1950 SERIES TAPE UNIT

FIELD ENGINEERING MAINTENANCE MANUAL

PN 9360

STORAGE TECHNOLOGY CORPORATION

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CHAPTER 1

GENERAL INFORMATION

1.1 INTRODUCTION

The Model 1950 Series Tape Units (Figure 1-1) are nine-track tape transports available in a number of configurations designed to meet the needs of the intermediate computer user. The tape units provide reliable recording and retrieval of data on half-inch magnetic tape in three recording formats at speeds of 50, 75, or 125 inches per second (ips).

All tape units are capable of writing and reading data in phase-encoded (PE) format with a density of 1600 bits per inch (bpi). Depending upon the model selected, the tape units can also write and read data in group-coded recording (GCR) with a density of 6250 bpi, non-return-to-zero indicated (NRZI) at 800 bpi, or all three formats. The format capabilities for each model are:

1951	PE/GCR
1952	PE/NRZI
1953	PE/GCR/NRZI

The 1951 and 1953 tape units are designed to interface with the STC Model 1935 Format Control Unit (FCU), allowing the FCU to control up to four TUs in a radial bus configuration. The 1952 tape unit has a digital interface for connection to a USER controller in either a radial bus or daisy-chain configuration. The performance specifications, as a function of speed and format, for the tape units are listed in Table 1-1.

This chapter includes the following information to familiarize the reader with the 1950 Series Tape Units:

- Specifications
- General Description
- Operator Panel
- Operating Procedures
- Operator Maintenance

The remaining chapters of the manual provide tape unit installation instructions, a description of the interface, a functional description of operation, maintenance procedures, and replacement procedures.

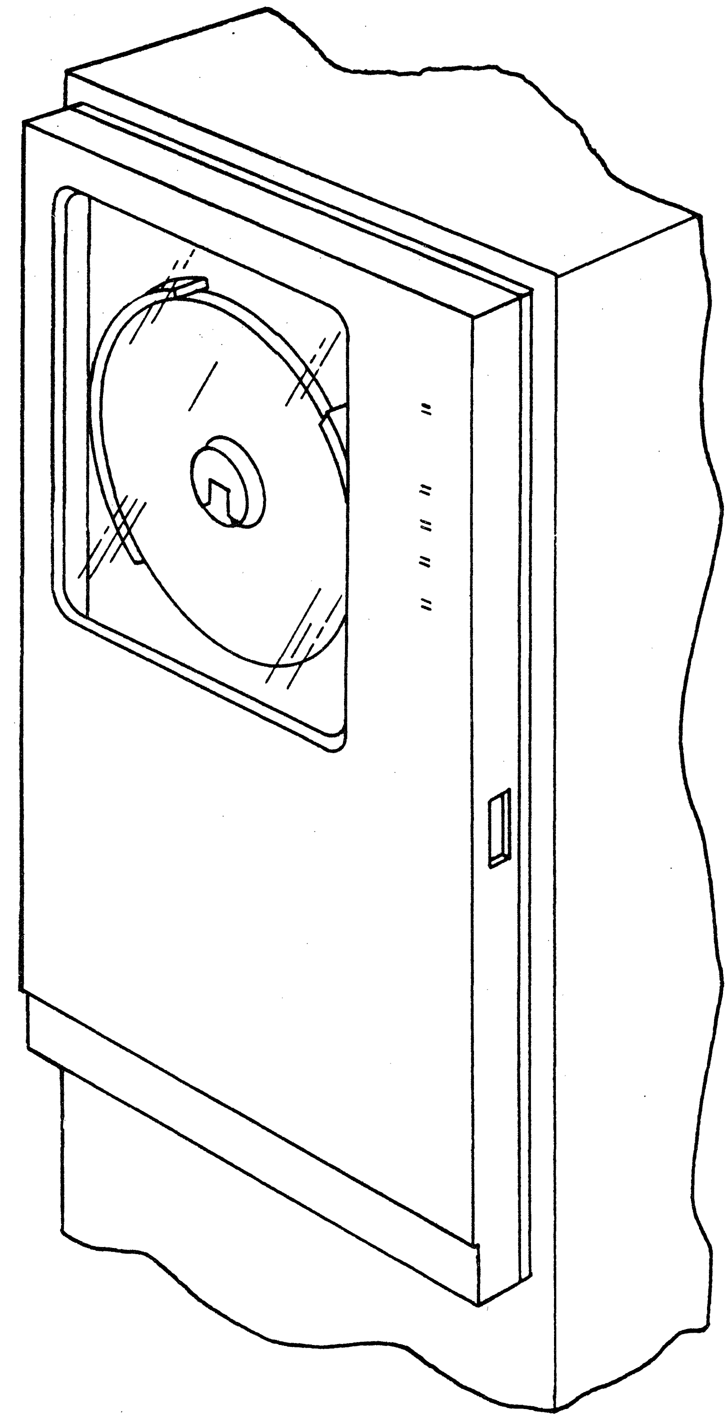


Figure 1-1. Model 1950 Series Tape Unit

Table 1-1. Performance Specifications

Tape Speed	125 ips	75 ips	50 ips
Rewind Time (maximum) (2400 foot reel)	60 seconds	60 seconds	60 seconds
Data Density			
GCR	6250 bpi	6250 bpi	6250 bpi
PE	1600 bpi	1600 bpi	1600 bpi
NRZI	800 bpi	800 bpi	800 bpi
Data Transfer Rate			
GCR	781 kB/s	469 kB/s	313 kB/s
PE	200 kB/s	120 kB/s	80 kB/s
NRZI	100 kB/s	60 kB/s	40 kB/s
Interblock Gap (IBG)			
GCR	0.3 inches	0.3 inches	0.3 inches
PE/NRZI	0.6 inches	0.6 inches	0.6 inches
Access Time (nominal)			
Write			
GCR	1.2 msec	2.0 msec	2.9 msec
PE	1.2 msec	2.0 msec	2.9 msec
NRZI	2.0 msec	3.3 msec	4.9 msec
Read			
GCR	1.4 msec	2.3 msec	3.3 msec
PE	2.0 msec	3.3 msec	4.9 msec
NRZI	2.8 msec	4.7 msec	6.9 msec
Tape Start Time	1.1 msec	1.8 msec	2.7 msec

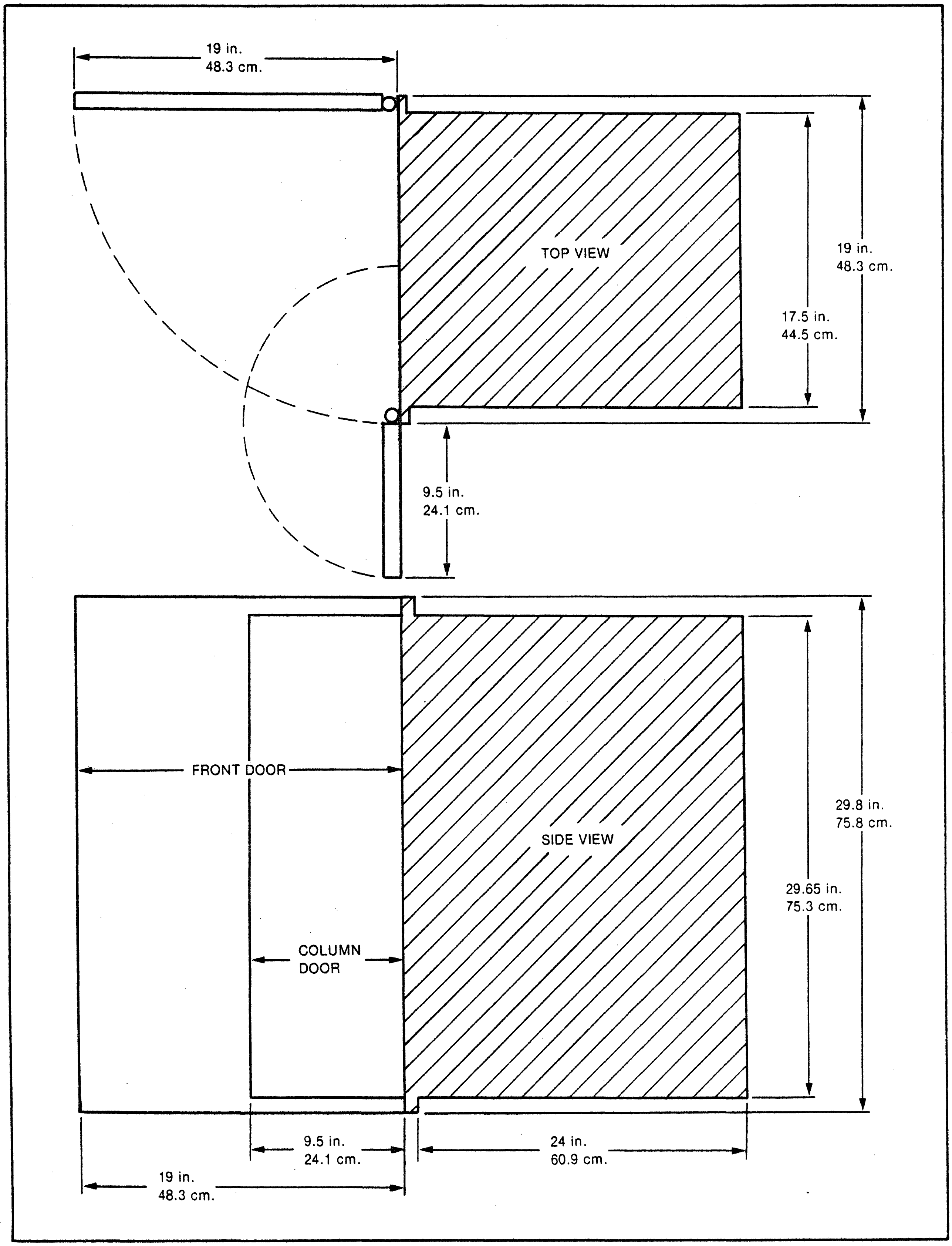


Figure 1-2. Tape Unit Dimensions

1.2 SPECIFICATIONS

1.2.1 PHYSICAL DIMENSIONS

The tape unit is designed to mount in a standard 19-inch RETMA or universal rack. The nominal dimensions of the tape unit (refer to Figure 1-2) are:

Height	29.8	inches (75.8 cm)
Width	19.0	inches (48.3 cm)
Depth	24.0	inches (60.9 cm) behind mounting flanges
Protrusion	4.8	inches (12.2 cm) in front of flanges
Weight	340	pounds (154 kg)

1.2.2 ENVIRONMENTAL REQUIREMENTS

For data reliability the recommended operating range is:

20% to 80% humidity (non-condensing)
60 to 90 ° F (16 to 32 ° C)

The conditions for optimum tape performance are:

37% to 42% humidity (non-condensing)
60 to 72 ° F (16 to 22 ° C)

The altitude range is from sea level to 1100 feet (335 meters). A change of pulley ratios in the pneumatics supply provides an altitude range of 1100-6000 feet (335-1830 meters).

1.2.3 POWER REQUIREMENTS

The tape unit is designed to operate on any one of the single-phase power sources listed below:

120 Vac	(+10%,-15%)	60 Hz	16 amps (nominal)
208 Vac	(+10%,-15%)	60 Hz	8 amps (nominal)
220 Vac	(+10%,-15%)	60 Hz	8 amps (nominal)
220 Vac	(+10%,-15%)	50 Hz	8 amps (nominal)
240 Vac	(+6%,-10%)	50 Hz	8 amps (nominal)

