SPERRY UNIVAC

8406 Double-Sided Diskette Subsystem

General Description

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The SPERRY UNIVAC 8406 Double-Sided Diskette Subsystem at Work

1. Introduction

1.1. THE CONCEPT

A terminal peripheral device combining random-access speed and large-scale storage with desk-top operation and a minimal investment — that's the SPERRY UNIVAC 8406 Double-Sided Diskette Subsystem!

Compatible with the latest SPERRY UNIVAC intelligent terminals and data communications controllers, the diskette subsystem offers:

- Peripheral storage on flexible diskettes
- High-speed data access
- Simple and reliable operation
- Versatile design

The flexible diskette is an inexpensive and reusable medium for quick-change data storage. With the double-sided, dual-density diskette subsystem, up to 8 million bits (1 megabyte) of information can be stored on a diskette. An additional, optional disk drive can be included in this diskette subsystem to increase the storage to 16 million bits (on two diskettes).

The diskette subsystem retrieves data from a flexible diskette by random-access techniques, reducing data recovery rates and minimizing the need for extensive file directories. Editing capabilities make data update a simple, quickly performed procedure. Partial or complete files can be stored as called from a remote host processor, or working files can be prepared for later transmission to the host processor. You will be able to develop numerous other uses for this versatile storage device.

At your terminal, you can select the disk drive to read or write data and to seek new storage locations from any position, or your host processor can do the same things from a remote location with simple coded procedures. You can list stored data — whether sent to you over the communications line or entered at your terminal — from diskette to a printer, and you can copy the data on another medium, such as a second diskette. Depending on your application, you can even merge existing data from one diskette with new data entered from your terminal keyboard and create a composite record of old and new data stored on another diskette. Thus, the diskette subsystem offers not only efficient data storage but also a flexible data-handling system, easily adapted to the highly developed applications of your intelligent terminal and its supporting equipment.

1.2. CHARACTERISTICS

The diskette subsystem (Figure 1–1) is a freestanding, moving-head disk storage device that can read from or write on both sides of a flexible diskette in either single-density or double-density format. Designed for use with data terminals and as convenient for desk-top operation as a modern typewriter, the diskette subsystem provides random-access data storage in a compact device at a low cost. For a storage medium, the diskette subsystem uses 8-inch flexible diskettes. Access doors in the front of the cabinet allow for quick insertion and loading of diskettes.

A single disk drive is supplied with the diskette subsystem; optionally, the subsystem can be equipped with two disk drives. The diskette subsystem controller contains control circuitry for either one or two disk drives. The disk drives and the controller are mounted in a common cabinet, providing a self-contained, freestanding device. A separate external power cable supplies primary power to cabinet equipment.

An interface and cable connection allow the diskette subsystem to be used as a peripheral device by a host controller. The interface is located in the host controller. Up to four diskette subsystems, or a combination of diskette subsystems and other peripheral equipment compatible with an 8-bit interface, can share the same peripheral interface in the host controller.

Data transfer between the interface and diskette subsystem occurs in the form of 8-bit characters. The parallel transfer of each character includes a parity bit for error checking. Commands from the host controller and status reports from the diskette subsystem are also presented to the interface as complete 8-bit information bytes.

1.3. DISKETTE COMPATIBILITY

The 8406 double-sided diskette subsystem is compatible with single-sided, 128-byte-per-sector diskettes prepared on the 8406 single-sided diskette subsystem. Data can be read from or written onto these single-sided diskettes using the 8406 double-sided diskette subsystem.

1.4. FUNCTIONS AND APPLICATIONS

Basic functions provided by this diskette subsystem include:

- Reading and writing of 8-bit characters on a properly formatted new or existing single-density or double-density diskette
- High-speed head positioning to any location on either side of a flexible diskette
- Storage capacity of up to 1 million 8-bit bytes on a single 2-sided diskette
- Write protection capability for recorded diskettes
- Generating and checking character and block parity
- Complete addressability as a peripheral device
- Full compatibility with processor-controlled data communications networks

The diskette subsystem offers compact size, attractive design, and modest pricing. It is easy to use with a variety of host terminals because data formatting operations are largely built in, and its simple read, write, search, and seek operations can easily be commanded by host operations to create many highly sophisticated functions for the most advanced of terminal applications.

