WANG

DS

Data Storage Cabinet
User's Manual

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CONTENTS (continued)

PREFACE

This manual describes the operation of the DS Data Storage Cabinet and its information storage peripherals. These peripherals are designed to provide reliable, high-volume storage for Wang CS and 2200 MicroVP systems.

Information for using the Data Storage Cabinet is organized into seven chapters. Chapter 1 contains general information; Chapter 2 explains how to use the diskette drive in the cabinet; Chapter 3 discusses the operation of the removable hard disk cartridge; and Chapter 4 discusses the fixed hard disk drive. Chapter 5 describes the operation of the RAM Disk feature of the Data Storage Cabinet. Chapter 6 discusses the Streaming Tape Cassette drive unit. Chapter 7 describes the tape commands for operating the Streaming Tape Cassette drive. Appendixes cover error messages, and physical specifications for the storage units.

For additional information on system operations, refer to the following reference manuals:

Multi-User BASIC-2 Language Reference Manual	700-4080
2200 Basic - 2 Utilities Reference Manual	700-6855
CS Introductory Manual	715-1213
2200MVP Introductory Manual	700-4693
2200 General I/O Instruction Set Reference Manual	700-3514

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CHAPTER 1
GENERAL INFORMATION

INTRODUCTION

The DS Data Storage Cabinet (refer to Figure 1-1) provides disk storage to CS and 2200 MicroVP Systems. The DS can also be used with 2200 MVP, 2200 LVP, and 2200 VP systems. The DS Data Storage Cabinet houses a number of storage devices and can be configured with either two or four half-height 5 1/4-inch devices, as shown in Figures 1-2 and 1-3. Not all configurations are available. Refer to sales information for configurations that are offered.

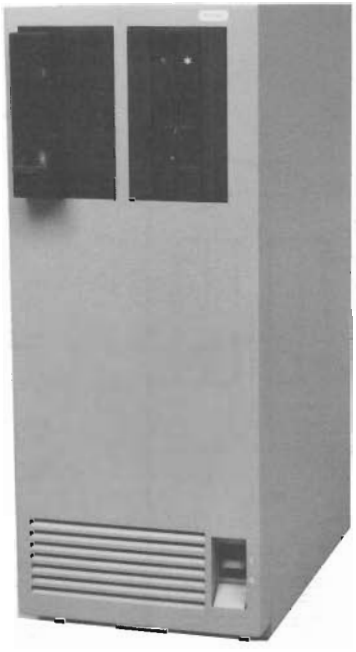


Figure 1-1. DS Data Storage Cabinet

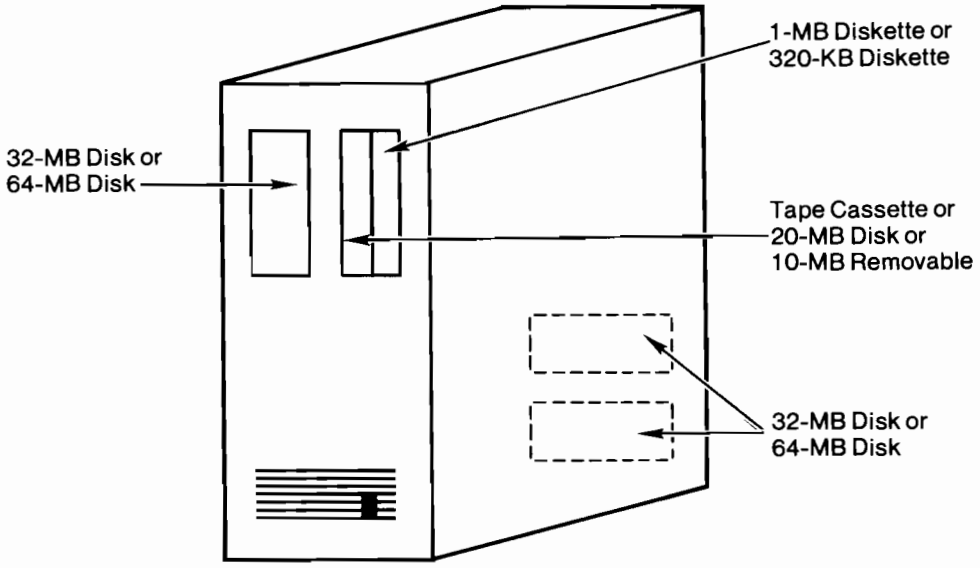


Figure 1-2. DS Data Storage Cabinet with Two Half-Height Devices

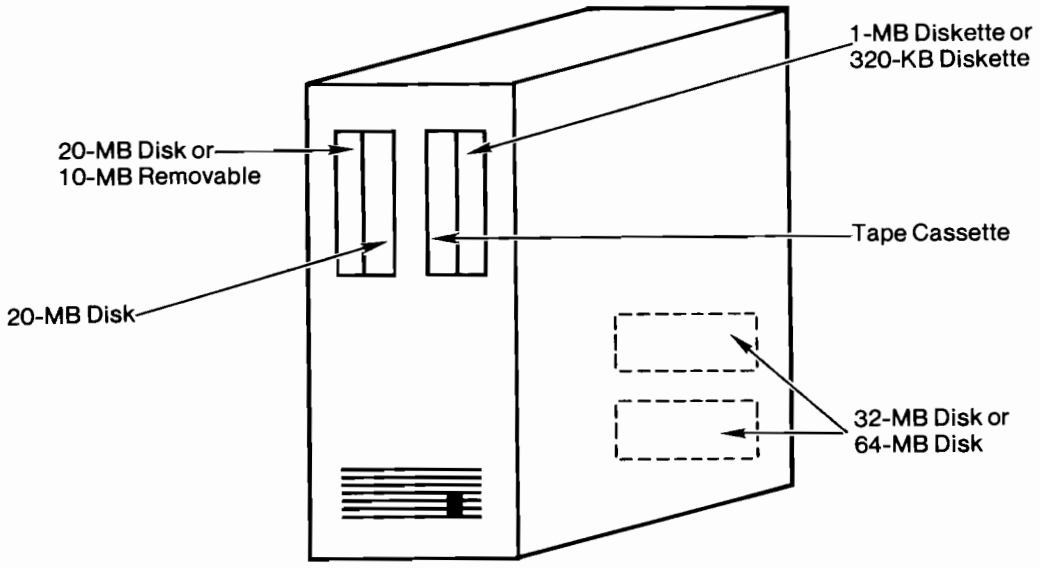


Figure 1-3. DS Data Storage Cabinet with Four Half-Height Devices

The DS Data Storage Cabinet is flexible enough to meet the storage requirements of most users. DS units can be upgraded by adding additional storage devices when storage requirements exceed the initial configuration. Up to three DS units can be attached to a CS or 2200 system. DS units can also be shared by up to 16 CS or 2200 systems by utilizing the Model 2275MUX Multiplexer and the 2275MUXE Extender.

The Data Storage Cabinet is controlled by a Disk Processing Unit (DPU) which is built into the cabinet unit. The DPU controls all of the physical storage devices within the DS as well as managing the DS sector caching and RAM Disk. The DS caches up to 1024 sectors in its RAM memory in order to optimize access performance. The caching algorithm makes use of sector access order and frequency of use in order to intelligently determine which sectors to keep buffered in memory. Access to sectors buffered in the cache is very fast since these sectors are read from memory without having to access the disk again.

The DPU enables users to set aside a portion of the memory normally used for sector caching for use as a high-speed RAM Disk. Once a RAM Disk has been established, it is accessed as a normal disk platter and supports all normal disk commands. RAM Disk is discussed in Chapter 5.

INSTALLATION

The Data Storage Cabinet must be unpacked, inspected, and installed by a Wang service representative.

Note: Upon delivery of the unit, call the Wang service office and request that this service be performed. Failure to follow this procedure voids the warranty.

The DS unit is connected to the CS or MicroVP system with the cable that is enclosed in the packaging container. The cable connects the disk controller, which is installed in the CS or MicroVP, and the connector on the rear panel of the DS. The DS is connected to one of the following disk controllers, depending upon the system configuration.

- 22C03 Disk Controller
- 22C11 Dual Controller
- 22C32 Triple Controller
- 2275MUX Disk Multiplexer

CONTROLS AND INDICATORS

The Power ON/OFF switch is located on the lower right corner side of the Data Storage Cabinet. Upon power on, the diskette drive lamp is lit indicating that the unit is going through a series of diagnostics testing. When the lamp goes out (after approximately one minute), the devices in the cabinet are ready to use. If the lamp blinks after one minute, this may indicate a faulty device. Try the diagnostics again by turning the power off and then on again.

Note: If after several tries the lamp still blinks, it indicates that a device in the unit is malfunctioning. Follow this procedure.

1. Press RESET from the system terminal. If the lamp does not go out it indicates a problem in the DPU, contact your Wang service representative. Otherwise go to Step 2.

2. Run the DS Configuration Utility (see the next section). In the list of DS devices, the faulty device is identified by the message "failed built-in test".

3. Contact a Wang service representative and describe the problem found in Step 2. Devices not at fault may still be used successfully.

A drive is in operation, reading data from or writing data to the disk, when its corresponding lamp is lit. Do not power off the Data Storage Cabinet while a drive is in operation.

DS CONFIGURATION UTILITY

The DS Configuration Utility lists the addresses of all the devices in the cabinet. This utility is found as a menu pick on the Wang DS Data Storage Cabinet Utilities menu.

To run the DS Configuration Utility, choose its entry on the DS Data Storage Cabinet Utility Menu and press RUN/EXEC. The first prompt requests that you supply the base address of the DS unit. Press RETURN. The screen displays information on all the devices (including RAM Disk) in the DS. This information includes device addresses, device storage capacities, number of platters, and sectors per platter.

ORDERING SUPPLIES

Diskettes and removable disk cartridges for the Data Storage Cabinet and other supplies are listed in the WangDirect Catalog. To obtain a copy of the catalog or to order supplies, call WangDirect at 1-800-225-0234.

MAINTENANCE

Wang recommends that you perform no maintenance on the Data Storage Cabinet. For periodic cleaning and service, you should contact a Wang service representative.

CHAPTER 2
USING DISKETTES

OVERVIEW

The Data Storage Cabinet uses either a 5 1/4-inch, 320-KB or a 1-MB double-sided double-density (DSDD) diskette drive.

A write-protect slot (also called write-enable) is provided on each diskette to prohibit writing over information already stored. Valuable programs or data can be protected from inadvertent loss by using the write-protect tabs. If the slot on a diskette is covered, information can be read from the diskette but no information can be written 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 the write-protect slot is uncovered.

TAKING CARE OF DISKETTES

Diskettes are a reliable and safe media for storing electronic information. However, if diskettes are not handled properly, information can be partially or totally lost. Therefore, you should maintain backup copies of all important diskettes. Use the System Utilities to record backup copies.

Follow the steps below to properly care for your diskettes:

1. Use a felt tip pen when you label a new diskette. Never use ball point pens or pencils, as they can scratch the diskette's surfaces.

2. Do not touch the exposed surfaces of the diskette.

3. Keep your diskettes free from dust and dirt.

4. Keep your diskettes away from any type of magnetic material. Such exposure can erase or distort the information on a diskette.

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

6. Maintain an acceptable environment with temperatures between 50° and 125°F (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 so that information on them becomes irretrievable.

7. Do not open the door of the diskette drive if the red indicator light, located on the front of the drive, is on. You can scratch the surface of a diskette while it is being read from or written to by opening the door when the indicator light is on.

