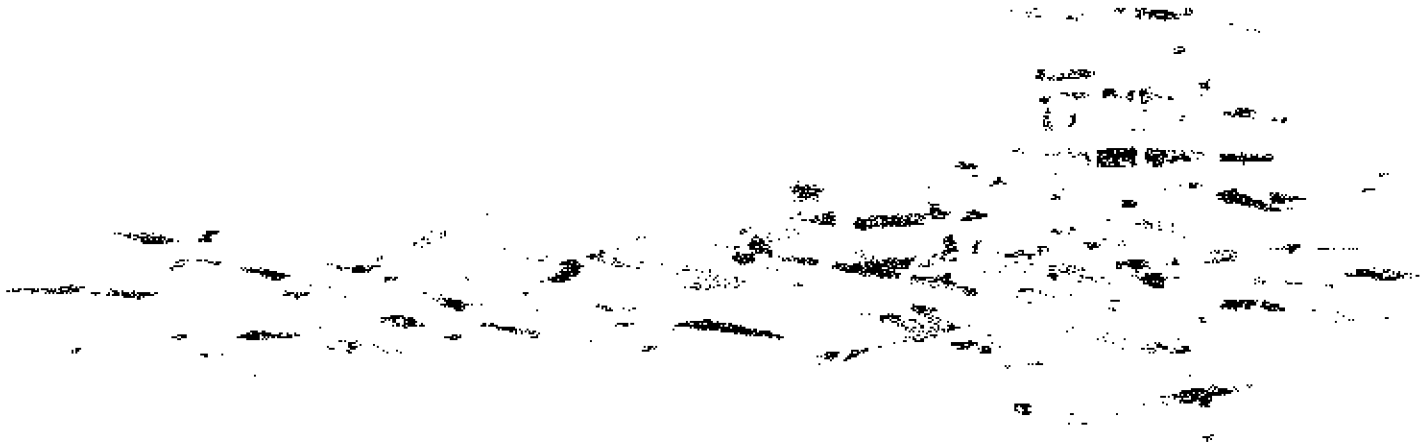
CONTROL DATA®
6603-A/B/C
DISK FILE CONTROLLER



CONTROL DATA
CORPORATION

Reference Manual

CONTROL DATA®
6603-A/B/C
DISK FILE CONTROLLER

Reference Manual

REVISION RECORD

REVISION	DESCRIPTION
A	Manual released. This manual supersedes the 6603-A/B/C Disk File Controller section of the
(11-1-70)	obsolete 6000 Series Peripheral Equipment Reference Manual, Pub. No. 60156100. The information
	contained herein is the same as that found in Rev. J of the obsolete manual.

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CONTENTS

FIGURES

TABLES

6603-A/B/C DISK FILE CONTROLLER

The CONTROL DATA® 6603-A/B/C Disk System consists of the 6603 Disk File Controller and a Bryant Series 4000 Disk File. The system may be used with the 6000 Series Computer Systems.

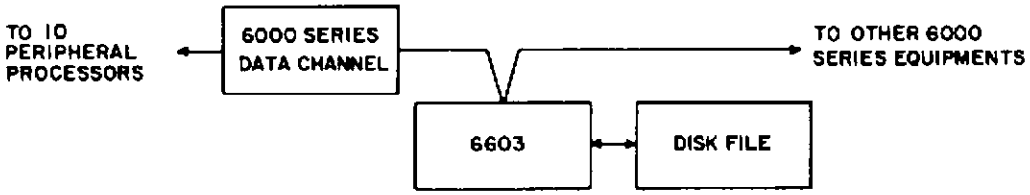


Figure 1. Typical System Configuration

FUNCTIONAL DESCRIPTION

SYSTEM RELATIONSHIP

The 6603 Disk System provides nonvolatile random access storage for 37,355,520 12-bit words. Data is written on, or read from the disk file (in parallel), i.e., each of the 12 bits is written on, or read from a separate disk surface.

