WANG

2200 LVP

SYSTEM OVERVIEW

The 2200LVP Central Processing Unit (CPU) is a high-performance processor that can support up to 13 terminals and up to 16 jobs concurrently in a multiprogramming environment. Designed for simplicity of operation and flexibility in system configuration, the 2200LVP can easily be adapted to meet each user's unique processing requirements.

The 2200LVP is available in two versions: the Model 2200LVP and the Model 2200LVPC. The Model 2200LVPC incorporates all features of the Model 2200LVP and also provides expansion for user memory, input/output (I/O) slots, and disk storage capacity.

The 2200LVP utilizes a user-defined, fixed-partition memory configuration and an extremely fast and efficient central processor that provides multiprogramming capabilities to all system users. In a fixed-partition memory scheme, user memory is divided into a number of distinct areas called *partitions*. Each partition can contain a separate program. The central processor allocates intervals of processing time to each partition in turn; thus the program in an individual partition executes for a brief time slice before the central processor services the next partition. Response time, an important consideration in a multiuser environment, is extremely fast for all users, regardless of the number of partitions or type of program currently executing.

The 2200LVP is programmable in the popular BASIC-2 language. The interactive programming and debugging capabilities of Wang's high-level BASIC-2 language make program development on the 2200LVP an easy task for programmers and reduce training time for new users.

Two types of disk drives are available with the 2200LVP: a dual-sided, double-density (DSDD) diskette drive and a fixed disk, Winchester-style drive. The combination of these drives creates a total, cost-effective disk-based system for small business systems users.

System users communicate directly with the 2200LVP by using any 2200 Series Terminal. Each terminal consists of a large, easy-to-read, 24 by 80 (24 lines, 80 characters per line) CRT screen display and a typewriter-style keyboard. To accelerate communication and increase response time, the system performs automatic data compression on information transmitted to each terminal. Since each terminal can also support its own local printer, screen dumps can be output on all printers and all standard printing operations can be performed. All 2200 Series Terminals

Model 2336DW Terminal

generate extensive bar and line graphics using standard program statements to provide valuable displays for business applications. Wang 2200DW Series Terminals support an optional 2200 Word Processing Software package, thus enabling users to perform both word processing and data processing applications at the same terminal.

Terminals can be attached to the 2200LVP either locally at distances ranging up to 2,000 feet (609.6 meters), or remotely by using modems and telephone lines. Optionally, the 2200LVP can be equipped with communications controllers so that remote devices can be attached directly to the CPU and accessed by a user at the terminal. Asynchronous, synchronous, and advanced bit-oriented protocols are supported by the 2200LVP processor.

Additionally, the 2200LVP supports a wide range of other peripheral devices. These devices include a selection of flexible and hard disk drives, and an extensive array of printers and plotters. To support peripherals, the 2200LVP chassis contains three I/O slots; the 2200LVPC chassis contains seven I/O slots. Each I/O slot can contain a controller, capable of controlling one or more peripherals.

HIGH-SPEED PERFORMANCE

The 2200LVP central processor is a fast, custom-designed MSI processor built from reliable, high-performance components. Central processor memory cycle time, usually sufficient to execute and retrieve a control memory instruction as well as to read 2 bytes of user memory, is 600 nanoseconds. Combined with an extremely low overhead operating system and incremental compiler, the 2200LVP provides exceptional response time for all system users.

To illustrate the speed of the central processor, a representative selection of BASIC-2 floating-point arithmetic operations is listed in the following table along with the times required for each computation. These times represent average execution times and assume full 13-digit precision for each operation.