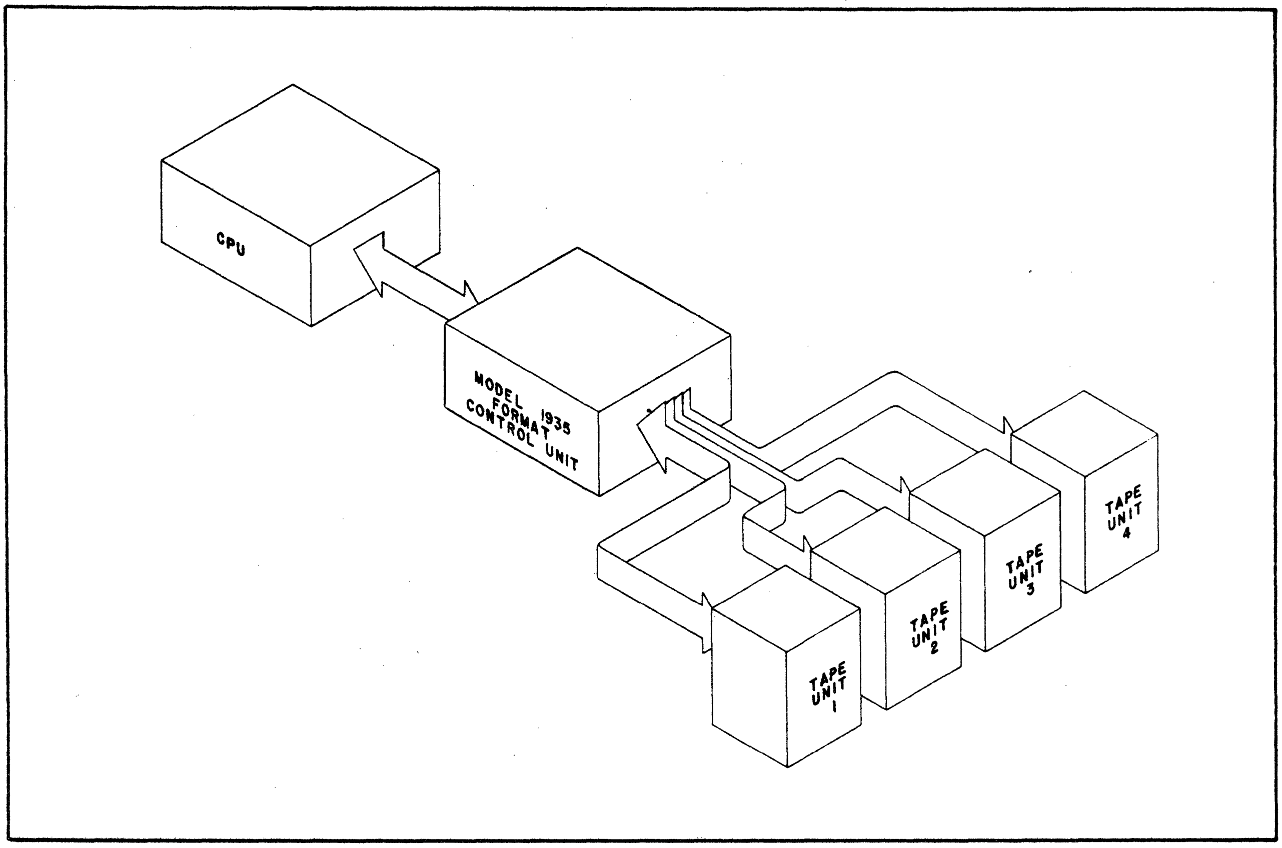


Figure 1-3. Tape Subsystem Radial Configuration

1.3 GENERAL DESCRIPTION

A tape unit configuration with GCR capability will write and read group-coded recording (GCR) format data at 6250 bpi. A tape unit configuration with NRZI capability will write and read a no-return-to-zero indication (NRZI) format data at 800 bpi. All tape unit configurations have the capability to write and read phase encoded (PE) format data at 1600 bpi. The tape unit is conditioned for the format to be recorded or read back by the program from the controlling device when the tape unit is positioned at the beginning of tape (BOT) marker (also called "load point").

Data can be read when tape is moving either forward or backward but data recording can be performed only during forward tape motion. Separate write and read data paths permit read during write to provide immediate verification of recorded data.

Other tape unit features include: automatic tape threading; self-loading vacuum columns that gently handle tape; power loss interlocks and servo failure sensors to prevent accidental damage to tape; a vacuum tape cleaner to remove debris from the tape before it passes over the read/write head; a high speed foot to reduce tape wear during high speed rewind; and a write ring interlock to protect data files when the write enable ring is removed.

1.3.1 SUBSYSTEM DESCRIPTION

The PE/GCR or PE/GCR/NRZI (tri-density) tape subsystem consists of one STC Model 1935 Formatter Control Unit (FCU, or "controller") and up to four 1951 and/or 1953 tape units in a radial interface arrangement. Figure 1-3 shows the typical configuration of such a tape subsystem. (Refer to the 1935 Formatter Control Unit FEMM, PN 9357, for further information regarding the operation of the FCU.)

The PE/NRZI tape subsystem consists of a tape controller and up to four Model 1952 tape units in either a radial interface or a daisy-chain interface arrangement.

1.3.2 TAPE UNIT DESCRIPTION

The tape transport mechanism is mounted on an aluminum deck casting (Figures 1-4 and 1-5). The deck casting is mounted on hinges to provide easy access to all elements of the tape unit behind the casting and inside the frame assembly (Figure 1-6) in order to simplify maintenance. The tape unit is comprised of seven major functional areas: the operator panel, the tape unit control logic, the data handling electronics, the capstan servo system, the reel servo system, the power supply, and the pneumatics system. Refer to the general block diagram, Figure 1-7. Figure 1-8 shows the arrangement of the printed circuit cards in the logic card cage.

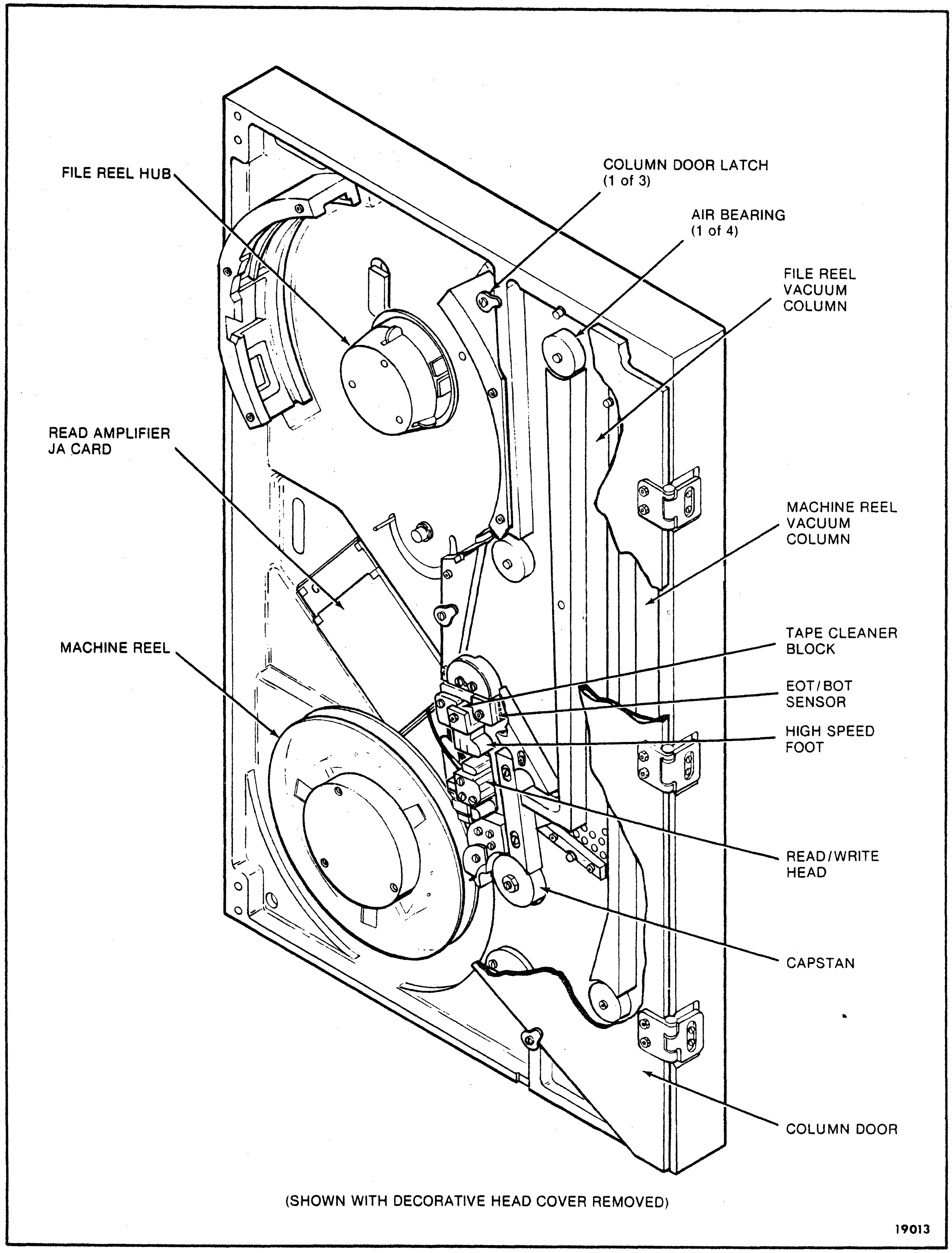


Figure 1-4. Tape Deck

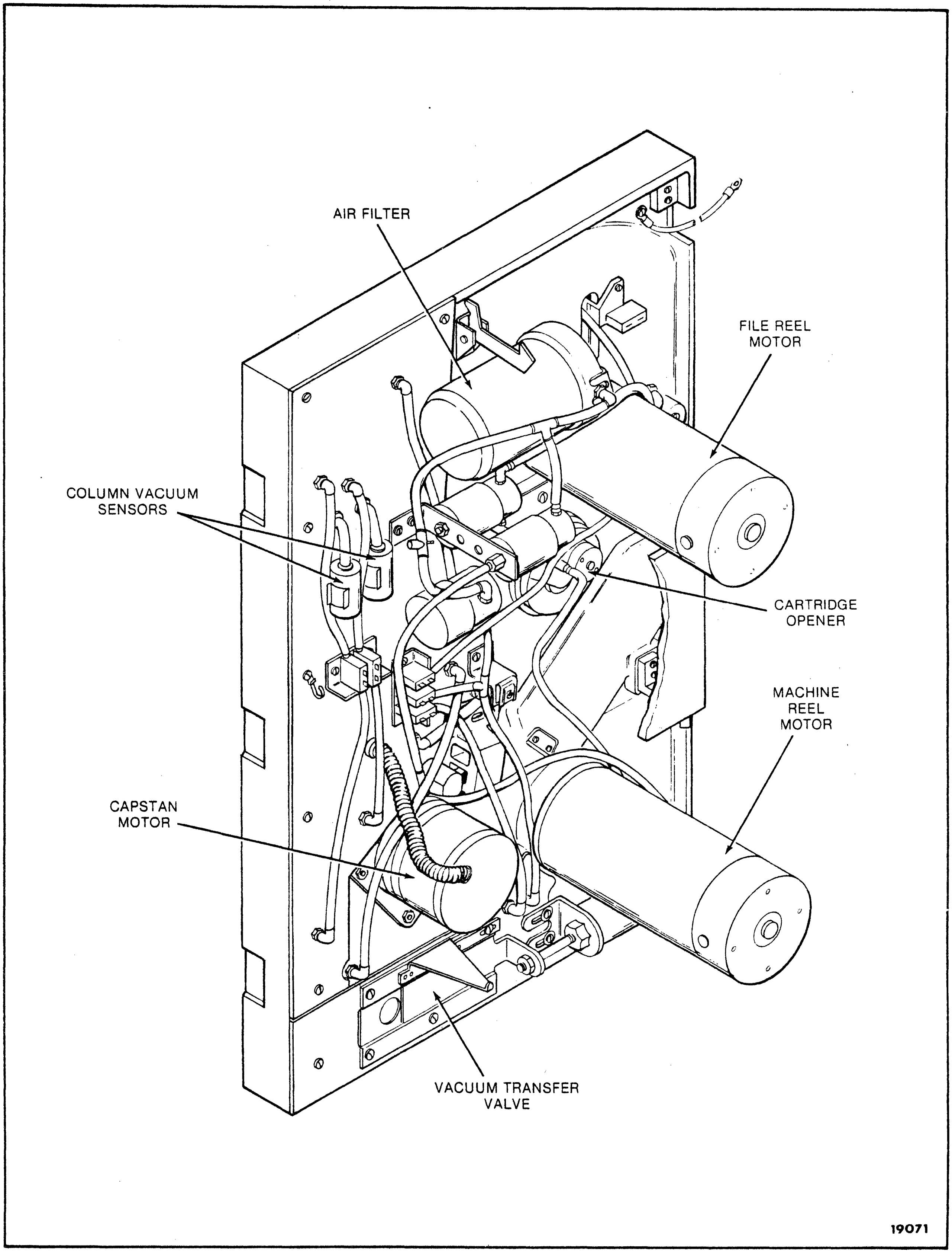


Figure 1-5. Tape Deck (Rear View)

