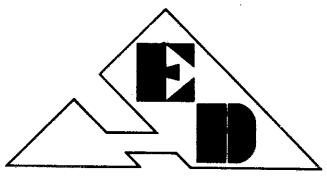


AED 2500

USERS MANUAL

FLOPPY DISK STORAGE SYSTEM

ADVANCED ELECTRONICS DESIGN, INC.

3197 PARK BOULEVARD • PALO ALTO, CALIFORNIA 94306 • (415)493-4914

INTRODUCTION

GENERAL DESCRIPTION

The AED 2500 Flexible Disk Sub-system is a compact, direct access, removable disk unit intended to simplify the distribution, processing and storage of digital information.

The 2500 is designed for applications that demand data handling simplicity and convenience, plus a high degree of operational reliability. Typical applications for the 2500 are control store loading, auxiliary storage, data logging, key-entry recording, programmable calculator storage, point-of-sale recording, accounting machine storage and minicomputer storage.

The 2500 is composed of a drive mechanism, power supply, formatting electronics, drive electronics, computer interface, and mechanical package. Connections are made to the host system by a signal cable.

The 2500 can write and read disks interchangeably from unit to unit.

The FD/IV Flexible Disk Cartridge used in the 2500 is a flat disk composed of a Mylar substrate coated with a magnetic oxide. For protective purposes during handling, operation and storage, the disk is encased in a flexible plastic envelope, eight inches square by one-sixteenth inch thick.

DESIGN FEATURES

The 2500 includes the following operational features:

Digital Applications Oriented	Designed specifically for digital data processing applications. Its unique design makes it an attractive alternative to tape cassettes, tape cartridges, paper tape, or card readers.
High Performance Parameters	The 2.5 megabit capacity, 250K bps transfer rate, and random access capability, makes it an ideal device for applications requiring low-cost, on-line data storage.

AED 2500 FLEXIBLE DISK FORMATTER

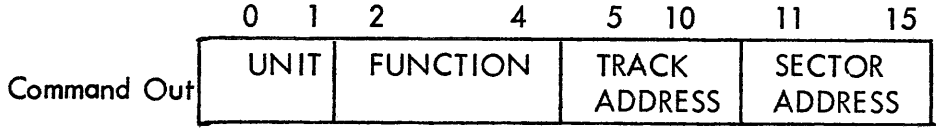
INTRODUCTION

The formatter can control up to 4 each MEMOREX 651 Flexible Disk Drives, each drive capable of seeking between tracks independent of the other drives. However, only one drive at a time can transfer data. A write protect bit can be recorded at the time a track is initialized to allow selected records to be protected. An error detection word is recorded after the address during initialize and after a data record. This allows automatic error detection during read back. The sector capacity is jumper selectable from 64 words to 1028 words; the record length then is programable between 2048 (track record) and the selected sector capacity.

All communication to the formatter is by 16 bidirectional timed multiplexed lines with 4 function select input lines. Also, status lines to generate interrupts are available from the Formatter.

COMMAND FORMAT

When the command function input is true the 16 data lines are defined as follows:



Bits 0-1 Contain the drive select bits

Bit 2 Defines sector/track record during write or read operation, use as write protect override during initialization

Bits 3-4 Defines operation

00 Rezero
01 Read
10 Write
11 Initialize

Bits 5-15 Defines address of requested data field.
(Initiates seek if different than present address)

STATUS FORMAT

When the status function is true, the 16 data lines are defined as formatter status.

	0	1	2 3	4	5	6&7	8 11	12 15
Status In	DF	AM	Rd Error	Wrt Error	Sel Error	Spare	Busy Seek	On Line

Bit 0 — Data Flag - when true indicates that the formatter is ready to accept the next word when writing, or the next word is available when reading. This Bit is reset when a Data In or Data Out function is true.

Bit 1 — Address Mark Flag - When true indicates that the address mark will be on the data lines when the Data In function is true.

Bit 2 — Error indication that the specified address not found within 2 revolutions.

Bit 3 — Error indication that a error check was detected - either address or data field.

Bit 4 — Write error - indication that selected drive unsafe, latch is set or write attempt on protected record.

Bit 5 — Select error - attempt to select either more than one drive or two non-existant drives

Bit 6&7 — Spare

Bit 8-11 — Busy Seeking - indication that drive 0-3 is not on specified track.

Bit 12-15 — On line - indication that drive 0-3 is not on line (drive motor off).

AED 2500 FLEXIBLE DISK FORMATTER

Data Input

When the data in function is true the data lines will indicate the contents of the output buffer of the formatter. The data will be valid only for 64 microsec. after the data flag goes true. When reading address marks, the data lines will also be valid for 64 microsec. after the address mark flag goes true.

Data Output

When the data out function is true, the formatter input buffer will be set to the status of the data lines. When writing, the data out commands must be received within an average of 64 microsec. but in no case longer than 128 microsec. after the data flag is set. If the above requirements are violated, the record will be completed by writing zeros until the sector/ track is full. An interrupt line is available to indicate that the full record is written.

Controls

Write Protect Switch - When on and track record selected during an initialize, the address mark will have a write protect bit recorded. When off, write of a protected sector/track is inhibited.

Initialize Switch - When on allows address marks to be written. If off, the initialize function is inhibited.

Logical Select Switches - Assigns address to each physical drive. If more than one drive is at the same address a select error is indicated when selection is commanded.

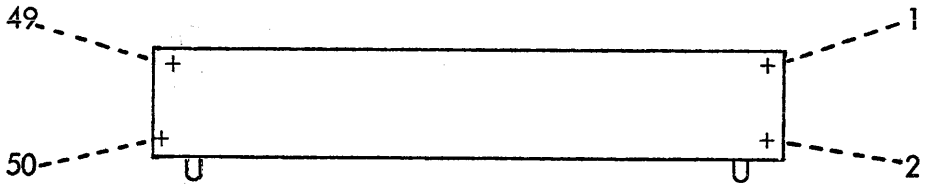
Indicators

The following status indications are displayed on the front panel.

Select	One for each drive
Seek Error	Same as bit 2 of status
Data Check Error	Same as bit 3 of status
File Unsafe	Any drive unsafe
Select Error	More than one drive selected or requested drive address does not exist.

Connector J1

3M part no. 3433-1003 (mates with 3M part no. 3425-0000)



As viewed from pin side

PIN #	SIGNAL
1	-D8
3	-D9
5	-D3
7	-D2
9	
11	-D15
13	-Data Out
15	-D7
17	
19	-D6
21	-D5
23	-Command Out
25	-D14
27	-Status In
29	-D4
31	-D1
33	-Data Flag
35	-DØ
37	-D11
39	-Device End
41	-D12
43	-D10
45	-IPL
47	-D13
49	-Data In

All signals are low true

Note: All even numbered pins 2-------48 are logic ground

FUNCTIONAL CHARACTERISTICS

DISK DRIVE

GENERAL OPERATION

The drive consists of control and read/write electronics, disk drive motor, read/write head, head actuator, track access mechanism, and removable disk. The primary functions performed by the drive are:

* Receive and generate control signals
* Access the appropriate track
* Write or read data upon command

The internal functions of the drive and the required interface signals to and from the using system are shown in Figure 1. The Read, Write, Safety and Control Logic are the interface electronics between the formatter and drive. The Track Positioning Actuator positions the read/write head to the desired track on the disk. The Head Load Actuator loads the disk against the read/write head and data may then be recorded or read from the disk. Each of the logic blocks and signal names shown are later discussed under Logic and Analog Functional Descriptions.

The electronics are packaged on one PCB. The PCB contains:

1. Sector/Index Detector Circuits
2. Track Position Actuator Driver
3. Head Load Actuator Driver
4. Read/Write Amplifier and Transition Detector
5. Data/Clock Separation Circuits
6. Safety Sensing Circuits

An electrical stepping motor (Track Position Actuator) and lead screw positions the read/write head. The stepping motor rotates the lead screw clockwise or counterclockwise in 15° increments. A 15° rotation of the lead screw moves the read/write head one track position. The using system increments the stepping motor to the desired track. Track verification is accomplished by checking track addresses.

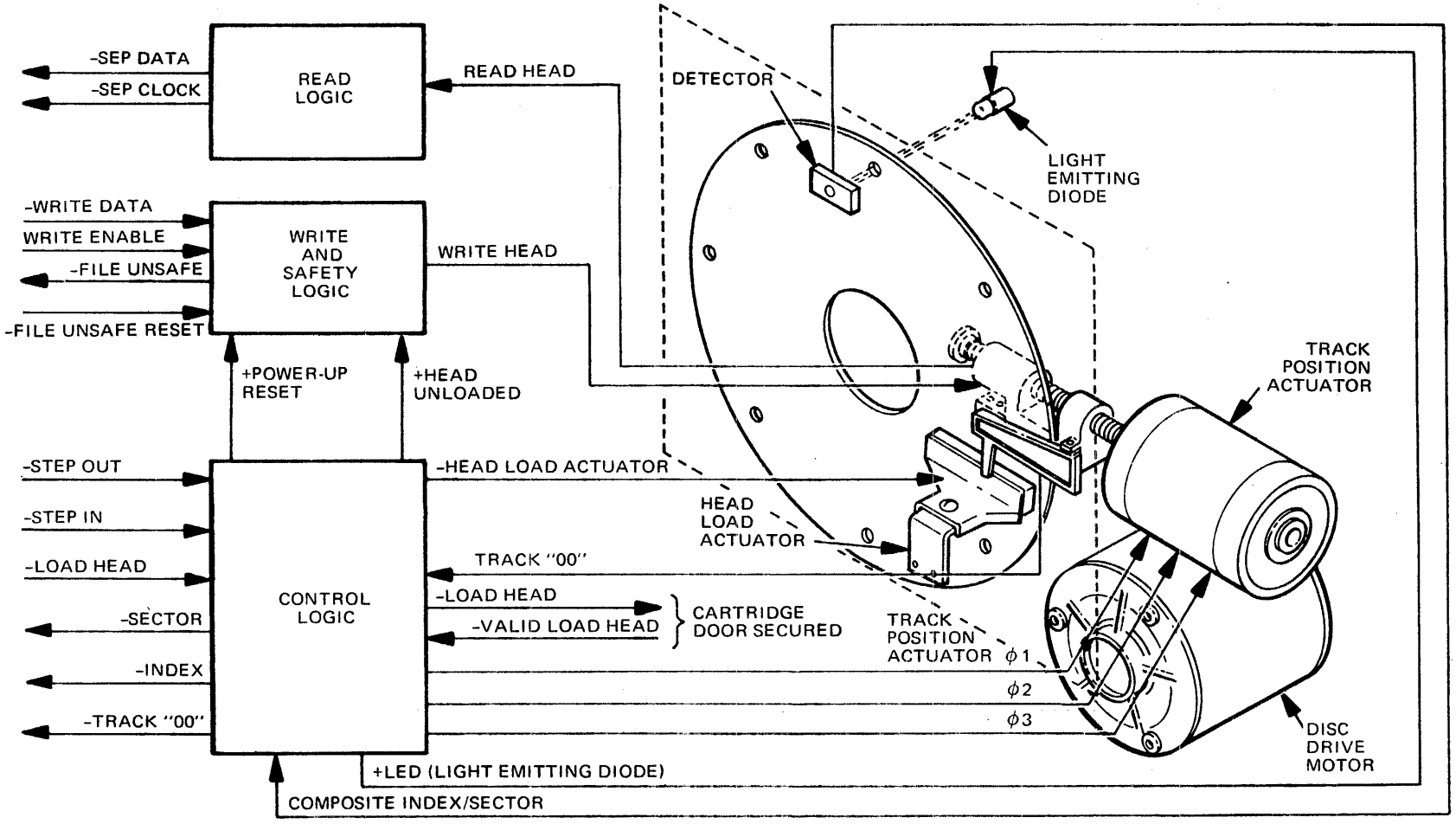


Figure 1. Functional Diagram

The disc drive motor rotates the spindle at 375 rpm through a belt-drive system. 50 or 60 Hz power is accommodated by means of a stepped pulley. A registration hub, centered on the face of the spindle, positions the disc. A clamp (that moves in conjunction with the insertion door) fixes the disc to the registration hub.

The read/write head is in direct contact with the disc. The head surface has been designed to obtain maximum signal transfer to and from the magnetic surface of the disc with minimum head/disc wear. The write portion of the head is wider than the read portion. When reading with a narrow head, a normal deviation from the center of the track does not affect the signal-to-noise ratio, and permits disc interchangeability from unit to unit.

The read/write head is mounted on a carriage that is moved by the lead screw. As shown in Figure 2, head load is achieved when the disc is lightly loaded against the rigidly mounted head by moving a load pad against the disc with a solenoid actuated bail. Head to disc compliance is achieved by restraining the disc between the head and the load pad.

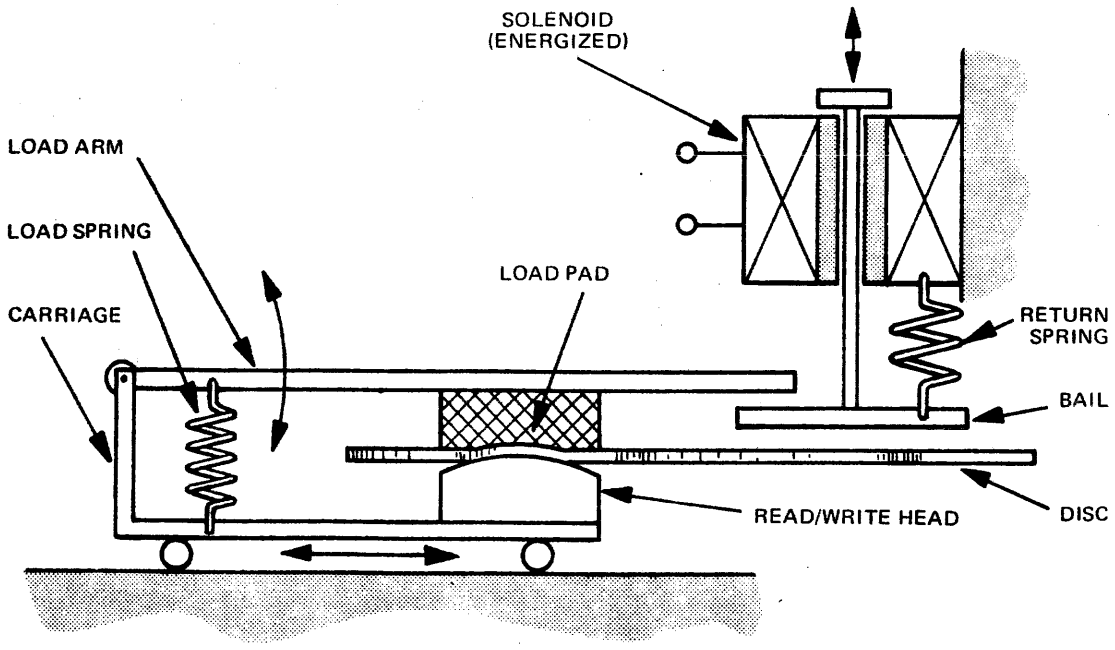


Figure 2. Head Load Mechanical Assembly

The disc is vertically mounted in the 651 it rotates at 375 rpm in a plastic envelope, which protects and cleans the recording surface during operation. The disc, 7.5 inches in diameter, has 32 holes spaced around the periphery for sector definition. There is also one additional hole for indexing. Figure 3 shows the disc cartridge and disc configuration.

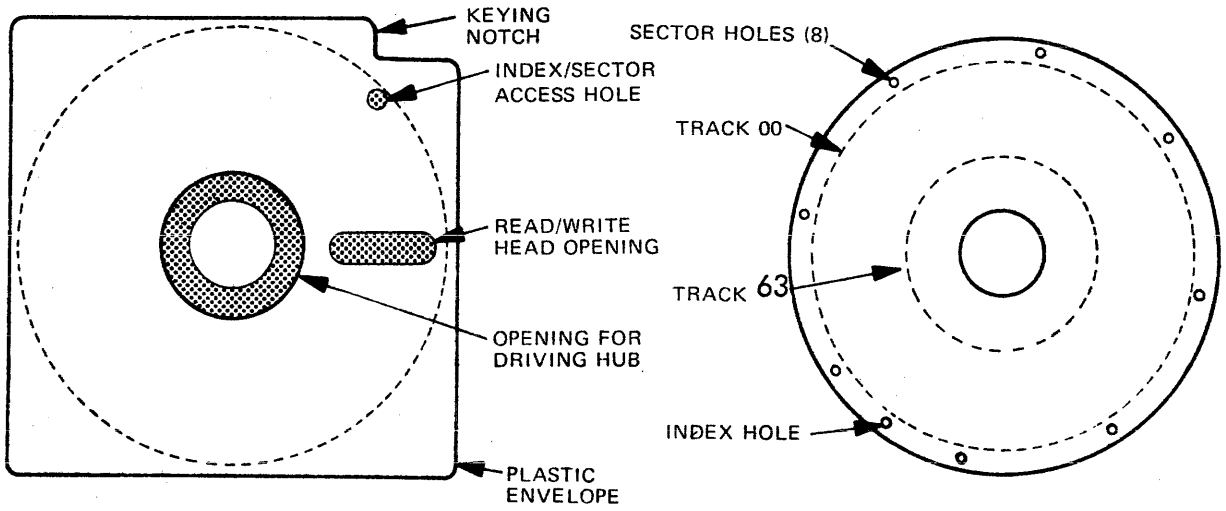


Figure 3. Disc Cartridge and Disc Configuration

LOGIC AND ANALOG FUNCTIONAL DESCRIPTIONS

This section discusses each logic block and signal name shown in Figure 1. The descriptions are divided into each of three logic blocks: Control, Write and Safety, and Read.

Control Logic

The basic functions of the Control Logic are to place the read/write head on the proper track, hold the disc against the head for write or read operations, and indicate disc rotational position. Control and formatter functions are as follows.

STEP OUT — Increments the Track Position Actuator. Each pulse moves the head one track outward from the center of the disc.

STEP IN	Increments the Track Position Actuator. Each pulse moves the head one track inward toward the center of the disc.
LOAD HEAD	Loads or unloads the disc from the read/write head.
SECTOR and INDEX	Provides disc sector and index position information. Each signal is a separate output. These pulses are generated from equally spaced holes located around the periphery of the disc (Figure 3) and are used for the formatting and orientation of data on the disc.
TRACK 00	Indicates when the read/write head is located at Track 00.

Transducer signals between the 2500 Control Logic and electromechanical assemblies are as follows:

POWER-UP RESET	Resets the internal logic to the proper state when power is turned on.
HEAD UNLOADED	Logic signal to the Write and Safety Logic to insure that the disc is loaded against the read/write head before write operations begin.
HEAD LOAD ACTUATOR	Energizes the solenoid shown in Figure 2. It is a function of LOAD HEAD .
TRACK 00	Switch closure indicating that the read/write head is located at Track 00.
LOAD HEAD, VALID LOAD HEAD	Switch closure interlock indicating that the cartridge door is secured. If this condition is not satisfied, the read/write head cannot be loaded.

TRACK POSITION ACTUATOR	Driving function to increment the Track Position Actuator motor clockwise or counterclockwise. It is a function of STEP OUT or STEP IN.
LED	Provides power to the Light Emitting Diode (LED).
COMPOSITE INDEX/SECTOR	Detector signal input to the Control Logic. As shown in Figure 3, 32 holes (0.10 inches diameter) divide the disc into equal sectors. The ninth hole (same diameter) spaced midway between two sector holes indicates one disc revolution. The LED and Detector (photo transistor) are placed on opposite sides of the disc (Figure 1). As the disc revolves, the holes pass between the LED and Detector illuminating the Detector and turning it on. The Detector output is shaped by a threshold detector and an output pulse is obtained. Output is normally at +5 Volts with a transition to 0 Volts for the pulse. Internally within the Control Logic, the INDEX and SECTOR signals are separated and are transmitted via separate interface lines.

Write and Safety Logic

The basic function of the Write and Safety Logic is to convert digital data received from the user into analog form for recording on the disc, and to insure that the file is in proper condition before recording begins. Formatter functions are as follows:

WRITE DATA	A generated composite signal consisting of alternating data and clock
WRITE ENABLE	A gating function activated during the write operation. This signal is used to control the recording of data on the proper track and sector.

Read/Write Capability	Designed to be used as a file in applications requiring recording and retrieving of data on a disk interchangeable basis.
Compact	Small and compact allows the designed more freedom for integration into a system.
Interlocks	Contains interlocks which prevent damage to a disk during loading or unloading
Write Protect	Logic is provided to disable the write circuits should the user wish to protect data recorded on the disk.
Reliability	Designed for trouble-free operation with exceptionally reliable data handling capabilities.

OPTIONS

The following options can be provided with the 2500

Power	Available for 220 Vac 50/60 Hz applications .
Chassis Slides	Available with chassis slides where there are space limitations and easier accessibility is desired for servicing.

FILE UNSAFE	Any one of the underlisted electronic conditions within the 2500 can produce this signal and disable the write driver circuits: 1. Write enable and no write current. 2. Write current and no write enable. 3. Write enable and head not loaded. 4. Write enable and no write data.
FILE UNSAFE RESET	Resets a latch in the Write and Safety Logic block when conditions have been corrected which produced the FILE UNSAFE signal. Initially, when power comes on, the latch is reset automatically within the 2500.

Transducer signal communication between the 2500 Write Logic and the write head is as follows:

WRITE HEAD	Supplies current to the write head. The direction of this current reverses each time a WRITE DATA pulse is received.

Read Logic

The basic function of the Read Logic is to receive pulses from the disc and convert this composite signal into separate clock and data lines. Data and clock come from the Read Logic block when the disc is loaded onto the head. Formatter functions are as follows:

SEP DATA	Digital data bits read from the disc.
SEP CLOCK	Digital clock bits read from the disc.

Installation

ENVIRONMENT

The file is designed to operate within the temperature and humidity ranges specified in Table 2.

TABLE 2. TEMPERATURE-HUMIDITY RANGES FOR FILE AND DISC CARTRIDGE

	OPERATING	NON-OPERATING
Temperature	60°F to 100°F	40°F to 120°F
Relative Humidity	20% to 80%	90% max
Wet Bulb Temperature (max)	78° F	
Heat Generated (max)	346 BTU/hr	

The disc must be used within the operating temperature and humidification conditions specified above to ensure interchangeability. Also, exposure of the disc to magnetic fields greater than 50 oersteds can cause loss of data.

Performance of the 2500 can be seriously degraded by improper environment. Dust and other airborne contaminants are a major threat to the operating life of the recording components and the actuator. The file utilizes a vertical disc drive arrangement to minimize particle settling at the head/disc area. Environmental protection similar to that used for magnetic tape and removable disc pack installations should be observed.

CONNECTORS AND CABLES

All internal cables are factory installed prior to shipment.

