WANG

CS
CS/386

OVERVIEW

The Wang CS/386-D and CS/386-N are the newest additions to the CS Series of computer systems. The CS/386-D consists of a central processing unit (CPU) and internal storage devices. The CS/386-N requires a DS (data storage cabinet). The CPU (a high-performance Intel 80386-16MHZ processor) can support up to 16 terminals and 16 jobs concurrently in a multiprogramming environment. The CS/386-D can support up to three storage devices, including the DPU in one cabinet resulting in a compact and cost-effective minicomputer system. The CS/386-D/N systems are available in four versions: 1M, 2M, 4M, and 8M. All are programmable in the popular BASIC-2 language.

The CS/386-D/N chassis contains nine input/output (I/O) slots to support a wide range of other peripheral devices. Each I/O slot can contain a controller for one or more peripheral devices. These devices include a selection of flexible and hard external disk drives and an extensive array of printers.

The CS/386-D/N systems offer data communications capabilities and an operating system with extremely low overhead. Designed for simplicity of operation and flexibility in system configuration, the CS/386-D/N can be easily adapted to meet each user's unique processing requirements.

System users can communicate directly with the CS/386-D/N by using any Wang 2236, 2336, 2436, or 2536 terminal. Each terminal consists of a large, easy-to-read, 24 by 80 or 25 by 80 (24 lines and 25 lines, 80 characters per line) CRT screen display with a typewriter-style keyboard. The system performs automatic data compression on information transmitted to each terminal to accelerate communication and increase response time.

Since each terminal can support its own local printer, screen dumps and standard printing operations can be performed. All CS Series terminals generate extensive bar and line graphics by using standard program statements to provide the user with valuable displays for business applications.

Wang 2436DW, 2536DW Series terminals support an optional word processing software package. This package enables users to perform both word processing and data processing applications at the same terminal.

Terminals can be attached to the CPU either locally, at distances up to 2,000 feet (609.6 meters), or remotely, through the use of modems and telephone lines. Optionally, the CS/386-D/N can be equipped with communications controllers that allow remote devices to be attached directly to the CPU and accessed by a user at the terminal. In addition, the CS/386-D/N system supports asynchronous, synchronous, and advanced bit-oriented protocols.

The CS/386 CPU uses a fixed-partition memory configuration defined by the user and a fast, efficient central processor to extend multiprogramming capabilities to system users. In a fixed-partition memory scheme, user memory is divided into a number of distinct areas called *partitions*, each of which 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 is executed briefly before the CPU services the next partition.

High-Speed Performance

The CS/386 central processor is a high-performance, industry standard 80386-16MHZ processor built with fast, reliable components. CPU memory cycle time is 125 nanoseconds — usually sufficient to execute and retrieve a control memory instruction, as well as to read two bytes of user memory. When combined with the low-overhead operating system and the incremental compiler, the CS/386 CPU provides exceptional response time for all system users.

To illustrate the speed of the CPU, Table 1 lists a selection of typical BASIC-2 performance operations and the times required for each computation. These times represent average execution times and assume up to 11-digit precision for each operation.

Table 1. Performance of CS/386 and MVP

Module & # of Repetitions	CS Seconds	CS/386 Seconds
Expressions/1,000	5.00	2.00
Array Elements/1,000)	8.00	3.00
Array as a Parameter/500	25.00	10.00
Conditional Jumps/3,000	7.00	4.00
Integer Arithmetic/1,000	5.00	2.00
Trigonometric Functions/500	29.00	12.00
Subroutine Calls/2,000	7.00	3.00
Array References/2,000	4.00	2.00
Integer Arithmetic/3,000	6.00	3.00
Standard Functions/500	4.00	4.00
Total Seconds	100.00	45.00

BENEFITS

The main benefits of the CS/386-D/N are its high speed and easy operation. Its high speed provides a short response time for all users; its easy operation lets beginners quickly learn how to use the system.

The CS/386 CPU also provides high-speed, alphanumeric string processing capabilities. For example, Table 2 lists the times measured when the specified BASIC-2 operations were performed upon an alpha array consisting of one thousand 8-character elements.

Table 2. BASIC-2 Alpha Array Operation Times

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

Easy Operation

The CS/386 CPU is easy to operate and to program. No special job-control languages or elaborate operating procedures are involved. 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. Partition sizes can range from 1K to the maximum size of data memory. Each terminal can control one or more partitions.

