WANG

CS

CS-D/N, CS/386 and CS/Turbo User's Guide
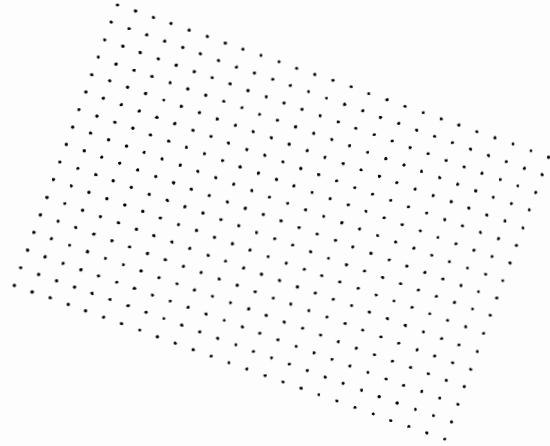
CS-D/N, CS/386 and CS/Turbo User's Guide

Disclaimer of Warranties and Limitation of Liabilities

Software Notice

FCC and DOC Notices

The Federal Communications Commission (FCC) and the Canadian Department of Communications (DOC) require that information regarding the interference potential of electrical equipment be included in the user documentation for the equipment. They also require that specific information be provided for components that will be connected to the Public Switched Telephone Network (PSTN).

Electromagnetic Interference Requirements

Wang Laboratories, Inc., manufactures both Class A verified computers and peripherals and Class B certified computers and peripherals. To determine which of the following warnings apply to the equipment, the user should refer to the label affixed to the device.

An example of a Class A verified label is the following:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

An example of a Class B certification label is the following:

FCC I.D. B4YPC250-16

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC Warning

For Class A – This equipment[1,2,4] has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his or her own expense.

For Class B – This equipment[1,2,3,4] has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and the receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

- Consult the dealer or an experienced radio/television technician for help.

DOC Warning

For Class A – This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

For Class B – This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Connection to the PSTN

FCC Part 68 Requirements

If this equipment connects to the PSTN, it complies with Part 68 of the FCC Rules. A label is affixed to this equipment that contains, among other information, the FCC Registration Number (REN) and Ringer Equivalence Number (REN) for this equipment. Upon request, the user must provide this information to the telephone company.

The REN is useful to determine the number of devices that the user may connect to the telephone line and still have all those devices ring when the telephone number is called. In most but not all areas, the sum of the RENs of all devices connected to one line should not exceed five (5). To be certain of the number of devices that the user may connect to the line, as determined by the REN, the user should contact the local telephone company to determine the maximum REN for the calling area.

If the telephone equipment causes harm to the telephone network, the telephone company may discontinue service temporarily. If possible, the user will be notified in advance. However, if advance notice is not practical, the user will be notified as soon as possible. The user will be informed of the right to file a complaint with the FCC.

The telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the proper functioning of the equipment. If such changes are made, the user will be notified in advance to give the user an opportunity to maintain uninterrupted telephone service.

If the user experiences trouble with this telephone equipment, the telephone company may ask that the user disconnect the equipment from the network until the problem has been corrected or until the user is sure that the equipment is not malfunctioning. For service or repairs, the user should contact the point of sales representative or Wang Laboratories, Inc.

This equipment may not be used in conjunction with coin service provided by the telephone company. Connection to party lines is subject to state tariffs.

DOC Notice for Canadian Users

Notice – If this equipment contains a Canadian Department of Communications label, it identifies DOC-certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational, and safety requirements. The DOC does not guarantee that the equipment will operate to the user's satisfaction.

Before installing this equipment, the user should ensure that it is permissible for it to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly (telephone extension cord). The user should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request that the user disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines, and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

Caution: Users should not attempt to make such connections themselves, but should contact the appropriate electrical inspection authority or electrician, as appropriate.

Load Number – The Load Number (LN) assigned to each terminal device denotes the percentage of the total load that can be connected to a telephone loop. The termination on a loop may consist of any combination of devices, subject only to the requirement that the total of the Load Numbers of all devices does not exceed 100. An alphabetical suffix is also specified in the Load Number for the appropriate ringing type (A or B), if applicable. For example, LN=20A designates a Load Number of 20 and an "A" type ringer. The Load Number for this equipment can be found in the installation instructions pertaining to connection to the PSTN.

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(1) This equipment requires the use of shielded cables.

(2) If the user attaches a Class A verified device to equipment otherwise labeled as Class B, the combined system meets Class A regulations only. Class A specifications provide reasonable protection against radio and television interference in a commercial environment. Operation of Class A equipment in a residential environment may cause interference.

(3) This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

(4) Any modifications to this equipment not expressly approved by Wang Laboratories, Inc., could void the user's authority to operate this equipment.

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Preface

The Wang CS-D is a disk-based computer system that consists of the central processing unit (CPU) and internal storage devices. This user's guide explains how to master initialize the CS-D, configure the system (partition generation), back up the system platter, execute the user diagnostics, and perform routine maintenance procedures. It also describes how to use diskettes, fixed hard disk drives, streaming tape cassettes, and RAMdisk.

This user's guide is intended for all users of the CS-D and is organized as follows:

- Chapter 1 contains general information.
- Chapter 2 discusses the system components.
- Chapter 3 describes how to initialize the system.
- Chapter 4 explains the operation of the CS-D.
- Chapter 5 describes the system errors and error-recovery procedures.
- Chapter 6 explains how to use the diskette drive in the CS-D.
- Chapter 7 discusses the fixed hard disk drive.
- Chapter 8 describes the CPU and Disk Storage/Printer Controller RAMdisk.
- Chapter 9 discusses the streaming tape cassette drive unit.
- Appendixes describe physical specifications, cables, available peripherals, preventive maintenance, and error messages for the CS-D.

This manual should be used in conjunction with the following documents:

Multiuser BASIC-2 Language Reference Manual (700-4080F) – Describes the system's operational features, documents the set of system commands, and describes each statement in the BASIC-2 instruction set.

BASIC-2 Utilities Reference Manual (715-3949) – Describes the utilities provided with the BASIC-2 Operating System. This manual includes specifications for the utilities as well as installation and operating instructions.

Programming in BASIC (700-3231G) – Introduces the beginner to BASIC programming and to peripherals that are frequently used with the CS series of computers.

In addition to the documents listed above, a separate reference manual is provided for each optional peripheral device attached to the system.

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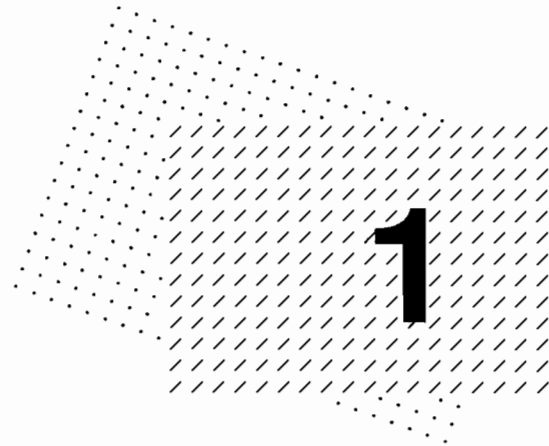
Introduction

Overview

This chapter provides an introduction to the Wang CS-D/N. It discusses system features, typical system configuration, system memory, the system platter, BASIC-2 language features, the operating system, terminals, system expansion, environmental considerations, and installation of the CS-D/N.

> *Note: CS-D/N refers to a system that has a disk drive inside the unit. CS-N refers to a system that does not have a disk inside the unit and requires an external disk unit.*

System Features

The Wang CS-D/N is a versatile, disk-based computer system that concurrently supports multiple users programming in the Wang BASIC-2 language. As many as 64 terminals can run up to 64 jobs with the same response time as a single-user interactive system. The CS-D/N system has two options; the CS/386 and the CS/Turbo. The CS/386 is a 16 MHz 80386 central processor that supports up to 16 terminals and 16 tasks. The CS/Turbo is a 33 MHz 80386 central processor that supports up to 64 terminals and 64 tasks. A basic CS-D/N system includes the following components:

- A CS-D/N central processing unit (CPU); The CS/386 has 1 MB, 2 MB, 4 MB, or 8 MB of user memory and the CS/Turbo has 4 MB, 8 MB, 16 MB, or 32 MB of user memory

- A CS-D/N internal disk system with 1 diskette, 1 streaming tape drive, and 1 fixed disk drive (up to 140 MB). You can also use DS storage units or the SCSI disk system

- Nine input/output (I/O) controller slots

- One to 64 Model 2336 DE/DW, 2426 DW, 2436 DE/DW, 2436 WP, or 2536 DW terminals

The CS-D/N also provides multiprogramming (a feature usually available only on larger systems). The operating system executes several programs concurrently enabling several users to share a single CPU. A terminal can control more than one program, allowing foreground (interactive) and background (noninteractive) processing. Multiple users can share global (re-entrant)programs and variables, greatly reducing the memory required to perform multiuser applications. The CS-D/N overlaps processing and I/O to efficiently use the memory and peripherals that support a variety of applications.

The CS-D/N is easy to program and operate by using BASIC-2, a variety of powerful system commands, and application software available from Wang Laboratories, Inc., and other vendors. Since the user at each terminal can access all system resources directly from the keyboard, the CS-D/N does not require special personnel to oversee system operation. Direct access saves programming, job turnaround, and operating time.

The CS-D/N is flexible enough to meet the storage requirements of most users. When storage requirements exceed the initial configuration, you can upgrade CS-D/N units by adding a DS Disk Storage Unit with an additional 420 MB of disk space per unit. disk drive (up to 140 MB). As many as 16 CS-D/N or CS-N systems can share the internal drives using the 2275 MUX multiplexer and the 2275 MUXE extender.

The CS-D/N contains an internal Disk Storage/Printer Controller (DSPC). The DSPC caches up to 1,024 sectors in its random access memory (RAM) to optimize disk access performance. The caching algorithm uses sector access order and frequency of use to intelligently determine which sectors to keep buffered in memory. Access to sectors buffered in the cache is extremely fast; the CS-D/N reads these sectors from memory without the need to access the disk again.

The DSPC controls the physical storage devices within the CS-D/N and manages the CS-D/N sector caching and DSPC RAMdisk (a form of temporary storage). The DSPC lets you set aside a portion of the memory normally used for sector caching for use as a high-speed DSPC RAMdisk. Once you establish DSPC RAMdisk, you can access it as a normal disk platter. (DSPC RAMdisk supports all normal disk commands.) For a discussion of DSPC RAMdisk, refer to Chapter 8. The DSPC also contains a 22C02-type printer interface for the system printer.

User memory not assigned to partition programming space is available for another kind of RAMdisk called CPU RAMdisk. Since you are using memory to emulate disk storage (and there is no physical disk address), CPU RAMdisk access is considerably faster than access to an actual disk. For a discussion of CPU RAMdisk, refer to Chapter 8.

The modular design of the CS-D/N is economical and permits easy expansion and physical relocation of its components. Connections between the CPU and each terminal can be either local or remote (RS-232-C/CCITTV.24). You can adapt the system to a wide variety of applications and configurations. Each terminal supports a local printer.

You can redefine allocation (configuration) of system resources as needed. The CS-D/N provides security by letting you selectively restrict access to its resources.

For a detailed discussion of the programming language features of the CS-D/N, refer to the *Multiuser BASIC-2 Language Reference Manual*. Figure 1-1 illustrates the CS-D/N unit, which houses the CPU and internal storage devices.

1.2-MB or 320-KB Diskette Drive

LEDs

On/Off Switch

Tape
Cassette
Drive

Internal Drive Cables

DSPC

Internal Hard Disk

System Printer Connector

MUX Connector

I/O Chassis
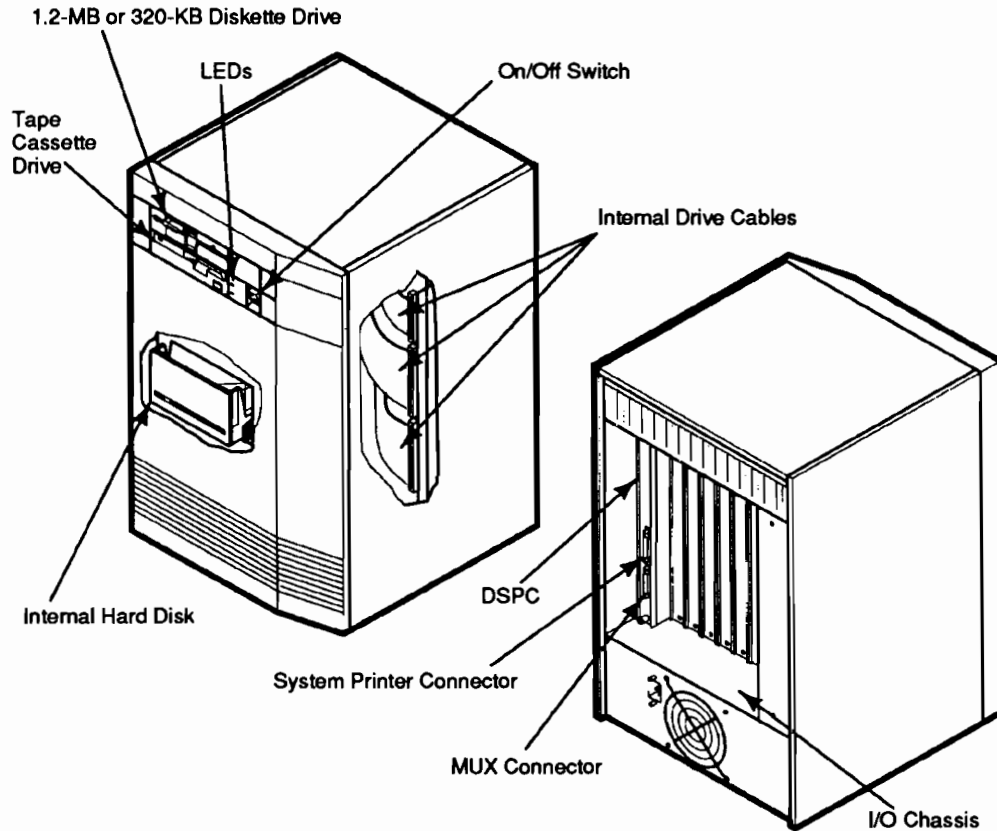
Figure 1-1.   CS-D/N Unit

Typical System Configuration

A CS-D/N can be configured with a variety of peripheral devices and options. A typical system might include

- A 386 CPU with 1 to 64 MB of user memory
- Three Model 2536 DW terminals for interactive communication with the CPU
- A 64 MB disk drive for system files
- A 150 MB streaming tape cassette for system backup
- A 1.2 MB diskette for software loading and program and data storage
- A model PM017 line printer for hardcopy output

Each unit is designed for easy integration into the office environment. Figure 1-2 illustrates a typical configuration.
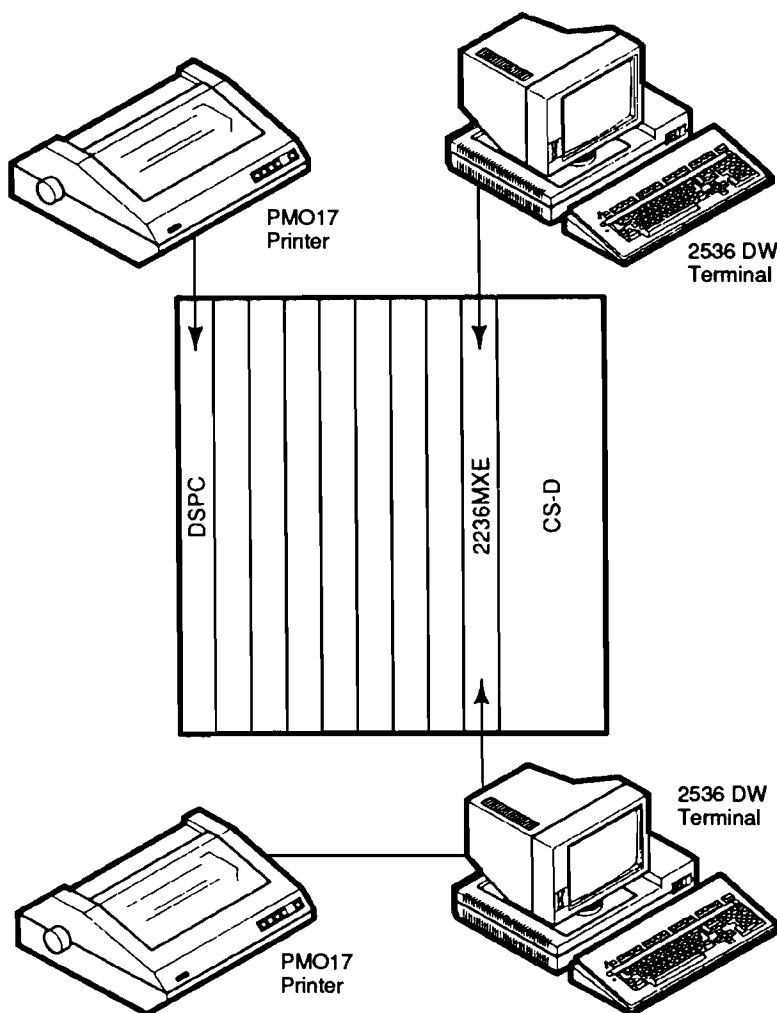
Figure 1-2. Typical CS-D/N Configuration

System Memory

The CS-D/N uses two distinct types of memory: control memory for system needs and user memory for user programs and data. Control memory contains the operating system, Multiuser BASIC-2 interpreter, and other system data; it is inaccessible to the user and the user's programs and data. User memory contains user programs and data, as well as some system control information. The size of the user memory (1 MB, 2 MB, 4 MB or 8 MB for a CS/386; 4 MB, 8 MB, 16 MB, or 32 MB for a CS/Turbo) determines the size of the particular CS-D/N.

The CS-D/N organizes user memory into partitions. User memory in each partition is distinct from memory in any other partition; programs and data in one partition are not generally accessible to programs and data in another partition. However, global partitions of available memory can be set up so that any other program in the system can access programs stored in this area of memory.

Up to sixty-four partitions for a CS/Turbo, or 16 paritions for a CS/386, of user memory can be used for programs and data. The remaining memory can be used for CPU RAMdisk. Refer to Chapter 8 for more information on CPU RAMdisk.

Up to 64terminals for a CS/Turbo or 16 terminals for a CS/386, can concurrently access the memory partitions. While configuring the system, you assign each partition either to one terminal on the system or to the null terminal (no particular terminal). Only one terminal at any time controls each partition, giving each user essentially a standalone system. However, terminals can control more than one partition simultaneously. You can change ownership of these partitions during system operation without reconfiguration. For information on partitioning and terminal assignment, refer to Chapter 3.

The System Platter

The operating system, Multiuser BASIC-2 interpreter, system utilities, and other system programs are provided on two system diskettes. You can install the files on these diskettes onto a single system platter. When you power up the CS-D/N, it loads the operating system and interpreter from one system platter into the control memory. The system diskettes shipped with each CS-D/N also contain a variety of hardware diagnostic routines, as well as a utility program to generate, execute, and save system configurations.

> *Caution: Handle the system platters with extreme care because they contain valuable configuration information. Make a backup copy at the earliest opportunity to protect against accidental loss or destruction.*

Chapter 3 describes how to load the operating system and the Partition Generator utility from the system platter. It also provides suggested procedures for creating a backup copy of the system platter. Chapter 5 discusses the procedure for loading and executing the diagnostic routines from the system platter.

BASIC-2 Language Features

The Wang CS-D/N, running Multiuser BASIC-2, supports the BASIC-2 language, whose powerful and flexible capabilities provide a wide range of applications. Multiuser BASIC-2 is compatible with earlier versions of Wang BASIC-2, so you can use all Wang software previously developed for the Wang 2200 Series or CS systems on the CS-D/N system.

Data Handling Capability

Multiuser BASIC-2 contains instructions for data testing, manipulation, and logical operations at the bit and byte levels, comparable in scope to many assembler languages. Many data operation statements can support both numeric and alphanumeric expressions and can operate on all or parts of alphanumeric arrays. These features enhance the CS-D/N's data handling capability.

System Commands

System commands provide complete control over system operations and also serve as powerful debugging tools. Statements exist to facilitate common programming tasks such as

- Conditional processing (decision-making)
- Branching
- Looping
- Passing data to subroutines
- Overlaying program modules
- Accepting and processing operator-entered data

I/O Operations

The CS-D/N provides a variety of instructions for controlling disks and plotters and for formatting output to the printer and CRT displays. Several groups of special purpose statements perform operations such as code conversion, sorting, matrix arithmetic, and customized I/O control.

Multiprogramming Features

The CS-D/N implements, in Multiuser BASIC-2, a number of statements to support the following:

- Interpartition sharing of programs and variables
- Temporary control of shared devices by one partition
- Specification of multiuser system-configuration parameters
- Other multiprogramming features

Numeric Operations

The CS-D/N carries numeric operations to 10 digits of accuracy for most operations. You can specify whether to round or to truncate the results at 13 digits. When you do not require full precision, the CS-D/N can pack numeric data from eight bytes to as few as one byte. You can specify trigonometric arguments in degrees, radians, or gradians.

Variables

Multiuser BASIC-2 supports numeric variables and alphanumeric string variables (both scalar and array). The maximum number of elements in one-dimensional arrays is 65,535, and 255 by 255 in two-dimensional arrays. Each alphanumeric array element or alpha-scalar-variable can be from 1 to 124 bytes long. You can use alphanumeric arrays in data manipulation statements as scalar variables (the CS-D/N ignores element boundaries), providing a convenient technique for manipulating extremely long character strings.

The Operating System

In addition to Multiuser BASIC-2, which supports up to 64 for the Turbo, or 16 for the CS/386, concurrent programs, the CS-D/N can also execute VP BASIC-2 previously used by the 2200VP and 2200SVP systems. VP BASIC-2, which configures the CS-D/N as a single-user, one-partition system, is generally more restrictive than Multiuser BASIC-2 and is not usually used with the CS-D/N. For a discussion of the general instruction set for the CS-D/N, refer to the *Multiuser BASIC-2 Language Reference Manual*.

Interactive Terminals

The 2536 DW terminal lets each user easily control and communicate with the system. The terminal consists of a 25-line by 80-character-per-line, cathode ray tube (CRT) screen and displays a full 128-character set. The keyboard contains a 10-key numeric keypad and 34 user-definable function keys.

The 2536 DW terminal can display both box and character graphics. It can display bright, blinking, underlined, and reverse video (dark characters on a light background) characters. Special features of the 2536 DW terminal also include an audio signal to indicate a variety of error conditions, repeating keys, a self-configuration menu, and the capacity to support a screen dump to its own local printer. For details about the features of the 2536 DW terminals, see Chapter 2.

System Expansion

The modular design of the CS-D/N makes it easy to add memory and peripheral devices. The CPU supports up to 8 MB (32 MB for Turbo) of user memory. You can configure the CPU with up to 16 (64 for Turbo)terminals, several disk models (internal and external), high-speed printers (up to 600 lines per minute), and an industry-compatible, 9-track magnetic tape. Appendix C lists the peripheral devices that you can add to the system.

The CS-D/N also supports telecommunications options. These options allow the system to share information, either locally or remotely, over telephone lines and modems, with another compatible system or with a host computer.

Environmental Considerations

Although the CS-D/N is designed to operate in most office environments, a room with clean air and controlled temperature and humidity promotes optimal system performance. The power source should be grounded, adequate for present and proposed system needs, regulated, and noise-free. The room should have space for future expansion and be accessible to operating personnel, yet sufficiently removed from the main traffic flow. (See Appendix D for further information.)

Installation

Special factory packing techniques require that a Wang service representative unpack, inspect, and install the CS-D/N. When the system arrives, call the Wang Customer Engineering Office to request that your system be installed. Failure to follow this procedure voids the warranty.

The Wang service representative verifies that all equipment has been delivered, inspects each unit for shipping damage, connects each device in the system, and performs tests to verify the proper operation of all system components.

If you plan to use modems and telephone lines, install them before the Wang equipment arrives. The Wang service representative will connect the Wang equipment to the modems. The modem vendor or phone company, however, must connect all modems to the proper transmission lines.

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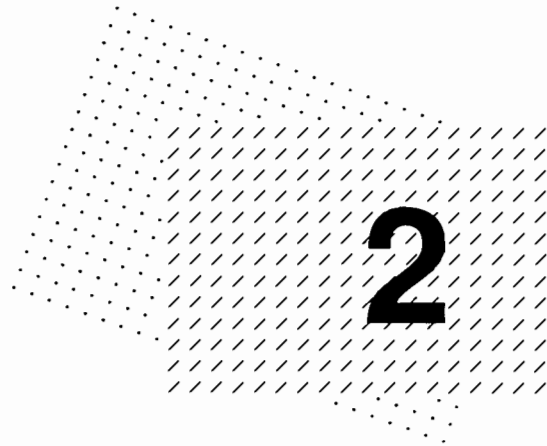
System Components

Overview

This chapter discusses two of the important components of the CS-D/N system: the CPU and storage devices. It also describes terminals, keyboards, printers, communications controllers, and additional external storage devices.

The Central Processing Unit

The central processing unit (CPU) contains the 386 processor, interpreter, memory, and system logic necessary to resolve and execute programs, perform arithmetic operations, and control the input and output of data. The smallest CS-D CPU contains 1 MB of user memory and nine available I/O slots, including the Disk Storage/Printer Controller (DSPC). (You can expand user memory to a maximum of 32 MB in the Turbo.)
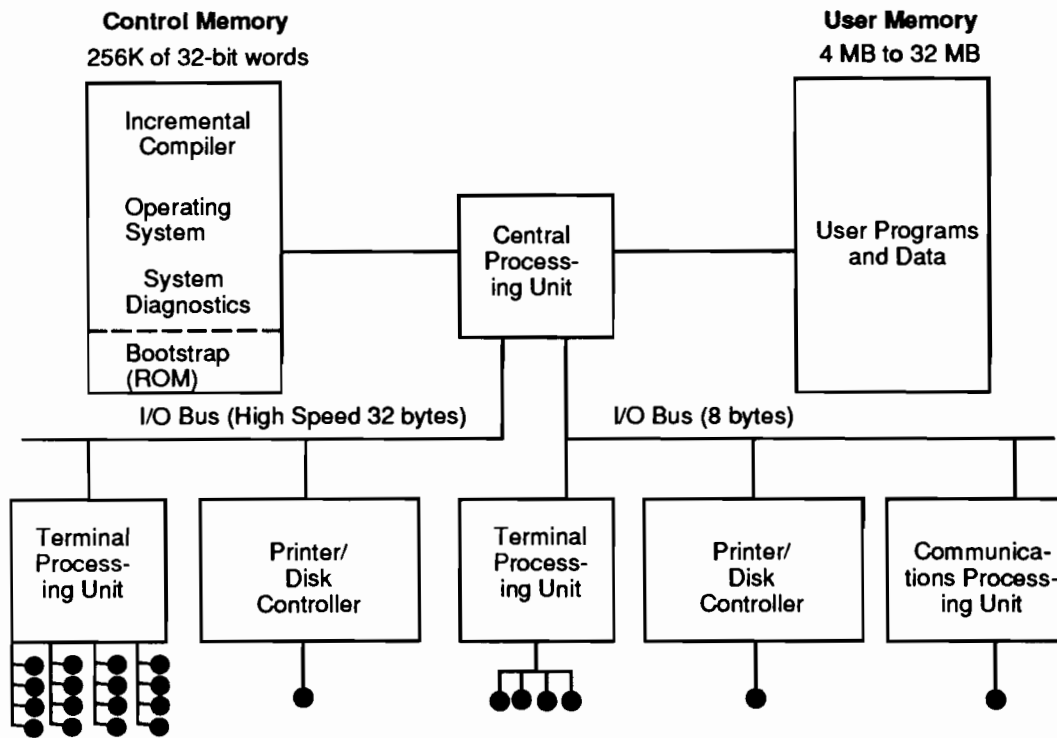
Figure 2-1.   Organization of the CS-D/N

The CPU and operating system use many techniques to maintain optimum memory integrity and efficiency. The CS-D/N provides overlapped I/O and program execution, significantly shortening the overall processing time of foreground (interactive) and background (noninteractive) jobs. To save memory, the CS-D/N stores all programs in condensed form. In addition, multistatement lines can conserve memory, speed program execution, and logically group related statements.