INSERTING A DISKETTE

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

1. Rotate the door release lever to the position as shown in Figure 2-1. The door snaps open.

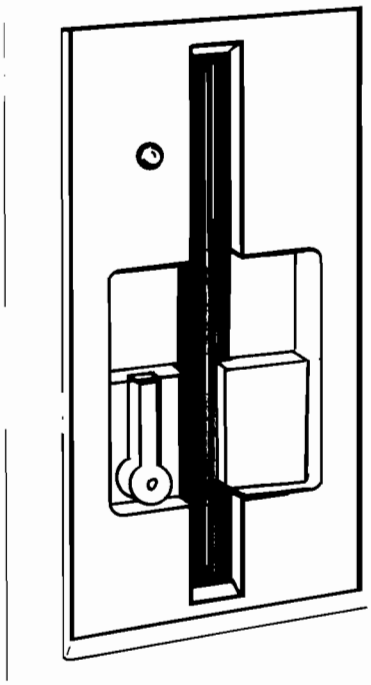


Figure 2-1. Opening the Diskette Drive Door

2. Grasp the diskette as indicated in Figure 2-2 and 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 and Up arrows 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.

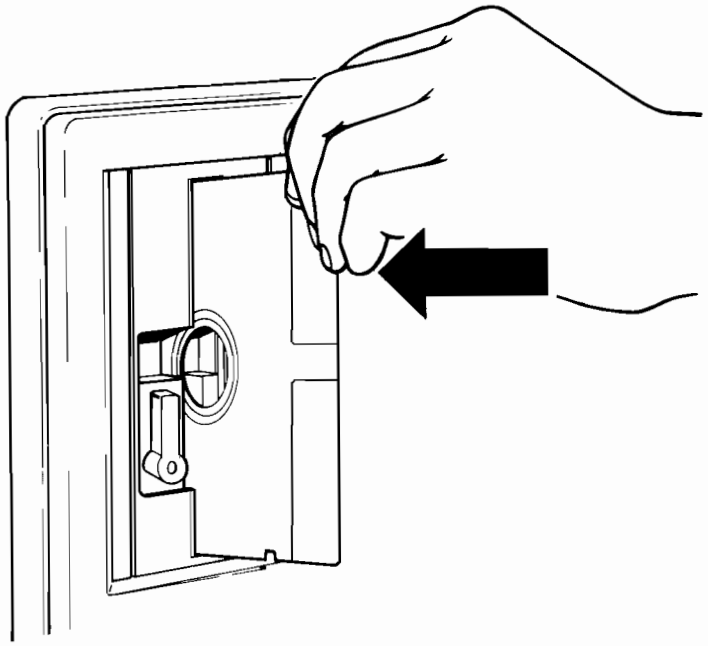


Figure 2-2. Inserting a Diskette

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

DISKETTE FORMATS

Before a diskette can store information, it must be formatted. Formatting allocates fixed length storage areas, called sectors, on the diskette. The standard format for BASIC-2 disk operations uses 256-byte sectors. This format should be used for normal CS and 2200 MicroVP operations.

The 5 1/4-inch diskette also supports the Wang PC (Professional Computer) 512-byte sector format so that data can be easily interchanged between the Wang CS or MicroVP and Wang PC systems. The 512-byte sectoring is transparent to the CS 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 the diskette were formatted with 256-byte sectors. All BASIC-2 disk operations can be performed. Although the 512-byte format provides more diskette capacity, it is not recommended for normal CS operations since disk write is considerably slower than with the 256-byte sector format.

Diskettes formatted by a 320-KB diskette drive with 256-byte sectors result in a diskette with 320 KB of storage: when formatted with 512-byte sectors, the capacity is 360 KB. Diskettes formatted by a 1-MB diskette drive with 256-byte sectors result in a diskette with 1.2 MB of storage; when formatted with 512-byte sectors, the capacity is 1.2 MB. The 1-MB diskette drive cannot format 320-KB nor 360-KB diskettes. Both 320-KB and 360-KB diskettes can be read by the 1-MB diskette drive; however, writing is not advisable. 320-KB and 360-KB diskettes written by a 1-MB diskette drive may not be able to be read by a 320-KB drive.

DISKETTE DRIVE ADDRESSING

The address of the diskette drive is dependent on the base address of the DS unit as shown in Table 2-1. The addresses given in the table are reserved strictly for diskette drive use. No other platter may be assigned to these addresses, nor may the diskette drive be located at a different address.

Table 2-1. Diskette Drive Addresses

DS Base Address	Diskette Drive Address
/D10	/D10
/D20	/D20
/D30	/D30

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 the information on the diskette is no longer needed.

Each diskette is protected from accidental overwriting when the write-protect slot is covered. You must uncover the write-protect slot to allow writing before attempting to format the diskette.

Formatting a Diskette

You can format a diskette by either using the $FORMAT DISK statement in the BASIC-2 language or by running the Wang Format Utility. To format a diskette, perform the following steps:

1. Remove the diskette from its envelope. Check to see that the write-protect notch is uncovered.

2. Properly orient the diskette, as indicated by arrows 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. You initiate disk formatting by mounting the System Utilities and entering LOAD RUN. A menu of utilities on the system disk is displayed. Select the Format Platter utility and answer the questions displayed on the screen 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.

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

   $FORMAT DISK T {file# / disk}

   Refer to the *BASIC-2 Language Reference Manual* for more information on the $FORMAT DISK statement.

   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, it is recommended that you use the Wang Format Utility supplied with BASIC-2. This utility reduces the chance of accidentally formatting the wrong disk.*

5. If formatting is unsuccessful, the system indicates a format error (I93). Generally, format errors result from three causes.

   a. The drive latch is not tightly closed.
   b. The write-protect notch is covered.
   c. The diskette is defective.

   Remove the diskette from the drive and format another one.

   Note: *If a diskette cannot be formatted, it cannot be used for storage and should be discarded.*

If the formatting procedure fails repeatedly with several diskettes, there may 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 format, the diskette drive also supports the Wang PC format. To format a diskette with the Wang PC format, follow the procedure for standard CS format. However, instead of using the $FORMAT DISK statement to invoke formatting, use the following statement:

```
$GIO disk-address (0600 0700 70A0 4002 88D0 7040 0130 6A10 6802 4001
            8B67, alpha-variable)
```

where: the alpha-variable is dimensioned to be 15 bytes long

The BASIC-2 $GIO statement formats the diskette into 512-byte sectors. Upon execution of the $GIO statement, Bytes 1-5 and 9-15 of the alpha-variable are used by the system, while Bytes 6-8 are set to the error return. Error return values are listed here.

```
HEX(000000) if no errors
HEX(000004) if echo error.  Retry the command.
HEX(010000) if ERR I98
HEX(020000) if ERR I91
HEX(040000) if ERR I94
HEX(000100) if ERR I95
HEX(000200) if ERR I93
HEX(000400) if ERR I96
```

Appendix B further defines the error messages.

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.

The following is an example of a BASIC-2 program that you can create and store as a utility. This program formats your diskettes with the Wang PC format.

```
10 DIM G$15
20 REM Format the diskette
25 $GIO /D10 (0600 0700 70A0 4002 88D0 7040 0130 6A10 6802 4001 8B67,
    G$)
30 IF STR(G$,6,3) = HEX(000000) THEN 50
40 IF STR(G$,6,3) = HEX(000004) THEN 20: ELSE STOP "Disk error"
50 STOP "Formatting Complete"
```

Disk Access Modes

Once a diskette has been formatted to contain the necessary sector information, it is ready for storing data and programs. Information can be maintained on CS diskettes in one (or both) of the following two modes:

1. The Automatic File Cataloging mode is 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 reference to its specific location on the disk.

2. The Absolute Sector Addressing mode is a direct method in which you access each sector by providing the specific sector address.

The Automatic File Cataloging mode is the recommended cataloging method used by most Wang software for maintaining data files. Under Automatic File Cataloging, the operating system maintains a catalog on each disk. The catalog consists of a Catalog Area, where program and data files are stored, and a Catalog Index, which contains the name of each file and its location in the Catalog Area. Whenever a new file is created, the system automatically records the file name and location. When a particular file is accessed, the system 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. Only the file names need be remembered. You can use a LIST DC statement to obtain the names of existing files.

Absolute Sector Addressing is typically used to record information on PC formatted diskettes. The Absolute Sector Addressing mode is composed of eight BASIC-2 statements and commands that enable you to read or write information in specific sectors on a formatted disk. You cannot create a Catalog Index in this mode, and programs and files are not referenced by name. Files are identified only 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 system does not automatically index your files.

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

Defining a Catalog Index

In the Automatic Cataloging mode, you must create a Catalog Index on the diskette before any programs or data can be stored. A SCRATCH DISK statement performs this operation called "scratching the disk." 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. The end of the Catalog Area is usually specified as the last available sector on the disk.

The size of the Catalog Index is defined with the LS parameter in a SCRATCH DISK statement. For example, LS = 10 indicates that 10 sectors are reserved for the Catalog Index. If no value is specified, the default value is 24.

The last sector in the Catalog Area is specified with 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 to be used 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 20 sectors be reserved for the Catalog Index; END = 1279 specifies that Sector 1279 is the last sector to be used by the catalog. The number of sectors allocated for the catalog and data storage may be other values. Refer to the *BASIC-2 Language Reference Manual* for further information on the SCRATCH DISK statement.

After a diskette is formatted and scratched, it is ready for data and program storage.

Note: *You can 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 displays the following message on the CRT:*

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

CHAPTER 3
USING THE REMOVABLE HARD DISK CARTRIDGE

OVERVIEW

The removable hard disk cartridge is capable of storing up to 10 MB of data, the equivalent of approximately 4,000 typewritten pages, on a 5 1/4-inch Winchester-type disk. The 5 1/4-inch hard disk resides in a disk cartridge that can be easily inserted or removed from the Data Storage Cabinet.

The removable disk cartridge (refer to Figure 3-1) features a write-enable tab. The write-enable tab allows you to choose whether or not the disk drive can write data on the disk. When the write-enable tab is inserted onto the cartridge, both read and write operations can occur. When the write-enable tab is removed, only read operations can occur. This feature allows you to protect valuable data on your disk.

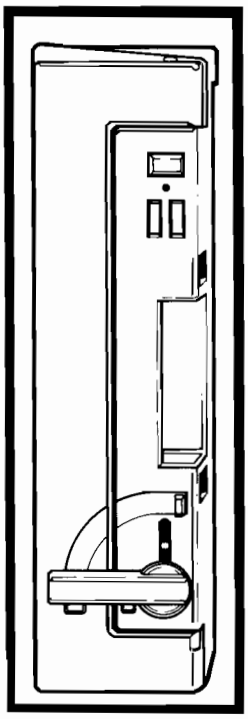


Figure 3-1. Removable Disk Cartridge

The removable disk cartridge is easy to use. A driver drawer mechanism allows you to pull the driver out of its housing, which is permanently installed in the disk drive unit.

CONTROLS AND INDICATORS

Figure 3-2 shows the controls and indicators that allow you to operate and monitor your disk drive.