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

Because each user communicates with the system interactively, the program requests the required information with clear, nontechnical prompts. For the programmer, interactive operation greatly simplifies program development and maintenance. Programs can be entered, edited, and run directly from the terminal keyboard. In addition, the CS/386 processor performs a range of error checks to detect and identify various types of errors. It also provides an extensive set of editing functions to facilitate error correction.

FUNCTIONAL ORGANIZATION

The CS/386-D/N operating system and incremental compiler reside in 256 KB of control storage memory that is independent from user data memory.

The microprogram, consisting of the operating system and incremental compiler, directs the execution of the CPU and coordinates 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 controlling peripherals that would otherwise require frequent or dedicated CPU attention.

The CS/386-D is an open-slotted system that can be ordered with either a 320-KB or a 1.2-MB diskette drive; a 45-MB streaming tape drive; and one fixed 20-, 32-, 64-, or 140-MB Winchester drive. The CS 386-N has no internal disk, but can be upgraded to a "D" (disk) unit at any time. The CS/386-D storage can be easily upgraded by adding one or two external Data Storage Cabinets (DS). (Each DS can store up to 316 MB of data.)

The combination of the removable diskette, the fixed Winchester drive, and the streaming tape drive makes the off-line storage capacity

of the CS/386 virtually unlimited. These storage devices are easy to unload and store, and are less susceptible to destruction from operator errors, program errors, or hardware malfunctions.

Up to 16 CPUs can share the fixed disk drive of the CS/386-D by using the 2275 MUX and 2275 MUXE extenders. The 2275 MUXE allows three additional CPUs to share the same fixed disk. Once the 2275 MUX has been connected, three 2275 MUXE extenders can be added to the CS/386-D. Each 2275 MUXE extender allows four additional CPUs to connect to the same fixed disk. The additional CPUs can be CS/386-Ds (which have their own internal storage), CS/386-Ns (which do not have their own internal storage), or any other type of CS/2200 CPU.

Figure 1 illustrates the architecture of the CS/386-D/N.

CPU MEMORY ORGANIZATION

The following features of the CPU contribute to its highly efficient use of memory:

- Dedicated control memory for storage of the incremental compiler and the operating system
- Partitioned user memory for user programs and data