Programmable device selection allows increased flexibility for I/O operations. One user can monopolize the devices allocated to all users during system configuration to secure exclusive access to those devices. (For further information, refer to the *Multiuser BASIC-2 Language Reference Manual.*)

System diagnostics automatically verify proper CPU operation whenever you master initialize the system. In addition, the CS-D/N signals hardware and software errors detected during any system operation by an audible tone, a code identifying the error, and its approximate position. If you prefer to handle errors through program control, you can suppress system response to many types of errors.

Debugging facilities provide complete program, variable, and subroutine cross-reference listings. You can step through the execution of a program one statement at a time, observing variable assignments and program transfers as they occur. You can also interactively edit program lines, immediate mode lines, and input date values both during and after entry.

CS/386 Central Processing Unit

The CS/386 central processor is a high-performance, custom-designed 80386 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.

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 which are loaded into 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.

The CPU is provided with 1 MB of user memory and may be expanded to 8 MB. User memory can be divided into a maximum of 16 separate partitions. The multiuser operating system and the BASIC-2/386 incremental compiler will reside in a separate control memory. Full memory parity is provided throughout both control and user memory. The CPU support up to 16 interactive terminals concurrently.

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 1 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.

CS/386 Turbo

The CS/386 Turbo central processor is a high-performance, industry-standard 80386 33-MHz processor built with fast, reliable components. CPU memory cycle time is 60 nanoseconds – usually sufficient to execute and retrieve a control memory instruction, as well as read two bytes of user memory. When combined with the low-overhead operating system and the incremental compiler, the CS/386 Turbo provides exceptional response time for all system users.

The CPU can support up to 64 terminals with 64 jobs running concurrently in a multiprogramming environment. The CS/386 Turbo is available in four versions: 4 MB, 8 MB, 16 MB, and 32 MB.

The main benefits of the CS/386 Turbo are its high-speed I/O bus and two new controllers. The bus provides a short response time for all users through its high-speed terminal controller; its easy operation lets beginners quickly learn how to use the system.

The 16-port terminal controller is an 80286 12-MHz coprocessor that runs on the 32-byte high-speed data bus. The shared memory concept allows the 256 KB of terminal controller memory to be directly accessible by the CPU through the high-speed bus.

The new high-speed printer/disk controller also uses an 80286 12-MHz coprocessor on the 32-byte I/O bus. The 256 KB of controller memory allows faster disk tranfers with more users on the system.

The CS/386 Turbo operating system and incremental compiler reside in 256 KB of control storage memory independent from user data memory.

The microprogram, comprised 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 CPU and I/O processing to overlap; thus, the CPU is not responsible for controlling peripherals that would otherwise require frequent or dedicated CPU attention.

The Multiuser BASIC-2/Turbo Operating System, which runs on the CS/386 Turbo, 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.

The Multiuser BASIC-2/Turbo 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 (the system automatically performs the tasks associated with disk maintenance) and Absolute Sector Addressing mode (the programmer can directly access any sector on the disk).

The CS/386 Turbo also functions in 3-byte addressing mode where the disk platter can be the same size as the hard disk, eliminating the 16 MB per disk address restriction. Functioning in this mode, the CS/386 Turbo with a 64-MB hard disk in the DS and a Revision 4 PROM can have a single disk platter address of 64 MB.

I/O Controllers

The standard CPU has nine I/O controller slots. Each can hold an I/O controller board for managing one or more peripheral devices. Eight I/O slots are available for use. The CS-D/N reserves the ninth I/O slot for the internal DSPC (which supports a printer). Some I/O controllers possess front-end intelligence, which allows the controller to perform I/O processing and CPU processing concurrently.

Device Addresses

A unique device address, consisting of three hexadecimal digits, identifies the controller for every peripheral device attached to the CPU. The operating system uses the first digit of the device address to identify what type of I/O routines control the device. The second and third digits of the address represent the hardware address set on the controller. The CS-D/N uses this address to electronically identify that device when it transmits information to or from it. For example, the address for a printer attached to the CPU is usually 215, while the address for plotters is usually 413 or C13.

The last two digits of the device address of the CRT are always 05. The device address of the keyboard is always 001. The last two digits of the device address of a local printer (i.e., a printer directly attached to a terminal) are always 04.

If a single disk unit is the only one on the system, the fixed drive usually has address D11, while the diskette drive has address D10. For more information on the procedures for addressing a disk, when the system contains more than one drive, refer to the *Multiuser BASIC-2 Language Reference Manual.*

The 2236 MXE Terminal Processor requires one I/O slot and can support up to four terminals. (You can place up to four of these controllers in one CPU.) Unlike the device addresses set on most peripheral processors, the CS-D/N does not use the physical device address set on the 2236MXE Terminal Processor to access the terminals. Instead, the program address of all CRTs, keyboards, and local printers is the same for all terminals on the system. The operating system automatically translates the program addresses into the appropriate physical address for the processor port. Thus, each program in each partition addresses its terminal and local printer as if they were the only ones on the system.

Each terminal is connected to the CS/386 Turbo by a Wang Model 22C32 triple controller, a Model 2236 MXE terminal processor, or an MXF 16-port high-speed terminal controller. The MXF performs as fast on the new 32-byte bus as the MXE performs on the 8-byte bus. 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, ports of the Model 2236 MXE can support asynchronous communication in half- or full-duplex at line speeds ranging from 110 to 9,600 bps.

The MXF Terminal Controller can support up to 16 terminals running per controller and up to 4 controllers per system. The MXF has an 80286 12-MHz coprocessor and 256 KB of system random access memory (SRAM) that it shares with the CPU. The MXF uses only the high-speed bus.

Output Buffering

Each terminal is connected to a 2236MXE (or MXF) Terminal Processor, or a 22C32 Triple Controller that controls data input and output at the terminals. You can concurrently create hardcopy printout to a local printer with CRT displays at each terminal. To contend with the speed discrepancies between the asynchronous line, the CRTs, and local printers, the terminal processor and triple controller collect keystrokes into lines of text and buffer the CRT and local printer output. Buffering allows the CPU to devote more of its time to the execution of programs than if it had to pause frequently to test the ready status of I/O devices.

Line Handling

Line handling between the 386 CPU and each terminal is asynchronous and full-duplex. Since the terminals and the 2236MXE (or MXF) Terminal Processors are RS-232-C/CCITTV.24 compatible, both local and long-distance terminal placement are possible. You can place local terminals up to 2,000 feet (610 meters) away from the CS-D/N and use telephone lines and modems for unlimited distance to remote terminals.

Terminal Configuration

You can use any combination of local, extended-local, and remote connection. However, the terminal connected to 2236MXE Port 1 should reside in the same area as the CPU; it acts as the system console for master initialization when you turn on the system and is used to report and correct system errors. Allowable configurations of the terminals relative to the CPU and 2236MXE processor are as follows:

Local – For distances up to 25 feet (7.6 meters), transmission rates of 38.4K baud are available. Use a Wang-supplied cable for a direct four-wire connection. (This is the standard configuration.)

Extended Local – For distances from 25 feet (7.6 meters) to 2,000 feet (610 meters), optional Wang-supplied cables provide direct extended-local connection at speeds of 38.4K baud. These cables are available in lengths up to 2,000 feet (610 meters).

Remote – For distances greater than 2000 feet (610 meters), you must use two asynchronous, full-duplex, RS-232-C compatible modems operating at the same baud rate, and suitable transmission lines to provide the communications link. Plug one modem into the terminal and plug the other into the terminal processor. The following two types of remote configurations are possible, depending upon the distances involved:

Distances up to 5 miles (8 kilometers) – Short-haul modems using private, voice-grade lines with a four-wire connection between modems provide communication.

Distances exceeding 5 miles (8 kilometers) – Private (dedicated) or switched (dial-up), voice-grade telephone lines provide the connection between telecommunication modems. The modem selected determines whether these lines must be two-wire or four-wire.

You can select line speeds ranging from 300 baud to 38.4K baud (38.4K baud equals about 38,400 characters per second). The CS-D/N supports baud rates of 300, 600, 1,200, 2,400, 4,800, 9,600, 19,200, and 38,400. The Model 2236MXE Terminal Processor and the 2536 DW terminal each have a set of switches for setting the transmission speed. You must set both the Model 2236MXE Terminal Processor and the terminal connected to it at the same baud rate. The transmission character has an 11-bit format (1 start + 8 data + 1 odd parity + 1 stop bit).

Special cables are required for modem connections of Wang equipment and are available in 12 foot (3.7-meter), 25 foot (7.6-meter), and 50 foot (15.2-meter) lengths. You must also set modems at the same baud rate as the terminal and terminal processor.

Memory Partitions

The CS/386 and CS/Turbo user memory is the area of memory available to the user's programs and data. User memory is also divided into a maximum of 16 partitions (64 for Turbo) of fixed size, (the partitions are not subject to any bank restrictions) each of which is capable of executing a separate program. Partitions can be any memory size up to a maximum of data memory.

A procedure called partition generation defines the system configuration (i.e., number and sizes of partitions, the terminals and peripherals attached to each partition, etc.). You can change the allocation of system resources (system configuration) whenever necessary. Since you can generate, name, and store on the system disk a number of different system configurations, you can make partition generation similar to loading a program and perform it automatically when you power up the CS-D/N. Chapter 3 describes the process of system configuration and the parameters that you can modify during system configuration (i.e., background/ foreground partitions, disabled programming mode, bootstrap programs).

Each user has a distinct memory area or partition for program and variable storage. There is, however, only one central processor. The central processor executes the program in each partition sequentially.

By bypassing inactive partitions, overlapping I/O with CPU processing, and switching between users frequently, the CS-D/N ensures good response time for each user. The CS-D/N appears to execute each user program simultaneously, creating the appearance of a single-user system for each user.

The CS-D/N partitioning scheme imposes some programming constraints due to timing considerations of the operating system. You cannot use unbuffered, time-dependent software and associated devices with the operating system. For a discussion of programming considerations and BASIC-2 language enhancements for multiprogramming, refer to the *Multiuser BASIC-2 Language Reference Manual*. If you require time dependency, the CS-D/N can use the VP BASIC-2 programming language.

The same hardware, at different times, supports both systems. The CS-D/N simultaneously supports up to 16 partitions with 16 terminals for a CS/386 and 64 partitions with 64 terminals for a CS/Turbo. A single terminal can also control more than one partition. Partitions that are attached to a terminal (running an interactive job, for example) are said to be running in the foreground. Partitions that are not attached to a terminal (running non-interactive jobs, for example) are said to be running in the background.

To initiate program execution and to permit necessary user or program interaction, you can switch a terminal that controls several partitions from one partition to the next. If a program running in a background partition attempts to communicate with a shared terminal that is attached to another partition, the CS-D/N suspends program execution until the current partition releases the terminal.

Either you or program control can release a terminal to a specific partition or make it available to any waiting partition. For each partition, only the terminal assigned to the partition can list the program in the partition, release the terminal to that partition, or modify the program executing in the partition. However, you can attach a partition assigned to the null terminal to any terminal upon request. You can also assign partitions to the null terminal at any time during system operation.

Each partition functions independently of the others in a manner similar to a separate, single-user system. However, any partition may be declared global, so that its subroutines and specially labeled global variables are accessible to other partitions within its bank or system in the case of the CS/386 (a global partition can be any size in a CS/386 CPU). Since BASIC-2 program text in a global partition is re-entrant, two or more partitions can simultaneously execute the same statement in a shared subroutine. Several users can interrogate and modify global variables, providing a convenient mechanism for interpartition communication. (Note that although other partitions can access and modify global variables, they cannot modify global programs.)

In many cases, the special features of global partitions also speed throughput and allow several users to concurrently process several related applications at each of the terminal sites. This concurrent processing allows users to share the application programs, eliminating the need to duplicate those programs. For a detailed discussion of global programming capabilities, refer to the *Multiuser BASIC-2 Language Reference Manual*.

You can inhibit programming and Immediate mode operations for any partition(s). In the Disabled Programming mode, the CS-D/N limits you to BASIC-2 software, preventing inadvertent or unauthorized use of certain data files and programs. You can only load and execute a program called START that provides a menu of operations that the CS-D/N can perform to load other software.

RAMdisk

You can create a temporary storage area, called CPU RAMdisk, from memory not assigned to partitions. Since you are using user memory to emulate disk storage and there is no physical disk address, RAMdisk access is considerably faster than access to an actual disk. But since RAMdisk provides only temporary storage, you lose all information stored when you power off the system.

The CS-D/N contains two types of RAMdisk: CPU RAMdisk and Disk Storage Printer Controller (DSPC) RAMdisk. The memory allocated to CPU RAMdisk is contiguous and resides beyond the partitions allocated to terminals and background tasks. The CS-D/N also allows up to 900 sectors of its cache memory to be set aside for use as an onboard DSPC RAMdisk. For more information on the CPU and DSPC RAMdisk, refer to Chapter 8.

Terminals and Keyboards

You can use a variety of 2200 interactive terminals and terminal emulations with the Wang CS-D/N. The interactive terminal is your principal means of communicating with the CS-D/N. These different terminals have different physical characteristics but offer similar functional capabilities.

Terminals

The terminals that you can attach to the CS-D/N include

- 2236 DE/DW
- 2336 DE/DW
- 2426 DW
- 2436 DE/DW
- 2436 WP
- 2536 DW

Additional 2200 terminal emulators, available through Wang and other vendors, allow a Wang PC, as well as IBM and IBM clones, to act as a CS/2200 terminal.

The 2236 terminal is a single unit made up of the CRT and keyboard. The 2336 and 2436 models offer detached keyboards. For more information on the 2436D-type interactive terminal, refer to the *2436 Series Interactive Terminal User's Manual*.

The 2436WP is a multitasking, standalone word processor that offers the added functional capabilities of 2200 Terminal Emulation. It provides local word processing, printing, forms, and merge print capabilities. When connected to a Wang 2200 minicomputer system, it becomes a remote terminal with the same basic functional capabilities as a Wang 2236 DE/DW terminal. This terminal provides a file transfer and archive system that allows 2436 documents to be stored in an archive file on the 2200 system.

The 2536 DW terminal supports data processing applications, graphic applications, and an optional Wang CS word processing software package. It offers a detached PC-style keyboard. This keyboard consists of a typewriter keypad, a numeric keypad, program control keys, and 16 special function keys.

Keyboards

Three different keyboards are available for the 2336 and 2436 series terminals:

DE-style keyboard – Primarily supports data entry. It consists of a typewriter-style keypad along with a numeric keypad. In addition, this keyboard supports certain BASIC-2 keywords with single keystrokes and function keys with built-in edit functions.

DW-style keyboard – Supports both word processing and data entry. This keyboard offers the typewriter keypad, the numeric keypad, and a cursor control pad. The cursor control pad allows you to move the cursor up, down, left, and right. In addition, this keyboard offers single-key screen scrolling (previous/next screen) and editing (insertion and deletion of text). The labelled function keys support word processing functions such as INDENT, PAGE, and CENTER.

Expanded DW keyboard – Offers the standard DW features with additional keys that support foreign character sets.

Disk Units

The disk storage unit is included within the CS-D/N cabinet. The CS-D can accommodate either a 320-KB or a 1-MB diskette, one fixed Winchester, and one 150-MB streaming tape cassette. In addition, you can use all the current 2200 disk peripherals with the Wang CS-D. Available units include the Model 2260 and 2270A Series Disk Drives, the Model 2275 Disk Drive, the Model 2280 Disk Drive, and the DS Data Storage Cabinet.

These drives offer various amounts of storage in combinations of diskette drives and fixed/removable hard drives (e.g., Winchester drives). The CS-D stores information on the disk units in platters that you designate. A platter consists of a number of sectors and can contain up to 16 MB of storage, depending upon the disk model.

You can attach up to three disk units (including an internal disk drive) to any one CPU. These units include a DS, a 2275, or pairs of 2280. In addition to those three units, you can attach other 2260 and 2270 disk drives. The disk unit can also contain up to 32 disk platters.

The 22C11-HS is the printer/disk controller, an 80286 12-MHz coprocessor with 256 KB of SRAM. It tranfers data between the printer or disk and the CPU faster under heavy I/O loads than the MVP or CS/386. The 22C11-HS also has a 22C80 port so that it can tie into a 2275 MUX.

Up to 16 CPUs can share one fixed disk drive using the 2275 MUX and 2275 MUXE extenders. The 2275 MUX allows three additional CPUs to share the same fixed disk. Once you connect the 2275MUX, you can add three 2275 MUXE extenders to the CS-D/N. Each 2275MUXE extender allows four additional CPUs to connect to the same fixed disk.

Multiuser BASIC-2 provides a number of statements to let you store and retrieve data and programs on any of the available disk units.

Printers

The CS-D/N can use any Wang 2200 printer as a hardcopy output device. To access printers, BASIC-2 statements such as PRINT, PRINT USING, and LIST are used.

You can write user application programs for a specific printer or use the Generalized Printer Driver (for Wang Professional Computer (PC) printers). The CS-D/N system platter contains several printer driver tables that you can use with the Generalized Printer Driver feature of the BASIC-2.

The CS-D/N defines printers as either a system printer or a terminal printer. A system printer, accessible to all users, is attached to either the DSPC or a separate printer controller installed in the CS-D/N. (The default address setting for the system printer is 215.) For information on accessing the system printer, refer to the *Multiuser BASIC-2 Language Reference Manual*. A terminal printer is attached to one of the terminals and can be accessed only from that terminal. Only 2200 printers can be attached to terminals. (The 2536DW terminal can also accommodate any PC-type Centronix interface printer while the 2436WP terminal supports only local serial printing.) BASIC-2 provides statements that allow the application program to direct hardcopy output to either type of printer.

Wang Laboratories, Inc., offers a range of printers including matrix printers for draft quality output, daisy wheel and laser printers for high-quality letter output, and band printers for high-speed output. You must attach all printers to either the DSPC (plugged into the last slot of the CS-D/N), a 22C02 controller, a 22C11 Dual Controller, a 22C32 Triple Controller, or directly to a terminal.

Communications Controllers

A software package working in conjunction with a communications controller board handles telecommunications interfaces to other systems. Packages are available for both asynchronous and synchronous communications.

You can configure the CS-D/N with the following Wang Communications Controller Models:

Model 2236 MXE and MXF – Supports asynchronous and full-duplex handling at selectable line speeds ranging from 300 to 38,400 bits per second (bps). In addition, one or more ports of the Model 2236 MXE can support asynchronous communication in half- and full-duplex at line speeds ranging from 110 to 9,600 bps.

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

Table 2-1 compares the various communication controllers available for the CS-D/N.

Table 2-1.   Controllers for Communications

Emulation	MXE	2227B	2228B	2228C D-4	2228D LCO	2258	MXF
Asynchronous							
RCM	Yes	Yes	Yes	Yes	-	-	Yes
ASC	Yes	Yes	Yes	Yes	-	-	Yes
ASC with							
Flow control	Yes	-	-	-	-	-	Yes
Asynchronous/Synchronous							
Burroughs							
Poll Select	-	-	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	-

3

Master Initializing
the CS-D/N

Overview

The CS-D/N is designed so that you can perform most routine maintenance yourself. This chapter explains how to master initialize the CS-D/N, a process that includes powering up the system, mounting the system platter, and loading the system programs, and how to perform partition generation, use the disk and diskette drives, and back up the system platter.

CS-D/N Controls and Indicators

The Power ON/OFF switch (labeled I/O) is located on the upper right corner of the CS-D/N. To turn the power on, press the I on the I/O switch. If you have a diskette drive the lamp lights up indicating that the CS-D/N is undergoing a series of diagnostics tests. When the lamp goes out (after about one minute), the devices in the CS-D/N are ready to use. If, after one minute, the lamp starts to blink, you have a faulty DSPC device. Try the diagnostics again by turning the power off and then on again.

A lamp that continues to blink after several minutes indicates a malfunctioning DSPC device in the unit. Follow this procedure to correct the malfunction:

1. Press RESET from the system terminal. If the lamp does not go out, it indicates a problem in the DSPC. Contact a Wang service representative. Otherwise proceed to step 2.

2. Run the DS Configuration utility. In the list of CS-D/N devices, the message "failed built-in test" identifies the faulty device. (Refer to the section "Configuration Utility" in this chapter.)

3. Contact a Wang service representative and describe the problem found in step 2. You can still use devices that are not at fault.

When a drive lamp is lit, the drive is in operation, reading data from or writing data to the disk.

> *Caution: Do not power off the CS-D/N while a drive is in operation.*

Master Initialization

Master initialization is the process of powering up components of the CS-D/N, loading the operating system and BASIC-2 interpreter, and determining if any malfunctions exist. In the CS-D/N, the bootstrap Programmable Read Only Memory (PROMs) contain the resident (hardwired) microcode. These PROMs are the area that functions when you turn on the CPU. Neither user memory nor control memory contains any information when you first power up the CS-D/N.

Before the CS-D/N can perform any operations, you must load the operating system and BASIC-2 interpreter from the system platter into the control memory. The CS-D/N can then manage the processes of interpreting and executing the BASIC text, overseeing variable and program storage in user memory, and controlling I/O.

You can master initialize the CS-D/N only at Terminal 1 (the terminal attached to the primary 2236 MXE or MXF Terminal Processor at Port 1). For this reason, locate Terminal 1 at the central system site as close as possible to the CPU and disk drive.

The CS-D/N automatically invokes bootstrap routines from Terminal 1 whenever you

- Power up the system
- Execute the Immediate mode $INIT password command (in order to reconfigure the system)
- Detect certain CPU malfunctions

You need only verify that you properly mounted the system disk.

The CS-D/N clears both user memory and control memory when you power down the system. Therefore, you must master initialize the system following any power-down operation or whenever you reallocate the system resources. In rare instances, you may have to power off and master initialize the CS-D/N to recover from an error condition.

> ***Caution:*** *Always save any valuable programs or data residing in memory before powering off the CS-D/N.*

Use the following procedure to master initialize the CS-D/N:

1. Power up the CPU, the system disk, each terminal, and any other device you are going to use. (Always power up the system before mounting the system platter.) If the system is already running and you must master initialize to reconfigure the system, you do not have to power the system components down and then up again. Executed at Terminal 1, the Immediate mode form of $INIT causes the system to initiate the bootstrap routines as if you had just powered up the system.

2. Mount the system platter, containing the BASIC-2 interpreter and operating system, as well as a variety of hardware diagnostics and other system programs.

3. Use the RESET and function keys to load the operating system and BASIC-2 interpreter from the system platter into control memory.

The following sections describe each of these procedures in detail.

Powering Up the CS System

To power up the CS system, follow these steps:

1. Turn the power switch on the CPU to the ON position.

2. Turn on the CRT and printers. As soon as the system warms up (15 seconds), the CRT of Terminal 1 displays a self-identification message. This message indicates that the terminal has passed its internal diagnostics. It has the following format:

```
2536DW      R0101  19200BPS    8 + O   (USA)
```

Message component descriptions follow:

```
2536DW      Model number

R0101       Revision number of terminal firmware, preceded by R

19200BPS    Data rate followed by BPS

8 + O       Number of data bits (7 or 8); E is even parity,
            0 is odd parity, and N is no parity

(USA)       Version of the keyboard and CRT character set,
            enclosed in parentheses
```

3. The following message should appear on the CRT at Terminal 1:

```
MOUNT SYSTEM PLATTER
PRESS RESET
```

(Press RESET only after the disk controller has run the diagnostic and the floppy disk light has gone out.)

If the MOUNT SYSTEM PLATTER PRESS RESET message does not appear, or if it is incomplete, the bootstrap diagnostics detect an error. Master initialize the system again. If the second attempt fails, refer to Master Initialization Error Recovery in Chapter 5. If you still cannot perform master initialization, call your Wang service representative.

Powering Up the CS/386 System

To power up the CS/Turbo system, follow these steps:

1. Turn the power switch on the CPU to the ON position.
2. Turn on the CRT and printers. As soon as the system warms up (15 seconds), the CRT of Terminal 1 displays a self-identification message. This message indicates that the terminal has passed its internal diagnostics. It has the following format:

```
2536DW      R0101  19200BPS    8 + O  (USA)
```

Message component descriptions follow:

```
2536DW      Model number

R0101       Revision number of terminal firmware, preceded by R

19200BPS    Data rate followed by BPS

8 + O       Number of data bits (7 or 8); E is even parity, O
            is odd parity, and N is no parity

(USA)       Version of the keyboard and CRT character set,
            enclosed in parentheses
```

3. The CS/386 runs an internal CPU diagnostic and displays the following on the CRT as the test is running:

```
256 SRAM
XXXX PRAM
```

4. The following message should appear on the CRT at Terminal 1:

```
MOUNT SYSTEM PLATTER
PRESS RESET
```

(For a CS-D press RESET only after the disk controller has run the diagnostic and the floppy disk light has gone out.)

If the MOUNT SYSTEM PLATTER PRESS RESET message does not appear, or if it is incomplete, the bootstrap diagnostics detect an error. Master initialize the system again. If the second attempt fails, refer to Master Initialization Error Recovery in Chapter 5. If you still cannot perform master initialization, call your Wang service representative.

Powering Up the CS\Turbo System

To power up the CS/Turbo system, follow these steps:

1. Turn the power switch on the CPU to the ON position.

2. Turn on the CRT and printers. As soon as the system warms up (15 seconds), the CRT of Terminal 1 displays a self-identification message. This message indicates that the terminal has passed its internal diagnostics. It has the following format:

   ```
   2536DW      R0101  19200BPS    8 + O   (USA)
   ```

   Message component descriptions follow:

   ```
   2536DW      Model number

   R0101       Revision number of terminal firmware, preceded by R

   19200BPS    Data rate followed by BPS

   8 + O       Number of data bits (7 or 8); E is even parity, O
               is odd parity, and N is no parity

   (USA)       Version of the keyboard and CRT character set,
               enclosed in parentheses
   ```

3. The CS/386 runs an internal CPU diagnostic and displays the following on the CRT as the test is running:

   ```
   DRAM 32064 KB
   ```

4. The following message should appear indicating that the MXF and the 22C11 HS controllers have passed their diagnostics and the CPU can interrupt each of the Turbo controllers :

   ```
   System Interface Control Card Diagnostic Status:

       *2nd 22C11 Diag. - - - PASS
       *1st MXF Diag.   - - - PASS
       *2nd MXF Diag.   - - - PASS

   CS386 Interrupt MXF/22C11 test:

       *Receive 2nd-22C11 interrupt!
       *Receive 1st-MXF interrupt!
       *Receive 2nd-MXF interrupt!
   ```

5. The Turbo tests cache on its controllers by displaying the following messages as the test is running.

   ```
   Move EPROM Memory Test Program to DRAM and Enable CACHE...
   DRAM 25728 KB
   ```

6. The following message should appear on the CRT at Terminal 1:

   ```
   MOUNT SYSTEM PLATTER
   PRESS RESET
   ```

   (For a CS-D press RESET only after the disk controller has run the diagnostic and the floppy disk light has gone out.)

If the MOUNT SYSTEM PLATTER PRESS RESET message does not appear, or if it is incomplete, the bootstrap diagnostics detect an error. Master initialize the system again. If the second attempt fails, refer to Master Initialization Error Recovery in Chapter 5. If you still cannot perform master initialization, call your Wang service representative.

7. If you want to bypass the diagnostic test (and skip steps 4 and 5), press RESET as soon as Step 3 starts. The following message will appear:

    ```
    Flooding Memory
    ```

    Go to step 6.

Mounting the System Platter

You should copy the system files onto another disk or diskette and mount these diskettes at each master initialization. Use the system platter solely as backup. (Refer to the section, "Backing up the System Platter.")

When you first mount the system platter, use the following procedure:

1. Remove the system platter from its envelope. Make sure that the platter moves freely in the jacket. The diskette should not be write-protected.