Data transfer rate for sequential words is:

1.4 usec per word for the two outer disk zones
1.8 usec per word for the two inner disk zones

DISK ORGANIZATION

The disk surface organization is illustrated in Figure 2 and is described as follows:

Zones	Tracks	Sectors	Bit-Positions Per Track†
1 (outer)	128	128	45,056
2 (outer)	128	128	45,056
3 (inner)	128	100	35,200
4 (inner)	128	100	35,200

Sector count is initiated at the reference mark. There is a group switch gap between the end of the last sector and the reference mark. This area is ordinarily not used for data storage.

There are two separate banks of 12 parallel disk surfaces (Figure 3). However, data can be transferred to or from only one bank at a time. The head groups shown in Figure 3 each serve one disk zone.

A Read or Write operation can be programmed to start at any location by function codes which specify track, sector, and head group.

RECORD FORMAT

A record is a series of sequential data words sent from the Peripheral Processor by a single output operation. It always starts at the beginning of a sector.

A record consists of four words of all zeros, a series of data words, and a check word. Figure 4 shows various record formats. The minimum record length of six words (6-bit positions per surface) occurs when only one data word is written. The four words of all zeros that designate the start of a record and the check word are written automatically by the disk system.

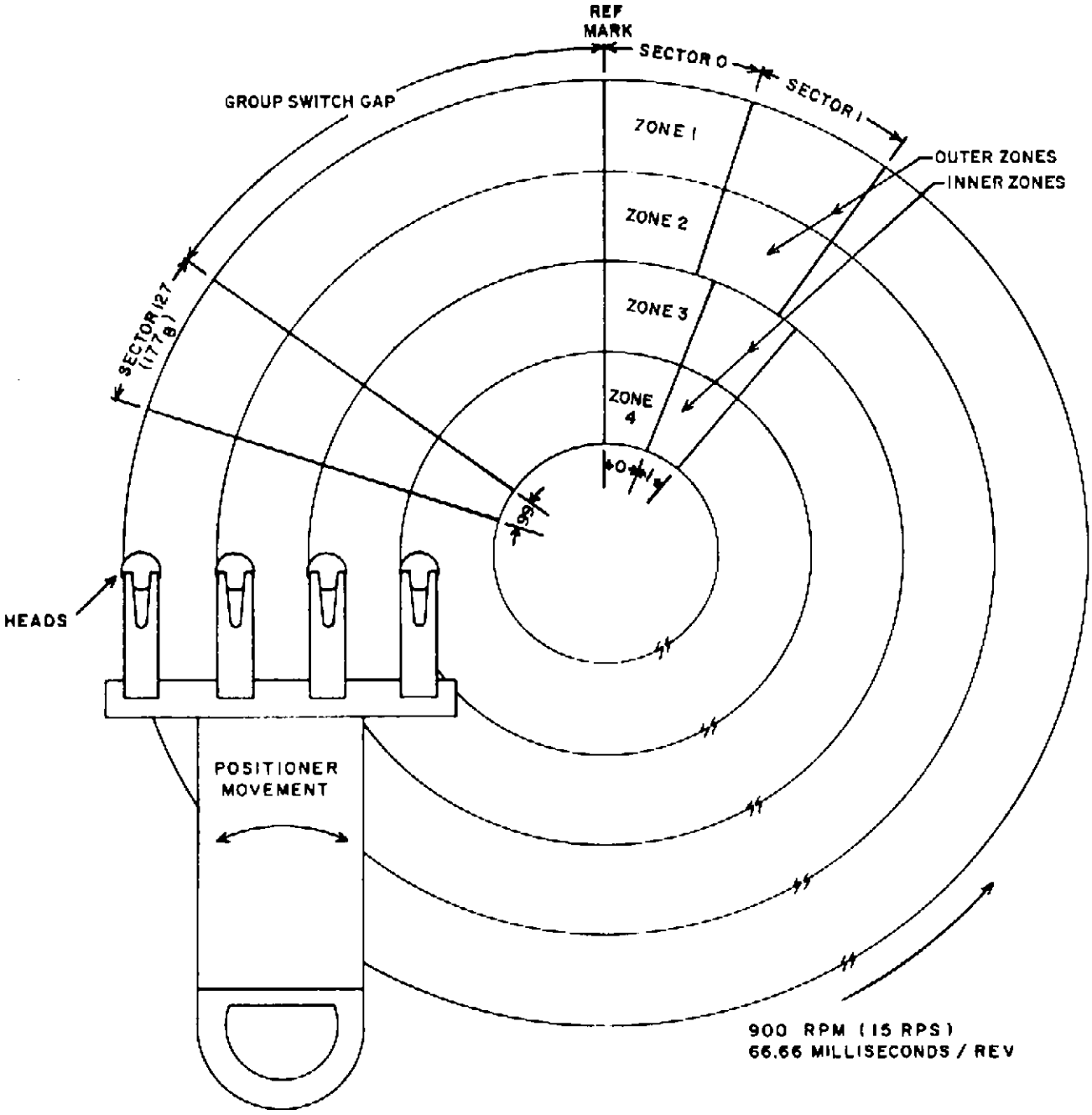
A maximum of 45,051 data words* can be stored on each track in each of the two outer zones. The maximum is 35,195 data words per track in each of the two inner tracks.

