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MARINE CORPS

TECHNICAL MANUAL
OPERATION AND MAINTENANCE INSTRUCTIONS

SIGNAL DATA RECORDER
REPRODUCER
R D-432/TYQ

TEXAS INSTRUMENTS INCORPORATED
F19628-77-C-0126

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5-40 Blank	0	6-28 Blank	0	6-61	0
5-41	0	6-29 .. 0	0	6-62 Blank	0
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SECTION I
GENERAL DESCRIPTION

1-1. INTRODUCTION.

1-2.This technical manual provides operating and servicing instructions for the Signal Data Recorder Reproducer RD-432/TYQ (hereinafter referred to as the Transport). Section I contains a general description of the equipment, its purpose, and basic principles of operation, along with a description of Transport major assemblies. Section II contains information for unpacking, installation, and interface signal requirements. Section III provides operating instructions for the Transport. Section IV describes the principles of operation of the Transport components and circuits. Section V describes maintenance procedures. Section VI contains the Transport schematic diagrams and includes a description of logic symbols and signal conventions. Related publications are listed in table 1-1.

1-3.The Transport (figure 1-1) records and reproduces 9-track NRZI (Non Return to Zero) digital information at a density of 800 bits per inch and is fully compatible with all applicable provisions of the American National Standards Institute (ANSI) standards governing the recording and reproducing of NRZI digital data. To record or reproduce data, the Transport moves *1A* inch, computer grade, magnetic tape across a dual-gap magnetic read/ write/erase head assembly in response to commands from an external controller, a Built-In Test Equipment (BITE) module A2A4, or the operator's control panel. Tape motion is bidirectional at 75 inches per second. Bidirectional deskewing allows data to be read in both directions. The Transport accepts reel sizes up to 101/2 inches in diameter with up to 2,400 feet of tape. Tape threading and loading is performed automatically by the Transport.

1-4. DESCRIPTION OF EQUIPMENT.

1-5.The Transport is completely self-contained. The Transport's electronics are enclosed in a card cage A2 containing plug-in printed-circuit modules for the tape drive circuits, read/write amplifiers, line drivers A2A15 and receivers A2A16, power supply regulators A2A6, and built-in test equipment A2A4. All power transistors and high-wattage components are mounted on a single heatsink assembly Al to provide more efficient cooling and easier access to components for maintenance. The input power transformer, bridge rectifiers, filter capacitors, and fuses are contained on a single power supply chassis A3, which is easily removable for repair or replacement.

1-6. SPECIFICATIONS.

1-7.A tabular listing of performance characteristics and specifications for the Transport is given in table 1-2.

1-8. EQUIPMENT SUPPLIED.

1-9.Table 1-3 is a listing of equipment supplied with the Transport.

1-10. PHYSICAL DESCRIPTION.

1-11.The components of the Transport (figure 1-2) are assembled on a machined aluminum casting which is mounted to a box-like housing. The entire assembly is designed to be slide-mounted into a cabinet in a bookcase configuration. Two alignment pins at the rear of the unit permit proper alignment in a cabinet; and two latching handles and seven captive screws, located on the front panel, provide for securing the Transport in the cabinet. A dust cover door, hinged at the left rear of the unit, protects the tape reels and overlaps the vacuum tank door (27,

Table 1-1. Related Publications

Publication Title	Publication Number
Operation and Maintenance Instructions,	T.O. 10M1-7-7-1
Auxiliary Interpretation Data Processing	TM 11-5895-1028-14
Group OL-80(V)/TYQ-I 1(V)	
Operation and Maintenance Instructions,	T.O. 10M 1-7-5-1
Augmented Interpretation Data Processing	TM 11-5895-1029-14
Group OL-87(V)/TYQ	TM 08045-15/11
Operation and Maintenance Instructions,	T.O. 31S5-4-760-1
Multiplexer XIO-2	TM11-5895-1032-14
TM 08045-15/18	
Illustrated Parts Breakdown,	T.O. (to be supplied)
Signal Data Recorder Reproducer	TM
RD-432/TYQ	TM
Test Procedures Manual	T.O. 10MI-7-9-8-2
Fault Isolation Diagnostics	TM11-5895-1021-14/4
Imagery Interpretation Segment	TM 08045-15/4
Work Cards, Periodic Inspection	T.O. 10MI-7-9-6WC-I
Requirements for Imagery	TM11-5895-1021-14/2
Interpretation Segment	TM 08045-15/2

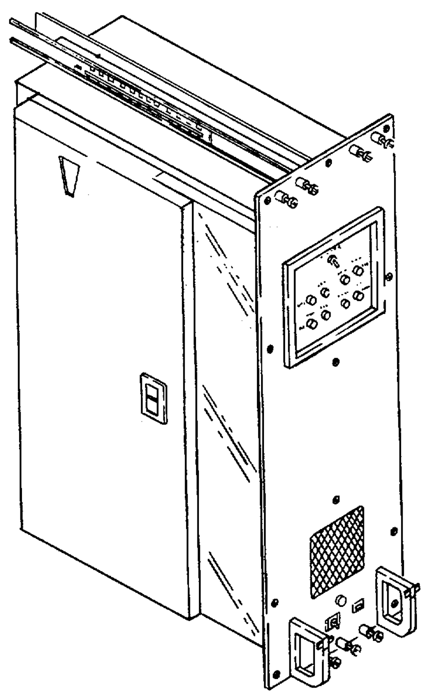


Figure 1-1. Signal Data Recorder Reproducer RD-432/TYQ

Table 1-2. Transport Specifications

Characteristic	Specification
Tape speed	75 inches per second (ips)
Speed stability	2 percent
Rewind time	Less than 150 seconds for 2,400 feet
Start time (from 0 to 75 ips)	3.0 milliseconds maximum (with start holdover delay set to zero)
Start distance	0.105 -0.020 inch (with start holdover delay set to zero)
Stop time	3.0 milliseconds maximum (with stop holdover delay set to zero)
Stop distance	0.13 +0.02 inch (with stop holdover delay set to zero)
Skew:	
Static	3.0 microseconds maximum
Dynamic (all ones data)	2.5 microseconds maximum
Read direction	Bidirectional (read deskewing is provided in both directions)
Tape type	3M 777 or equivalent (do not use back-coated tape)
Tape format	9-track NRZI
Beginning- and end-of-tape sensing	Reflective marker detection
Tape reels	Up to 101/2 inch diameter
Tape threading, loading, and unloading	Fully automatic
Temperature range:	
Operating	-40° to +550C (excluding tape media)
Nonoperating	-55° to +71°C
Altitude range:	
Operating	Up to 12,000 feet
Nonoperating	Up to 50,000 feet
Humidity range:	
Operating	2- to 95-percent relative humidity
Nonoperating	2- to 100-percent relative humidity
Power requirements	120 +12 volts, 400 +40 Hz, 3-phase wye; 1 KVA maximum
Dimensions (including slides):	
Height	27.97 inches
Width	9.44 inches
Depth	30.69 inches
Weight	140 pounds (approximately)

Table 1-3. Equipment Supplied

Equipment	*Nomenclature/Part No.*
Signal Data Recorder Reproducer	RD-432/TYQ

figure 1-2). The vacuum tank door forms the outer wall of the file and machine vacuum tanks (4 and 6) and is hinged at the front of the Transport. Input power and input/output (I/O) interface connections are made at rear panel connectors (48) J1 and J2, respectively. The following paragraphs describe the major Transport components required for the storage, guidance, and motion of the magnetic tape.

1-12. TAPE STORAGE. Tape is stored on a file reel, which is installed on a file reel hub (37, figure 1-2). The file reel hub is, in turn, mounted to the shaft of a file reel motor B1 (46). Tape is wound onto a machine reel (33) as it is moved in the forward direction. The machine reel is mounted to the shaft of a machine reel motor B2 (52). Two slack loops of tape, one for each reel, are stored in vacuum tanks formed by several rails, a plate sandwiched between the rails and the main casting, and a vacuum tank door (27). A file tank (4) is provided for the file reel loop and a machine tank (6) is provided for the machine reel loop. A vacuum blower B4 (68) maintains a pressure of -22 in H2O behind the loops in each tank so that the loops are normally drawn to the "bottom" of each tank with a force of approximately 7 oz/strand. Loop position sensors, which control the position of the loops through a reel servosystem consisting of the reel motors, the sensors, and intermediate electronics, are contained in each tank . The sensors (59, 61, and 67) are pressure sensors connected to the tanks through ports (2, 3, 7, 9, 15, 16, 19, 21, 24, and 26). Reel tachometers (29, 30, 38, and 39), which monitor and limit the velocity of the tape leaving each reel, are also used in the reel servosystem.

1-13. As tape is caused to move forward or in reverse by the capstan (25), the reel servosystem attempts to maintain the vacuum tank loops near the center of each tank. Upper servo sensor ports (9 and 15) detect loop travel toward the upper half of each tank while lower servo sensor ports (7 and 16) detect loop travel toward the lower half of each tank. If a loop travels across any of these ports away from the center of its tank, the associated reel motor will be commanded to turn its reel in such a way as to force the loop back toward the center again. The effect is to keep the loops within the tank areas defined by the upper and lower servo sensor ports. Upper safety sensor ports (2 and 24) and lower safety sensor ports (3 and 26) detect loop travel beyond the physical end of each tank and immediately shut down the reel servo and capstan drive systems if a loop should ever travel beyond those limits.

1-14. TAPE GUIDANCE. The tape is accurately guided over a tape/write/erase head (17, figure 1-2) by two tape guides (12 and 18). A tape cleaner (14), which removes loose debris from the oxide coating of the tape, is located next to the head. Two rollers (44) form a frictionless turn of 180 degrees for the tape as it leaves the file tank on its way to the head. A buffer (11), located in the tape path, is connected to the vacuum supply and forms a resilient loop in the tape. This loop works in conjunction with the rollers to provide dynamic control of tape tension during rapid starts and stops. The tape is held in the four corners of the vacuum tanks by vacuum applied through four corner ports. A typical port (1) is connected to the vacuum blower B4 (68) through a system of ducts located beneath the base plate of the vacuums tanks, and a solenoid-operated valve A4 (70). The valve diverts vacuum from the vacuum blower to either the machine reel (during auto thread) or the vacuum tanks (during auto load and normal tape operation). The valve also directs positive pressure airflow from the vacuum blower to air jets in the tape threading path during auto thread operations (paragraph 1-26).

1-15. TAPE MOTION. Tape is wrapped 180 degrees around a rubber-coated capstan (25, figure 1-2), which is mounted to the shaft of a low-inertia capstan motor/tachometer B3/G1 (58). As the motor is driven clockwise (reverse tape motion) or counterclockwise (forward tape motion), the tape is caused to move from one reel to the other through the vacuum tanks and across the read/write/erase head. A capstan servosystem, consisting of the capstan motor, an analog tachometer mounted to its shaft and intermediate electronics, maintains tape speed to within 2 percent of 75 ips during normal forward and reverse operations. The capstan servosystem also drives the tape during rewind. Rewind sensor ports (19 and 21) serve to control loop travel during rewind, and a Machine Reel Low Tape Sensor Q6 (32) causes the tape to slow down to normal speed when the amount of tape on the machine reel falls below 50 feet. This sensor is also used to halt auto thread operations if the BOT marker is not detected before 50 feet of tape is wound onto the machine reel.

1-16. Circuitry in the reel servosystems allows the reels to be turned at very slow speeds during auto thread, auto load, and unload operations. There are four low-speed modes for this purpose: file reel cw, file reel ccw, machine reel cw, and machine reel ccw. These are automatically selected during the various low-speed operations.

1-17. CONDITION SENSING. Various devices within the machine sense a number of-conditions associated with the handling of magnetic tape. These are described in the following paragraphs.

1-18. EOT/BOT Sensor. An End-Of-Tape (EOT)/Beginning-Of-Tape (BOT) Sensor Q10/Q9 (13, figure 1-2) detects reflective markers located near the physical ends of a reel of tape. The sensor consists of two light sensors and two infrared light emitters, which are arranged such that the light emitted by each emitter is reflected back from the surface of the respective reflective marker to its associated light sensor. When an EOT marker is sensed, an EOT status is set and an end-of-tape reply is sent to the controller. Likewise, when a BOT marker is sensed, BOT (or load point) status is set and a BOT reply is sent to the controller. The BOT sensor is also used during auto and manual thread operations and a front panel BOT lights when the BOT marker passes the sensor on its way to the machine reel.

1-19. Tape Cross Upper and Tape Cross Lower Sensors. A photoelectric Tape Cross Upper Sensor (5, figure 1-2) is used to detect the presence of tape in the threading path prior to an auto thread operation and to terminate an auto unload operation. A photoelectric Tape Cross Lower Sensor Q4 (31) detects when tape has passed through the head/guide area on its way to the machine reel during an auto thread operation. The lower sensor is used to monitor the passage of tape to the machine reel and flags a fault if it does not detect the presence of tape within 2 seconds after an auto thread sequence is initiated.

1-20. Vacuum Sense Bypass Port. This port (20, figure 1-2) is connected to a vacuum sensor which senses the presence of at least -1.5 in H2O vacuum pressure within the ducting behind the vacuum tanks. If the vacuum tank door is open, the port causes atmospheric pressure to enter the vacuum sensor feed line causing the sensor to open. Thus, the sensor will not signal the presence of vacuum and will inhibit an auto load operation if the tank door is open or if the vacuum blower is not operating.

1-21. Tape in Tank Sensors. A Tape in Machine Tank Sensor Q2 (23, figure 1-2) and a Tape in File Tank Sensor Q3 (42) detect the presence of tape loops in their respective tanks. These photoelectric sensors are used during auto load and unload operations.

1-22. File Protect Sensor. A File Protect Solenoid Assembly S13 (36, figure 1-2) is used to detect the presence or absence of a write enable ring on the file reel. The plastic write enable ring is pressed into a groove in the rear surface of the reel before mounting the reel on the file reel hub. When a reel with a write enable ring is mounted on the file reel hub, the write enable ring presses in a plunger on the File Protect Sensor, which actuates a switch within the sensor assembly. When the Transport assumes ready status, the actuated switch causes a solenoid within the sensor assembly to be energized which, in turn, withdraws the plunger away from the write enable ring. The switch also applies a signal to the write circuits and the controller indicating the Transport is write enabled. A reel of tape without the write enable ring cannot be overwritten and is, in effect, file protected.

1-23. Tape Threaded Sensor Port. A pressure sensor connected to a tape-threaded-sensor port (28, figure 1-2) is used during an auto thread operation to detect that the machine reel has captured the tape and is winding tape onto itself. When tape is being wound onto that reel, it is pulled tight across the port, thus closing a pneumatic bypass circuit, which allows the sensor to close and signals that the tape is threaded. If the sensor does not close within 4 seconds after TAPE CROSS UPR SNSR has been detected, the thread sequence will be halted.

1-24. CARD CAGE. A card cage A2 (49, figure 1-2) contains 16 plug-in printed-circuit modules. These modules contain all the logic circuits necessary for the writing, reading, and handling of magnetic tape. They also contain all low-power circuits for the reel and capstan servosystems. Circuits that provide reference voltages to the heatsink assembly Al for regulation of all four regulated power supply voltages (+5V, + 12V, -12V, and +30V) in the transport are also in the card cage. One module, the BITE Module A2A4, provides a means of testing various Transport performance characteristics and may be removed if not in use. Two interface modules interface Transport status, data, and command lines to the external controller via an interface cable (65) and the rear panel I/O connector J1, J2 (48). Three connectors (51, 64, and 66) provide the power and control interface between the card cage and the components mounted on the casting, front panel, and heatsink assembly Al. Two head cables (63) connect the read/write/erase head assembly to the write amplifier A2A14 and read preamplifier modules A2A10.A card retainer (71) is used to hold the modules in their connectors and may be moved up out of the way to remove modules for servicing. Figure 1-3 illustrates the location of all modules in the card cage, along with the location of all adjustments, controls, and indicators on the modules.

1-25. HEATSINK. A heatsink assembly Al (47, figure 1-2) contains the active power circuitry for the Transport. All power components including power transistors, power resistors, and power diodes are contained on the heatsink. It also contains two relays (Emergency Stop and Air Supply) used in the power control circuitry. The heatsink interfaces to the card cage through a heatsink/card cage interface connector A2PI (51) and to the power supply chassis through a power supply/tape drive interface connector AIPI (53).

1-26. VACUUM BLOWER. A vacuum blower B4 (68, figure 1-2) provides air pressure and vacuum for auto thread operations as well as vacuum for the vacuum tanks during auto load and normal tape drive operations. The intake (vacuum) side of the blower is connected through a manifold to the solenoid-operated valve A4 (70) while the output (pressure) side of the blower is ducted to both the valve and the air jets in the tape threading path. During auto thread, the valve blocks off the air pressure input to the valve, creating a positive pressure to the air jets in the tape threading path. The air pressure through the air jets, in turn, guides the tape through the tape threading path down to the machine reel. At the same time, the valve directs the vacuum from the vacuum blower to the core of the machine reel. Thus, as the leader end of the tape is threaded down to the machine reel, the vacuum pulls the tape against the core of the reel to capture the tape on the machine reel. After auto thread is completed, the valve switches the vacuum from the core of the machine reel to the vacuum tanks. This draws the tape into the vacuum tanks to form the tape loops. At the same time that vacuum is directed to the vacuum tanks, the valve opens the output (pressure) side of the vacuum blower to free space, thereby stopping the flow of air through the tape threading air jets and relieving any back pressure to the vacuum blower.

1-27. POWER SUPPLY ASSEMBLY. The power supply assembly A3 (55, figure 1-2) develops the unregulated dc voltages for the Transport as well as the ac excitation voltage for the reel servo motors. The power supply assembly is easily removed from the Transport for maintenance and contains the power transformer A3T1 (54), bridge rectifiers, filter capacitors, and protective fuses (56). The front panel POWER circuit breaker, AC ON indicator, and ELAPSED TIME indicator are connected to the power supply via a power supply/circuit breaker panel interface connector A3PI (57). All other power supply connections are made through the power supply/ heatsink interface connector AIPI (53).

1-28. EQUIPMENT INTERFACE.

1-29. The Transport interfaces with the host computer through the Magnetic Tape Control Unit (MTCU), which is located in the Multiplexer (XIO-2). A block diagram showing the control signals and read/write data lines between the Transport and MTCU is illustrated in figure 1-4.

1-30. The Transport signal control/data interface is of a single-ended simplex type and is designed for radial connection to the MTCU. The Transport interface specifications are listed in table 1-4 and the Transport driver and receiver circuits with associated terminator resistors are shown in figure 1-5. Interface signal pin assignments are listed in table 2-1.

Location	Module	Mnemonic
A1	Machine Reel Servo Drive	MSRV
A2	File Reel Servo Drive	FSRV
A3	Servo Control	SCON
A4	Built-In Test Equipment	BITE
A5	Capstan Drive and Field Regulator	CAPS
A6	Power Supply Regulators	VREG
A7	Load/Rewind	LOAD
A8	Sensor	SENS
A9	Auto Thread	AUTO
AI0	Read Preamplifier	RPRE
A11	Read Amplifier	RAMP
A12	Read Buffer	RBUF
A13	Write Control	WCON
A14	Write Amplifier	WAMP
A15	Line Driver	DRVR
A16	Line Receiver	RCVR

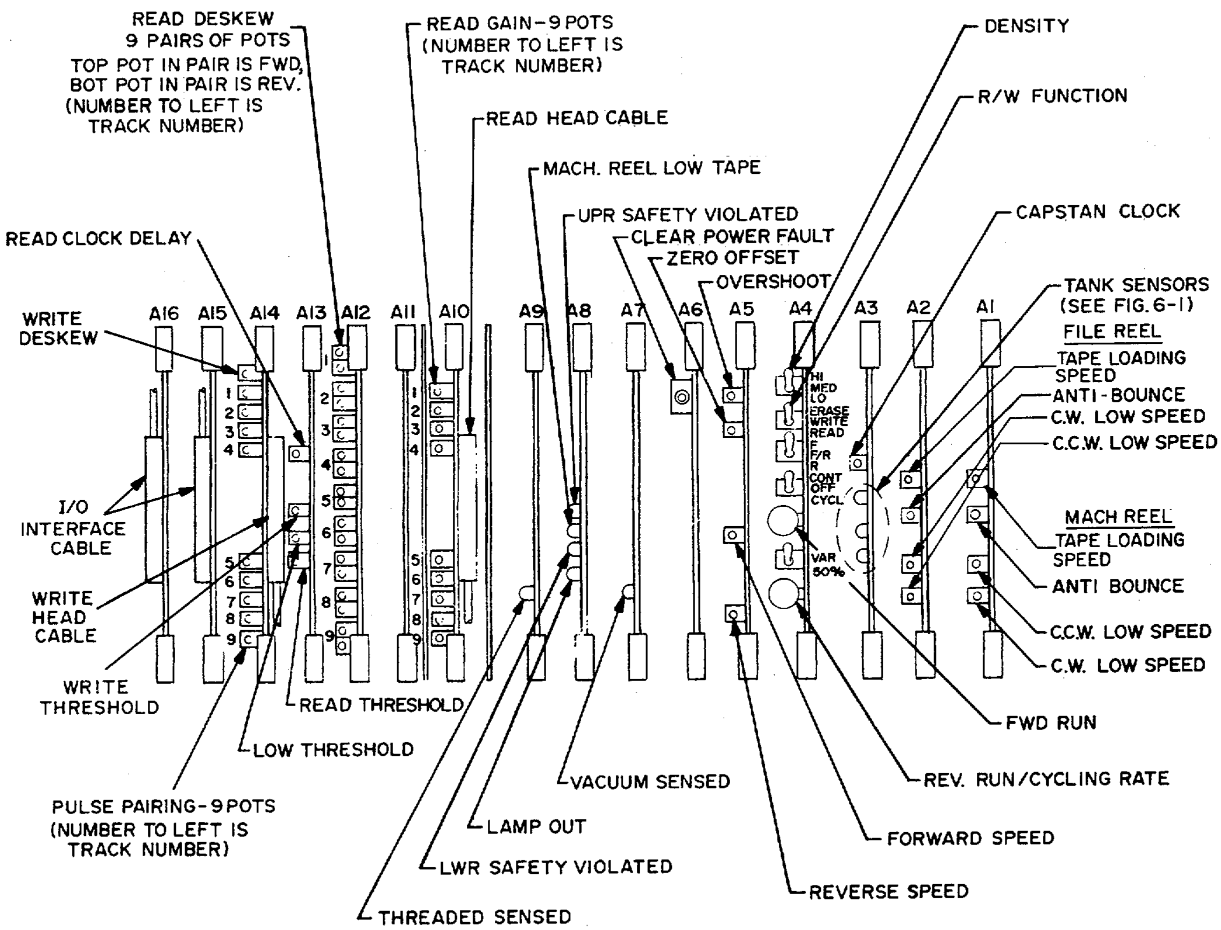


Figure 1-3. Card Cage A2, Location of Modules, Adjustments, Controls, and Indicators

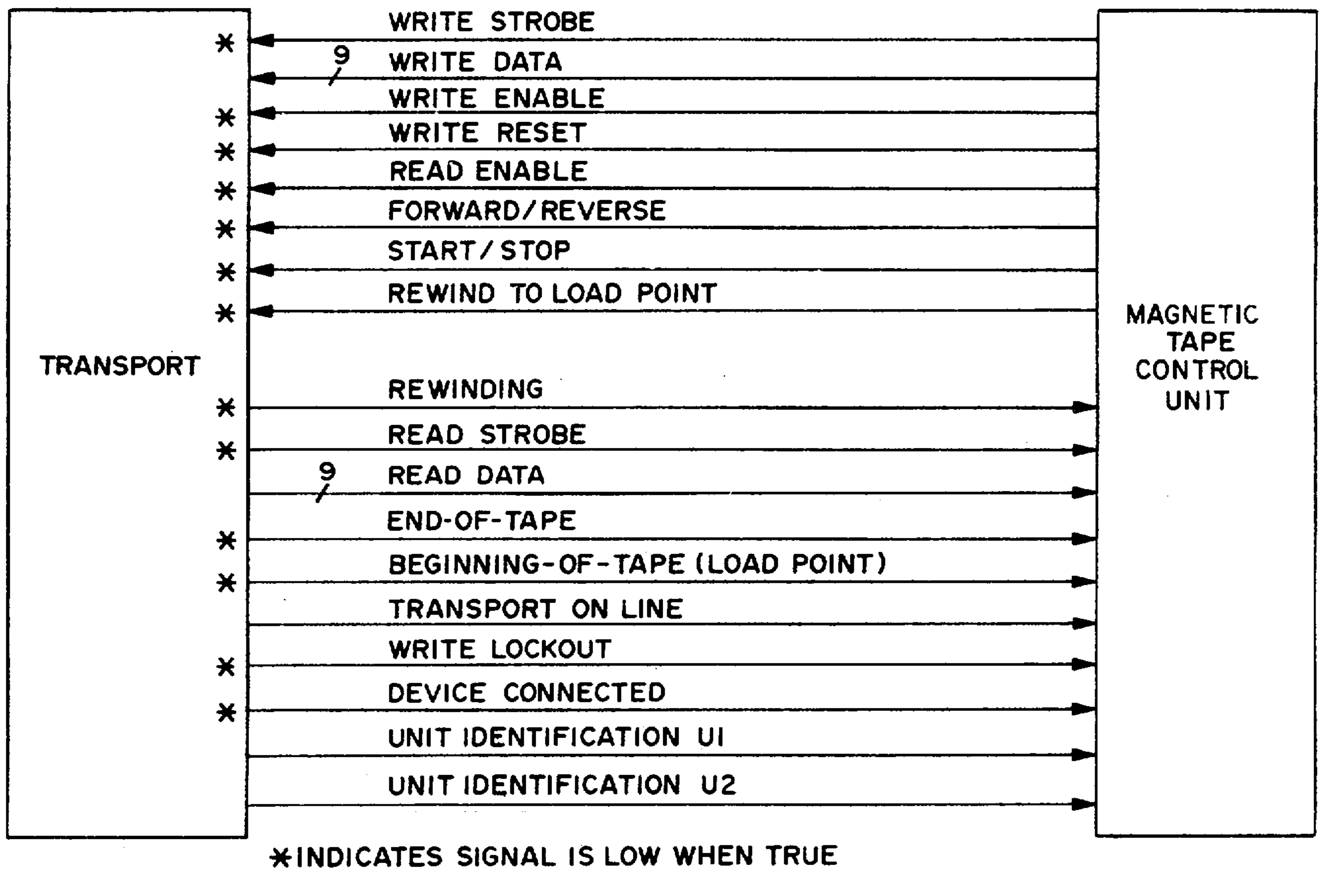


Figure 1-4. Transport System Block Diagram

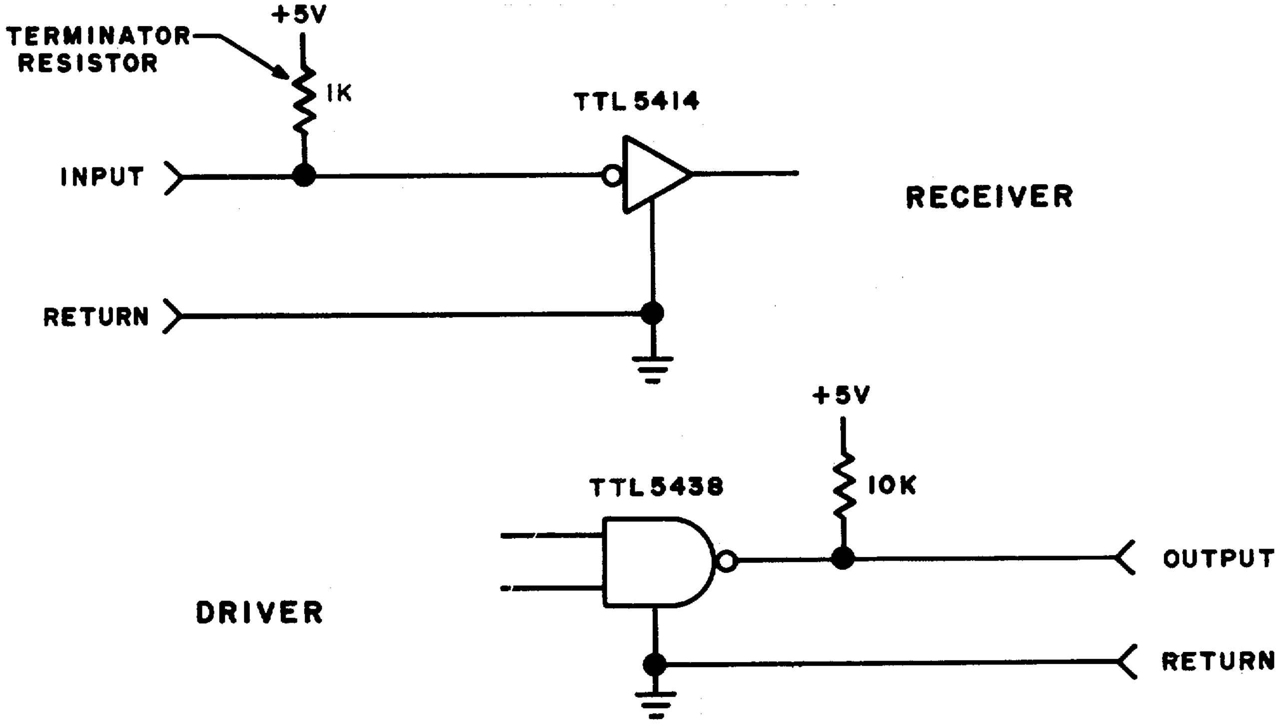


Figure 1-5. Receiver/ Driver Circuits

Table 1-4. Interface Specifications

Characteristic	Specification
Driver Type	TTL 5438
Receiver Type	TTL 5414
Cable Length	20 feet (maximum)
Conductor Type	Twisted pair
Input Signal Requirements (as measured from signal pin to return pin at interface connector):	
Write Strobe	
Write Enable	
Write Reset	
Read Enable	True = 0.0 +0.5 Vdc
Forward/Reverse	False = +3.0 +0.5 Vdc
Start/Stop	
Rewind to Load Point	
Write Data Lines	True = +3.0 +0.5 Vdc
	False = 0.0 40.5 Vdc
Output Signal Requirements (as measured from signal pin to return pin at interface connector):	
Rewinding	
Read Strobe	
End-of-Tape	True = 5.0 +0.25 Vdc (no load)
Beginning-of-Tape	False = 0.1 to 0.4 Vdc
Write Lockout	
Device Connected	
Unit Identification Lines	
Read Data Lines	True = 5.0 +0.25 Vdc (no load)
Transport-on-Line	False = 0.1 to 0.4 Vdc

SECTION II
INSTALLATION

2-1. GENERAL.

2-2. This section contains instructions on the preparation for use and shipment of the Magnetic Tape Transport when installed in the shelter. Included within this section is a reference for the installation and removal of the Transport from the ADP Rack.

2-3. PREPARATION FOR USE.

WARNING

The Transport weighs approximately 140 pounds and requires four men (or an authorized lifting device) to lift and transport the unit, and to mount in or remove from the ADP equipment rack.

2-4. UNPACKING. The Transport is shipped completely assembled. Normal procedures for preparing the Transport for use consist of the following:

a. Remove the Transport from the shipping container.
b. Visually inspect all assemblies and parts for evidence of damage as follows:
   Examine for dents, cracks or other evidence of mishandling
   Check all components for security of mounting and loose hardware
   Check all cables and connectors for loose, broken or bent contacts
   Check all rotating parts for binding.

2-5. DAMAGE REPORT. All damages and shortages should be reported in accordance with the regulations of the service having jurisdiction over the damaged equipment.

2-6. INSTALLATION. Normal installation of the Transport is in the ADP rack of an IA-, or A-Shelter.Refer to the appropriate shelter manual listed in table 1-1 for the Transport installation procedure.

2-7. To facilitate installation of the Transport in an environment other than the ADP rack, outline dimensions are provided in figure 2-1.

2-8. INTERFACE SIGNAL REQUIREMENTS.

2-9. INPUT/OUTPUT SIGNALS. All input/output signals for the Transport are applied through interface connector J2 (part number MS27508E20B35P), located on the rear panel of the unit. Table 2-1 lists all the Transport input/output signals along with the interface connector pin number assigned to each signal.

2-10. INPUT POWER REQUIREMENTS.

2-11. The Transport requires 120-volt (line-to-neutral), 3-phase (wye connected), 400-Hz power at input power connector J1 (part number MS27508E16B8P), located on the rear panel of the unit. Table 2-2 lists the input power connections for connector J1.

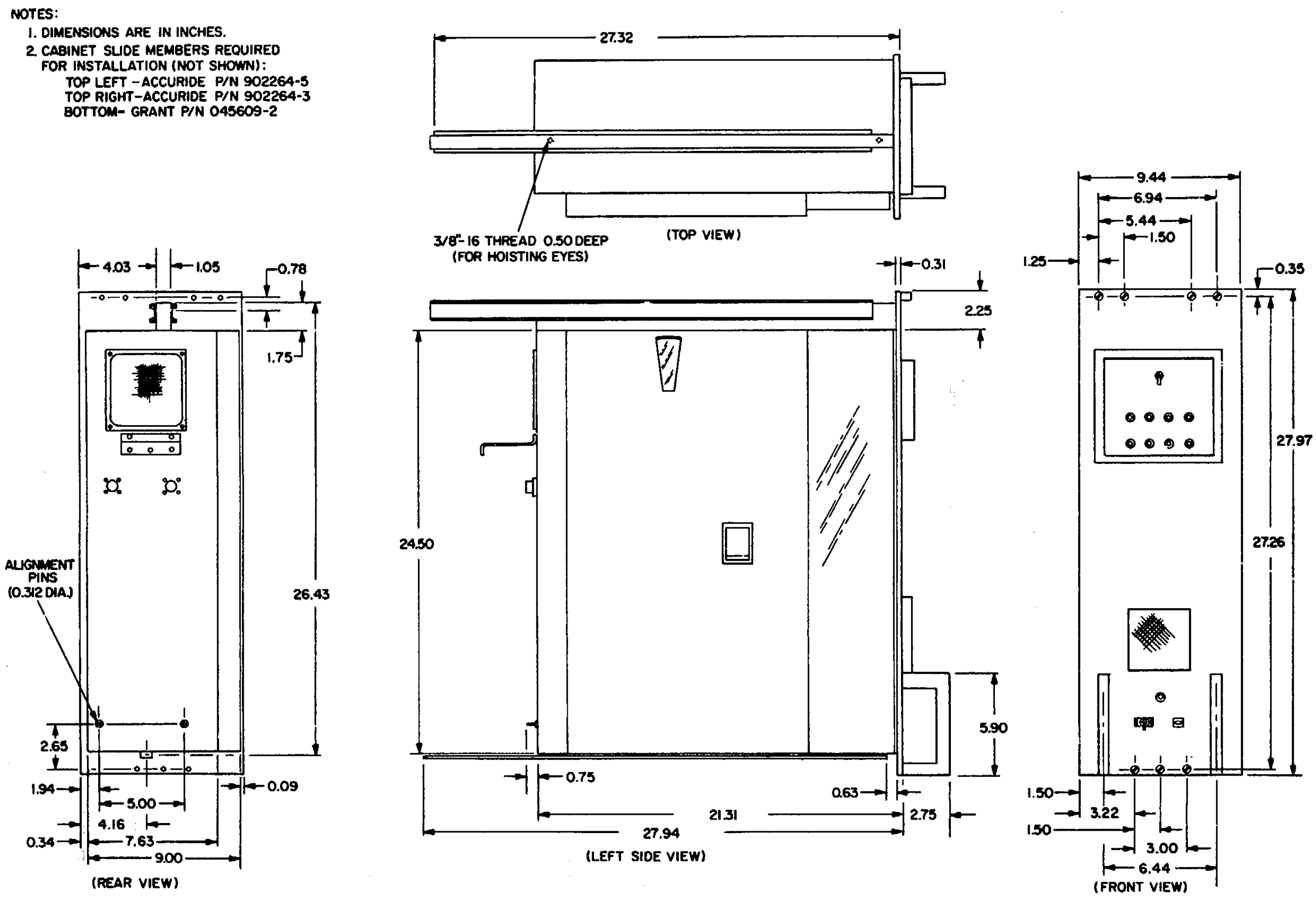


Figure 2-1. Transport Outline Dimensions and Installation Requirements

Table 2-1. Signal Interface Data

Pin (J2-)	Signal
I	Write Data Track 7
2	Write Data Track 7 Return
3	Write Data Track 6
4	Write Data Track 6 Return
5	Write Enable
6	Write Enable Return
7	Read Enable
8	Read Data Track 9 Return
9	Read Data Track 1
10	Unit Identification (UII) Return
11	Unit Identification (UIO)
12	Unit Identification (UIO) Return
13	(No Connection)
14	(No Connection)
15	(No Connection)
16	(No Connection)
17	(No Connection)
18	(No Connection)
19	Transport-on-Line
20	Beginning of Tape Return
21	Beginning of Tape
22	Read Strobe
23	Rewinding Return
24	Write Data Track 8
25	Write Data Track 1 Return
26	Write Data Track 1
27	Write Strobe
28	Write Strobe Return
29	Write Data Track 3 Return
30	Write Data Track 3
31	Write Data Track 5 Return
32	Write Data Track 5
33	Write Reset Return
34	Read Enable Return
35	Read Data Track 9
36	Read Data Track I Return
37	Unit Identification (UI1)
38	(Spare)
39	(Spare)
40	(Spare)
41	(Spare)
42	(No Connection)
43	Transport-on-Line Return
44	Read Data Track 4 Return
45	End of Tape Return
46	Read Strobe Return
47	Rewinding
48	Write Data Track 8 Return
49	Write Data Track 9 Return

Table 2-1. Signal Interface Data (Cont)

Pin (J2-)	Signal
50	Write Data Track 9
51	Write Data Track 2 Return
52	Write Data Track 4
53	Write Data Track 4 Return
54	Write Reset
55	Forward/Reverse
56	Read Data Track 3 Return
57	Read Data Track 8
58	Device Connected Return
59	Device Connected
60	Write Lockout Return
61	Write Lockout
62	Read Data Track 4
63	End of Tape
64	Read Data Track 7
65	Rewind to Load Point Return
66	Write Data Track 2
67	Start/Stop Return
68	Start/Stop
69	Forward/Reverse Return
70	Read Data Track 3
71	Read Data Track 8 Return
72	Read Data Track 2
73	Read Data Track 2 Return
74	Read Data Track 6
75	Read Data Track 7 Return
76	Rewind to Load Point
77	Read Data Track 5
78	Read Data Track 5 Return
79	Read Data Track 6 Return

Table 2-2. Input Power Connections

Pin (J1-)	Signal
A	120V, 400 Hz, Phase A
B	120V, 400 Hz, Phase B
C	120V, 400 Hz, Phase C
D	Neutral (Power Return)
E	Chassis Ground
F	(No Connection)
G	(No Connection)
H	(No Connection)

2-12. GROUNDING.

2-13. The Transport circuit grounds are isolated from chassis ground, or frame ground. These grounds must be connected together at some point in the system, and it is recommended they be connected together in the Magnetic Tape Control Unit (MTCU).

2-14. TAPE PATH DIMENSIONS.

2-15. Figure 2-2 illustrates the relative location of all critical components along the tape path.

2-16. OPERATIONAL CHECKOUT.

2-17. Perform a checkout of the Transport after installation in accordance with the procedure in paragraph 5-7.

2-18. PREPARATION FOR SHIPMENT.

2-19. REMOVAL. Procedure for removal of the Transport from the ADP rack of an IA- or A-Shelter is located in the appropriate shelter manual. Refer to table 1-1 for the necessary Transport removal procedure.

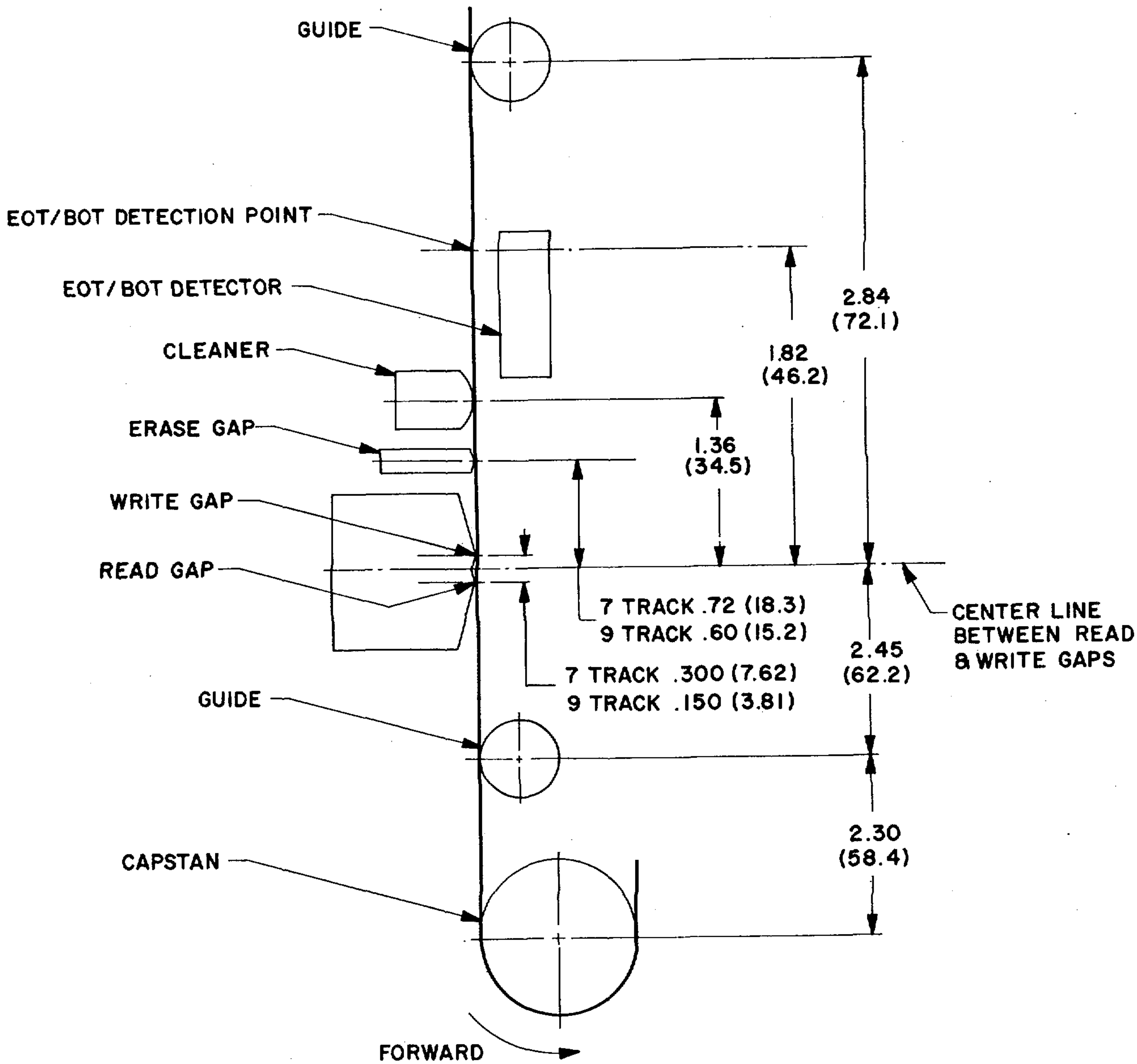


Figure 2-2. Tape Path Dimensions

SECTION III
OPERATING INSTRUCTIONS

3-1. GENERAL.

3-2. This section provides instructions for operating the Transport. Instructions include preoperational procedures, tape loading, normal tape operation, and unloading tape. Instructions for affixing EOT/BOT marker strips and installing a write enable ring are also included.

3-3. PREOPERATIONAL PROCEDURES.

3-4. The following procedures should be performed before operating the Transport:

a. Check that all cables are properly connected (refer to section II).

b. Check that all printed circuit boards are seated properly in the card cage.

3-5. DESCRIPTION OF CONTROLS AND INDICATORS.

3-6. The front panel of the Transport is illustrated in figure 3-1. Refer to table 3-1 for a description of each control and indicator.

3-7. EOT/BOT MARKER STRIP LOCATIONS.

NOTE

The Transport will not load a reel of tape having a BOT marker closer than 7 feet from the end of the tape.

3-8. For proper Transport operation, EOT (end-of-tape) and BOT (beginning-of-tape or load point) reflective marker strips must be affixed to the tape before placing the reel of tape on the Transport. Figure 3-2 illustrates the proper locations for the EOT and BOT marker strips.

3-9. WRITE ENABLE RING.

3-10. To write on a reel of tape, a write enable ring must be installed in the groove provided in the rear surface of the reel before the reel is placed on the Transport. See figure 3-3 for write enable ring installation.

3-11. TAPE THREADING/LOADING PROCEDURES (See Figure 3-4)

3-12. AUTO THREAD PROCEDURE. To load a reel of tape on the Transport, proceed as follows:

a. Set front panel POWER circuit breaker to ON; AC ON indicator shall light.

b. Open dust cover door.

c. Pull out handle of file reel hub.

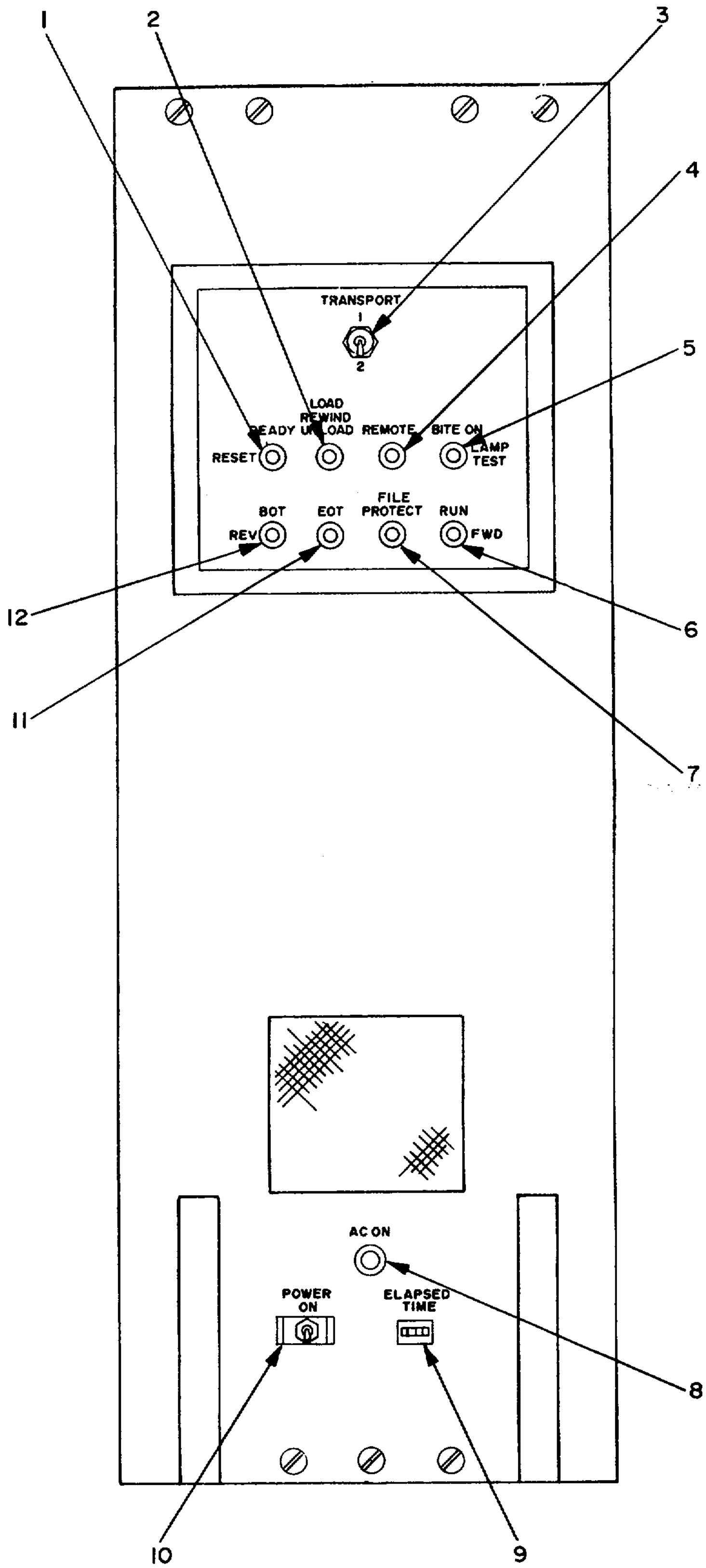


Figure 3-1. Transport Controls and Indicators

Table 3-1. Transport Controls and Indicators

Figure 3-1 Index No.	Control or Indicator	Function
1	READY indicator	When lighted, indicates Transport is in ready status (vacuum present in vacuum tanks and reel servos active) and is ready to execute local commands or be placed in remote status.
	RESET pushbutton switch	When pressed, terminates or clears the following functions: Automatic thread and load Automatic load Rewind Unload BOT indicator during manual thread Reel brake release Remote status Forward latch [refer to RUN pushbutton (6)].
2	LOAD REWIND UNLOAD indicator	When lighted, indicates Transport is performing a load, rewind, or unload operation.
	LOAD REWIND UNLOAD pushbutton switch	When pressed, initiates one of the following operations, if the corresponding preconditions exist: a. Reel brake release-if tape is not present anywhere in thread path or vacuum tanks. [Pressing RESET pushbutton (I) will reset reel brake release.] b. Automatic thread and load-if tape is present in upper thread chute (covering upper tape cross sensor), but not present anywhere else in thread path or vacuum tanks. [Pressing RESET pushbutton (1) will terminate automatic thread and load operation.] c. Automatic load-if tape is threaded and wound onto machine reel, but not present in vacuum tanks. [Pressing RESET pushbutton (I) will terminate automatic load operation.] d. Unload-if Transport is in ready status [READY indicator (I) is lighted], not in remote status [REMOTE indicator (4) is out], and tape is positioned at BOT [BOT indicator (12) is lighted]. [Pressing RESET pushbutton (1) will terminate unload operation.] e. Rewind-if Transport is in ready status [READY indicator (1) is lighted], not in remote status [REMOTE indicator (4) is out], and tape is not positioned at BOT [BOT indicator (12) is out]. [Pressing RESET pushbutton (1) will terminate rewind operation.]
3	TRANSPORT switch	Selects Transport address number (1 or 2).
4	REMOTE indicator	When lighted, indicates Transport is in remote status.
	REMOTE pushbutton switch	When pressed, places Transport in remote status if READY indicator (1) is lighted and BITE ON indicator (5) is out. Pressing REMOTE pushbutton during an auto thread and load or auto load operation causes Transport to assume remote status upon detection of BOT at completion of auto thread and load or auto load operation. [Pressing RESET pushbutton (1) returns Transport to local status. In addition, remote status is automatically terminated if Transport loses ready status] [READY indicator (1) goes out].

Table 3-1. Transport Controls and Indicators (Cont)

Figure 3-1 Index No.	Control or Indicator	Function
5	BITE ON indicator	Flashes if BITE module MODE SELECTOR switch is not in OFF (center) position or BITE module R/W FUNCTION SELECT switch is not in READ position, or if Test Mode A or Test Mode B is jumper selected on BITE module.
	LAMP TEST pushbutton switch	When pressed, causes all front panel indicators, except AC ON, to light.
6	RUN indicator	When lighted, indicates tape is in motion under capstan control.
	FWD pushbutton switch	When pressed, sets a forward latch, causing tape to run in a forward direction at 75 ips; if Transport is in ready status [READY indicator (1) is lighted], not in remote status [REMOTE indicator (4) is out], and tape is not positioned at EOT [EOT indicator (11) is out]. Forward latch is reset when one of the following conditions occur: a. RESET pushbutton (1) is pressed. b. REMOTE pushbutton (4) is pressed. c. Any reverse command, including rewind, is initiated [LOAD REWIND UNLOAD pushbutton (2) or REV pushbutton (12) is pressed]. d. EOT is detected [EOT indicator (11) lights]. e. BOT is detected [BOT indicator (12) lights]. f. Loss of ready status [READY indicator (1) goes out].
7	FILE PROTECT Indicator	When lighted, indicates writing on tape is inhibited. (Indicator lights when there is no reel on file reel hub or when a write enable ring is not installed on file reel.)
8	AC ON indicator	When lighted, indicates primary ac power is applied to the power supply circuits.
9	ELAPSED TIME indicator	Indicates total operating (power-on) time of the Transport in hours and tenths of an hour.
10	POWER circuit breaker	In ON position, applies primary ac power to the Transport and provides 10-ampere protection for the power supply circuits.
11	EOT indicator	Lights whenever Transport has detected EOT marker during forward tape motion. Indicator goes out upon detection of EOT marker during reverse tape motion or if ready is lost [READY indicator (1) goes out].
12	BOT indicator	When lighted, indicates tape is positioned at BOT (load point) if Transport is in ready status [READY indicator (1) is lighted]. During manual thread operation, BOT indicator lights when BOT marker is detected to indicate BOT marker has passed the BOT sensor and is being wound on the machine reel [indicator remains lighted until RESET pushbutton (1) is pressed).
	REV pushbutton switch	When held pressed, causes tape to move in reverse direction at 75 ips (including off BOT); if Transport is in ready status [READY indicator (1) is lighted] and not in remote status [REMOTE indicator (4) is out]. Tape stops when pushbutton is released.

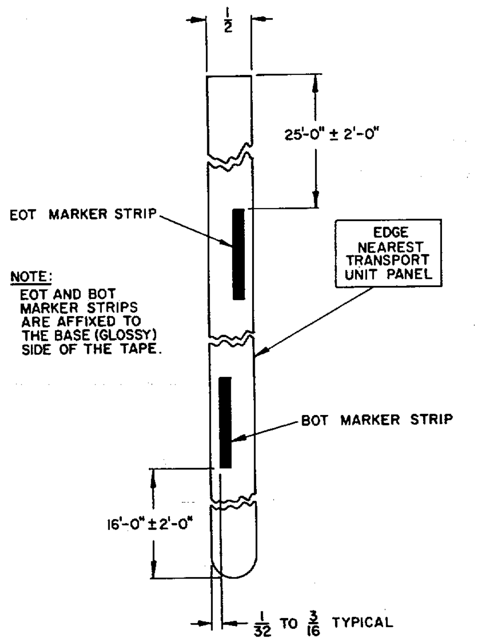


Figure 3-2. EOT/BOT Tape Marker Locations

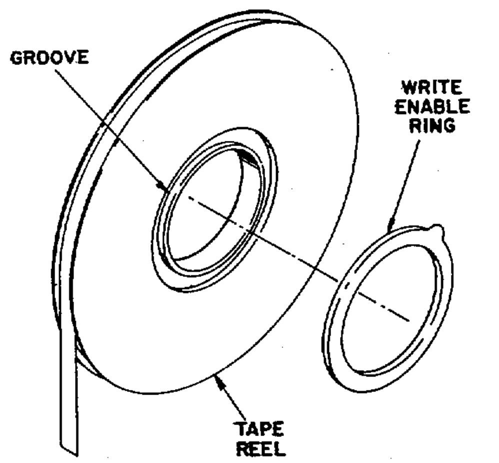


Figure 3-3. Write Enable Ring Installation

NOTE

Do not use back coated tape. Use 3M 777 tape or equivalent.

d. Place reel of tape on file reel hub, press reel firmly back against rear flange of hub, and close handle. Reel is seated properly if it does not wobble when turned by hand.

NOTE

The Transport will automatically thread tape with a wrinkled leader, providing the wrinkled portion is no more than 1/-inch high when layed on a flat surface. If the leader is excessively wrinkled, smooth it out or cut it off. If neither of these is practical, thread tape manually in accordance with paragraph 3-18. For best results, prepare the tape end as shown in figure 3-5.

e. Thread tape through upper thread chute and drop end down over center tape guide as shown in figure 3-4, detail A. This is accomplished by wrapping tape around flared outer portion of chute and pulling end of tape gently toward machine reel; tape will automatically slide into chute.

