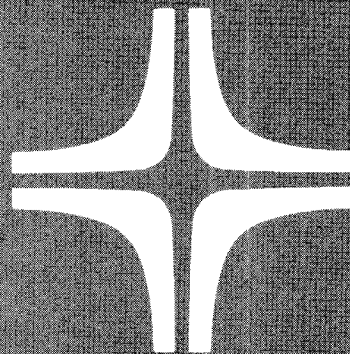


8416/8418 Disk Drive



General Description

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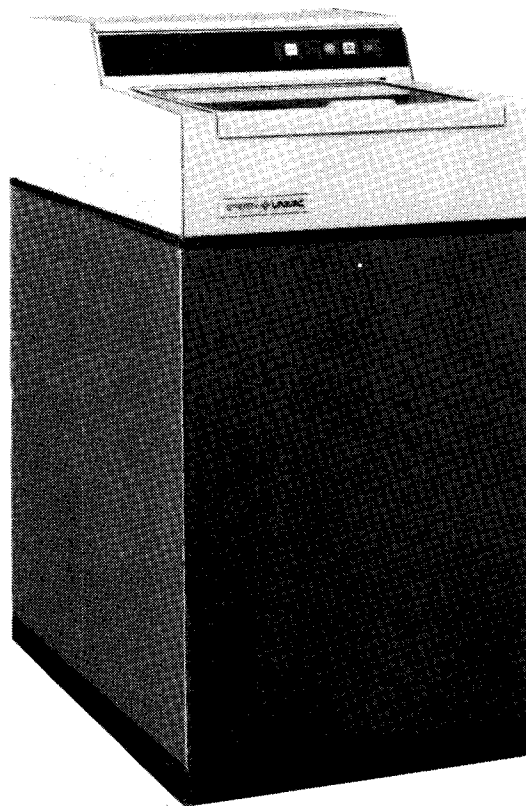
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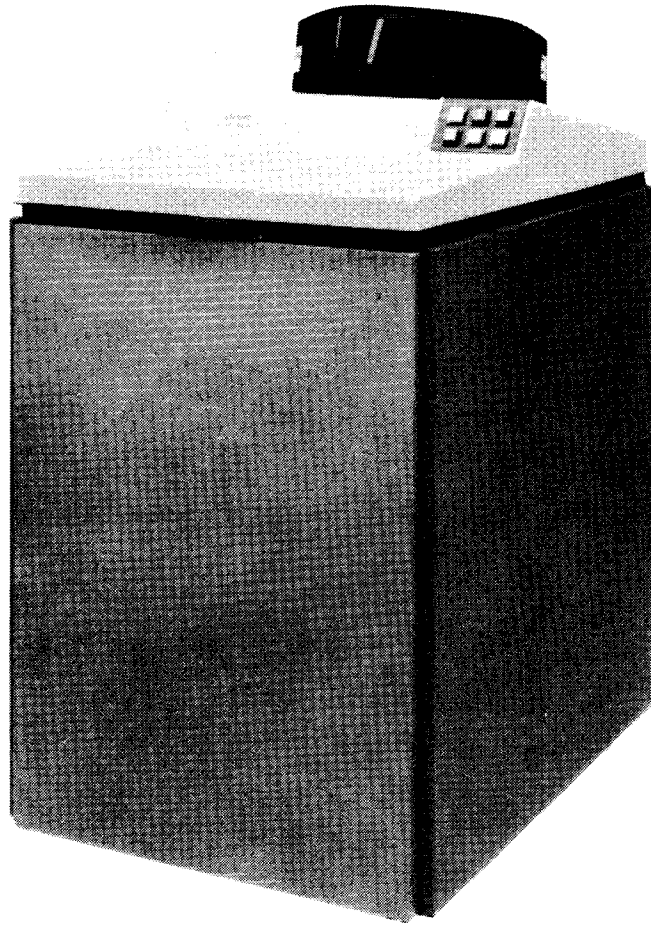
1. Introduction

The SPERRY 8416 and 8418 disk drives (Figure 1-1) are random access drives featuring removable and interchangeable disk packs that permit storage of either 28.9 or 57.9 million bytes (MB) of net information. All surfaces are serviced by the same moving actuator mechanism that contains one head for every usable surface.



a. 8416 Disk Drive

Figure 1-1. SPERRY Disk Drives (Part 1 of 2)



b. 8418 Disk Drive

Figure 1-1. SPERRY Disk Drives (Part 2, of 2)

2. Functional Description

2.1. GENERAL PERFORMANCE

The 8416 and 8418 disk drives are cabled to a controller or control unit using a shielded cable compatible with an 8-bit bidirectional byte interface. Power is derived from the system ac power source and distributed to the drive motor, the cabinet power supply, and the cooling fan. The operator ON/OFF power switch located on the operator control panel applies the power to the motor, power supply, and fan.