Operation	Central Processing Time
Addition (+)	0.11 msec
Subtraction (-)	0.11 msec
Multiplication (*)	0.39 msec
Division (/)	0.79 msec
Exponentiation (↑)	6.40 msec
LOG	3.30 msec
LGT	2.90 msec
EXP	3.40 msec
SQR	1.80 msec
SIN	4.60 msec
COS	4.70 msec
TAN	8.00 msec
ARCSIN	12.90 msec
ARCCOS	13.00 msec
ARCTAN	10.20 msec
RND	0.28 msec
MOD	1.10 msec
ROUND	0.12 msec
Matrix Inversion (10 x 10)	0.57 sec
Matrix Inversion (20 x 20)	4.30 sec

2200LVP
Central Processing Unit (CPU)

The 2200LVP also provides high-speed, alphanumeric-string processing capabilities. For example, the following timings were recorded with the specified BASIC-2 operations performed upon an alpha array consisting of 1000 eight-character elements.

Operation	Central Processing Time
Search for a specified value	0.02 sec (maximum)
Memory sort of random data	1.68 sec

EASY OPERATION

The 2200LVP is simple to operate and easy to program. There are no special job control languages or elaborate operating procedures. System resources are allocated through a supplied partition generation program that guides the user through the process of configuring user memory. By running this program, the user creates partitions and assigns them to terminals. Each terminal can control one or more partitions.

Once the system memory has been configured, each partition functions independently. Within each partition, a user can develop and execute a program as if the partition were alone on a single-user system.

Because each user communicates with the system interactively, a program can request needed information with clear, nontechnical prompts. For the programmer, interactive operation greatly simplifies the tasks of program development and maintenance. Programs can be entered, edited, and run directly from the terminal keyboard.

In addition, the 2200LVP processor performs a range of error checks that detect and identify many different types of errors, and provides an extensive set of edit functions to facilitate error correction.

FUNCTIONAL ORGANIZATION

The 2200LVP consists of a microprogrammed MSI processor coupled with a number of special purpose LSI input/output (I/O) processors and controllers. The operating system and incremental compiler reside in a dedicated control storage memory that is independent from user data memory. The operating system and incremental compiler direct the execution of the CPU and coordinate communication with the I/O processors. The independent I/O processors permit the overlap of CPU and I/O processing. Thus, the CPU is relieved of the responsibility for controlling peripherals that would otherwise require frequent or dedicated CPU attention. Refer to the figure, "Logical Organization of the 2200LVP" for an illustration of the 2200LVP architecture.

MEMORY ORGANIZATION

The efficient memory organization of the 2200LVP is one of its most significant features. The 2200LVP stores its system programs and user programs (including application software) in two separate memory areas called control memory and user memory.

Control memory is the memory area that stores the BASIC-2 incremental compiler, the operating system, and the system diagnostics. The 2200LVP control memory contains 32K of 24-bit words. When powering on the system, the operator loads the system programs from a platter into control memory, where the system programs reside until the operator powers off or reinitializes the system. Because control memory is a separate memory area that cannot be accessed by the user or the user's programs, system programs are protected against accidental interference or destruction brought on by the user program.

User memory is the area of memory available to the user's programs and data. User memory on the 2200LVP can be increased from a minimum of 32K bytes to a maximum of 256K bytes, organized into one to four banks of 64K bytes. User memory on the 2200LVPC ranges from 64K bytes to 512K bytes, organized into one to eight banks of 64K bytes.

The user can divide each memory bank into a number of partitions of fixed size, each of which can execute a separate program. Partitions cannot span bank boundaries. The operating system and the incremental compiler require 3K bytes of memory in the first bank for storage of control information; in each subsequent bank, 8K bytes of memory are unavailable to the user. Thus, a total of 61K bytes of memory in Bank 1 and 56K bytes of memory in Banks 2 through 8 is available for partitioning. In addition, the system reserves 1K bytes of memory in each user partition for tracking the state of the partition; for example, the system can track the files that the partition has open. Because the system programs are stored separately, all remaining memory in