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Figure 1-1. SPERRY UNIVAC 8406 Double-Sided Diskette Subsystem

2. Equipment Description

2.1. OVERVIEW

The SPERRY UNIVAC 8406 Double-Sided Diskette Subsystem weighs about 35 pounds with a single disk drive and 50 pounds with two disk drives. The components are housed in a lightweight aluminum case which is rugged and compact. A front panel contains operator controls and indicators, and spring-loaded doors permit direct access to each disk drive for easy loading and unloading of flexible diskettes.

When the optional second disk drive is included in the diskette subsystem, a diskette may be inserted in each drive and operations may then be performed on either drive. (Disk drives are selected one at a time for any operation.) Each disk drive has its own read/write heads that can read from or write on either side of a flexible diskette. Each drive also has its own driving mechanism and related electronic components and circuitry. A single diskette subsystem controller provides the control circuitry for both disk drives.

Indicators on the front panel inform the operator of the operating status of the diskette subsystem. Status reports to the host controller can also be used to relay diskette subsystem operating information to the operator.

For a summary of diskette subsystem specifications, refer to Section 5.

2.2. DISKETTES

The medium used in the diskette subsystem is a self-contained cartridge consisting of a flexible magnetic disk in an enclosing jacket (see Figure 2–1). The diskette jacket is inserted into a disk drive, and the magnetic disk is free to rotate within the jacket. A wiping material lines the interior of the jacket and cleans the magnetic disk of foreign material. Access slots on the two sides of the jacket allow the read/write heads of the disk drive to make contact with the magnetic disk. The two sides of the magnetic disk provide a total storage capacity of 8 million bits.

Each magnetic disk has a small index hole punched near the center. With each revolution of a spinning disk, this hole rotates past an access window in the jacket to provide timing and indexing information to the diskette subsystem circuitry. A hole is also punched in the diskette jacket when the user wants the magnetic disk inside the jacket to be write protected; once punched, the hole can be covered with opaque tape to permit writing on the diskette. Figure 2–1 identifies the index hole and the correct location of the write protect hole.

The diskette is inserted into the horizontal opening of the disk drive with the diskette label facing down and the read/write slot toward the back (away from the disk drive door). The diskette can be loaded or unloaded with all power on and the disk drive spindle rotating.

Diskette specifications are located in Section 5.

