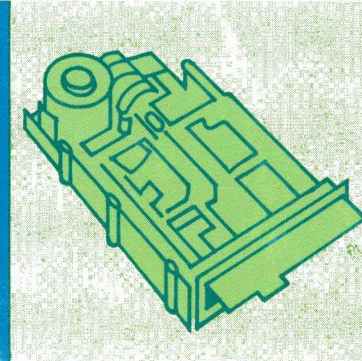
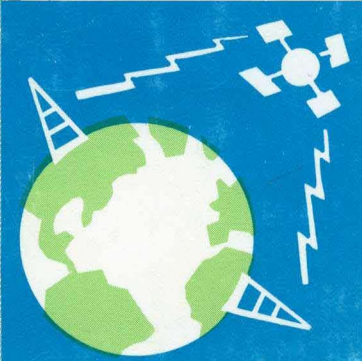
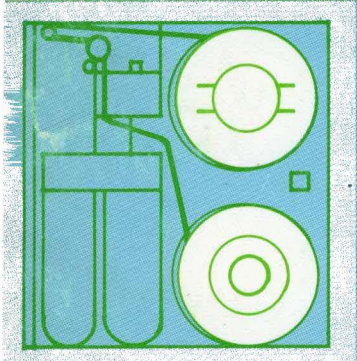
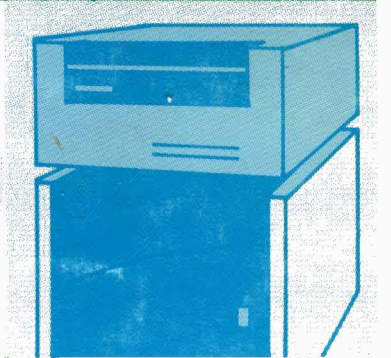
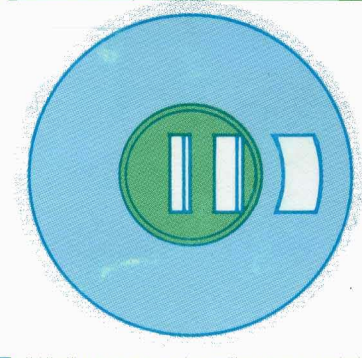
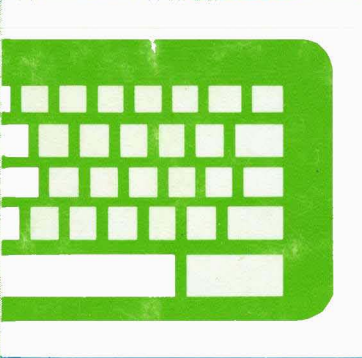
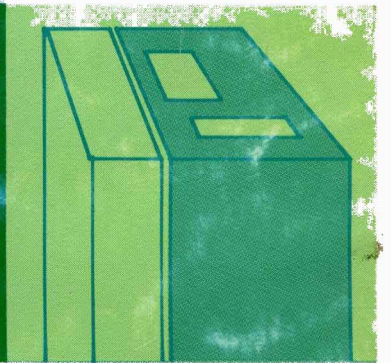
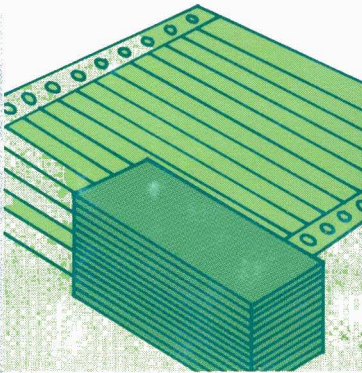
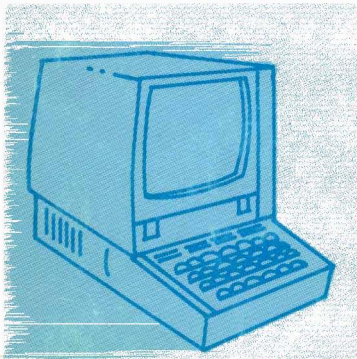


Magnetic Storage Equipment

Version W



Magnetic Storage Equipment



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Introduction to BW-303 Magnetic Tape Transport

BW-303 General Description

In this activity, refer to figures 1 through 4 and table 1 as you listen to the audiotape.

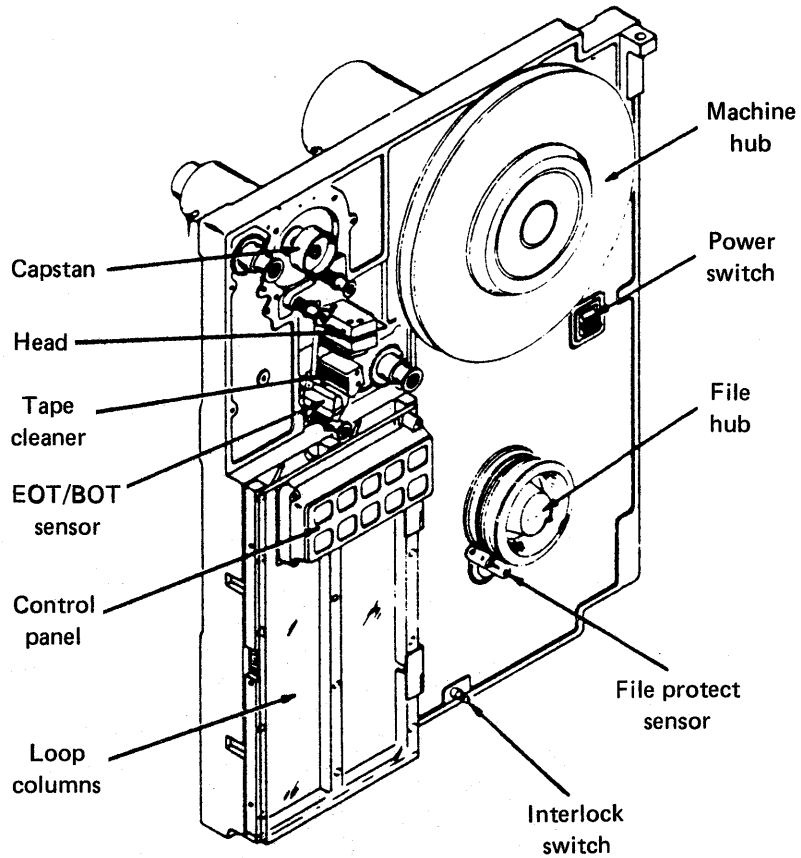


Figure 1. Physical configuration

BW-303 Magnetic Tape Transport

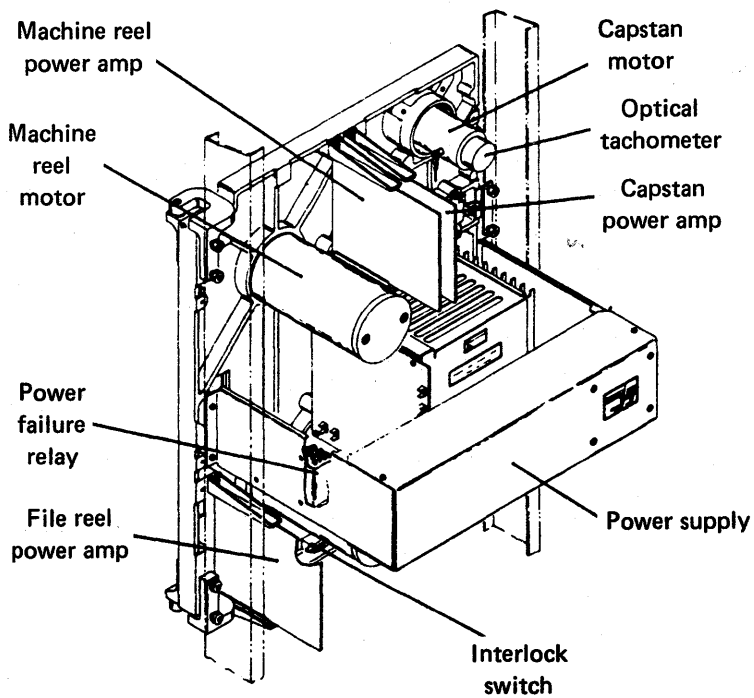
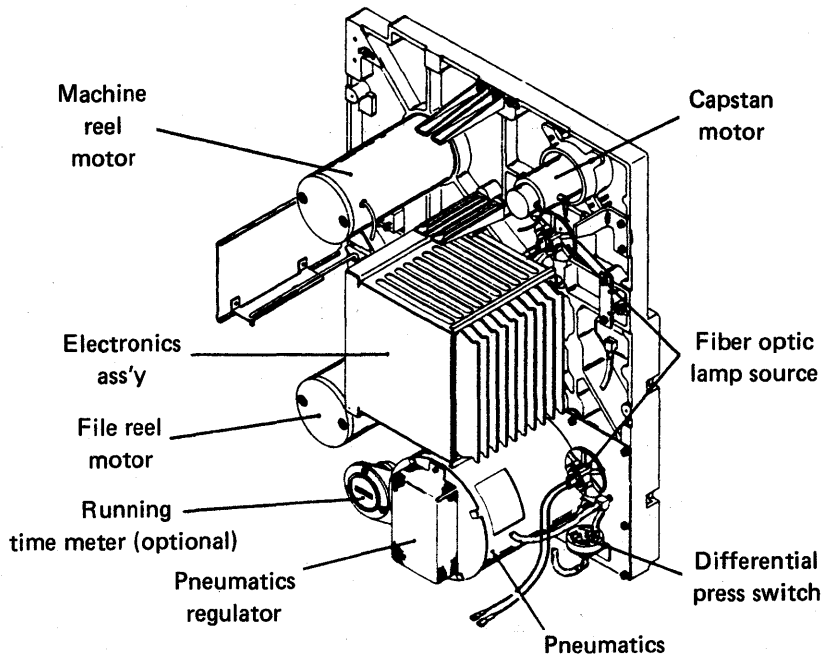
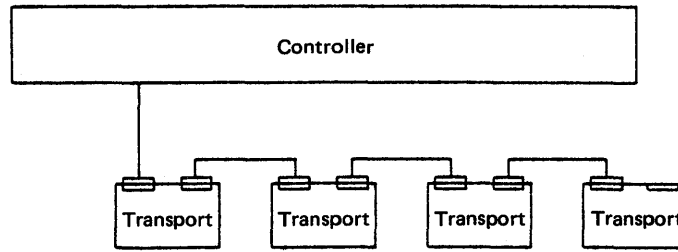
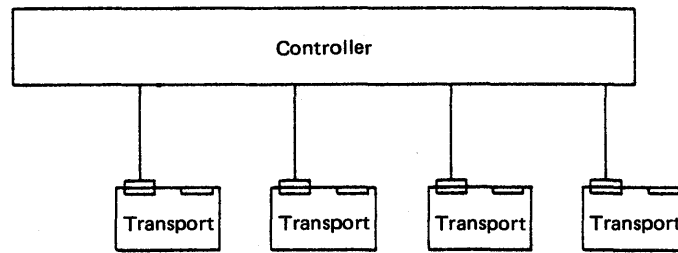


Figure 2. Physical configuration



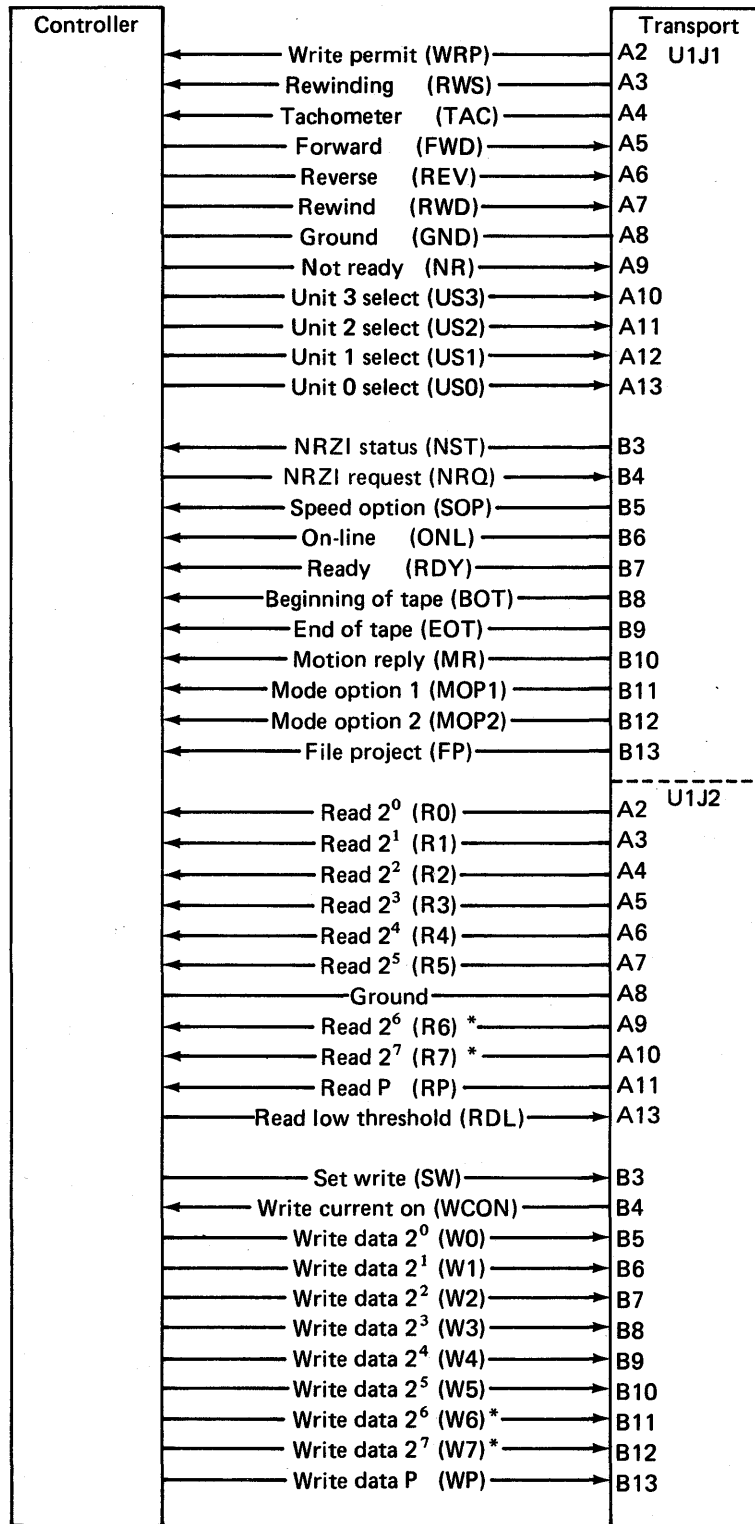
(a) Daisy chain



(b) Radial

Figure 3. System connection

BW-303 Magnetic Tape Transport



* 9-track only

Figure 4. Interface lines

TABLE 1
Interface Lines Description

<u>NAME</u>			<u>DESCRIPTION</u>
<u>Unit Selection:</u>			
On-Line (ONL)	O	L	Indicates unit has been manually placed in an on-line condition.
Ready (RDY)	O	L	Indicates unit has completed load sequence and is not rewinding.
Unit Select (US0-US3)	I	L	(Any of 4 lines) Selects tape unit.
Not Ready (NR)	I	L	This line clears write condition and terminates on-line condition. This line should remain True until on-line status (ONL) becomes False.
<u>Motion Control:</u>			
Forward (FWD)	I	L	This line causes tape to be moved in forward direction.
Reverse (REV)	I	L	This line causes tape to be moved in reverse direction and clears write condition. Beginning-of-Tape status inhibits response to this command.
Rewind (RWD)	I	L	This line causes unit to initiate a rewind operation, provided tape is not at load point. Tape is positioned at load point at end of this operation. This line also clears write condition. This line should be held True until acknowledged by rewind status.

BW-303 Magnetic Tape Transport

TABLE 1—Continued

<u>NAME</u>		<u>DESCRIPTION</u>
<u>Transport Status:</u>		
Motion Reply (MR)	O L	Indicates tape is in motion in response to Forward or Reverse command. MR goes False when tape motion command is dropped. After this, tape will stop within specified stop time. While tape is being stopped, a new motion command in opposite direction of last command will not be accepted. Motion Reply I/O will not go True until tape has stopped. A new motion command in same direction as last command will be accepted without stopping tape and Motion Reply will go True.
Rewinding (RWS)	O L	Indicates unit is rewinding. This line remains True until tape is positioned at load point reflective marker.
Tachometer (TAC)	O P	This line is a pulse train output of capstan tachometer. Its repetition rate is proportional to tape speed.
Beginning of Tape (BOT)	O L	Indicates tape is positioned at load point reflective marker.
End of Tape (EOT)	O L	Indicates end of tape reflective marker has passed sensor. This line will remain True until end of tape reflective marker has passed sensor in reverse direction.
Write Data (W0-W7, WP)	I L	(Any of 9 lines) This line represents direction of flux desired on tape for data to be recorded. False = Direction of IBG flux.
Read Data (R0-R7, RP)	O L (PE) P (NRZI)	(Any of 9 lines) This line represents read data. In phase encoded operation, a transition from True to False indicates a 1 bit when tape is moving forward and a 0 bit when tape is moving backward. For NRZI operation, a 1 data bit is indicated by a True pulse.

TABLE 1—Continued

<u>NAME</u>			<u>DESCRIPTION</u>
<u>Read/Write Operation:</u>			
NRZI Request (NRQ)	I	L	In a dual mode transport, this line selects NRZI mode. This line should remain True until NRZI status is received.
NRZI Status (NST)	O	L	Indicates unit is in NRZI mode.
Read Low Threshold (RDL)	I	L	Selects low read clipping level.
File Protect (FP)	O	L	Indicates unit is not write enabled. (File protect ring removed from file reel.)
Set Write (SW)	I	L	Whenever FWD goes True, this line is sampled within 20 μ sec. If this line is True, the tape unit's write condition is set, provided tape unit is write enabled. A False on this line enables clearing of tape unit's write condition.
Write Current On (WCON)	O	L	Indicates unit is write enabled and current is flowing in write and erase heads.
Write Permit (WRP)	O	L	In both cases below, previous tape motion is assumed to be forward. <ol style="list-style-type: none"> 1. Following a forward command, this line goes True when tape has reached operating speed and moved specified IBG distance. In a write operation, controller must not transmit write data, if this line is False. 2. Following a reverse command, this line goes True when tape motion is equal to previous stop distance.

BW-303 Magnetic Tape Transport

TABLE 1—Continued

<u>NAME</u>			<u>DESCRIPTION</u>		
<u>Hardware Description:</u>					
Speed Option (SOP)	O	L	Indicates tape speed (False = 25 ips, True = 50 ips).		
Mode Option (MOP1, MOP2)	O	L	<u>Recording Mode</u>	<u>MOP1</u>	<u>MOP2</u>
			NRZI Only (9-Track)	True	False
			NRZI Only (7-Track)	False	False
			PE Only (9-Track)	True	True
			Dual Mode (9-Track)	False	True

Component Location and Operation

Introduction

The first part of this activity provides practice in identifying the components of a BW-303 magnetic tape transport. In the second part, you will run the machine through a sequence of operations. Blanks are provided for you to check each step as it is completed.

Tools

Phillips and standard screwdrivers
Reel of magnetic tape
Write enable ring

CAUTION: To avoid electrical shock, remove power from the tape transport before opening any panels.

Lab Activity Instructions

1. Examine the BW-303. Then identify the component parts and assemblies indicated in the following three diagrams. Choose the names of the parts and assemblies from the following list and write the correct letters in the blanks. Not all names will be used. Correct your answers with the answer key located at the end of the exercise.

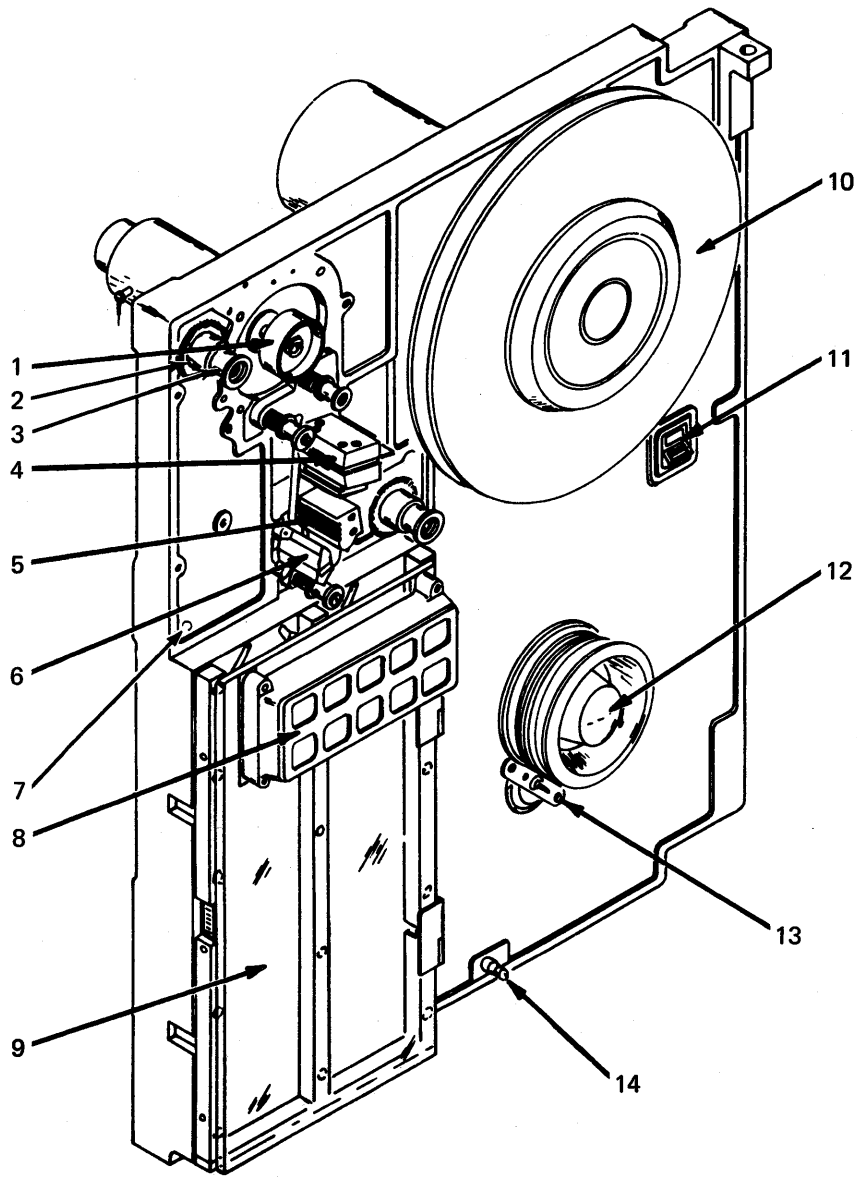
Names of Parts and Assemblies

- a. Magnetic tape controller
- b. Magnetic tape transport translator board
- c. Input/output logic board
- d. Control logic board
- e. Reel logic board
- f. Capstan logic board
- g. Read recovery board
- h. Read logic board*
- i. Write driver board, five-channel*
- j. Write driver board, four-channel*
- k. Reel power amplifier (machine) board
- l. Reel power amplifier (file) board
- m. Capstan power amplifier board
- n. End-of-tape/beginning-of-tape (EOT/BOT) sensor
- o. Pneumatic regulator system
- p. Control panel
- q. Sensor
- r. Capstan
- s. Capstan motor
- t. Blower
- u. Loop column sensor
- v. Tape tachometer
- w. File protect
- x. Read/write/erase head
- y. Power switch
- z. Power supply
- aa. Power distribution system
- ab. Triac
- ac. Line filter
- ad. Power sequencer
- ae. Resistor assembly
- af. Toggle switch
- ag. Circuit breaker
- ah. Temperature sensor (130F, 54.4C)
- ai. Temperature sensor (140F, 60C)
- aj. Lamp—amber
- ak. Lamp—red
- al. File/machine reel motors
- am. Interlock switch
- an. Vacuum motor
- ao. Tape cleaner
- ap. Cabinet latch screw
- aq. Loop columns
- ar. Machine reel
- as. File protect sensor
- at. File hub
- au. Fiber optic lamp source
- av. Pneumatics
- aw. Differential pressure switch
- ax. Power failure relay
- ay. Optical tachometer
- az. Logic chassis

Component Location and Operation

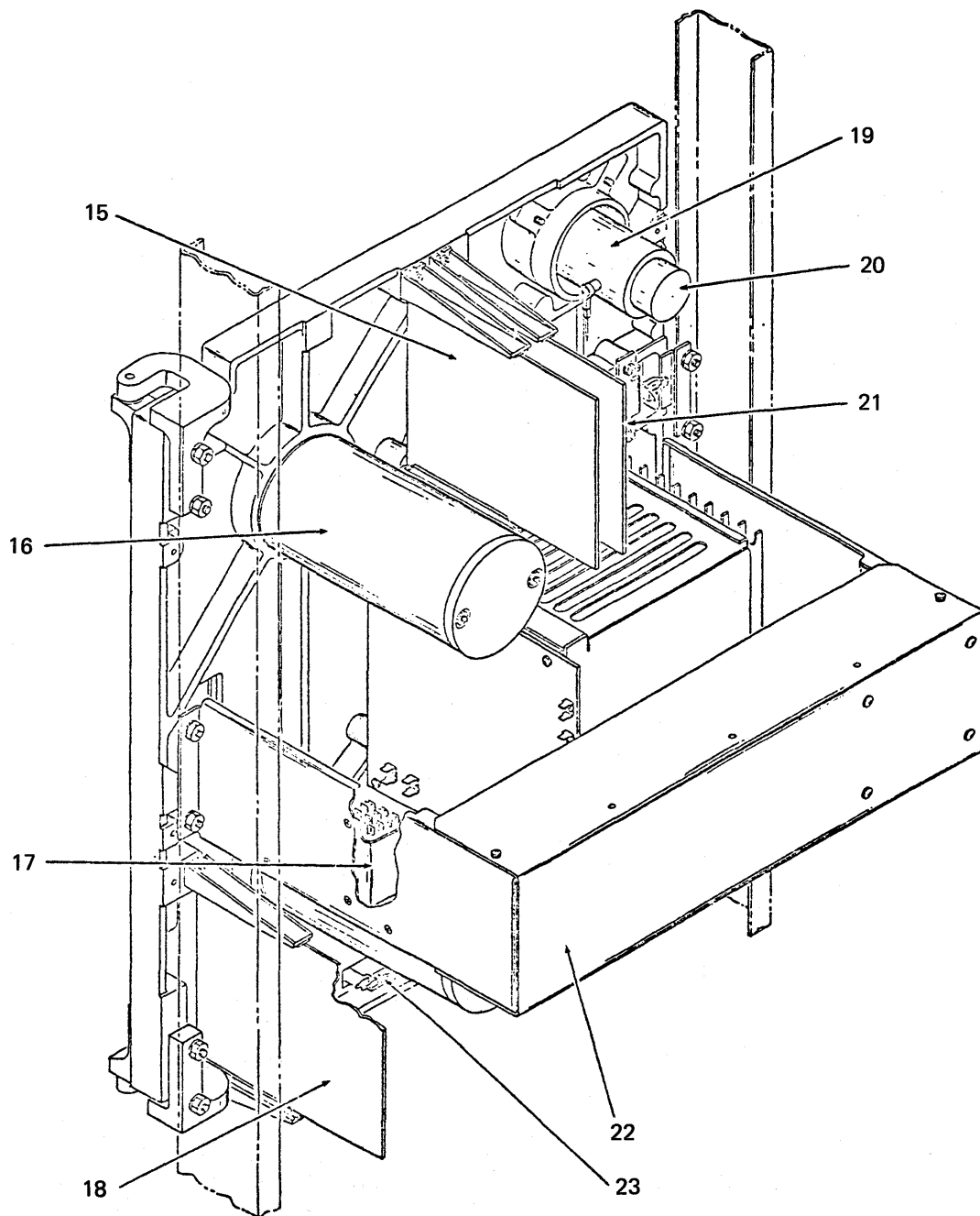
- | | |
|-----------|-----------|
| 1. _____ | 23. _____ |
| 2. _____ | 24. _____ |
| 3. _____ | 25. _____ |
| 4. _____ | 26. _____ |
| 5. _____ | 27. _____ |
| 6. _____ | 28. _____ |
| 7. _____ | 29. _____ |
| 8. _____ | 30. _____ |
| 9. _____ | 31. _____ |
| 10. _____ | 32. _____ |
| 11. _____ | 33. _____ |
| 12. _____ | 34. _____ |
| 13. _____ | 35. _____ |
| 14. _____ | 36. _____ |
| 15. _____ | 37. _____ |
| 16. _____ | 38. _____ |
| 17. _____ | 39. _____ |
| 18. _____ | 40. _____ |
| 19. _____ | 41. _____ |
| 20. _____ | 42. _____ |
| 21. _____ | 43. _____ |
| 22. _____ | |

BW-303 Magnetic Tape Transport



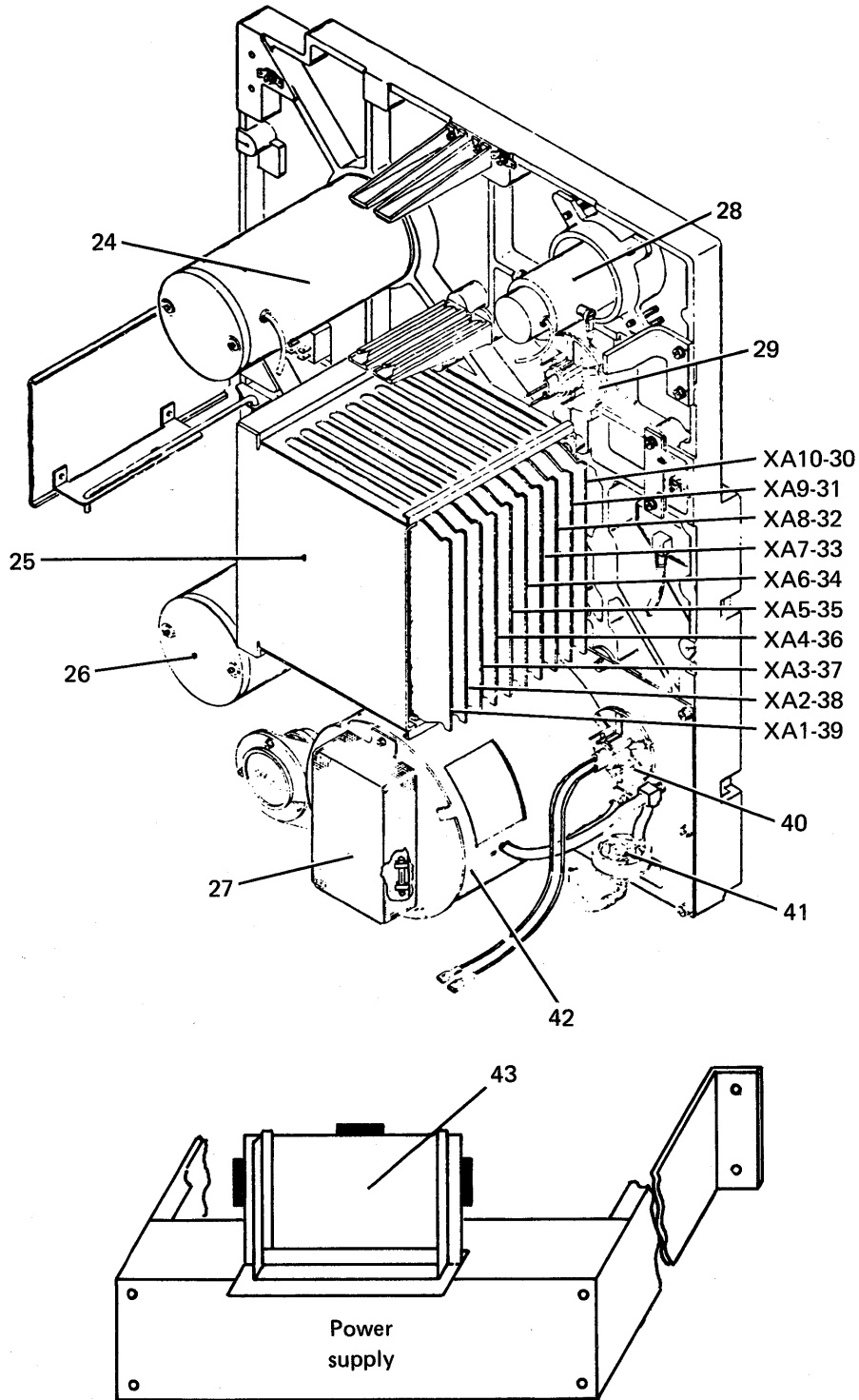
Magnetic tape transport physical configuration

Component Location and Operation



Magnetic tape transport physical configuration

BW-303 Magnetic Tape Transport



Magnetic tape transport physical configuration

2. Use the following instructions to operate the BW-303.

Loading Procedure

To thread the tape, perform the following steps:

- _____ a. Open the front door of the transport to permit access to the tape deck.
- _____ b. Pull out the cabinet door interlock switch.
- _____ c. Install the write enable ring within the inner surface cutout on the tape reel if a write operation is to be performed.