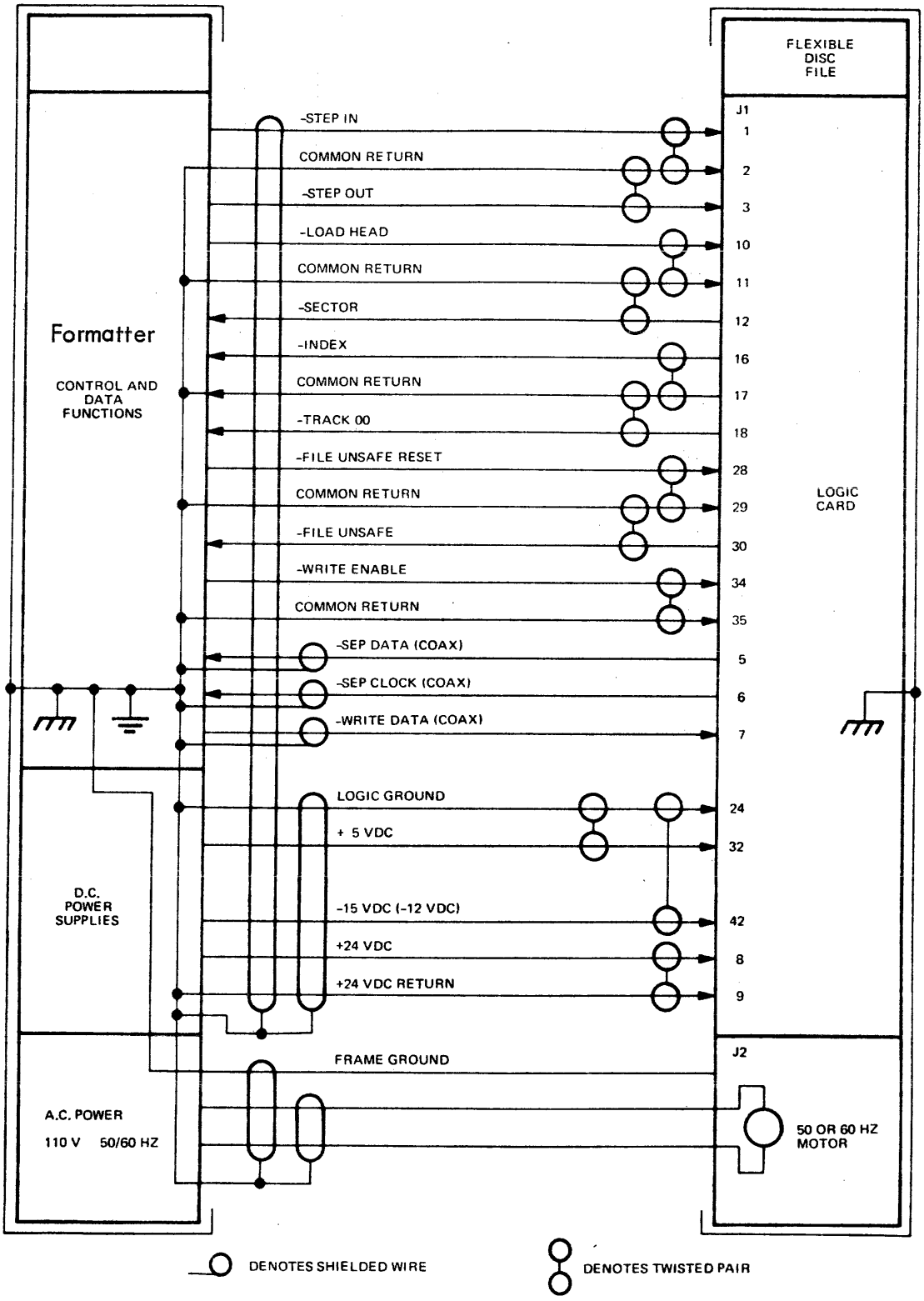


Figure 13. Flexible Disc Wiring Diagram

POWER

The power inputs required are listed in Table 7.

TABLE 7. POWER PARTITIONING

POWER SIGNAL DESIGNATION	CONNECTOR AND PIN	POLARITY	DRIVE CHARACTERISTIC	PULSE WIDTH	COMMENTS
LOGIC GROUND	J1-24	Logic ground	Logic ground	Logic ground	DC power supply ground
+5VDC	J1-32	Positive	+5 ± 0.10VDC @ 0.6A 50 mv ripple	Power level	Logic Power supply
-15VDC	J1-42	Negative	-15 ± 0.30VDC @ 0.12A 50 mv ripple	Power level	DC power supply for read/write amplifiers
(-12VDC)*			-12 ± 0.25VDC @ 0.12A 50 mv ripple		
+24VDC	J1-8	Positive	+22 ± 1VDC @ 2.0A 100 mv ripple	Power level	DC power supply for head positioning motor and head load solenoid
+24VDC RETURN	J1-9	DC Power ground	DC power ground	DC power ground	+24VDC power ground
110 VAC 50/60Hz	J2 Three terminal socket	Line AC	110 ± 10% VAC @ 0.75A 50/60 ± 0.5Hz single phase	Line AC	Must be provided from a branch circuit protected at no more than 20 amperes.
FRAME GROUND	J2 Center Socket	Frame ground	Frame ground	Frame ground	Center socket of 3-wire AC socket

*May be used in lieu of -15 Volts with no modifications to the file or cables.

Operating Procedures

Operation of the 2500 is fully automated requiring no operator intervention during normal operation. The disc cartridge should be handled carefully when being inserted or removed from the 2500. The following paragraphs give procedures necessary for insertion of the disk cartridge in the 2500 and for cartridge handling. Also included are some suggested software procedures for handling error conditions which might occur during writing or reading operations.

CARTRIDGE LOADING AND HANDLING

The cartridge consists of the flexible disc encased in a plastic jacket. Wipe cushions are bonded to the inside of the jacket. The disc is housed and rotates between these cushions during normal operation. Figure 17 shows how the cartridge is inserted in the cartridge guide. This is accomplished by merely opening the door, inserting the cartridge into the cartridge guide, and closing the door.

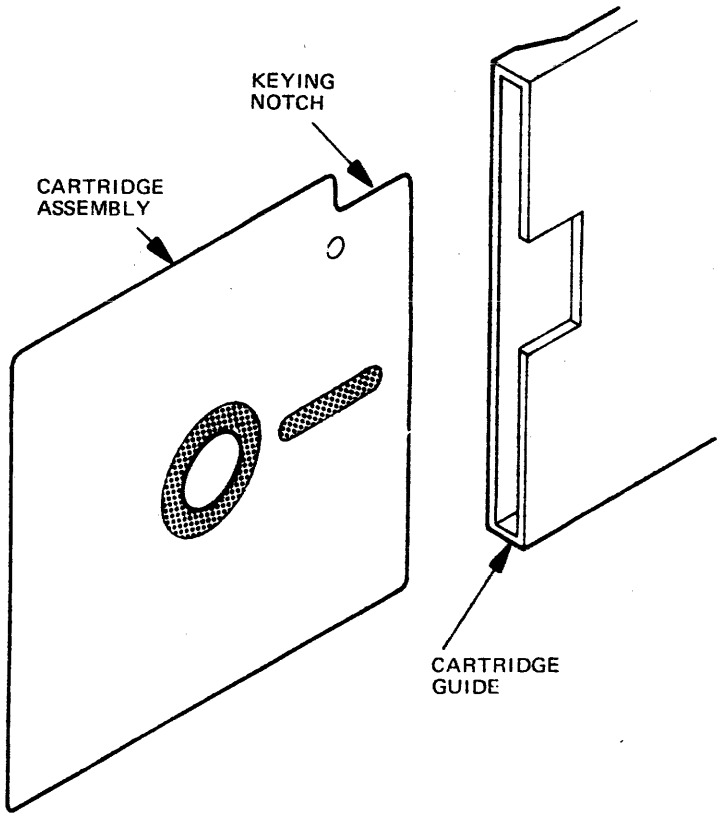


Figure 17. Cartridge Loading

When removed from the 2500, the cartridge is stored in a plastic coated envelope. to protect the cartridge, the same care and handling procedures specified for computer magnetic tape apply. These precautionary procedures are as follows:

1. Return the cartridge to its storage envelope whenever it is removed from file.

2. Store cartridges vertically.

3. Keep cartridges away from magnetic fields and from ferromagnetic materials which might become magnetized. Strong magnetic fields can distort recorded data on the disc.

4. Replace storage envelopes when they become worn, cracked, or distorted. Envelopes are designed to protect the disc.

5. Do not write on the plastic cartridge with a lead pencil or ball-point pen. Writing pressure may damage the disc.

6. Do not smoke while handling cartridges. Heat and contamination from a carelessly dropped ash can damage the disc.

7. Do not expose cartridges to heat or sunlight. The read/write head on the 2500 cannot properly track a warped disc.

8. Do not touch or attempt to clean the disc surface. Abrasions may cause loss of stored data.

ERROR DETECTION AND CORRECTION

Write Error

If an error occurs during a write operation, it will be detected on the next revolution by doing a read operation, commonly called a "write check". To correct the error, another write and write check operation must be done. If the write operation is not successful after 10 attempts have

been made, error correction should be attempted on another track. If the error still persists, the disc should be considered defective and discarded.

Read Error

Most errors that occur will be "soft" errors; that is, by performing an error recovery procedure the data will be recovered.

Soft errors are usually caused by:

1. Airborne contaminants that pass between the read/write head and the disc. These contaminants will generally be removed by the cartridge self-cleaning wiper.

2. Random electrical noise which usually lasts for a few μsec.

3. Small defects in the written data and/or track not detected during the write operation which may cause a soft error during a read.

The following procedures are recommended to recover from the above mentioned soft errors:

1. Reread the track 10 times or until such time as the data is recovered.

2. If data is not recovered after using step 1, access the head to the adjacent track in the same direction previously moved, then return to the desired track (i.e., if at track 20, then moved to track 30 where an error occurs, move to track 31, and return to track 30.)

3. Repeat Step 1.

4. If data is not recovered, the error is not recoverable.

CARTRIDGE GUIDE ASSEMBLY

FUNCTIONAL DESCRIPTION

File accessing components consist of the Cartridge Guide Clamp, Hub and Spindle, and Head Load Actuator assemblies. The purpose of this electromechanical assembly group is to properly position the cartridge and disk for accurate track addressing, place the disk in contact with the head, and rotate the disk.

CARTRIDGE GUIDE ASSEMBLY - Description

A cartridge inserted in the cartridge guide correctly positions the disk between the clamp assembly and the hub for proper rotation and track accessing when the drive motor is operating. The cartridge guide is mounted on pivots that permit it to be swung outward to provide access to other assemblies. An extension spring retains the cartridge guide in its normal position.

CARTRIDGE GUIDE ASSEMBLY - Removal

1. Remove Light Emitting Diode assembly
2. Disconnect and remove extension spring

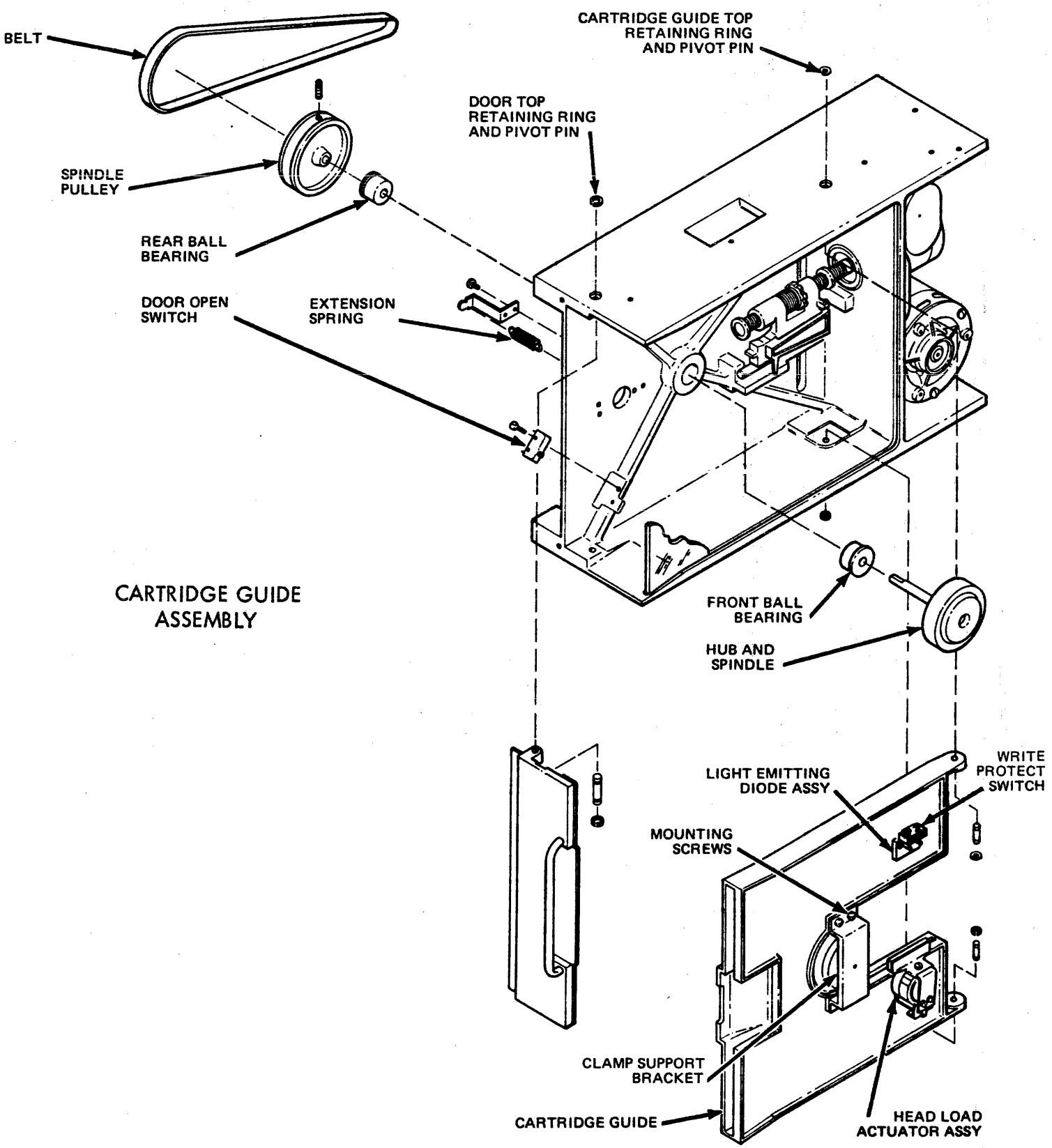
CAUTION

> Top and botton pivot pin retaining rings are different. When removing rings, identify for correct reinstallation. Bottom two rings are wavy in shape.

3. Remove Head Load Actuator assembly.
4. Remove top two pivot pin retaining rings.
5. Remove bottom two pivot pin retaining rings.
6. Remove tope and bottom pivot pins.
7. Pull cartridge guide straight out from drive front.

CARTRIDGE GUIDE ASSEMBLY - Replacement

1. Place cartridge guide in position.
2. Insert cartridge guide pivot pins.
3. Install top pivot pin retaining rings, making certain to use correct rings.
4. Install bottom pivot pin retaining rings.
5. Install extension spring.
6. Close door, and verify that cartridge guide actuates Door Open Switch.



CARTRIDGE GUIDE ASSEMBLY

CLAMP, HUB AND SPINDLE, AND DOOR ASSEMBLIES

CLAMP ASSEMBLY

DESCRIPTION

The Clamp Assembly consists of a ball bearing mounted rotary clamp that is spring-loaded to press the disk against the drive hub. The resulting friction causes disk and clamp rotation in response to hub rotation. The clamp must be aligned symetrically with the hub to avoid eccentricity during rotation.

ALIGNMENT

1. Apply ac power
2. Verify that door is closed and no cartridge is installed
3. Slightly loosen four screws in clamp support bracket sufficiently to withdraw clamp from contact with hub.
4. Press clamp support bracket against cartridge guide, and check clamp rotation for wobble. If clamp rotation is true, hold clamp support bracket against cartridge guide to maintain clamp-to-hub contact, and tighten four screws; if not, repeat steps 3 and 4.
5. Recheck clamp rotation for eccentricity.

REMOVAL

1. Open door.
2. Remove four Clamp Assembly mounting screws from clamp support bracket.
3. Remove Clamp Assembly.

REPLACEMENT

1. Open door.
2. Position Clamp Assembly in cartridge guide.
3. Install four Clamp Assembly mounting screws.
4. Perform Clamp Assembly alignment.

HUB AND SPINDLE ASSEMBLY

DESCRIPTION

The Hub and Spindle Assembly consists of a hub and spindle that mounts in ball bearings in the baseplate access hole. A spindle pulley is installed on the spindle outside the baseplate. The assembly is driven by the drive motor and belt to provide disk rotation within the Cartridge Assembly.

REMOVAL

1. Remove belt from pulleys
2. Disconnect and remove extension spring.
3. Swing cartridge guide out on pivots.
4. Loosen spindle pulley set screw, and remove pulley.
5. Remove hub and spindle.
6. Remove both ball bearings from baseplate hole.

REPLACEMENT

1. Swing cartridge guide out on pivots.
2. Install ball bearings in baseplate spindle hole.
3. Install hub spindle in ball bearings.
4. Slide spindle pulley onto spindle.
5. Press pulley against bearing to eliminate axial play, and tighten pulley set screw.
6. Position cartridge guide, and connect extension spring.
7. Install belt.

DOOR ASSEMBLY

DESCRIPTION

The Door Assembly is mounted to the baseplate on pivots, and provides access to the cartridge guide to actuate the Door Open Switch. The door must be closed for disk file operation.

DOOR ASSEMBLY (continued)

REMOVAL

1. Disconnect and remove extension spring.
2. Swing cartridge guide out on privots
3. Remove top and bottom door pivot pin retaining rings.
4. Remove top and bottom door pivot pins.
5. Remove door.

REPLACEMENT

1. Swing cartridge guide out on pivots.
2. Position door and align pivots with pivot pin holes.
3. Insert top and bottom door pivot pins.
4. Install retaining rings on pivot pins.

HEAD LOAD ACTUATOR ASSEMBLY AND DOOR OPEN SWITCH

HEAD LOAD ACTUATOR ASSEMBLY

DESCRIPTION

The Head Load Actuator Assembly consists of a solenoid assembly with an armature extension that operates a bail and wiper pad. The purpose of the assembly is to control the action of the load arm, which is spring-loaded to press the disk in the cartridge guide against the head mounted on the carriage assembly. When the solenoid is deactuated, armature spring action moves the bail away from the disk. The bail contacts the load arm tab, and bail travel moves the load arm pressure pad out of contact with the disk. The solenoid is energized by the -LOAD HEAD signal. When the solenoid is actuated, the armature moves the bail toward the disk, which places the wiper pad lightly in contact with the cartridge, and disengages the bail from the load arm tab. The load arm spring moves the released load arm toward the disk, and the load arm pressure pad presses the disk against the head. The position of the bail on the armature extension is adjustable, and must be adjusted so that the bail is out of contact with the load arm tab when the solenoid is actuated, but accomplishes the required amount of load arm travel when the solenoid is deactuated. The load arm spring must be capable of supplying a pressure of 10 to 18 grams between the load arm pressure pad and the head.

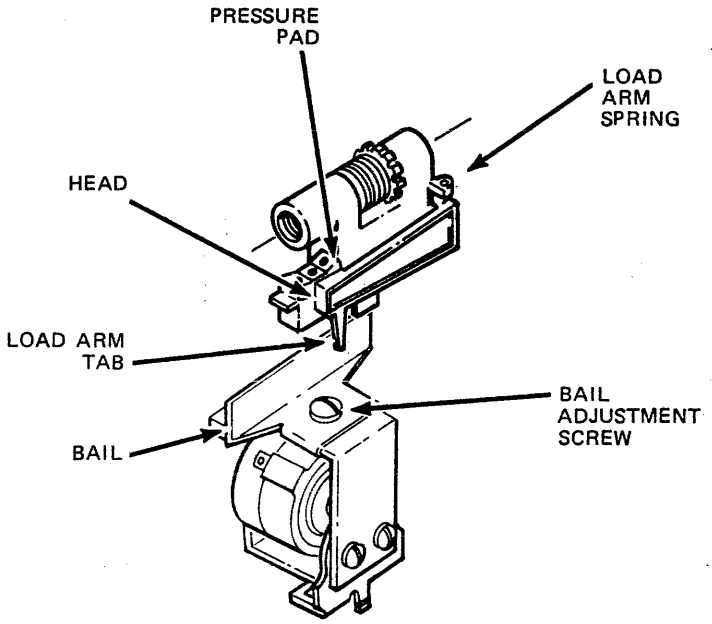
LOAD ARM SPRING FORCE CHECK

1. Load head (initiate -LOAD HEAD signal) so that actuator solenoid is energized (or group TP28 on PCB).
2. Connect gram gage to load arm tab.
3. Pull gage until load arm pressure pad breaks contact with head. Gage must indicate 10 to 18 grams; if not, replace carriage assembly.

ACTUATOR BAIL ALIGNMENT CHECK

1. Load head.
2. Access track 00

NOTE Track accessing may be accomplished normally by interfacing equipment procedures, or manually step the carriage to access a track, a jumper must be connected to chassis ground. Touching the jumper free end to PCB test point TP26 steps the carriage in, touching it to TP27 steps the carriage out.



3. Verify that the clearance between bail and load arm tab is .020 +.010, -.001 in.
4. Unload head, and verify that bail moves load arm so that pressure pad will not contact the disk cartridge during cartridge interchange.
5. Load head, and access track 31.
6. Repeat steps 3 and 4.
7. Load head, and access track 63.
8. Repeat steps 3 and 4.
9. If requirements of steps 3 and 4 are not met at all three accessed tracks, perform adjustment procedure.

ACTUATOR BAIL ADJUSTMENT PROCEDURE

1. Load head.
2. Loosen actuator bail adjustment screw.
3. Adjust bail position to correct alignment check discrepency.
4. Tighten bail adjustment screw.
5. Repeat alignment check.

CAUTION

When performing the following removal and replacement procedures, use care to prevent bail or fingers from contacting head.

REMOVAL

1. Remove PCB
2. Disconnect actuator leads from connector PC1.
3. Disconnect and remove extension spring.
4. Swing cartridge guide out on pivots.
5. Remove actuator mounting screw from back of cartridge guide.

   Remove actuator assembly, carefully guiding leads through baseplate access hole to avoid damaging crimp pins.

REPLACEMENT

1. Swing cartridge guide out on pivots.
2. Insert actuator leads through baseplate access hole.
3. Position actuator assembly on cartridge guide, making certain that actuator bail is between load arm tab and cartridge position.
4. Install mounting screw through cartridge guide.
5. Connect actuator leads to connector PC1.
6. Perform actuator bail alignment check before placing disk in service.

DOOR OPEN SWITCH

DESCRIPTION

The Door Open Switch is a two position button actuator switch, which is spring-loaded to the contacts-open position (door open). When the door is closed, the extension spring seats the cartridge guide so that the switch is actuated. When the door is open, the cartridge guide is released, and the switch is deactuated. The switch contacts enable the head load actuator solenoid control circuits; the head cannot be loaded when the door is open.

REMOVAL

1. Remove PCB.
2. Disconnect switch leads from PC1.
3. Disconnect and remove extension spring.
4. Swing cartridge guide out on pivots.
5. Remove switch retaining screws.
6. Remove switch, carefully guiding leads through baseplate access hole.

REPLACEMENT

1. Insert switch leads through baseplate access hole, and position switch on baseplate.
2. Install switch retaining screws.
3. Connect leads to PC1.
4. Before placing drive in service, verify that cartridge guide actuates switch when properly seated.

HEAD CARRIAGE AND HEAD POSITION ACTUATOR ASSEMBLIES

FUNCTIONAL DESCRIPTION

Track accessing components consist of the Head Carriage, Head Position Actuator, and Track 00 Switch assemblies. The purpose of this assembly group is to provide file access by track address.

DESCRIPTION

The recording head is mounted on a carriage that travels parallel to a horizontal radius of the vertically mounted disk. The carriage is driven toward or away from the disk center by a rotating screw on which the carriage is mounted. The screw is rotated in either direction by the head position actuator. This actuator is a stepping motor that rotates the screw in 15 degree increments. The linear head travel resulting from one rotation increment is equal to the center-to-center distance between two adjacent tracks on the disk. Track accessing depends upon the initial alignment of the carriage on the screw so that the head is radially positioned over a track centerline. Carriage stops are mounted on either end of the screw to prevent inadvertant carriage overtravel. The stops must be correctly positioned after the head radial alignment is complete.