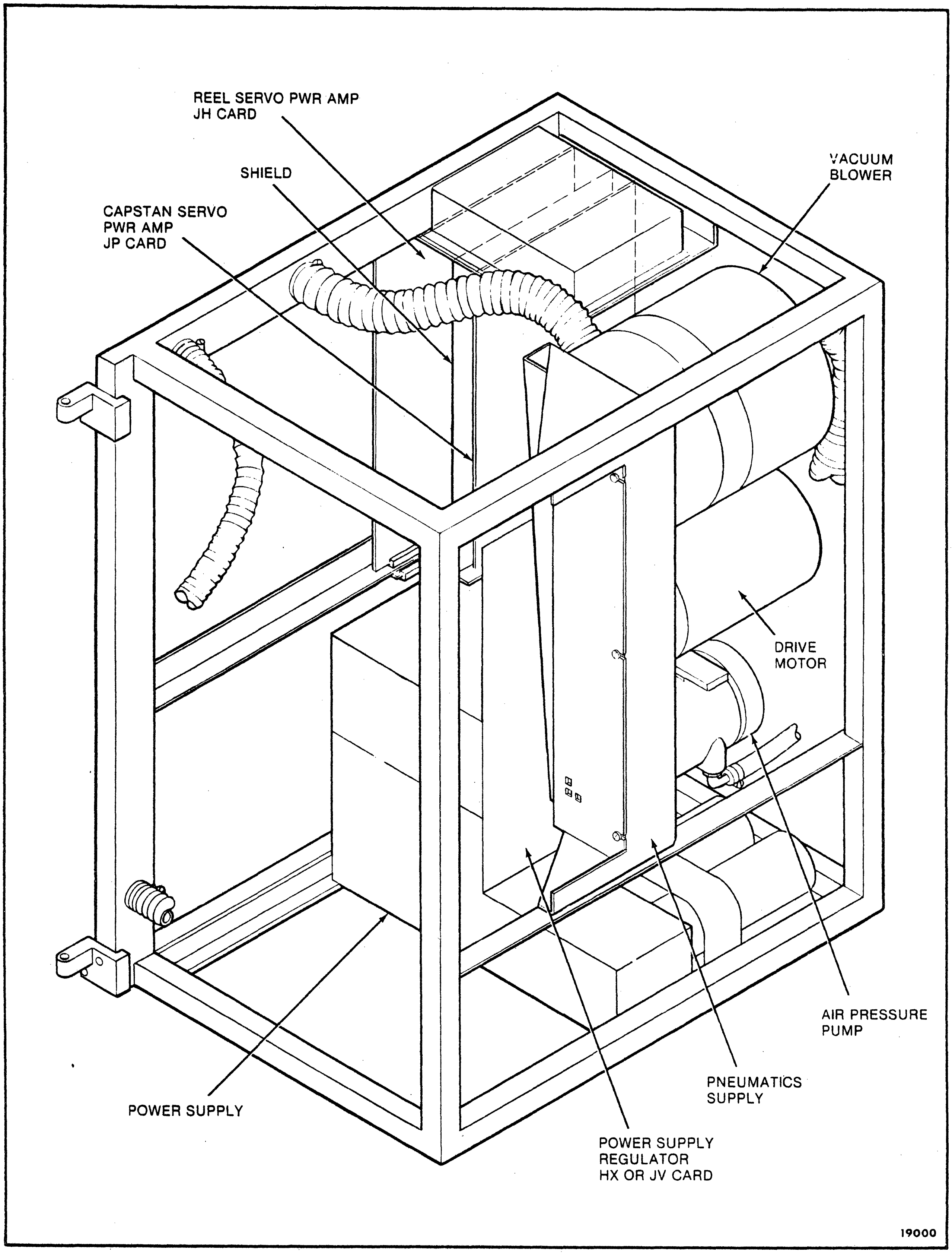


Figure 1-6. Frame Assembly

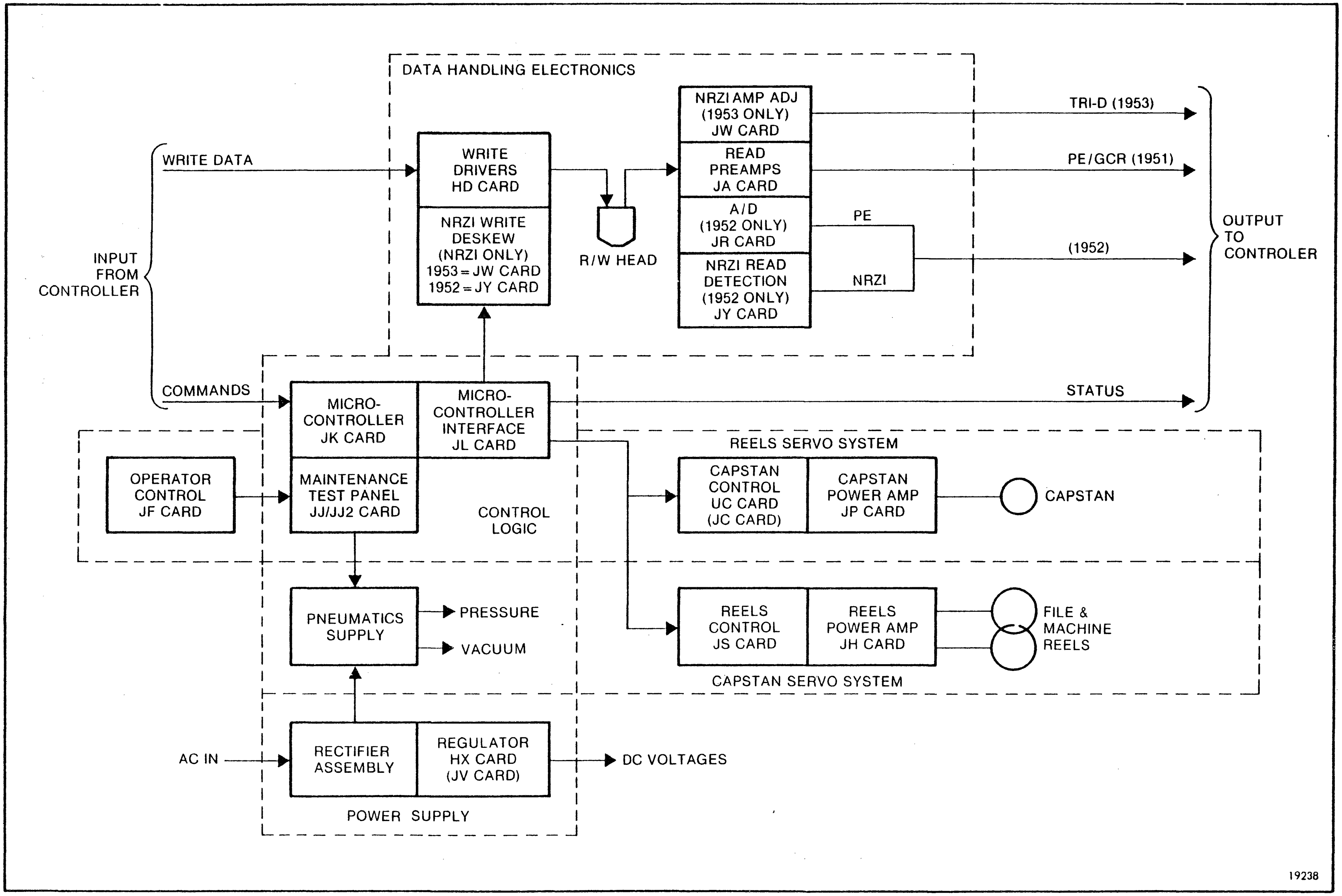


Figure 1-7. General Block Diagram

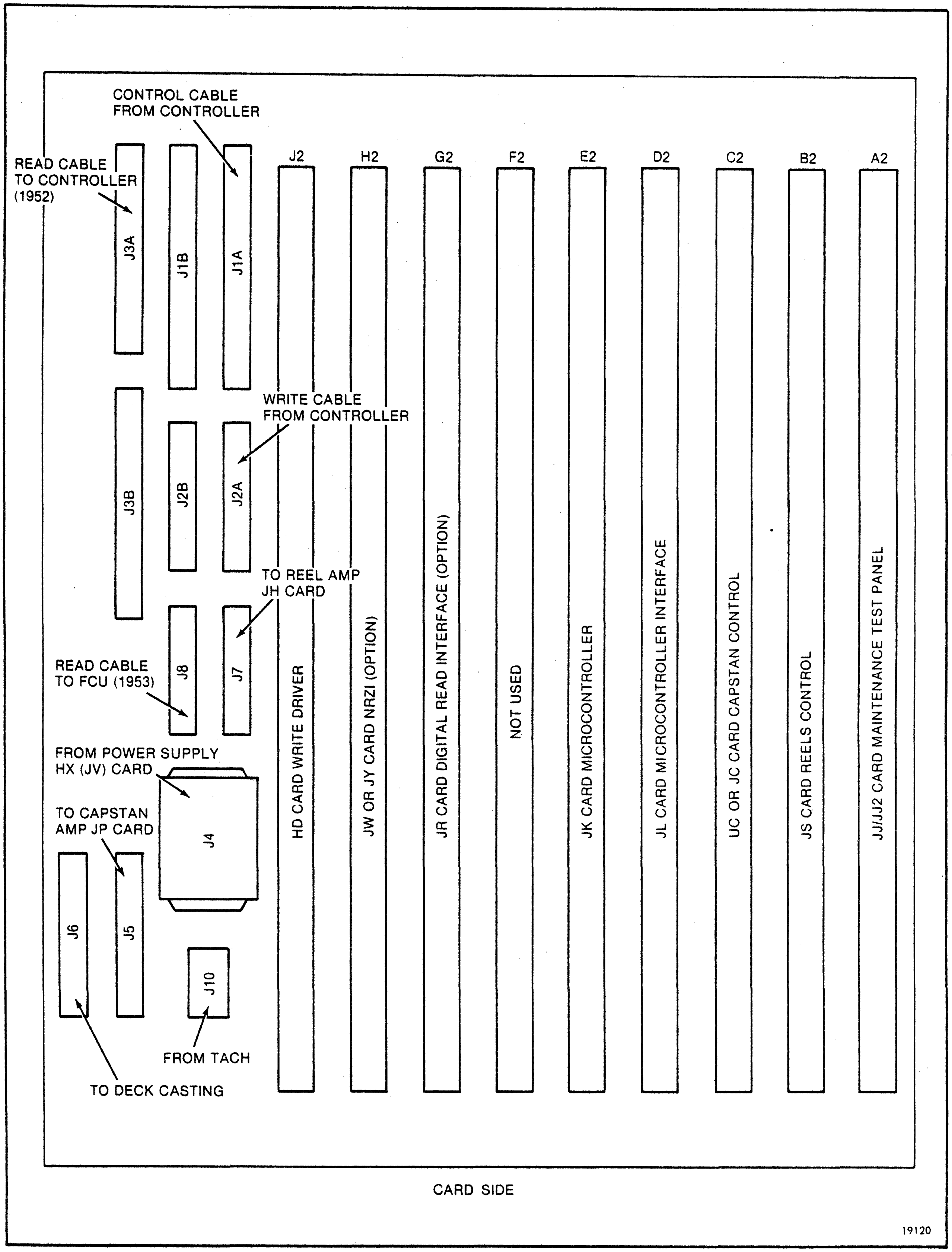


Figure 1-8. Logic Card Cage

1.3.2.1 Operator Panel

Switches, mounted on the front door, permit the operator to manually control the tape unit. Indicator lamps provide the operator with a visual display of the operating mode and status of the tape unit. The indicators and the electronics supporting the switches are physically mounted on the JF printed circuit card behind the front door.

1.3.2.2 Control Logic

Tape unit control is performed by the JK and JL cards in the logic card cage. The control logic responds to commands from the operator panel and the controller, generates the control signals for the capstan and reel servo systems, monitors the interlock and fault detection circuits, and provides status information to the operator panel and controller.

The JJ/JJ2 card performs various subsidiary control functions. The operator panel lamp drivers, responding to control logic outputs, are located on this card as well as additional electronics for the operator panel switches. Also located on this card are: the EOT/BOT sensor circuits; a power safe detector circuit; power amplifiers and solenoid drivers that respond to control logic output commands to manipulate various motors and valves on the tape transport; and the internal maintenance test panel.

1.3.2.3 Data Handling

PE and GCR format data is handled by two cards. Incoming data is sent through the write driver card (HD) before being applied to the write head. This card also enables the erase head to remove unwanted data and noise from tape before the tape passes the write head. During a read operation, the JA card, mounted on the deck casting, amplifies the data from tape and, in the 1951 tape unit, sends this data in analog form directly to the Model 1935 Formatter Control Unit.

The NRZI format capability of a tri-density (1953) tape unit configuration requires an additional card. Input NRZI format write data is skew compensated on the JW card prior to being sent to the write drivers. Analog NRZI format read data from the read amplifiers is normalized by adjustable amplifiers on the JW card prior to being sent to the Model 1935 Formatter Control Unit.

The digital read interface of a 1952 tape unit requires two additional cards. The analog-to-digital conversion is performed on the JR card. The NRZI format data requires both write and read skew compensation, which is performed on the JY card.

1.3.2.4 Capstan Servo System

The capstan servo logic card (UC or JC) and the capstan power amplifier card (JP) comprise the capstan servo system electronics. The capstan servo responds to signals from the control logic and provides the appropriate drive signal to the capstan motor to move tape forward, backward, or in rewind.

1.3.2.5 Reel Servo System

The reel servo logic card (JS) and the reel power amplifier card (JH) comprise the reel servo system electronics. The reel servo system responds to signals from the column vacuum sensors and control logic in order to control the tape during threading, column loading, run, and rewind operations.

1.3.2.6 Power Supply

The power supply is comprised of a rectifier assembly and regulator card (HX in ferro power supply or JV in linear power supply). The rectifier assembly contains the discrete components including power transformer, bridge rectifiers, filter capacitors, and fuses. The power supply provides logic voltages for the electronics and power voltages for the capstan and reel motors.

1.3.2.7 Pneumatics System

The pneumatics supply contains a motor which drives an air pump and a vacuum blower. These provide positive air pressure and vacuum at strategic locations around the tape transport in order to manipulate tape during threading and columns loading modes and to control the tape in the vacuum columns during normal run and rewind operations. Air pressure and vacuum sensors located throughout the transport casting provide status information to the control logic. The pneumatics supply also provides cooling for heat sinks and the reel motors.