NOTE: The write enable ring is to be installed only if a write operation is to be performed. Ensure that valuable data has not been stored on the reel before a write operation.

- _____ d. Place the file reel onto the supply reel hub. Ensure that the file is fully seated against the supply hub face. Push the hub in to lock the reel in place.
- _____ e. Manually rotate the machine reel hub clockwise and thread the tape as shown in figure 5.
- _____ f. Wind at least three full wraps of the tape onto the take-up reel.

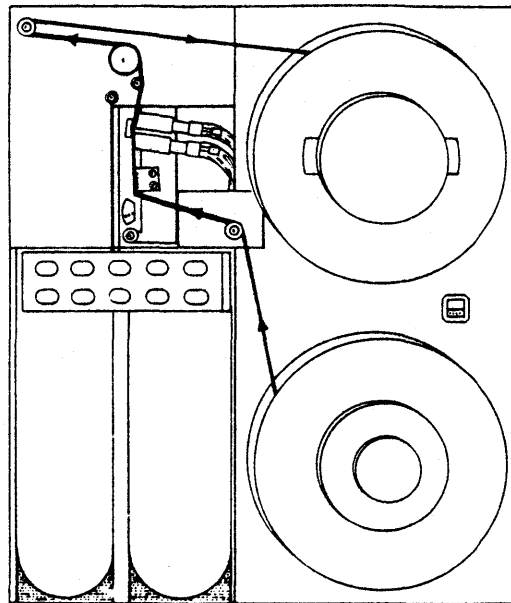


Figure 5. Tape loading

BW-303 Magnetic Tape Transport

To turn the power on and load the tape, perform the following steps:

- _____ g. Open the back cover and turn the main power on.
- _____ h. With the tape threaded, press the power switch and close the front door. The power indicator will illuminate, and the tape should now load properly.
- _____ i. Touch the load/rewind touch control pad. The tape will load into the vacuum column and move forward until the beginning-of-tape marker is reached. The BOT/EOT indicator will illuminate.

To rewind tape to the beginning-of-tape marker, perform the following steps:

- _____ j. When the transport is under system control (on-line), it must first be cleared by pressing the CLEAR switch. This places the transport in the off-line mode.
- _____ k. In the off-line mode, depress the LOAD/REWIND switch to initiate a tape rewind to BOT.

Unloading Procedure

To unload tape from the tape transport, perform the following steps:

- _____ l. In the off-line mode, depress the UNLOAD switch.

NOTE: During the unload sequence, the tape is rewound to the BOT marker and then moved in the reverse direction until the remainder of the tape is removed from the reel. Power to the reel motors is removed and the pneumatics are disabled to permit removal of the supply reel.

- _____ m. At the completion of the unload sequence, the POWER switch is depressed to place the tape transport in a power-down condition.
- _____ n. The supply reel is removed from the tape transport by repeating steps a through d of this lab exercise in their reverse order.

ANSWER KEY

1. r
2. q
3. v
4. x
5. ao
6. n
7. ap
8. p
9. aq
10. ar
11. y
12. at
13. as
14. am
15. k
16. al
17. ax
18. l
19. s
20. ay
21. m
22. z
23. am
24. al
25. az
26. al
27. o
28. s
29. au
30. g and i
31. g and i
32. g and i
33. g and h
34. g and j
35. g and j
36. f
37. e
38. d
39. c
40. au
41. aw
42. av
43. b

Theory of Operation

BW-303 Functional Description

In this activity, refer to the following tape transport block diagram (figure 6) as you listen to the audiotape.

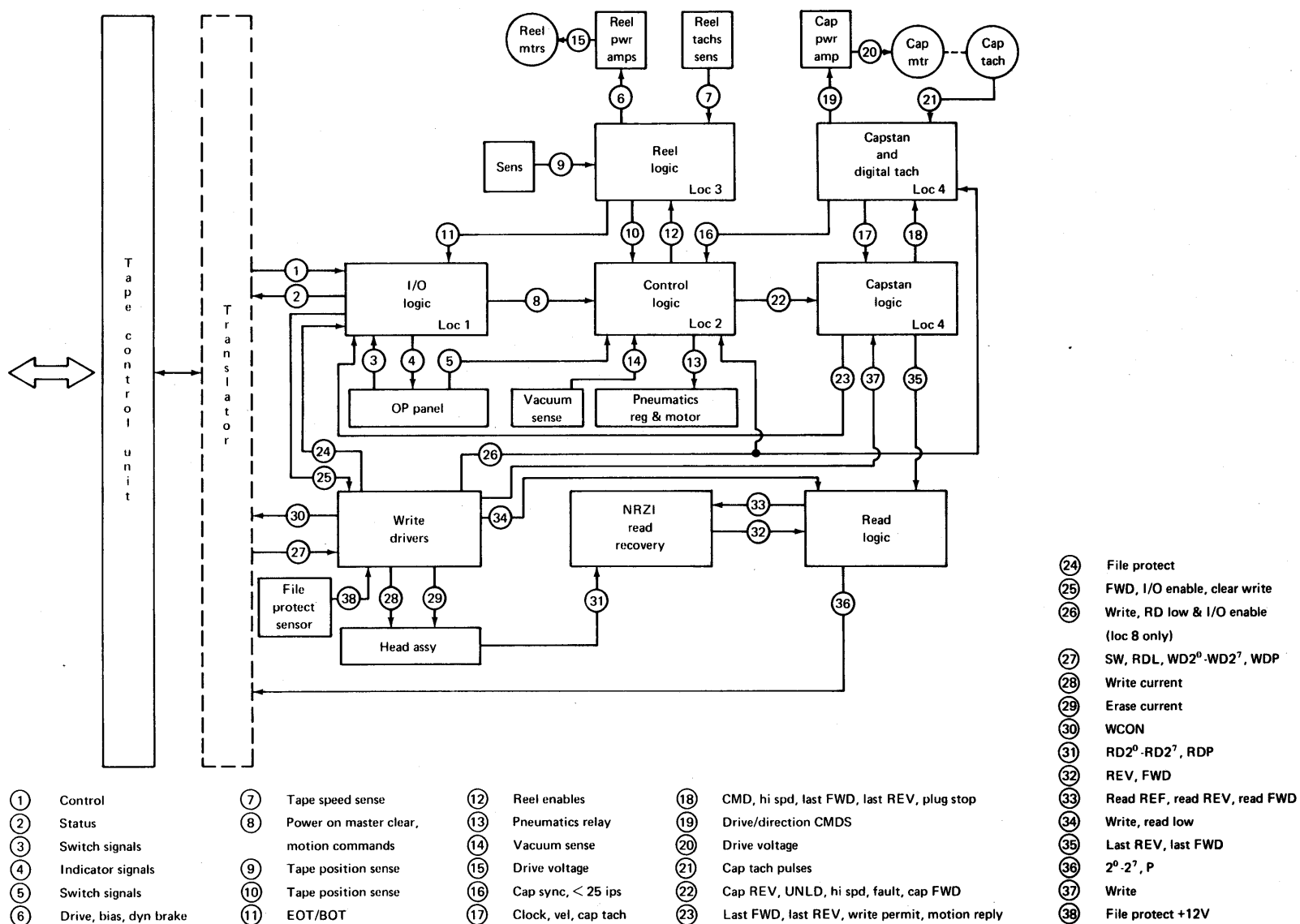


Figure 6. Tape transport block diagram

READY Operation

This reading discusses the logic controlling conditions necessary to generate a READY signal.

Several conditions must occur for the tape drive to be in a READY condition. After the tape is first loaded, the reels go into a rewind state until the BOT (beginning of tape) marker is sensed. Then the READY condition is established. The READY condition is also established if the tape is not in motion, either forward or reverse.

The theory of operation is shown in figure 7.

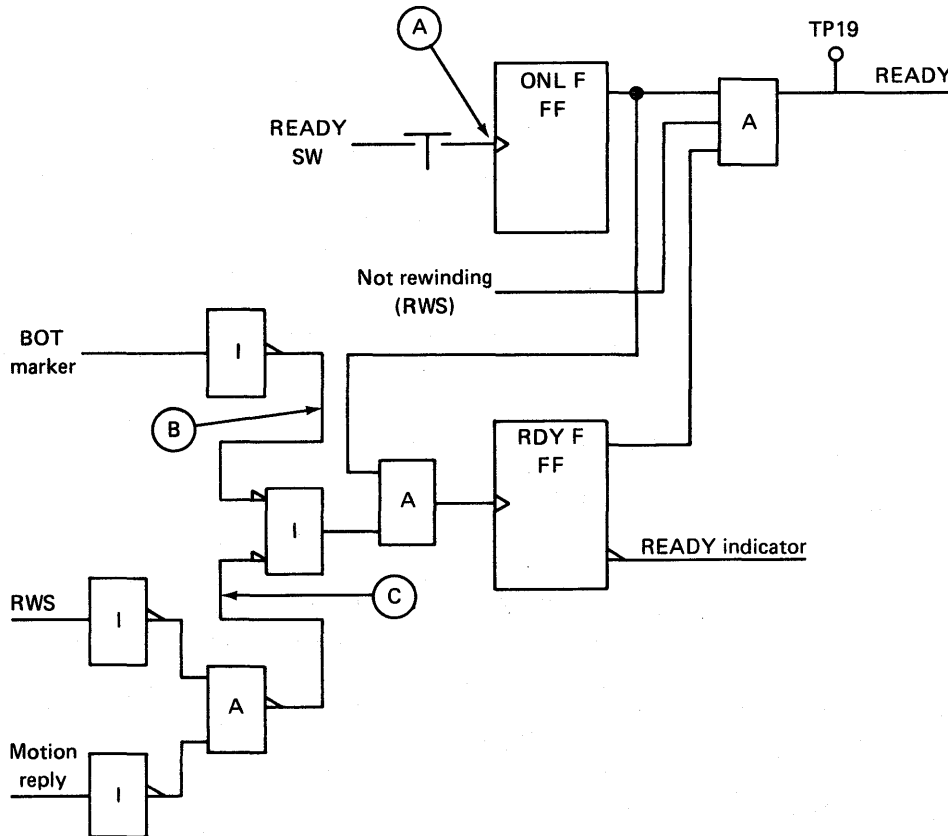


Figure 7. Establishing READY condition

With the tape loaded onto the tape drive, depressing the READY switch (point A) on the operator panel sets the ONL F flip-flop. If BOT is sensed and the tape is not in motion, the RDY flip-flop will set point B, turning on the READY IND and the READY

Theory of Operation

condition. This READY condition can be monitored at TP19. Thereafter, the RDY flip-flop is set through the circuits at point C. Figure 8 is a flow diagram for establishing the READY condition.

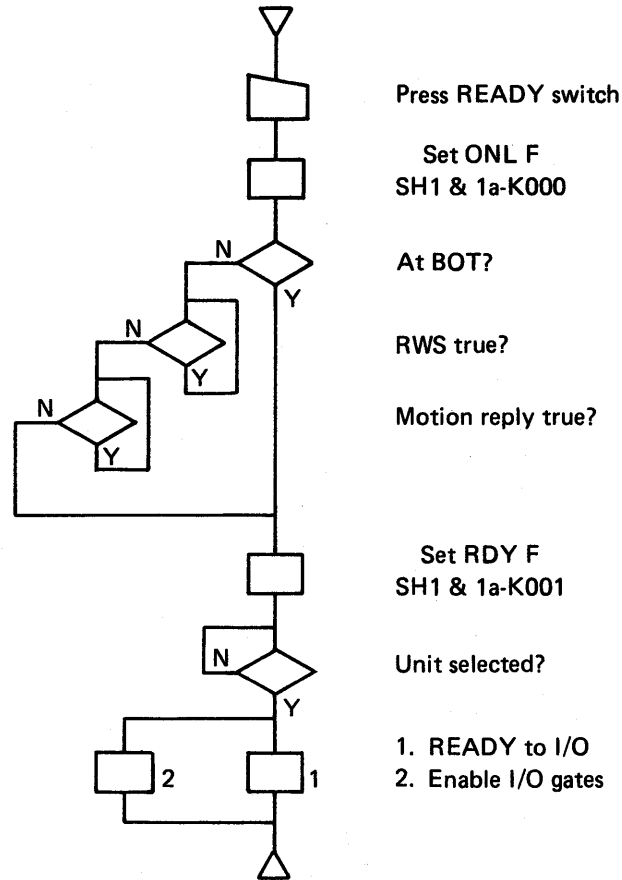


Figure 8. READY flow diagram

After the tape drive is selected by the I/O controller, the I/O gates will be enabled and READY is sent to the controller. (See figure 9.)

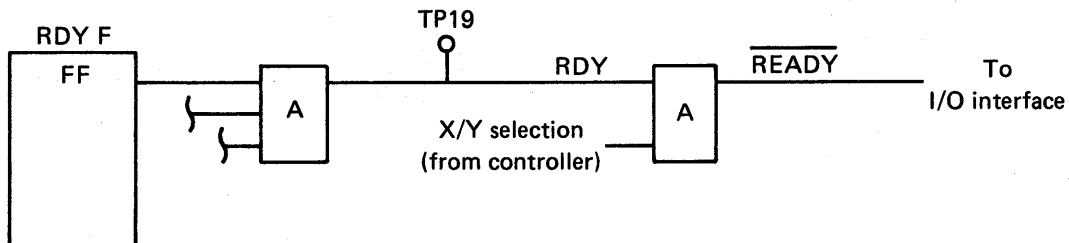


Figure 9. READY to controller

WRITE Operation

This reading describes the activities that occur during a write operation.

After the tape drive is selected and before the actual writing on tape begins, several conditions must be satisfied:

1. The tape reel must have the 'write' ring installed. This removes the reset condition from the WRITE FF (see block F of figure 10).
2. The tape drive must have previously been selected by the controller, which generates a control signal called I/O EN. The appropriate operator control switches are pressed to generate the signal called SW (see block B of figure 10).
3. The controller sends the signal FWD (forward) to set the WRITE FF (see block H of figure 10).
4. When the WRITE FF turns on, it enables the erase head to become active (block N of figure 10). At the same time, a reset is removed from the WRITE Data FF (see block U of figure 10).

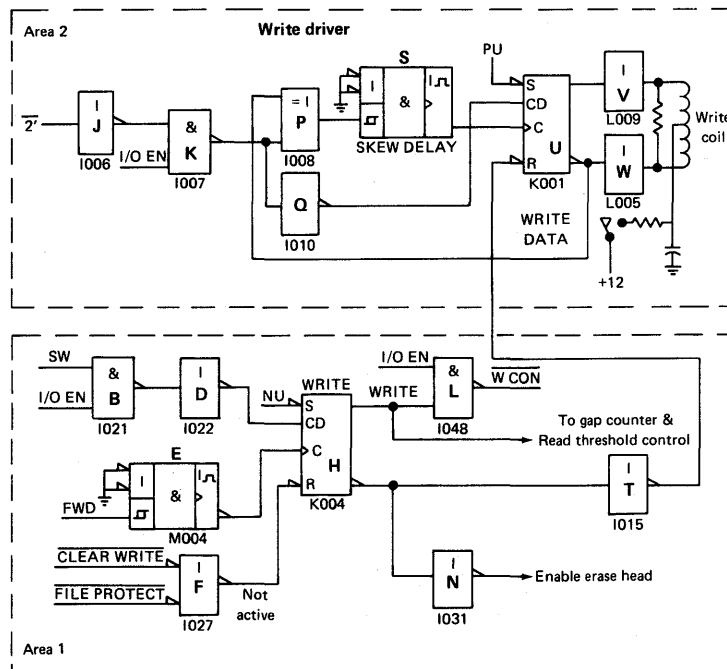


Figure 10. Simplified write logic

Theory of Operation

Next data is sent to the write head circuitry. Area 2 in figure 10 represents logic for a single channel of the read head. A bit on the write driver circuitry activates the single shot skew delay, enabling the write coil to record data onto the tape.

The following write-flow diagram (figure 11) summarizes the sequence of write-flow events.

WRITE Operation

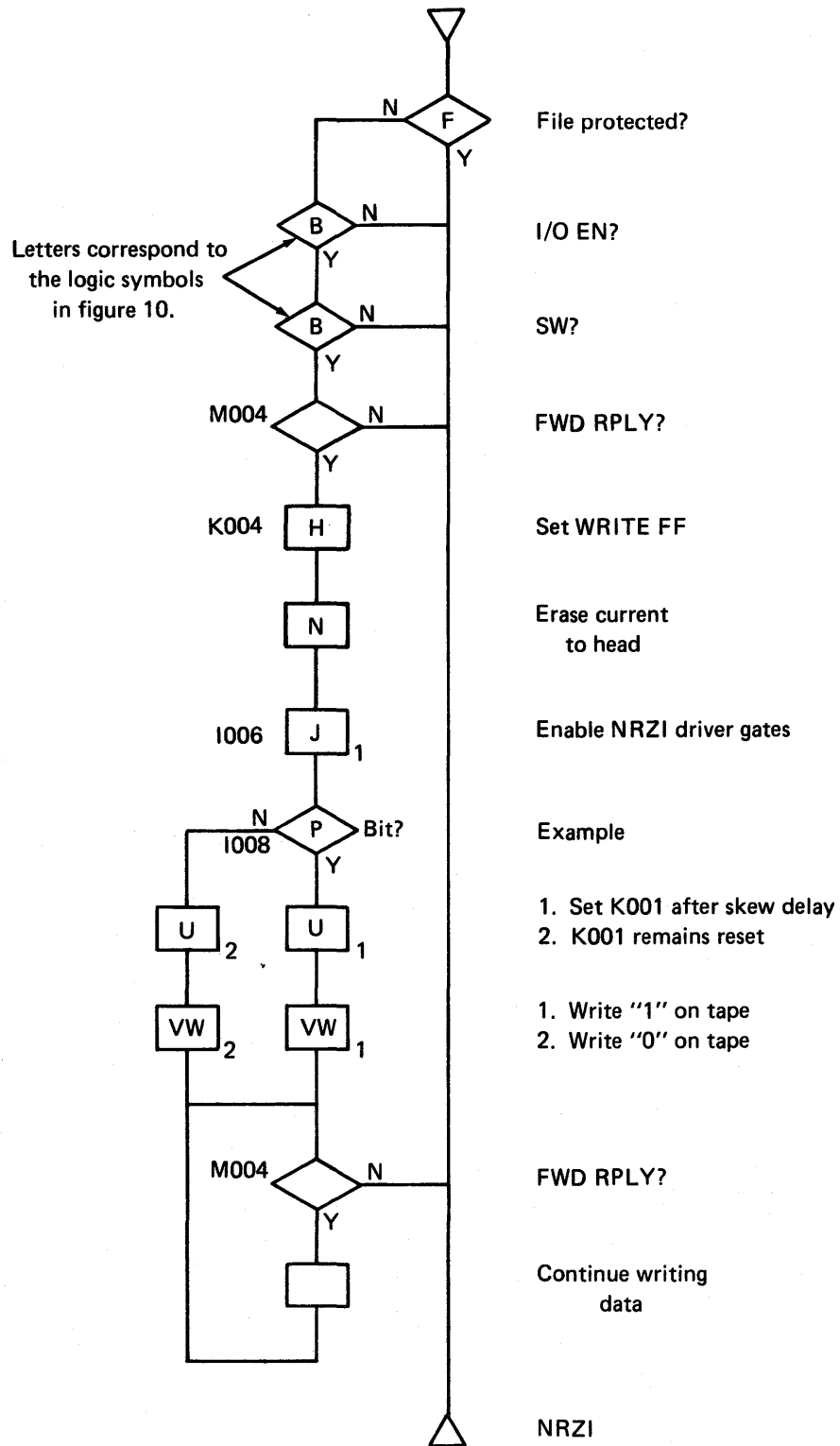


Figure 11. Write flow diagram

Theory of Operation

The tape is prepared for writing by following the logic flow diagram in figure 11. The first step is to make sure the file is protected by determining if the write pin is installed. If the answer is yes, the file is protected and the system would exit through the yes line. If the answer is no, the system would go to the next point, which is the question "Has an I/O been enabled?" If the answer is no, the exit route is taken. If the answer is yes, the switches are checked to see if they are properly set. After the switches are checked, the forward command is given. This sets the write flip-flop. Erase current is sent to the head. The NRZI driver gates are enabled. Depending on the condition of I008 (block P), a zero or a one will be written by following through the U and VW blocks. If there is a continuing forward reply, then more data is written. If there is no longer a forward reply, then the system exits from this process.

Maintenance Procedures

Preventive Maintenance Procedures

In this activity, refer to figures 12 and 13 as you listen to the audiotape.

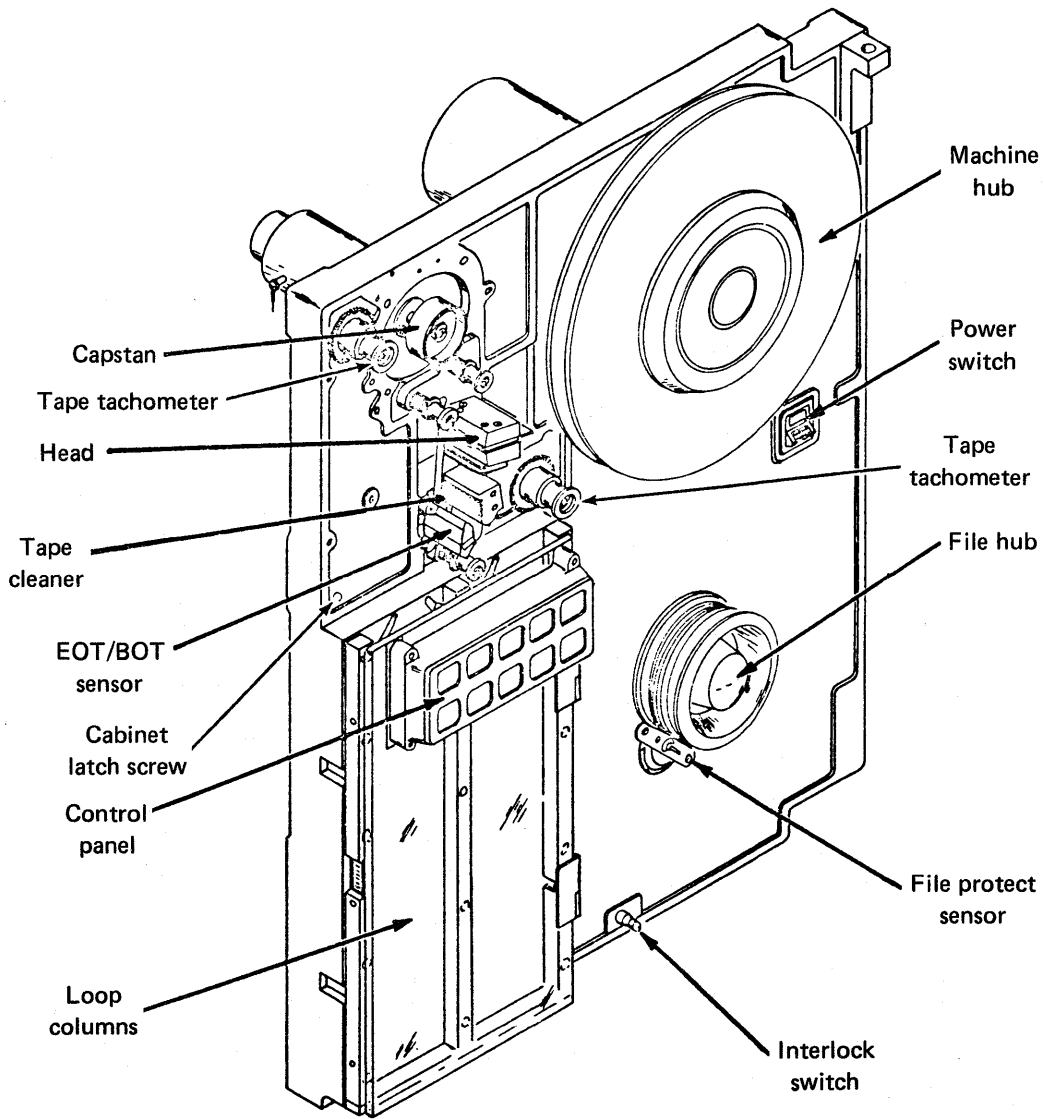


Figure 12. Magnetic tape transport tape drive, front view

Maintenance Procedures

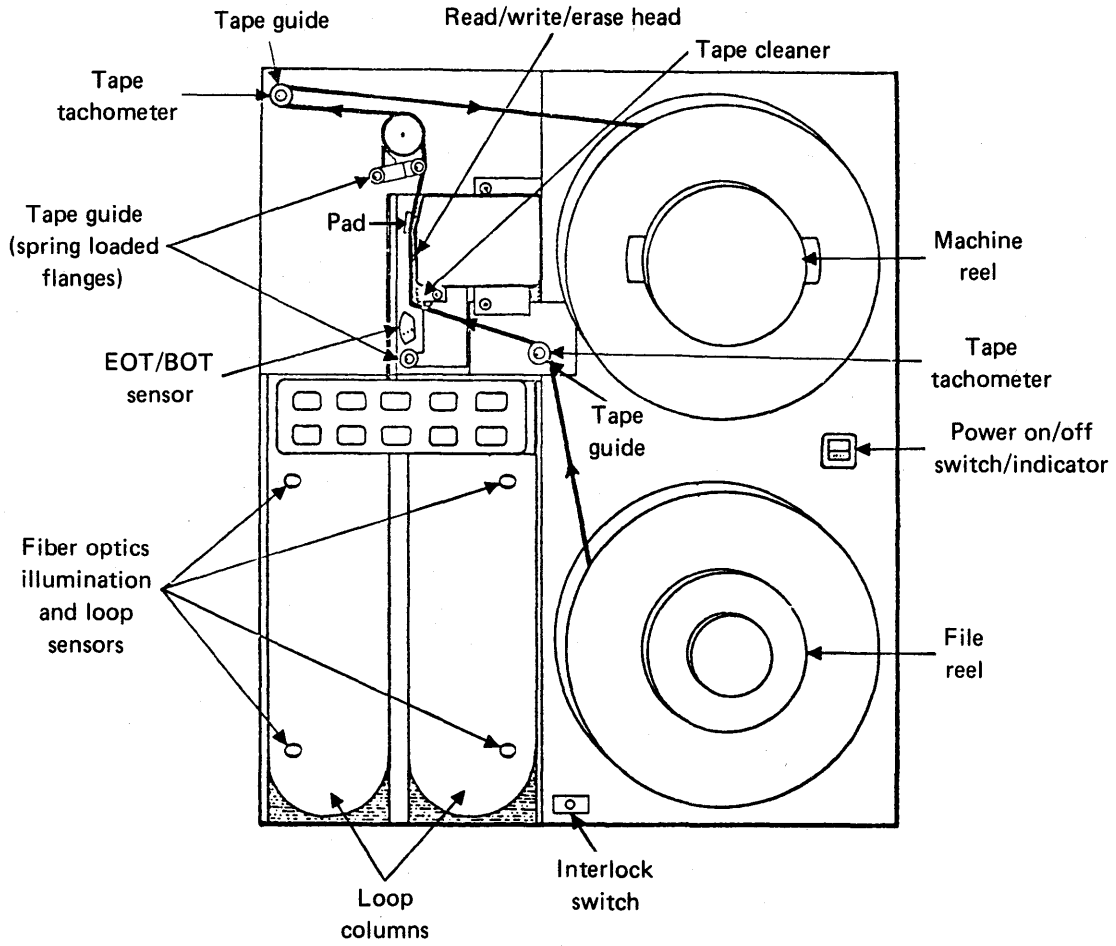


Figure 13. Magnetic tape transport tape load path

Magnetic Tape Electrical Lab

The purpose of this laboratory activity is to practice making checks and adjustments within the magnetic tape unit.