NOTE

The free end of the tape may hang all the way to the bottom of the Transport panel, but should not extend below the panel to avoid being caught when the dust cover is closed.

f. Close dust cover door.

g. Press LOAD/REWIND/UNLOAD pushbutton. The following sequence will take place:

1. The vacuum motor will turn on.

2. Three seconds later, the file reel will turn ccw.

3. When the tape is fully drawn into the upper thread chute, the file reel and machine reel will both turn cw.

4. The tape will automatically feed through the thread path and be captured by the machine reel.

5. The tape will be wound onto the machine reel until the BOT sensor detects the BOT marker. At this time, the reels will continue to turn for 2 seconds longer at a slower speed.

NOTE

This completes the auto thread sequence. The auto load sequence proceeds as follows:

6. Vacuum will be applied to the vacuum tanks and both reels will turn ccw for 12 second and stop.

7. Two and one-half seconds later, the machine reel will turn ccw and feed a loop of tape into the machine tank. When the loop is detected by the tape in machine tank sensor, the machine reel will stop.

8. The file reel will then turn cw and feed a loop of tape into the file tank. When this loop is detected by the tape in file tank sensor, the machine reel will again turn ccw and both reels will feed tape into their respective tanks.

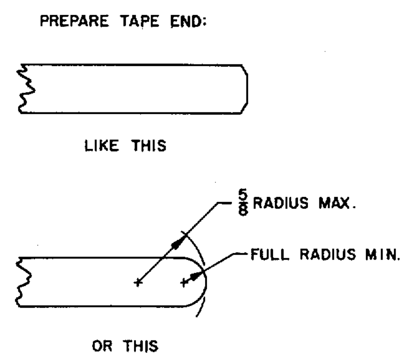


Figure 3-5. Tape End Preparation

9. When the reel servo sensors (see figure 3-4, detail C) detect that both loops are in the center of each tank, the reel servosystem will be activated and the tape will run in REVERSE direction until BOT is detected and then stop. At this point, the Transport is in ready status and the load sequence is completed.

NOTE

The thread and load sequences may be halted at anytime prior to step 9, above, by pressing the RESET pushbutton. A reverse search for BOT may be halted by pressing the RESET pushbutton during step 9.

3-13. FAULT INDICATION AND RECOVERY DURING THREAD/LOAD SEQUENCES. The automatic threading and loading sequences are provided with monitors that detect improper or unacceptable conditions that might interfere with successful completion of these sequences. The following paragraphs describe these conditions and discuss methods of recovering from them.

NOTE

The following paragraphs assume that the Transport is in proper working condition. Refer to section V for troubleshooting routines if a machine fault is suspected.

3-14. Failure to commence execution of an auto thread sequence. The Transport will not execute an auto thread sequence if the tape is not in the upper thread chute, covering the upper tape cross sensor, or if the tape is covering the lower tape cross sensor, tape in file tank sensor, or tape in machine tank sensor.

3-15. The file reel withdraws tape, pays tape out and then withdraws tape again and stops. A timer monitors the passage of tape through the threading path. If the tape does not cross the lower tape cross sensor within 1.5 seconds after the reels begin to turn cw, a thread failure fault is set by that timer which causes the file reel to withdraw the tape and stop. The tape will fail to feed through the threading path if its leader is badly wrinkled.Correct by smoothing or removing the wrinkled section of the leader. If this is not possible, thread tape manually in accordance with paragraph 3-18.

3-16. The tape winds onto the machine reel and stops, without loading, after approximately 50 feet of tape has been wound onto the machine reel. If 50 feet (or more) of tape is wound onto the machine reel during auto thread, the machine reel low tape sensor flags a fault and halts the auto thread sequence. This will occur if the BOT sensor fails to detect a BOT marker during the auto thread sequence and is caused by either the absence of a BOT marker or if the marker is more than 50 feet from the end of the tape.

3-17. Auto load sequence begins but reels do not turn to feed tape into the tanks. A vacuum sensor detects the presence of vacuum in the Transport vacuum ducting and also detects if the vacuum tank door is open. If the door is open, auto load will not be completed. Correct by closing the door.

3-18. MANUAL THREAD PROCEDURE. If a reel of tape cannot be automatically threaded by the Transport, the tape may be manually threaded as follows:

a. Mount reel to file reel hub.

b. Press LOAD/REWIND/UNLOAD pushbutton to release reel brakes.

c. Open vacuum tank door.

CAUTION

Do not use clips, sticky tape, or any other device to attach the tape to the machine reel, or damage to the tape could result.

d. Thread tape through threading path as shown in figure 3-4, detail B, and onto machine reel. (The hole in the flange of the machine reel provides finger access to hold the tape end against the core of the reel until the friction of one or two wraps of tape keeps it there.

e. Close vacuum tank door.

f. Manually wind tape onto machine reel by turning it cw until BOT indicator lights.

g. Close dust cover door.

h. Press LOAD/REWIND/UNLOAD pushbutton. An auto load sequence will take place as described in paragraph 3-12, steps e.6 through e.9.

3-19. AUTO LOAD PROCEDURE. If tape is threaded between both reels and is not detected in either vacuum tank by the tape in tank sensors, it may be loaded by the following procedure:

a. Open dust cover door.

CAUTION

Tape must be carefully wound onto the reels to avoid damage to the tape, which could result in loss of data. Do not physically handle the tape.

b. Withdraw tape fully from both tanks by manually turning either, or both, reels (file reel ccw, machine reel cw) until tape is in threading path as shown in figure 3-4, detail B.

c. Close dust cover door.

d.Press LOAD/REWIND/UNLOADpushbutton. An auto load sequence will take place as described in paragraph 3-12, steps e.6 through e.9.

e. Reverse search for BOT may be halted by pressing RESET pushbutton.

3-20. IN-TANK LOAD PROCEDURE/RECOVERY FROM LOSS OF READY STATUS.

3-21. If the Transport is in a not ready status (vacuum supply is off and reel servos are inactive) and the tape is detected in the vacuum tanks, ready status may be restored by performing an in-tank load. Proceed as follows:

a. Press LOAD/REWIND/UNLOAD pushbutton. The vacuum will come on and the reel servos will become active when tank vacuum exceeds -15 in. H_2O.

b. If the Transport will not execute an in-tank load, perform an auto load in accordance with paragraph 3-19.

3-22. REWIND PROCEDURE.

3-23. A rewind operation to BOT may be commanded if a ready status exists (vacuum supply on and reel servos active), the Transport is not in remote status, and the tape is not already at BOT. Press the LOAD/REWIND/UNLOAD pushbutton; the following sequence will take place:

NOTES

Rewind operation may be terminated at any point by pressing the RESET pushbutton.

a. The tape will run in reverse direction for 1 second at normal speed.

b. The tape speed will then increase to an average of 300 ips until less than 50 feet of tape remains on the machine reel.

c. At that point, the speed will return to normal until BOT is detected and the tape will stop.

3-24. UNLOAD PROCEDURE.

3-25. The tape may be unloaded if the Transport is not in remote status and the tape is at BOT by pressing the LOAD/REWIND/UNLOAD pushbutton; the following sequence will take place:

NOTES

1. If the tape is not at BOT, rewind to BOT as described in paragraph 3-22.
2. An unload operation may be halted at any time by pressing the RESET pushbutton.

a. The vacuum supply will turn off.

b. The machine reel will turn cw until all tape is withdrawn from the vacuum tanks.

c. Both reels will then turn ccw until the tape uncovers the tape cross upper sensor at which time the reels will stop and unload is complete.

3-26. SELECTING REMOTE STATUS.

3-27. Remote status may be selected manually as follows:

a. If Transport is in ready status (vacuum supply on and reel servos active), press REMOTE pushbutton.

b. If Transport is not in ready status, load tape as described in paragraph 3-12, 3-19, or 3-20 and press REMOTE pushbutton after it assumes ready status.

3-28. Remote status may be selected automatically by pressing the REMOTE pushbutton immediately after pressing the LOAD/REWIND/UNLOAD pushbutton to initiate an auto thread operation. The Transport will automatically assume remote status upon detection of BOT at the end of the thread/load operation.

3-29. Remote satus may be manually cleared at any time by pressing the RESET pushbutton. In addition, remote status will automatically be cleared by loss of Transport ready status. 3-30. RUN FORWARD PROCEDURE.

3-30. RUN FORWARD PROCEDURE

3-31. The tape may be run forward manually from any point on the tape (including BOT) if the Transport is not in remote status by pressing the RUN pushbutton. The tape will continue to run forward until one of the following actions occur:

a. BOT is detected.
b. EOT is detected.
c. Remote or rewind is selected.
d. RESET pushbutton is pressed.
e. Ready status is lost.

3-32. RUN REVERSE PROCEDURE.

NOTE

Exercise caution when pressing REV pushbutton if the tape is at, or near, the true BOT marker (first BOT marker on the tape). If the REV pushbutton is used to back the tape over the true BOT marker, any further reverse commands, initiated locally or remotely, could run the tape completely off the machine reel.

3-33. The tape may be run in reverse manually from any point on tape (including BOT) if the Transport is not in remote status by pressing and holding the REV pushbutton. The tape will run in reverse until the pushbutton is released.

SECTION IV
THEORY OF OPERATION

4-1. INTRODUCTION.

4-2. This section describes the theory of operation of the Transport including the electromechanical system, associated control logic, and read/write electronics. First, a brief description of the major functional systems comprising the Transport is given. Then, the relationship between electromechanical and electronic circuits is explained, followed by detailed functional theory of operation for each system comprising the Transport. Module schematic drawings and logic symbols referenced in this section are located in section VI. (Logic symbols are shown with their truth tables.)

4-3. GENERAL FUNCTIONAL SYSTEM DESCRIPTIONS.

4-4. The Transport consists of eight functional areas:

a. Reel Servosystem. The reel servosystem supplies and takes up tape in response to tape motion signals received from the capstan drive system. The reel servosystem also supplies and takes up tape directly during auto thread, load, and unload operations.

b. Capstan Drive System. The capstan drive system causes the capstan motor to move tape at controlled speeds in response to tape motion commands generated locally or from the Magnetic Tape Control Unit (MTCU).

c. Auto Thread Operation. The auto thread operation automatically threads the free end of a file tape onto the machine reel, finds the Beginning-of-Tape (BOT) marker, and initiates an auto load sequence.

d. Auto Load Operation. The auto load operation moves tape into the vacuum tanks following an auto thread operation. The auto load system also monitors ready system status in preparation for normal Transport operation.

e. Rewind Operation. The rewind operation permits automatic high-speed rewind of the tape until approximately 50 feet of tape remains, then continues normal reverse speed to BOT.

f. Ready System. The ready system monitors various Transport circuits to establish the ready condition. The ready system then applies power to the reel motors, capstan motor, and the main air supply. If one of the monitored conditions exceeds a preset limit, the ready system shuts off power to the reel motors, capstan motor and main air supply, thus causing an emergency shutdown condition of the tape unit.

g. Read/Write Operation. The read/write operation allows nine tracks of data to be accepted from the MTCU and recorded on magnetic tape in modified Non-Return-to-Zero (NRZ) format. Data recorded in nine-track NRZ format can be read and transferred to the MTCU. Reading and writing for maintenance alignments is accomplished locally, using a Built-In Test Equipment (BITE) Module PCB A2A4.

h. Unload Operation. The unload operation removes tape from the servo tanks when the tape starts at BOT, spools the tape to the file reel, and cancels the tape ready status.

4-5. ELECTROMECHANICAL/ELECTRONIC INTERFACE.

4-6. Figure 4-1 illustrates the relationship between the electromechanical and electronic circuits of the Transport. The vacuum tanks (file tank and machine tank) each store a loop of tape that acts as a buffer during tape movements. In this way, tape speed across the read/write head is precisely determined by the capstan motor and associated drive circuits. The tape loops in the two tanks are maintained by various sensors that control two independent, but virtually identical, servosystems. Each servomotor feeds tape into the tank or removes tape from the tank, depending on the position of the tape loop. When the tape loop is positioned between the upper and lower servo sensors (for either file tank or machine tank), the associated file or machine reel servomotor drive voltage is reduced by dynamic braking to hold the tape in this position.

4-7. REEL SERVOSYSTEM.

4-8. The reel servosystem supplies and takes up tape in response to the tape motion caused by the capstan drive
system. It also supplies and takes up tape directly during auto thread, load, rewind, and unload operations. The system consists of two identical, closed-loop reel servos; one for the file reel and one for the machine reel. The servo loops differ in the directional (cw or ccw) input-output signals. Each reel servosystem consists of a reel motor, a vacuum tank, sensors in that tank, a reel tach, a Servo Drive Module A2AI or A2A2, and one-half of the Servo Control Module A3. Operating principles of the reel servosystem are described in the following paragraphs.

4-9. Tape Loop Position. The only difference among the three tape motion conditions (Stop, Forward, and Reverse) is the location of the tank loops relative to the four servo sensors and the direction of rotation of the reels and capstan (figure 4-2). Capstan rotation causes this loop displacement which, in turn, causes reel rotation. As the capstan rotates ccw (forward), both tank loops are displaced upward. Eventually, the tape loops cross the cw (file reel upper and machine reel lower) servo sensors. As they do, pneumatic servo sensors respond to the pressure change from vacuum on one side of the loops to atmospheric pressure on the other. This pressure change causes an increased servo drive (40 Vac supply voltage) to the reel servo that increases its reel speed cw, thereby forcing the loops back down again. As tape motion continues, the reels continue to turn cw faster until the loops enter the area between the upper and lower servo sensors. In this region, the servo sensors detect the entry of the loops into the braking zones and signal the reel Servo Control Module A2A3 to turn on the brake drive to reduce ac drive power to the reel motors. This action allows full power servo operation only when needed to force the tape back to the braking zone.

4-10. A REVERSE (cw) command to the capstan causes loop travel downward. Eventually, this results in the loops crossing the ccw (file reel lower and machine reel upper) servo sensors. These sensors, like the cw sensors, detect the pressure change as the loops pass over them and signal A2A3 to remove the brake drive. This allows the full 40 Vac to increase reel servo speed ccw. The tape motion continues ccw rotation until the loops enter the braking zone again causing dynamic braking action. The reel servos, in effect, try to keep the tape loops in the braking zones regardless of the direction of tape travel.

4-11. Power Output. A simplified schematic diagram of reel motor power control is shown in figure 4-3. The out-put of the servo drivers Dl, D2 applies pulses to SCRs and pulse transformers. Power is applied to the armature via the four SCRs (SCR l-SCR 4) and the reel motor supply winding (40 Vac) of main power transformer T1. This circuit is arranged such that if SCR 1 and SCR 4 are triggered at the start of each primary power half-cycle, full-wave current flows from left to right through the motor armature. Each SCR conducts on alternate half-cycles and turns off at the end of each half-cycle. If SCR 2 and SCR 3 were turned on at the start of each half-cycle, cur-rent would flow from right to left through the armature. Thus, the direction of armature current flow and, there-fore, the direction of rotation of the reels, is controlled by firing one of the two SCR pairs. The SCRs are fired through pulse transformers TCw and Tccw. Note that if the primary of Tew is excited. through driver DI, its two secondaries trigger SCR 1 and SCR 4. Thus, machine reel cw power is controlled through pulse transformer T,,. The ccw power is controlled through pulse transformer TC,, and driver D2 in a similar manner.

4-12. Dynamic Braking. Dynamic braking is applied to the reel motors when the tape is between the upper and lower servos or the braking zone. This braking action is accomplished by applying the brake drive signal from A2A3 to the base of transistor Q920 (see figure 4-3). Since only small corrections are needed when the tape is between the center servos, most of the 40 Vac drive is shunted to ground through resistor R13. Resistor R13 is effectively paralleled through the servomotor. The current path, when braking is applied, is through the reel motor

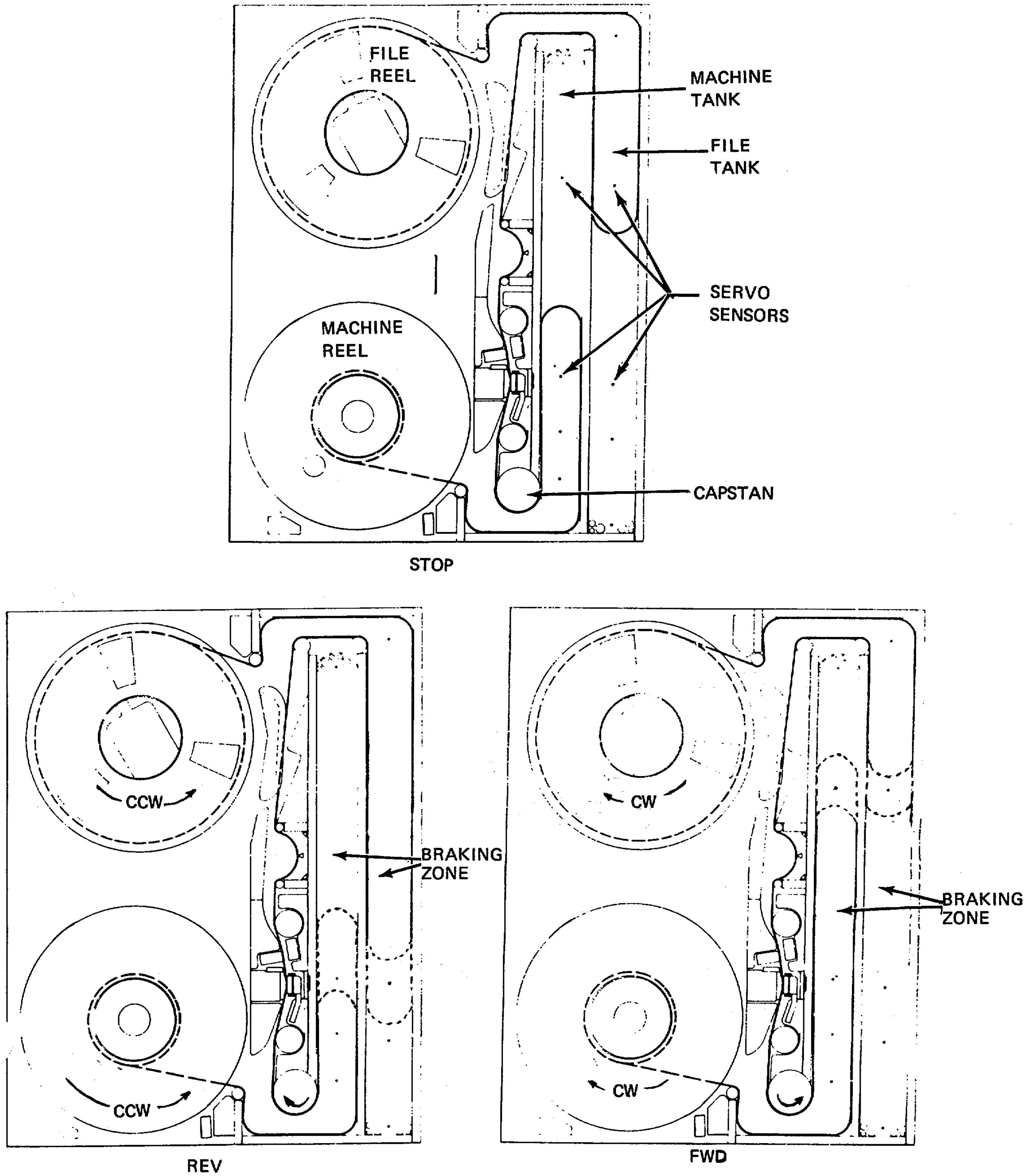


Figure 4-2. Tape Loop Position

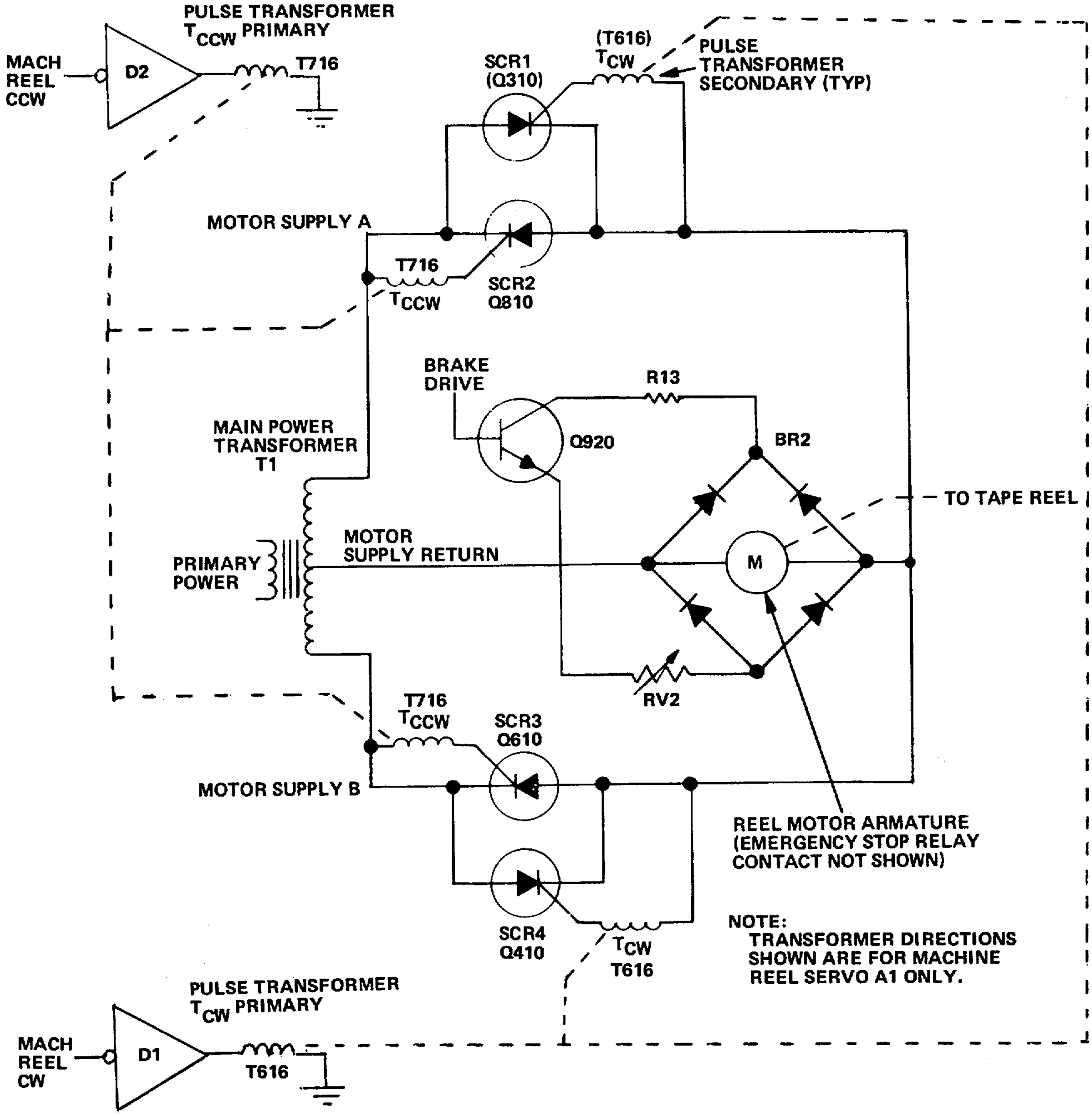


Figure 4-3. Machine Reel Power Control Simplified Schematic

and through the paralleled diode bridge BR2, R13, and Q920 to ground. Diode bridge BR2 causes the reel armature current to always flow in the same direction regardless of motor rotation. This permits the use of a single NPN brake transistor to turn dynamic braking on or off with the position of the tape inside the tanks. A temperature-sensitive resistor (RV2) provides overtemperature protection for the servomotor.

4-13. Auto Thread. The auto thread system automatically threads the free end of a reel of tape onto the machine reel, finds the BOT marker, and commands an auto load sequence. It consists of a group of tape sensors, a pneumatic system, and Auto Thread Module A2A9.

4-14. Tape Sensors. There are five tape sensors (see figures 4-1 and 6-4), four photoelectric sensors and one pneumatic sensor. The pneumatic sensor S12 is the Threaded Sensor that detects tight tape in the threading path when the thread blower is on. This sensor operates at + 10 inches H2O. The photoelectric sensors are:

a. Tape Cross Upper Sensor DS1/Ql, which detects the presence of tape in the upper thread chute.
b. Tape Cross Lower Sensor DS4/Q4, which detects the tape as it crosses the open area between the head plate and the machine reel.
c. Low Tape Mach Reel Sensor DS5/Q6, which detects a level of 50 feet of tape or more on the machine reel.
d. BOT Sensor DS5/Q9, which detects the BOT marker on the tape.

4-15. Pneumatic System. The pneumatic system provides guiding and motive force for handling the free length of tape as it travels through the threading path. It consists of solenoid-operated valve K2 (figure 6-5, sheet 2) and vacuum blower B4. The valve provides positive pressure for a series of air jets and the threaded sensor. The valve also provides negative pressure for the core of the machine reel. Air rushing into this core allows the end of the tape to be captured by the machine reel during threading.

4-16. Threaded Sensor S12. The threaded sensor port that is connected to the positive thread pressure ducting, the threaded sensor, and the atmosphere is open during threading. Because this port is open to atmosphere, the positive pressure inside the small tubes that feed the threaded sensor is very low and the sensor will not operate. When the machine reel captures the tape, it pulls it tight against the file reel which is paying out tape slightly slower than the machine reel is taking it up. As a result, the threaded sensor port is closed by the tight tape causing the pressure to build up inside the tubes. Once the pressure builds up to + 10 inches H20 or higher, the sensor operates, signaling that the tape is threaded.

4-17. CAPSTAN DRIVE. The capstan drive system causes the capstan motor to move tape at controlled speeds in response to tape motion commands from local or remote equipment. It consists of a capstan, a capstan motor BB with an integral analog tachometer, a capstan drive module A2A5, power driver, and one pneumatic rewind sensor S4 and S9 in each vacuum tank. Figure 4-4 is a logic diagram of the capstan drive. Figure 6-11 is a schematic diagram of Capstan Drive Module A2A5.

4-18. DETAIL FUNCTIONAL DESCRIPTION.

4-19. POWER CONTROL. The pulse transformers (T716 and T616) on modules A2AI and A2A2, which apply firing pulses to the gates of the SCRs, are excited by drivers Q933 and Q926 (figure 4-5). Each driver is driven by an oscillator consisting of an RC network and a unijunction transistor. When the oscillator is turned on, the pulse transformer primaries are excited with high current pulses at the rate dictated by the oscillator frequency which, in turn, is determined by the time constant of the RC network.

4-20. For full power operation (not in braking zone), the oscillator pulses the transformers once every millisecond. For low-power operation (in braking zone), the RC time constant is adjustable through potentiometer R740 or R742 to fire the pulse transformer once for each half-cycle of primary power somewhere during the half-cycle. Firing the SCRs during (instead of at the beginning of) each half-cycle causes the average current through the motor to be less than maximum. The longer the firing pulses are delayed from the start of each half-cycle, the

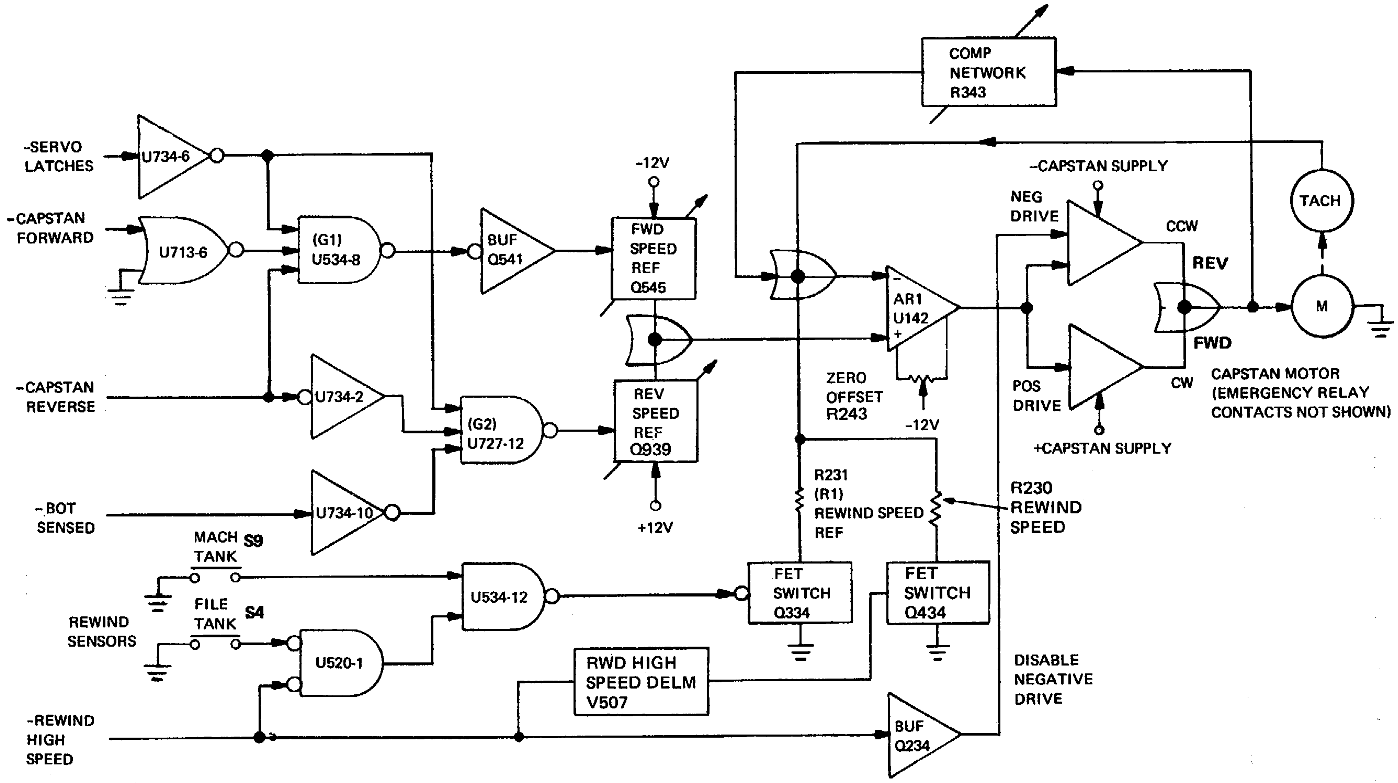


Figure 4-4. Capstan Drive Logic Diagram

lower the current and, hence, the lower the speed. All low-speed adjustments permit variation in pulse delays from one-quarter to one-half cycle. This permits reel motor current to be varied from about half maximum to zero.

4-21. Synchronizing flip-flops FF1 through FF4 (figure 4-5) are provided to synchronize the excitation of the unijunction oscillators with the zero crossing points of the primary power. This ensures that the reel SCRs fire at the start of each half-cycle during full power operation or at some fixed time following the start of the half-cycle during low-power operation.

4-22. The flip-flops (FF1 through FF4) are JK types, which are forcibly reset or allowed to set depending on the state of the signals controlling full power or low-power operation. When they are allowed to set, the flip-flops set on the leading edge of the next zero crossing pulse.

4-23. Zero crossing pulses are generated by a zero crossing detector. This detector (figure 4-5) consists of a comparator which has one input connected to a 12 Vac voltage winding on the power transformer and the other input connected to circuit ground. The comparator switches whenever the sinusoidal signal from the transformer crosses the zero crossing point. A pulse shaper and edge detector also are contained in the zero crossing detector to provide a fixed length pulse for every zero crossing point of the input signal.

4-24. REEL TACH. Each reel tachometer consists of a roller which is in contact with the tape next to each reel, a reflective skirt on that roller, one phototransistor Q7 and Q8, and one infrared light-emitting diode (LED) DS6 and DS7. The skirt has four reflective sides on it. The LED and phototransistor are arranged so that light from the LED reflects back to the phototransistor when any one of the four sides of the skirt is perpendicular to the line bisecting the angle between the LED and phototransistor. The light misses the phototransistor if the skirt turns only a few degrees either way from perpendicular. This allows reel pulses to be generated proportional to their speed.

4-25. As the reel turns and the tape moves, the roller turns. As it turns, each of the four reflective sides of the skirt causes light to fall on the phototransistor, once for each revolution of the roller. Thus, four light pulses are received by the phototransistor for each revolution of the roller. The phototransistor is suitably connected to a comparator and pulse shaper, located on Module A2A3, which produces one electrical pulse for each light pulse.

4-26. TACH FEEDBACK. An adjustable capstan clock oscillator (figure 4-5) produces pulses at a rate determined by the tape speed. For example, the CAPSTAN CLOCK frequency at 75 ips is approximately 6.2 kHz. The speed control feedback loop functions by comparing the frequency of the pulses coming from the reel tach (as tape is moving) to the frequency of the CAPSTAN CLOCK pulses. If the TACH pulses are coming slower than the CAPSTAN CLOCK pulses, the reel motor continues to receive power; if pulses are coming faster, the motor coasts. Thus, by choosing a particular capstan clock frequency, the speed of the tape at the reel can be prevented from exceeding the adjusted value.

4-27. Forward Operation. Referring to figure 4-5, assume that a FORWARD command is received by the capstan servo and tape begins to move forward. Dynamic braking is removed as the tape violates the respective sensor. If the applied full power does not return the tape rapidly back to the braking zone, then an overspeed detection circuit will assist in controlling the servo's speeds. The CAPSTAN CLOCK pulses are gated with the UPPER and LOWER SERVO SENSOR signals and fed to a four-stage (divide by 16) binary clock counter. The counter starts counting pulses as soon as the loop leaves the braking zone.

4-28. The counter overflows after counting 16 CAPSTAN CLOCK pulses. This sets counter full flip-flop FF5 and resets overspeed flip-flop FF6. This condition, counter full set, overspeed reset, capstan running, and the loop out of the dead zone, always results in full power to the machine reel motor. At the same time, the full power cw gate (G2) is satisfied (assume FF6 is reset and lower servo sensor is violated). This activates the cw unijunction oscillator causing the cw pair of SCRs to fire for their maximum period. This causes the machine reel to turn cw and will aid in returning the tape back between the upper and lower servo sensors.

4-29. As the reel turns, the reel tach produces TACH pulses. Each TACH pulse resets the counter and attempts to pass through gate G3. Pulses cannot pass through G3, however, if FF5 is set; that is, TACH pulses cannot set FF6 if the counter has overflowed sometime following the last TACH pulse but before the present one. Note that the trailing edge of each TACH pulse resets FF5 in preparation for the next TACH pulse or the next counter overflow, whichever comes first.

4-30. When the tape reaches the desired location between the upper and lower sensors, the TACH pulses are close enough together to reset the counter before it has counted 16 clock pulses. Then gate G3 is enabled for the next TACH pulse since FF5 had not been set (no overflow occurred). Gate G3 then sets FF6, thereby cutting off gate G2 which shuts down the cw SCRs; the motor full power is removed and braking is applied as the tape enters the braking zone. If the tape speed again falls below the desired speed, the counter again overflows, the lower servo sensor will again be violated, and full cw power is applied to the reel motor.

4-31. Reverse Operation. Reverse capstan motion causes the same sequence of events as described above except that the counter only counts CLOCK pulses when the loop is violating the ccw servo sensor. Gate G 1 and the cw SCRs are active in reverse. During high-speed reverse, the capstan speed will be controlled based on the maximum servo control speed capability.

4-32. 25-IPS Detector. A 25-ips detector, which is simply a retriggerable one-shot, is used in the logic to force normal servo power when there are no capstan commands. This prevents the reel servo from allowing its loop to drift out of the vacuum tank during stop conditions. If there are no capstan commands, counter full flip-flop FF5 cannot be set because the counter has nothing to count. If FF5 is not set, overspeed FF6 is set by random TACH pulses that cut off all motor power. This is the reason for the 25-ips detector, which not only jam resets FF6 if tape speed is lower than 25 ips, but inhibits setting of FF6 through below 25-ips flip-flop FF7. A timing diagram showing the relationship among the various signals of the reel servosystem is shown in figure 4-6.

4-33. CAPSTAN DRIVE SYSTEM.

4-34. /CAPSTAN FORWARD and /CAPSTAN REVERSE are the only signals that initiate capstan motion.
Each is a wired OR at the output of circuits on the various card cage modules. Each circuit may command capstan motion during normal transport operation such as rewind, remote forward, BITE reverse, etc., and all like commands are ORed together to form /CAPSTAN FORWARD and /CAPSTAN REVERSE.

4-35. /CAPSTAN FORWARD is gated with /SERVO LATCHES and /CAPSTAN REVERSE inverted at NAND gate GI. The output of GI is true if /CAPSTAN FORWARD is true, /SERVO LATCHES is true, and /CAPSTAN REVERSE is false. This means that forward tape motion can only be commanded if both reel servos are active (reel moves with tape position changes only) and no reverse tape motion is being commanded.

4-36. /CAPSTAN REVERSE is gated with /SERVO LATCHES and /BOT sensed at NAND gate G2. The out-put of this gate represents reverse tape motion and is only true if both reel servos are active and the tape is not at BOT.

4-37. The output of G1 is buffered by Q541 and drives adjustable forward speed reference circuit Q545. This circuit, when enabled, applies a precisely adjusted negative voltage derived from -12V to a wired OR gate. The out-put is applied to the noninverting input of operational amplifier AR1 (U142) and is the voltage level against which the capstan tachometer output is compared during normal forward tape motion. The output of gate G2 drives adjustable reverse speed reference circuit Q939 which applies a precisely adjusted positive voltage derived from + 12V to the wired OR gate input of ARI. This positive voltage is the reference for normal reverse tape motion.

4-38. When neither GI nor G2 is enabled, the wired OR input to ARI is at zero volts and no tape motion occurs. A ZERO OFFSET R243 adjustment is provided on the Capstan Drive Module to compensate for the operational amplifier and other circuit tolerances so that the output of ARI can be adjusted to exactly zero volts when its input is at zero volts.

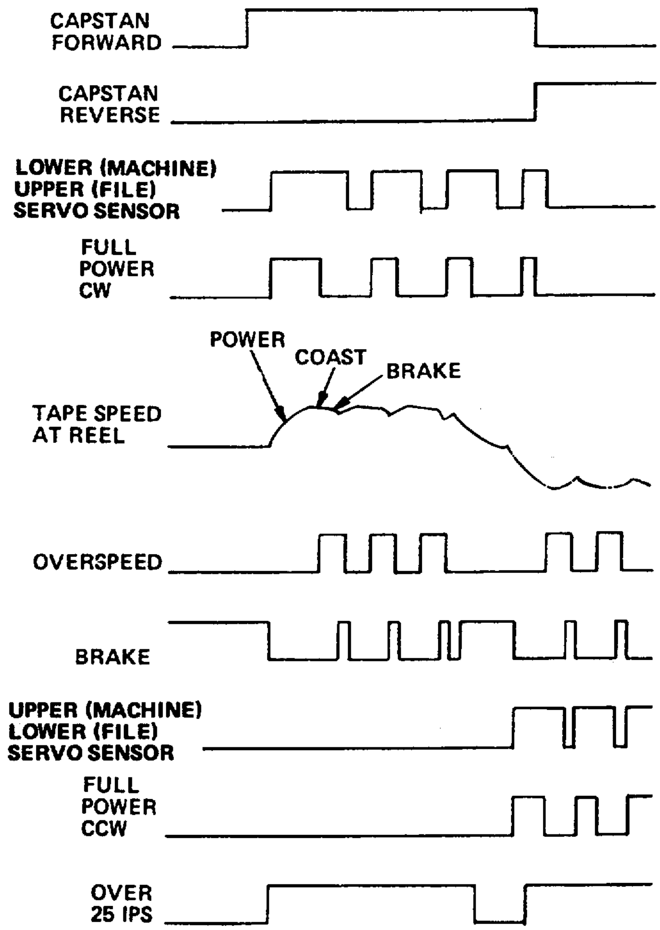


Figure 4-6. Reel Servo System Timing Diagram

4-39. The output of operational amplifier ARI is connected to a pair of complementary drive circuits. A simplified schematic is shown in figure 4-7. One circuit drives the capstan motor ccw (negative voltage, forward tape motion) and the other cw (positive voltage, reverse tape motion). Referring to figure 4-4, each driver circuit responds to a signal from the operational amplifier ARI and applies a voltage to the capstan motor accordingly.

4-40. The motor tachometer output is fed back to the inverting input of operational amplifier AR1. This closes the loop in the capstan drive circuit and forms a capstan servosystem whose input is one of three levels (OV, -V, or +V) and whose output is capstan motion (stop, ccw, or cw). The rotational speed of the capstan is directly proportional to the amplitude of the input level.

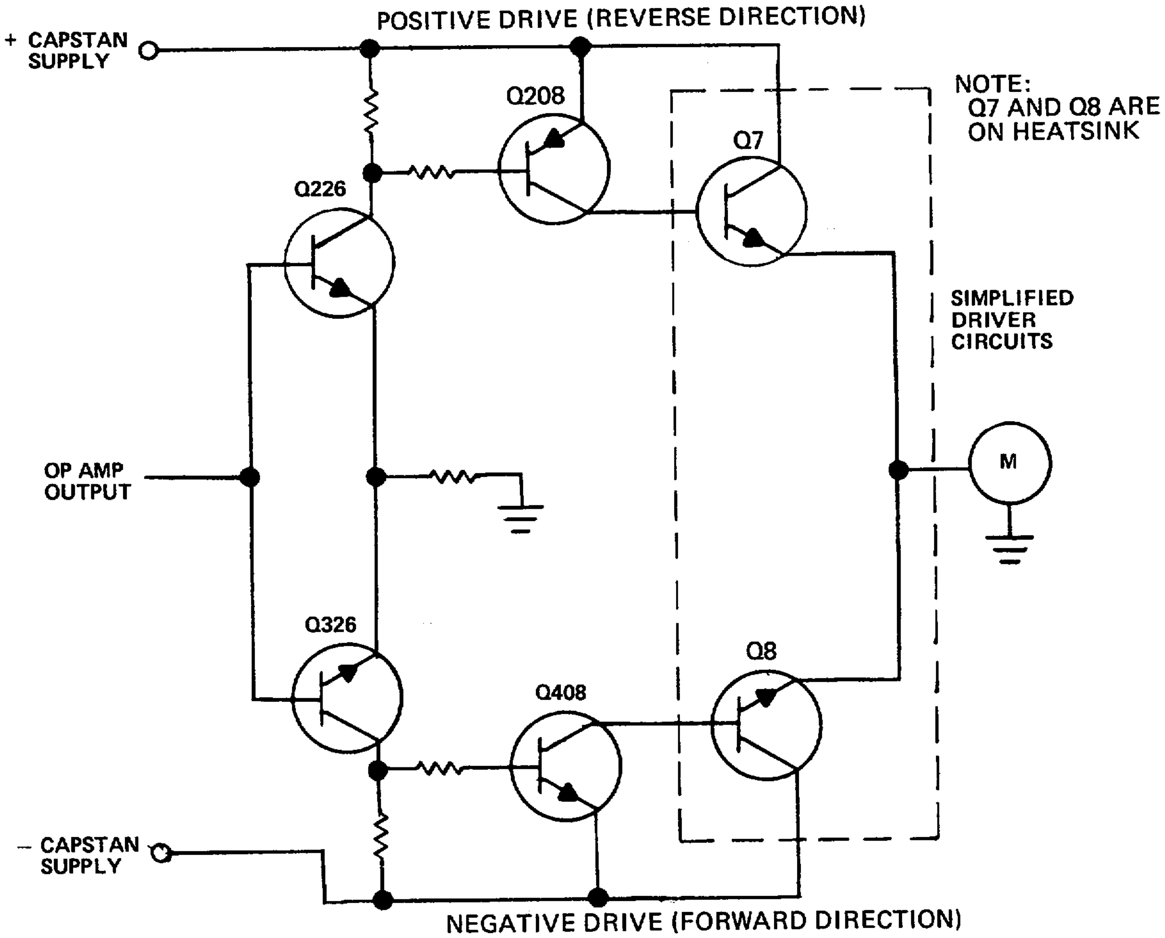


Figure 4-7. Capstan Drive Circuit, Simplified Schematic

4-41. The capstan servo is designed so that the operational amplifier saturates during the first 80 percent of a change in mode. That is, maximum current is applied to the capstan motor during the first 80 percent of any start or stop action. Thus, start time and stop time at the capstan are not adjustable; each is always at the minimum permitted by the parameters of the capstan servosystem. Some control of the shape of the last 20 percent of start or stop velocity profiles is provided by adjustable compensation network R343. This applies controlled negative feedback to the operational amplifier from the output of the motor driver. This aids in reducing oscillations in the start/stop profile.

4-42. AUTO THREAD SYSTEM.

4-43. Reel Motion. All reel motion during auto thread (as well as auto load and unload) is controlled by the reel servosystem low power circuits A2AI and A2A2 in response to signals from the control logic A2A3. The rotational speed of the reels is adjustable to optimize auto thread performance.

4-44. Auto Thread Logic. The sequence of events that makes up an auto thread operation is clocked and timed by a thread clock circuit on A2A9. This circuit consists of oscillator U114 and U125 which has a period of 0.5 second and thread clock counter U131 in conjunction with 1 of 16 decoder U239. This circuit provides pulses at discrete intervals of 0.5-second multiples following counter reset. (To assist in the following discussion, reference may be made to the Threading Timing Diagram, figure 5-17, and the Auto Thread Module A2A9 Schematic Dia-gram, figure 6-15).

4-45. (Refer to figure 6-5.) An auto thread sequence is initiated if gate U811-6 is satisfied; that is, if tape is across the upper sensor, is not in the tanks, is not across the lower sensor, and the LOAD/REWIND/UNLOAD pushbutton is pressed (assuming LOCAL status). Gate U811-6 sets Thread Status flip-flop U840-12 which, in turn, releases the counter, the decoder, and all flip-flops (either directly or indirectly in chains) from the forced reset state. It also activates the vacuum port solenoid to cause a positive airflow path down the thread route. Transistor Q706 on the auto thread A2A9 schematic provides the necessary ground for this solenoid action.

4-46. The counter starts counting as soon as its reset input is released by the thread status flip-flop through inverter U411-8 and gate U419-10. Initial backup flip-flop U641-8 is set 3 seconds later through gate U626-10. This occurs when count of 6 goes true, which is actually 6 counts of Y/2-second intervals. This 3-second interval allows the vacuum blower to come up to speed before the tape starts to move.

4-47. When the initial backup flip-flop is set, the counter is forced reset again through inverter U411-6 and gate U419-10 and it stays reset until the initial backup flip-flop is reset again. This allows the logic to wait an indefinite period for the file reel to wind up the tape threaded through the upper thread chute. The length of this tape is unknown so the logic waits without timing it. The initial backup flip-flop commands file reel ccw through inverter U314-6, and the file reel starts to wind up the tape leader.

4-48. When the tape is wound up far enough to expose the tape cross upper sensor, the initial backup flip-flop is reset through its reset input U840-10. This releases the counter to count again and turns off file reel ccw. Exposing the tape cross upper sensor also sets threading flip-flop U426-12 through inverters U626-13 and U626-1. The threading flip-flop commands file reel cw through gate U326-12 and the tape starts on its way through the threading path.

4-49. Since the counter was reset by initial backup, it starts counting at zero when the tape starts to move through the threading path. If the tape does not cover the tape cross lower sensor within 1.5 seconds, thread failure flip-flop U426-10 is set through gate U633-8. Once set, the thread failure flip-flop commands file reel ccw through inverter U326-8, turns off file reel cw at gate U326-12, and primes gate U641-3. The tape is withdrawn until the tape cross upper sensor is exposed which resets the thread status flip-flop through gate U641-3, thereby terminating the auto thread sequence.

4-50. The automatic withdrawing of tape and termination of the auto thread sequence is provided in the logic to prevent unnecessary spilling of tape if the tape end gets caught during the initial phase of auto thread. If this timer was not provided, the file reel would pay out tape for 4 seconds, which would spill substantial lengths of tape into the transport cabinet.

4-51. If the tape crosses the tape cross lower sensor before 1.5 seconds, /MACH REEL cw becomes true through gate U326-6 and the auto thread sequence continues normally. The logic is now looking for the threaded sensor to actuate. If it is not actuated by the end of 4 seconds, thread check flip-flop U817-8 sets through gate U817-6. The thread check flip-flop immediately resets the thread status flip-flop, which terminates the auto thread sequence. This occurs if the machine reel does not capture the tape and pull it tight across the threaded sensor port within 4 seconds. This is another safety feature included in the logic to avoid unnecessary spillage of tape if a failure occurs.

4-52. When the machine reel captures the tape and pulls it tight, the threaded sensor actuates and sets threaded sensor flip-flop U617-8. The threaded flip-flop removes the drive signal for Q706 and the vacuum solenoid returns to its spring-loaded position for tank vacuum.

4-53. The logic is now looking for the BOT marker. If it is closer to the end of the tape than 50 feet, thread complete flip-flop U426-13 sets through gate U633-12 when the marker is detected (/BOT sensed goes true). If the BOT marker is not present, or if it is more than 50 feet from the end of the tape, /LOW TAPE MACH REEL eventually goes false and sets the thread check flip-flop through gate U633-6, thereby terminating the auto thread sequence. This feature is included in the logic to prevent the Transport from looking indefinitely for a BOT marker if it is not on the tape.

4-54. When the thread complete flip-flop is set by /BOT SENSED, the counter reset input is pulsed once through edge detector U419-1, inverters U432-2, U411-4, and gate U419-10. This starts the counter off at zero again since it had been counting all during the search for a BOT and could be at any count. The thread complete flip-flop also causes /END THREAD STATUS to go true through inverter U432-6 which slows down the speed of the machine reel and turns off /FILE REEL cw through gate U326-12. This ensures a smooth stop for the reels at the end of the auto thread sequence.

4-55. At the end of 2 seconds following thread complete, a /SET LOAD command initiates an auto load sequence by setting a normal load flip-flop in the auto load logic (figure 6-13) which causes /LOAD OP to go true. /LOAD OP resets the thread status flip-flop through inverters U314-10 (figure 6-15) and U611-6, which terminates the auto thread sequence.

4-56. Two self-test features are provided in the auto thread logic. One is the partial power test mode. If test point TP-4 is connected to circuit ground, the tape is not in the tanks, or not across the tape cross lower sensor, gate U840-6 is satisfied. This primes gates U331-3, -8, and -11 and releases counter reset through gate U419-10. It also energizes the emergency stop relay (not shown, see figure 6-5) through the /PARTIAL POWER TEST MODE signal to allow the reel motor circuits to drive the reels. The counter then counts and alternately enables gates U331-11 and -6 and U331-3 and -8 once every 4 seconds through the fourth stage output of the counter and inverter U883-2. These gates alternately command the reel motors to turn the reels cw and ccw through the four low-speed command lines. As the reel turns for 4 seconds in each direction, their speeds can be checked and adjusted by counting the number of revolutions in each 4-second interval.

4-57. The other self-test feature is a part of test mode B on the BITE Module A2A4. The Transport automatically runs tape forward (from BITE), rewinds, unloads, rethreads, and loads again when test point 3 on the BITE module is grounded. The part of test mode B contained in the auto thread logic is the part that controls the auto thread segment of that test mode.

4-58. When test mode B is selected, /TEST MODE B is true, which primes gate U641-6 through inverters

U833-4. When the tape is withdrawn from both tanks during the unload portion of test mode B, /TAPE NOT-

IN-TANKS becomes true and satisfies gate U641-6 which, in turn, sets the thread status flip-flop. Note that gate

U641-6 bypasses gate U811-6. This allows the thread status flip-flop to be set even though the tape is still across the tape cross lower sensor and the LOAD/REWIND/UNLOAD button has not been pressed. When the thread status flip-flop is set, the vacuum port solenoid actuates and auto thread proceeds normally except that the tape is withdrawn from the machine reel at the start of the auto thread sequence instead of from the upper thread chute as it is when tape is manually threaded for a normal auto thread.

4-59. AUTO LOAD SYSTEM.

4-60. The auto load system moves tape into the vacuum tanks following an auto thread and places the tape at the load (BOT) position in preparation for normal Transport operation. The auto load system consists of several condition sensors and part of Load/Rewind Module A2A7. The condition sensors are two photoelectric tape-in- tank sensors (one for each tank) and the pneumatic vacuum sensed upper/lower safety and servo sensors. The tape-in-tank sensors, DS2/Q2 and DS3/Q3, detect the presence of tape in each vacuum tank when a loop in the tank passes between the photosensor and its exciter lamp. The safety sensors, S1 and S5, are used to provide emergency shutdown capability if violated after tape is loaded. The tape cross upper and tape cross lower sensors, DSI/Ql and DS4/Q4, detect if tape is threaded properly between the reels, which is a necessary condition for an auto load. The servo sensors S2, S3, and S8 activate the servos as tape leaves the braking zones.

4-61. The vacuum-sensed sensor S11 detects the presence of vacuum pressure in the vacuum tanks when there is no tape in the tanks. This sensor consists of a 1-inch H20O pressure sensor connected through a pair of tubes to the vacuum ducting behind the baseplate of the vacuum tanks and to a hole that passes through the center tank rail. This hole is covered by the vacuum tank door when the door is closed and is open to atmosphere when the door is open. With the door closed and with no tape in the tanks, the pressure in the vacuum ducting builds up to about 3 inches H20 when the main air supply is turned on. This is sufficient to actuate the vacuum-sensed sensor which signals that the air supply is on. If the tank door is open, however, the pressure at the sensor falls to near zero and the sensor does not actuate. This arrangement ensures that tape is not loaded into the vacuum tanks if either the air supply is not on or if the tank door is open.

4-62. Refer to the Loading Timing Diagram, figure 5-18, and Load/Rewind/Module A2A7 Schematic Diagram, figure 6-13, during the following discussion of the auto load system logic. Gates U141 and U341 of Load/Rewind Module A2A7 are quad comparators. These comparators are used to interface all photoelectric condition sensors to the rest of the logic and are biased to switch state at about 2. 1V through resistors R333 through R338. Since each sensor is a grounded emitter phototransistor with a 10K collector pullup resistor to +5V, the maximum volt- age swing from any photosensor is OV to +5V. Thus, the "light-on" state of any sensor is between OV and +2V and the "light off" state is between approximately +2. 2V and +5V. This allows sufficient margin on either side for misalignment between the sensor and its light source and possible sensitivity drift in the sensor with temperature changes.

4-63. Normal load flip-flop U314-11 is the master control flip-flop for normal load operations. When reset, this flip-flop jam resets all sequence timing single-shots in the normal load logic through inverter U328-4. It also disables /CAPSTAN REVERSE and the two low-speed load signals through the same inverter. This prevents accidental operation of the single-shots or of the three lines during other operations.

4-64. Normal load flip-flop U314-11 is set through gate U106-8. This gate is satisfied when the tape is threaded between the reels (across tape cross lower sensor), is not in either vacuum tank (both TAPE-IN-TANK signals are false), and either a /SET LOAD command is received from the auto thread logic or the LOAD/REWIND/ UNLOAD pushbutton is pressed. The latter two are ORed through gate U706-11.

4-65. The normal load flip-flop is reset instantly during a load operation if the tape enters the file tank before it enters the machine tank. This is accomplished through gate U120-3 and inverter U328-12 and is used to abort a misload which is characterized by the tape entering the wrong tank first. It can also be reset through gate U306-12 by pressing the RESET pushbutton, detecting BOT during reverse search through gate U706-3, or by failing to load tape into the tanks within a certain period of time.

4-66. When the normal load flip-flop is set, /LOAD OP goes true through inverters U328-4 and U620-12, which resets an auto thread operation if one had been in progress. /LOAD OP or IN-TANK-LOAD also goes true through gate U420-13 and causes the ready circuitry to energize the emergency stop relay in preparation for powering the reel and capstan motors. The ready circuitry also turns on the main air supply in response to /LOAD OP or IN-TANK-LOAD true.

4-67. Load delay single-shot U642-6 is triggered when normal load flip-flop U314-11 is set and disables gate U106-6 for a few seconds. This prevents reel motion until the air supply builds up full vacuum in the vacuum tanks. At the end of the load delay, gate U106-6 looks for /VACUUM SENSED to be true through inverter U606-10. If it is true, this gate causes /MACH REEL CCW LOAD to go true which commands the machine reel servo to turn its reel slowly ccw and feed tape into the machine tank. If /VACUUM SENSED is false, the logic waits indefinitely for it to go true before causing the reels to turn.

