at either 134.5 or 300 bps.

Comparing the performance of the 5110 to that of the earlier IBM 5100, the most significant factor is the increased speed of the 5110's diskettes over the 5100's cartridge tape drive. In addition, the 5110 offers two to three times the internal computing power of the 5100, provides the capability to update diskette or tape data files in place, and can turn off its CRT display under program control. When the CRT is off, up to 18 percent of the total CPU processing time becomes available to the user rather than being used to refresh the CRT. Also, during certain jobs, printing on the 5110's IBM 5103 Printer can be performed while calculations are taking place.

The BASIC and APL languages have been significantly extended over their counterparts for the 5100. Here are some highlights of the increased flexibility and power of the 5110 BASIC language:

- The Dimension statement allows the user to enter an array of any size as long as it fits into memory. The user can also specify the number of characters, from 1 to 255, for a character variable.
- Error trapping by the user program can identify most errors, including end of file, I/O, and data conversion errors.
- A new FORM statement can be used in place of an IMAGE statement, adding among other uses the capability to automatically float a dollar sign, insert commas in numbers over 999.99, and convert a six-digit date to the more familiar month, day, year format.
- A new system function enables sorts to be performed in memory.

CAPACITY: 16,384, 32,768, 49,152, or 65,536 bytes.

CHECKING: A parity bit is associated with each byte.

RESERVED STORAGE: A total of 4,400 bytes of main memory is reserved for the BASIC interpreter in addition to the read-only memory; for APL, a total of 6,700 bytes is reserved.

CENTRAL PROCESSOR

GENERAL: The two general models of the 5110 are distinguished by their storage media. Model 1 offers magnetic tape and optional diskette storage. Model 2 allows diskette storage only. Each model is available in 12 submodels offering a choice of the BASIC and/or APL languages and main memory sizes of 16K, 32K, 48K, or 64K bytes.

The internal structure of the 5110 has not been detailed publicly. It is based on a single-card microprocessor. The basic memory speed is quite fast. This may be compromised by the internal organization of registers and I/O arrangements, but no definite comment can be made at this time.

The instruction repertoire is effectively that of the BASIC and/or APL languages. These high-level languages permit symbolic addressing of data values, loop control, and program flow structuring, along with procedure-oriented facilities for numeric computations. Alphanumeric strings can be handled for display or printing of table heads, interactive prompting, error or condition displays, etc.

Each 5110 computer includes a 1024-character display and a keyboard. The keyboard keytops are engraved with symbols corresponding to the elements of the language implemented in each model. For BASIC models, most of the language statement keywords can be entered with a single key depression in conjunction with the Command key. Also on BASIC models, the accompanying 10-key numeric keypad can be used as function keys, with the meanings defined by user programming. On both BASIC and APL models, the top row of keys carries alternate usages for various system and peripheral functions.

An optional audible alarm is provided which can be programmed to indicate the completion of particular tasks or error conditions.

The BASIC and APL interpreters are implemented in read-only memory, or, as IBM refers to it, read-only storage (ROS). ROS is implemented in MOSFET technology for the 5110 with 72K- and 96K-bit chips. Also included in ROS are system control functions and I/O drivers. The system functions include a diskette sort feature which can be invoked from either BASIC or APL programs. It features full record sorting or record address sorting.

PHYSICAL SPECIFICATIONS: The 5110 computer occupies a space 8 by 17.5 by 24 inches and weighs between 43 and 50 pounds. It operates on conventional 115-volt, grounded AC power. The optional tape cartridge unit measures 7.25 by 10 by 12.25 inches and weighs 20 pounds. The optional printer weighs 55 pounds and measures 12.25 by 14 by 24 inches. The optional diskette unit measures 17.75 by 22.25 by 29 inches; the single-drive version weighs 120 pounds and the dual-drive version weighs 136 pounds.