The disk controller or control unit generates and controls the drive unit that provides head selection and positioner movement, generation of the bit patterns to be written by the drive unit, and bit deserialization and interpretation of the data read by the unit.

Head selection and cylinder positioning are accomplished by strobing the appropriate select bits and cylinder address of the control logic. The drive then performs the operation and signals either completion or error conditions.

During the write operation, the controller or control unit generates the proper format including such items as gap characters, data fields, and error correction codes. Data is then serialized and sent to the drive unit at a 5 megahertz (MHz) average transfer rate.

The disk drive provides the read circuitry required to recover data from the disk surface and convert it to a digital bit stream. The clock signal permits the controller to deserialize the bit stream and obtain byte-timing synchronization. The controller then analyzes the data, separates the various gaps and fields, verifies the check characters, and transfers the appropriate data to the system.

The controller or control unit generates and checks an error correction code, used for error detection and correction, which is appended to the data fields. In this way, if an error is detected, the controller uses this code to correct the data read just prior to transferring it to the system.

The format used by the controller or control unit uses address marks to identify the beginning of a sector. Address marks are generated and detected by the controller or control unit. The address mark is a unique pattern with no data or clock bits recorded on the tracks at the beginning of the sector field.

2.1.1. Disk Pack

The 8416/8418 disk pack consists of four disks, 14 inches (35.6 cm) in diameter, on a vertical shaft. Pack height is approximately 3.9 inches (9.9 cm). Circular protective plates are mounted above the top disk and under the bottom disk to protect the assembly.

The four disks provide seven surfaces (0 to 6) on which data is recorded (Figure 2-1). An additional surface (1 for each pack) is used as a positioning surface for a servo head. The entire assembly rotates at a speed of 2800 rpm.

The disk pack is removable and interchangeable only between its own drives. Interchangeability with other disk drives is nonexistent. The 8416 disk pack cannot be physically installed in the 8418 disk drive (and vice versa). Disk packs can be safely stacked up to five high for storage purposes.

A removable dust cover is an integral part of the removable pack handle. The disk pack is placed on the machine spindle and the handle is turned clockwise to lock the disk pack to the spindle before the cover and handle can be removed. The pack and its dust cover can be stored when not in use in a special pack rack located on the rear of the top drive cover.

NOTE:

The pack should not be stored on the front top drive cover since drive vibration may cause it to fall to the floor.