1.3.3 TAPE UNIT FEATURES

1.3.3.1 Power Window

The power window automatically closes when the columns begin to load tape after the threading mode.

1.3.3.2 Window-Up Switch

Mounted on the inside of the front door is a microswitch used to detect the position of the power window. The switch is wired to the JF card and causes the reels to be shut down if the power window is lowered.

1.3.3.3 Night Latch

During periods of inactivity the power window is secured by a night latch. The night latch is a flexible plastic hook that holds the power window in the closed position whenever the pneumatics system is off.

1.3.3.4 Automatic File Hub Option

The optional automatic file hub pneumatically locks the file reel hub after the operator has positioned the reel on the hub and has pressed the LOAD switch on the operator panel. The latch is automatically released when the tape is fully unloaded onto the file reel. By the time the power window is fully open and the operator can physically touch the file reel for removal, the file reel hub has been released.

1.4 OPERATOR PANEL

The operator controls and indicators (Figure 1-9) are located on the right side of the front door. The operator panel contains switches to permit manual operation of the tape unit. The indicators provide tape unit status information. Descriptions and uses of these switches and indicators are provided below.

1.4.1 POWER

SWITCH - Actuation of this switch alternately applies and removes AC input power to the tape unit. For the switch to be operative, the MAIN POWER circuit breaker on the power supply must be in the ON position.

INDICATOR - The indicator lights when AC input power is applied to the power supply provided the power supply overvoltage and overcurrent sensors have not been tripped.

1.4.2 FILE PROTECT

INDICATOR - The indicator lights when a tape load operation is begun provided there is no write enable ring installed in the file (supply) tape reel. The indicator remains illuminated until a tape unload operation is completed.

1.4.3 LOAD/REWIND

SWITCH - When the columns are not loaded, actuation of this switch initiates a tape load operation and positions tape at the beginning of tape marker (BOT). If tape is already loaded, actuation of this switch causes tape to rewind to BOT.

INDICATOR - The indicator lights when tape is positioned at BOT or at or beyond EOT.

1.4.4 ON LINE

SWITCH - Actuation of this switch during a tape load operation sets the tape unit to Online Status when the tape load operation is completed and thus makes the tape unit available to the controller. When the tape unit is in Online Status, and the Select input line is asserted, the tape unit is under the control of the controller input lines. Online Status may be reset by pressing the RESET switch.

INDICATOR - The indicator lights when the tape unit is in Online Status.

1.4.5 SELECT

INDICATOR - The indicator lights when the tape unit is selected by the controller.

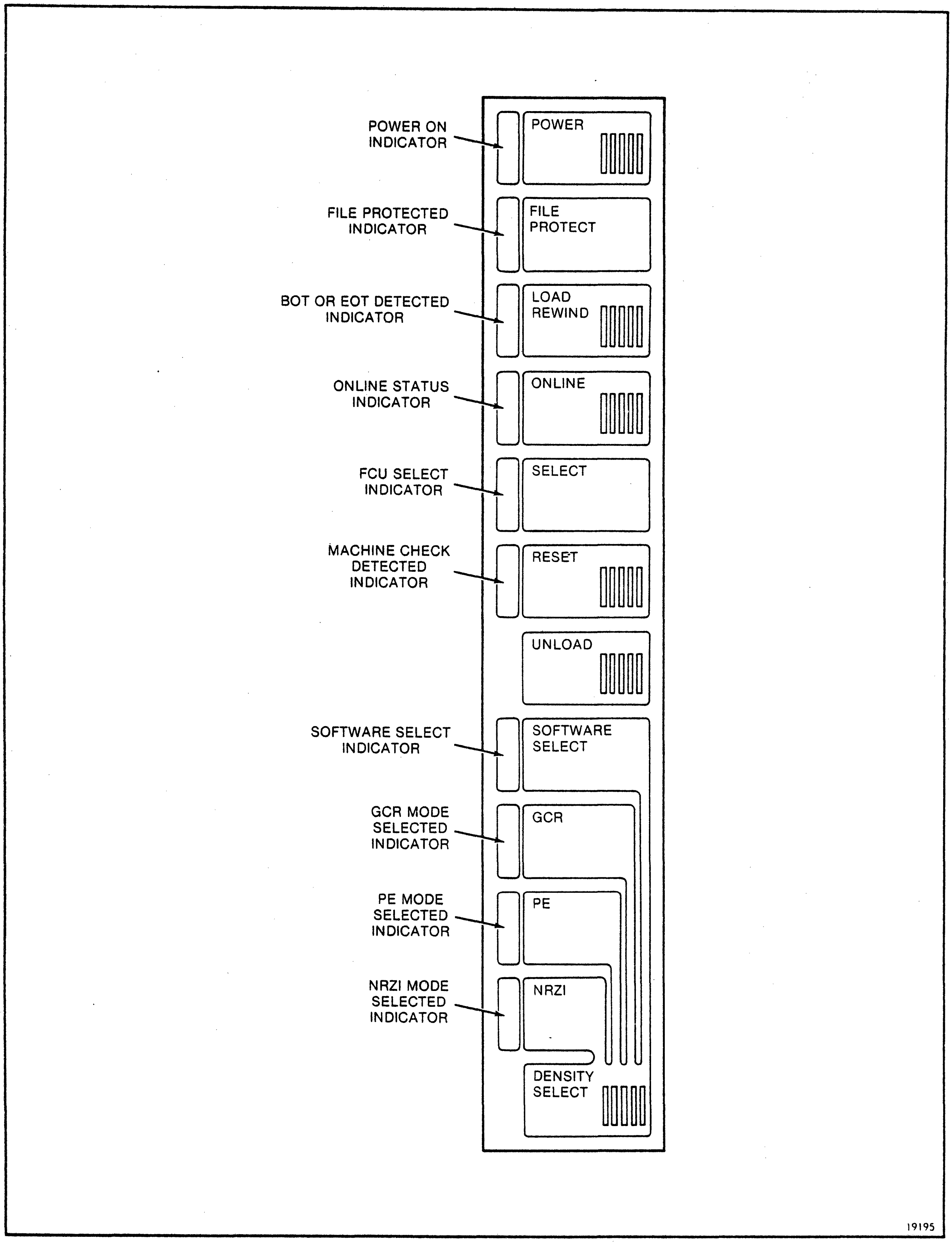


Figure 1-9 . Operator Panel (1951 / 1953)

1.4.6 RESET

SWITCH - Actuation of this switch causes a machine reset in the tape unit (including resetting Online Status) and all tape motion stops. During a high speed rewind operation, one actuation of the switch slows the capstan to normal operating speed, and a second actuation stops all capstan motion.

INDICATOR - The indicator flashes to indicate that a machine check exists within the tape unit. The machine check code appears on the internal maintenance test panel LEDs (JJ card). (Refer to Appendix A.)

1.4.7 UNLOAD

SWITCH - When tape is loaded in the columns but not positioned at the beginning of tape marker (BOT), actuation of this switch causes the tape unit to perform a high speed rewind operation. When BOT is detected, tape will unload at normal operating speed onto the file (supply) reel. If tape is already positioned at BOT or is not loaded in the columns, actuation of this switch causes tape to unload onto the file reel. This switch is effective only when the tape unit is not in Online Status.

1.4.8 DENSITY SELECT

1.4.8.1 1951/1953 (PE/GCR and Tri-Density) TU Only

SWITCH - Actuation of this switch causes the Density Selection to advance to the next allowable state. The allowable states, in sequence, are:

PE/GCR (1951)	Software Select→PE→GCR→Software Select...
PE/GCR/NRZI (1953)	Software Select→NRZI→PE→GCR→Software Select...

This switch may be actuated at any time but the density is not changed until the next operation from BOT.

INDICATORS - In software select mode, the SOFTWARE SELECT indicator and the indicator representing the current density of the tape unit is illuminated. In manual density select mode, the indicator representing the manual density selection is illuminated; actual density internal to the tape unit must be changed by FCU command.

The Write Density indicator status is passed to the FCU via Diagnostic Sense Byte 2 (DSB2).

The tape unit is placed in Software Select mode following power on. The next density selection will be determined by the system software command from the FCU.

1.4.8.2 1952 (PE/NRZI) TU Only

SWITCH - Actuation of this switch causes the Density Selection to advance to the next allowable state. The allowable states, in sequence, are:

Software Select → NRZI → PE → Software Select...

INDICATORS - One of three separate indicators is illuminated, depending on the density selected. The indicators display the density requested, but the actual density internal to the tape unit is changed only when tape is positioned at BOT.

The tape unit is placed in Software Select mode following power on. In Software Select mode, the density selection is made by the High Density (HDN) interface line from the controller.

1.5 OPERATING PROCEDURES

The switches of the operator panel may be used in various sequences to accomplish desired operations. The common operating procedures are:

1.5.1 THREADING

1. Place the tape reel or cartridge on the file reel hub,matching the cartridge alignment tab with the cutout in the restraint, then latch the file hub locking lever. Make certain that the reel is secure.

2. Press the LOAD/REWIND switch. The cartridge, if used, is opened. The file reel positions the tape leader at the entrance to the threading path and sends tape into the threading path and down to the machine reel hub. Vacuum on the machine reel hub pulls the tape in and holds it while the reel winds on a few wraps. If tape does not reach the machine reel in approximately ten seconds, the tape rewinds and a second loading sequence begins automatically. If the second attempt is unsuccessful, the tape rewinds, the cartridge closes, and the RESET indicator flashes to signal a problem.

   A manual thread procedure is provided to accommodate open-reel tapes with defective leaders. The manual sequence is entered by pressing the LOAD/REWIND switch a second time before the tape leader is positioned in the threading path. Reel motion stops but pneumatics remain activated, allowing manual placement of the tape leader in the tape path. A third depression of the LOAD/REWIND switch causes the thread sequence to continue.

3. When the machine reel is wrapped, tape is moved forward until the beginning of tape (BOT) marker is found. Vacuum is automatically transferred to the vacuum columns and this, in conjunction with the reels unwinding tape, loads the columns. The window automatically closes at this time.

4. When the columns are loaded, the tape unit automatically moves tape forward to the BOT marker. If BOT is not found within 1.5 seconds, the tape is searched in the backward direction. If no BOT marker is found, tape unloads and the RESET indicator flashes.

5. When BOT is sensed, the LOAD/REWIND indicator lights and the tape unit is ready for operation.

1.5.2 ONLINE

Pressing the ONLINE switch enables the logic to accept input control from the controller after the LOAD/REWIND indicator is lit.

1.5.3 REWIND

1. If the tape unit is operating online, press the RESET switch.

2. Press the LOAD/REWIND switch. Tape rewinds at high speed, drops to normal operating speed just prior to the beginning of tape marker (BOT), and stops at BOT.

1.5.4 UNLOAD

1. If the tape unit is operating online, press the RESET switch.

2. Press the REWIND/UNLOAD switch. Tape rewinds at high speed, drops to normal operating speed just prior to the beginning of tape marker (BOT), stops momentarily at BOT, and then unloads onto the file reel.

1.6 OPERATOR MAINTENANCE

There are several operator maintenance procedures which should be performed daily or during each eight-hour shift under normal operating conditions (every four hours when the tape unit is exposed to excessive contamination). (To perform preventive maintenance, see Chapter 5.)

Because cleanliness is crucial to successful magnetic tape operations, these procedures are for cleaning the tape unit. Except as noted in the file reel hub cleaning procedure, cleaning should be done using transport cleaning fluid (STC PN 6167) to moisten a lint-free cloth (STC PN 6168) or foam-tipped swab (STC PN 11698). Do NOT use isopropyl alcohol. After applying cleaner, allow a few minutes for excess fluid to evaporate before mounting a tape.

1.6.1 READ/WRITE HEAD AND TAPE CLEANER BLOCK

Clean the read/write head and the tape cleaner block using a lint-free cloth moistened with transport cleaning fluid. Make certain the head and cleaner block are free of oxide deposits. Use foam-tipped swabs to clean the cleaner block.

1.6.2 TAPE GUIDES AND AIR BEARINGS

Clean the tape guides and air bearings using a lint-free cloth moistened with transport cleaning fluid. To reach otherwise inaccessible areas, foam-tipped swabs may be used. If necessary, the edge of a data processing card may be used to clean the flange corners of the guides.

1.6.3 CAPSTAN

Clean the capstan using a lint-free cloth moistened with transport cleaning fluid and wrapped around the index finger.

CAUTION

Do NOT touch the outer, tape-contacting surface of the capstan with the bare hand as the surface is sensitive to contamination. Always use a cloth when handling the capstan and grip only the hub of the capstan. Take care as the capstan is easily dented and replacement will be required.

With the free hand, slowly rotate the capstan hub while wiping the capstan surface with the moistened cloth. Two or three revolutions is sufficient. Wipe the capstan with a dry, lint-free cloth to remove excess cleaning fluid.

1.6.4 VACUUM COLUMNS AND COLUMN DOOR

Clean the columns and inside surface of the column door using a lint-free cloth and transport cleaning fluid. The sharp corner of a folded data processing card may be used to remove stubborn oxide buildup from the corners. Check the bottom of the columns for bits of tape and other foreign materials.