INPUT/OUTPUT CONTROL

The processor provides one I/O port for attaching one diskette drive and one printer. A separate facility is provided for connecting the communications option. However, when the 5110 is used as a communications terminal, user programs cannot be entered. In the Model 1, if both the external

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PERIPHERALS

MODEL	DESCRIPTION & SPEED
INTEGRAL WITH 5110 PROCESSOR	
CRT/Keyboard	1024 characters; 16 lines of 64 characters; black on white or reverse, switch-selected; spread-out of left or right 32-char. line half, switch-selected; full screen edit capability; upper and lower case characters displayed
INTEGRAL WITH 5110 MODEL 1	
Magnetic Tape Cartridge Drive	Uses 3M-style tape cartridge containing 300 feet of 0.25-inch tape; data recorded in 512-char. physical blocks with logical records separated by record marks, program interpreted; 40 inches/sec.; 2850 char./sec. read, 950 char./sec. effective write including write with backspace and read/check
MAGNETIC TAPE	
5106-11	Auxiliary Tape Unit; same specifications as integral unit above; usable only with 5110 Model 1
PRINTERS	
5103-11	Serial, bi-directional, 132 positions, 10 char./inch, full APL/BASIC char. set, up to 6-part forms, 80 upper and lower case char./sec.
5103-12	Serial, bi-directional, 132 positions, 10 char./inch, 6 lines/inch, full APL/BASIC char. set, up to 6-part forms, 120 upper and lower case char./sec.
OTHER DEVICES	
5825	Parallel I/O Adapter; IEEE 488-1975 compatible
6103	Serial I/O Adapter; RS-232 compatible, 20 to 9600 bps
TV Monitor	Multiple CRT monitors can be connected serially; contact IBM for configurational possibilities and prices

APL language enhancements for the 5110 include:

- Additional system commands for diskette I/O.
- Multiple-record reads and writes.
- Printer left margin control.

The 5110 ranges in price from $9,875 for a minimum configuration to $32,925 for a fully configured system, thereby extending into the low end of the System/34 price range. Deliveries began in February 1978. Field upgrades from the IBM 5100 to the 5110, priced from $3,000 to $5,800 depending on the 5100 model, are scheduled to start in June 1978.

As it did with the 5100, IBM is offering the 5110 as a purchase-only machine with an optional purchase pilot test plan. This plan enables a potential user to rent the system for three months, and the rental period can be extended for another three months.

USER REACTION

While the 5110 is too new for a definitive evaluation, Datapro contacted two users to get an idea of why they purchased the 5110 and what they were using the system for. One user owned a pharmacy, and the other was a data processing consultant.

Each of these users had previously owned a 5100 system, and both felt they needed the increased performance and **cartridge drive and the printer are included, the printer is attached to the cartridge drive, which is then attached to the processor. This represents the data flow path; each of the units has to be plugged into a wall outlet. One External I/O Adapter is a prerequisite for attachment of any external peripheral combination.**

The Serial I/O Adapter feature permits connecting a wide range of peripheral devices available from sources other than IBM. Usefulness of the feature is somewhat limited by a maximum data transfer rate of 9600 bps. Otherwise, it is quite flexible. Permissible data codes include 5-level Baudot, 6-bit-plus-parity BCD, 7-bit-plus-parity ASCII, 7-bit ASCII without parity, and 8-bit ASCII without parity. Device control is exercised through the APL or BASIC language; no specific devices are supported. The adapter requires the 1524 Expansion Feature, and is available under the Pilot Test Plan.

The Parallel I/O Adapter provides the capability to attach up to 14 IEEE 488-1975 compatible devices such as laboratory instruments, plotters, and printers to the IBM 5110, with the 5110 acting as the sole controller in the network. The feature is operated directly from the APL or BASIC languages with device-dependent message exchange in either 8-bit binary or 7-bit ASCII code.

MASS STORAGE

5114 DISKETTE UNIT: Contains one or two diskette drives for a maximum storage capacity of 2.4 million bytes. The unit provides a direct-access storage capability, supports multiple open files up to 10, and offers a media exchange capability with other diskette devices. Average access time is 243 milliseconds, including rotational delay but excluding head loading time. Rotational speed is 360 rpm. IBM diskette types 1, 2, and 2D can be initialized and used to READ/WRITE data and to LOAD/SAVE programs and data. Their specifications are as follows:

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diskette storage advantages offered by the 5110. Both users reported that they had had so much success with their 5100's that they did not consider any other system besides the 5110. The pharmacist was still using his 5100 programs on the new system and said that he was experiencing a 50 percent increase in overall processing speed. The consultant was using the system for software development and his own business applications, and said that he had experienced no problems in the 5100 to 5110 transition.□

Diskette Type	Maximum Capacity, Megabytes	Data Transfer Rate, Kilobytes/second
1	0.306	31.3
2	0.606	31.3
2D	1.212	62.5

A maximum of two 5114 Diskette Units with four drives can be attached to any model of the IBM 5110, providing a total on-line storage capacity of up to 4.8 million bytes.