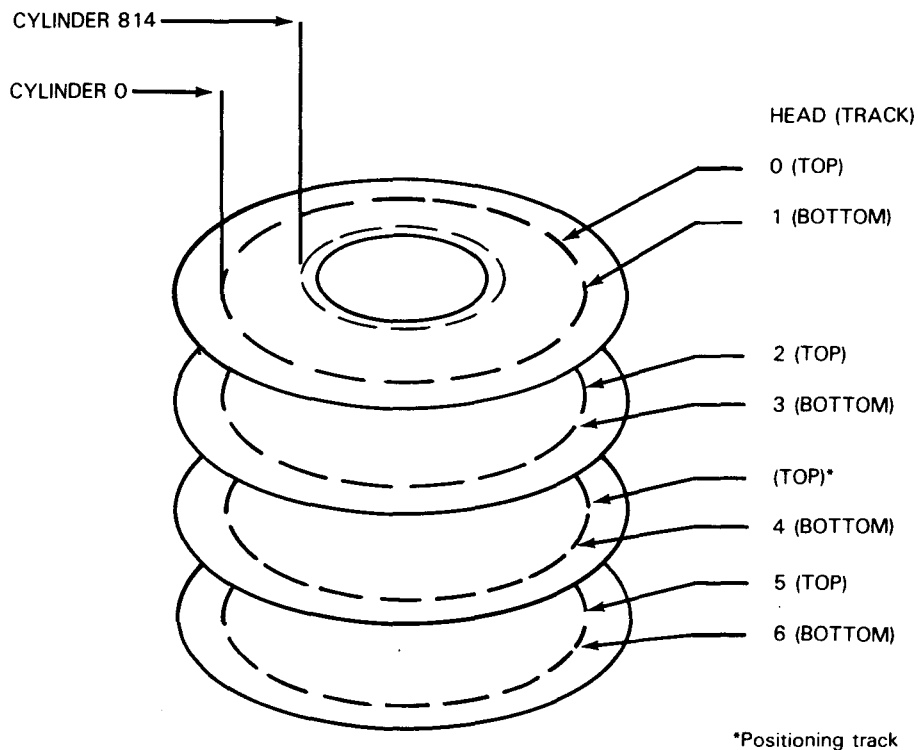


Figure 2-1. Disk Pack Configuration

2.1.2. File Organization

Each disk pack has a total of 815 tracks on each surface. For the 8416 models and certain 8418 models, only 411 primary tracks are used for data plus seven spare tracks. The other 8418 models use 808 tracks as primary tracks plus seven spare tracks.

Each track has an error flagging capability. This (under program control) permits switching to one of the spare tracks if the addressed track is flagged as defective. Forty records of 256 bytes each can be stored on each track.

2.1.3. Accessor Assembly

The accessor mechanism consists of a combination of eight arms (seven data, plus one for fine positioning) mounted on a support tower. Each arm has a head that services one of the disk surfaces. The support tower carrying the arms is moved to any of the 411 primary track positions for the 8416 (815 primary track positions for the 8418) by an electromagnetic closed loop positioning system.

The vertical alignment of the heads can be compared to a cylinder (Figure 2-1). The access mechanism moves the head directly from one cylinder to any other without returning to a home position. Access to the data of the disk pack is obtained by positioning the array of read-write heads mounted on the carriage to any one of the track positions for the different 8416 and 8418 models.

2.1.4. Programmed Servo Offset

The programmed servo offset enables the drive to respond to a command to move the accessor a short distance from its designated track location. This function can be used to recover marginal data due to servo positioning inaccuracies, or to attempt to recover data, if a nonrecoverable data error occurs due to small magnetic defects.

The combination of bits received on drive busses 2, 3, 4, and 7 under a control tag provides ± 2 position offsets. Drive bus 2 initiates the offset and drive bus 7 indicates that an offset is to be performed. Drive bus 3 gives the magnitude and drive bus 4 gives the direction.

If data cannot be recovered after all servo offset combinations have been tried, the error is considered nonrecoverable. If a write command is attempted during a servo offset operation, the drive generates a device check condition. A nonzero length seek is permitted from an offset position. Also, it is valid to command a seek to an offset position.

The offset is cleared by issuing a seek start command or when the offset control bit of drive bus bit 7 is inactive or by issuing a restore command. Offset is not cleared when mod select is dropped. The nominal time required to accomplish an offset is 14 milliseconds (ms); maximum time is 18 ms. When seeking to or from an offset position, the offset time must be added to the seek time to determine the total access time.

2.1.5. Safety Circuits

2.1.5.1. Device Check Condition

Any of the following conditions can trigger a device check condition (selected drive unsafe) on the 8416/8418 disk drives. The fault must be cleared before normal operation can be resumed (except as specified in 2.1.5.2).

NOTE:

In addition to the listed conditions, early warning of excess temperature lights the DEVICE CHECK warning indicator (see Figure 3-1 and Table 3-1) and presents a signal to the interface. But this does not power-down the device. If the early warning is ignored and the temperature rises to an unsafe level, the drive will power-down completely.

1. PLO unsafe

Write oscillator is not synchronized with disk speed.

2. Write ready unsafe

Write gate is on while head is not aligned on the cylinder.

3. AC write unsafe (either of the following):

- Multiple heads selected while write gate is on.
- No write transition detected when write gate is on.

4. Offset/write unsafe

Write gate is on while offset is active.

5. DC unsafe

Write current sensed while write gate is on.

NOTE:

In addition to causing a device check, the following unsafes cause the heads to retract from the pack:

6. Pack speed unsafe

Occurs when the pack speed falls to less than approximately 90 percent of normal when the heads are extended.