WRITE DISABLED   WRITE ENABLED
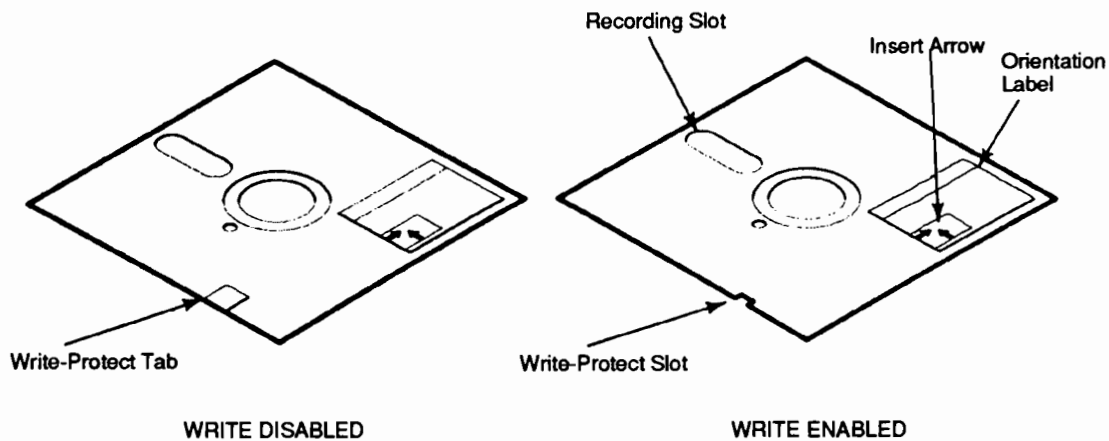
Figure 3-1.   A 5 1/4-Inch Double-Sided Double-Density Diskette Showing the Write-Protect Feature

2. Open the door of the diskette drive by raising the door release lever to its horizontal position.

3. Grasp the diskette from the side opposite the write-protect slot. Slip it into the slot in the drive. Be sure the edge of the diskette closest to the recording slot goes into the drive first. Use the Insert arrow on the orientation label to confirm that the position of the diskette is correct as you insert it in the drive. Slip the diskette completely into the drive. (See Figure 3-2.)
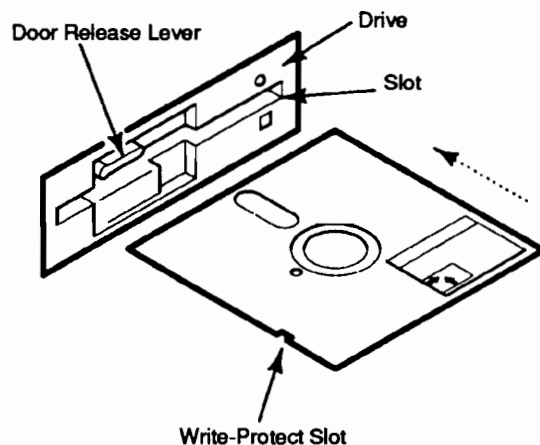
Figure 3-2.   Inserting a Diskette

4. Close the diskette drive door by lowering the door release lever to the vertical position.

5. Remove the system platter when the system program has been loaded. Raise the door release lever to the horizontal position and remove the diskette. Immediately place the system platter in its protective envelope.

Loading the System Programs

When the system platter is properly mounted, follow these steps to load the system programs:

1. Press RESET, located in the upper-left corner of the keyboard. The following prompt appears on Terminal 1:

   KEY SF'?

2. Press a special function key (SF) to specify the disk address where the system files are located. (The SF keys are arranged across the top of the keyboard.) The following options are available for loading BASIC-2 from the system platter:

SF KEY	Disk Address From Which to Load BASIC-2
'00	D11 (or 310)
'01	D10 (or B10)
'02	D21 (or 320)
'03	D20 (or B20)
'04	D31 (or 330)
'05	D30 (or B30)

Normally, you assign the diskette drive in the primary or default diskette unit address B10, and the first fixed drive address 310. If there is an additional disk unit on the system, address the disks on the second drive as B20 and 320.

Note: To override the default system file name @@, enter the file name immediately before pressing the SF key. The name of the file you choose must begin with @ and be no more than four characters long. This feature allows more than one operating system to functionally reside on a platter.

3. Choose BASIC-2 from the menu. Wait approximately 25 seconds for the CS-D/N to load the BASIC-2 interpreter and operating system into controlmemory from diskette. The following message appears:

```
Loading:   Multiuser BASIC-2 Release X.X (for CS CPU)

                    OR

Loading:   Multiuser BASIC-2 CS/386 Release X.X (for CS/386
CPU)

                    OR

Loading:   Multiuser BASIC-2 CS/Turbo Release X.X (for CS/Turbo
CPU)

where X.X is the number of the release being used.
```

If you press the wrong function key (e.g., if you mounted the system platter at address 310, but you press SF key '01), the screen displays an error message in the following form:

```
***SYSTEM ERROR (DISK 00XX)***

        PRESS RESET
```

To recover from a system error, follow these steps:

1. Press RESET and the correct function key.
2. If RESET fails, turn the system off, wait at least 5 seconds, turn the system on again, and repeat the master initialization sequence.
3. If this approach fails, try the master initialization error recovery procedures discussed in Chapter 5.
4. If you still cannot complete master initialization, call your Wang service representative.

When you load the operating system, the CS-D/N loads and runs the @GENPART program from the system platter. @GENPART allows you to interactively create a system configuration or automatically execute any configuration stored on the system platter. @GENPART also allows the CS-D/N to load other programs resident on the system platter into partitions and execute them automatically with no further intervention after configuration.

If @GENPART is not on the system platter, you can only configure the CS-D/N into a limited system in which Terminal 1, the default disk drive, and any local printer attached to Terminal 1 are ready for limited use. Terminal 1 displays the READY (BASIC-2) message. You can only use the other terminals and system resources after configuring the system.

Partition Generation
(System Configuration)

Partition generation (system configuration) divides the resources of the CS-D/N among the various users. This section discusses the use of the @GENPART utility program to create, save, and execute system configurations. @GEN-PART is supplied on the system platter with every CS-D/N.

User-Specified System Configuration Parameters

You can specify the following parameters when configuring a system:

- Number of partitions
- Number of terminals
- Size of each partition
- Terminal associated with each partition
- Programmability of each partition
- Bootstrap program for each partition
- Addresses of the peripherals attached to the system
- Access to peripherals
- System message
- System reconfiguration password
- Any entries for printer driver tables
- CPU number

System Configuration Using @GENPART

The process of master initialization, discussed previously, creates a limited BASIC-2 system having a single partition with Terminal 1 controlling all of the user memory. Only Terminal 1, any local printer attached to it, and the system disk drive are operative at this time. No other system devices are available until you execute a configuration. This section describes how to make the other devices operative.

As a part of master initialization, the CS-D/N microcode automatically loads and runs @GENPART from the system platter if such a file exists. (The system always assumes @GENPART to be the name of the system configuration program, whether Wang-supplied or user-written.) If @GENPART is not on the system platter, Terminal 1 displays the READY message. When you first execute @GENPART, the CS-D/N loads the parameters from the previously loaded configuration (called current) and displays a list of previously saved configurations. A prompt inquires if you are going to load a different configuration and displays the list of @GENPART options.

You then respond to the prompts each option displays. Use the function keys to advance from option to option. For a complete description of generating a sample configuration, refer to the *BASIC-2 Utilities Reference Manual.*

The standard Wang @GENPART program lets you perform the following functions:

Create configurations for future execution and storage – If you are creating a configuration for the first time, create a new definition, execute it, and store it for future use. If you want to modify a previously defined one, use the function keys to load and modify the old configuration.

Load and execute previously defined configurations – If you want to execute a system configuration without making modifications, select a configuration from the list of configuration names displayed on the screen and execute it.

It is also possible to modify the @GENPART utility program so that the CS-D/N loads a specified configuration and executes it automatically when you master initialize the system. For a complete discussion on @GENPART operations, refer to the *BASIC-2 Utilities Reference Manual.*

Using the Disk/Diskette Drive

After you initialize the CS-D/N, you can use a disk or diskette to store programs or data files. However, you must configure the disk system before you can format an unused disk or diskette. (Refer to the "Configuration Utility" section in this chapter.)

> *Caution: Ordinarily, you do not format a used disk or diskette before storing additional files since formatting destroys any information previously recorded on the diskette. For this reason, you must never format or scratch disks or diskettes containing packaged programs.*

Formatting Disks or Diskettes

You can format fixed disks as well as removable diskettes by using the $FOR-MAT command in the BASIC-2 language or by running the Wang-supplied Format Disk Platter utility. The Format Disk Platter utility produces the same results as executing a $FORMAT command, but prompts you to verify that you are formatting the proper disk. This feature lets you be sure that you are not formatting a disk or diskette that contains information that you want to keep.

> *Note: If you are using a DS cabinet or CS/D with an R4 prom, the DS configuration utility must be used to first partition the disk before formatting.*

For instructions on how to use the $FORMAT command, refer to the *Multiuser BASIC-2 Language Reference Manual*. For instructions on how to use the Format Disk Platter utility, refer to the *BASIC-2 Utilities Reference Manual*.

Utilities Menu

The system platter contains a variety of system programs. (The file names of these programs begin with the at symbol (@).) For a detailed description of these programs, refer to the *BASIC-2 Utilities Reference Manual*. Figure 3-3 illustrates the System Utilities Menu.

```
                        System Utilities

Select an item and press RUN/EXEC                        Partition n, ddk
                                                         Terminal d

        Partition Generator
        Partition Status
        Format Disk Platter
        Move File
        Backup Platter
        Recover from Backup
        System Install
        Make a Reference List of File Names
        Initialize Date and Time
        DS Utilities
        DOS Utilities
        Game
```

Figure 3-3.   System Utilities Menu

Defining a Catalog Index

Before you can store the first program, data file, or RAMdisk on a disk or diskette in the Automatic Cataloging mode, you must create a catalog. The process of creating a catalog is called scratching the disk or diskette. You use the SCRATCH DISK statement to perform the operation.

> *Caution: Take care not to scratch a disk or diskette containing packaged programs or valuable files since a SCRATCH DISK statement overwrites the previous catalog index.*

In a SCRATCH DISK statement, you must specify how many sectors to reserve for both the Catalog Index (where the CS-D/N stores the file names), and the Catalog Area (where the CS-D/N stores the actual contents of the files).

To define the size of the Catalog Index – Use the LS parameter in the SCRATCH DISK statement. For example, LS = 10 indicates that the CS-D/N reserves 10 sectors for the Catalog Index. If you do not specify a value, the system assigned (default) value is 24. (The first sector, sector 0, can hold 15 file names, and each subsequent sector can hold 16 file names.)

The Catalog Index always begins at the first sector on a disk or diskette (sector numbering starts with zero) and occupies a number of sequential sectors that you specify.

To specify the last sector in the Catalog Area – Use the END parameter in a SCRATCH DISK statement. For example, END = 1023 indicates that the CS-D/N uses sector 1023 as the last sector for the catalog area. You must specify the END parameter.

The Catalog Area begins immediately after the Catalog Index and occupies all sequential sectors up to and including the user-specified last or ending sector. You should specify the end of the Catalog Area as the last available sector on the disk or diskette.

To scratch a disk, diskette, or RAMdisk follow these steps:

1. Mount a formatted disk or diskette in the drive.

2. Enter a SCRATCH DISK statement. For example:

   ```
   SCRATCH DISK T/D10, LS = 20, END = 1023
   ```

   LS = 20 specifies that the CS-D/N reserves 20 sectors for the Catalog Index. END = 1023 specifies that the catalog uses sector 1023 as the last sector. The number of sectors allocated for the catalog index and data storage can vary depending on your system and programming requirements. (For further information, refer to the *Multiuser BASIC-2 Language Reference Manual.*)

3. Press RETURN.

4. Repeat steps 1 and 2 for any other disk or diskette that you must scratch. After you format and scratch a disk or diskette, it is ready for data and program storage.

5. Verify these steps using one of the following procedures:

  – Use the DS Configuration Utility to determine the end size of each platter.

  – Use a LIST DC T [/disk address] statement to check the size of the Catalog Index. Entering the statement LIST DC T/D10 after scratching disk D10 in the manner shown above would cause the screen to display

```
INDEX SECTORS  = 00020
END CAT. AREA  = 01023
CURRENT END    = 00019
```

Backing Up the System Platter(s)

After loading the system programs, make a backup copy of the system platter(s) using the BASIC-2 disk commands. The BASIC-2 commands and the system utilities provide the flexibility of backing up an entire platter or backing up the platter file by file.

> *Caution: Make at least one copy of each system platter on another disk-ette or on a disk in the fixed/removable disk drive in case the original is accidentally damaged or destroyed.*

You can use BASIC-2 statements to copy or move an entire platter, or to copy single files.

Using Diskettes

Each diskette provides a write-protect slot to prohibit writing over information already stored. You can protect valuable programs or data from inadvertent loss by using the write-protect tabs. If you cover the slot on a 5 1/4-inch diskette, you can read information from the diskette but you cannot write any information onto the diskette. To write-protect the diskette, place one of the adhesive tabs supplied with the diskettes over the write-protect slot.

All blank diskettes are manufactured without the tabs covering the write-protect slot. Diskettes can accept data only when you uncover the write-protect slot.

> *Note: The procedure for write protecting 5 1/4-inch CS/2200 diskettes is exactly the opposite of the procedure for 8-inch diskettes on 2200 systems. An open slot on an 8-inch diskette protects it from overwriting; you can write only when you cover the slot.*

Copying and Moving Platters

To copy an entire platter (including scratched files), enter

```
COPY T/xxx, TO T/yyy,
```

To move an entire platter (removing scratched files), enter

```
MOVE T/xxx, TO T/yyy,
```

The disk address of the system platter is xxx and the address of the new disk or diskette on which you make the copy is yyy. The following statement copies the entire catalog of the original platter to the destination platter.

```
MOVE T/D10, TO T/340,
```

Moving One File

To move a platter one file at a time, enter

```
MOVE T/xxx, filename TO T/yyy,
```

This statement causes the CS-D/N to copy only the named file from the Catalog Area of the original platter to the Catalog Area of the destination platter. Two examples of valid syntax follow:

```
MOVE T/D11, "Bonds" TO T/D10,
MOVE T/310, "@@" TO T/340,
```

You can copy other programs on the system platter, individually, in a similar manner. (For a complete explanation of the MOVE statement, refer to the *Multiuser BASIC-2 Language Reference Manual.*)

When the system software is on multiple diskettes, use the above procedures to make a backup copy of each diskette.

CS-D/N and CS/386 Utilities

The utilities provided with the CS-D/N enable you to manage the storage devices and RAMdisk of your system.

> ***Note:*** *When upgrading these units from R3 to R4 proms, all winchester addresses must be backed up to an external device, tape, or floppy prior to replacing the prom. Once the prom is replaced, the surfaces will be unreadable and must be configured and formatted for use. (Refer to the section "Configuration Utility" in this chapter for additional information.)*

After you configure the CS-D/N, load the Utilities menu. Use the following two commands to display this menu:

1. SELECT DISK xxx (Press RETURN.)

   The three-digit hexadecimal number (xxx) is the device address of the disk on which the system utilities reside.

2. LOADRUN (Press RETURN.)

The DS Utilities menu appears (see Figure 3-4). Utilities that require user-entered information display a series of prompts requesting this information. When prompted, type the necessary response and press RETURN. The utility requests additional information or performs the specified procedure.

The following sections discuss the Configuration utility and the Protect/Unprotect utility. Chapter 8 discusses the RAMdisk Allocation utility and the Cache Usage utilities. Chapter 9 discusses the Backup disk platters to Tape Cassette utility and the Restore Disk Platters from Tape Cassette utility.

```
                    DS Utilities (Release 3.0)
                                             Partition X, ddd k
                                                   Terminal dd
Select an item and press RUN/EXEC

        DS Configuration
        Protect/Unprotect CS-D Surfaces
        RAMdisk Allocation
        Cache Usage
        Backup disk platters to Tape Cassette
        Restore disk platters from Tape Cassette
```

Figure 3-4.   DS Utilities Menu

Configuration Utility

The Configuration utility has two functions. The utility configures winchester drives into platter addresses (required when used with a Revision 4 PROM or greater). The utility is also used to list the addresses of the devices in the CS-D/N.

To run the Configuration utility, follow this procedure:

1. Select DS Configuration from the Utilities Menu (see Figure 4-1) and press RUN/EXEC.

```
                    DS Configuration

        Base Address of DS unit (D10, D20, or D30):  D10

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                                             RETURN - Proceed
                                             FN/TAB - Exit
```

Figure 3-5.   DS Configuration Screen

The first prompt requests the base address of the DS or CS-D. (See Figure 4-2.)

2. Select the correct address and press RETURN. (If you are setting up a configuration, this address is used for the base disk address.)

   The screen displays information on each device (including DS and DSPC RAMdisk, if configured) in the DS and CS-D. This information includes device addresses, device storage capacities, number of platters, and sectors per platter. Figure 4-3 is a sample configuration information screen.

```
                  DS   C o n f i g u r a t i o n

Drive SELECT 3
Diskette Drive                    1.2 MB with 4160 sectors
4160 on D10

64 MB Fixed Hard Disk             7 surfaces
65024 on D11      38912 on D12    4096 on D13    65024 on D14    65024 on D15
65024 on D16      38912 on D17

64 MB Fixed Hard Disk             2 surfaces
65024 on D18      38912 on D19

20 MB Fixed Hard Disk             2 surfaces
38912 on D51    38912 on D52

Streaming Cassette Tape Drive     150 MB tape drive
Address: D5F                      Cassette is not in place

                                        '15 - Start Setup
                                        RUN - Expand display
        DS PROM revision level: DD      RETURN - Restart
              Protocol level: 1         FN/TAB - Exit
```

Figure 3-6.   CS-D/N Sample Configuration Information Screen

3. To display expanded information on the storage devices, press RUN from the screen shown in Figure 4-3. The expanded information appears in Figure 4-4.

   If the CS-D/N PROM level is 2.0 or greater, a surface-protect feature exists and the screen displays a Protect field. (See Figure 4-4.)

```
              C u r r e n t   P l a t t e r   U s e

Disk     Index   Current  Catalog  Pro-  Disk     Index   Current  Catalog  Pro-
Address  Size        End  Maximum  tect  Address  Size        End  Maximum  tect
D10         9'      3767     4000   No
D11        70'     24624    65023   No    D51       47&     11156    38911   No
D12        250     30980    38911   No    D52       50'      6120    38911   No
D13        49'     10472    65023   No
D14         10     52977    65023   No
D15        10'     64777    65023   No
D16       100'     19746    65023   No
D17       129'     61008    65023   No
D18       129'     34267    65023   No

                                         RUN - Repeat Screen
                                         RETURN - Restart Program
                                         FN/TAB - Exit
```

Figure 3-7.   CS-D/N Configuration Information Screen (Expanded Display)

The Protect field displays the surface protection status. The contents of the Protect field are:

Content	Description
No	The surface is unprotected; writing is possible.
Soft	The surface is soft protected; writing is not possible. Soft protect is a programmable surface-write inhibit.
Hard	The surface is hard protected; writing is not possible. To remove a hard protect-write inhibit, power down and power up the CS-D/N.
n/a	The CS-D/N does not have a PROM revision greater than 1. You cannot alter the Protect field.

4. If a new configuration is not needed, press RETURN to restart the program, or press FN/TAB to exit. To start a new configuration go to step 5.

5. To "start setup" of a new configuration of surface assignments, press SF key '15 from the screen shown in Figure 4-3. The surface assignments screen appears in Figure 4-5.

It is possible to reconfigure a single Winchester drive from one to a maximum of fourteen addressable disk surfaces.

Note: This utility requires DS Prom level 4.0 or greater within a Wang DS or CS/D cabinet.

```
                Setup D.S. Disk Surface Assignments

3 Winchesters with sectors available
No. 1 = 260,096      No. 2 = 260,096      No. 3 = 77,824

Master Disk      Catalog          Slave Disk    Catalog
Address          Maximum          Address       Maximum

D11              0                D51           0
D12              0                D52           0
D13              0                D53           0
D14              0                D54           0
D15              0                D55           0
D16              0                D56           0
D17              0                D57           0
D18              0                D58           0
D19              0                D59           0
D1A              0                D5A           0
D1B              0                D5B           0
D1C              0                D5C           0
D1D              0                D5D           0
D1E              0                D5E           0

Use D.S defaults  Y
                                            FN/TAB - Exit
```

Figure 3-8. Setup D.S. Disk Surface Assignments

If you want to use the default disk surface assignments, type Y and press RETURN. The program calculates the default disk assignments and takes you to the configuration file name @DEFAULT. (See Figure 4-6.)

Note: DS defaults are:

30 MB drive has 2 disk addresses with 10 MB each
64 MB drive has 4 disk addresses with 16 MB each
140 MB drive has 14 disk addresses with 10 MB each
112 MB drive has 7 disk addresses with 16 MB each

```
            Setup D.S. Disk Surface Assignments

3 Winchesters with sectors available
No. 1 = 260,096    No. 2 = 260,096    No. 3 = 77,824

Master Disk     Catalog         Slave Disk    Catalog
Address         Maximum         Address       Maximum

D11               0             D51             0
D12               0             D52             0
D13               0             D53             0
D14               0             D54             0
D15               0             D55             0
D16               0             D56             0
D17               0             D57             0
D18               0             D58             0
D19               0             D59             0
D1A               0             D5A             0
D1B               0             D5B             0
D1C               0             D5C             0
D1D               0             D5D             0
D1E               0             D5E             0

Configuration file name @DEFAULT

                                         FN/TAB - Exit
```

Figure 3-9. @DEFAULT Configuration

If you do not want to use the default disk surface assignments, type N and press RETURN. The program enables you to tailor a unique configuration. (See Figure 4-7.)

```
                 Setup D.S. Disk Surface Configured Assignments

3 Winchesters with sectors available
No. 1 = 260,096     No. 2 = 260,096     No. 3 = 77,824

Master Disk     Catalog             Slave Disk    Catalog
Address         Maximum             Address       Maximum

D11             0                   D51           0
D12             0                   D52           0
D13             0                   D53           0
D14             0                   D54           0
D15             0                   D55           0
D16             0                   D56           0
D17             0                   D57           0
D18             0                   D58           0
D19             0                   D59           0
D1A             0                   D5A           0
D1B             0                   D5B           0
D1C             0                   D5C           0
D1D             0                   D5D           0
D1E             0                   D5E           0

Winchester X        Master or Slave M
B = 1.2 (4160)     C = 10MB (38912) D = 16MB  (65024)  R = Remaining or Value
Amount for surface D11 = 00260096

All entries made and acceptable? Y/N __

                                                      FN/TAB - Exit
```

Figure 3-10.   Setup D.S Disk Surface Configured Assignments

The surfaces on a single Winchester drive must be assigned to either the left
"Master" or the right "Slave" column that is shown on the screen. Make your
selection (M or S) and press RETURN.

You must also determine the amount of disk surface space you want on your
drive. To do this, follow these steps:

1. Select B, C, or D for the standard platter size numeric value that you
    want and then press the RETURN key.
        or

2. Enter a numeric sector value and then press the RETURN key. The
    utility automatically assigns the platter size beginning with the first
    unused platter address and consectively fills each platter.

3. Enter spaces or 0 and press RETURN to end the selection for the drive
    specified.

4. Select R and then press RETURN to choose the remainder of the drive's
    sectors.

If your entries are complete and you respond with a Y(yes) to accept the
configuration, the program takes you to the Configuration file name @DE-
FAULT. You can change the configuration name at this time or you can use the
name @DEFAULT. (See Figure 4-6.)

If your entries are not complete and you respond with a N (no), the program
returns you to the "DS Configuration" screen (Figure 4-2).

Sample Configuration

The sample configuration of surface assignments shows a DS or CS-D cabinet with three Winchesters. Two 64 MB Winchesters have been assigned to the Master address columns and a 20 MB Winchester drive has been assigned to the Slave address with surface sizes varying from:

```
4160  =  1.2 MB image
38912 = 10 MB image
65024 = 16 MB image
```

Surfaces greater than 65024 sectors require both the 3 byte addressing of the DS Prom level 4 and the 386 Release 2.0 operating system. Surfaces greater than 65024 must be established with the type 2 (&) catalogued index area.

> *Note: The hashing algorithm for 3-byte addressing is available with the CS/386 operating system Release 2.0 or greater.*

Type Index	Invoked By
0	SCRATCH DISK T /hhh
1	SCRATCH DISK ' T /hhh
2	SCRATCH DISK & T /hhh

```
              Sample D.S. Disk Surface Assignments

3 Winchesters with sectors available
No. 1 = 260,096     No. 2 = 260,096     No. 3 = 77,824

Master Disk      Catalog          Slave Disk    Catalog
Address          Maximum          Address       Maximum

D11   1          65024            D51   3        38912
D12   1          65024            D52   3         4160
D13   1          38912            D53   3         4160
D14   1          38912            D54   3         4160
D15   1           4160            D55   3         4160
D16   1           4160            D56   3         4160
D17   1           4160            D57   3         4160
D18   1           4160            D58   3         4160
D19   1           4160            D59   3         4160
D1A   1           4160            D5A   3         4160
D1B   1          27264            D5B   3         1472
D1C   2         150016            D5C               0
D1D   2          65024            D5D               0
D1E   2          45056            D5E               0

Winchester 3    Slave   0 Sectors remaining

All entries made and acceptable? Y/N __

                                      FN/TAB - Exit
```

Figure 3-11.   Sample D. S. Surface Assignments

If your entries are complete and you respond with a Y(yes)to accept the configuration, the program takes you to the Configuration file name @DEFAULT. You can change the file name at this time or use the file name @DEFAULT. (See Figure 4-6.)

If your entries are not complete and you respond with a N (no), the program returns you to the "DS Configuration" screen (Figure 4-2).

Configuration File Name @DEFAULT

The configuration file name @DEFAULT stores your selection of surface configuration into a six sector file on the system surface.

```
              Configuration FileName @DEFAULT

  Configuration file name @DEFAULT


                                              FN/TAB - Exit
```

Figure 3-12.   Configuration FileName @DEFAULT

You can execute your disk assignments in the configuration file @DEFAULT from terminal 1 by following the steps listed below. You can create your disk surface configuration from any terminal.

1. Press RESET and then press SF key '10 to apply. (See Figure 4-9.)

If you did not use @DEFAULT go to step 2.

2. Enter the FileName of your choice and press RETURN.

3. Enter printer address 005 and press RETURN. (See Figure 4-10.)

```
          Setup D.S. Disk Surface Configured Assignments

  3 Winchesters with sectors available
  No. 1 = 260,096      No. 2 = 260,096      No. 3 = 77,824

    Master Disk     Catalog         Slave Disk    Catalog
    Address         Maximum         Address       Maximum

      D11             0               D51            0
      D12             0               D52            0
      D13             0               D53            0
      D14             0               D54            0
      D15             0               D55            0
      D16             0               D56            0
      D17             0               D57            0
      D18             0               D58            0
      D19             0               D59            0
      D1A             0               D5A            0
      D1B             0               D5B            0
      D1C             0               D5C            0
      D1D             0               D5D            0
      D1E             0               D5E            0

  Hard copy to printer 005
                                    FN/TAB - Exit
```

Figure 3-13.   D.S. Surface Assignments

Note: DS Prom level 4 or greater is required in the cabinet. You can only apply changes from terminal 1.