SPECIAL TOOLS

Field Service Alignment Cartridge, PN 204136

HEAD RADIAL ALIGNMENT CHECK

1. Perform steps 1, 2, and 3 of head radial alignment procedure.
2. Compare amplitudes of two adjacent oscilloscope displayed lobes. They must be equal within 40 percent.
3. Access track 30, and then reaccess track 31.
4. Repeat step 2
5. If amplitudes are not as specified in step 2, perform head radial alignment procedure.
6. Disconnect and remove test equipment.

HEAD RADIAL ALIGNMENT PROCEDURE

NOTE

Both drive and Field Service Alignment disk must be exposed to ambient room temperature for at least 20 minutes prior to performing alignment procedure.

1. Insert Field Service Alignment cartridge into cartridge guide.
2. Track accessing may be accomplished normally, by interface programming procedures, or manually. To manually step the carriage to access a track, a jumper must be connected to chassis ground. Touching the jumper free end to PCB test point TP26 steps the carriage in, touching it to TP27 steps the carriage out.
3. Connect oscilloscope direct probes to differentially monitor PBC test points TP1 and TP2 (head signals). Set oscilloscope to sync on PCB test point. Set time base to 160 milliseconds per sweep; set amplitude to 50 vm/cm.

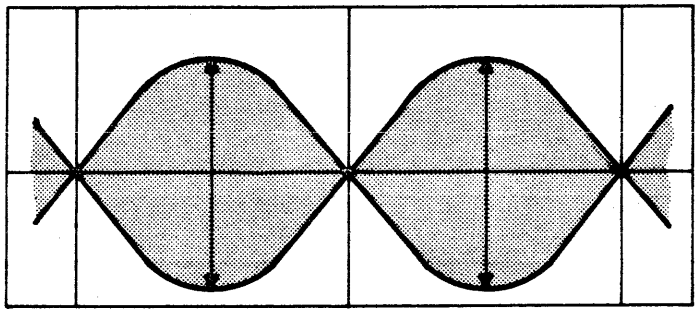
NOTE

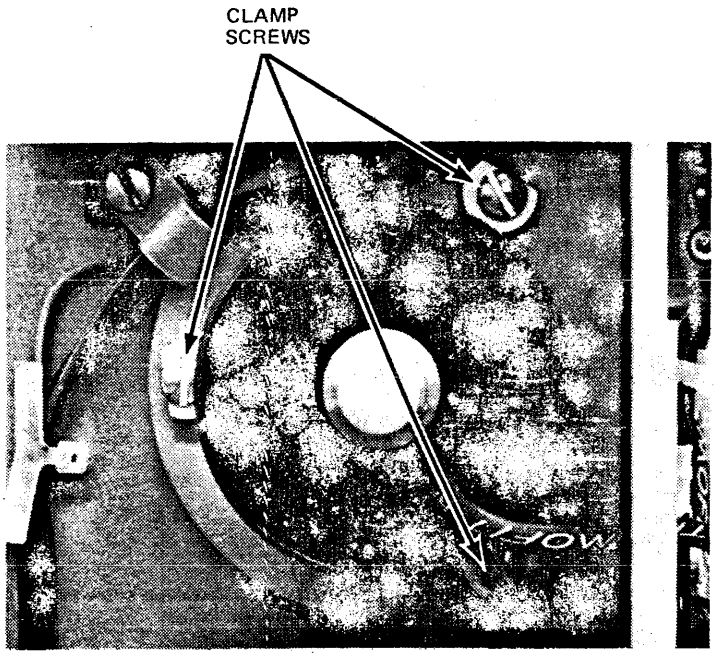
An alignment pattern is recorded on Field Service Alignment disk track 31. The oscilliscope should now display a signal envelope.

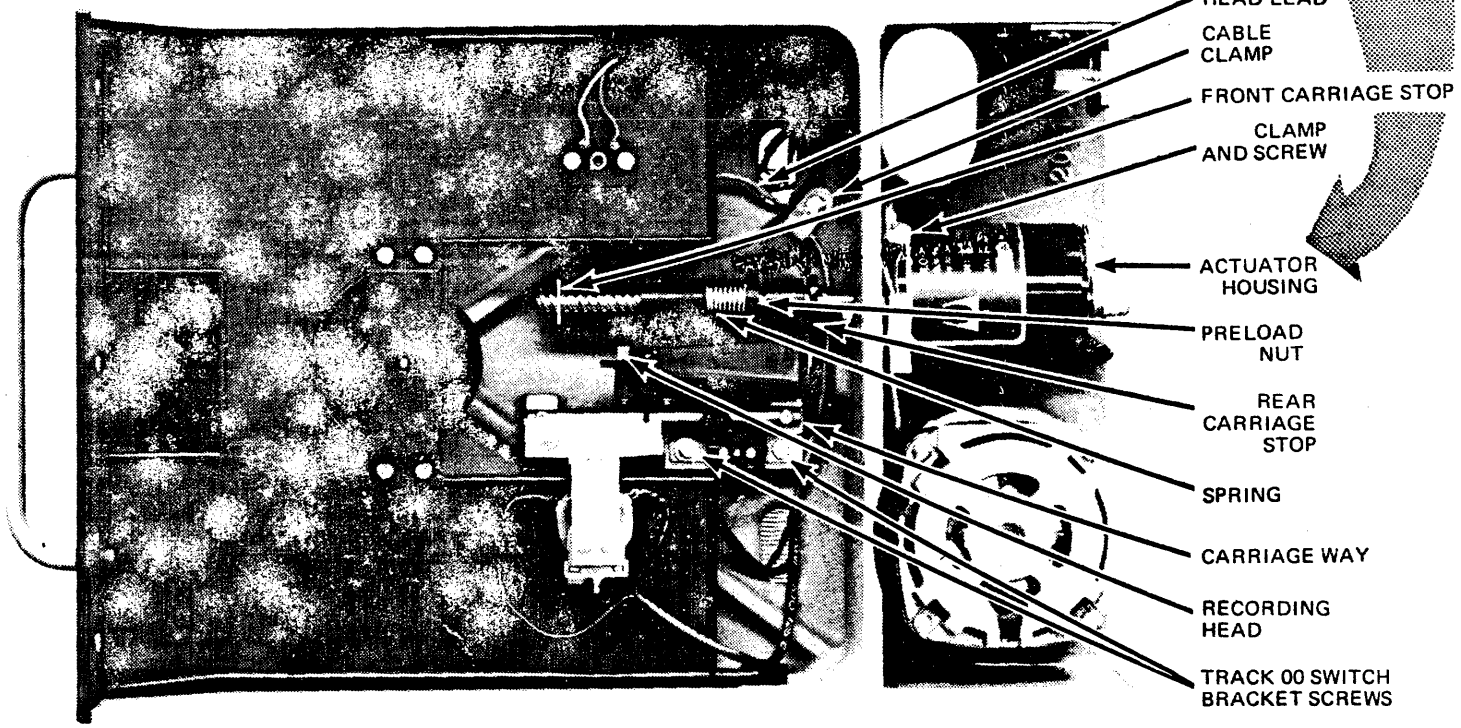
4. Assure that phase Ø2 of the stepping motor is energized at track position 31 (TP17).
5. Loosen three screws in track position actuator housing-to-baseplate clamps sufficiently to permit housing rotation.
6. Rotate housing until oscilloscope displays distinct lobe patterns and then adjust housing radial position until two adjacent lobes are equal in amplitude.
7. Retighten clamp screws without disturbing alignment.
8. Access track 30, and then reaccess track 31.
9. Compare amplitudes of two adjacent lobes. They must be equal within 5 percent; if not, repeat steps 5, 6, and 7.
10. Access track 32, and then reaccess track 31.
11. Repeat step 9.
12. Disconnect and remove test equipment.

HEAD RADIAL ALIGNMENT

Proper oscilloscope display for radial head alignment (as shown in figure below).







CARRIAGE STOP ADJUSTMENT PROCEDURE

1. Perform head radial alignment check.
2. Load head, and access track 00.
3. Loosen rear carriage stop set screw.
4. Insert a 0.007-inch gage (one IBM card) between rear carriage stop and carriage.
5. Press rear carriage stop firmly against gage, tighten set screw, and remove gage.
6. Access track 63.
7. Repeat steps 2 through 4 for front carriage stop.

HEAD CARRIAGE AND TRACK POSITION ACTUATOR REMOVAL AND REPLACEMENT

REMOVAL

1. Remove PCB.
2. Disconnect actuator leads from connector PC1.
3. Loosen front carriage stope set screw, and remove stop.

CAUTION

The head lead can be damaged by stress, crimping or excessive flexing. To avoid damage, it must be handled with care. When removing the carriage and lead, the cable clamp location and lead routing should be noted to assure correct reinstallation.

4. Remove cable clamp from head lead, and note routing.
5. Loosen three clamp screws and release actuator from clamps holding actuator to baseplate.
6. Rotate actuator lead screw to disengage it from carriage. Carefully guide actuator leads through baseplate access hole so as not to damage crimp pins, and remove actuator and screw.
7. Remove carriage from way, and carefully guide head lead and connector through access hole, avoiding tension on lead.

HEAD CARRIAGE AND TRACK POSITION ACTUATOR (continued)

REPLACEMENT

1. Insert head lead and connector through baseplate access hole, and install carriage on way.
2. Insert actuator screw through baseplate access hole into unthreaded opening in carriage.
3. Insert spring and preload nut into carriage opening, and thread preload nut onto actuator screw.
4. Press carriage toward actuator to compress spring, and rotate actuator screw to thread screw into threaded opening in carriage.

NOTE

Pressure exerted in step 4 establishes carriage assembly preload force. Preload force is correct when gap is less than 1/16 of an inch(the width of a nickle) and clearance exists between the nut and carriage.

5. Position actuator on baseplate, and install clamps and retaining screws.
6. Install front carriage stop on actuator screw, and tighten set screw.
7. Connect actuator leads to connector PC1.
8. Install head lead in cable clamp as shown, allowing 4-1/2 inches of lead between clamp and head. Carefully route lead and connector through baseplate access hole.
9. Perform head radial alignment procedure and carriage stop adjustment procedure prior to placing drive in service.

TRACK 00 SWITCH ASSEMBLY

DESCRIPTION

The Track 00 Switch is a two-position actuator button switch that generates the TRACK 00 head position status signal. The switch is actuated by a cam surface on the carriage assembly when the carriage is in the track 00 position. Following the head radial position alignment, this switch must be positioned so that it is actuated when the head is positioned at track 01, and is deactuated when the head is stepped to track 02.

NOTE

The switch circuit is ANDed with the actuator motor circuit to indicate a true Track 00. In this manner, switch hysteresis and adjustment tolerance are not critical. Switch closure must be measured at the switch, not the Track 00 line.

ADJUSTMENT CHECK

1. Load head, and access track 01.
2. Verify that Track 00 Switch is actuated.
3. Access track 02.
4. Verify that Track 00 Switch is deactuated.
5. If condition specified in steps 2 and 4 are not met, perform Track 00 Switch adjustment procedure.

ADJUSTMENT PROCEDURE

1. Perform head radial alignment check
2. Loosen two retaining screws in bracket.
3. Slide bracket to right so that switch is deactuated.
4. Gently slide bracket to left until switch actuator button touches carriage cam; then exert pressure until hearing switch actuating click.
5. Tighten bracket retaining screws while holding switch in actuated position.

TRACK 00 SWITCH ASSEMBLY (continued)

ADJUSTMENT PROCEDURE

6. Access track 02, and verify that switch becomes deactuated. If not, slightly loosen left-hand bracket screw, and gently nudge bracket downward until switch is deactuated.
7. Perform Track 00 Switch adjustment check.

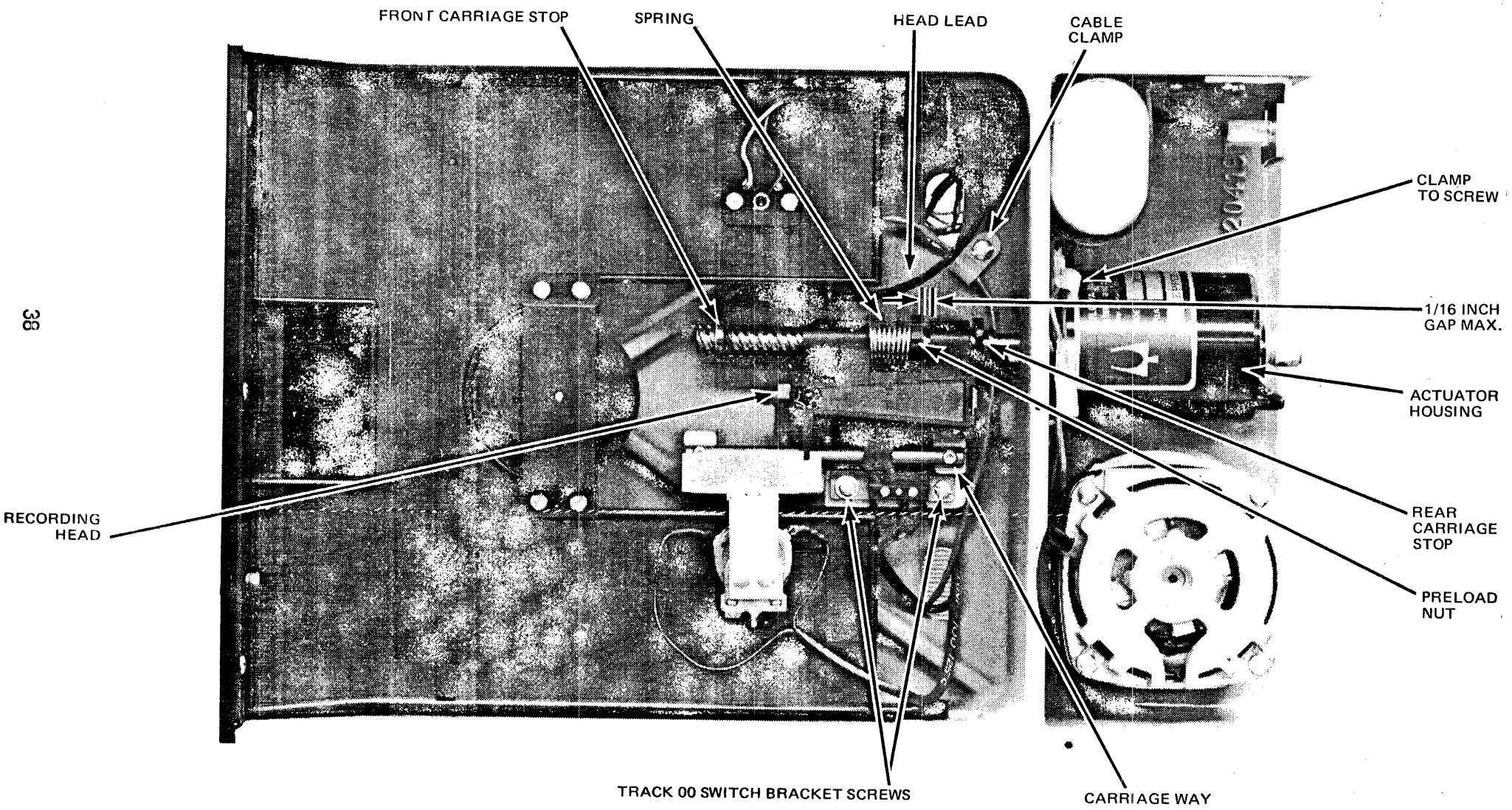
REMOVAL

1. Remove PCB.
2. Disconnect switch leads from connector PC1.
3. Remove retaining screws at either end of bracket.
4. Remove bracket and switch assembly, carefully guiding leads through baseplate access hole.

REPLACEMENT

1. Insert switch leads through baseplate access hole, and position bracket and switch on baseplate.
2. Install retaining screws in bracket.
3. Connect switch leads to connector PC1.
4. Perform Track 00 Switch adjustment procedure.

Track 00 Switch Assembly



DRIVE MOTOR ASSEMBLY

FUNCTIONAL DESCRIPTION

Index and sector accessing components consist of the drive motor and the index and sector sensing components. The latter are the Light Emitting Diode Assembly and the Photo Transistor Assembly. These components provide disk rotation and relative degree of rotation status signals.

DESCRIPTION

The drive motor is a constant speed ac motor used to drive the disk. The ac power to drive the motor is supplied by the host system. The drive motor operates whenever the required voltage appears across the J2 ac terminals.

REMOVAL

1. Turn off drive ac power.
2. Remove belt from pulleys.
3. Remove two screws from connector bracket to free bracket and connector. Do not disassemble connector from bracket.
4. Remove two capacitor strap screws and strap to free capacitor.
5. Remove belt guard and assembly wiring cable clamps.
6. Remove four motor-to-baseplate screws to free motor, and remove entire assembly, leaving wires and motor pulley connected.

REPLACEMENT

1. Insert motor shaft and attached motor pulley through baseplate access hole, and position motor on baseplate.
2. Install four motor-to-baseplate screws.
3. Install belt guard.
4. Position capacitor and strap, and install strap screws.
5. Position connector bracket with attached connector, and install two bracket screws.
6. Install belt on pulleys.

MOTOR PULLEY

DESCRIPTION

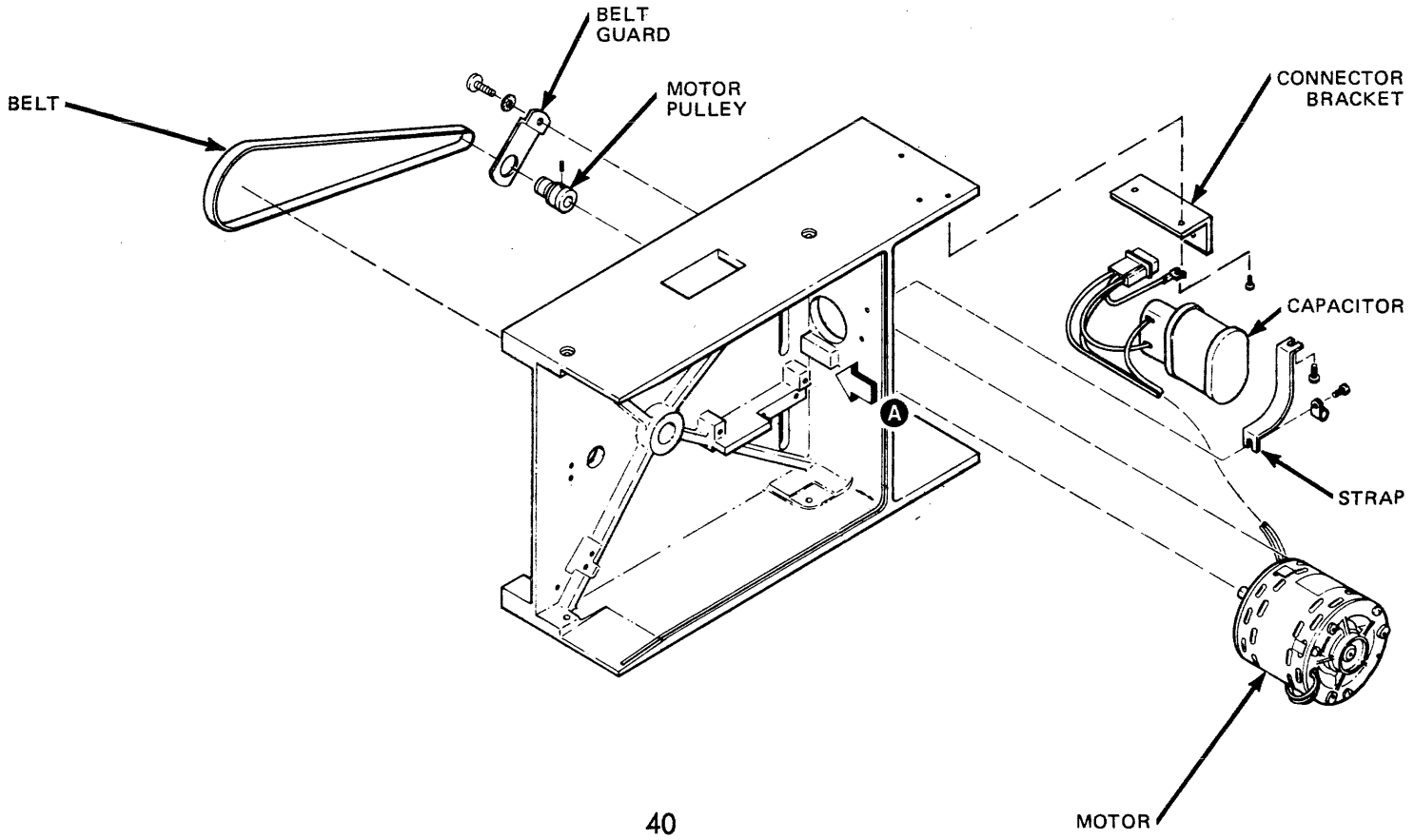
The drive motor may be operated by either 50-Hz or 60-Hz ac power. This is accomplished by use of a dual-radius motor pulley, which can be mounted on the motor shaft so that either the smaller radius pulley or the larger radius pulley faces away from the motor. The belt is installed on the pulley facing away from the motor. The motor pulley must be installed with the smaller radius pulley facing away from the motor for 50 Hz operation, and the larger radius pulley facing away from the motor for 50 Hz operation.

REMOVAL

1. Loosen set screw in pulley.
2. Slide pulley off end of shaft.

REPLACEMENT AND ADJUSTMENT

1. Determine frequency of drive motor power.
2. Engage pulley on end of motor shaft, directionally oriented according to preceding motor pulley description.
3. Align motor pulley with spindle pulley so that plains of rotation are aligned within 1/32 of an inch.
4. Tighten set screw in motor pulley.



INDEX AND SECTOR SENSING COMPONENTS

DESCRIPTION

These components consist of the Light Emitting Diode assembly, mounted on the front of the cartridge guide, and the Photo Transistor assembly, mounted behind the cartridge guide. The line of sight connecting these two components is perpendicular to the plane of the disk, and intersects the disk at the circle formed by the 32 sector holes and the index hole. When the disk is rotating, light emission from the light emitting diode actuates the photo transistor, which generates a 5-volt pulse, each time one of the 0.10-diameter holes in the disk exposes the photo transistor to the light emitting diode. An adjusting screw on the Photo Transistor assembly permits positioning the photo transistor along the arc of the disk holes so that the leading edge of the index/sector pulse occurs simultaneously with coincidence of the recording head and the geometric index or sector radius on the disk. This alignment is accomplished with the aid of the Field Service Alignment disk. Bursts of 16 transitions each are recorded on tracks 07 and 56 of this disk. The initial transition peak of the burst occurs 100 microseconds after the leading edge of the SECTOR pulse.

SPECIAL TOOLS

Field Service Alignment Cartridge, PN 204136

Read/Write Adapter Plug, PN 204296

ALIGNMENT CHECK

1. Perform steps 2, 3, (4 if applicable), 5 and 9 of index and sector alignment procedure.
2. Verify that first peak of burst occurs 100 $\pm$ 40 microseconds after start of oscilloscope sweep. Record time.
3. Access track 56.
4. Repeat step 2.
5. If tolerances specified in steps 2 and 4 are not met, perform index and sector timing alignment procedure.
6. Disconnect and remove test equipment.