7. Velocity unsafe

Heads moving too fast.

8. Power unsafe

DC power below specified limits.

9. Inner guard band detection unsafe

Failure of the drive to detect the inner guard band area of the pack during an initial head load or a restore operation.

All nine listed conditions immediately deactivate selected online, selected file protect, selected index, and selected seek incomplete. Gated attention is deactivated immediately on the occurrence of conditions 6 through 9.

2.1.5.2. Automatic Reset

An automatic reset of the first four unsafe conditions listed in 2.1.5.1 is attempted by the drive. This reset is initiated as follows: When an unsafe condition occurs in a drive, the current operation is terminated by the drive and the controller or control unit. The controller or control unit informs the system of the device check and the system software recovery procedure. The resulting selection and deselection of the drive by the controller or control unit then allows the drive to attempt to reset the unsafe.

Conditions 1–4 that are subject to an automatic reset are defined as soft unsafes; conditions 5–9 are defined as hard unsafes. Soft unsafes appear as hard unsafes to the system if they cannot be reset by the recovery procedure. In this situation, no further reset is attempted.

Unsafes 5–9 are not subject to an automatic reset. The drive may be turned off and then back on again to reset these faults. If the unsafe recurs right after or during the loading of the heads, service is required. The DEVICE CHECK indicator lights if any unsafe occurs, but will switch off when and if the unsafe is reset.

Unlike unsafes 1–4, unsafes 5–9 cause the drive to go offline, the RUN indicator to extinguish, and the STOP indicator to light. This occurs when deactivation results from the controller or control unit module line select being activated.

2.1.6. Device Identifier Plate

The device address is provided on a metal plate located near the upper left corner of the front of the disk drive.

2.1.7. Specifications

Table 2-1 lists the general specifications for the 8416/8418 disk drives.

Table 2-1. 8416/8418 Disk Drive Specifications

| Specification | 8416/8418 -04/05 | 8418 -02/03 |
|--|-------------------|-------------------|
| Data capacity (MB) | | |
| Million bytes net* | 28.96 | 57.92 |
| Million bytes gross | 36.80 | 73.70 |
| Capacity per track (bytes) | | |
| Bytes net* | 10,240 | 10,240 |
| Bytes gross | 13,030 | 13,030 |
| Positioning Times (ms)** | | |
| Minimum seek time | | |
| track-to-track | 10 | 10 |
| Average access time | 27 | 33 |
| Maximum seek time | | |
| full stroke | 45 | 60 |
| Number of data heads | 7 | 7 |
| Data bit rate/second (bps) | 5.0×10^6 | 5.0×10^6 |
| Disk rotation speed (counterclockwise, rpm) | $2800 \pm 3.5\%$ | $2800 \pm 3.5\%$ |
| Bit density (bpi) (bits/inch maximum) | 4040 | 4040 |
| Track density (tracks/inch) | 370 | 370 |
| Number of track (primary + alternate surface) | 404 + 7 | 808 + 7 |
| Disk latency (ms) | | |
| Average (1/2 revolution) | $10.7 \pm 3.5\%$ | $10.7 \pm 3.5\%$ |
| Maximum (full revolution) | $21.4 \pm 3.5\%$ | $21.4 \pm 3.5\%$ |
| Number of Disk Data Surfaces | 7 | 7 |
| Start-up-time (seconds) (head load and seek to cylinder 0) | 30 | 30 |
| Maximum stop time (seconds) | 30 | 30 |

* Net capacity is governed by the fixed record of the controller or control unit. There are 40 records per track with 256 bytes of storage per record.

** Positioning times stated are maximum values for the time computed over at least 1024 seeks. The average access time is the time to perform all possible seeks divided by the number of such seeks.

2.2. CONFIGURATIONS

Figure 2-2 shows the configuration for the 8416/8418 disk drives. Table 2-2 describes the drives available and their features.