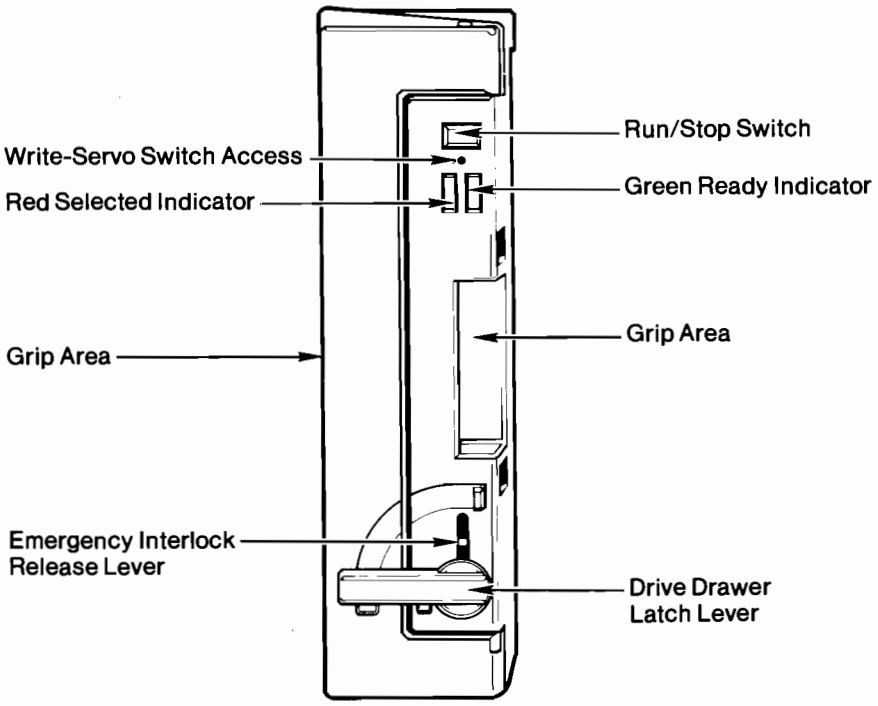


Figure 3-2. Removable Disk Cartridge Controls and Indicators

Drive Drawer Latch Lever

The drive drawer latch lever allows you to open and close the drive drawer for disk cartridge insertion or removal. When the drive is in use or when the spindle is slowing down, this lever is locked. It is also locked when power is not supplied to the drive. The latch lever points to the left in the locked position.

Run/Stop Switch

The run/stop switch allows you to either stop or start the disk cartridge. When this switch is pressed to start the disk cartridge, the drive spindle approaches operating speed and the read/write heads become operational. When this switch is pressed to stop the drive, the drive spindle slows to a stop and the read/write heads are withdrawn.

The run/stop switch must be used to stop the drive and to withdraw the read/write heads from the disk cartridge prior to changing a disk cartridge.

Emergency Interlock Release Lever

The emergency interlock release lever allows the disk cartridge to be removed from the disk drive when electrical service is interrupted during an extreme emergency. Normally, the disk cartridge can only be removed when power is supplied to the drive.

Red Selected Indicator

The red selected indicator lights when the drive is selected (on-line). The indicator does not light when the drive is deselected (off-line). This indicator may be lit when the latch lever is turned to the vertical position during drive removal.

Green Ready Indicator

The green ready indicator either lights continuously, does not light, or flashes in varying degrees of frequency to alert you to specific operating conditions.

- Continuously Lighted -- The drive is ready for use.
- Not Lighted -- The drive is not ready for use.

TAKING CARE OF A DISK CARTRIDGE

The disk cartridge is reliable and safe media for storing electronic information. However, if a cartridge is not handled properly, information can be partially or totally lost.

Follow the steps below to properly care for your disk cartridges:

1. Do not drop the disk cartridge.

2. Do not touch the exposed surfaces of the disk.

3. Keep your disk free from dust and dirt.

4. Keep your cartridges away from any type of magnetic material. Such exposure can erase or distort the information on a disk.

5. Maintain an acceptable environment with temperatures between 50° and 125°F (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 so that information on them becomes irretrievable.

INSERTING A DISK CARTRIDGE

Perform the following steps to insert a disk cartridge:

1. Make sure that power is supplied to the disk drive.

2. Rotate the drive drawer latch lever clockwise until it points upward (refer to Figure 3-3).

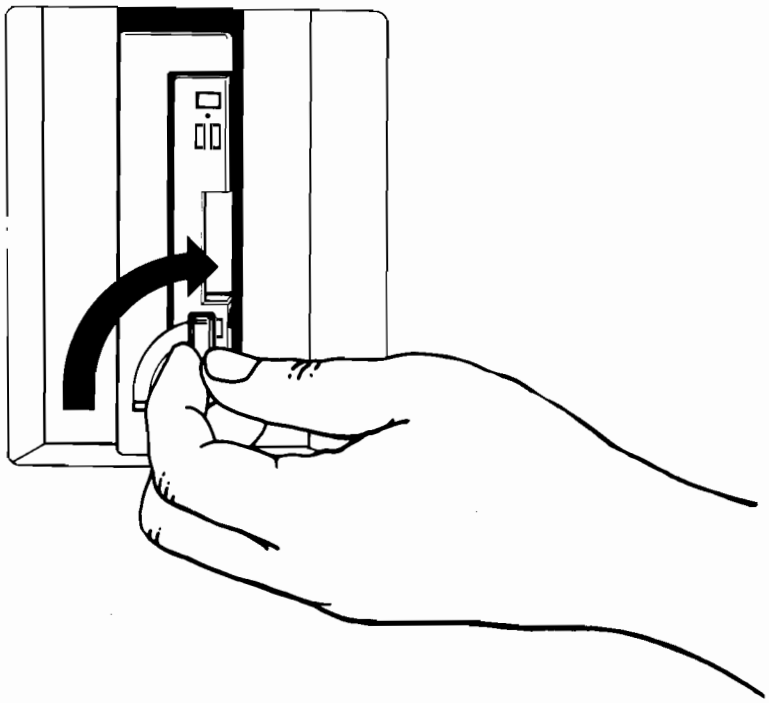


Figure 3-3. Unlocking the Drive Drawer

3. Grasp the drive by its grip area and withdraw the drive drawer from its housing (refer to Figure 3-4).

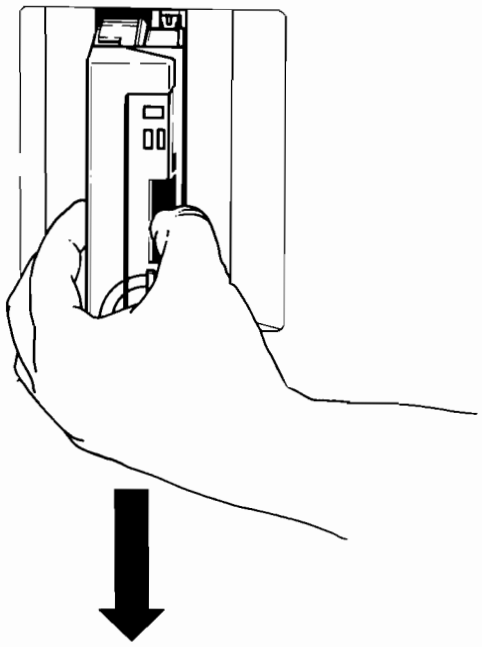


Figure 3-4. Pulling Out the Drive Drawer

4. Open the drive door until the cartridge receiver extends to the left about one quarter inch (refer to Figure 3-5).

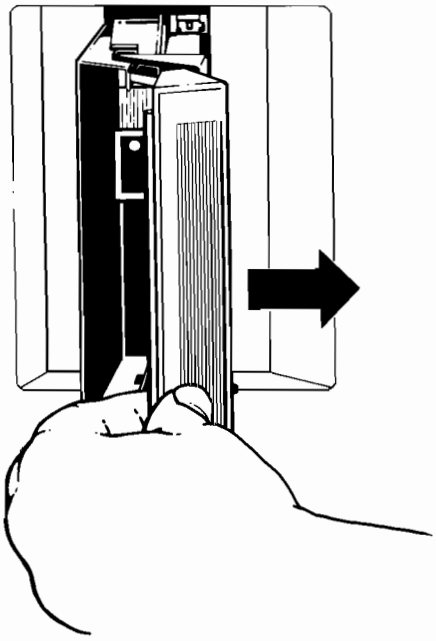


Figure 3-5. Opening the Drive Door

5. Grasp the disk cartridge. (If you want to write information onto the disk or if you are inserting a new disk cartridge, do not remove the write-enable tab.) If you want to prevent the drive from writing onto the disk remove the write-enable tab by performing the following steps:

   a. Place your thumbnail into the slot between the write-enable tab and the side of the disk cartridge (refer to Figure 3-6).

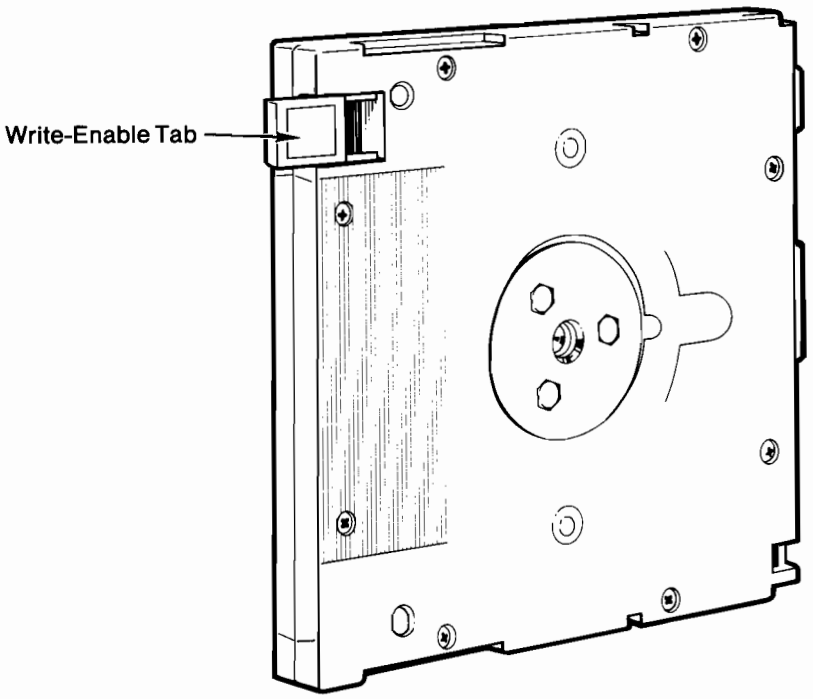


Figure 3-6. Removing the Write-Enable Tab

   b. Move the write-enable tab toward the front of the disk cartridge until it slides completely out of the cartridge.

   c. To replace the write-enable tab, simply align the grooves of the write-enable tab with the rim on the inside of the cartridge and slide the write-enable tab completely onto the disk cartridge.

6. Position the disk cartridge so that the write-enable tab or opening (if the tab has been removed) is at the top right-hand side of the cartridge. Hold the disk door completely open and slide the disk cartridge into the cartridge receiver (refer to Figure 3-7).

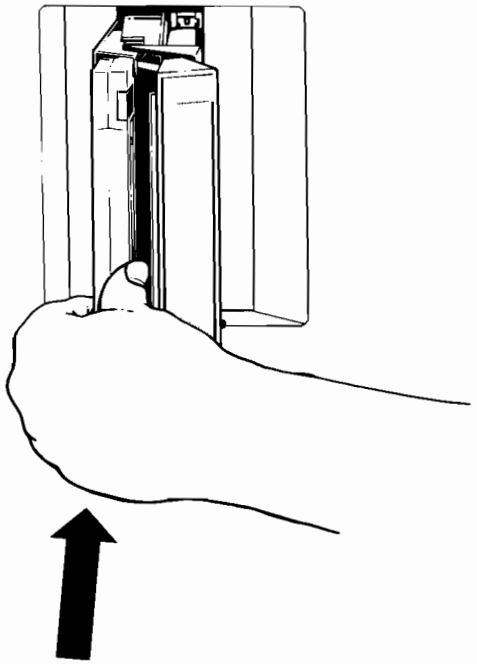


Figure 3-7. Inserting the Cartridge

7. When the cartridge is fully inserted, close the drive door (refer to Figure 3-8). The disk cartridge snaps into its operating position.

