Wang Laboratories 2200 Series

MANAGEMENT SUMMARY

Wang Laboratories' 2200 Series product line has undergone numerous changes since its introduction in 1973. The older processors have been replaced, and many of the former packaged configurations are no longer being marketed. Pricing and functionality have followed market demand. The currently marketed product line consists of the 2200VP, 2200MVP, 2200LVP and 2200SVP processors, all of which are multi-user or multi-user upgradeable systems. The 2200 Series product line also includes the 2200 PCS-III, a packaged system which is single-user oriented.

The CPU and floppy disk drive are packaged together with appropriate cables and a cabinet to produce an integrated system. The 2200 PCS-III includes the CPU, CRT, keyboard and single-sided double density minidiskette drive in a standard CRT-size enclosure as well as an optional disk multiplexer controller. The number of peripherals that can be attached to a given system depends on the number of I/O slots that are available, with most peripherals requiring one slot.

Wang began marketing the original 2200 Series in the spring of 1973, based on the 2200A and 2200B processors, which featured a microprogrammed BASIC interpreter. Later, the 2200C was made available, offering more capabilities than the 2200B.

The S and T versions of the 2200 Series, introduced in January 1975, offered as standard equipment numerous features formerly available as options. They were repackaged to take advantage of newer integrated circuits, which also resulted in cost savings. In addition, the new processors offered increased performance through improved interpreter subroutines.

In all 2200 Series CPUs, highly efficient use of memory is achieved through the use of separate control memory to store the BASIC-2 interpreter and operating system. ▷

The current Wang 2200 Series product line includes two multi-user processors, two single-user processors which can be upgraded to multi-user, and a single-user-oriented packaged system. All are programmed in BASIC or BASIC-2. Prices for basic systems range from $6,000 and $70 monthly maintenance for a 2200VP with a 32K memory to $21,000 and $268 monthly maintenance for a 2200MVP with a 256K memory.

MAIN MEMORY: 32K on all systems to 256K on the 2200MVP
DISK CAPACITY: 143K to 480 megabytes
WORKSTATIONS: Up to twelve on the 2200MVP, four on the 2200LVP, and one on the other models
PRINTERS: 30 cps to 600 lpm
OTHER I/O: Magnetic tape, paper tape, punched cards

CHARACTERISTICS

MANUFACTURER: Wang Laboratories, Inc., One Industrial Avenue, Lowell, Massachusetts 01851. Telephone (617) 459-5000.

Wang Laboratories was one of the first companies to produce programmable calculators. These products have been expanded to include minicomputer-based small business systems, including data and word processing. Wang Laboratories maintains 300 sales and service offices in 80 countries. Customer engineers are located in 270 of those locations. Wang states that its over 4500 sales, service, and support personnel make it second only to IBM in small business systems support.

MODELS: 2200VP, 2200MVP, 2200SVP, 2200LVP, PCS-III computing system. ▶
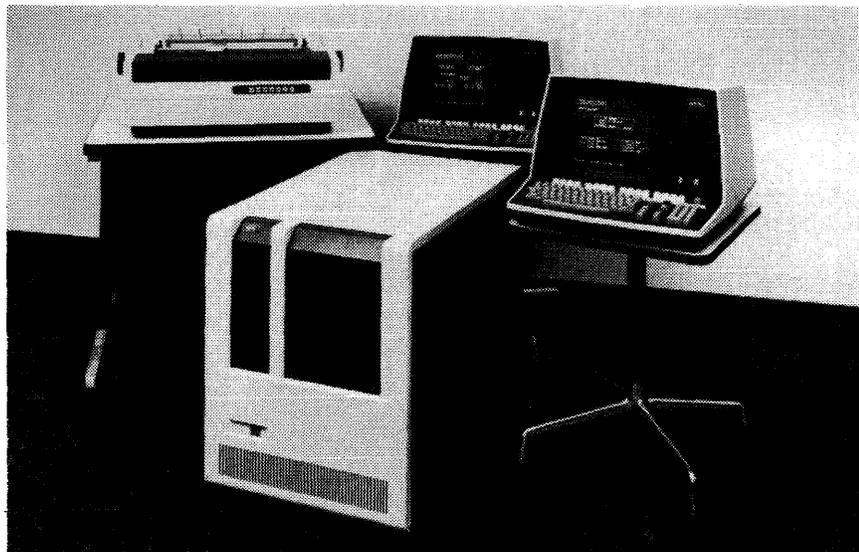
Wang's 2200LVP uses a one-megabyte dual-sided, double-density diskette and a 2-, 4-, or 8-megabyte fixed disk. User memory can be expanded from 32K bytes to 128K bytes. The system can support from one to four terminals and can perform multiple functions concurrently with no sacrifice in response time.

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CHARACTERISTICS OF THE 2200 SERIES SYSTEMS

Model	VP	MVP	LVP	SVP	PCS-III
Main Storage					
Type	MOS/RAM	MOS/RAM	MOS/RAM	MOS/RAM	MOS/RAM
Cycle Time (microseconds per word)	0.60	0.60	0.60	0.60	1.60
Minimum Capacity (bytes)	32K	32K	32K	32K	32K
Maximum Capacity (bytes)	64K	256K	128K	64K	32K
Error Checking	Stand.	Stand.	Stand.	Stand.	None
Maximum No. of Terminals	1	12	4	1	1
Standard No. of I/O Slots	9	9	3 or 9	NA	NA

▷ The Model 2200VP processor, announced in September 1976, introduced the second generation 2200 Series CPU design with enhancements such as a maximum of 64K bytes of user memory, faster execution time, wider internal data paths, faster memory, error checking, and the BASIC-2 programming language. The 2200VP is software-compatible with former 2200S and 2200T processors, allowing easy upgrades for improved performance.

The Model 2200MVP processor was the first multi-user processor that Wang offered for the 2200 Series. The 2200MVP can support up to twelve interactive terminals and up to sixteen concurrent jobs. Each terminal has access to a foreground and multiple background partitions. CPU-intensive jobs such as printing and sorting can be processed in the background while interactive applications programs or program development tasks are executed in the foreground.

The Model 2200LVP central processing unit is a high-performance processor which can support as many as four users simultaneously and provide computing speed and power unavailable on other machines in its price range. The LVP employs a user-defined, fixed-partition memory configuration to extend multiprogramming capabilities to system users.

The 2200LVP utilizes two new disk drive units, featuring the latest advances in hardware design. The soft-sectored, dual-sided double density diskette can store approximately one megabyte of data and quickly provide backup. A fixed-only rigid disk drive utilizes new 8" Winchester technology. Both the DSDD diskette and the fixed-disk drive are integrated into the compact system housing.

The Model 2200SVP is a compact single-user, high-performance processor. Programmable in Wang's BASIC-2 language, the 2200SVP is designed to meet the requirements of both the first-time user and large corporations. The 2200SVP incorporates the DSDD diskettes or an optional fixed-only rigid disk. The 2200 SVP, LVP, MVP, and VP are software-compatible.