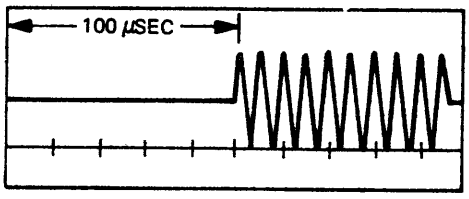
ALIGNMENT PROCEDURES

1. Perform head radial alignment check.
2. Insert Field Service Alignment cartridge in cartridge guide.

NOTE

The Alignment disk contains only one sector hole, versus 32 for a regular disk. It therefore cannot be used for Index/Sector diagnostics, only for alignment.

3. Connect oscilloscope direct probes to differentially monitor PCB test points TP1 and TP2 (head signal). Set oscilloscope to sync positively on leading edge of SECTOR pulse. Set time base to 10 ms/cm.
4. Disconnect head lead connector from PCB, and insert R/W adapter plug in its place. Connect head lead connector to adapter plug.
5. Apply ac and dc power to drive, load head, and access track 07.
6. Insert screwdriver through baseplate top access hole and rotate detector shaft as required to position burst within first 30 ms of oscilloscope sweep.
7. Expand oscilloscope time base to 100 microseconds / cm.
8. Rotate detector shaft to adjust burst so that first peak occurs 100 microseconds after start of sweep.
9. Expand oscilloscope time base to 20 microseconds / cm.



10. Repeat step 8.

11. Access track 56. First peak of track 56 burst must occur 100 ± 40 microseconds after start of sweep. If not, repeat step 8 and compensate this adjustment in the direction required to permit track 56 to be within tolerance. Do not exceed 100 ± 40 micresecond setting at either track.

CAUTION

Failure to meet tolerance specified in step 11 may be caused by a misaligned track position actuator, broken carriage, or damaged Field Service Alignment disk.

12. Disconnect and remove test equipment.

LED AND PHOTO TRANSISTOR ASSEMBLIES

LIGHT EMITTING DIODE ASSEMBLY

DESCRIPTION

The Light Emitting Diode assembly is mounted over a hole on the front of the cartridge guide. The diode is installed in a mounting block, and emits invisible infrared light whenever dc power is applied to the drive.

REMOVAL

1. Remove PCB
2. Disconnect diode leads from connector PC1.
3. Remove two mounting screws.
4. Remove assembly, carefully guiding leads through baseplate access hole.

REPLACEMENT

1. Insert diode leads through baseplate access hole.
2. Position assembly and install two mounting screws.

CAUTION

Diode leads must be connected exactly as shown in Logic Manual to ensure correct polarity.

3. Connect diode leads to connector PC1.

PHOTO TRANSISTOR ASSEMBLY

DESCRIPTION

The major components of the Photo Transistor assembly are the detector assembly, detector shaft, retaining ring, and detector spring. The detector shaft is threaded, and screws into the detector assembly. The relative position of the detector assembly on the shaft determines the timing alignment. Light from the light emitting diode, applied to the photo transistor when a disk index or sector hole passes between

the two, turns on the transistor, and a threshold detector circuit generates the timing pulse. Discrimination between INDEX and SECTOR pulses is accomplished by circuitry on the PCB.

REMOVAL

1. Remove PCB
2. Disconnect transistor leads from connector PC1.
3. Disconnect and remove extension spring.
4. Swing cartridge guide out on pivots.
5. Remove retaining ring from detector shaft.
6. Grasp spring and detector assembly, and unscrew and remove detector shaft through baseplate access hole.
7. Withdraw spring and detector assembly, carefully guiding leads through baseplate access hole.

REPLACEMENT

1. Insert leads through baseplate access hole, and insert spring and detector assembly into position.
2. Insert detector shaft through access hole, and screw shaft into detector assembly.
3. Install retaining ring on shaft.
4. Connect photo transistor leads to connector PC1.
5. Perform index and sector timing alignment procedure before placing drive in service.

GENERAL OPERATION OF AED 2500 DISK SYSTEM

The AED 2500 is composed of 3 basic sections: the format and the drive interface electronics, the power supply and the actual disk drive. The format electronics control: the transfer of information with the host system, write and read timing, data formatting, and error logic. The drive interface logic concerns drive selection, track addressing and head load logic.

The formatter can control up to four Memorex 651 Flexible Disk Drives. Each drive has independent track addressing logic and seeks independently of other drives. Data can be transferred with only one drive at a time.

The disk is formatted into 64 tracks. Each track composed of an optional number of sectors. The number of sectors determines the word capacity of each sector. A sector can store from 64 to 1028 16 bit words. Also, data can be transferred a track at a time allowing for the transfer of 2048 words. Each track and sector has an address mark used for seek verification.

The formatter is controlled by four functions: Command Out, Status In, Data Out, and Data In. Command Out gates 16 bits of information to the formatter defining drive selection, type of function, track, and sector. Status In gates 16 bits of status from the formatter. Data Out gates 16 bits of data to the formatter. Data In gates 16 bits of data from the formatter. All information is transferred to and from the formatter via a 16 bit bi-directional bus.

Before information can be written to, or read from, the disk, it is necessary to format the media. The formatting is accomplished by writing the address mark for the sectors and index for each track. This process is known as initialization. It is executed by means of the Initialize Command and the Initialize Switch located on the control panel. For each initialize command issued the specified track, and only that track, will be initialized. At the end of the initialize cycle device end will be indicated on the appropriate interface line. It is also possible to write protect a track and the sector of that track during the initialize process.

Once the media is initialized it is now possible to write data onto it and thus read data from it. Data can be transferred under two modes of operation, these being track and sector. The mode is specified by the command that has been issued, be it a read or write function. If sector mode is specified, data (the number of 16 bit words depending on the sector option) will be transferred to or from the selected sector. If track mode is defined, the data is transferred per the complete track specified, the number of words being 2048. It should be noted

that it is not possible to interchange between the two modes on the same track. It is possible to change from track to track. If it is desired to change modes on a track, it is first necessary to initialize the track, and to specify the new mode on the next write command to that track. Note also, that it is not necessary to make a transfer for every available word per track or sector. The words not written will be filled by the formatter with zeros.

Upon the execution of a write or read command the first step is the selection of the desired drive. Once this is accomplished the track address portion of the command is loaded into the appropriate register, compared to the track counter, and a seek will take place until the proper track is reached. Next it will search for the address mark that will compare to the address specified by the command. Once it locates the correct address mark it is also necessary to verify the error code that has been written for the address mark. If it can not locate the proper address mark within two revolutions after the seek is complete, an address check will be signified. If it compares to an address mark but the error code indicates unreliable data then a data check is signified. Once it verifies the proper address mark and error code, the formatter is ready to transfer data be it write or read. When the formatter requires a data transfer it will so indicate by means of the signal called data flag. Note, that at the end of a record in the write cycle, an error code is generated. It will be used in the read for data verification. During a read, if the error code indicates incorrect data, a data check will be signified.

A Device End will be generated after the desired function has been completed, or if an error occurred during the completion of said function. Note, that a device end does not occur after a rezero command.

A Rezero Command has the function of resetting a file unsafe from the disk drive itself, and resinking the track counters by forcing a seek to track zero. A rezero is not normally required, since a seek to track zero is done at the power up cycle.

Write Protect is accomplished at the time of initialization by means of the Write Protect Switch. If the switch is in the up position during initialize, a protect bit is written in the address mark. Now it is not possible to write on this track or sector, whichever the case, unless the write protect switch is in the up position. If the switch is down, the write is not allowed. The process to follow is to initialize with the switch up, write the information with the switch up, then after writing put the switch in the down position. This will inhibit writing on that record till the switch is placed in the up position. Note, the write protect switch can be overriden during initialize by the appropriate bit in the command.

IPL stands for Initial Program Load. By engaging the IPL switch on the control panel the formatter is forced to attempt a read of track zero in the track mode from the drive selected as logical unit 0.

The thumbwheel switches, located on the control panel, are for the logical selection of the drives. Each switch is associated with one particular drive and is so labled. The switch works in conjunction with the select bits issued to the formatter in the Command Word. If the switch setting equals the binary value of the two select bits then the associated drive is selected and is so indicated on the control panel. Note that only **two** bits within the Command Word are used for the drive selection, therefore, the range of the switch setting may vary from 0 to 3.

AED 2500 INTERFACE INFORMATION

Introduction

The interface to the AED 2500 is composed of 16 bidirectional data lines, 4 control lines, 2 status lines, and 1 function line. The interface uses negative-true logic and the active level for all signals is Ø volts or low.

Data and control information are transferred to or from the disk formatter by the 16 bidirectional line designated D0-D15. The information can be interpreted as Data In, Data Out, Command Word, or Status Word. Which type of information is determined by the control line that is active during the time of the information. These control lines are Command Out, Status In, Data Out, and Data In. No two control lines should be active on the interface bus at one time.

The two Status Lines are Data Flag and Device End. These lines are reflected directly onto the bus by the formatter and require no control signals for gating.

The Function Line is designated as IPL and is also reflected directly onto the bus.

Signal Definition

D0 - D15	16 bidirectional lines normally known as the data lines
CO	Command Out - Control signal when active indicates that the Command Word is present on the 16 data lines, gates information into appropriate registers within the disk formatter
SI	Status In - Control signal used to gain access to the Disk Status Word. When active will gate status from formatter onto bus.
DO	Data Out - Control signal used to gate information on 16 data lines into the Data Buffer within the formatter
DI	Data In - Control signal for gating information from Data Buffer onto the bus.

Data Flag	Signal when active indicates that the disk formatter requires a data transfer
Device End	Signal when true indicates that completion of a disk operation (Initialize, Write or Read) or that an error has occurred during some operation
IPL	Initial Program Load - Active only during time that the IPL switch on control panel is engaged. (At the time switch is released the formatter will do a Read in track mode of Track 00)

Output Timing

To insure proper operation of Command Out it is necessary to have the information stable on the data line before activating Command Out. Also the information must be stable at the trailing edge of Command Out. These requirements are necessary since both the leading and trailing edges of Command Out are used to latch information within the formatter. Command Out should be active at least 50 nanoseconds. Command Out can be active for whatever time is desired within reason.

For Data Out it is necessary that the information be stable on the data lines at the trailing edge. The same pulse width considerations are true as for Command Out.

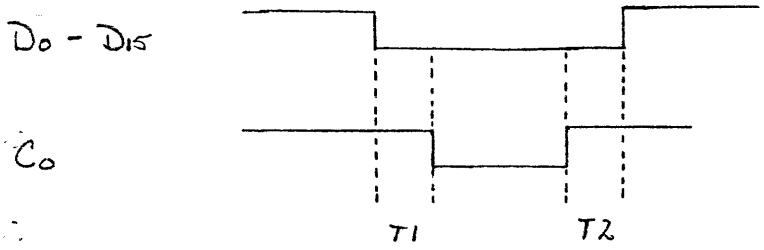
Input Timing

Status In or Data In should be active for enough time to assure the integrity of the information before the status or data is latched. This time consideration should allow for at least 6 gate delays and the delay of the cable plus any internal delays within the host interface.

Data Timing

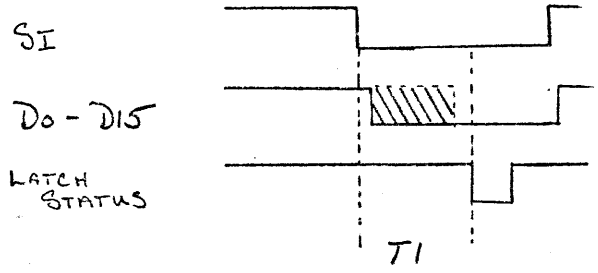
The disk formatter indicates request for data transfer by activating Data Flag be it a read or write operation. Typically once Data Flag becomes true there are 64 microseconds in which to complete a Data Out or Data In cycle. Data Flag will be reset by the leading edge of Data In or the trailing edge of Data Out.

Command Out Timing



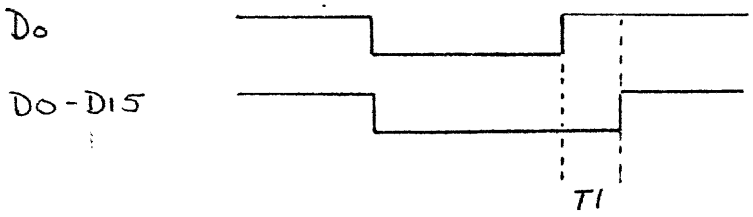
T1 & T2 - Typically 50 to 100 nanoseconds

Status In Timing



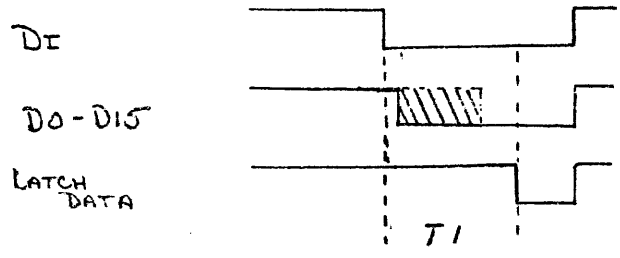
T1 - Typically 100 ns (minimum 80 ns)

Data Out Timing



T1 - Typically 50 ns

Data In Timing



T1 - Typically 100 ns (minimum 80 ns)

Circuit Description

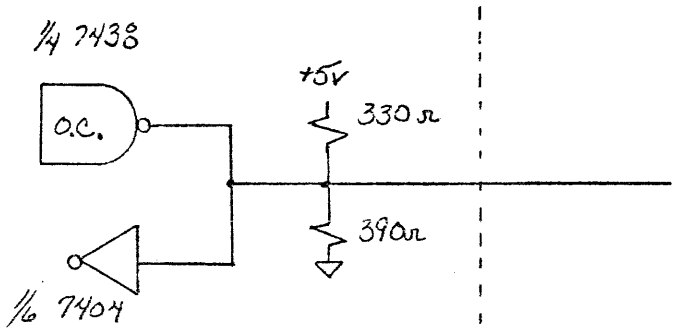
Each output signal from the formatter is driven by a standard SN 7438 TTL buffer with open collector output.

Input signals are received by a standard SN 7404 inverter.

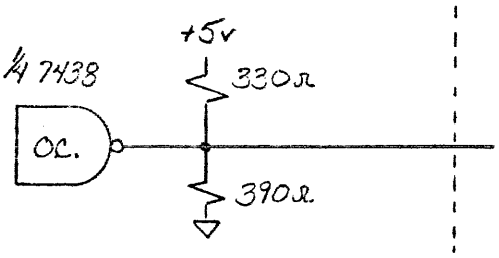
All lines are terminated by register network of 330 ohms to +5 volts and 390 ohms to logic ground.

CIRCUIT FOR 16 BIDIRECTIONAL DATA LINES

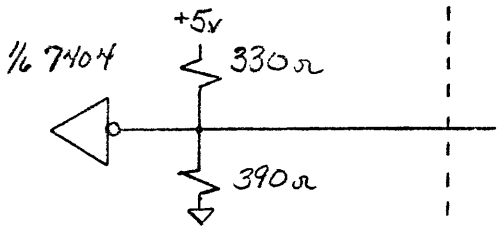
AED 2500



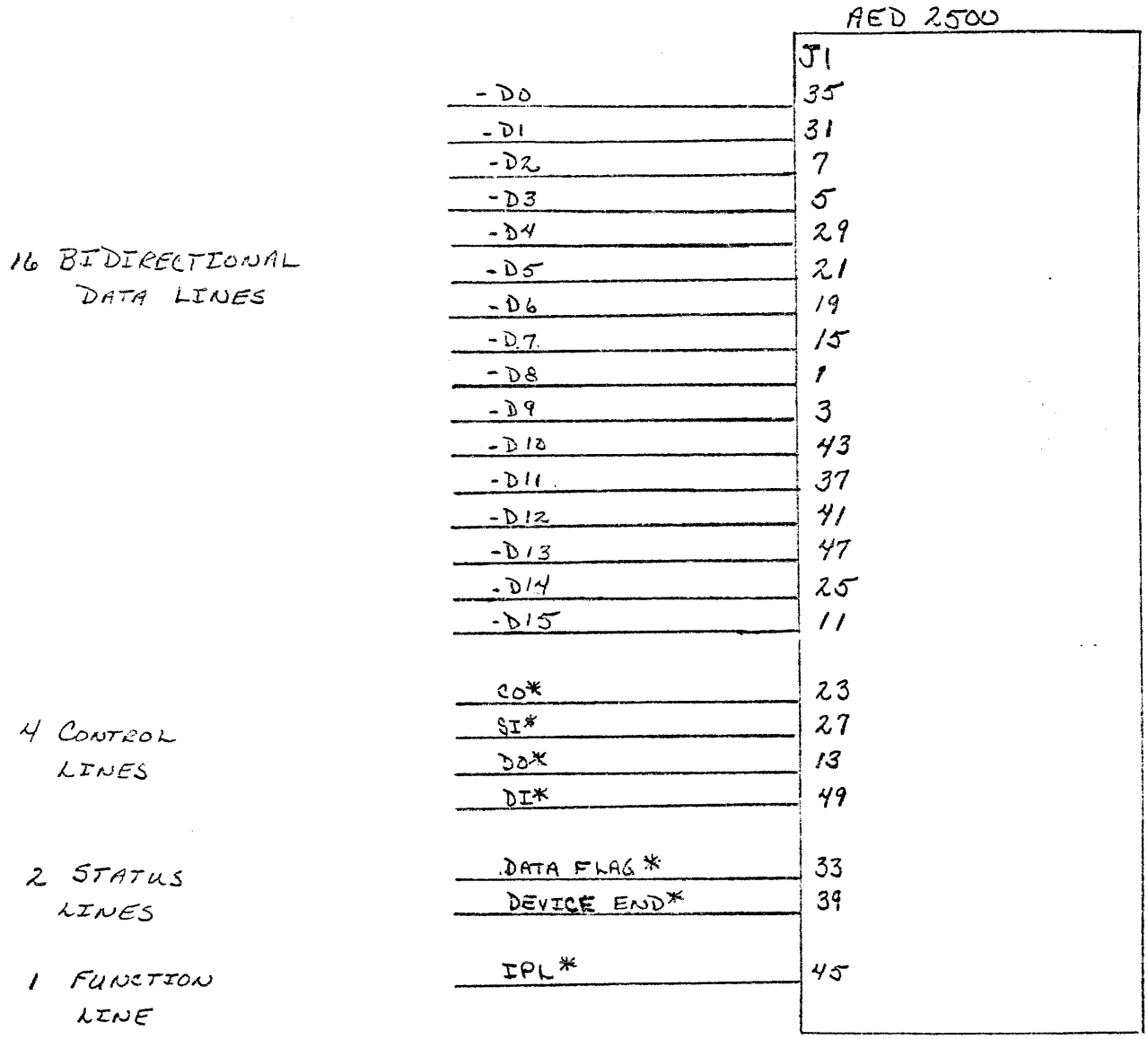
CIRCUIT FOR OUTPUT DRIVER



CIRCUIT FOR INPUT RECEIVER



AED 2500 Interface Signals



NOTE: ALL EVEN NUMBERED PINS 2-50 ARE GROUND

ADVANCED ELECTRONICS DESIGN, INC.

754 NO. PASTORIA • SUNNYVALE, CALIFORNIA 94086 • (408) 733-3555

AED 2500 FLOPPY DISK STORAGE SYSTEM
FLEXIBLE DISK INSTRUCTIONS DEC PDP-11 SERIES

DISK FORMAT:

Each Disk has 64 tracks with the number of sectors jumper selectable from 32 to 2 (2^n) with sector capacity of 64 to 1024, 16 bit words. Also a track record may be programable selected for 2048 words per track.

Each track is initialized, and contains an address area for each track and sector. The address area contains a sync word - address word and an error check word. The data field when written contains a sync word, n data words and an error check word. Before the data field can be written or updated the address is verified and error checked. When the disk is initialized, a write protect bit can be written with the sync word which will inhibit a write operation unless the W.P. switch is on.

INSTRUCTIONS:

The operation of the DMA Interface and Formatter are controlled by four addresses. One address is assigned to control function "Out" and status "In" and has a standard address of 764000. Another address serves as the Current Bus Address and has a standard address of 764004. The third address serves as the Word Count Register having a standard address of 764006. Note that the Word Count Register contains the two's complement form of the number of words to be affected by a given function. The last address serves as a Special Register and allows for interrupt enable and access to special status. This register has a standard address of 764002.

COMMAND FORMAT (Load Into 764000)

15 14 13	12 11	10 9 8 7 6 5	4 3 2 1 0
FUNCTION	UNIT	TRACK NO.	SECTOR NO.

Bits:

15 Selects sector record (inhibits writing of write protect bit during initialize.

14-13 00 Rezero and reset
01 Read Record
10 Write Record
11 Initialize track - If initialize switch is on.

12-11 Selects Logical Unit 0 thru 3.

10-5 Selects track 0-63 and initiates seek if different from existing track.

4-0 Selects sector 0-31.

15	14	13	12	11	10	9	8	7 4	3 0
Data Flag	Address Flag	Address Error	Data Check	Write Error	Select Error	Protect Error	Initial. Error	Busy Seeking	On-Line

BITS

15	Data flag - when true indicates data transfer required.
14	Address flag - when true indicates address is available (for diagnostics).
13	Address error - indicates requested address not found within two revolutions.
12	Data check - indicates that the error code detected an error either in the address mark or data field.
11	Write error - indicates a file unsafe condition. Must be reset by a rezero command.
10	Select error - attempted to select either more than one drive or no drive.
9	Protect error - an attempt was made to write on a protected area without the Write Protect Switch in the up position.
8	Initialize Error - an initialize command was issued without the Initialize Switch in the up position.
7-4	Logical drive unit seeking.
3-0	Logical drive unit has media installed.

SPECIAL REGISTER

When loading into this register Bit 6 is used to either enable or disable the interrupt. Bit 6 set will enable the interrupt; Bit 6 reset will disable the interrupt.

When reading from this register Bits 15, 14 and 7 give status. Bit 15 is an "OR" function of all error conditions. When it is true, it indicates that some error condition has occurred. Bit 14 when true indicates that a Time Out error has occurred. This error indicates that the DMA Interface has initiated a Data Transfer but did not receive slave sync within a specified time. Bit 7 is the Done Status; when true it indicates that the task is complete or an error condition has occurred during the completion of said task.

Note: When the Disk System is powered up, the Interrupt Enable is in the reset condition. Thus it is necessary to load Bit 6 into address 764002 before interrupts will occur.

CURRENT BUS ADDRESS REGISTER (764004)

Contains the bus address to or from which data will be transferred. The register is incremented by two at the end of each data transfer.

WORD COUNT REGISTER (764006)

Contains the two's complement of the total number of words to be affected by a given function. It increments by one after each word transfer.

OPERATION

The command instruction (load into 764000) initiates the operation; therefore, the bus address register and word count register must be initialized before the command.

INTERRUPTS

The interrupt vector has a standard address of 170. An interrupt request is generated upon receiving device end from the disk formatter. Device end is true under the following conditions:

A. Completion of read or write cycle
B. Completion of initialize cycle
C. Select Error
D. Seek Error (address error)
E. Write Error
F. Initialize Error

IPL

The IPL function is modified such that the word count register is preset to zero and bus address register is set to zero. If the program is in a run loop, then activating the IPL switch will load the first two K of core from track zero of drive zero.