4-68. When tape is detected in the machine tank, /TAPE-IN-MACH TANK becomes true. This disables gate U106-6 through gate U120-6 which stops the machine reel from turning. At the same time, gate U306-6 is satisfied making /FILE REEL CW LOAD true which causes the file reel to start feeding tape into the file tank. When tape is detected in the file tank, TAPE-IN-FILE TANK becomes true and U106-6 is again satisfied through gate U120-6 causing the machine reel to turn ccw again. Now both reels are feeding tape into their tanks.

4-69. There are two servo latch flip-flops on Load/Rewind Module A7: file reel servo latch U715-12 and machine reel servo latch U722-12. Each of these flip-flops produces a servo latch signal that enables or disables the full power circuits in each of the two reel servos. For example, with /FILE REEL SERVO LATCH true (its flip-flop set), the full power circuits of the file reel servo are active (the low-power circuits are also disabled by this signal); whereas, if this signal is false (flip-flop reset), the full power circuits are disabled and the low power circuits enabled.

4-70. It is necessary to set the two servo latches during an auto load sequence to establish full servo power. This is done individually to each servo latch as the conditions suitable for full servo power are met. The file reel servo latch is set by gate U715-6 which is satisfied by /FILE REEL CW LOAD true, tape in both tanks, and /FILE REEL UPR SRVO SNSR false. This means that the file reel servo latch is set if the file reel is being commanded to load tape, tape is present in both tanks, and the file reel loop has entered or moved below the file tank dead zone.

4-71. Since both servo latches are held reset by servo latch set delay single-shot U630-6 through gate U729-10, the file reel servo latch does not set until /2 second has elapsed from the time the tape entered the file tank, even if gate U715-6 is fully satisfied before then. This delay is incorporated to provide the tank sensors sufficient time to stabilize in the changing vacuum pressure.

4-72. The machine reel servo latch is set through gate U722-6 which is satisfied by /MACH REEL CCW LOAD true, tape in both tanks, and /MACH REEL UPR SRVO SNSR false. This is analogous to the file reel servo latch set conditions. The servo latch set delay also holds back setting of this flip-flop as it does for the file reel servo latch.

4-73. As the loops move toward the center of the tanks, the servo latches wait for them to cross the upper servo sensors. When a loop crosses an upper servo sensor, the servo latch for that loop sets (providing the %/2-second servo latch set delay has timed out), and full power is applied to that reel servo. Then, the loop is maintained in the braking zone as described previously in the reel servosystem. When both servo latches are set, /SERVO LATCHES becomes true through gate U729-4 and inverter U606-4. (The SERVO LATCHES signal is the most significant part of the machine ready system.) Gate U729-4 also enables gate U736-1 which commands /CAPSTAN REVERSE causing tape to reverse. It also primes gate U706-3 which, when BOT is sensed through inverter U606-6, resets the normal load flip-flop. This terminates the normal load sequence at BOT.

4-74. Load tank fault timer single-shot U630-10 is triggered by /MACH REEL CCW LOAD through inverter U620-8 and allows the normal load sequence to continue for 2 seconds. If TAPE-IN-TANK is not true at the end of 2 seconds, the normal load flip-flop resets through edge detector U420-1, gates U413-4 and U306-12, and inverter U328-2. This fault timer is used to prevent an unnecessary tape spillage if something prevents tape from entering the tanks during normal load conditions.

4-75. In-tank load flip-flop U314-8 is used to establish full power from a not-ready condition when the tape is still in the tanks. This flip-flop is set by gate U314-3, which is satisfied by tape threaded and in both tanks (gates U120-11, U120-8, and U113-10) and by pressing the LOAD/REWIND/UNLOAD pushbutton.

4-76. When the in-tank load flip-flop sets, it causes /LOAD OP OR IN-TANK LOAD to become true through gate U420-13. Eventually, the vacuum in the vacuum tanks rises above -10 inches HO0 and the two lower safety sensors, one in each tank, actuate. These pressure sensors are in series and when both sense -10 inches HO0 or higher and actuate, LWR SAFETY SNSRS VIOLATED becomes false indicating that a safe level of vacuum pressure exists in both tanks. This satisfies gate U613-8 through inverter U606-12 which attempts to set both servo latches simultaneously. When the upper and lower servo sensor are set, the brake and reduced torque signals will be set from U630 and U731, respectively.

4-77. When the in-tank load flip-flop sets, it triggers in-tank load fault timer single-shot U440-6. This single-shot prevents the servo latches from setting for 1.6 seconds through gate U729-10. This delay prevents setting the servo latches during the stabilization period of the two lower safety sensors.

4-78. When the in-tank load fault timer goes out, the servo latches set and ready status is assumed. The in-tank load flip-flop is reset through gates U729-13 and U729-4 as soon as both servo latches are set. This terminates an in-tank load operation.

4-79. The in-tank load fault timer also generates a pulse through edge detector U420-10 at the end of 1.6 seconds. If this pulse arrives at gate U314-6 before LWR SAFETY SNSRS VIOLATED becomes false, the in-tank load flip-flop resets through gates U314-6, U729-13, and inverter U328-10. This aborts an in-tank load if full tank pressure is not present by the end of 1.6 seconds.

4-80. REWIND SYSTEM.

4-81. The rewind system permits automatic rewind to BOT at the highest possible tape speed consistent with safe operation of the reel servos. It consists of logic contained on Load/Rewind Module A2A7, Capstan Drive Module A2A5, and one pneumatic rewind sensor S4 and S9 in each vacuum tank. Refer to the Rewind Timing Diagram, figure 5-19, and Load/Rewind Module A2A7 Schematic Diagram, figure 6-13, during the following discussion.

4-82. A rewind sequence starts with normal reverse tape motion for 1 second. This allows the reel to start turning. At the end of 1 second, the capstan runs at a higher speed (rewind speed) for as long as the loops in the vacuum tanks stay above the rewind sensors. If either loop drops below its rewind sensor, the capstan slows down. This prevents the capstan from getting ahead of the reel servos, causing a loop fault. When the tape remaining on the machine reel falls below approximately 50 feet, the tape speed returns to normal and remains at normal speed until BOT is detected. BOT ends the rewind sequence.

4-83. Master rewind flip-flop U906-6 (figure 6-13) is set by pressing the LOAD/REWIND/UNLOAD push-button, setting unload prime flip-flop U914-15, or by commanding REWIND either from BITE or from the interface logic through the wired OR gate at input pin P2-17. Once set, the rewind flip-flop remains set for the entire rewind sequence. The rewind flip-flop commands /CAPSTAN REVERSE through inverters U920-4, U920-12, and U406-6 and OR gate U736-10.

4-84. Rewind speed is attained by shunting the tachometer feedback signal to ground through the parallel resistor combination R231 and R230. This forces the servo to run the capstan faster to balance ARI. Resistor R231 is shorted to circuit ground through FET switch Q334, which is controlled by a /REWIND HIGH SPEED signal from the rewind logic and the two vacuum tank rewind sensors. Resistor R230 is shorted to ground after a 730-ms time delay from U507. Both FET switches Q334 and Q434 must be closed to have high-speed rewind. High speed is allowed if /REWIND HIGH SPEED is true and the tape loops are not violating either rewind sensor. If a loop violates a sensor, Q334 is turned off and capstan high speed shows until the sensor is again covered. This prevents the capstan servo from getting ahead of the reel servos during rewind which could cause loop faults in the vacuum tanks. Negative drive is also inhibited during rewind. This is done to prevent unnecessarily rapid capstan deceleration when any slow-down command is received by FET switches Q334 and Q434.

4-85. Low tape mach reel flip-flop U914-12, which has been forced reset by the rewind flip-flop through OR gate U706-8 while the rewind flip-flop was reset, is automatically set when the rewind flip-flop is set. The /MACH REEL LOW TAPE SNSR, which is buffered by comparator U341-14, resets the low tape mach reel flip-flop through inverter U127-10 and OR gate U706-8 when the level of tape on the machine reel falls below 50 feet. The low tape mach reel flip-flop then sets rewind slow-down single-shot U930-6.

4-86. The rewind slow-down single-shot is used during manual termination of the rewind sequence. This single-shot allows manual rewind reset flip-flop U941-8 to be set through AND gate U941-6 and inverter U920-8 when the RESET pushbutton is pressed. (Note that the low tape mach reel flip-flop is cleared by the RESET push-button; this sets the rewind slow-down single-shot.) The manual rewind reset flip-flop resets the rewind flip-flop and maintains /CAPSTAN REVERSE true through OR gate U736-10. The capstan runs at normal speed until the rewind slow-down single-shot times out after I second. When the single-shot times out, it automatically resets the manual rewind reset flip-flop and rewind is terminated.

4-87. Following low tape, the capstan continues to run at normal reverse speed until BOT is detected. BOT sensed resets the rewind flip-flop through inverter U606-6 and AND gate U706-3. (This gate is enabled whenever both servo latches are set, which is always the case during rewind.)

4-88. READY SYSTEM.

4-89. The ready system monitors the condition of various parts of the Transport circuitry and detects excessive loop travel in the vacuum tanks. If the monitored conditions are satisfactory, the ready system allows the Trans-port to assume ready status and applies power to the reel motors, the capstan motor, and the main air supply. When selected to remote operations, it signals the interface circuitry that the Transport is ready to accept commands. If at any time one of the monitored conditions goes beyond acceptable limits, the ready system shuts down all motor power including the main air supply and stops the Transport from accepting any further commands. The ready system consists of an emergency stop relay, pneumatic upper and lower safety sensors in the vacuum tanks, and Sensor Module A2A8. Refer to the Ready System Logic Diagram (figure 4-8) and Sensor Module A2A8 Schematic Diagram (figure 6-14) during the following discussion of the ready system.

4-90. Power to the reel and capstan motors is applied through contacts of an emergency stop relay. If this relay is energized, the three motor drive circuits are connected to their respective motors. If the relay is dropped out (an emergency stop condition), each motor armature is disconnected from its drive and is shorted by the relay contact. This ensures rapid braking from back-emf generated in the motors if the motor armatures are turning when the relay drops out.

4-91. The emergency stop relay is driven by driver Q807 from OR gate U539-1. This gate accepts inputs from /PARTIAL POWER TEST MODE, reel brake release flip-flop U339-8 and U445-3, and the emergency stop flip-flop U539-6. /PARTIAL POWER TEST MODE requires application of low-speed power to the reel motors; therefore, the emergency stop relay must be energized. The emergency stop flip-flop is essentially the keeper of the ready status. When it is reset, it allows the application of full normal power and energizes the emergency stop relay.

4-92. The emergency stop flip-flop may be reset by any one of three commands: /UNLOAD OP, /LOAD OP, or IN-TANK LOAD. OR gate U707-6 and inverter U139-8 provide the means for resetting the flip-flop. Thus, if any one of the four commands is active, the emergency stop flip-flop resets, the relay is energized, and motor power is applied.

4-93. The emergency stop flip-flop also controls the main air supply. It does this through NAND gate U707-8, inverter U815-6, driver Q921, and the main air supply relay. Gate U707-8 is satisfied and turns on the vacuum blower if the emergency stop flip-flop is reset and /UNLOAD OP is inactive. An unload operation requires that the vacuum blower be turned off.

4-94. Once emergency stop flip-flop U539-6 is reset by one of the four commands, it remains reset when the command goes false, providing neither of the two pairs of vacuum tank safety sensors is violated. Note that gate U707-6 disables NAND gate U531-11 through inverter U139-8 so that the SET 1 input of the emergency stop flip-flop is disabled when /UNLOAD OP is true. This gate, however, becomes active and looks for a violation of the safety sensors through OR gate U531-3 when the command goes false. Thus, if the vacuum blower is on and if tape is in the tanks and not violating a safety sensor, the emergency stop flip-flop command (SET I input) goes false. It immediately sets and stops the Transport if a safety sensor is violated.

4-95. The emergency stop flip-flop has a second input. SET 2 is driven by wired OR gate Gl which monitors TAPE-IN-FILE TANK and the two safety sensors. If any one of the two safety sensors or tape is removed from the file tape in tank sensor, the emergency stop flip-flop U539-6 goes high. This shuts off power to the motors and is a response to either a command to do so or a potentially damaging situation.

4-96. /MACHINE RESET is generated by the ready system and is used to terminate or initialize all automatic sequences in the Transport. It is produced at driver U715-11 from one of three inputs to NOR gate U345-6. The inputs are the RESET pushbutton, the SET 2 input to the emergency stop flip-flop, and the output of NAND gate U445-6. This gate forces /MACHINE RESET true if the emergency stop flip-flop is set. This automatically clears all automatic sequences when ready status is lost. The gate releases /MACHINE RESET when the LOAD/ REWIND/UNLOAD pushbutton is pressed to permit starting an auto load or auto thread sequence.

4-97. MACHINE READY, which signals true ready status to the rest of the Transport, is produced by NAND gate U515-3 from /SERVO LATCHES (which can only be true if the emergency stop flip-flop is reset) and /LOAD OP, or /UNLOAD OP status. The Transport is not ready to accept commands during any of these three automatic sequences.

4-98. The reel brake release flip-flop releases the reel brakes for a manual thread operation. It does this by energizing the emergency stop relay through gate U539-12 and by turning off the reel brake transistors through gate U345-8. Gate U345-8 permits only the reel brake transistors to turn off if the emergency stop flip-flop is set and /PARTIAL POWER TEST MODE is not active. The reel brake release flip-flop is set by the LOAD/ REWIND/UNLOAD pushbutton and is reset by the RESET pushbutton, the emergency stop flip-flop in the reset state, and by wired OR gate G1.

4-99. READ/WRITE SYSTEM.

4-100. Figure 4-9 is a simplified block diagram illustrating the major components of the read/write system. During write operations, WRITE DATA and WRITE command signals from a magnetic tape control unit (MTCU) are converted to Transport logic levels by Line Receiver Module A2A16 and gated to Write Amplifier Module A2A14 and Write Control Module A2A13. Write Amplifier A2A14 provides current to the erase head and the appropriate write current waveform to the write head portion of the read/write head.

4-101. The read/write system operates with a modified NRZ recording system. This method of recording relates the data to changes in record current. By interpreting each current change as a “1” and the absence of a current change as “0,” a logic representation of 110101 is illustrated in figure 4-10. This is accomplished by using a record

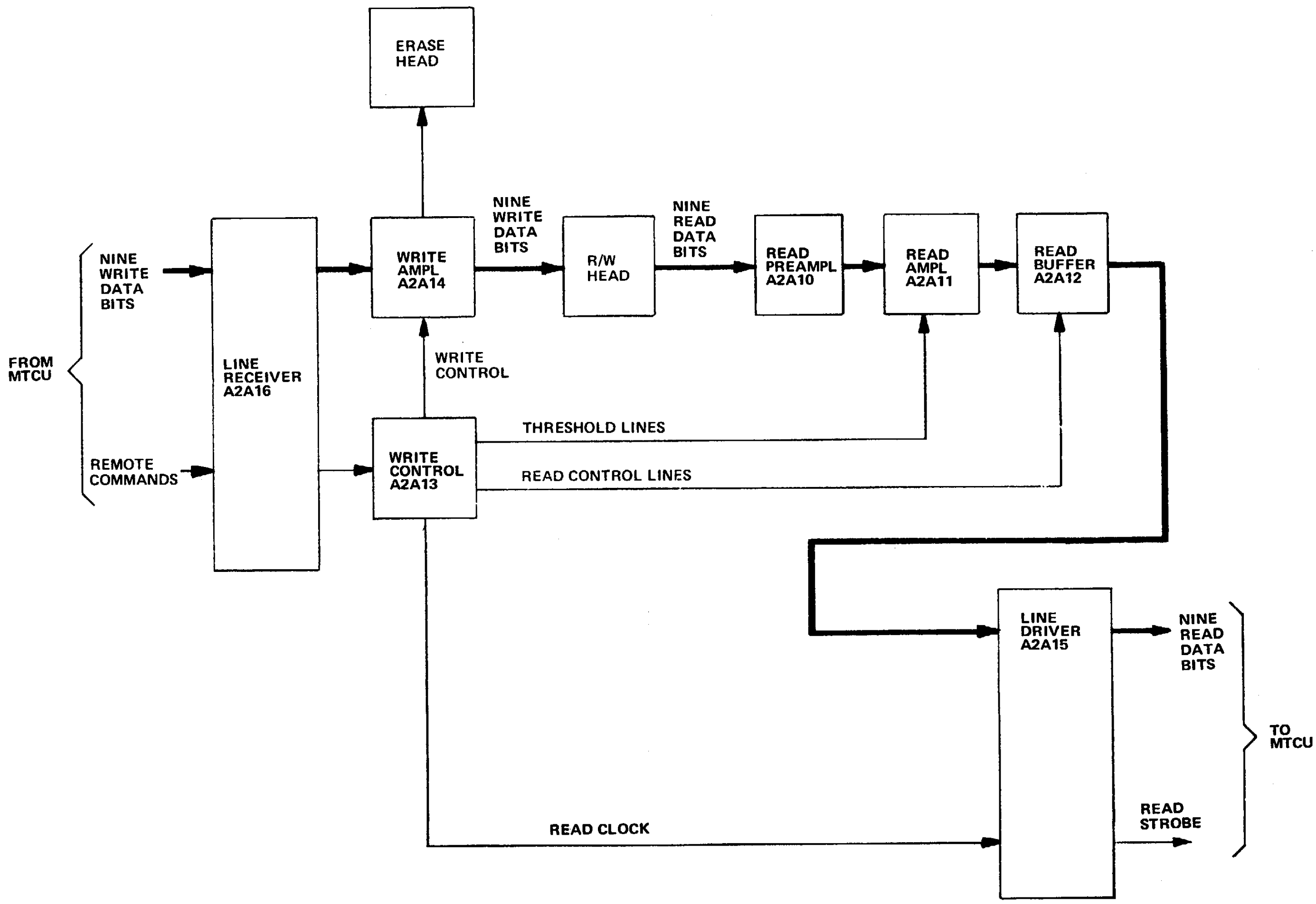


Figure 4-9. Read/Wire System Simplified BlockDiagram

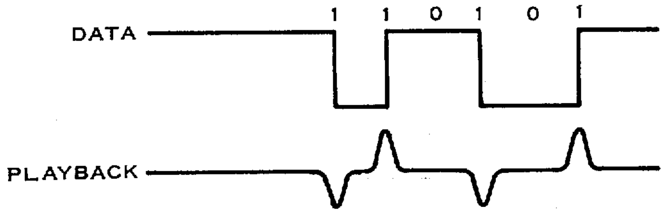


Figure 4-10. Logic Representation of 110101

amplifier in the form of a symmetrically triggered flip-flop. The flip-flop is driven by pulses from the data source where the presence of a pulse indicates a “1” and produces a transition in the flip-flop and, consequently, a reversal in the state of magnetization of the tape.

4-102. During write operations, tape is driven into magnetic saturation in either direction. Each bit of data on tape can be pictured as a microscopic bar magnet oriented in the direction of magnetization. During read operations, the recorded tape is moved at a constant velocity over the read head, the flux surrounding the microscopic bar magnet, created at each point of transition, excites the windings of the read head, producing a voltage pulse. The amplitude of the voltage pulse is proportional to tape speed and its width is inversely proportional to the speed of tape. The shape of the voltage signal is similar to a Gaussian curve as shown in figure 4-10. Read Preamplifier Module A10 detects the signal, Read Amplifier Module A2A 11 amplifies the signal, and Read Buffer Module A2A12 generates a digital output corresponding to the information represented by the pattern of flux transitions on the tape.

4-103. Read commands from the MTCU are gated through Line Receiver Module A2A16 to Write Control Module A2A13. During read operations, Write Control Module A2A13 supplies threshold levels to the read amplifiers on A2A11 and read control signals to Read Buffer Module A2A12. Nine read data bits from the Read Buffer Module A2A12 are applied to the MTCU via Line Receiver Module A2A15. A READ CLOCK from Write Control Module A2A13 is gated through Line Receiver Module A2A15, producing a READ STROBE used to transfer the nine read data bits from the transport to the MTCU.

4-104. WRITE OPERATIONS. Write operations involving the MTCU are executed with the Transport in remote mode. The true /SELECTED, READY and REMOTE signal applied to Line Receiver Module A2A16 is inverted by gate U907-11 (figure 6-22) to enable control signals and data from the MTCU to be accepted by the Transport. The /WRITE STROBE, WRITE ENABLE, and /WRITE RESET signals from the MTCU cause Line Receiver Module A2A16 to provide /REMOTE WRITE CLOCK, /REMOTE SET WRITE STATUS, and /WRITE RESET ALLOW signals, respectively, to the Write Control Module A2A13. Nine WRITE DATA TRACK signals from the MTCU cause Line Receiver Module A2A16 to provide nine /WRITE DATA signals to Write Amplifier Module A2A14.

4-105. Write Control. Figure 4-11 illustrates the write control portion of Write Control Module A2A13 (figure 6-19). In order to produce the high WRITE ENABLED signal (needed to allow Write Amplifier Module A2A14 to write data in NRZ format), the output of gate U608-8 must be high.

4-106. In local mode, the true /INTERNAL SET WRITE STATUS signal from BITE Module A2A4 produces the high WRITE ENABLED signal via gate U608-8, inverter U817-10, and gate U825-6. The /INTERNAL SET WRITE STATUS signal also produces a true /INTERNAL WRITE DATA which causes the Write Amplifier Module A2A14 to write “ones” on all tracks.

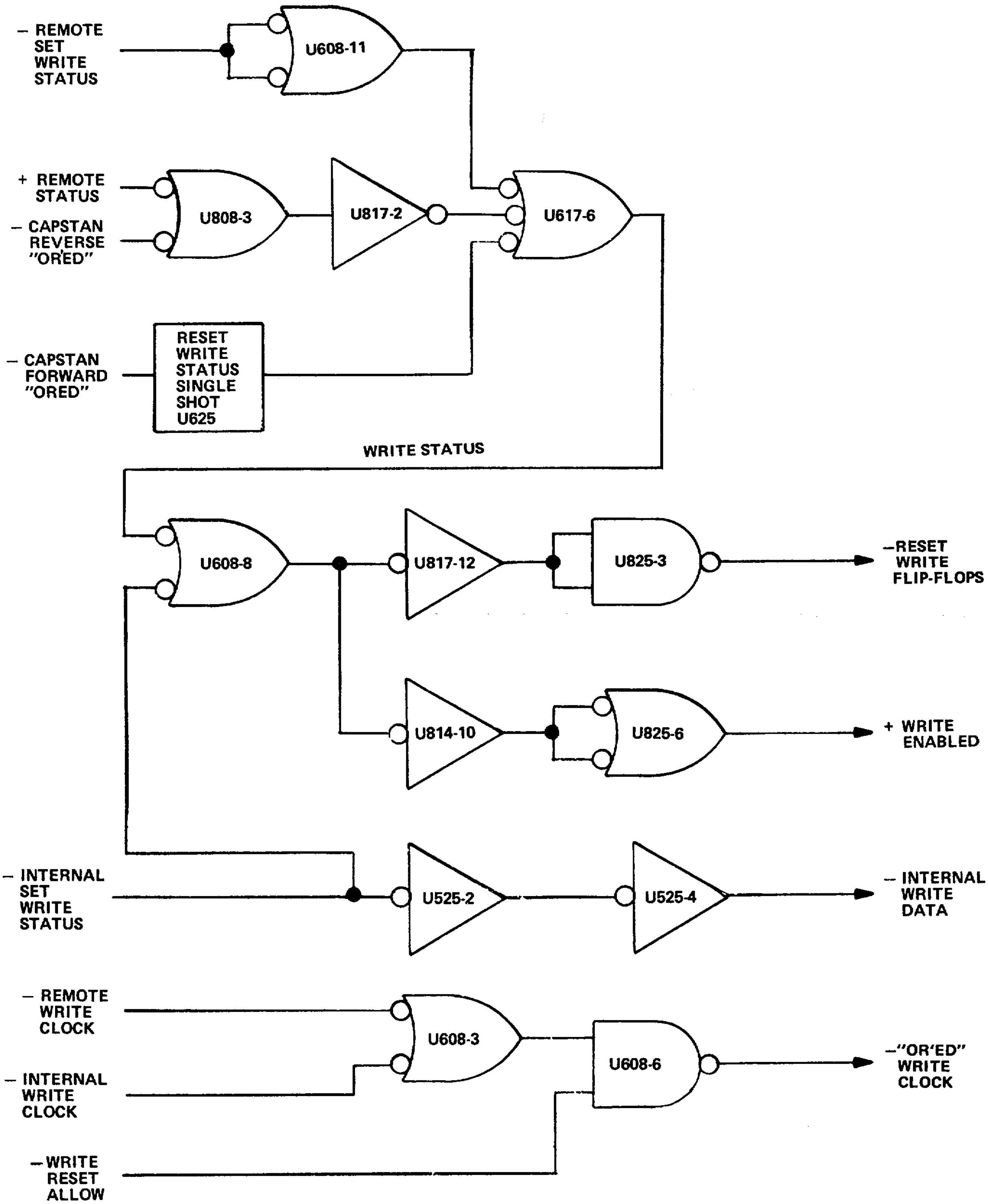


Figure 4-11. Write Control Functional Block Diagram

4-107. In remote mode the true /REMOTE SET WRITE STATUS signal,- via gates U608-11, U617-6 and U608-8, produces the WRITE ENABLED. However, the output of gate U617-6 will be held high via gate U808-3 and inverter U817-2 if either reverse motion is commanded or the Transport is in local mode while attempting a remote write operation.

4-108. When the /WRITE RESET ALLOW signal A2A16 goes low, indicating the end of a write operation, the /RESET WRITE FLIP-FLOPS signal also goes low via inverter U817-12 and U825-3. This causes all write flip-flops on the Write Amplifier Module A2A14 to be reset, effectively writing the Longitudinal Redundancy Check (LRC) character.

4-109. The ORED WRITE CLOCK is produced (via gate U608-3 and U608-6) from either the /REMOTE WRITE CLOCK or the /INTERNAL WRITE CLOCK from the BITE Module A2A4. The /WRITE RESET ALLOW signal allows the MTCU to inhibit the WRITE CLOCK during write operations, causing the Transport to erase tape. Erase head operation is enabled by +12V supplied from the file protect switch. The FILE PRO-TECT signal is generated when a write enable ring is installed on the file reel.

4-110. Writing Data. Write data is received at the input of Write Amplifier Module A2A14 (figure 4-12) from the MTCU via Line Receiver Module A2A16. Figure 4-12 illustrates track 1, one of the nine data tracks in detail. A true /WRITE DATA signal (data = 1) is inverted by U311-8. The output of U311-8 is held low until the /ORED WRITE CLOCK goes low, allowing the write data to affect pin 4 of write flip-flop U315, driving pin 15 of U315 high.

4-111. The /ORED WRITE CLOCK is also synchronized with a 20 MHz DELAY CLOCK pulse from free-running oscillator U332-10 via flip-flop U526. This synchronized pulse is used to clock a right-to-left shift register, whose output sequentially generates a clock pulse to the write flip-flop for each data bit, from one to nine, or nine to one. The direction of the shift is controlled by jumper W227 in steering circuit U326 and is dependent on the mechanical skew of the head (the amount the head is cocked from its zero axis). The amount of time the clocks can be delayed is adjustable via Write Skew Adjust R236 in the oscillator circuit.

4-112. The high inputs at pins 4 and 16 of write flip-flop U315 causes the output state of the flip-flop to change at the leading edge of the DELAYED WRITE CLOCK pulse coming from shift register U631. A change in the write flip-flop output state produces a change in the direction of current through the write head via drivers Q111 and Q112. This change produces a change in direction of magnetic flux which will write a one on tape. A false /WRITE DATA signal at the input to U311-8 (data = 0) generates a low at pins 4 and 16 of write flip-flop U315, causing the output to remain unchanged at the leading edge of the DELAYED WRITE CLOCK pulse. No change at the write flip-flop output causes no change in magnetic flux from the write head. Resistors R114 and R212 form a compensating network to obtain a symmetrical playback waveform; adjustment is made by potentiometer R237.

4-113. Writing locally is done by BITE Module A2A4 (figure 6-10). With the Transport in the local mode of operation, an /INTERNAL SET WRITE STATUS command issued by BITE Module A2A4 to Write Control Module A2A 13 (figure 4-11) generates WRITE ENABLED and /INTERNAL WRITE DATA signals at the out-put of A2A13. A /INTERNAL WRITE CLOCK also issued by the BITE Module generates /ORED WRITE CLOCK from Write Control Module A2A13 to Write Amplifier Module A2A14. The /ORED WRITE CLOCK (figure 4-12) strobes the /INTERNAL WRITE DATA through gate U311-8 to the input of write flip-flop U315. The /INTERNAL WRITE DATA is clocked through to the write head, producing “ones” on all tracks.

4-114. ROAD OPERATION. The read system receives data signals from the read head, then amplifies, deskews, and transmits data to the MTCU. Figure 4-13 is a simplified functional diagram showing the read control function.

4-115. Read Control. The signals necessary to shift read data out at a specific time are generated on Write Control Module A2A13 (see figures 4-13 and 6-17). An active /READ DATA ORED from Read Buffer Module

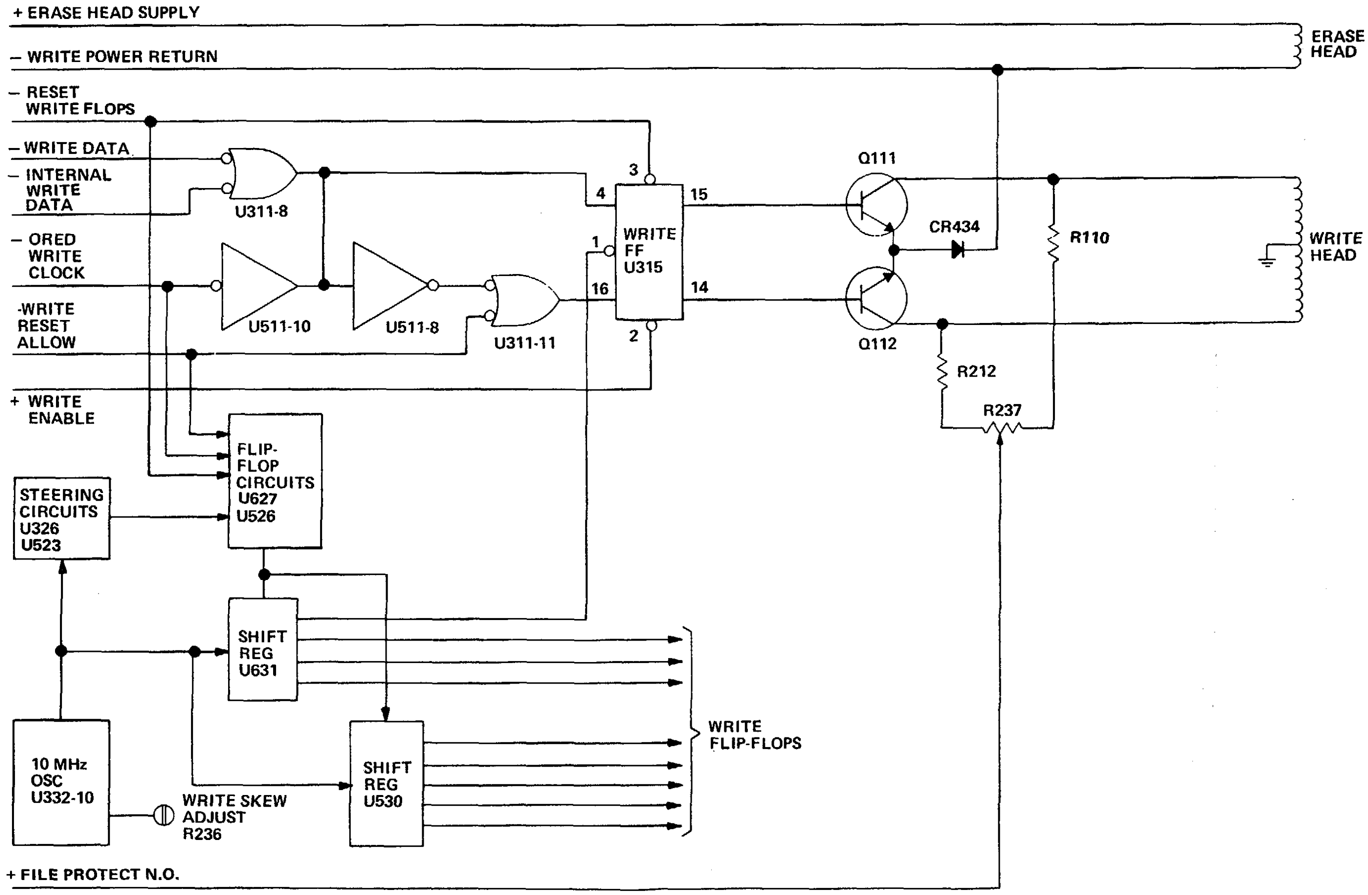


Figure 4-12. Write Amplifier Functional Block Diagram

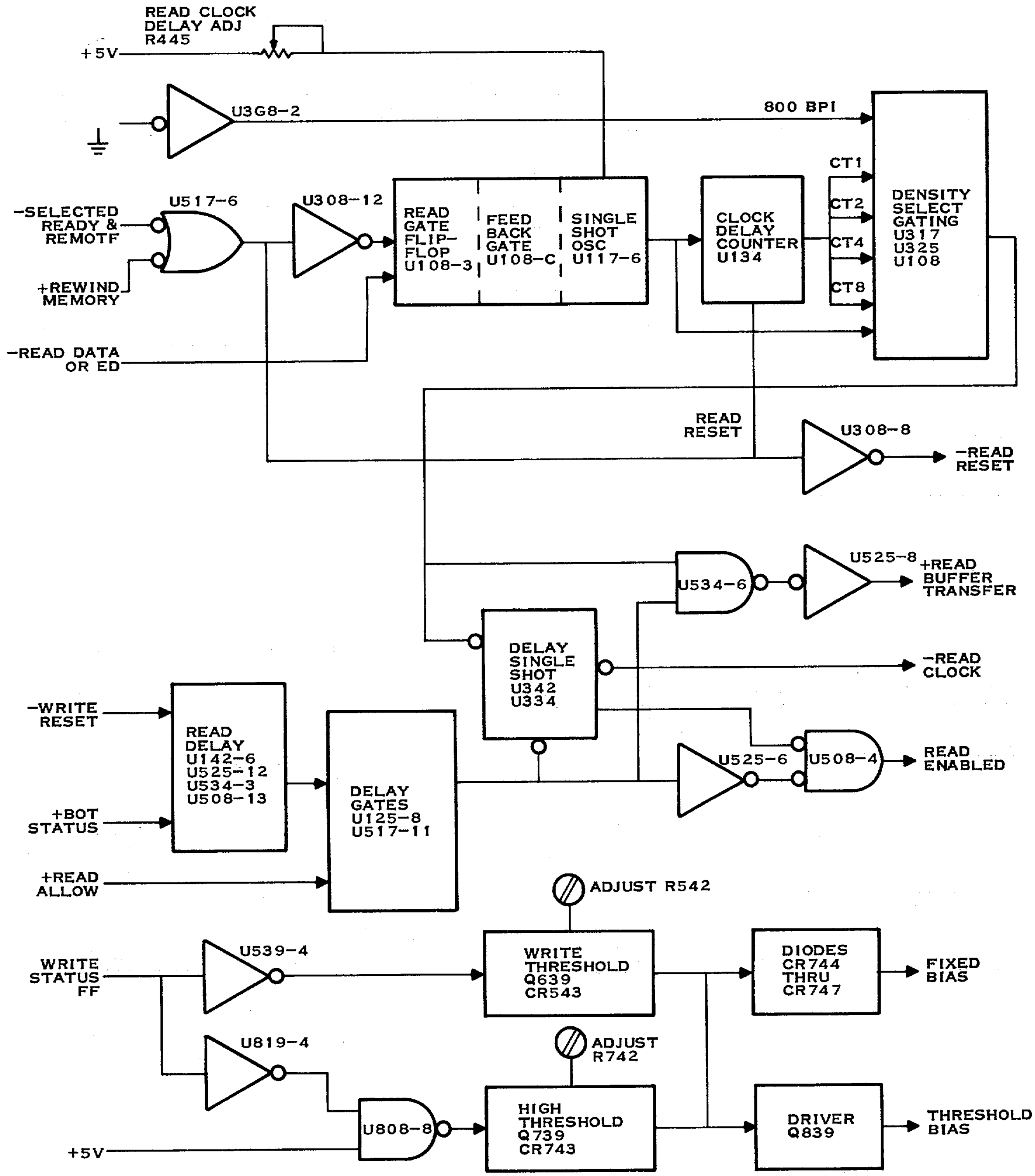


Figure 4-13. Read Control, Functional Block Diagram

A2A12 is sent to Write Control Module A2A13 to set read gate flip-flop U108-3, which enables single-shot oscillator U117-10. The /READ DATA ORED signal is true whenever one track indicates a recorded one. The output at U 117-10 clocks clock delay counter U134. Density select gating circuits U317 and U325 determine at what time the counter pulse occurs. The high output of inverter U308-2 selects 800BPI, and a decode occurs when CTI and CT2 are coincident with the clock. The output of the density select gating circuit is gated with a FEEDBACK DELAY pulse by NAND gate U534-6 and inverted by U525-8 to produce the READ BUFFER TRANSFER command to Read Buffer Module A2A12. The output of the density select gating circuit also is applied to delay single-shots U334 and U342 to generate a /READ CLOCK to Line Driver Module A2A15 and, via clock delay timing, to generate READ ENABLED to Read Buffer Module A2A12. The /READ CLOCK produces a READ STROBE which is used by the MTCU to accept read data from the Transport. Fixed bias and threshold bias levels are also developed on Write Control Module A2A13 for use on Read Amplifier Module A2AII1.

4-116. If tape is at BOT when a READ command is initiated, the false /WRITE RESET and true BOT STA-TUS signals initiates a read delay. When the READ ALLOW signal is true, the delay single-shots are unclamped and gates U534-6 to U508-4 are enabled. Thus, the delay single-shots only produce READ ENABLED after the appropriate delay.

4-117. Read Data Flow. Figure 4-14 is a functional block diagram of the read system. Since all nine read channels (tracks) of the read amplifier are identical, only channel one is illustrated and described. The READ DATA signals are preamplified on Read Preamplifier Module A2A10 (figure 6-14) by differential amplifier U139 and gain adjusted by potentiometer R248. The output of the differential stage is a push-pull signal that is applied to the threshold section of Read Amplifier Module A2AI 1 (figure 6-15). The threshold section performs the function of full-wave rectification, thresholding, and amplification. Rectification is performed by diodes CR113 through CR116, which are pre-biased by the fixed bias input from Write Control Module A2A13. Amplification of the rectified signal is performed by Q118. Transistor Q118 is normally biased at cutoff and is turned on by the rectified signal. Thresholding is accomplished by varying the emitter bias of Q118 with the threshold bias input selected on the Write Control Module. The level of threshold selected depends on whether the amplifier is in the read or write mode. The output of Q118 is buffered by Q123, which serves as the drive for the peak detector circuit consisting of Q131 and Q126. Transistor Q135, which is initially turned on, inverts and integrates the peak detector signal. Limiter inverter Q140 turns on when the positive-going input overcomes the emitter bias set up by VR141 and R142. This allows rejection of noise pulses whose width is less than 10 percent of the cell time. The low-going output of Q140 is inverted by Q148 and coupled to Read Buffer Module A2A12 (figure 6-16). Here, data is inverted by Q121 to trigger either the forward or reverse read deskew single-shot. The /CAPSTAN FOR-WARD command (from either the BITE Module A2A4 or the MTCU via Line Receiver Module A2A16) at the input of Read Buffer Module A2A12 determines which single-shot is selected. Potentiometer R237 is used to adjust forward skew delay and R238 adjusts the reverse skew delay. After deskewing, the READ DATA pulse is gated together with the DATA pulses from the remaining channels to generate the READ DATA ORED signal used by Write Control Module A2A13 to initiate the read control timing signals. Besides being ORed together, data is stored in a 9 bit storage register U212 and U1112. This storage register is unclamped when /READ RESET goes high. A second 9 bit storage register, U312 and U912, is unclamped by the high /READ ENABLE. Data is transferred from U212/U1112 to U312/U912 by the high READ BUFFER TRANSFER pulse. The nine /READ DATA signals are then transferred in parallel to the MTCU via the Line Driver Module A2A15.

SECTION V
MAINTENANCE

5-1. GENERAL.

5-2. This section contains the necessary instructions to maintain the Transport (Signal Data Recorder Reproducer RD-432/TYQ). Included in this section are checkout and adjustment procedures, fault isolation flow charts, and disassembly and removal procedures for the Transport and its components. The Transport schematic diagrams are contained in section VI and should be referred to when troubleshooting the Transport.

5-3. PREVENTIVE MAINTENANCE.

5-4. Preventive maintenance procedures pertaining to the Transport are provided in the workcards, T.O. 10M 1-7-9-6WC- 1.

5-5. CORRECTIVE MAINTENANCE.

5-6. The following paragraphs provide instructions for isolating and correcting malfunctions that occur in the Transport. Checkout procedures are provided to test the functioning of the Transport. These procedures use Built-In Test (BIT) and Fault Isolation Diagnostic (FID) test programs. Internal offline testing of the Transport can be accomplished with the use of the Built-In Test Equipment (BITE) Module A4. Table 5-1 lists the tools and test equipment required to perform the tests and adjustments described in this section. The items of test equipment listed are recommended and may be substituted with an equivalent item.

Table 5-1. Equipment Required, but not Supplied, for Maintenance

Name	Model or Part Number
Multimeter	Triplett, Model 630NS or equivalent
Oscilloscope	Tektronix, Model 465 or equivalent
Vacuum Gage (0-50 inches H20O)	Dwyer, Model 2050 or equivalent
Scratch Tape	3M777 tape (2,400 feet) or equivalent
Digital Voltmeter (0.1-percent accuracy)	Fluke, Model 8000A or equivalent
Master Alignment Tape	Miltope, Part No. 220-7071
File Protect Sensor Adjustment Gage	Miltope, Part No. 445306
Guide Roller Adjustment Fixture	Miltope, Part No. 461432
Card Extender	Miltope, Part No. 462846-1
Mini Test Clips (2)	Pomona, 3781-12-0 or equivalent

5-7. MAGNETIC TAPE UNIT (1,2) BIT. For a quick go/no-go test of the Transports, the following proce-dure is used to perform the Magnetic Tape Unit (1,2) BIT. This BIT can be performed only with the Transports installed in an operating shelter.

a. Ensure that the shelter Power Control Panel circuit breaker for the Transport (MAG TAPE) being tested is ON.

b. Turn the Transport POWER switch (10, figure 3-1) to ON.

c. Thread and load a scratch tape that has a write enable ring attached (refer to paragraphs 3-9 and 3-11).

d. Depress the REMOTE indicator on the Transport front panel (4, figure 3-1). The REMOTE indicator will light, placing the Transport in a remote status condition.

e. Press DISK LOAD pushbutton on the Computer.

f. When the DISK RECOVERY message appears on the QRU Video Indicator, press EXIT pushbutton on the QRU Keyboard.

g. Press STATUS pushbutton on the QRU Keyboard.

h. When BIT message appears on the QRU Video Indicator, select the number beside the MAGNETIC TAPE UNIT BIT for the Transport under test and enter this number on the QRU Keyboard.

i. Press XMIT Pushbutton on the QRU Keyboard.

j. Follow the instructions provided on the QRU Video Indicator.

k. If BIT failed, press RESPND on the QRU Keyboard to rerun the test.

l. If BIT fails again, press EXIT on the QRU Keyboard to exit the BIT test.

5-8. MAGNETIC TAPE TRANSPORT (MTT) FAULT ISOLATION DIAGNOSTIC (FID) TEST. The

MTT FID tests functions of the Transport. If an error is encountered during the test, an error message is \pardisplayed on the QRU Video Indicator indicating which Transport PCB and/or cable is defective. Complete instructions for performing the MTT FID are contained in the Test Procedures Manual T.O. 10MI-7-9-8-2.

5-9. CHECKOUT AND ADJUSTMENT PROCEDURES. The following paragraphs describe the checkout

and adjustment procedures that are normally required in routine maintenance or troubleshooting activities. If a fault, loss of adjustment, or failure is suspected to have occurred in the Transport, the problem can be located and corrected in either of two ways: (1) by following the pertinent fault isolation flow chart and performing the corrective action indicated on the chart, or (2) by proceeding directly to the paragraph dealing with the fault if the fault is well defined.

WARNING

Dangerous voltages, which could cause death or serious injury to personnel, exist within the Transport. Exercise extreme caution when working within or around those areas protected by covers and warning labels when Transport power is on.

5-10. Transport Service Access. Perform the following steps to gain access to a Transport for service without removal of the unit.

a. Set the MAG TAPE circuit breaker on the shelter Power Control Panel to OFF.

b. Loosen the seven captive screws on the Transport front panel.

c. Release the two front latching handles by pushing the safety latches at the top of each handle up until the red mark is visible. Press the PUSH buttons and rotate the handle latches to a horizontal position. This will extend the Transport approximately 1.5 inches out of the cabinet.

d. Grasping handles, slowly pull the unit all the way out (stepping aside to allow clearance for the unit) to the locked-open position. Spring latches will snap when the unit is locked open.

e. Release the two fasteners at the front of the access cover on the left side of the extended unit and swing the cover open.

f. After servicing is complete, close the access cover and latch both latches before pushing the unit back into the rack.

g. If the electrical connector at the rear of the Transport was disconnected, connect it and latch the cable retractor.

h. Release the slide latch on the bottom side (approximately 6 inches from the front of the slide) and carefully push the unit into the rack. Secure the unit in the cabinet by rotating the front handle latches until they lock. Press the safety latches (at top of each handle) until red mark is hidden. Tighten the seven captive screws on the front panel.

5-11. To gain access to the printed circuit boards and internal components of the Transport, remove the right side panel by loosening the quarter-turn fasteners that secure the panel to the frame and lift the panel off.

5-12. Voltage Measurements. Table 5-2 lists the dc voltages in the Transport, along with their respective tolerances and test points. To measure these voltages, set the front panel POWER circuit breaker to ON and connect the digital voltmeter between the specified test point for each voltage and circuit ground. A convenient test point for circuit ground is located on the power supply assembly just to the right of the capstan motor.

5-13. Photoelectric Sensor Checks. To determine if all photoelectric sensors in the Transport are functioning properly, proceed as follows:

a. Remove tape from Transport.
b. Set POWER circuit breaker to ON.
c. Open vacuum tank door.

Table 5-2. Transport DC Voltages

Voltage (See Note)	Tolerance	Test Point (Measure to Circuit Ground)
+5V Regulated	±0.25V	TP5 of Regulator Module A6
+ 12V Regulated	±0.6V	TP7 of Regulator Module A6
+30V Regulated	±1.5V	TP3 of Regulator Module A6
-12V Regulated	±0.6V	TPI of Regulator Module A6
+ 10V Unregulated	±1.5V	TP6 of Regulator Module A6
+ 18V Unregulated	±2.7V	TP8 of Regulator Module A6
+40V Unregulated	±6.0V	TP4 of Regulator Module A6
- 18V Unregulated	±2.7V	TP2 of Regulator Module A6
+30V Unregulated Relay Supply	±4.5V	Fuse F7 (cap)
+38V Unregulated Capstan Supply	±5.7V	TP3 of Capstan Drive Module A5
-38V Unregulated Capstan Supply	±5.7V	TP6 of Capstan Drive Module A5

NOTE: The +5V, + 12V, and -12V regulated supplies are adjustable. Refer to paragraph 5-18 for adjustment procedure.

d. Using a multimeter or oscilloscope (2V/CM vertical sensitivity and lMS/CM free-running horizontal sweep), monitor the test point listed in table 5-3 for each sensor while performing the steps of the procedure column. Verify that the indication specified in the normal indication column is obtained for each step. If a normal indication is not obtained, perform the procedure(s) given in the last column to correct the malfunction.

5-14. Adjustment of Tape Cross Lower Sensor. To adjust the Tape Cross Lower Sensor, proceed as follows:

a. Thread tape onto machine reel and pull tape tight in threading path (see figure 3-4, detail B).
b. Set POWER circuit breaker to ON.
c. Monitor TP2 of Load/Rewind Module A7 with multimeter or oscilloscope (2V/CM vertical sensitivity and 1.OMS/CM free-running horizontal sweep).
d. With opaque card covering sensor, TP2 shall be +4.0 Vdc minimum. If voltage is not as specified, replace A7 or photocell (refer to paragraph 5-65).
e. Remove opaque card and verify voltage does not drop below +3.0 Vdc. If voltage drops below +3.0 Vdc, loosen screw securing sensor lens block (34, figure 1-2) and rotate block until voltage at TP2 is +3.0 Vdc minimum.

f. With tape removed, TP2 shall be +0.3 Vdc maximum. If voltage is not as specified, loosen holddown screws for both the sensor lens block and lamp lens block (34 and 31, figure 1-2) and rotate both blocks simultaneously to obtain a null (minimum voltage) at TP2. If TP2 is still greater than +3.0 Vdc, replace photocell (refer to paragraph 5-65).

g. Repeat steps a., e., and f., above, until TP2 is +3.0 Vdc minimum with tight tape and +0.3 Vdc maximum with tape removed.

5-15. Adjustment of Machine Reel Low Tape Sensor. To adjust the Machine Reel Low Tape Sensor, proceed as follows:

a. Remove tape from Transport.
b. Set POWER circuit breaker to ON.
c. Observe LTM indicator on Sensor Module AS.
d. With opaque card covering sensor, LTM indicator shall be out. If indicator is lighted, replace Load/ Rewind Module A7, Sensor Module A8, or sensor photocell (refer to paragraph 5-66).

e. With nothing covering sensor, LTM indicator shall be lighted. If indicator is out, loosen holddown screws for both the sensor lens block and lamp lens block (32 and 35, figure 1-2) and rotate both blocks simultaneously until LTM indicator lights. If indicator remains out, replace sensor photocell (refer to paragraph 5-66), Load/Rewind Module, or Sensor Module.
f. Thread a reel of tape onto Transport and run tape forward (using BITE, refer to paragraph 5-25) until 50 feet of tape is on machine reel (about 5 seconds running time). LTM indicator shall be out. If indicator is lighted, run forward for I second longer. If indicator remains lighted, adjust sensor lens block and lamp lens block until LTM indicator goes out.

g. Run tape reverse until LTM indicator lights again. If indicator remains out or it is necessary to run reverse for more than 1 second to make indicator light, run tape forward and reverse, and adjust sensor and lamp lens blocks as required until the conditions specified in steps (1) and (2), below, are achieved.

(1) LTM indicator is lighted for first 5 seconds of forward tape motion from BOT and out for all forward tape motion thereafter.
(2) LTM indicator is out for all reverse tape motion prior to last 5 seconds before BOT and lighted for last 5 seconds of reverse tape motion.

Table 5-3. Photoelectric Sensor Checks

Sensor	Figure 1-2 Index No. Test Point	Procedure	Normal Indication	Procedure for Abnormal Indication
Tape Cross Upper Sensor (Lamp)	8 TP3 of Load/ Rewind Module 5 A7	a. Cover sensor with opaque card b. Uncover sensor	a. +4 Vdc min b. +0.3 Vdc max	Check lamp, photocell, Load/ Rewind Module. Replace defective component.
Tape Cross Lower Sensor (Lamp)	34 TP2 of Load/ Rewind Module 31 A7	a. Cover sensor with opaque card b. Uncover sensor	a. +4 Vdc min b. +0.3 Vdc max	(1) Adjust Tape Cross Lower Sensor (refer to paragraph 5-10). (2) Check lamp, photocell, Load/Rewind Module. Replace defective component
Tape in File Tank Sensor (Lamp)	42 TP1 of Load/ Rewind Module 43 A7	a. Cover sensor with opaque card b. Uncover sensor	a. +4 Vdc min b. +0.3 Vdc max	Check lamp, photocell, Load/ Rewind Module. Replace defective component.
Tape in Machine Tank Sensor (Lamp)	22 TP5 of Load/ Rewind Module A7 23	a. Cover sensor with opaque card b. Uncover sensor	a. +4 Vdc min b. +0.3 Vdc max	Check lamp, photocell, Load/ Rewind Module. Replace defective component.
Machine Reel Low Tape Sensor (Lamp)	32 TP6 of Load/ Rewind Module A7 35	a. Cover sensor with opaque card b. Uncover sensor	a. +4 Vdc min b. +0.3 Vdc max	(1) Adjust Machine Reel Low Tape Sensor (refer to para-graph 5-11). (2) Check lamp, photocell, Load/Rewind Module. Replace defective component.
BOT Sensor	13 TPI of Sensor Module A8	a. None b. Place length of tape with BOT marker through guide/head area and position BOT marker directly over and facing BOT sensor.	a. +4.5 Vdc min b. +0.5 Vdc max	a. Check BOT Sensor, Sensor Module. Replace defective component. b. (1) Move tape back and forth through guide area. If TPI switches between +0.5 Vdc and +4.5 Vdc, test is valid. (2) Check BOT Sensor, Sensor Module. Replace defective component.
EOT Sensor	13 TP2 of Sensor Module A8	a. None	a. +4.5 Vdc min b. Place length of tape with EOT marker through guide/head area and position EOT marker directly over and opposite EOT sensor.	a. Check EOT Sensor, Sensor Module. Replace defective component. b. (1) Move tape back and forth through guide area. If TP2 switches between +0.5 Vdc and +4.5 Vdc, test is valid. (2) Check EOT Sensor, Sensor Module. Replace defective component.

Table 5-3. Photoelectric Sensor Checks (Cont)

Sensor	Figure 1-2 Index No.	Test Point	Procedure	Normal Indication	Procedure for Abnormal Indication
File Reel Tach	38, 39	TP4 of Servo Control Module A3	Spin Tach roller	Voltage shall switch between +0.3 Vdc max and +4.5 Vdc min as Tach roller turns.	(1) Remove screw securing tach cover to casting, remove cover, and reinstall screw in casting. Loosen screw securing Tach assembly to casting and adjust assembly to obtain normal indication. Tighten Tach assembly mounting screw, remove cover mounting screw, then install
Machine Reel Tach	30, 29	TP5 of Servo Control Module A3	Spin Tach roller	Voltage shall switch between +0.3 Vdc max and +4.5 Vdc min as Tach roller turns.	and secure cover with screw.
					(2) -Check Tach assembly LED, Tach assembly sensor, Servo Control Module. Replace defective component.

5-16. Pneumatic Sensor Checks. To determine if all pneumatic sensors in the Transport are functioning properly, proceed as follows:

a. Thread tape as shown in figure 3-4, detail B. This may be accomplished manually or in auto thread by pressing RESET pushbutton before auto load starts.

b. Set POWER circuit breaker to ON.

NOTE

In steps c. through f., below, check the threaded sensor [59, figure 1-2 (top switch)].

c. Using test clip, ground TP3 of Auto Thread Module A9 (this will cause the solenoid valve to operate).

d. Using test clip, ground TP5 of Sensor Module A8 (this will cause the vacuum motor to turn on).

e. Observe THS indicator on A9. With tape hanging slack between reels, THS indicator shall be out. If indicator is lighted, clean sensor port (28, figure 1-2). If this does not correct condition, replace Auto Thread Module A9 or threaded sensor.

f. Turn reels in opposite direction to pull tape taut; THS indicator shall light. If indicator remains out, replace Auto Thread Module A9 or threaded sensor.

g. Remove test clips from A8TP5 and A9TP3.

h. Thread tape between reels as shown in figure 3-4, detail B.

NOTE

In steps i. through 1., below, check the main vacuum sensor [59, figure 1-2 (next to top switch)].

i. Open vacuum tank door wide.

j. Observe that VAS indicator on Load/Rewind Module A7 is out. If indicator is lighted, replace Load/ Rewind Module A7 or main vacuum sensor.

k. Press LOAD/REWIND/UNLOAD pushbutton; main vacuum supply shall come on. Observe that VAS indicator remains out. If indicator lights, clean main vacuum sensor bypass port (20, figure 1-2).

l. Close vacuum tank door and observe that VAS indicator lights and that a normal load takes place. If indicator remains out, check main vacuum supply for adequate vacuum. If vacuum is good, replace Load/Rewind Module A7 or main vacuum sensor.