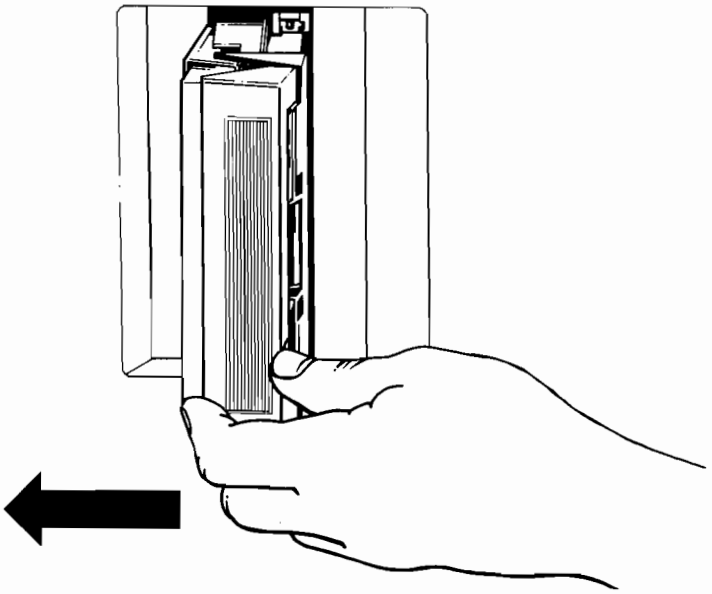


Figure 3-8. Closing the Drive Door

8. Rotate the drawer latch lever counterclockwise until it points to the left. Slide the drive drawer back into the housing (refer to Figure 3-9). Disk cartridge insertion is now completed.

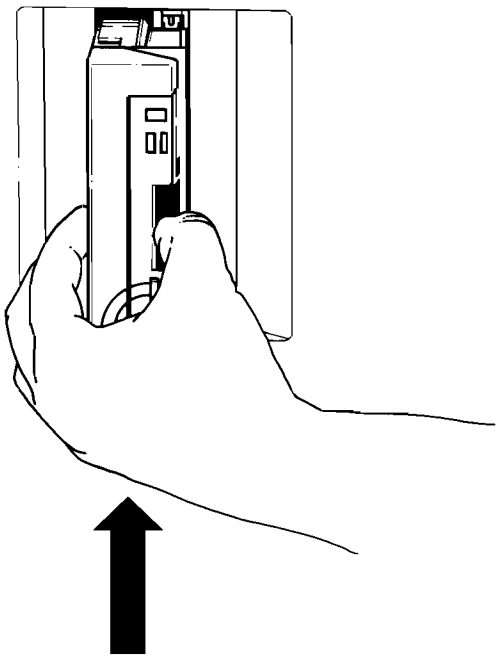


Figure 3-9. Sliding the Drive Drawer into the Housing

Note: *If you have just inserted a new unused disk drive cartridge, you must perform a disk formatting operation. To perform this operation, refer to the section entitled "Using the Removable Disk Cartridge".*

9. Start your drive by pressing the run/stop button.

   When the drive starts, the spindle approaches operating speed, the ready/write heads become operational, and the green ready indicator flashes once per second. When the green ready indicator lights continuously, the drive is ready for use.

REMOVING A DISK CARTRIDGE

Under normal conditions the disk cartridge can only be removed when power is supplied to the drive. Perform the following steps to remove a disk cartridge:

1. Press the run/stop button. The green ready indicator flashes once per second as the drive spindle slows down to a stop and the read/write heads are withdrawn.

2. When the green ready indicator is not lighted, rotate the drawer latch lever clockwise until it is pointing upward. Grasp the grip areas on the drive and withdraw the drive drawer from its housing.

3. Open the drive door as far as it can open and pull out the disk cartridge.

4. Close the drive door and rotate the drawer latch lever counterclockwise until it is pointing to the left. Slide the drive drawer back into the housing.

Caution: *Under conditions of extreme emergency the disk cartridge should be removed only by a Wang service representative. The disk cartridge can be removed using the emergency interlock release if electric service has been interrupted during an emergency.*

REMOVABLE HARD DISK ADDRESSING

The address of the removable hard disk is dependent on the base address of the DS unit as shown in Table 3-1. The addresses given in the table are reserved strictly for removable hard disk use. No other platter may be assigned to these addresses, nor may the removable hard disk be located at a different address.

Table 3-1. Removable Hard Disk Addresses

DS Base Address	Removable Hard Disk Address
/D10	/D1F
/D20	/D2F
/D30	/D3F

USING THE REMOVABLE HARD DISK CARTRIDGE

The disk must be formatted each time a new, unused disk cartridge is used in your drive. Disk formatting is essential for proper drive operation. During formatting, all data on the disk is erased. Accordingly, care should be exercised when using the formatting functions to prevent accidental erasure of important data from your disk.

Formatting a Disk

Follow these steps to perform the formatting operations:

1. Make sure your system is on.

2. Insert the new cartridge into the drive if you have not already done so. Be sure not to remove the write-enable tab.

You can format a disk either by running the Wang-supplied @FORMAT utility or by using the $FORMAT DISK statement, as described in Section 2.5. The general form of the $FORMAT DISK statement is as follows:

$$\$\text{FORMAT DISK T} \left\{ \begin{matrix} \text{file\#} \\ \text{disk} \end{matrix} \right\}$$

For example, if the address of the removeable disk cartridge is D1F, enter a statement of the following form:

```
$FORMAT DISK T/D1F
```

It takes approximately 22 minutes to format a disk cartridge.

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 removable disk drive supports both Automatic File Cataloging and Absolute Sector Addressing to control disk operations. (Refer to the section entitled "Disk Access Modes".) The Automatic File Cataloging mode is the recommended method for maintaining data files on disk.

The process of creating a catalog on a hard disk is identical to that of creating a catalog on the diskette. The ending sector of the disk is 38,911.

An example of a SCRATCH DISK statement follows, assuming the disk has an address of D1F and 25 sectors are desired for the catalog index.

```
SCRATCH DISK'T/D1F, LS = 25, END = 38911
```

The SCRATCH DISK statement is explained in detail in Chapter 2 and in the *Multi-User BASIC-2 Language Reference Manual*.

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

CHAPTER 4
USING A FIXED HARD DISK DRIVE

OVERVIEW

Fixed hard disks provide fast access to a large capacity of disk storage. Fixed hard disks are housed within the DS Storage Cabinet and provide no removable media. Information stored on fixed disks should be periodically backed up onto other devices with removable storage for offline storage.

Since CS and MicroVP systems can access a maximum of 16 MB of data at one disk address, the larger fixed disks are logically divided into a number of smaller disk platters that are addressed with different disk addresses. Refer to Table 4-1 and Table 4-2.

Table 4-1. Fixed Hard Disk Platters

Fixed Hard Disk	Platters	Platter Size
20-MB	2	10-MB
32-MB	2	16-MB
64-MB	4	16-MB

FIXED DISK ADDRESSING

The addresses of fixed disk platters is dependent on the base address of the DS unit and the number of fixed disks installed. Table 4-2 shows the addresses that are allocated for fixed disk platters.

Table 4-2. Fixed Disk Platter Addresses

DS Base Address	Fixed Hard Disk Address	
	Primary Address	Secondary Address
/D10	/D11 to /D1E	and /D51 to /D5E
/D20	/D21 to /D2E	and /D61 to /D6E
/D30	/D31 to /D3E	and /D71 to /D7E

DS units with a single fixed disk use platter addresses starting at /D11, /D21, or /D31. Platters on a second fixed disk can use either primary or secondary addresses depending on the "drive select" cable configuration selected at installation time (refer to Appendix C). Platters on a third fixed disk use platter addresses unused by the first and second fixed disks.