PDP-11 SECTOR IPL

READ TRACKS 0 & 1

```
776     640     BR 500
500   12706     MOV #776, RO
  2     776
  4   12737     MOV #636, @ #170      ;INTERRUPT VECTOR
  6     636
510     170
 12    5037     CLR, @ #172
 14     172
 16   12737     MOV #100, @ #164002   ;ENABLE INTERRUPT
520     100
 22  164002
 24       1     WAIT
 26   12700     MOV #1000,RO          ;MEMORY ADR
530    1000
 32   12701     MOV #120001, R1       ;READ CMD TK #0
 34  120001
 36   12702     MOV #120007, R2
540  120007
 42    4737     JSR R7, DISKI0        ;READ TK#0
 44     600
 46   12700     MOV #10000, RO        :MEMORY ADR
550   10000
 52   12701     MOV #120040, R1       ;READ CMD TK#1
 54  120040
 56   12702     MOV #120047, R2
560  120047
 62    4737     JSR R7, DISKI0        ;READ TK#1
 64     600
 66     137     JMP @ #12130          ;JUMP TO ODT
570   12130
 72
 74
 76
```

WRITE TRACKS 0 & 1

```
1000    12706   MOV #776, R6
   2      776
   4    12737   MOV #636, @ #170     ;INTERRUPT VECTOR
   6      636
  10      170
  12     5037   CLR, @ #172
  14      172
  16    12737   MOV #100, @ #164002 ;ENABLE INTERRUPT
  20      100
  22   164002
  24     5000   CLR, RO              ;MEMORY ADR
  26    12701   MOV #140000, R1      ;WRITE CMD TK#0
  30   140000
  32    12702   MOV #140007, R2
  34   140007
  36     4737   JSR R7, DISKI0       ;WRITE TK#0
  40      600
  42    12700   MOV #10000, R0       ;MEMORY ADR
  44    10000
  46    12701   MOV #140040, R1      ;WRITE CMD TK#1
  50   140040
  52    12702   MOV #140047, R2
  54   140047
  56     4737   JSR R7, DISKI0       ;WRITE TK#1
  60      600
  62        3                        ;BREAKPOINT
  64                                 ;TRAP TO ODT
  66
```

DISK I/O ROUTINE

```
600     12737   MOV #177400,@#164006  ;WORD COUNT
  2    177400
  4    164006
  6     10037   MOV RO, @ #164004     ;MEMORY ADR
610    164004
 12     10137   MOV R1, @ #164000     ;CMD
 14    164000
 16         1   WAIT
```

```
620     20201   CMP R2, R1            ;LAST SECTOR?
  22     1404   BEQ                   ;YES
  24    62700   ADD #1000, RO         ;INC MEM ADR
  26     1000
630     5201   INC, R1               ;INC SECTOR
  32      762   BR 600
  34      207   RTS R7                ;RETURN
636         2   RTI                   ;INTERRUPT RETURN
```

ADVANCED ELECTRONICS DESIGN, INC.
754 N.Pastoria, Sunnyvale,Ca.94086 (408)733-3555

PDP-11/AED 2500 FLOPPY DISK DIAGNOSTICS

Residing on track 00 in Unit 0 of the AED 2500, this diagnostic program permits the user of a PDP-11 to test for proper operation of the AED 2500 and the DMA Interface. WRITE, READ, and COMPARE tests are performed for single or dual-drive AED 2500 Floppy Disk systems. For a triple-drive AED 2500, utilize either the single drive or dual drive programs.

To use this diagnostic, power up the AED 2500, PDP-11 and Teletype. Place the diagnostic diskette in Unit 0. HALT the PDP-11, EXAMINE 776_8, DEPOSIT 777_8 in location 776_8, EXAMINE 776_8, and depress START. This places the PDP-11 in the RUN mode, looping in 776_8. Next, lift the IPL switch on the AED 2500 control panel. This transfers tracks 00 and 01 from the diagnostic disk into the lower 4K of the PDP-11 core.

With the 4K of core loaded, an * is printed on the Teletype, signifying the PDP-11 DEBUG program is running. The listing of these programs follows:

I. Overlay of Interrupt vectors which permits the 1000_8 Program to run:

Location	Contents	Location	Contents	Location	Contents
000776	/000640	000506	/001000	000516	/012737
000500	/012706	000510	/000170	000520	/000100
000502	/000776	000512	/005037	000522	/164002
000504	/012737	000514	/000172	000524	/000001
				000526	/000000

II. The 1000_8 Program READs Track 01 into the second 2K of PDP-11 memory:

Location	Contents	Location	Contents	Location	Contents
001000	/012737	001030	/000001	001060	/012700
001002	/010000	001032	/000000	001062	/000002
001004	/164004	001034	/012577	001064	/000514
001006	/012737	001036	/177746	001066	/005737
001010	/174001	001040	/005237	001070	/001010
001012	/164006	001042	/001010	001072	/001366
001014	/012737	001044	/012577	001074	/000205
001016	/012130	001046	/177730	001076	/000000
001020	/000170	001050	/032777	001100	/000000
001022	/012737	001052	/004000		
001024	/020040	001054	/177724		
001026	/164000	001056	/001403		

III. The 20[illegible] Program WRITEs the first two tracks of Unit 0 from the first 4K of PDP-11 memory:

Location	Contents	Location	Contents	Location	Contents
002000	/012737	002030	/012700	002060	/0007[illegible]
002002	/002100	002032	/040000	002062	/000000
002004	/000170	002034	/012701	002064	/000000
002006	/005037	002036	/000002	002066	/000000
002010	/000172	002040	/012737	002070	/000000
002012	/012706	002042	/174000	002072	/000000
002014	/000776	002044	/164006	002074	/000000
002016	/012737	002046	/010037	002076	/000000
002020	/000100	002050	/164000	002100	/005301
002022	/164002	002052	/062700	002102	/001401
002024	/005037	002054	/000040	002104	/000002
002026	/164004	002056	/000001	002106	/000003

Upon completion, the 2000_8 Program returns the system to the DEBUG Program, resulting in an * printed by the Teletype.

IV. The 3000_8 Program is an INITIALIZE Program which allows the AED 2500 Formatter to place address marks on disks. Be sure to lift the INIT switch when running this program:

Location	Contents	Location	Contents	Location	Contents
003000	/012737	003036	/164000	003074	/177700
003002	/003050	003040	/062700	003076	/122000
003004	/000170	003042	/000040	003100	/012701
003006	/005037	003044	/000001	003102	/177700
003010	/000172	003046	/000772	003104	/012702
003012	/012706	003050	/005302	003106	/005000
003014	/000776	003052	/001402	003110	/012703
003016	/012737	003054	/000002	003112	/005500
003020	/000100	003056	/000000	003114	/004537
003022	/164002	003060	/000003	003116	/002000
003024	/012700	003062	/177700	003120	/000400
003026	/160000	003064	/142000	003122	/012701
003030	/012702	003066	/004537	003124	/003000
003032	/000100	003070	/001030	003126	/000111
003034	/010037	003072	/005500		

When completed, the system is returned to DEBUG and an * is printed by the Teletype.

V. The 4000_8 Program is a WRITE, READ, COMPARE diagnostic for the dual drive AED 2500 (UNIT 0,1):

Location	Contents	Location	Contents	Location	Contents
004000	/012737	004034	/000100	004070	/164004
004002	/004700	004036	/164002	004072	/012737
004004	/000170	004040	/012737	004074	/140206
004006	/005037	004042	/144207	004076	/164000
004010	/000172	004044	/164000	004100	/000001
004012	/012706	004046	/000001	004102	/012737
004014	/000776	004050	/012737	004104	/023700
004016	/012737	004052	/027740	004106	/164000
004020	/177400	004054	/164000	004110	/012737
004022	/164006	004056	/012737	004112	/177400
004024	/012737	004060	/177400	004114	/164006
004026	/006000	004062	/164006	004116	/012737
004030	/164004	004064	/012737	004120	/006000
004032	/012737	004066	/006400	004122	/164004

Location	Contents	Location	Contents	Location	Contents
004124	/012737	004260	/012737	004414	/012737
004126	/147707	004262	/007400	004416	/007400
004130	/164000	004264	/164004	004420	/164004
004132	/000001	004266	/012737	004422	/012737
004134	/012737	004270	/120206	004424	/123705
004136	/024200	004272	/164000	004426	/164000
004140	/164000	004274	/000001	004430	/000001
004142	/012737	004276	/012700	004432	/000402
004144	/177400	004300	/000200	004434	/000000
004146	/164006	004302	/012701	004436	/000000
004150	/012737	004304	/007400	004440	/012700
004152	/006400	004306	/012702	004442	/000200
004154	/164004	004310	/006400	004444	/012701
004156	/012737	004312	/022122	004446	/007400
004160	/143705	004314	/001230	004450	/012702
004162	/164000	004316	/005300	004452	/006400
004164	/000001	004320	/001374	004454	/022122
004166	/012737	004322	/012737	004456	/001147
004170	/020240	004324	/023700	004460	/005300
004172	/164000	004326	/164000	004462	/001374
004174	/012737	004330	/012737	004464	/012700
004176	/177400	004332	/177400	004466	/000200
004200	/164006	004334	/164006	004470	/012701
004202	/012737	004336	/012737	004472	/007400
004204	/007000	004340	/007000	004474	/012702
004206	/164004	004342	/164004	004476	/006000
004210	/012737	004344	/012737	004500	/012122
004212	/124207	004346	/127707	004502	/005300
004214	/164000	004350	/164000	004504	/001401
004216	/000001	004352	/000001	004506	/000774
004220	/012700	004354	/012700	004510	/012700
004222	/000200	004356	/000200	004512	/000200
004224	/012701	004360	/012701	004514	/012701
004226	/007000	004362	/007000	004516	/007000
004230	/012702	004364	/012702	004520	/012702
004232	/006000	004366	/006000	004522	/006400
004234	/022122	004370	/022122	004524	/012122
004236	/001257	004372	/001201	004526	/005300
004240	/005300	004374	/005300	004530	/001401
004242	/001374	004376	/001374	004532	/000774
004244	/012737	004400	/012737	004534	/012737
004246	/027740	004402	/024200	004536	/020240
004250	/164000	004404	/164000	004540	/164000
004252	/012737	004406	/012737	004542	/012707
004254	/177400	004410	/177400	004544	/004016
004256	/164006	004412	/164006	004546	/000000
				004550	/002000

This program will continue to RUN until an error is detected. To stop the Program, cause a SELECT ERROR by changing the AED 2500 Thumbwheel A or B to a different UNIT number. This error will return the system to DEBUG and an * will be printed on the Teletype.

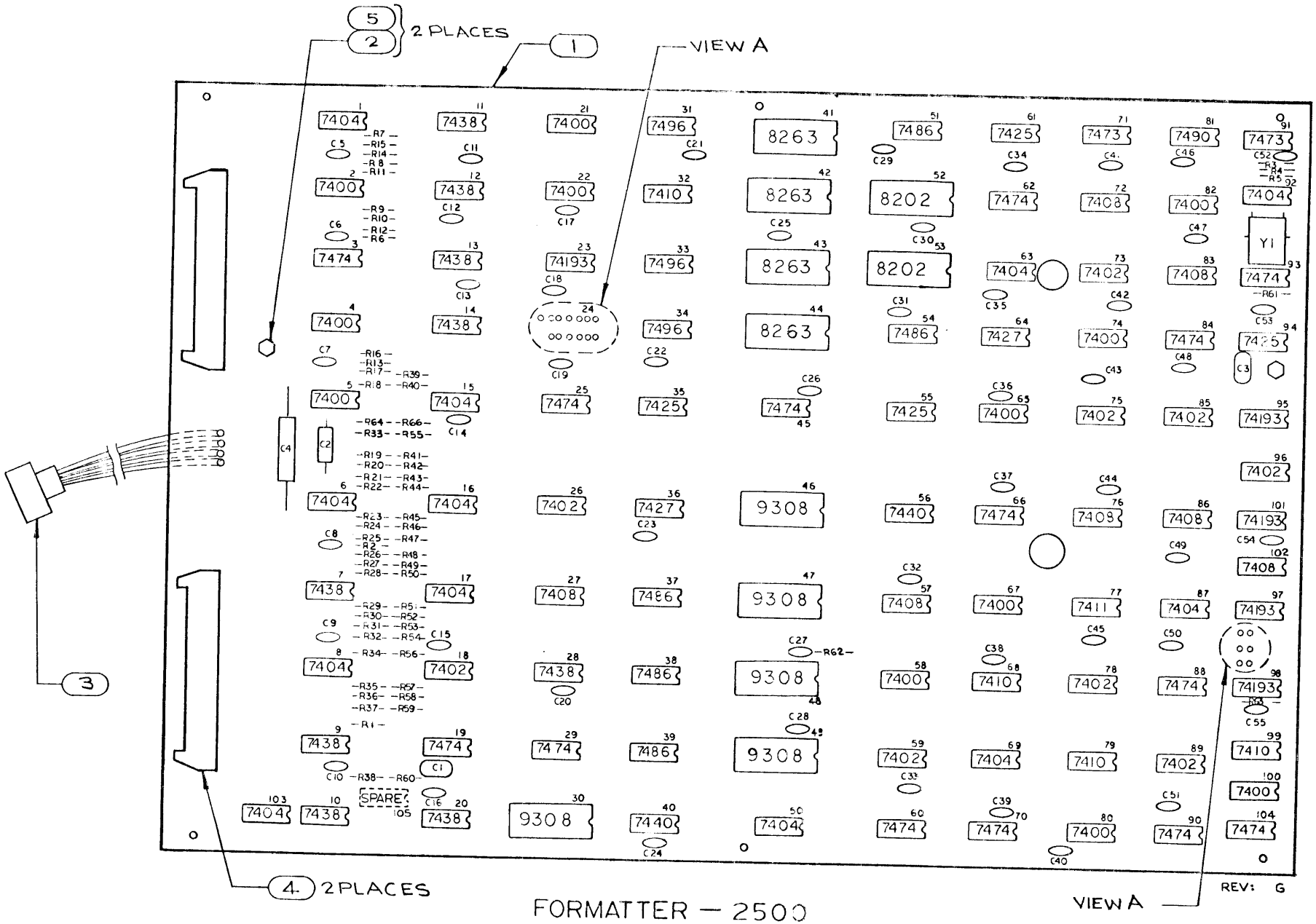
VI. The 5000_8 Program is a single drive (UNIT 0) equivalent to the 4000_8 Program:

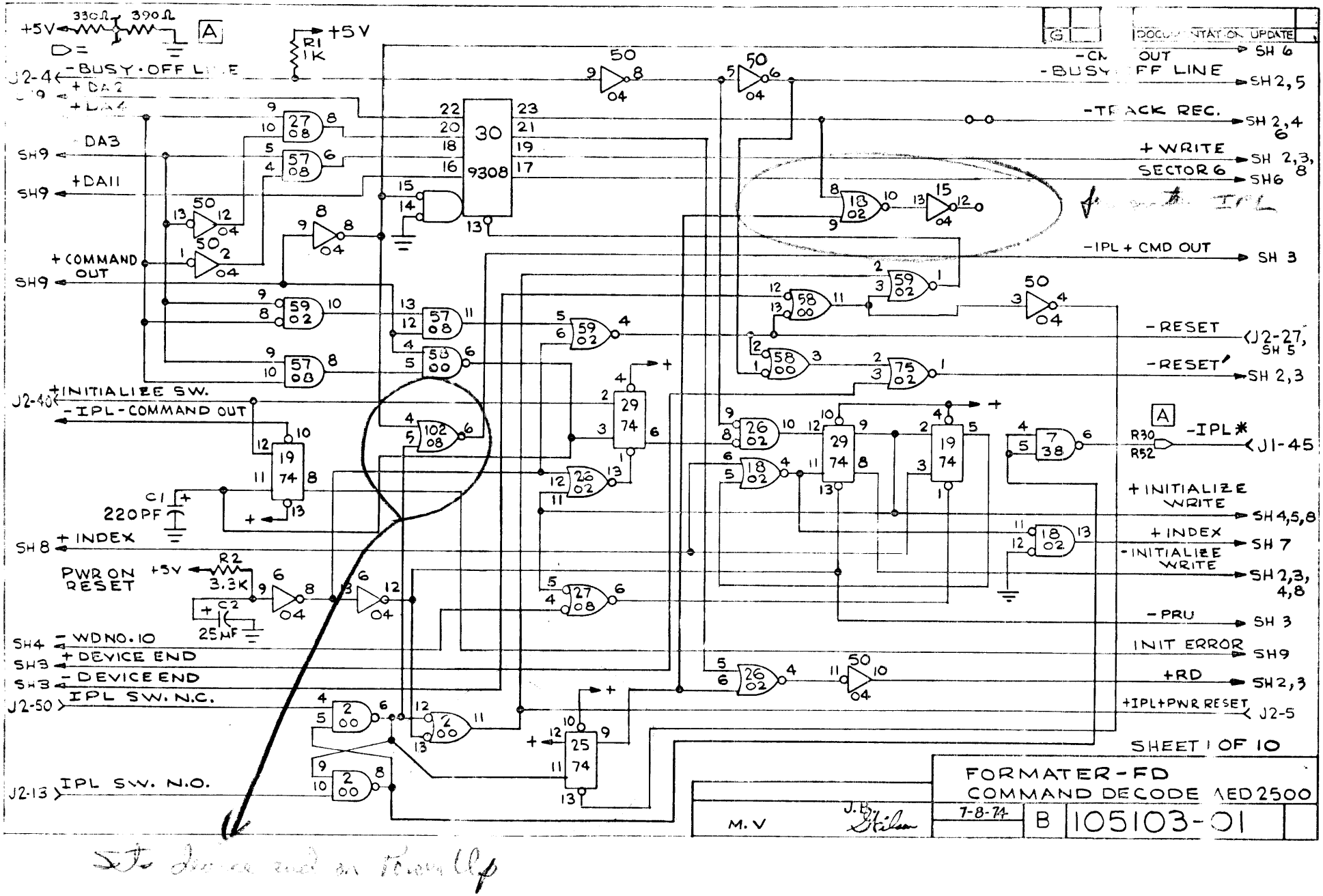
Location	Contents
005000	/012737
005002	/004700
005004	/000170
005006	/005037
005010	/000172
005012	/012706
005014	/000776
005016	/012737
005020	/177400
005022	/164006
005024	/012737
005026	/006000
005030	/164004
005032	/012737
005034	/000100
005036	/164002
005040	/012737
005042	/140207
005044	/164000
005046	/000001
005050	/012737
005052	/177400
005054	/164006
005056	/012737
005060	/006400
005062	/164004
005064	/012737
005066	/140307
005070	/164000
005072	/000001
005074	/012737
005076	/177400
005100	/164006
005102	/012737
005104	/006000
005106	/164004
005110	/012737
005112	/143707
005114	/164000
005116	/000001
005120	/012737
005122	/177400
005124	/164006
005126	/012737
005130	/006400
005132	/164004
005134	/012737
005136	/143705
005140	/164000
005142	/000001
005144	/012737
005146	/177400
005150	/164006
005152	/012737
005154	/007000
005156	/164004
005160	/012737
005162	/120207
005164	/164000
005166	/000001
005170	/012700
005172	/000200
005174	/012701
005176	/007000
005200	/012702
005202	/006000
005204	/022122
005206	/001160
005210	/005300
005212	/001374
005214	/012737
005216	/177400
005220	/164006
005222	/012737
005224	/007400
005226	/164004
005230	/012737
005232	/120307
005234	/164000
005236	/000001
005240	/012700
005242	/000200
005244	/012701
005246	/007400
005250	/012702
005252	/006400
005254	/022122
005256	/001135
005260	/005300
005262	/001374
005264	/012737
005266	/177400
005270	/164006
005272	/012737
005274	/007000
005276	/164004
005300	/012737
005302	/123707
005304	/164000
005306	/000001
005310	/012700
005312	/000200
005314	/012701
005316	/007000
005320	/012702
005322	/006000
005324	/022122
005326	/001112
005330	/005300
005332	/001374
005334	/012737
005336	/177400
005340	/164006
005342	/012737
005344	/007400
005346	/164004
005350	/012737
005352	/123705
005354	/164000
005356	/000001
005360	/012700
005362	/000200
005364	/012701
005366	/007400
005370	/012702
005372	/006400
005374	/022122
005376	/001067
005400	/005300
005402	/001374
005404	/012700
005406	/000200
005410	/012701
005412	/007400
005414	/012702
005416	/006000
005420	/012122
005422	/005300
005424	/001401
005426	/000774
005430	/012700
005432	/000200
005434	/012701
005436	/007000
005440	/012702
005442	/006400
005444	/012122
005446	/005300
005450	/001401
005452	/000774
005454	/012707
005456	/005000
005460	/000000
005462	/116407