CAUTION

Do NOT use alcohol or hub cleaner in the columns as these solvents will remove the glass-beaded tape lining the sides of the vacuum columns and also attack the urethane coating on the capstan wheel.

1.6.5 FILE REEL HUB

Clean the expansion surface of the file reel hub using a lint-free cloth moistened with hub cleaning fluid (STC PN 12120).

CAUTION

Do NOT use transport cleaning fluid.

1.6.6 EOT/BOT SENSOR

Use a dry foam swab to wipe the EOT/BOT sensor window. Transport cleaning fluid may be used if necessary.

CHAPTER 2

INSTALLATION

2.1 INTRODUCTION

This chapter provides instructions for unpacking and inspection, preliminary checkout, cabinet mounting, and a performance check of the tape unit.

2.2 UNPACKING AND INSPECTION

1. Inspect the shipping carton for evidence of in-transit damage. Contact the carrier and manufacturer if damage is evident.
2. Remove the tape on the flaps of the shipping tray. (See Figure 2-1.)
3. Lift both shipping cartons straight up. Some force may be required because of packing around the tape unit.
4. Remove the two corrugated cardboard shipping corners. Save all packing materials until checkout and installation are complete.
5. Locate and remove the plastic bags containing the manual, the coiled I/O cables, and the tape unit mounting hardware.
6. Sever the polyband straps that secure the tape unit to the pallet.
7. Clip off the two cable clamps (opposite the front door hinges) which wrap around the frame and tie down the deck casting.
8. Remove the rails mounting hardware and the mounting rails that are secured to the tape unit.
9. To facilitate the preliminary checkout, the tape unit should be set upright on a sturdy table and checked prior to installation in the rack. To prevent damage to the front door, first place the two shipping corners lengthwise on the table such that they will support the tape unit frame just behind the front door and near the back of the frame.

   WARNING

   The tape unit weighs approximately 340 pounds (154 kilograms). Use sufficient personnel or adequate mechanical aids to set the tape unit upright. Use a forklift to move the tape unit.

10. Set the tape unit upright on the two shipping corners on the table.
11. Visually inspect the exterior of the tape unit for evidence of physical damage that may have been incurred during transit.

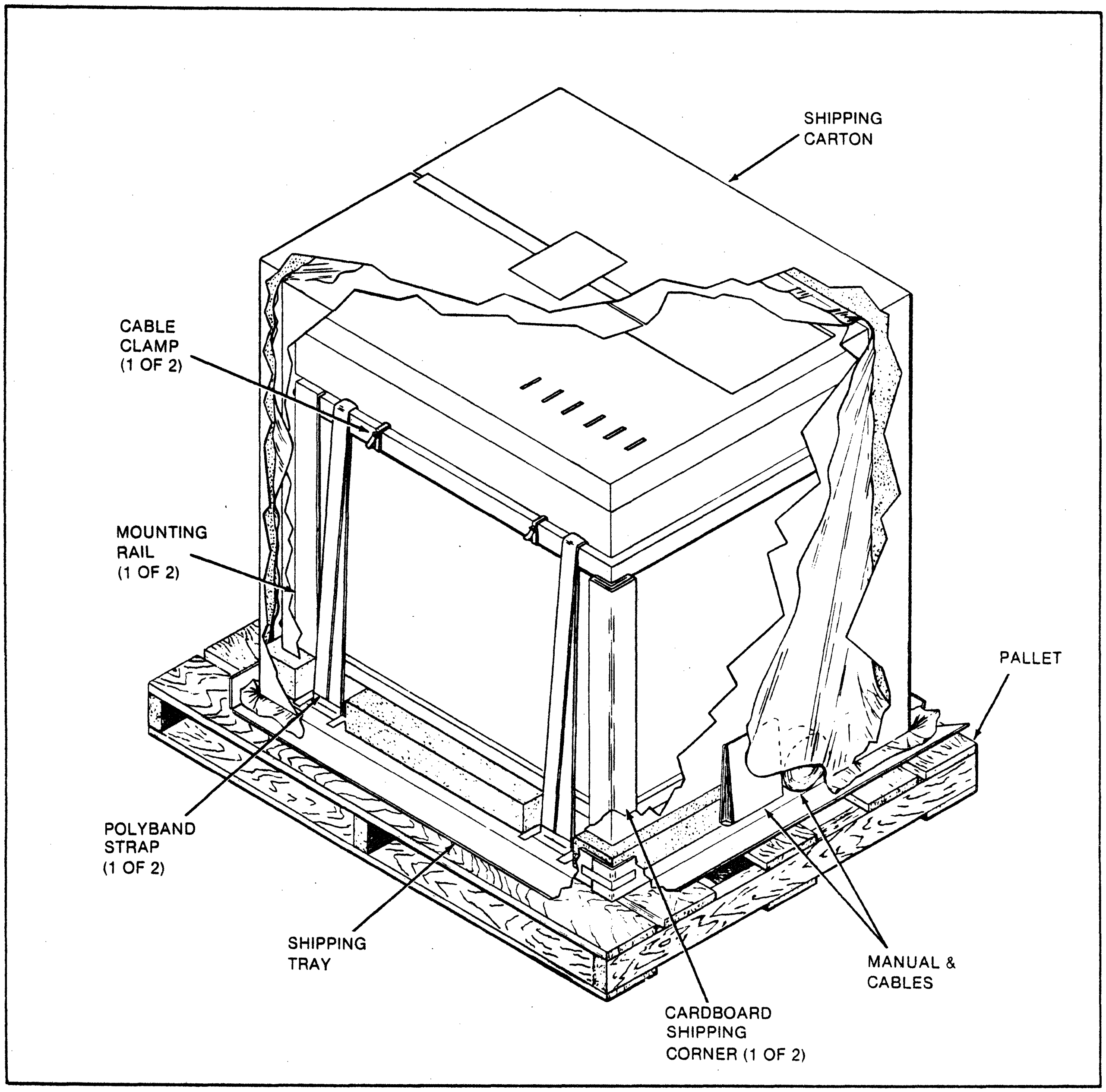


Figure 2-1. Tape Unit Packaging

12. Locate the latch access hole inside the front door at the top of the deck casting. Insert a straight-slot screwdriver through the access hole and push the tape deck latch. The deck casting swings away from the electronics frame.

13. Remove the tape and foam padding around the logic card cage.

14. Check for loose hardware throughout the tape unit and tighten as necessary. Verify that all cable connections are tight. Refer to Logic Sheets CA001 and CA002 for internal cable connections. Ensure that the PROMs on the JK printed circuit card (slot E2) are secure in the sockets.

15. Proceed to the Preliminary Checkout procedure.

2.3 PRELIMINARY CHECKOUT

The preliminary checkout tests the major electrical functions of the tape unit off-line before it is installed in an equipment rack. Test the tape unit before connecting to the controller.

Verify the ac power requirements before connection. The operating voltage, operating frequency, and recommended fuse rating of the tape unit can be found on a nameplate on the back of the deck casting. The voltage tolerances are given in Section 1.2.3.

The National Electrical Manufacturers Association (NEMA) recommends that the tape unit be grounded for safety. The tape unit is equipped with a three-conductor power cable to ground the deck and cage. The center pin of the power plug is the ground connection.

The checkout procedure and expected results follow. If any of these expected results do not occur or if a faulty condition persists, notify a company representative and discontinue the installation procedure.

1. Check that the pneumatics vacuum blower drive belt is positioned on the correct vacuum blower pulley for the altitude at the site. The belt should be on the larger flange for altitudes below 1100 feet (335 meters) and on the smaller flange for altitudes between 1100 and 6000 feet (335 and 1830 meters).

2. Check the pneumatics drive belt tension using the procedure described in Section 5.4.2.

3. Make certain that the MAIN POWER circuit breaker on the power supply inside the frame assembly is in the OFF position, then plug in the AC power cord.

WARNING

Do NOT touch any other part of the tape unit when turning on the MAIN POWER circuit breaker.

4. Turn on the MAIN POWER circuit breaker inside the frame assembly.

5. Press the operator panel POWER ON switch. The POWER ON indicator should light and the cooling fan in the frame assembly being to function. If the POWER ON indicator does not illuminate, disconnect the input power and check the tape unit fuses.

6. Check and adjust the power supply outputs using the procedure described in Section 5.4.1.

7. Mount an open reel scratch tape with a write enable ring installed. There should be a BOT reflective marker within the first 18 feet (6 meters) of the tape.

8. Press the LOAD/REWIND switch once. The pneumatics should activate and the vacuum transfer valve should select tape threading mode (right-hand position).

9. The file reel should turn backward (CCW) until the tape leader end is positioned at the entrance to the threading path. At this time both file and machine reels should turn forward (CW). Tape should thread and wrap onto the machine reel. Tape will continue forward until the BOT marker is sensed (8 to 10 seconds).

   If the tape leader end is not automatically found, it must be manually positioned in the threading path. Press the LOAD/REWIND switch, place the tape leader in the threading path, and press the LOAD/REWIND switch once again.

10. When BOT is sensed, the vacuum transfer valve should select tape loading mode (left-hand position). After two seconds the machine reel should turn counterclockwise to dump tape into the machine column.

11. When the tape loop approaches the top of the machine column, the machine reel should stop and the file reel should begin turning clockwise to dump tape into the file column.

12. When the tape loop approaches the top of the file column, the reel servo is enabled to position the tape in the center of the columns.

13. The capstan should activate and the tape unit should initiate a forward search for BOT. If BOT is not sensed after approximately 4 seconds in the forward mode, tape is searched in the backward mode.

14. When BOT is found, tape motion should stop. The LOAD indicator should light and the FILE PROTECT indicator should be off.

15. Press the ONLINE switch. The ONLINE indicator should light.

16. Press the LOAD/REWIND switch. There should be no response.

17. Press the REWIND/UNLOAD switch. There should be no response.

18. Press the RESET switch. The ONLINE indicator light should go off.

19. Perform the Pneumatics Levels Adjustment procedure (Section 5.4.3).

20. Perform the Capstan Velocity Check program (Section 5.3.2.8) and the Capstan Ramp Check program (Section 5.3.2.9).

21. Press the REWIND/UNLOAD switch. Tape should unload onto the file reel.

22. The preliminary checkout is completed; proceed with the tape unit installation.

2.4 CABINET MOUNTING

The tape unit is designed to be mounted in a standard 19-inch RETMA or universal cabinet with a minimum panel space of 29.8 inches (75.8 cm). Refer to Figures 2-2 and 2-3 for other installation dimensional requirements.

1. Position the two mounting rails at the sides of the cabinet rack and secure the rails front and back to the rack with screws and lockwashers as shown in Figure 2-4.

2. Using a forklift, place the tape unit assembly on the rails.

3. Slide the tape unit assembly into position on the rails.

4. Install tie-down screws and lockwashers to secure the tape unit assembly to the mounting rails as shown in Figure 2-4.

5. Connect the tape unit cables to the controller. Figure 2-5 shows the cabling of a tape unit to a Model 1935 FCU and the proper orientation of the connectors. Refer to Chapter 3 for specific details concerning interface connections.

2.5 PERFORMANCE CHECK

Perform the Quarterly Maintenance Program, steps 4 through 10 (Section 5.2.2).