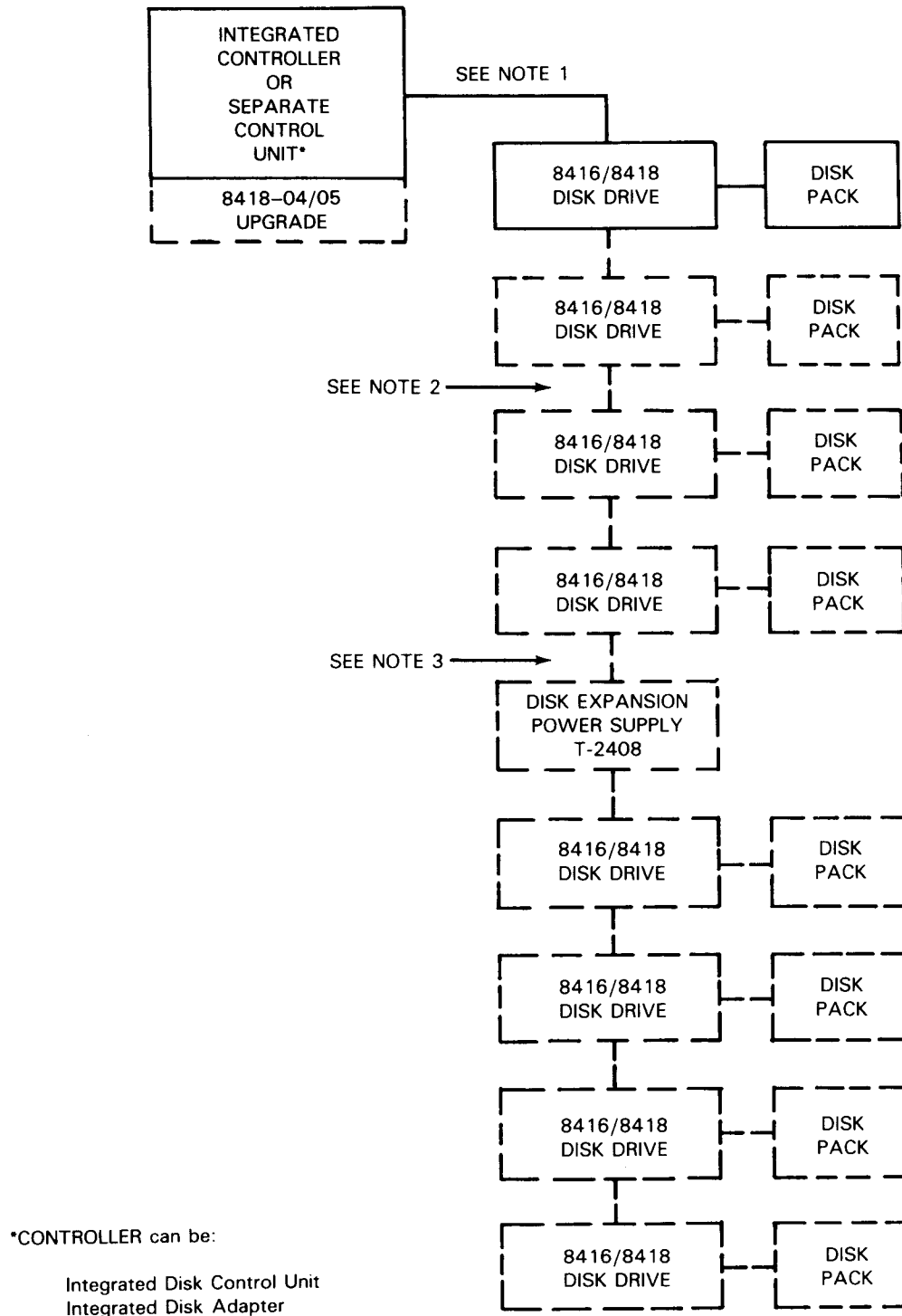


Figure 2-2. 8416/8418 Disk Drive Configuration (Part 1 of 2)

NOTES:

1. Intermix of 8416 and 8418 drives is permitted. However, the 8416 must be placed nearest the controller with the 8418 drives attached next. The maximum total number of drives is 8.
2. A corner transition feature can be selected and placed either between the second and third disk drives or between the fourth disk drive and the disk expansion power supply.
3. When total number of drives exceeds four, the disk expansion power supply must be connected between the fourth and fifth drives on the signal cable. This expansion unit gets its ac power from an ac wall outlet and provides dc power to all disk drives.