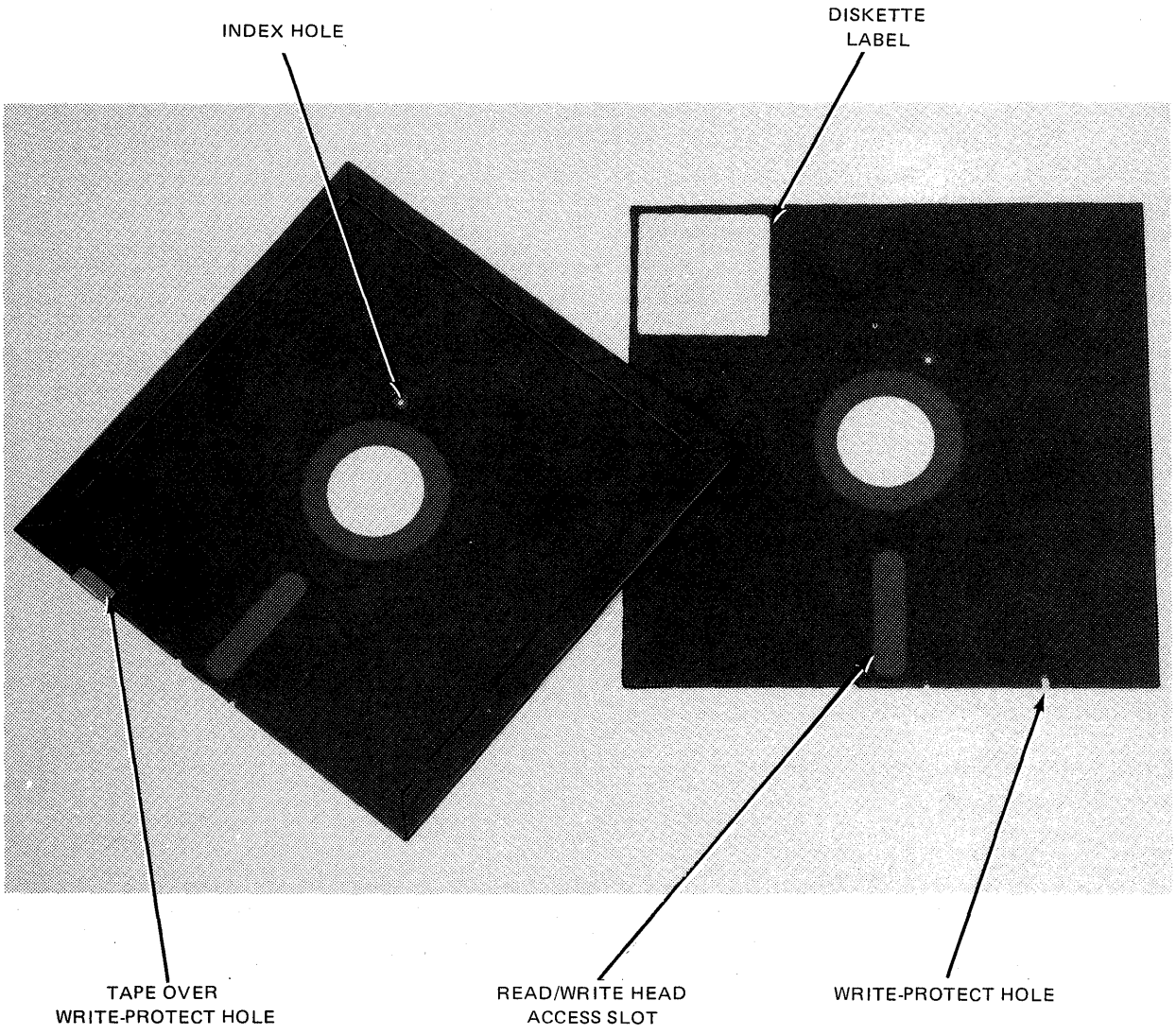

Figure 2-1. Diskettes for the Double-Sided Diskette Subsystem

2.3. CONTROLS AND INDICATORS

The few controls and indicators on the diskette subsystem are used to prepare the device for operation and to indicate the operating state of the device. A set of indicators is present for each of the two disk drives, whether or not a second disk drive is installed. Figure 2-2 shows the location of the controls and indicators on the diskette subsystem, and Table 2-1 summarizes their functions.