In addition, the integral and/or auxiliary cartridge tape units can be used to store data and programs in a 5110 Model 1 system (see Peripherals table). The maximum capacity of a tape cartridge is 204K bytes. Data and programs can be indexed for direct retrieval, but the method of access is necessarily sequential rather than random.

INPUT/OUTPUT UNITS

See Peripherals table.

COMMUNICATIONS CONTROL

The Communications Adapter permits the 5110 Computer to communicate with a remote IBM or other computer; the 5110 appears as an IBM 2741 typewriter terminal. Half-duplex, asynchronous transmission at 134.5 or 300 bits per second is supported via a user-supplied modem with an RS-232C interface, such as the Bell System 103. Transmission over a leased line or the public telephone network is possible. Only the EBCDIC transmission code is supported. While in the communications mode, the keyboard and display of the 5110 logically correspond to the keyboard and printer of a 2741. Received data can be simultaneously printed if the optional printer is included. Alternatively, the magnetic tape cartridge can serve as the origin and/or destination of data in the Model 1.

User programs cannot be entered or executed while the 5110 is in the communications mode. The Expansion Feature is a prerequisite for the Communications Adapter. The 5110, operating as an IBM 2741 terminal, is supported by all IBM System/370 configurations that include an Integrated Communications Adapter or a 3704/3705 Communications Controller through standard teleprocessing access methods such as BTAM, TCAM, and VTAM.

A binary synchronous communications capability allows the 5110 to function on a switched, leased, or private communications line as a processor terminal emulating 3741 line protocol with BASIC or APL program control. The IBM 5110 can also operate as a tributary station residing on a multipoint communications line as a compatible member of the IBM family of BSC terminals in conjunction with System/370 Model 115 through 195 control station at transmission rates of 1200 to 4800 bps.

SOFTWARE

OPERATING SYSTEM: The system control functions are integrated into the ROS module, with some main memory space required for symbol tables, etc. System control functions are primarily concerned with coordinating the interface between the user programs and the language interpreters and peripheral devices.

In effect, there are three modes of usage: program development, interactive program writing with execution, and interactive execution of a previously written and stored program. Depending on the computer model, the programming language may be BASIC, APL, or either of the two. IBM presently offers four application program libraries for business, scientific/engineering, statistical problems, and plotting.

PROGRAMMING LANGUAGES: *BASIC* for the 5110 supports stream data files and matrix (two-dimension array) operations. Independent output to the printer of data displayed on the built-in CRT is supported. BASIC includes capabilities for manipulating alphanumeric strings. The 5110 BASIC language includes some significant extensions over IBM 5100 BASIC, as listed in the Management Summary of this report. The statements use English-like forms, so BASIC is the logical choice for first-time users. In addition to ROS, the BASIC interpreter occupies 4,400 bytes of main memory, which is not available to the user. A prerecorded data cartridge containing an instruction program for the BASIC language is available optionally.

APL for the 5110 supports arrays of up to 63 dimensions, as well as comprehensive mathematical, logical, and relational operators and functions. Independent output to the printer of data displayed on the built-in CRT is also supported. APL language extensions for the 5110 include additional system commands for diskette input/output, multiple-record reading and writing, and printer left margin control. APL is the logical choice if complex mathematical or logical operations are required.

APPLICATION PROGRAMS: IBM currently supports four "Libraries": Business Analysis, MATH, Statistics, and Print Plot. The Business Analysis library is available only for BASIC machines, while the other three are available in both BASIC and APL versions. In addition, four accounting packages and three specialized packages are available from IBM. Each of the application programs is supplied on magnetic tape cartridges and comes with a user's guide.