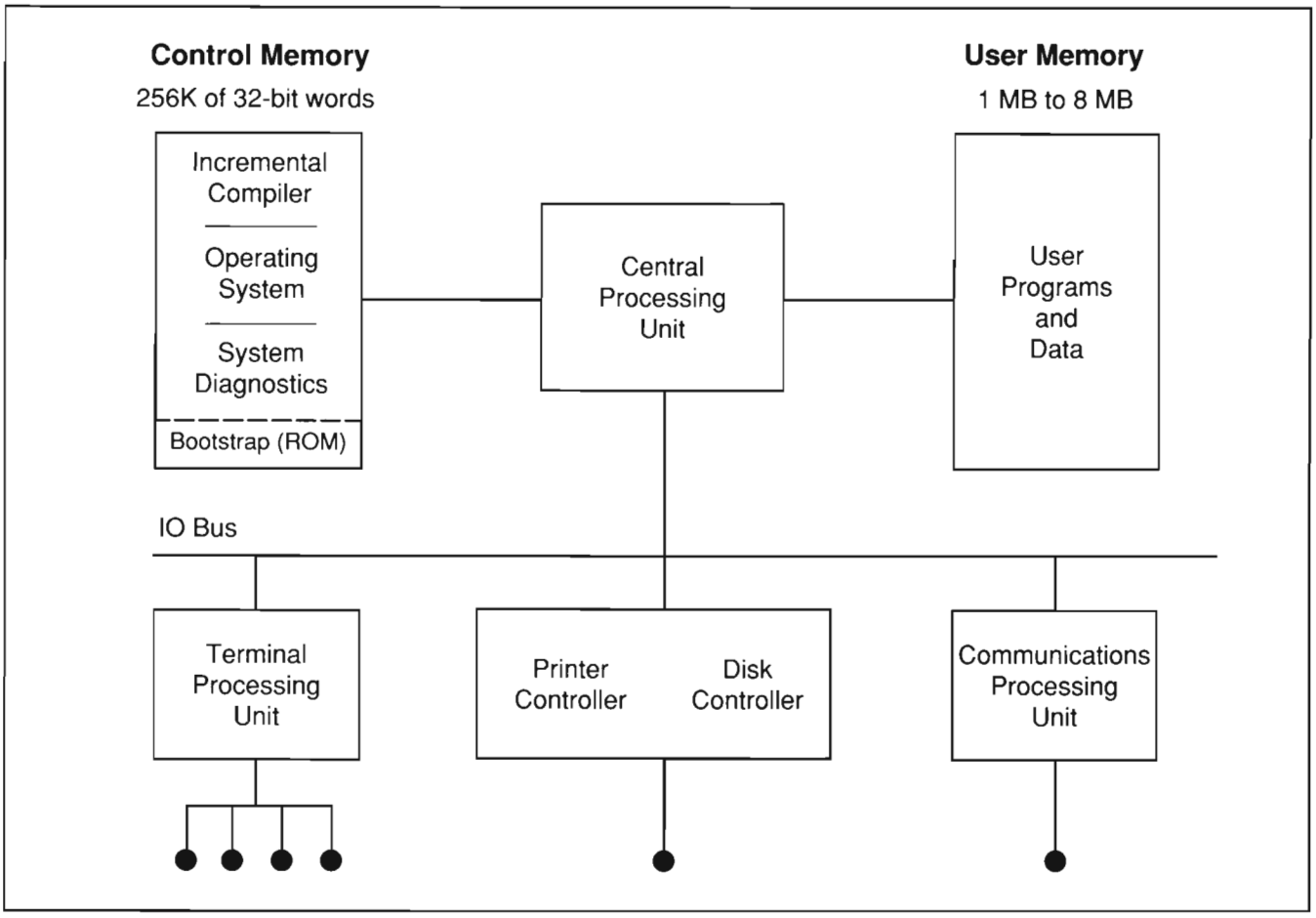

Figure 1. Logical Organization of the CS/386-D/N

- Unique "atomization" technique for storing program text
- Unpartitioned user memory for CPU RAMdisk

Dedicated Control Memory

The CS/386 control memory contains 256 KB of 32-bit words. When the system is powered on, the system programs are loaded into control memory from the system disk and reside in memory until the system is either powered off or reinitialized. Since the contents of control memory are inaccessible to the user or the user's programs, the system programs are always protected against accidental interference or destruction.

User Memory

User memory is the area of memory available to the user's programs and data. User memory is divided into a number of partitions of fixed size, each of which is capable of executing a separate program. Partitions can be any memory size up to a maximum of data memory. A fixed amount of memory is reserved for system control information.

Memory can be allocated to as many as 16 partitions. Unused memory may be allocated to CPU RAMdisk. Table 3 lists the amount of user memory for each version of the CS/386-D/N.

Table 3. User Memory

System Version	User Memory
CS/386-10 D/N	1 MB
CS/386-20 D/N	2 MB
CS/386-40 D/N	4 MB
CS/386-80 D/N	8 MB

Atomization

The CS/386 CPU uses an atomization technique to automatically condense each program line. The condensed format conserves the memory needed for program storage and also contributes to fast program execution.

CPU RAMdisk

CPU RAMdisk allows a portion of user memory to be used as a high-speed disk. All of the BASIC-2 disk statements can be used with the CPU RAMdisk logical platter. Since user memory is used to emulate disk storage and there is no physical disk address, CPU RAMdisk access is considerably faster than access to an actual disk. CPU RAMdisk, however, provides only temporary storage; all information stored is lost when the system is powered off.

INTERNAL STORAGE DEVICES

In addition to the memory in the CPU, the CS/386-D cabinet has internal storage capacity for

- A Disk Storage/Printer Controller (DSPC), located in the ninth I/O slot, to speed processing
- Cached DSPC memory that can be used as cache only or cache plus DSPC RAMdisk
- Three internal storage devices: one diskette drive, one fixed Winchester drive, or one streaming tape drive

Table 4 lists the maximum number and types of Wang storage devices a single CS/386-D can accommodate.

Disk Storage/Printer Controller

To speed processing and provide extensive error detection and correction, the CS/386-D is controlled by an intelligent Disk Storage/Printer Controller (DSPC) inserted into I/O slot 9. The DSPC board contains 256 KB of cache memory (1,024 sectors). In addition, the DSPC includes a 22C02-compatible printer interface to control output sent to a system printer.