The 2200 PCS-III is a computer system providing data entry and business/scientific calculation capabilities at ▷

▶ DATE ANNOUNCED: 2200VP, 11/76; 2200MVP, 3/77; 2200SVP, 4/80; 2200LVP, 4/80; PCS-III, 4/80.

DATE OF FIRST DELIVERY: 2200VP, 12/75; 2200MVP, 1/78; 2200LVP, 6/80; 2200SVP, 9/80; PCS-III, 10/80.

NUMBER INSTALLED TO DATE: 50,000 2200 Series systems.

DATA FORMATS

BASIC UNIT: 8- or 16-bit data memory, 24-bit control memory.

FIXED-POINT OPERANDS: Internally, 8- or 16-bit (4-bit on the PCS-III) binary operations are performed. User arithmetic (BASIC) fixed-point operations can be done using alphanumeric expression.

FLOATING-POINT OPERANDS: Microprogrammed floating-point operation is standard. Operand length is 13 digits, consisting of maintissa, sign, and two-digit exponent.

INSTRUCTIONS: The Wang 2200 Series product line incorporates a microprogrammed BASIC interpreter; thus, all user programming is done in BASIC. With the exception of the 2200 PCS-III, the current 2200 Series CPU's use BASIC-2, an enhanced version of the original BASIC which is said to improve the clarity of the syntax in any instructions and which still offers upward compatibility with the earlier BASIC language. BASIC-2 adds approximately 25 more verbs to the language. Among the several revisions and enhancements are six new math functions, more accurate algorithms for some math functions, math and I/O errors now tested under program control, more accurate matrix inversion techniques, an available option to ROUND/NO ROUND results, extended array limits, and a host of other improvements in the areas of alphanumeric expressions and CRT cursor controlling. BASIC instructions are available to perform SORT, MERGE, and SEARCH functions.

INTERNAL CODE: 8-bit ASCII, 8-byte packed decimal for floating-point arithmetic.

MAIN STORAGE

STORAGE TYPE: Dynamic MOS/LSI random-access memory (RAM).

CYCLE TIME: 600 nanoseconds on 2200VP, 2200MVP, 2200SVP, 2200LVP; 1.6 microseconds on the PCS-III.

CAPACITY: 2200MVP's are sold with a minimum of 32K bytes of user memory and can be expanded to a maximum of 256K bytes. 2200VP's are sold with a minimum of 32K bytes and can be expanded to a maximum of 64K bytes. 2200LVP's are sold with a minimum of 32K bytes of user ▶

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PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION AND SPEED
MAGNETIC TAPE	
2209	9-track, 12.5-ips, 800-bpi, 10.5-inch reels, 10K-bps, with controller
2209A	9-track, 12.5-ips, 1600 bpi, 10.5-inch reels, 20K-bps, with controller
22D09	9-track, 800-bpi, drive only
CARD EQUIPMENT	
2244B	Reader; 80-column, punched card or mark sense; 300 cpm, with controller
22D44	2244B without controller
PAPER TAPE	
2203	Reader; forward or reverse read; 300 cps
PRINTERS/PLOTTERS	
2221W	132-column, 96-character, 9 x 9 dot matrix, 200 cps
2231W-1	112-column, 96-character, 9 x 9 dot matrix, 120 cps
2231W-2	132-column, 96-character, 9 x 9 dot matrix, 120 cps
2231W-3	Graphic CRT accessory matrix printer for 2282
2231W-6	132-column, 70 cps, matrix line printer, high density
2232B	Digital flatbed plotter; 31 x 48 inches, four-quadrant, 0.01-inch steps, with controller
22D32	2232B without controller
2251	40-column, 96-character, 7 x 8 dot matrix, 100 cps
2261W	136-column (68 expanded characters), 10-pitch or 160-column (80 expanded characters), 12-pitch; 96-character, 11 x 9 matrix (10-pitch) or 9 x 9 matrix (12-pitch); 220 lpm independent of pitch; 4 matrix heads, bidirectional, 6 or 8 lines per inch
2263-1	132-column, 64 ASCII characters, chain; 400 lpm
2263-2	132-column, 64 ASCII characters, chain; 600 lpm
2263-3	132-column, 96 ASCII characters, chain; 430 lpm
2272-2	Drum plotter; 16 inches by unlimited inches, 0.01-inch steps, pin-feed platen, digital input, program-selectable three pen holders
2273-1	Band printer, 250 lpm
2273-2	Band printer, 600 lpm
2281W	Wang daisy printer plotter, 30 cps
2282	Graphic CRT only; 12" screen, 800 x 512 addressable locations; 112-character ASCII set, upper/lower, 15 sizes of character
IP41L	Image printer; 18 pages/minute, two paper trays; 10-, 12-, or 15-pitch
TERMINALS/KEYBOARDS	
2236DE	Interactive CRT terminal/workstation; alphanumeric keyboard, 10-key numeric keypad, special function keys, 24 lines of 80 characters; plug-compatible with any standard Wang printer
2210A	CRT display; 12-inch, 16 lines of 64 characters, upper/lower case keyboard, includes mini-diskette drive in console, with controller
2210B	Same as 2210A except 24 lines of 80 characters
2226A	CRT display; 12-inch, 16 lines of 64 characters, upper/lower case keyboard in console, with controller
2226B	Same as 2226A except 24 lines of 80 characters
22D31	Keyboard console only for 12-inch CRT
22D33	Same as 22D31 with single minidiskette drive

▷ either local or remote sites. Its compact design makes portability an added feature. Contained within the PCS-III is a central processor with a standard 32K of random access user memory. Since only 700 bytes are utilized for system overhead, all remaining memory is accessible to the user. The PCS-III incorporates within the single compact unit a 9-inch CRT, a single-sided double density 5¼ inch diskette, and a BASIC language keyboard for text entry.

Wang has also recently released IDEAS (Inquiry Data Entry Access System), an application development tool used to create and maintain data files, generate sophisticated screen formats, solicit and validate operator- ▷

▶ memory and can be expanded to a maximum of 128K bytes. The 2200SVP is sold with a minimum of 32K bytes and can be expanded to a maximum of 64K bytes. The 2200 PCS-III is sold with 32K bytes of user memory.

CHECKING: Parity checking in both data memory and control memory is standard on all 2200 Series systems except the 2200 PCS-III.

RESERVED STORAGE: 3K (700 bytes on the PCS-III) bytes of main memory are reserved for use by the BASIC-2 operating system on the 2200SVP and 2200VP for the first 64K of user memory; additionally, 1K/partition is reserved on the 2200MVP and 2200LVP systems.