4. Enter any remarks for the hard copy and press RETURN. (See Figure 4-11.)

```
            Setup D.S. Disk Surface Configured Assignments

3 Winchesters with sectors available
No. 1 = 260,096     No. 2 = 260,096     No. 3 = 77,824

Master Disk     Catalog          Slave Disk   Catalog
Address         Maximum          Address      Maximum

D11             0                D51          0
D12             0                D52          0
D13             0                D53          0
D14             0                D54          0
D15             0                D55          0
D16             0                D56          0
D17             0                D57          0
D18             0                D58          0
D19             0                D59          0
D1A             0                D5A          0
D1B             0                D5B          0
D1C             0                D5C          0
D1D             0                D5D          0
D1E             0                D5E          0
```
Hard copy to printer 005
Remark for hard copy 890101

```
                              FN/TAB - Exit
```

Figure 3-14.   DS Surface Assignments

5. Enter Y (yes) to execute the configuration or N (no) to go back to the screen shown in Figure 4-9 and press RETURN.

```
            Proposed D.S. Disk Surface Assignments

3 Winchesters with sectors available
No. 1 = 260,096     No. 2 = 260,096     No. 3 = 77,824

Master Disk     Catalog          Slave Disk   Catalog
Address         Maximum          Address      Maximum

D11   1         65024            D51   3      38912
D12   1         65024            D52   3       4160
D13   1         38912            D53   3       4160
D14   1         38912            D54   3       4160
D15   1          4160            D55   3       4160
D16   1          4160            D56   3       4160
D17   1          4160            D57   3       4160
D18   1          4160            D58   3       4160
D19   1          4160            D59   3       4160
D1A   1          4160            D5A   3       4160
D1B   1         27264            D5B   3       1472
D1C   2        150016            D5C          0
D1D   2         65024            D5D          0
D1E   2         45056            D5E          0
```

Apply Y or N __

Figure 3-15.   Proposed D.S. Surface Assignments

The program loops to the DS Configuration utility for visual verification.

Protect/Unprotect Surfaces Utility

The Protect/Unprotect Surfaces utility lets you write protect the surfaces of the storage devices in the CS-D/N. To run the Protect/Unprotect utility, follow these steps:

1. Select it on the Utilities Menu (Figure 3-4) and press RUN/EXEC.

   The first prompt requests the base address of the CS-D/N unit.

2. Press RETURN.

   The screen displays information on each device (including RAMdisk) in the CS-D/N. This information includes device addresses, index size, sector end, the catalog maximum, and surface protection of each surface. Figure 3-15 is a sample Current Platter Use (DS surfaces) screen.

```
                Current  Platter  Use
                  DS  Surfaces

Disk     Index  Current  Catalog  Pro-    Disk     Index  Current  Catalog  Pro-
Address  Size   End      Maximum  tect    Address  Size   End      Maximum  tect

D30       7     253       1231     No
D31      24     6716     65000     No
D32      24     6824     65000     No
D33      24     4534     65000     No
D34      24     7408     65000     No
D35      24     9655     65000     No

Valid keys to alter Protect                         RUN - Accept Screen?
N to set 'No' to disable Soft Protect            RETURN - Restart Program
S to Soft Protect;  H to Hard Protect             FN/TAB - Exit
```

Figure 3-16.   Sample Current Platter Use (CS-D/N Surfaces) Screen

The screen shown in Figure 3-15 enables you to accept or change the surface protection values for platter surfaces.

3. Press RUN to accept the information and the surface protection values displayed on the screen.

   The CS-D/N positions the cursor on the first character of the Protect field for each surface. You can change the Protect value by keying the value N (no), S (soft protect), or H (hard protect).

4. Press RUN when you set all surfaces (refer to Figures 3-15 and 3-16).

```
                Current  Platter  Use
                  DS  Surfaces

Disk     Index  Current  Catalog  Pro-   Disk     Index  Current  Catalog  Pro-
Address  Size   End      Maximum  tect   Address  Size   End      Maximum  tect

D30      7      253      1231     Soft   D70      5      8        200      No
D31      24     6716     65000    Soft
D32      24     6824     65000    Soft
D33      24     4534     65000    Soft
D34      24     7408     65000    No
D35      24     9655     65000    No


Highlighted fields denote changes made
Do you wish to set new defaults (Y or N) N            RETURN - Proceed
                                                      FN/TAB - Exit
```

Figure 3-17.   Current Platter Use (Applying Protection on CS-D/N Surfaces) Screen

5. Continue by pressing one of the following keys and then press RETURN:

   – Press N to return to the screen in Figure 3-15.

   – Press Y to set the new protection values.

   You proceed to the screen in Figure 3-17.

```
                Current  Platter  Use
                  DS  Surfaces

Disk     Index  Current  Catalog  Pro-  Disk     Index  Current  Catalog  Pro-
Address  Size       End  Maximum  tect  Address  Size       End  Maximum  tect

D30      7          253     1231  Soft  D70      5          8        200  No
D31      24        6716    65000  Soft
D32      24        6824    65000  Soft
D33      24        4534    65000  Soft
D34      24        7408    65000  No
D35      24        9655    65000  No

Highlighted fields denote changes made              RETURN - Proceed
Desired Protection Applied                          FN/TAB - Exit
```

Figure 3-18.   Current Platter Use (Protection Applied on CS-D/N Surfaces) Screen

4
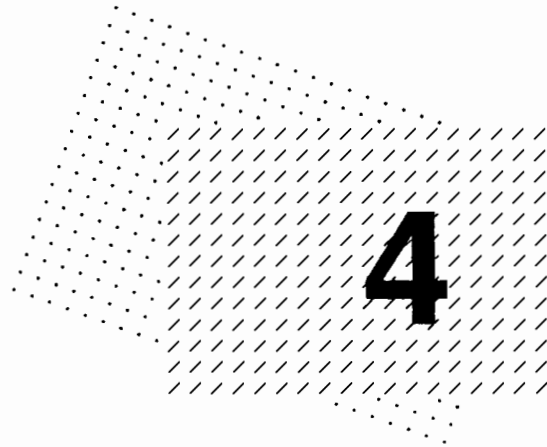
Operating the CS-D/N

Overview

This chapter introduces you to the operation of the CS-D/N. It includes general instructions for running preprogrammed software modules and provides information on using the CS-D/N workstation as a calculator. In addition, this chapter presents a sample BASIC-2 program, along with an explanation of the program itself and the procedures for entering, running, and saving the program.

Running Software Packages

You can easily run preprogrammed software packages on the CS-D/N. Most Wang software packages contain starting modules named START, although some have starting modules with other names. Check the manual supplied with your software package for the required module name.

Loading the Starting Module

To load the starting module, insert the program diskette in the CS-D/N diskette drive or the DS diskette drive and use one of the following procedures:

- If the software packages contain the file START, follow these steps:
    a. Press SHIFT and RESET.
    b. Enter the following

        ```
        SELECT DISK hhh
        ```

        where hhh is the name of the diskette containing the software package.

    c. Enter the following command to clear memory, load the starting module, and begin program execution

        ```
        LOAD RUN (RETURN)
        ```

- If the software package does not contain the file START, enter the following commands:

    ```
    CLEAR (RETURN)
    LOAD RUN [/disk address], "xxxxx" (RETURN)
    ```

    where is "xxxxx" the name of the starting module.

Entering Data

During program execution, operator prompts usually appear on the screen. Remember the following facts when responding to these prompts:

A displayed question mark – In general, indicates that the CS-D/N expects a keyboard entry.

A numeric value – Enter a maximum of 10 digits, a decimal point, a sign, and a signed 2-digit exponent. (The program itself can impose more restrictive limits on a response.) If you are entering a sign, it must precede the digits. Use the letter E to mark the beginning of the exponent. The following examples are acceptable numeric entries:

```
25.15
-79.5
4.56E4
+23.2437E-12
```

An alphanumeric response – Enter any keyboard characters except some sequences containing commas and double quotes. (Refer to INPUT statement in the *Multiuser BASIC-2 Language Reference Manual*.) Most software packages remove the restrictions imposed by the INPUT statement by using the KEYIN statement or the LINPUT verb.

To correct a response to a prompt before you enter it – Use the Edit mode key (see Chapter 2).

When you have typed a response and it appears in the form you want – Press RETURN to enter the response and terminate the keyboard entry.

After you enter a response – The CS-D/N can signal an error condition with a message in the form of ERR Yxx, where Y represents a letter prefix of the error class and xx represents an error number (see Appendix E for a discussion of system execution error messages). The CS-D/N displays an English description of the error and a question mark. To continue, check the form of the response and enter another.

Using the CS-D/N in Immediate Mode

The CS-D/N can resemble a calculator when you enter a BASIC-2 statement without a preceding line number. To perform quick calculations, you can enter unnumbered, single, or multiple-statement lines in Immediate mode. To display the results, use the PRINT statement. If the system detects no syntax errors, it executes an Immediate mode statement when you press RETURN. For example:

```
:PRINT 25 + 273 (RETURN)
:298
```

In this example, when you press RETURN, the CS-D/N immediately executes the line, evaluates the expression 25 + 273, and displays the result. The CS-D/N does not save the line in memory.

You can enter multiple-statement lines (individual statements separated by colons) in the Immediate mode. For example:

```
:PRINT 3 + 8:  PRINT 15/9:  PRINT 144/4.2
```

Upon execution, the screen displays

```
11
1.666666666667
34.28571428571
```

To edit an Immediate mode statement, use the function keys along the top of the keyboard. First press the EDIT key, located in the top right corner of the terminal keyboard, to activate the editing capabilities of these keys. For example, pressing the EDIT key then pressing the RECALL key causes the most recently entered Immediate mode statement to appear on the screen. You can then edit and re-execute it. For an explanation of the capabilities of these keys, refer to the *Multiuser BASIC-2 Language Reference Manual*.

Arithmetic Operations

The CS-D/N can operate on numeric quantities as large as 9.99×10^{99} and as near to zero as 10^{-99}. You can represent these quantities (which can be positive or negative) within this range by a maximum of 13 digits, a decimal point and sign, and a two-digit positive or negative integer exponent. The letter E in a quantity indicates times ten raised to the power of.

The arithmetic symbols, or operators, of BASIC-2 are as follows:

```
+ addition
- subtraction
* multiplication
/ division (5/4 reads 5 divided by 4)
↑ exponentiation (5 ↑ 4 reads 5 raised to the 4th power)
```

Arithmetic symbols can link any number of variables and constants in an expression. The underlined expressions that follow are some simple examples:

```
PRINT 12/7
PRINT 23*110000*32.1*4
PRINT 63/22.5E23
PRINT 4↑23
```

The CS-D/N evaluates expressions that use the same arithmetic operators left to right. For expressions with mixed arithmetic operators, the CS-D/N observes the following priorities of evaluation:

1. All exponentiation (↑) is performed left to right.
2. All multiplication and division is performed left to right.
3. All addition and subtraction is performed left to right.

The CS-D/N checks the validity of all combinations of constants and variables connected by arithmetic operators in this order. At each stage of evaluation, you must define the operation for the given values. This operation must yield a valid numeric quantity. For example, the expressions in Table 4-1 are invalid for the reasons shown.

Table 4-1.   Invalid Arithmetic Expressions

Invalid Expression	Reason
(3.4E26*4) /9.7E17	3.4E26*4 yields an invalid numeric quantity of 10^{100}.
17/((4*5)-20)	After evaluating ((4*5)-20), the system attempts to divide 17 by 0, an undefined operation.
(-3) ↑ 3.5	The exponentiation (↑) operation is undefined for non-real results.

If the result of evaluating an expression or a portion of an expression yields a quantity Q in the following range, the value Q is zero.

$$-10^{-99} < Q < 10^{-99}$$

BASIC-2 Functions

A BASIC-2 function is a special type of instruction that accepts a given value and returns a unique value. If you include the function in a PRINT statement, the CS-D/N displays the result. PRINT SQR(55), for instance, prints the square root of 55.

Table 4-2 lists some BASIC-2 functions that you can use in Immediate mode.

Table 4-2.   BASIC-2 Functions

Function	Result
ARCCOS	Returns the arccosine of an expression.
ARCSIN	Returns the arcsine of an expression.
ARCTAN (or ATN)	Returns the arctangent of an expression.
EXP	Finds the value of E raised to the value of the expression.
LOG	Returns the natural logarithm of an expression.
SIN	Returns the sine of an expression.
SQR	Finds the square root of an expression.
TAN	Returns the tangent of an expression.

For an explanation of other BASIC-2 functions and keywords, see the *Multiuser BASIC-2 Language Reference Manual*.

Numeric Variables

When you use the CS-D/N in Immediate mode, you can assign values to variables and perform operations on those variables. To designate a numeric variable in BASIC, use a letter of the alphabet A through Z or a letter followed by a single digit you assign such as A0, A1 through A9, B0, B1 through B9, C0, C1 through Z7, Z8, and Z9A.

The letters in variables must be uppercase. Variables such as A and A0 are distinct. There are 286 numeric variables available for use in BASIC-2. You can assign any legal numeric value to a numeric variable.

Variables retain their values until you explicitly clear them from memory or assign them new values. The commands CLEAR, RUN, and LOAD RUN are some of the commands that cause the CS-D/N to clear variables from memory.

Remember that when you assign variables in Immediate mode the values stored in variables can change. Perform Immediate mode operations involving variables only at times when you know that disturbing the values stored in the program-created variables causes no harm. While running a program, refrain from performing Immediate mode calculations that involve variables, unless the author of the program has specifically documented that Immediate mode operations do not adversely affect the operation of the program.

For further information on BASIC-2 variables, refer to the *Multiuser BASIC-2 Language Reference Manual* or *Programming in BASIC*.

Entering and Running a BASIC-2 Program

Programming on the CS-D/N using BASIC-2 is not difficult. You can learn the simple syntactical rules and most frequently used commands very quickly from reading Programming in BASIC. With this knowledge, even a beginner can write simple, functional programs. Further reading and practice can help with the more advanced BASIC-2 commands and features. The *Multiuser BASIC-2 Language Reference Manual*, the prime source of the wide variety of commands, functions, and statements to which the CS-D/N responds, discusses the many BASIC-2 programming features that can make programs more powerful and efficient.

This section explains how to enter and run a simple program, list it on the CRT screen and printer, save it on disk, retrieve it from disk and modify it, and resave it on disk.

Entering the Program

The sample program illustrated in this section enables the CS-D/N to function like a simple calculator. When the CS-D/N is executing the program, you enter two numbers on the keyboard and indicate the operation to perform. The CS-D/N then displays the answer on the CRT screen. The program performs the following BASIC-2 functions:

- Instructs the CS-D/N how and where to store information that you entered or produced by processing
- Displays prompts on the screen
- Accepts your input from the keyboard
- Processes entered data according to a defined formula
- Displays results on the screen

To enter a program line, type a line number, followed by one or more BASIC-2 statements and their operands. Press RETURN to terminate each line. When you press RETURN, the CS-D/N saves the entire line in memory.

You should number program lines in multiples of 10. Then, you can insert new lines between already existing lines by assigning the new line an intermediate statement number. When you enter such a line number on the keyboard, the CS-D/N places it in its proper place in the program. The computer normally executes these statements in sequential order, though several BASIC-2 statements allow you to change the order of execution.

Type the following program, pressing the RETURN key after each line:

```
10   DIM A$1

20   INPUT "WHAT TYPE OF OPERATION (+,-,X,/) DO YOU WANT TO
PERFORM", A$

30   INPUT "ENTER FIRST NUMBER", A

40   PRINT A; A$; " ";

50   INPUT B

60   IF A$= "+" THEN GOTO 170

70   IF A$= "-" THEN GOTO 180

80   IF A$= "X" THEN GOTO 190

90   IF A$= "/" THEN GOTO 200

100  GOTO 20

110  PRINT A; A$; B; "EQUALS"; C

120  INPUT "DO YOU WANT ANOTHER OPERATION", B$

130  IF STR(B$,1,1) = "Y" THEN 20

140  IF STR(B$,1,1) = "N" THEN 160

150  GOTO 120

160  END

170  REM ADDITION:   C=A+B: GOTO 110

180  REM SUBTRACTION:   C=A-B: GOTO 110

190  REM MULTIPLICATION:   C=A*B: GOTO 110

200  REM DIVISION:   IF B< >0 THEN 220

210  PRINT "DIVISION BY ZERO IS AN ILLEGAL OPERATION, START
AGAIN

PLEASE": GOTO 20

220  C=A/B: GOTO 110
```

Listing the Program

To review the program entered in memory, enter the following command:

```
LIST
```

This command lists the entire program on the CRT one screen at a time. You must press RETURN when ready to review each subsequent screen. LIST [line number] lists the specified line only; LIST 10, for example, lists only line 10. When you direct output to some device other than the CRT, the LIST S command lists the program one screen at a time.

To obtain a hardcopy listing of the program, turn on the printer and press the SELECT switch. When you select the printer, its SELECT switch indicator lamp is lit. Enter the following command from the keyboard to select the printer for listing:

```
SELECT LIST 215
```

This statement changes the default output address from the primary address 005 (the CRT) to the address 215 (the system printer). Next, enter LIST and press RETURN. Program listings formerly displayed on the CRT are now listed on the printout. To again obtain program listings on the CRT, enter the following command:

```
SELECT LIST 005
```

Next, enter LIST and press RETURN. If you attach a local printer to the rear of a terminal, access it at address 204. For further discussion of the SELECT statement and its various parameters, refer to the *Multiuser BASIC-2 Language Reference Manual* and the individual printer manuals.

Running the Program

Once the CS-D/N saves the program, press RUN and then RETURN to execute it. (Note that memory saves the program text each time that you press RETURN.) When you press RUN, followed by the RETURN key, the screen displays the following prompt:

```
WHAT TYPE OF OPERATION (+,-,X,/) DO YOU WANT TO PERFORM?
```

As an example, enter +. The screen displays the following prompt:

```
ENTER FIRST NUMBER?
```

Enter 25. The screen displays the following prompt:

```
25 + ?
```

Enter 75. The screen displays the following prompt:

```
25 + 75 EQUALS 100

DO YOU WANT ANOTHER OPERATION?
```

Enter YES. The program once again asks, WHAT TYPE OF OPERATION (+,-,X,/) DO YOU WANT TO PERFORM?

The program recognizes an attempt to divide by zero. Enter /. When the screen displays ENTER FIRST NUMBER?, type 100. The following prompt appears on the screen.

```
100 /?
```

Enter 0. The screen displays the following prompt:

```
DIVISION BY ZERO IS AN ILLEGAL OPERATION.   START AGAIN PLEASE.
WHAT TYPE OF OPERATION (+,-,X,/) DO YOU WANT TO PERFORM?
```

The program continues processing until you enter NO or N to the question, DO YOU WANT ANOTHER OPERATION?

Saving the Program on Diskette

To save this program on diskette, load a new diskette into the diskette drive, format it, and establish a catalog as detailed in Chapter 3. Enter the following command:

```
SAVE T/xxx, ADDING
```

where xxx is the device address of the diskette where you want the program saved. Then enter the command, LIST DCT. The screen displays

```
INDEX SECTORS = 00020
END CAT. AREA = 01023
CURRENT END   = 00033

NAME     TYPE    START    END     USED    FREE
ADDING    P      00029    00033   00005   00000
```

Listing the Catalog Index verifies that the program is in fact saved on the diskette.

For more information on saving programs on diskette, refer to the *Multiuser BASIC-2 Language Reference Manual*.

Retrieving the Program From Diskette

To retrieve the program from diskette, type the following command:

```
SELECT DISK xxx
```

where xxx is the device address of the disk containing the program you want retrieved. The CS-D/N selects the system diskette drive. Then, type the following command:

```
LOAD RUN "ADDING"
```

The CS-D/N loads and then runs the adding machine program.

Modifying the Program

There are several ways to improve the adding machine program. One of the major difficulties of the program occurs when you enter something other than +, -, X, or / in response to the prompt for the type of operation. If, for instance, you entered 999 in response to WHAT TYPE OF OPERATION (+,-,X,/) DO YOU WANT TO PERFORM?, two events occur. First, the program cuts off the last two nines, because of the DIM statement in line 10. Second, when the program executes line 40, 9 actually appears on the screen in place of an operational sign. The program continues processing until it reaches line 100. At that point, since the value of A$ is not +, -, X, nor /, the program loops back to line 20 to request the type of operation again.

You can use the LINPUT statement to avoid the first situation. The POS function can rectify the second. Follow these steps.

1. Replace line 20 with the following statement:

    ```
    :20 LINPUT "WHAT TYPE OF OPERATION (+,-,X,/) DO YOU WANT TO
    PEFORM"-A$
    ```

2. Insert line 25 as follows:

    ```
    :25 IF POS("+-X/"=A$) = 0 THEN GOTO 20
    ```

3. Delete line 100 by typing

    ```
    :100
    ```

When you run this version of the program, the LINPUT statement in line 20 causes an underscore to follow the prompt to enter the operational sign. The LINPUT statement also ensures that you only enter one character in response to this prompt.

The POS function causes the system to locate the position of the variable A$ in the character string "+-X/". If you enter + for the variable A$, POS ("+-X/"=A$) equals 1, since + is in the first position of the character string in the POS function. Likewise, -, X, and / equal 2, 3, and 4, respectively. Any character other than one of these has no position in the character string and is equal to 0. If you enter such a character, the IF/THEN statement in Line 25 causes the program to go back immediately to line 20 and request the operational sign again.

For more information on the LINPUT statement and the POS function, refer to the *Multiuser BASIC-2 Language Reference Manual*.

Resaving the Modified Program

To resave the modified program, enter

```
RESAVE T/D10, "ADDING"
```

T/xxx is the device address of the modified program. This command copies the new version of the program called ADDING over the old version, saving it under the same name. Subsequently, when the CS-D/N executes LOAD RUN T/xxx, "ADDING", it loads the new version of the adding program.

Explanation of the Program

The following section examines the adding machine program in detail and discusses the use and purpose of each BASIC-2 command.

Line 10:

```
10 DIM A$1
```

The DIM statement is a dimension statement. It limits the length of the information that you can store in variable A$. This statement guarantees that, if you entered an inappropriate response such as + + + + + + + to the question WHAT TYPE OF OPERATION (+,-,X,/) DO YOU WANT TO PERFORM?, the adding machine program would not generate a prompt on the screen such as

```
44 + + + + + + + + ?
```

The dimension statement causes the CS-D/N to cut off the seven extra plus signs and store a variable of only one character long. As a result, the screen displays

```
44 + ?
```

There are many other uses of the DIM statement. For more information on the DIM statement, refer to *Programming in BASIC* and the *Multiuser BASIC-2 Language Reference Manual*.

Lines 20 and 30:

```
20 INPUT "WHAT TYPE OF OPERATION (+,-,X,/) DO YOU WANT TO PER-
FORM",A$

30 INPUT "ENTER FIRST NUMBER", A
```

The INPUT statements are the computer's way of receiving information from you. The CS-D/N stores the information you entered, such as A$ and A, in this program.

A$ is called an alphanumeric variable. You can distinguish alphanumeric variable names from numeric variable names by a dollar sign ($) immediately following the variable name. Alphanumeric variables can contain any kind of character: letters, digits, or special characters. You should not use them in mathematical computations, for they do not necessarily contain numbers. This program uses A$ to store the character +, -, X, or /. (For more information on variables, refer to the *Multiuser BASIC-2 Language Reference Manual.*)

The quoted phrases in statements 20 and 30 are called literals. In such a statement, the literal prompts you to enter the first number of the arithmetic operation. The INPUT statement automatically displays a question mark following the prompt. (BASIC-2 does not require the literal in the INPUT statement.) If you do not enter the literal, the INPUT statement simply displays a question mark. However, a lone question mark is of little use to someone who does not know the program. It is a good idea to always provide prompts. The literal in the INPUT statement is one means of providing prompts.

For more information on the INPUT statement, refer to *Programming in BASIC* and the *Multiuser BASIC-2 Language Reference Manual.*

Lines 40 and 50:

```
40 PRINT A; A$; " ";
50 INPUT B
```

The PRINT statement causes values and literals to appear on the CRT screen. It can also determine the spacing of the printed material. A comma causes the CS-D/N to display elements in zones, each 16 characters wide. This is ideal for charts, in which you must arrange figures in columns and rows, but it is not convenient for this program. This program uses a semicolon instead which leaves no additional spaces between printed elements.

In line 40, the PRINT statement instructs the computer to display the current value of variables A and A$. As in the INPUT statement, the screen displays the literals (those characters and phrases contained in quotation marks) as you wrote them in the program line (even if the literal is a blank space, as in line 40).

For more information on the PRINT statement, refer to *Programming in BASIC* and the *Multiuser BASIC-2 Language Reference Manual.*

The INPUT statement in line 50 (an example of an INPUT statement not containing a literal) causes the question mark to appear on the screen. For example, when you run the program as in the previous section, 25 + ? appears. The value of A is 25, and + is the value of A$. The space after the plus sign results from the coding of the literal space, " ", in line 40. The question mark results from the INPUT statement. The CS-D/N places the question mark immediately after the literal space because of the semicolon in line 40.

Lines 60 to 90:

```
60 IF A$ = "+" THEN GOTO 170
70 IF A$ = "-" THEN GOTO 200
80 IF A$ = "X" THEN GOTO 210
90 IF A$ = "/" THEN GOTO 220
```

The CS-D/N does not have to execute program instructions in statement numeric sequence; you may want to direct the computer to execute statements out of sequence. The adding machine program demonstrates two ways of altering the sequence of program execution. Lines 60, 70, 80, and 90 use the IF/THEN statement. This statement causes the CS-D/N to divert execution to the portion of the program that handles the appropriate arithmetic operation specified in variable A$. The program later uses another statement, GOTO, to redirect the order of program execution.

Lines 60, 70, 80, and 90 test the value you entered for the alphanumeric variable, A$. They determine what operation you want to perform on the values assigned to variables A and B. This test lets the CS-D/N branch to a special routine for each operation. In the special routine, the CS-D/N can compute the solution of the operation, store it in a variable, and return it for processing in line 110 as screen display.

When A$ has a value of +, the program transfers control to the addition routine at line 170. When A$ has a value of -, the program transfers control to the subtraction routine at line 180. When A$ has a value of X, the program transfers control to the multiplication routine at line 190. When A$ has a value of /, the program transfers control to the division routine at line 200.

Line 100:

```
100 GOTO 20
```

If you enter any value other than +, -, X, or / for A$, the computer falls through statements 60, 70, 80, and 90 to line 100, where the GOTO statement sends the program control back to line 20. This GOTO statement ensures that you enter an operational symbol.

For more information on the GOTO statement, refer to *Programming in BASIC* and the *Multiuser BASIC-2 Language Reference Manual*.

Line 110

```
110 PRINT A; A$; B; "EQUALS "; C
```

In line 110, as in line 40, the PRINT statement includes variable values and a literal. Here, there are three numeric variables (A, B, and C), an alphanumeric variable (A$), and a literal ("EQUALS").

Line 120

```
120 INPUT "DO YOU WANT ANOTHER OPERATION", B$
```

Line 120 requests a value for alphanumeric variable B$.

Lines 130 to 160

```
130 IF STR(B$,1,1) = "Y" THEN 20
140 IF STR(B$,1,1) = "N" THEN 160
150 GOTO 120
160 END
```

Lines 130 and 140 introduce another function of BASIC-2 (STR), that is, isolating a particular character from an alphanumeric string. In this case, the program examines the value of the first character in variables B$ for the character "Y" or the character "N". By examining the first character of the string instead of every character, lines 130 and 140 let the program continue. You can enter the abbreviated answer Y or N to the question asked in line 120.

In short, line 130 means that if the first character of the variable B$ is equal to Y, the program should go to line 20. If you enter Y or YES (or, because of first-character isolation, any word beginning with Y), the program sends control back to line 20. Line 140 exihibits similar logic. In this case, if the first character of the response is N, the program sends control to statement 160, an END statement, causing the program to end.

However, if the first character of B$ is other than Y or N, the program falls through to line 150. There, the program sends control back to line 120. This procedure guarantees that you respond correctly, provided that the first character of the response is either Y or N.

For more information on the STR function, refer to the *Multiuser BASIC-2 Language Reference Manual*.

Lines 170 to 190:

```
170 REM ADDITION:  C=A+B:  GOTO 110
180 REM SUBTRACTION:  C=A-B:  GOTO 110
190 REM MULTIPLICATION:  C=A*B:  GOTO 110
```

These three lines are examples of multiple-statement lines. In each, the lines group together three short statements, separated by colons. You can group together short statements to keep the program from growing too large and to aid in program clarity.

The purpose of the REM statement is to document the program. Here, REM ADDITION labels the portion of the program that computes addition problems. A REM statement is nonexecutable and is ignored by the CS-D/N when you run the program; however, the screen displays it whenever you list a program.

For more information on the REM statement, refer to *Programming in BASIC* and the *Multiuser BASIC-2 Language Reference Manual*.