NOTE

In steps m. through t., below, check the servo sensors [61, figure 1-2 (all switches) and 67, figure 1-2 (top switch and next to bottom switch)].

m. Check that tape is still loaded in the vacuum tanks.

n. Set POWER circuit breaker to OFF (down) position and remove Servo Drive Modules A1 and A2 from card cage.

o. Set POWER circuit breaker to ON. Using test clip, ground TP5 of Sensor Module A8 (this will cause the vacuum motor to turn on). Hold reels so that tape is not drawn to bottom of vacuum tanks.

p. Monitor the group of indicators located near the back edge of Servo Control Module A3 (figure 5-1). Each indicator corresponds to one of the six sensing ports near the center of the vacuum tanks and will light when the tape crosses the corresponding sensing port in the direction that will cause reel servo action.

NOTE

If an indicator fails to respond as specified in steps q. through t., below, clean the associated sensor port. If this does not correct condition, replace Servo Control Module A3 or the sensor associated with the indicator.

q. Turn file reel so that file reel loop moves above file reel upper servo sensor port and observe that FSU indicator lights.

r. Move loop down and observe that FSU indicator goes out as loop passes file reel upper servo sensor port and that FSL and FR indicators light as loop passes the next two sensor ports, respectively.

s. Turn machine reel so that machine reel loop moves above machine reel lower servo sensor port and observe that MSL indicator lights.

t. Move loop down and observe that MSL indicator goes out as loop passes machine reel lower servo sensor port and that MSU and MR indicators light as loop passes the next two sensor ports, respectively.

NOTE

In steps u. through x., below, check the safety sensors [59 and 67, figure 2-1 (next to top switch and bottom switch)].

u. Monitor LSV and USV indicators of Sensor Module A8.

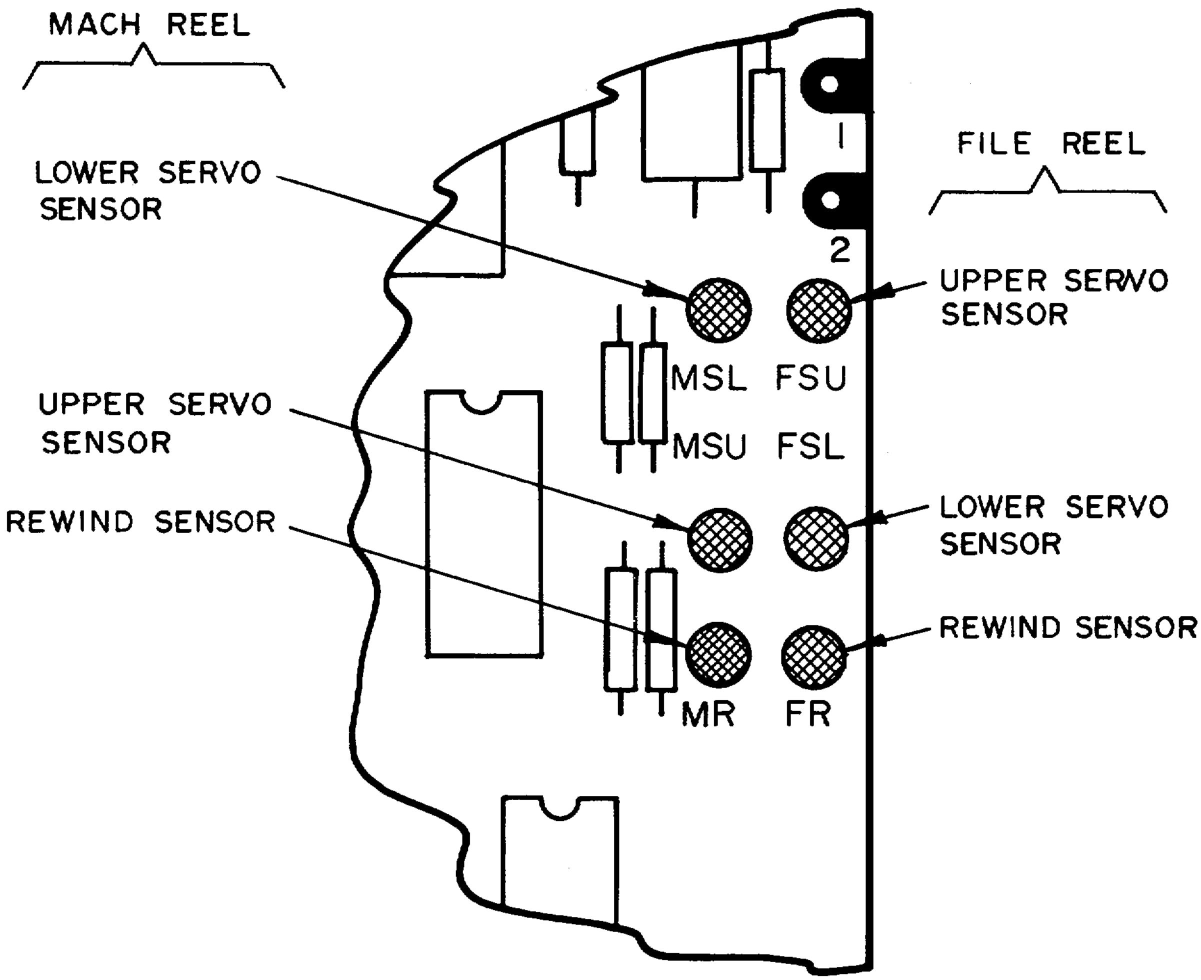


Figure 5-1. Servo Control Module A3, Location of Servo Sensor Indicators

NOTE

If LSV or USV indicator does not respond as specified in steps v. and x., below, clean the associated sensor port. If this does not correct condition, replace Sensor Module A8 or sensor associated with malfunctioning sensor port.

v. Move file reel tape loop beyond lower safety sensor port and observe that LSV indicator lights. Move tape loop beyond upper safety port and observe that USV indicator lights.

w. Move file reel tape loop between upper and lower safety sensor ports. LSV and USV indicator shall be out.

x. Move machine reel tape loop beyond lower safety sensor port and observe that LSV indicator lights. Move tape loop beyond upper safety sensor port and observe that USV indicator lights.

y. Set POWER circuit breaker to OFF (down) position, remove test clip from A8TP5, and install Servo Drive Modules A1 and A2.

5-17. Vacuum Supply Measurement. To measure the vacuum supply, proceed as follows:

a. Set POWER circuit breaker to ON.

b. Thread and load reel of tape on Transport.

c. Remove cap from vacuum measurement fitting (60, figure 1-2) and connect input hose of vacuum gage to fitting. Vacuum shall be 23 -3 inches H20 and is not adjustable. Remove vacuum gage and replace cap on vacuum measurement fitting.

5-18. File Protect Sensor Assembly, Check and Adjustment. The file protect sensor adjustment gage listed in table 5-1 is used to check the operation of the Transport file protect sensor. The positions on the gage provide a margin of clearance for the extreme positions of the file protect ring and the groove in the tape reel. Allowance is made for the eccentricity of the hub and reel. To use the gage, proceed as follows:

a. Place adjustment gage firmly and squarely against file reel hub flange and lock in place.

b. Rotate hub and gage until pin on file protect switch drops into slot marked “Radial Clearance”. If pin does not drop in freely, reposition file protect switch assembly by loosening housing screws. Retighten housing screws. This check should be performed at four positions, 90 degrees apart.

c. Set POWER circuit breaker to ON.

d. Using test clip, ground TP4 on Sensor Module A8 (this will cause the solenoid to energize when the pin is pushed in far enough to activate a switch inside the solenoid assembly).

e. Turn hub and gage in clockwise direction and check the following:

(1) Solenoid operates on or before level marked “Actuate”.

(2) Solenoid plunger is drawn in so pin clears raised surface marked “Energized Clearance”.

f. If correct condition is not obtained in step b. or e., above, rotate gage to level marked “Setup 1”. Adjust height of actuating pin in solenoid so that it just touches surface of gate (adjust pin by inserting punch or stiff wire in hole in pin and turn pin with solenoid actuated). Repeat steps b. through e., above.

g. The level “Setup 2” is to be used only if the solenoid cannot be made to operate at the “Setup 1” position.

h. If the solenoid cannot be made to work properly at either level, replace the entire sensor assembly.

i. Remove test clip from A8TP4.

5-19. Tach Roller Adjustment. To adjust the file or machine reel tach roller (5 or 6, figure 5-2), proceed as follows:

a. Remove all tape from Transport.

b. To gain access to file reel tach roller locking screw (4), proceed as follows:

(1) Remove cap (1) from Transport enclosure.

(2) Pass 5/32 -inch Allen-head wrench through opening in Transport enclosure and insert into Allen-head setscrew (2). Do not remove setscrew at this time.

(3) Pass long-nosed pliers through right side of Transport to capture setscrew; then, while carefully removing setscrew from access hole (3), grasp setscrew with long-nosed pliers and withdraw setscrew from Transport.

NOTE

The tach roller locking screws (4 and 6) require the same size Allen-head wrench as the rail mounting screw (11). Use this screw to determine the proper wrench size.

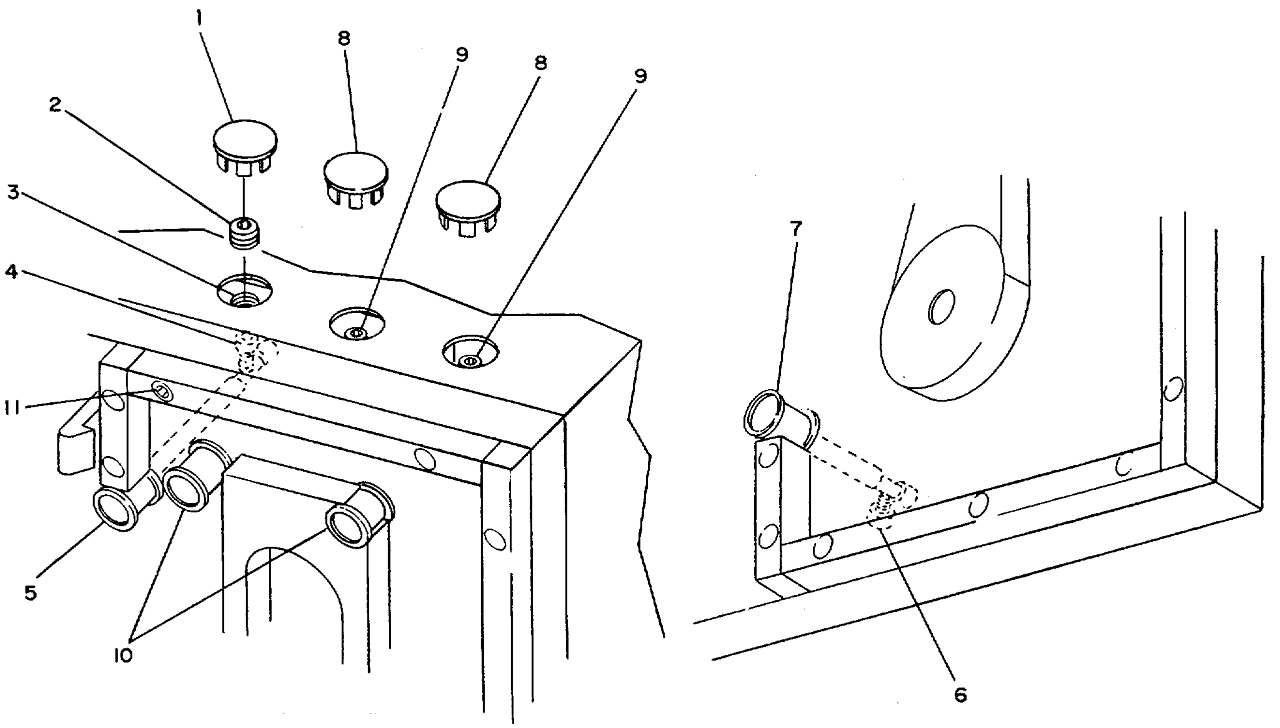


Figure 5-2. Tach and Tach Rollers, Locking Screw Locations

c. Loosen tach roller locking screw (4 or 6).

d. Attach guide roller adjustment fixture to casting next to roller to be adjusted (figure 5-3). Do not tighten fixture holddown bolt at this time.

e. Pivot fixture gently against body of roller and slide roller in or out until fixture fits in between roller flanges.

f. Tighten flanges holddown bolt.

g. Tighten tach roller locking screw (4 or 6, figure 5-2).

h. Remove guide roller adjustment fixture. Roller is adjusted correctly if tape passing around roller touches stainless steel base of vacuum tank or surface of vacuum tank door near roller.

i. If file reel tach roller was adjusted, install setscrew (2) and cap (1) by reversing procedure described in step b., above.

5-20. Tank Roller Adjustment. To adjust a tank roller (10, figure 5-2), proceed as follows:

a. Remove all tape from Transport.

b. Remove cap screw (8) from Transport enclosure.

NOTE

The tank roller locking screw (9) requires the same size Allen-head wrench as the rail mounting screw (11). Use this screw to determine the proper wrench size.

c. Pass Allen-head wrench through opening in Transport enclosure and loosen tank roller locking screw (9).

d. Hold guide roller adjustment fixture against casting with undercut side facing casting (figure 5-3). Slide fixture gently against body of roller and slide roller in or out until fixture fits in between roller flanges.

e. While holding fixture firmly against casting and roller body, tighten tank roller locking screw (9, figure 5-2). Remove guide roller adjustment fixture.

f. Roller is adjusted correctly if tape passing around roller does not touch stainless steel base of vacuum tank or surface of vacuum door near roller.

g. Install cap (8).

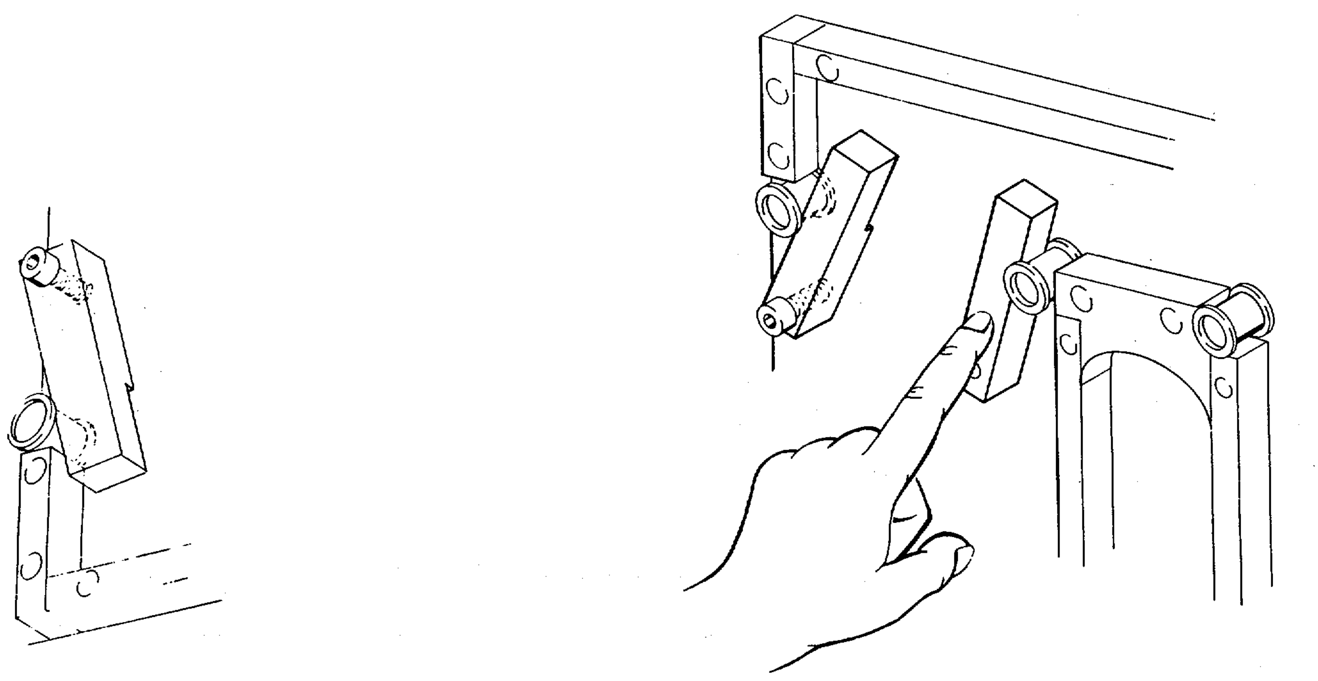


Figure 5-3. Guide Roller Adjustment Fixture Placement

5-21. File Reel Hub and Machine Reel Adjustment and Removal. To adjust or remove the file reel hub or machine reel, proceed as follows:

a. Set POWER circuit breaker to ON.

b. Place full reel of tape squarely and firmly on file reel hub, lock hub, and load tape normally.

c. Turn POWER circuit breaker off, remove Servoamplifier Modules A1 and A2; then set POWER circuit breaker to ON.

d. Using test clip, ground TP5 on Sensor Module A8; the main air supply will come on. Hold or tape reels so that loops are not drawn to bottom of tanks.

e. To adjust or remove file reel hub, pull out hub handle and loosen Allen-head locking screw (1, figure 5-4). This screw will break loose twice as it is turned ccw. The first time it breaks loose, the screw loosens from its tapped hole; the second time, it frees a locking wedge inside the hub.

f. An adjusting screw (3, figure 5-4) prevents the hub from moving in toward the reel motor. Back up this screw before adjusting hub. Do not touch this screw if only removing and replacing the same hub.

g. Slide hub axially on shaft until tape is centered between reel flanges where it leaves reel and enters vacuum tanks. Make sure reel is seated properly on hub. Turn locking cap screw (1) cw until it is firmly locked. Make sure this screw is tight; otherwise, hub may move when Transport is operated.

h. Turn adjusting screw (3) cw until it meets resistance; then stop.

i. To adjust machine reel, first unscrew decorative circular disk (4, figure 5-4). (Disk may be removed by pressing thumb against disk and rotating disk ccw or by using a pair of needle-nose pliers to grip the two small holes in disk and turning ccw.)

j. Unlock and adjust machine reel as described in steps e. through h., above, with the exception that the machine reel has fixed flanges and no handle.

k. Turn POWER circuit breaker off, remove test clip from A8TP5, and install Servoamplifier Modules A1 and A2. Replace decorative disk in machine reel.

5-22. Regulated Power Supply Voltage Adjustments. To adjust the +5V, + 12V, and -12V regulated dc voltages, proceed as follows:

a. Turn POWER circuit breaker off.

b. Remove Power Supply Regulators Module A6, insert card extender in slot A6, and install module A6 on card extender.

c. Set POWER circuit breaker to ON.

d. Monitor A6TP5 and adjust +5V Trim potentiometer on module A6 for +5.0 +0.25 Vdc.

e. Monitor A6TP7 and adjust + 12V Trim potentiometer on module A6 for + 12.0 +0.6 Vdc.

f. Monitor A6TPI and adjust -12V Trim potentiometer on module A6 for -12.0 +0.6 Vdc. g. Turn POWER circuit breaker off, remove module and card extender, and install module back in slot A6.

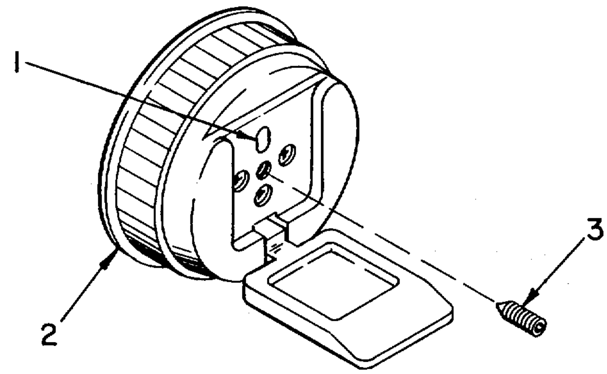
5-23. Low-Speed Check and Adjustment. To check the auto thread, auto load and unload reel speeds (low speeds), proceed as follows:

a. Remove all tape from Transport.

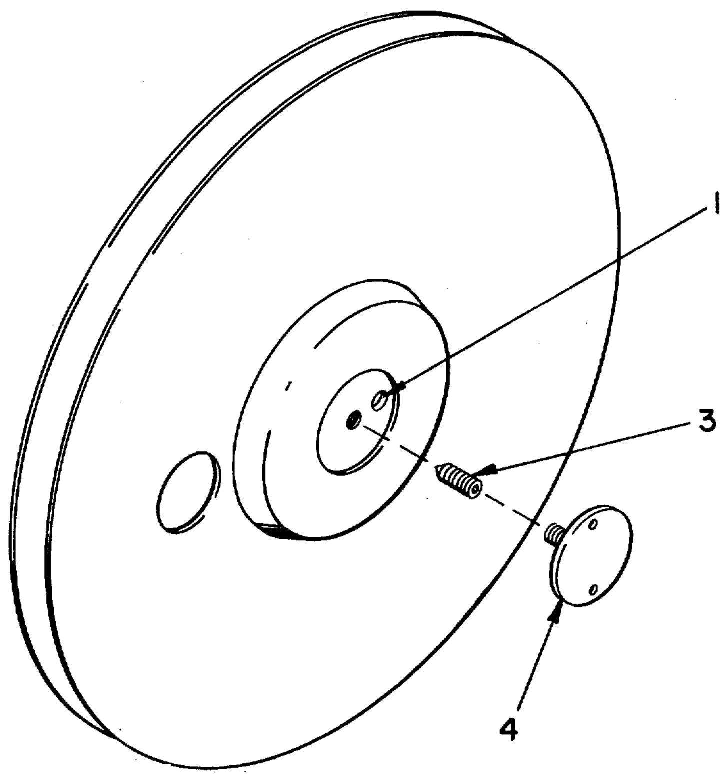
b. Set POWER circuit breaker to ON.

c. Using test clip, ground TP4 of Auto Thread Module A9; reel hubs will turn alternately cw and ccw for 4 seconds in each direction at low speed.

d. Measure and adjust speeds in accordance with table 5-4.



FILE REEL HUB



MACHINE REEL

Figure 5-4. File Reel Hub and Machine Reel

Table 5-4. Low-Speed Tests and Adjustments

Reel (Direction)	Revolutions in 4 Seconds	Adjustment
File (cw)	3½ ± ¼	A2, second potentiometer down
File (ccw)*	6½ ± ½	A2, bottom potentiometer
Machine (cw)	14 ± 1	A1, bottom potentiometer
Machine (ccw)	6¼ ± ½	A1, second potentiometer down

*Cover Tape Cross Lower Sensor when adjusting file reel ccw speed.

e. Remove test clip from A9TP4.

5-24. Tape Loading Speed Adjustment. There are two tape loading adjustments; A1R537 and A2R537. These potentiometers are adjusted so that the tape is positioned properly in the machine and file reel tanks during tape loading. Refer to the Stop diagram in figure 4-2 for proper tape position. The potentiometers control the force at which the reels release tape to the machine and file vacuum tanks. To perform the tape loading speed adjustment, proceed as follows:

a. Set the POWER circuit breaker to ON (10, figure 3-1).

NOTE

While loading tape into the machine and file tanks, observe the speed at which the reel motors feed tape after vacuum has been applied to the vacuum tanks. Improper speed of the reel motors may be the result of improper adjustment of R537 on modules Al or A2.

b. Load a full reel of tape on the Transport (refer to paragraph 3-12).

c. Indications of improper adjustment of R537 are:

(1) Tape does not load into vacuum tanks during the 2.4-second loading period. This is an indication that R537 is adjusted too low.

(2) Tape bunches at entry to vacuum tank, indicating that R537 is adjusted too high.

d. If the tape is not positioned properly in the vacuum tanks, unload tape and adjust R537 on the failing machine (A1) or file (A2) reel module (refer to figure 1-3 for location of R537). Potentiometer is adjusted in one-half turn increments.

e. Continue to monitor the tape loading sequence after each adjustment.

f. If improper loading of a vacuum tank continues, consult figure 5-13, Auto Load Fault Isolation Flow Chart.

g. When proper tape loading has been accomplished, unload the tape and turn POWER circuit breaker off.

5-25. BITE Operation. Table 5-4 lists the modes of operation for BITE Module A4 and describes tape motion for each mode. The BITE Module controls and test points are shown in figure 5-5. (The BITE Module may be removed from the Transport when not in use.)

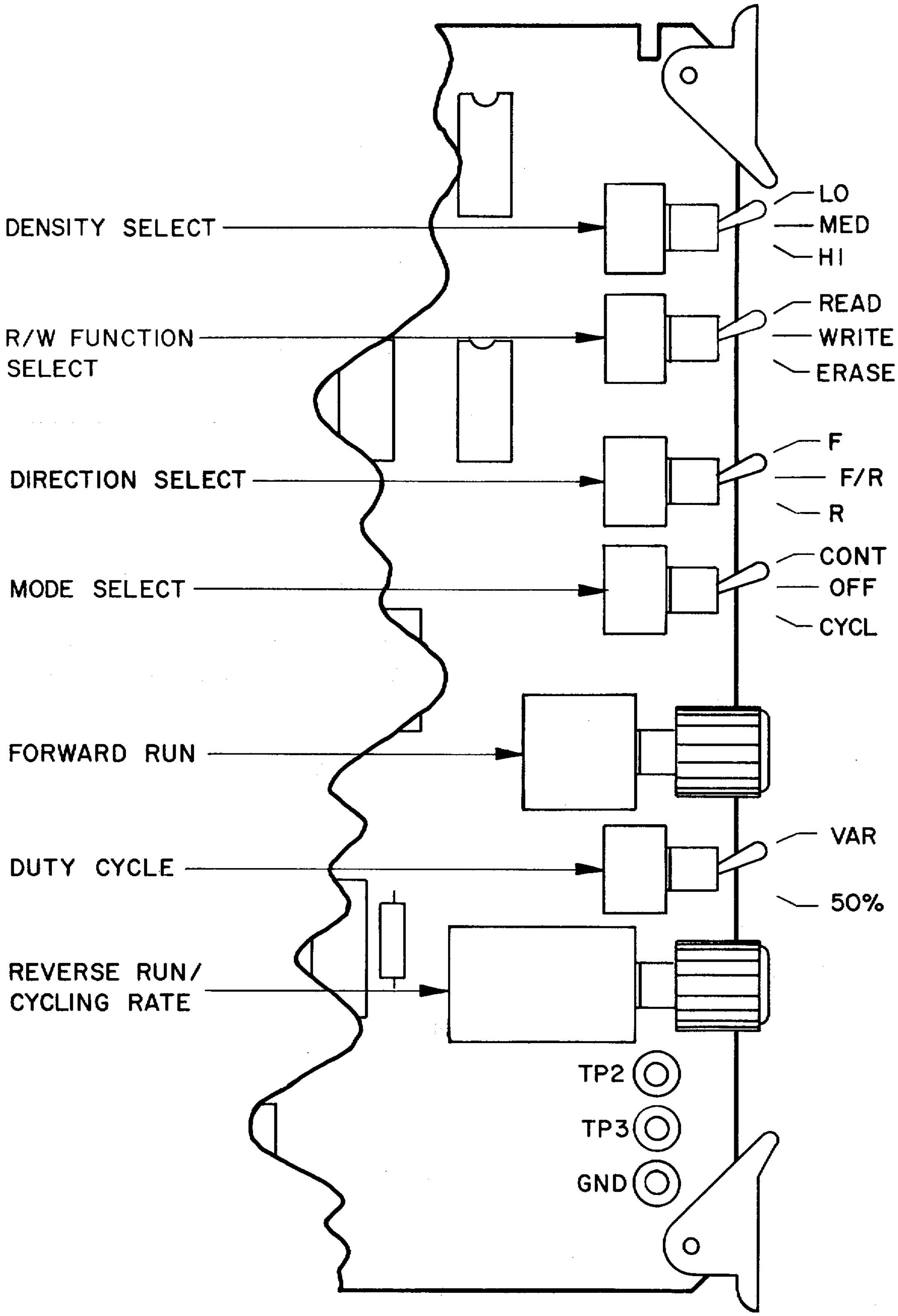


Figure 5-5. BITE Module, Controls and Test Points

5-26. Special Test Modes. There are two special test modes available in the BITE Module: TEST MODE A and TEST MODE B. These test modes may be used as required to automatically exercise the various operating modes of the Transport. A description of each test mode follows:

a. Test Mode A. When selected, causes the Transport to move tape under control of the BITE Module capstan command circuits until an EOT marker is detected. Upon detection of an EOT marker, the Transport will automatically rewind to BOT and again move tape under BITE control. This sequence will repeat until the test mode is halted.

b. Test Mode B. When selected, causes the Transport to move tape under control of the BITE Module capstan command circuits until an EOT marker is detected. Upon detection of an EOT marker, the Transport will automatically rewind and unload the tape until the tape uncovers the tape cross upper sensor, at which time the Transport will automatically execute an auto thread operation. Upon detection of BOT after auto load, the tape will again move under BITE control. This sequence will repeat until the test mode is halted.

5-27. Selecting Special Test Modes. To select a special test mode, proceed as follows:

a. Set POWER circuit breaker to ON and load a reel of tape.

b. Set BITE controls (refer to table 5-5) for any combination of capstan commands and duty cycles that result in a net forward tape movement.

Table 5-5. BITE Operation

	Control Settings			Potentiometers	
Mode	**Mode Select Switch**	**Direction Select Switch**	**Duty Cycle Switch**	**Forward Run**	**Reverse Run/ Cycling Rate**
Off	OFF	-	-	-	-
Continuous Forward	CONT	F	-	-	-
Continuous Reverse	CONT	R	-	-	-
Stop	CONT	F/R -	-	-	-
Start/Stop Forward	CYCL	F	50 percent	-	Varies cycling rate from 1 cycle/ second to 35 cycles/second at a fixed duty cycle of 50 percent.
Start/Stop Reverse		R	50 percent	-	-
Forward/ Reverse		F/R	50 percent	-	-
Start/Stop Forward		F	*VAR	Varies forward run period	Varies stop period
Start/Stop Reverse			*VAR	Varies stop period	Varies reverse run period
Forward/ Reverse			*VAR	Varies forward run period	Varies reverse run period

*In VAR DUTY CYCLE modes, the FWD RUN and REV RUN/CYCLING RATE potentiometers vary their respective run or stop periods from 15 milliseconds to 0.5 second. Thus, any duty cycle from 3 to 97 percent may be obtained.

c. Stop tape motion and place reflective marker on tape in EOT location (figure 3-2) at a point down tape where it is desired to have rewind take place.

d. Using test clip, connect TP2 (for Test Mode A) or TP3 (for Test Mode B) of BITE Module to circuit ground (bottom test point).

e. Start tape motion.

5-28. Writing or Erasing Tape With BITE. The BITE Module may be used to write all “ones” on tape or to erase a previously written tape.

a. To write all “ones”, proceed as follows:

(1) Load reel of scratch tape with write enable ring on Transport.

(2) Set R/W FUNCTION SELECT switch on BITE to WRITE.

(3) Set DENSITY SELECT switch on BITE to LO (200 BPI), MED (400 BPI), or HI (800 BPI) as desired.

(4) Select F, CONT on BITE to move tape forward. The tape will be written all “ones” on all tracks at the density selected.

(5) The density may be varied by changing the setting of the DENSITY SELECT switch.

(6) To stop writing, set R/W FUNCTION SELECT switch on BITE to READ.

(7) Writing will automatically stop during any reverse operation including rewind.

b. To erase a previously written tape, proceed as follows:

(1) Set R/W FUNCTION SELECT switch on BITE to ERASE.

(2) Select F, CONT on BITE to move tape forward. The tape will be erased on all tracks.

(3) To stop erasing, set READ/WRITE FUNCTION SELECT switch on BITE to READ.

5-29. Capstan Drive System Test Procedure and Adjustments. A test of the capstan drive system consists of using the BITE Module to command continuous or start/stop tape motion for the purpose of checking tape speed and start/stop characters. To perform a full test of the capstan drive system, proceed as follows:

a. Set POWER circuit breaker to ON and load a reel of tape having all “ones” written on all tracks.

NOTE

An all “ones” tape may be written using BITE (refer to paragraph 5-28).

b. Connect one channel of oscilloscope preamplifier to TP4 of Read Preamplifier Module A10. Set oscilloscope vertical sensitivity to IV/CM and horizontal sweeptime to IMSEC/CM. Set oscilloscope for EXT NEG sync and connect trigger input to TP9 of Capstan Drive Module A5.

c. Select CYCLE, FORWARD, 50 percent on BITE and observe an all “ones” pattern on the oscilloscope for each forward command issued by BITE. Verify that the start profile, as displayed on oscilloscope, is as shown in figure 5-6.

NOTE

Perform steps d. through h., below, to check and adjust capstan speed.

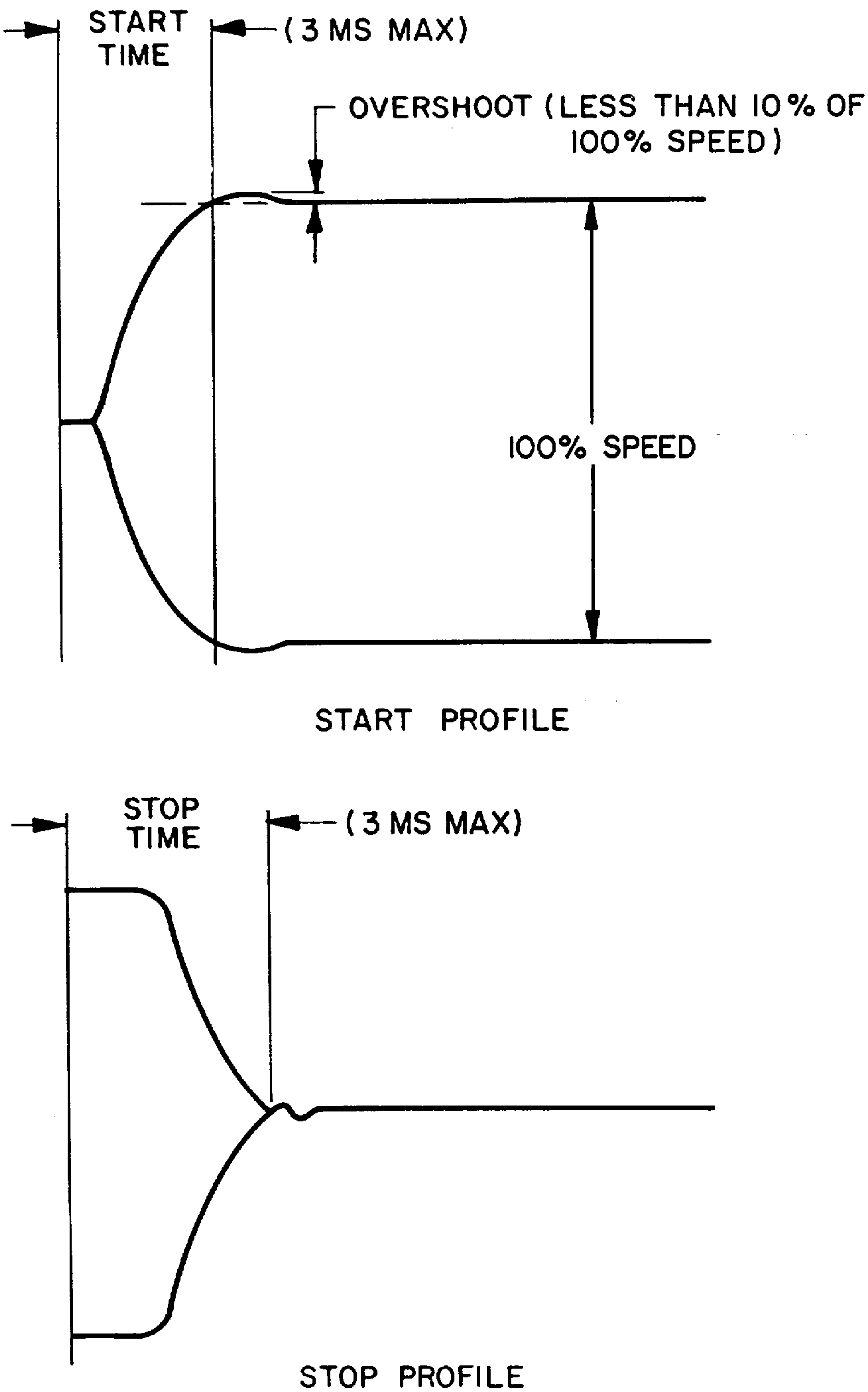


Figure 5-6. Start and Stop Profiles

d. Select FORWARD, CONT on BITE module.

e. Connect digital voltmeter between TPI (+) of Capstan Drive Module A5 and circuit ground (-). Forward capstan speed is correct if tachometer output level at ASTP1 is -0.72 -0.014 Vdc as indicated on digital volt-meter. If tachometer output is not as specified, adjust FWD (second from bottom) potentiometer on module A5.

f. Select REVERSE, CONT on BITE module.

g. Reverse capstan speed is correct if tachometer output level at A5TPI is +0.72 -0.014 Vdc as indicated on digital voltmeter. If tachometer output is not as specified, adjust REV (bottom) potentiometer on module A5.

h. Set MODE SELECT on BITE module to OFF and jumper A5TP8 to GND. Connect digital voltmeter between TP2 (+) of A5 and circuit ground (-). Verify that digital voltmeter indicates 0.0 -0.5 Vdc. If voltage is not as specified, adjust ZERO (top) potentiometer on module A5.

NOTE

Perform steps i. and j., below, to check and adjust tape start time.

i. Select CYCLE, FORWARD and 50 percent on the BITE and observe forward profile on oscilloscope. Verify that start profile is as shown in figure 5-6 over full range of BITE module CYCLING RATE potentiometer.

(1) If profile has substantially longer start time than specified in figure 5-6, remove tape and clean capstan.

(2) If profile breaks up, rings, or has a distinct hole at some cycling rates, adjust tape buffer by removing plug from hole in vacuum tank door over buffer valve (10, figure 1-2) and adjust valve with screwdriver.

(3) If profile has an overshoot exceeding 10 percent of normal speed, adjust COMP (second from top) potentiometer on Capstan Drive Module A5 until profile is correct.

j. Select CYCLE, REVERSE, 50 percent on BITE and connect oscilloscope trigger input to TP7 of Capstan Drive Module. Observe reverse start profile on scope. Verify that start profile is as shown in figure 5-6 over full range of CYCLING RATE potentiometer. If profile is not as specified, refer to steps i.(l) through i.(3), above.

k. If buffer valve was adjusted in step i.(2), above, replace plug in hole of vacuum tank door.

NOTE

Perform steps l. and m., below, to check tape stop time.

l. Set oscilloscope for EXT POS sync and observe reverse stop profile. Verify that stop profile is as shown in figure 5-6 over full range of CYCLING RATE potentiometer. Stop time is not adjustable.

m. Select CYCLE, FORWARD, 50 percent on BITE module, connect oscilloscope vertical input to TP9 of Capstan Drive Module, and observe forward stop profile. Verify that stop profile is as shown in figure 5-6 over full range of CYCLING RATE potentiometer.

5-30. Capstan Clock Check and Adjustment. To check and adjust the capstan clock, proceed as follows:

a. Set POWER circuit breaker to ON and load a full reel of tape on Transport.

b. Connect oscilloscope vertical input to TP2 of Servo Control Module A3. Set oscilloscope for INT POS sync, 50SEC/CM horizontal sweep time, and 2V/CM vertical gain.

c. Oscilloscope shall display a string of positive capstan clock pulses with a pulse-to-pulse period of 260 +410 microseconds. If pulse period if out of tolerance, adjust the potentiometer on Servo Control Module A3 until it is correct.

NOTE

"Hover" is defined as average loop travel of approximately % inch about a sensor port during continuous forward or reverse tape motion.

d. Select CONT, FORWARD on BITE Module and observe action of tank loops. Loops should rise above two upper servo sensor ports, slowly drift back down and hover about the sensor ports for each FORWARD command. If loops continue to drift upward and cause loop faults, adjust Capstan Clock potentiometer on A3 cw until loops behave properly. If loops bounce substantially above the sensor port rather than hover, adjust potentiometer ccw until they behave correctly. Repeat for CONT, REVERSE; loops will hover about lower servo sensor ports.

5-31. Reel Servosystem Check. The reel servosystem may be tested as follows:

a. Perform low-speed check and adjustment as specified in paragraph 5-23 if indicated by poor auto thread or auto load performance.

b. Set POWER circuit breaker to ON and load a full 2,400-foot reel of tape on Transport.

c. Select CONT, FORWARD on BITE and move tape down from BOT for about 5 seconds and stop.

d. Select CYC, F/R, 50 percent on BITE and sweep CYCLING RATE potentiometer on BITE slowly over its full range and back again.

e. Repeat this sweep several times while observing travel of tape loops in vacuum tanks. Find cycling rate (or range of rates) that produces greatest loop travel.

f. The reel servosystem is operating correctly if loops come no closer than 1 inch to the safety sensors in each tank.

g. Repeat steps d., e., and f., above, with full machine reel.

5-32. If the reel servosystem fails during this test (a loop fault occurs), proceed to point "C" of the Reel Servo-system fault isolation flow chart.

5-33. Anti-Bounce Adjustment. The reel servosystem is provided with a circuit that offsets the pull of the vacuum on the loops in the vacuum tanks. This prevents the loops from continually bouncing when there is no tape motion. To adjust the anti-bounce circuit, proceed as follows:

a. Set POWER circuit breaker to ON and load a full reel of tape in Transport.

b. With tape at BOT, turn top (anti-bounce) potentiometer on File Reel Servo Amplifier Module A2 ccw until file reel loop drops to lower servo sensor port and bounces at that port.

c. Turn same potentiometer cw until loop moves to upper sensor port, bounces once off that port and stops.

d. Force loop back to lower port again by turning file reel cw. Loop should climb back up to upper port again and stop. Adjust potentiometer as necessary to achieve this condition.

NOTE

The upper servo sensor port in the machine tank is the lower of the two center ports.

e. Turn top potentiometer on Machine Reel Servoamplifier Module A1 cw until machine reel loop is pulled down to upper servo sensor port and bounces at that port.

f. Turn same potentiometer ccw until loop moves up to lower servo sensor port, bounces off that port and stops.

g. Force loop back to upper port again by turning machine reel cw. Loop should climb back to lower port again and stop. Adjust potentiometer as necessary to achieve this condition.

5-34. Erase Head Adjustments. Whenever an erase head is replaced or removed from the Transport, it must be adjusted. To adjust an erase head, proceed as follows:

a. Turn POWER circuit breaker off and loosen two Allen cap screws that secure erase head to side of write head. Remove tape cleaner if necessary, but replace cleaner before adjusting erase head. Leave erase head screws just loose enough to allow head to be moved by hand, but tight enough not to move on its own.

b. Load reel of scratch tape on Transport.

c. Using dual trace oscilloscope, monitor read preamplifier outputs from tracks 1 and 9 at A10TPI and A10TP9 simultaneously in chopped or alternate mode. Set oscilloscope vertical gain to 50OmV/CM and sweep time to ImSEC/CM. Trigger oscilloscope on AO1TPI.

d. Select F, CONT, WRITE, LO DENSITY on BITE and write an all "ones" pattern for about 4 minutes from BOT.

NOTE

Write an all "ones" pattern as required during the erase head adjustment procedure. The erase head must be adjusted as it is erasing this pattern. Erasing previously erased tape will result in incorrect adjustment of this head.

e. Select OFF, READ on BITE and rewind to BOT.

f. Using test clip, ground A13TP7. Circuit ground is available at bottom test point on Al through A9.

g. Select F, CONT, READ on BITE; tape will move forward and be erased by erase head.

h. Adjust erase head toward or away from tape until peak-to-peak amplitudes of signals at both A10TP1 and A10TP9 are between 0.05V and 0.2V. If either signal is greater than 0.2V, the end of erase head associated with that signal (TP9 is associated with edge of tape nearest Transport panel and TP1 is associated with edge furthest from panel) is too far away from tape; move it closer. If either signal is less than 0.05V in amplitude, that end of head is too close to tape; move it further away.

i. When erase head is adjusted properly, turn POWER circuit breaker off and tighten erase head screws.

j. Set POWER circuit breaker to ON, reload tape, and recheck amplitudes measured in step h., above. Adjust erase head if it moved out of adjustment when screws were tightened.

k. Unload tape and remove test clip from A13TP7. This completes erase head adjustment procedure.

5-35. Read/Write Test and Alignment Procedures. The read/write circuitry of the Transport may be tested and aligned as described in the following paragraphs.

5-36. Read Preamplifier Gain, Check and Adjustment. There is one read preamplifier gain adjustment for each of the nine tracks on tape. To check and adjust the read preamplifier gains, proceed as follows:

a. Load reel of scratch tape on Transport.

b. Set oscilloscope for INT NEG sync, ImSEC/CM sweep time, and 1.0 or 2.0V/CM vertical sensitivity.

Monitor Read Preamplifier I output at A1OTPI.

c. Set BITE module switches to MED DENSITY, WRITE, CONT, and F. Tape shall move forward and an all "ones" pattern shall appear at A10TP1.

d. Adjust top potentiometer (Read Gain 1) on A10 until signal at A10TPI has a peak-to-peak amplitude of 7.OV.

e. Connect oscilloscope to A10TP2 and adjust second potentiometer down (Read Gain 2) on A10 for an amplitude of 7.OV.

f. Repeat step e., above, for test points TP3 through TP9 on A10 while adjusting adjacent potentiometers until all nine read preamplifier outputs are adjusted for an amplitude of 7.OV.

g. Unload tape and select OFF, READ on BITE. This completes the read gain adjustment procedure.

5-37. Skew Test. The noncompensated skew of the Transport may be measured as follows:

a. Turn off POWER circuit breaker and disconnect write head cable from A14 in Card Cage.

b. Load master alignment tape, specified in table 5-1, on Transport.

c. Connect one input of dual trace oscilloscope to A10TPI and the other input to A10TP9. (These are the read preamplifier outputs for the two outside tracks.) Set vertical sensitivity of both oscilloscope channels to 1.OV/CM and sweep time to 5#uSEC/CM. Set oscilloscope for chopped mode, EXT POS SYNC and connect trigger input to A10TP1.

d. Select F, CONT, READ on BITE. The scope will display two read preamplifier outputs slightly displaced from each other.

e. Move oscilloscope trigger input to earlier of two signals and adjust oscilloscope controls to display signals as shown in figure 5-7.

f. Uncompensated skew, as shown in figure 5-7, shall be as follows:

Static Skew = 3 #s maximum

Dynamic Skew = 2.5 ,s maximum

g. Select R, CONT, and READ on BITE and repeat steps e. and f., above.

h. Unload master alignment tape and plug write head cable back into A14. Select OFF, READ on BITE. This completes the skew test procedure.

5-38. Threshold Adjustments. There are three threshold level adjustments in the Transport: a Write threshold, a Read threshold, and a Low threshold. (The Low threshold level is not used and is not adjusted.) Check and adjust the Write and Read levels as follows:

NOTE

Tape must be blank for Write threshold adjustment.

a. Load reel of scratch tape on Transport.

b. Monitor track 4 Read Preamplifier output at A10TP4 with an oscilloscope. Set vertical sensitivity to 1.0V/CM and vary sensitivity according to requirements of the measurements to be made in the following steps. Set sweep time to 1mSEC/CM and sync to INT NEG.

c. Select F, CONT, WRITE, MED DENSITY on BITE and adjust amplitude of signal at A10TP4 to 2.4V 0O.IV peak-to-peak with fourth potentiometer down (Read Gain 4) on A10.

d. Move scope probe to track 4 read buffer output at A12TP4. Set vertical sensitivity to 1.OV/CM.

e. Set Write threshold level by adjusting second potentiometer down on Write Control Module A13 until pulses that make up the signal at A12TP4 flicker on and off. Level is correctly set when pulses are gone most of time, but may flicker occasionally across screen.

f. Select F, CONT, READ on BITE and rewind to BOT.

g. When tape moves forward again, move oscilloscope back to A10TP4, set vertical sensitivity to 0.5V/CM and adjust fourth potentiometer down on A10 for a peak-to-peak signal amplitude between 1.75V and 1.85V.

h. Move probe back to A12TP4 and set vertical sensitivity to 2V/CM.

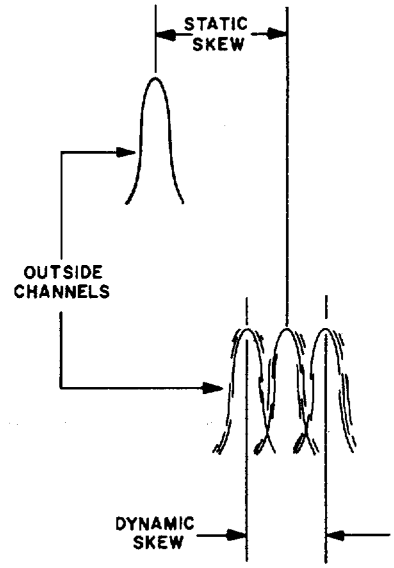


Figure 5-7. Skew Adjustment

i. Set Read threshold level by adjusting bottom potentiometer on A13 for the condition described in step e., above.

j. Rewind to BOT and select F, CONT, WRITE, MED DENSITY on BITE.

k. Monitor A10TP4 and adjust fourth potentiometer down on A10 for a signal amplitude of 7.OV peak-to-peak.

l. Unload tape and select OFF, READ on BITE. This completes the threshold adjustment procedure.

5-39. Pulse Pairing Adjustments. When data is written on tape, a slight difference in intensity between the write flux density in one direction and the density in the opposite direction can cause a relative shift between one set of flux reversals and the other. When such a tape is read, the read signal will exhibit a time shift between its set of positive pulses and its set of negative pulses that was not present in the original data fed to the write amplifier. This shift is called pulse pairing and is adjusted in each of the nine write amplifiers as follows:

a. Load reel of scratch tape on Transport.

b. Monitor TPI (Read Buffer 1) of Read Buffer Module A12 with oscilloscope. Select 2V/CM vertical sensitivity.

c. Select F, CONT, WRITE, HI DENSITY on BITE.

d. Trigger internal positive on signal at A12TPI and set sweep time to display three positive pulses. (It may be necessary to uncalibrate the sweep time to do so.) Display will look like figure 5-8. Note that the center pulse is actually two pulses combined into one when the sweep time is correctly set.

e. Adjust second potentiometer down (Pulse Pairing 1) on Write Amplifier Module A14 until two center pulses completely overlap as shown in figure 5-8. This is the correct setting for that potentiometer.

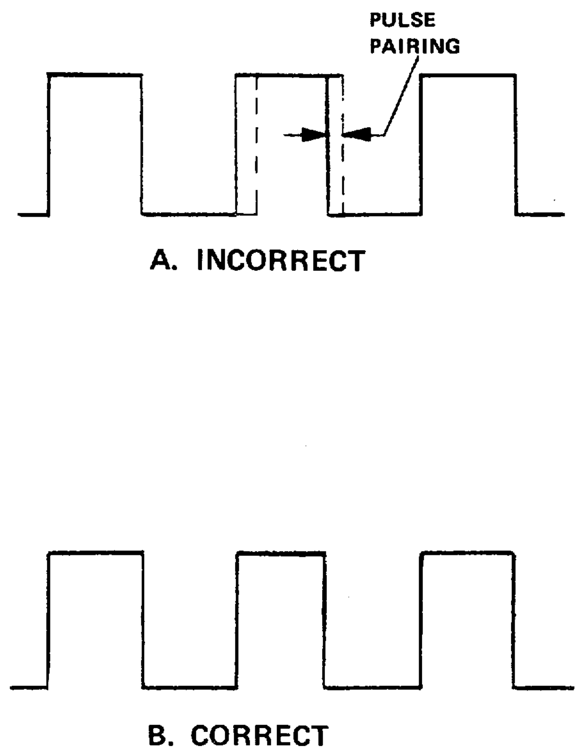


Figure 5-8. Pulse Pairing Adjustment

f. Repeat step e., above, for A12TP2 (Read Buffer 2) and third potentiometer down (Pulse Pairing 2) on A14, then for A12TP3 and fourth potentiometer down on A14, etc., until all nine Write Amplifier pulse pairing potentiometers have been adjusted. Do not adjust the top potentiometer on A14.

g. Unload tape and select OFF, READ on BITE. This completes the pulse pairing adjustment procedure.

5-40. Read Deskew Adjustments. The read data outputs of the Transport are electronically deskewed so that all bits in each character, presented to the controller, occur simultaneously even though they may have been detected at slightly different times. To perform a read deskew adjustment, proceed as follows:

CAUTION

Do not high-speed rewind master alignment tape. Use REV pushbutton switch.

a. Turn POWER circuit breaker off.
b. Unplug write head cable from Write Amplifier Module A14.
c. Set POWER circuit breaker to ON and load master alignment tape specified in table 5-1.
d. Monitor TP1 (Read Buffer 1) of Read Buffer Module A12 with oscilloscope (2V/CM vertical sensitivity, 1µSEC/CM sweep time).
e. Select F, CONT, READ on BITE.
f. Trigger internal positive on signal at A12TPI and adjust width of positive pulses to 4.0 microseconds with top potentiometer (Read Fwd Skew 1) on A12.

NOTE

Read Buffer Module has 18 potentiometers which are arranged in 9 pairs. The top pair is used to adjust the skew delay for track 1, the next pair down is used for track 2, the third pair for track 3, etc., through the ninth pair of potentiometers. The top potentiometer of each pair adjusts the read skew delay in forward and the bottom potentiometer of each pair adjusts the skew delay in reverse. The test point next to each pair of potentiometers is associated with the read track whose skew delay is controlled by that pair of potentiometers.

g. Repeat step f., above, for the remaining eight tracks in forward.

h. Select R, CONT, READ on BITE and repeat step f., above, for all nine tracks in reverse.

i. Reverse tape to BOT.

NOTE

If tape advances to EOT while performing steps j. through n., below, reverse tape to BOT to continue adjustments.

j. Monitor and sync on positive excursion of signal at A12TPI with one channel of dual trace oscilloscope in chopped mode. Select F, CONT, READ on BITE.

NOTE

If no signal is found to be delayed from the signal at TP1 in step k., below, monitor and sync oscilloscope on the signal at TP1 and omit step 1., below.

k. With other channel of dual trace oscilloscope, monitor signals, one at a time, at eight remaining test points on A12. Find test point whose signal is delayed the most from signal at TP1.

l. Sync oscilloscope on positive excursion of signal found in step k., above, and monitor that same signal.

m. Connect other channel of oscilloscope to one of the other test points on A12. Still moving tape forward, adjust forward skew delay potentiometer for that test point until trailing edge of both signals coincide. This adjusts the skew for the track associated with that test point in the forward direction.

n. Repeat step m., above, for all seven remaining tracks in forward.

o. Select R, CONT, READ on BITE.

NOTE

If tape rewinds to EOT while performing step p., below, advance tape to BOT to continue adjustments.

p. Repeat steps j. through n., above, but change forward to reverse. Adjust read skew delays in reverse with bottom potentiometer of each pair of potentiometers on A12.

q. When all read deskew adjustments are complete, remove master tape and reconnect write head cable. Select OFF, READ on BITE.

5-41. Write Deskew Adjustment. The Transport is provided with an adjustable circuit that compensates for mechanical errors in the write head. This allows data to be written on tape with all the bits in each character essentially aligned with a line perpendicular to the edge of the tape. This adjustment is called write deskew.

NOTE

Write deskew cannot be accomplished correctly unless read deskew is properly aligned. Do not attempt a write deskew adjustment without first performing the read deskew adjustments of paragraph 5-40.

5-42. To adjust write deskew, proceed as follows:

a. Load reel of scratch tape on Transport.

b. Monitor TP1 and TP9 of Read Buffer Module A12 with both channels of dual trace oscilloscope in chopped mode. Set vertical gain to 5V/CM and sweep time to 1µSEC/CM. Sync external positive on TP1.

c. Select F, CONT, WRITE, LO DENSITY on BITE.