DSPC RAMdisk

The DSPC allows users to set aside a portion of its cache memory for use as a DSPC RAMdisk. Once the DSPC RAMdisk has been established, it is accessed as a standard disk platter and supports all standard disk commands. The DSPC RAMdisk is not permanent storage; its contents are lost if the DSPC RAMdisk is deallocated, or if power to the CS/386-D is lost. DSPC RAMdisk is best suited for frequently accessed programs or data files whose contents remain constant. As many as 900 sectors (256 bytes/sector) of cache memory may be allocated for use as a DSPC RAMdisk. If the number of sectors to allocate is specified as 0, the DSPC RAMdisk is deallocated.

Diskette Drive

The diskette drive uses a 5 1/4-inch double-sided double-density (DSDD) diskette drive for removable storage. Two DSDD diskette formats are supported on each of the possible diskette drives: 256 bytes per sector (bps) and 512 bps. All the CS systems data and word processing applications use the standard 256-bps format.

Table 4. Number of Storage Devices Allowed

320-KB or 1-MB Diskette*	20-MB Fixed Hard Disk	32-MB Fixed Hard Disk	64-MB Fixed Hard Disk	140-MB Fixed Hard Disk	Streaming Tape Cassette
1	1	-	-	-	-
1	-	1	-	-	-
1	-	-	1	-	-
1	-	-	-	1	-
1	1	-	-	-	1
1	-	1	-	-	1
1	-	-	1	-	1
1	-	-	-	1	1

* A diskette is mandatory.

The 512-bps format, which is the Wang Professional Computer (PC) format, is used for interchange purposes. The 512-byte sectoring is transparent to the CS/386-D Operating System. The DSPC maps one 512-byte physical sector into two 256-byte logical sectors.

The 1.2-MB diskette drive can read and write to 320-KB diskettes. However, not all 320-KB diskette drives can read media written by the 1.2-MB diskette drive.

The BASIC-2 programming language accesses diskettes with the 512-bps format as if the platter were formatted with 256-byte sectors. All BASIC-2 disk operations can be performed.

Fixed Disk Drive

Fixed hard disks provide fast access to a large amount of disk storage. Information stored on fixed disks should be periodically backed up onto other devices with removable storage for off-line storage. The fixed hard disk (Winchester) drives are formatted to 256 bps.

Streaming Tape Drive

The streaming tape cassette drive is a mass storage and recovery device with a storage capacity of 45 MB at 8,000 bits per inch (bpi). The drive uses a new Backup/Recovery utility that works on a platter image basis. The drive supports backup by way of reference files. It can run without constant user interaction and while the disk is in regular use.

Table 5 compares the various diskette drives and hard disk drives used by the CS/386-D.

FEATURES

Foreground/Background Operation

Since each terminal on the system can be assigned more than one memory partition, each terminal can run several jobs concurrently. The job that is in the process of communicating with the terminal at a given time is said to be running in the *foreground*. The job or jobs associated with the terminal, but not communicating with it, are said to be running in the *background*.

The terminal's attention can be transferred from one partition to another to shift the current foreground job into the background and a particular background job into the foreground. Thus, the operator can interact with each program as needed. A typical example of foreground/background

Table 5. Comparison of Drives

	320-KB Diskette	1-MB Diskette	20-MB Hard Disk	32-MB Hard Disk	64-MB Hard Disk	140-MB Hard Disk
Disk Platters	1	1	2	2	4	14 or 7
Capacity/ Platter	320 KB (360 KB for PC)	1 MB (1.2 MB for PC)	10 MB	16 MB	16 MB	10 MB or 16 MB
Sectors/ Platter	1,280 (1,440 for PC)	4,160 (4,800 for PC)	38,912	65,024	65,024	38,912 or 65,024
Bytes/Sector	256 (512 for PC)	256 (512 for PC)	256	256	256	256 256
Average Access Time	100 ms	100 ms	68 ms	45 ms	27 ms	27 ms 27 ms
Data Transfer Rate	250 KB/sec	500 KB/sec	5 MB/sec	5 MB/sec	5 MB/sec	5 MB/sec 5 MB/sec

operation would be running a batch-type job requiring minimal operator interaction (such as payroll processing) in the background while running an interactive job (such as word processing) in the foreground.