The estimated time to complete this activity is three hours.

Objectives

- Identify and measure proper signals in the magnetic tape unit.
- Perform selected adjustments to the magnetic tape unit.

Materials Required

- Oscilloscope and three 10X scope leads
- Ground lead
- Voltmeter with pin tip probes
- PC card puller, CDC Part No. 86732000
- Card extender, CDC Part No. 59516401
- Potentiometer adjustment tool or small screwdriver
- Scratch tape (any used tape on which data can be written)
- Master skew tape, CDC Part No. 64216000 (a precision recorded tape with 1's in all bits)

Introductory Information

The procedures in this lab are to determine if a magnetic tape transport is functioning correctly.

The areas checked are:

START TIME – The time it takes for the capstan to reach full velocity after the command is given.

STOP TIME – The duration of time it takes for the capstan to go from full velocity to a stopped condition.

The BOT sensor is checked and adjusted.

Maintenance Procedures

TACHOMETER OUTPUT – The monitoring of the capstan speed by a tachometer. It is during this time that reading and writing occurs.

The loop box sensor is checked and adjusted.

The read head digital and analog signals are observed.

The laboratory procedure follows. When you complete a step, put a check mark in the space provided.

Procedure

Start Time Check

This check measures the time required for the tape to reach normal velocity after the FWD switch is pressed. The FWD switch is the red toggle switch located on the end of the circuit card at location XA2. This check would normally be performed after the capstan motor had been replaced and realigned.

- _____ Step 1. Apply power to the tape drive unit.
- _____ Step 2. Load the master skew tape and advance to BOT.
- _____ Step 3. Attach oscilloscope probe for channel A to XA4-TP16.
- _____ Step 4. Set oscilloscope according to table 2.

TABLE 2
Oscilloscope Set-Up

Triggering Mode: DC
Triggering Slope: EXT-
Volts/CM: .2
Time/CM: 2ms

- _____ Step 5. Attach oscilloscope sync probe to XA4-TP3.
- _____ Step 6. Alternately place switch S1 (FWD-REW) to the FWD position, release it, and depress the CLEAR switch on the control panel. Observe the oscilloscope. The signal displayed should compare with the signal in figure 14. The positive portion of the pulse should be 15 ± 2.5 ms.

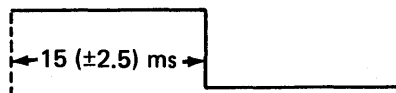


Figure 14. Start time pulse

_____ Step 7. If necessary, adjust potentiometer R17 on AR2 board until proper signal is observed. AR2 (Capstan Power Amplifier board) is the right most logic board of the two boards located to the right of the capstan motor and above the logic board assembly. If you are in doubt as to which component is R17, consult page 4-117 in the *Control Data Magnetic Tape Transport Field Service Manual*, Pub. No. 49756400.

Stop Time Check

_____ Step 8. Remove power from the tape drive unit.

_____ Step 9. Remove the oscilloscope probes from the tape unit.

_____ Step 10. Put logic board XA4 on the extender board in the unit.

_____ Step 11. Restore power to the magnetic tape unit.

_____ Step 12. If the master skew tape is near the end from the previous activity, it will have to be rewound to BOT. If this is necessary, then do so at this time.

_____ Step 13. Attach the oscilloscope sync probe to XA4-TP3.

_____ Step 14. Attach the oscilloscope channel A probe to XA10-TP10. This connection is for $\triangle B$ operation. This is the unit that is probably in your facility. Table 3 has been included for your assistance if you are in doubt. Units $\triangle A$, $\triangle E$, and $\triangle F$ will use this same point. Units $\triangle C$ and $\triangle D$ will use XA7-TP19.

Maintenance Procedures

TABLE 3
Transport Characteristics

Model	Speed (ips)	Recording Mode	Density (bpi)	Track
△A	25	PHASE ENCODE	1600	9
△B	25	DM	800/1600	9
△C	25	NRZI	800	9
△D	25	NRZI	200/556/800	7
△E	50	PHASE ENCODE	1600	9
△F	50	DM	800/1600	9

_____ Step 15. Set oscilloscope according to table 4.

TABLE 4
Oscilloscope Set-Up

Triggering Mode: DC Triggering Slope: EXT- Volts/CM: .05 Time/CM: 5ms
--

_____ Step 16. Alternately place switch S1 (FWD-REW) to the FWD position, release it, and depress the CLEAR switch on the control panel. Observe the oscilloscope. The waveform should compare with waveform A in figure 15.

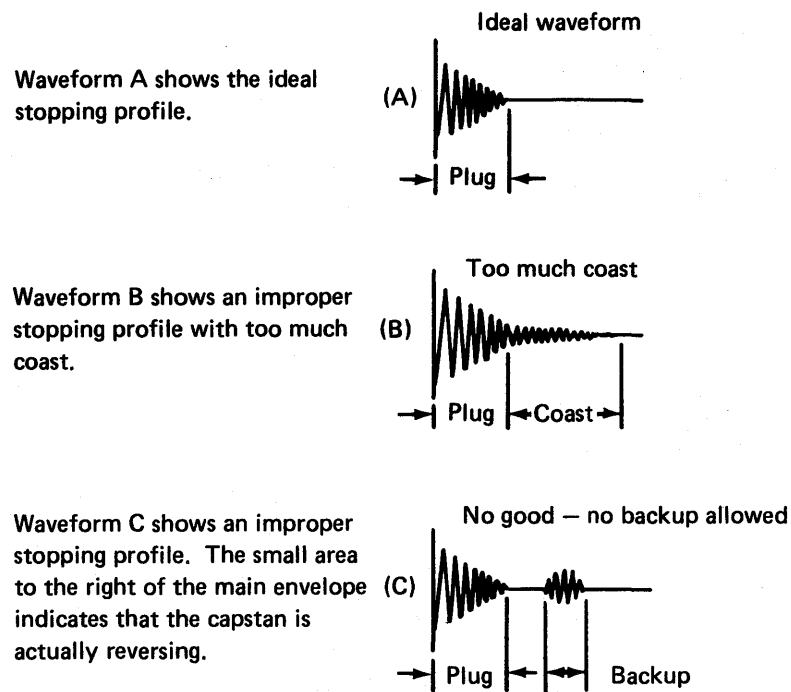


Figure 15. Stop time waveforms

- _____ Step 17. If the waveform displayed is not the same as waveform A, then adjust XA4-R7 to obtain the desired waveform. Some coast is acceptable, but no backup should be observed. If you are in doubt as to the location of R7, consult page 4-123 in the *Control Data Magnetic Tape Transport Field Service Manual*, Pub. No. 49756400.
- _____ Step 18. Using the same TPs, repeat the above procedure for reverse motion.
- _____ Step 19. Rewind the skew tape, and remove it from the tape unit.
- _____ Step 20. Remove power from the tape unit.
- _____ Step 21. Remove the extender card, and place XA4 back in its normal position.
- _____ Step 22. Remove the oscilloscope probes from the tape unit.

BOT Sensor Check

- _____ Step 23. Restore power to the tape transport.
- _____ Step 24. Load a scratch tape. (A scratch tape is a used tape that may be recorded on; it is *not* the skew tape.)
- _____ Step 25. Position the tape with the BOT marker over the BOT/EOT sensor.
- _____ Step 26. Connect the voltmeter (+) to XA3-TP13 and (-) to chassis ground.
- _____ Step 27. Adjust R3 for $4.0 \pm .1$ volts DC. R3 is the bottom potentiometer of the two blue precision potentiometers at the center of the board end facing you on the XA3 board. If these test conditions can't be met, remove the lamp, rotate it 90 degrees, and recheck. Continue this process until you are able to perform the adjustment or until the lamp has been rotated 360 degrees, at which time the lamp is to be discarded and a new lamp installed and checked.
- _____ Step 28. Move the BOT marker off the BOT/EOT sensor, and verify that the voltage drops to less than 1.5 volts DC. The reading should range from .5 – 1 volt DC.
- _____ Step 29. Position the tape with the EOT marker over the BOT/EOT sensor.
- _____ Step 30. Connect the voltmeter (+) to XA3-TP10.
- _____ Step 31. Adjust R8 for $4.0 \pm .1$ volts DC. R8 is the top potentiometer of the two blue precision potentiometers at the center of the XA3 board end facing you. If the reading can't be obtained, the same movement of the lamp is required as in step 27 to complete this measurement.

Tachometer Output Check

- _____ Step 32. Remove the voltmeter from the tape unit.
- _____ Step 33. Rewind the scratch tape to BOT.
- _____ Step 34. Attach the oscilloscope sync probe and the channel A probe both to XA3-TP15.
- _____ Step 35. Set oscilloscope according to table 5.

TABLE 5
Oscilloscope Set-Up

Triggering Mode: AC Triggering Slope: EXT + Volts/CM: .5 Time/CM: .2 ms
--

_____ Step 36. Place switch S1 in the FWD position to activate forward motion.

_____ Step 37. Observe the waveform on the oscilloscope. It should be similar to waveform A of figure 16. This signal is generated by the machine reel tachometer. It provides an indication of tape speed and assists in controlling the velocity of the take-up reel.

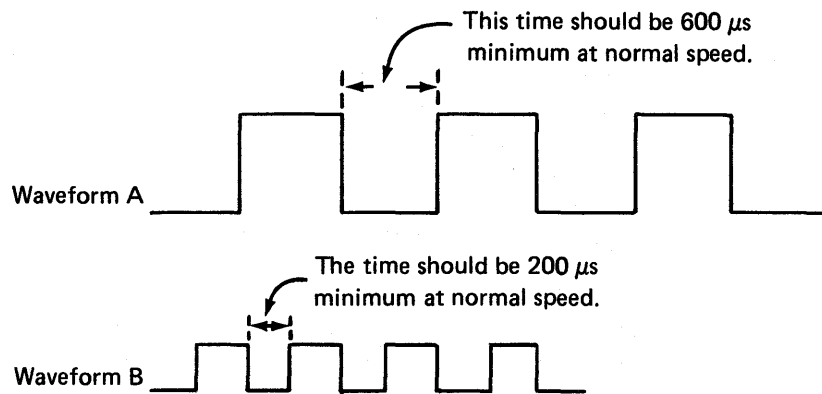


Figure 16. Machine reel tachometer waveforms

_____ Step 38. Place switch S1 in the REW position to activate reverse tape motion.

_____ Step 39. Observe the waveform on the oscilloscope. It should be similar to waveform B of figure 16. As you can see, the time shortened because of the increase in speed in the reverse direction.

_____ Step 40. Rewind the scratch tape so that the tape is out of the feed path, but do not take the spool off the reel hub.

_____ Step 41. Remove power from the tape unit.

_____ Step 42. Remove the oscilloscope probes from the tape unit.

Loop Box Fiber Optics Check

- _____ Step 43. Remove the XA3 card, and put it on the extender board. Then place the extender board back in the circuit.
- _____ Step 44. Restore power to the tape unit.
- _____ Step 45. Connect the negative lead of the voltmeter to a suitable tape unit ground.
- _____ Step 46. Connect the positive lead of the voltmeter to the following test points on the extender card. This checks the sensors of the loop column fiber optics, which control the motion of the tape reels. Each test point should measure 4.0 volts DC minimum. If any of the readings are less than 4.0 volts, a possible cause may be the fiber optics bundle. Move it to a different position, and perform the check again.

<u>TEST POINT</u>	<u>SENSOR</u>
8B	Left Upper Sensor
12B	Left Lower Sensor
8A	Right Upper Sensor
12A	Right Lower Sensor

- _____ Step 47. Load a tape. Observe that each pair of sensor test points should drop to zero when completely covered by tape. 8A, 8B should drop to zero when upper sensor is blocked. 12A, 12B should drop to zero when lower sensor is blocked.
- _____ Step 48. Remove power from magnetic tape unit.
- _____ Step 49. Restore the XA3 card to its normal position without the extender board.

Read Head Digital and Analog Signals

- _____ Step 50. Restore power to the tape unit.
- _____ Step 51. Remove the scratch tape.
- _____ Step 52. Load the master skew tape and advance to BOT.
- _____ Step 53. Connect channel A oscilloscope probe to the first test point listed in table 6 in the digital column.

_____ Step 54. Connect channel B oscilloscope probe to the first test point listed in table 6 in the analog column.

_____ Step 55. Connect the oscilloscope sync probe to the same test points to which the channel B oscilloscope probe is connected.

TABLE 6
Read Head Test Points

Track	Digital Test Point	Analog Test Point
2 ⁰	XA7-TP2	XA8-TP6
2 ¹	XA7-TP3	XA8-TP8
2 ²	XA7-TP5	XA8-TP10
2 ³	XA7-TP7	XA9-TP6
2 ⁴	XA7-TP9	XA9-TP8
2 ⁵	XA7-TP11	XA9-TP10
2 ⁶	XA7-TP13	XA10-TP6
2 ⁷	XA7-TP15	XA10-TP8
2 ^P	XA7-TP17	XA10-TP10

_____ Step 56. Set oscilloscope according to table 7.

TABLE 7
Oscilloscope Set-Up

Triggering Mode: AC Triggering Slope: EXT + Volts/CM – Channel A: .2 Volts/CM – Channel B: .05 Time/CM: 50 μ s Display selected: Alternate

_____ Step 57. Place switch S1 in the FWD position. This will start tape movement. The read head circuitry is also active, even though it is not under control of the computer.

_____ Step 58. As the transport is reading forward, observe the signals displayed. They should be similar to those in figure 17.

Maintenance Procedures

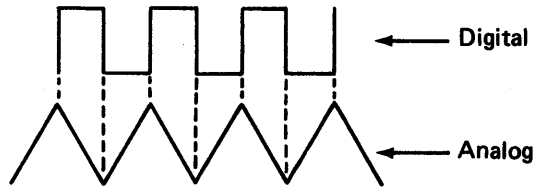


Figure 17. Read head waveforms

- _____ Step 59. Connect the oscilloscope probes to each one of the test points in table 6, and monitor the signals.
- _____ Step 60. Rewind and remove the master skew tape.
- _____ Step 61. Remove power from the tape unit.
- _____ Step 62. Turn all switches to off. Return all materials used to their proper conditions and storage places.

Summary

Describe what you did in this laboratory.

Describe what you learned in this laboratory.

In this laboratory, you performed some of the electrical checks that are required when checking a tape drive for proper operation or when installing a new tape drive. These checks included the tape start and stop, loop sensors, EOT/BOT sensors, and the read head signals. Normally you would perform additional diagnostics from the central processor.

In this laboratory, you should have learned to set up the oscilloscope to measure the tape signals and to adjust the transport for proper operation.

Magnetic Tape Controller FA-107A

FA-107A General Description

In this activity, refer to figure 18 as you listen to the audiotape.

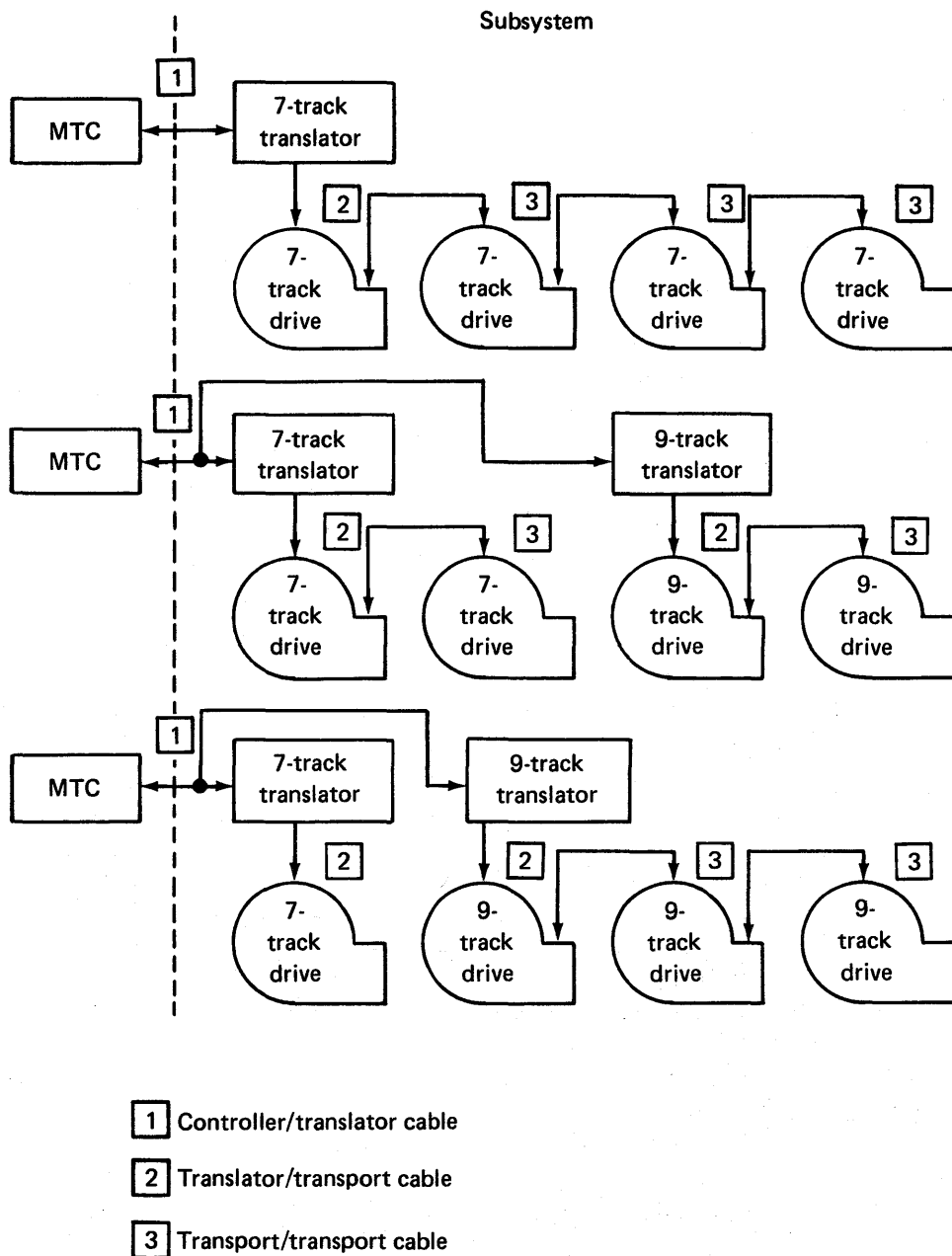


Figure 18. Typical tape subsystems

BW-812 Tape Translator

In this activity, refer to figures 19 through 27 as you listen to the audiotape.