Lines 200 to 220:

```
200 REM DIVISION:  IF B< >0 THEN 220

210 PRINT "DIVISION BY ZERO IS AN ILLEGAL OPERATION.  START
AGAIN PLEASE":  GOTO 20

220 C=A/B:  GOTO 110
```

The program gives the division routine three lines to ensure that you do not enter zero as a divisor. If Lines 200 and 210 did not exist, a computational error code (C62 or C63) would appear on the screen, and the program would immediately terminate.

The IF/THEN statement in line 200 is another statement used to instruct the program to process statements out of sequence. Here, line 200 tests to determine whether the divisor, B, is less than or greater than zero. If the divisor is not zero, this statement is true, and the program skips to line 220, where the program computes the quotient and sends control back to line 110 for display. If the divisor is zero, this statement is false, and the program falls through to line 210, the screen displays the message, and the program sends control back to line 20. As result, the program does not perform the division computation.

For more information on the IF/THEN statement, refer to *Programming in BASIC* and the *Multiuser BASIC-2 Language Reference Manual*.

5

System Errors and Recovery

Overview

This chapter describes CPU hardware errors and general system errors. It also describes the procedures for error recovery and explains how to use the hardwarediagnostics to help identify any potential problems.

Types of System Errors

The CS-D/N is designed to be as trouble free as possible. However, you can encounter problems from time to time. The CS-D/N provides error messages to help you identify them. These messages consist of an error code and a brief description of the problem (see Appendix E for the different error messages).

Two types of system errors can occur on the CS-D/N: CPU hardware errors that indicate malfunctions in the CPU hardware (registers, user and controlmemory, etc.), and general system errors that indicate an illegal operation or an operation the CS-D/N cannot perform. The CPU performs two different types of corresponding system error diagnostics: the CPU hardware error diagnostics and the general system error diagnostics.

CPU Hardware Errors

If a CPU hardware error occurs, write down the error message displayed at Terminal 1. This error information lets the Wang service representative quickly locate the malfunctioning components if the general recovery procedures outlined later in this chapter cannot correct the error, or if the error recurs intermittently. When the general procedures fail, try the specific procedures discussed in Appendix E. If the procedures in Appendix E fail or the error conditions recur, call your Wang service representative.

The CPU hardware error diagnostics detect and report any malfunction that occurs in the CPU hardware (e.g., registers, and user and control memory). The error-checking routines treat the entire CPU as a single unit (since memory errors can affect all users of the system). The current configuration scheme does not affect the error-checking routines or error-recovery procedures. Whenever the CS-D/N accesses a location in memory, it automatically performs a parity check to verify that the accessed memory contents are valid and the accessed location is not faulty.

Whenever you execute RESET or CLEAR, the CS-D/N automatically verifies the entire memory and alerts you to any memory error condition. If the CS-D/N discovers a hardware error, all the terminals sound an audible tone and Terminal 1 displays a system error message. Although you have several options, perform the corrective procedure for the hardware errors at Terminal 1.

General System Errors

General error messages indicate that you attempted an illegal operation or that the CS-D/N cannot perform a desired operation. To handle general system errors that are not hardware related, use program control in a user application program.

The CS-D/N handles the general error routines separately for each partition. The terminal attached to the partition in which the error occurred displays the error message. If the error occurs while the partition is running a background job, the CS-D/N suppresses the error message display until it releases the terminal to the background partition.

The CS-D/N signals general error messages by an audible tone and a display on the screen of the terminal attached to the partition in which the errors occurred. Error messages consist of a two-digit number with a letter prefix. An arrow points to the approximate location of the error in an Immediate mode or Program mode line. The CS-D/N also provides an English description of the error. For a detailed discussion of the types of general error diagnostics performed by the CS-D/N and the techniques for recovering from such errors, see the *Multiuser BASIC-2 Language Reference Manual*.

Error Recovery

When CPU hardware errors occur during master initialization, or after the operating system has assumed control of program execution, the CS-D/N can display several possible system error messages. Program control cannot handle these hardware errors.

A hardware error represents a system hardware malfunction that may be a one-time occurence. Any information that the CS-D/N supplies or receives after the hardware error has occurred may be invalid. You can perform the following when such errors occur:

- Master initialization recovery
- General hardware recovery

Master Initialization Error Recovery

When the system power is turned on, the bootstrap fails to display the complete MOUNT SYSTEM PLATTER PRESS RESET message on the screen. This condition usually indicates a CPU-related or I/O-related error.

1. Turn off the system power and check the cabling and device addresses. Wait five seconds, then power up the CS-D/N again. Do not turn off the terminal when performing this procedure.

2. Respond to the KEY SF? message by pressing a function key. The following errors can occur:

   - The hex-digit display of the function key does not appear on the screen. You did not press the function key firmly or you pressed the wrong function key. Press RESET and then press the function key again.

   - The KEY SF? message reappears on the screen. This error indicates that the CS-D/N could not locate the specified system file on the specified disk. Make sure that you properly mounted the system platter at the specified address and press the function key again.

   - The ***SYSTEM ERROR (DISK 00XX)*** PRESS RESET message appears. This error message indicates that you pressed the wrong function key or that a disk hardware error occurred (while the bootstrap was trying to load the disk file specified by the function key). Make sure that you properly mounted the platter. Press RESET and then the function key. If the general procedure fails, see "Disk Errors and Recovery Messages" in Appendix E for a specific recovery procedure.

If these general procedures fail, call your Wang service representative.

General Hardware Error Recovery

Whenever the operating system detects a memory error during its normal operation, the CS-D/N reports a system error message by an audible tone at each terminal and a display at Terminal 1. A memory failure causes the following message to appear at Terminal 1:

```
              ***SYSTEM ERROR (MMMM XXXX)***

PRESS RESET

                AECM - Addressing Error Control Memory

                AEDM - Addressing Error Data Memory

                BECM - Bit Error Control Memory

                BEDM - Bit Error Data Memory

where MMMM =    PECM - Parity Error Control Memory

                PEDM - Parity Error Data Memory

                REDM - Read Error Data Memory

                VECM - Verify Error Control Memory

                VEDM - Verify Error Data Memory

and    XXXX =   Location and Nature of Error
```

The general procedure used to recover from system errors in user and/or control memory is as follows.

When the PRESS RESET message appears on line 1 of the CRT, press RESET. The SF Key message appears on the CRT. Then choose one of the following three procedures:

Caution: Procedures 1 and 2 should only be used when there is no need to save the current contents of user memory. Procedure 3 should be used when you want to save the contents of user memory.

1. Select the diagnostic from the Start Up menu, or press SF'16 through '19 to load the diagnostic menu and choose the applicable diagnostic (see the section in this chapter that discusses Hardware Diagnostics).

   Although this procedure is recommended, execute Procedure Number 3 if the CS-D/N cannot reproduce the current contents of user memory and you must save it. If the CS-D/N does not discover any errors during the execution of the hardware diagnostics, presume the error condition to be transient. Proceed with Procedure Number 2. Note that in Procedure Number 2, the CS-D/N erases the contents of user memory.

2. First, power down and then power up the CS-D/N. Then press SF'00 through '03 to load BASIC-2 from Disk D11 (310), D10 (B10), D21 (320), or D20 (B20), respectively, to restart the system. Reconfigure the system with the @GENPART utility to resume multiuser operation.

Use this procedure when an unknown system error has compromised the system validity and you suspect the condition at fault is temporary and does not require execution of a diagnostic routine. For example, the CPU was jarred or a cable was stepped on or shaken loose.

3. Press SF'15 to resume normal operation, using the operating system and application program currently loaded. The CS-D/N will return (if possible) to Console Input mode and display the READY BASIC-2 message.

   Since the CS-D/N did not erase user memory, you can now determine the point in program execution where the system error occurred. Print out the key program variables.

   Caution: Undertake this procedure at your risk. If you perform a reset on one of the partitions, you may not be able to continue program execution from that point. Instead you must restart with a Run command. The hardware error can recur and the operating system may not function properly.

When the general procedures outlined here fail, refer to "Disk Error Messages and Recovery" in Appendix E for more detailed recovery procedures. If the detailed recovery procedures fail or a system error condition recurs, contact your Wang service representative.

Using the Hardware Diagnostics

The hardware diagnostics are a set of programs that exhaustively test the CPU hardware components and attempt to identify any malfunctions. To load the diagnostic program, select the CPU diagnostic at master initialization. You should execute the hardware diagnostic programs of this system:

- At least once every 60 to 100 hours of light-to-normal operation
- Whenever errors cause a suspected hardware malfunction
- Whenever a Wang service representative requests their execution

You can only run the diagnostics after master initialization or a system error has occurred. As with master initialization, you can only execute the hardware diagnostics at Terminal 1.

Execute the diagnostic routines as quickly as possible when you observe a suspected problem. The environmental conditions of the test should closely resemble those under which the problem occurred.

Caution: Since the diagnostic programs destroy the contents of user memory, save all valuable programs and data on disk prior to running the diagnostics.

To help your Wang service representative locate and correct any problems, obtain a hardcopy trace of the diagnostic run. Turn on the printer attached to the CPU during diagnostic execution, assign it either address 215 or 204, and then select it by pressing SELECT. If no errors occur, they will print under the appropriate diagnostic test title.

The diagnostics run continuously until you press RESET or the CS-D/N detects an error. When the CS-D/N detects an error, it stops diagnostic processing or displays an error message. For a discussion of possible error causes, see Appendix E. If a hardware error recurs, contact your Wang service representative.

Table 5-1 provides a functional description of each diagnostic. To select another diagnostic, press RESET (or make a selection from the diagnostic menu) and then press the appropriate function key (SF'16 through '19) after each. To reselect BASIC-2, press SF'00 through '05, or select the diagnostic from the start up menu and use menu control for the diagnostic selection.

Table 5-1.   Functions of the User Diagnostic

Diagnostic	Function
CPU	Tests the CS-D/N processor
Control Memory	Tests control memory
Data Memory	Tests data memory

Random, intermittent problems and permanent component failure are often due to static electricity, electromagnetic interference (EMI), temperature and humidity extremes, and excessive airborne dust and dirt. Prolonged operation in a poor environment produces permanent failure. Make every effort to secure an environment which, if not optimal, at least provides the operating conditions required for satisfactory system performance. Appendix D describes the required environmental conditions for optimal performance.

Loading the Diagnostics Menu (VLSI CPU Only)

To load the Diagnostics menu, turn off the CS-D/N. Then, turn the system on, press RESET, and then press one of the following function keys:

SF Key	Procedure
SF key '16	Load diagnostics from Disk D11 (or 310)
SF key '1	Load diagnostics from Disk D10 (or B10)
SF key '18	Load diagnostics from Disk D21 (or 320)
SF key '19	Load diagnostics from Disk D20 (or B20)

The following display appears after you select the Diagnostic menu (VLSI CPU only)

```
(SF key '16, '17, '18, or '19):

KEY SF'
USER DIAGNOSTIC MENU
'00 CPU DIAGNOSTIC              '02 DATA MEMORY DIAGNOSTIC
'01 CONTROL MEMORY DIAGNOSTIC
```

Press the appropriate function key to load the desired diagnostic.

The CPU Diagnostic

This diagnostic tests the CS-D/N processor. This test runs continuously until either an error occurs (the pass number stops incrementing) or you press RESET. If an error occurs, contact your Wang service representative. When a sufficient number of successful test passes have occurred (at least five to ten passes), press RESET. Press the appropriate function key to restore the Diagnostics menu to the screen, or to reload BASIC-2.

The Control Memory Diagnostic

This diagnostic tests the control memory. The CS-D/N repeats the control memory diagnostic tests until you press RESET. It displays or prints error messages whenever it discovers memory failures. When a sufficient number of successful test passes have occurred (at least five to ten passes), press RESET. Press the appropriate SF key to restore the Diagnostics menu to the screen, or to load BASIC-2.

The Data (User) Memory Diagnostic

This diagnostic tests data (user) memory. The CS-D/N repeats the user memory diagnostic tests until you press RESET. It displays or prints error messages whenever it discovers memory failures. When a sufficient number of successful test passes have occurred (at least five to ten passes), press RESET. At the completion of the diagnostic tests to pass control to the BASIC-2 operating system, press RESET. Then to load the operating system, press the appropriate function key.

The Turbo Diagnostic

For the Turbo system, load the diagnostic from the @BOOT menu. The following diagnostic test automatically starts to run until you press RESET. The @BOOT menu re-appears for you to load the operating system.

DRAM Double Word Pattern Test (Turbo Only)

This diagnostic tests the SRAM (Control Memory) and the DRAM (User Memory) by moving a byte pattern through all memory locations. It displays error messages whenever it discovers a memory failure by providing the location of the faulty SIMM. Upon successful completion of this test, the diagnostic automatically starts the next test.

DRAM Data Byte Fast Exchange Test (Turbo Only)

This diagnostic tests the Turbo's ability to read and write to the high-speed controller's memory. A memory address count is displayed as this test is running. If an error occurs, the test stops at the memory location that has failed. Upon successful competion of this test, the diagnostic automatically starts the next test.

System Interface Card Test (Turbo Only)

This diagnostic tests the ability of the CPU to interrupt each of its controllers to obtain the controller's diagnostic status. If the CPU cannot interrupt the controller, a failure message is displayed next to the controller affected. Upon successful completion of this test, the diagnostic automatically starts the next test. Upon successful completion of between five and ten test passes, press RESET.

6
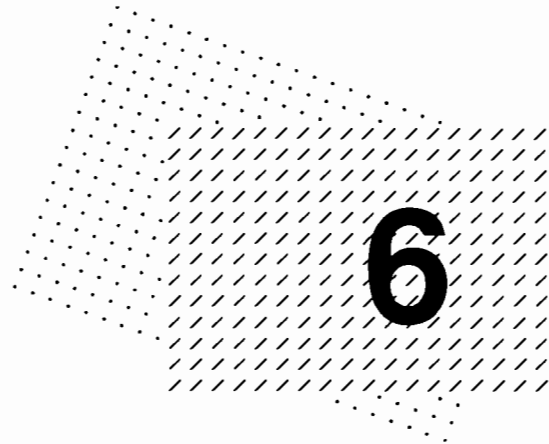
Using Diskettes

Overview

This chapter describes how to use diskettes with your diskette drive. It also explains how to care for, insert, format, and address your diskettes. Two methods forformatting diskettes are presented: Automatic File Cataloging Mode and Absolute Sector Addressing Mode.

Taking Care of Diskettes

Diskettes are a reliable and safe media for storing electronic information. However, if you do not handle diskettes properly, the information stored on them can be partially or totally lost. Therefore, you should make backup copies of all important diskettes using the System Utilities.

To properly care for your diskettes, follow these guidelines:

- Use a felt tip pen when you label a new diskette. Never use ball point pens or pencils. (They can scratch the diskette's surfaces.)

- Do not touch the exposed surfaces of the diskette.

- Keep your diskettes free from dust and dirt.

- Keep your diskettes away from any type of magnetic material (including placing diskettes on top of a terminal). Such exposure can erase or distort the information on a diskette.

- Do not fold, bend, or cause the diskettes to warp.

- Maintain an acceptable environment with temperatures between 50°
  and 125F° (10° and 52°C) and a relative humidity between 8% and 80%.
  Conditions that exceed any of these limits can physically change the
  recording surfaces making information irretrievable.

- Do not open the door of the diskette drive if the red indicator light, lo-
  cated on the front of the drive, is on. You can scratch the surface of a
  diskette while reading or writing to it.

Inserting a Diskette

Use the following steps to load your diskette into the drive:

1. Rotate the door release lever to the horizontal position. See Figure 6-1.
   The door snaps open.
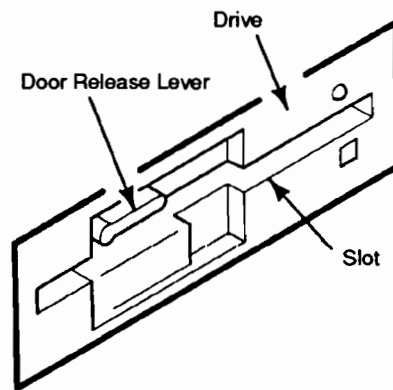
Figure 6-1.   Opening the Diskette Drive Door

2. Grasp the diskette from the edge opposite the write-protect slot and slip
   it into the slot in the drive. See Figure 6-2. Be sure that the edge of the
   diskette closest to the recording slot enters the drive first. Use the In-
   sert arrow on the orientation label to confirm that the position of the
   diskette is correct as you insert it in the drive. Slip the diskette com-
   pletely into the drive.
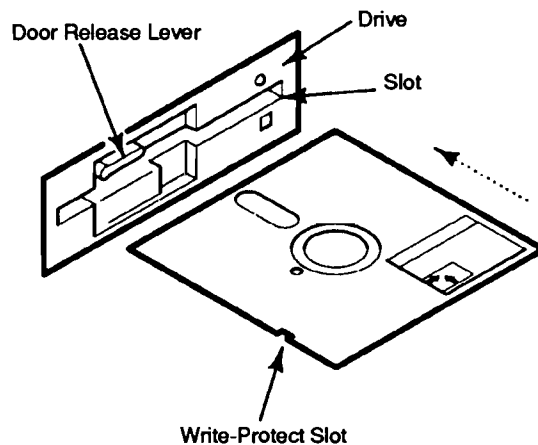
Figure 6-2.   Inserting a Diskette

3. Close the diskette drive door. The diskette is now ready to use.

Diskette Formats

Before you can store information on a diskette, you must format it. Formatting allocates fixed-length storage areas, called sectors, on the diskette. The standard format for BASIC-2 disk operations uses 256-byte sectors. You should use this format for normal CS, CS-D/N, and 2200 MicroVP operations.

The 5 1/4-inch diskette also supports the Wang PC (Professional Computer) 512-byte sector format. You can interchange data between the Wang CS, CS-D/N, or MicroVP and Wang PC systems. The 512-byte sectoring is transparent to the CS-D/N Operating System. (The system maps two 256-byte logical sectors into one 512-byte physical sector.) BASIC-2 accesses diskettes with the PC format as if you formatted them with 256-byte sectors. You can perform all BASIC-2 disk operations.

Although the 512-byte format provides more diskette capacity, Wang Laboratories. Inc., does not recommend its use for normal CS-D/N operations because disk write operations are considerably slower when using this format.

A 320-KB diskette drive formats a 256-byte sector diskette into 320 KB and a 512-byte sector diskette into 360 KB. A 1-MB diskette drive formats 256-byte sector and 512-byte sector diskettes into 1.2 MB. The 1-MB diskette drive cannot format 320-KB nor 360-KB diskettes but it can read both 320-KB and 360-KB diskettes. However, Wang Laboratories, Inc., does not recommend using write operations on them. A 320-KB drive may not be able to read 320-KB and 360-KB diskettes written by a 1-MB diskette drive.

Diskette Drive Addressing

The address of the diskette drive depends on the base address of the CS-D/N unit. Table 6-1 lists the available address for the diskette drive. The CS-D/N reserves these addresses strictly for diskette drive use. You cannot assign these addresses to another platter nor assign the diskette drive to a different address.

Table 6-1.   Diskette Drive Addresses

CS-D/N Base Address	Diskette Drive Address
/D10	/D10
/D20	/D20
/D30	/D30

If you connect a DS Data Storage Cabinet to the CS-D/N, you must assign the diskette a different device address than the CS-D/N. For example, if you selected 10 for the CS-D/N, use either 20 or 30 for the DS Data Storage Cabinet.

Using the Diskette Drive

You must format a new diskette before you can use it to store information. Formatting a used diskette destroys any information recorded on the diskette. For this reason, you should only format a used diskette when you no longer need the information on the diskette.

The CS-D/N or DS uses either a 5 1/4-inch, 320-KB or a 1-MB double-sided double-density (DSDD) diskette drive.

Each diskette has a write-protect slot (also called write-enable) that prohibits writing over information already stored. You can protect valuable programs or data from inadvertent loss by using the write-protect tabs. To write-protect the diskette, place one of the adhesive tabs supplied with the diskettes over the write-protect slot. Now you can read information from the diskette but cannot write information onto it.

All blank diskettes are manufactured without the tabs covering the write-protect slots. Diskettes can accept data only when you leave the write-protect slot uncovered. Therefore, you must uncover the write-protect slot before formatting the diskette.

Formatting a Diskette

You can format a diskette by using either the $FORMAT DISK statement in the BASIC-2 language or by running the Wang Format utility.

Format Utility

To format a diskette using the Wang Format utility, perform the following steps:

1. Remove the diskette from its envelope. Make sure that the write-protect slot is uncovered.
2. Orient the diskette properly, as indicated by the Insert arrow on the label, before inserting it into the diskette drive. Be sure the diskette is firmly seated in the drive. Then close the drive latch.
3. Press the RESET button on the keyboard.
4. Initiate disk formatting. Mount the System Utilities and enter LOAD RUN. The CS-D/N displays a menu of utilities on the system disk.
5. Select the Format Platter utility and answer the questions the screen displays to format the disk platter. It takes approximately 45 seconds to format a 320-KB diskette; it takes approximately 2 minutes to format a 1-MB diskette.

Note: You can also perform a PC disk format with this utility.

BASIC-2 $FORMAT DISK Statement

Alternately, you may use the BASIC-2 $FORMAT DISK statement. The general form of the $FORMAT DISK statement is:

```
$FORMAT DISK T    file#
disk
```

For more information on the $FORMAT DISK statement, refer to the BASIC-2 Language Reference Manual.

Some examples of valid format statements are:

```
$FORMAT DISK T/D10
$FORMAT DISK T#1
where D10 is the address of the diskette drive.
```

Caution: Formatting overwrites all data previously stored on the disk. To prevent the accidental formatting of the wrong disk, use the Wang Format utility supplied with BASIC-2. This utility reduces the chance of accidentally formatting the wrong disk.

If formatting is unsuccessful, the CS-D/N indicates an error. Generally, format errors result from the following three causes:

- The drive latch is not tightly closed. (I93 error)
- The write-protect slot is covered. (I95 error)
- The diskette is defective. (I93 error)

Remove the diskette from the drive and format another one.

Note: If you cannot format a diskette, do not use it for storage. Discard it.

If the formatting procedure fails repeatedly, there could be a hardware problem with the diskette drive. Contact your Wang service representative.

Formatting a Diskette for Wang PC Interchange

In addition to the standard CS-D/N format, the diskette drive also supports the Wang PC format. To format a diskette with the Wang PC format, follow the procedure for the standard Format Utility. For the type of format, select type 2.

The Format Utility formats the diskette into 512-byte sectors. Formatting a diskette for PC interchange using a 320-KB diskette drive produces a 360-KB diskette. Formatting a diskette for PC interchange using a 1-MB diskette drive produces a 1.2-MB diskette.

Disk Access Modes

Once you format a diskette to contain the necessary sector information, you can use it to store data and programs. You can maintain information on CS-D/N diskettes in one (or both) of the following ways:

Automatic File Cataloging Mode – An indirect method in which you assign each program and data file a name. You may later access the program or data by this name, without referencing its specific location on the disk.

Absolute Sector Addressing Mode – A direct method in which you access each sector on the disk by providing the specific sector address.

To maintain data files, use the Automatic File Cataloging mode for most Wang software. Under Automatic File Cataloging, the operating system maintains a catalog on each disk. The catalog consists of a Catalog Area, which contains the program and data files, and a Catalog Index, which contains the name of each file and its location in the Catalog Area. Whenever you create a new file, the CS-D/N automatically records the file name and location. When you access a particular file, the CS-D/N automatically looks up the file name in the Catalog Index to determine the file's location. Thus, you do not have to remember the exact sector location of each file on disk. You only have to remember file names. To obtain the names of existing files, you can use a LIST DC statement.

Use Absolute Sector Addressing to record information on PC formatted diskettes. The Absolute Sector Addressing mode consists of eight BASIC-2 statements and commands that let you read or write information in specific sectors on a formatted disk. In this mode, you cannot create a Catalog Index nor reference programs and files by name. You can only identify files by reference to their starting sector addresses. Similarly, you must save or load records from a file by specifying a starting sector address. You are responsible for maintaining all file addressing information; the CS-D/N does not automatically index your files.

For detailed information on both modes of disk addressing, refer to the *Multi-User BASIC-2 Language Reference Manual*.

Defining a Catalog Index

In the Automatic Cataloging mode, you must create a Catalog Index on the diskette before you can store any programs or data. This process is called scratching the disk. A SCRATCH DISK statement performs this operation. Take care not to scratch a diskette with packaged programs or important files since a SCRATCH DISK statement overwrites a previous Catalog Index.

In a SCRATCH DISK statement, you specify the number of sectors to reserve for the Catalog Index and the last sector in the Catalog Area. The Catalog Index always begins at the first sector on a disk (sector numbering starts with zero) and occupies the number of sequential sectors that you specify. The Catalog Area begins immediately after the Catalog Index and occupies all sequential sectors up to and including the last sector you specify. You should specify the end of the Catalog Area as the last available sector on the disk.

To define the size of the Catalog Index, use the LS parameter in a SCRATCH DISK statement. For example, LS = 10 indicates that the CS-D/N reserves 10 sectors for the Catalog Index. If you do not specify a value, the default value is 24.

To specify the last sector in the Catalog Area, use the END parameter in a SCRATCH DISK statement. For example, END = 1279 indicates that Sector 1279 (the last accessible sector on a DSDD diskette, containing a total of 1280 sectors numbered from 0 to 1279) is the last sector the CS-D/N can use for the Catalog Area.

To scratch a diskette, perform the following steps:

1. Insert a formatted diskette in the diskette drive.
2. Enter a statement such as

   SCRATCH DISK'T/D10, LS = 20, END = 1279

3. Press RETURN. LS = 20 specifies that the CS-D/N reserves 20 sectors for the Catalog Index; END = 1279 specifies that Sector 1279 is the last sector that the catalog uses.

After you format and scratch a diskette, you can use it to store data and programs.

For further information on the SCRATCH DISK statement, refer to the *BASIC-2 Language Reference Manual* and the *Multi-User BASIC-2 Language Reference Manual*.

> ***Note:*** *You can use a LIST DC T /disk-address statement to check the size of the Catalog Index. If you enter the statement LIST DC T/D10 after scratching disk D10, the screen displays the following message:*

```
INDEX SECTORS = 00020'
END CAT. AREA = 01279
CURRENT END   = 00019
```

7

Using a Fixed Hard Disk Drive

Overview

This chapter describes how to use the fixed disk drive. It explains how to address, format, and back up fixed disks.

Understanding Fixed Disks

Fixed hard disks provide fast access to a large capacity of disk storage. Housed within the CS-D/N, fixed hard disks provide no removable media. For off-line storage, periodically back up information stored on fixed disks onto other devices with removable storage.

Since CS, CS-D/N, and MicroVP systems can access a maximum of 16 MB of data at one disk address, you should divide the larger fixed disks into a number of smaller disk platters and assign each platter a different disk address for a 2-byte addressing mode. With the CS/386 or CS/Turbo and a DS or DSPC Revision 4 prom, 3-byte addressing is possible. You can access more than 16 MB on the CS-D/N and DS fixed disks. Refer to chapter 3 in this manual "Master Initializing the CS-D/N/N" or to the *BASIC-2 Utilities Reference Manual* for additional information.

Table 7-1.   Fixed Hard Disk Platter Size

Fixed Hard Disk	Platters	Platter Size
20 MB	2	10 MB
32 MB	2	16 MB
64 MB	4	16 MB
140 MB	7	16 MB
140 MB	14	10 MB

Note: You can install the 140-MB fixed hard disk drive into either 7 platters at 16 MB each or 14 platters at 10 MB each.

Fixed Disk Addressing

The addresses of fixed disk platters depend on the base address of the CS-D/N. Table 7-2 lists the addresses that the CS-D/N allocates for fixed disk platters. CS-D/N units with a fixed disk use platter addresses starting at /D11, /D21, or /D31.

Table 7-2.   Fixed Hard Disk Platter Addresses

CS-D/N Base Address	Fixed Hard Disk Platter Address	
	Primary Address	Secondary Address
/D10	/D11 to /D1E	/D51 to /D5E
/D20	/D21 to /D2E	/D61 to /D6E
/D30	/D31 to /D3E	/D71 to /D7E ·

If you connect a DS Data Storage Cabinet to the CS-D/N, you must assign the fixed disk to a different device address than the CS-D/N. For example, if you selected 10 for the CS-D/N, use either 20 or 30 for the DS Data Storage Cabinet.