CENTRAL PROCESSOR

GENERAL: All Wang 2200 Series systems use microprogram-controlled central processing units. The program- ▶

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▷ entered data, and produce complex reports. IDEAS generates highly modularized BASIC code which can be easily modified through the use of the system resident macros or can be used as it is for simple application systems. The IDEAS access method is the powerful Hashed Index Keyed Access Method, HIKAM, which offers a unique combination of hashing and indexing access techniques; it handles insertions and deletions, optimizes data storage and retrieval, minimizes overflow, is significantly faster than indexing, and performs well in both sequential and random access environments.

All systems manufactured by Wang are modular. They can be expanded from minimal processors to larger systems simply by installing additional memory plus the desired peripheral devices such as disk and diskette drives, printers, plotters, magnetic tape drives, telecommunications devices, and terminals.

2200 Series product line prices begin at $6,500 for a 2200 PCS-III with 32K bytes of user memory, a single dual-sided double density diskette drive, and a CRT display. Prices range up to $21,000 for a 2200MVP processor with 256K bytes of user memory. A minimal 32K byte 2200LVP with a 1-megabyte dual-sided double density diskette costs $8,000. A minimal 32K-byte 2200VP costs $8,000. A 2200SVP with 32K bytes of user memory, a dual-sided double density diskette drive, and a 24 x 80 2236DE interactive direct entry workstation costs $8,700, including data entry and business graphics features.

One noteworthy aspect of Wang 2200 Series pricing is that the company quotes the amount of user memory in contrast to other vendors who quote total memory. When total memory is quoted by vendors, storage required for compilers and operating systems is included, but little user memory may remain in the configuration. With the 2200 Series, a separate control memory of about 48K bytes is included in the 2200VP and 2200SVP and 60K bytes in the 2200LVP and 2200MVP to accommodate the BASIC-2 interpreter and operating system.

Simplicity of programming is a significant 2200 Series feature. A BASIC-2 language interpreter, which resides in control memory, is included in the 2200 Series product line. The interpreter is loaded into RAM from a storage device. The BASIC-2 language was developed because it is easy to learn, allowing for ready implementation of programs by the user. An extensive operating system is not required because BASIC-2 language statements, when executed, invoke a large number of functions, providing system and input/output control. The Wang systems are interpreter-based, permitting the user to program directly in BASIC-2 without the need for intermediate compiling or assembling.

The Model 2236DE interactive terminal offers the capability to create highlighted displays, to utilize special graphic characters, and to draw box graphics at any screen location. Screen displays may be altered using various commands, allowing flexibility of program output. Model 2236DE terminals can be attached locally ▷

▶ ming language, BASIC, is integral to the CPU. The interpreter is loaded from disk on the 2200VP, 2200MVP, 2200SVP, and 2200LVP; on the 2200 PCS-III, the interpreter is a firmware package permanently in ROM.

The 2200VP CPU maintains a high degree of upward compatibility with earlier 2200 Series CPU's and peripherals, while major components have been redesigned to provide improved performance and programmability. The VP features a processor with a microinstruction cycle time of 600 nanoseconds. The improved hardware performance, combined with a more efficiently designed operating system, enables the 2200VP to execute most instructions six to ten times faster than the former 2200T CPU. The 2200VP can address up to 64K bytes of user memory, and full memory parity checking is provided throughout both user and control memory.

The 2200SVP and 2200LVP processors incorporate the features of the 2200VP processor with state-of-the-art disk technology, dual-sided double density diskettes, and fixed Winchester disks. The processors are packaged in chassis suited to small businesses.

The 2200MVP is a multi-user CPU which allows up to 16 partitions of memory to execute up to 16 concurrent jobs, while interfacing with up to 12 terminals. The 2200MVP is compatible with the 2200VP, 2200SVP, and 2200LVP and is upward compatible with the former processors in the 2200 Series product line. More than 480 megabytes of storage can be used on the 2200MVP through six large-capacity disk drives of 80 megabytes each.

In the 2200 PCS-III processor, a 42.5K-byte BASIC interpreter is separately "hardwired" into a ROM area, leaving nearly the entire RAM area available for user data and programs. By hardwiring the interpreter, the 2200 PCS-III is instantly ready to use, with the user memory directly accessible and available for processing. The 2200 PCS-III is a self-contained, portable, desk-top computer that features minidiskette storage.

REGISTERS: There are 48 internal registers in the 2200VP, MVP, LVP, and SVP. All registers are accessed solely by the CPU and are not available to programmers.

INDIRECT ADDRESSING: Microprogrammed.

INDEXING: None.

INSTRUCTION REPERTOIRE: See Languages.

INSTRUCTION TIMINGS: The following instruction times are given in *milliseconds* and provide 13-digit floating-point precision.

2200 VP (or MVP using one partition):

Add/Subtract	0.11
Multiply	0.39
Divide	0.76
Square Root	1.70
Sine	4.40

2200 PCS-III:

Add/Subtract	0.8
Multiply	3.8
Divide	7.4

INTERRUPTS: Internally, none. BASIC-II provides eight levels of soft interrupts on the 2200VP, MVP, LVP, and SVP; none of the 2200 PCS-III.

PHYSICAL SPECIFICATIONS: The 2200 CPU is contained in one enclosure. The 2200VP and MVP enclosures measure 12.1 inches high, 21 inches deep, and ▶

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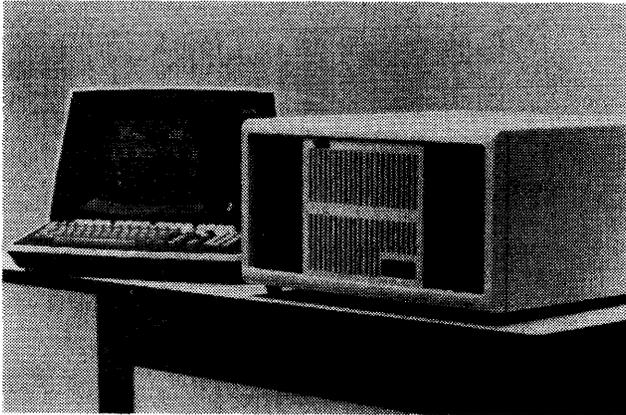
The 2200SVP is one of the newest additions to Wang's 2200 series. A single-user system, the 2200SVP is programmable in Wang's BASIC-2 language, offers memory expansion to 64K bytes, and includes a newly-designed 500K single-sided, double-density diskette. An additional 500K diskette can be added.

▷ to the CPU at distances of up to 2,000 feet, or remotely via modems and telephone lines.

The major source of software for the 2200 Series is Wang's independent software vendor network. This network has created literally thousands of applications that can be run on the 2200 Series product line. Applications have been created for diversified fields, both commercial and scientific. Many software packages written by the software network are cross-licensed between vendors to allow for national and regional coverage. Wang sales personnel can coordinate and provide liaison between the user and those software houses which have developed 2200 Series applications.