† There are 352 bit positions available on each track in a sector.

*Some additional data may be stored in the group switch gap but this practice is not recommended.

Index Mark = Revolution Mark (Master "starting" point of a revolution).

Sector Mark = Reference Mark located at the start of each sector.



EACH ZONE CONTAINS 128 TRACKS
(TRACK 127 OUTERMOST WITHIN EACH ZONE)

2 OUTER ZONES DIVIDED INTO
128 SECTORS

2 INNER ZONES DIVIDED INTO
100 SECTORS

EACH SECTOR CONTAINS 352_{10}
BIT POSITIONS

GROUP SWITCH GAP APPROXIMATELY
3 SECTORS WIDE

Figure 2. Disk Surface

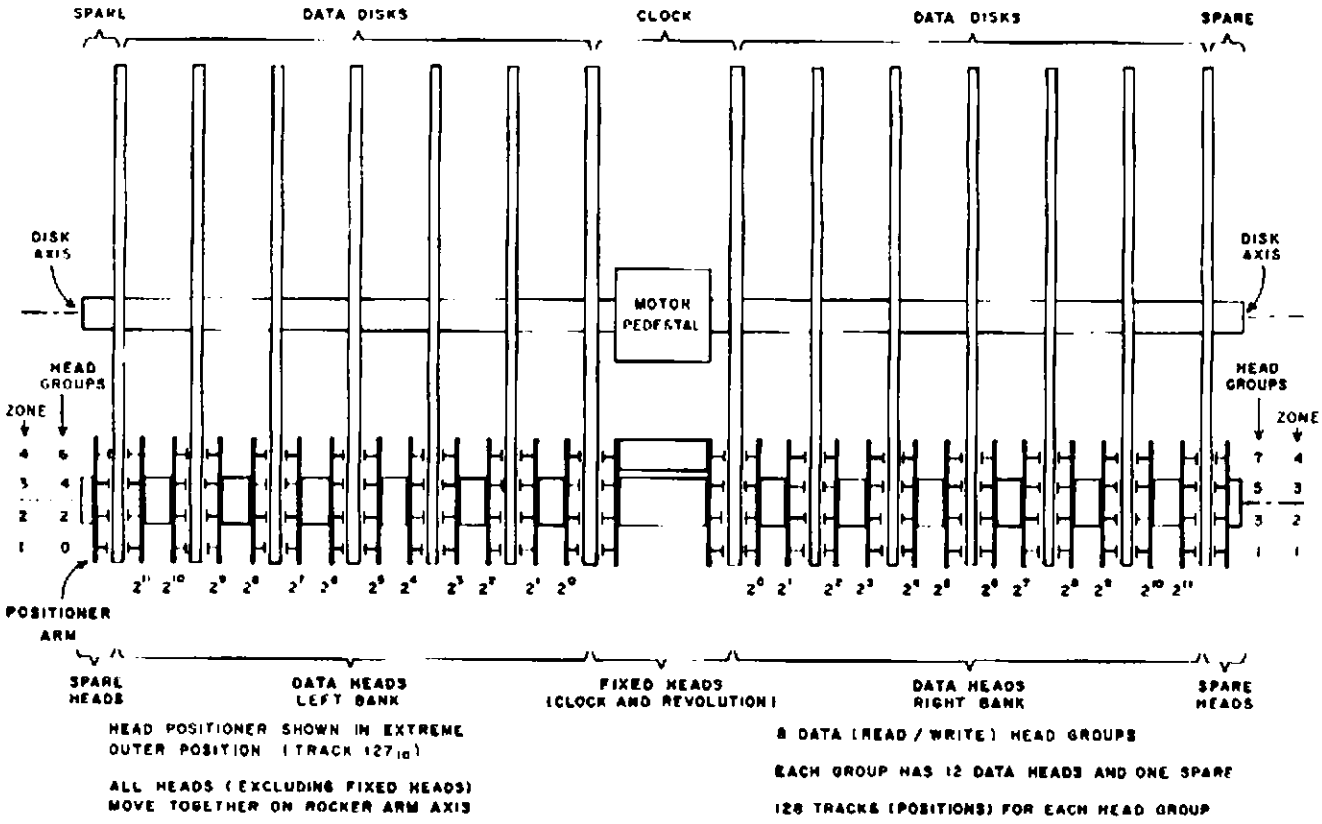


Figure 3. Disk Organization

If the record length is longer than can be accommodated in a single track, it must be segmented and written on more than one track.

Record length may vary as shown in Figure 4. A record can be shorter or longer than a sector. If a record only partially fills a sector, the remaining portion of the sector cannot be used since a new record can start only at the beginning of a sector.

During a Read operation the input instruction must specify the exact number of data words in the record (exclusive of the four zero words and the check word). The disk system does not signal the Peripheral Processor to terminate an input operation when it reaches the end of a record. Thus, if the word count specified in the input instruction is too large the disk will read the check word and data beyond the record of interest.

CHECK WORD

The disk system automatically writes a check word at the end of each record written on the disk (see Figure 4). This check word is used to verify the accuracy of the record when it is read from the disk. During a Read operation the disk system again generates the check word and automatically compares it with the original. If the two check words are not identical, an error occurred when the record was written or during the Read operation.

If there is a check word error the Parity Error status bit (bit 7) is set. Each input operation should be followed by a status check to sense for a parity error.

If an input instruction does not specify the exact number of data words in the record the check word comparison will be meaningless and the parity error status bit will be set. During a Write operation the parity error status bit will always be set, but is not significant. Status should be checked for a parity error only after a Read operation.