NOTE

If this adjustment is being made after the installation of a new read/write head assembly, it may be necessary to add or delete jumper W223 on Write Amplifier Module A14 in order to align the trailing edges of the signals. Add or delete jumper W223 if the signal edges cannot be adjusted as specified in step d., below.

d. Adjust top potentiometer (Write Skew) on Write Amplifier Module A14 to align trailing edges of signals at TP1 and TP9 to within 1.0 As.

e. Unload scratch tape and select OFF, READ on BITE. This completes the write deskew adjustment procedure.

5-43. Read Clock Delay Adjustment. The read clock in the Transport is delayed from where each data character is detected. This delay is adjustable so that the clock pulse for a particular character will appear one-half cell time later in time from where that character appeared. One adjustment is provided, which is set while reading a packing density of 800 bpi.

5-44. To adjust the read clock delay, proceed as follows:

a. Turn POWER circuit breaker off.

b. Using test clip, connect TP3 of Write Control Module A13 to circuit ground (bottom test point).

c. Load reel of scratch tape on Transport.

d. Using dual trace on oscilloscope, monitor TP2 (READ CLOCK) and TP1 (READ DATA ORED) of Write Control Module A13 simultaneously in chopped mode. Set vertical sensitivity to 2V/CM, sweep time to 2ctSEC/ CM and trigger external negative on signal at TP1.

e. Select F, CONT, WRITE, HI DENSITY on BITE and write for about 1 minute.

f. Select F, CONT, READ on BITE and rewind to BOT. When tape begins to read forward after rewind, adjust top potentiometer (READ CLOCK DELAY) on Write Control Module A13 until leading edges of positive pulses at TP2 occur 8.4 its after negative excursions of signal at TPI.

g. Unload tape, turn POWER circuit breaker off, and remove test clip from A13TP3. This completes the read clock delay adjustment.

5-45. DISASSEMBLY AND REMOVAL PROCEDURES.

5-46. The following paragraphs describe disassembly and removal procedures for various Transport components and assemblies. Unless otherwise noted, installation procedures are the reverse of removal procedures.

WARNING

Dangerous voltages, which could cause death or injury to personnel, exist within the Transport. Before attempting to remove any Transport components, turn the POWER circuit breaker off and disconnect the power cable from rear panel connector J1.

5-47. Right Side Panel. Access to the Transport electronics and components is accomplished by removing the right side panel. To remove panel, loosen 10 quarter-turn fasteners securing panel to Transport frame and lift panel away from unit.

5-48. Front Panel Dress Plate. To remove the control panel or circuit breaker panel, the front panel dress plate must first be removed. In addition, the front panel dress plate may be removed to obtain access to Transport components located directly behind the front panel. To remove front panel dress plate, remove 13 screws securing dress plate to front panel and lift dress plate away from front panel.

5-49. Air Filter. To remove air filter, grasp filter with hand and gently pull edges of filter out from behind panel. To install filter, gently push edges of filter back into opening between front panel dress plate and EMI screen.

5-50. EMI Screen. The EMI screen is located directly behind the air filter. To remove the EMI screen, proceed as follows:

a. Remove air filter (refer to paragraph 5-49).

b. Remove front panel dress plate (refer to paragraph 5-48).

c. Remove four flat-head screws securing EMI screen and two retaining brackets to front panel.

5-51. Control Panel. To remove the control panel, proceed as follows:

a. Remove air filter (refer to paragraph 5-49).

b. Remove front panel dress plate (refer to paragraph 5-48).

c. Disconnect control panel plug (66, figure 1-2) from card cage.

d. Remove four flat-head screws securing control panel to front panel and remove control panel and cable from unit.

5-52. Circuit Breaker Panel. To remove the circuit breaker panel, proceed as follows:

a. Remove air filter (refer to paragraph 5-49).

b. Remove front panel dress plate (refer to paragraph 5-48).

c. Disconnect circuit breaker panel plug (57, figure 1-2) from power supply. If circuit breaker panel is to be completely removed from unit, open all cable clamps securing circuit breaker panel cable to casting.

d. Remove four flat-head screws securing circuit breaker panel to front panel and remove circuit breaker panel from unit.

5-53. Heatsink Assembly Components. To remove the heatsink assembly, or to obtain access to other components located behind the heatsink assembly, proceed as follows:

a. Disconnect heatsink assembly plug (51, figure 1-2) from card cage.

b. Disconnect power supply plug (53, figure 1-2) from heatsink assembly.

NOTE

To completely remove the heatsink assembly from the Transport, perform steps c. and d., below. To position the heatsink assembly for access to components located near the heatsink assembly, omit step c. and proceed to step d.

c. Tag and remove all Transport wires from terminal boards TB I1 and TB2 of heatsink assembly.

d. Using no. 10 T-handle Allen-head wrench supplied with Transport, remove six Allen-head screws securing heatsink assembly to casting and gently remove or reposition heatsink assembly, being careful not to snag or strain any cables or wires.

5-54. Power Supply. To remove the power supply, proceed as follows:

a. Disconnect power supply plug (53, figure 1-2) from heatsink assembly and open all cable clamps securing power supply cable to casting.

b. Disconnect circuit breaker panel plug (57, figure 1-2) from power supply.

c. Using no. 10 T-handle Allen-head wrench, remove six Allen-head screws securing power supply to casting and remove power supply.

5-55. Lamps. There are five incandescent bi-pin lamps in the Transport. Remove the lamps as described in the following paragraphs.

5-56. Tape Cross Upper Sensor Lamp (5, Figure 1-2). To remove the tape cross upper sensor lamp, proceed as follows:

a. Remove two screws that secure upper threading guide (41, figure 1-2) and remove the guide.

b. Remove lamp by pulling it straight out.

c. Clean base of guide and surface to which it mounts of any debris before replacing guide.

5-57. Tape In Machine Tank Sensor Lamp (22, Figure 1-2). To remove the tape in machine tank sensor lamp, proceed as follows:

a. Open vacuum tank door.

b. Remove two screws that secure short piece of tank rail, located over lamp next to capstan, and remove rail.

c. Remove lamp by pulling it straight out.

d. Clean mounting surface of rail, and surface to which it mounts, of any debris before replacing rail.

NOTE

When replacing the rail, press it gently to the left to compress an O-ring in the right wall of the head/guide plate. Make sure that the rail does not contact the capstan after the screws are locked down and that it does contract the long rail directly above it.

5-58. Tape Cross Lower Sensor Lamp (34, Figure 1-2). To remove the tape cross lower sensor lamp, proceed -as follows:

a. Remove screw that secures lens block over lamp and remove block.

b. Remove lamp by pulling it straight out.

c. Replace block.

d. Adjust tape cross lower sensor as described in paragraph 5-14.

5-59. Machine Reel Low Tape Sensor Lamp (35, Figure 1-2). To remove the machine reel low tape sensor lamp, proceed as follows:

a. Remove screw that secures lens block over lamp and remove block.

b. Remove lamp by pulling it straight out.

c. After replacement, adjust low tape sensor as described in paragraph 5-15.

5-60. Tape In File Tank Sensor Lamp (43, Figure 1-2). To remove the tape in file tank sensor lamp, proceed as follows:

a. Open vacuum door.

b. Remove two screws that secure block between two tank rollers and remove block.

c. Remove lamp by pulling it straight out.

d. Clean mounting surface of block and surface to which it mounts of any debris before replacing blocks.

5-61. Photosensors. There are six photosensors (excluding the reel tach sensors) in the Transport. Remove these sensors as described in the following paragraphs.

5-62. Tape Cross Upper Sensor (8, figure 1-2). To remove the tape cross upper sensor, proceed as follows:

a. Open vacuum tank door.

b. Remove two screws that secure Z-shaped cover at right of upper thread chute and remove cover.

c. Remove sensor by pulling it straight out of its socket.

5-63. EOT/BOT Sensor (13, Figure 1-2). To remove the EOT/BOT sensor, proceed as follows:

a. Remove right side panel (refer to paragraph 5-47).

b. Remove screw securing EOT/BOT sensor connector (62, figure 1-2) to head plate and disconnect connector from head plate.

c. Remove screw securing EOT/BOT sensor to head plate and remove sensor.

5-64. Tape In Machine Tank Sensor (23, Figure 1-2). To remove the tape in machine tank sensor, proceed as follows:

a. Remove right side panel (refer to paragraph 5-47).

b. Locate sensor socket. (Sensor socket is located just to the left of the capstan motor and above the lower group of pressure sensors.)

c. Remove screw that secures socket to casting and remove socket.

d. Remove sensor by pulling it straight out of socket.

5-65. Tape Cross Lower Sensor (31, Figure 1-2). To remove the tape cross lower sensor, proceed as follows:

a. Remove screw that secures sensor lens block to panel and remove block.

b. Remove sensor by pullling it straight out of socket.

c. After replacement, adjust tape cross lower sensor as described in paragraph 5-14, 5-66. Machine Reel Low Tape Sensor (32, Figure 1-2). To remove the machine reel low tape sensor, proceed as follows:

a. Remove two screws that secure sensor assembly to panel and pull sensor assembly gently away from the panel.

b. Remove screw (behind sensor assembly) that secures sensor socket to sensor assembly and remove socket.

c. Remove sensor by pulling it straight out of socket.

d. After replacement, adjust low tape sensor as described in paragraph 5-15.

5-67. Tape In File Tank Sensor (42, Figure 1-2). To replace the tape in file tank sensor, proceed as follows:

a. Open vacuum tank door.

b. Remove top tank rail covering sensor by removing three 6-32 socket-head cap screws that secure rail to casting.

c. Remove sensor by pulling it straight out.

5-68. File Protect Sensor (36, Figure 1-2). To remove the file protect sensor, proceed as follows:

a. Remove right side panel (refer to paragraph 5-47).

b. Remove four sensor leads from terminals 1 through 4 of terminal board TB2 and open all cable clamps securing sensor wires to Transport.

c. Remove file reel hub as described in paragraph 5-21, steps e. and f.

d. Remove three screws securing sensor to casting and remove sensor.

e. When replacing sensor, connect sensor leads as follows:

Black..TB2-1
White TB2-2
Black/White TB2-3
Black/Yellow TB2-4

f. After replacing sensor, adjust sensor as described in paragraph 5-14.

5-69. Reel Tach Sensors (30 and 38, Figure 1-2). Each of the reel tach sensors contain one LED and one phototransistor, which are plugged into sockets contained within the sensor assemblies. To replace an LED or phototransistor, proceed as follows:

a. Remove screw securing cover over sensor assembly and remove cover (figure 5-9).

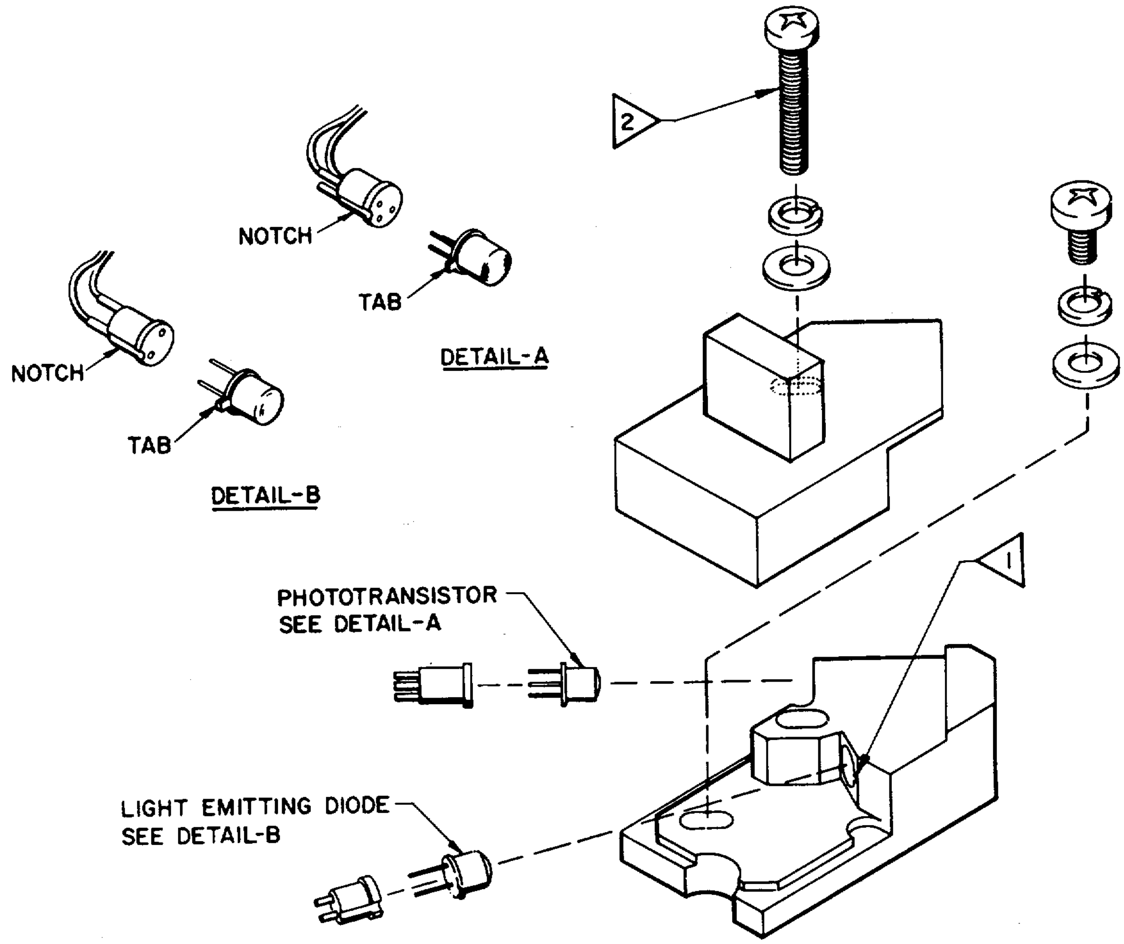
b. Gently pull out required socket.

c. Pull device to be replaced out of its socket.

NOTE

The LEDs are polarized. When replacing an LED, make certain to plug LED into socket as shown in figure 5-9.

d. Adjust tach sensor, if necessary, by loosening screw that secures sensor to panel and sliding sensor assembly back and forth until output of sensor (A3TP3 for file reel and A3TP4 for machine reel) is maximum. Refer to paragraph 5-13 and table 5-3 for test procedure.



NOTE:

1. ALIGN TAB ON CELL OR LED WITH NOTCH IN SENSOR BLOCK WHEN INSERTING INTO BLOCK.
2. AFTER REMOVAL OF COVER REINSTALL SCREW BEFORE ADJUSTING BLOCK.

Figure 5-9. Reel Tach Sensors, Removal and Installation

5-70. Printed Circuit Modules. To remove a printed circuit module from the Card Cage, proceed as follows:

a. Turn POWER circuit breaker off.

b. Slightly loosen screws that secure module retainer (71, figure 1-2) to upper rail of Card Cage.

c. Slide retainer up and to the left.

d. Grasp both extractor handles of module to be removed and push top handle up and bottom handle down until module is free of connector. Remove module.

5-71. The printed circuit modules listed in table 5-6 require adjustment if replaced. Adjust as specified in the paragraphs listed in table 5-6.

Table 5-6. Printed Circuit Module Adjustment Procedures

Module	Location	Adjustment Procedure Paragraphs
Servoamplifier	A1, A2	5-23, 5-33
Servo Control	A3	5-30
Capstan Drive	A5	5-29
Voltage Regulator	A6	5-22
Read Preamplifier	A10	5-36
Read Buffer	A12	5-40
Write Control	A13	5-38, 5-43
Write Amplifier	A14	5-39, 5-41

5-72. Read/Write/Erase Head. To remove a head assembly, proceed as follows:

CAUTION

To avoid damaging the head surface, protect the surface by taping a folded soft tissue across its surface before removal.

a. Open Transport door.

b. Open vacuum tank door.

c. Remove four screws securing head mounting plate to Transport.

NOTE

To gain access to the head mounting screws in step d., below, loosen cable clamps and cables as required to pull the head mounting plate far enough away from Transport.

d. Gently pull head mounting plate away from Transport and remove two screws securing head-to-head mounting plate.

e. Gently push head mounting plate back against Transport and retain in place with one or two screws removed in step c., above.

f. Remove two screws securing head cover to head and gently pull cover back away from head.

g. Unplug both head connectors, one at a time, by pulling each connector out from back of head.

h. Remove screw that secures leads from cable shields to head cover.

i. Unplug erase head cable (small, 2-pin connector) and remove entire head assembly.

5-73. When replacing a head assembly, observe the following requirements:

a. Clean base of head and surface to which it mounts of any dust or other foreign matter.

b. When replacing head mounting plate, firmly press plate up and to the right to ensure top and right walls of plate make good contact with their mating surfaces. Make certain curved capstan shield (part of head mounting plate) does not contact capstan.

c. Adjust erase head as described in paragraph 5-34.

d. Adjust Read/Write circuitry as described in paragraphs 5-36, 5-39, 5-40, and 5-41.

5-74. Capstan (25, Figure 1-2). To remove the capstan, proceed as follows:

a. Open vacuum tank door.

b. Remove screw securing capstan to motor shaft. (Grip capstan gently to facilitate loosening screw.)

c. Slide capstan off motor shaft.

NOTES

1. When replacing the capstan, the roll pin in the motor shaft should mate with the deeper pair of slots in the end of the capstan hub. The shallower pair of slots is not used.

2. Always clean the surface of the capstan after handling.

5-75. Pressure Sensors (59, 61, and 67, figure 1-2). To remove a pressure sensor, proceed as follows:

a. Remove right side panel (refer to paragraph 5-47).

NOTE

The front panel dress plate and the control panel, EMI screen, or circuit breaker panel may be removed to provide easier access to the sensor. Refer to paragraphs 5-48, 5-50, 5-51, and 5-52 for the applicable procedures.

b. Tag and remove lugged wires and air hose from sensor, carefully noting to which sensor fitting the hose is attached.

c. Remove four nuts and washers, securing sensors on threaded studs.

d. Slide sensors off studs and remove sensor.

CAUTION

When replacing a sensor, make certain that the hose is attached to the proper fitting. One fitting is for negative pressure and the other fitting is for positive pressure.

5-76. Capstan Motor. To remove the capstan motor, proceed as follows:

a. Remove right side panel (refer to paragraph 5-47).

b. Disconnect capstan motor and tachometer leads from terminals 5, 6, 7, and 8 of terminal board TB2.

c. Remove capstan (refer to paragraph 5-74).

d. Remove four bolts securing capstan motor assembly to casting and remove motor assembly.

e. Remove four bolts securing motor plate to motor and remove plate.

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5-77. When replacing the capstan motor, connect the motor and tachometer leads as follows:

a. Tachometer leads:

Red TB2-6

Black TB2-5

b. Motor leads:

Red..TB2-7

Black TB2-8

5-78. Reel Motor. To remove a reel motor, proceed as follows:

a. Remove right side panel (refer to paragraph 5-47).

b. Disconnect motor leads from terminal board TB1 (file reel motor) or TB2 (machine reel motor) on heatsink.

c. Remove reel or reel hub (refer to paragraph 5-21, steps e. and f.).

d. Remove bolts securing motor to casting and remove the motor.

5-79. When replacing a reel motor, connect the motor leads as follows:

a. File reel motor:

Red..TB1-7

Black TB1-8

b. Machine reel motor:

Red..TB2-3

Black TB2-2

5-80. After replacing reel motor, adjust reel or reel hub as described in paragraph 5-21.

5-81. Vacuum Blower. To remove the vacuum blower, proceed as follows:

a. Remove right side panel (refer to paragraph 5-47.

b. Tag and remove six motor leads from terminals 1, 2 and 3 of terminal board TBI on heatsink.

c. Loosen clamp securing positive thread pressure hose to blower housing.

d. Remove three bolts securing three-legged blower clamp to casting and remove clamp and blower.

5-82. When replacing the vacuum blower, connect the blower motor leads as tagged on the vacuum blower that was removed or refer to sheet 2 of the Tape Drive Power Control schematic diagram (figure 6-5) for vacuum blower wiring information.

5-83. TROUBLESHOOTING.

5-84. Figure 5-10 is a general fault isolation flow chart for the Transport and figures 5-11 through 5-16 are individual fault isolation flow charts for the power supply circuits, auto thread operation, auto load operation, reel servosystem, capstan drive circuits, and read/write circuits, respectively. The fault isolation flow charts are designed to aid the maintenance technician in isolating Transport malfunctions to a faulty component or assembly and should be referred to whenever a discrepancy is noted during a test or adjustment or whenever the equipment is suspected of being inoperative. If a particular symptom or malfunction cannot be associated with one of the individual fault isolation flow charts listed above, reference should be made to the general fault isolation flow chart. This will lead the technician to the faulty component or to the appropriate flow chart associated with the failure. However, if a symptom can be related to a particular circuit or operation, the technician may refer directly to the fault isolation flow chart associated with that circuit or operation.

5-85. Additional troubleshooting aids for Transport threading, loading, rewinding and unloading are included in individual timing diagrams, figures 5-17 through 5-20. These diagrams show the sequence of events and PCB test points used during the timing diagram function.

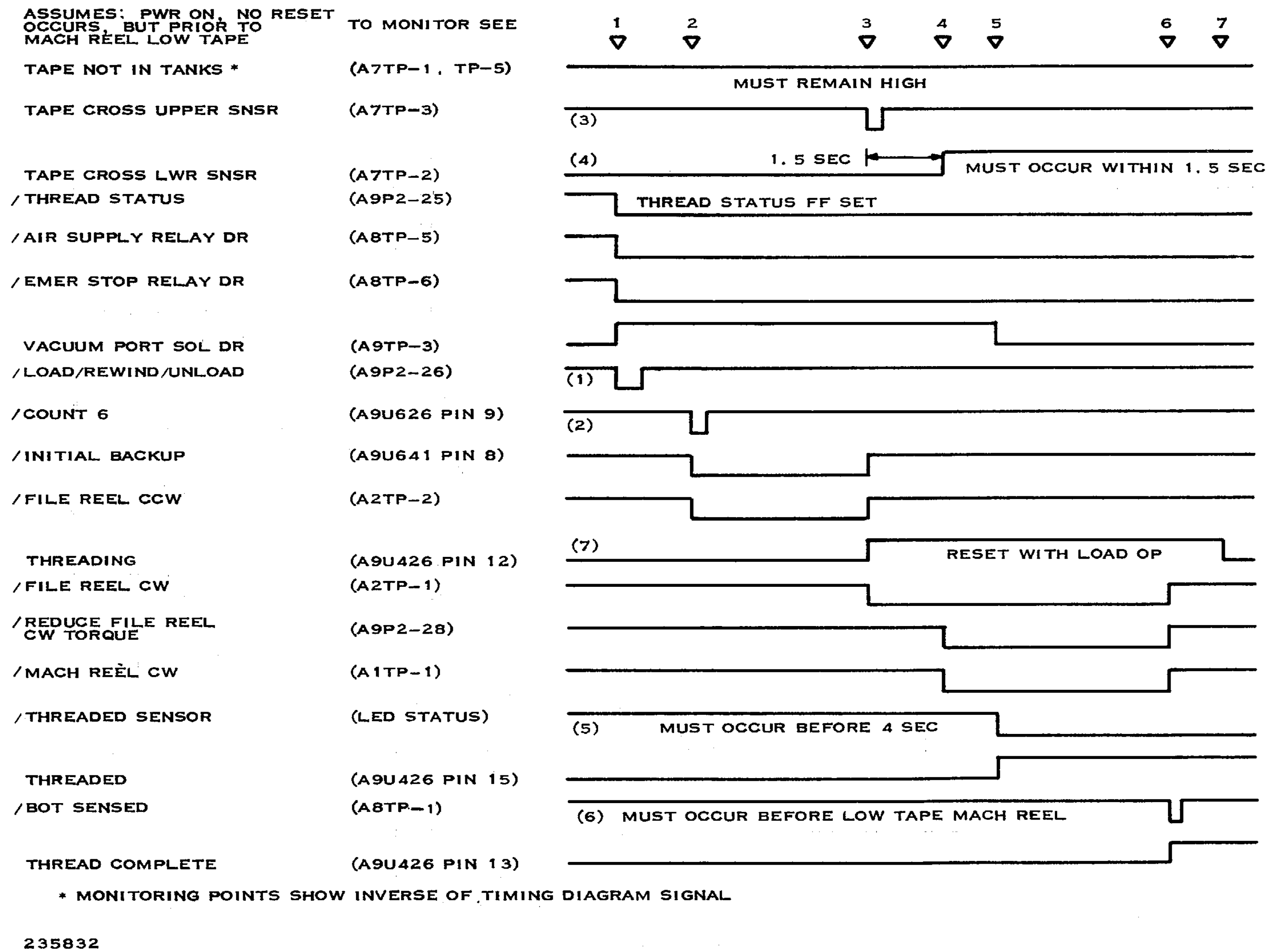


Figure 5-17. Threading, Timing Diagram

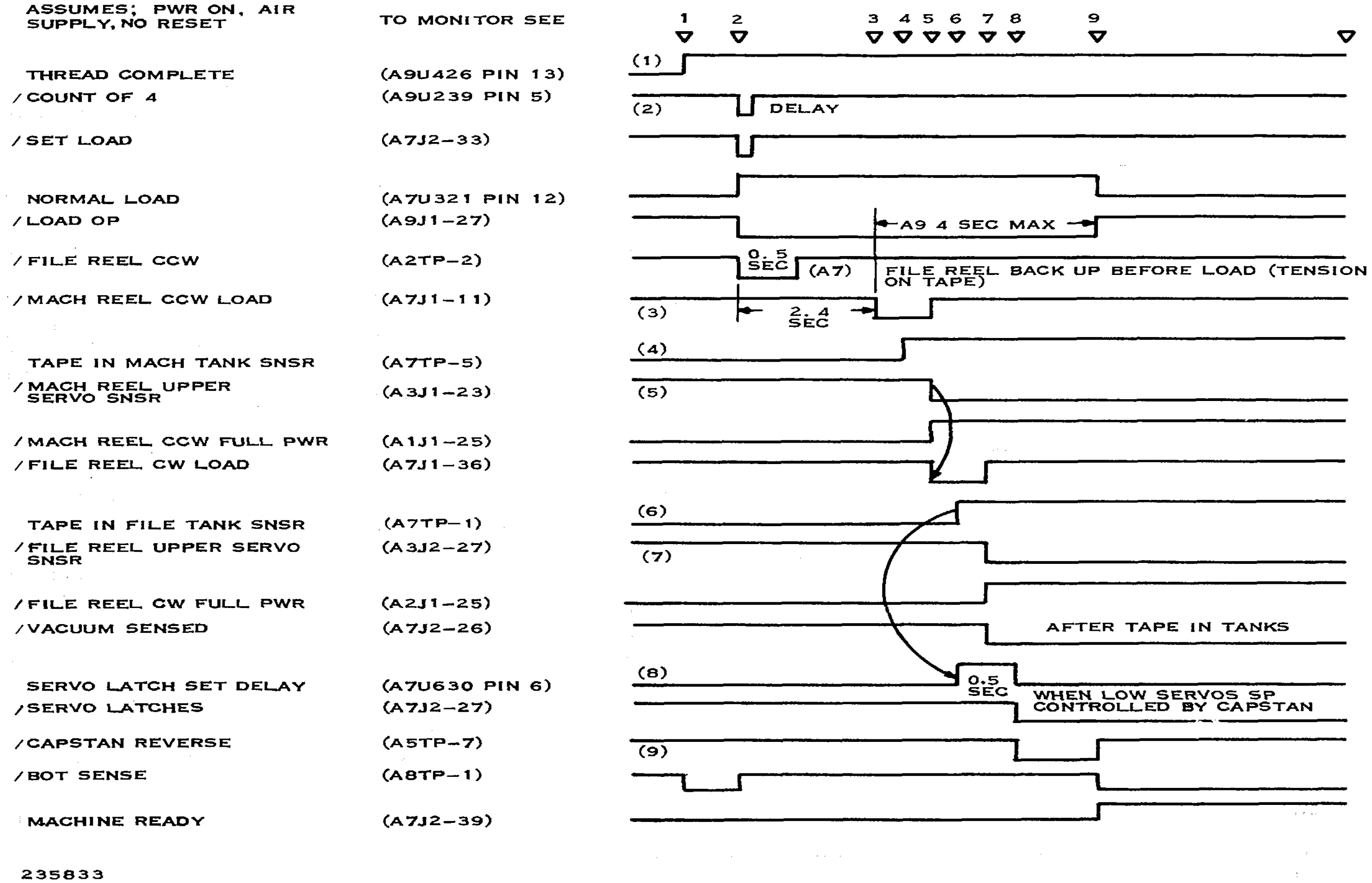


Figure 5-18. Loading, Timing Diagram

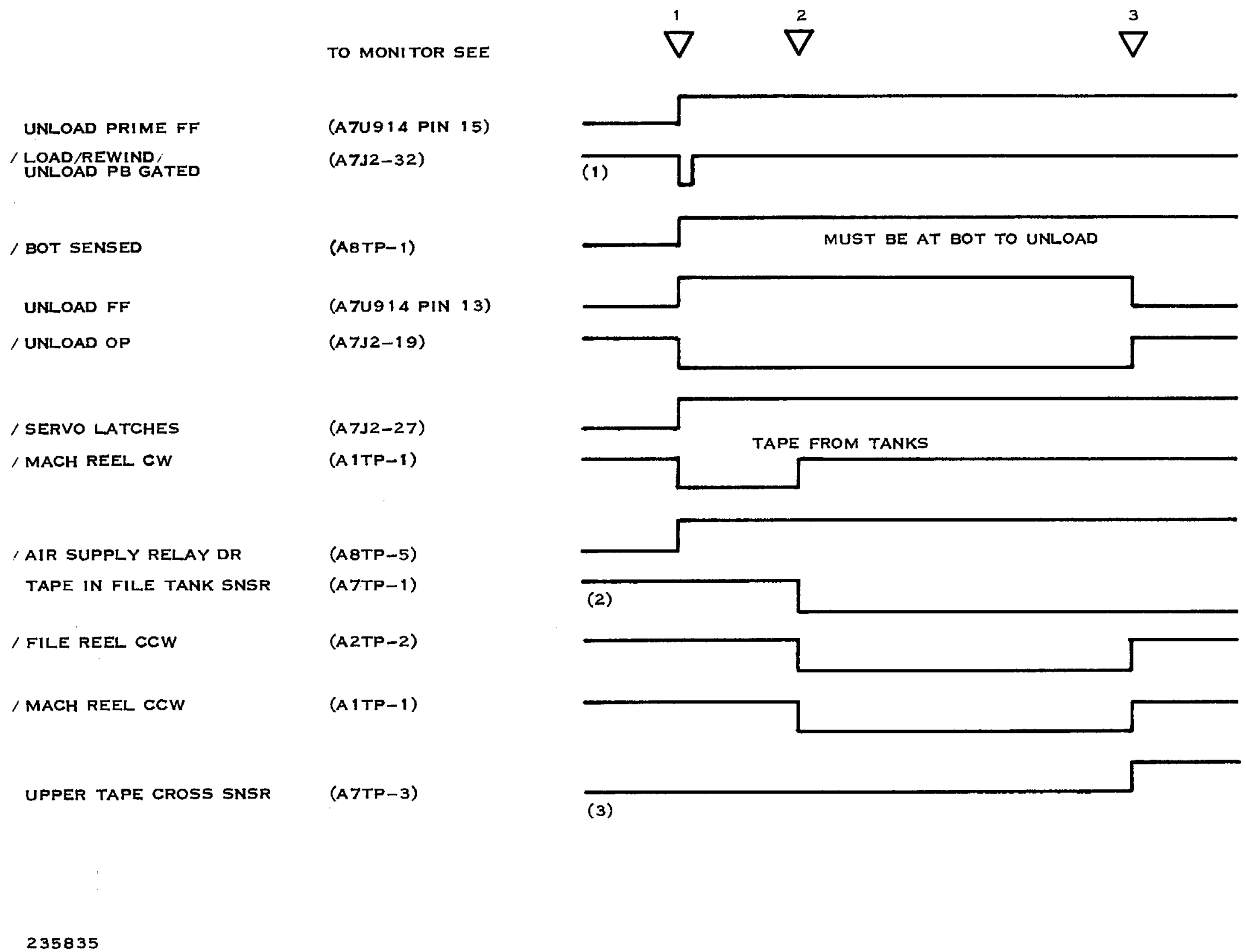


Figure 5-19. Rewind, Timing Diagram

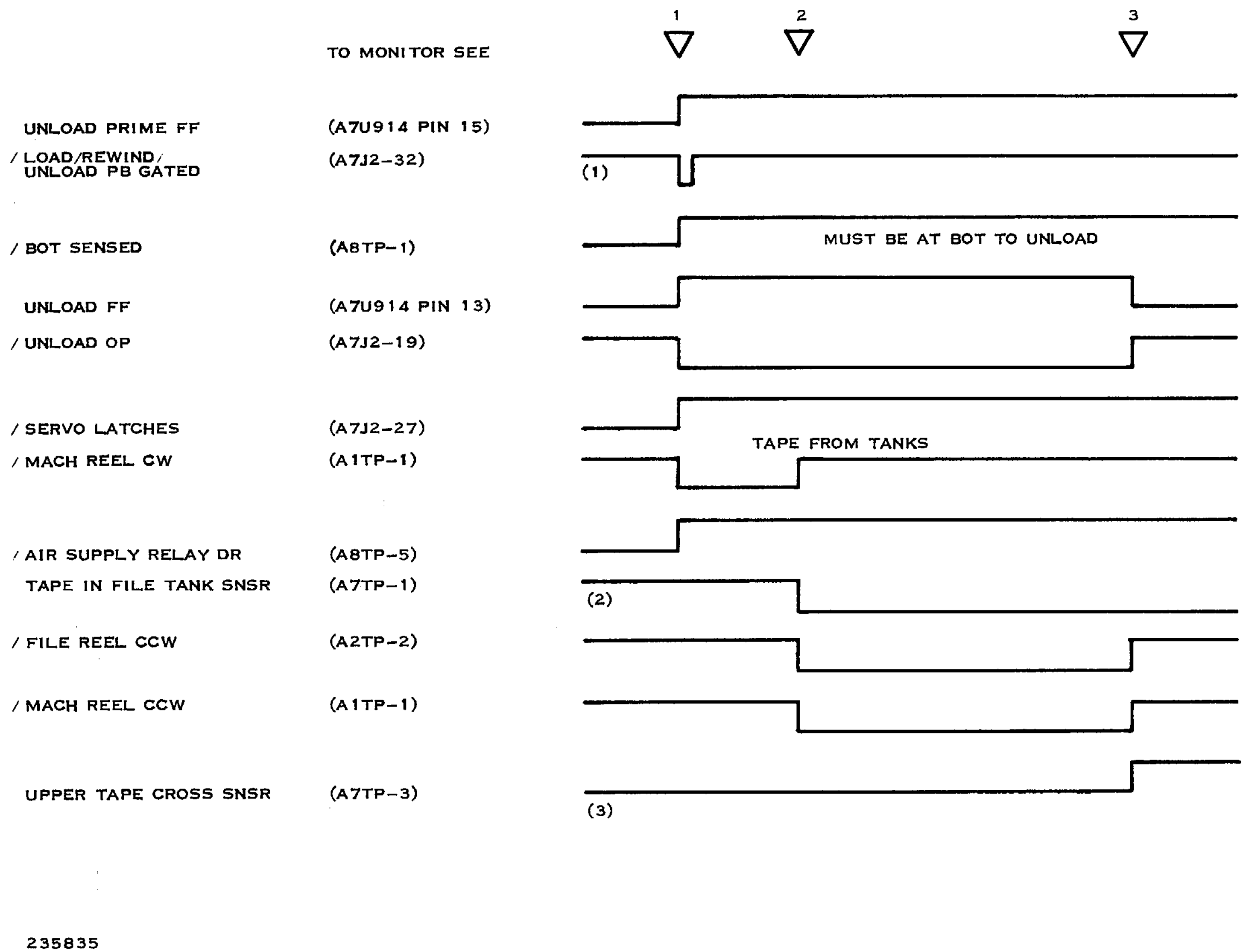


Figure 5-20. Unload, Timing Diagram

SECTION VI
DIAGRAMS

6-1. GENERAL.

6-2. This section contains the Transport schematic diagrams and internal wiring information for I/O interface connector J2. Descriptions of the signal labeling conventions and logic symbols that appear on the schematic dia-grams and plug-in module component location information are also included in this section.

6-3. SIGNAL LABELING CONVENTIONS.

6-4. The majority of signal names that appear on the Transport schematic diagrams are prefixed with either the absence of a polarity symbol or a slash (/) polarity symbol. An absent polarity symbol indicates the signal is true when at its more positive state and false when at its more negative state. Conversely, a / polarity symbol indicates the signal is true when at its more negative state and false when at its more positive state. Since TTL logic is used in the Transport, an absent symbol state is normally approximately +5 volts and a / state is normally approximately 0 volts. In some cases, however, the absent symbol state may be +12V, +4V, or some other level and the / state may be -3V, -12V, or another negative level. Analog signals or signals in which polarity would be meaningless, such as signal ground returns, also are not prefixed by a polarity symbol.

6-5. Generally, all input signals appear on the left of the schematic diagrams and all output signals appear on the right of the schematic diagrams. In addition, the source (interconnection point from which a signal originates) of each input signal is given in brackets adjacent to the signal name. The interconnection point reference consists of the module connector or component reference designation followed by the dashed terminal (pin) number (e.g., AIJIL-38, J2-5, etc.). Similarly, all the load interconnection points for each output signal are identified in brackets adjacent to the signal name.

6-6. PLUG-IN MODULE COMPONENT AND TEST POINT LOCATIONS.

6-7. COMPONENT LOCATIONS. All plug-in modules of the Transport utilize a grid system for locating components, using the three-digit reference designations shown On the schematic diagrams. As shown in figure 6-1, each card contains numbers in both the vertical and horizontal axes. The vertical numbers may range from I to 9 and correspond to the first digit of the three-digit reference designation. The horizontal numbers range from 05 to 40 and are referenced to the last two digits of the reference designation. Therefore, resistor R325 (see figure 6-1) is located where vertical grid number 3 intersects with horizontal grid number 25.

6-8. TEST POINT LOCATIONS. All plug-in module test points are located on the outer edge of the module and are numbered consecutively, starting with TPI at the top of the module.

6-9. LOGIC SYMBOLS.

6-10. Figure 6-2 illustrates the logic symbols that appear on the schematic diagrams in this section and provides a description and truth table (where applicable) for each symbol.

6-11. I/O INTERFACE CONNECTOR J2 WIRING.

6-13. SCHEMATIC DIAGRAMS.

6-14. Table 6-1 lists the figure number and title for each of the Transport schematic diagrams.

Table 6-1. List of Schematic Diagrams

Figure Number	Title
6-4	Schematic, Tape Drive Sensors
6-5	Schematic, Tape Drive Power Control
6-6	Schematic, Control Panel
6-7	Schematic, Machine Reel Servo Drive Module Al
6-8	Schematic, File Reel Servo Drive Module A2
6-9	Schematic, Servo Control Module A3
6-10	Schematic, Built-In Test Equipment Module A4
6-11	Schematic, Capstan Drive and Field Regulator Module A5
6-12	Schematic, Power Supply Regulators Module A6
6-13	Schematic, Load/Rewind Module A7
6-14	Schematic, Sensor Module A8
6-15	Schematic, Auto Thread Module A9
6-16	Schematic, Read Preamplifier Module A10
6-17	Schematic, Read Amplifier Module All
6-18	Schematic, Read Buffer Module A12
6-19	Schematic, Write Control Module A13
6-20	Schematic, Write Amplifier Module A14
6-21	Schematic, Line Driver Module A15
6-22	Schematic, Line Receiver Module A16
6-23	Schematic, Power Supply

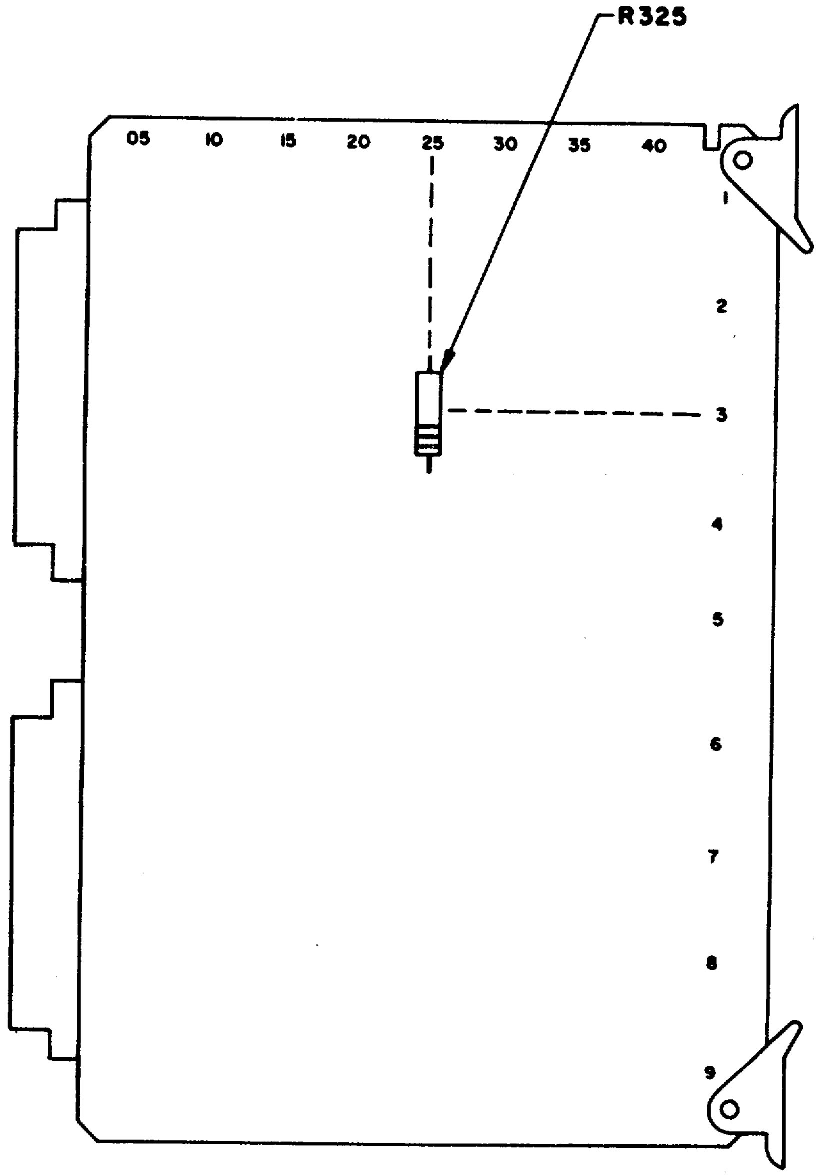
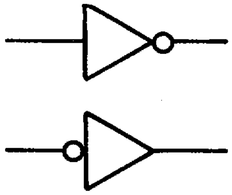
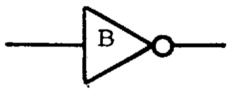


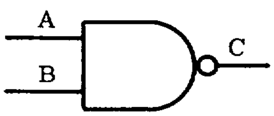
Figure 6-1. Plug-in Module Component Locations



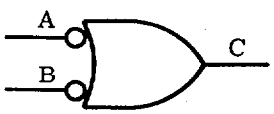
Inverters



Buffer inverter (open collector)

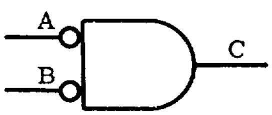


Inverting positive "and" gate

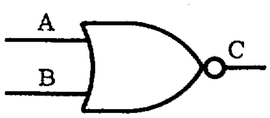


Inverting negative "or" gate

A	B	C
H	H	L
H	L	H
L	H	H
L	L	H

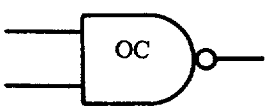


Inverting negative "and" gate

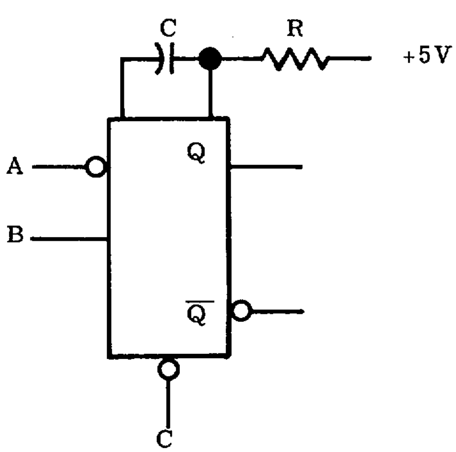


Inverting positive "or" gate

A	B	C
H	H	L
H	L	L
L	H	L
L	L	H

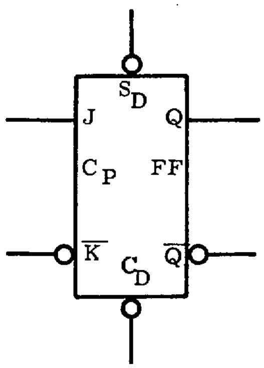


"OC" denotes an open collector output



One-shot. Triggers on either positive edge (B) or negative edge (A), cleared or held reset by low input at C. Output pulse period is approx. 1/2 RC for 96S02 and 1/3 RC for 9602 and 96L02

Figure 6-2. Logic Symbols (Sheet 1 of 3)



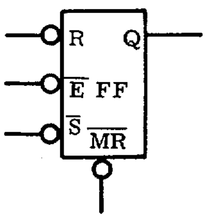
J-K flip flop. Toggles at positive excursion of C_P input in direction determined by $\overline{J}$ and $\overline{K}$ inputs.

Synchronous

J	$\overline{K}$	Q
L	H	N.C.
L	L	L
H	H	H
H	L	Toggles

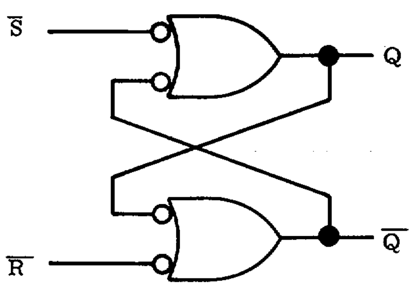
Asynchronous (overrides J, $\overline{K}$ and C_P inputs)

S_D	C_D	Q
L	L	H
L	H	H
H	L	L
H	H	N.C.



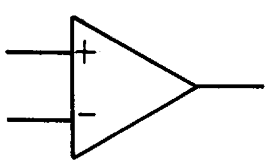
RS flip flop
Note - there are four of these flops in one DIP. The $\overline{E}$ and $\overline{MR}$ inputs, which are common to the four flops, are shown only once on the schematic diagram for each DIP.

$\overline{R}$	$\overline{S}$	$\overline{MR}$	Q
—	—	L	L
L	L	H	L
H	L	H	H
L	H	H	L
H	H	H	N.C.



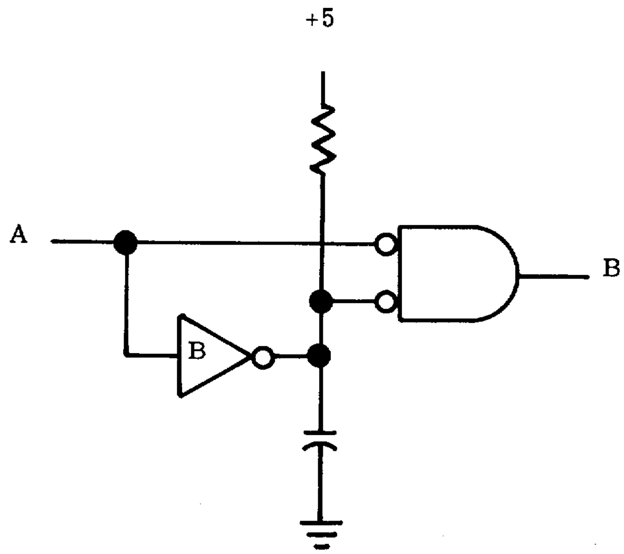
RS flip flop

$\overline{R}$	$\overline{S}$	Q	$\overline{Q}$
L	L	H	H
L	H	L	H
H	L	H	L
H	H	N.C.	

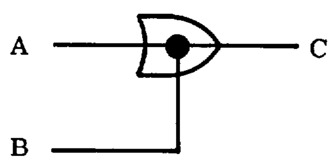


Comparator
If - input is more positive than + input, output will be low.
If + input is more positive than - input, output will be high.

Figure 6-2. Logic Symbols (Sheet 2 of 3)

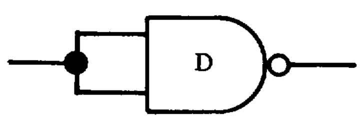


Edge detector. A positive pulse will appear at B for every negative excursion of input A.



Wired "or"

A	B	C
H	H	H
H	L	L
L	H	L
L	L	L



Buffer driver; used where loads exceed normal fan-out.