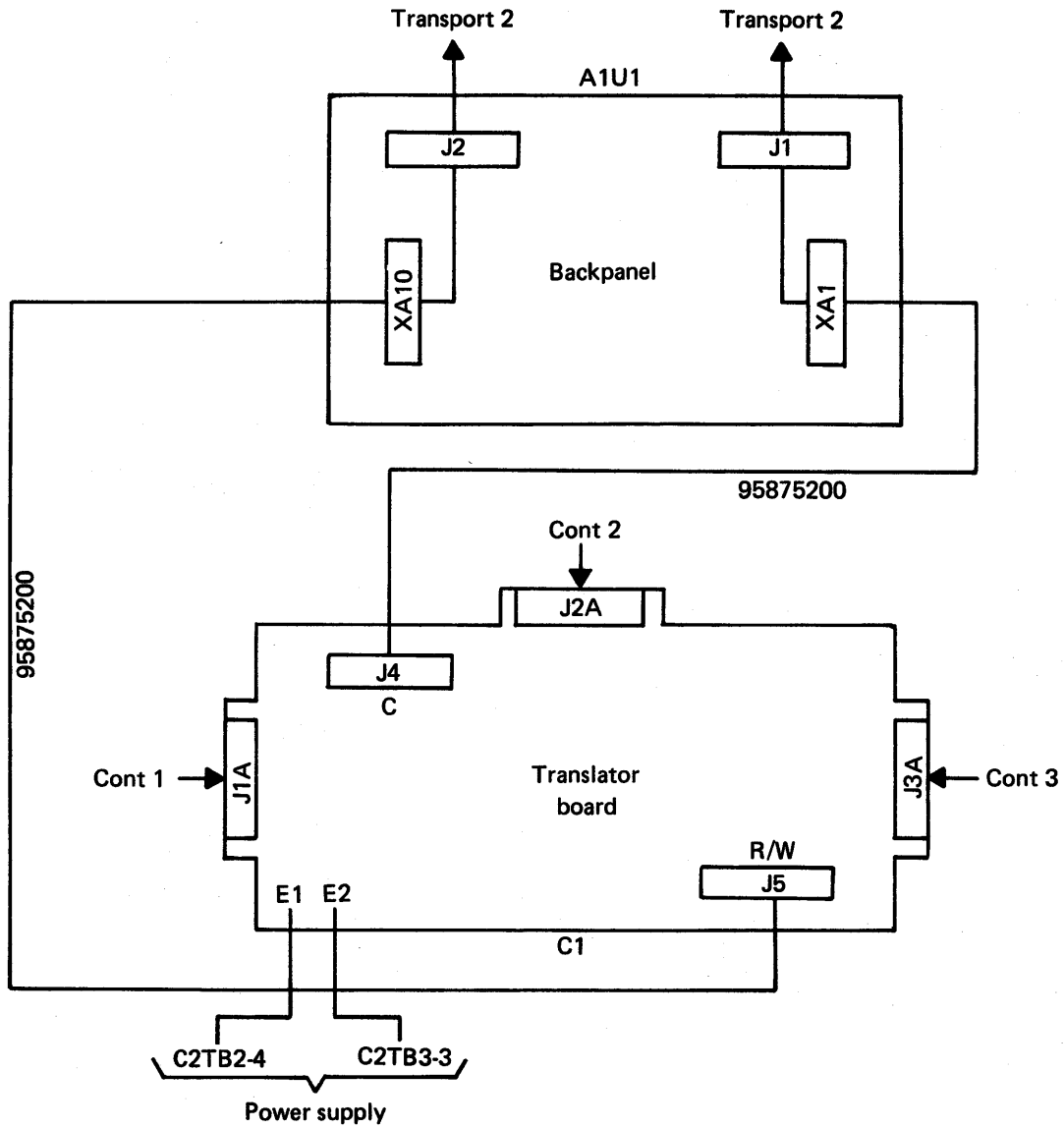


Figure 19. Translator to transport cabling

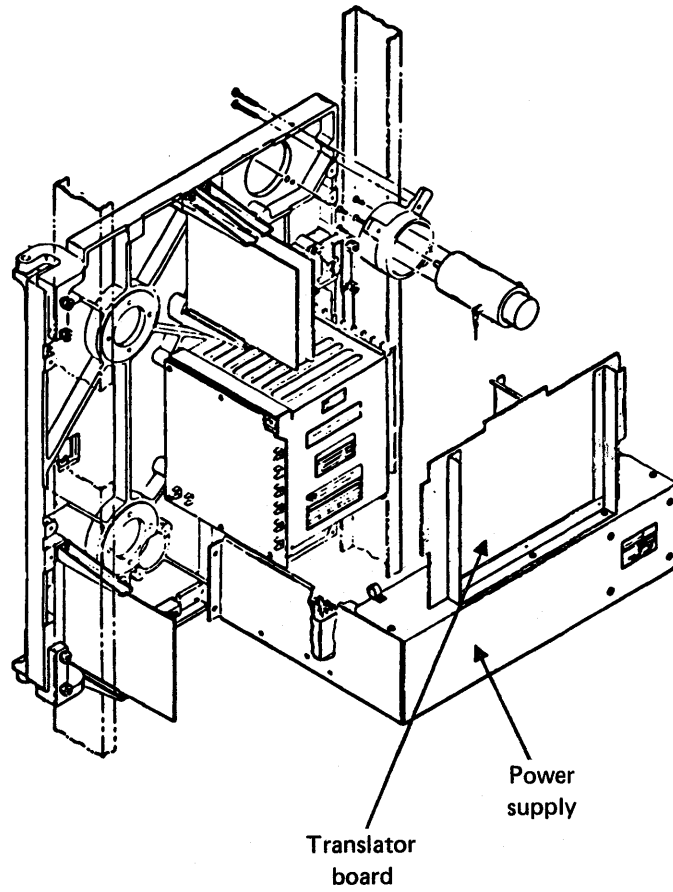


Figure 20. Translator board and power supply

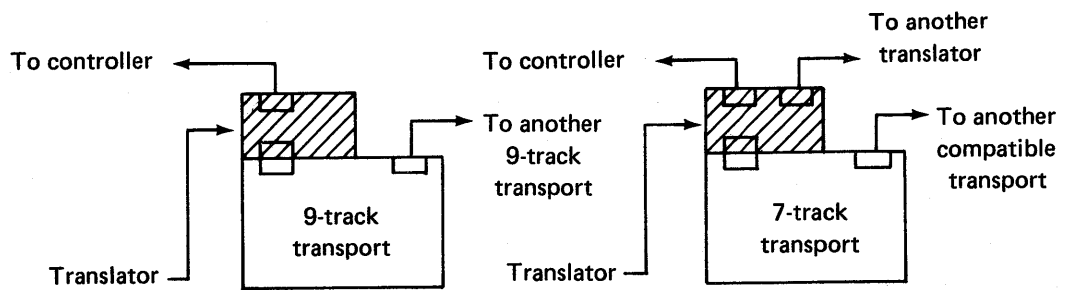


Figure 21. Transport I/O plug configuration with translators

Magnetic Tape Controller

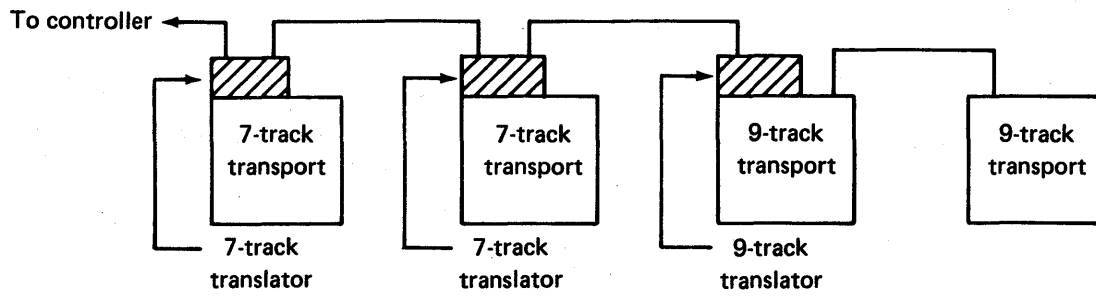


Figure 22. Daisy-chaining a mix of 7-track and 9-track transports

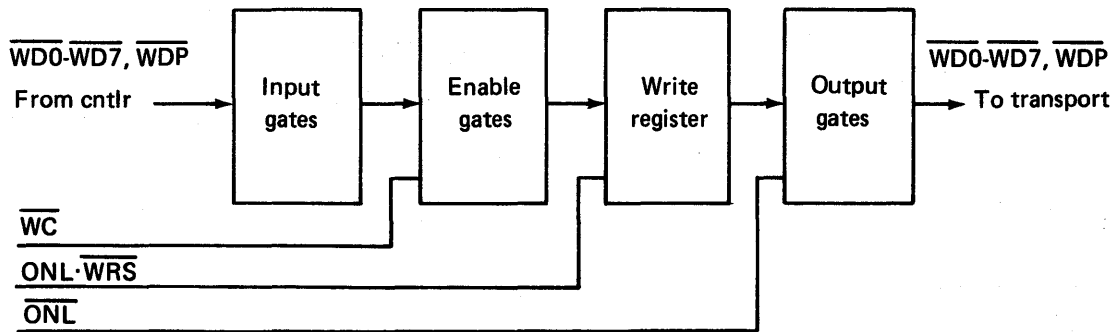


Figure 23. Write data flow

Magnetic Tape Controller

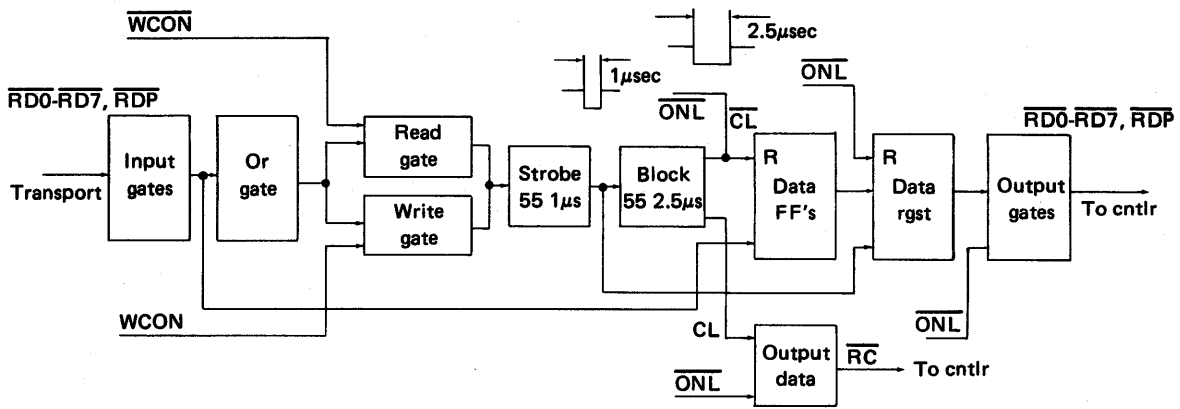


Figure 25. Read data flow

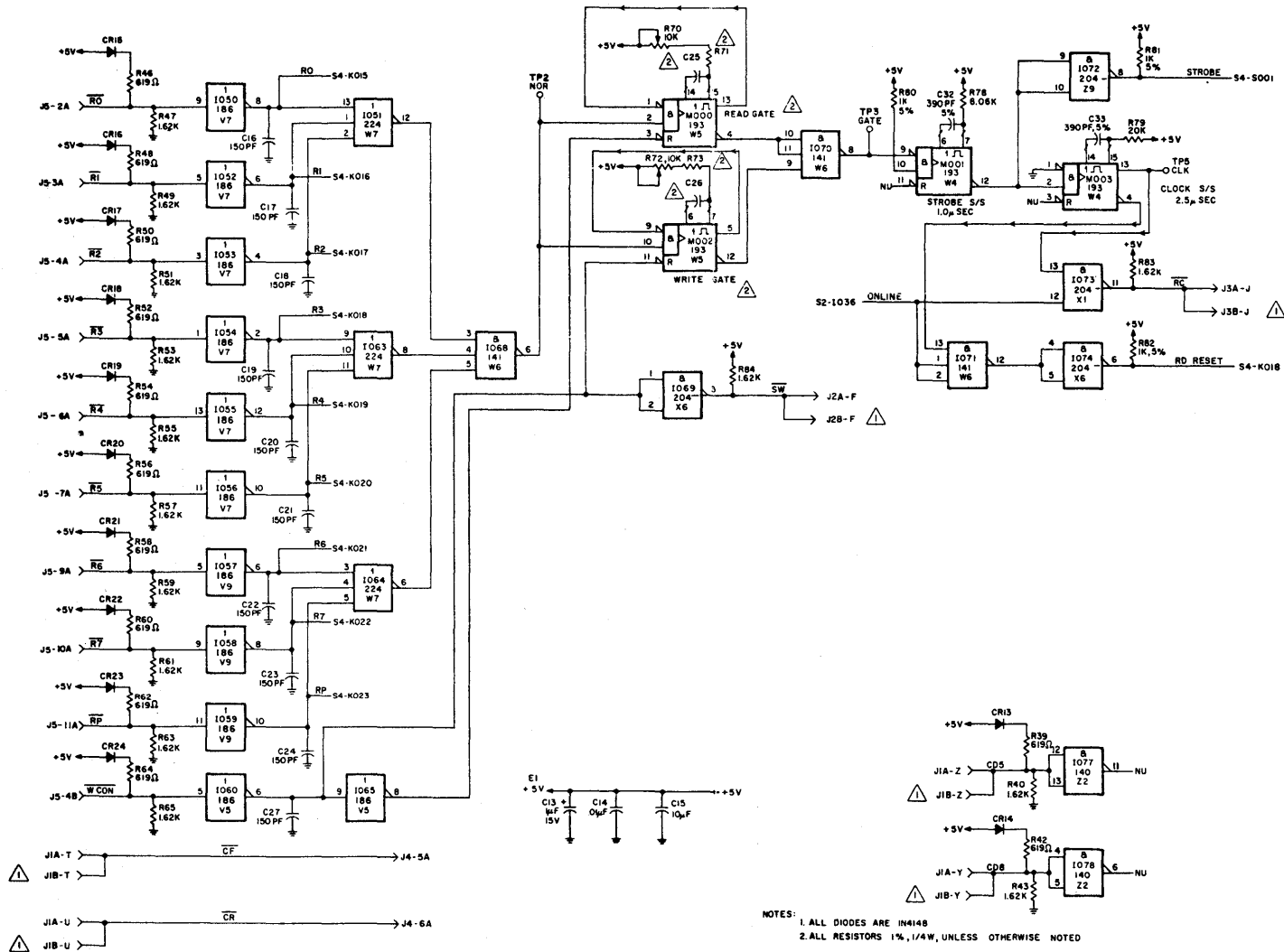


Figure 26. Logic diagram of the read circuitry

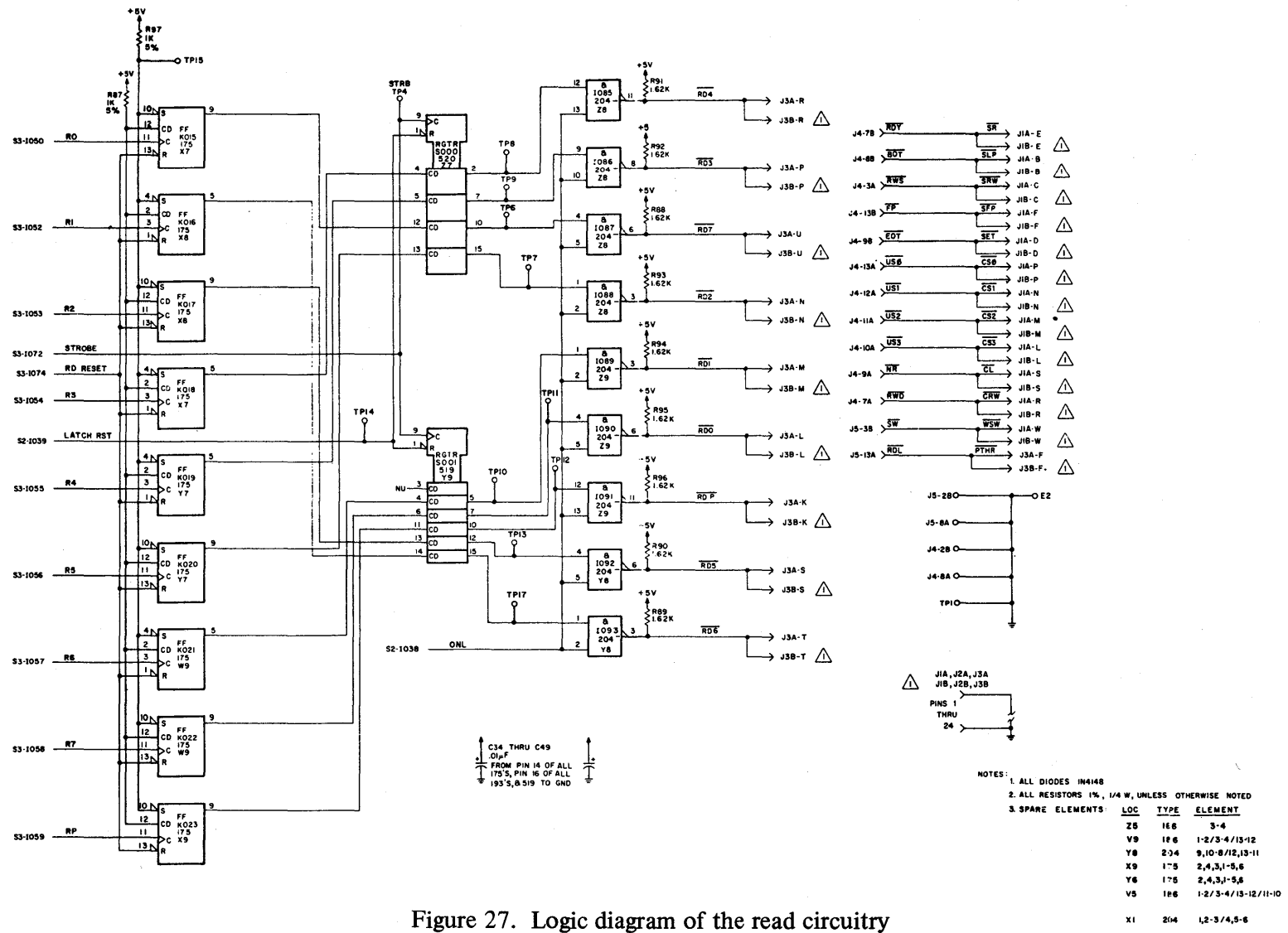


Figure 27. Logic diagram of the read circuitry

TABLE 8
Interface Lines

<u>NAME</u>	<u>DESCRIPTION</u>
SELECT (CS = COMMAND SELECT)	Selects a particular on-line transport from a group connected to a common interface cable.
NOTE: Four (4) individual lines for units 0, 1, 2, and 3 (Signal Level).	
OFF-LINE (CL = COMMAND OFF-LINE) (Signal Level)	Clears the write condition when asserted and terminates the on-line condition of the selected transport. Assertion should be maintained until acknowledged by the negation of the on-line status.
FORWARD (CF = COMMAND FORWARD) (Signal Level)	Causes tape to be driven in the forward direction, providing the transport is selected and ready.
REVERSE (CR = COMMAND REVERSE) (Signal Level)	Clears the write condition when asserted and causes the tape to be driven in the reverse direction, provided that the transport is selected and ready. Load point status inhibits the response to this command.
REWIND (CRW = COMMAND REWIND) (Signal Level)	Clears the write command on the selected transport and initiates a rewind operation provided that the transport is ready, and not at load point. Tape is positioned at load point at the end of this operation. Assertion should be maintained until acknowledged by rewind status. (Minimum 2 microseconds)
HIGH SPEED (CH = COMMAND HIGH SPEED) (Signal Level)	(Not Used)
REMOTE DENSITY SELECT (CD8 and CD 5 = COMMAND DENSITY 800 and 556) (Signal Level)	(Not Used)
SET WRITE (WSW = WRITE SET WRITE) (Signal Level)	The assertion transition of CF causes the WSW line to be sampled following a 20 microsecond maximum delay period.

TABLE 8—Continued

<u>NAME</u>	<u>DESCRIPTION</u>
<p>SET WRITE (WSW = WRITE SET WRITE) (Signal Level) (Continued)</p>	<p>Assertion transition of the WSW line enables the setting of the selected and on-line transport write condition provided the transport is ready and write enabled.</p> <p>Negation of the WSW line enables the clearing of the transport's write condition.</p> <p>The desired logic level of WSW shall be maintained for not less than 20 microseconds after the assertion edge of CF.</p>
<p>WRITE DATA (WD = WRITE DATA) WD0 - WD7, WDP (Signal Level)</p>	<p>These lines receive data to be recorded on tape as a character and must be electrically stable at assertion transition time of write clock and for 2 microseconds minimum, thereafter.</p>
<p>WRITE RESET (WRS = WRITE RESET) (Signal Level)</p>	<p>The assertion transition causes the LRCC character to be written on tape, provided the transport is in the write mode. Assertion must be maintained for a minimum of 2 microseconds.</p>
<p>WRITE CLOCK (WC = WRITE CLOCK) (Signal Pulse)</p>	<p>The assertion transition of this pulse causes the character, represented by the write data lines to be written on tape. The transport must be in the write condition and the assertion of the write clock must be maintained for a minimum of 2 microseconds.</p>
<p>PROGRAMMABLE THRESHOLD (PTHR = PROGRAMMABLE THRESHOLD) (Signal Level)</p>	<p>The assertion of this line causes the transport to read data from the tape at a reduced clipping level.</p>
<p>ON-LINE (SL = STATUS ON-LINE) (Signal Level)</p>	<p>Acknowledges that the selected transport has been manually placed in an on-line condition.</p>
<p>READY (SR = STATUS READY) (Signal Level)</p>	<p>Indicates that the transport is selected on-line, the initial loading sequence is complete and the transport is not rewinding.</p>

TABLE 8—Continued

<u>NAME</u>	<u>DESCRIPTION</u>
LOAD POINT (SLP = STATUS LOAD POINT) (Signal Level)	Indicates that the transport is selected, on-line, and the tape is positioned at the load point reflective strip.
DENSITY STATUS (SD = STATUS DENSITY) NOTE: Three individual lines SD2, SD5, and SD8 (Signal Level)	Indicates the state of Remote Density Select lines (CD5 and CD8), decoded into 200, 556, 800 CPI. Only one density at a time can be asserted from a selected and on-line transport.
REWIND (SRW = REWIND STATUS) (Signal Level)	Indicates that the selected and on-line transport is engaged in a rewind operation. This status remains true until the tape is positioned at the load point reflective strip.
READ DATA (RD = READ DATA) RD0 - RD7, RDP (Signal Level)	These lines transmit detected characters read from the tape and presents them to the interface. The read data lines are settled at the assertion transition time of read clock, and remain settled until 1 μ sec. maximum, before the next read clock.
READ CLOCK (RC = READ CLOCK) (Signal Pulse)	Indicates that a character has been read from tape and is present on the read data lines. Assertion time is 2 μ sec minimum, 3 microseconds maximum.
WRITE STATUS (SW = STATUS WRITE) (Signal Level)	Indicates that the selected transport is write enabled and current is flowing in the write and erase heads.
FILE PROTECT (SFP = STATUS FILE PROTECT) (Signal Level)	Indicates that the selected and on-line transport is not write enabled (write ring is not present in the file reel).

Introduction to the Storage Module Drive

Assembly Component Location

The Control Data storage module drives are high-speed, random-access, digital storage devices that connect to a central processor through a controller. The major differences among drives are in their storage capacities and configurations. Three configurations are illustrated in this activity, which introduces some of the component functions and locations of the SMD drive.

Configurations

One model has a drive on top, called top mounted drive (see figure 28).

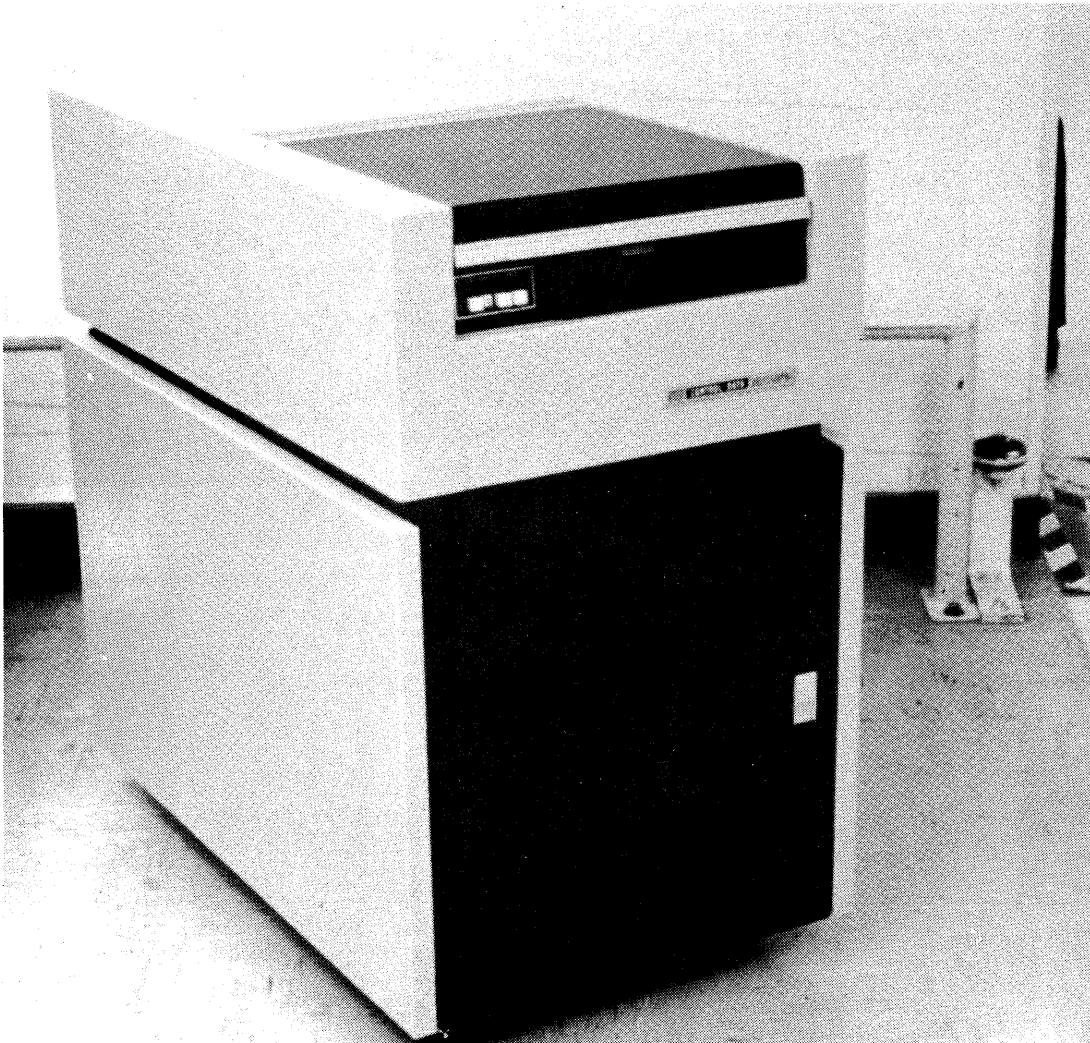


Figure 28. Top mounted drive

Another model has a drawer mounted drive. The drawer mounted unit slides out for convenient access (see figure 29).

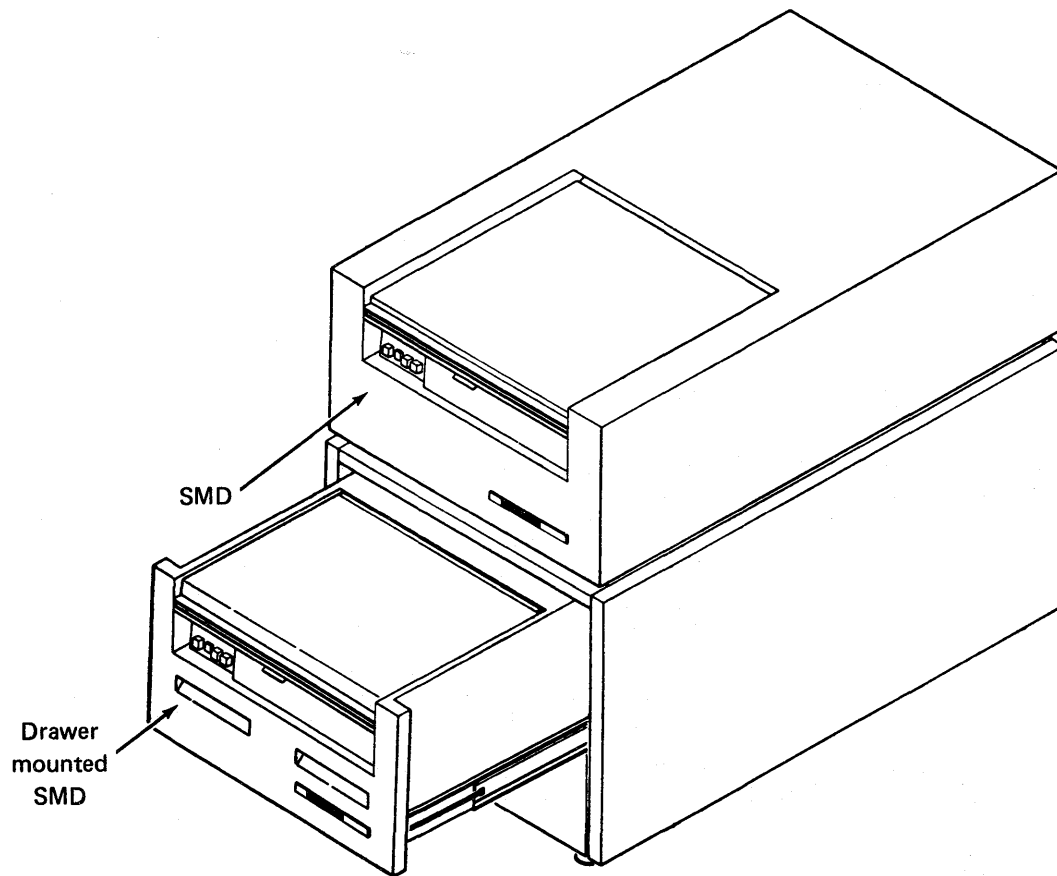


Figure 29. Cabinet with top and drawer mounted drives

A third model, drawer mounted drive (see figure 30), does not use the basic cabinet as do the other models. It is designed to be placed on cabinets or other types of supporting bases.

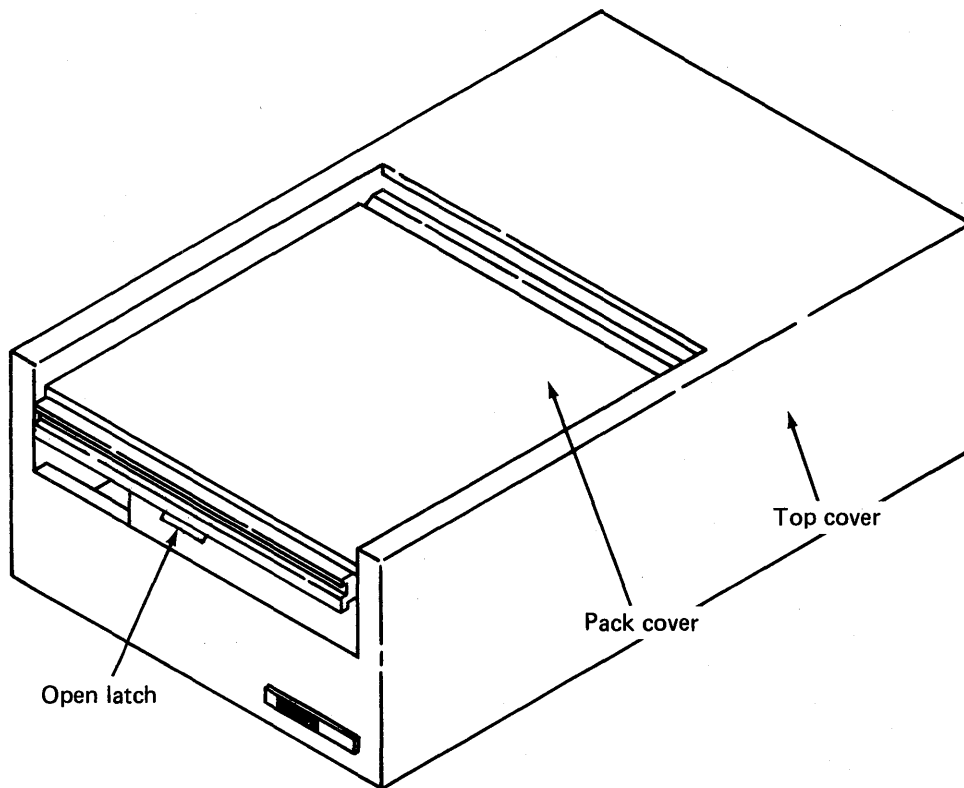


Figure 30. Drawer mounted drive

Assembly Locations

Top Cover

The top cover assembly (see figure 30) protects drive assemblies during operation. It consists of two parts. The top cover, or drive cover, is opened for pack loading by releasing the latch under its cover. When the cover is opened, power to the drive motor is disabled, thus stopping the spindle assembly from turning.

Spindle Assembly

The spindle assembly holds and rotates the disk pack, as shown in figure 31. When a disk pack is installed and the cover is closed, the drive motor keeps the pack turning continuously.

Read/Write Heads

The read/write heads (see figure 31) both read and write data to disk. These heads are controlled by a servo mechanism and actuator unit.

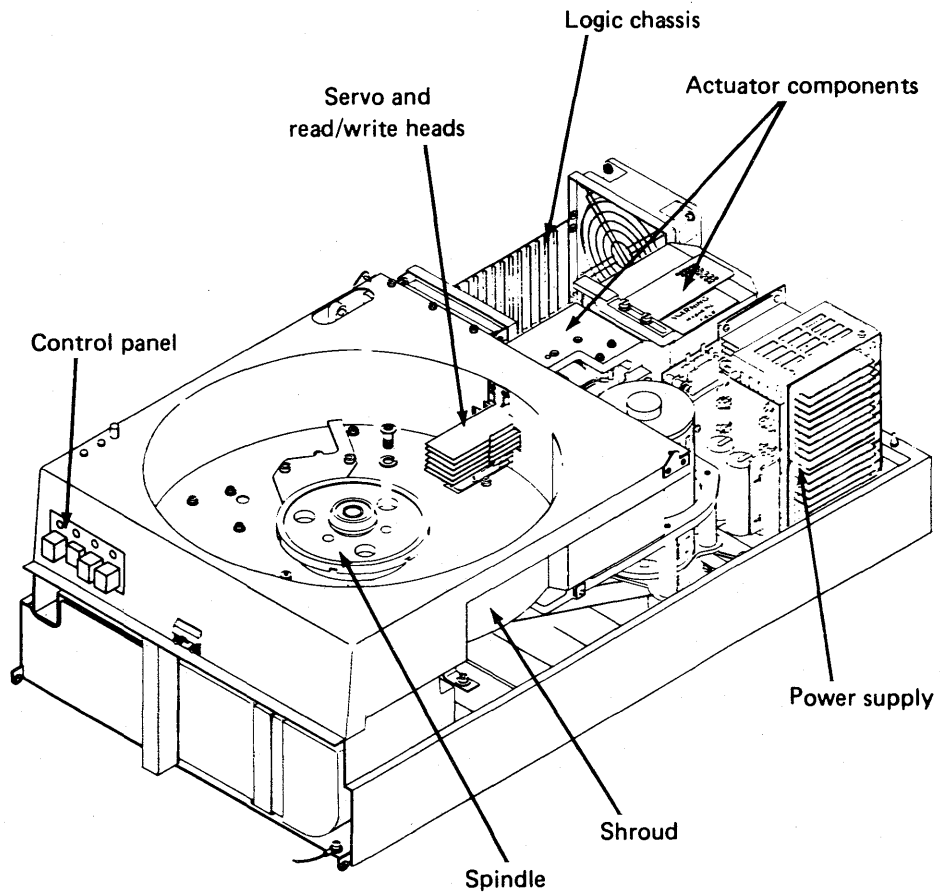


Figure 31. Assembly locations

Actuator Unit

The actuator unit (see figure 32) consists of a magnet assembly, rail bracket assembly, head-arm assembly, head cam and coil, and a carriage.