LEGEND:

- Standard equipment
- - - - Option Equipment

Figure 2-2. 8416/8418 Disk Drive Configuration (Part 2 of 2)

Table 2-2. 8416/8418 Disk Drive Configuration Descriptions

| Configuration | Description |
|---------------------|---|
| 8416 | |
| 02 disk drive | Provides direct access storage using removable disk pack. Average head positioning time is 30 ms, average latency time is 10.7 ms. Transfer rate is 625K bps. Data capacity is 28.9 MB of removable storage; 60 Hz. |
| 03 disk drive | Same as 8416-02 except 50 Hz. |
| F1216-01 disk pack | Provides 28.9/36.8 MB (net/gross) of removable storage for the 8416 disk drive. |
| 8418 | |
| 04 disk drive | Provides 28.9 MB of direct access storage using removable disk pack F1216-02; 60 Hz. |
| 05 disk drive | Same as 8418-04 except 50 Hz. |
| 02 disk drive | Provides 28.9/38.8 MB (net/gross) on the 8418-04/05 or 57.9/73.7 MB (net/gross) on the 8418-02/03 of removable storage. |
| F2198-00* disk pack | Field kit to convert 8418-04 to an 8418-02 or an 8418-05 to an 8418-03. |

* 8418-04/05 upgrade

3. Controls and Indicators

3.1. INITIAL OPERATION

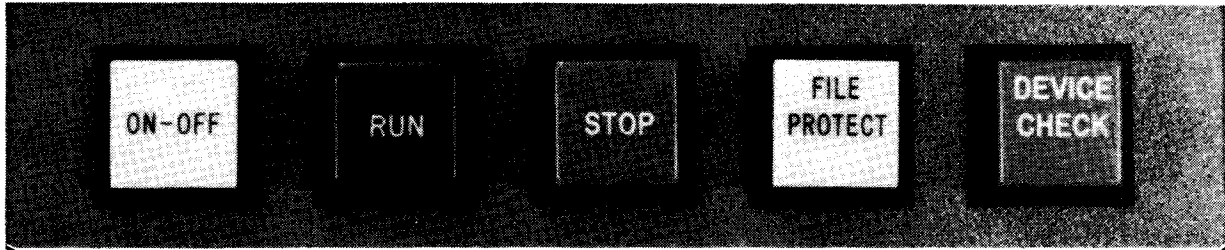
When power is initially applied to the disk drive, only the STOP indicator is lit. Upon pressing the ON/OFF switch, the ON indicator lights and the STOP indicator remains lit. The spindle then comes up to speed and the heads load to track 0, but the drive remains offline.

In following the initial sequence, the STOP indicator remains lit until the drive is up to speed, the heads are loaded, and the drive is in the ready state. Then, the RUN indicator lights.

These indications provide the operator with a known set of conditions at all times to sequence the drive to the ready condition.