Figure 6-2. Logic Symbols (Sheet 3 of 3)

LEGEND

1. Corner Port
2. File Tank Upper Safety Port
3. Machine Tank Lower Safety Port
4. File Tank
5. Tape Cross Upper Sensor Lamp DS1
6. Machine Tank
7. Machine Reel Lower Servo Sensor Port
8. Tape Cross Upper Sensor Q1
9. File Reel Upper Servo Sensor Port
10. Buffer Valve
11. Buffer
12. Tape Guide
13. EOT/BOT Sensor
14. Tape Cleaner
15. Machine Reel Upper Servo Sensor Port
16. file Reel Lower Servo Sensor Port
17. Read/Write/Erase Head
18. Tape Guide
19. Machine Tank Rewind Sensor Port
20. Vacuum Sense Bypass Port
21. file Tank Rewind Sensor Port
22. Tape in Machine Tank Sensor Lamp DS2
23. Tape in Machine Tank Sensor Q2
24. Machine Tank Upper Safety Sensor Port
25. Capstan
26. File Tank Lower Safety Sensor Port
27. Tank Door
28. Tape Threaded Sensor Port
29. Machine Reel Tach Roller
30. Machine Reel Tach Sensor Q1
31. Tape Cross Lower Sensor Q4
32. Machine Reel Low Tape Sensor Q6
33. Machine Reel
34. Tape Cross Lower Sensor Lamp DS4
35. Machine Reel Low Tape Sensor Lamp DS6
36. File Protect Solemoid Assembly S13
37. File Reel Hub
38. File Reel Tach Sensor Q7
39. File Reel Rach Roller
40. Vacuum Door Catch
41. Upper Thread Chute
42. Tape-in-file Tank Sensor Q3
43. Tape-in-File Tank Sensor Lamp DS3
44. Roller

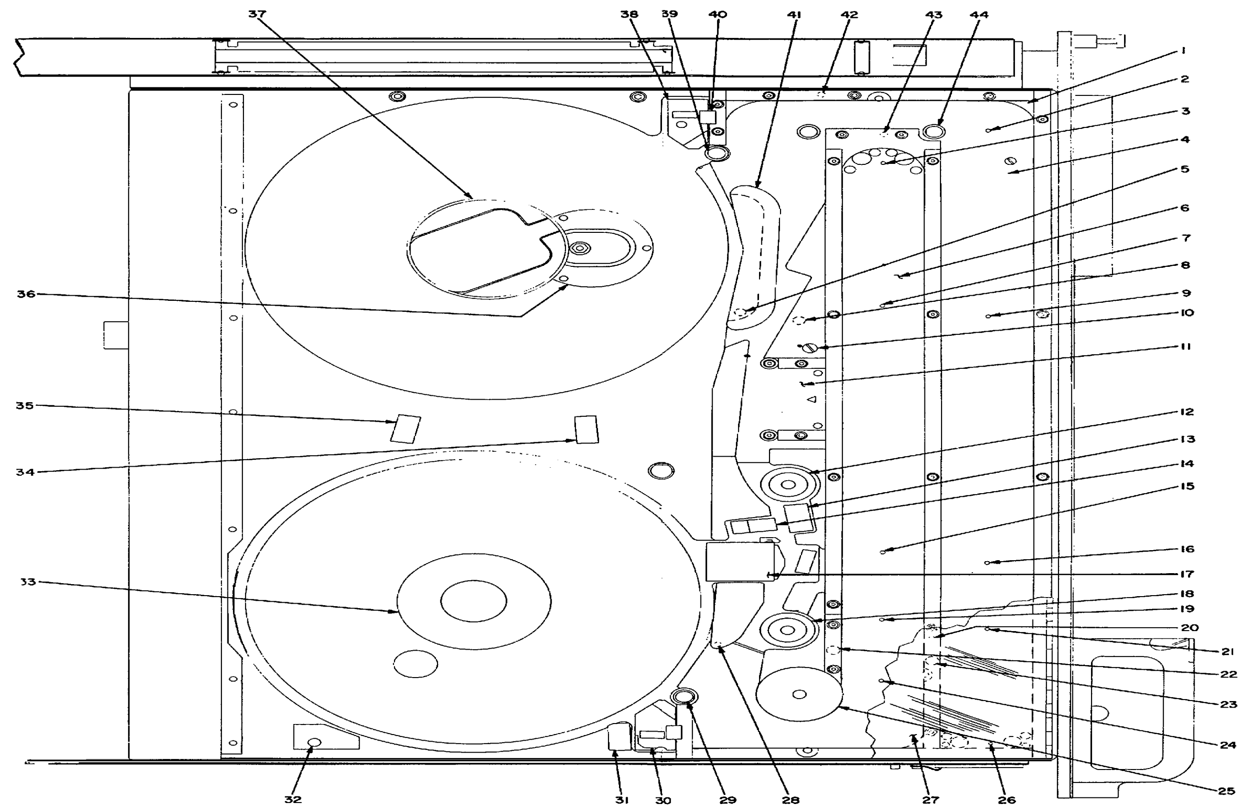


Figure 1-2. Transport Components (Sheet 1 of 2)

LEGEND

45. Cooling Blower
46. File Reel Motor B1
47. Heat Sink Assembly A1
48. Primary Power and I/O Connectors J1 and J2
49. Card Cage A2
50. Line Filter Assembly A7
51. Heat Sink/Card Cage Interface Connector A2P1
52. Machine Reel Motor B2
53. Power Supply/Heat Sink Interface Connector A1P1
54. Transformer A3T1
55. Power Supply Assembly A3
56. Fuse Panel, Part of A3
57. Power Supply/Circuit Breaker Panel Interface Connector A3P1
58. Capstan Motor/Tach. B3/G1
59. Pressure Switches
60. Vacuum Test Port
61. Pressure Switches
62. EOT/BOT Sensor Connector
63. Head Cables
64. Card Cage/Tape Drive Interface Connector
65. I/O Cables
66. Card Cage/Control Panel Interface Connector P2
67. Pressure Sensors
68. Vacuum Blower B4
69. Thread Pressure Adj. Valve
70. Solenoid-Operated Valve A4
71. Card Retainer

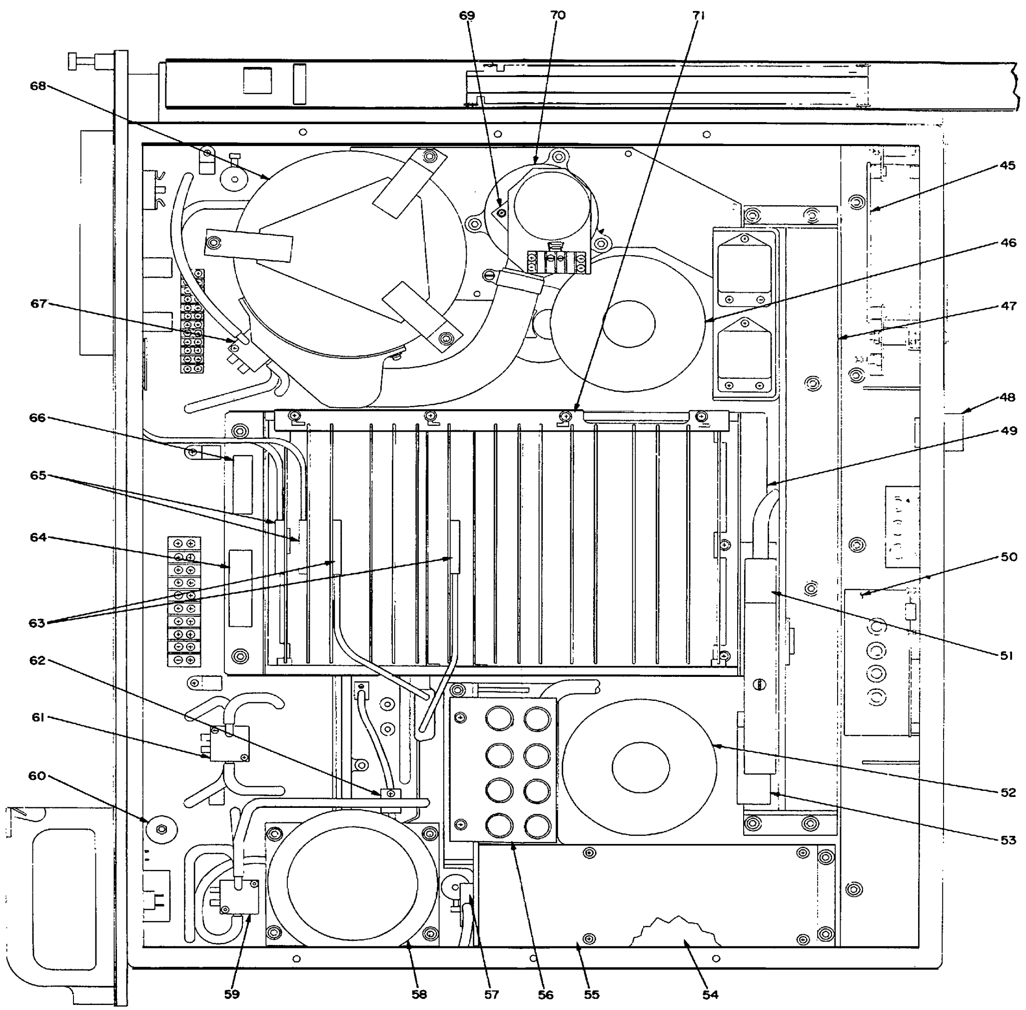


Figure 1-2. Transport Components (Sheet 2 of 2)

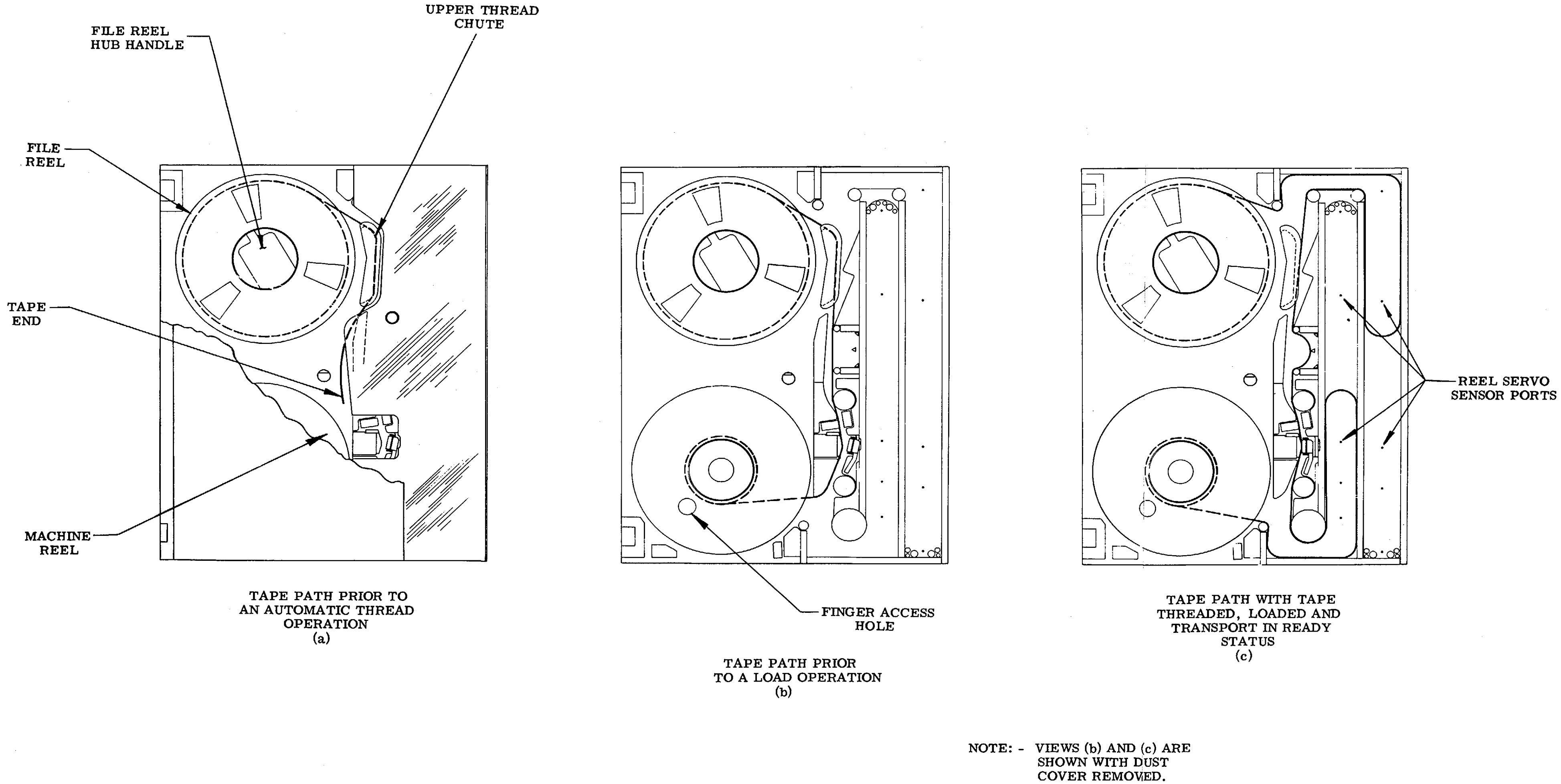


Figure 3-4. Tape Path Diagram

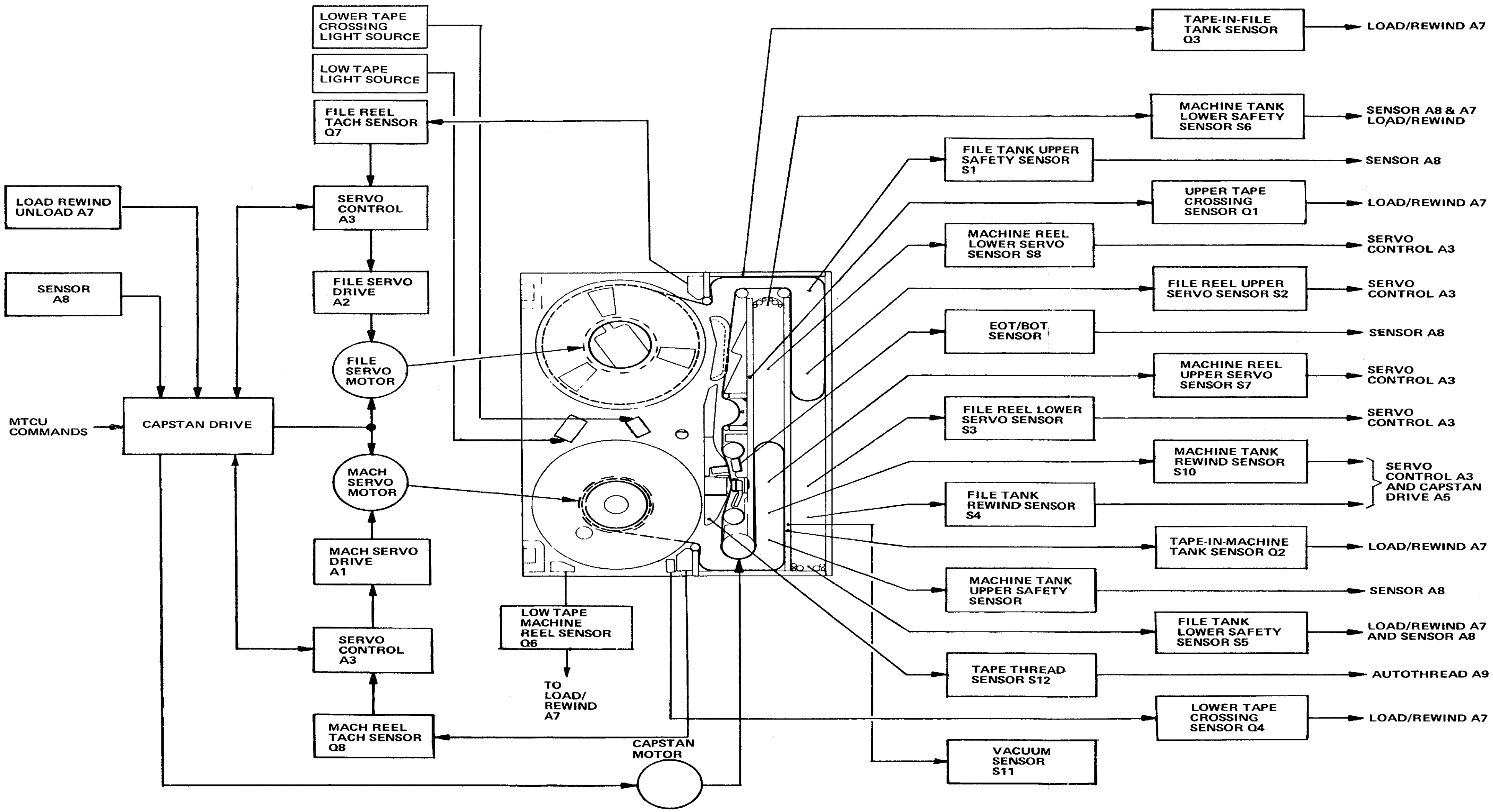


Figure 4-1. Electromechanical Functional Diagram

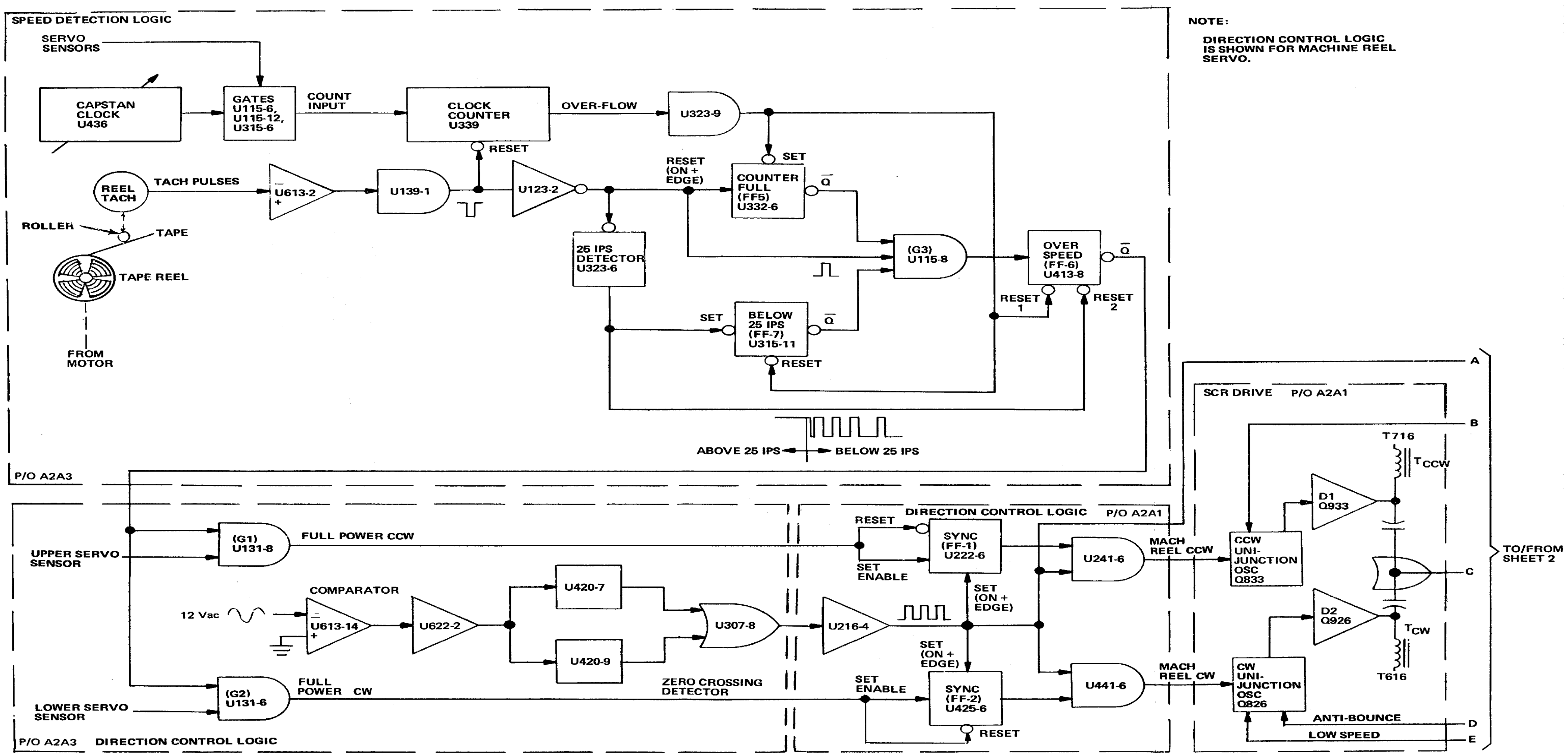


Figure 4-5. Reel Servosystem Logic Diagram (Sheet 1 of 2)

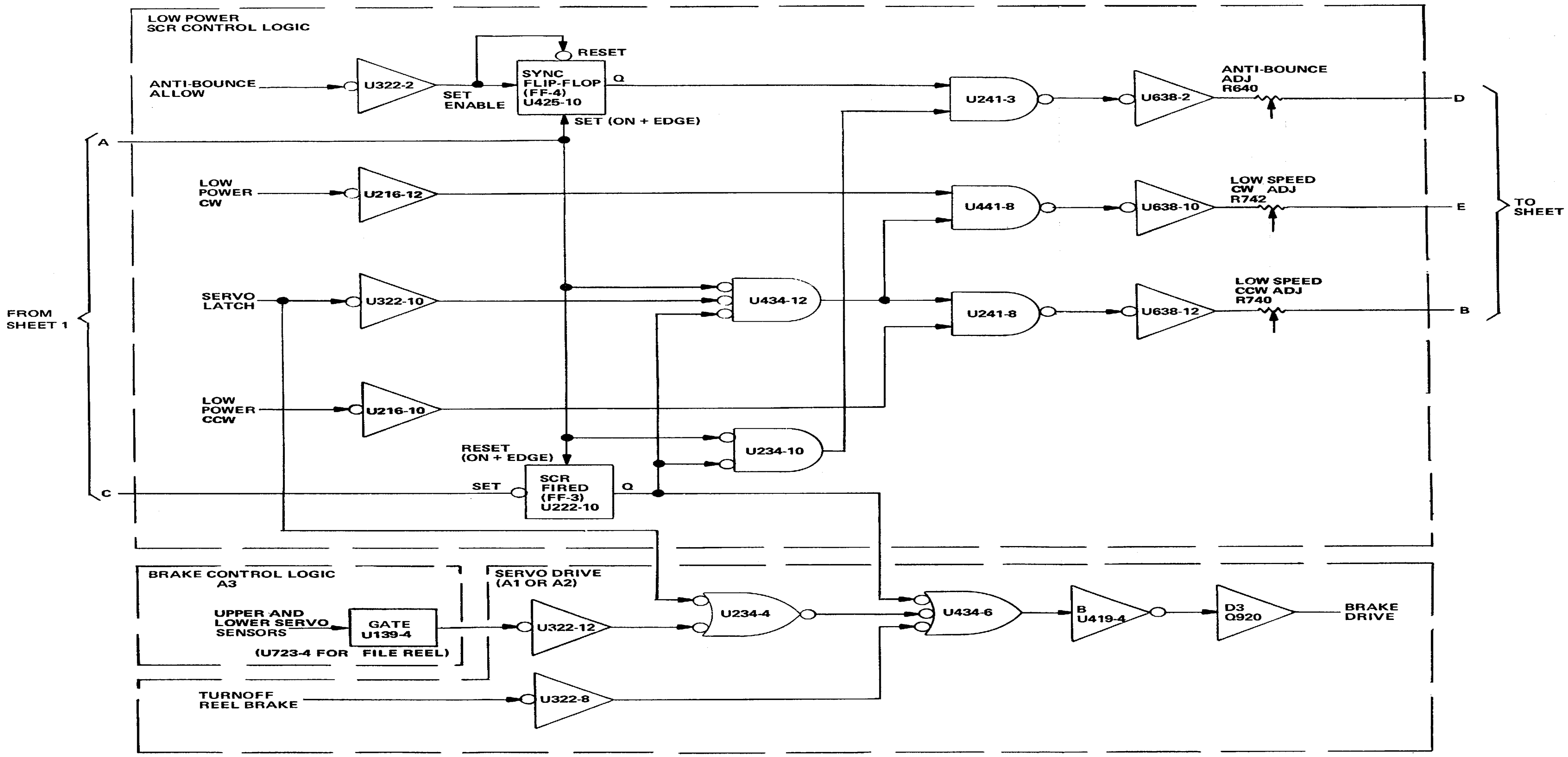
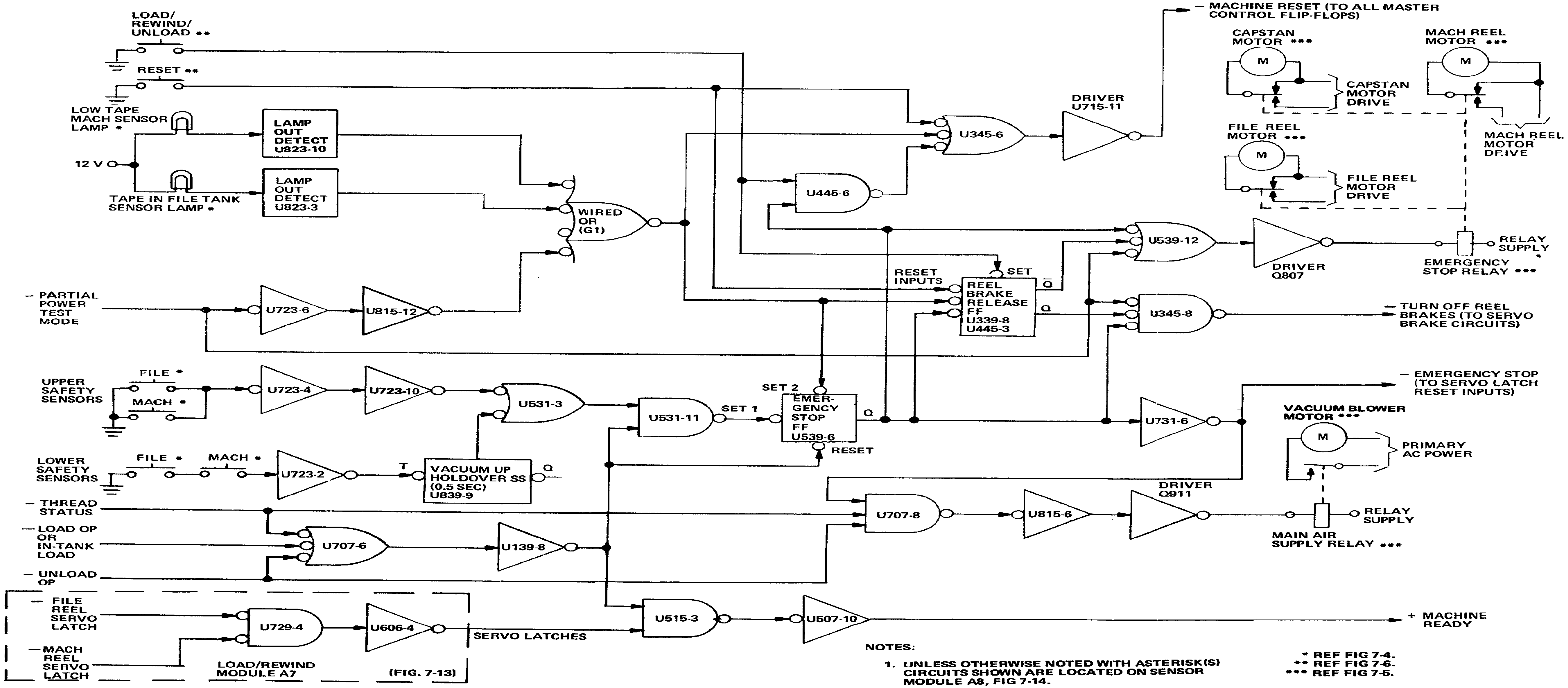


Figure 4-5. Reel Servosystem Logic Diagram (Sheet 2 of 2)



NOTES:

1. UNLESS OTHERWISE NOTED WITH ASTERISK(S) CIRCUITS SHOWN ARE LOCATED ON SENSOR MODULE A8, FIG 7-14.

* REF FIG 7-4.
** REF FIG 7-6.
*** REF FIG 7-5.

Figure 4-8. Ready System Logic Diagram

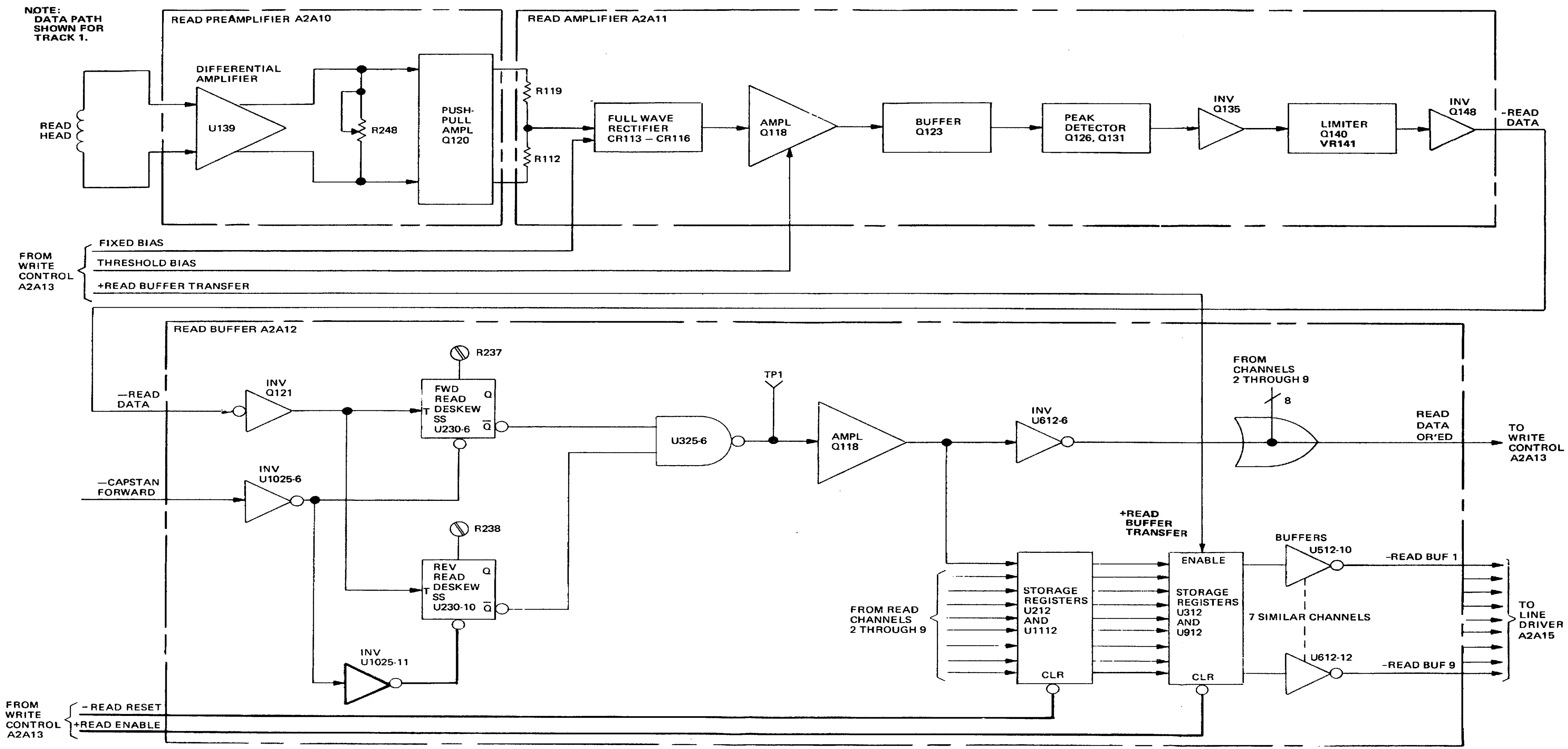


Figure 4-14. Read Data, Functional Block Diagram

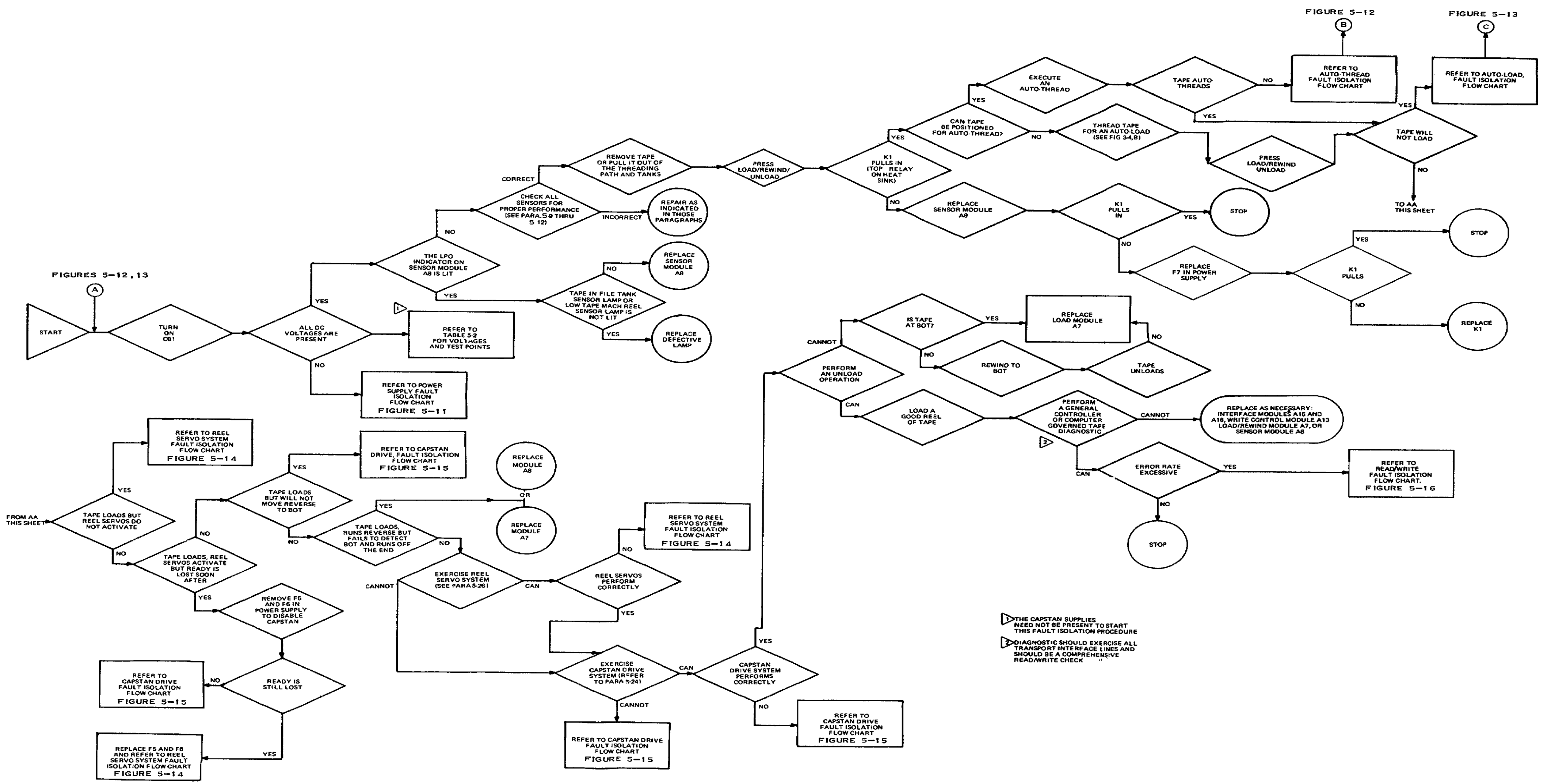


Figure 5-10. Transport, Overall Fault Isolation Flow Chart

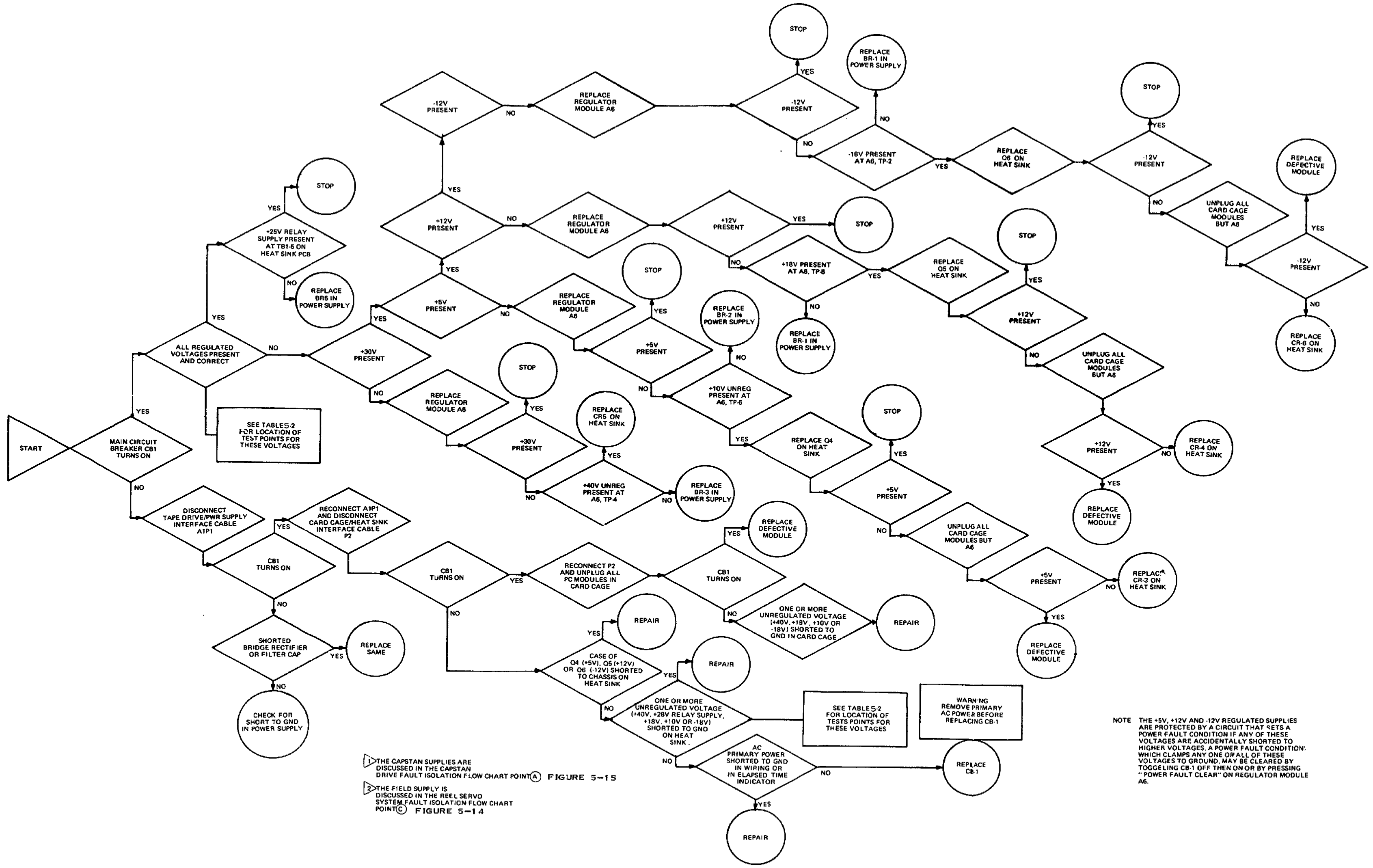


Figure 5-11. Power Supply, Fault Isolation Flow Chart

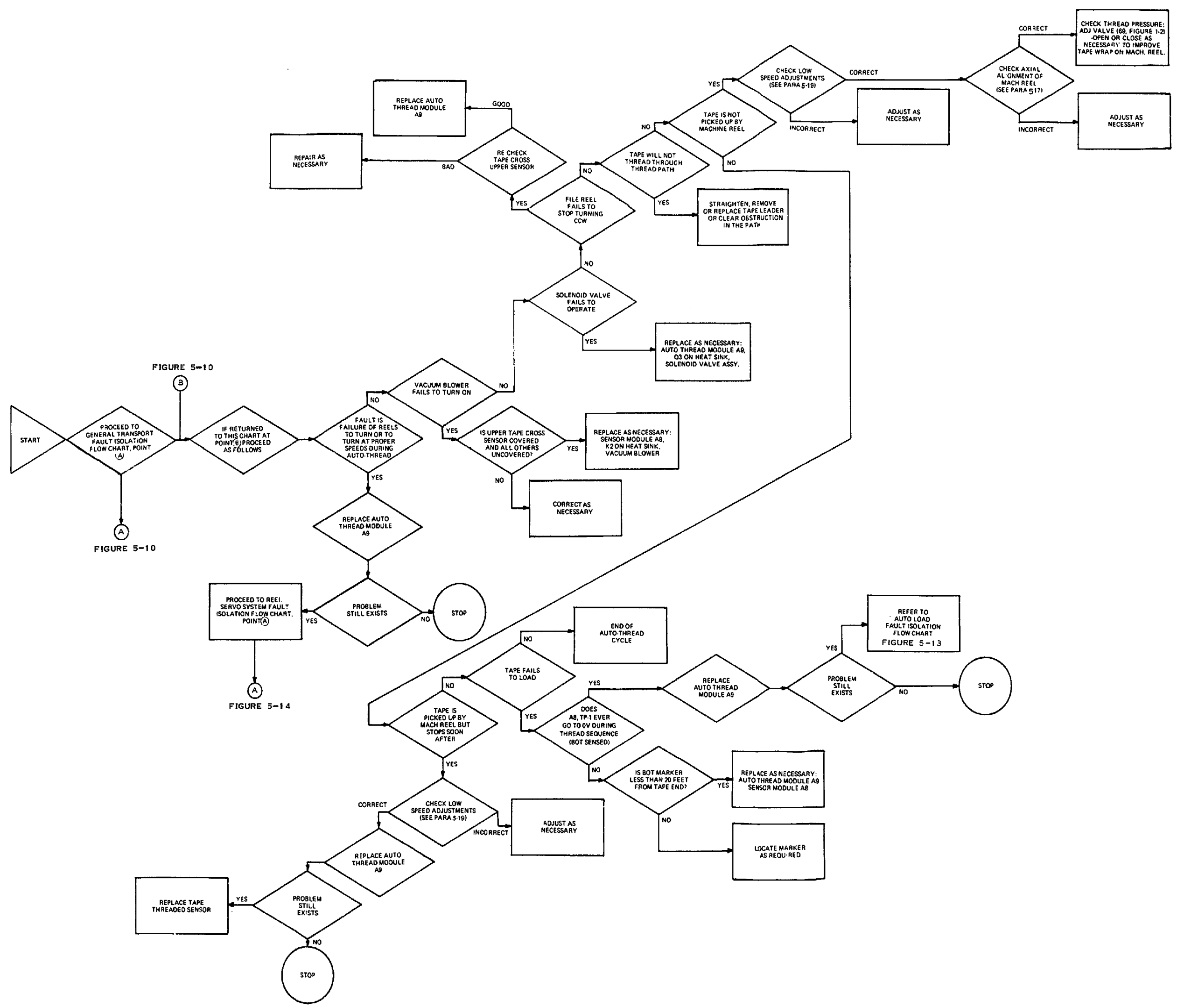


Figure 5-12. Auto Thread,
Fault Isolation Flow Chart

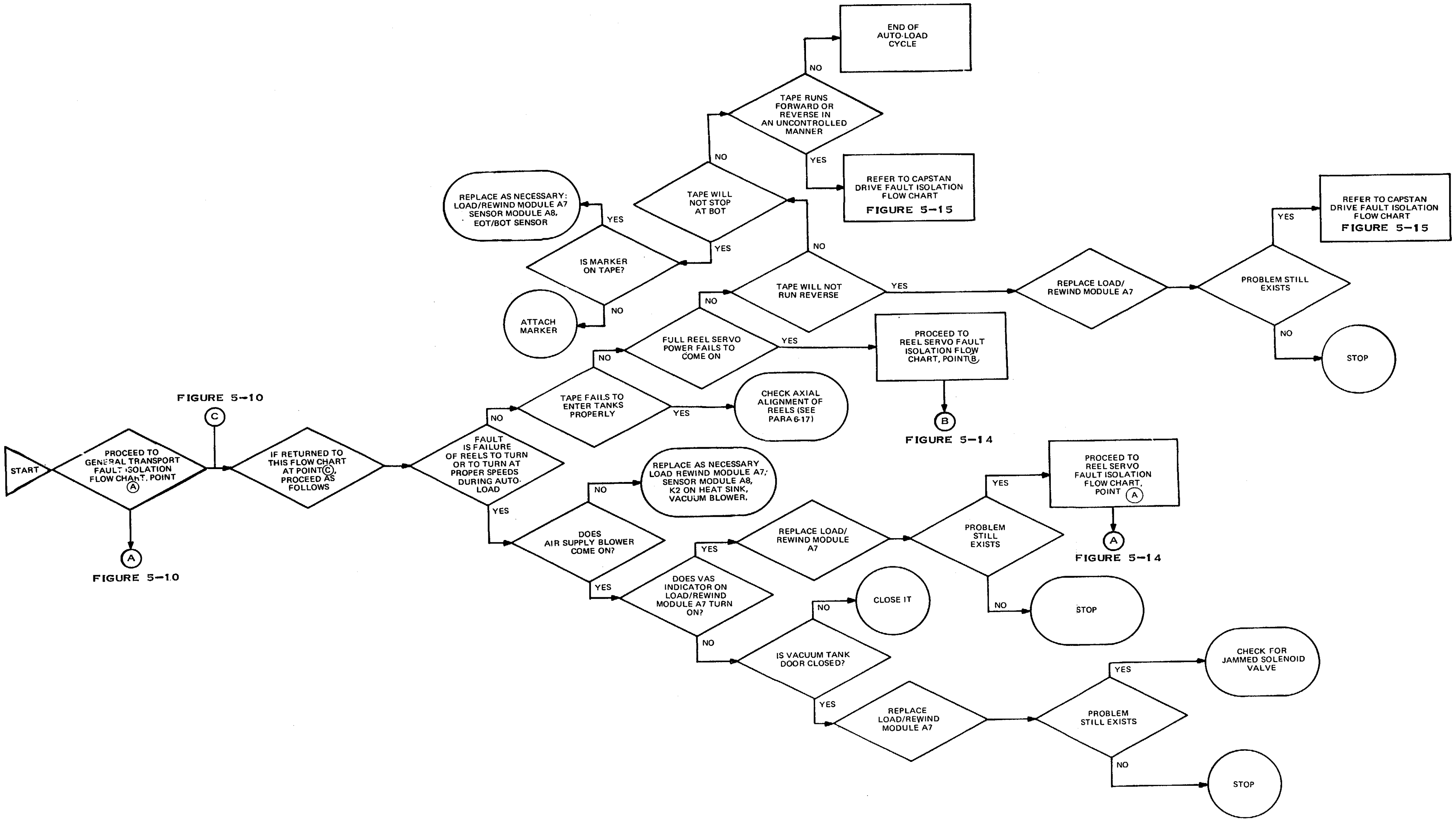


*Figure 5-13. Auto Load,
Fault Isolation Flow Chart*

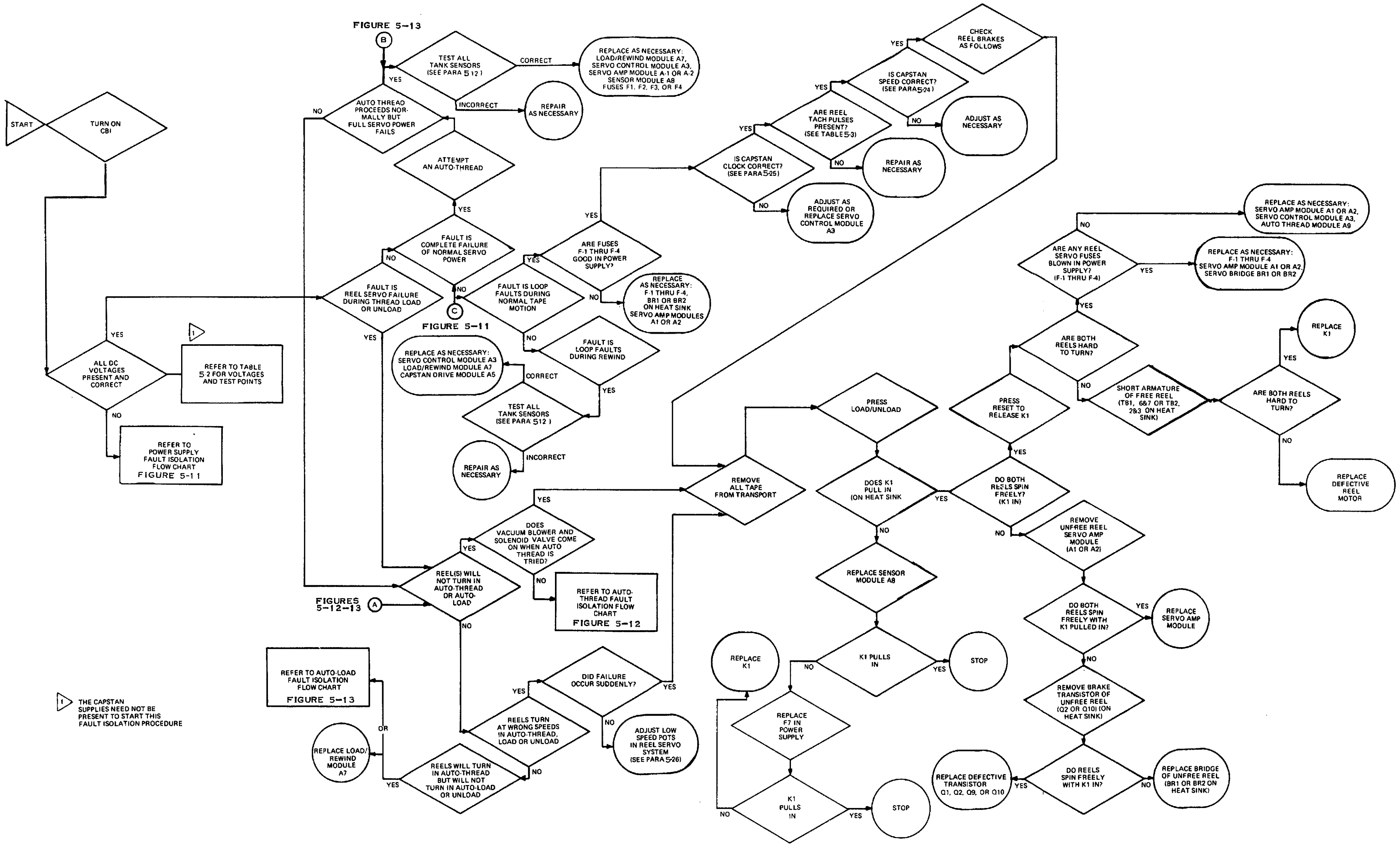


Figure 5-14. Reel Servo System, Fault Isolation Flow Chart

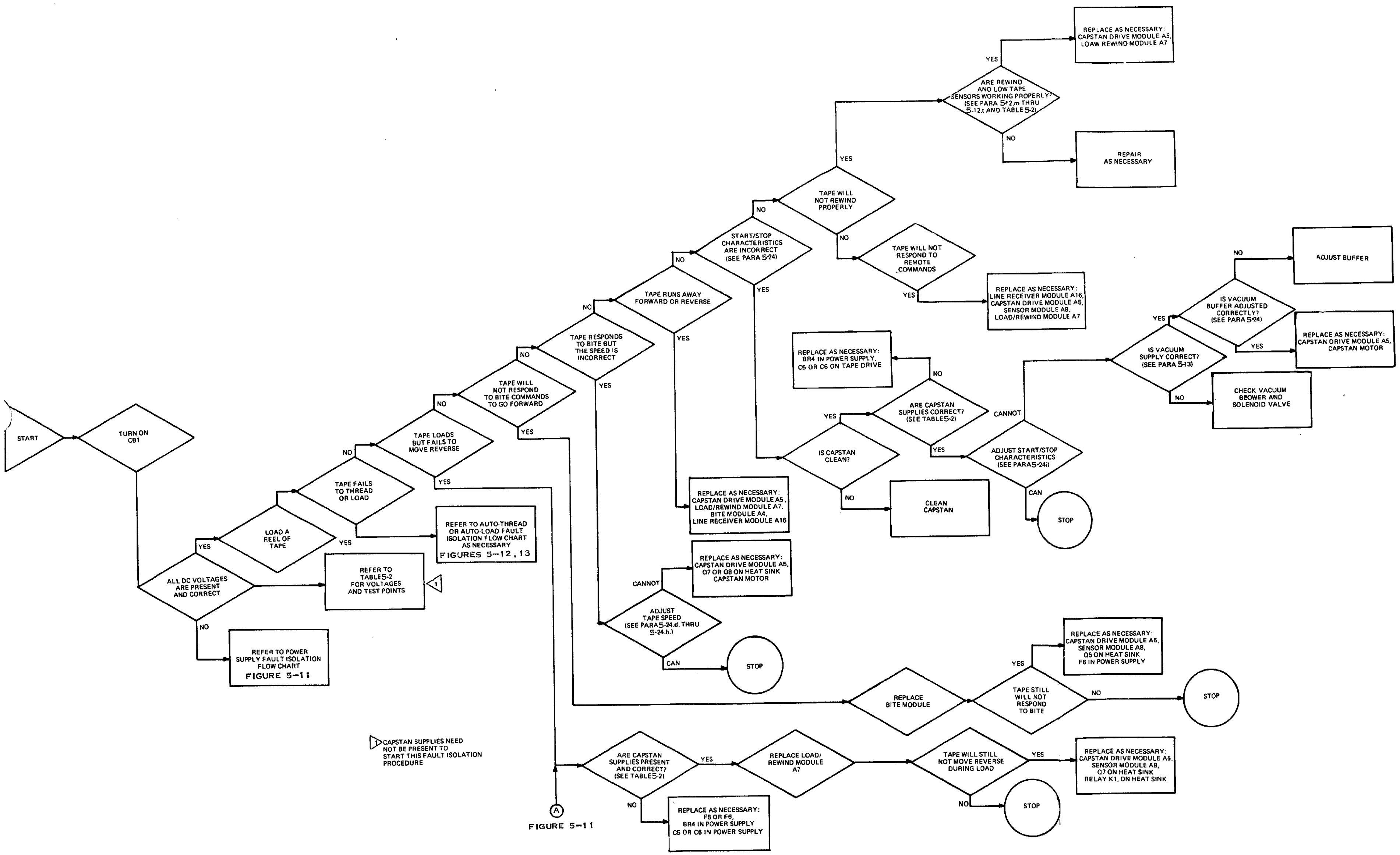


Figure 5-15. Capstan Drive Fault Isolation Flow Chart

TABLE 1. POOR DATA RELIABILITY TROUBLE ANALYSIS

STEP	PROBABLE CAUSE	CORRECTIVE ACTION
1	POOR TAPE	REPLACE TAPE
2	DIRTY HEAD	CLEAN HEAD
3	DIRTY TAPE PATH	CLEAN TAPE PATH
4	DIRTY CAPSTAN	CLEAN CAPSTAN
5	EXCESSIVE SKEW	CHECK FREEDOM OF EDGE GUIDES (FIG. 1-2, 12 & 18)
6	READ GAINS TOO LOW OR TOO HIGH	(SEE PARA. 5-31)
7	THRESHOLD LEVELS INCORRECT	(SEE PARA. 5-33)
8	INCORRECT SKEW COMPENSATION	(SEE PARA 5-35 &5-36)

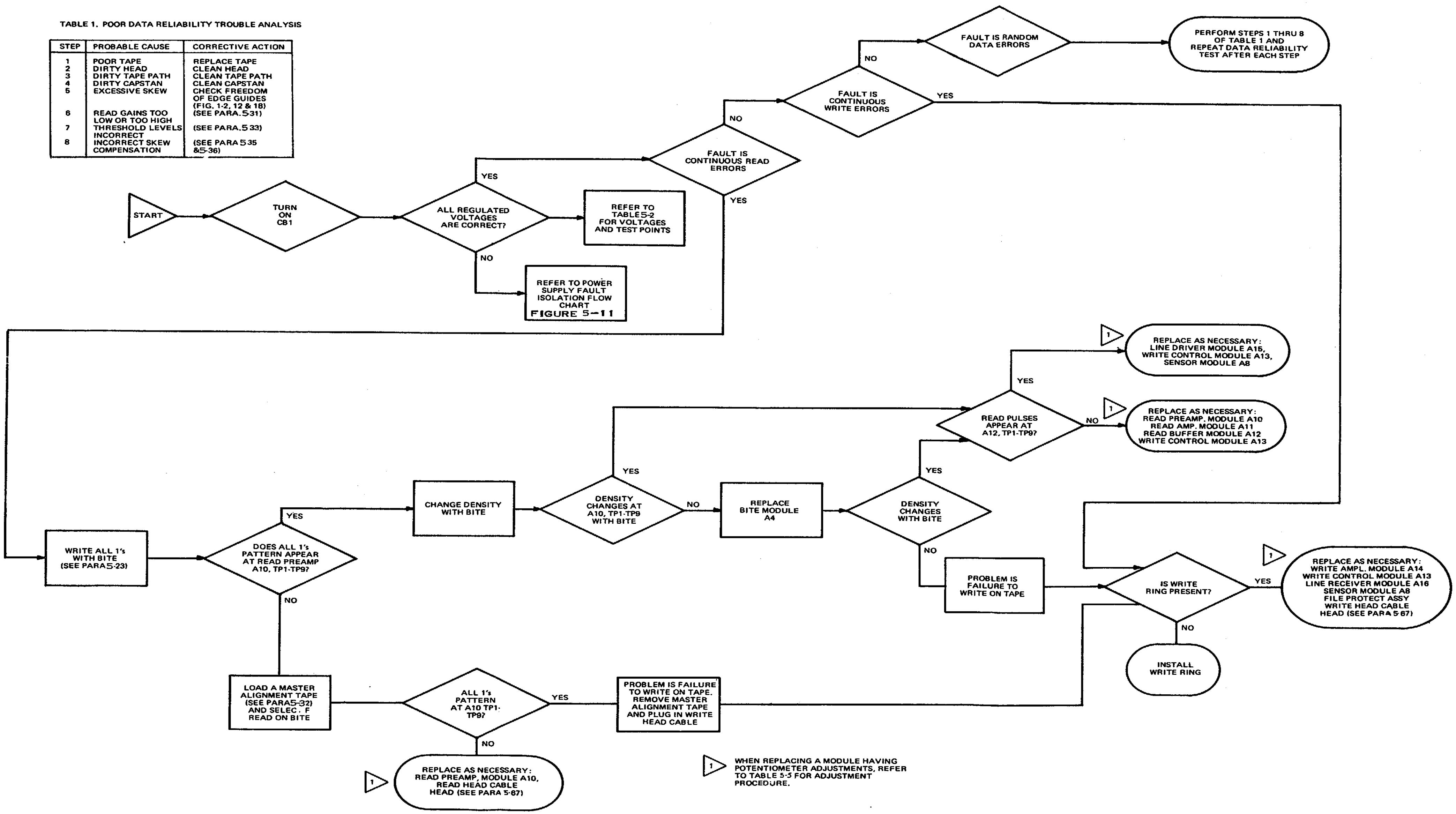
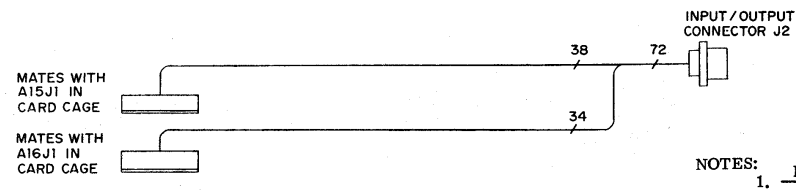


Figure 5-16. Read/Write Circuits, Fault Isolation Flow Chart



NOTES:
1. N/ DENOTES NUMBER OF WIRES.
2. ALL SIGNALS AND RETURNS ARE TWISTED PAIRS.