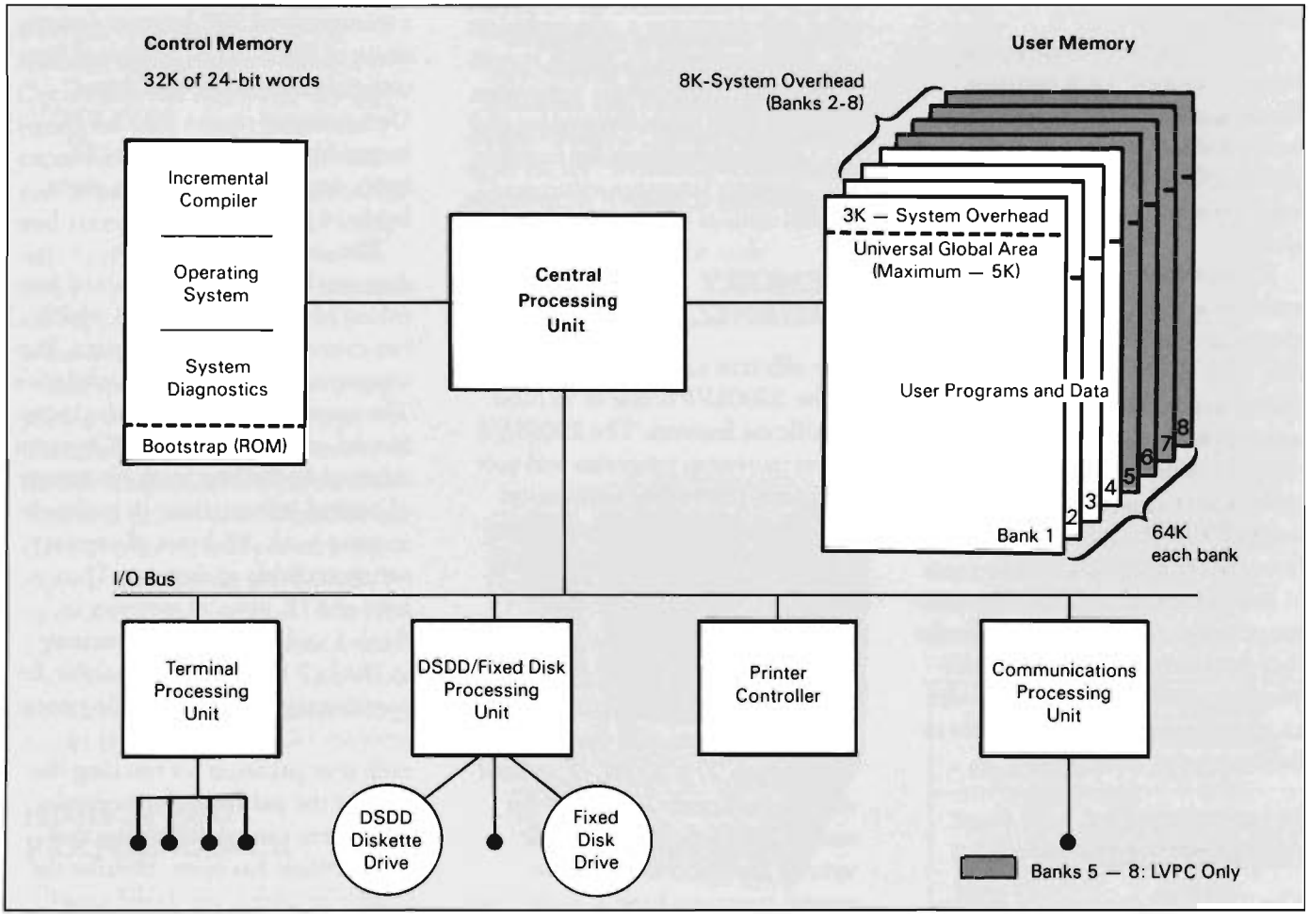
each partition is available for user programs and data.