Wang also has developed and markets its own software packages, including the five available General Business System (GBS) accounting modules: Module 1 includes invoicing, accounts receivable, sales analysis, and inventory capabilities; Module 2 consists of order entry and inventory reporting; Module 3 consists of accounts payable and general ledger; Module 4 includes payroll; Module 5 consists of bill of materials. In addition, there is an inventory management package that is compatible with GBS. These modules can be run on a minimum system consisting of any 2200 Series CPU with 32K bytes of memory and a 2231W printer. One version runs on a 5- or 10-million-byte disk with a single diskette, while a second version runs on a triple-diskette system.

The General Business Systems modules are installed and maintained by software vendors located in each of the Wang districts throughout the United States and Canada. The modules are provided to the software vendors through a license fee arrangement from Wang. Installation prices charged by the software vendor are directly related to the complexity of the installation. Thus, no prices for the GBS software are given at the end of this report.

▷ 14.5 inches wide and weigh 47 pounds. The 2200SVP measures 12 inches high, 21 inches wide, and 26 inches deep. The 2200LVP measures 27 inches high, 20.4 inches wide, and 30 inches deep. The 2200 PCS-III measures 18.75 inches high, 19.75 inches wide, and 20.5 inches deep and weighs 62 pounds.

On the 2200VP, MVP, LVP, and SVP, high-speed RAM is used for control memory. The systems microcode is stored on a diskette or disk and must be loaded into a special 48K-byte (2200VP and SVP) or 60K-byte (2200MVP and LVP) RAM memory called control storage at the start of each day. This process takes about ten seconds. Loading is controlled by a bootstrap routine which is permanently resident in a small section of ROM.

INPUT/OUTPUT CONTROL

I/O CHANNELS: On the 2200 Series CPU's, all data transfers are through programmed I/O only.

SIMULTANEOUS OPERATIONS: Most peripherals have independent microprocessor-based controllers with extensive buffering capabilities, allowing overlapped I/O capabilities. True multi-processing capabilities exist within the 2200 Series product line. Both the MVP and LVP can execute 16 concurrent jobs. All 2200 Series processors have disk multiplexing capabilities, allowing the sharing of processing between multiple processors.

CONFIGURATION RULES

The 2200VP and MVP CPU's contain slots for nine I/O controllers. The 2200LVP contains either three or nine slots for I/O controllers. Each I/O controller can support one or more devices. The number of devices that can be plugged into the system is limited only by the number of I/O slots available. The SVP can support two printers, one terminal, and one telecommunications device.

WORKSTATIONS: The 2200VP, SVP, and PCS-III will each support one workstation; the 2200LVP will support 4; and the 2200MVP will support twelve.

DISK STORAGE: The 2200MVP and 2200VP can support 480 megabytes of disk storage (six 80-megabyte drives). The 2200SVP can support over one megabyte of single-sided, double-density diskette storage and over four megabytes of fixed disk storage (500,000 bytes of diskette storage is standard). The 2200LVP can support one megabyte of double-sided, double-density diskette storage and up to eight megabytes of fixed disk storage. The PCS-III single-sided, double-density diskette drive contains 140K bytes, and a second drive can be added.

MAGNETIC TAPE UNITS: Nine-track tape drives which record at 800 or 1600 bpi are available with controller. A drive-only model is available with 800 bpi density only.

PRINTERS: Printers are available with print speeds ranging from 30 cps to 600 lpm.

MASS STORAGE

2280 FIXED/REMOVABLE DISK DRIVE: The three models 26, 53, or 80 megabytes. The removable disk cartridge and the first fixed disk each contain 13.6 megabytes, with the second and third fixed disks each containing 26 megabytes. The disks revolve at 3600 rpm. Average rotational delay is 8.33 milliseconds, and the average access time is 38 milliseconds. The data transfer rate is 1.2 megabytes per second. The 2280 is multiplexible with a 2280MUX Disk Multiplexer. The 2280 can be used with the 2200VP, MVP, and LVP systems. ▶

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▷ IDEAS (Inquiry Data Entry Access System) is a development tool used to create and maintain data files, to generate sophisticated screen formats, to solicit and validate operator-entered data, and to produce complex reports. IDEAS produces highly modularized BASIC code which can be easily modified through the use of resident system subroutines.

Additional specialized applications, which are problem-oriented and not as generalized as the modules, are available from Wang Laboratories and independent software houses. Such applications include an insurance package, a patient billing package, a mortgage management package, a distributors inventory package, plotter utilities, and a civil engineering surveying package.

The 2200 Series product line competes directly with the IBM Series 1 systems and System 32, the Data General CS Series, and the DEC Datasystem line. The 2200LVP competes with the Texas Instrument DS990, model 2 among others. The 2200 PCS-III Personal Computer System and the 2200SVP are active in the competitive "table-top" computer market with IBM's 5120, DEC's Datasystem 150, and the Hewlett Packard 9845.

Wang Laboratories' financial picture continues to show strong improvement. Sales of the company's products increased by 69 percent from fiscal 1979 to fiscal 1980—to $543 million—and net income increased by 82 percent. With an installed base exceeding 40,000, Wang is ranked as the number 2 worldwide supplier of small business systems.

USER REACTION

In our 1980 user survey, Datapro received thirty responses from users of Wang's 2200 Series systems. Eight users had a total of forty-eight 2200VP's, and the other twenty-two users had thirty-four 2200MVP's. Geographically, the thirty users almost blanket the United States, from Massachusetts in the East to Hawaii in the West, with every section in between represented.

The users included four developers of software, five service bureaus, three manufacturers, a savings and loan, an office of a very large soup company, a CPA firm, a printing company, a trust company, a large commercial farm, a contractor, an elevator company, and a senior high school.

Accounting was by far the most reported application, with paryoll/personnel the runner-up. Other applications reported were transaction processing, retail, insurance, engineering/scientific, distributed processing, banking/finance, word processing, manufacturing, government, education, and construction. In-house personnel had been the main source of applications programs for twenty-two of the users. Other leading sources were programs from the manufacturer, contract programming, and proprietary software packages. BASIC was the only programming language in use. ▷

▶ 2280MUX DISK MULTIPLEXER: This "star" type disk multiplexer permits any combination of three 2200 LVP, MVP, or VP's to share a Model 2280 disk drive or pair of 2280 disk drives. The multiplexer allocates disk time to multiple systems in a manner which enables all systems to have virtually concurrent access to the disk. The 2280 disk multiplexer configuration consists of the multiplexer board and individual connector cables to each of up to three 2200 Series processors.