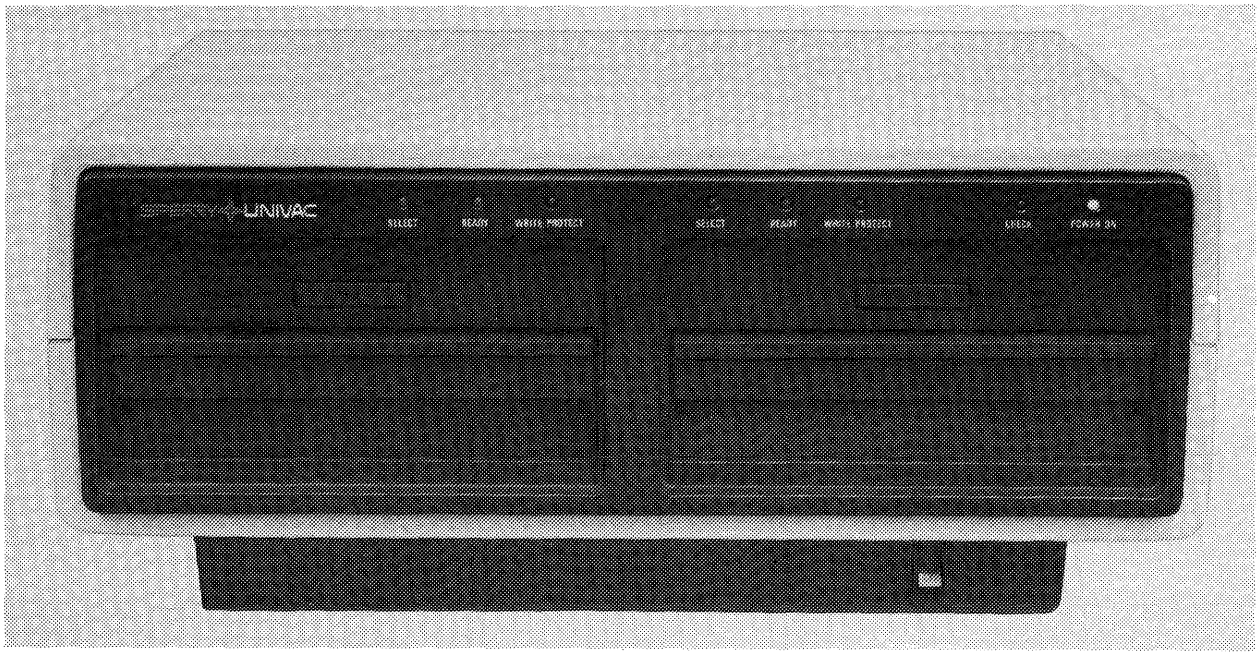

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Figure 2-2. Diskette Subsystem Controls and Indicators

Table 2-1. Functions of Diskette Subsystem Controls and Indicators

Control/Indicator	Function
POWER	Pushbutton switch/circuit breaker applies or removes primary input power to the diskette subsystem.
POWER ON	When lit, indicates that primary power is applied.
CHECK	When lit, indicates that an error was detected during a diskette subsystem operation.
SELECT (one for each disk drive)	When lit, indicates that the associated drive disk is selected.
READY (one for each disk drive)	When lit, indicates that the associated disk drive is ready for operation: diskette is installed, disk drive door is closed, and disk drive is spinning.
WRITE PROTECT (one for each disk drive)	When lit, indicates that the associated drive has a write protected diskette installed.
Busy	This unlabeled indicator is located in the door latch of each disk drive. Lights to indicate the disk drive is engaged in a read, write, or search operation and the read/write heads are loaded.

2.4. CONFIGURATIONS

2.4.1. Diskette Subsystem

The diskette subsystem configuration is simply determined: the diskette subsystem has either one or two disk drives. This is the only option offered.

2.4.2. Diskette Subsystem/Host Controller Configurations

The diskette subsystem is connected to the host controller through a peripheral interface that is part of the host controller. This interface provides a standard parallel connection between the host and the diskette subsystem. A "daisy chain" method of interconnecting cables permits four peripheral devices, which may include not only diskette subsystems but also other devices compatible with an 8-bit interface, to share the peripheral interface in the host. Maximum cable distance from the peripheral interface to the diskette subsystem (or to the last link in a daisy-chain connection) is 200 feet.