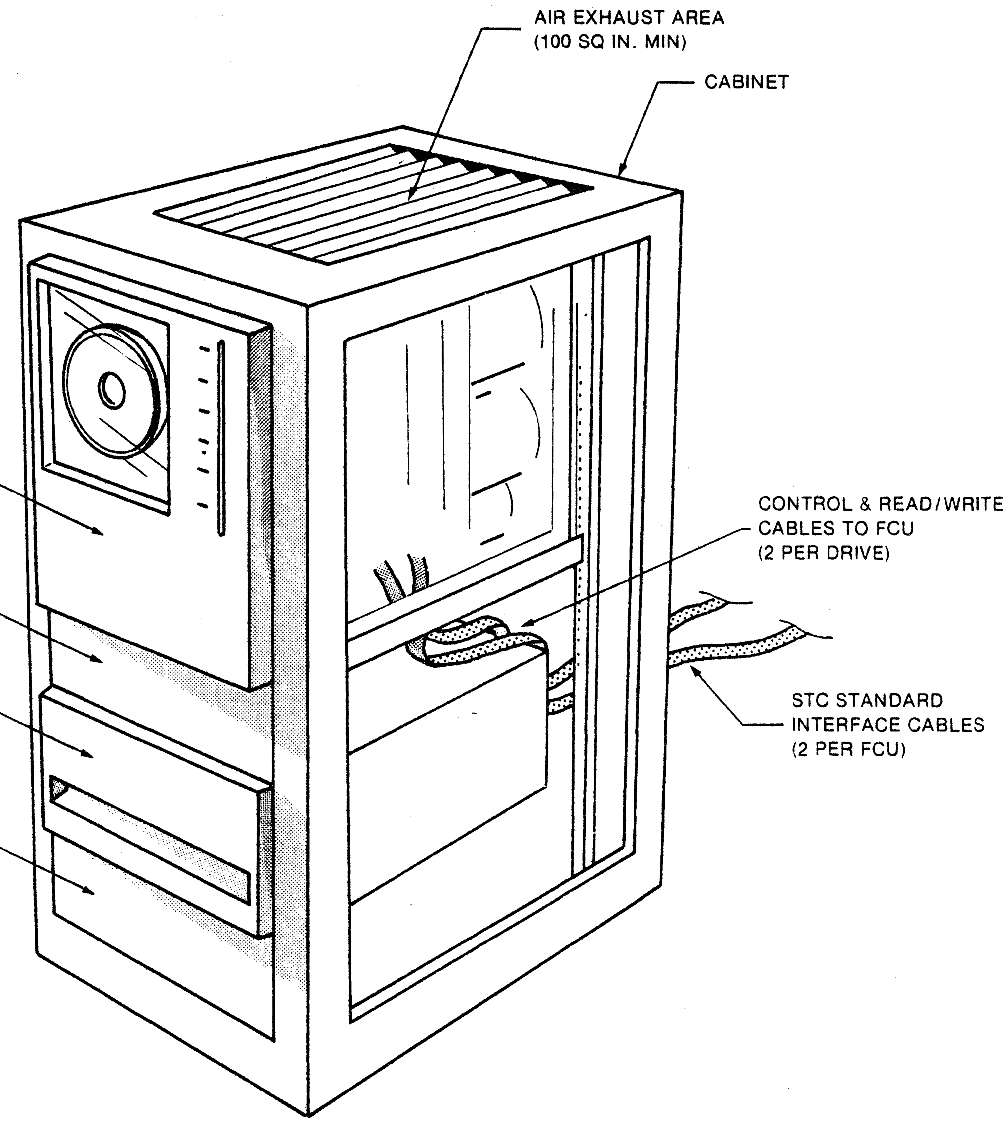


Figure 2-2. Tape Unit Installed in a Cabinet

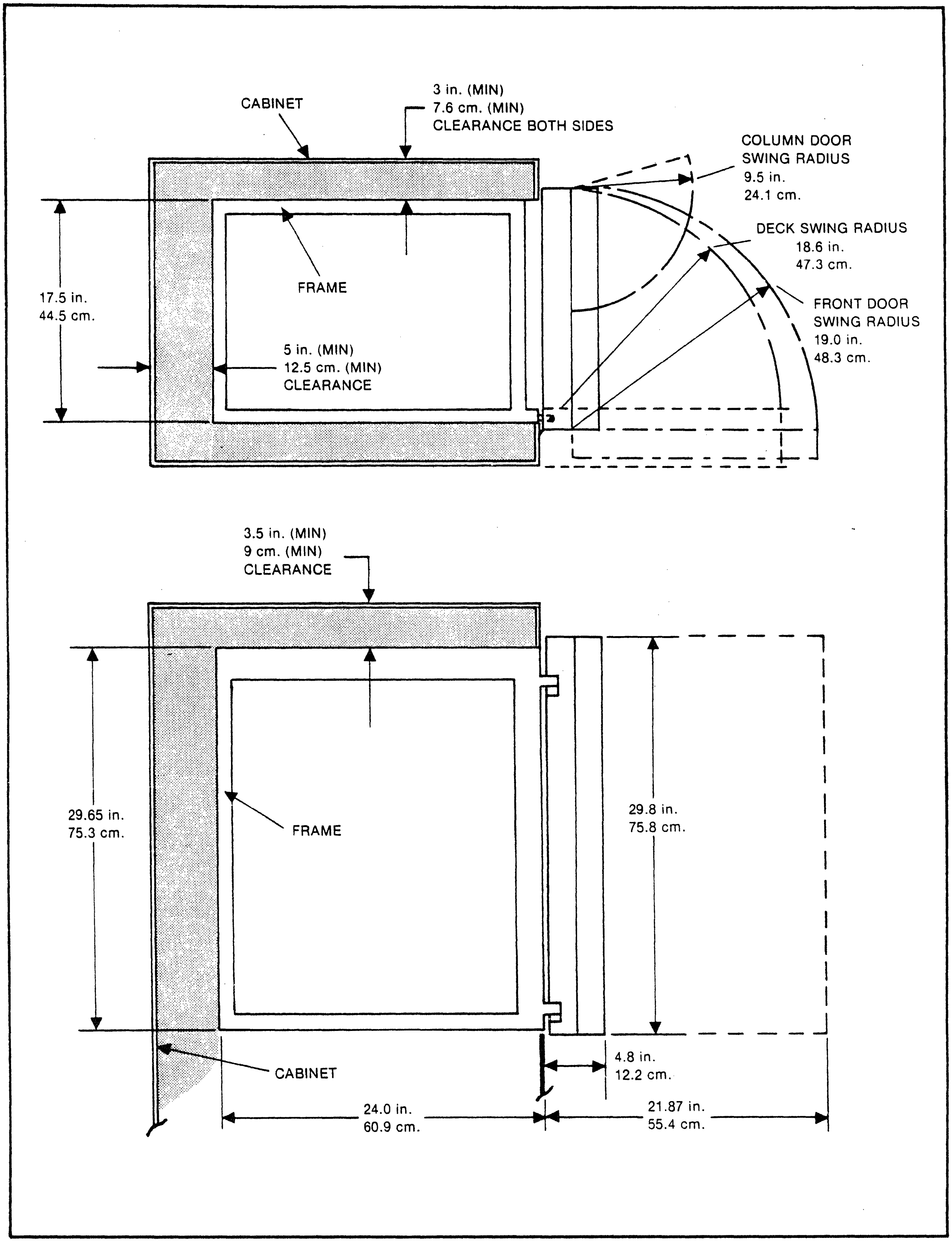


Figure 2-3. Tape Unit Mounting Dimensions

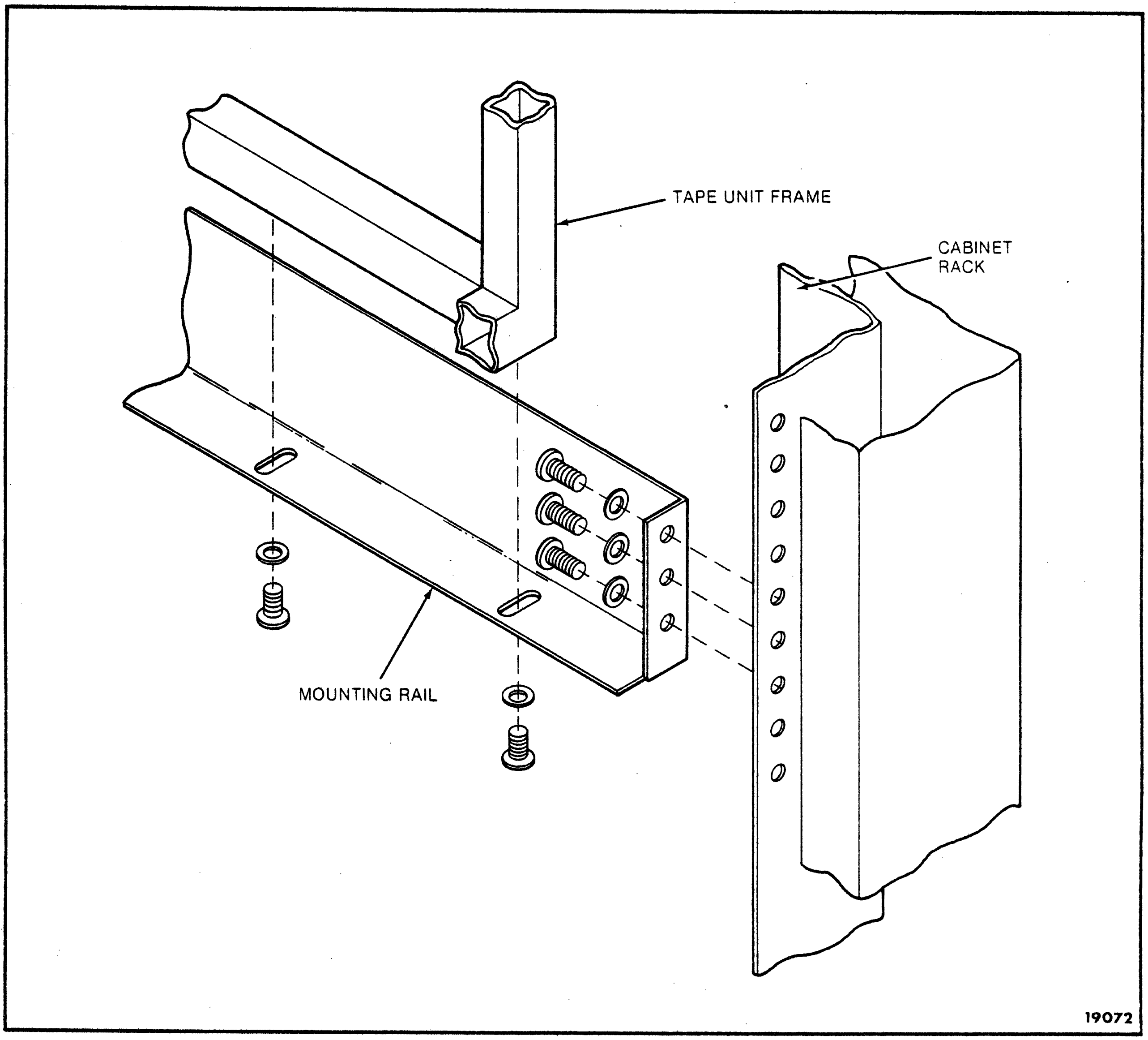


Figure 2-4. Tape Unit Installation

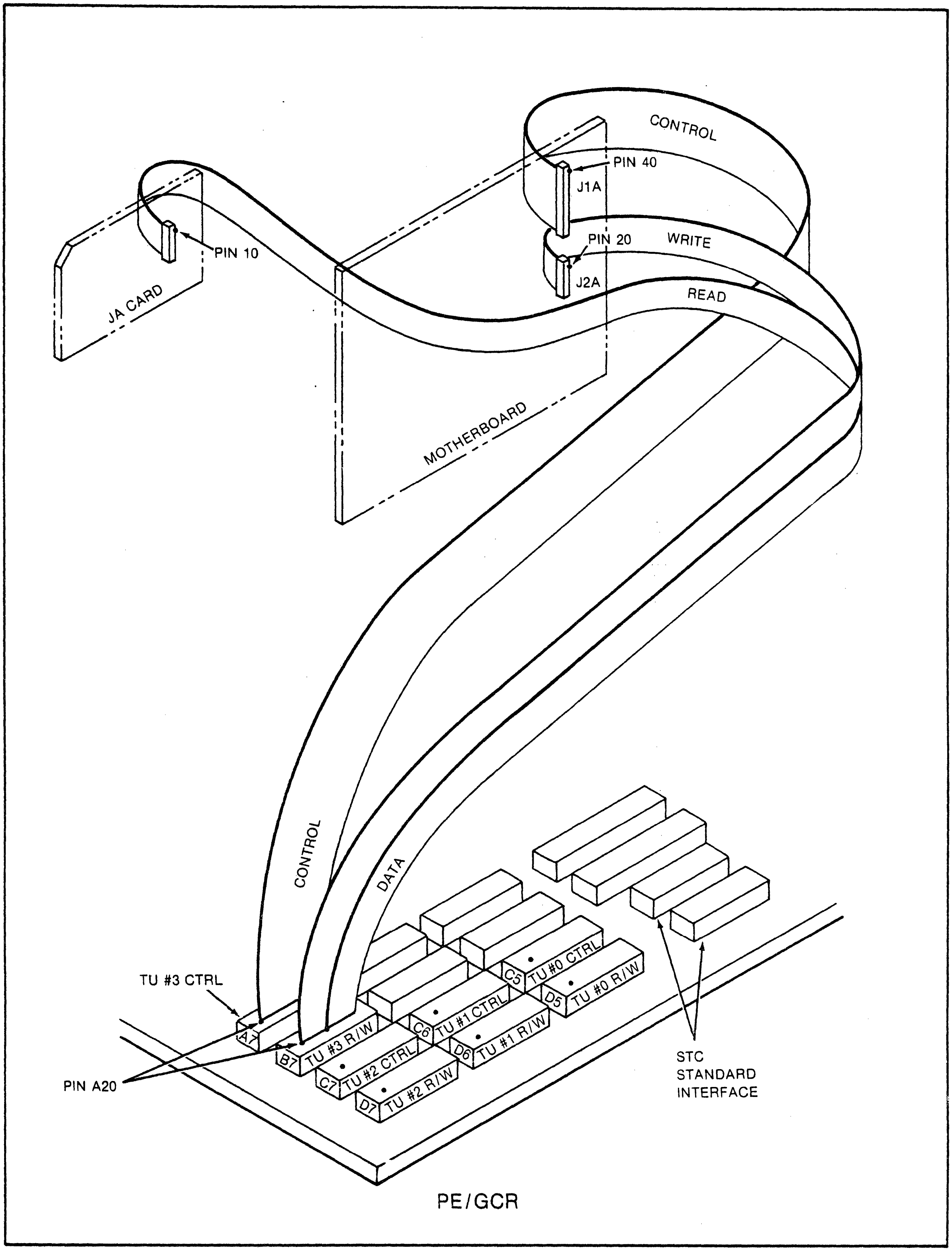


Figure 2-5A. 1951 (PE/GCR) TU to FCU Cabling

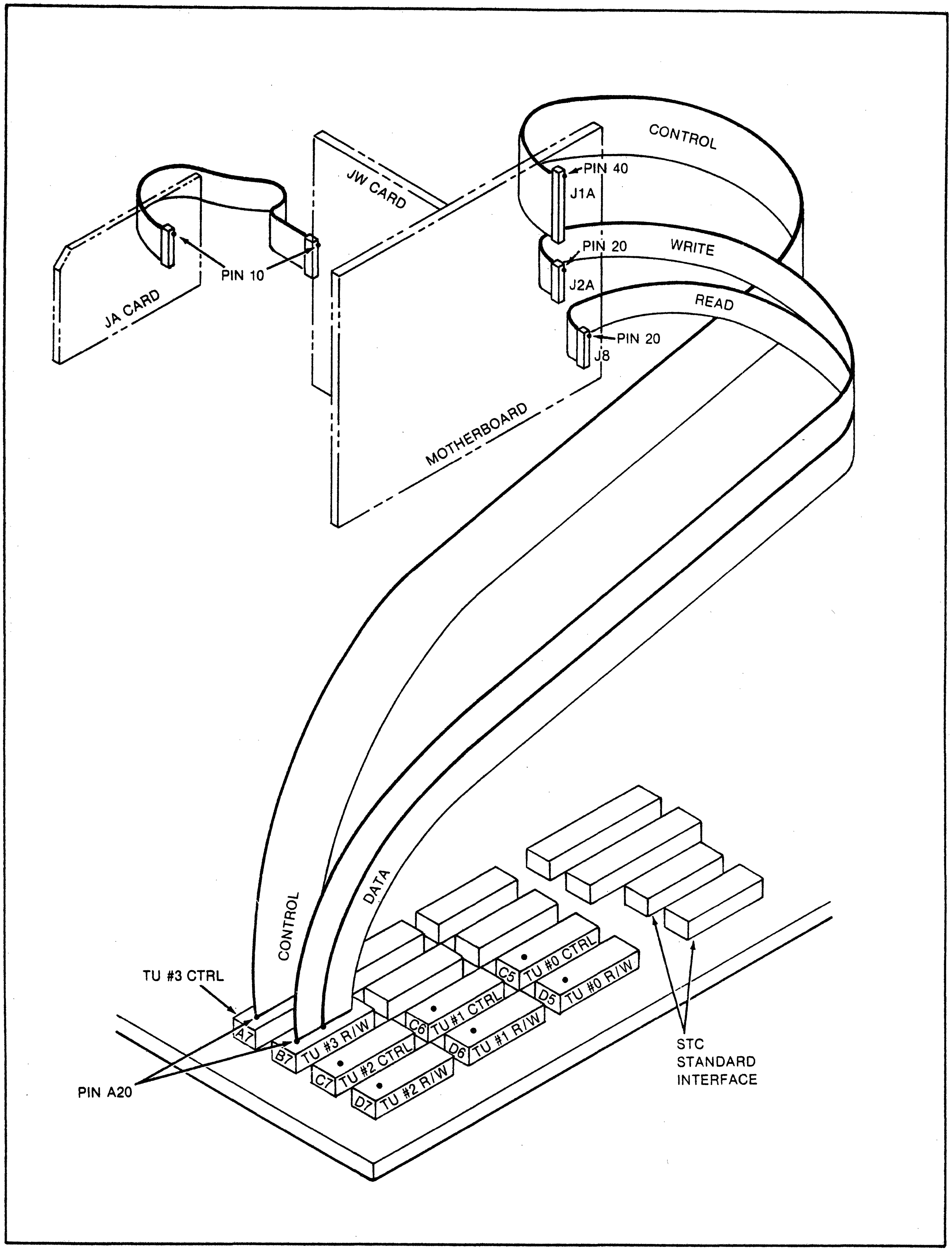


Figure 2-5B. 1953 (Tri-Density) TU to FCU Cabling

CHAPTER 3

INTERFACE

3.1 INTRODUCTION

This chapter provides a description of the tape unit to controller interface circuits and of all input and output interface signals. The 1952 (PE/NRZI) tape unit configuration is treated separately although many of the interface signals are identical to the 1951 and 1953 (PE/GCR and tri-density) interface signals.

3.2 1951/1953 INTERFACE

The 1951 and 1953 (PE/GCR and tri-density) interface connections are shown in Figures 3-1A and 1B. The tape unit and formatter control unit (FCU) interface circuits are shown in Figure 3-2. The FCU interface must use the circuits shown in the figure or use equivalent circuits. Two 40-conductor, flat, twisted-pair cables are provided to connect the tape unit to the FCU. Equivalent cables may be used but the maximum cable length from tape unit to FCU is 20 feet (6 meters).

The asserted (low) level of the digital interface signals is 0 Vdc to 0.7 Vdc. The typical unasserted (high) level is 3.4 (+0.3) Vdc. The dc reference level on each phase of the read data analog output interface signals is 0 volts.

The digital interface resistive termination for each signal is 180 ohms to +5 Vdc and 390 ohms to ground. The termination includes a ground wire connected in both the tape unit and the FCU. The analog interface resistive termination is 56 ohms to ground on each phase.

3.2.1 1951/1953 INPUT LINES

3.2.1.1 Select (SEL)

With the tape unit in Ready Status and Online Status, asserting the Select input line allows all control and motion command input lines to be effective for the tape unit. When unasserted, all control and motion command input lines are ineffective. Status output lines are valid independent of Select.