2260BC AND 2260C FIXED/REMOVABLE DISK DRIVES: The two series of drives are similar except that the BC's are multiplexible and the C's are not. These disk drives accommodate one removable disk platter and one fixed platter and are available in four models. Model 2260BC1/4 stores 2.5 million bytes; Model 2260BC1/2 stores 5 million bytes; Model 2260BC1 stores 10 million bytes; and Model 2260BC2 stores 20 million bytes. Data is transferred in 256-byte blocks at a rate of 312K bytes per second. Average head positioning time is 20 to 40 milliseconds. Average rotational latency time is 12.5 milliseconds. The 2260C disk drive is handled with a single controller, while the 2260BC uses two "daisy-chained" drives per controller. Each controller requires one I/O slot. The drives are supported by all Wang systems except the 2200SVP and the PCS-III.

2270A DISKETTE DRIVES: The Series 2270A is available in three configurations: Model 2270A-1 (one diskette, 315K bytes); Model 2270A-2 (two diskettes, 630K bytes); and Model 2270A-3 (three diskettes, 946K bytes). These disks can be used with all current 2200 Series models except the 2200SVP and the PCS-III. Data is transferred in 256-byte blocks at a rate of 31,000 bytes per second. Average head positioning time is 320 milliseconds, and average rotational delay is 80 milliseconds. The 2270A drive is also an IBM 3741-compatible drive. Up to three drives housed in the same cabinet can be supported by a single controller. Each controller requires one I/O slot.

2200 PCS-III MINIDISKETTE DRIVE: Features one or two drives each containing a 5.25-inch diskette with up to 143K bytes of program or data storage. Each diskette contains 35 tracks per surface, 16 sectors per track, and 256 bytes per sector. The average access time is 180 milliseconds.

2230MX DISK MULTIPLEXER: The Model 2230MXA/B permits sharing one 2260BC disk drive among up to four CPU's. This multiplexer is a "daisy-chain" device, requiring a 2230MXA for the first CPU and a 2230MXB for connecting the second, third, and fourth CPU's. One 2230MX multiplexer must be connected to each CPU sharing the disk drive. Not compatible with the 2200SVP.

22C32 TRIPLE CONTROLLER: Provides the means to support one 2236DE interactive terminal, one 2200 Series parallel printer, and one 2280, 2260C, or 2270A disk drive.

INPUT/OUTPUT UNITS

Please see Peripherals/Terminals table.

COMMUNICATIONS CONTROL

2207A ASYNCHRONOUS INTERFACE CONTROLLER: The 2207A provides an RS-232-C interface between a 2200VP CPU and any Teletype-compatible peripheral, terminal, or laboratory instrumentation device. Two switch-selectable operating modes are provided: eight-bit transparent mode or seven-bit even-parity mode. Five data rates are also switch-selectable from 110 to 1200 bits per second.

2227B ASYNCHRONOUS TELECOMMUNICATIONS CONTROLLER: The 2227B operates in either full- or half-duplex mode and has a switch-selectable character length ▶

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► Sixty-four of the systems had been purchased; eleven were being rented; and the rest were leased. The average life of the 2200VP's was thirty-three months, and the average 2200MVP had been in use for sixteen months. The average 2200VP had two workstations attached, while the average 2200MVP had 2.6 workstations. Two of the 2200VP users plan to replace their systems in 1980 with equipment from a different manufacturer; the other twenty-eight users have no plans to replace their systems this year.

The users' ratings are tabulated below.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	23	6	0	1	3.7
Reliability of mainframe	18	10	2	0	3.5
Reliability of peripherals	8	16	4	2	3.0
Maintenance service:					
Responsiveness	8	15	3	3	3.0
Effectiveness	9	12	7	2	2.9
Technical support:					
Trouble-shooting	5	14	8	1	2.8
Education	4	10	8	7	2.4
Documentation	4	11	10	4	2.5
Manufacturer's software:					
Operating system	11	11	1	3	3.2
Compilers and assemblers	10	7	0	1	3.4
Applications programs	6	7	6	3	2.7
Ease of programming	16	10	1	1	3.5
Ease of conversion	11	7	4	2	3.1
Overall satisfaction	14	14	1	1	3.4

*Weighted Average on a scale of 4.0 for Excellent.

Only thirteen of the thirty users indicated that they had experienced any significant problems with their systems, and only three failed to report any significant advantages. The highest-ranking advantage was that the systems are easy to expand or reconfigure. The next most reported advantage was that the users are happy with the systems' response time. Other advantages reported, more or less in sequence, were that the programs and data are compatible with other systems, that productivity aids help to keep programming costs down, that terminals and peripherals are compatible, that the systems are power/energy efficient, that the database language is effective, and that delivery and/or installation of equipment and software was ahead of schedule.

No one problem seemed to stand out above the others, and the problems which had been encountered were reported by very few users. Four users felt that the system proposed by the vendor had proven to be too small; three said that the delivery and/or installation of the equipment was late; six found that their costs had exceeded expectations; three said that the vendor did not provide all the promised software or support; two felt that the vendor's enhancements and changes to hardware and software are hard to keep up with; and four said that the equipment was excessively noisy.

Individual comments included, "Wang hardware has excellent price/performance advantage over the other systems we evaluated (NCR 8200, Burroughs B800, ▷

► (five to eight bits), stop bits (one or two), and parity (odd, even, or none). Any one of the following rates can be set via the initializing communication control vector; 50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2400, 3600, 4800, 7200, or 9600 bps. With this controller, a system can be programmed to function like a variety of asynchronous terminals (Teletype, IBM 2741 typewriter terminal, Wang word processing terminal) or to communicate with another comparably equipped system. The unit can operate at switch-selectable data rates of 110, 150, or 300 bits per second through a Bell 103A or equivalent modem and can operate at 1200 bps through a Bell 202C when connected to a switched line. The unit can also operate at 1800 bps when directly connected to a dedicated line. All Wang processors support the 2227B through the $GIO instructions and utility software packages. The 2227N null modem adapter is used when connecting to a dedicated line.

2228B BISYNCHRONOUS COMMUNICATIONS CONTROLLER: The 2228B contains a microprocessor, ROM, RAM, and I/O buffers to execute a communications program. Currently three emulator programs are available from Wang: IBM 2780, IBM 3780, and IBM 2741. One program is included in the price of the controller, and other emulator programs may be ordered for $200 each. The following modems can be used: Bell 201A (2000 bps), Bell 201C (2400 bps), or Bell 208B (4800 bps).

2228C BISYNCHRONOUS COMMUNICATIONS CONTROLLER: The 2228C can support Wang's 3275 bisynchronous emulator in addition to all of the software supported by the 2228B.

2250 PARALLEL INTERFACE CONTROLLER: The 2250 provides an eight-bit program-controlled parallel input and output interface to similar peripherals. The unit can support data rates up to 10K characters per second. The normal operating mode for the 2250 is to pass seven-bit ASCII characters with the eighth bit set to logical zero. The 2250 is supported by the standard BASIC interpreter on the 2200VP.