2.5. STANDARD FEATURES

All double-sided, dual-density diskette subsystems are equipped to perform the following functions:

- Format and prepare new diskettes for data storage in either single-density or double-density format
- Read single or multiple sectors of data
- Write single or multiple sectors of data
- Select disk drive and side of diskette
- Seek to specified track from any position on either side of a flexible diskette
- Search diskette for specified data
- Report status
- Detect and report errors

3. Operating Characteristics

3.1. GENERAL OPERATION

The SPERRY UNIVAC 8406 Double-Sided Diskette Subsystem accepts data from a SPERRY UNIVAC data communications controller or terminal; each character is recorded on magnetic disk as an 8-bit byte. Data recording, data retrieval, random-access searching, and disk preparation, as well as other diskette subsystem operations, are directed by 8-bit command bytes. These operations are entered under the control of a host controller, such as an intelligent display terminal or processor. For each command function, the diskette subsystem reports status, noting the successful completion of the command or the occurrence of an error. Status can also be reported upon request. Automatic error recovery, parity safeguards, and built-in power-on confidence test routines further increase the operational reliability of the diskette subsystem. These and other functions of the diskette subsystem are described in the following paragraphs.

3.2. DISKETTE FORMAT

Track and sector formatting is accomplished by host command before data is initially recorded on the diskette. This diskette preparation procedure is largely an automatic function of the diskette subsystem. However, the host controller must supply permanent addresses to each track and sector to identify their locations on the diskette. An example showing a diskette formatted for 256 bytes per sector is shown in Figure 3–1.

Each side of the diskette contains 77 tracks (00 through 76). Of these, the outer track is the index track (00), which is reserved for indexing, identification, and formatting information. The next 74 tracks (01 through 74) are used for recording data. The inner two tracks (75 and 76) are held in reserve and are used for data if, during preparation, one or two of the regular data tracks are found to be unusable. If more than two regular data tracks, on one or both sides of the diskette, are found to be unusable, the diskette cannot be used.

For single-sided, single-density diskette formatting, the index track (00) and the data tracks (01 through 74) are divided into 26 sectors, each having a storage capacity of 128 bytes.

For double-sided, double-density formatting, the index tracks (00) on both sides of the diskette are divided into 26 sectors. Each side may have a storage capacity of 128 or 256 bytes, depending on the host commands. The number of data sectors depends on the byte capacity of the sectors. If the diskette is prepared for 256 bytes per sector, each data track on both sides of the diskette will contain 26 sectors (Figure 3–1). If the diskette is prepared for 512 bytes per sector, each data track will contain 15 sectors. If the diskette is prepared for 1024 bytes per sector, there will be 8 sectors for each data track on the diskette.