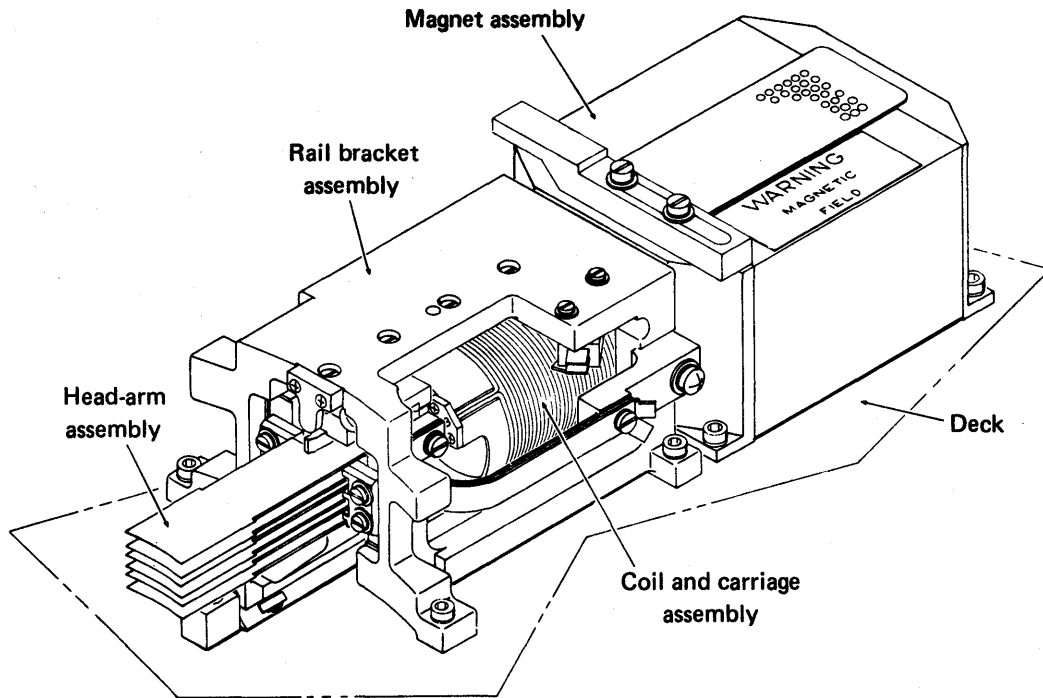


Figure 32. Actuator unit (with heads extended)

Actuator Pre-Amp Board

Most of the power circuit controls for the actuator are contained in a servo pre-amp board near the back of the drive (see figure 33).

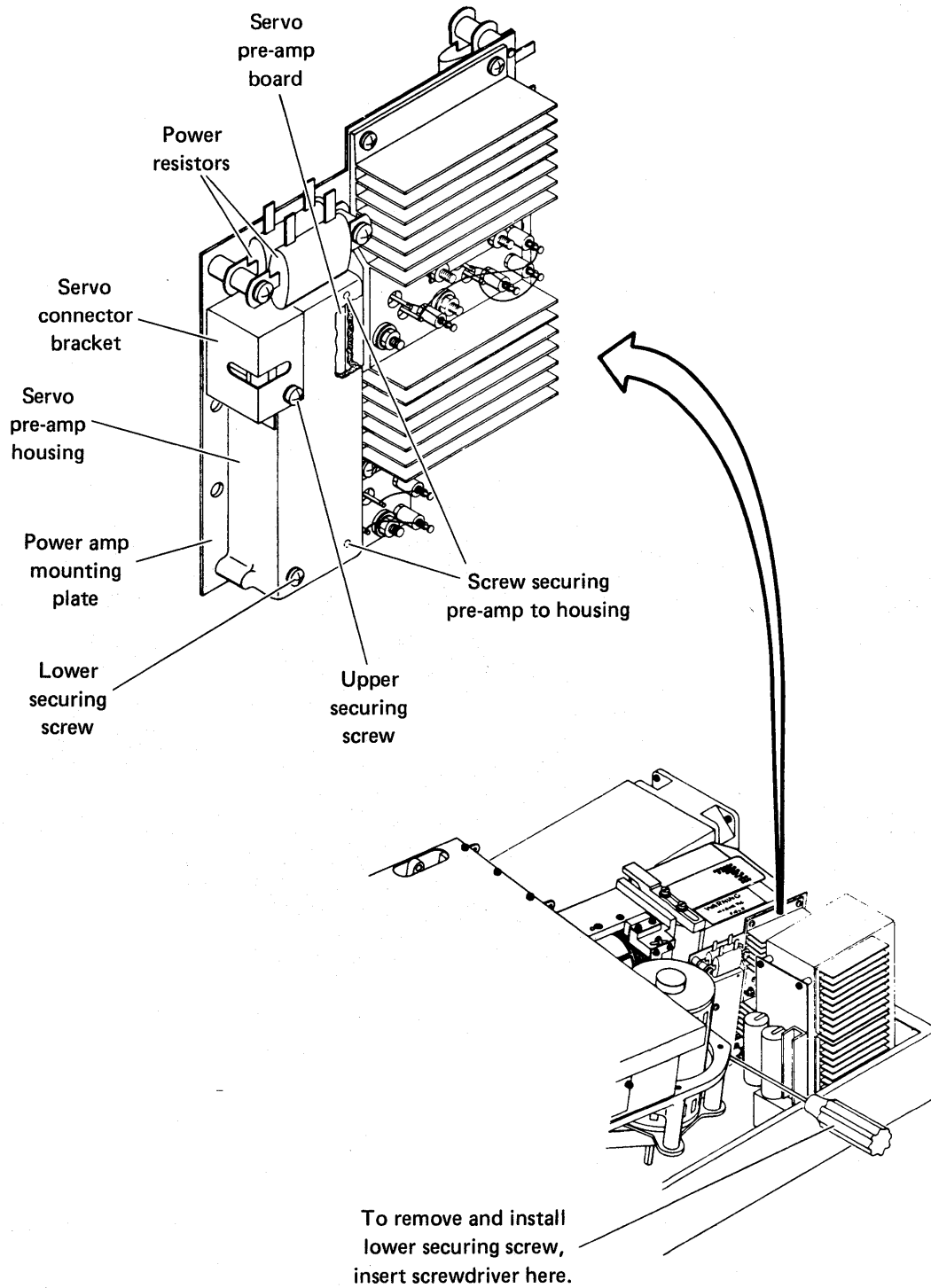


Figure 33. Actuator pre-amp board

Logic Chassis

The logic chassis serves as the mounting point for the logic cards (see figure 34). Here the logic chassis is pivoted to an upright position for convenient insertion and removal of cards.

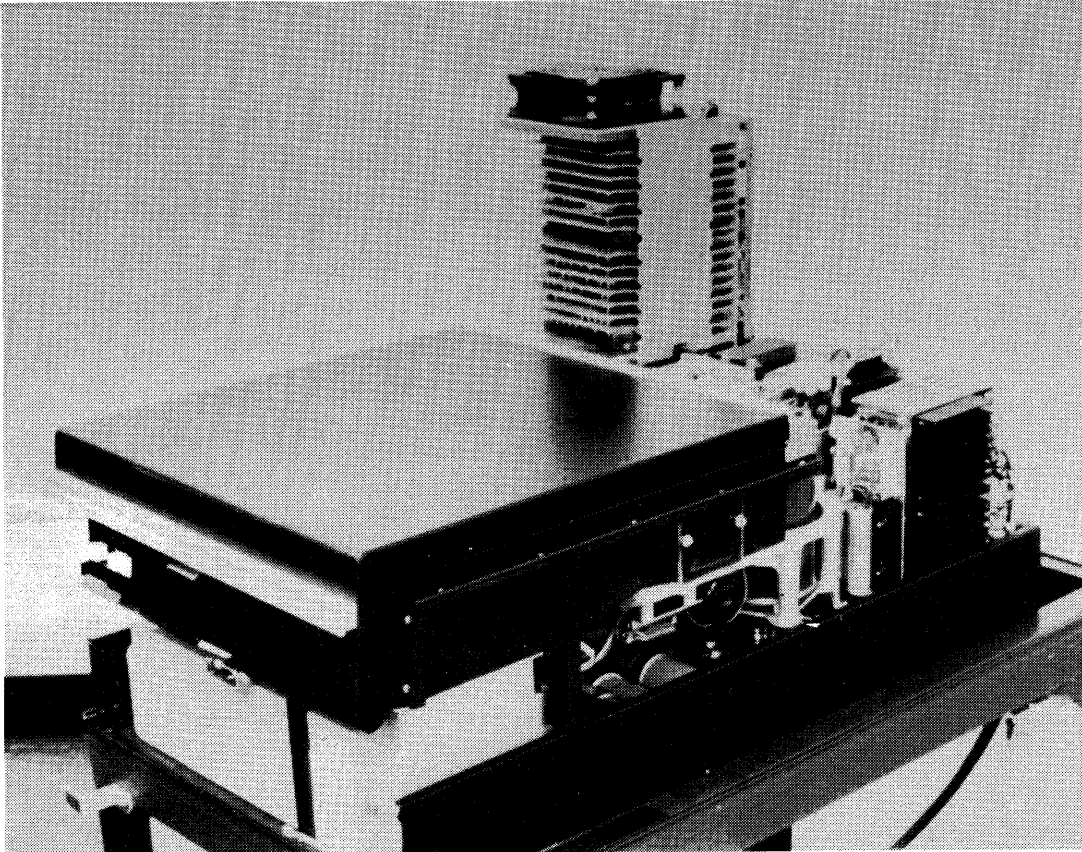


Figure 34. Logic chassis

Circuit Connectors

Circuit connectors are easily seen from the rear of the drive. These connectors are used to connect circuit voltages, logic signals and communication lines (via coax cables) to the drive.

CAUTION: Use extreme care when raising and lowering the logic chassis to make sure these connectors do not come loose. If they do, there is a possibility of the heads “crashing” and becoming severely damaged. With loose connectors, the electrical protective circuits do not function properly in slowing down the heads before they reach their extreme limits of movement (see figure 35).

Power Supply

The power supply is also located at the rear of the drive (see figure 35). Its purpose is to distribute all AC and DC power to the drive. Also note the power ON/OFF switches and hour meter.

Air Flow System

The air flow system provides ventilation and cooling air for the drive (see figure 36).

- A. The system intake is located beneath the cabinet and is filtered by the primary filter to prevent large particles from entering the system.
- B. After air is first filtered, it moves up to cool the drive.
- C. The air entering the mechanical drive area is filtered by the absolute filter, which takes out any particles that might be harmful to the drive or disk mechanisms.
- D. The blower applies positive pressure to the pack area. This provides upward dispersion of air toward the drive cover opening when it is opened to prevent outside (unfiltered) air from entering the pack area.
- E. Air flows over the logic cards and the power supply component, and is exhausted at the upper rear of the machine by exhaust fans.

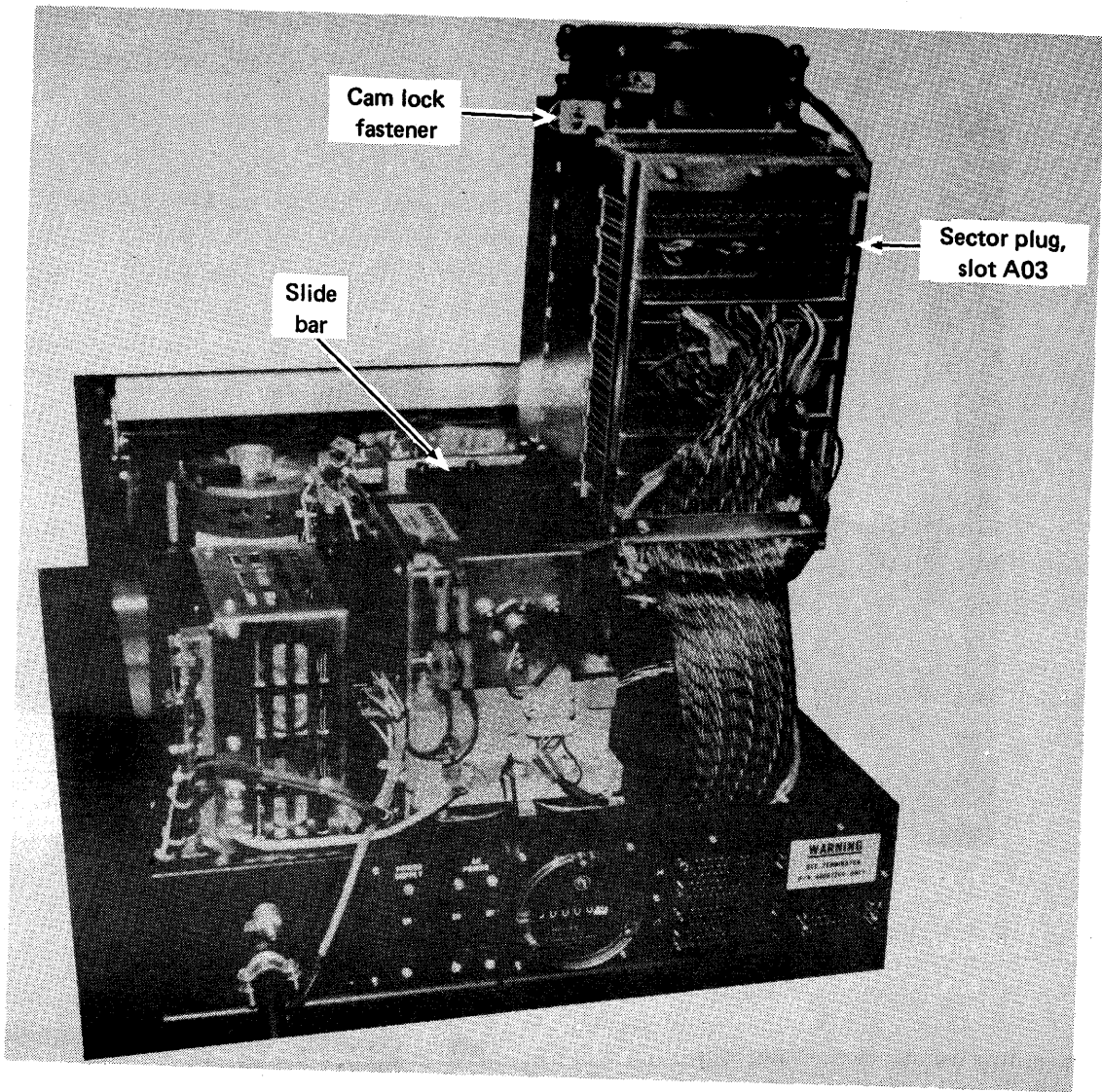


Figure 35. Logic chassis connectors

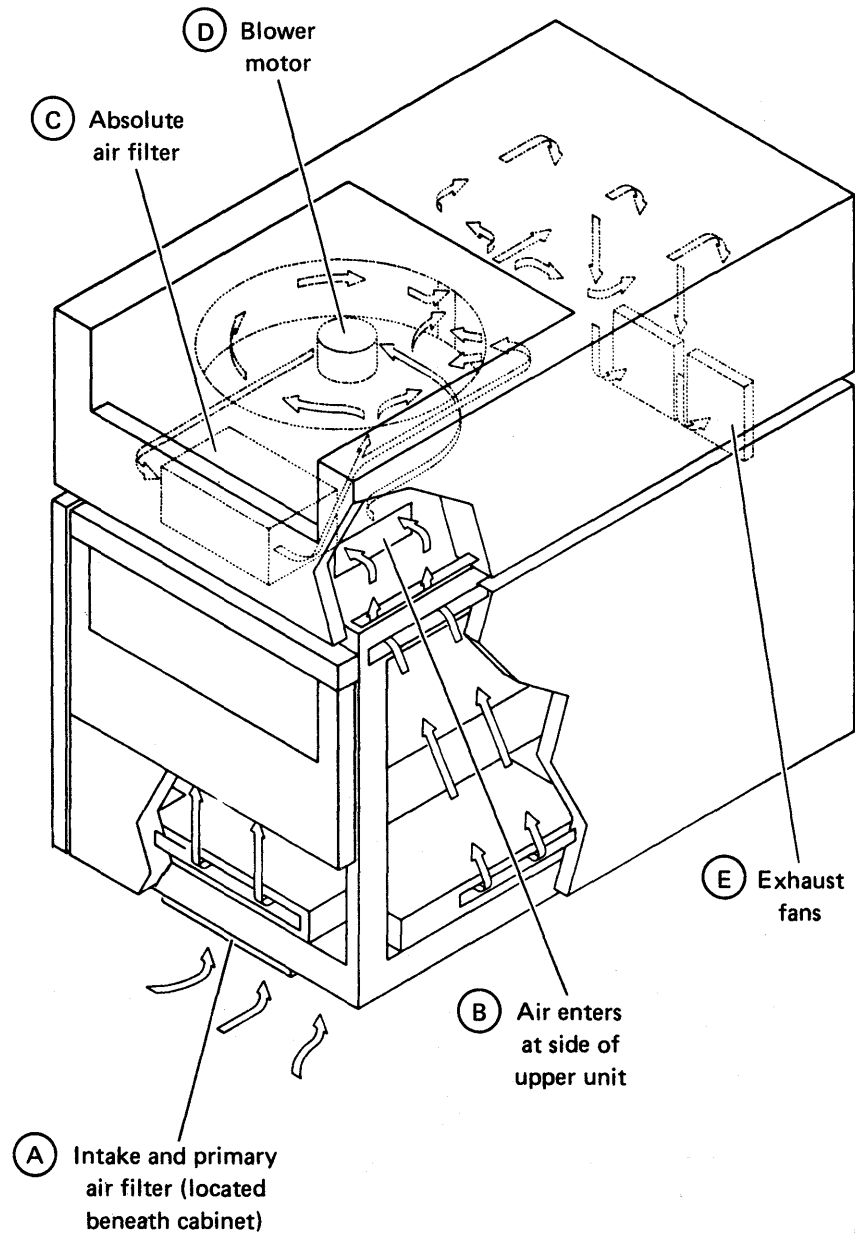


Figure 36. Air flow system diagram

Familiarization

Component Location Lab

Introduction

In this activity, you will locate and identify major components of a storage module drive. As you progress through this activity, write the correct letters and words in the blanks provided. Use this write-up as a guide for opening the case of the SMD.

Reference Materials

Control Data SMD Hardware Maintenance Manual, Pub. No. 83311300

Tools

No special tools are required.

Lab Procedures

1. Review Safety Precautions

Before attempting to locate components on the SMD, read the following safety precautions. **PAY SPECIAL ATTENTION TO THE WARNING TO KEEP ALL WATCHES, DISK PACKS, METERS AND OTHER TEST EQUIPMENT AT LEAST TWO FEET AWAY FROM THE VOICE COIL MAGNET (toward rear of SMD) WHEN CASE ASSEMBLY IS RAISED.** The strong magnetic field may damage your watch if it gets within two feet of the magnet.

Safety Precautions

Observe the following safety precautions at all times. Failure to do so may cause equipment damage and/or personal injury.

- Use care while working with power system. Line AC voltages are present at AITB1.
- Keep hands away from actuator during seek operations and when reconnecting leads to voice coil. (Under certain conditions, emergency retract voltage may be present, causing sudden reverse motion and head unloading.)
- When performing head alignment, utilize the carriage locking pin to prevent personal injury.
- Use caution while working near heads. Because fingerprints can damage them, clean heads immediately if they are touched.
- Keep pack access cover closed unless it must be open for maintenance. This prevents the entrance of dust into the pack area.

Familiarization

- Keep all watches, disk packs, meters and other test equipment at least two feet away from voice coil magnet when case assembly is raised.
- Use scratch pack, not data pack, for maintenance procedures; otherwise, customer data may be destroyed.
- Do not use CE alignment disk pack unless specifically directed to do so. These packs contain prerecorded alignment data that may be destroyed if test procedure requires drive to write. This alignment data cannot be generated in the field.
- Install deck rear holddown screw and spacer before raising deck assembly and installing support bracket. Remove screw and spacer and install in keeper hole (in back of deck) after deck assembly is back in operating position.
- Do not remove any logic card without first turning POWER SUPPLY circuit breaker off.
- If power to spindle motor is lost while heads are loaded and voice coil leadwire is disconnected, immediately retract carriage manually. Otherwise, heads will crash when disk speed is insufficient to permit heads to fly.
- If drive fails to power-down when START switch is pressed, disconnect black voice coil leadwire and manually retract carriage before troubleshooting malfunction.

2. Raise Case Assembly and Pack Cover

Raise

The case assembly is hinged at the front of the drive and opens from the rear. Refer to figure 37.

1. Depress two push release catches and lift case assembly slightly.
2. Swing out case door to obtain clearance for logic chassis fan.
3. Lift case assembly (approximately 110 degrees) until case assembly stops and is supported by support arms. (In older units, a top cover support rod must be installed.)

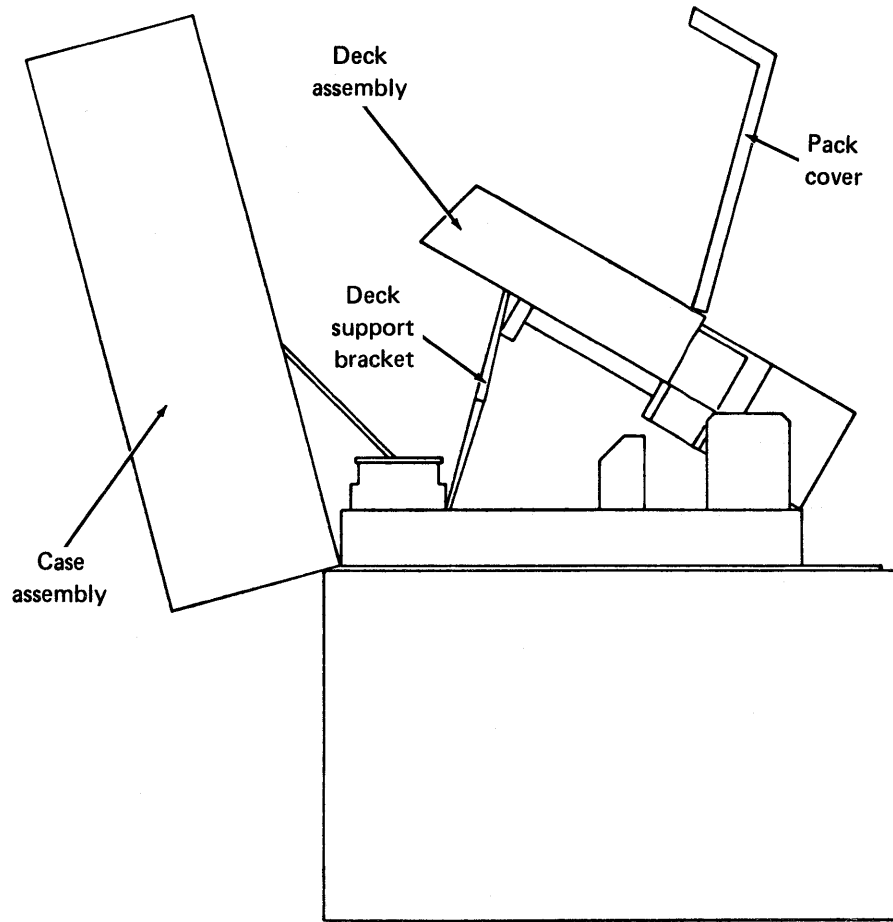


Figure 37. Drive maintenance position
(S/C 17 and Abv)

NOTE: To raise the deck assembly read pages 3-5 and 3-8 in the reference manual.

Familiarization

3. Identify Components

Identify the following assemblies by matching the letters in figure 38 with the names on this list.

- _____ 1. Logic chassis fan
- _____ 2. Pre-amp and power amp
- _____ 3. Blower shroud (Blower inside)
- _____ 4. Magnet
- _____ 5. Shroud
- _____ 6. Servo and read/write heads
- _____ 7. Speed sensor
- _____ 8. Velocity transducer
- _____ 9. Hysteresis brake
- _____ 10. Control panel
- _____ 11. Carriage and voice coil
- _____ 12. Drive motor
- _____ 13. Spindle
- _____ 14. Power supply
- _____ 15. Logic chassis
- _____ 16. Rail bracket
- _____ 17. Spindle lock plate

Lower the case assembly after you have located all components.

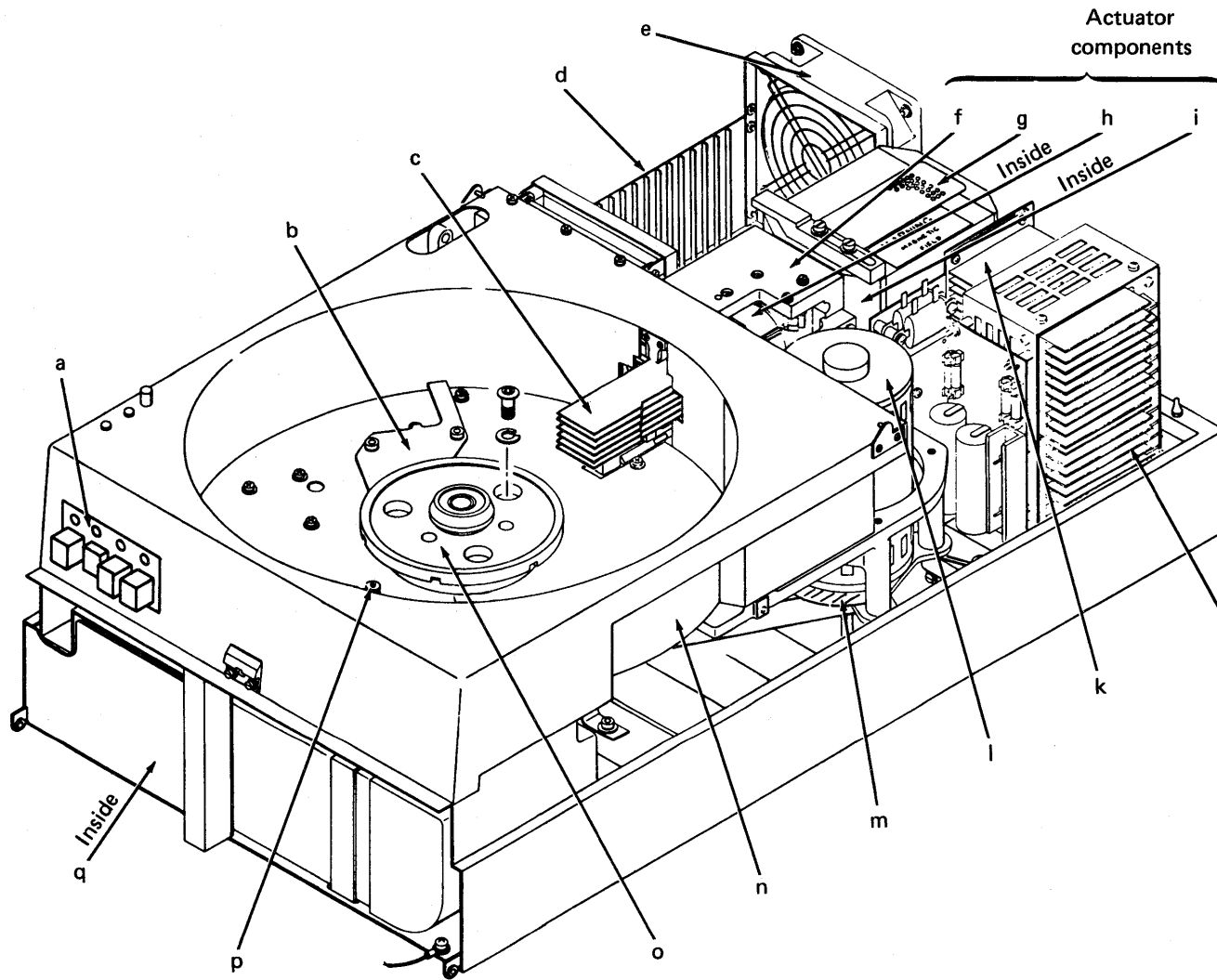


Figure 38. Electromechanical assemblies

Familiarization

Lower

1. Lower case assembly until case door is about to contact logic chassis fan. (In older units, a top cover support rod must be removed.)
2. Swing out case door to obtain clearance for logic chassis fan.
3. Continue to lower case assembly until case door clears logic chassis fan.
4. Push case door to closed position.
5. Push top of case assembly until two push release catches secure case assembly to frame.

4. Identify Functions

DIRECTIONS: Supply the correct answer(s) for each of the following items.

1. The four control panel indicators are _____ , _____

_____.
2. The purpose of the _____ switch is to enable or disable the write driver.
3. What happens when a loss of spindle motor speed occurs?

4. What holds the disk pack in place? _____
5. A head arm consists of what four components? _____ ,

_____ , _____ , and _____
_____ .
6. The deck assembly contains two transducers: a _____
transducer and a _____ transducer.