The 2200LVP permits the user to economize on memory use by defining one or more global partitions within each memory bank. The variables stored in a global partition are accessible to other partitions within that bank. Though a global partition in one bank cannot be accessed by partitions in other banks, a 5K byte area of Bank 1 can be reserved as a *universal* global partition area. A universal global partition, located entirely within this 5K byte area, can be employed to store control variables used by any partition in any bank.

The 2200LVP utilizes a unique "atomization" technique to automatically condense each program line. The condensed format not only conserves the memory needed for program storage but also contributes to fast program execution.

MULTIUSER OPERATION

The 2200LVP supports the BASIC-2 Multiuser Operating System and the BASIC-2 Language. The BASIC-2 Multiuser Operating System provides facilities for program coordination and the sharing of system resources. The operating system protects multiple users from disk and printer contention problems through BASIC-2 language features that enable a program to seize



Logical Organization of the 2200LVP

temporary control of a device and, subsequently, release it. The BASIC-2 language also prevents interprogram conflict through the use of global variables, which are specified by the user as accessible to several BASIC-2 programs.

The BASIC-2 Multiuser Operating System enables users to prevent unauthorized access of important files and unauthorized execution of critical programs by selecting Disabled Programming mode. In Disabled Programming mode, a terminal functions exclusively under program control. The operator can neither enter nor modify program text from the specified terminal and the operator's ability to interact with the system and obtain access to disk files is completely determined by the program controlling the terminal. The program can implement custom-designed security measures, such as password protection and specific file access rights for users working at the terminal.

The BASIC-2 Multiuser Operating System includes a set of BASIC-2 instructions for handling disk operations. These operations allow the programmer to choose between Automatic File Cataloging mode, in which the system automatically performs the tasks associated with disk maintenance, and Absolute Sector Addressing mode, in which the programmer can directly access any sector on the disk.

SINGLE-USER OPERATION

The 2200LVP can be configured as a single-user, stand-alone system with the same features and language capabilities as the multiuser arrangement. Unlike most single-user systems, the 2200LVP enables a single terminal to control several programs executing concurrently, while maintaining fast execution speeds. A single-user LVP can be upgraded to a multiuser LVP. Thus, the 2200LVP is an excellent choice for the first-time user because it combines high-performance computing with the capacity for extensive future expansion.

FOREGROUND/BACKGROUND OPERATION

Since each terminal on the system can be assigned more than one memory partition, several different jobs can run concurrently on each terminal. The terminal communicates with only one job at a time. The job currently communicating with the terminal is said to be running in the *foreground.* The job or jobs associated with a terminal but not currently communicating with the terminal are said to be running in the *background.* A terminal can be switched from one partition to another, shifting the current foreground job into the background and shifting a particular background job into the foreground to permit operator communication with that program. A typical example of foreground/background operation might involve running a batch-type job requiring minimal operator interaction (such as payroll processing) in the background, while a more interactive job (such as word processing) runs in the foreground.

BASIC-2

BASIC-2 is a high-level programming language designed for interactive programming and ease of use. Wang Laboratories, Inc., has developed a variety of extensions and enhancements that are included in BASIC-2 to facilitate the tasks of writing, documenting, and debugging programs, and to provide flexible language capabilities for a wide range of applications.

The BASIC-2 instruction set is both comprehensive and extremely powerful. The math package includes numerous system-defined mathematical and trigonometric functions; the results obtained are accurate to 13 digits and can be either rounded or truncated. Alphanumeric data can be compared, analyzed, and modified with an extensive array of data manipulation statements. These statements permit the programmer to manipulate characters at the bit and byte levels and to perform various Boolean and binary arithmetic operations.

A group of BASIC-2 system commands enable each user to control system operations in each partition from the terminal keyboard. The

system commands also serve as extremely efficient debugging tools.

In addition to the standard general-purpose BASIC-2 statements, BASIC-2 provides several groups of special-purpose statements that perform such operations as code conversion, sorting, matrix arithmetic, and customized I/O control. BASIC-2 also includes statements that enable the user to share program text, manage shared resources, initialize and edit the system time and date, alert the CPU when a local or remote terminal is connected or disconnected, allow a screen image to be transferred to a variable for further processing, and define system configurations.