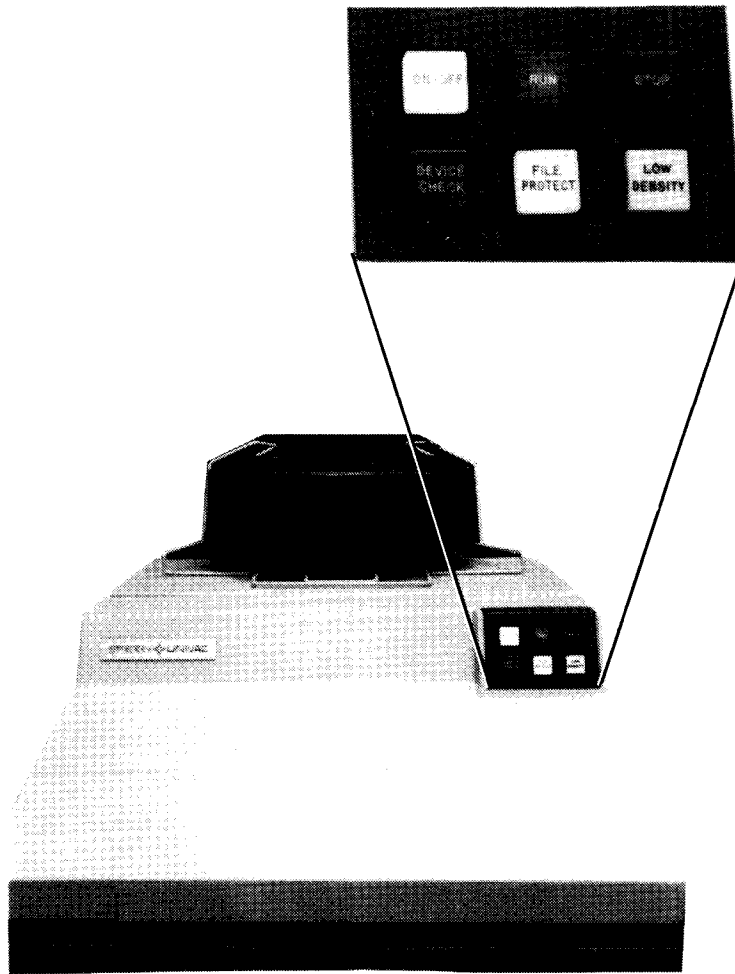
3.1.1. Operator Controls and Indicators

Operator control switches and indicators are located in the top left portion of the disk drive (Figure 3-1). Table 3-1 describes the operator controls and indicators.



a. 8416 Disk Drive

Figure 3-1. 8416/8418 Disk Drive Controls And Indicators (Part 1 of 2)



b. 8418 Disk Drive

Figure 3-1. 8416/8418 Disk Drive Controls And Indicators (Part 2 of 2)

Table 3-1. 8416/8418 Disk Drive Control and Indicator Descriptions (Part 1 of 2)

| Control/Indicator | Description |
|---------------------------------|--|
| ON/OFF switch/indicator | <p>An alternate action switch with an indicator that lights when in the ON position.</p> <p>When pressed to ON position:</p> <ol style="list-style-type: none"> 1. ON indicator lights. 2. Enables power to disk drive motor. 3. When disk pack is up to speed, the heads load to cylinder 0. <p>When pressed to OFF position:</p> <ol style="list-style-type: none"> 1. ON indicator blinks until pack has stopped, then switches off. 2. Disk drive reverts to STOP conditions without waiting for disk pack to stop. 3. The heads unload. 4. The drive motor power is turned off after the heads unload. |
| RUN momentary switch/indicator | <p>Pressing and releasing this switch after the disk pack is loaded, cover closed, disk pack revolving at desired speed, heads loaded, and no DEVICE CHECK indication (and provided the disk drive is not selected), the following action results:</p> <ol style="list-style-type: none"> 1. RUN indicator lights. 2. STOP indicator extinguishes. 3. Attention status is generated. 4. Allows the controller to access the drive for positioning and reading or writing functions by means of enabling selected line on. If the file protect function is active, the disk drive is available for positioning and reading only. <p>There is no need to wait until the disk drive has completely cycled up to the ON state to activate the RUN switch. If the ON and RUN switches are activated in sequence, the drive immediately changes from STOP to RUN after the normal power cycle is complete.</p> |
| STOP momentary switch/indicator | <p>Pressing this switch:</p> <ol style="list-style-type: none"> 1. Lights all control panel indicators for lamp test. When switch is released, STOP indicator remains lit. 2. Switches off RUN indicator if ON indicator is lit. 3. Causes disk drive to go into the STOP state and inactivates selected-on-line at the completion of the current operation. 4. Upon completion of current operation, the RUN indicator switches off and the STOP indicator lights. <p>This indicator blinks when the ON/OFF switch is pressed to the ON position if either the disk pack is not mounted or the cover is not closed.</p> |

Table 3-1. 8416/8418 Disk Drive Control and Indicator Descriptions (Part 2 of 2)

| Control/Indicator | Description |
|--|---|
| DEVICE CHECK indicator | This indicator lights if any of the conditions monitored by the file safety circuits are detected. To reset the safety circuits and to turn off this indicator, press the disk drive ON/OFF switch first to ON then to OFF. |
| FILE PROTECT switch/indicator | File protect switch. When set ON, inhibits write operations. |
| LOW DENSITY switch/indicator (8418-02/03 only) | When pressed, permits only cylinders 0-410 to be accessed. This allows disk packs written on an 8418-04/05 to be used on an 8418-02/03 since the 8418-04/05 operates only in the low density mode and does not have this switch on its control panel. |

3.1.2. Operator Access Cover

When installing or removing a disk pack from the disk drive, it is necessary to open the operator access cover. When the cover is raised, the drive shuts down in the same fashion as if the OFF sequence of the ON/OFF SWITCH is activated. When the cover is closed, the drive cycles up in the same fashion as if the ON sequence of the ON/OFF switch is activated.