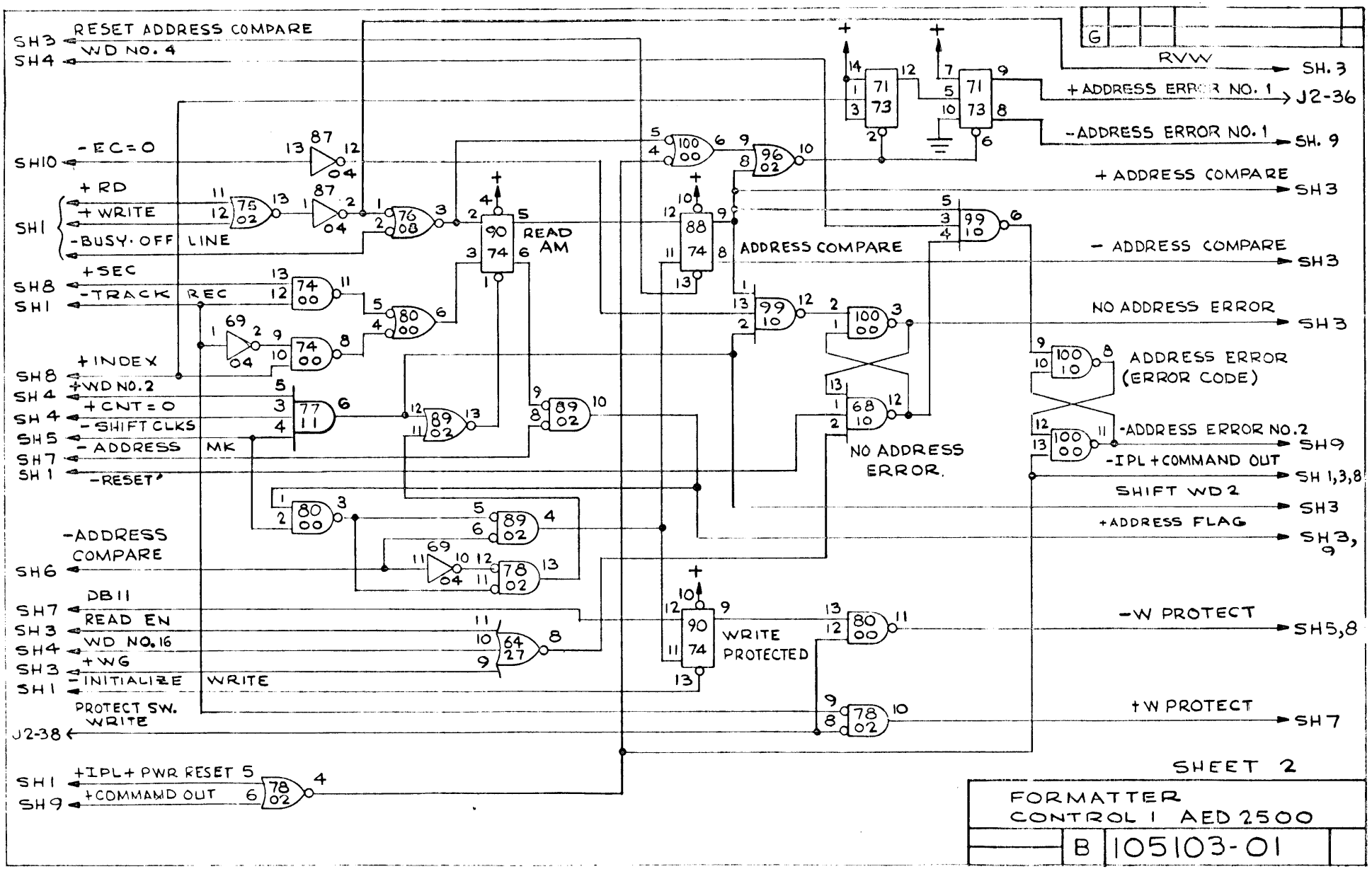
AED 2500

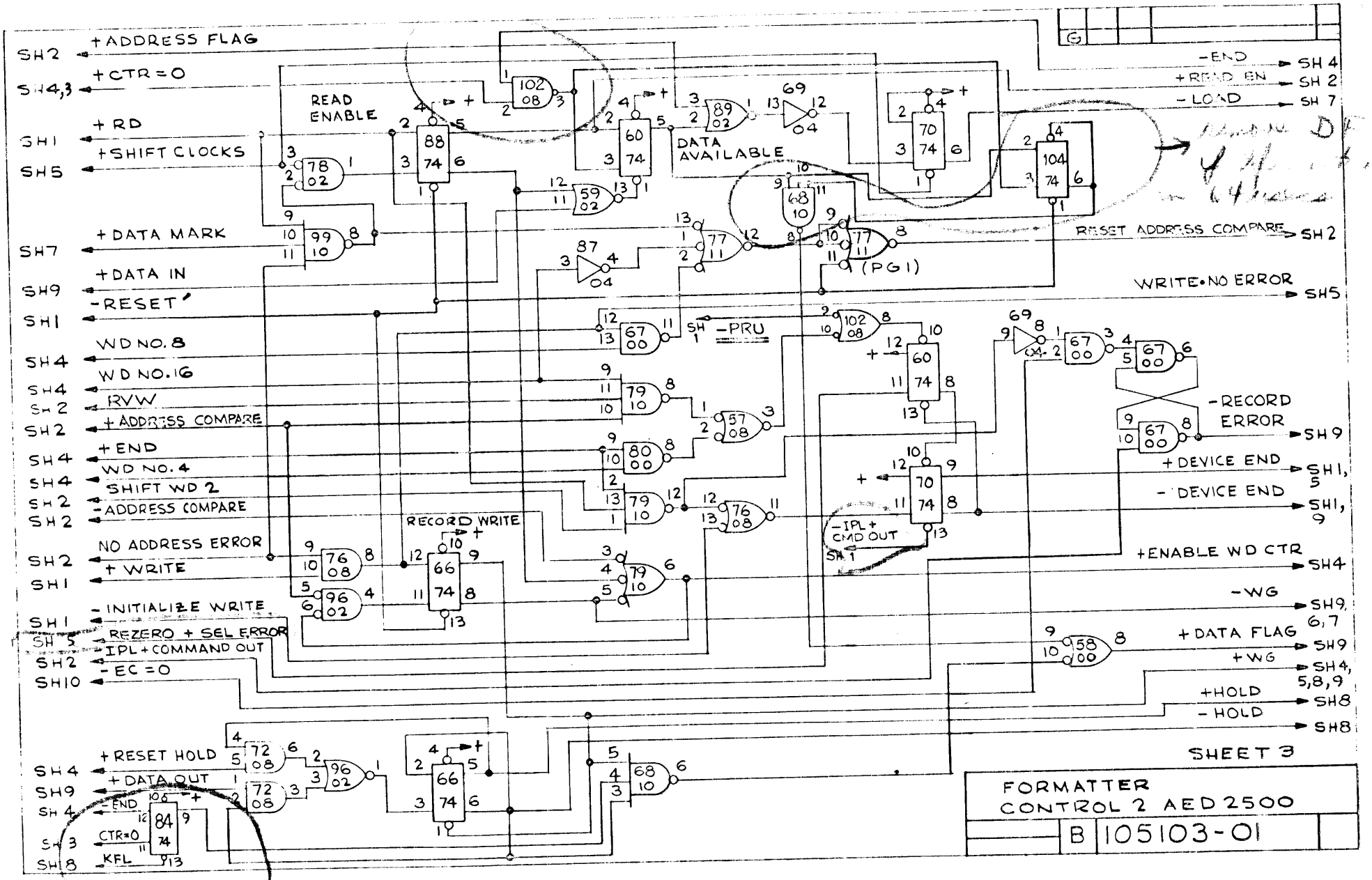
DRIVE & FORMATTER

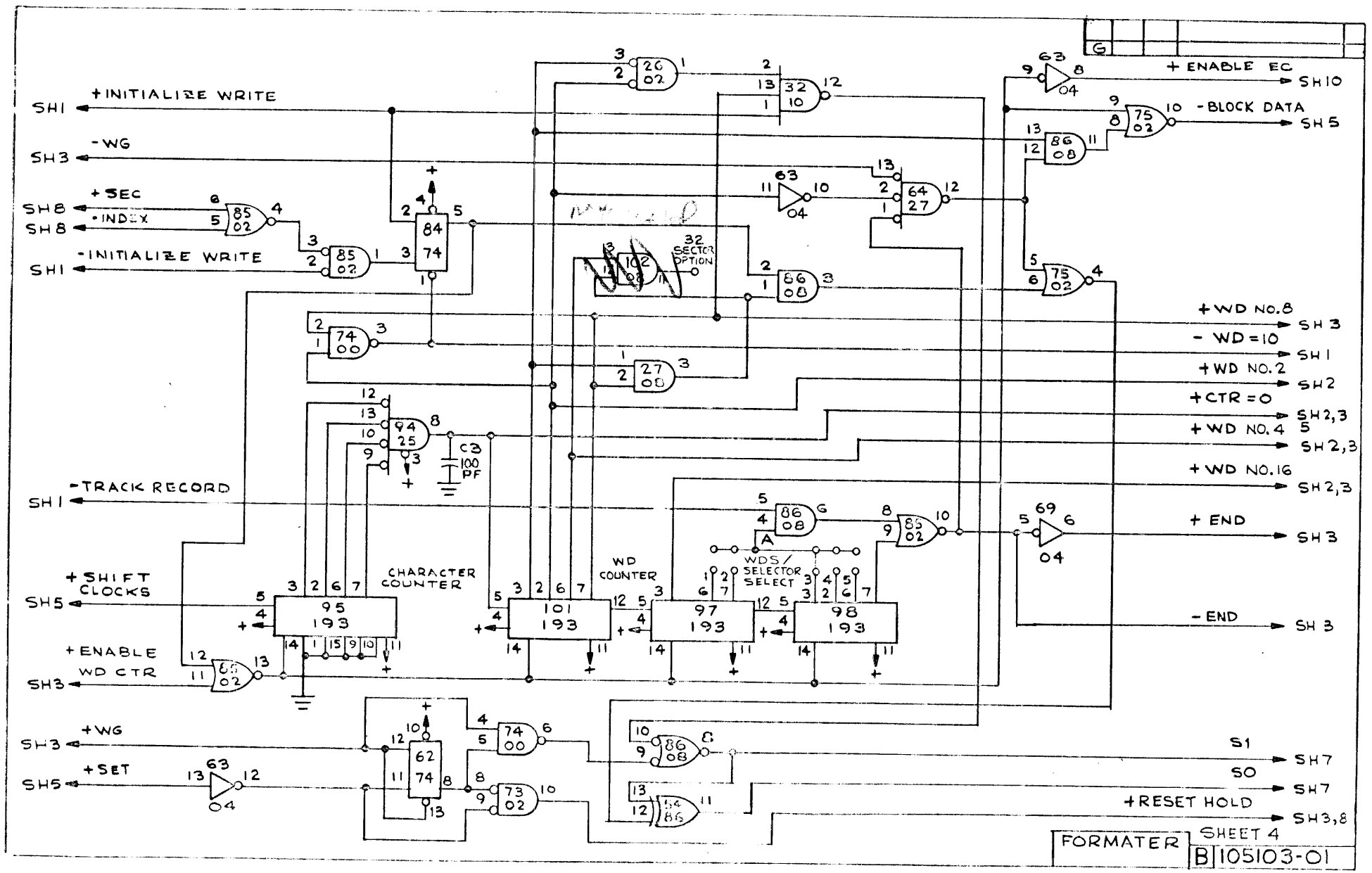
Logic Diagrams

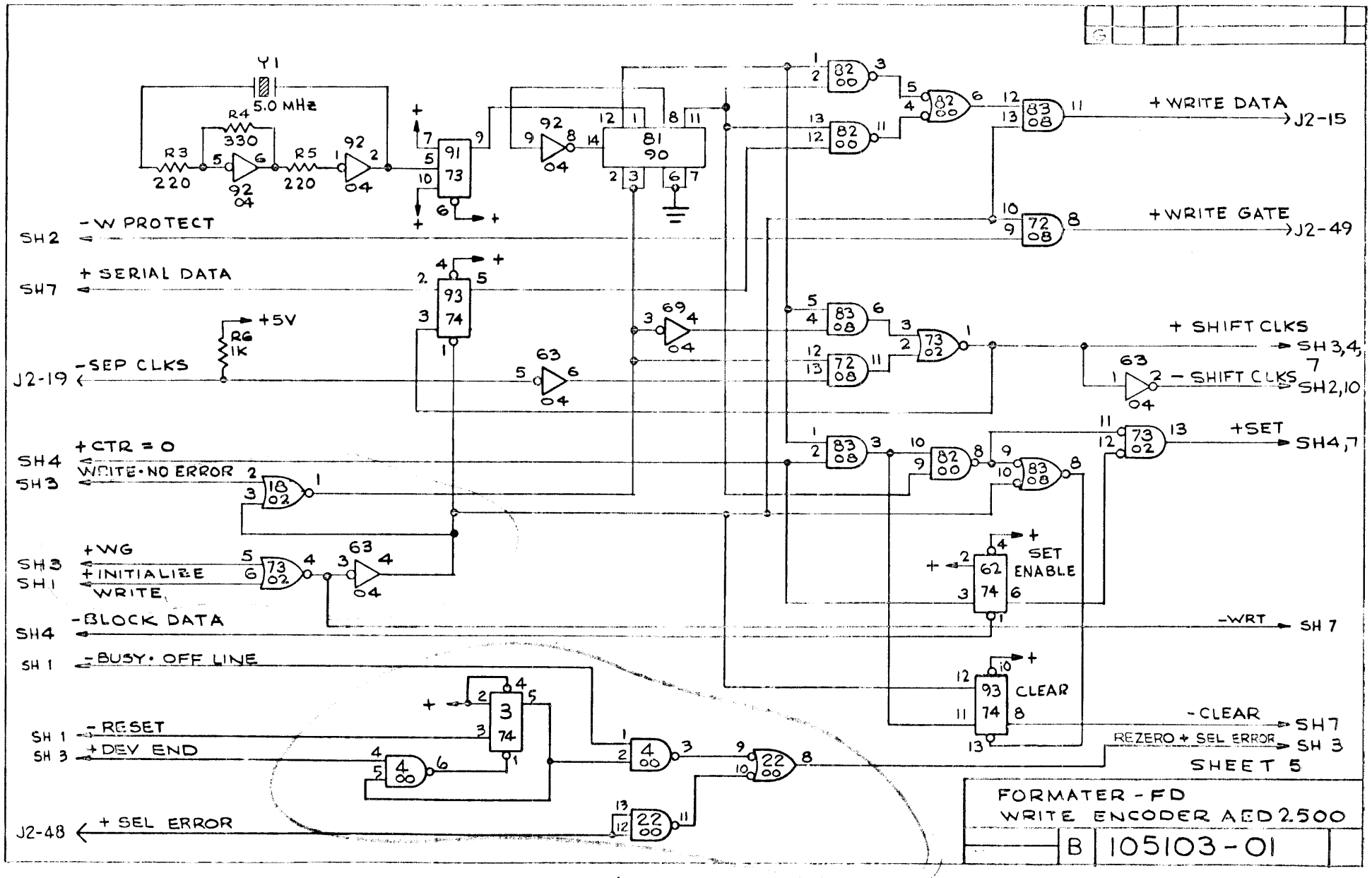

5
2
2 PLACES
1
VIEW A
3
4.
2 PLACES
VIEW A
REV: G
FORMATTER — 2500

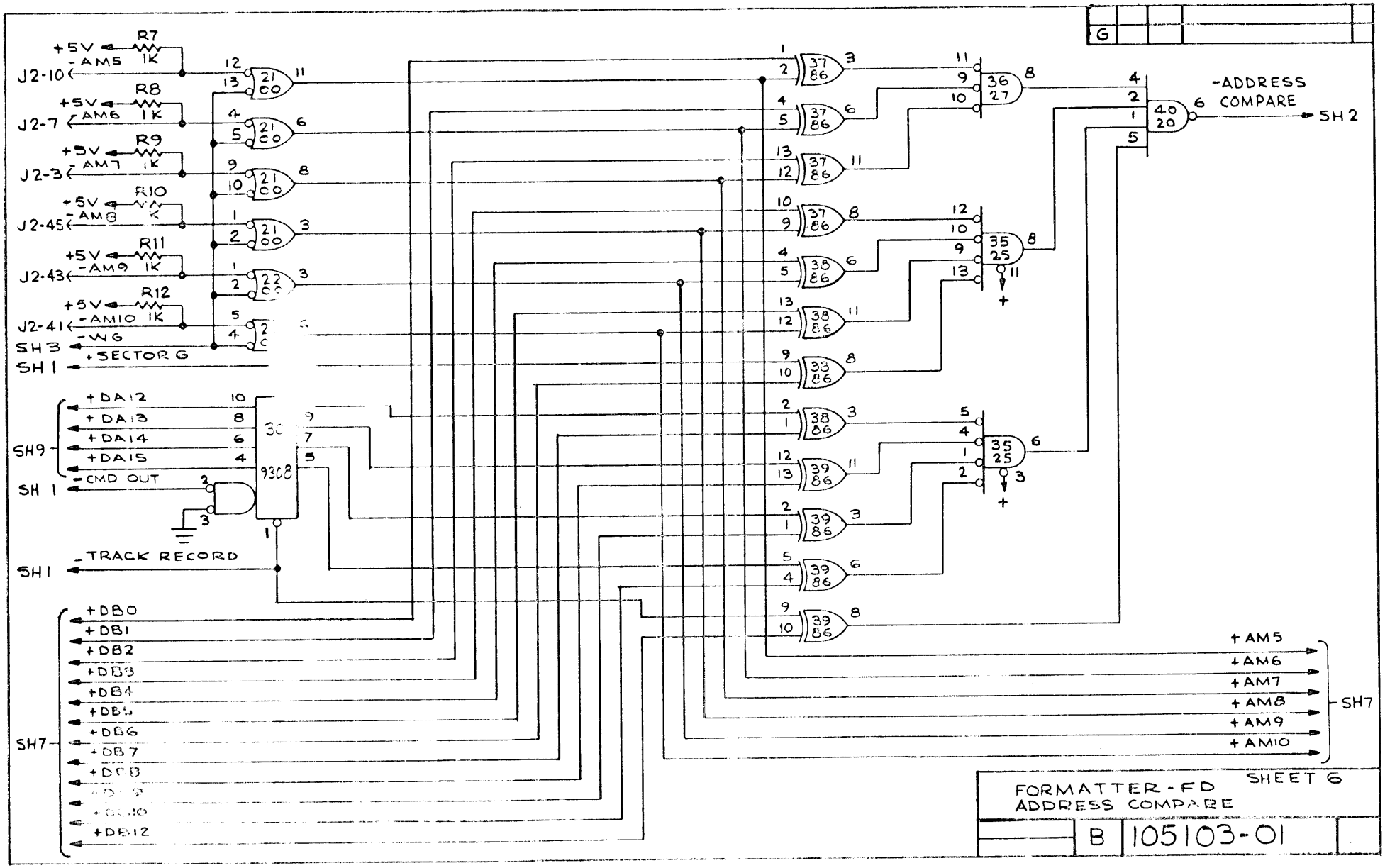

+5V
330Ω
390Ω
A
R1
1K
+5V
-BUSY · OFF LINE
J2-4
+DA2
+DA4
DA3
SH9
+DA11
SH9
+ COMMAND OUT
SH9
+INITIALIZE SW.
J2-40
-IPL-COMMAND OUT
C1
220PF
SH 8 + INDEX
PWR ON RESET
+5V
R2
3.3K
C2
25MF
SH4 = WDNO.10
SH3 + DEVICE END
SH3 - DEVICE END
J2-50 IPL SW. N.C.
J2-13 IPL SW. N.O.
-BUSY · OFF LINE
SH 2,5
-TRACK REC.
SH 2,4,6
+ WRITE
SECTOR 6
SH 2,3,8
SH6
-IPL + CMD OUT
SH 3
-RESET
J2-27, SH 5
-RESET'
SH 2,3
A
R30
R52
-IPL*
J1-45
+INITIALIZE WRITE
SH 4,5,8
+INDEX
SH 7
-INITIALIZE WRITE
SH 2,3, 4,8
-PRU
SH 3
INIT ERROR
SH9
+RD
SH 2,3
+IPL+PWR RESET
J2-5
SHEET 1 OF 10
FORMATER-FD
COMMAND DECODE AED2500
M.V
J.B. Gilson
7-8-74
B
105103-01

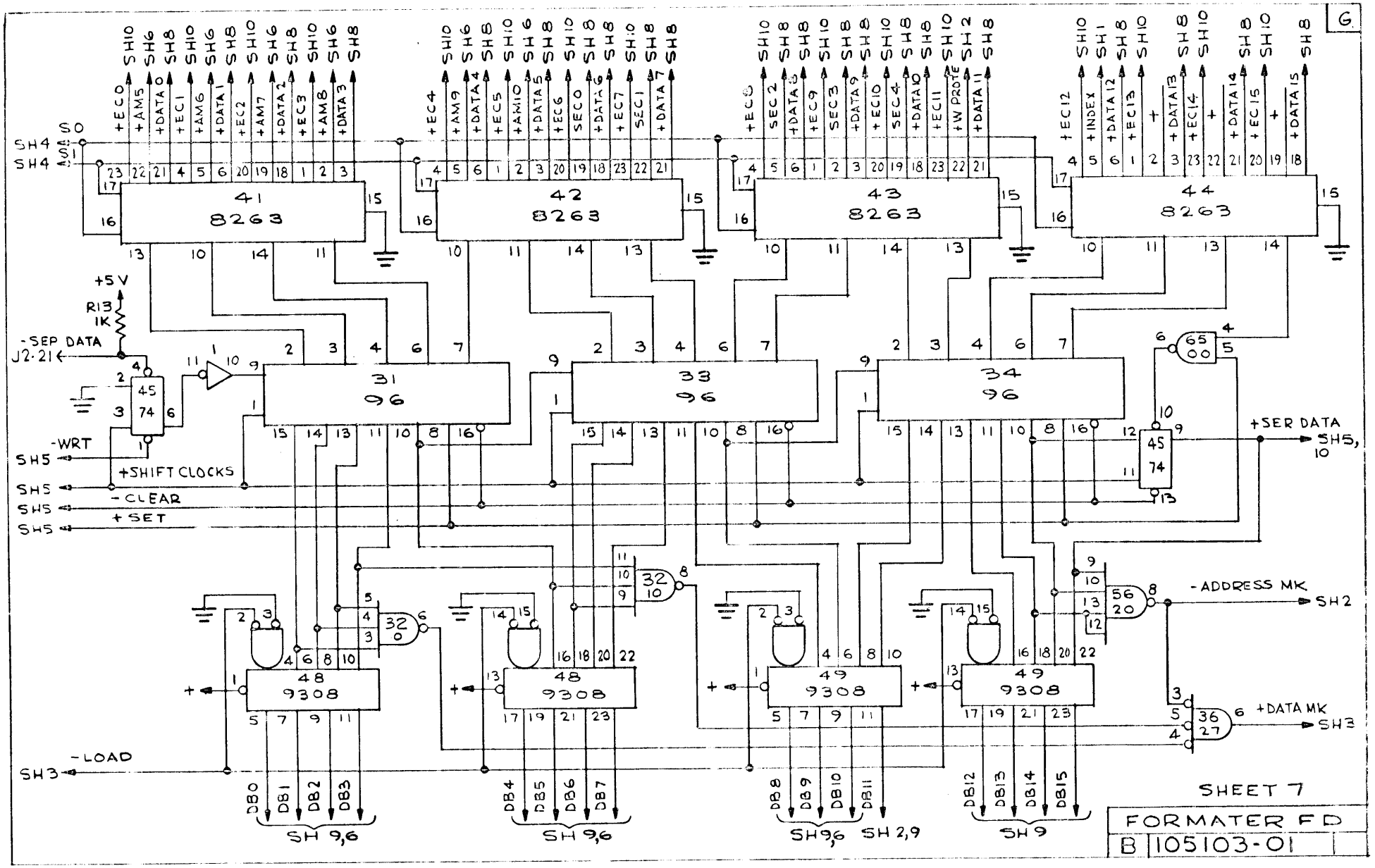

RESET ADDRESS COMPARE
SH3
WD NO. 4
SH4
- EC = 0
SH10
+ RD
+ WRITE
SH1
-BUSY· OFF LINE
+SEC
SH8
-TRACK REC
SH1
+INDEX
SH8
+WD NO.2
SH4
+ CNT = 0
SH4
- SHIFT CLKS
SH5
- ADDRESS MK
SH7
SH1
-RESET*
READ AM
-ADDRESS COMPARE
SH6
DB11
SH7
READ EN
SH3
WD NO.16
SH4
+WG
SH3
-INITIALIZE WRITE
SH1
PROTECT SW. WRITE
J2-38
+IPL+ PWR RESET 5
SH1
+COMMAND OUT 6
SH9
ADDRESS COMPARE
NO ADDRESS ERROR.
WRITE PROTECTED
RVW
SH. 3
+ADDRESS ERROR NO. 1
J2-36
-ADDRESS ERROR NO. 1
SH. 9
+ ADDRESS COMPARE
SH3
- ADDRESS COMPARE
SH3
NO ADDRESS ERROR
SH3
ADDRESS ERROR (ERROR CODE)
-ADDRESS ERROR NO.2
SH9
-IPL + COMMAND OUT
SH 1,3,8
SHIFT WD 2
SH3
+ADDRESS FLAG
SH3, 9
-W PROTECT
SH5,8
+W PROTECT
SH7
SHEET 2
FORMATTER CONTROL I AED 2500
B 105103-01