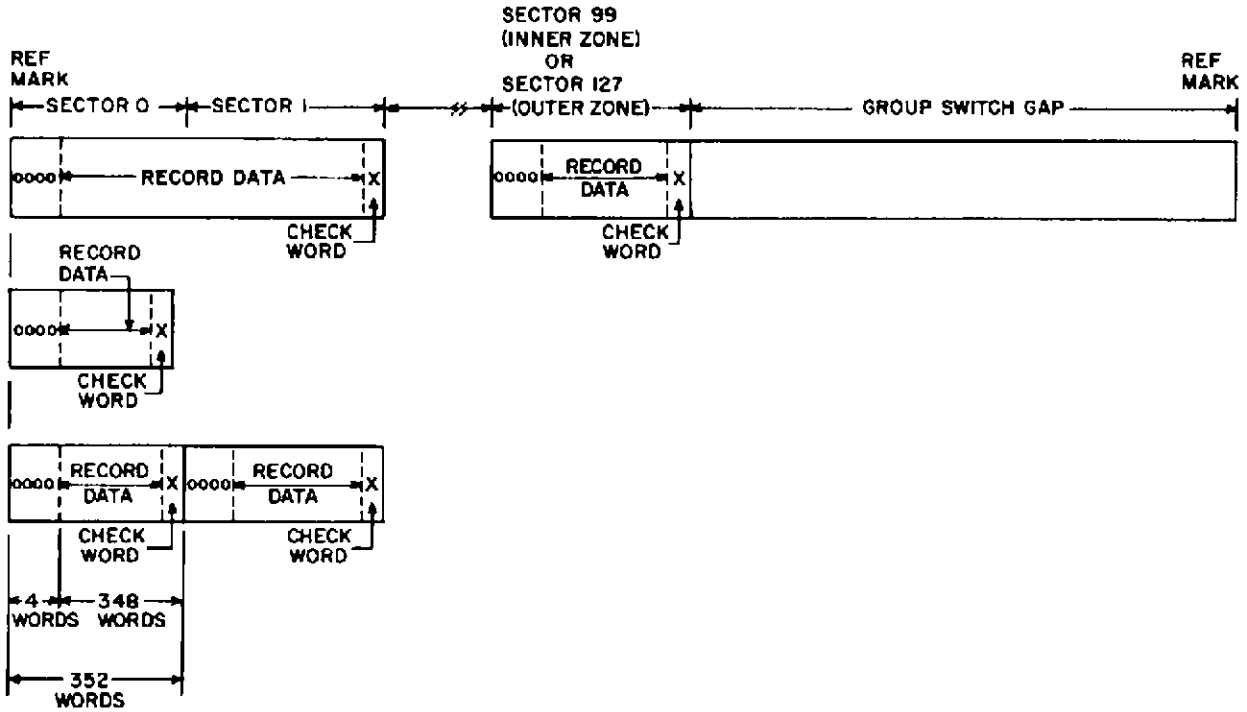


Figure 4. Record Formats

CODES

TABLE 1. 6603 DISK CODES

Function Codes	
Read Sector sSS*	1oosSS†
Write Sector sSS	1o1sSS
Select Track tTT**	11otTT
Select Head Group H***	16011
Request Status	1700
Status Reply Codes	
Ready	0opsSS
Not Ready	0ipsSS
No Parity Error	0rosSS
Parity Error	0r1sSS

*sSS = 000-177
**tTT = 000-177
***H = 0-7
†Small characters binary digits; large characters octal digits.

Function Codes

Read Sector sSS (1ooSS)

This code prepares the disk system to read beginning at sector sSS. It must be issued prior to each Read operation.

Write Sector sSS (1o1SS)

This code prepares the disk system to write beginning at sector sSS. It must be issued prior to each Write operation.

Select Track tTT (1o1r TT)

This code positions the heads over track tTT. The Peripheral Processor exits to the next instruction immediately after issuing this code. However, the disk will be Not Ready for a period of 201-267 ms while the heads reposition.

Select Head Group H (1601H)

This code selects head group H. Bits 3-5 are normally clear, however, this value may be different for a particular installation. In any case bits 3-5 will be a constant for operational programming. The site customer engineer will have the correct value.

Status Request (1700)

This code selects the disk system for an input of the status reply word. An input instruction must follow to read in the status reply word.

Status Reply Codes

The disk status word consists of the current sector (sSS), a Parity Error bit (p) and a Not Ready bit (r).

Ready (00pSS) — Bit 8

Bit 8 is clear when the disk system is not engaged in a track selection (head repositioning) operation. The sector currently under the read/write heads is indicated by sSS.

Not Ready (01pSS) — Bit 8

Bit 8 is set when the disk system is engaged in a track selection (head repositioning) operation. The sector currently under the read/write heads is indicated by sSS.