INTERCONNECTION LIST

J2-	A2A15J1-	A2A16J1-	SIGNAL NAME	J2-	A2A15J1-	A2A16J1-	SIGNAL NAME
1	-	47	Write Data Track 7	41	-	16	Spare
2	-	48	Write Data Track 7 Return	42	-	-	(No Connection)
3	-	33	Write Data Track 6	43	24	-	Transport on Line Return
4	-	34	Write Data Track 6 Return	44	44	-	Read Data Track 4 Return
5	-	19	/Write Enable	45	36	-	End of Tape Return
6	-	20	/Write Enable Return	46	22	-	/Read Strobe Return
7	-	43	/Read Enable	47	41	-	Rewinding
8	26	-	Read Data Track 9 Return	48	-	50	Write Data Track 8 Return
9	49	-	Read Data Track 1	49	-	46	Write Data Track 9 Return
10	20	-	Unit Identification (UI1) Return	50	-	45	Write Data Track 9
11	39	-	Unit Identification (UI0)	51	-	28	Write Data Track 2 Return
12	40	-	Unit Identification (UI0) Return	52	-	37	Write Data Track 4
13	-	-	(No Connection)	53	-	38	Write Data Track 4 Return
14	-	-	(No Connection)	54	-	39	/Write Reset
15	-	-	(No Connection)	55	-	25	/Forward/Reverse
16	-	-	(No Connection)	56	46	-	Read Data Track 3 Return
17	-	-	(No Connection)	57	33	-	Read Data Track 8
18	-	-	(No Connection)	58	18	-	Device Connected Return
19	23	-	Transport On Line	59	17	-	Device Connected
20	38	-	Beginning of Tape Return	60	14	-	Write Lockout Return
21	37	-	Beginning of Tape	61	13	-	Write Lockout
22	21	-	/Read Strobe	62	43	-	Read Data Track 4
23	42	-	Rewinding Return	63	35	-	End of Tape
24	-	49	Write Data Track 8	64	31	-	Read Data Track 7
25	-	30	Write Data Track 1 Return	65	-	18	/Rewind to Load Point Return
26	-	29	Write Data Track 1	66	-	27	Write Data Track 2
27	-	41	/Write Strobe	67	-	24	/Start/Stop Return
28	-	42	/Write Strobe Return	68	-	23	/Start/Stop
29	-	32	Write Data Track 3 Return	69	-	26	/Forward/Reverse Return
30	-	31	Write Data Track 3	70	45	-	Read Data Track 3
31	-	36	Write Data Track 5 Return	71	34	-	Read Data Track 8 Return
32	-	35	Write Data Track 5	72	47	-	Read Data Track 2
33	-	40	/Write Reset Return	73	48	-	Read Data Track 2 Return
34	-	44	/Read Enable Return	74	29	-	Read Data Track 6
35	25	-	Read Data Track 9	75	32	-	Read Data Track 7 Return
36	50	-	Read Data Track 1 Return	76	-	17	/Rewind to Load Point
37	19	-	Unit Identification (UI1)	77	27	-	Read Data Track 5
38	15	-	Spare	78	28	-	Read Data Track 5 Return
39	16	-	Spare Return	79	30	-	Read Data Track 6 Return
40	-	-	Spare				

Figure 6-3. I/O Interface Connector J2, Connection and Wiring Data

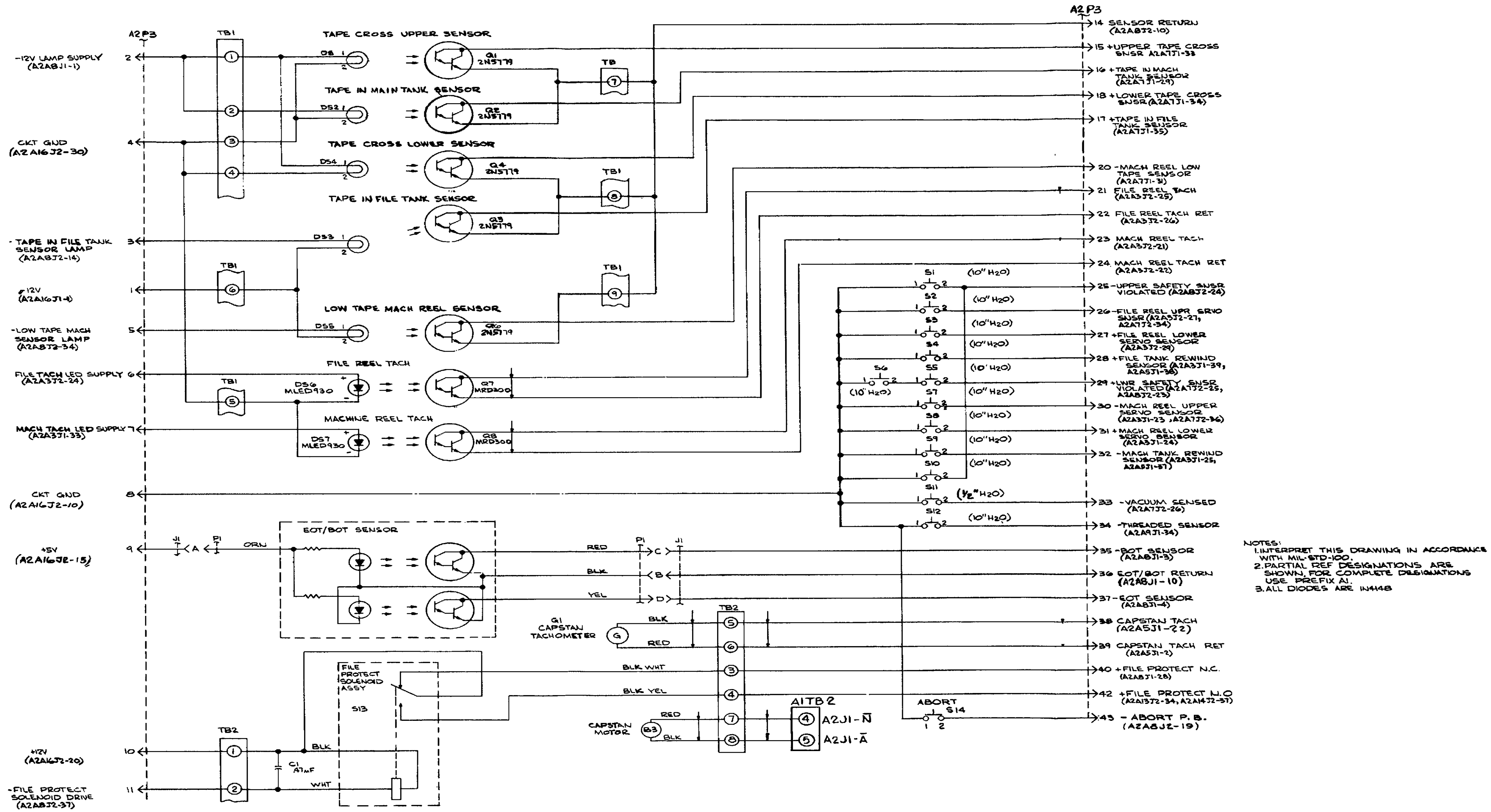
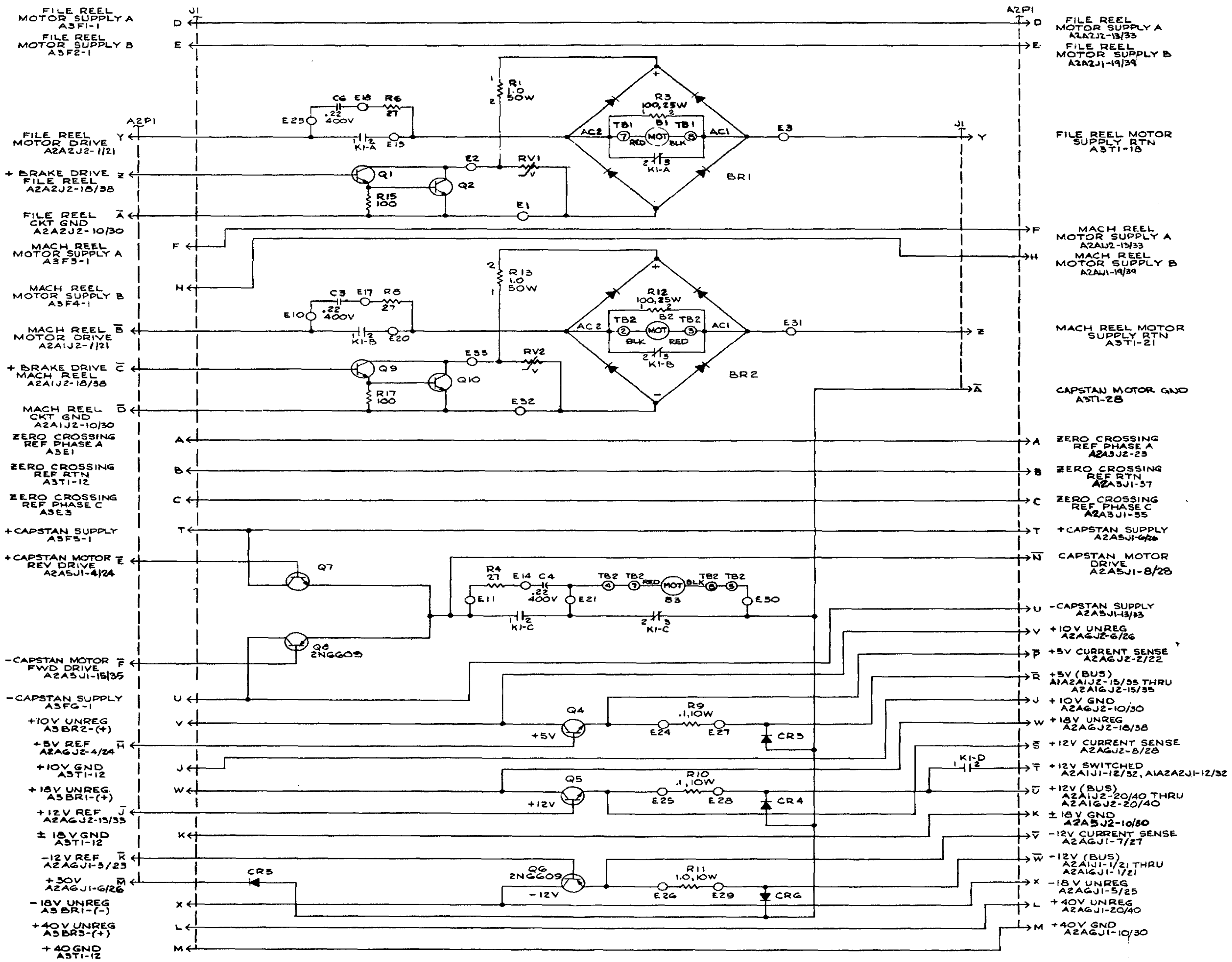


Figure 6-4. Schematic, Tape Drive Sensors



NOTES: UNLESS OTHERWISE SPECIFIED

1 INTERPRET THIS DRAWING IN ACCORDANCE WITH MIL-STD-100.
2 ALL RESISTORS ARE IN OHMS ±5% 1/2W.
3 ALL CAPACITORS ARE IN MICROFARADS ±10%
4 ALL DIODES ARE 1N1202A
5 ALL TRANSISTORS ARE 2N3773
6 PARTIAL REF DESIGNATIONS ARE SHOWN FOR MOST COMPONENTS. FOR COMPLETE DESIGNATIONS USE PREFIX A1A1, EXCEPT FOR THE FOLLOWING: B1,B2,B4,A4,A2P1 & SOURCE/LOAD INFORMATION WHICH ARE PREFIXED A1.

Figure 6-5. Schematic, Tape Drive Power Control (Sheet 1 of 2)

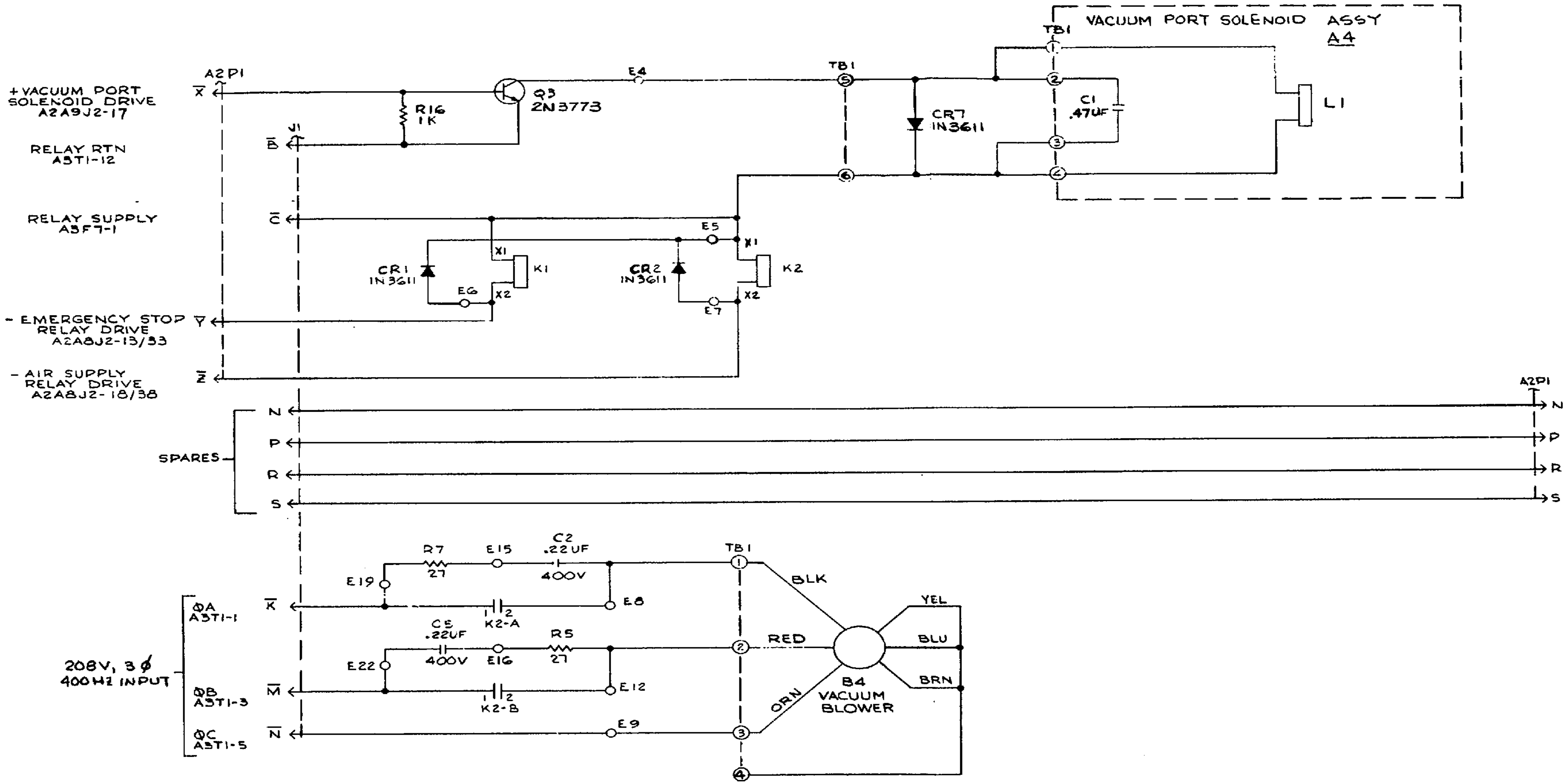
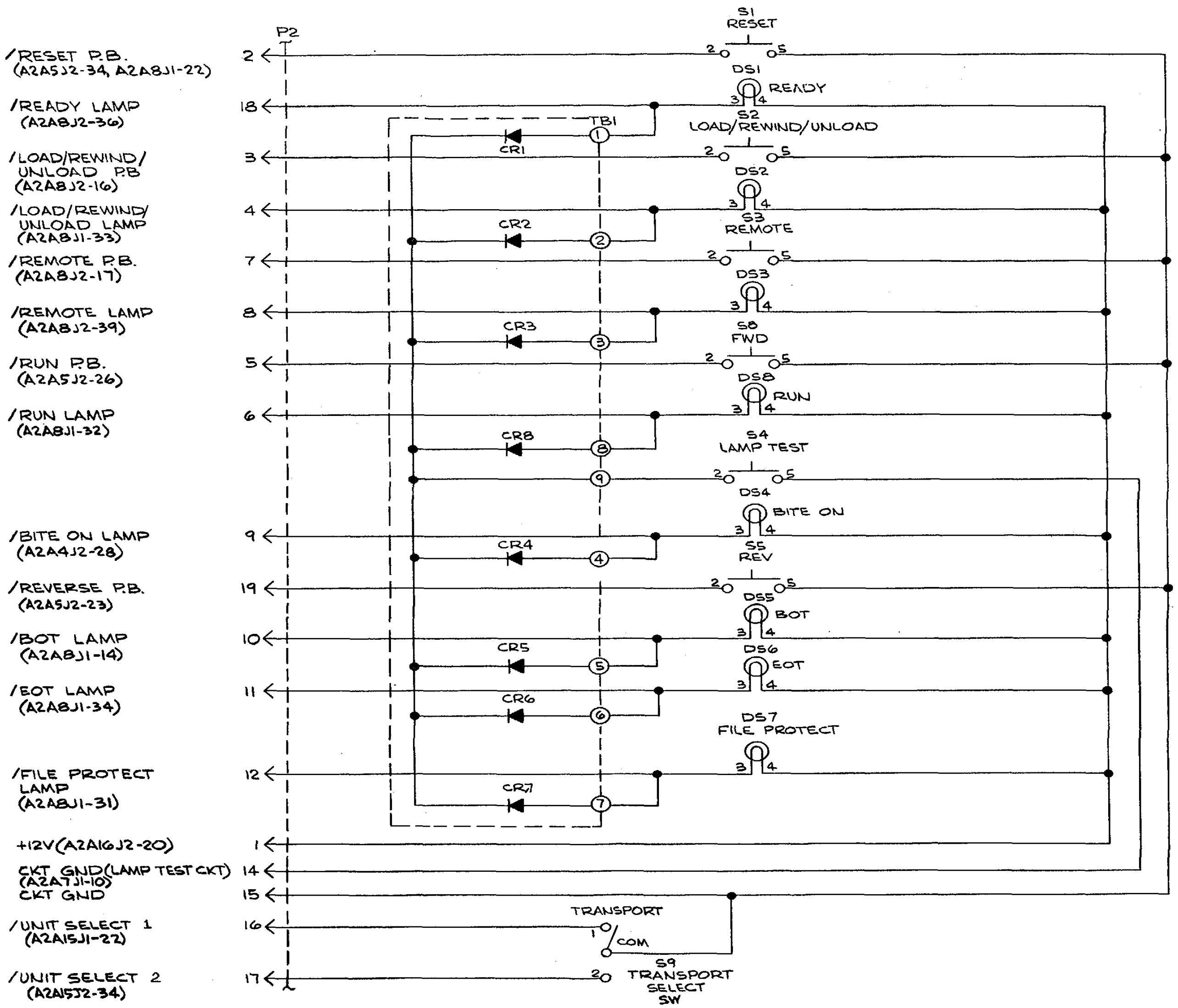
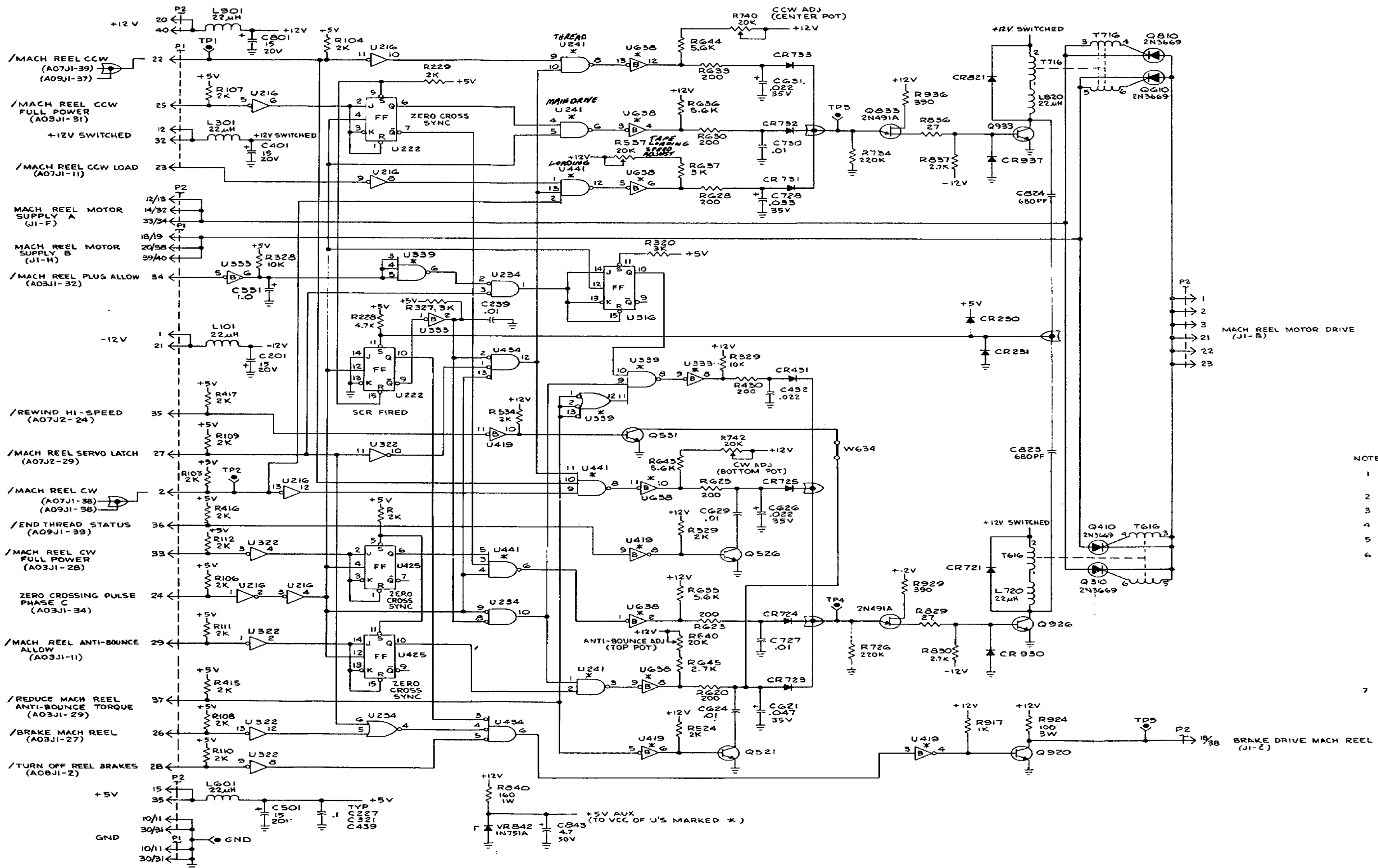


Figure 6-5. Schematic, Tape Drive Power Control (Sheet 2 of 2)



NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL DIODES ARE IN4148
ALL LAMPS ARE #382
2. DS1 IS PART OF S1; (TYPICAL, S1 THRU S8)

Figure 6-6. Schematic, Control Panel



NOTES: UNLESS OTHERWISE SPECIFIED:

1. INTERPRET THIS DRAWING IN ACCORDANCE WITH MIL-STD-100.
2. ALL RESISTORS ARE IN OHMS ±5%, ¼W.
3. ALL CAPACITORS ARE IN MICROFARADS ±10%.
4. ALL DIODES ARE 1N4148.
5. ALL TRANSISTORS ARE 2N2219A.
6. ALL U'S ARE AS FOLLOWS:

TYPE	GND PIN	+5V PIN	REF DESIGNATIONS
5404	7	14	U216, U322
5416	7	14	U333, U419, U638
5400	7	14	U241
5402	7	14	U234
5410	7	14	U339, U441
5427	7	14	U434
9024	8	16	U222, U316, U425

7. PARTIAL REF DESIGNATIONS ARE SHOWN.-FOR COMPLETE DESIGNATIONS USE PREFIX.

Figure 6-7. Schematic, Machine Reel Servo Drive Module A1

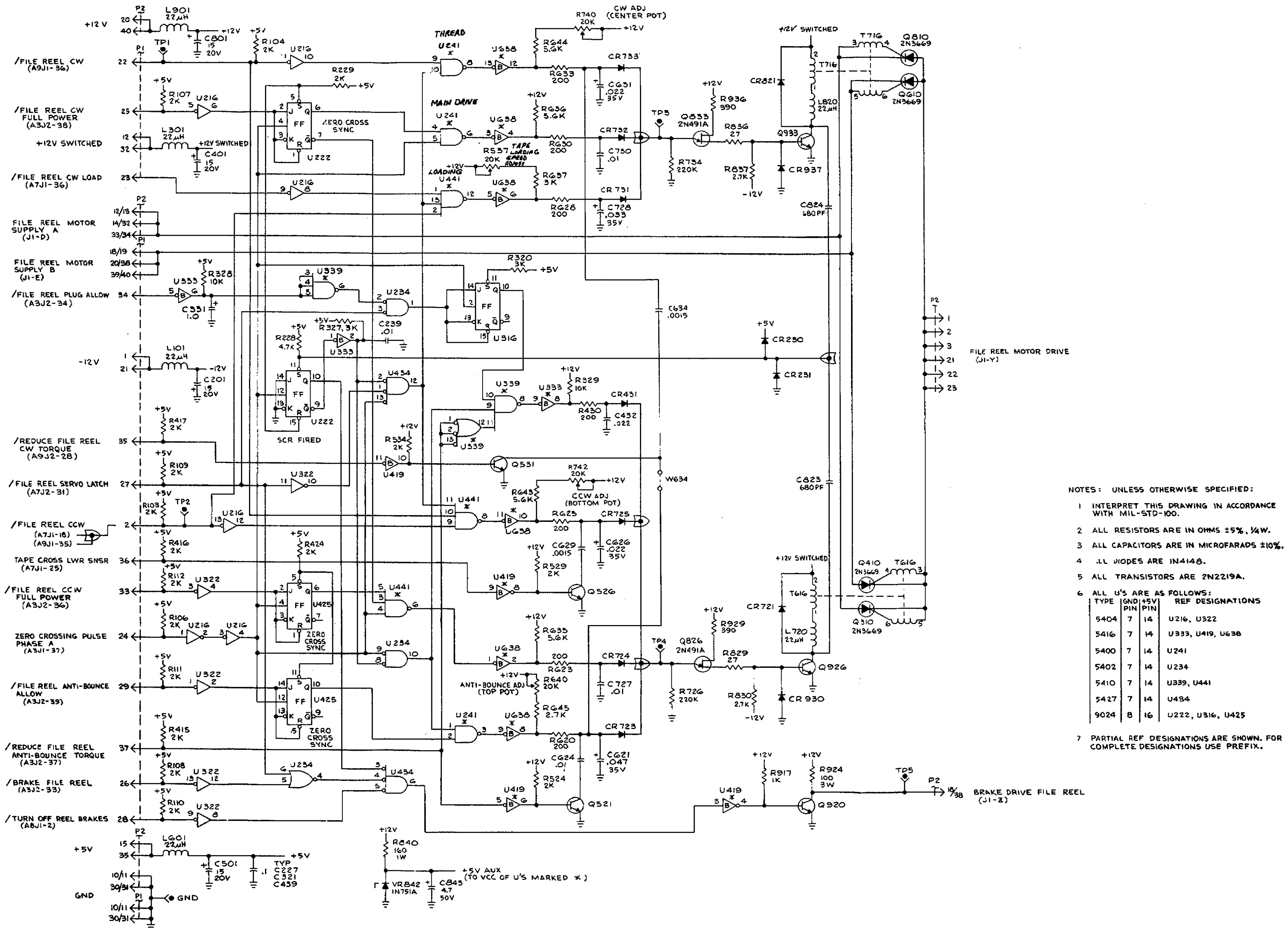
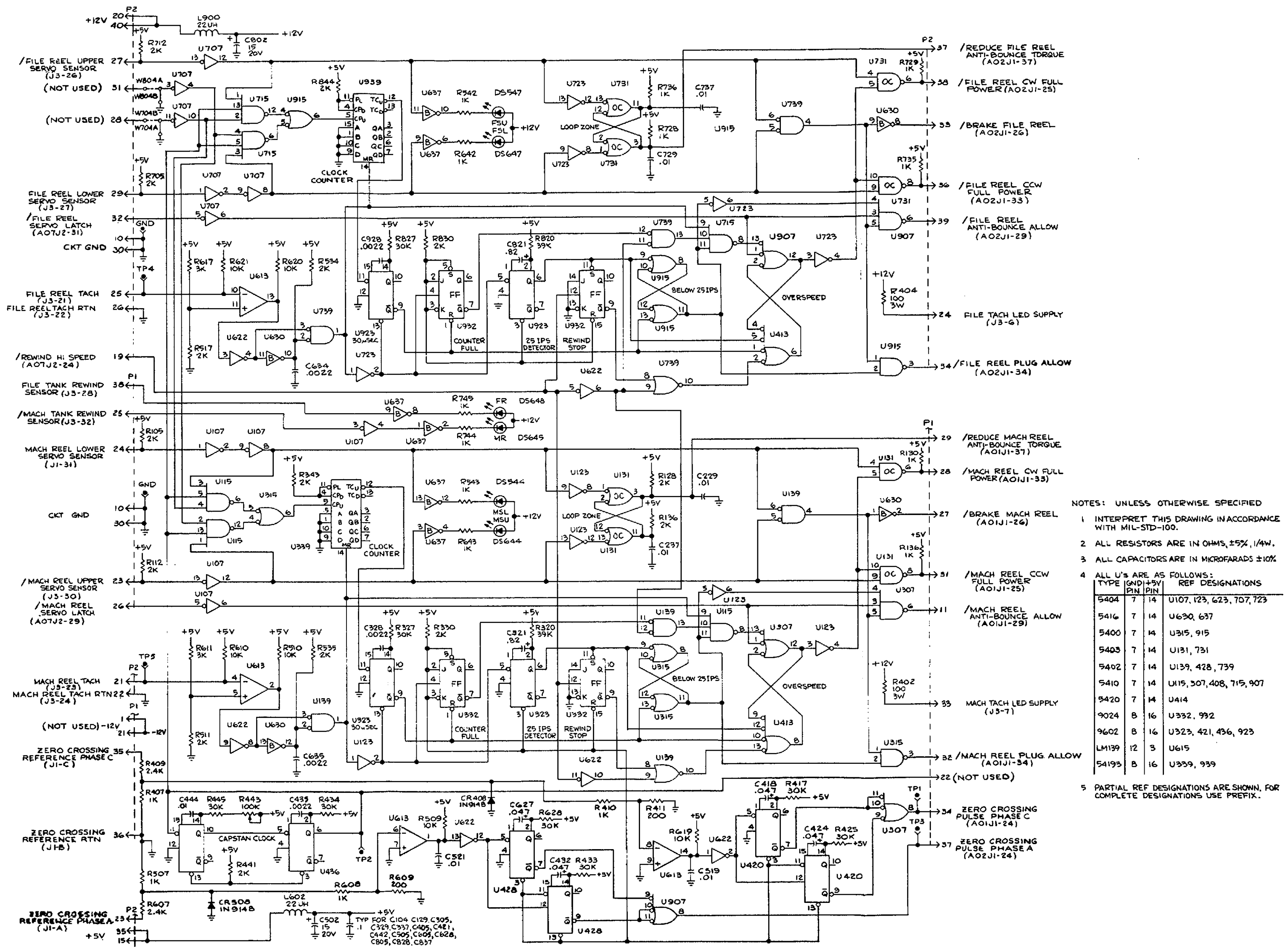


Figure 6-8. Schematic, File Reel Servo Drive Module A2



NOTES: UNLESS OTHERWISE SPECIFIED

1 INTERPRET THIS DRAWING IN ACCORDANCE WITH MIL-STD-100.

2 ALL RESISTORS ARE IN OHMS, ±5%, 1/4W.

3 ALL CAPACITORS ARE IN MICROFARADS ±10%

4 ALL U's ARE AS FOLLOWS:

TYPE	GND PIN	+5V PIN	REF DESIGNATIONS
5404	7	14	U107, 123, 623, 707, 723
5416	7	14	U630, 637
5400	7	14	U315, 915
5403	7	14	U131, 731
5402	7	14	U139, 428, 739
5410	7	14	U115, 307, 408, 715, 907
5420	7	14	U414
9024	8	16	U332, 932
9602	8	16	U323, 421, 436, 923
LM139	12	3	U615
54193	8	16	U339, 939

5 PARTIAL REF DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATIONS USE PREFIX.

Figure 6-9. Schematic, Servo Control Module A3

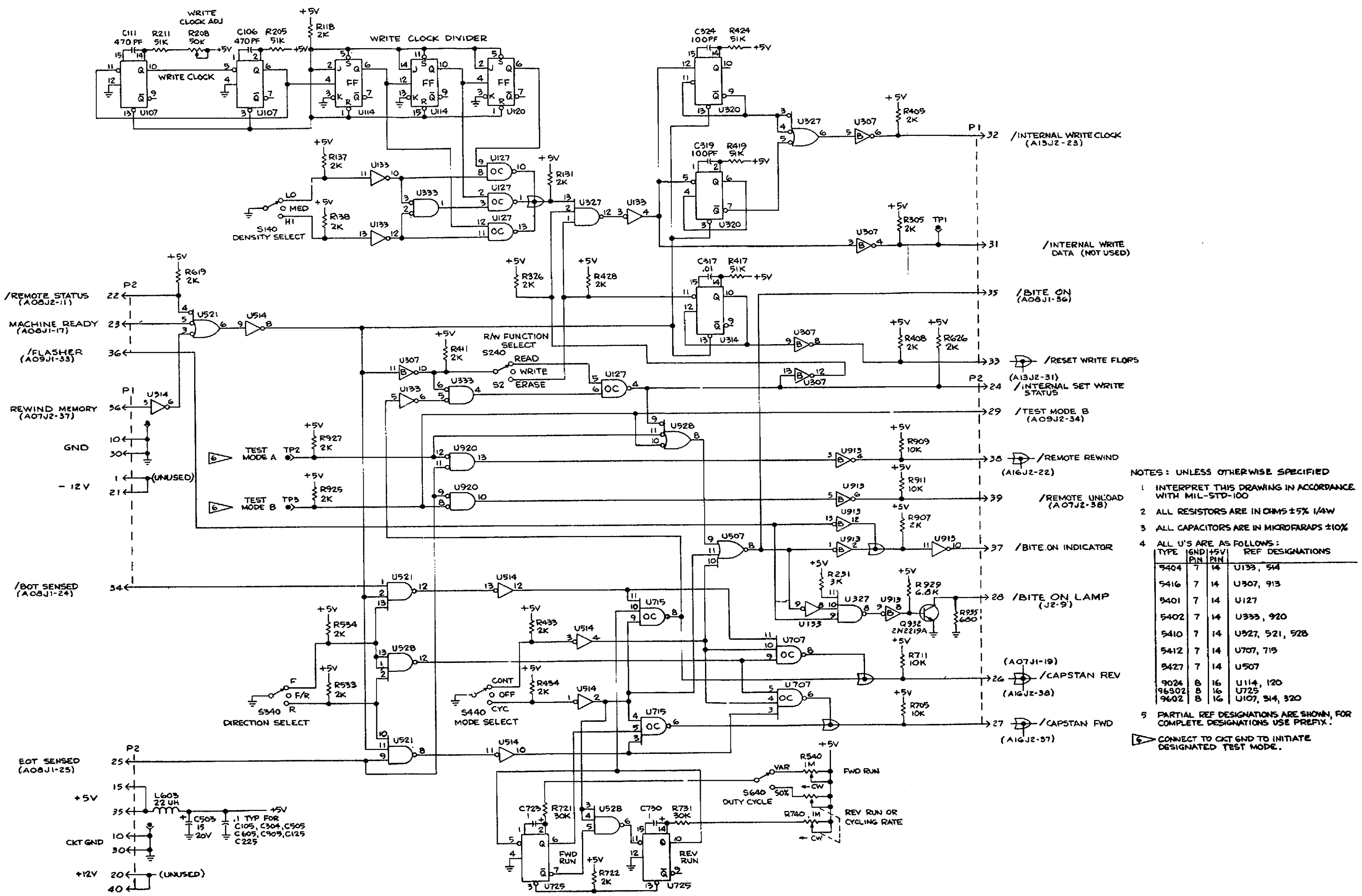
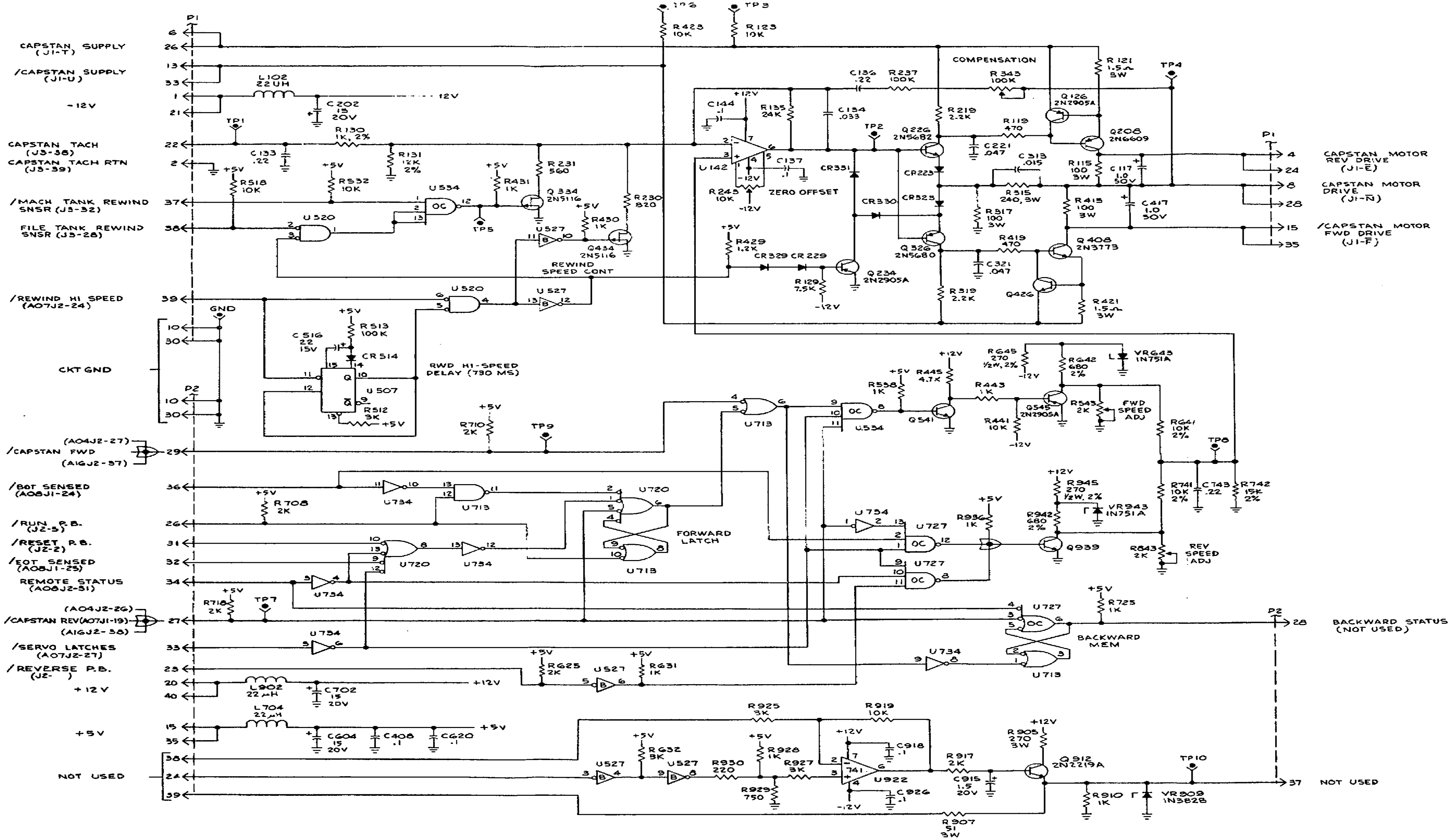


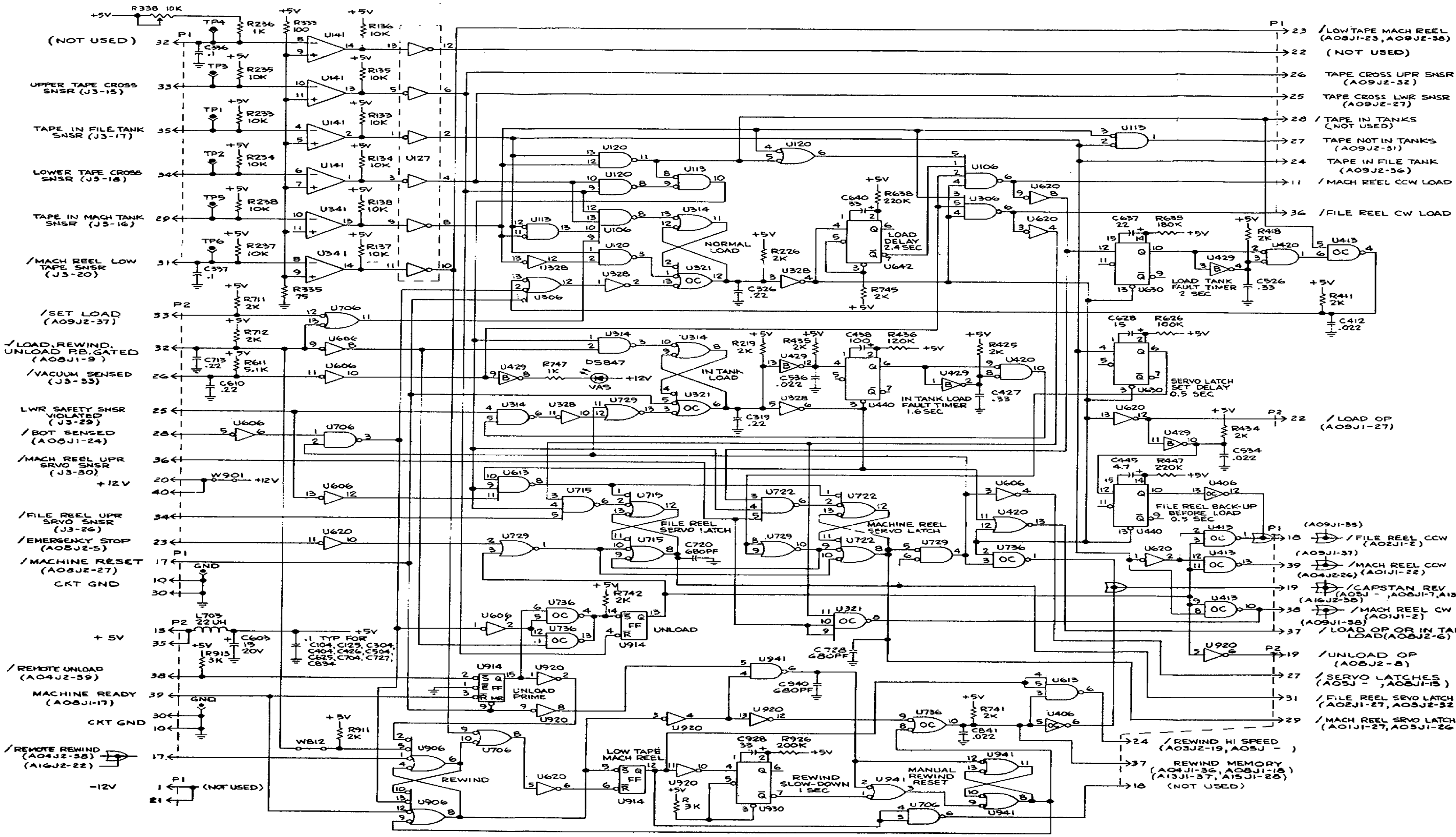
Figure 6-10. Schematic, Built-In Test Equipment Module A4



NOTES: UNLESS OTHERWISE SPECIFIED:
1. INTERPRET THIS DRAWING IN ACCORDANCE WITH MIL-STD-100.
2. ALL RESISTORS ARE IN OHMS ±5%, 1/4W.
3 ALL CAPACITORS ARE IN MICROFARADS ±10%.
4. ALL TRANSISTORS ARE 2N2219A.
5. ALL DIODES ARE 1N4148.
6 ALL U'S ARE AS FOLLOWS:

TYPE	GND PIN	+5V PIN	REF DESIGNATIONS
5404	7	14	U734
5416	7	14	U527
5400	7	14	U713
5402	7	14	U520
5412	7	14	U534,727
5420	7	14	U720
96L02	8	16	U507
μA741	—	—	U142,922

Figure 6-11. Schematic, Capstan Drive and Field Regulator Module A5



NOTES : UNLESS OTHERWISE SPECIFIED

1 INTERPRET THIS DRAWING IN ACCORDANCE WITH MIL-STD-100.

2 ALL RESISTORS ARE IN OHMS ±5% 1/4W.

3 ALL CAPACITORS ARE IN MICROFARADS ±10%

4 ALL U's ARE AS FOLLOWS:

TYPE	GND PIN	+5V PIN	REF DESIGNATIONS
5404	7	14	U127, 328, 606, 620, 920
5405	7	14	U406
5416	7	14	U429
5400	7	14	U120, 314, 706, 941
5401	7	14	U413, 736
5402	7	14	U113, 420, 729
5410	7	14	U306, 613, 715, 722
5412	7	14	U321
5420	7	14	U106, 906
9314	8	16	U914
96L02	8	16	U440, 630, 642, 930
LM139	12	3	U141, 341

5 PARTIAL REF DESIGNATIONS ARE SHOWN, FOR COMPLETE DESIGNATIONS USE PREFIX.

Figure 6-12. Schematic, Power Supply Regulators Module A6

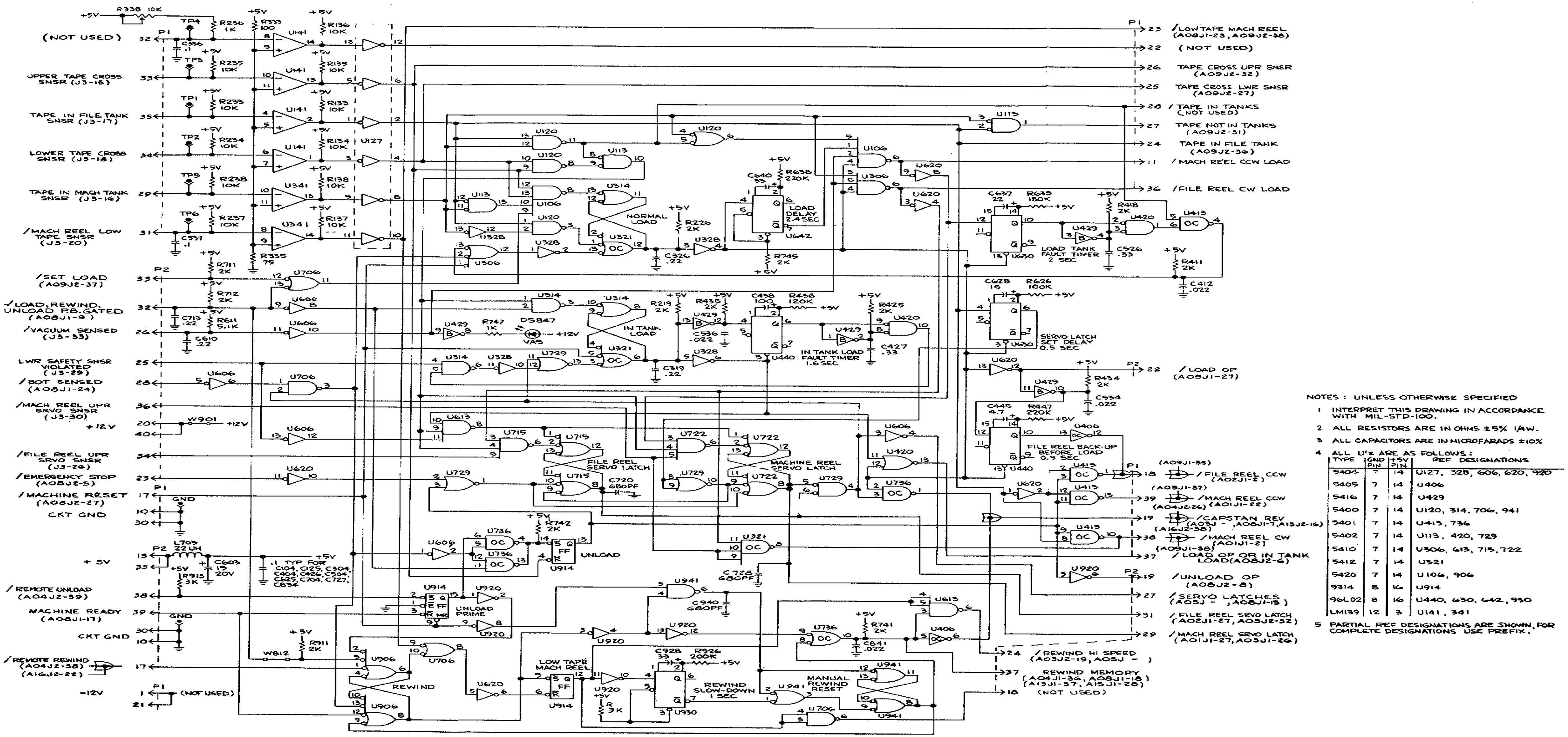
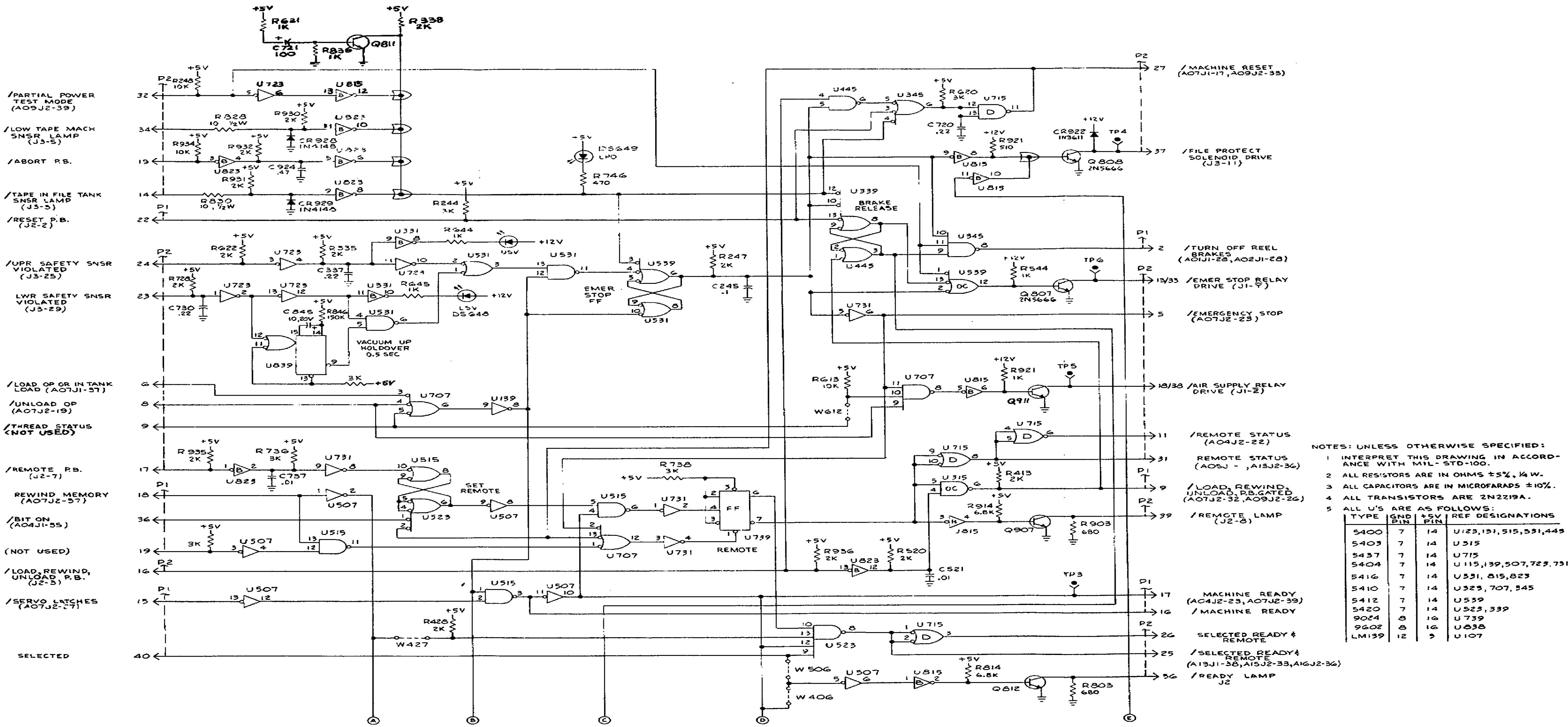


Figure 6-13. Schematic, Load/Rewind Module A7



TYPE	GND PIN	+5V PIN	REF DESIGNATIONS
5400	7	14	U123, 131, 515, 531, 445
5403	7	14	U315
5437	7	14	U715
5404	7	14	U115, 139, 507, 723, 731
5416	7	14	U331, 815, 823
5410	7	14	U325, 707, 345
5412	7	14	U539
5420	7	14	U523, 339
9024	8	16	U739
9602	8	16	U838
LM139	12	3	U107

Figure 6-14. Schematic, Sensor Module A8 (Sheet 1 of 2)

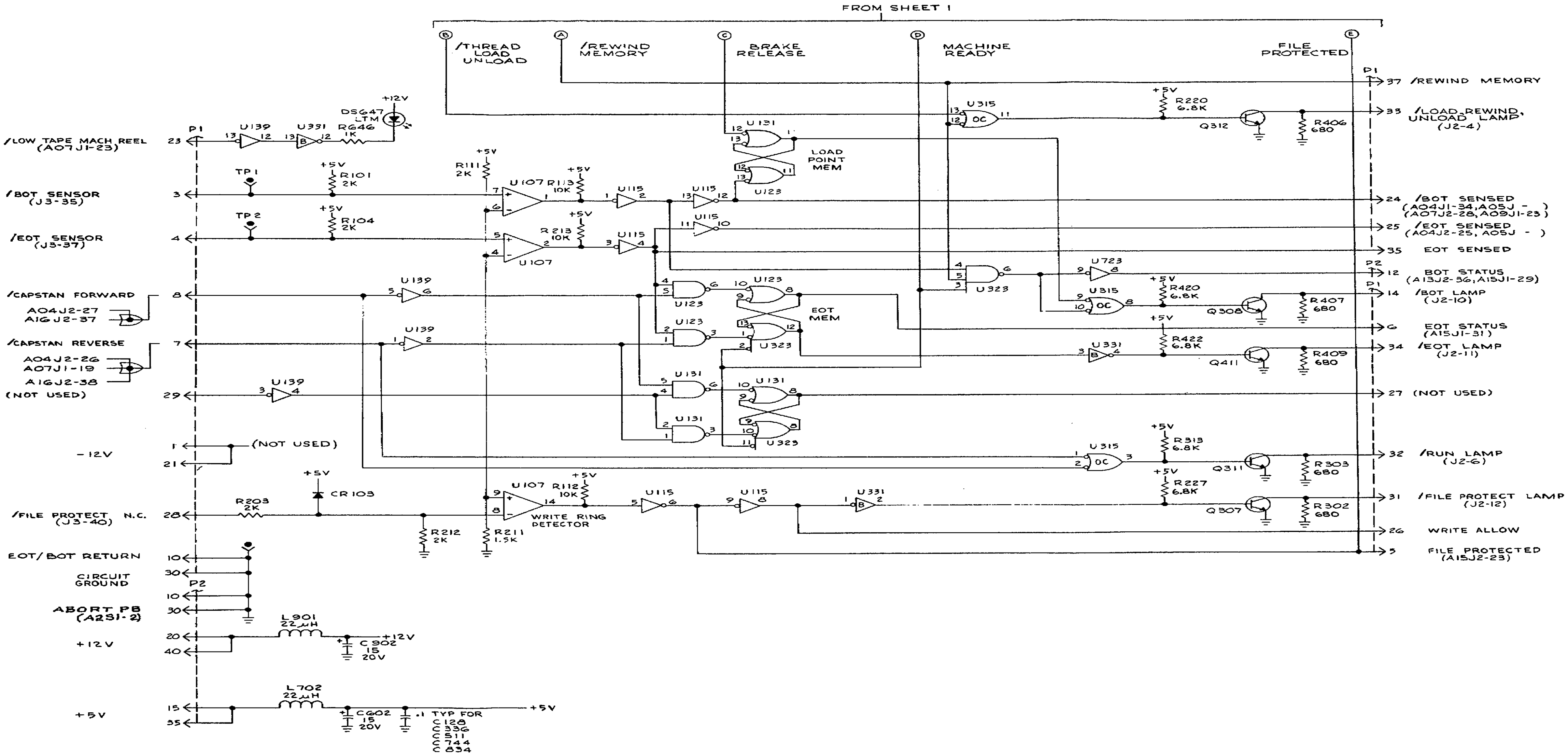
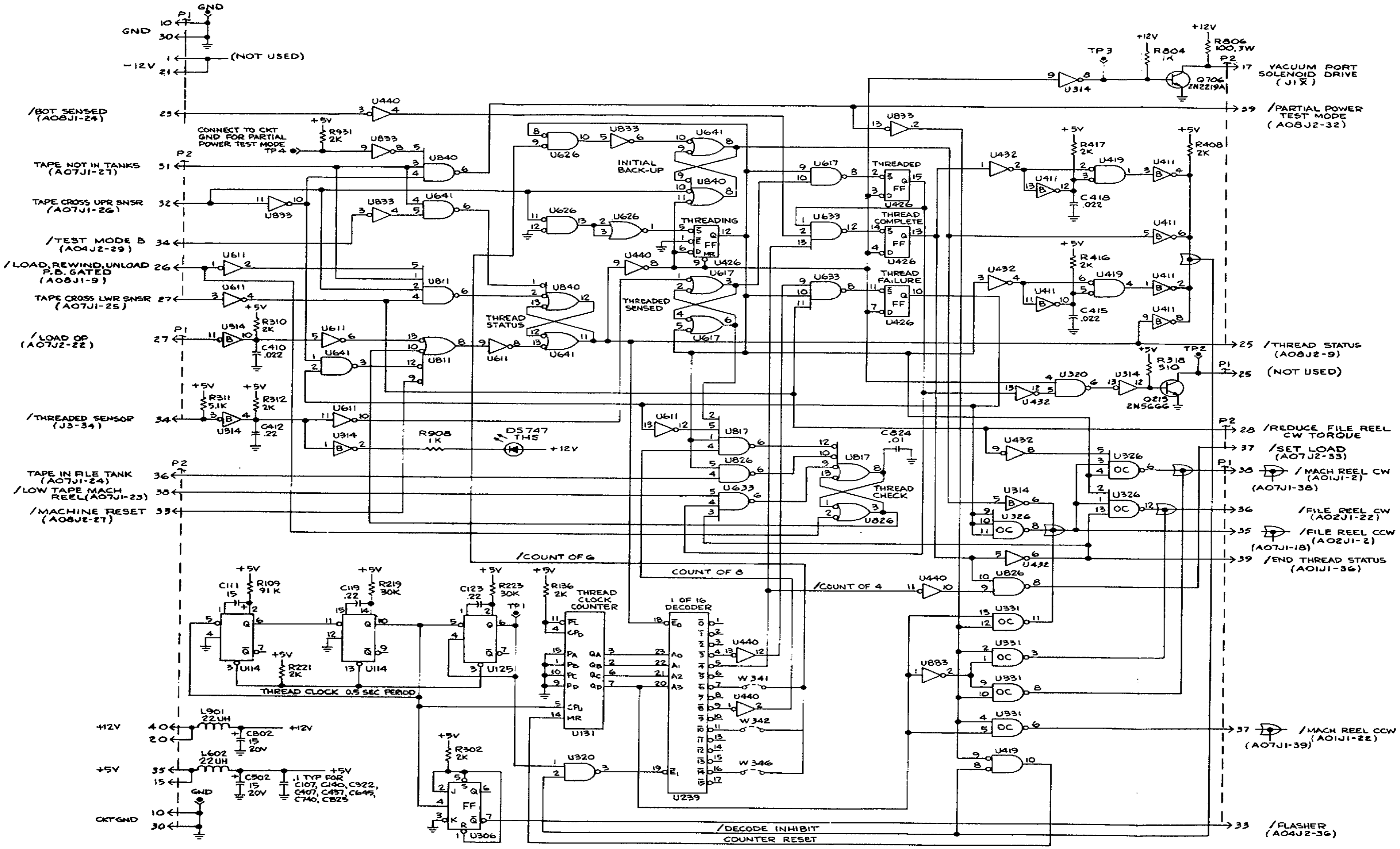