Select may be asserted before or after the assertion of a command line but tape unit operation will begin upon the assertion of the later command. Select must remain asserted for the duration of a Set Forward Motion or Set Backward Motion command. If Select is reset before Set Forward Motion or Set Backward Motion, the operation will terminate. In this mode of operation Select acts as a start/stop line.

Select must remain asserted for a Set Rewind or Set Rewind/Unload command only until the command has been accepted, which is signaled when the tape unit resets the Ready Status output line. Select must remain asserted for a Reset Online command only until the command has been accepted, which is signaled when the tape unit resets the Online Status output line.

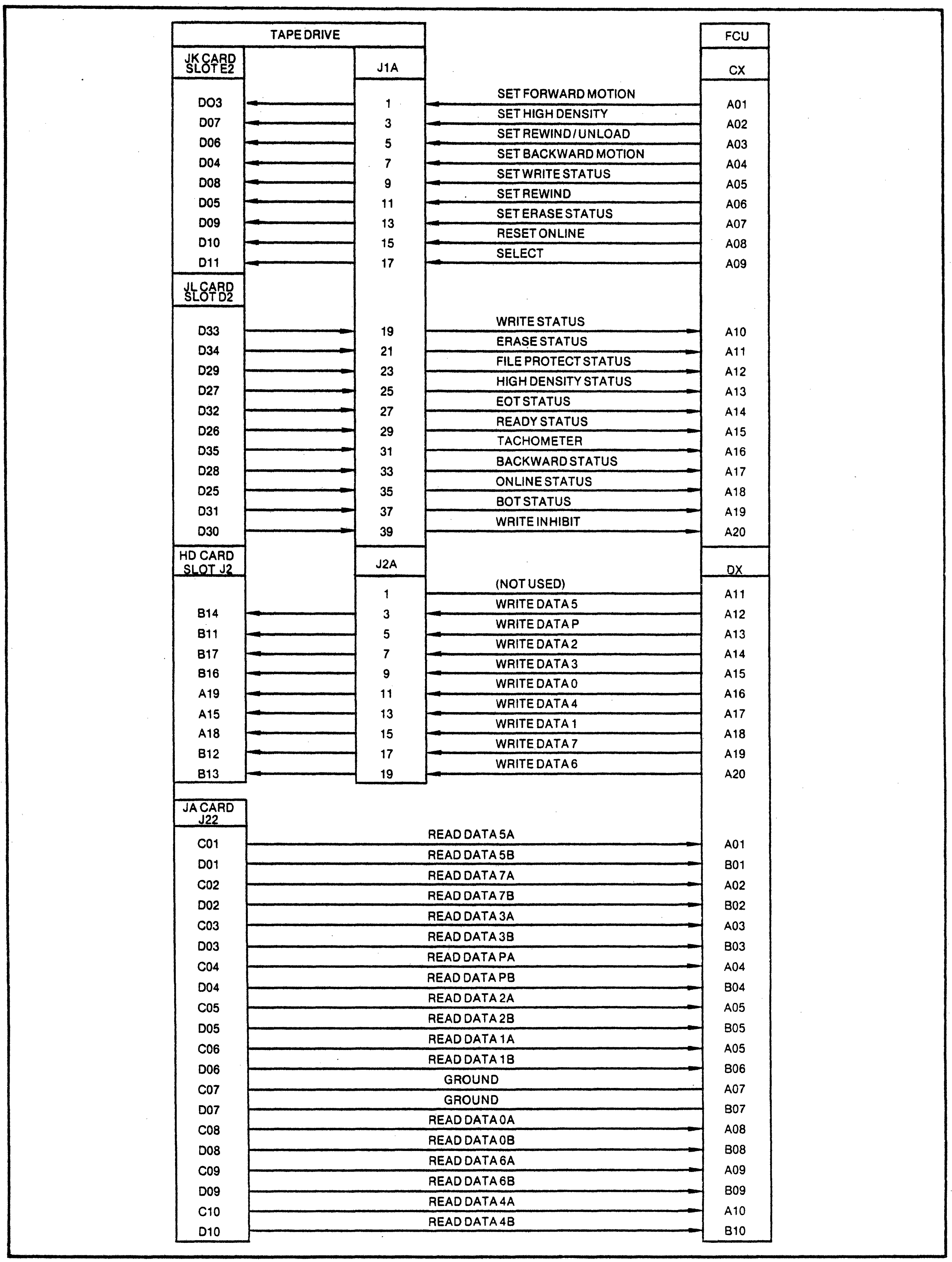


Figure 3-1A. 1951 (PE/GCR) Interface Connections

TAPE DRIVE JK CARD SLOT E2	J1A	Signal	Direction	FCU CX
D03	1	SET FORWARD MOTION	←	A01
D07	3	SET HIGH DENSITY	←	A02
D06	5	SET REWIND/UNLOAD	←	A03
D04	7	SET BACKWARD MOTION	←	A04
D08	9	SET WRITE STATUS	←	A05
D05	11	SET REWIND	←	A06
D09	13	SET ERASE STATUS	←	A07
D10	15	RESET ONLINE	←	A08
D11	17	SELECT	←	A09

JL CARD SLOT D2	J1A	Signal	Direction	CX
D33	19	WRITE STATUS	→	A10
D34	21	ERASE STATUS	→	A11
D29	23	FILE PROTECT STATUS	→	A12
D27	25	HIGH DENSITY STATUS	→	A13
D32	27	EOT STATUS	→	A14
D26	29	READY STATUS	→	A15
D35	31	TACHOMETER	→	A16
D28	33	BACKWARD STATUS	→	A17
D25	35	ONLINE STATUS	→	A18
D31	37	BOT STATUS	→	A19
D30	39	WRITE INHIBIT	→	A20

HD CARD SLOT J2	J2A	Signal	Direction	DX
	1	(NOT USED)	←	A11
B14	3	WRITE DATA 5	←	A12
B11	5	WRITE DATA P	←	A13
B17	7	WRITE DATA 2	←	A14
B16	9	WRITE DATA 3	←	A15
A19	11	WRITE DATA 0	←	A16
A15	13	WRITE DATA 4	←	A17
A18	15	WRITE DATA 1	←	A18
B12	17	WRITE DATA 7	←	A19
B13	19	WRITE DATA 6	←	A20

JW CARD SLOT H2	J8	Signal	Direction	DX
B40	1	READ DATA 5A	→	A01
B41	2	READ DATA 5B	→	B01
B36	3	READ DATA 7A	→	A02
B37	4	READ DATA 7B	→	B02
B34	5	READ DATA 3A	→	A03
B35	6	READ DATA 3B	→	B03
B30	7	READ DATA PA	→	A04
B31	8	READ DATA PB	→	B04
B26	9	READ DATA 2A	→	A05
B27	10	READ DATA 2B	→	B05
B14	11	READ DATA 1A	→	A06
B15	12	READ DATA 1B	→	B06
	13	GROUND	→	A07
	14	GROUND	→	B07
B12	15	READ DATA 0A	→	A08
B13	16	READ DATA 0B	→	B08
B08	17	READ DATA 6A	→	A09
B09	18	READ DATA 6B	→	B09
B04	19	READ DATA 4A	→	A10
B05	20	READ DATA 4B	→	B10