No Parity Error (00qSS) — Bit 7

Bit 7 is clear if a parity error is not detected during a Read operation.

Parity Error (01qSS) — Bit 7

Bit 7 is set if a parity error is detected during a Read operation or if an input instruction does not specify the exact number of data words in the record. This bit will always remain set after a Write operation, but is not significant. It is intended for use only after a Read operation.

PROGRAMMING CONSIDERATIONS

Timing

Sector Selection: The Read or Write function codes select a specific sector for a Read or Write operation. When one of these codes is issued the disk does not respond until the designated sector reaches the heads. At this time the disk returns an inactive signal that permits the Peripheral Processor to execute the next instruction.

A Read or Write instruction must follow within 9.1 usec on the two outer zones and within 11.9 usec on the two inner zones. This period allows enough time to load the A register with the word count and activate the Data Channel. If a Read or Write instruction does not follow within this period the Read or Write operation will not start at the beginning of the sector.

Track Selection (Head Repositioning): The time required to reposition the read/write heads depends on the angular position of the disk with respect to the heads when the function code is issued. It is not dependent on the distance the heads must travel.

The minimum repositioning time of approximately 201 ms (3 disk revolutions) occurs if the function code is issued when the group switch gap is under the heads (just prior to revolution mark). The maximum repositioning time of about 268 ms (4 revolutions) results if the function code is issued when sector zero is under the heads (just after revolution mark).

If the Peripheral Processor issues either the Read or Write function code to the disk during the repositioning period, the disk does not respond. Thus, the Data Channel remains active until head repositioning is complete. The disk then accepts the Read or Write code and returns an Inactive signal to the Data Channel.

The Not Ready status bit (bit 8) is available to indicate if a head positioning operation is in progress.

Head Group Selection: Head group selection can be accomplished within the group switch period* if the group-select function code is issued at least one ms before the revolution mark passes under the heads. If the code is issued later than this, switching will not take place until the group switch gap again passes under the heads. The maximum delay is one revolution (67 ms).

The disk cannot respond to either a Read or Write function code during the group switching time. If either of these codes is issued during this period, the disk neither accepts the code nor inactivates the Data Channel until head selection is complete.

There is no status condition to indicate that a group switch operation is in progress.

Programming Techniques

Some of the techniques developed here are listed as aids to the programmer.

*Group switch period is the period of time the group switch gap passes under the read/write heads.

Half Track Technique: One way to organize data on the disk is the half-track idea where the programmer considers alternate sectors to be numbered consecutively around the track (the sector count is incremented by two). The skipped sectors are numbered in the same fashion. In this sense each track contains two half-tracks. The advantage of this method is that an entire sector time is available for programming between reading or writing consecutive sectors. This time is needed to load or unload the peripheral memory, and set up parameters for the next sector.

Parameter Storage: The programmer allows several words per sector for parameter storage. One way to use them is as follows:

1) Let word 501_8 contain the number of the next sector in which there is a continuation of the current record.

2) Let word 502_8 contain the number of words in the sector which are occupied by the current record. This scheme enables the processing of variable length records.

Programming Example

This program writes one record on the disk and reads one record from the disk.

```
100     6500        Jump to 0103 if
  1     0103        channel is inactive
  2     7500        Disconnect (deactivate) channel
  3     7700        Function -
  4     1700        Request Status
  5     7400        Activate Channel
  6     7000        Input Status Reply to A
  7     7500        Disconnect Channel
110     2200        Check Status
  1     0400        for Ready
  2     0402        Jump if Ready
  3     0300        Stop if disk is Not Ready
  4     7700        Function -
  5     1 ιοt TT    Select Track tTT (7 bits)
  6     7700        Function -
  7     160H        Select Head group H (3 bits)
120     7700        Function -
  1     1 οιs SS    Select Write Sector sSS (7 bits)
  2     2000        Set A = 100 for
  3     0100        100 word output
  4     7400        Activate channel
  5     7300        Output from
  6     0200        0200
  7     7500        Disconnect Channel
```

```
130     7700        Function -
  1     1 oos SS    Select Read Sector sSS (7 bits)
  2     2000        Set A = 100 for 100 word input
  3     010X        Set to 101 if Check Word is also desired
  4     7400        Activate Channel
  5     7100        Input to
  6     0300        0300
  7     7500        Disconnect Channel
140     7700        Function -
  1     1700        Request status
  2     7400        Activate Channel
  3     7000        Input Status Reply to A
  4     7500        Disconnect Channel
  5     2200        Check Status
  6     0200        for Check Word error
  7     05EE        Jump to error routine if error is detected
150     NI          Continue on in program
```