Component Location Lab

7. Head assemblies are said to _____ when the disk spins and the heads are loaded.
8. What causes the voice coil positioner to move? _____
9. What logic cards are not located in the logic card chassis?
_____ and _____
10. Where is the maintenance panel located? _____
11. What component senses carriage motion? _____
12. How is air that enters the SMD filtered? _____
13. How many disks are on the SMD disk pack? _____
14. The ground spring is used to do what? _____
15. In which direction does the disk pack rotate? _____

Familiarization

ANSWER KEY

Section 3 – Identify Components

1. e 2. k 3. q 4. g 5. n 6. c 7. p 8. i
9. m 10. a 11. h 12. l 13. o 14. j 15. d
16. f 17. b

Section 4 – Identify Functions

1. START, READY, FAULT, PROTECT 2. PROTECT 3. Emergency
retract 4. Spindle assembly 5. Head load spring, head, cam surface, rigid
arm 6. speed sensing, velocity 7. fly 8. EMF 9. Write, Analog
10. Back of control panel 11. Velocity transducer 12. Absolute filter
13. Five 14. Bleed off static electricity 15. CCW

Operating the Storage Module Drive

Introduction

In this activity, you will turn on, load, unload and turn off a storage module drive. Follow the instructions in the *CDC SMD Hardware Reference Manual*.

Reference Materials

CDC SMD Hardware Reference Manual, Pub. No. 83322200

Tools

Scratch disk pack

Lab Procedures

Follow the manual instructions on pages 2-1 through 2-5 to:

1. Load
2. Power-up
3. Power-down
4. Unload

Read/Write Circuitry

Read/Write Operations (SMD)

DIRECTIONS: Complete the statements, and answer the questions that follow.

1. The current necessary to do a write in the disk pack comes from the _____ .
2. How many heads can be selected at one time? _____
3. What kind of condition exists when more than one head is selected? _____
4. Name two advantages of MFM recordings.

5. The result of interaction between flux changes when writing on a pack is called _____ .
6. A sine wave on a disk pack is written in _____ .
7. The 9.67 MHz is generated by the _____ .
8. Compensated MFM data is used for _____ .
9. The read analog-to-digital converter uses high and low resolution channels for what purpose? _____
10. What is the purpose of the low pass filter on the preamplifier? _____
11. The missing address on a disk pack constitutes a(n) _____ .
12. What are the pattern decode registers used for? _____
13. MFM data is written _____ on the disk pack as analog signals.

Read/Write Circuitry

ANSWER KEY

1. write driver circuits
2. One
3. Fault
4. Fewer flux reversals, head operation efficiency
5. peak shift
6. analog
7. dibits
8. peak shift
9. Detect zero crossover
10. Alternate high frequency noise
11. address mark
12. To convert NRZ to MFM data
13. serially

Preventive Maintenance

Preventive Maintenance Lab

Introduction

In this activity, you will perform some basic preventive maintenance activities. Follow the instructions in the SMD maintenance manual. With some activities, particularly those pertaining to lubrication and filter coat, it may not be necessary for you to actually perform the operation. Rather, just familiarize yourself with the procedure.

Reference Materials

Control Data SMD Hardware Maintenance Manual, Pub. No. 83311300

Tools

Filter coat, CDC Part No. 12210958

Lint-free cloth, CDC Part No. 12209713

Lubricant paste, CDC Part No. 95016101

Media cleaning solution, CDC Part No. 95033502

Adhesive tape

Small, hard bristle brush

Deck support bracket (if SMD is SN16 or below), CDC Part No. 87073000

Lab Procedures

Follow the maintenance manual instructions on pages 2-1 through 2-4, 3-11, and 3-57 in order to:

1. Inspect actuator assembly.
2. Clean primary filter.
3. Clean shroud and spindle.
4. Clean and lubricate lockshaft.
5. Clean carriage rails and bearings (to raise the deck, read pages 3-5 and 3-8).

SMD Review

This activity reviews the SMD servo system, which controls the head positioning mechanism. It reviews terminology introduced in previous activities and describes the application of the disk servo surface, magnetic patterns on the disk surface, waveforms for dibit signals, and the operation of the servo surface in establishing data tracks on the disk surface.

Introduction

The servo system is responsible for providing the majority of the timing for the disk drive, in addition to providing the signals necessary to control a seek operation and to provide error detection.

Read each of the following frames, and answer the question. Check your answer with the one provided, before going on to the next frame.

Data Surface Layout

1. The data surfaces in the disk pack of the SMD are similar in many ways to any typical disk surface. The actual layout of one of these surfaces is described in the following frames.

Looking down from the top of a recording surface, as in figure 39, you may recall some of the terms that are applicable. For example, the recordable surface beneath one head at any given time is known as a _____.

track

2. The recordable surface beneath all heads at any given time, or the amount of recordable surface without repositioning the heads, is known as a _____.

cylinder

3. Tracks on a data surface form concentric circles; they do not spiral toward the center, as do the tracks of a phonograph record. _____ (True/False)

true

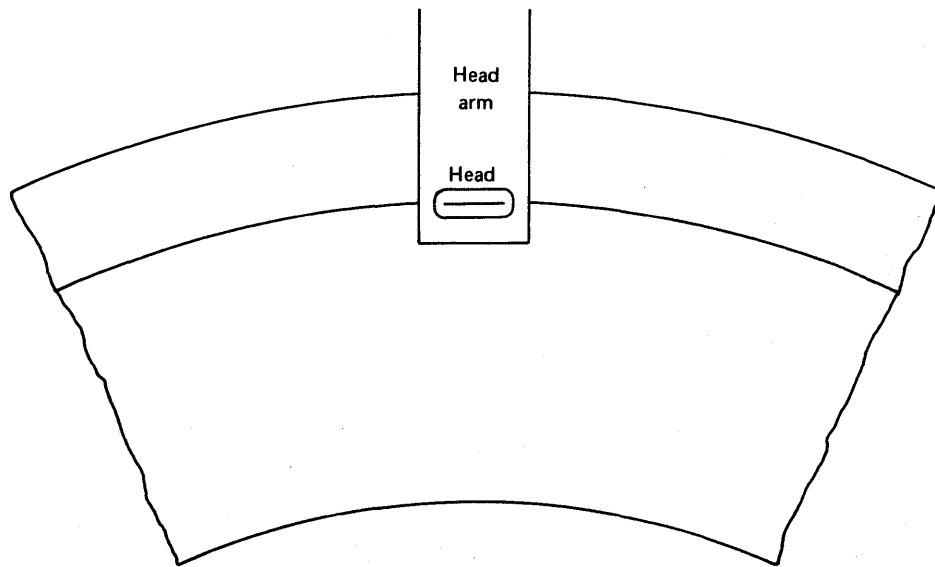


Figure 39. Top view of the disk surface

4. A disk pack for an SMD has _____ data recording surface(s).

5

5. Now refer to figure 40. The actual recordable area on the surface of these disks is about two inches. Squeezed into the space of these two inches are 823₍₁₀₎ data tracks. The spacing between these tracks is extremely close, with only .0026 inches between them. The tracks are numbered from 0 through 822₍₁₀₎ starting at the outer edge.

The SMD uses a disk pack with a total of _____ cylinders.

823

Preventive Maintenance

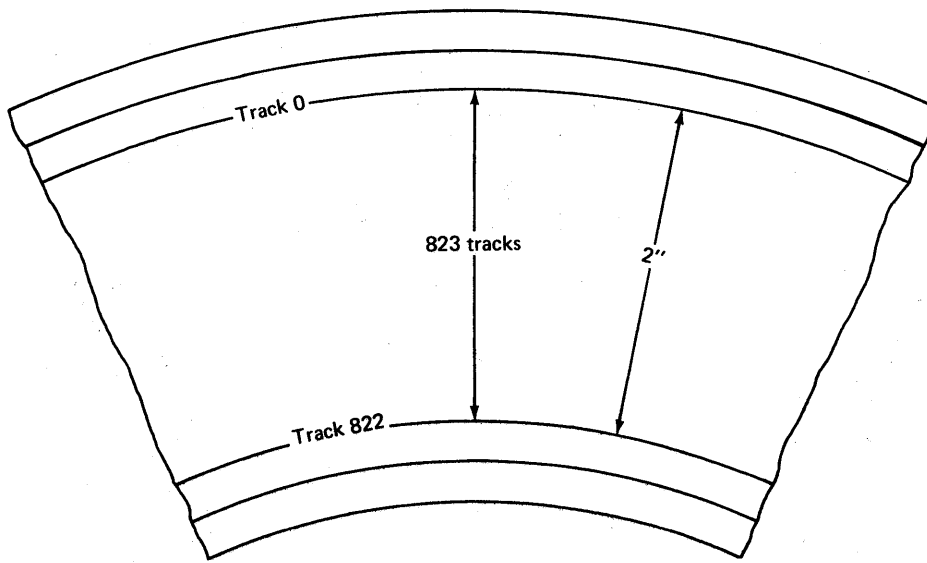


Figure 40. The recordable area of the disk surface

6. Each surface has a total of _____ tracks.

823

7. Each cylinder is made up of a total of _____ surfaces.

5

8. Refer now to figure 41. The surface shown has space allocated for things other than data. The outer edge of the disk has space reserved for the heads to land, or more properly, to load, since they do not physically touch the surface. This space is wide enough for the pad which surrounds the actual data head. The head pad is aerodynamically designed to fly above the surface on the thin film of air which is developed by the rotating surface. The pad must be fully over the surface to ensure that enough of the aerodynamic surface is available to safely fly the head. Since the head pad is quite large, it prevents this area on the outer edge of the disk from being used for recording.

The heads must have space to _____, since they are unloaded (retracted) for removal and installation of the disk pack.

load

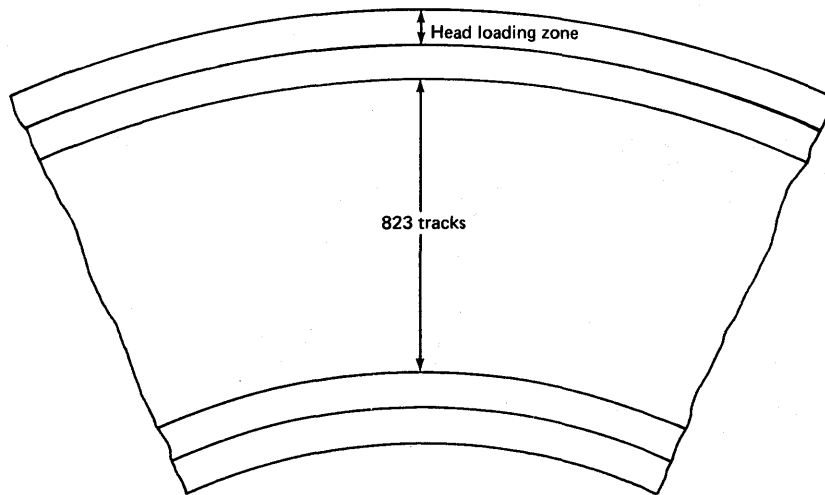


Figure 41. Head loading zone

9. Refer to figure 42. The area shown here, between the head loading zone and the data tracks, is called the outer guard band area. The actual outer guard band is a specially recorded area located only on the *servo* surface and results in a void space on each *data* surface. It is used basically for timing purposes and as an indication of reverse end of travel for the positioner. It consists of a space that is equivalent to 24 tracks.

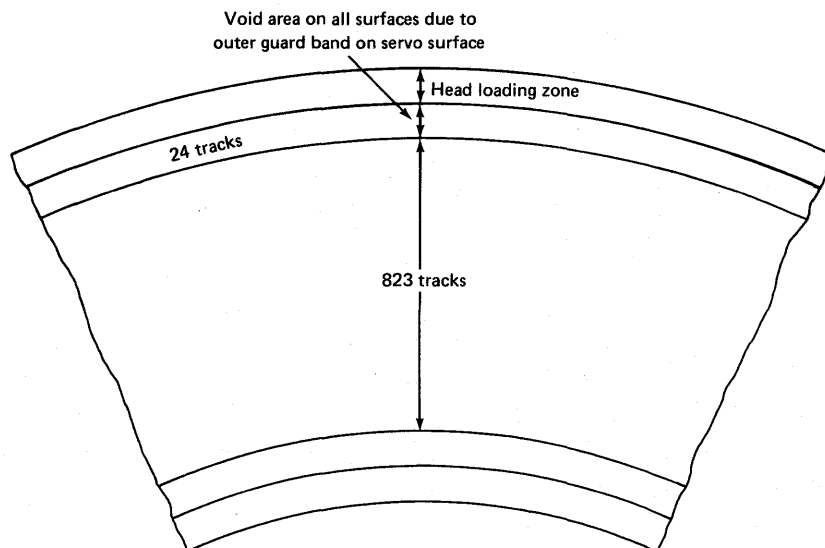


Figure 42. Outer guard band

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A special area on the inside of the surface is also set aside as a guard band area as shown in figure 43. This area is known as the inner guard band and is equivalent to 36 tracks wide.

The outer guard band is used to determine reverse end of travel; the inner guard band is used to determine forward _____.

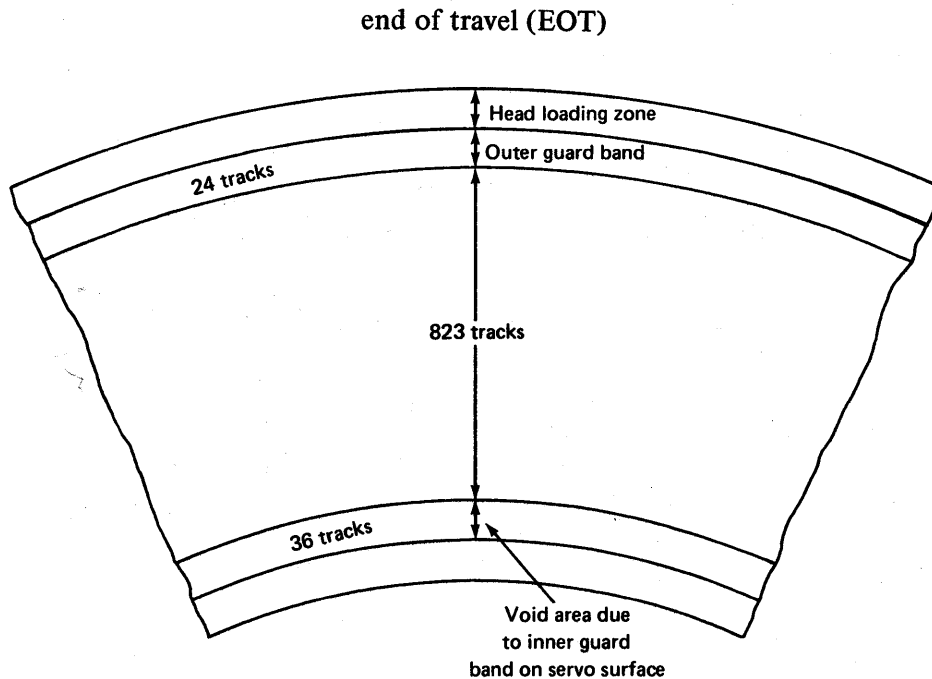


Figure 43. Inner guard band

Servo Surface

10. The servo surface is used to provide timing, to detect when the heads are beyond the data recording cylinders, to keep the heads on cylinder, to generate cylinder (track) pulses during a seek operation, and to develop sector and index timing.

The servo method of generating timing has two distinct advantages over other methods. First, since the timing comes from the disk pack and this surface is spinning at exactly the same speed as all other surfaces, the timing is more precise. Secondly, since the timing is generated from the disk pack, there are fewer problems when moving the disk pack from one SMD to another.

11. The magnetized spots on the surface generate signals called dibits. The term dibit (or *dī bit*) is short for dipole bit, which means a pair of equal and opposite magnetic poles separated by a small distance. Note in figure 44 that each dipole is reversed from the previous dipole; the servo surface is recorded at the factory in that manner.

On the servo surface, each dipole has its magnetic poles _____
from the previous dipole.

reversed

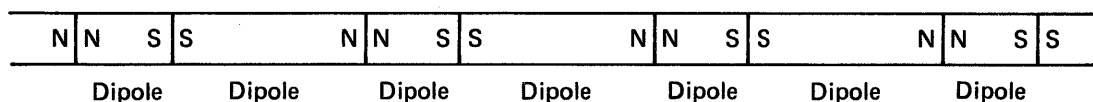


Figure 44. Magnetic pattern on the servo surface

12. As these magnetic dipoles pass under the servo head, an electrical signal is induced by the change in magnetic flux at the poles. Note in figure 45 that at each set of south poles a negative pulse is induced. The size of the dipoles alternates between long and short, which causes a complete sine wave to be generated and then leaves a space before generating another sine wave.

Where two south poles meet, a _____ (positive/negative) pulse is developed by the servo head, and where two north poles meet a _____ (positive/negative) pulse is developed by the servo head.

negative, positive

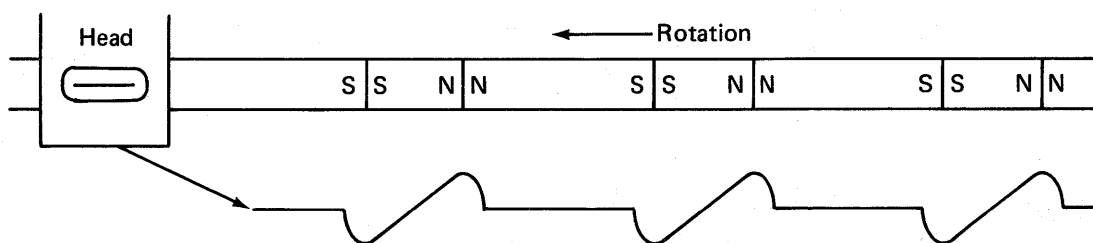


Figure 45. Dipole waveform

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13. The physical length of the dipoles alternates between long and short, causing a _____ between cycles.

space

14. The waveshapes shown in figure 46 are the dibit signals. The pattern of dipoles in (a) generates a waveshape which starts with a positive alternation; therefore, this pattern is referred to as positive dibits. The pattern of dipoles in (b) generates a waveshape which starts with a negative alternation; therefore, this pattern is referred to as negative dibits. Remember that these dipoles can only be recorded at the factory, so when a new disk pack is received for the SMD, the pack will already have these dipoles recorded.

Two types of waveshapes are developed on the servo surface, one which starts with a positive alternation and is called a _____ dibit and one which starts with a negative alternation and is called a _____ dibit.

positive, negative

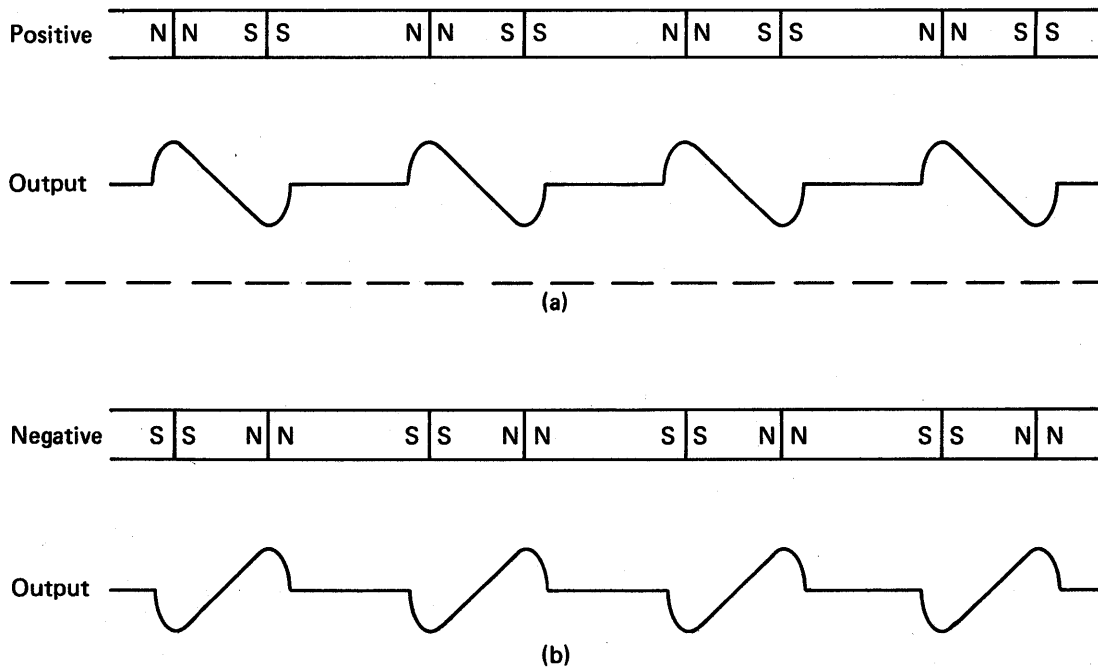


Figure 46. Positive and negative dibit patterns

15. The dibit patterns are recorded in side-by-side tracks on the servo disk surface. In the area of the data tracks (between the outer and inner guard bands), they alternate between positive and negative patterns as shown at the top of figure 47. (Note that the positive is also called odd and the negative is also called even.) The waveshape at the bottom of figure 47 shows how the signal would appear if the servo head is directly between a positive and a negative dibit track. Both tracks would be inducing a voltage of equal amplitude when the head is positioned midway between them. By having the dipoles offset between adjacent tracks, the waveshape would have a positive dibit signal, followed immediately by a negative, and so on. When the head is directly in the center between the two patterns, the dibit waveshape would be balanced as it is in figure 47. A later frame explains an out of balance waveshape. The waveshape shown in figure 47 is used as the timing for the basic 806 Khz clock.

In the data track area, the dibit tracks alternate between _____ and _____ patterns.

positive, negative or negative, positive

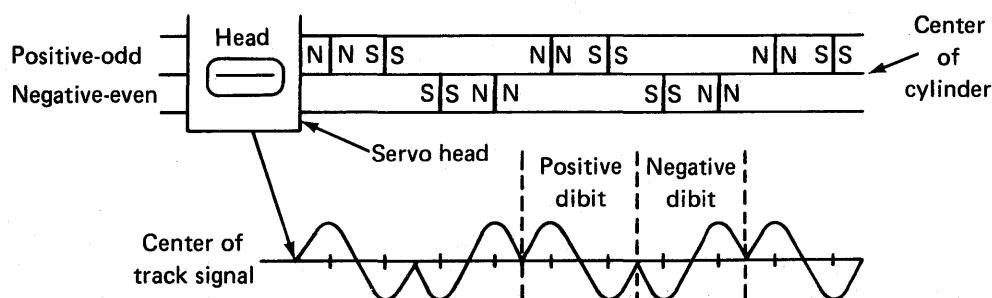


Figure 47. Center of track dibit waveform

16. Figure 48 shows a portion of the servo surface with the head loading area having no recorded data and with the guard band and the alternating tracks of even and odd dibit patterns in the data area. An important concept to remember here is that a positive (or odd) track goes all the way around the surface and a negative (or even) track does the same. Each dibit track is a concentric circle, as are data tracks. In fact, the placement of these recorded tracks determines the location of the data tracks, as you will see in later frames.

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In the data area on the servo surface, the servo head is positioned correctly when it is centered between a _____ and a _____ dibit track.

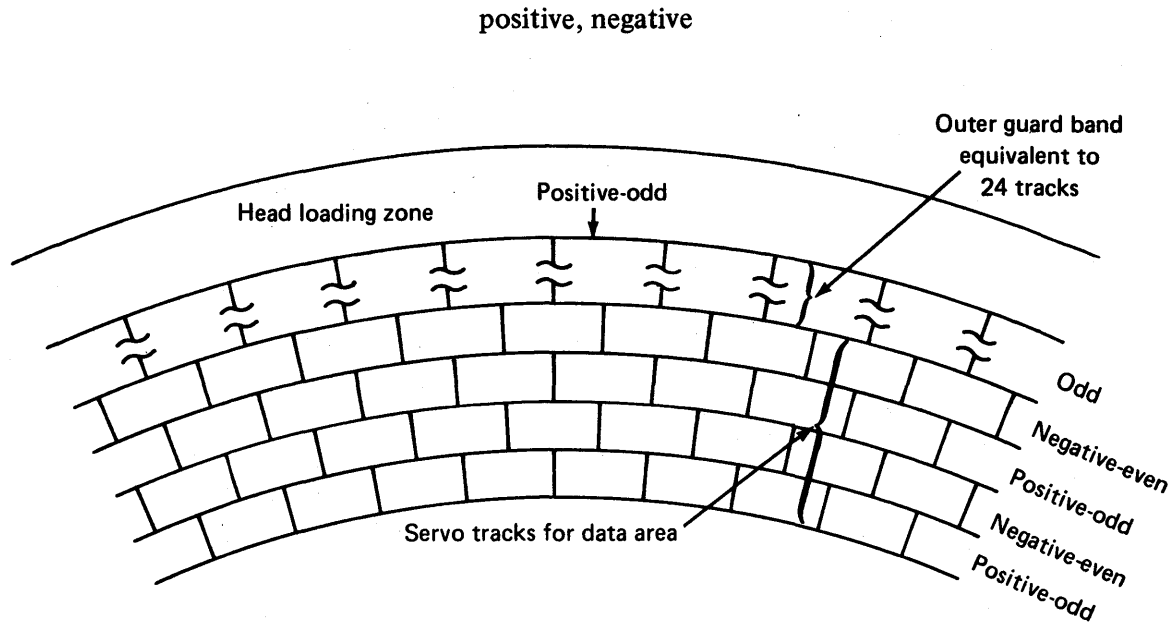


Figure 48. Dibit patterns on the servo surface

17. The servo disk surface, illustrated in figure 49, has a total of 883₍₁₀₎ dibit tracks. Immediately inside of the head loading zone is a band of 24₍₁₀₎ positive dibit tracks, which is known as the outer guard band. When the heads initially load, they pass through this band on their way to cylinder 0. The signal generated from the outer guard band assists in finding cylinder 0. This area is also used to detect reverse end of travel when the heads are doing a return to zero seek.

The outer guard band is used when the heads initially _____, and when doing a return to zero seek, it helps determine _____.

load, reverse end of travel

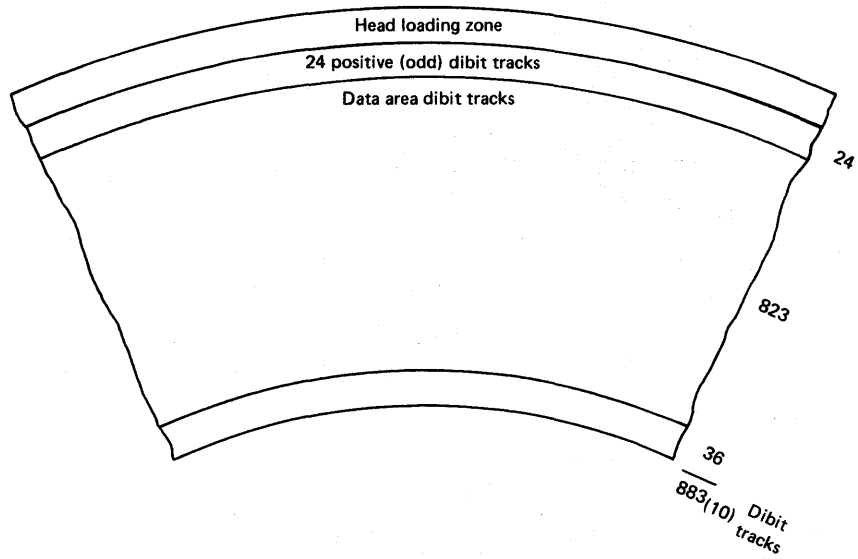


Figure 49. Servo surface tracks

18. Refer to figure 50. The next 823₍₁₀₎ dibit tracks start with a negative (even) dibit track and alternate between negative and positive, with the last track being positive (odd). The signal, which is developed by the servo head when it is not in a seek operation, is used to generate the basic 806 KHz clock signal to control the disk-drive timing for write operations.

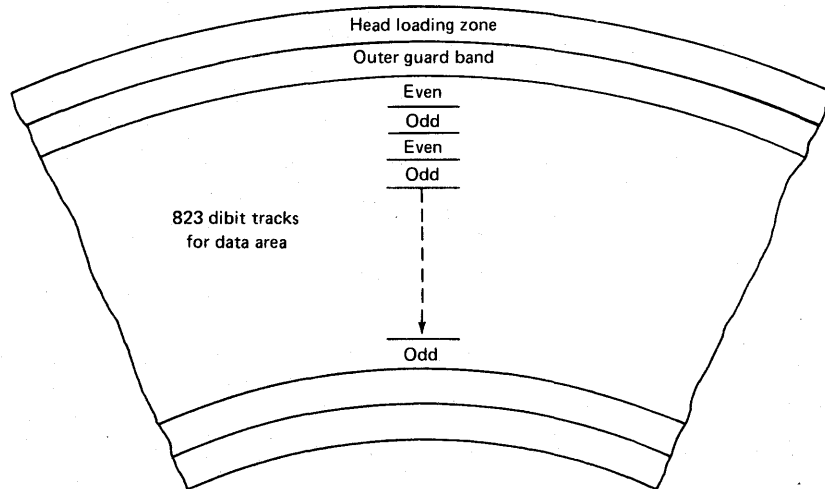


Figure 50. Dibit tracks for the data area

Preventive Maintenance

19. The information within the circle in figure 51 shows the relationship between the servo tracks and the data tracks on the data recording surfaces. The servo head is shown centered between the first even dibit track and the next odd dibit track, and since all the heads move together, all of the data heads are in the exact same spot on their respective surfaces. This position of the servo head is track number 1, while tracks 0 and 2 are shown only for reference. With the servo head precisely between dibit tracks, the resulting output signal is balanced.