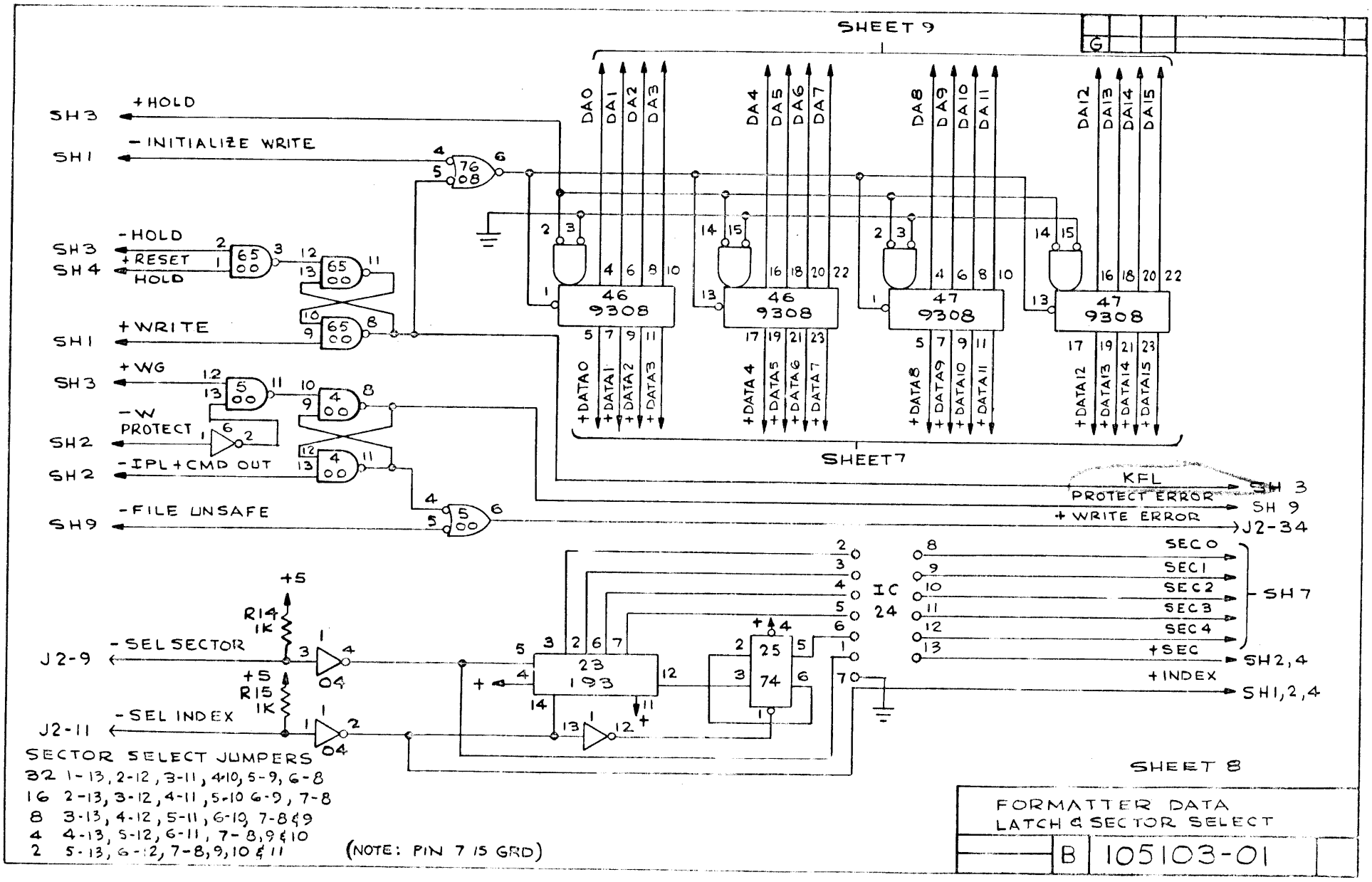

SH2 +ADDRESS FLAG
SH4,3 +CTR=0
SH1 +RD
SH5 +SHIFT CLOCKS
SH7 +DATA MARK
SH9 +DATA IN
SH1 -RESET
SH4 WD NO. 8
SH4 WD NO. 16
SH2 RVW
SH2 +ADDRESS COMPARE
SH4 +END
SH4 WD NO. 4
SH2 SHIFT WD 2
SH2 -ADDRESS COMPARE
SH2 NO ADDRESS ERROR
SH1 +WRITE
SH1 -INITIALIZE WRITE
SH5 -REZERO + SEL ERROR
SH2 -IPL + COMMAND OUT
SH10 -EC=0
SH4 +RESET HOLD
SH9 +DATA OUT
SH4 -END
SH3 CTR=0
SH8 -KFL
READ ENABLE
DATA AVAILABLE
RECORD WRITE
-IPL + CMD OUT
SH1
(PG1)
-PRU
-END SH4
+READ EN SH2
-LOAD SH7
RESET ADDRESS COMPARE SH2
WRITE•NO ERROR SH5
-RECORD ERROR SH9
+DEVICE END SH1, 5
-DEVICE END SH1, 9
+ENABLE WD CTR SH4
-WG SH9, 6, 7
+DATA FLAG SH9
+WG SH4, 5, 8, 9
+HOLD SH8
-HOLD SH8
SHEET 3
FORMATTER
CONTROL 2 AED 2500
B 105103-01

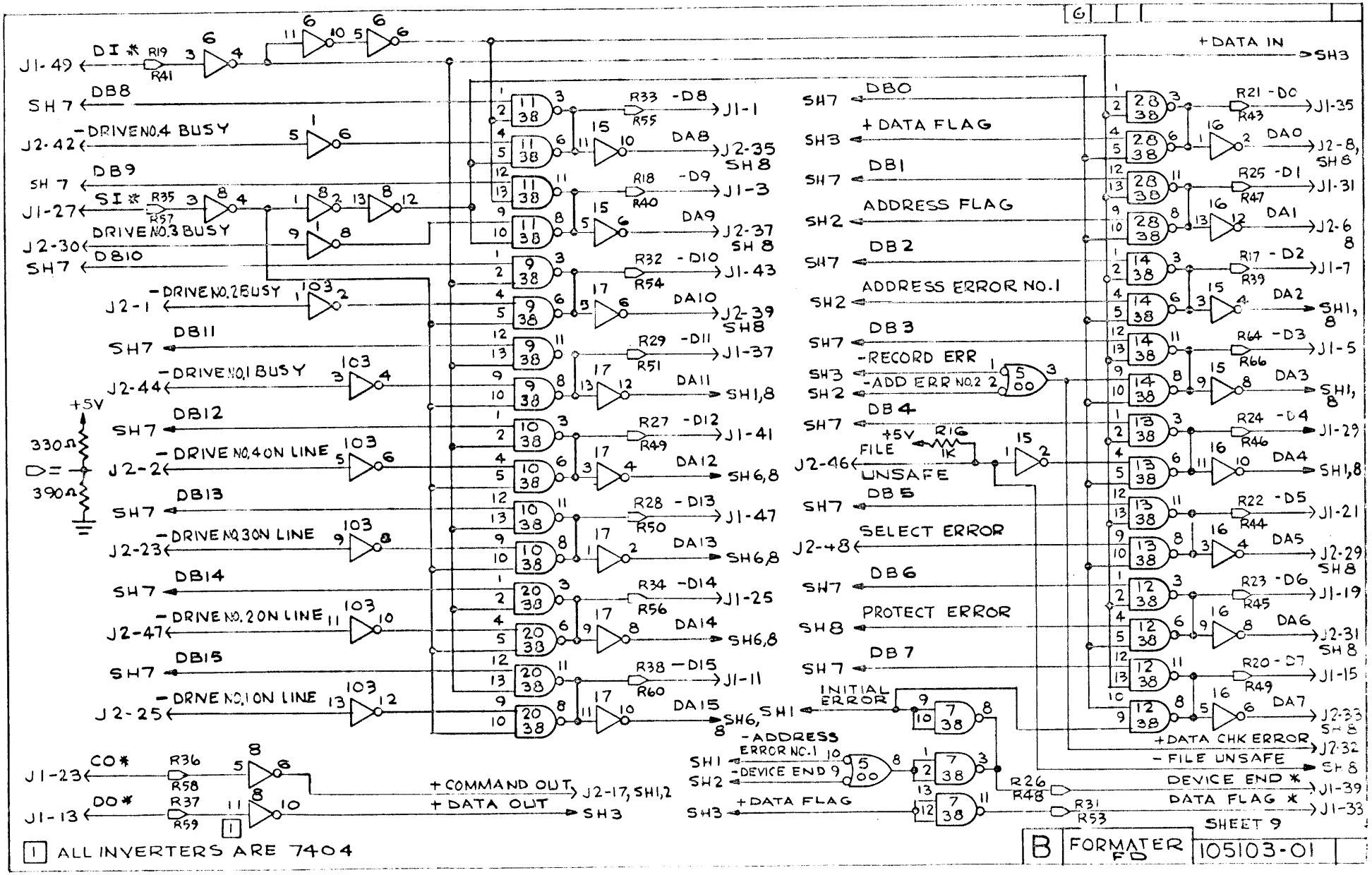

+INITIALIZE WRITE
SH1
-WG
SH3
+SEC
SH8
-INDEX
SH8
-INITIALIZE WRITE
SH1
-TRACK RECORD
SH1
+SHIFT CLOCKS
SH5
+ENABLE WD CTR
SH3
+WG
SH3
+SET
SH5
CHARACTER COUNTER
WD COUNTER
WDS/ SELECTOR SELECT
32 SECTOR OPTION
C3 100 PF
+ENABLE EC
SH10
-BLOCK DATA
SH5
+WD NO.8
SH3
-WD=10
SH1
+WD NO.2
SH2
+CTR=0
SH2,3
+WD NO.4
SH2,3
+WD NO.16
SH2,3
+END
SH3
-END
SH3
S1
SH7
S0
SH7
+RESET HOLD
SH3,8
FORMATER
SHEET 4
B 105103-01

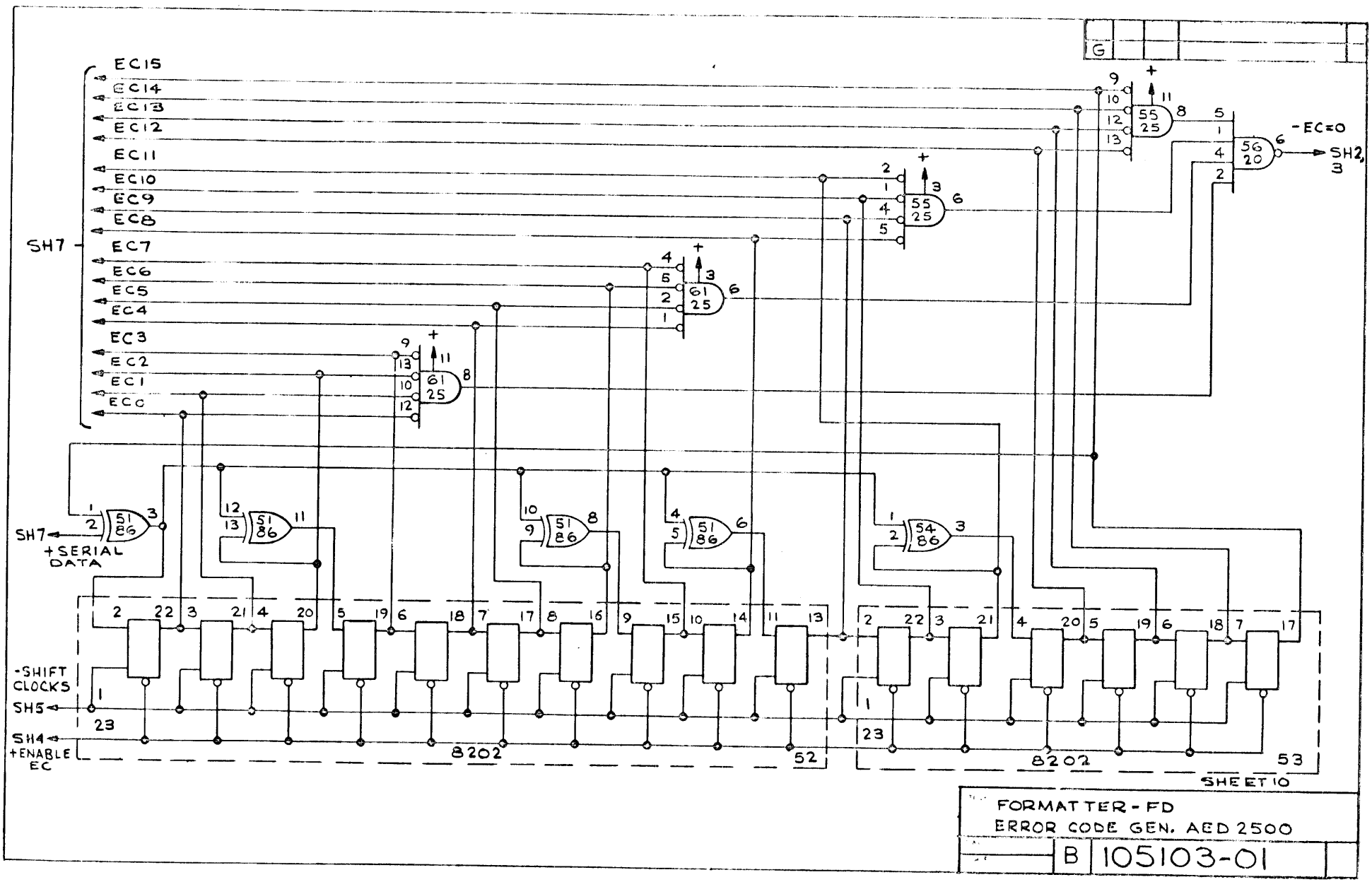

Y1
5.0 MHz
R4
330
R3
220
R5
220
92
04
91
73
81
90
-W PROTECT
SH2
+ SERIAL DATA
SH7
93
74
+5V
RG
1K
-SEP CLKS
J2-19
69
63
+CTR = 0
SH4
WRITE·NO ERROR
SH3
18
02
+WG
SH3
+INITIALIZE
SH1
WRITE
73
02
-BLOCK DATA
SH4
-BUSY· OFF LINE
SH 1
3
74
-RESET
SH 1
+DEV END
SH 3
4
00
22
00
+ SEL ERROR
J2-48
82
00
83
08
72
08
+ WRITE DATA
J2-15
+ WRITE GATE
J2-49
+ SHIFT CLKS
SH 3,4,7
- SHIFT CLKS
SH2,10
+SET
SH4,7
62
74
SET
ENABLE
-WRT
SH 7
CLEAR
-CLEAR
SH7
REZERO + SEL ERROR
SH 3
SHEET 5
FORMATER - FD
WRITE ENCODER AED 2.500
B
105103-01

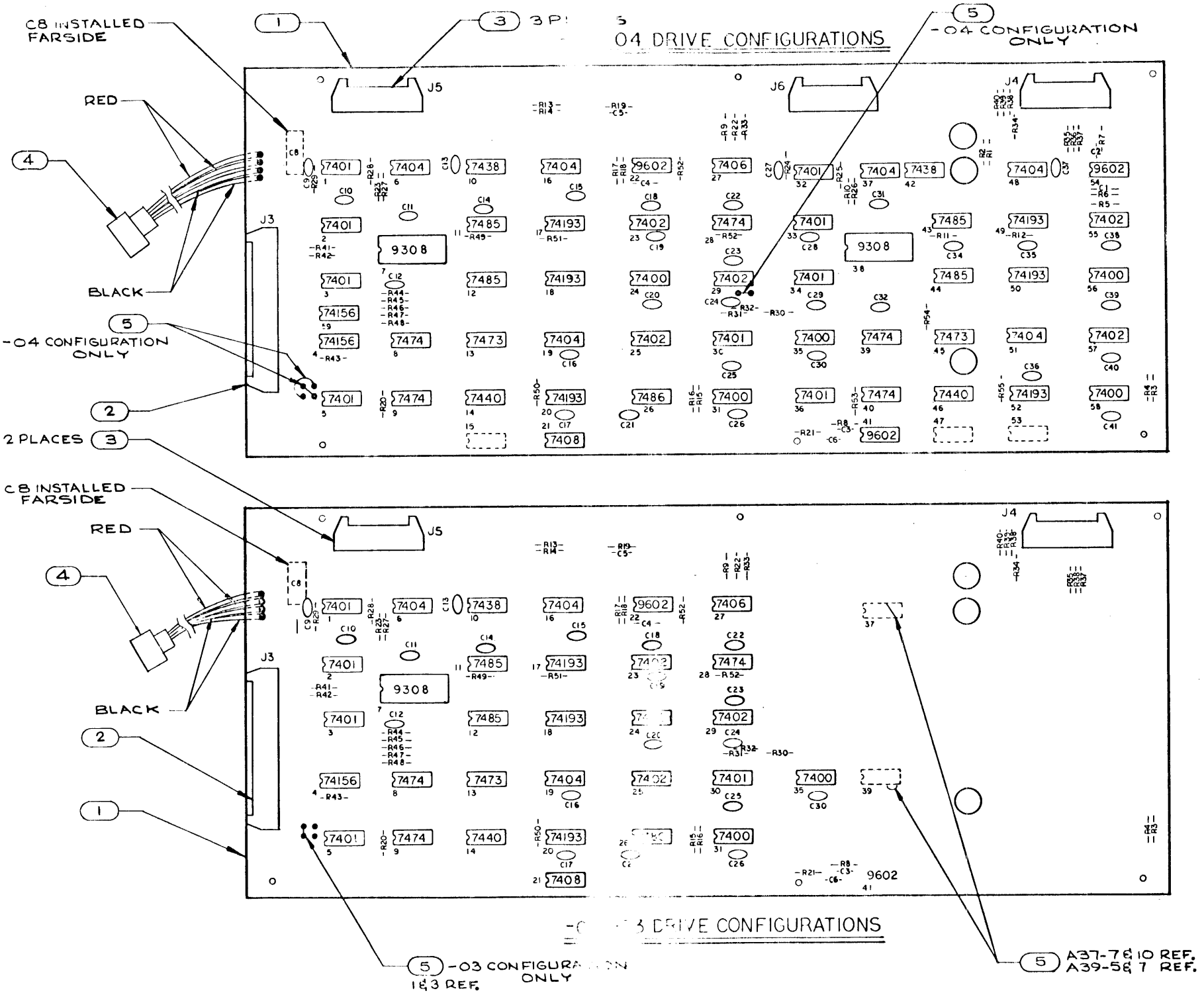

G
+5V
R7
1K
-AM5
J2-10
+5V
R8
1K
-AM6
J2-7
+5V
R9
1K
-AM7
J2-3
+5V
R10
1K
-AM8
J2-45
+5V
R11
1K
-AM9
J2-43
+5V
R12
1K
-AM10
J2-41
-WG
SH3
+SECTOR G
SH1
+DA12
+DA13
+DA14
+DA15
SH9
-CMD OUT
SH 1
9308
-TRACK RECORD
SH1
+DB0
+DB1
+DB2
+DB3
+DB4
+DB5
+DB6
+DB7
+DB8
+DB9
+DB10
+DB12
SH7
-ADDRESS COMPARE
SH 2
+AM5
+AM6
+AM7
+AM8
+AM9
+AM10
SH7
SHEET 6
FORMATTER-FD
ADDRESS COMPARE
B
105103-01

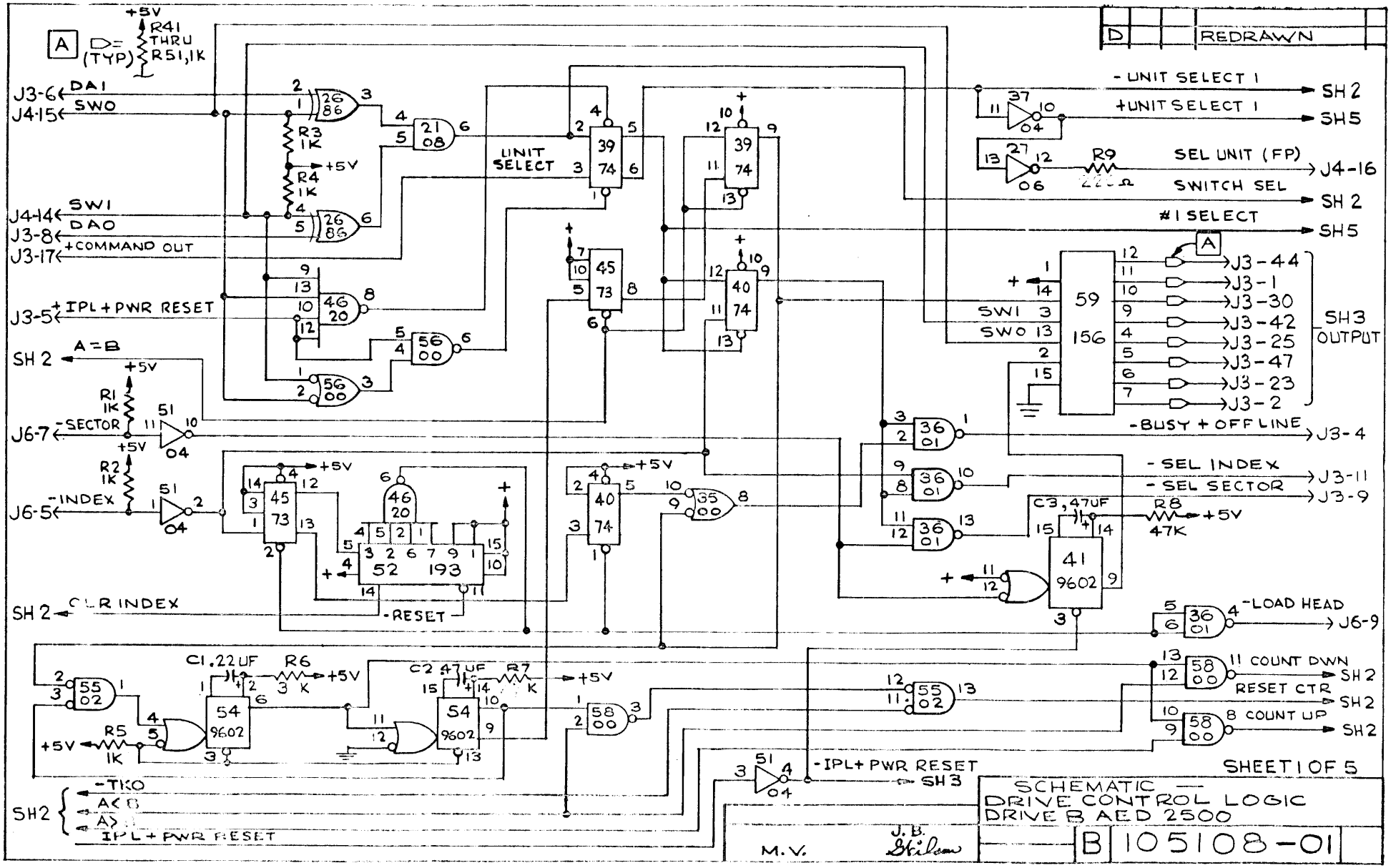

G
41 8263
42 8263
43 8263
44 8263
31 96
33 96
34 96
45 74
65 00
45 74
32 0
32 10
56 20
36 27
48 9308
48 9308
49 9308
49 9308
+5V
R13 1K
-SEP DATA
J2-21
-WRT
SH5
+SHIFT CLOCKS
-CLEAR
+SET
+SER DATA
SH5, 10
-ADDRESS MK
SH2
+DATA MK
SH3
-LOAD
SH3
DB0
DB1
DB2
DB3
DB4
DB5
DB6
DB7
DB8
DB9
DB10
DB11
DB12
DB13
DB14
DB15
SH 9,6
SH 9,6
SH9,6 SH 2,9
SH 9
SHEET 7
FORMATER FD
B 105103-01