The BASIC-2 Programming Language

The CS/386 CPU supports BASIC-2, a high-level programming language designed for interactive programming on the CS/386-D/N. Beginning programmers can learn BASIC-2 easily. Wang Laboratories, Inc., has developed a variety of extensions and enhancements to BASIC-2 to make it easy to write, document, and debug programs, as well as to provide flexible language capabilities for a wide range of applications.

The BASIC-2 instruction set is comprehensive and extremely powerful. A math package includes numerous system-defined mathematical and trigonometric functions. The results obtained are accurate to 11 digits and can be either rounded or truncated.

Alphanumeric data can be compared, analyzed, and modified with a variety 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.

System commands let the user control system operations in each partition from the keyboard. System commands also serve as useful debugging tools.

In addition to the standard general-purpose BASIC statements, BASIC-2 provides several groups of special-purpose statements that perform such specialized operations as code conversion, sorting, matrix arithmetic, read/write MS-DOS files, and customized I/O control. Language enhancements within BASIC-2 also include statements that let the user share program text, manage shared resources, and define system configurations.

Multiuser BASIC-2/386 Operating System

The Multiuser BASIC-2/386 Operating System, which runs on the CS/386-D/N, supports the

BASIC-2 language and provides facilities for program coordination and the sharing of system resources. The operating system protects multiple users from disk and printer conflicts by using BASIC-2 language features that enable a program to seize temporary control of a device and, subsequently, to release it.

Users can select Disabled Programming mode to prevent unauthorized access to important files and unauthorized execution of critical programs. In Disabled Programming mode, a terminal functions exclusively under program control; an operator is prevented from entering or modifying program text, as well as from directly accessing disk files from the specified terminal.

The Multiuser BASIC-2/386 Operating System includes a set of BASIC-2 instructions for handling disk operations. These instructions 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-Terminal Operation

The CS/386-D/N can be configured as a single-terminal, standalone system with the same features and language capabilities as the multiuser arrangement. Unlike most single-user systems, the CS/386-D/N enables a single terminal to control several programs or background tasks executing concurrently, while maintaining fast execution speeds. Thus, the CS/386-D/N is an excellent choice for the first-time user because it combines high-performance computing with the capacity for expansion from a single-user system to a multiuser system.

Communications Capabilities

The CS/386-D/N supports a full range of communications capabilities between remote terminals and the CPU and between the CS/386-D/N 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 CS/386-D/N by a Wang Model 22C32 Triple Controller or a Model 2236MXE 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 38,400 bits per second (bps). In addition, one or more ports of the Model 2236MXE can support asynchronous communication in half- or full-duplex at line speeds ranging from 110 to 9,600 bps.

For remote connection, two RS-232-C-compatible modems (e.g., Wang Telemodem or WA3451) are required to provide the communication link. Remote terminals, located miles from the CPU, can function as 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 at the terminal site.

For communicating with other computer systems, the CS/386-D/N can be configured with Wang Communications Controller Model 2227B, 2228B, 2228C, or 2228D-4:

- Model 2227B supports asynchronous-only communications in half- or full-duplex, at line speeds ranging from 110 to 9,600 bps.
- Models 2228B and 2228C offer a choice of synchronous or asynchronous communications at speeds ranging from 0 to 4,800 bps. In addition, Model 2228C supports 3275 Emulation.
- Model 2228D-4 offers synchronous communications at speeds ranging from 0 to 9,600 bps.

For communicating with the Wang VS, the 2200/VS Local Communications Option (LCO) is supported. This hardware and software package enables a Wang CS/386-D/N to communicate with the Wang VS computer system. Communications between the CS/386-D/N and the VS system occur at speeds of 4.27 megabits per second over dual coaxial cable facilities.

Table 6 compares the various communication controllers available for the CS/386-D/N. Table 7 lists the line speeds of these devices.