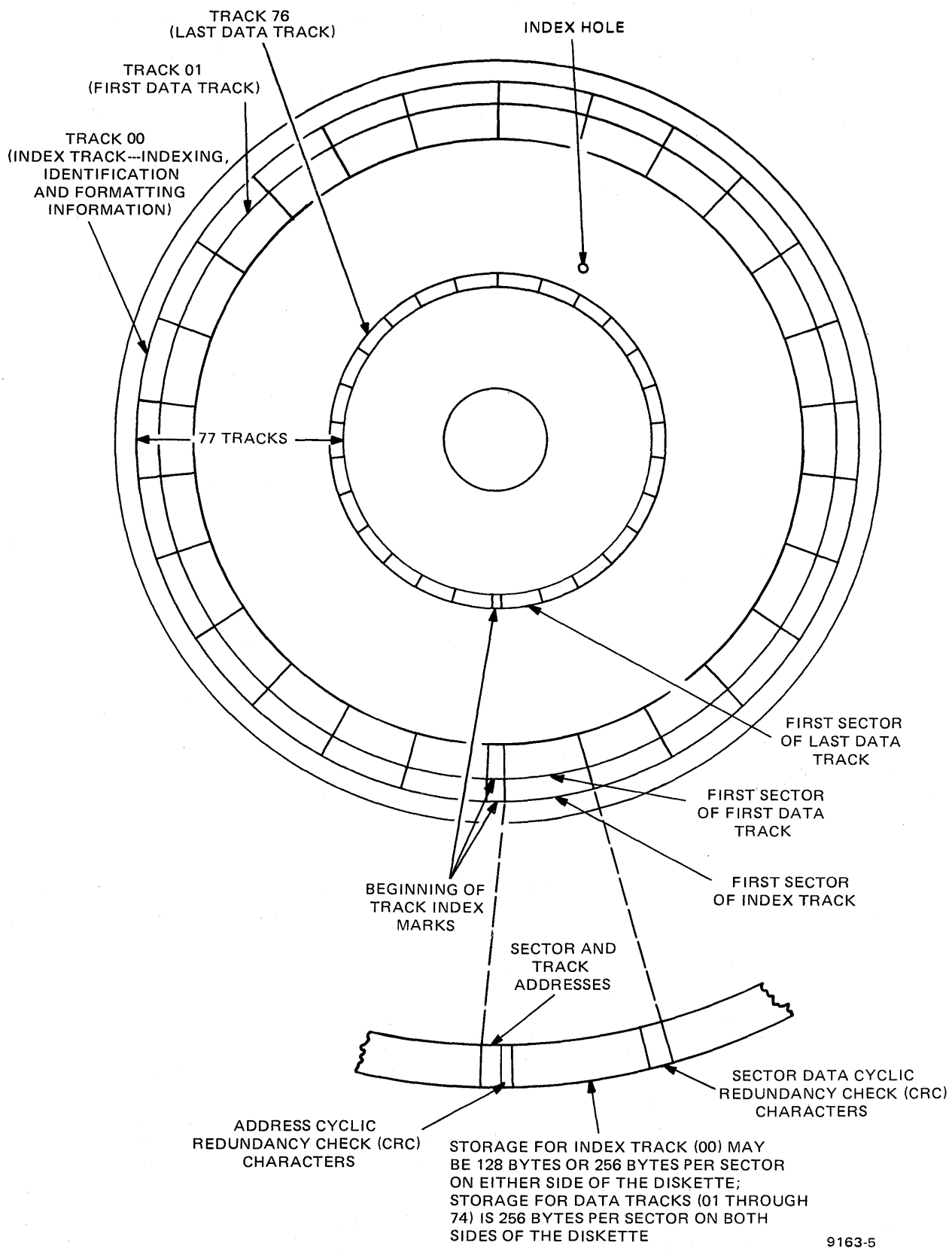

Figure 3-1. Diskette Track and Sector Format for Double Density (256 Bytes per Sector)

3.3. DISKETTE PREPARATION

Diskette preparation consists of mapping out the tracks and sectors over the entire surface of the diskette, identifying each track and sector with an address supplied by the host controller, and filling each sector with zeroes. A prep-track command from the host initiates the preparation of a single track. A prep-disk command initiates the preparation of all tracks on both sides of a diskette. Diskette preparation is a one-time operation for each new diskette; the procedure can also be applied to used diskettes to strip them of old data in preparation for complete rewriting.

3.3.1. Deleting Bad Tracks

Of the 77 tracks on each side of a magnetic diskette, the diskette subsystem can use 74 to store data and 1 (track 00) to store indexing, identification, and formatting information. The remaining two tracks are held in reserve in case unusable tracks are discovered during diskette preparation procedures. Bad tracks are deleted by host command, with the diskette subsystem flagging the specified track on both sides of the diskette as permanently unusable. If more than two bad tracks are discovered on one or both sides of the diskette, or if track 00 on either side of the diskette is faulty, the diskette cannot be used.

3.3.2. Addressing Conventions

Track and sector addresses are provided at the time of diskette preperation. A numerical sequence of 74 addresses is supplied for the tracks, and a numerical sequence of addresses, repeated for each track, is also supplied for the sectors. The number of sectors in each track will vary with the diskette preparation format used; the sectors may be prepared to store 128, 256, 512, or 1024 bytes of data. The addresses are supplied one track at a time by the host controller and, as the addresses are received, address cyclic redundancy check (CRC) characters are generated and written on the diskette sector following the addresses (Figure 3-1).