You can view the addresses of all devices included in the CS-D/N cabinet from the CS-D/N Configuration Utility. Access this utility from the Wang Utilities menu.

Using a Fixed Hard Disk Drive

As with any disk device, you must format and scratch each fixed disk platter the first time you use it. You should format a fixed disk platter only when you first use it, since formatting the disk overwrites all information contained on that disk.

Formatting a Fixed Disk

You can format a disk either by running the Wang-supplied @FORMAT utility or by using the $FORMAT DISK statement. The general form of the $FORMAT DISK statement is as follows:

```
$FORMAT DISK T  file#
disk
```

For example, if the address of the fixed disk is D11, enter a statement of the following form:

```
$FORMAT DISK T/D11
```

The CS-D/N takes approximately 22 minutes to format a 10-MB platter of a fixed disk. It takes approximately 35 minutes to format a 16-MB platter of a fixed disk.

> *Caution: Formatting a disk overwrites all data previously stored on the disk. To prevent the accidental formatting of the wrong disk, use the Wang-supplied @FORMAT utility.*

Defining a Catalog Index

The fixed disk drive supports both Automatic File Cataloging and Absolute Sector Addressing to control disk operations. (Refer to the section entitled "Disk Access Modes.") Wang Laboratories, Inc., recommends the Automatic File Cataloging mode for maintaining data files on the fixed disk.

The process of creating a catalog on the fixed disk is identical to that of creating a catalog on the diskette. The ending sector of the fixed disk is 38,911 for a 10-MB platter and 65,023 for a 16-MB platter in 2-byte addressing mode.

The following is a sample SCRATCH DISK statement (assuming an address of D11 for the fixed disk and 25 sectors for the catalog index):

```
SCRATCH DISK'T/D11, LS = 25, END = 65023
```

For a detailed explanation of the SCRATCH DISK statement, see the *Multi-User BASIC-2 Language Reference Manual* and the section entitled "Disk Access Modes" in Chapter 6.

> *Caution: If you have previously established a Catalog Index and Catalog Area, the SCRATCH DISK statement will overwrite the existing information on the disk.*

Installing System Files

If the fixed hard disk drive is the principal disk unit on the system, follow these steps to install the system files:

1. Load the system software from the system diskette.
2. Copy the system software onto a formatted and scratched fixed disk drive.

Now you can load the system programs from the fixed disk drive. The original system diskette can serve as a backup for the system disk. After you have copied the system programs onto the fixed disk, you can recopy the programs onto a separate diskette or a removable hard disk cartridge to create a duplicate copy of the System Software.

To copy system files from the diskette drive to the fixed disk drive, use the Install System Files utility provided on the system platter. To use this utility, follow these steps:

1. Type LOAD RUN and then press RETURN.
2. Select Install System Files from the menu.

The program provides prompts that ask you to supply the details of the file transfer. The Install System Files utility can only transfer system files, i.e., files with names that begin with the @ character.

After you have copied the system files onto the fixed disk, you can make extra backup copies of the software using this procedure:

1. Insert a formatted and scratched diskette into the drive.
2. Copy the system files onto the diskette from the fixed disk drive.

You can also use the Install System Files utility to update system files by overwriting existing system files. Since this utility overwrites only the specific files being changed and leaves the remainder of the disk intact, use it for system updates.

Backing Up a Fixed Hard Disk

Information on any disk or diskette can be lost through hardware failure, software problems, or operator error. Therefore, you should periodically back up important data. You can copy selected files onto a diskette or removable disk using the @MOVEFIL utility. You can back up an entire fixed disk using the @BACKUP utility. These utilities are located on the system platter. You can also back up a fixed disk by using the streaming tape cassette drive (refer to Chapters 9 and 10).

8
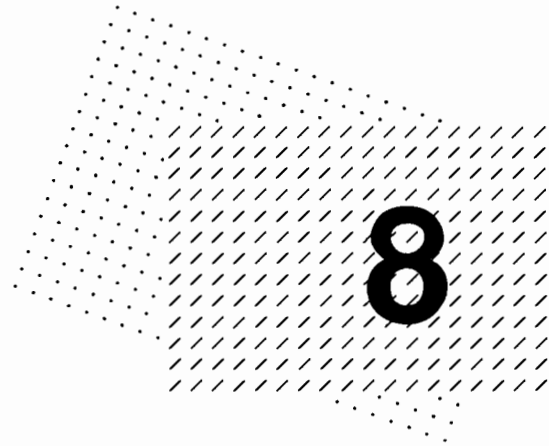
Using RAMdisk

Overview

This chapter discusses two types of temporary storage areas: CPU RAMdisk and Disk Storage Printer Controller (DSPC) or DS RAMdisk.

CPU RAMdisk

This section discusses the process of establishing and accessing CPU RAMdisk. You can use all standard BASIC-2 disk statements (except DISK TRACE) with CPU RAMdisk.

CPU RAMdisk is a portion of user memory that you can use to emulate disk storage. Access to CPU RAMdisk is considerably faster than access to an actual disk. Normal access time for CPU RAMdisk is 1.5 milliseconds per sector.

> *Caution: Since RAMdisk is not a permanent form of storage, you lose its contents when the CS-D/N loses power or when you deallocate it. Only place temporary files or files that have up-to-date backups located in permanent storage into RAMdisk.*

Setting up CPU RAMdisk

After youconfigure the CS-D/N using @GENPART, you can use all memory and memory not assigned to partitions for CPU RAMdisk. To specify an address for CPU RAMdisk, enter the address /340 into the Master Device Table using the @GENPART utility. As with other devices, you can assign CPU RAMdisk exclusively to a specified partition or to all partitions.

The CS-D/N uses the number and size of memory partitions that you configured to determine the size of the CPU RAMdisk. Each 1 KB of memory not used for partitions provides 4 RAMdisk sectors. For a description of the number of available sectors of CPU RAMdisk for a particular MB amount, refer to Table 8-1.

Table 8-1.   CPU Size Available

# of MB	Sectors
2 MB	4096
4 MB	12282
8 MB	28672
16 MB	57344

> *Note: If the configuration you defined allocates all of user memory for partitions, there is no memory left for CPU RAMdisk.*

Accessing CPU Ramdisk

After you master initialize the CS-D/N, CPU RAMdisk is available but contains no useful information. You must scratch it and copy or write files that you need to it. For example:

```
SCRATCH DISK T/340, LS=5, END=350
MOVE T/D10, "PROGRAM" to T/340,
MOVE T/D10, "OVERLAY" to T/340,
```

In the above example, SCRATCH DISK established a Catalog Index of 5 sectors for a 350 sector CPU RAMdisk. Then, the files "PROGRAM" and "OVERLAY" were copied to RAMdisk for quick access.

Before powering off or reconfiguring the CS-D/N, copy all information that you need to a real disk unit. You lose all information stored in CPU RAMdisk when you power off or reconfigure the CS-D/N.

DSPC or DS Ramdisk

This section describes how to establish DSPC or DS RAMdisk. It also explains the cache hit rate to help you determine the proper size for DSPC or DS RAMdisk.

You can set aside up to 900 sectors of cache memory (high-speed memory for temporary storage) for use as an onboard DSPC or DS RAMdisk. This RAMdisk has many potential uses such as storing frequently accessed program or data files, as a scratch area for programs that do sorting of data files, or as an area for storing messages used in CPU-to-CPU communications.

DSPC or DS RAMdisk Addressing

The platter address of the RAMdisk depends on the base address that you assigned to the CS-D/N or DS unit. Table 8-3 lists the addresses that you can assign to DSPC RAMdisk. The CS-D/N reserves these addresses strictly for DSPC RAMdisk use. You cannot assign another platter to these addresses nor assign DSPC RAMdisk a different address.

Table 8-2.   DS or DSPC RAMdisk Addresses

CS-D/N or DS Base Address	DS or DSPC RAMdisk Address
/D10	/D50
/D20	/D60
/D30	/ D70

Defining DSPC or DS RAMdisk

To define the RAMdisk, use the DS Allocation utility. This utility prompts you for the address of the DSPC or DS RAMdisk and the number of sectors you want to assign to it. Since you can only assign cache memory currently not in use to RAMdisk, define the RAMdisk as soon as you power on the CS-D/N or DS unit. If you try to define a RAMdisk after you use the CS-D/N, there may not be enough memory available to create a RAMdisk of the size you want.

Once you define the RAMdisk, you must deallocate it before you can change its size. To deallocate the RAMdisk, create a RAMdisk of zero sectors.

Caution: If you deallocate the RAMdisk, you lose its contents.

BASIC-2 Disk Command Support

Once you define the DSPC or DS RAMdisk of the CS-D/N, it responds to BASIC-2 disk commands (refer to *Multi-User BASIC-2 Language Reference Manual*). The DSPC RAMdisk supports all of the BASIC-2 disk commands including $FORMAT DISK, SCRATCH DISK, and VERIFY.

Specifying the DS or DSPC RAMdisk Address

To specify DSPC RAMdisk, access the DS or DSPC RAMdisk Allocation utility from the Wang CS-D/N Utilities menu. The first prompt requests specification of the DS RAMdisk address. Only use the following addresses: D50, D60, or D70 (refer to Table 8-1). After accepting the address, the utility checks the disk unit at the specified address to determine if it exists. If the disk unit specified is not a CS-D/N or DS, then the screen displays the message "Specified disk is not a part of a DS". Enter a new address.

If the disk is busy (i.e., in exclusive use by another user) or does not exist, the screen displays the message "Disk unavailable". If the disk is a CS-D/N, wait until the disk is available and then re-enter the disk address.

Allocating Cache Memory to DS or DSPC RAMdisk

Once you enter the address of the RAMdisk, the utility prompts you for the number of sectors to allocate to it. If you enter a number less than zero or greater than 900, the screen displays "Illegal DS RAMdisk size." In this case, you must re-enter the size of the RAMdisk.

If the CS-D/N does not have enough free cache to create the requested DSPC RAMdisk, the screen displays "Insufficient cache space available." You must re-specify the size of the DSPC RAMdisk.

If you try to allocate a RAMdisk in a CS-D/N unit where one currently exists, the screen displays the message "DSPC RAMdisk already allocated." To set up the new RAMdisk, you must first deallocate the old DSPC RAMdisk. To do this, enter a size of zero sectors. Once you de-allocate the old RAMdisk, you can allocate the new RAMdisk.

> *Caution: When you enter a size of zero sectors, you destroy all data currently in RAMdisk.*

CS-D/N Cache Usage Utility

This section describes the use of the Cache Usage utility. It allows you to monitor accesses made to the CS-D/N's cache and DSPC or DS RAMdisk. The Disk Processing Unit (DPU) counts the number of sector read and write requests it receives and keeps separate counts for RAMdisk and cache hits. The utility periodically reads the request counts from the DPU and uses them to update its display of cache and DSPC RAMdisk activity. Since you create the RAMdisk from cache memory, you can determine what size RAMdisk allows for optimal performance.

Starting the Utility

To run the Cache Usage utility, choose its entry on the Utility Menu and press RUN/EXEC. The first prompt requests that you supply the base address of the CS-D/N unit that you want monitored (refer to Table 8-3).

After accepting the address, the Cache Usage utility checks the disk unit at the specified address to determine if it is a Wang CS-D/N. If the disk unit specified is not a CS-D/N, then the screen displays the message "Specified disk is not a DS." Enter a new address.

If the disk is being used (i.e., in exclusive use by another user) or is not a CS-D/N, the screen displays the message "Disk unavailable". If the disk is a CS-D/N, wait until the disk is available and then re-enter the disk address.

> *Note: Do not run this utility in more than one partition at a time. You will encounter errors in both partitions.*

Cache Usage Display

The second screen of the Cache Usage utility displays the usage information in two sections: disk/cache usage and RAMdisk usage. The disk/cache usage section displays accesses made to diskettes and hard disks. A bar graph showing the cache hit rate indicates the number of reads of cached sectors and the number of actual reads from disk. The second section lists accesses made to DSPC RAMdisk.

To monitor usage, the utility periodically reads the access counts from the DSPC. Each time it reads the counts from the DPU, the DPU clears its count to zero. The utility keeps a running total of the number of accesses made by adding the counts from the DPU to its own counters. Then, the screen displays these counts and a bar graph indicating the cache hit rate.

If the utility determines that the size of the RAMdisk has changed, the screen displays the message "RAMdisk size changed." Press ERASE to clear the counts. (The totals displayed are no longer valid.)

Understanding the Hit Rate

To calculate the cache hit rate, divide the number of sector read requests that were cache hits by the total number of sector read requests. This number indicates the effectiveness of cache for the set of applications that made the accesses.

In order to achieve the best performance, the cache hit rate should be as close to 100% as possible. A hit rate of 100% indicates that cache is satisfying all accesses. Since accessing cache is much faster than accessing a disk, you have reached the optimum level of performance.

The actual hit rate achieved by any given set of applications is lower than 100%. It depends on how much of the available disk capacity you use and the manner you use to access it. You can expect a set of programs that randomly access a very large area of disk to have a relatively low hit rate; you can expect a set of programs that only access a small area of disk to have a higher hit rate.

Suggested Method of Analysis

The Cache Usage utility helps you select the optimum size DPU RAMdisk for your CS-D/N. There are no hard and fast rules for determining the correct size. The guidelines given below are just that, guidelines. Your perception of changes in system performance should be the final determining factor in deciding what size to make the RAMdisk. Follow these steps to determine the best RAMdisk size:

1. Determine if you can use the RAMdisk for your applications. You can use the RAMdisk to hold the read-only data files and program overlays that you frequently use. If your system has no such files that could fit into the RAMdisk, then you probably have no use for one.

   While you should not use RAMdisk to hold files that have no backup, there are some useful exceptions such as temporary files used by programs to sort data or programs that use a shared file for CPU-to-CPU communications. Based on the planned contents of RAMdisk, estimate the size of RAMdisk that you need.

2. Determine the cache hit rate of your applications with no RAMdisk allocated. After your applications have run for some length of time, use the utility to obtain the cache hit rate. Since the hit rate calculation is more accurate when you make large numbers of requests to the DPU, a significant amount of system activity produces better results.

3. Set up the RAMdisk and begin using it. Based on the estimation made in Step 1, define the size of the RAMdisk and load it with your programs and/or data files.

4. Repeat Step 2 to determine the cache hit rate when you run applications with RAMdisk.

5. Adjust the RAMdisk size based on the new cache hit rate and number of accesses to the RAMdisk. If the new hit rate is the same or close to the original cache hit rate, then you can make the RAMdisk larger and use it to hold more of your applications.

    In cases where the cache hit rate has significantly decreased, examine the number of accesses to both cache and the RAMdisk to determine the correctness of the RAMdisk size. If the number of accesses to the RAMdisk is small when compared to the number of accesses to cache, then the RAMdisk is too large. In this case, system performance has probably decreased.

    If the number of accesses to RAMdisk are much larger than the number of accesses to cache, then the RAMdisk size should be acceptable.

    If the number of accesses to the RAMdisk are approximately equal to the number of accesses to cache, then use your perception of the system performance to determine if you should increase or decrease size of the RAMdisk.

6. Repeat Steps 4 and 5 if you are not satisfied with the system performance. Repeat these steps until you are satisfied with the level of system performance.

9
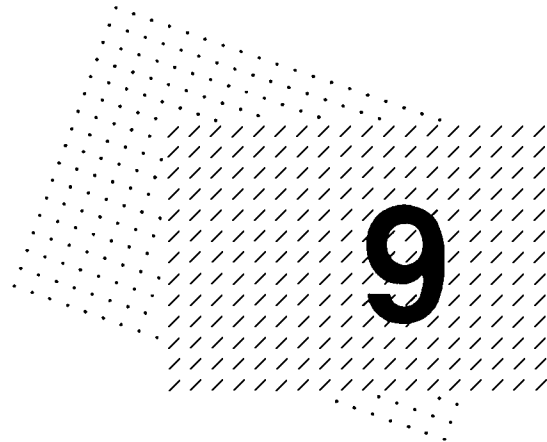
Using the Streaming
Tape Drive

Overview

This chapter describes how to use the streaming tape cassette drive (STCD). It explains how to address, handle, insert, back up, and restore tape cassettes as well as describes the write-protect features of the STCD.

Understanding the STCS

The STCD is a mass storage backup and recovery device for the CS-D/N or DS. It can back up an entire hard disk, up to 150 MB, on a single 600-ft tape cassette. When used with the CS-D/N or DS Disk Backup and Restore utilities, the STCD provides a fast and convenient means of backing up and restoring the contents of the disk drives in the CS-D/N or other disk units attached to the system.

> *Note: The CS-D/N Disk Backup and Restore utilities use sectors of cache memory. You can set aside a portion of cache memory as RAMdisk (refer to Chapter 8). When you use both RAMdisk and the CS-D/N Disk Backup and Restore utilities, you can allocate a maximum of 750 sectors of cache to RAMdisk.*

Cassette Drive Addressing

The address of the STCD depends on the base address of the CS-D/N or DS unit itself. Table 9-1 lists the addresses that you can assign to the STCD. The CS-D/N or DS reserves these addresses strictly for STCD use. You cannot assign another platter to these addresses nor assign the STCD a different address.

Table 9-1.   STCD Addresses

CS-D/N Base Address	STCD Address
/D10	/D5F
/D20	/D6F
/D30	/D7F

If you connect a DS Data Storage Cabinet to the CS-D/N, you must assign the STCD in the DS a different device address than the CS-D/N. For example, if you selected D5F for the CS-D/N, use either D6F or D7F for the DS.

Write Protect Features of the Tape Cassette

To protect tapes from overwriting, remove the write-enable tab on the tape cassette (refer to Figure 9-1). When the write-enable tab is in place, you can write over the tape. When the write-enable tab is removed, you cannot write over the tape. Insert a flat-bladed instrument into the slot to remove the write-enable tab. Figure 9-1 shows the normal position of the write-enable tab in the slot for blank tape cassettes.

Write-Enable Tab
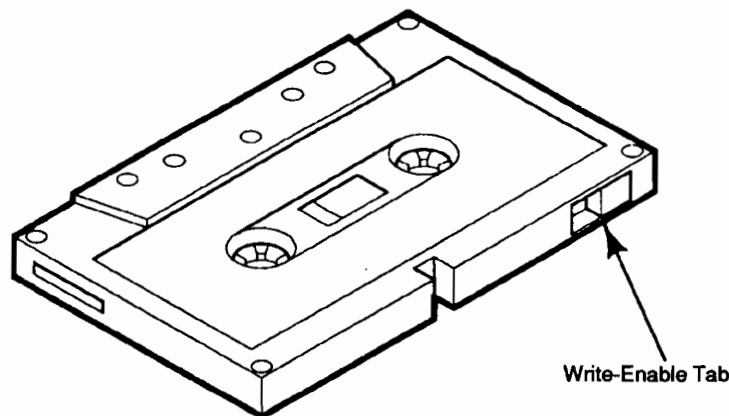
Figure 9-1.   Tape Cassette

Handling of Tape Cassettes

Observe the following precautions to protect data stored on a tape cassette:

- Never leave cassettes in the drive for extended periods of time.
- Store the cassettes in their protective cases, in a cool dry place.
- Do not expose tapes to prolonged direct sunlight, strong magnetic fields, excessive humidity, or temperature extremes.
- Keep your computer area clean of dust and smoke.
- If you expose a tape cassette to a significantly higher or lower temperature than the STCD operating area, allow the tape cassette to adjust to the STCD environment for at least 30 minutes before using it.
- Insert a pencil or a ball point pen in the reel hub to remove the slack of a tape cassette. Rotate the hub gently in the tightening direction.
- Avoid rotating the hub except for removing tape slack. Never allow the tape to slacken on purpose.

Inserting the Tape Cassette

Use the following steps to insert a tape cassette into the STCD (see Figure 9-2):

1. Press the Eject button to remove any cassette that is already in the STCD.
2. Hold the new cassette with the recording surface face down and the write-enable tab closest to the insertion slot.
3. Insert the new cassette all the way into the insertion slot until the seating mechanism engages. The tape drive pulls the cassette mechanically into the proper position. You can now use the cassette.
4. The STCD's drive activity indicator comes on and goes off several times when the STCD is reading, writing, or seeking data, or rewinding, or erasing the tape.

   Caution: While the tape is running, never turn off the power or eject the cassette.

Remove the tape cassette when you are not using the STCD. When you insert a cassette, the tape is always in contact with the recording and erasing heads.

   Caution: If you leave a cassette in the drive for extended periods of time, you can damage the tape.
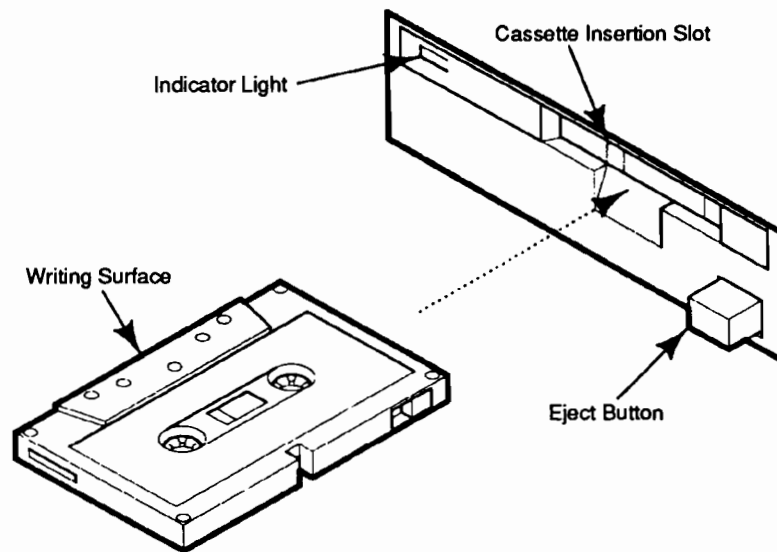
Figure 9-2.   Inserting a Tape Cassette

Backup and Restore Disk Platters to Tape Utilities

This section describes the Backup Disk Platters to Tape Cassette and Restore Disk Platters from Tape Cassette utilities.

Performing a Backup and Restore Operation

To operate the STCD, perform the following steps:

1. Power on the CS-D/N or DS. The STCD clicks as it runs through an internal diagnostic. The STCD is then ready to use.

2. Check the presence of the write-enable tab on the tape cassette (refer to the section entitled "Write Protect Features of the Tape Cassette").

3. Insert the tape cassette (refer to the section entitled "Inserting the Tape Cassette").

4. SELECT DISK to the CS-D/N or DS diskette drive, insert the DS utilities diskette, and type LOAD RUN to run the utilities. When the CS-D/N displays the utilities menu, select the desired utility.

5. Run the backup or restore utility (refer to the sections entitled "Backing Up Disk Platters to a Tape Cassette" and "Restoring Disk Platters from a Tape Cassette").

The STCD's drive activity indicator comes on and goes off several times during backup and restore operations. When the light is on, the STCD is reading, writing, or seeking data, or rewinding, retensioning, or erasing the tape.

When you finish running a utility, press the Eject button to remove the tape cassette.

> **Caution:** *Do not leave a cassette in the drive for an extended period of time.*

Backing Up Disk Platters to a Tape Cassette

The Backup Disk Platters to Tape Cassette utility backs up one or more disk platters to tape. This utility erases a new tape or allows you to append data onto an existing tape.

Use the following steps to backup one or more platters to a single tape cassette.

1. Insert the tape cassette into the drive.
2. Specify the tape cassette drive address. Enter D5F, D6F or D7F (refer to Table 9-1). Press RETURN.

```
                    Backup Disk Platters to Cassette

      Address of tape cassette drive (D5F, D6F, or D7F): D7F

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                                              RETURN - Proceed
                                              RN/TAB - Exit
```

Figure 9-3.   Backup Disk Platters to Cassette

The utility prompts you whether to append to an existing tape or to erase a new tape. Appending a tape places the surfaces to be backed up at the end of the data currently recorded on the tape cassette. Erasing a tape erases the contents of the current tape before the surfaces to be backed up are written.

3. Enter A for append or E for erase. Press RETURN.

    Note: A valid tape drive response with an incorrect tape mounting causes one of the following error messages to appear on your screen:

```
    150 MB Tape Drive - Cassette is 150 MB protected
    150 MB Tape Drive - Cassette is  45 MB protected

    Adjust Cassette                          FN/TAB - Exit
```

Select "Adjust Cassette" and proceed to the next step.

4. Specify the disk platters. The utility displays the Tape Directory (see Figure 9-4). Make an entry for each disk platter to be backed up.

   - The descriptive name identifying the backup item. This name can be as simple as a date in the form mm/dd/yy. Press RETURN.
   - The platter address. Press RETURN.
   - The starting and ending sector address of each item to be backed up. Press RETURN. (If you do not specify an item, the starting address defaults to zero and the ending address defaults to the current end of the catalog.)

   Note: *After each entry, the utility prompts you, "Accept this entry? (Y or N)".*

After you specify each platter to be backed up, the utility automatically displays its total capacity in the MB (Megabyte) field. At the end of the MB field, the utility displays a running total of the capacities of all the platters to be backed up.

```
                    Backup Disk Platters to Cassette

         150 MB Tape Drive - Cassette is 150 MB
         Address of tape cassette drive (D5F, D6F, or D7F): D7F
         Append onto tape or Erase tape (A or E): E

Name to be put in Tape Directory     Platter    Start    End    Mb
11/19/90 SYSTEM PLATTER              /D10         0      3463    0.8

                                                               ----
                                                               0.8

                                              RETURN - Proceed
                                              FN/TAB - Exit
```

Figure 9-4.   Backing Up Platters to Tape Cassette Screen

The utility then

- Rewinds and places the tape into Wang Format Mode.

- Retensions the tape and positions itself to the end of previous data or erases a new tape.

- Places a check mark next to the platter address as the utility copies each platter and sector range to tape. (Internal copies, all within the same CS-D/N or DS, are much faster than copying from a disk in one CS-D/N to the tape of a second CS-D/N or a DS Data Storage Cabinet.)

- Appends a new entry to the tape directory after backing up each platter. The entry contains the descriptive name, disk platter address, and the sector address range.

For partial platter backup, first copy the files to be backed up to an empty disk platter, such as RAMdisk or a blank diskette. Then, backup this platter with the backup utility.

Restoring Disk Platters From a Tape Cassette

The Restore Disk Platters from Tape Cassette utility restores one or more disk platters from tape.

Use the following steps to restore a platter from a tape cassette:

1. Insert the tape cassette into the drive.
2. Specify the tape cassette drive address. Enter D5F, D6F or D7F (refer to Table 9-1). Press RETURN.

```
          Restore Disk Platter from Cassette

Address of tape cassette drive (D5F, D6F, or D7F): D7F
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                                        RETURN - Proceed
                                        FN/TAB - Exit
```

Figure 9-5.   Restore Disk Platter from Cassette Screen

3. Specify the destination disk address. Enter the address of the destination disk platter. Press RETURN. (The destination platter address does not have to be the same as the address from which you made the backup.)

   The utility reads the tape directory and displays its contents on the screen (see Figure 9-6).

4. Use the space bar to select an item you want to restore.

   Repeat the processes in Steps 3 and 4 until you restore all desired files to the destination disk platter.

```
          Restore Disk Platter from Cassette

   150 MB Tape Drive - Cassette is 150 MB
   Address of tape cassette drive (D5F, D6F, or D7F): D7F

Tape Directory                        Surface
                           From  To   Beg   End     MB
11/19/90 SYSTEM PLATTER    /D10        0    3463    0.8

                                                    -----
                                                    0.8

                                              RUN - Proceed
   Select Item to Restore          SPACE/BACKSPACE - Move cursor
                                           RETURN - Select item
                                           FN/TAB - Exit
```

Figure 9-6.   Restoring Disk Platters From Tape Cassette Screen

5. Move the cursor to the desired item and press RETURN.

   The prompt "Address of disk platter to restore to: _____ " appears.