Table 6. Controllers for Communications

Emulation	MXE	2227B	2228B	2228C	2228D D-4	2258 LCO
Asynchronous						
RCM	Yes	Yes	Yes	Yes	-	-
ASC	Yes	Yes	Yes	Yes	-	-
ASC With Flow Control	Yes	-	-	-	-	-
Asynchronous/Synchronous						
Burroughs Poll Select	Yes	Yes	Yes	Yes	-	-
Synchronous						
2780/3780/3741	-	-	Yes	Yes	-	-
2200-2200	-	-	Yes	Yes	-	-
2200/WP	-	-	Yes	Yes	-	-
2200/VS TCCopy	-	-	Yes	Yes	-	-
IBM 3275	-	-	-	Yes	-	-
IBM 3271 BSC	-	-	-	-	Yes	-
2200/VS	-	-	-	-	-	Yes

Table 7. Line Speeds of the Communication Controllers

Device	Line Speed (bps)	Mode
MXE	300 - 38,400	Terminal
	110 - 9,600	Asynchronous TC
2227B/28B/28C	110 - 9,600	Asynchronous
2228B/28C	0 - 4,800	Synchronous
2228D-4	0 - 9,600	Synchronous

Compatibility With 2200 Systems

The CS/386 CPU has been designed to preserve maximum compatibility with single-user and multiuser 2200 or CS Series systems. Since the CS/386 CPU is compatible with the 2200MVP, the MicroVP, and the CS, multiuser software written for the 2200MVP, MicroVP, and CS functions correctly on the CS/386.

BASIC-2 supported on the CS/386 CPU is identical to the BASIC-2 language on the 2200VP, SVP, LVP, MVP, MicroVP, and CS. The CS/386 also supports Wang BASIC syntax, providing a significant degree of compatibility with earlier Wang 2200 systems. Since each interactive terminal functions like a single-user CS or 2200 system for program development purposes, language compatibility ensures that programmers familiar with CS or 2200 systems can quickly become productive on the CS/386-D/N.

The CS/386 CPU lets programmers use the memory available for multiuser programs with maximum efficiency. If programmers must adapt a single-user program for multiuser operations on a CS/386, they may want to modify the program to take advantage of these multiprogramming features. In general, such modification is not extensive. When memory space is not a problem, however, the program can be loaded and run in each partition with little or no modification.

CABINET SPECIFICATIONS

Size
Height
23.1 in. (58.6 cm)
Width
13.6 in. (34.6 cm)
Depth
20.3 in. (51.5 cm)
Weight (standard unit without storage devices)
66 lb (30 kg)

Control Memory Size
256 KB of 32-bit words

User Memory Size
CS/386 - 10N: 1 MB
CS/386 - 20N: 2 MB
CS/386 - 30N: 4 MB
CS/386 - 80N: 8 MB

Available I/O Slots
9

Memory Cycle Time
125 nsec

Power Requirements
115 Vac + 10%, 60Hz + 1 Hz
230 Vac + 10%, 50Hz + 1 Hz

Heat Output
1,020 Btu/hr

System Compatibility
Wang CS-D/N, 2200 MicroVP, 2200 LVP, 2200 SVP, and 2200 MVP-type systems

Operating Environment
Temperature
50°F to 90°F (10°C to 32°C)
Relative humidity, noncondensing
35% to 65% recommended
20% to 80% allowable
Noise level
Running continuously 35 dB(A)

OPERATING SYSTEM SPECIFICATIONS

Maximum Number of Partitions
16

Minimum Partition Size
1.25 KB

Maximum Partition Size
Up to 8M

Maximum Number of Terminals
16

ORDERING SPECIFICATIONS

The interactive multiuser central processing unit (CPU) must include the BASIC-2/386 incremental compiler, the latest release of the BASIC-2/386 Multiuser Operating System, and extensive system diagnostics. The CPU must contain approximately 256K of 32-bit words of control memory and nine I/O slots. The CPU must be provided with 1 MB of user memory and must be expandable to 8 MB. User memory must be divisible into a maximum of 16 separate partitions. The multiuser operating system and the BASIC-2/386 incremental compiler must reside in a separate control memory. The memory cycle time must be 125 nanoseconds nominal. Full memory parity must be provided throughout both control and user memory. The CPU must be able to support up to 16 interactive terminals concurrently. The system must support the BASIC-2 language, provide a complete set of I/O instructions to control system peripherals, and include both automatic cataloging and direct addressing instructions for disk I/O operations. Both synchronous and asynchronous communications hardware, on a single board, must be available for direct installation within the processor.

Standard Warranty Applies

WANG

ONE INDUSTRIAL AVENUE
LOWELL, MASSACHUSETTS 01851
TEL. (508) 459-5000, TELEX 172108

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