MANUAL OPERATION

SWITCHES AND INDICATORS

AUTOMATIC ON Switch/Indicator

This switch/indicator starts the disk file. It is dimly lighted during start up and brightly lighted when the file is ready for use. All other switches except AUTOMATIC OFF are disabled.

AUTOMATIC OFF Switch/Indicator

This switch/indicator turns off the file when the AUTOMATIC ON switch is lighted.

MANUAL ON Switch/Indicator

This switch/indicator permits use of all other switches except AUTOMATIC ON and AUTOMATIC OFF.

NOTE

The following switches are effective only when the MANUAL ON switch is lighted.

MANUAL OFF Switch/Indicator

This switch/indicator turns off the file when the MANUAL ON switch is lighted.

DISK MOTOR ON Switch/Indicator

This switch/indicator starts the disk drive motor. It is lighted when power is applied.

DISK MOTOR OFF Switch/Indicator

This switch/indicator turns off the disk drive motor.

HYDRAULIC MOTOR ON Switch/Indicator

This switch/indicator starts the hydraulic motor and applies power to the positioner control circuits. It is lighted when power is applied.

HYDRAULIC MOTOR OFF Switch/Indicator

This switch/indicator turns off the hydraulic motor and removes power from the positioner control circuits.

ELECTRONICS ON Switch/Indicator

This switch/indicator applies power to the electronic circuits.

ELECTRONICS OFF Switch/Indicator

This switch/indicator removes power from the electronic circuits.

HEADS ON Switch/Indicator

This switch/indicator places the heads in a working attitude.

HEADS OFF Switch/Indicator

This switch/indicator moves the heads away from the disk faces.

OPERATING PROCEDURES

The operator is also referred to Control Data 6603 A-C Disk System Service Handbook (Pub. No. 60127000).

Automatic Mode

To start automatic operation, press AUTOMATIC ON pushbutton. Indicator lights within the AUTOMATIC ON and DISK MOTOR ON pushbuttons light when the disk drive motor starts. The AUTOMATIC ON light is dimly lighted at this time.

After approximately a 60-second delay, indicator lamps within the HYDRAULIC MOTOR ON, HEADS ON, and ELECTRONICS ON pushbuttons light simultaneously with the starting of the hydraulic motor.

When the hydraulic system becomes operative and the head pads are prepared to begin Read/Write operations, the AUTOMATIC ON indicator lamp is brightly lighted, indicating the file is ready for use.

The stop automatic operation, simply press the AUTOMATIC OFF pushbutton. The data heads move immediately away from the disk faces, the hydraulic and disk motor is de-energized, and the storage disks coast to a stop.

Manual Mode

To start manual operation press MANUAL ON. Next press DISK MOTOR ON and HYDRAULIC MOTOR ON. After waiting approximately 60 seconds, press HEADS ON. It is possible to place heads in a flying altitude with the disk motor off by pushing MANUAL ON, HYDRAULIC MOTOR ON and, after 60 seconds, HEADS ON.

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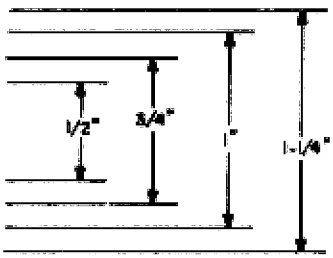

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