DISK STORAGE

The 2200LVP features two disk drive units: the dual-sided, double-density (DSDD) diskette drive and the Winchester-style, fixed disk drive. Both the DSDD diskette drive and an optional fixed-disk drive are mounted directly within the compact, office-style cabinet. The cabinet also contains the central processor, thereby saving the space that separate drives would customarily occupy.

Dual-Sided, Double-Density Diskette Drive

Standard equipment on the 2200LVP includes a dual-sided, double-density diskette drive that can store approximately 1 megabyte of data. When used with the fixed disk drive, the DSDD provides a means of backup that is cost-effective and easy to use since fewer diskettes are needed.

In addition to providing backup capabilities, the DSDD diskette also serves as the medium for archiving data and transferring system software and application packages. The DSDD diskette drive is compatible with industry standard format.

Fixed Disk Drive

An 8-inch fixed disk drive is available as optional equipment on the 2200LVP. The fixed disk approach eliminates the costly mechanical and electronic requirements of combining a removable platter with a fixed platter. Fixed-type heads provide a fast, yet economical, method of data access due to both a decrease in head loading force and a minimizing of the air gap between the heads and the disk surface. The decrease in the size of the air gap permits a greater data density than was previously possible, enabling the user to access data faster and store more data in the same space.

Additionally, this fixed disk drive uses lubricated disk surfaces that permit the head to "take-off" and "land" on the platter surface during power-up and power-down procedures. This technology greatly reduces the possibility of a "head crash," helps ensure the integrity of the data, and lessens the expensive downtime that accompanies a crash. The combination of these features creates a compact disk drive that retains the performance and reliability of other models.

Wang Laboratories, Inc., offers the fixed-disk drive as system options available in 2-, 4-, and 8-megabyte capacities on the 2200LVP, and 2-, 4-, 8-, 16-, and 32-megabyte capacities on the 2200LVPC.

COMMUNICATIONS CAPABILITIES

The 2200LVP supports a full range of data communications options between remote terminals and the CPU and between the 2200LVP and other computer systems. Wang Laboratories, Inc., also offers a number of software packages to emulate common communications protocols.

Each terminal is connected to the 2200LVP by a Wang Model 22C32 Triple Controller, a Model 2236MXE Terminal Processor, or a Model 2236MXD Terminal Processor. These devices control I/O operations between the CPU and the terminals. Line handling between the CPU and each terminal is asynchronous and full-duplex, with selectable line speeds ranging from 300 to 19,200 bits per second (bps)

For remote connection, two RS-232-C compatible modems (e.g., Wang WA3451) are required to provide the communications link. Remote terminals located miles from the CPU can function exactly like local terminals, communicating directly with the system to perform operations

within their assigned partitions. Both remote and local terminals can have their own local printers to produce hard copy output at the terminal site. Refer to the illustration for an example of a typical communications configuration.