2252A BCD INPUT INTERFACE: The 2252A is used to interface external devices such as digital voltmeters, digital panel meters, counters, etc., to 2200 systems. Inputs to the 2252A can be up to ten BCD digits or up to forty bits of binary information. Data can be either fixed or floating point. The logic interface is TTL/DTL-compatible.

2254 IEEE-488 INTERFACE: This interface requires one I/O slot in the CPU and transfers data in byte-serial and bit-parallel modes, along with BUS control and management information. Devices connected to the interface may be any one of the following: Listener, Talker, Talker/Listener, or Controller. The 2254 can be field-settable to operate as a controller or non-controller. Up to fifteen devices can be connected.

MODEL 2236MXD TERMINAL PROCESSOR: Provides the means to support as many as four Model 2236 interactive terminals per each 2236MXD. Three 2236MXD may be used in conjunction with the 2200MVP; only one MXD may be used with the 2200LVP. The 2236MXD serves as a front-end processor between terminals and the main CPU. Other specifications are identical to those of the MXC.

OPTION 62B COMMUNICATIONS CONTROLLER: Allows Wang's minidiskette-based PCS-III system to function as an "intelligent" distributed processing terminal, using binary synchronous communications protocols in turnkey emulation utilities packages for the IBM 2780, 3780, or 3741 and asynchronous emulation packages for Teletype and IBM 2741 procedures. A software package for any one device type is provided at no additional charge with each Option 62B controller. ►

▷ Qantel)" and ". . . the recently introduced IDEAS package is a fine set of programs which perform most file management operations without the need for any programming."

One user, a service bureau, added the following to the survey form:

"The Wang 2200 [an MVP, in this case] system is modular and expansion is extremely easy. We have just recently incorporated the use of Wang's new 2280 disk drive (80 megabytes) . . . and 4 new 2236DE graphics terminals. The new peripherals were fully functional within an hour after being uncrated and we have encountered absolutely no problems."

Twenty-seven of the users said that they would recommend their system to other users; three said that they would not. Two of those three were responsible for almost all of the low ratings.□

▶ SOFTWARE

OPERATING SYSTEM: None (see next paragraph).

LANGUAGES: All programming is done in BASIC or BASIC-2. A BASIC-2 language interpreter which resides in control memory is embedded in the 2200 Series processors. The interpreter is loaded into RAM from a storage device. The BASIC-2 language was developed because it is easy to learn, allowing for ready implementation of programs by the user. An extensive operating system is not required because BASIC-2 language statements, when executed, invoke a large number of functions, providing system and input/output control.

In general, the user is offered a choice of two operating modes, program and immediate. In the immediate mode, single and multiple BASIC-2 statements are executed as on-line instructions. This mode can be implemented without altering existing programs. For example, the operator can use the 2200 Series system to perform arithmetic calculations during an interactive program without disrupting program execution.

Programming features in the program mode include the use of four types of variables, with each type having as many as 286 names available. These variable types are numeric, numeric array, string and string array. One- and two-dimensional numeric or arithmetic string arrays can be used.

User-defined special functions are subroutines, program functions, or character strings stored in memory which can be accessed by special function keys. Sixteen keys are available; each key controls two special functions, for a total of 32 special functions.

Debugging and error diagnostics are standard features available to the user. When an error is made during program entry, a diagnostic error pointer and an error code indicate the portion of the line containing the error along with a code referencing the type of error. In the programmable trace function, either a CRT display or a printout is made whenever a program transfer occurs or when a program variable receives a new value. Another debugging aid is the halt/step operation (a key on the keyboard): one program statement is displayed and executed each time the halt/step key is pressed. This aid permits a line-by-line program analysis.

The useful program editing features are statement renumbering, line correction, and line insertion. Whole programs or program segments can be renumbered, with new statement number increments as defined by the user. Line corrections can be made in three ways: backspacing through a line to the point of error and then retyping the corrected line from that point, deleting the entire line by re-entering the line number and striking the return key, or replacing the line by re-entering the line number and keying in the correct program statement.

Program loading can be accomplished from the keyboard or, as in the case of chained program operation, under program control. Entire programs or portions of programs can be saved on disk. Saved programs are identified by alphanumeric name from disk storage. A special program protection command, SAVE P, when included in the program, prevents listing or altering of the program. On all 2200 Series systems except the PCS-III, programs can be scrambled to ensure even greater security.

INTEGRATED SUPPORT SYSTEMS: ISS has two functions. First, it provides a complete selection of stand-alone utilities, a file access management system, and programming aids; and second, it integrated these system elements with one another and with user software by means of a common access procedure. ISS is supplied by Wang on four functionally organized diskettes. These diskettes can be converted to any Wang standard storage device. One diskette provides system support utilities, one provides the KFAM file access management system, one provides a sort software system, and the fourth provides programming aids. The software is also available on a dual-sided double-density diskette.

The utilities are stand-alone routines designed to perform tasks frequently required in a disk-based data processing system: Copy/Verify, Sort Disk Catalog, Disk Dump, Compression (which reduces the size of source program files by eliminating spaces, remark lines, and nonessential line numbers), and Decompress (which copies program files and breaks up all multi-statement lines by assigning a unique line number to each BASIC statement). Others include List/Cross Reference, List, Reconstruct Catalog Index, and Create Reference File.

The KFAM (Keyed File Access Method) is a software system designed to produce, search, and maintain an index to the records in a disk-based data file. KFAM includes subroutines which are incorporated into user-written application programs. These subroutines perform all the required applications on the index (e.g., random-access search, sequential-access search, adding and deleting records). KFAM also provides the utility programs required to set up new files and provide all necessary file maintenance. KFAM is available in versions to support configurations ranging from a single-CPU system to multiple-CPU/multiple-disk systems.

Programming aids offer the programmer a variety of subroutines which may be incorporated into application programs. The programming aids subroutines include search catalog index, allocate data file space, free unused sectors, data entry, open/close output, alphanumeric input, etc. Programming aids also include SORT-4, a flexible, free-standing sort routine.

APPLICATIONS PROGRAMS: Wang Laboratories offers 2200 Series applications programs through three groups: the software vendor network; the Wang Users' group; and the Wang in-house software development staff. The major source of software for the 2200 Series product line is Wang's independent software vendor network. Commercial and scientific applications have been created for diversified fields. Many software network-developed ▶

Wang Laboratories 2200 Series

▶ packages are cross-licensed between vendors, allowing national and regional access.

Most of the currently available applications programs have been developed by users and software vendors. Wang's in-house software group has produced the utilities, standard subroutines, an extremely comprehensive statistical analysis package, and several accounting packages. Brief descriptions of some Wang-developed and supported packages follow:

GBS Invoicing System: Accepts and edits invoice data entered by the operator and accesses and updates the customer file, inventory file, salemen sales analysis file, and accounts receivable open item file. Invoices can be printed interactively as they are entered or printed subsequent to entry. A detail invoice register is also generated.