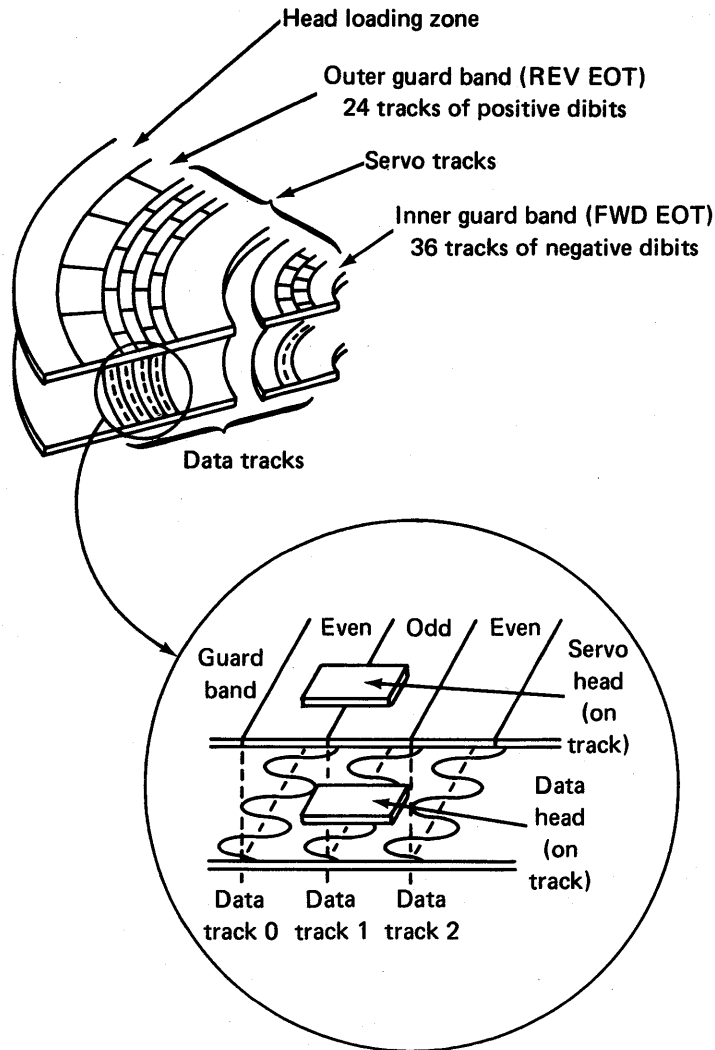


Figure 51. Servo and data surfaces compared

Being balanced means that the servo head is detecting an equal amount of magnetism from each of the two tracks between which it is positioned. However, if the head moves either forward or backward, even a slight amount, it means that it is detecting

more magnetism from one servo track than from the other. The signal then becomes imbalanced and generates an error voltage. This error voltage causes the positioner to move the heads so the servo head is again precisely between dibit tracks.

An error voltage is developed when the servo signal becomes imbalanced. This occurs when the _____ move off from the precise middle of the track.

heads

20. After the 823₍₁₀₎ alternating positive and negative dibit servo tracks, there is a field of 36₍₁₀₎ negative (even) dibit tracks. Refer to figure 52. This field is known as the inner guard band and is used to detect forward end of travel when the heads move too far during a forward seek.

The outer guard band detects _____ EOT, and the inner guard band detects _____ EOT.

reverse, forward

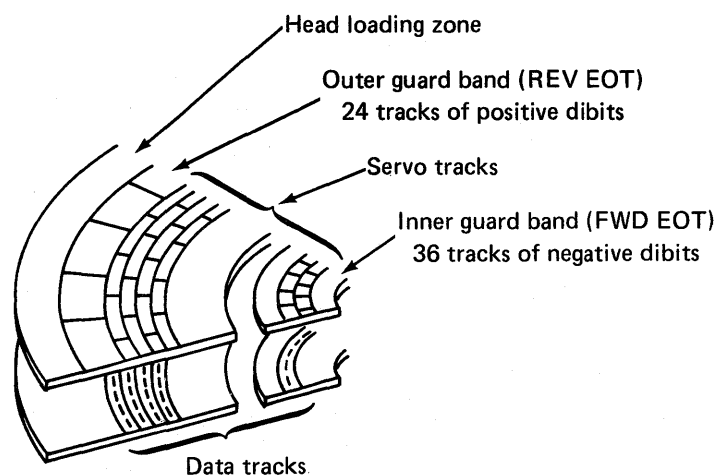


Figure 52. Servo surface and data surface

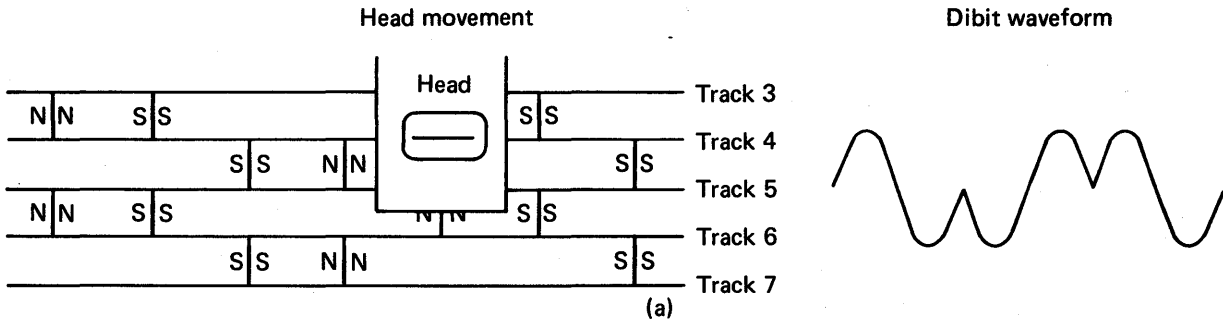
21. The outer guard band is made up of 24₍₁₀₎ _____ dibit tracks, and the inner guard band is made up of 36₍₁₀₎ _____ dibit tracks.

positive, negative

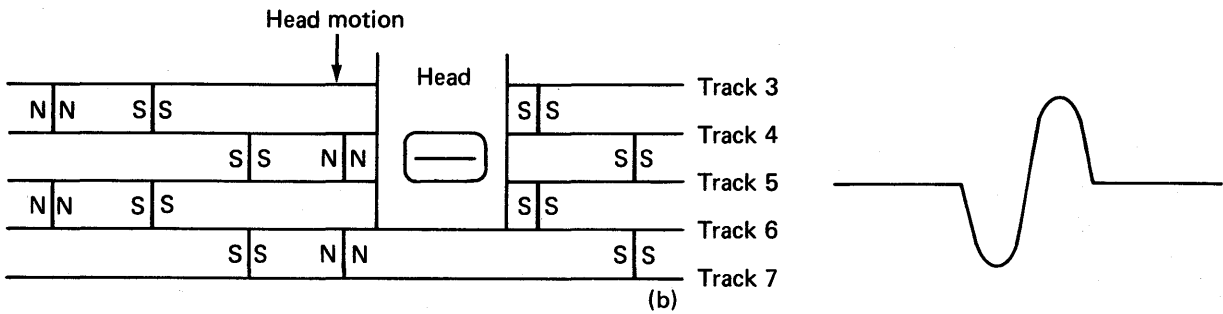
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22. During a seek operation, the servo head moves across the dibit tracks. By using the amplitude of the positive and negative dibits, it can be determined precisely when the heads move past the midway point between the positive and negative dibit tracks, and a track pulse (cylinder pulse) can be generated. Remember that the cylinder pulses update the difference counter during a seek operation.

Figure 53 shows the changes in the dibit waveform as the head is advanced from track 4 during a forward seek. Each section is explained on the figure.

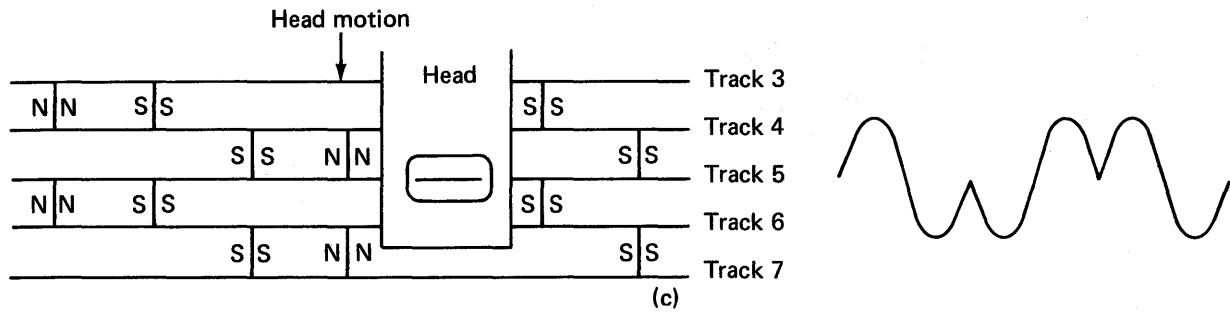


a. Head is centered on track 4 and has an equal amount of voltage induction from the positive servo track and the negative servo track on each side of track 4.

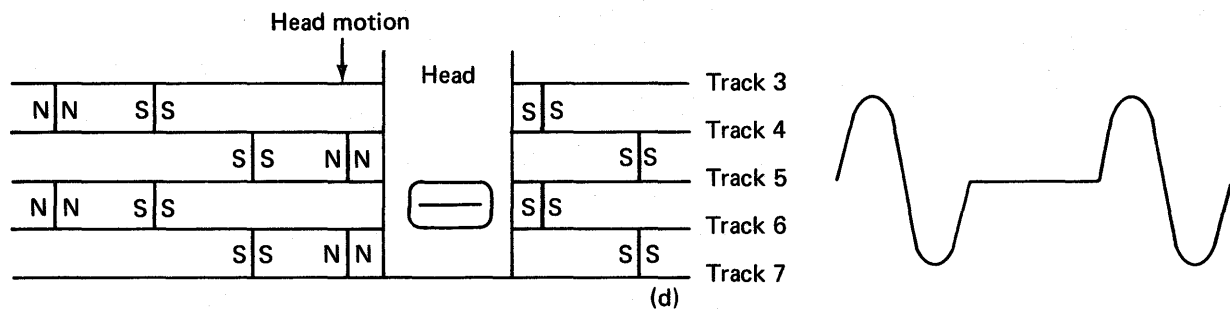


b. As the head is advanced from track 4 going toward track 5, the head detects a stronger signal from the negative dibit track and a weaker signal from the positive dibit track.

Figure 53. Dibit patterns during head movement



c. The head is now centered over track 5, and the dibit patterns are again equal. At this time a cylinder (track) pulse is generated.



d. The head is now over a positive dibit track, and more voltage is being induced from the positive track than from the negative track. The dibit pattern shows the change in waveforms as a result of being in this position.

Figure 53. (Continued)

A track pulse is generated when the positive and negative dibits are of equal

amplitude

23. To detect and generate track pulses, the SMD uses a comparator network that separates and compares the amplitude of the positive peaks of both the positive and negative dibit waveforms. Figure 54 shows the comparator network. Note that all the heavily shaded peaks are the positive peaks of the positive dibits.

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In figure 54, the output from the negative peak detector is inverted prior to being summed with the output of the positive peak detector.

With the dibit waveshape of equal amplitude, as shown in figure 54, the output of the summing amplifier is _____ volts, since the output of the negative peak detector is inverted before being summed with the output of the positive peak detector.

zero

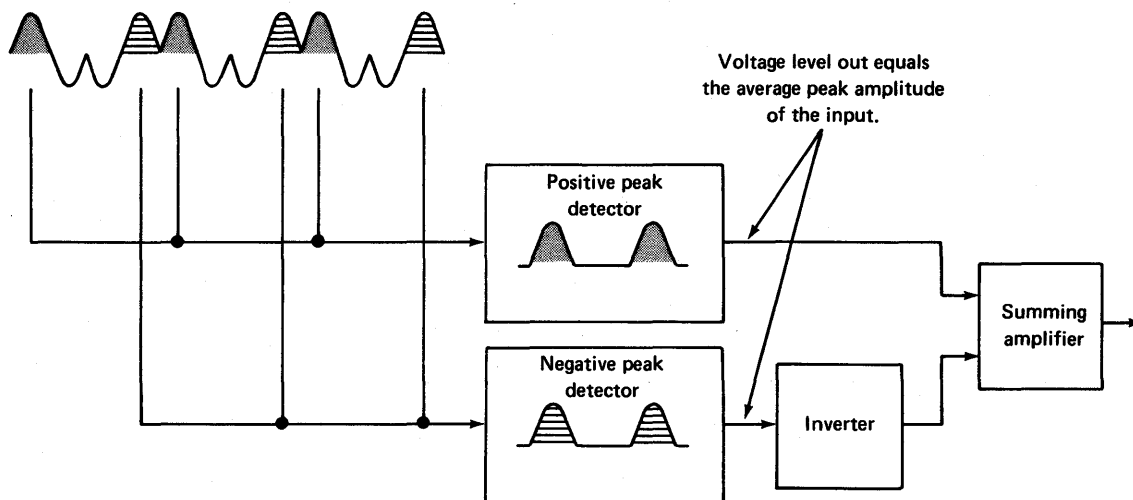


Figure 54. Comparator network

24. As the head moves during a seek operation, it crosses positive and negative dibit tracks. Frame 22 and figure 53 explain the resulting dibit waveforms as the head is moved across the dibit tracks. Figure 55 shows the resulting waveform from the summing amplifier as the head is being moved. Note that a sine wave is developed at the output as the dibit patterns change at the input.

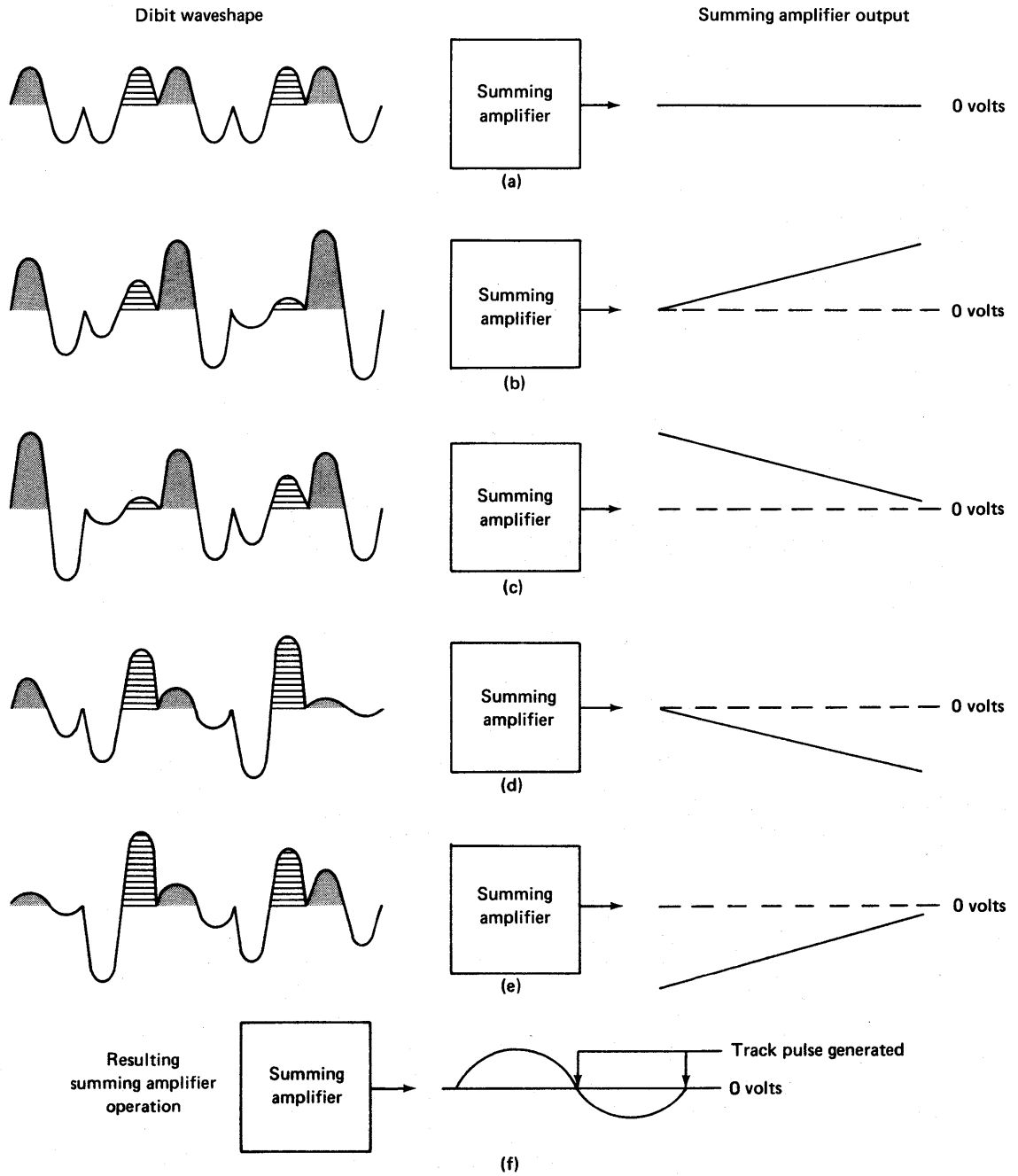


Figure 55. Summing amplifier operation

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Each of the sections of figure 55 is explained as follows:

- a. The servo head is centered between two dibit tracks. The on-cylinder condition is present at this time.
- b. The servo head has moved toward a positive dibit track, and as a result, the positive dibit signal is getting larger and the negative dibit signal is getting smaller. The positive peak detector provides a larger signal to the summing amplifier than the negative peak detector, and this causes the output of the summing amplifier to become increasingly positive.
- c. Once the servo head passes the center of the positive dibit track, the positive dibits become smaller. As they do so, the output of the summing amplifier decreases toward zero. When the positive and negative dibit waveforms are equal, the servo head is precisely over a track (on cylinder) and the output of the summing amplifier is 0 volts. A track pulse is generated at this time.
- d. The servo head has now moved over a negative dibit track, and the operation is similar to (b) above, except that the output of the summing amplifier is negative.
- e. The servo head is now approaching the next track, and the operation is similar to (c) above, except that the summing amplifier output is approaching 0 from some negative voltage.
- f. This section shows that the resulting summing amplifier output resembles a sine wave. When the summing amplifier output crosses the 0 volt reference, the dibit patterns are equal, which means the servo head is precisely on a track. Therefore, a track pulse is generated each time the summing amplifier output crosses the zero line.

Summary

In review, the servo surface is used for five operations. They are to:

1. Generate a signal to keep the heads on cylinder.
2. Detect forward and reverse EOT.
3. Generate cylinder pulses during a seek operation.
4. Provide signals used as the basic 806 Khz clock.
5. Develop sector and index pulses and control sector timing.

To produce the signals to perform these operations, the surface is prerecorded at the factory with a pattern of dibit tracks. These tracks are broken into areas, with the first area just to the inside of the head loading area. The first area is called the outer guard band and is made up of 24 positive dibit tracks. The next area is 823(10) tracks alternating between positive and negative dibit tracks. These tracks are used to determine the data tracks on the data surfaces. The last 36 tracks are all negative dibit tracks and make up the inner guard band.

General Maintenance and Adjustment Lab

The purpose of this activity is to teach you basic maintenance procedures on the SMD. In some of the following projects you perform voltage checks; in others you use the oscilloscope to display waveforms. In either case, you are *not* to make any mechanical adjustments on the SMD.

You will also be using the Field Test Unit to exercise and verify correct operation of mechanical and electrical access mechanisms.

Objective

When you complete this activity, you should be able to operate the Field Test Exerciser and perform checks on electrical/mechanical components.

Materials Required

- Phillips and standard screwdrivers
- Top cover support rod for S/C 07, without 37686 and below only, CDC Part No. 87062300
- Deck support bracket, S/C 16 and below, CDC Part No. 87073000
- Field test exerciser with head alignment circuitry, CDC Part No. 75255006
- Digital VOM (Ballentine 345 or equivalent)
- Potentiometer adjustment tool, CDC Part No. 12212278
- Dual trace oscilloscope and two 10X probes
- Scope probe tips (hatchet type), CDC Part No. 12212885
- Long-nosed pliers

Introduction

This lab is divided into several sections, each one a unique procedure. They are:

- Set-up and Operation of the Field Test Unit
- Plus and Minus 5 VDC Regulator Check
- Head Arm Alignment Check
- Velocity Gain Check

Set-up and Operation of the Field Test Unit (FTU)

The FTU is housed within a small portable metal case resembling a suitcase and can easily be transported by service personnel. Cables from this tester plug into the I/O connectors of the SMD, where cables from the central processor would normally attach.

The purpose of the FTU is to exercise the SMD in several varied operations off-line. They are:

1. Accessing any cylinder
2. High-speed accessing between cylinders
3. Sequential access (FWD, REV)
4. X-N access
5. Random access using a free-running counter

The laboratory procedure follows. When you complete a step, put a check mark in the blank provided.

- _____ Step 1. Raise the case assembly on the SMD to expose the electrical and mechanical components.
- _____ Step 2. Loosen the four screws holding the top cover of the logic chassis on. (Do not remove these screws.)
- _____ Step 3. Remove the cover, and slightly tighten the screws again to keep them from vibrating out.
- _____ Step 4. Loosen the four thumb screws, and remove the two I/O connectors from the rear of the SMD chassis.
- _____ Step 5. Remove the I/O cable from inside the cover of the FTU, and attach one end to the FTU operator's panel and the other ends to the disk drive I/O connectors. (See figure 56.)

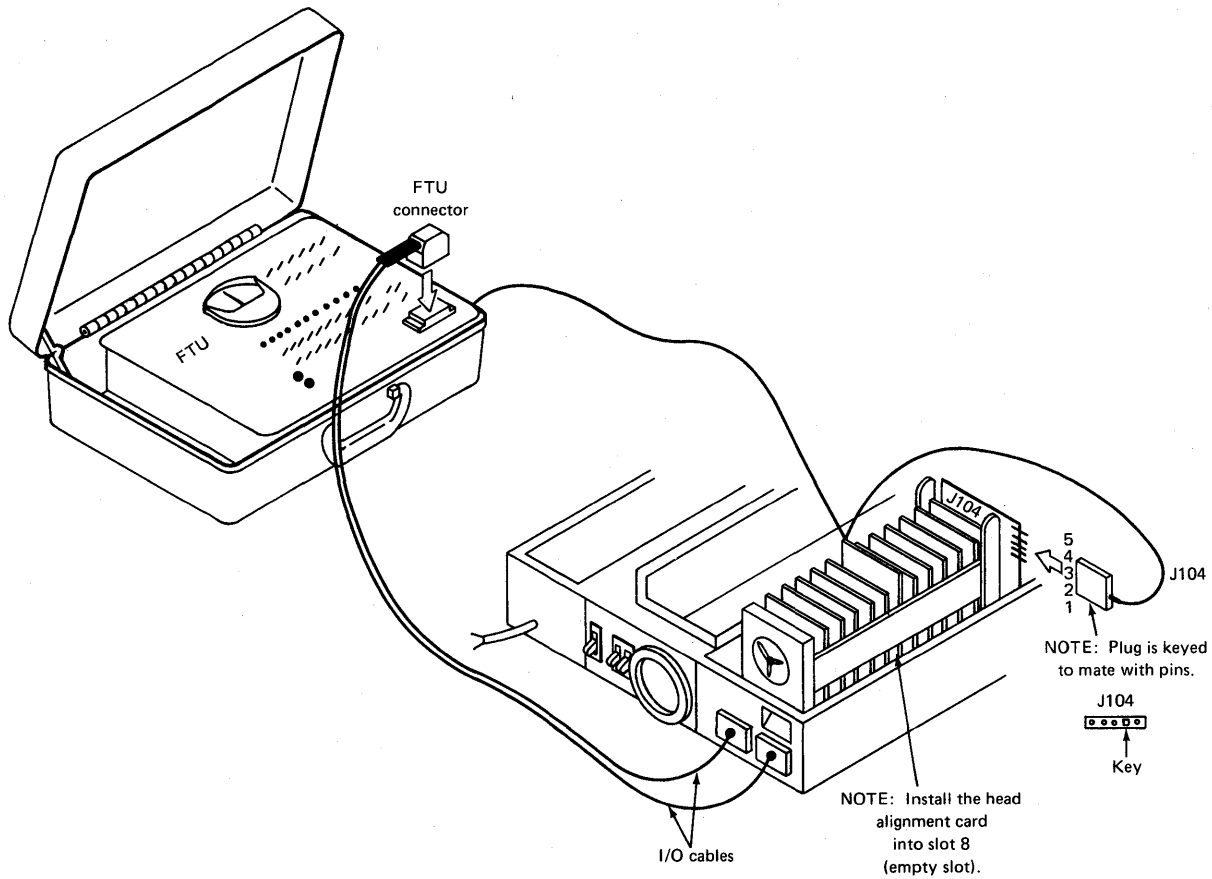


Figure 56. FTU installation

_____ Step 6. Insert the head alignment card into the empty position in the card cage (slot 8).

_____ Step 7. Plug the small connector into the small tiny pins on the side of card J104 (see figure 56).

Caution: It is possible to put this connector on upside down. Be sure that when it is installed, pin 5 is at the top and pin 1 on the bottom.

_____ Step 8. Plug the line cord from the FTU into a 110 VAC wall outlet.

_____ Step 9. Power up the SMD, and install a scratch pack.

Operating the FTU

The first operation to perform is a direct access to cylinder 240 (F0₁₆). Before the access can be activated, the drive must first be addressed using the following procedure and figure 57.

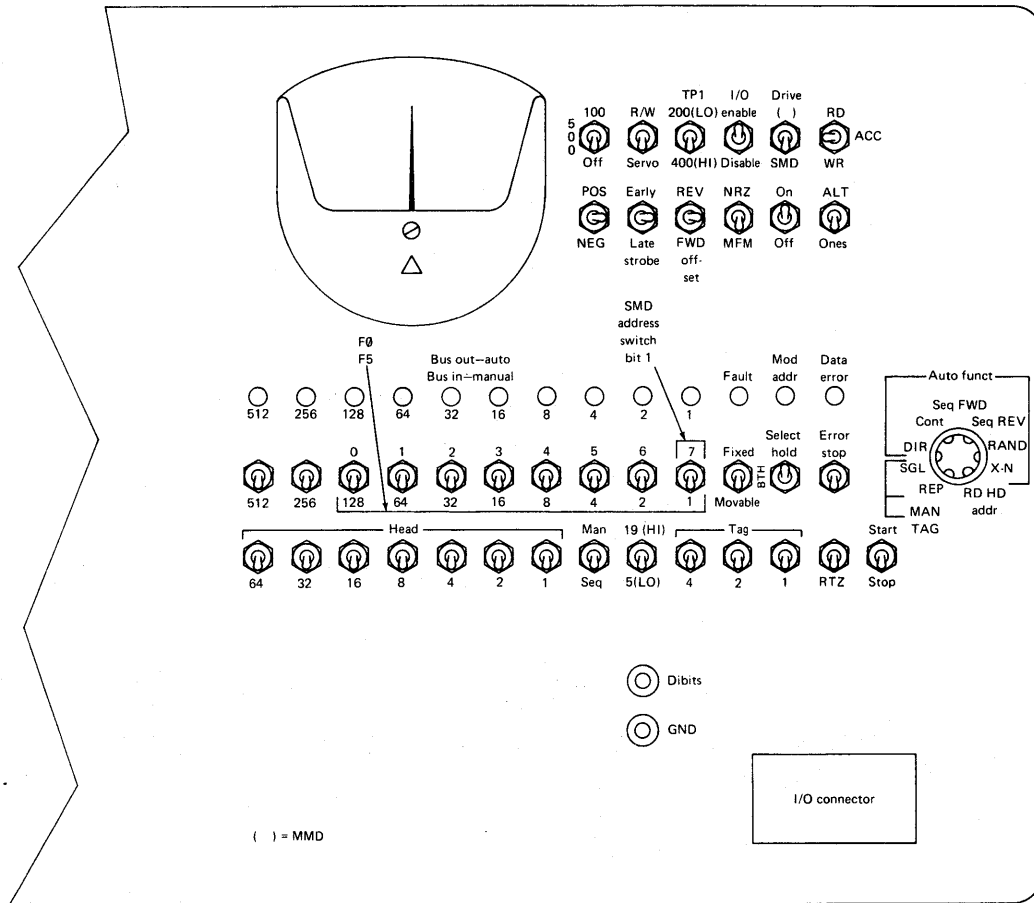


Figure 57. FTU operator's panel

- _____ Step 10. Set the START/STOP switch to the STOP position.
- _____ Step 11. Set the DRIVE switch to type of drive under test. (Set to MFM.)
- _____ Step 12. Set the I/O ENABLE/DISABLE switch to the ENABLE position.
- _____ Step 13. Set the SELECT HOLD switch to the UP position.