Although each of the sectors in a track is given a sequential address, address assignments do not have to follow the physical sequence of track sectors. In a series of sector addresses, for example, the second sector in the series need not be located next to the first sector, nor the third next to the fourth; instead, a defined number of physical sectors separates each sector in the entire series. This method of assigning sector addresses provides an efficient means of accommodating the diskette subsystem to the input/output rates of different host controllers.

3.4. DISK DRIVE AND DISKETTE SIDE SELECTION

To begin a diskette function, the host controller must first issue a command selecting a disk drive and a diskette side. Once selected, a disk drive and diskette side remain available for diskette operations until another disk drive or diskette side is selected.

3.5. SEEK TO TRACK

Seek-to-track commands, issued by the host controller, relocate the read/write head of a disk drive to new track positions.

3.5.1. Home Position

An internal track counter in the diskette subsystem is used to determine the track position of the read/write heads. When the diskette subsystem receives power and is turned on, the read/write heads are moved to the first track — home position or track 00 — and the internal track counter is reset to zero.* When a new track position is requested by means of a seek-to-track command, the read/write heads are moved across the diskette and the track count is adjusted for each track passed. When the track count matches the track number requested by the seek-to-track command, the seek operation is completed.

3.5.2. Random-Access Seeking

Once in position over a track, the read/write heads of a disk drive do not return home before performing a new seek-to-track command. Instead, the heads are automatically moved in the direction of the requested track, and the track count is adjusted up or down until the right match occurs. The read/write heads remain in position even when the door of an operating disk drive is opened to remove or insert a diskette. However, a command to seek track 00 occurs when the door is closed. This command returns the read/write heads to home position.

3.5.3. Error Prevention

The diskette subsystem checks the track number in each seek-to-track command to determine if it is a legal address. During read and write operations, the diskettte subsystem also reads the track and sector addresses recorded on magnetic disk to validate the track position of the read/write heads.

During disk preparation, the deletion of a bad track may disturb the sequence of usable tracks on a diskette. For this circumstance, the diskette subsystem provides an automatic track-finding routine that prevents errors in track-counting circuitry.

3.6. WRITE OPERATION

A write operation, initiated by a command from the host controller, stores data on a magnetic diskette in the diskette subsystem.

3.6.1. Sector Writing

The host controller transfers data a sector at a time to the diskette subsystem. A write command prepares the diskette subsystem to write each sector of information and also identifies the sector address for storing the information on disk. Data is transferred from the host buffer to the diskette subsystem in sector-size blocks. These blocks will contain 128, 256, 512, or 1024 bytes per sector, depending on the diskette preparation format used. If the block of data contains less than the number of bytes required to fill a sector, the end of the transfer is indicated by a last-character interface signal; the diskette subsystem then fills all remaining storage space in that sector with zeroes. A status report from the diskette subsystem to the host completes the writing of each sector of data on disk.

**A diskette must also be in place and the disk drive doors must be closed to permit the read/write heads to return to home position when the diskette subsystem receives power.*

3.6.2. Error Prevention

The parallel transfer of each character to the diskette subsystem is accompanied by a parity bit. Cyclic redundancy check (CRC) characters are written on diskette with each sector of recorded data and are validated when the sector of data is read.

3.7. READ OPERATION

A read operation retrieves data from storage on a magnetic diskette. As with write operations, read operations transfer data one sector at a time by way of a command from a host controller. The read command specifies a sector address for each transfer of data. The diskette subsystem completes the read command by reporting status to the host controller.

During the read operation, CRC character validation is performed for each sector of recorded information.

3.8. STATUS REPORTING AND ERROR DETECTION

After executing a command, or upon the immediate detection of an error, the diskette subsystem reports status to the host controller. The host receives each status report in the form of an 8-bit status byte. By command, the host terminal can also request the status of a disk drive at any time; in response, the diskette subsystem sends the last accumulated status byte for the selected disk drive.