GBS Accounts Receivable: Creates and maintains an open item or balance forward file. On balance forward customers, all cash is entered as general payments. For open item customers, cash may be applied to specific items or entered as general payments. The month-end cycle includes aging and service charge computation, aged trial balance, customer statements, and file purge.

GBS Sales Analysis: Accumulates and reports sales analysis data by customer, by salesman, and by product. These three reports indicate sales for the current period and year to date. Sales are shown as a comparison to cost for the indicated periods.

GBS Order Entry: Accepts and edits order data entered by the operator. Customer files and inventory files are accessed for validation purposes. The quantity ordered is checked for availability on inventory files; the operator is notified where an overallocation situation exists; shipping papers are printed; and the open order file is updated. Orders are then accessible for adjustment and/or reprint. The shipping confirmation program then accesses individual orders to be invoiced. Corrections or changes may be entered at confirmation time.

GBS Inventory Control: Creates, maintains, and updates the inventory master file. Reporting includes sales analysis, stock status reporting, low stock/inactive items reports, physical inventory sheets, inventory variance reports with file adjustment, and various file inquiry reports.

GBS Accounts Payable: An open item accounts payable system in which vouchers are entered, edited, and verified through the CRT/keyboard. Distribution to the general ledger is provided. Items are selected for payment by a specified due date or by keying specific vendor/invoice numbers. A provision is made for passing manually written checks through the system. Full file management and inquiry capabilities are provided.

GBS General Ledger: A complete general ledger reporting system which takes the user from keying in journal entries, through the trial balance and its subsequent correcting entries, into the income statement, balance sheet, budget reports, and various schedule reports. Formats of the various reports are controlled by codes in the chart of accounts master file.

IDEAS: Inquiry Data Entry Access System is an application development tool which can be used to create and maintain data files, generate sophisticated screen formulas, solicit and validate operator-entered data, and produce complex reports.

Statistics/Engineering General Program Library: Includes a wide variety of programs for common problems in statistics (including several regression analyses), civil and sanitary engineering, electrical engineering, chemical engineering, and structural engineering.

General Plotter Utilities: Provide users of digital plotters with full plotting capabilities. These are stand-alone programs which scale, plot, and alphanumerically label rectangular, parametric, or polar equations; bar charts; pie charts; point plots; and line graphs. The user can select either linear, logarithmic, or polar scales for special plots. No technical programming background is necessary to produce graphs.

PRICING

POLICY: The Wang 2200 Series systems are available for purchase, lease, or rental. Most software (i.e., application packages) is separately priced and is available directly from Wang Laboratories and also from independent software houses. Marketing personnel at Wang can assist users in selecting software houses that can meet their particular user needs.

Wang Laboratories, Inc., offers two-, three-, and five-year leases, with separate service contracts mandatory for one year on leased equipment (see Support below).

Rentals are available either with or without an option to purchase. Rental agreements include full maintenance of the equipment. On rentals with option to purchase, rebates are offered depending on the term of rental (minimum rental terms are three months, with maximum rental for up to 24 months). The amount of rebate applicable to system purchase depends on the particular rental plan agreed upon; ten plans are available. However, the service portions of the rental do not apply to purchase.

SUPPORT: The equipment is sold with a 90-day warranty on parts and labor plus a one-year warranty on parts manufactured by Wang Laboratories. Maintenance beyond the 90-day warranty is offered on a contract basis depending on the nature of the equipment.

Initial installation and system testing are performed at no charge. After the initial system installation, a small service charge to cover the cost of maintenance personnel expenses is made for each peripheral device added to the system.

Training is available at the company's training facility in Burlington, Massachusetts. Scheduled five-day courses are given covering system operation, programming, and applications. Users pay for course enrollment plus travel and accommodation expenses incurred during training.

Sales personnel are trained at company headquarters and assigned to over 115 sales offices located throughout the United States. Wang has 300 offices in eighty countries.■

Wang Laboratories 2200 Series

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
SYSTEMS			
2200VP			
2200VP-8	CPU, 9 I/O slots, 32K memory	$ 6,000	$ 70.00
2200VP-16	CPU, 9 I/O slots, 64K memory	8,500	97.00
2200MVP			
2200MVP-8	CPU, 9 I/O slots, 32K memory, extended configuration chassis	9,000	81.00
2200MVP-16	Same with 64K memory	12,000	107.00
2200MVP-32	Same with 128K memory	15,000	172.00
2200MVP-48	Same with 192K memory	18,000	220.00
2200MVP-64	Same with 256K memory	21,000	268.00
2200SVP			
2200SVP-8	CPU, 500K single-sided double-density diskette, 32K memory	6,000	68.00
2200SVP-16	Same with 64K memory	9,000	95.00
2200LVP			
2200LVP-8	CPU, 3 I/O slots, 1-megabyte double-sided double-density diskette, 32K memory, cabinet	8,000	80.00
2200LVP-16	Same with 64K memory	11,000	108.00
2200LVP-32	Same with 128K memory	14,000	170.00
PCS-III			
2200PCS-III-8	Personal Computing System, 9-inch CRT (64 x 16, upper/lower case), 140K single-sided double-density diskette, 32K memory	6,500	88.00
MEMORY			
V3264	32K to 64K upgrade (for 2200VP, 2200MVP, 2200SVP, and 2200 LVP)	3,000	28.00
V32128	32K to 128K upgrade (for 2200MVP and 2200LVP)	8,000	90.00
V32192	32K to 192K upgrade (for 2200MVP)	11,000	139.00
V32256	32K to 256K upgrade (for 2200MVP)	16,000	187.00
V64128	64K to 128K upgrade (for 2200MVP and 2200LVP)	5,000	62.00
V64192	64K to 192K upgrade (for 2200MVP)	8,000	113.00
V64256	64K to 256K upgrade (for 2200MVP)	13,000	161.00
MASS STORAGE			
2260-1/4	1.25-megabyte fixed and 1.25-megabyte removable disk drive with 22C12 controller and stand	7,200	108.00
2260-1/2	2.5-megabyte fixed and 2.5-megabyte removable disk drive with 22C12 controller and stand	9,200	108.00
2260C	5-megabyte fixed and 5-megabyte removable disk drive with 22C12 controller and stand	11,200	108.00
2260C-2	Dual 5-megabyte fixed and 5-megabyte removable disk drives with 22C12 controller and stands	18,400	173.00
2260BC-1/4	1.25-megabyte fixed and 1.25-megabyte removable disk drive with 22C13 controller and stand	8,000	108.00
2260BC-1/2	2.5-megabyte fixed and 2.5-megabyte removable disk drive with 22C13 controller and stand	10,000	108.00
2260BC	5-megabyte fixed and 5-megabyte removable disk drive with 22C13 controller and stand	12,000	108.00
2260BC-2	Dual 5-megabyte fixed and 5-megabyte removable disk drives with 22C13 controller and stand	19,000	173.00
2270-1	1/4-megabyte single removable diskette drive only	3,200	36.00
2270-2	1/2-megabyte dual removable diskette drives only	4,700	49.00
2270-3	3/4-megabyte triple removable diskette drives only	6,200	70.00
2270A-1	1/4-megabyte Wang/3740 diskette, single removable diskette drive only	3,600	33.00
2270A-2	1/2-megabyte Wang/3740 diskette, dual removable diskette drives only	5,100	49.00
2270A-3	3/4-megabyte Wang/3740 diskette, triple removable diskette drives only	6,600	65.00
2280-1	13.4-megabyte fixed and 13.4-megabyte removable disk drive with 22C14 disk processing unit and controller	19,000	206.00
2280-2	40.2-megabyte fixed and 13.4-megabyte removable disk drive with 22C14 disk processing unit and controller	20,000	216.00
2280-3	67-megabyte fixed and 13.4-megabyte removable disk drive with 22C14 disk processing unit and controller	21,000	227.00
2280N-1	13.4-megabyte fixed and 13.4-megabyte removable disk drive only	17,000	184.00
2280N-2	40.2-megabyte fixed and 13.4-megabyte removable disk drive only	18,000	195.00
2280N-3	67-megabyte fixed and 13.4-megabyte removable disk drive only	19,000	206.00
22C03	Disk/diskette controller	200	2.50
2297	Optional stand for 2260C series drives	250	N/C
OP-103	Additional single-sided, double-density minidiskette drive for PCS-III	1,000	9.00
MAGNETIC TAPE			
2209	Magnetic tape drive, 9-track, 800-bpi, with controller	10,400	98.00
22D09	9-track, 800-bpi drive only	10,000	96.00
2209A	Magnetic tape drive, 9-track, 1600-bpi, with controller	15,000	119.00
2250	8-bit parallel I/O interface controller	400	2.50