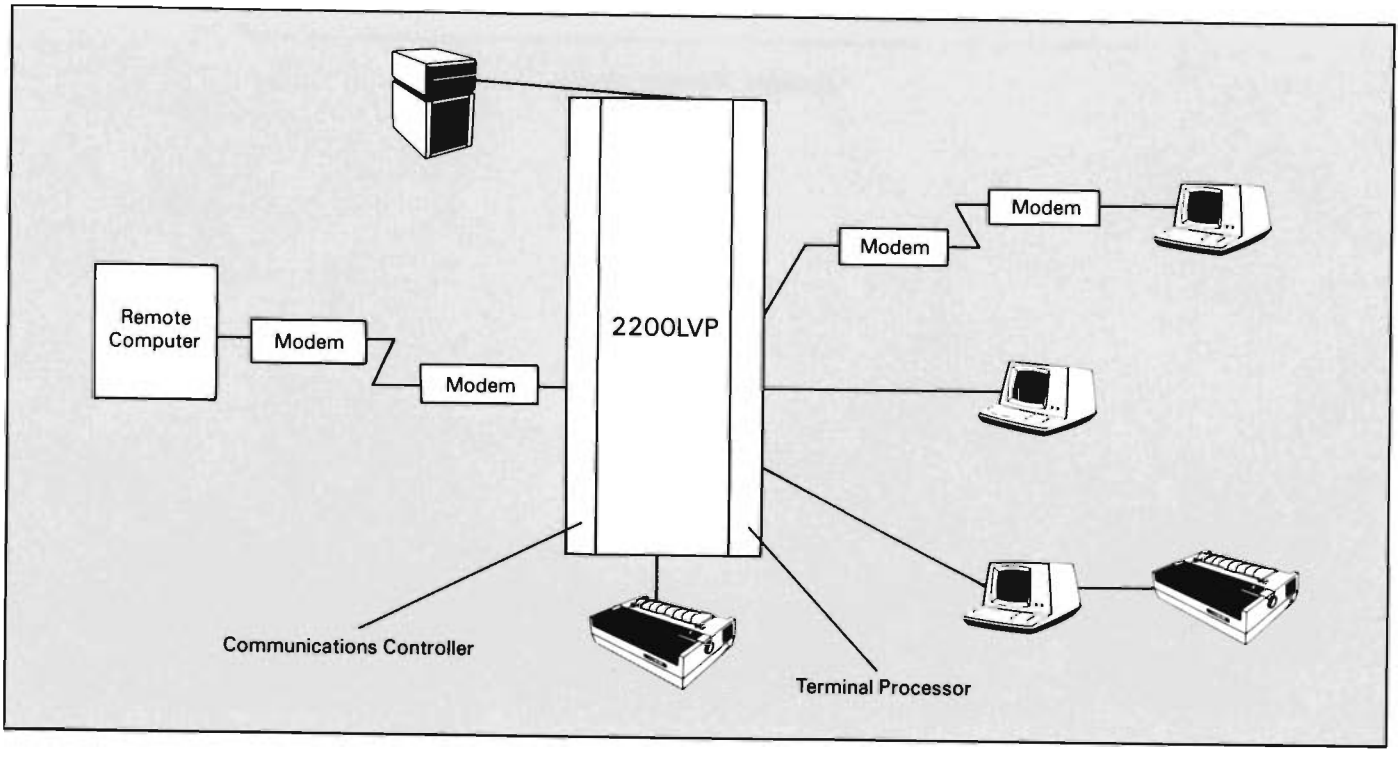
For communicating with other computer systems, the 2200LVP can be equipped with Wang communication controllers, Models 2227B, 2228B, 2228C, or 2228D. The Model 2227B supports asynchronous-only communications in half- or full-duplex, at line speeds ranging from 300 to 9600 bps. The Model 2228B and Model 2228C offer a choice of synchronous or asynchronous communications at speeds ranging from 300 to 4800 bps. Additionally, the Model 2228C supports 3275 Emulation. The Model 2228D Communications Controller offers synchronous communications at speeds ranging from 300 to 19,200 bps and supports the following protocols.

- MAILWAY®
- 2780/3780
- 3274 SNA
- ASYNC - Teletype Emulation
- Remote WangNet
- X.25 Packet Network Access
- 3274 BSC (3271)

COMPATIBILITY WITH OTHER 2200 SYSTEMS

Software compatibility is an important consideration in the selection of a new system. The 2200LVP has been designed to preserve maximum compatibility with single-user and multiuser 2200 Series systems. Since the 2200LVP is compatible with the 2200MVP, multiuser software written for the 2200MVP functions correctly on the 2200LVP.