Figure 6-14. Schematic, Sensor Module A8



NOTES: UNLESS OTHERWISE SPECIFIED

1 INTERPRET THIS DRAWING IN ACCORDANCE WITH MIL-STD-100.

2 ALL RESISTORS ARE IN OHMS ±5% 1/4W

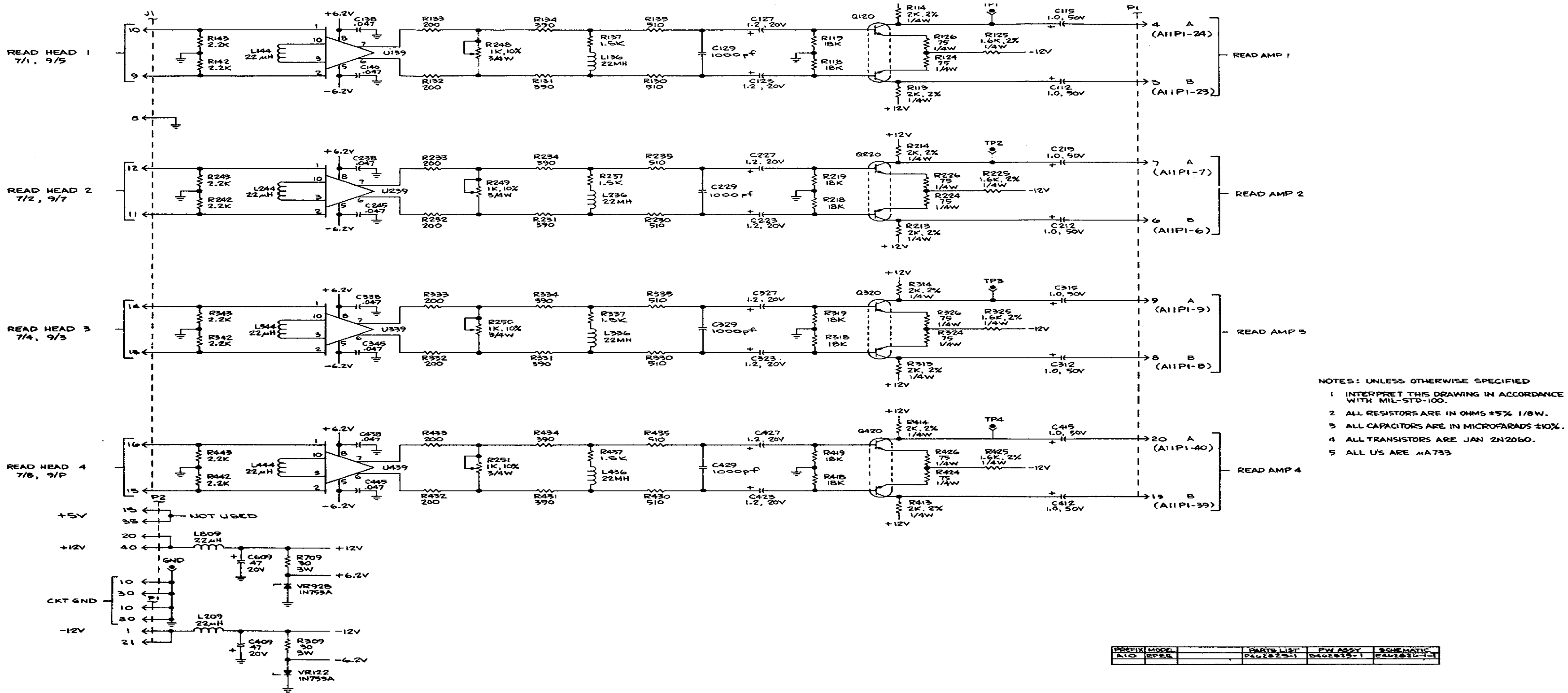
3 ALL CAPACITORS ARE IN MICROFARADS ±10%

4 ALL U'S ARE AS FOLLOWS:

TYPE	GND PIN	+5V PIN	REF DESIGNATIONS
5404	7	14	U432, 440, 611, 833
5416	7	14	U314, 411
5400	7	14	U320, 617, 641, 826
5403	7	14	U331
5402	7	14	U419, 626
5410	7	14	U633, 840
5412	7	14	U326
5420	7	14	U811, 817
54154	12	24	U239
54193	8	16	U131
9024	8	16	U306
9314	8	16	U426
96L02	8	16	U114
9602	8	16	U125

5 PARTIAL REF DESIGNATIONS ARE SHOWN, FOR COMPLETE DESIGNATIONS USE PREFIX.

Figure 6-15. Schematic Auto Thread Module A9



PREFIX	MODEL		PARTS LIST	PW ASSY	SCHEMATIC
A10	RPEG		P462825-1	D462825-1	E462826-1-1

Figure 6-16. Schematic, Read Preamplifier module A10 (Sheet 1 of 2)

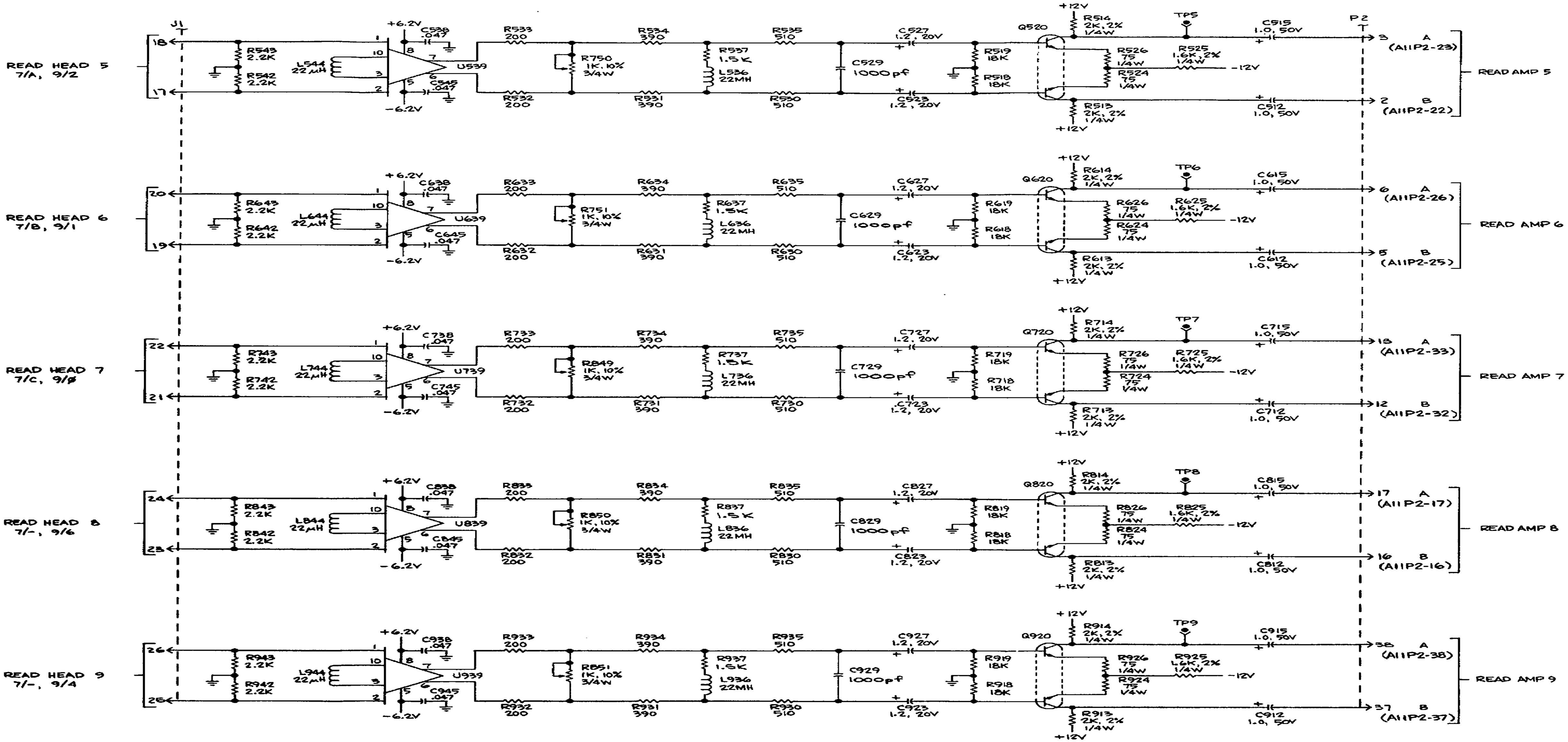
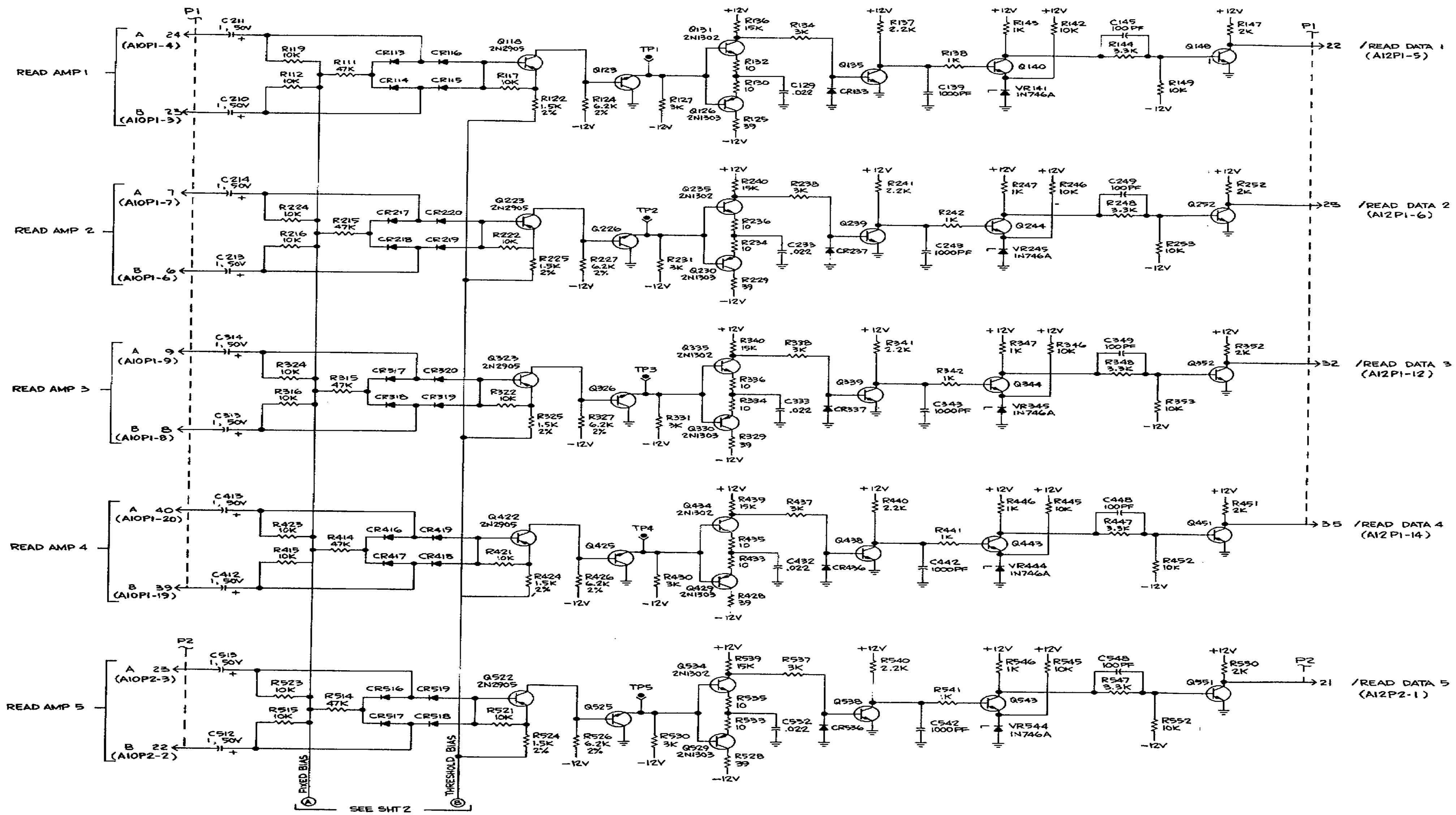


Figure 6-16. Schematic, Read Preamplifier module A10 (Sheet 2 of 2)



NOTES: UNLESS OTHERWISE SPECIFIED
1 INTERPRET THIS DRAWING IN ACCORDANCE WITH MIL-STD-100.
2 ALL RESISTORS ARE IN OHMS ±5% 1/8W.
3 ALL CAPACITORS ARE IN MICROFARADS ±10%.
4 ALL TRANSISTORS ARE 2N2219A.
5 ALL DIODES ARE IN914B.

Figure 6-17. Schematic, Read Amplifier module A11 (Sheet 1 of 2)

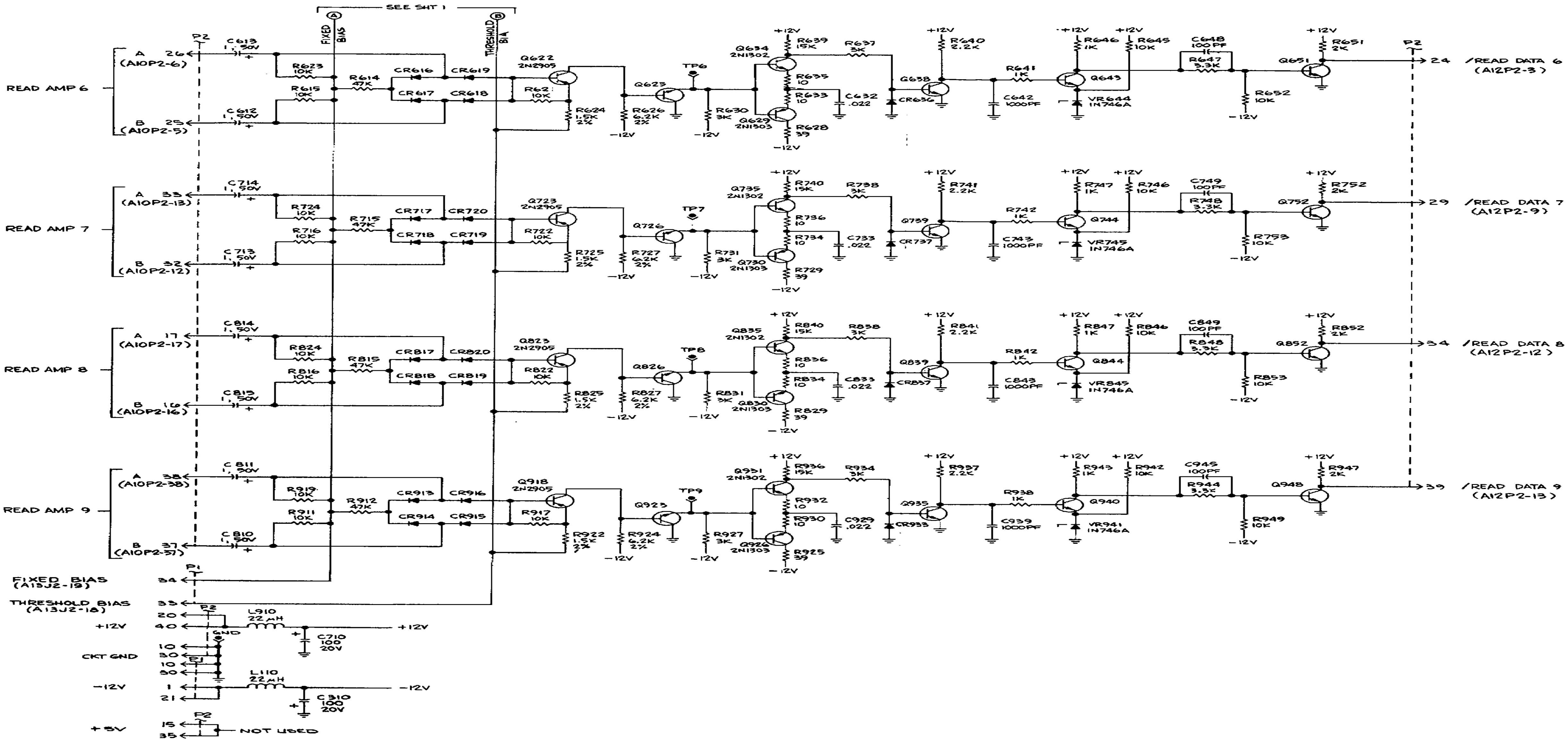
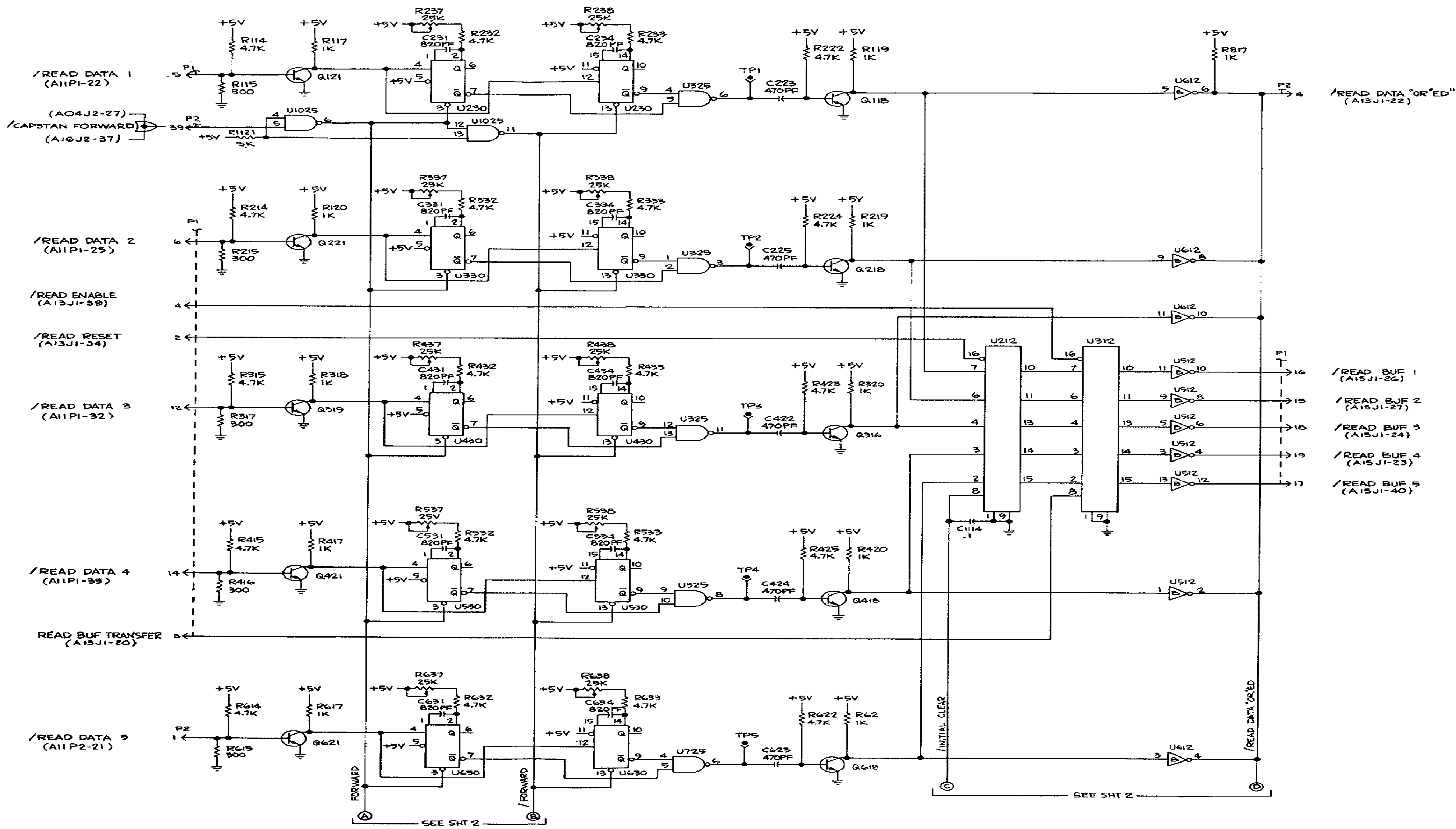


Figure 6-17. Schematic, Read Amplifier module A11 (Sheet 2 of 2)



NOTES: UNLESS OTHERWISE SPECIFIED

1. INTERPRET THIS DRAWING IN ACCORDANCE WITH MIL-STD-100.
2. ALL RESISTORS ARE IN OHMS ±5% 1/8W.
3. ALL CAPACITORS ARE IN MICROFARADS ±10%.
4. ALL TRANSISTORS ARE 2N2219A.
5. ALL U'S ARE AS FOLLOWS:

TYPE	GND PIN	+5V PIN	REF DESIGNATIONS
5416	7	14	U512, 612, 812
5400	7	14	U325, 725, 1025
9602	8	16	U230, 330, 430, 530, 630, 730, 830, 930, 1030
5496	12	5	U212, 312, 912, 1112

6. PARTIAL REF DESIGNATIONS ARE SHOWN, FOR COMPLETE DESIGNATIONS USE PREFIX.

Figure 6-18. Schematic, Read Buffer module A12 (Sheet 1 of 2)

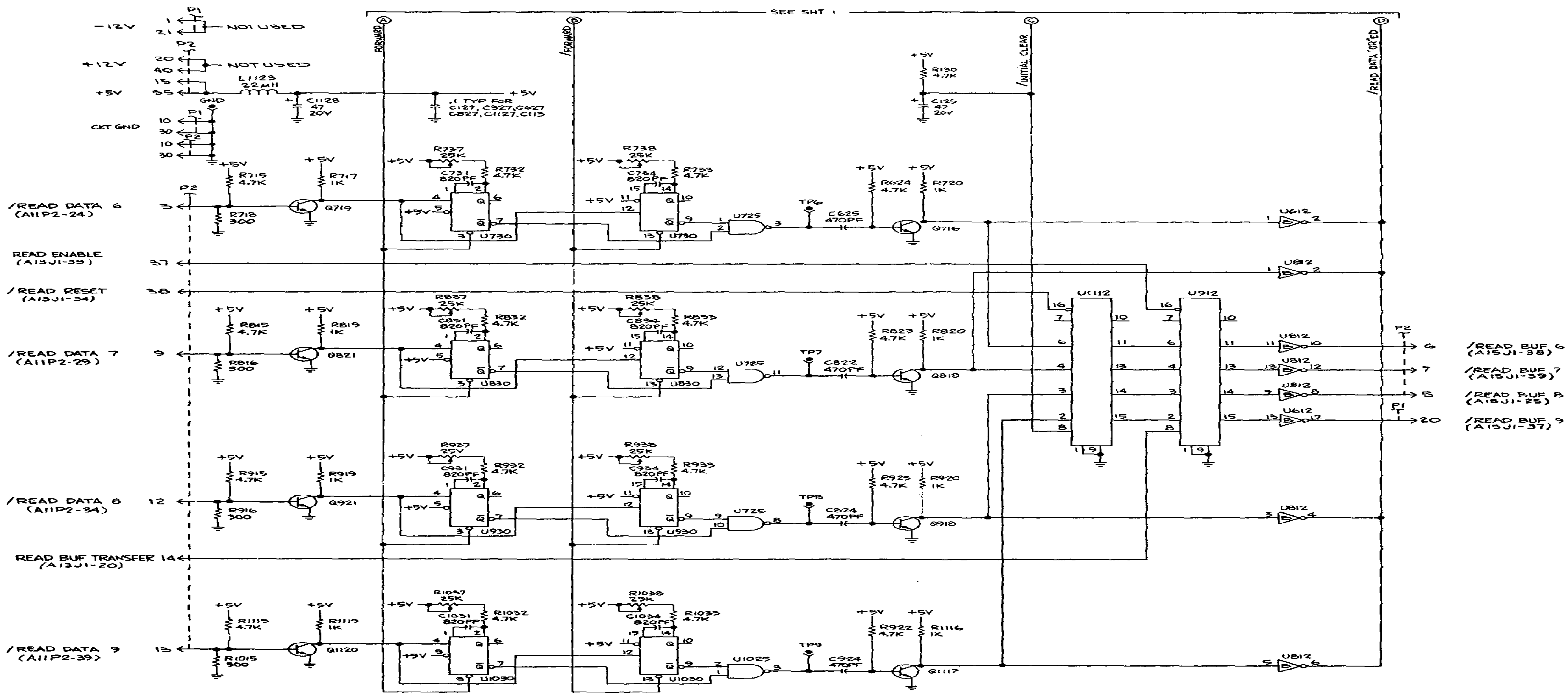


Figure 6-18. Schematic, Read Buffer module A12 (Sheet 2 of 2)

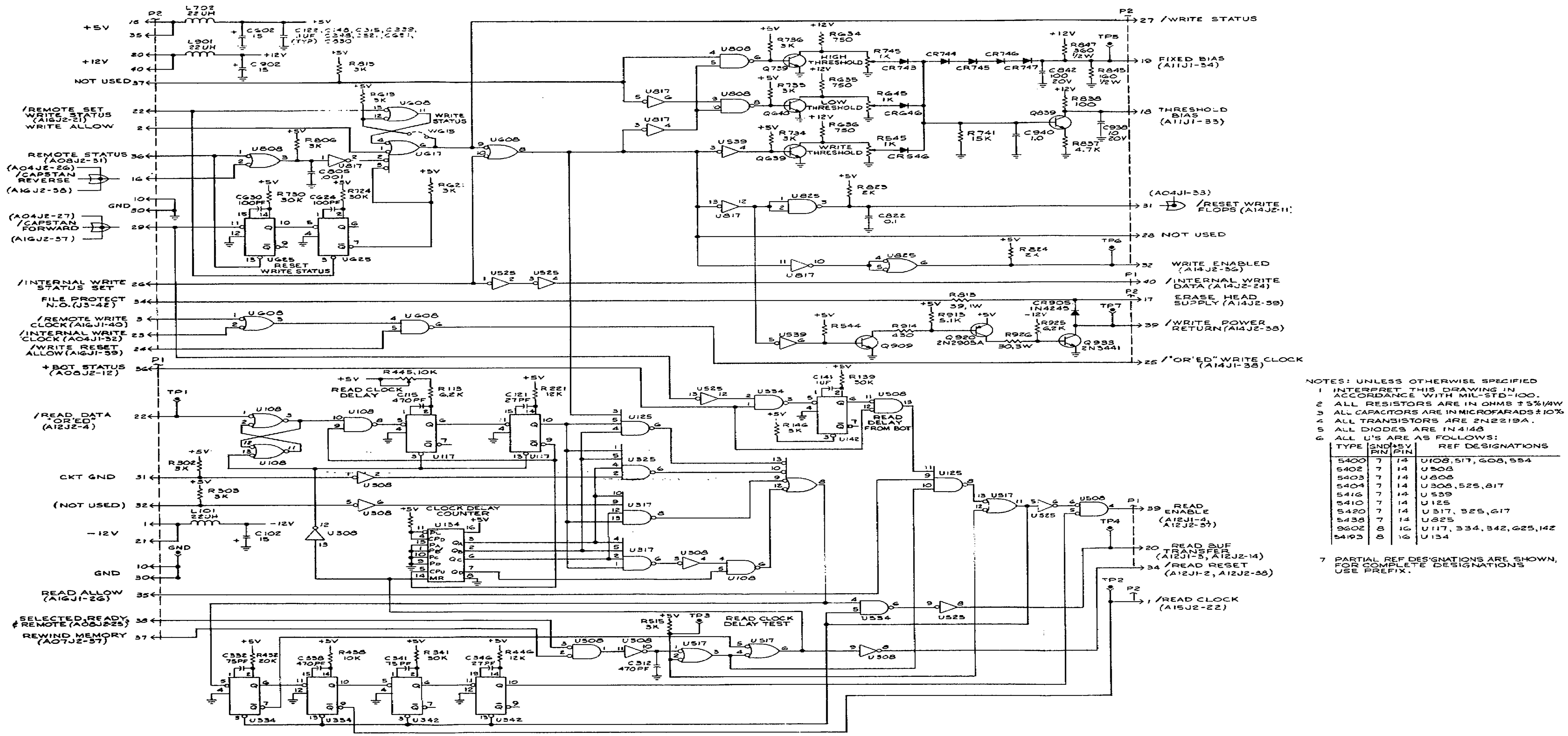
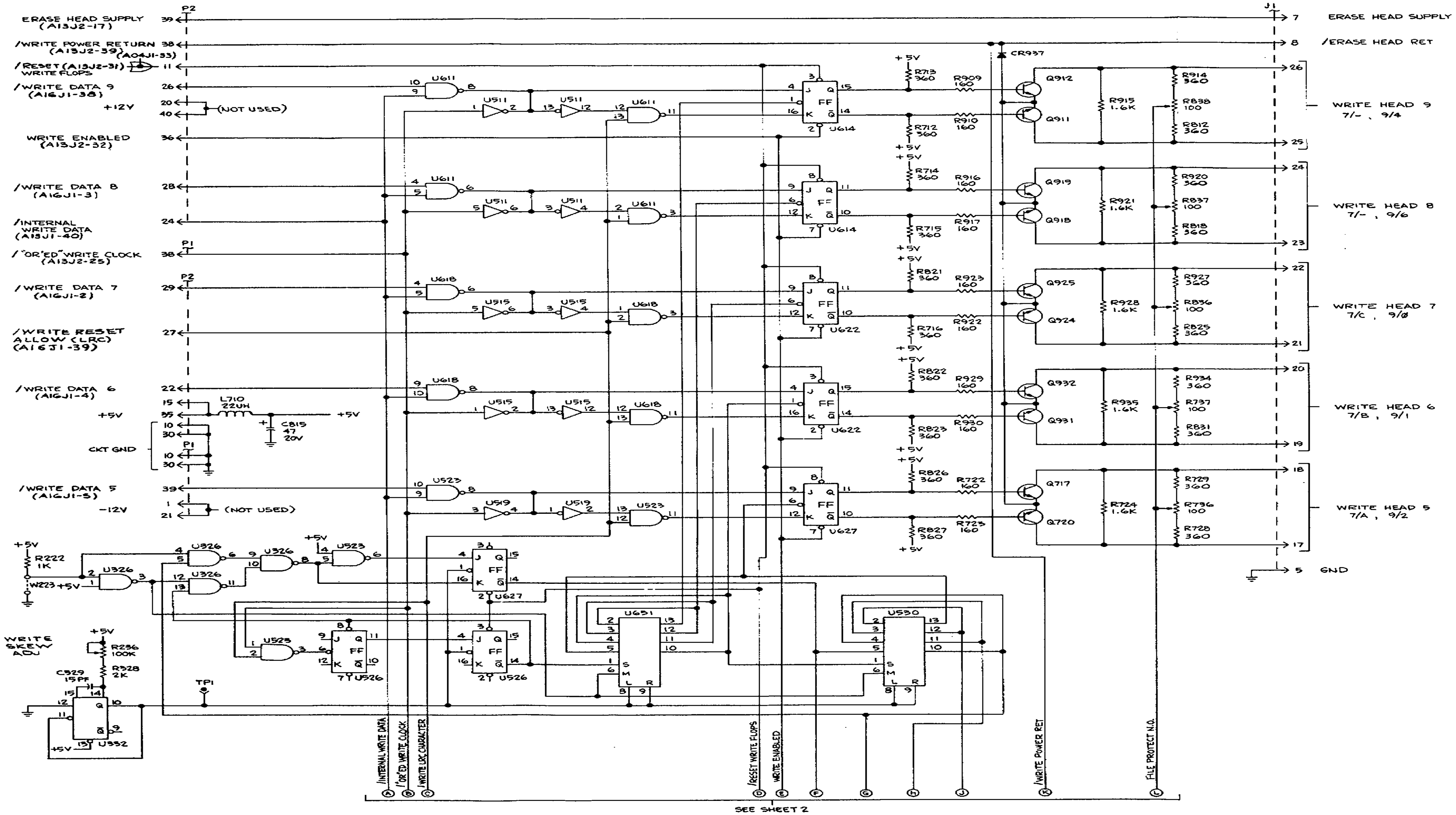


Figure 6-19. Schematic, Write Control Module A13



NOTES : UNLESS OTHERWISE SPECIFIED

1. INTERPRET THIS DRAWING IN ACCORDANCE WITH MIL-STD-100.
2. ALL RESISTORS ARE IN OHMS ±5% 1/4W.
3. ALL CAPACITORS ARE IN MICROFARADS ±10%
4. ALL TRANSISTORS ARE 2N2219A.
5. ALL DIODES ARE IN4245.
6. ALL U'S ARE AS FOLLOWS:

TYPE	GND PIN	+5V PIN	REF DESIGNATIONS
936	7	14	U511, 515, 519
946	7	14	U311, 318, 326, 523, 611, 618
5476	13	5	U315, 322, 526, 614, 622, 627
5495	7	14	U530, 631
9602	8	16	U332

7. PARTIAL REF DESIGNATIONS ARE SHOWN, FOR COMPLETE DESIGNATIONS USE PREFIX.

Figure 6-20. Schematic, Write Amplifier Module A14 (Sheet 1 of 2)

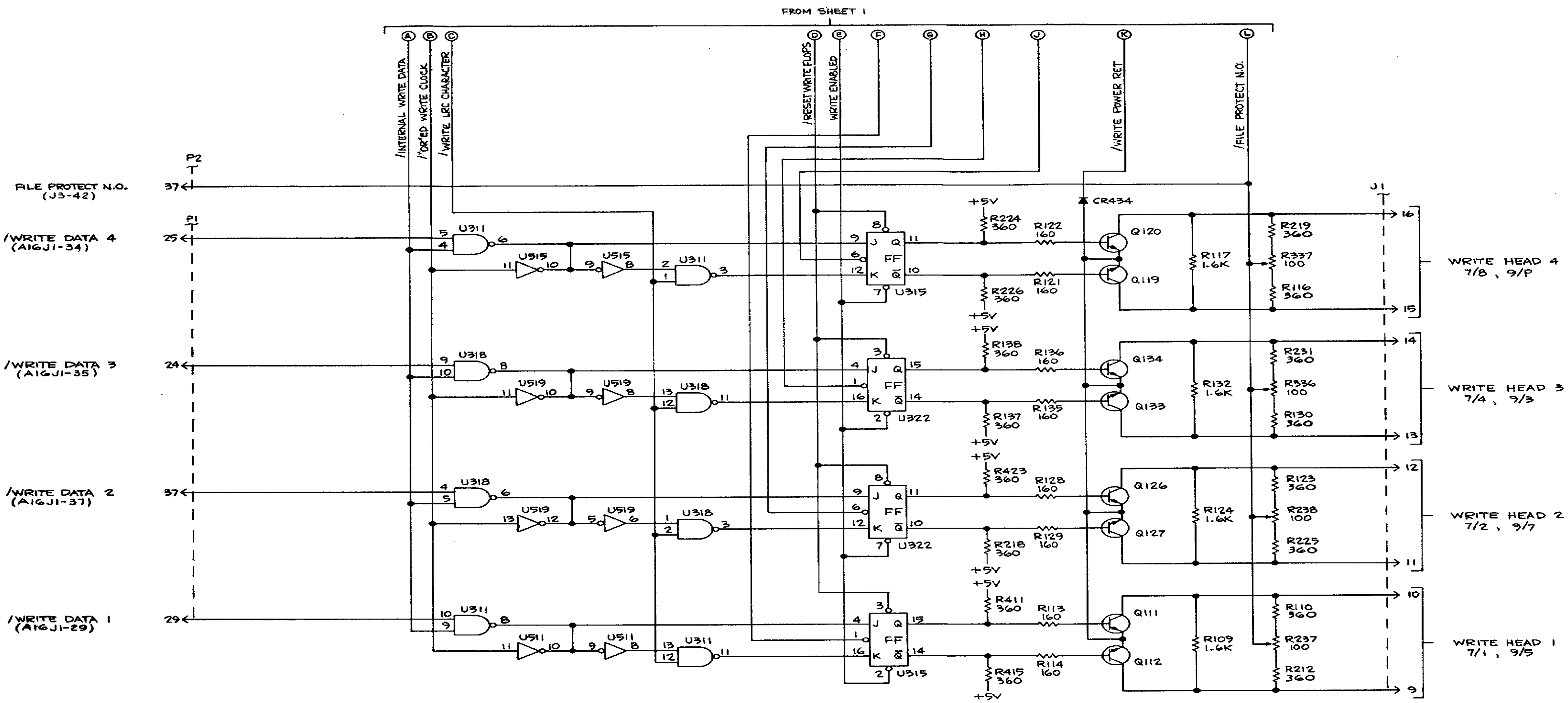


Figure 6-20. Schematic, Write Amplifier Module A14 (Sheet 2 of 2)

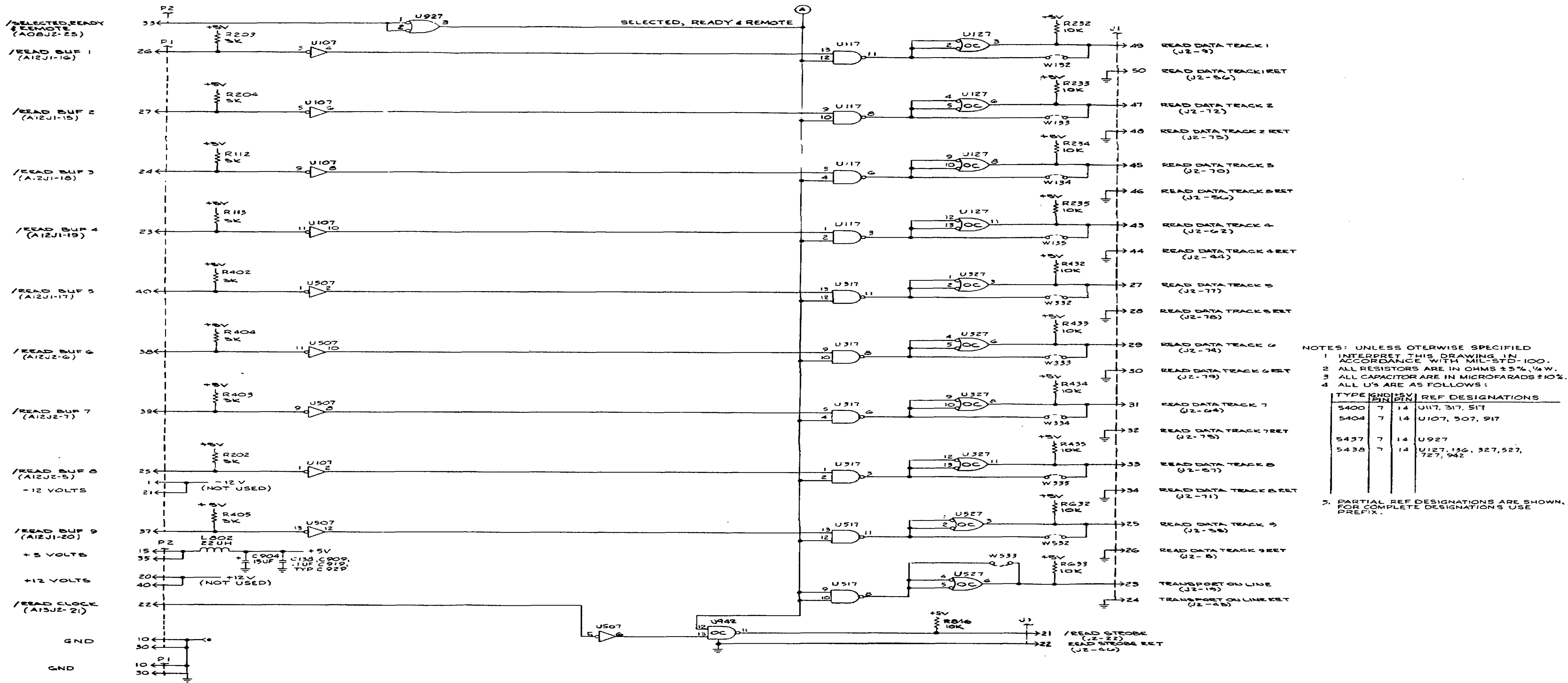


Figure 6-21. Schematic, Line Driver Module A15 (Sheet 1 of 2)

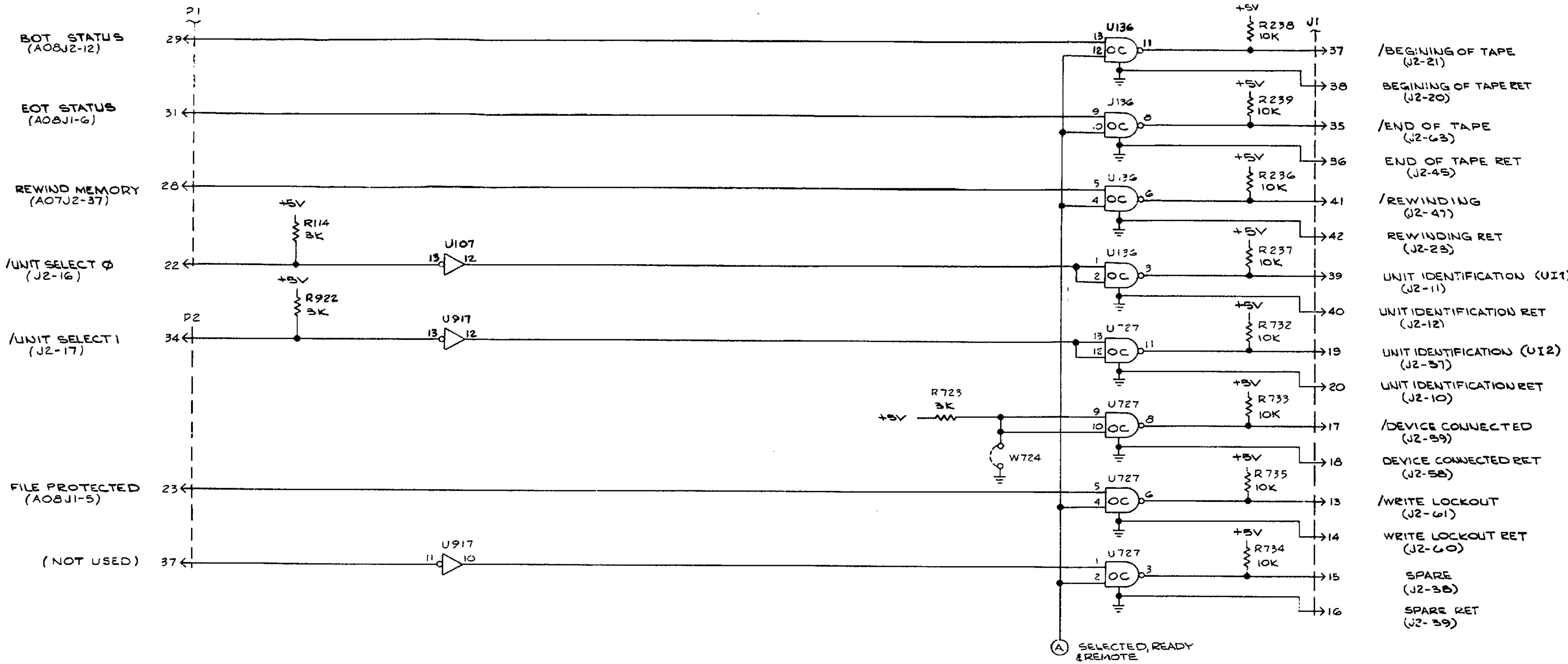


Figure 6-21. Schematic, Line Driver Module A15 (Sheet 2 of 2)

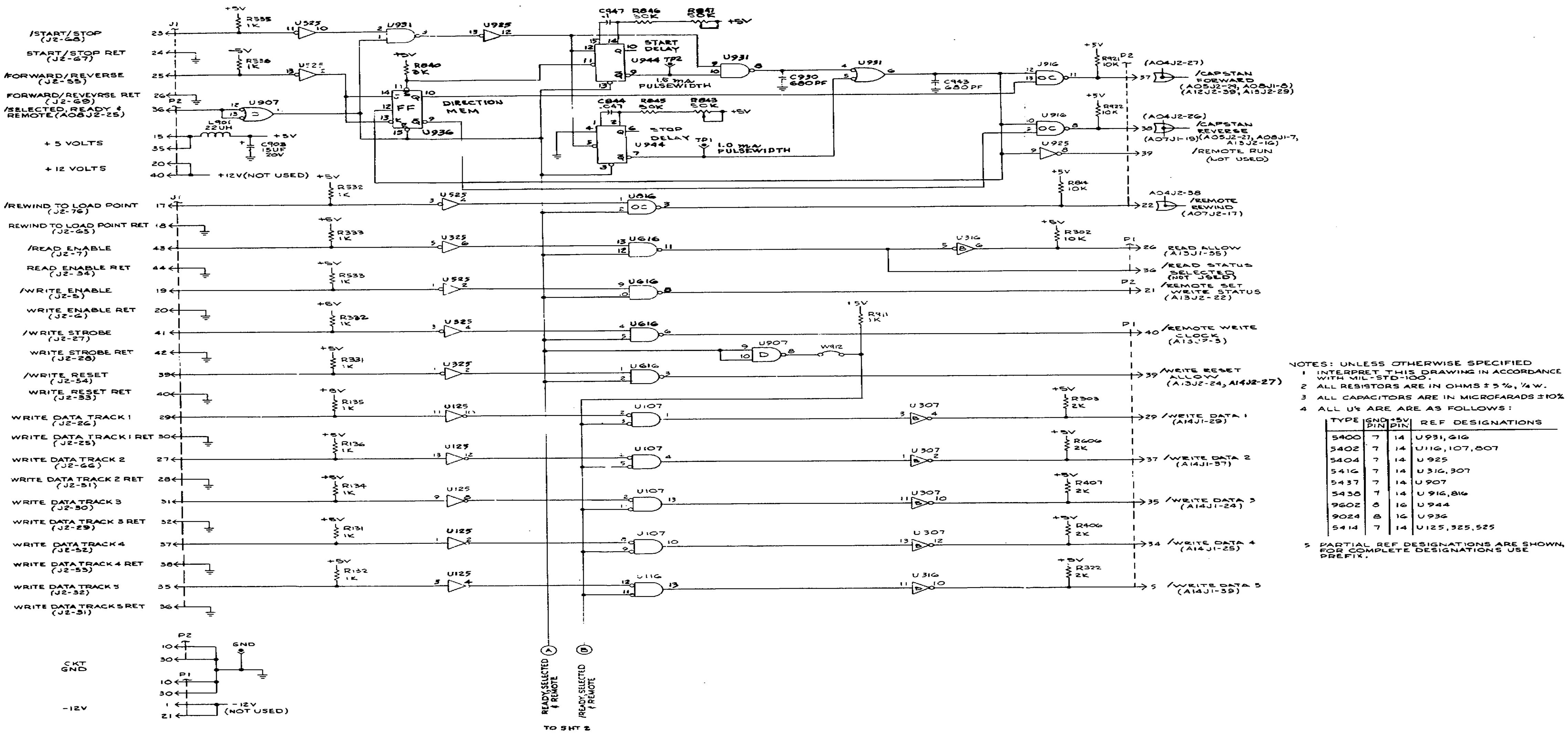


Figure 6-22. Schematic, Line Receiver Module A16 (Sheet 1 of 2)

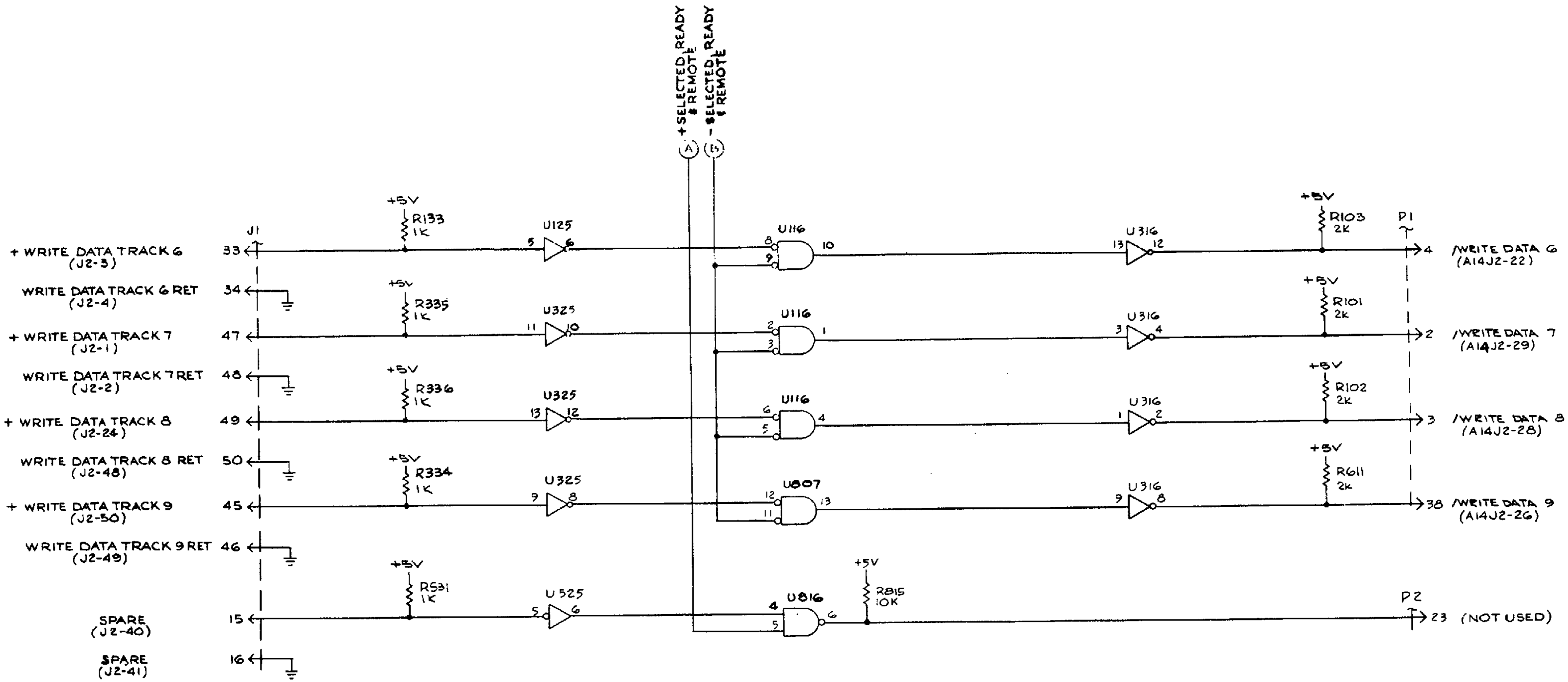


Figure 6-22. Schematic, Line Receiver Module A16 (Sheet 2 of 2)

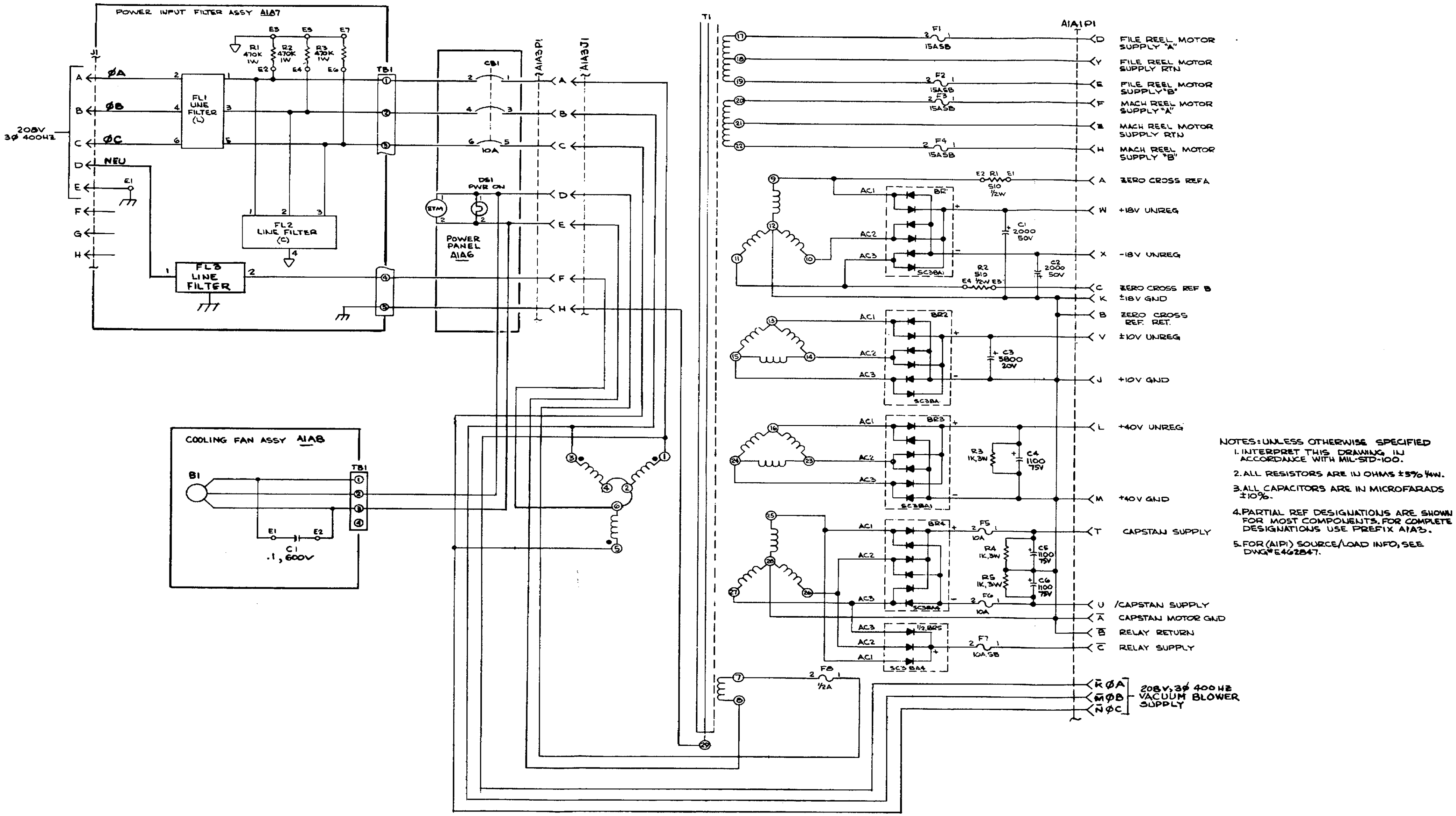


Figure 6-23. Schematic, Power Supply

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