Wang Laboratories 2200 Series

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
CARD EQUIPMENT			
2244B	Hopper-feed mark sense/punched card reader with controller, 300 cpm	6,500	81.00
22D44	Card reader only	5,500	69.00
22CO6B	Card reader controller	1,000	13.00

PRINTERS/PLOTTERS

All printers must be attached to the 22CO2 controller, directly to the 2236DE interactive terminal, or to the 22C11 dual controller (print plus diskette) or the 22C32 triple controller for diskette, printer, and 2236DE.

		Purchase Price	Monthly Maint.
2221W	Matrix printer with stand; 132 col., 200 cps, 10-pitch	5,000	60.00
2231W-1	Matrix printer; 112 col., 120 cps, 10-pitch	2,900	35.00
2231W-2	Matrix printer; 132 col., 120 cps, 12-pitch	3,200	35.00
2231W-3	2282 graphic CRT accessory matrix printer	3,800	35.00
2231W-6	Matrix line printer, high density, 132 col., 70 cps	3,300	35.00
2232B	Digital flatbed plotter, 31" x 48", with controller	8,000	62.00
22D32	Plotter only	7,800	60.00
22CO1	Output writer/plotter controller	200	2.50
2251	Line printer; 40 col., 100 cps	1,200	14.00
2261W	Matrix line printer; 220 lpm, dual pitch	7,000	75.00
2263-1	Line printer; 400 lpm, 64 char.	14,500	155.00
2263-2	Line printer; 600 lpm, 64 char.	16,000	168.00
2263-3	Line printer; 430 lpm, 96 char.	17,000	180.00
2272-2	Drum plotter with three pens	3,200	35.00
2273-1	Band printer; 250 lpm	8,500	87.00
2273-2	Band printer; 600 lpm	12,000	124.00
2281W	Wang daisy printer/plotter, 30 cps	4,500	44.00
OP-123	Monodirectional forms tractor option for 2281W	250	N/C
BFT-1	Bidirectional forms tractor for 2281W; necessary for plotting on 2281W	300	N/C
2282	Graphic CRT only; 12" screen; 112 upper/lower ASCII characters	3,600	19.00
IP41L	Image printer; 18 pages/minute; 10-, 12-, or 15-pitch	32,000	453.00
22CO2	Printer/drum plotter controller	200	2.50
22C11	Dual controller, printer/drum plotter and diskette	300	3.50
22C32	Triple controller for diskette, printer, and one 2236DE interactive terminal	1,000	6.00
2211M	Line printer multiplexer (maximum 4 CPU and 1 printer)	1,000	13.00
2295	2231W printer stand	250	N/C

TERMINALS

		Purchase Price	Monthly Maint.
2236DE	Interactive terminal; CRT/keyboard, 24 x 80, 10-key pad, function keys	2,700	20.00
2236MXD	4-port terminal multiplexer for 2236DE	1,200	10.00
2210A	12" CRT; 64 x 16, upper/lower case keyboard with single minidiskette drive and controller	3,800	27.00
2210B	12" CRT; 80 x 24, upper/lower case keyboard with single minidiskette drive and controller	4,200	33.00
2226A	12" CRT; 64 x 16, upper/lower case keyboard with controller	2,200	12.00
2226B	12" CRT; 80 x 24, upper/lower case keyboard with controller	2,600	18.00
22D31	12" CRT; keyboard console only	1,200	6.00
22D33	12" CRT; keyboard console with single minidiskette drive	2,800	21.00
22C31	Triple controller for disk/diskette, keyboard, line printer	400	2.50
22C33	80 x 24 upper/lower case CRT controller	1,000	10.00
22C34	64 x 16 upper/lower case CRT controller	600	3.50

TERMINAL OPTIONS

		Purchase Price	Monthly Maint.
OP-31	Audio signal for 2210, 2226	200	2.00
OP-32	Keyboard clicker for 2210, 2226	80	N/C
OP-33	80 x 24 upper/lower case CRT controller	400	6.00
OP-101	Additional minidiskette drive for 2210 only	1,000	9.00

I/O INTERFACES

		Purchase Price	Monthly Maint.
2207A	I/O interface controller, RS-232C, selectable bps	600	3.50
2227B	Buffered asynchronous telecommunications controller	750	17.00
2227N	Null modem	50	N/C
2228B	Bisynchronous communications controller	1,500	17.00
2228C	Bisynchronous communications for IBM 3275 emulation	1,700	19.00
2228N	Null modem	50	N/C

I/O INTERFACE OPTIONS FOR 2200SVP

		Purchase Price	Monthly Maint.
OP27B	Buffered asynchronous telecommunications controller	750	19.00
OP28B	Bisynchronous communications controller	1,500	19.00
OP28C	Bisynchronous communications controller for IBM 3275 emulation	1,700	22.00

I/O INTERFACE OPTION FOR PCS-III

		Purchase Price	Monthly Maint.
OP-62B	Bisynchronous communications option	1,500	17.00