The addressses of all devices included in the DS cabinet can be viewed by the DS Configuration Utility. This utility is found as a menu pick on the Wang DS Data Storage Cabinet 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 it is used. A fixed disk platter should be formatted only when it is first used 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
```

It 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".) The Automatic File Cataloging mode is the recommended method 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.

An example of a SCRATCH DISK statement follows, assuming the fixed disk has an address of D11 and 25 sectors are desired for the catalog index.

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

The SCRATCH DISK statement is explained in detail in the section entitled "Disk Access Modes" in Chapter 2 and in the *Multi-User BASIC-2 Language Reference Manual*.

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

INSTALLING SYSTEM FILES

If the fixed hard disk drive is the principle disk unit on the system, you should first load the System Software from the system diskette and copy the System Software onto a formatted and scratched fixed disk drive. You can thereafter 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, the programs can be recopied onto a separate diskette or a removable hard disk cartridge to create a duplicate copy of the System Software.

Use the Install System Files utility provided on the system platter to copy system files from the diskette drive to the fixed disk drive. To use this utility, type LOAD RUN and then press RETURN. Select Install System Files from the menu. The program provides prompts that require 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 by inserting a formatted and scratched diskette into the drive. Then, you can copy the system files onto the diskette from the fixed disk drive.

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

BACKING UP A FIXED HARD DISK

It is possible to lose information from any disk or diskette through hardware failure, software problems, or operator error. Therefore, it is important to 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 provided on the system platter. You can also back up a fixed disk by using the tape cassette drive (refer to Chapters 6 and 7).

CHAPTER 5
USING THE RAM DISK

OVERVIEW

The Data Storage Cabinet allows up to 900 sectors of its cache memory to be set aside for use as an onboard RAM Disk. This RAM Disk 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. Because the RAM Disk is not a permanent form of storage, its contents are lost when power is removed or the RAM Disk is de-allocated, thus it is recommended that only temporary files or files that have up-to-date backups located in permanent storage be placed in RAM Disk.

RAM DISK ADDRESSING

The platter address of the RAM Disk is dependent on the base address of the DS unit itself as shown in Table 5-1. The addresses given in the table are reserved strictly for RAM Disk use. No other platter may be assigned to these addresses, nor may the RAM Disk be located at a different address.

Table 5-1. RAM Disk Addresses

DS Base Address	RAM Disk Address
/D10	/D50
/D20	/D60
/D30	/D70

DEFINING RAM DISK

The RAM Disk is defined using the Wang DS RAM Disk Allocation Utility. This utility prompts you for the address of the RAM Disk and the number of sectors to be assigned to it. Since only cache memory that is not currently being used may be assigned to RAM Disk, it is recommended that the RAM Disk be defined as soon as the DS unit is powered on. Attempts made to define a RAM Disk after the DS has been in use may fail if there is not enough memory avaliable to create a RAM Disk of the requested size. Once the RAM Disk has been defined, it must be de-allocated before its size can be changed. To de-allocate the RAM Disk, you must create a RAM Disk of zero sectors.

Note: *De-allocating the RAM Disk causes its contents to be lost.*

BASIC-2 Disk Command Support

Once the RAM Disk of the DS has been defined, it responds to BASIC-2 disk commands (refer to *Multi-User BASIC-2 Language Reference Manual*). All of the BASIC-2 disk commands are supported including: $FORMAT DISK, SCRATCH DISK, and VERIFY.

DS RAM DISK ALLOCATION UTILITY

This section describes the use of the DS RAM Disk Allocation Utility. This utility is found as a menu pick on the Wang DS Data Storage Cabinet Utilities menu.

Specifying the RAM Disk Address

The first prompt requests that you specify the address of the RAM Disk to be created. The only addresses that are allowed are D50, D60, or D70 (refer to Table 5-1). After accepting the address, the utility checks the disk unit at the specified address to determine if it is a Wang DS. If the disk unit specified is not a DS, then the message "Specified disk is not a DS" is displayed and you are requested to enter a new address.

If the disk is busy (i.e., in exclusive use by another user) or is not a DS, the message "Disk unavailable" is displayed. If the disk is a DS, wait until the disk is available and then re-enter the disk address.

Allocating Cache Memory to RAM Disk

Once the address of the RAM Disk is entered, the utility prompts you for the number of sectors to be allocated to it. Entering a number less than zero or greater than 900 causes "Illegal RAM Disk size." to be displayed. In this case you must re-enter the size of the RAM Disk.

If the DS does not have enough free cache to create the requested RAM Disk, then "Insufficient cache space available." is displayed and you must re-specify the size of the RAM Disk.

Attempting to allocate a RAM Disk in a DS unit where one currently exists causes the message " RAM Disk already allocated." to be displayed. In order to set up the new RAM Disk, the old RAM Disk must first be de-allocated. To do this, enter a size of zero sectors. Once de-allocated, the new RAM Disk can be allocated.

Warning: *When you enter a size of zero sectors, all data that is currently in RAM Disk is destroyed.*

DS CACHE USAGE UTILITY

This section describes the use of the DS Cache Usage Utility. This utility is found on the Wang DS Utilities menu; it allows you to monitor accesses made to the DS's cache and RAM Disk. The DS Disk Processing Unit (DPU) counts the number of sectors read and write requests it receives; separate counts are kept for RAM Disk and cache hits. The utility periodically reads the request counts from the DPU and uses them to update its display of cache and RAM Disk activity. Since the DS RAM Disk is created from cache memory, monitoring this activity can help you discover what size RAM Disk allows for optimal performance.

Starting The Utility

To run the Cache Usage Utility, choose its entry on the DS Data Storage Cabinet Utility Menu and press RUN/EXEC.

The first prompt requests that you supply the base address of the DS unit that is to be monitored (refer to Table 5-1). After accepting the address, the utility checks the disk unit at the specified address to determine if it is a Wang DS. If the disk unit specified is not a DS, then the message "Specified disk is not a DS" is displayed and you are requested to enter a new address.

If the disk is busy (i.e., in exclusive use by another user) or is not a DS, the message "Disk unavailable" is displayed. If the disk is a DS, wait until the disk is available and then re-enter the disk address.

Cache Usage Display

The second screen of the utility displays the usage information. The screen is divided into two sections: disk/cache usage and RAM Disk usage. The disk/cache usage section shows accesses made to diskettes and hard disks. The number of reads of cached sectors and the number of actual reads from disk are indicated by a bar graph showing the cache hit rate. The second section shows accesses made to RAM Disk.

The utility monitors usage by periodically reading the access counts from the DS DPU. Each time the counts are read 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, these counts are displayed on the screen along with a bar graph that indicates the cache hit rate.

If the utility determines that the size of the RAM Disk has changed, it displays the message "RAM Disk size changed." You should clear the counts by pressing ERASE since the totals displayed are no longer valid.

Understanding the Hit Rate

The cache hit rate is calculated by dividing the number of sector read requests that were cache hits by the total number of sector read requests This number provides an indication as to 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% means that all accesses are being satisfied by cache; and since accessing cache is much faster than accessing a disk, the optimum level of performance has been reached. The actual hit rate achieved by any given set of applications is lower than 100% and depends on how much of the available disk capacity is used, as well as the manner by which it is accessed. A set of programs that randomly accesses a very large area of disk can be expected to have a relatively low hit rate; while a set of programs that only access a small area of disk can be expected to have a higher hit rate.

Suggested Method of Analysis

The purpose of the Cache Usage Utility is to help you select the optimum size RAM Disk for the system. There are no hard and fast rules that can be used to determine 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 RAM Disk. The following steps are recommended to determine the best RAM Disk size.

1. Determine if the RAM Disk can be used by your applications. The RAM Disk should be used to hold the read-only data files and program overlays that are frequently used. If your system has no such files that could fit into the RAM Disk then you probably have no use for one.

   While it is recommended that RAM Disk not be used 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 RAM Disk, estimate the size of RAM Disk needed.

2. Determine the cache hit rate of your applications with no RAM Disk 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 large numbers of requests are made to the DPU, a significant amount of system activity produces better results.

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

4. Repeat Step 2 to determine the cache hit rate when your applications are run with RAM Disk.

5. Adjust the RAM Disk size based on the new cache hit rate and number of accesses to the RAM Disk. If the new hit rate is the same or close to the original cache hit rate, then the RAM Disk can probably be made larger and used to hold more of your applications.

   In cases where the cache hit rate has decreased significantly, the number of accesses to both cache and the RAM Disk must be examined in order to determine the correctness of the RAM Disk size. If the number of accesses to the RAM Disk is small when compared to the number of accesses to cache, then the RAM Disk is too large. In this case system performance has probably decreased.

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

   If the number of accesses to the RAM Disk are approximately equal to the number of accesses to cache, then only your perception of the system performance can be used to determine if the RAM Disk size should be increased or decreased.

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

CHAPTER 6
USING THE STREAMING TAPE CASSETTE DRIVE

OVERVIEW

The Streaming Tape Cassette Drive (STCD) is a mass storage backup and recovery device for the CS and 2200 MicroVP systems. The STCD can back up an entire hard disk, up to 45 megabytes (MB), on a single 450-ft tape cassette. When used with the DS Disk Backup and Restore Utilities it provides a fast and convenient means of backing up and restoring the contents of the disk drives in the DS cabinet or other disk units attached to the system.

Note: *The DS Disk Backup and Restore Utilities use sectors of cache memory. A portion of cache memory may be set aside for RAM Disk (refer to Chapter 5). When both RAM Disk and the DS Disk Backup and Restore Utilities are being used, a maximum of 750 sectors of cache may be allocated to RAM Disk.*

CASSETTE DRIVE ADDRESSING

The address of the STCD is dependent on the base address of the DS unit itself as shown in Table 6-1. The addresses given in the table are reserved strictly for STCD use. No other platter may be assigned to these addresses, nor may the STCD be located at a different address.

Table 6-1. STCD Addresses

DS Base Address	STCD Address
/D10	/D5F
/D20	/D6F
/D30	/D7F

WRITE PROTECT FEATURES OF THE TAPE CASSETTE

Locate the blank tape cassette packaged in a plastic container. You can protect tapes from being written over by using the write-protect tab on the data cassette (refer to Figure 6-1). When the write-protect tab is in place, you cannot write over the tape. When the write-protect tab is removed, you can write over the tape. Insert a flat-bladed instrument into the slot to remove the write-protect tab. The tape cassette in Figure 6-1 shows the normal position of the write-protect tab in the slot for blank tape cassettes.

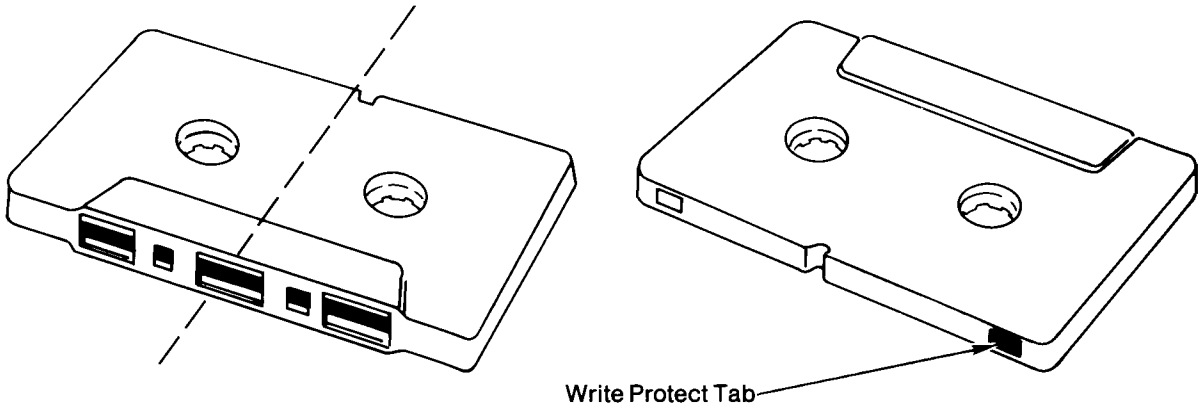


Figure 6-1. Tape Cassette

HANDLING OF TAPE CASSETTES

You should observe several 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 a cassette is exposed to significantly higher or lower temperatures than the STCD operating area, allow it to acclimate to the STCD environment for 30 minutes or more before using it.
- If the tape in the cassette is too loose, the tape can be damaged when the cassette is loaded. The slack can be removed by rotating the hub gently in the tightening direction using a pencil or a ball point pen inserted in the reel hub.
- 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 drive (refer to Figure 6-2):

1. Remove any cassette that may be in the cassette insertion slot by pressing the Eject button.
2. Hold the new cassette so that the recording surface faces down and the write-protect tab is closet to the insertion slot.
3. Insert the new cassette all the way into the insertion slot until the seating mechanism engages. The cassette is pulled in mechanically to the proper position. The cassette is now ready to use.
4. The SCTD's drive activity indicator comes on and goes off several times when the SCTD is reading, writing, or seeking data, or rewinding, or erasing the tape.

Caution: *Never turn off the power to the SCTD while the tape is running. Never eject the cassette while the tape is running.*

5. When the SCTD is not in use, remove the tape cassette. When a cassette is inserted, the tape is always in contact with the recording and erasing heads. Leaving a data cassette in the drive for extended periods of time may cause damage to the tape.

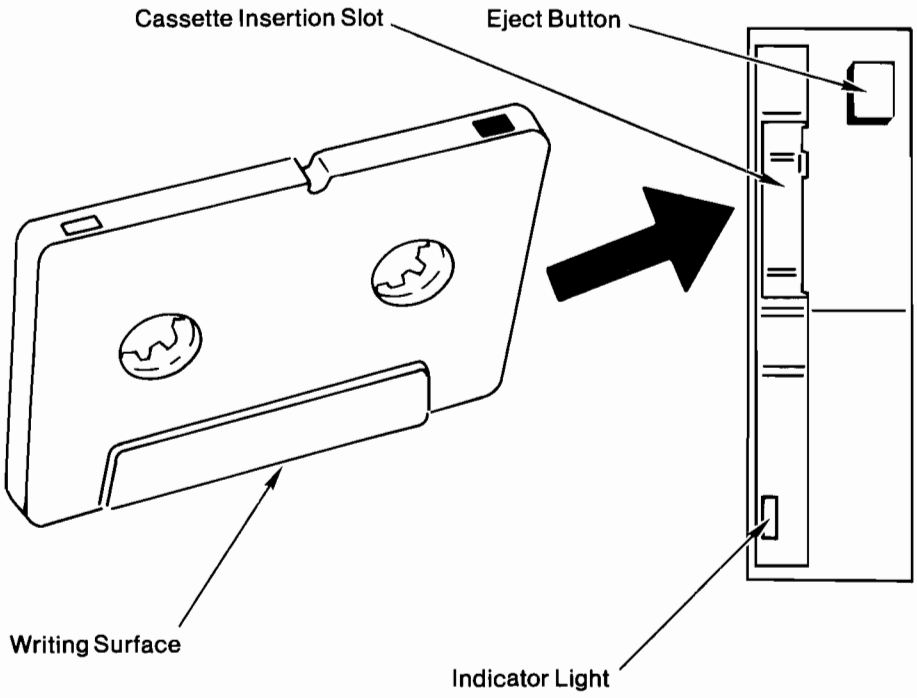


Figure 6-2. Inserting a Tape Cassette

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 SCTD, perform the following steps:

1. Power on the DS cabinet. The SCTD clicks as it runs through an internal diagnostic. The SCTD is then ready for use.

2. Check the presence of the write-protect tab on the tape casstte (refer to the Section entitled "Write Protect Features of the Data Cassette").

3. Insert the tape cassette (refer to the Section entitled "Inserting the Data Cassette").

4. To run the utilities, SELECT DISK to the DS diskette drive, insert the DS utilities diskette, and LOAD RUN. When the menu is displayed, 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".

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

7. When you finish running a utility, remove the tape cassette by pressing the Eject button. Do not leave a cassette in the drive for an extended period of time.

Backing Up Disk Platters to a Tape Cassette

Use the Backup Disk Platters to Tape Cassette Utility to backup one or more disk platters to tape. This utility will erase a new tape or allow you to append data onto an existing tape.

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

1. *Mount Tape*: Insert the tape cassette into the drive.

2. *Tape Cassette Drive Address*: Enter D5F, D6F or D7F (refer to Table 6-1). Press RETURN.

3. *Append or Erase*: The user is asked whether the utility is to append to an existing tape or to erase a new tape. Enter A for Append or E for Erase. Press RETURN.

4. *Disk Platters*: In this step the Tape Directory is displayed and the following information is added to the directory. Enter for each disk platter to be backed up --

   - The platter address. Press RETURN.

   - The descriptive name identifying the backup item. Press RETURN.

   - The starting and ending sector address of each item to be backed up. Press RETURN.

     If no item is specified, the starting address defaults to zero and the ending address defaults to the current end of the catalog.

   - If there are no more platters to be backed up, enter blanks (spaces) in the platter address field. Press RETURN.

The utility then proceeds unattended by performing the following:

- The tape is rewound and is placed into Wang Format Mode.

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

- Each platter and sector range is copied to tape. Note that internal copies (all within the same DS) are much faster than copying from a disk in one DS to the tape of a second DS.

- After all platters are backed up, a new or updated directory is written to the tape. The directory includes an entry for each platter backed up. The entry contains the descriptive name, disk platter address, and the sector address range.

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

Restoring Disk Platters from a Tape Cassette

Use the Restore Disk Platters from Tape Cassette Utiliy to restore one or more disk platters from tape.

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

1. *Mount Tape*: Insert the tape cassette into the drive.

2. *Tape Cassette Drive Address*: Enter D5F, D6F or D7F (refer to Table 6-1). Press RETURN.

3. *Destination Disk Address*: Enter the address of the destination disk platter. Press RETURN. (The destination platter address need not be the same as the address from which the backup was made.)

4. *Tape Directory*: The tape directory is read and displayed on the screen. Use the space bar to select an item to be restored.

   Repeat the process in Step 4 until all desired files have been restored to the destination disk platter.

CHAPTER 7
TAPE CASSETTE COMMANDS

OVERVIEW

The Streaming Tape Cassette Drive (STCD) is instructed to perform tape operations via commands (see Table 7-1) issued with the BASIC-2 $GIO statement. The Wang supplied utilities are sufficient for most users. However, this chapter documents the tape cassette commands for those programmers who need to write customized utilities.

RECORDING FORMAT

A STCD tape can be used to record several sets of data. Each set of data is separated by a file mark and has an associated directory entry for locating the data set. Data sets can be appended onto previously recorded tapes, but data can never be overwritten or deleted.

The STCD records data using an 8-track serpentine format. The drive records data on one track, reverses direction, and records data on the next track until all tracks are used. The ninth track is used to record a tape directory.

The STCD records at a density of 8000 bits per inch (bpi), and reads and writes at a speed of 90 inches per second (ips). The data written is recorded in 512-byte blocks. In order to make efficient use of the streaming characteristic of the STCD, the DS provides a 64 KB tape buffer which can hold up to 128 tape blocks. The tape buffer is usually filled before data is written so that several blocks are written at one time. The tape buffer is allocated from disk cache memory whenever needed for tape operations. The buffer is released for cache use whenever a REWIND TAPE command is executed.

After all the data in a data set has been written, a file mark is written. The file mark is a special identifiable data block marking the end of the data set. A directory entry is then recorded identifying the data set and its location on the tape.

Table 7-1. Tape Commands

Command	Function
BACKUP SECTORS	Copies a range of sectors from a DS disk to tape
ERASE TAPE	Erases the entire tape
GET STATUS	Obtains tape drive status information
READ BLOCK	Reads a block of data from the tape buffer
READ FILE MARK	Positions the tape past the next file mark
READ N FILE MARKS	Reads 1-15 file marks
REREAD LAST BLOCK	Transfers the last block of data read again
RESTORE SECTORS	Copies a range of sectors from tape to a DS disk
RETENSION TAPE	Respools the tape
REWIND TAPE	Positions tape to the beginning
SEEK BLOCK	Positions the tape to a specified data block
SEEK DIRECTORY BLOCK	Positions the tape to a directory block
SEEK END OF DATA	Positions the tape after the recorded data
WRITE BLOCK	Writes a block of data to the tape buffer
WRITE FILE MARK	Writes a file mark at the current tape position

TAPE OPERATIONS

This section presents an overview of the basic tape operations as they relate to the tape commands described in the section entitled "Tape Commands".

Starting Tape Operations

The GET STATUS command can be used to determine if a tape drive is present at the specified address. After mounting a tape cassette in the tape drive, the tape must be rewound using the REWIND TAPE command. The other tape commands are not enabled until a REWIND TAPE has been performed. After rewinding, the tape should either be retensioned using the RETENSION TAPE command or erased using the ERASE TAPE command. A previously recorded tape should be retensioned to ensure that it is uniformly wound and will move at a constant rate. Before using a new tape, it must be entirely erased. Erasing a tape will automatically retension it.

Positioning the Tape

Before data can be written or read from the tape, the tape must be positioned to the proper location. The tape uses 8 tracks for data and one track for a tape directory. Use SEEK BLOCK and SEEK DIRECTORY BLOCK to position to a data block or a directory block, respectively. Specifying block 0 positions the tape to the beginning of data or the beginning of the directory. Once a seek to a data block or a directory block has been done, SEEK END OF DATA can be used to position after the data or directory so that information can be appended onto the tape. READ FILE MARK and READ N FILE MARKS are used to skip past the specified number of data sets delimited by file marks.

Reading Data From Tape

To read data from the tape, the tape is positioned to the desired block and information is read with the READ BLOCK or RESTORE SECTORS command. These commands do not read past file marks. If a file mark is encountered, it can be read past by using the READ FILE MARK command.

Writing Data To Tape

To write data onto the tape, the tape must first be positioned beyond the current end of data. Positioning beyond the data for appending can be done by using the SEEK END OF DATA command. Data is then written by using the BACKUP SECTORS and WRITE BLOCK commands, which transfer blocks of data into the tape buffer.

Note: *Data can be appended onto a tape, but data cannot be successfully overwritten without first erasing the entire tape.*

The tape buffer holds up to 128 blocks. When the tape buffer is full, the buffered blocks are automatically written to tape. To write a partially full buffer, use the WRITE FILE MARK command. WRITE FILE MARK writes any remaining blocks to tape followed by a file mark, which terminates the data set.

After a data set has been written, add an entry to the tape directory. Position the tape to the end of the directory and then write the new directory entry with WRITE BLOCK and WRITE FILE MARK.

Ending Tape Operations

Rewind the tape using a REWIND TAPE command to end tape operations so that the media is not exposed when the cassette is removed from the drive. REWIND also releases the tape buffer memory for disk cache use.

TAPE COMMANDS

The tape commands in Table 7-1 can be issued with $GIO statements in a BASIC-2 program to perform tape drive operations. The $GIO sequences and the entry and exit parameters for each tape command are described in the following section. Each command is of the following format:

```
$GIO COMMAND NAME /DxF (command sequence, G$) [variables]

where:  /DxF = tape drive address (D5F, D6F, or D7F)
```

All commands finish by returning error information in the variable G$. All commands return the following:

```
STR(G$,6,1) = error code (hex(00) if no error)
STR(G$,7,2) = command error (hex(0000) if no error)
```

The command error byte is nonzero if the command is invalid or is not received correctly by the DS unit. If a command error is received, verify that the command issued is valid, and then reissue it. The error code byte is nonzero if a tape or disk error occurred while executing the tape command. Refer to Appendix B for the list of possible error conditions.

The following terms are used in the descriptions of the tape commands:

```
disk platter address:  hex(00) for /D10 (/D20 or /D30)
                       hex(01) for /D11 (/D21 or /D31)
                       hex(02) for /D12 (/D22 or /D32)
                           .
                           .
                           .
                       hex(0F) for /D1F (/D2F or /D3F)

                       hex(10) for /D50 (/D60 or /D70)
                       hex(11) for /D51 (/D61 or /D71)
                       hex(12) for /D52 (/D62 or /D72)
                           .
                           .
                           .
                       hex(1E) for /D5E (/D6E or /D7E)
```

disk sector address: 2-byte binary value

number of sectors: 2-byte binary value

block#: 3-byte binary value (1st block is 0)

Backup Sectors

The BACKUP SECTORS command copies the specified range of sectors from a disk, contained with the DS unit housing the STCD, to the tape buffer. If the tape buffer is full, the buffered data is written to tape at the current tape location. If an error occurs during the write to tape, the tape buffer is emptied.

Entry: STR(G$,2,2) = disk starting sector address
STR(G$,4,1) = disk platter address
STR(G$,11,2) = number of sectors to backup (1 to 256)

```
$GIO BACKUP SECTORS /DxF (0600 0700 70A0 68D0 7040 682E 6833 6A40 6800
6A20 6230 8B67 6AB0 6AC0 8B67 4000 8706, G$)
```

Exit: STR(G$,6,1) = error code
STR(G$,7,2) = command error

Erase Tape

ERASE TAPE erases the entire tape and then repositions the tape to the beginning of the tape (BOT).

Note: *New tapes and recorded tapes that are to be reused must be erased before write operations are performed.*

Entry: none

```
$GIO ERASE TAPE /DxF (0600 0700 70A0 68D0 7040 682E 6831 8B67 4000
8706, G$)
```

Exit: STR(G$,6,1) = error code
STR(G$,7,2) = command error

Get Status

GET STATUS returns the tape drive status defined in Table 7-2. GET STATUS can be used to determine if a tape drive actually exists at the specified address. The command terminates after five seconds if the device does not respond.

Entry: none

```
$GIO GET STATUS /DxF (0E14 0F00 12E2 0600 0700 70A0 68D0 7040 682E
6816 4000 8705 1A00 C340, G$) G$; STR(S$,,VAL(STR(G$,5,1)))
```

Exit: STR(G$,6,1) = error code
STR(G$,7,2) = command error
STR(G$,8,1), bit 10 = 1 if the command timed out
STR(S$,1,17) = tape drive status

Table 7-2. Tape Drive Status Bytes

Status Byte	Remarks
1	DS type (ASCII 3)
2	Device type (ASCII E if tape cassette drive)
3	Protocol level used for CS/DS communication (ASCII)
4	DS PROM revision number, low digit (ASCII)
5	DS PROM revision number, high digit (ASCII)
6-8	Approximate maximum number of sectors on tape (binary)
9-16	Reserved
17	Hex(00) if drive ok, Hex(FF) if drive not present or malfunctioning

Read Block

If the tape buffer is empty, it is first loaded with blocks from the tape until a file mark is found or the buffer is full. Then the READ BLOCK command reads one block (512 bytes) of tape data from the tape buffer. An LRC check is done on the data transmitted. If an LRC error occurs, the REREAD LAST BLOCK command can be used to transfer the data again. If READ BLOCK encounters a file mark, a File Mark Read error is returned and the tape is positioned after the file mark.

Entry: none

```
$GIO READ BLOCK /DxF (0600 0700 70A0 68D0 7040 682E 684A 8B67 4000
8B76 D00F C341 8B52 E00F 0626 0800, G$) STR(B$(),,512)
```

```
Exit:  STR(G$,6,1) = error code
       STR(G$,7,2) = command error
       STR(B$(),,512) = data block
```

Read File Mark

READ FILE MARK positions the tape past the next file mark skipping any intervening data blocks.

Entry: none

```
$GIO READ FILE MARK /DxF (0600 0700 70A0 68D0 7040 682E 6836 8B67 4000
8706, G$)
```

```
Exit:  STR(G$,6,1) = error code
       STR(G$,7,2) = command error
```

Read N File Marks

The READ N FILE MARKS command reads 1 to 15 file marks.

Entry: STR(G$,2,1) = number of file marks to read (1-15)

```
$GIO READ N FILE MARKS /DxF (0600 0700 70A0 68D0 7040 682E 683B 8B67
6A20 4000 8706, G$)
```

```
Exit:  STR(G$,6,1) = error code
       STR(G$,7,2) = command error
```

Reread Last Block

The REREAD LAST BLOCK command transfers the last block of data read to the CS or 2200 again. REREAD LAST BLOCK is used to recover from transmission errors detected by a bad LRC in a READ BLOCK operation. Use REREAD LAST BLOCK immediately following the bad READ BLOCK.

Entry: none

```
$GIO REREAD LAST BLOCK /DxF (0600 0700 70A0 68D0 7040 682E 684C 8B67
4000 8B76 D00F C341 8B52 E00F 0626 0800, G$) STR(B$(),,512)
```

```
Exit:  STR(G$,6,1) = error code
       STR(G$,7,2) = command error
       STR(B$(),,512) = data block
```

Restore Sectors

RESTORE SECTORS copies the specified range of sectors from the tape starting at the current tape position to a disk contained within the DS unit housing the STCD. The copy terminates if a file mark is encountered. The actual number of sectors copied is returned.