6. Enter the desired destination disk surface in the "To" field.

5. Repeat steps 5 and 6 until all surfaces to be restored have been selected. Press RUN to proceed.

   Your screen is updated to show the list of surfaces to be restored.

6. Verify your selection and press RUN to proceed.

   As the RESTORE program runs, the following comments appear on your screen:

   - Retensioning tape.
   - Positioning to data.
   - Copying data from tape to disk platter /hhh.

   A check is set to the left of the directory item when a surface is restored.

   - Rewinding.
   - Restore completed.

   Press SF key '15 to list the contents of the directory to a printer.

A

System Specifications

Introduction

This appendix provides the specifications for the CS-D. It supplies specifications for the CPU, disk drives, and the streaming tape cassette drive.

CS-D CPU Specifications

CPU Size

Height
23.05 in. (58.55 cm)
Width
13.62 in. (34.59 cm)
Depth
20.28 in. (51.51 cm)
Weight
66.01 lb (30 kg) (No I/O options)
88.11 lb (40 kg) (Fully loaded)

Available I/O Ports

8 I/O Ports (9th I/O port reserved for Disk Storage/Printer Controller)

Memory Size

Control memory – 32 KB

User memory – 1 MB, 2 MB, 4 MB, or 8 MB for CS/386
4 MB, 8 MB, 16 MB, or 32 MB for CS/Turbo

Power Requirements

115 V + 10%, 50 or 60 Hz + 1 Hz - 3.0 A
230 V + 10%, 50 or 60 Hz + 1 Hz - 1.5 A
345 W

Heat Output

1,020 BTU

Cable Lengths

Data
12.0 ft (3.6 m)
Power
6.0 ft (1.8 m)

Environmental Requirements

Temperature
50° to 90° (10° to 32° C)
Humidity
10% to 80% relative humidity, noncondensing
Noise Level
35 dB(A) (running continuous)

DiskDrive Specifications

Table A-1.   Disk Drive Specification Chart for 2-Byte Addressing Mode

	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	7
Capacity/ Platter	320 KB (360 KB) for PC)	1 MB (1.2 MB for PC)	10 MB	16 MB	16 MB	10 MB	16 MB
Sectors/ Platter	1,280 (1,440 for PC)	4,160 (4,800 for PC)	38,912	65,024	65,024	38,912	65,024
Bytes/ Sector	256 (512 fo 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

Streaming Tape Cassette Drive Specifications

Recording

Capacity – Up to 150 MB with 600 ft tape

Density – 8,000 bpi

Format – Read operation, serial/serpentine; Write operation, serial/serpentine; Physical tracks, 9

Tape Speed

90 ips, read/write forward

90 ips, read/write reverse

Tape Heads

Dual read-after-write, full-width erase bar

Data Transfer Rate (drive to controller)

Up to 86,700 bytes per second at 90 ips

B
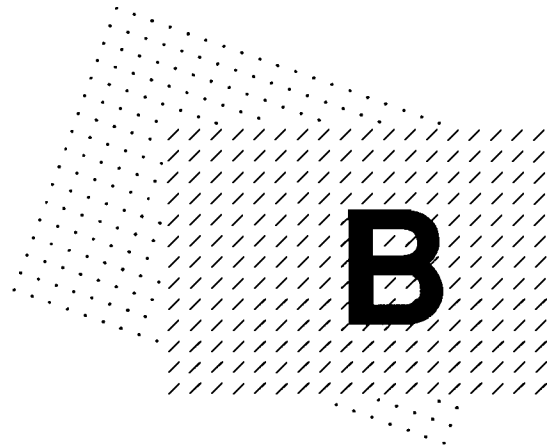
Terminal Cables

Introduction

This appendix provides the available cable lengths for connecting your terminals to the CS-D and your equipment to modems.

Terminal/CPU Cable

With each terminal, you receive one 8-ft (2.4-m) cable that connects to power source and one 25-ft (7.6-m) direct connection cable. Additionally, you can order an optional direct connection cable for a terminal. Table B-1 lists the nonextendable cables for direct connection up to 2,000 ft (606.1 m).

Table B-1.   Direct Connection Cables

Length In Feet	Length In Meters	Part Number
50	15.2	120-2342-1
100	30.3	120-2342-2
200	60.6	120-2342-3
300	90.9	120-2342-4
400	121.5	120-2342-5
500	151.5	120-2342-6
600	181.8	120-2342-7
700	212.1	120-2342-8
800	242.4	120-2342-9
900	272.7	120-2342-10
1,000	303.0	120-2342-11
1,250	378.8	120-2342-12
1,500	454.5	120-2342-13
1,750	530.3	120-2342-14
2,000	606.1	120-2342-15

You can purchase optional modem cables in lengths of 12 ft (3.7 m), with extensions of 25 ft (7.6 m) and 50 ft (15.2 m). Combined cable distance, however, from Wang equipment to a modem is 50 ft (15.2 m) maximum according to Electronic Industries Association (EIA) standards.

Table B-2.   Modem Cables

Length In Feet	Length In Meters	Part Number
12	3.	220-0332
25	7.6	220-0333
50	15.2	220-0334

C
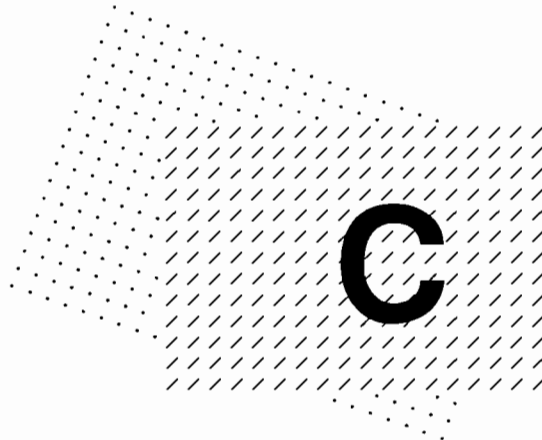
Available Peripherals

This appendix lists the other devices supported with the CS-D/N. The CS-D/N supports all CS peripherals and most 2200 peripheral devices currently listed on the standard 2200 products price list, except unbuffered and time-dependent devices. For example, some exclusions include certain instrument interfaces, the Model 2209 9-Track Tape Drive and the Disk Controller 22C31 (Triple Controller). A list of supported devices (as of the publication date of this manual) follows.

Model Number	Description
DS	*Data Storage Cabinet*
DS	320-KB Diskette
DS-1.2	1-MB Diskette
DS-TS	Streaming Tape Cassette
DS-20	20-MB Hard Disk
DS-32	32-MB Hard Disk
DS-64	64-MB Hard Disk
DS-112	112-MB Hard Disk
DS-140	140-MB Hard Disk

Model Number	Description
	Disk Drives
2270A	Diskette Drive (IBM 3740 Compatible)
2270A-1	.25 MB
2270A-2	.50 MB
2270A-3	.75 MB
2275	Fixed/Removable Disk Drives
	2275-10
	2275-20
	2275-30
	2275-60
2280	Fixed/Removable Disk Drives
2280-1	26.8 MB
2280-2	53.6 MB
2280-3	80.5 MB
	Tape Drives
2209A	Nine-Track Tape Drive - 1600 bits per inch (bpi)
2229	Four-track, 6400 BTI
	Terminals
2236 DE	Interactive Terminal
2236 DW	Interactive Terminal
2336 DE	Interactive Terminal
2336 DW	Interactive Terminal
2236 MXE	Interactive Terminal Processor and Asynchronous Controller
2426 DW	Interactive Terminal with Expanded Keyboard
2436 DE	Interactive Terminal
2436 DW	Interactive Terminal
2436 WP	WOA 2436 Emulation
2536 DW	Interactive Terminal
	Printers
2273-1	Band Printer - 250 lpm
2273-2	Band Printer - 600 lpm
2200/PM018	Daisy Printer - 60 cps
2200/PM017	Matrix Line Printer
2200/PM010	Matrix Character Printer
2200/PM016	Matrix Character Printer
2200/PM060	Matrix Printer
LCS8	Laser Printer
LCS15	Laser Printer
BFT-1	Bidirectional Forms Tractor for 2281W
BFT-2	Bidirectional Forms Tractor for 2281WC

Model Number	Description
	Communications Controllers
2227B	Buffered Asynchronous Communications Controller
2228B	Synchronous/Asynchronous Communications Controller
2228C	Synchronous/Asynchronous Communications Controller
2228D	Data Communications Controller
2275MUX, 2275MUXE	Disk Multiplexer Controllers

D

Maintenance and Environment

Introduction

This appendix describes the preventive maintenance and environmental conditions that you should use with your CS-D/N.

Preventive Maintenance

Wang Laboratories, Inc., recommends that a company representative service your equipment twice a year. A maintenance agreement is available to have this service performed automatically. If you do not purchase a maintenance agreement, you must arrange for any servicing. A maintenance agreement protects your investment and offers the following benefits:

Preventive maintenance – A Wang representative semi-annually inspects, adjusts, lubricates, cleans, and updates your equipment. Preventive maintenance minimizes the chances of unexpected downtime.

Fixed annual cost – When you buy a maintenance agreement, you receive one purchase order for service for an entire year and one annual bill. You can arrange for other billing arrangements if desired.

Your local Wang Sales/Service Office can provide further information regarding maintenance agreements.

Note: Wang Laboratories, Inc., neither honors maintenance agreements for, nor guarantees any user-modified equipment. Damage to equipment incurred as a result of such modification is the financial responsibility of the user.

Environmental Considerations

When the temperature exceeds the recommended range, both component failure rates and the loss of data (through distortion of data storage materials) are likely to increase.

Airborne contaminants can accumulate rapidly on the circuit boards and their components, forming a film. This film not only prevents adequate heat dissipation from the electronic elements, but also creates leakage paths, causing errors in the system signals.

Dust causes excessive wear in the disk read/write heads and the oxide coatings of storage media. Clean or replace regularly the filters of all HVAC (heating, ventilating, air conditioning) equipment. In areas where these filters do not sufficiently remove airborne contaminants, install an electrostatic air filter.

Low humidity increases the probability of static buildup, causes oxide shed in data storage materials, and increases the static charge given to carpets and clothing. When you come in contact with the CS-D/N, the resultant static discharge (which could be several thousand volts) can cause system errors or destruction of data. High humidity rapidly deteriorates paper stock and magnetic disks and tape. Install humidifiers or dehumidifiers in the environment's heating, ventilating, and air conditioning systems as required.

Install nonstatic carpeting. Treat other carpeting that is already installed with nonstatic spray, or install an electrically conductive mat under the system operating area and properly connect it to an earth ground to prevent static buildup.

Computers and peripherals can malfunction due to electromagnetic interference (EMI) from devices such as radio transmitters and industrial motors. EMI can enter the system by conduction through wiring and cabling or by direct radiation. An illustration of EMI is a television which becomes full of "snow" when a car with a poorly tuned engine idles outside (radiated EMI) or someone turns on a hair dryer or vacuum cleaner in the next room (conducted EMI).

To minimize such interference, dedicate the three-prong AC power line. Make sure you ground, properly install in a steel conduit, and isolate the power line from interference-generating devices like office machines, fluorescent lighting, motors, and HVAC units. If you place these devices near the system area, relocate, repair, or filter them to make sure that they do not disturb the CS-D/N. (Install EMI filters, isolation transformers, and line conditioners on the system's AC power line.) In cases of high residual EMI, you may have to shield all peripheral cables.

The recommended operating environment is as follows:

Environmental Factor	Acceptable Limits
Temperature	60° F to 80° F (15° C to 27° C)
Relative Humidity	40% to 60%, noncondensing
Dust	No obvious accumulation in a 24-hour period
Power	Grounded, noise-free, dedicated 115 or 230 VAC ± *10%, 50 or 60 Hz ± 1.0 Hz*
Interference	Control all sources of static electricity, extreme magnetism, and EMI

In addition, follow these guidelines:

- Keep an accurate service history on all equipment.

- Avoid consuming food and beverages, smoking, and performing any other activity not related to operation of the CS-D/N while near the equipment.

- Avoid touching magnetic disks and tape. Do not expose them to direct sunlight, strong magnetic fields, or freezing temperatures. If subjected to extremes, allow the media to return to normal operating conditions before use (24 hours is recommended), and test the media thoroughly.

- Return the diskette to its storage envelope whenever you remove it from the drive. Replace the storage envelopes when they become worn, cracked, or distorted. These envelopes protect the diskette.

- Use felt-tip pens to write on the media label. Never use an eraser to alter a label. Instead, use a new label.

- Always make a duplicate copy (backup) of tapes and diskettes. Then safely store the backup in a different area.

  Note: Your CS-D/N includes an exhaust fan and entry vents. Do not obstruct these vents and fan. Therefore, never place system equipment immediately adjacent to file cabinets or other surfaces that might impede proper air flow.

E

Error Messages and Recovery

Introduction

This appendix describes error messages that you may encounter using your CS-D/N and how to recover from them. It divides the errors message into categories of disk, input/output (I/O), tape command, and system.

Error Messages and Recovery

This section explains the significance of each system error and suggests possible recovery procedures. If these procedures fail, call your Wang service representative. If you encounter a system error, you should execute a control memory diagnostic. However, if you press RESET and then SF"15, the CS-D/N may resume execution of the currently loaded application program. If the error recurs, run a memory diagnostic to locate the defective memory location. Refer toChapter 5 for instructions on how to run diagnostics.

Disk Errors

Several possible disk errors can occur while trying to load disk information. Consult the following description of each possible disk error to determine if you can correct the problem. Then, attempt to reload. If errors continue, call your Wang service representative. For more information on all disk errors, refer to the *Multiuser BASIC-2 Language Reference Manual.*

D80 File Not Open

Meaning

The CS-D/N cannot perform the file operation upon a closed file.

Action

Open the file before attempting to read from it or write to it.

D81 File Full

Meaning

The CS-D/N cannot write any more information into the indicated file.

Action

Correct the program or transfer the file to another platter, reserving additional space on the new platter for this file.

D82 File Not Found

Meaning

The file name does not exist. Otherwise, you loaded a data file as a program file or a program file as a data file.

Action

Make sure that you entered the file name correctly, that you mounted the proper disk, and that you accessed the correct disk drive.

D83 File Already Exists

Meaning

The file name already exists in the Catalog Index.

Action

Use a different name or catalog the file on a different platter.

D84 File Not Scratched

Meaning

You attempted to rename or write over a file that has not been scratched.

Action

Before you can rename or write over a file, you must scratch it.

D85 Index Full

Meaning

The Catalog Index contains no space for new names.

Action

Scratch unwanted files and compress the catalog using a MOVE statement, or mount a new disk platter and create a new catalog.

D86 Catalog End Error

Meaning

Several possible errors could have occurred. The defined Catalog Area ends within the Catalog Index or has no more available space to store information. Otherwise, you issued a MOVE END statement that tried to move the end of the Catalog Area to the area already occupied by cataloged files.

Action

Correct the SCRATCH DISK or MOVE END statement, or increase the size of the Catalog Area by executing a MOVE END statement. Alternately, scratch unwanted files and compress the catalog using a MOVE statement, or mount a new disk platter and create a new catalog.

D87 No End-of-File

Meaning

The DSKIP END statement cannot locate an end-of-file record. (Neither a DATASAVE DC END nor a DATASAVE DA END statement recorded an end-of-file record in the file.)

Action

Write an end-of-file trailer after the last data record in the file.

D88 Wrong Record Type

Meaning

The system encountered a program record when it expected a data record or vice versa.

Action

Make sure that you accessed the proper drive and file.

D89 Sector Address Beyond End-of-File

Meaning

A DATALOAD DC or DATASAVE DC statement accessed a sector address beyond the end-of-file. A bad disk platter can cause this error.

Action

Press RESET and run the program again. If the error persists, use a different platter or reformat the platter. If the error still exists, call a Wang service representative.

Input/Output (I/O) Errors

I90 Disk Controller Error

Meaning

The CS-D/N aborts the disk operation; the controller responded improperly at the beginning of the operation.

Action

Press RESET and rerun the program. If the error recurs, make certain that the disk unit is on and that all cables are connected properly. If the error persists, contact a Wang service representative.

I91 Disk Drive Not Ready

Meaning

The disk unit is not ready to use.

Action

Make certain that the program addresses the correct disk. Also, verify that the disk unit is on and in run mode, and that all cables are connected properly. Press RESET and rerun the program. If the error recurs, power the disk unit off, then back on, and rerun the program. If the error persists, call a Wang service representative.

I92 Timeout Error

Meaning

A device did not respond to the CS-D/N. If the device is a disk, the CS-D/N aborts the disk operation.

Action

Press RESET and run the program again. If the error recurs, make sure that you formatted the disk. If the error persists, call a Wang service representative.

I93 Format Error

Meaning

The CS-D/N detects invalid sector control information of the disk platter. If a disk operation is in progress, you may need to reformat the platter. If the formatting is in progress, the surface of the platter may be flawed.

Action

Reformat the disk platter. If the error recurs, replace the platter. If the error persists, contact a Wang service representative. The error can also occur if you attempt to access a disk formatted for use on a different type of system.

I94 Disk Controller Error

Meaning

The CS-D/N aborts the disk operation; the controller did not receive the disk command correctly.

Action

Press RESET and rerun the program. If the error recurs, make certain that the disk unit is on and that all cables are connected properly. If the error persists, contact a Wang service representative.

For those disks with a format key:

Meaning

This error message indicates that the format key is engaged.

Action

You cannot perform disk operations until you turn off formatting with the format key.

I95 Device Error

Meaning

The disk cannot perform the requested operation.

Action

Repeat the operation. If you were writing to a disk, make certain that the disk is not write-protected. If the error recurs, power the disk off and back on, and perform the operation again. If the error persists, contact a Wang service representative.

I96 Data Error

For Read operations:

Meaning

The checksum calculations (CRC or ECC) indicate that the data read is incorrect. For disk drives that perform ECC, your attempt to correct errors was unsuccessful.

Action

Rewrite the data. (The read sector may have been written incorrectly.) If read errors recur, reformat the platter.

For Write operations:

Meaning

The LRC calculation indicates that the data sent to the disk is incorrect. The CS-D/N did not write data.

Action

Repeat the write operation. If write errors recur, make certain that all disk cables are connected properly.

If either error persists, contact a Wang service representative.

I97 LRC Error

Meaning

A longitudinal redundancy check (LRC) error occurred while the CS-D/N was writing or reading a sector. An LRC error usually indicates a transmission error between the disk and the CPU.

Action

Press RESET and rerun the program. If the error recurs, rewrite the flawed sector. (The sector may have previously been written incorrectly.) If the error persists, contact a Wang service representative.

I98 Illegal Sector Address or No Platter

Meaning

The indicated sector is not on the disk platter, or the specified drive contains no platter.

Action

Make sure that you accessed the correct drive. Correct the program statement, or make sure that you inserted the diskette into the drive.

I99 Read-After-Write-Error

Meaning

The comparison of read-after-write to a disk sector failed, usually indicating a defective platter.

Action

Rewrite the information. (The data may have previously been written incorrectly.) If the error recurs, replace the platter. If the error persists, contact a Wang service representative.

Tape Command Error Codes

Each time you issue a command to the streaming tape cassette drive, the CS-D/N sends a return code. The return code indicates whether or not the CS-D/N completed the command. If not successful, the return code provides error information. Refer to Chapter 10 for descriptions of tape commands.

If an error occurs while accessing the disk in response to a Backup Sectors or Restore Sectors tape command, the command returns the following errors.

Some of the errors encountered with tape commands are the same as the corresponding I/O errors. See the section entitled "I/O Errors" for a discussion of the following error conditions:

- I91 Disk Drive Not Ready
- I93 Format Error
- I95 Device Error
- I96 Data Error
- I98 Illegal Sector Address or No Platter
- I99 Read-After-Write Error

The following return codes apply to the tape cassette device.

T10 No Tape Cassette

Meaning

There is no cassette in the tape cassette drive.

Action

Make sure that you inserted a tape cassette into the drive before issuing tape commands.

T11 No Tape Cassette Drive

Meaning

There is no tape cassette drive.

Action

The CS-D/N cannot perform the tape command without an operational tape cassette drive.

T12 Write Protect

Meaning

The CS-D/N cannot perform the write operation with a write-protected tape cassette.

Action

To write to the tape cassette, unprotect it.

T13 End of Tape

Meaning

The CS-D/N encountered the end of tape. If reading, there is no more data on the tape. If writing, there is no available space on the tape.

Action

Cease the read/write operation. The tape utilties normally handle this problem.

T14 Unrecoverable Data Error

Meaning

The CS-D/N cannot perform the read or write operation.

Action

Make sure that you loaded the right cassette. Retry the operation. If the error occurs again, power the CS-D/N off (when not in use), back on, and retry the operation. If the error persists, try the operation with a different tape cassette. If the error continues, contact a Wang service representative.

T15 Bad Data Block

Meaning

The CS-D/N could not read the next data block on tape.

Action

Remount the tape and try the operation again from the beginning. If the error persists, try a different tape cassette. If the error continues with different tape cassettes, contact a Wang service representative.

T17 No Data

Meaning

There is no more data on the tape to read.

Action

Make sure that you mounted the correct tape cassette.

T1A File Mark Read

Meaning

The CS-D/N read a file mark from the tape.

Action

Verify that a file mark was written on the tape.

T1B Illegal Command

Meaning

The command issued is not a legal tape command.

Action

Correct the program.

T1C Power on/RESET

Meaning

The tape drive was reset in the middle of an operation.

Action

Retry the operation.

T20 Invalid Number of File Marks

Meaning

The number of file marks specified in the command must be 1 to 15.

Action

Correct the program.

T23 Insufficient Buffer Space

Meaning

You may have defined too large a RAMdisk and the CS-D/N cannot perform tape operations.

Action

Deallocate the RAMdisk (making sure you save all the needed data elsewhere) and retry the tape operation. If the RAMdisk is not causing the problem, then the CS-D/N did not release the tape buffer (probably because the CS-D/N aborted a tape operation). To release buffer space, issue a REWIND TAPE command. If the error persists, power the CS-D/N off (when not in use) and back on.

T24 Tape Drive Error

Meaning

A tape drive bus parity error occurred.

Action

Try the operation again from the beginning. If the error persists, turn the unit off and back on (when not in use) and retry. If the error continues, contact a Wang service representative.

T26 LRC Error

Meaning

The longitudinal redundancy check (LRC) on the data sent is not correct.

Action

Retransfer the data using the REREAD command for tape reading or the WRITE BLOCK command for tape writing. If the error persists, contact a Wang service representative.

T27 Tape Device Error

Meaning

An unexpected device fault occurred.

Action

Retry the operation. If the error continues, turn the CS-D/N off (when not in use), turn it back on, and try again. If the error persists, contact a Wang service representative.

T30 Tape Device Error

Meaning

An unexpected device fault occurred.

Action

Retry the operation. If the error continues, turn the CS-D/N off (when not in use), turn it back on, and try again. If the error persists, contact a Wang service representative.

T31 Tape Device Error

Meaning

An unexpected device fault occurred.

Action

Retry the operation. If the error continues, turn the CS-D/N off (when not in use), turn it back on, and try again. If the error persists, contact a Wang service representative.

T32 Tape Device Error

Meaning

An unexpected device fault occurred.

Action

Retry the operation. If the error continues, turn the CS-D/N off (when not in use), turn it back on, and try again. If the error persists, contact a Wang service representative.

T33 Tape Device Error
Meaning

An unexpected device fault occurred.

Action

Retry the operation. If the error continues, turn the CS-D/N off (when not in use), turn it back on, and try again. If the error persists, contact a Wang service representative.

T34 Tape Device Error
Meaning

An unexpected device fault occurred.

Action

Retry the operation. If the error continues, turn the CS-D/N off (when not in use), turn it back on, and try again. If the error persists, contact a Wang service representative.

T35 Tape Device Error
Meaning

An unexpected device fault occurred.

Action

Retry the operation. If the error continues, turn the CS-D/N off (when not in use), turn it back on, and try again. If the error persists, contact a Wang service representative.

T36 Tape Device Error
Meaning

An unexpected device fault occurred.

Action

Retry the operation. If the error continues, turn the CS-D/N off (when not in use), turn it back on, and try again. If the error persists, contact a Wang service representative.

T37 Tape Device Error
Meaning

An unexpected device fault occurred.

Action

Retry the operation. If the error continues, turn the CS-D/N off (when not in use), turn it back on, and try again. If the error persists, contact a Wang service representative.

T38 Tape Device Error

Meaning

An unexpected device fault occurred.

Action

Retry the operation. If the error continues, turn the CS-D/N off (when not in use), turn it back on, and try again. If the error persists, contact a Wang service representative.

T39 Tape Device Error

Meaning

An unexpected device fault occurred.

Action

Retry the operation. If the error continues, turn the CS-D/N off (when not in use), turn it back on, and try again. If the error persists, contact a Wang service representative.

T3A Tape Device Error

Meaning

An unexpected device fault occurred.

Action

Retry the operation. If the error continues, turn the CS-D/N off (when not in use), turn it back on, and try again. If the error persists, contact a Wang service representative.

T3B Tape Device Error

Meaning

An unexpected device fault occurred.

Action

Retry the operation. If the error continues, turn the CS-D/N off (when not in use), turn it back on, and try again. If the error persists, contact a Wang service representative.

T3C Tape Device Error

Meaning

An unexpected device fault occurred.

Action

Retry the operation. If the error continues, turn the CS-D/N off (when not in use), turn it back on, and try again. If the error persists, contact a Wang service representative.

T3D Tape Device Error

Meaning

An unexpected device fault occurred.

Action

Retry the operation. If the error continues, turn the CS-D/N off (when not in use), turn it back on, and try again. If the error persists, contact a Wang service representative.

T3E Tape Drive Error

Meaning

An unexpected device fault occurred.

Action

Retry the operation. If the error continues, turn the CS-D/N off (when not in use), turn it back on, and try again. If the error persists, contact a Wang service representative.

System (Execution) Error Messages

As you enter the line during program resolution and execution, the CS-D/N initially checks each text line for various types of errors. The CS-D/N responds to an error condition by producing an audible tone, terminating the current operation immediately, displaying the erroneous line, and presenting beneath it the message ERR followed by an error code (with an arrow pointing to the approximate position of the error). Note that the CS-D/N stops error scanning when it detects the first error. Thus, if a line contains more than one error, the CS-D/N detects only the first error. You can recover some errors under program control.

These errors contain a letter prefix followed by a two-digit number (for example, A04). The letter identifies the particular class of errors, while the two-digit number identifies the specific error condition. (For example, an error commonly encountered during text entry is S13, Missing Comma. The S indicates a syntax error and the 13 identifies the error uniquely as Missing Comma.) There are seven classes of error conditions. These error classes and the letter prefixes which identify them are

Class of Errors	Letter Prefix
Miscellaneous errors	A
Syntax errors	S
Program errors	P
Computation errors	C
Execution errors	X
Disk errors	D
I/O errors	I

For the complete list of the errors included in each class and their specific recovery procedures, see the *Multiuser BASIC-2 Language Reference Manual.*

The CS-D/N detects errors in the first three classes listed (miscellaneous errors, syntax errors, and program errors) during text entry or program resolution. These errors can cause the CS-D/N to terminate the current operation and display an error message. Before proceeding with further operations, you must correct the error. Errors of this kind are called nonrecoverable; you cannot recover them under program control.

Errors in the four remaining classes (computation errors, execution errors, disk errors, and I/O errors) typically occur during program execution. You can recover them under program control without aborting the program or disrupting the display with an error message. Errors that the program can intercept before the operating system intervenes are called recoverable errors. The CS-D/N provides three BASIC-2 instructions for intercepting and responding to recoverable errors: the SELECT ERROR statement, the ERR function, and the ERROR statement.

For a discussion of error recovery under program control, see the *Multiuser BASIC-2 Language Reference Manual.*

F

CS-D and Turbo Diagrams

This appendix provides three CS-D and five Turbo diagrams. Figure F-1 depicts the possible cabling of your CS-D and other devices. Figure F-2 illustrates the Model 9558 Mother Board. Figure F-3 illustrates the Model 9559 Daughter Board. Figure F-4 illustrates the 386 Turbo C.2.1 CPU Board. Figures F-5 and F-6 illustrate the 386 Turbo MXF 16-Point Terminal Controller. Figures F-7 and F-8 illustrate the 386 Turbo Printer/Disk Dual Controller.