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- _____ Step 14. Set BUS OUT switches 1, 2, 4, and 8 to match drive's logic plug numbers, or drive's unit select switch settings (0, 1, or 2). (See figure 57.)
- _____ Step 15. Set the AUTO FUNCT switch to SGL (single function).
- _____ Step 16. Set TPI 200/400 switch to the 400 position and the HD 19/5 switch to the 5 position.
- _____ Step 17. Set the TAG switches in DOWN position.
- _____ Step 18. Actuate the START/STOP switch up and down once. The MOD ADDR indicator should come on, indicating that the drive is selected.
- _____ Step 19. Actuate the RTZ switch. (Return to zero.)

NOTE: Switches not mentioned have no effect on discussed operations.

Now that the drive is selected, the first operation of direct access to a cylinder 240 is performed as follows:

- _____ Step 20. Activate the RTZ switch.
- _____ Step 21. Make sure the START/STOP switch is transferred to the STOP position.
- _____ Step 22. Set FIXED/BTH/MOVABLE switch to the movable position.
- _____ Step 23. Set the BUS OUT switches to desired cylinder. Enter cylinder F0 (cylinder 240). (See figure 57.)
- _____ Step 24. Set the I/O ENABLE/DISABLE switch to the ENABLE position.
- _____ Step 25. Set the RD/ACC/WR switch to the ACC position.
- _____ Step 26. Set the AUTO FUNCT switch to the DIR position.
- _____ Step 27. Set the START/STOP switch to the START position.
- _____ Step 28. When move is complete, return START/STOP switch to the STOP position.

After access is complete, the BUS IN indicators should display the current address of F0.

- _____ Step 29. You may reselect the same cylinder and watch it move by transferring the RTZ switch; then move the START/STOP switch to the START position again. Make sure you leave the switch in the STOP position when you finish.

The next operation to perform is a high-speed access between two cylinders. In the previous procedure, you already specified and accessed cylinder 240 (F0). Now you will select cylinder 245 (F5) as the alternate track.

_____ Step 30. Set the BUS OUT switches to F5 (cylinder 245).

_____ Step 31. Set the AUTO FUNCT switch to the CONT position.

_____ Step 32. Set the START/STOP switch to the START position. (Repeated accessing should begin.)

_____ Step 33. To stop continued seek, move the START/STOP switch to the STOP position.

When the operation is stopped, the current cylinder should be displayed on the BUS IN indicators.

The third operation you will perform with the FTU is sequential access. This procedure causes the heads to access cylinders sequentially forward, reverse, one cylinder at a time.

During a forward seek, the actuator seeks forward to the maximum of 823 cylinders (one cylinder at a time), returns to cylinder zero, and seeks to the maximum legal address again.

_____ Step 34. Perform a direct access procedure if you wish to start at another position other than 000.

_____ Step 35. Set the AUTO FUNCT switch to SEQ FWD.

_____ Step 36. Set the START/STOP switch to START.

_____ Step 37. To stop the sequential forward access, set the START/STOP switch to the STOP position.

The other operations that can be performed with the FTU are documented in the *FTU Hardware Maintenance Manual*, Pub. No. 83322840A.

Plus or Minus 5-VDC Regulator Check

This procedure verifies the output of the plus or minus 5-volt power supplies while the drive is doing repeat accesses between cylinders. Power supply outputs are checked at

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the logic chassis backpanel. Before performing this voltage check, the logic chassis must be raised to its upright position.

- _____ Step 38. Loosen the turnlock fasteners that hold the logic chassis down, and swing it up in a vertical position.
- _____ Step 39. Move the plastic sidebar (located on top of the magnet assembly) toward the logic chassis until it stops.
- _____ Step 40. Lower the logic chassis onto the sidebar.
- _____ Step 41. Connect the digital volt/ohmmeter between ground and the +5V test blocks on the logic chassis backpanel. (See figure 58.)
- _____ Step 42. Using the FTU, perform repeated accesses (seeks) between cylinders 0 and 32.
- _____ Step 43. The plus 5-volt output should be $+5.10 \pm .05$ volts. If it is not, adjust the +5-volt power supply.

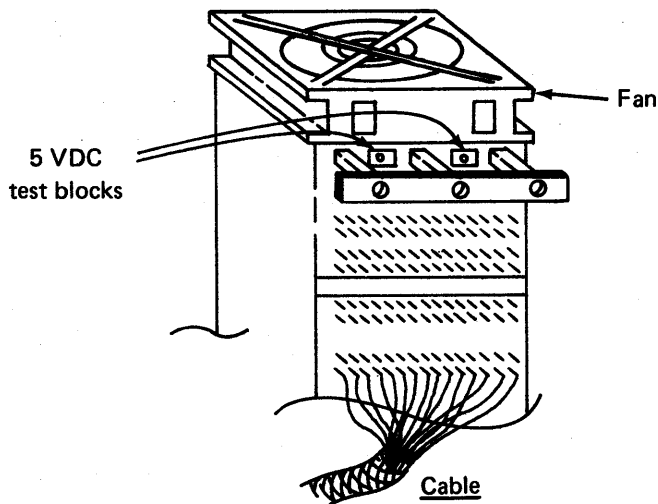


Figure 58. Rear of logic chassis in maintenance position

- _____ Step 44. Move volt/ohmmeter leads to the -5-volt fastener.
- _____ Step 45. The minus 5-volt output should be -5 ± 0.05 volts.
- _____ Step 46. If a change is necessary in the preceding steps, recheck both outputs and notify the lab administrator.
- _____ Step 47. When both power supply outputs are within specification, restore the drive to normal operation.

Head Arm Alignment Check

Before performing the head alignment procedure check, the drive, the FTU, and the CE pack must be at operating temperature. This requires approximately sixty minutes.

Normally to perform a head alignment check, you would use a Head Alignment Kit to assist you in determining how close the heads are aligned. However, in this project you will only display the dibit waveform on the oscilloscope and assume that head alignment is okay.

- _____ Step 48. With the CE pack installed and the oscilloscope connected to the dibit red bus connector on the FTU operator's panel, command the FTU to perform continuous seeks between cylinders 240 (F0) and 245 (F5) for thirty seconds. This allows settling of head/arm assembly.
- _____ Step 49. Stop continuous seeks, and command a direct seek to cylinder 245 (F5).
- _____ Step 50. A balanced dibit pattern, similar to figure 59, should be observable on the oscilloscope.

Preventive Maintenance

Oscilloscope Set-Up

Volts/div

CH1 – .05V/div

Time/div

A – 2 μ sec

B – Not used

Probe connections (use X20 probe)

CH1 to FTU dibit jack (red connector)

Ground to FTU GND jack

Trigger slope/mode

Slope = internal +

Mode = auto

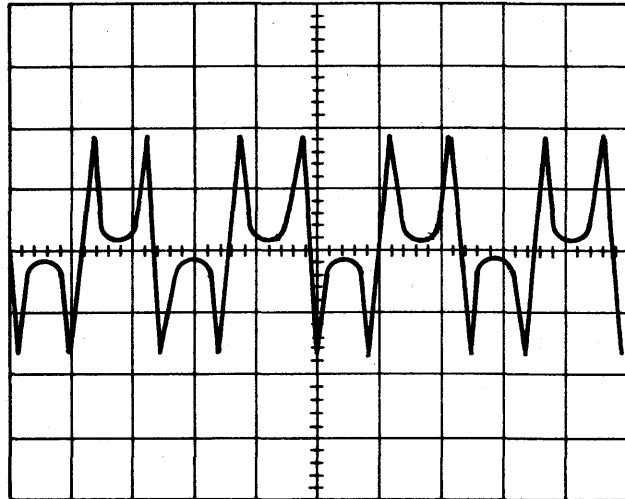


Figure 59. Balanced dibit pattern

_____ Step 51. When finished, command a return-to-zero seek and disconnect the oscilloscope probes.

Velocity Gain Check

This procedure checks the output of the velocity transducer circuit that controls seek time between cylinders 000 and 822.

_____ Step 52. With the scratch pack and FTU installed, connect the oscilloscope channel 1 to wirewrap pin A04-03A (on cylinder). Trigger on signal A04-07A (FORWARD SEEK).

_____ Step 53. Set the oscilloscope time per division to 10 ms per cm so that a 49-51 ms signal can be displayed.

_____ Step 54. Command continuous seeks between cylinders 000 and 822 (33616).

_____ Step 55. Observe that the waveform seek time is between 49 and 51 ms (figure 60).

_____ Step 56. When finished, restore the SMD to normal operations and remove the FTU.

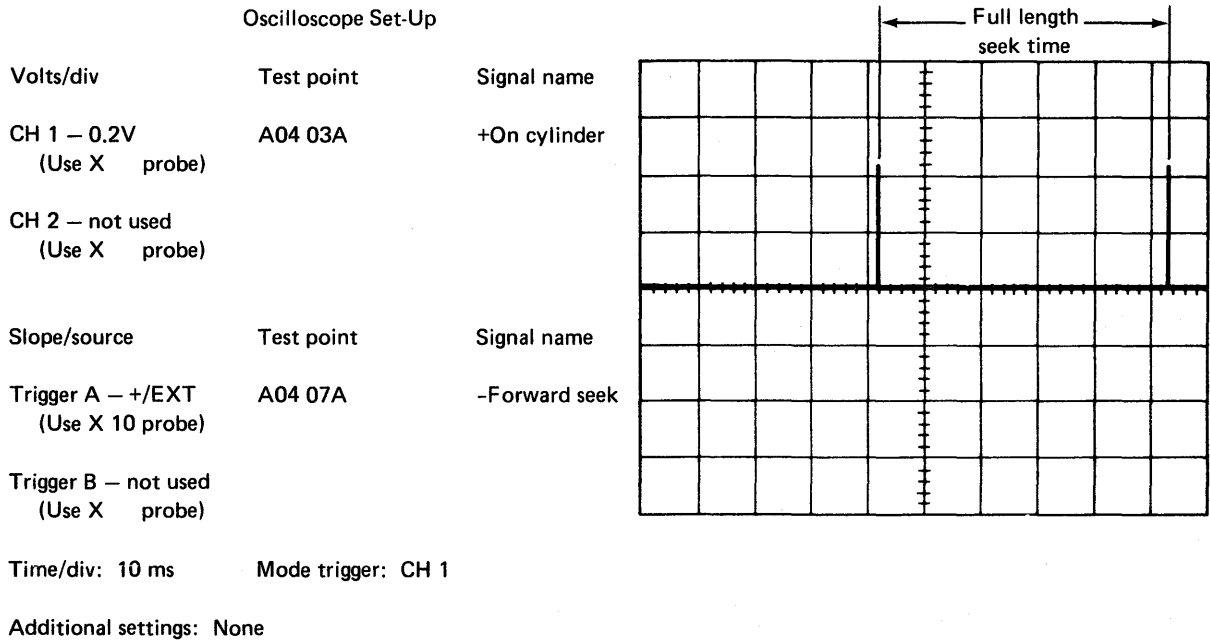


Figure 60. Velocity gain waveform

Summary

The projects you just performed have given you an introduction to some of the signals and operating concepts of the SMD. You are now aware of the value of the FTU in exercising the FTU. Without these exercises, a lot of programming would be required at the central processor. A second benefit of the FTU is that a tape drive can be taken off-line and problems diagnosed while the customer continues to use the central processor and other tape drives.

You have now completed this laboratory activity. Remove all power. Turn all switches to off. Return the required materials to their proper storage places.

Input/Output Operations

Polling Operations

This exercise reinforces your understanding of polling operations.

DIRECTIONS: Select the correct answers.

- _____ 1. Auto polling is when
- the controller is selecting drives after SEEK END conditions.
 - the controller is not selected and is polling drives for SEEK END conditions.
 - each of the 16 drive logical addresses is selected and one of the drives responds.
 - a drive is reselected.
- _____ 2. In the case of an initial power up, and on an auto polling operation, what address is contained within the drive select address register?
- no address
 - a random address
 - the address of the last drive selected
 - the address of the next drive to be selected
- _____ 3. How is poll update operation different from auto polling?
- The only difference is that the auto poll latch is set in the poll update operation.
 - Poll update takes place in either the upper eight addresses or the lower eight addresses.
 - The poll update interrogates the poll memory to determine which drives have been polled.

DIRECTIONS: Mark each of the following statements T for true or F for false.

- _____ 4. In an auto poll drive selection sequence, drive selection is sequential; after each drive is polled, the drive select address register advances.
- _____ 5. A poll update operation is initiated by a command from the DA and requires that the DA have the controller selected.
- _____ 6. In an auto poll sequence conclusion, the eight-address polling cycle must be completed before the controller can be selected.

Input/Output Operations

- _____ 7. If the drive selection is complete, and the Seek End line is inactive, the auto poll sequence resumes.
- _____ 8. The purpose of a poll update command is to check to see if drives have completed their respective seek operations.
- _____ 9. Only one drive can be selected at any given time; therefore, a maximum of only one seek end may be pending.
- _____ 10. A drive may be selected, then deselected before its seek end line is raised.

ANSWER KEY

- 1. b 2. b 3. b 4. T 5. T 6. T 7. T 8. T
- 9. F 10. T

Read/Write Operations (FA727)

DIRECTIONS: Mark each of the following statements T for true or F for false.

- _____ 1. The controller uses two circuits to provide timing during read/write operations: read data and serdes clock circuits.
- _____ 2. MFM data is serialized data going to the drive, and NRZ data is serialized data coming from the drive.
- _____ 3. Read data recovery circuits furnish timing pulses and are functional during a read gap A or read gap B operation.
- _____ 4. Read data recovery timing pulses are used to synchronize controller timing due to variations in disk pack speed.
- _____ 5. The shift register is used to serialize data before it is sent to the DA.
- _____ 6. The shift register is used to serialize data before it is sent to the drive.
- _____ 7. The write buffer register is used during write operations to hold write data received from the DA until it can be transferred to the shift register.
- _____ 8. The purpose of the PLO is to provide an input to the data converter that contains the phase and frequency information of the MFM data.
- _____ 9. The purpose of the data converter is to provide an input to the PLO that contains the phase and frequency information of the MFM data.
- _____ 10. The PLO is actually a phase lock loop that includes a phase comparator, error amplifier, voltage-controlled oscillator and a divide by 2 FF.
- _____ 11. RPS defined means Rotational Pulse Sensing.
- _____ 12. RPS defined means Rotational Position Sensing.
- _____ 13. RPS involves the drive raising an interrupt when it reaches a specific sector and goes true each time the sector is detected.
- _____ 14. Write gap A or B is initiated from the DA.

Input/Output Operations

- _____ 15. The format write command causes the controller to write an entire track of zeros.
- _____ 16. When the last ECC byte is received, it indicates that an extra corrective cycle must be performed.
- _____ 17. Every gap A contains an address mark.
- _____ 18. Retry is an automatic function of the controller.
- _____ 19. The DA initiates the retry function.
- _____ 20. The controller checks the ECC hardware via a bit-by-bit parity check that occurs after each shift.

ANSWER KEY

1. T 2. F 3. T 4. T 5. F 6. T 7. T 8. F
9. T 10. T 11. F 12. T 13. T 14. T 15. T
16. F 17. T 18. F 19. T 20. T

Flexible Disk Drive

General Operation

This exercise reinforces your knowledge of the general operation of the flexible disk drive.

DIRECTIONS: Choose the correct answers.

- _____ 1. How many recording surfaces are on the flexible disk?
- a. 77
 - b. 1
 - c. 5208
 - d. 2
- _____ 2. How many bits per byte are used in the format on the flexible disk drive?
- a. 16
 - b. 12
 - c. 24
 - d. 8
- _____ 3. The correct sequence for the 3 phases of the stepper motor in response to a STEP OUT command is
- a. 0B, 0C, 0A.
 - b. 0A, 0C, 0B.
 - c. 0C, 0B, 0A.
 - d. 0A, 0B, 0C.

DIRECTIONS: Mark the following statement T for true or F for false.

- _____ 4. The read/write head is automatically loaded as soon as the disk is properly loaded and the front panel door is secure.

Flexible Disk Drive

DIRECTIONS: Select the correct answer.

- _____ 5. A WRITE FAULT signal is not generated under which of the following conditions?
- a. if WRITE ENABLE is commanded and the head is not loaded
 - b. if WRITE ENABLE is commanded and no data is applied
 - c. if WRITE ENABLE is commanded and a READ command is in progress
 - d. if WRITE ENABLE is commanded and WRITE DATA is applied at the wrong rate

DIRECTIONS: Mark each of the following statements T for true or F for false.

- _____ 6. The low current operation automatically comes up when writing on track 43 or greater.
- _____ 7. A HEAD LOAD signal must be initiated prior to each read/write operation.

ANSWER KEY

1. b 2. d 3. b 4. F 5. c 6. T 7. T

Flexible Disk Drive Controller

Flexible Disk Drive System Lab

Introduction

In this activity, you will power up a flexible disk drive, load it with a flexible disk, and measure power supply voltages. Space is provided at the left of each step for you to check as you complete it.

Tools

Phillips and standard screwdrivers
VOM
Flexible disk

Lab Procedures

1. Flexible Disk Loading

- _____ a. Apply AC/DC power to unit.
- _____ b. Open FDD door.
- _____ c. Remove disk from storage envelope as shown in figure 61.
- _____ d. If disk is to be write protected (on units with Write Protect circuitry), be sure Write Protect slot is uncovered, as shown in figure 61.
- _____ e. Carefully slide disk into FDD, as shown, until jacket is solidly against stops.
- _____ f. Carefully close unit door. Ensure that the jacket is properly seated, the spindle has engaged disk, and the door is closed and latched.
- _____ g. Protect the empty envelope from liquids, dust, and metallic materials.

Flexible Disk Drive Controller

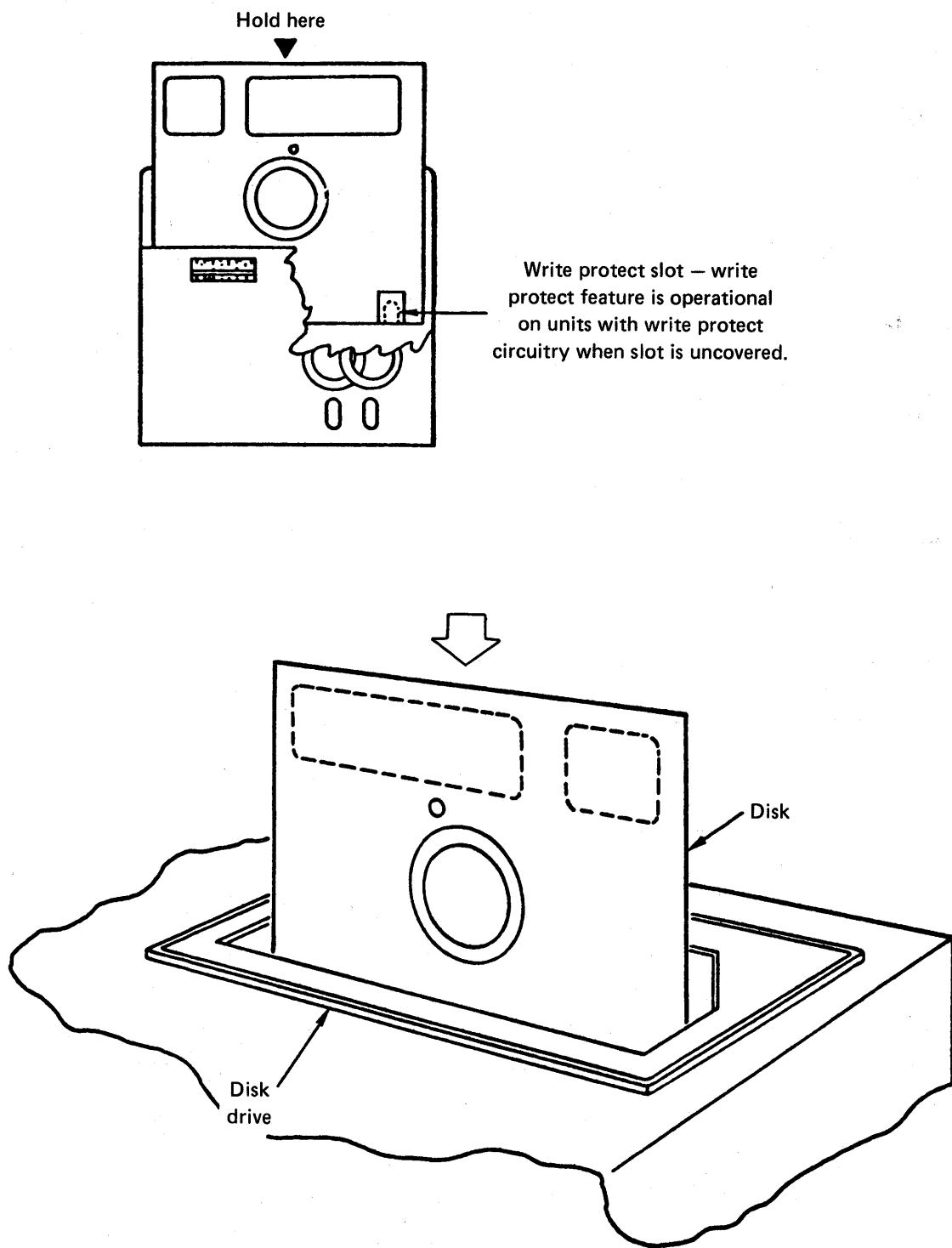


Figure 61. Disk installation

2. Measure Voltage

- _____ a. Remove rear cabinet cover from console to expose rear of FDD in order to observe voltages.
- _____ b. Locate connector J1 as shown in figure 62. Use the VOM to check voltages on pins as follows:
- +5V \pm 5% at J1-2, J1-4
 -5V \pm 5% at J1-6
 +24V \pm 10% at J1-12, J1-14
- _____ c. Configure the FDD for operation again by closing rear of cabinet.

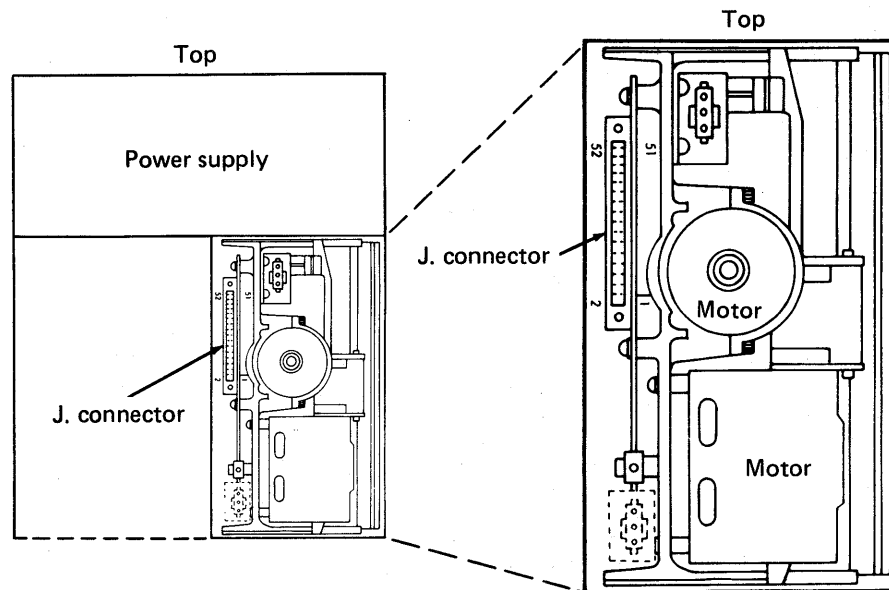


Figure 62. Connector location (rear view)

3. Flexible Disk Removal

- _____ a. Open FDD door to stop disk rotation and disengage spindle.
- _____ b. Remove disk from FDD, and put it in its storage envelope.
- _____ c. Close FDD door.
- _____ d. Remove AC/DC power from unit.

PROGRESS CHECK

1. Which switch, when pressed, places the tape transport under local (off-line) control?
 - a. SELECT
 - b. READY
 - c. FILE PROTECT
 - d. CLEAR

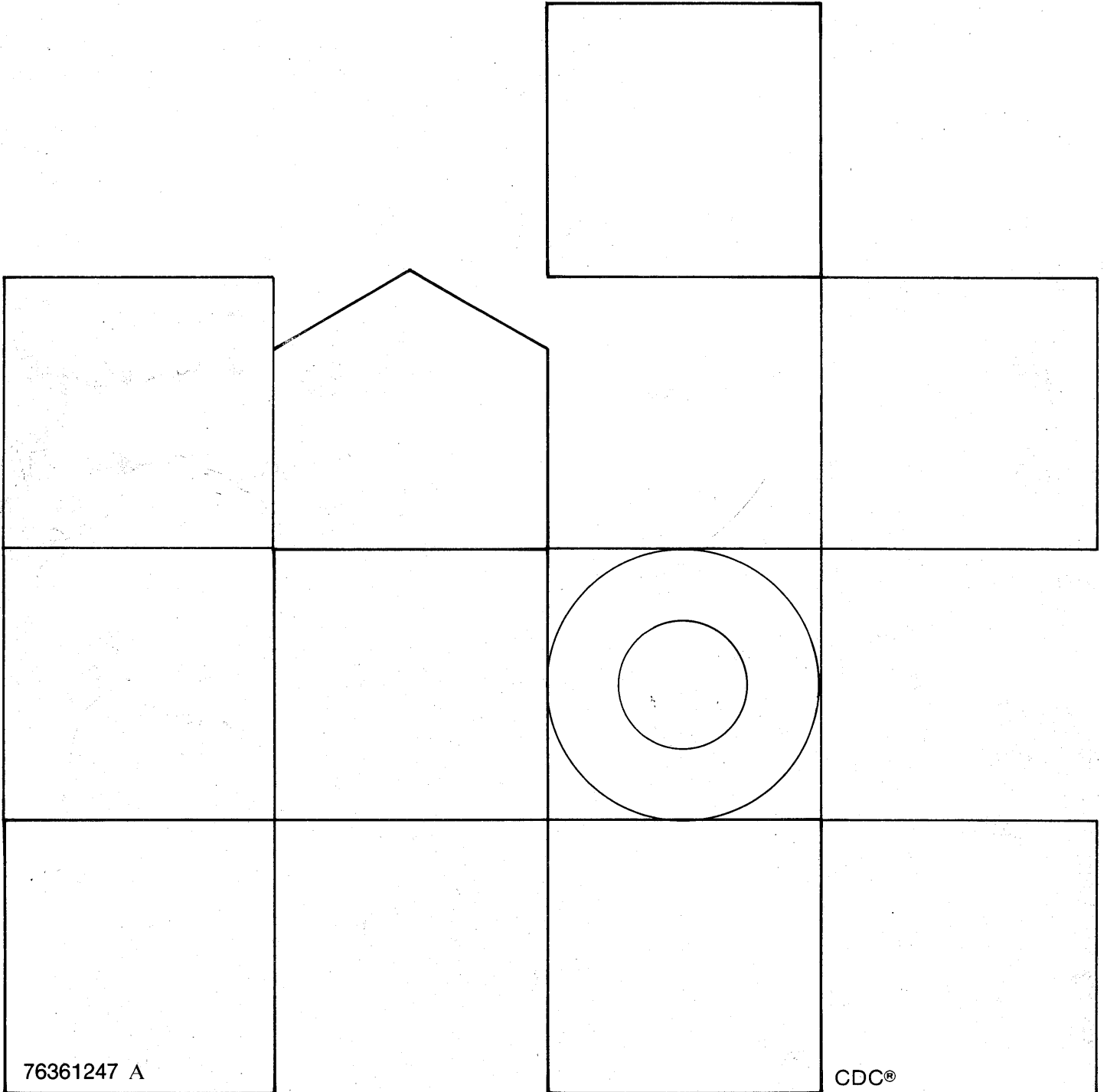
2. When loading tape, it does not stop at BOT. What is the most likely cause of this problem?
 - a. A missing EOT marker on the tape
 - b. No write enable ring installed on the supply reel
 - c. A bad loop column phototransistor
 - d. A missing BOT marker on the tape

3. Which tape transport component should never be touched with a bare hand?
 - a. Loop column glass
 - b. Capstan surface
 - c. EOT/BOT sensor
 - d. Loop column phototransistor

4. The capstan requires a starting distance of _____ in. to accelerate to 95 percent of its normal operating speed.
 - a. 0.19
 - b. 0.5
 - c. 0.75
 - d. 1.25

5. In phase modulation data recording on magnetic tape, the postamble that identifies the end of a data block consists of _____ characters that are the mirror image of the preamble.
 - a. 10
 - b. 21
 - c. 30
 - d. 41

6. Once the ONL F flip-flop is set and the READY switch is pressed, the RDY F flip-flop sets when the _____.
 - a. tape is moving
 - b. EOT is sensed
 - c. BOT is sensed
 - d. BOT is not sensed and tape is moving



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