```
Entry: STR(G$,2,2) = disk starting sector address
       STR(G$,4,1) = disk platter address
       STR(G$,11,2) = number of sectors to recover (1 to 256)

$GIO RESTORE SECTORS /DxF (0600 0700 70A0 68D0 7040 682E 6835 6A40
6800 6A20 6230 8B67 6AB0 6AC0 8B67 4000 870B 870C 8706, G$)

Exit:  STR(G$,11,2) = number of sectors copied
       STR(G$,6,1) = error code
       STR(G$,7,2) = command error
```

Retension Tape

RETENSION TAPE rewinds the tape, moves to the end of the tape, and then returns to the beginning of tape. This action relieves any tension on the tape, caused by intermittent motions or long term storage, by assuring that the tape is uniformly wound. The ERASE TAPE command also has the effect of retensioning the tape.

Note: *Tapes should be retensioned at the beginning and end of tape operations.*

```
Entry: none

$GIO RETENSION TAPE /DxF (0600 0700 70A0 68D0 7040 682E 6832 8B67 4000
8706, G$)

Exit:  STR(G$,6,1) = error code
       STR(G$,7,2) = command error
```

Rewind Tape

The REWIND TAPE command positions the tape to the beginning of tape (BOT) and enables the use of the other tape commands. Always issue a REWIND TAPE command to start tape operations after a tape has been mounted in the drive. REWIND TAPE is also used to terminate tape operations. Be sure to issue a REWIND TAPE command before dismounting a tape so that the recording media is not exposed. REWIND TAPE also frees the tape buffer for use as disk cache. Since the tape buffer uses one quarter of the available memory, it is recommended that the tape utilities release this memory after tape operations have been completed.

Entry: none

```
$GIO REWIND TAPE /DxF (0600 0700 70A0 68D0 7040 682E 6830 8B67 4000
8706, G$)
```

```
Exit:  STR(G$,6,1) = error code
       STR(G$,7,2) = command error
```

Seek Block

The SEEK BLOCK command positions the tape to the specified data block. The block is found by a series of successive approximations, in such a manner as to minimize the random block access time. If the block cannot be found, the tape is rewound and an error is returned. The SEEK BLOCK command is for positioning to data blocks only. Use SEEK DIRECTORY BLOCK for positioning to directory blocks.

Entry: STR(G$,3,3) = block#

```
$GIO BLOCK SEARCH /DxF (0600 0700 70A0 68D0 7040 682E 683F 8B67 6800
6A30 6A40 6A50 4000 8706, G$)
```

```
Exit:  STR(G$,6,1) = error code
       STR(G$,7,2) = command error
```

Seek Directory Block

SEEK DIRECTORY BLOCK positions the tape to the specified directory block. If the block cannot be found, the tape is rewound and an error if returned. SEEK DIRECTORY BLOCK must be used before any data can be read from the directory track. This command is for positioning to directory blocks only. Use SEEK BLOCK for positioning to data blocks.

```
Entry: STR(G$,3,3) = block#

$GIO SEEK DIRECTORY BLOCK /DxF (0600 0700 70A0 68D0 7040 682E 683F
8B67 6801 6A30 6A40 6A50 4000 8706, G$)

Exit:  STR(G$,6,1) = error code
       STR(G$,7,2) = command error
```

Seek End of Data

SEEK END OF DATA positions the tape after the recorded data, so that data can be appended onto the tape. If in the data area, SEEK END OF DATA positions the tape past the last recorded data. If in the directory track, SEEK END OF DATA positions the tape past the last directory block.

```
Entry: none

$GIO SEEK END OF DATA /DxF (0600 0700 70A0 68D0 7040 682E 683A 8B67
4000 8706, G$)

Exit:  STR(G$,6,1) = error code
       STR(G$,7,2) = command error
```

Write Block

The WRITE BLOCK command writes one block (512 bytes) of data to the tape buffer. An LRC check is done of the data transmitted. If an LRC error occurs, send the data again with another WRITE BLOCK command. If the tape buffer is full, the contents of the buffer are written to the tape.

```
Entry: STR(B$(),,512) = data block

$GIO WRITE BLOCK /DxF (0600 0700 70A0 68D0 7040 682E 6848 8B67 A002
8706, G$) STR(B$(),,512)

Exit:  STR(G$,6,1) = error code
       STR(G$,7,2) = command error
```

Write File Mark

The WRITE FILE MARK command writes any data in the tape buffer to tape and then writes a file mark at the current tape position.

Entry: none