The *Business Analysis/Problem Solver Library* includes 30 BASIC routines specifically oriented to problems in spread sheet, investment, depreciation, break-even, and time series analysis. The spread sheet analysis is a general report preparation tool that permits tabular presentation of data with line arithmetic (e.g., multiply line 2 by line 3) and cumulative column presentations. Data values can be input from the keyboard or from a previously recorded magnetic tape cartridge file. Some routines include the capacity to insert your own algorithm if the standard facilities provided do not include the operation you need. The investment analysis series of programs permits computation of return on investment, discounted cash flow analysis, multiple and single loan analysis, lease versus purchase analysis, and make versus buy analysis. Included in the depreciation analysis series of programs are straight line, sum-of-years digits, declining balance, and equipment units methods. The break-even or cost/volume profit analysis series permits computation with definite probablistic assumptions. The time series analysis group of programs provides a wide range of computational capabilities for time-oriented data for compound growth rate projection, moving average, and seasonal or cyclical analysis, as well as for simple statistical problems such as auto or cross covariance and correlation, exponential smoothing, and simple regression.

Generalized routines also provided in this library permit a user to construct and display histograms, create and update

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user files, resequence or rearrange records in files, and print data files. The optional printer is recommended for the spread sheet analysis program group.

The *Math/Problem Solver Library* includes a comprehensive set of numerical analysis routines. There are 37 programs in the APL library and 44 programs in the BASIC library, but essentially the same capabilities are provided with each library. The facilities provided can be broadly grouped into calculus, including integration, differentiation, and solution of ordinary differential equations; linear equations and matrix analysis, including eigenproblems, lease squares solutions, linear programming, and solution of linear equations; approximations to functions and zeroes of functions, including several interpolation and approximation methods, function smoothing, minimums and maximums of tabulated functions, etc.; and evaluations of advanced mathematical functions such as the Gamma function, Bessel and modified Bessel functions, elliptic integrals and functions, orthogonal polynomials, etc.

The *STAT/Problem Solver Library* includes 40 (APL) or 41 (BASIC) routines for the analysis of numerical data through commonly used statistical techniques. The routines can be broadly grouped into elementary statistics, including histogram, cross-tabulation, moment, tally, and Chi-square and T test; regression and correlation analysis, including simple, stepwise, multiple, and polynomial regression; multivariate analysis, including discriminant analysis, canonical correlation, and factor analysis; analysis of variance; time series analysis, including moving average, seasonal and cyclical analysis, auto and cross covariance and correlation, and triple exponential smoothing, nonparametric statistics; and biostatistics, including survival rate and profit analysis. Four routines in the library provide capabilities to enter and display/print, correct, modify, generate, or smooth data.

The *Print Plot/Problem Solver Library* includes a series of modules that provide a wide range of plotting capabilities and can utilize data received from a BASIC program, from an APL program, or directly from a keyboard. With the addition of a 6301 Serial I/O Adapter, the 5100 can utilize an absolute vector plotter or a storage display terminal. The program provides the capability for generating line graphs, bar charts, histograms, point plotting, and others. The user specifies metric or inch plotting, the size and location of the graph within the plot limits, the location of the origin within the graph, the X and Y values at the origin, horizontal and vertical scaling factors (either linear or logarithmic), automatic axes, automatic grids, horizontal and vertical dot density, special symbols, and any data files that are used in conjunction with program-generated and keyboard data. The platen is reversible so that the paper can be moved backward as well as forward.

The *Dental Office Management System* was designed by a practicing dentist to avoid an increase in personnel due to increased paperwork. This comprehensive system prints out a list of the dentist's scheduled patients along with the patients' account balances, produces insurance forms while the patient is present, separates patient charges from insurance charges, maintains a payment record for each third party, produces aged trail balances for both patients and third parties, calculates patient budget plans, and prints recall notices when scheduled. The system is capable of handling up to 30 patients per day, and produces a financial activity summary at the end of each day. The minimum configuration that will support the system consists of a 64K processor, one 5106 auxiliary tape unit, and one 5103-1 printer. The programs are written in the BASIC language.