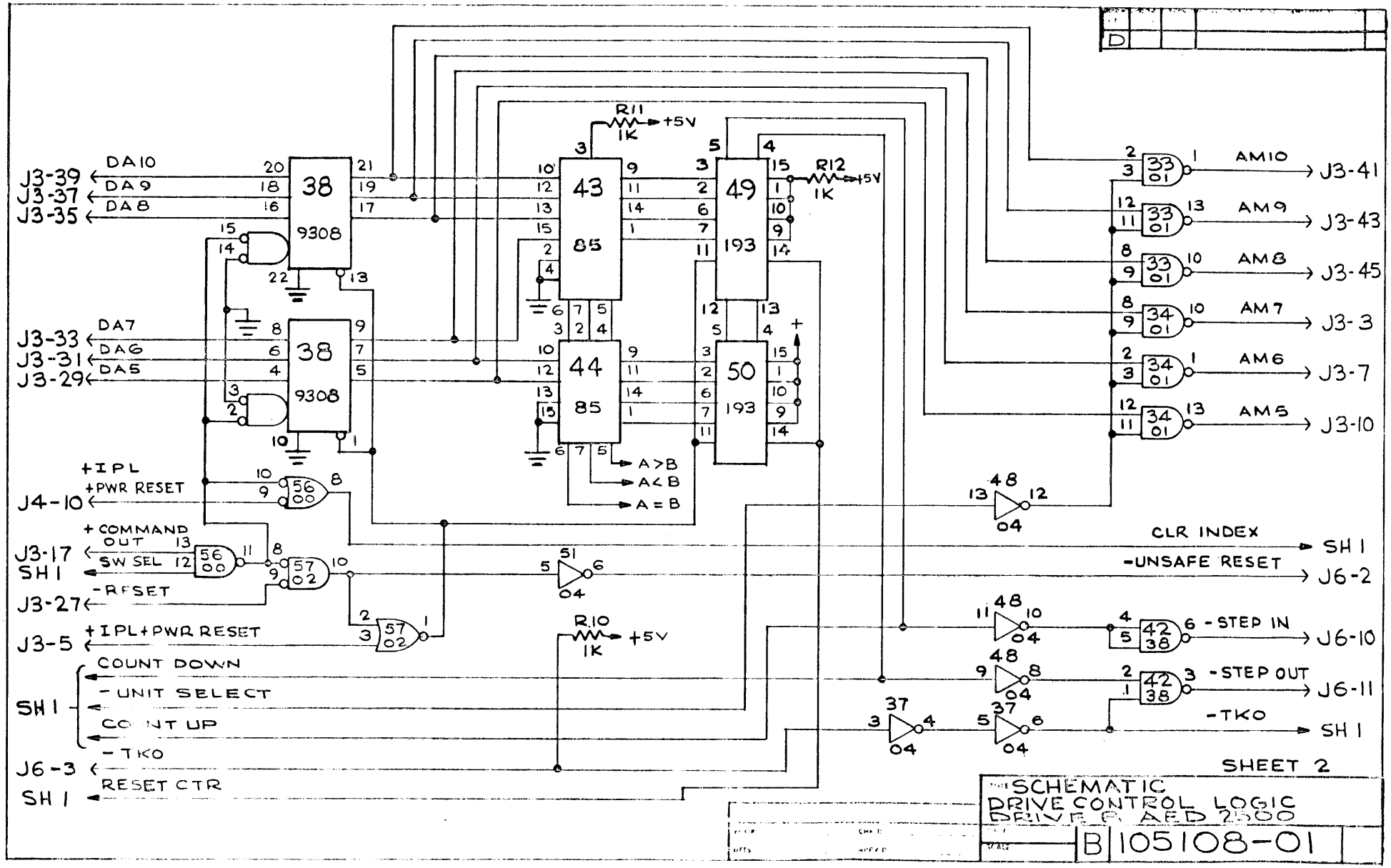

SHEET 9
SHEET7
SHEET 8
SH3 +HOLD
SH1 -INITIALIZE WRITE
SH3 -HOLD
SH4 +RESET HOLD
SH1 +WRITE
SH3 +WG
SH2 -W PROTECT
SH2 -IPL+CMD OUT
SH9 -FILE UNSAFE
DA0 DA1 DA2 DA3
DA4 DA5 DA6 DA7
DA8 DA9 DA10 DA11
DA12 DA13 DA14 DA15
46 9308
46 9308
47 9308
47 9308
+DATA0 +DATA1 +DATA2 +DATA3
+DATA 4 +DATA5 +DATA6 +DATA 7
+DATA8 +DATA9 +DATA10 +DATA11
+DATA12 +DATA13 +DATA14 +DATA15
KFL
PROTECT ERROR
+WRITE ERROR
SH 3
SH 9
J2-34
+5
R14 1K
R15 1K
J2-9 -SEL SECTOR
J2-11 -SEL INDEX
04
04
23 193
25 74
IC 24
SEC 0
SEC 1
SEC 2
SEC 3
SEC 4
+SEC
+INDEX
SH 7
SH2,4
SH1,2,4
SECTOR SELECT JUMPERS
32 1-13, 2-12, 3-11, 4-10, 5-9, 6-8
16 2-13, 3-12, 4-11, 5-10 6-9, 7-8
8 3-13, 4-12, 5-11, 6-10, 7-8 & 9
4 4-13, 5-12, 6-11, 7-8, 9 & 10
2 5-13, 6-12, 7-8, 9, 10 & 11
(NOTE: PIN 7 IS GRD)
FORMATTER DATA LATCH & SECTOR SELECT
B
105103-01

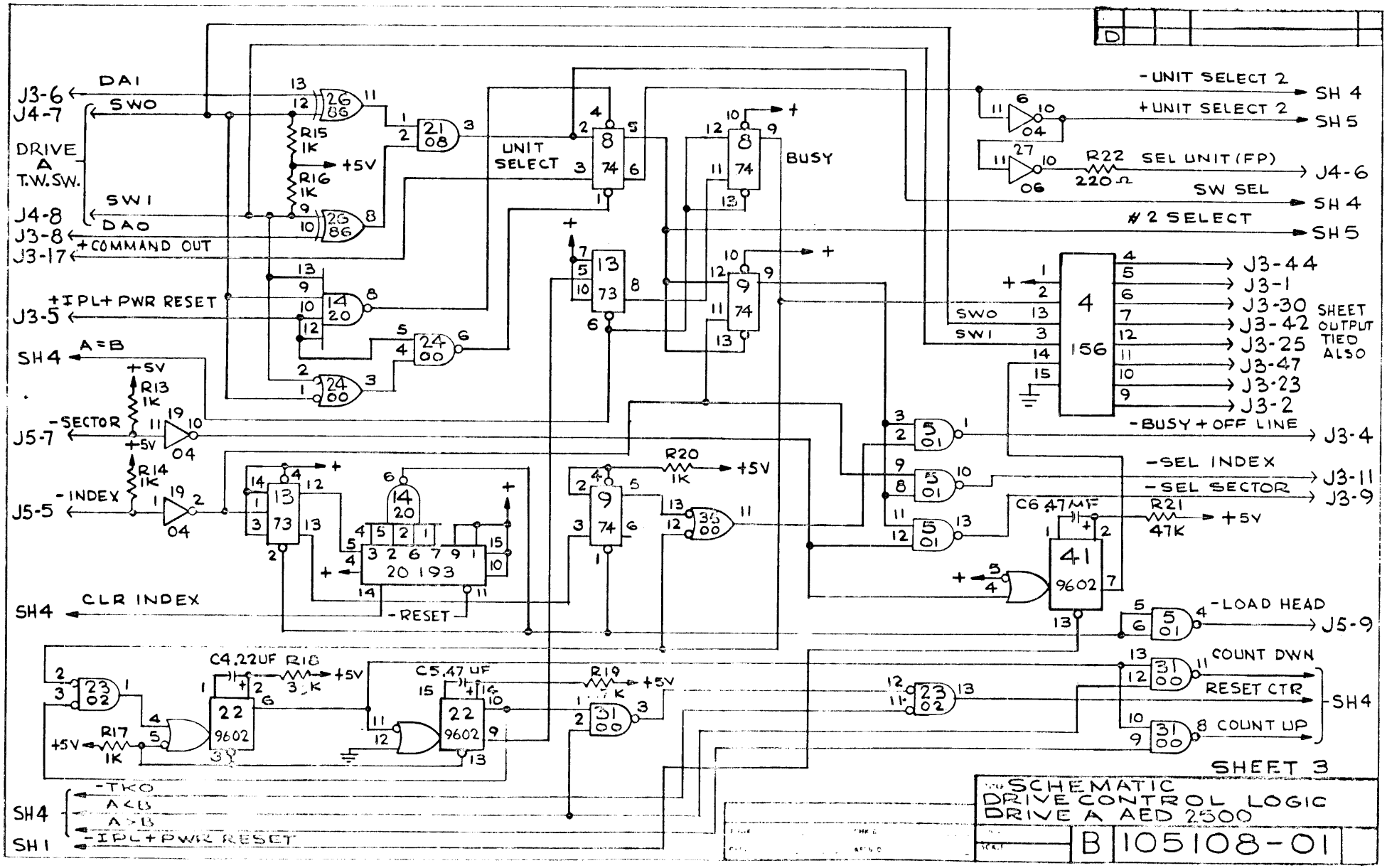

J1-49
DI *
R19
R41
SH 7
DB8
J2-42
-DRIVE NO.4 BUSY
DB9
J1-27
SI *
R35
R57
J2-30
DRIVE NO.3 BUSY
DB10
J2-1
-DRIVE NO.2 BUSY
DB11
J2-44
-DRIVE NO.1 BUSY
+5V
330Ω
390Ω
DB12
J2-2
-DRIVE NO.4 ON LINE
DB13
J2-23
-DRIVE NO.3 ON LINE
DB14
J2-47
-DRIVE NO.2 ON LINE
DB15
J2-25
-DRIVE NO.1 ON LINE
R33 -D8
R55
J1-1
DA8
J2-35
SH 8
R18 -D9
R40
J1-3
DA9
J2-37
SH 8
R32 -D10
R54
J1-43
DA10
J2-39
SH 8
R29 -D11
R51
J1-37
DA11
SH1,8
R27 -D12
R49
J1-41
DA12
SH6,8
R28 -D13
R50
J1-47
DA13
SH6,8
R34 -D14
R56
J1-25
DA14
SH6,8
R38 -D15
R60
J1-11
DA15
SH6, SH1
8
CO *
R36
R58
J1-23
DO *
R37
R59
+COMMAND OUT
+DATA OUT
J2-17, SH1,2
SH3
SH7
DB0
+DATA FLAG
SH3
DB1
ADDRESS FLAG
SH2
DB2
ADDRESS ERROR NO.1
SH2
DB3
-RECORD ERR
SH3
-ADD ERR NO.2
SH2
DB4
+5V
R16
1K
FILE
J2-46
UNSAFE
DB5
SELECT ERROR
J2-48
DB6
PROTECT ERROR
SH8
DB7
INITIAL
ERROR
-ADDRESS
ERROR NO.1
SH1
-DEVICE END
SH2
+DATA FLAG
SH3
R26
R48
R31
R53
+DATA IN
SH3
R21 -D0
R43
J1-35
DA0
J2-8,
SH 8
R25 -D1
R47
J1-31
DA1
J2-6
8
R17 -D2
R39
J1-7
DA2
SH1,
8
R64 -D3
R66
J1-5
DA3
SH1,
8
R24 -D4
R46
J1-29
DA4
SH1,8
R22 -D5
R44
J1-21
DA5
J2-29
SH 8
R23 -D6
R45
J1-19
DA6
J2-31
SH 8
R20 -D7
R49
J1-15
DA7
J2-33
SH 8
+DATA CHK ERROR
J2-32
-FILE UNSAFE
SH 8
DEVICE END *
J1-39
DATA FLAG *
J1-33
SHEET 9
1 ALL INVERTERS ARE 7404
B
FORMATER
FD
105103-01

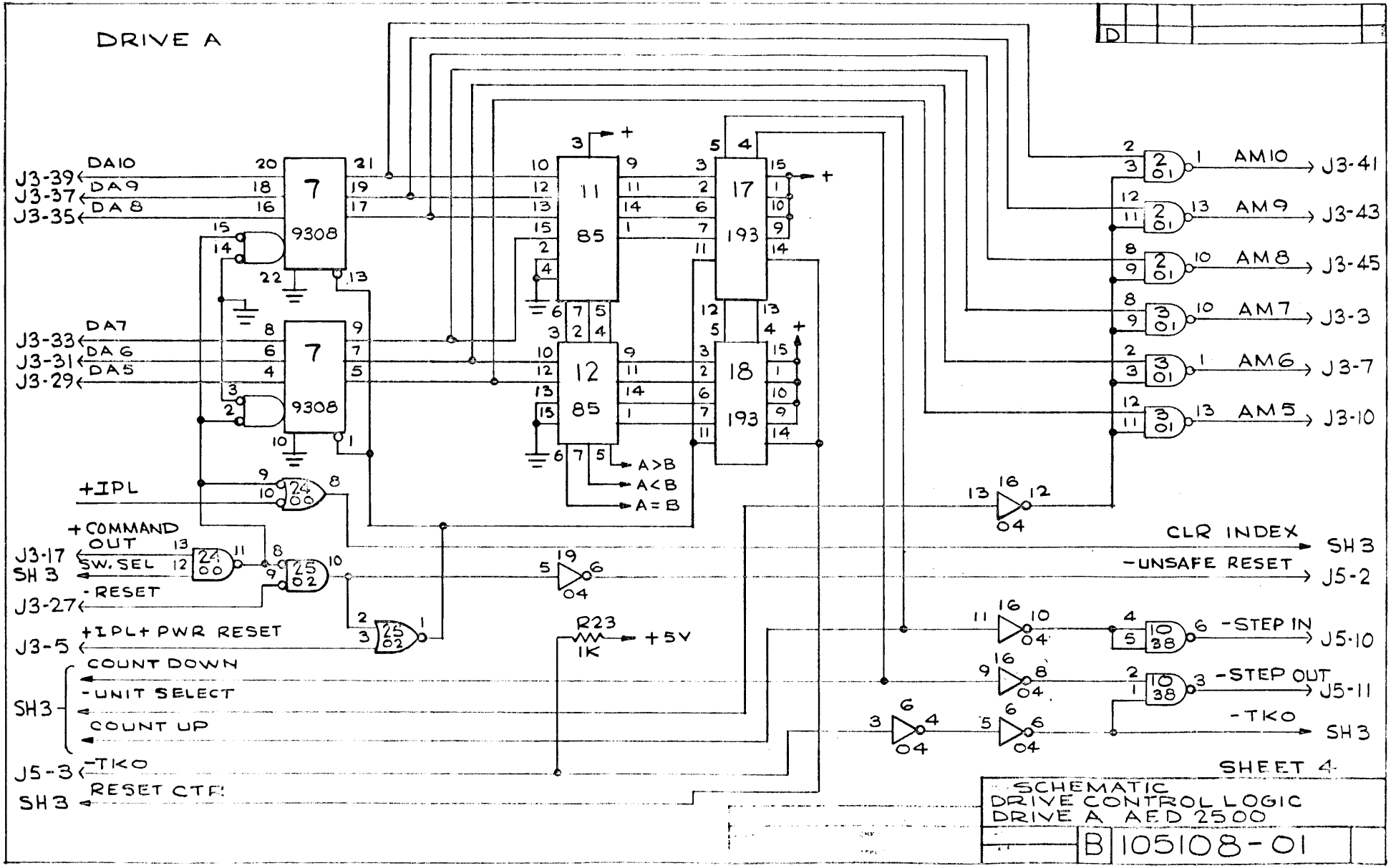

EC15
EC14
EC13
EC12
EC11
EC10
EC9
EC8
SH7
EC7
EC6
EC5
EC4
EC3
EC2
EC1
EC0
SH7
+SERIAL DATA
-SHIFT CLOCKS
SH5
SH4
+ENABLE EC
8202
52
8202
53
-EC=0
SH2, 3
SHEET 10
FORMATTER - FD
ERROR CODE GEN. AED 2500
B
105103-01

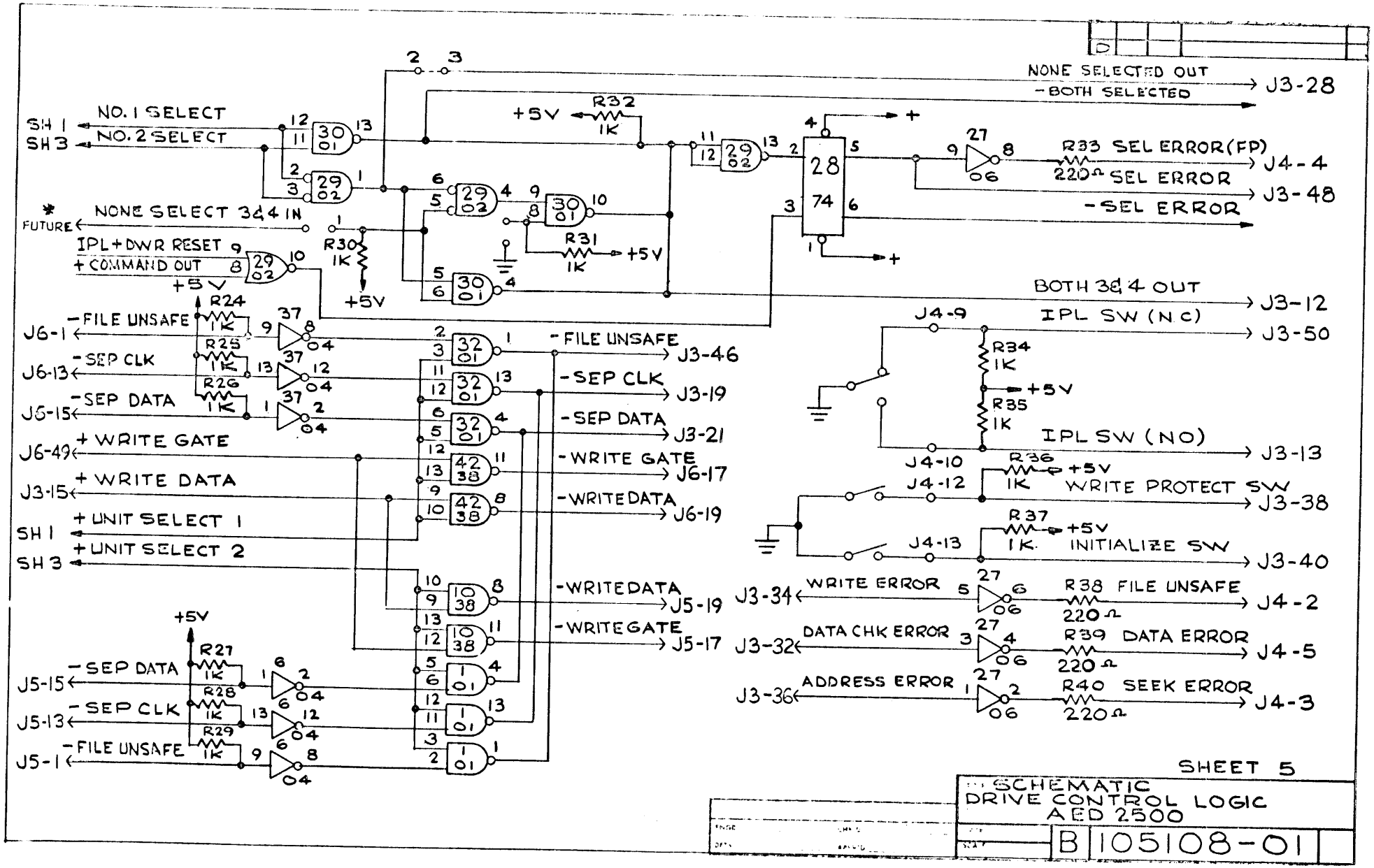

C8 INSTALLED FARSIDE
RED
BLACK
-04 CONFIGURATION ONLY
2 PLACES
J5
J6
J4
J3
9308
-04 DRIVE CONFIGURATIONS
-03 DRIVE CONFIGURATIONS
-03 CONFIGURATION ONLY
A37-7 REF.
A39-5 REF.


D REDRAWN
A
+5V
R41 THRU R51, 1K
(TYP)
J3-6 DA1
J4-15 SWO
R3 1K
R4 1K
+5V
J4-14 SW1
DAO
J3-8 +COMMAND OUT
J3-17
J3-5 +IPL + PWR RESET
UNIT SELECT
- UNIT SELECT 1
SH 2
+UNIT SELECT 1
SH 5
SEL UNIT (FP)
J4-16
R9
SWITCH SEL
SH 2
#1 SELECT
SH 5
SW1
SW0
59
156
J3-44
J3-1
J3-30
J3-42
J3-25
J3-47
J3-23
J3-2
SH3 OUTPUT
-BUSY + OFF LINE
J3-4
SH 2 A=B
J6-7 -SECTOR
R1 1K
J6-5 -INDEX
R2 1K
- SEL INDEX
J3-11
- SEL SECTOR
J3-9
C3, 47UF
R8 47K
+5V
SH 2 CLR INDEX
-RESET
-LOAD HEAD
J6-9
C1, 22UF
R6 3K
C2 47UF
R7 K
R5 1K
11 COUNT DWN
SH 2
RESET CTR
SH 2
8 COUNT UP
SH 2
-IPL + PWR RESET
SH 3
SHEET 1 OF 5
SH2 -TKO
A<B
A>B
IPL + PWR RESET
SCHEMATIC —
DRIVE CONTROL LOGIC
DRIVE B AED 2500
M.V.
J.B. Stilson
B 105108-01


J3-39 DA10
J3-37 DA9
J3-35 DA8
J3-33 DA7
J3-31 DA6
J3-29 DA5
38 9308
43 85
44 85
49 193
50 193
R11 1K +5V
R12 1K +5V
R10 1K +5V
A>B
A<B
A=B
+IPL +PWR RESET
J4-10
+COMMAND OUT
J3-17
SW SEL
SH 1
-RESET
J3-27
+IPL+PWR RESET
J3-5
COUNT DOWN
-UNIT SELECT
SH 1
COUNT UP
-TKO
J6-3
RESET CTR
SH 1
AM10 J3-41
AM9 J3-43
AM8 J3-45
AM7 J3-3
AM6 J3-7
AM5 J3-10
CLR INDEX SH 1
-UNSAFE RESET J6-2
-STEP IN J6-10
-STEP OUT J6-11
-TKO SH 1
SHEET 2
SCHEMATIC
DRIVE CONTROL LOGIC
DRIVE B AED 2500
B 105108-01


J3-6
J4-7
DRIVE A T.W.SW.
J4-8
J3-8
J3-17
DAI
SWO
SW1
DAO
+COMMAND OUT
R15 1K
R16 1K
+5V
UNIT SELECT
BUSY
+IPL+PWR RESET
J3-5
A=B
SH4
R13 1K
-SECTOR
J5-7
R14 1K
-INDEX
J5-5
CLR INDEX
SH4
-RESET
R20 1K
+5V
C6 47MF
R21 47K
-UNIT SELECT 2
SH 4
+UNIT SELECT 2
SH 5
R22 220Ω
SEL UNIT (FP)
J4-6
SW SEL
SH 4
2 SELECT
SH 5
SWO
SW1
J3-44
J3-1
J3-30
J3-42
J3-25
J3-47
J3-23
J3-2
SHEET OUTPUT TIED ALSO
-BUSY + OFF LINE
J3-4
-SEL INDEX
J3-11
-SEL SECTOR
J3-9
-LOAD HEAD
J5-9
C4.22UF R18
3.3K
C5.47 UF
R19 1.7K
R17 1K
COUNT DWN
RESET CTR
8 COUNT UP
SH4
-TKO
A<B
A>B
SH4
-IPL+PWR RESET
SH1
SHEET 3
SCHEMATIC
DRIVE CONTROL LOGIC
DRIVE A AED 2500
B
105108-01


DRIVE A
D
DA10
DA9
DA8
DA7
DA6
DA5
J3-39
J3-37
J3-35
J3-33
J3-31
J3-29
7
9308
11
85
12
85
17
193
18
193
AM10
AM9
AM8
AM7
AM6
AM5
J3-41
J3-43
J3-45
J3-3
J3-7
J3-10
A>B
A<B
A=B
+IPL
+COMMAND OUT
SW. SEL
J3-17
SH 3
-RESET
J3-27
+IPL+ PWR RESET
J3-5
R23
1K
+5V
CLR INDEX
SH3
-UNSAFE RESET
J5-2
-STEP IN
J5-10
-STEP OUT
J5-11
-TKO
SH3
COUNT DOWN
-UNIT SELECT
COUNT UP
SH3
-TKO
J5-3
RESET CTR
SH3
SHEET 4
SCHEMATIC
DRIVE CONTROL LOGIC
DRIVE A AED 2500
B
105108-01



SHEET 5

SCHEMATIC
DRIVE CONTROL LOGIC
AED 2500

B 105108-01