Figure F-1.   CS-D Cabling Diagram
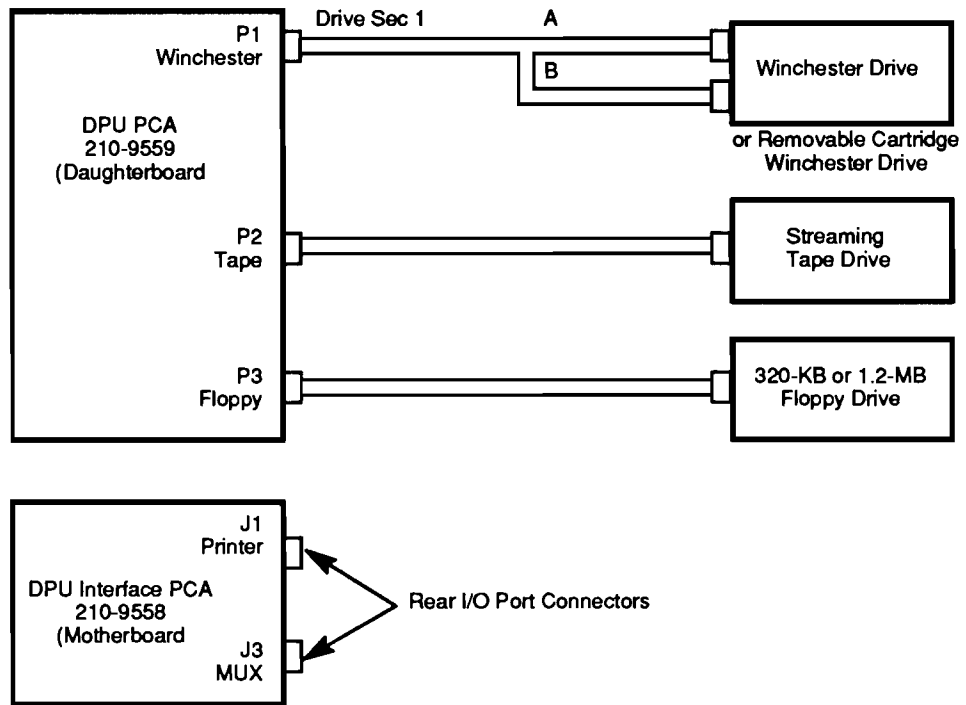
Note: Do not remove terminating resistors of Winchester drive.
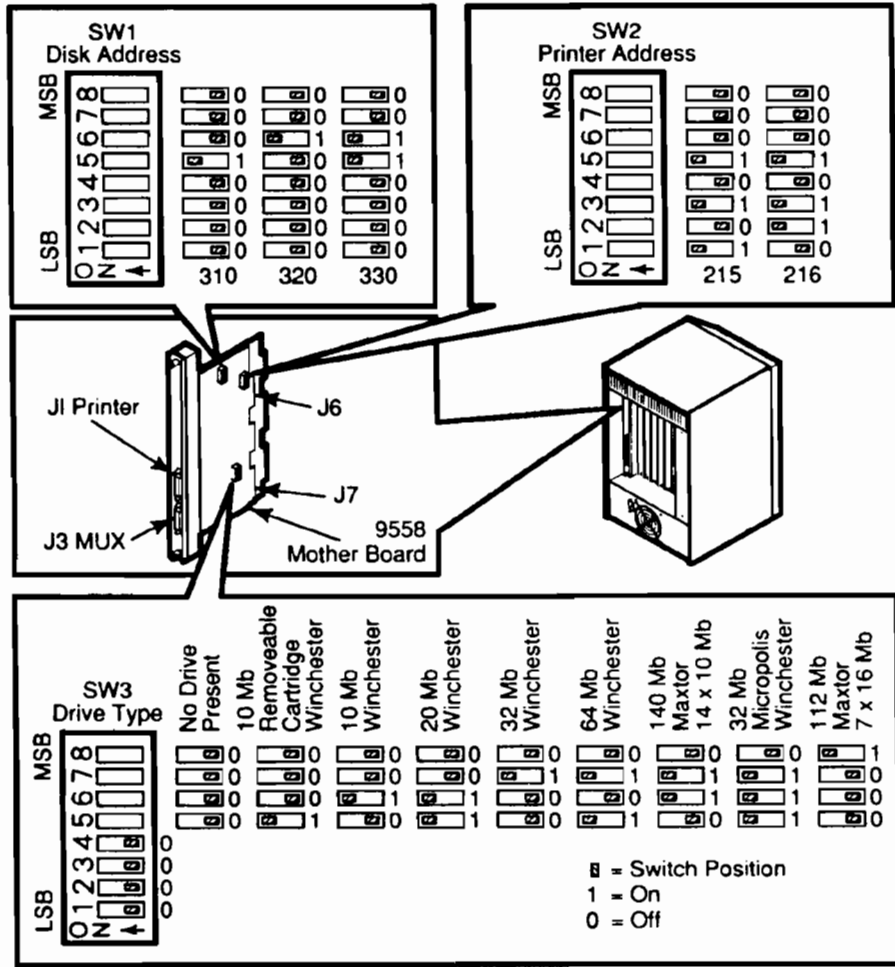
Figure F-2.   Model 9558 CS-D Mother Board
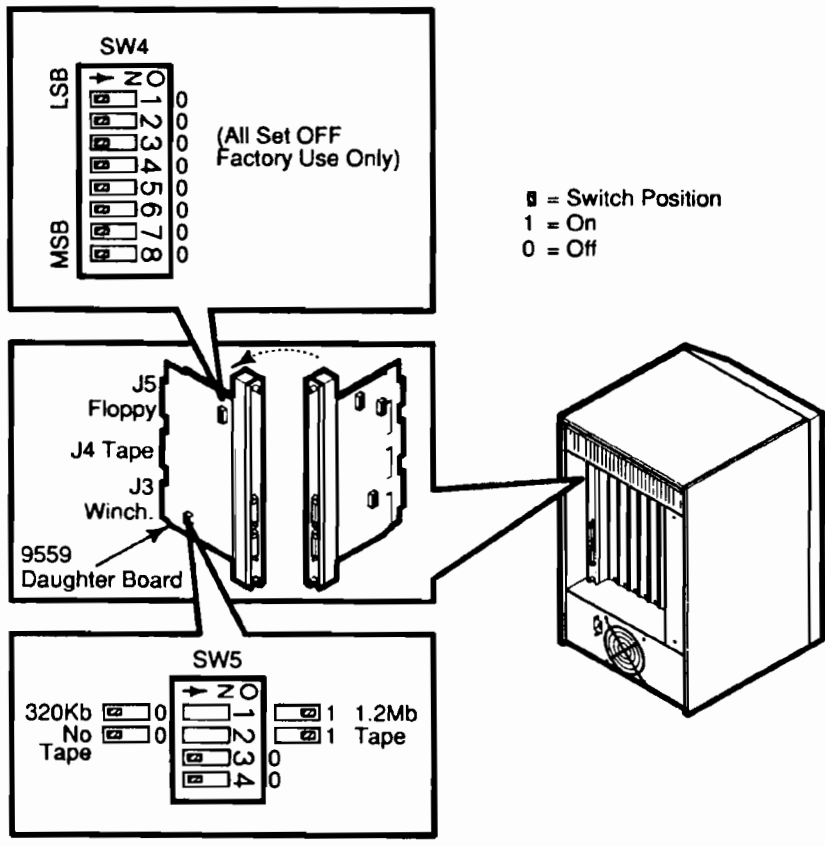
Figure F-3.   Model 9559 CS-D Daughter Board
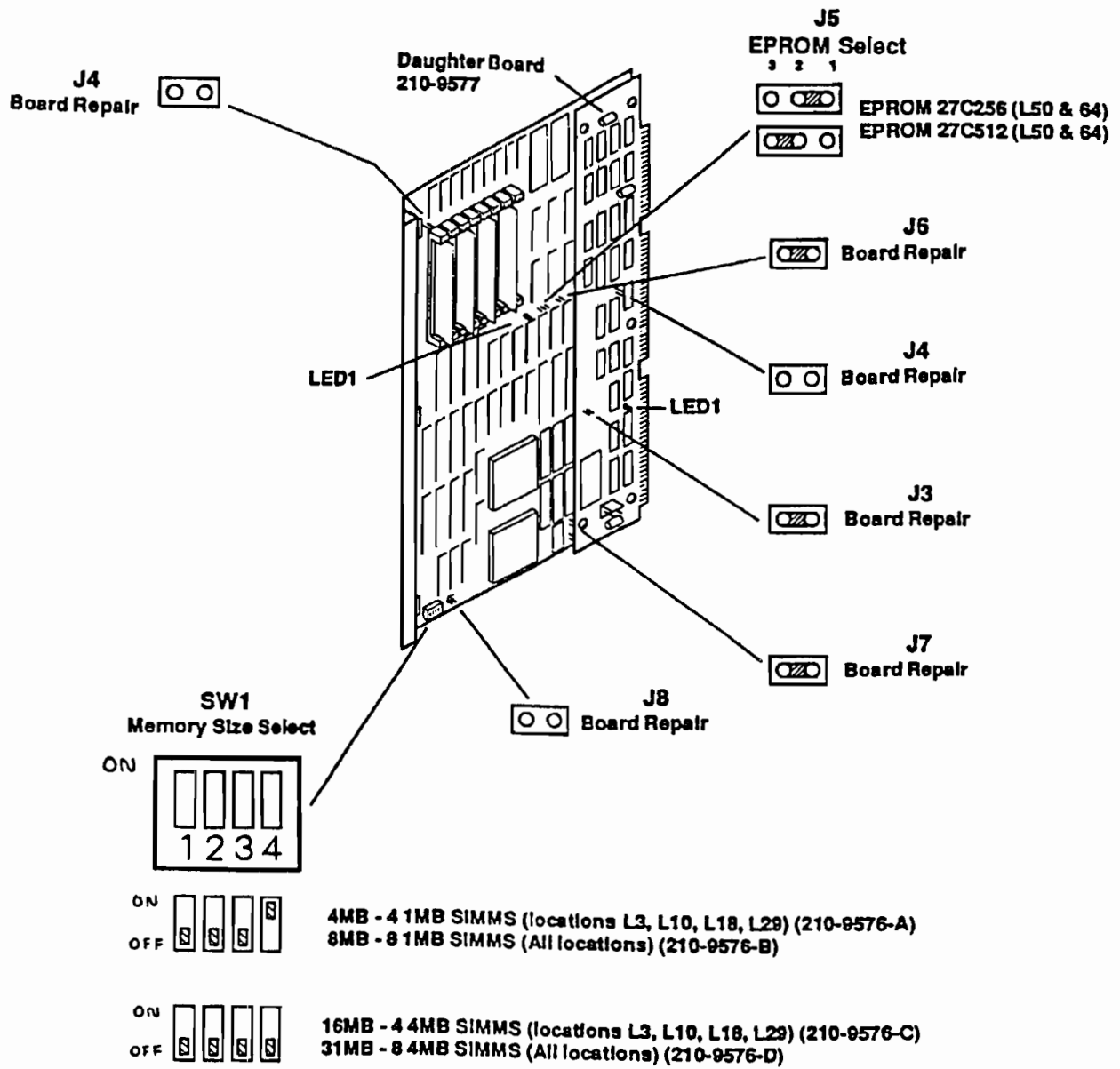
Figure F-4.   386 Turbo C.2.1 CPU Board 210-9576A/B/C/D
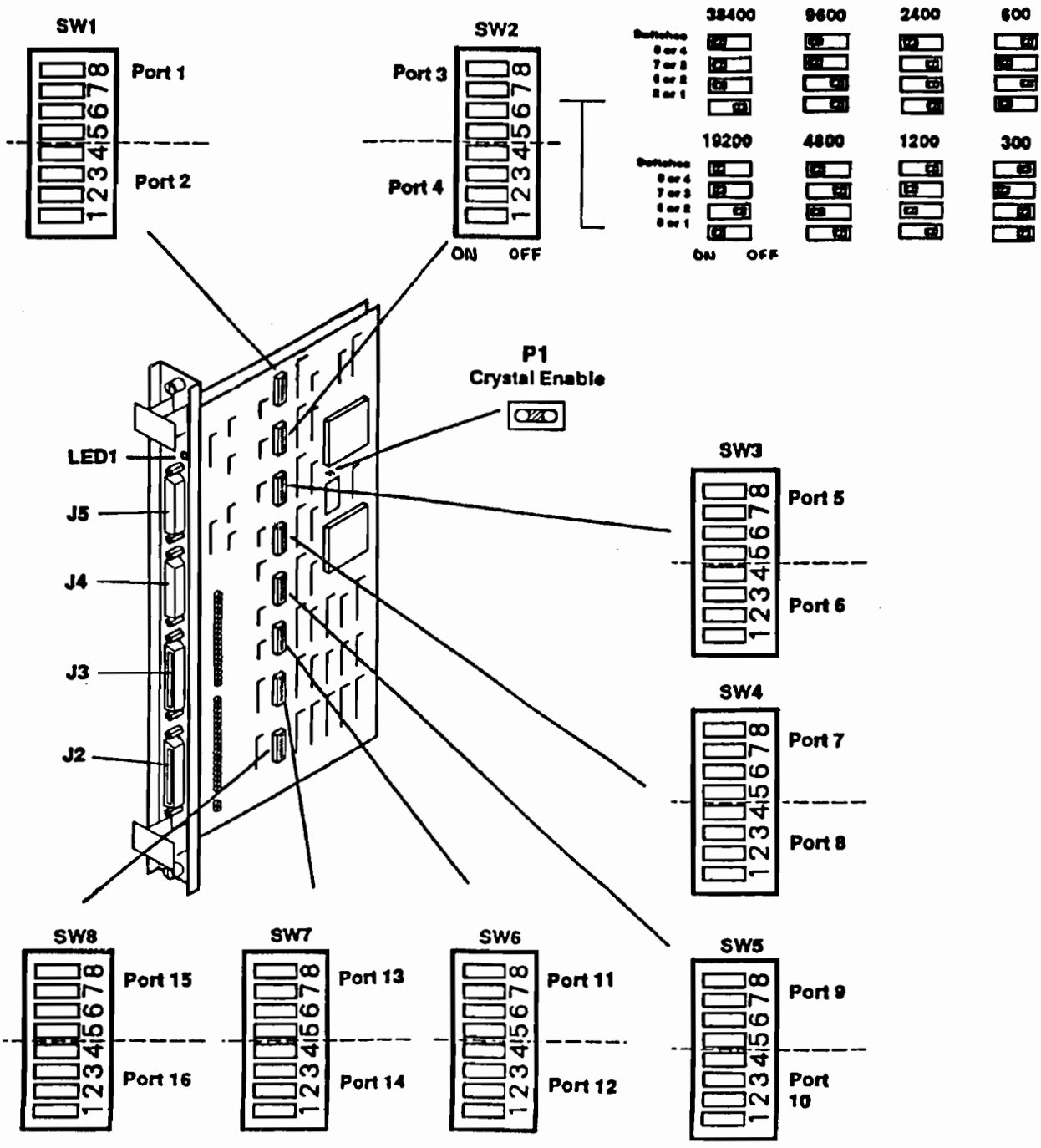
Figure F-5.   386 Turbo MXF 16-Port Terminal Controller (212-9717)

P1
Crystal Enable

LED1

J5

J4

J3

J2

SW1
On

1 2 3 4

1st MXF
Terminals
1-16

OFF ☑ ON

2nd MXF
Terminals
17-32

OFF ☑ ON

3rd MXF
Terminals
33-48

4th MXF
Terminals
49-64
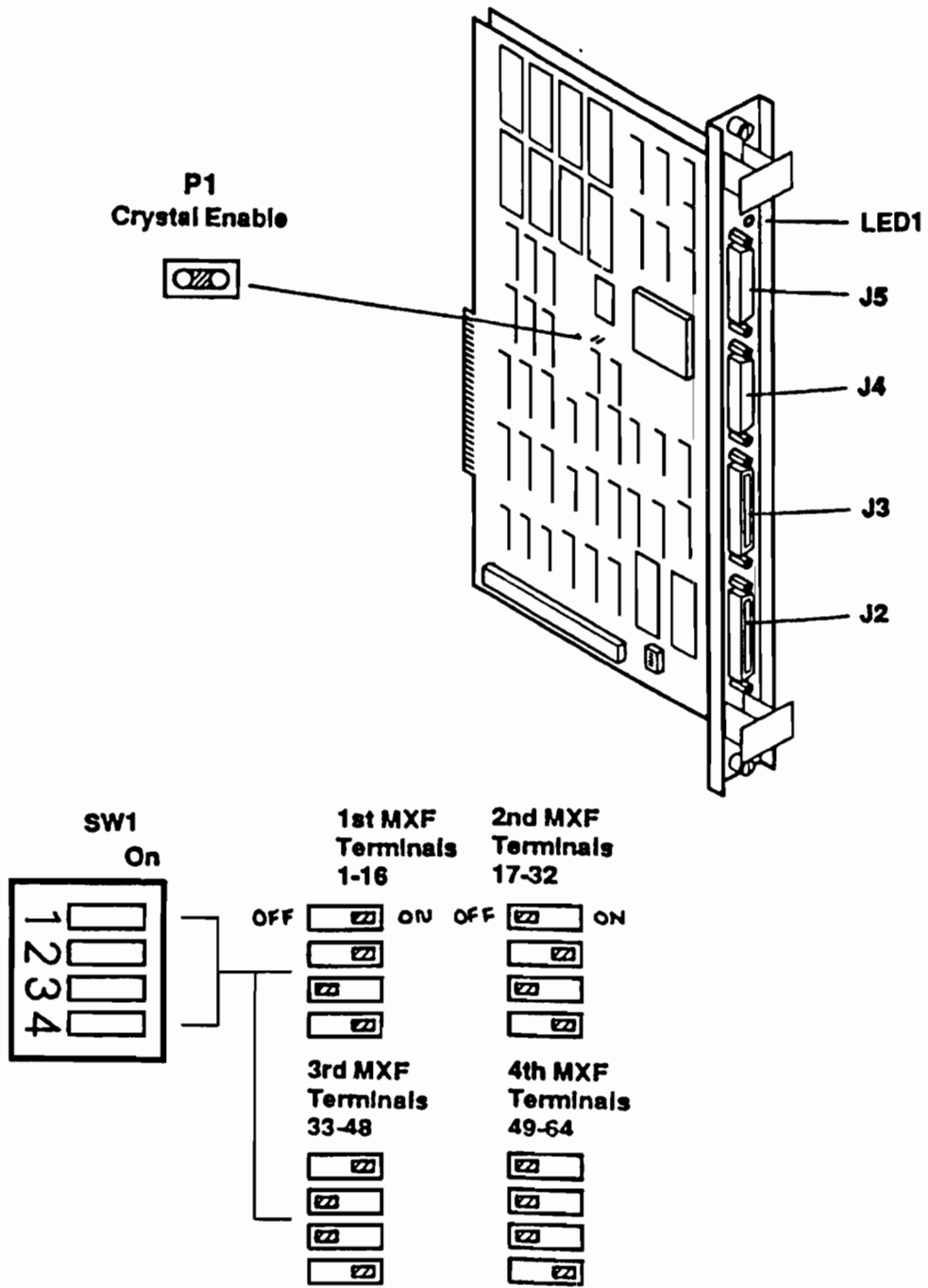
Figure F-6.   386 Turbo MFX 16-Point Terminal Controller (212-9717) (cont.)

P1
Crystal Enable

LED1

J4

J3

J2

SW1
Disk Address

1
2
3
4

OFF   ON

Address 310

OFF   ON

Address 320

OFF   ON

Address 330

OFF   ON
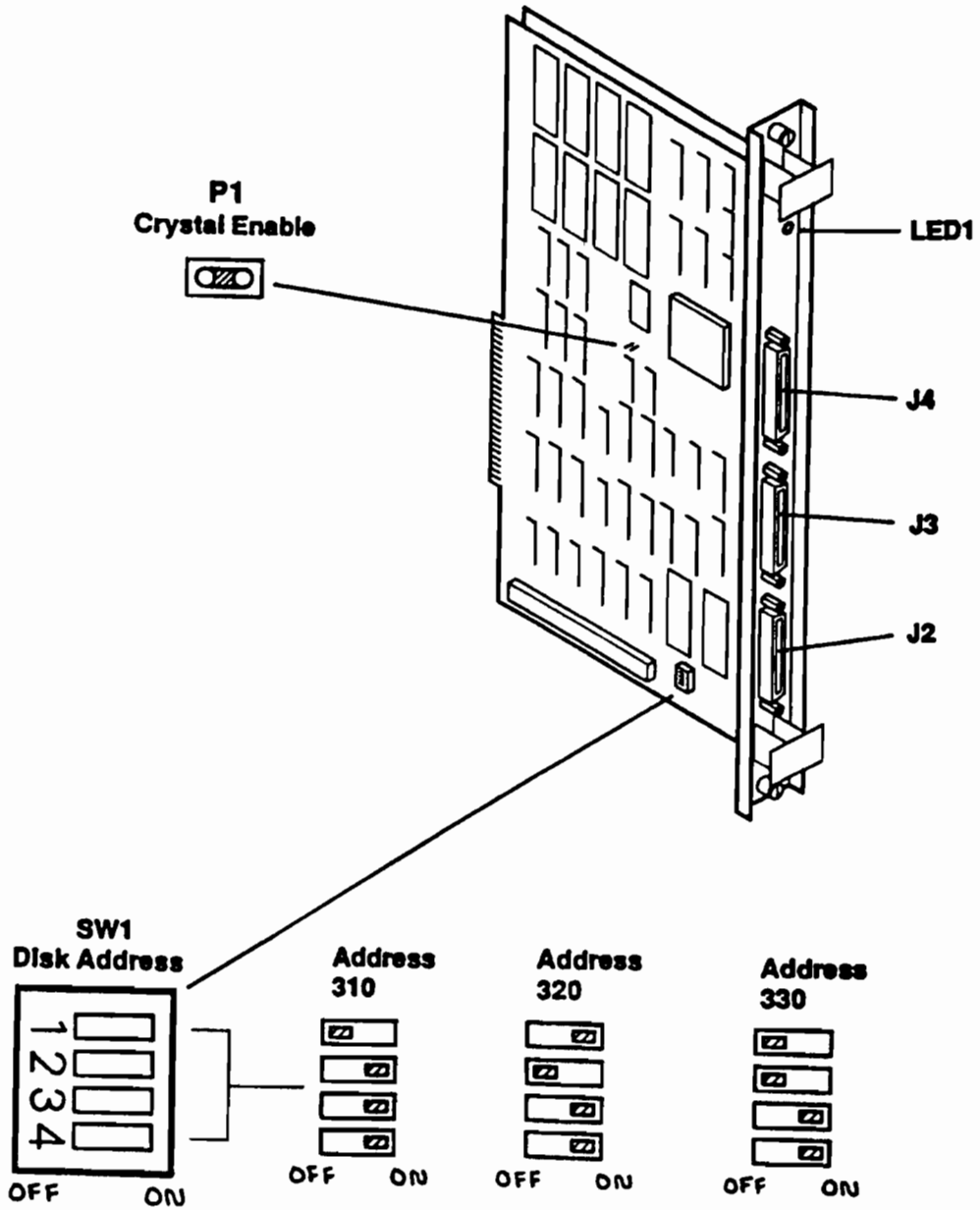
Figure F-7.   386 Turbo Printer/Disk Dual Controller (212-9718)

SW1
Disk MUX
Port Status

On

MUX Inactive

MUX Active

ON   OFF   ON   OFF

LED1

J4

J3

J2

SW2
Printer Address

On

1 2 3 4 5 6 7 8

Address 215

Address 216

Address 217

ON   OFF   ON   OFF   ON   OFF
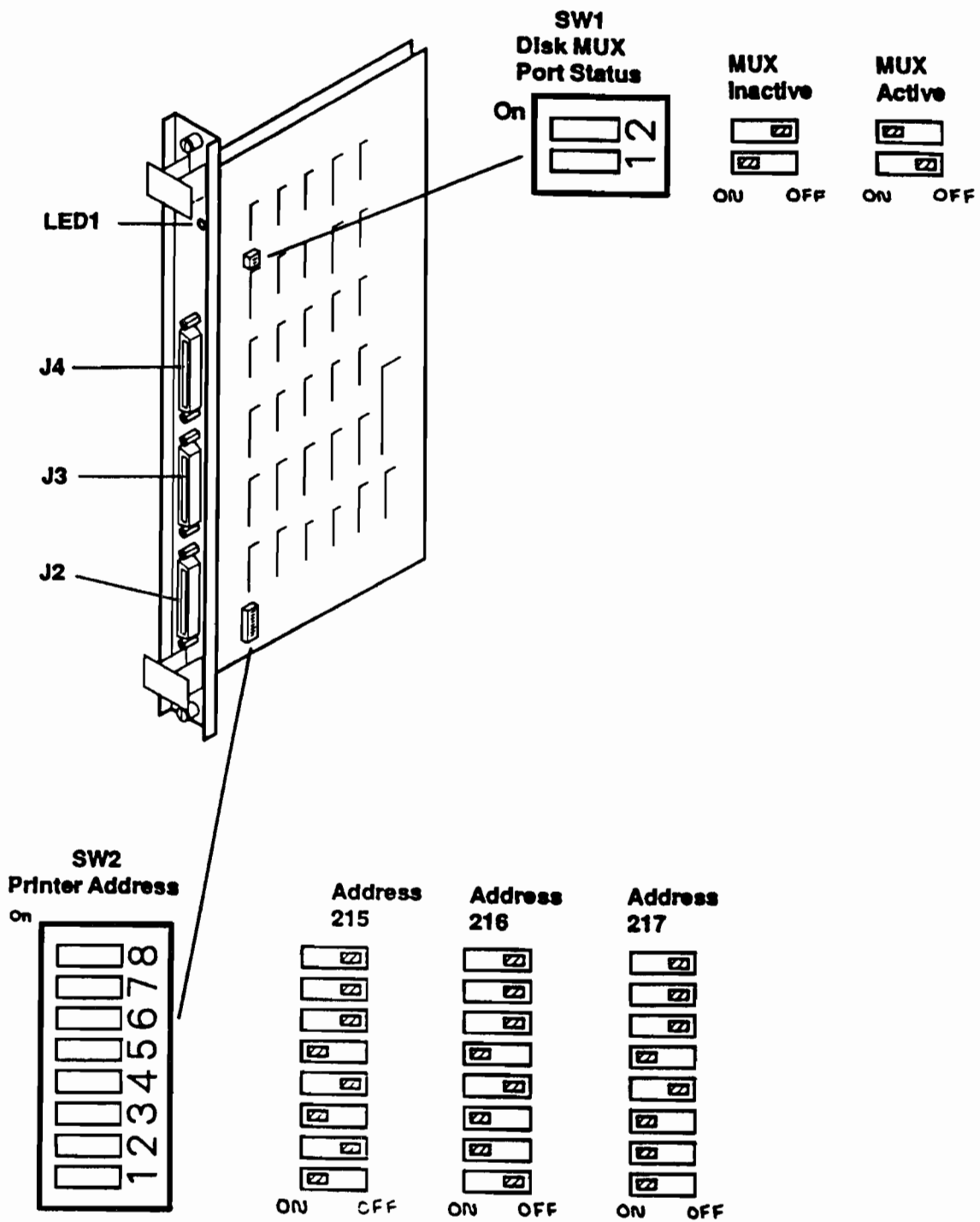
Figure F-8.   386 Turbo Printer/Disk Dual Controller (212-9718) (cont.)

G

Device Addressing

This appendix summarizes device addressing for the CS-D. Table G-1 shows the device addresses for the various devices in the CS-D.

Table G-1. Device Addressing

Device	Unit 10	Unit 20	Unit 30
Diskette	/D10	/D20	/D30
RAMdisk	/D50	/D60	/D70
Streaming Tape Cassette	/D5F	/D6F	/D7F
Fixed Hard Disk	/D11 – /D1E	/D21 – D2E	/D31 – /D3E

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WANG