The BASIC-2 language supported on the 2200LVP is identical to BASIC-2 on the 2200MVP and the 2200SVP. Additionally, the 2200LVP supports Wang BASIC



Typical Communications Configuration on the 2200 LVP

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syntax, providing a significant degree of compatibility with all earlier Wang 2200 systems. Since each 2200LVP terminal functions as a single-user 2200 system for program development purposes, this language compatibility means that programmers familiar with other 2200 systems can quickly become productive on the 2200LVP.

The 2200LVP offers several features that enable the programmer to use the memory available for multiuser programs with maximum efficiency. A programmer who must adapt a single-user program for multiuser operations on a 2200LVP can generally capitalize upon these features with a minimum amount of program modification. When memory space is not a problem, however, the program can generally be loaded and run intact in each partition.

SYSTEM UPGRADES

Any existing 2200LVP can be upgraded to a 2200LVPC. Both user memory and disk capacity can also be upgraded.

2200LVP/LVPC SPECIFICATIONS

Size
Height — 28.0 in. (71.1 cm)
Width — 20.4 in. (51.8 cm)
Depth — 30.0 in. (76.2 cm)

Weight
166 lb (75.5 kg)

User Memory Size
LVP — 32K bytes (standard); expandable to 64K, 128K, and 256K bytes
LVPC — 64K bytes (standard); expandable to 128K, 256K, 384K, and 512K bytes

Control Memory Size
32K bytes of 24-bit words

I/O Slots
LVP — 3
LVPC — 7

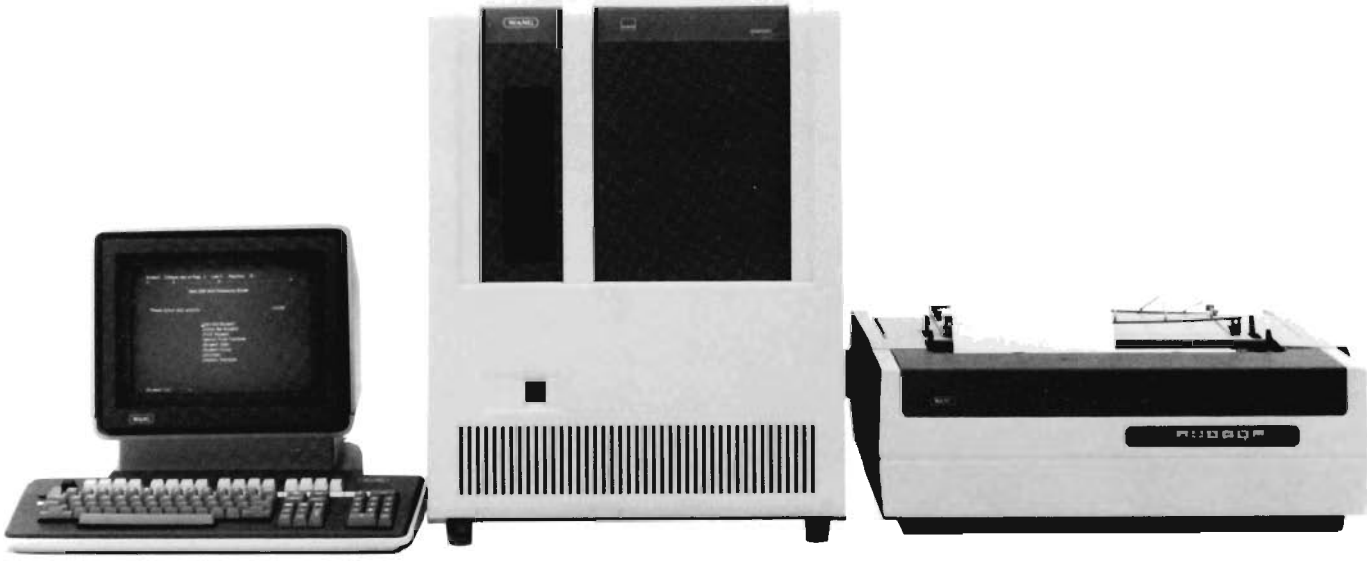
Memory Cycle Time
600 nsec

Power Requirements
115 VAC ± 10%, 60 Hz ± 1 Hz
230 VAC ± 10%, 50 Hz ± 1 Hz
317 W (maximum)