3.8.1. Error Detection

Errors reported by means of the status byte include the following:

- Incorrect character parity in data or command bytes
- Invalid block (CRC) parity in data read from the diskette
- Invalid block (CRC) parity in sector and track addresses
- Illegal track addresses in seek-to-track commands
- Unlocatable sector and track addresses in read and write commands

When a write-protected diskette is in a disk drive, its presence is reported to the host controller by the status byte. Any physical interference with the operation of a disk drive — such as an empty disk drive or an open disk drive door — is also immediately reported to the host in the status byte.

3.8.2. Error Recovery

The controller in the diskette subsystem contains routines used to attempt recovery from errors during seek operations, from CRC errors in sector and track addresses during write operations, and from CRC errors in data during read operations. Other recovery procedures for specific errors must be determined by local host controller programming procedures.

4. Maintenance Provisions

The SPERRY UNIVAC 8406 Double-Sided Diskette Subsystem contains a program that loads software to aid in maintenance, if required.

5. Specifications

The SPERRY UNIVAC 8406 Double-Sided Diskette Subsystem is designed to operate in a typical business environment. The physical, environmental, and technical specifications of the diskette subsystem are detailed in the following lists.

5.1. PHYSICAL CHARACTERISTICS

Width	51.54 centimeters (20.25 inches)
Height	22.86 centimeters (9.00 inches)
Depth	42.55 centimeters (16.75 inches)
Weight with one disk drive	15.88 kilograms (35 pounds)
Weight with two disk drives	22.68 kilograms (50 pounds)

5.2. POWER REQUIREMENTS

Voltage	100 to 120 volts ac or 200 to 240 volts ac
Phase	Single
Frequency	60 or 50 Hz
Wattage (per drive)	130 watts
Heat dissipation (per drive)	111.8 kilocalories/hour (129.9 watts)

5.3. ENVIRONMENTAL RANGE

Temperature	10 to 34 degrees Celsius (50 to 93 degrees Fahrenheit)
Humidity	5 to 80 percent

The 80-percent limit for relative humidity is a requirement of the flexible diskette storage medium. The diskette subsystem itself will tolerate 95-percent humidity.

5.4. OPERATING CHARACTERISTICS

5.4.1. Common Characteristics (Single Density and Double Density)

Rotational speed	360 rpm
Rotational period	166.67 milliseconds
Average latency	83.33 milliseconds
Byte size	8 bits per byte
Diskette format	
Total number of tracks	77 (each side)
Usable number of tracks	75 (each side)
Bit density (inside track)	Approximately 1260 bits per centimeter (3200 bits per inch)
Head load duration	No more than 15 diskette revolutions without a command
Interface	Transfers 8-bit (plus parity) data, command, and status signals
Command functions	Seek to track Data search Read sector Write data sector Write control sector Read multiple sectors Write multiple sectors Select drive and diskette side Send drive status Prepare normal track Prepare deleted track Prepare disk

5.4.2. Variable Characteristics

	Single Sided, Single Density	Double-Sided, Double-Density
Read/write speed	250,000 bits per second	500,000 bits per second
Diskette format		
Sectors per track	26	26, 15, or 8*
Bytes per sector	128	256, 512, or 1024
Data storage capacity per 2-sided diskette	242,000 bytes	0.98, 1.13, or 1.21 million bytes*
Track-to-track access time	3 milliseconds	3 milliseconds
Settling time	50 milliseconds	50 milliseconds
Head load time (can overlap with track-to-track access time)	70 milliseconds	70 milliseconds
Recording mode	Frequency modulation (FM)	Modified frequency modulation (MFM)

5.5. DISKETTE SPECIFICATIONS

Diameter	19.8 centimeters (7.79 inches)
Jacket size	20.3 by 20.3 centimeters (8.0 by 8.0 inches)

Purchase specifications for diskettes are in accordance with ANSI X3B8, "American National Standard for Unrecorded Flexible Disk Cartridge — General, Physical, and Magnetic Requirements."

**Respectively, for 256, 512, or 1024 bytes per sector*