```
$GIO WRITE FILE MARK /DxF (0600 0700 70A0 68D0 7040 682E 6834 8B67
4000 8706, G$)
```

```
Exit:  STR(G$,6,1) = error code
       STR(G$,7,2) = command error
```

APPENDIX A
SPECIFICATIONS

Data Storage Cabinet

Size

Height
23.0 in. (58.4 cm)
Width
9.5 in. (24.13 cm)
Depth
15.75 in. (40.00 cm)

Weight (standard unit without storage devices)

35.00 lb (15.75 kg), approximately

Cable Lengths

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

Power Requirements

347 W
1185 Btu/hr
115 Vac, 60 Hz
3.15 A
230 Vac, 50 Hz
1.57 A

Environmental Requirements

Temperature
50° to 90°F (10° to 32°C)
Humidity
10% to 80% relative humidity, non condensing
Noise Level
Runnning continuous - 35 dB(A)

Disk Drive Specifications

	320-KB Diskette	1-MB Diskette	Removable Hard Disk	20-MB Hard Disk	32-MB Hard Disk	64-MB Hard Disk
Disk Platters	1	1	1	2	2	4
Capacity/ Platter	320-KB	1-MB	10-MB	10-MB	16-MB	16-MB
Sectors/ Platter	1280 (1440 for PC format	4160 (4800 for PC format	38912	38912	65024	65024
Bytes/ Sector	256 (512 for PC)	256 (512 for PC)	256	256	256	256
Average Access Time	100 ms	100 ms	95 ms	68 ms	45 ms	27 ms
Data Transfer Rate	250 KB/sec	500 KB/sec	5 MB/sec	5 MB/sec	5 MB/sec	5 MB/sec

Streaming Tape Cassette Drive Specifications

Recording
Capacity: Up to 45 MB with 450-ft tape
Density: 8000 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

APPENDIX B
ERROR MESSAGES

INTRODUCTION

The following sections explain the significance of each DS error message and suggests possible recovery procedures. If these procedures fail, call your Wang service representative. A disk or tape error is usually serious enough to warrant executing a control memory diagnostic. However, it may be possible to resume execution of the currently loaded application program by pressing RESET and Special Function Key '15. If the error is reported again, a memory diagnostic should be run to locate the defective memory location. Refer to your system's Introductory Guide to run a memory diagnostic.

Several possible errors may occur while you are trying to load information on the DS units. The recommended recovery procedure involves consulting the following description of each possible disk or tape error to determine if the problem can be corrected and then attempting to reload. Should successive failures occur, contact your Wang service representative. All system errors are more fully documented in the Multi-User BASIC-2 Language Reference Manual.

DISK ERRORS

D80 File Not Open

The file operation cannot be performed upon a closed file.

D81 File Full

No more information can be written into the indicated file. Correct the program, or transfer the file to another platter, reserving additional space on the new platter for this file.

D82 File Not Found

The file name does not exist, or a data file was loaded as a program file or a program file as a data file. Ensure that the file name is entered correctly; ensure that the proper disk is mounted; and ensure that the correct disk drive is being accessed.

D83 File Already Exists

The file name already exists in the Catalog Index. Use a different name, or catalog the file on a different platter.

D84 File Not Scratched

A file must be scratched before it can be renamed or written over.

D85 Index Full

The Catalog Index contains no space for new names. 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

The defined Catalog Area ends within the Catalog Index or has no more available space to store information. This usually occurs because a MOVE END statement tries to move the end of the Catalog Area to the area already occupied by cataloged files. 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

Because neither a DATASAVE DC END nor a DATASAVE DA END statement recorded an end-of-file record in the file, the DSKIP END statement cannot locate an end-of-file record. Write an end-of-file trailer after the last data record in the file.

D88 Wrong Record Type

The system encountered a program record when a data record was expected or vice versa. Ensure that the proper drive and file is being accessed.

D89 Sector Address Beyond End-of-File

A DATALOAD DC or DATASAVE DC statement accesses a sector address beyond the end-of-file. This error can be caused by a bad disk platter. Press RESET and run the program again. If the error persists, use a different platter or reformat the platter. If the error still exists, contact a Wang service representative.

I/O ERRORS

I90 Disk Controller Error

The system aborts the disk operation because the controller responded improperly at the beginning of the operation. Press RESET and rerun the program. If the error recurs, make certain that the disk unit is on and all cables are properly connected. If the error persists, contact a Wang service representative.

I91 Disk Drive Not Ready

The disk unit is not ready for access. Make certain that the program addresses the correct disk. Also, make sure that the disk unit is on and in run mode, and all cables are properly connected. Press RESET and rerun the program. If the error recurs, power the disk unit off and then back on and rerun the program. If the error persists, contact a Wang service representative.

I92 Timeout Error

A device did not respond to the system. If the device is a disk, the system aborts the disk operation. Press RESET and run the program again. If the error recurs, ensure that the disk has been formatted. If the error persists, contact a Wang service representative.

I93 Format Error

The system detects invalid sector control information of the disk platter. If a disk operation is in progress, the platter may need to be reformatted. If the formatting is in progress, the surface of the platter may be flawed. 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 the user attempts to access a disk formatted for use on a different type of system.

I94 Disk Controller Error

The system aborts the disk operation because the controller did not receive the disk command correctly. Press RESET and rerun the program. If the error recurs, make certain that the disk unit is on and all cables are properly connected. If the error persists, contact a Wang service representative.

I95 Device Error

The disk cannot perform the requested operation. Repeat the operation. If performing a write operation, make certain that the disk is not write-protected. If the error recurs, power the disk off and back on, and again perform the operation. If the error persists, contact a Wang service representative.

I96 Data Error

For read operations, the checksum calculations (CRC or ECC) indicate that the data read is incorrect. For disk drives that perform ECC, the attempt to correct errors was unsuccessful. Rewrite the data; the read sector may have been written incorrectly. If read errors recur, reformat the platter.

For write operations, the LRC calculation indicates that the data sent to the disk is incorrect. The data has not been written. Repeat the write operation. If write errors recur, make certain that all disk cables are properly connected.

If either error persists, contact a Wang service representative.

I97 LRC Error

A longitudinal redundancy check error occurred while a sector was being written or read. An LRC error usually indicates a transmission error between the disk and the CPU. Press RESET and rerun the program. If the error recurs, rewrite the flawed sector; the sector may have been previously written incorrectly. If the error persists, contact a Wang service representative.

I98 Illegal Sector Address or No Platter

The indicated sector is not on the disk platter, or the specified drive contains no platter. Ensure that the correct drive is being accessed. Correct the program statement, or ensure that the diskette is inserted into the drive.

I99 Read-After-Write-Error

The comparison of read-after-write to a disk sector failed, usually indicating a defective platter. Rewrite the information; the data may have been previously written incorrectly. If the error recurs, replace the platter. If the error persists, contact a Wang service representative.

TAPE COMMAND ERROR CODES

Each command issued to the Tape Cassette Drive completes by receiving a return code from the DS. The return code indicates whether or not the command was successfully completed. If not successful, the return code provides error information. Refer to Chapter 7 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 following errors are returned. See the section entitled "I/O Errors" for a discussion of the 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

There is no cassette in the tape cassette drive. Ensure that a cassette has been inserted into the tape cassette drive before issuing tape commands.

T11 No Tape Cassette Drive

The tape command cannot be performed since there is no operational tape cassette drive.

T12 Write Protect

The write operation cannot be performed since the tape cassette has been write protected. To write, unprotect the tape cassette.

T13 End of Tape

The end of tape was encountered. If reading, there is no more data on the tape. If writing, there is no available space on the tape.

T14 Unrecoverable Data Error

The read or write operation could not be performed. Make sure the right cassette has been loaded. Retry the operation. If the error occurs again, power the DS off (when not in use) and 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

The next data block on tape could not be read. Remount the tape and try the operation again from the beginning. If the error persists, try a different tape cassette. If the error continues to be reported with different tape cassettes, contact a Wang service representative.

T17 No Data

There is no more data on the tape to be read. Be sure that the correct tape cassette has been mounted.

T1A File Mark Read

A file mark was read from the tape.

T1B Illegal Command

The command issued is not a legal tape command. Correct the program.

T1C Power on/RESET

The tape drive was reset in the middle of an operation. Retry the operation.

T20 Invalid Number of File Marks

The number of file marks specified in the command must be 1 to 15. Correct the program.

T23 Insufficient Buffer Space

If too large a RAM Disk has been defined, tape operations cannot be performed. If this is the case, deallocate the RAM Disk (making sure all the needed data has been saved elsewhere) and retry the tape operation. If the Ram Disk is not the problem then the tape buffer was not released, probably because a tape operation was aborted. To release buffer space, issue a REWIND TAPE command. If the error persists, power the DS off (when not in use) and back on.

T24 Tape Drive Error

A tape drive bus parity error occurred. 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 to be reported, contact a Wang service representative.

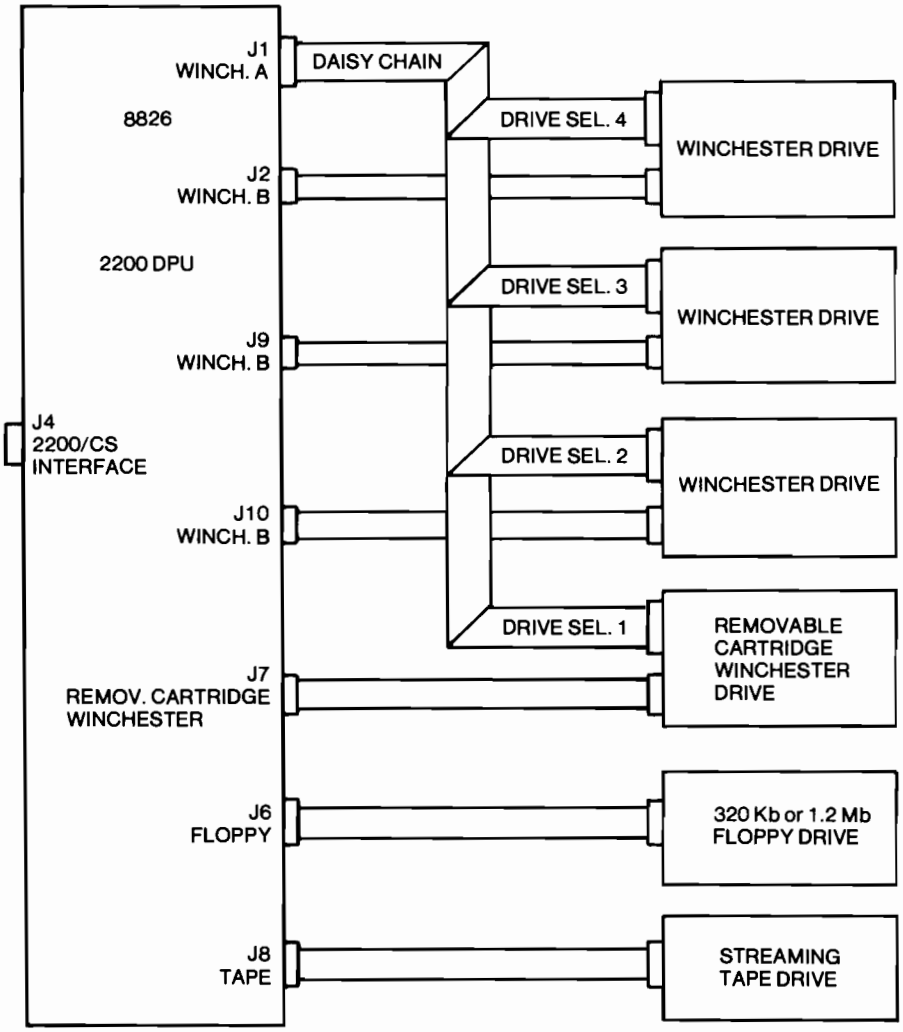
T26 LRC Error

The LRC on the data sent is not correct. Retransfer the data using REREAD for tape reading or WRITE BLOCK for tape writing. If the error persists, contact a Wang service representative.

T27 Device Error

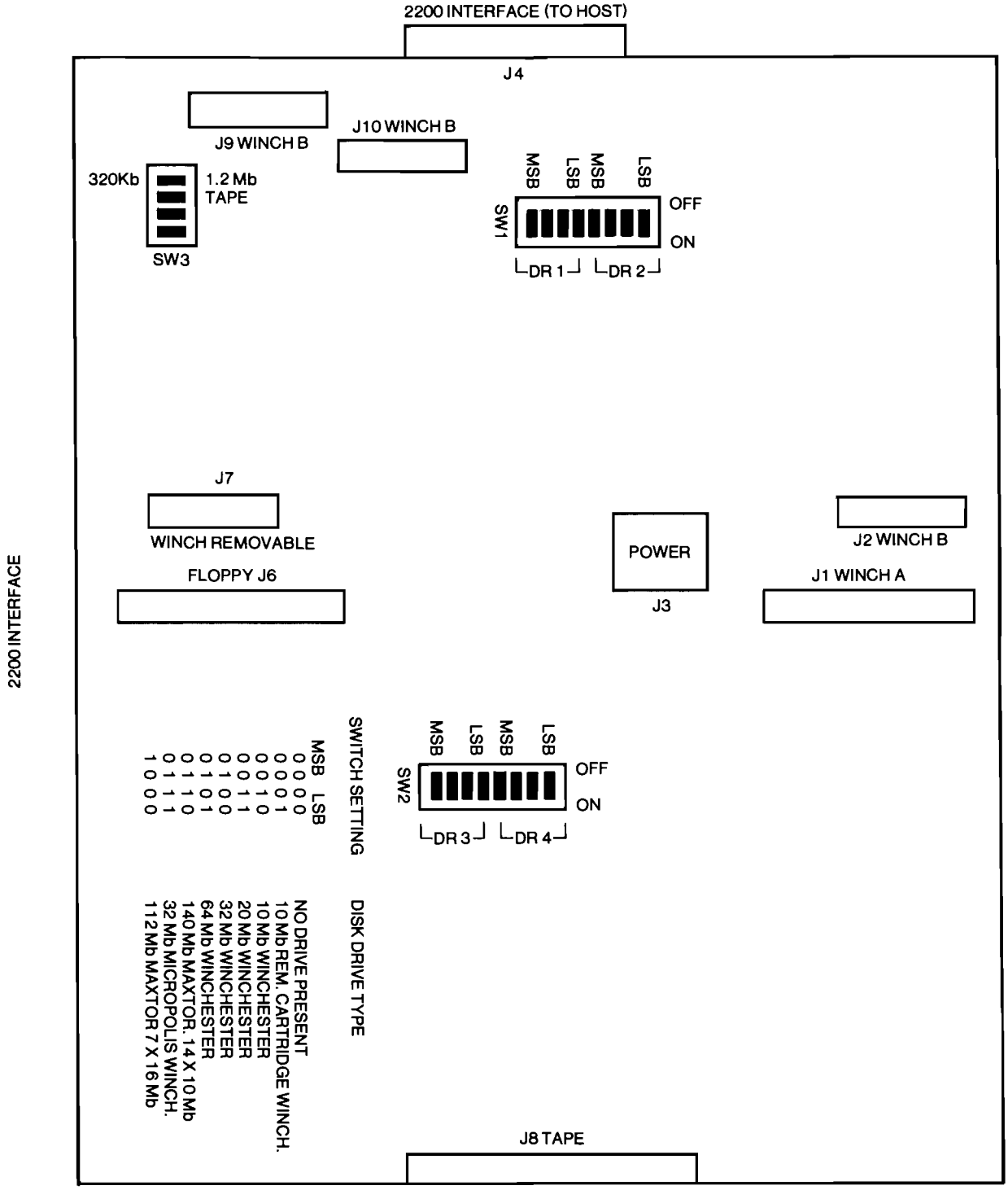
An unexpected device fault occurred. Retry the operation. If the error continues, power the DS off (when not in use) and back on and try again. If the error persists, contact a Wang service representative.

APPENDIX C
DS CABINET CABLING DIAGRAM



NOTES:
1. IF A REMOVABLE CARTRIDGE WINCHESTER IS USED, ITS "B" CABLE MUST BE CONNECTED TO J7. THIS DRIVE MUST BE LOCATED IN DRIVE 1 POSITION. ANY REMAINING WINCHESTER "B" CABLES CAN BE PLUGGED INTO ANY "B" RECEPTABLES.

2. TERMINATING RESISTERS OF DRIVE 2, 3, AND 4 MUST BE REMOVED. DRIVE 1 TERMINATING RESISTORS MUST NOT BE REMOVED.



C-2 DS Cabinet Cabling Diagram

APPENDIX D
DEVICE ADDRESSING

This Appendix summarizes device addressing for the DS Data Storage Cabinet. Device addresses are shown in Table D-1.

Table D-1. Device Addressing

Device	Unit 10	Unit 20	Unit 30
Diskette	/D10	/D20	/D30
Removable Hard Disk	/D1F	/D2F	/D3F
RAM Disk	/D50	/D60	/D70
Streaming Tape Cassette	/D5F	/D6F	/D7F
Fixed Hard Disk	/D11 -- /D1E /D51 -- /D5E	/D21 -- D2E /D61 -- D6E	/D31 -- /D3E /D71 -- /D7E

INDEX

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Customer Comment Form

Publication Number 715-0740

Title DS DATA STORAGE CABINET USER'S MANUAL

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