Fuses
5.0 amps (SB) for 115 V/60 Hz
2.5 amps (SB) for 230 V/50 Hz

Heat Output
1,084 Btu/hr

Operating Environment
Temperature
50° F to 90° F (10° C to 32° C)
Relative Humidity, noncondensing
35% to 65% recommended
20% to 80% allowable



Operating System Specifications

Memory Available for User Partitions
- 29K (29,696) bytes for 32K machines
- 61K (62,464) bytes for 64K machines
- 117K (119,808) bytes for 128K machines
- 229K (234,496) bytes for 256K machines
- 341K (349,184) bytes for 384K machines
- 483K (463,872) bytes for 512K machines

Overhead per Partition — 1K (1,024) bytes

Maximum Number of Partitions — 16

Minimum Partition Size — 1.25K (1,280) bytes

Maximum Partition Size
- Bank 1 — 61K (62,464) bytes
- Banks 2 - 8 — 56K (57,344) bytes

Maximum Number of Terminals — 13

Disk Storage Capacity

LVP — 1 megabyte DSDD (standard); optional 2, 4, and 8 megabyte fixed disk

LVPC — 1 megabyte DSDD (standard); optional 2, 4, 8, 16, and 32 megabyte fixed disk

DISK SPECIFICATIONS

	1-Megabyte (DSDD) Diskette Drive (Standard)	2-Megabyte Fixed Disk Drive (Option B)	4-Megabyte Fixed Disk Drive (Option C)
Tracks	149	254	510
Sectors/Track	26	32	32
Total Sectors	3,874	8,128	16,320
Bytes/Sector	256	256	256
Total Bytes	991,744	2,080,768	4,177,920
Average Access Time	91 msec	70 msec	70 msec
Average Latency Time	83.3 msec	9.6 msec	9.6 msec
Speed	360 rpm	3,125 rpm	3,125 rpm
Transfer Rate	0.5 megabit/sec	4.34 megabits/sec	4.34 megabits/sec

	8-Megabyte Fixed Disk Drive (Option D)	16-Megabyte Fixed Disk Drive (Option E)	32-Megabyte Fixed Disk Drive (Option F)
Tracks	1,020	2,044	4,088
Sectors/Track	32	32	32
Total Sectors	32,640	65,408	130,816
Bytes/Sector	256	256	256
Total Bytes	8,335,840	16,744,448	33,488,896
Average Access Time	70 msec	60 msec	60 msec
Average Latency Time	9.6 msec	10 msec	10 msec
Speed	3,125 rpm	3,000 rpm	3,000 rpm
Transfer Rate	4.34 megabits/sec	4.34 megabits/sec	4.34 megabits/sec

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ORDERING SPECIFICATIONS

The interactive, multiuser Central Processing Unit must contain a BASIC-2 incremental compiler, an operating system, and system diagnostics. There must be 32K bytes of 24-bit words of control memory. The operating system, incremental compiler, and system diagnostics must reside in control memory. The standard CPU must have 32K bytes of user memory and must be incrementally expandable to a maximum of 256K bytes. The CPU must be available in an option that supports memory expansion up to 512K bytes, and expansion to 7 I/O slots. The memory cycle time must be 600 nanoseconds. Full memory parity must be provided throughout both user and control memory. User memory must be divisible into 16 separate partitions. The system must be able to support up to 13 interactive terminals concurrently, and provide a complete set of I/O statements to control standard system peripherals. The system must also support a dual-sided, double-density diskette drive and an optional fixed-only disk drive. There must be available both synchronous and asynchronous communications hardware on a single board for installation directly within the processor.

Standard Warranty Applies

Wang Laboratories, Inc., reserves the right to change specifications without prior notice.

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