4. Interface

4.1. CONTROL INPUT LINES

The control input lines to the 8416/8418 disk drives consist of eight multifunction drive bus lines, three tag lines, and a module select line. The eight bus lines permit the transmission of functions that are decoded at the three discrete and sequential times of (1) set head and direction tag, (2) set difference tag, and (3) the control tag. The organization of the tag lines is shown in Table 4-1.

Table 4-1. Tag Control Line Organization

| Drive Bus Line | Control Tag Line | Set Difference Tag Line | Set Head and Direction Tag Line* |
|----------------|------------------|-------------------------|----------------------------------|
| 0 | Write Gate | Diff Mag 128 | Reverse Seek Direction |
| 1 | Read Gate | Diff Mag 64 | Diff Mag 512 |
| 2 | Seek Start | Diff Mag 32 | Diff Mag 256 |
| 3 | Offset Mag | Diff Mag 16 | Not used |
| 4 | Offset Reverse | Diff Mag 8 | Not used |
| 5 | Head Select | Diff Mag 4 | Head Address 4 |
| 6 | Restore | Diff Mag 2 | Head Address 2 |
| 7 | Offset Control | Diff Mag 1 | Head Address 1 |

* MSB = Most significant byte

4.1.1. Multifunction Drive Bus Lines

Controller or control unit to or from disk drive:

Drive Bus Line

- 0 Write data input lines (control to or from drive)
- 1 Read data input lines (control to or from drive)
- 2 Power sequence input lines (control to drive)
- 3 Status output lines (drive to control)
- 4 Write oscillator output line (PLO)
- 5 Power sequence output lines (drive to control)
- 6 Softscope lines (drive to control)
- 7 Drive to drive sequence line (drive to drive)

4.1.2. Tag Lines

- Set difference tag
- Set head and direction and difference MSB tag
- Control tag

4.1.3. Module Select

The module select is a unique line to each drive used to select and communicate to a particular disk drive.

5. Facility and Physical Requirements

5.1. ELECTRICAL REQUIREMENTS (VOLTAGE/CURRENT)

Phase

- 3-phase ac supplied from system
- Only single-phase ac used in any single disk drive

Voltage (ac)

- 200/208/240
 - 200/220/230/240
- | | | | | |
|---|-------------|--------|---|---------------------|
| { | (+6%, -15%) | @60 Hz | { | (± 2% single-phase) |
| } | @50 Hz | } | | |

Current (vac)

- Starting surge current less than 30 amperes
- Running current (amperes nominal)
 - @208 vac = 5.2
 - @220 vac = 5.0

Nominal vac requirements (kva)

- Typical = 1.0
- Maximum = 1.4

Voltage dc (supplied by system)

- +24 (+15%, -10%)
- +5 (+2%, -6.5%)

Current (dc) = amperes maximum

- +24 = 50
- +5 = 0.5

5.2. DIMENSIONS

| | <u>8416 [in.(cm)]</u> | <u>8418 [in.(cm)]</u> |
|-------|-----------------------|-----------------------|
| Width | 20.0 (50.8) | 22.5 (57.15) |

NOTE:

Add 1.0 in. (2.54 cm) for each side cover, when required.

| | | |
|----------|--|---------------|
| Height | 40 (101.6) | 40.25 (102.2) |
| Depth | 32.0 (81.3) | 31.8 (80.8) |
| Weight | Approximately 375 lb (4.28 kgm) | |
| Mounting | Adjustable standoffs (casters provided for installation) | |

5.3. ENVIRONMENTAL REQUIREMENTS

| | |
|-------------------|--|
| Cooling | No external forced air cooling is required |
| Heat Dissipation | Heat dissipation is less than 4000 Btu/hour (nominal 3200 Btu/hour) |
| Temperature | 10–34 °C (50–90 °F) with a maximum gradient of 10 °C (18 °F) |
| Relative humidity | 20–80% |
| Disk pack | Prior to a disk pack being used in a drive, it should be conditioned to the same environment as the drive for a maximum of two hours. This conditioning period is necessary to achieve temperature equilibrium between the drive and disk pack, and thus ensure correct track registration and data recording and retrieval. |