Computing for an Accounting Practice: Client Accounting, Time Management was written by a small CPA firm to provide write-up services for clients, as well as to provide a tool to manage the firm's practice. Besides write-up work, the system produces balance sheets and income statements with supporting schedules, statements of changes in financial position, trial balances, general ledgers, client billing worksheets, and employee productivity summaries. The minimum configuration that will support the system consists of a 32K processor and a 5103 printer. The programs are written in the BASIC language.

The *Travel Agency Accounting System* was designed to manage the cash flow of funds within a travel agency. The major areas handled by the system include sales and refunds, profit and loss statements, balance sheet accounting, journal entries, bank balance records, disbursement journal accounting, commercial invoicing, weekly ATC reporting, employee productivity, employee payroll, and airline ticket and itinerary writing. Month-end reports include a sales journal of receipts and invoices, a refund journal, a disbursements journal, an open transactions journal, a cash receipts report, and an accounts receivable journal for the agency's commercial accounts. The system can handle from one to six offices, up to 50 employees in all offices combined, up to 50 commercial accounts per office, and up to 250 cash and 150 credit card sales per office per week. The minimum configuration that will support the system consists of a 32K processor, a 5103 printer, and a 5106 auxiliary tape unit. The programs are written in the BASIC language.

The *Mortgage Closing and Property Settlement System* prepares the documents commonly required by mortgage lenders, title companies, and settlement attorneys for the transfer and settlement of real property. Automatic calculations include principal and interest payment, maturity date of a loan, annual percentage rate, mortgage insurance premium, daily interest, state and local transfer tax, escrow reserves, and recordation fee. The system produces a host of forms that include customized HUD settlement statements, federal truth in lending forms, instruction letters, and closing settlement documents. The system can handle up to 300 active cases or loans in the minimum configuration, depending on certain variables. The minimum configuration that will support the system consists of a 32K processor and a 5103 printer. The throughput can be increased by using a processor with a larger memory capacity. The programs are written in APL.

APL GRAPHPAK is a set of APL functions which provide interactive graphics support for devices which attach to the Serial I/O Adapter (6301) on a 5100 processor. A total of 62 functions provide capabilities ranging from fundamental graphic support through high-level graphics applications. The functions are grouped into the following component workspaces: fundamental graphic support, curve plotting, curve fitting, contour plotting, descriptive geometry, and auxiliary labeling. The system supports absolute vector plotter controllers with BCD vector encoding (Gould Brush 511, HP 7202A, HP 7203), microprocessor-controlled incremental plotters (Houston Instrument PTC-5/DP-1, Tektronix 4662, Zeta Research 230), and absolute vector storage display terminals (Tektronix 4013, Tektronix 4015, Tektronix terminals (Tektronix 4013, Tektronix 4015, Tektronix 40XX). The selection of a graphic device is the sole responsibility of the user. The minimum configuration that will support the system consists of a 32K processor, a 6301 serial I/O adapter, and a plotter.

The *APL Coordinate Geometry System (COGO)* is designed to solve civil engineering geometry problems that involve right-of-way, highway, bridge, and interchange design, construction layouts, and general land surveys. COGO is composed of 65 functions organized into 11 groups. These functions provide for points, lines, circular arcs, transitional spirals, areas, and parabolic curves. The results are shown on the IBM 5110 display screen. If a 5103 printer is attached to the processor, input data, calculated results, and plots can be printed. COGO calculations can also be displayed or plotted

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by using the GRAPHPAK package. The minimum configuration that will support the system consists of a 32K processor and a 5103 printer (if printed output is desired).

The *APL Econometric Planning Language* is an interactive program that works with economic variables and provides for data analysis and transformation, tabular and graphic display, parameter estimation, model solution, and file handling. Examples of the use of the system include estimating advertising effectiveness, analysis and estimation of potential demand, financial planning, projection of economic indicators, and the study of economic theories. The minimum configuration that will support the system consists of a 64K processor (64K) and a 5103 printer.

PRICING

POLICY: The 5110 Portable Computer is available for purchase or through a Purchase Pilot Test Plan. A separate maintenance contract is available. No installation assistance is provided with this product; the customer sets up the system from step-by-step instructions packaged with the unit. The warranty period extends from the date of shipment from the plant for a total of 10 days plus 3 months.

The Purchase Pilot Test Plan provides a Contract Period of three months' use for about 15 percent of the purchase price. This price includes maintenance, and is payable in three equal monthly installments. The plan applies to all models and processor options of the 5110 and to the 5103 Printers and 5106 Auxiliary Tape Unit as well. One additional period of three months can be contracted for. Conversion to purchase can be made at any time, with credit for up to 70 percent of the Test Plan payments. In effect, a three-month trial would raise the price of the 5110 hardware by 4.5 percent. A two-period (six-month) trial would up the hardware price by 9 percent. Purchase prices of the 5110 are protected during the contract period. Obviously, this plan is designed to stir interest in prospective users who are unable to see an immediate pay-off for the 5110 in their operations and are unwilling to risk the full purchase price on a "maybe" basis.

A separately priced set of magnetic tape cartridges furnishes instructions in the BASIC ($225) or APL ($295) programming language. Two source-code data cartridges and a user's guide accompany each program library and include instructional material. The program libraries are furnished for a one-time license fee. The user is expected to maintain duplicate, back-up copies of the data cartridges.

The standard 10 percent educational discount applies to the basic computer and peripherals.

MINIMUM BASIC SYSTEM: Consists of BASIC 5110 Model B11, which includes integral CRT display, magnetic tape cartridge drive, and 16,384 bytes of main storage. About 12,000 bytes of main storage are available to the user. The BASIC interpreter is included. The purchase price of this system is $9,875, and the monthly maintenance cost is $60.

MINIMUM BUSINESS-ORIENTED SYSTEM: Consists of BASIC 5110 Model B12, which includes integral CRT display, magnetic tape cartridge, and 32,768 bytes of main memory, plus the optional 5103-11 printer. About 28,400 bytes of main memory is available to the user. The BASIC interpreter is included. The purchase price is $14,825, and the monthly maintenance cost is $97.

LARGE SCIENTIFIC SYSTEM: Consists of APL 5100 Model A14, which includes integral CRT display, magnetic tape cartridge, and 65,536 bytes of main memory, plus the 5114 diskette unit with dual drives (2.4 megabytes), 5103-11 printer, and 5106 auxiliary tape unit. About 58,800 bytes of main memory is available to the user. The APL interpreter is included. The purchase price is $27,225, and the monthly maintenance cost is $158.50.■

EQUIPMENT PRICES

		Purchase	Monthly Maint.	3-Month Contract Period Charge
PROCESSORS AND MAIN MEMORY				
5110 Model 1	Portable Computer; includes 1024-character display, magnetic tape cartridge drive, ROS for language processor, and main memory as detailed below:			
	APL Language Interpreter—			
A11	With 16,384 bytes of main memory	10,875	60.00	1,635
A12	With 32,768 bytes of main memory	12,625	65.00	1,905
A13	With 49,152 bytes of main memory	14,375	70.00	2,175
A14	With 65,536 bytes of main memory	16,125	75.00	2,445
	BASIC Language Interpreter—			
B11	With 16,384 bytes of main memory	9,875	60.00	1,485
B12	With 32,768 bytes of main memory	11,625	65.00	1,755
B13	With 49,152 bytes of main memory	13,375	70.00	2,025
B14	With 65,536 bytes of main memory	15,125	75.00	2,295
	APL and BASIC Language Interpreters—			
C11	With 16,384 bytes of main memory	11,875	65.00	1,785
C12	With 32,768 bytes of main memory	13,625	70.00	2,055
C13	With 49,152 bytes of main memory	15,375	75.00	2,325
C14	With 65,536 bytes of main memory	17,125	80.00	2,595
5110 Model 2	Portable Computer; includes 1024-character display, ROS for language processor, and main memory as detailed below:			
	APL Language Interpreter—			
A21	With 16,384 bytes of main memory	9,475	45.00	1,425
A22	With 32,768 bytes of main memory	11,225	50.00	1,695
A23	With 49,152 bytes of main memory	12,975	55.00	1,965
A24	With 65,536 bytes of main memory	14,725	60.00	2,235