Figure 3-1B. 1953 (Tri-Density) Interface Connections

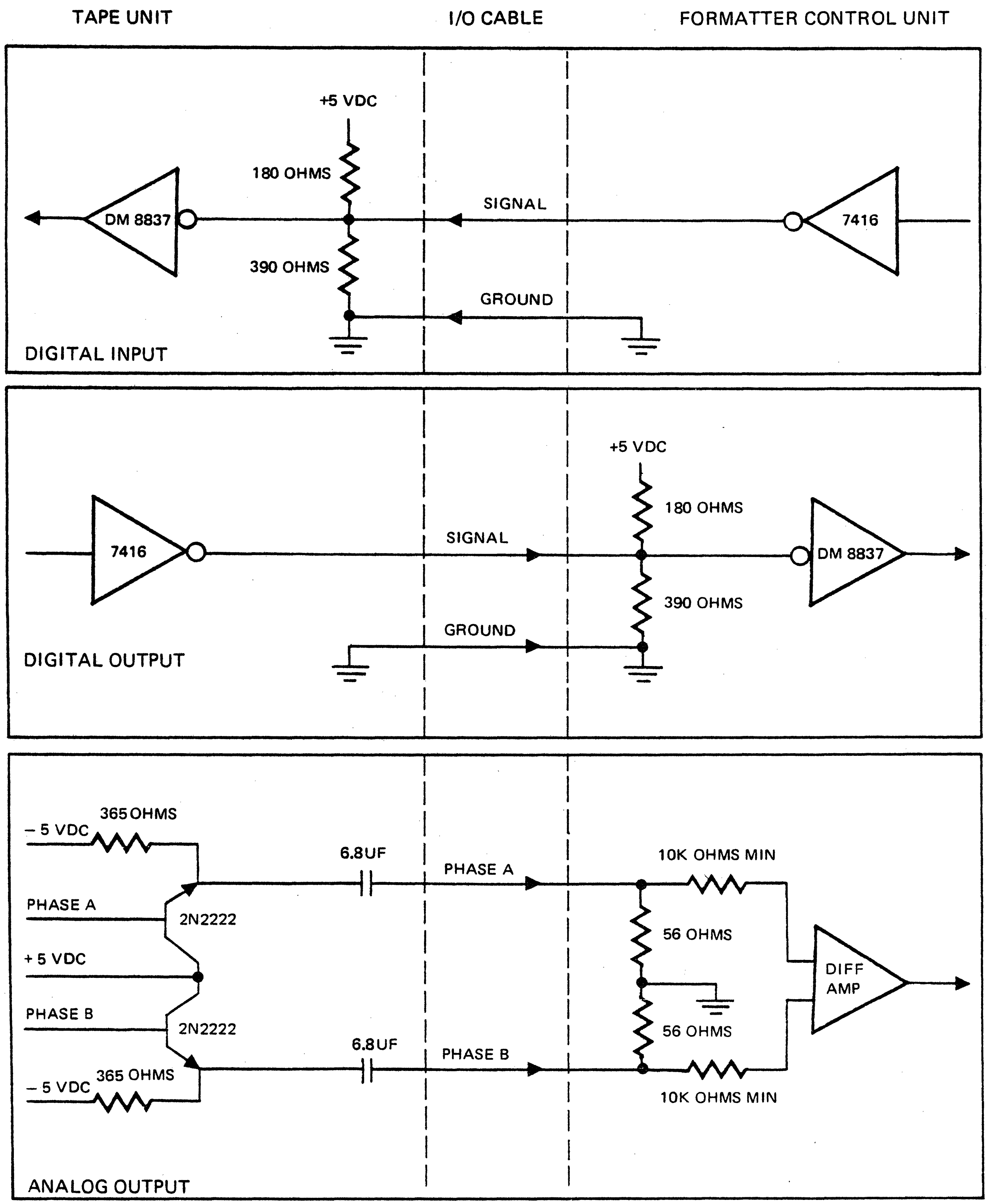


Figure 3-2. 1951/1953 (PE/GCR and Tri Density) Interface Circuits

3.2.1.2 Set Forward Motion (FWD)

When the Set Forward Motion input line is asserted, it commands the tape unit to move tape forward at rated tape speed. This line must remain asserted for the duration of the desired command operation length. The line is effective only if Select, Online Status, and Ready Status are asserted and is ineffective if any other command operation (Set Backward Motion, Set Rewind, Set Rewind/Unload) is in progress.

3.2.1.3 Set Backward Motion (BWD)

When the Set Backward Motion input line is asserted, it commands the tape unit to move tape backward at rated tape speed. This line must remain asserted for the duration of the desired command operation length. The line is effective only if Select, Online Status, and Ready Status are asserted and is ineffective if any other command operation (Set Forward Motion, Set Rewind, Set Rewind/Unload) is in progress.

A backward motion operation automatically resets Write Status and Erase Status in the tape unit. The Set Write Status and Set Erase Status input control lines are ineffective during a backward motion operation.

3.2.1.4 Set Rewind (RWD)

When the Set Rewind input line is asserted, it commands the tape unit to reset Ready Status and to move tape backward at rewind speed. When BOT is detected, the tape stops and Ready Status is set again. The line is effective only if Select, Online Status, and Ready Status are asserted and if tape is not already positioned at BOT. The line is ineffective if any other command operation (Set Forward Motion, Set Backward Motion, Rewind/Unload) is in progress.

Set rewind must remain asserted until the command has been accepted by the tape unit, which is signaled when the tape unit resets Ready Status. Alternately, a pulse duration of 16 microseconds of Set Rewind and Select simultaneously is sufficient to ensure setting a rewind command.

A rewind operation automatically resets Write and Erase Status and sets Backward Status in the tape unit.

3.2.1.5 Set Rewind/Unload (RWU)

When the Set Rewind/Unload input line is asserted, it commands the tape unit to reset Ready Status, move tape backward at rewind speed to BOT, stop tape motion momentarily at BOT, and then unload all tape onto the file reel. The line is effective only if Select, Online Status, and Ready Status are asserted, and is ineffective if any other command operation (Set Forward Motion, Set Backward Motion, Set Rewind) is in progress.

Set Rewind/Unload must remain asserted until the command has been accepted by the tape unit, which is signaled when the tape unit resets Ready Status. Alternately, a pulse duration of 10 microseconds of Set Rewind/Unload and Select simultaneously is sufficient to ensure setting a rewind/unload command.

A rewind/unload operation automatically resets Write and Erase Status and sets Backward Status in the tape unit.

3.2.1.6 Reset Online (RON)

Asserting the Reset Online input line resets the Online Status latch in the tape unit, causing the tape unit to go offline. If either a forward or backward command operation is in progress, the operation will be terminated. A Set Rewind or Set Rewind/Unload command operation in progress will continue to completion, then the command will be accepted. This line is effective only if Select and Online Status are asserted and its effectivity is independent of Ready Status. The tape unit can be placed online again only by pressing the ONLINE switch on the operator panel.

3.2.1.7 Set High Density (HDN)

This line is associated with the tape unit Density Mode Set. Refer to Section 3.2.3.2.

3.2.1.8 Set Write Status (WRT)

To set the tape unit to Write Enable, the Set Write Status input line must be asserted when the Set Forward Motion command is asserted. Write Enable is reset by issuing Set Forward Motion with Set Write Status held high (Set Read Forward mode) or by issuing Set Backward Motion (Set Read Backward mode). The Set Write Status is effective only if the tape unit File Protect Status output line is not asserted.

The tape unit goes from Write Enable to Write Status (write circuits and write head active) automatically, but only when Set Erase Status occurs simultaneously.

Set Write Status must remain asserted during command initiation until the tape unit responds with the corresponding state of Write Status. Alternately, a pulse duration of 16 microseconds (with Set Forward Motion and Select asserted) is sufficient to ensure setting Write Enable.

Both Write Status and Erase Status must be reset (unasserted) when a read-only command is to be initiated.

3.2.1.9 Set Erase Status (ERS)

To set the tape unit to Erase Status, the Set Erase Status input line must be asserted when the Set Forward Motion command is asserted. Erase Status is reset by issuing Set Forward Motion with Set Erase Status held high (Set Read Forward mode) or by issuing Set Backward Motion (Set Read Backward mode). The Set Erase Status line is effective only when File Protect Status is not asserted.

Set Erase Status must remain asserted during command initiation until the tape unit responds with the corresponding state of Erase Status. Alternately, a pulse duration of 16 microseconds (with Set Forward Motion and Select asserted) is sufficient to ensure setting Erase Status.

3.2.1.10 Write Data (WRP-WR7)

The nine Write Data input lines carry the data from the formatter control unit to the tape unit.

3.2.2 1951/1953 OUTPUT LINES

All tape unit output status lines are valid independent of Select and Online Status. The lines at all times represent the status that exists within the tape unit.

3.2.2.1 Ready Status (RDYS)

The Ready Status output line is asserted when the tape unit is able to operate with the formatter control unit, that is, when tape is loaded and the tape unit is not performing a rewind or rewind/unload operation. This line is controlled internally by the tape unit and is asserted following a tape load operation only after tape is positioned at BOT. The line is unasserted if tape is not loaded, if tape is being loaded or unloaded, or if a rewind or rewind/unload operation is in progress.

3.2.2.2 Online Status

The Online Status output line is asserted when the tape unit has been placed online by pressing the ONLINE switch on the operator panel provided tape is loaded in the columns. Online Status may be reset by a Reset Online Status command from the formatter control unit or by pressing the RESET switch on the operator panel.

3.2.2.3 Beginning of Tape Status (BOTS)

The Beginning of Tape Status output line is asserted when tape is positioned at the BOT marker. The line goes high when a Set Forward Motion command or a Set Rewind/Unload command is received from the formatter control unit.

3.2.2.4 End of Tape Status (EOTS)

The End of Tape Status output line is asserted when tape is positioned at or beyond the EOT marker. The line goes high when the trailing edge of the EOT marker is detected during a backward or rewind operation.

3.2.2.5 High Density Status (HDNS)

The High Density Status output line is asserted when the tape unit has been placed in GCR mode. High Density Status is reset (unasserted) when the tape unit is powered up, and when the tape unit is loaded or unloaded.

3.2.2.6 File Protect Status (PROS)

The File Protect Status output line is asserted after a load operation is initiated if the file reel does not contain a write enable ring. The line is unasserted when a write enable ring is present.

3.2.2.7 Erase Status (ERSS)

The Erase Status output line is asserted when the tape unit has been placed in Erase Status by a Set Erase Status command. This line cannot be asserted if File Protect Status is asserted, that is, if the file reel does not contain a write enable ring.

3.2.2.8 Write Status (WRTS)

The Write Status output line is asserted when the tape unit has been placed in Write Enable mode. Erase Status is asserted concurrently.

3.2.2.9 Backward Status (BWDS)

The Backward Status output line is asserted when the command in progress or just completed was a backward motion command (Set Backward Motion, Set Rewind, or Set Rewind/Unload). If the previous or current command is Set Forward Motion, this line is unasserted.

3.2.2.10 Write Inhibit (WNHB)

The Write Inhibit output line is asserted when the read/write head is positioned in the interblock gap (IBG). The line changes to unasserted in write mode when the proper IBG distance has been traversed. Write data transfer from the FCU should being immediately after the line is unasserted in order to generate a nominal IBG.

3.2.2.11 Tachometer (TACH)

The Tachometer output signal switches at a rate proportional to capstan velocity. From the rise to assertion of the line to the next rise to assertion represents 0.00565 inches of tape travel.

3.2.2.12 Read Data (RBP-RB7)

The nine pairs of Read Data output lines carry the amplified analog data from the tape unit to the formatter control unit during a read-only or read-after-write operation.

3.2.3 1951/1953 SPECIAL LINE EXTENSIONS

In order for the Model 1935 Formatter Control Unit (FCU) to accommodate the different speed and density models within the family of 1951/1953 tape units and also to accommodate special diagnostic programs, additional subsystem commands are used.

3.2.3.1 Set Diagnostic Command

To perform certain diagnostic tests on the tape unit, the FCU asserts Select and Set Write Status, and then asserts Rewind. This signals the tape unit that the remaining input control lines contain the command code for a diagnostic operation. The tape unit signals that it has accepted the command by changing Write Status from unasserted to asserted. Refer to Figure 3-3.

3.2.3.2 Density Mode Set

To select the recording format (density) of the tape unit, the FCU asserts Select, then one of three lines to select the desired density (Set High Density to select NRZI mode; Set Write Status to select PE mode; or Set Erase Status to select GCR mode), and then asserts Rewind/Unload. The tape unit signals that it has accepted the mode set by changing Write Status from unasserted to asserted. Refer to Figure 3-4.

3.2.3.3 Diagnostic Sense Command

To demand the transfer of an additional tape unit status information across the FCU/TU interface, the FCU asserts Select and Set Write Status and then asserts Rewind. Refer to Figure 3-5. The tape unit then places the next Drive Sense Byte (DSB) on the eight tape unit status lines and indicates that this byte is valid by changing Write Status from unasserted to asserted. To request the next Drive Sense Byte, the FCU resets and then sets Rewind and the tape unit responds as before.

Drive Sense Byte 0 is available 10 microseconds after Set Write Status is reset. Each byte remains valid until the next byte is requested or until Set Write Status is reset. Table 3-1 shows how the Drive Sense Bytes (DSB) are organized.

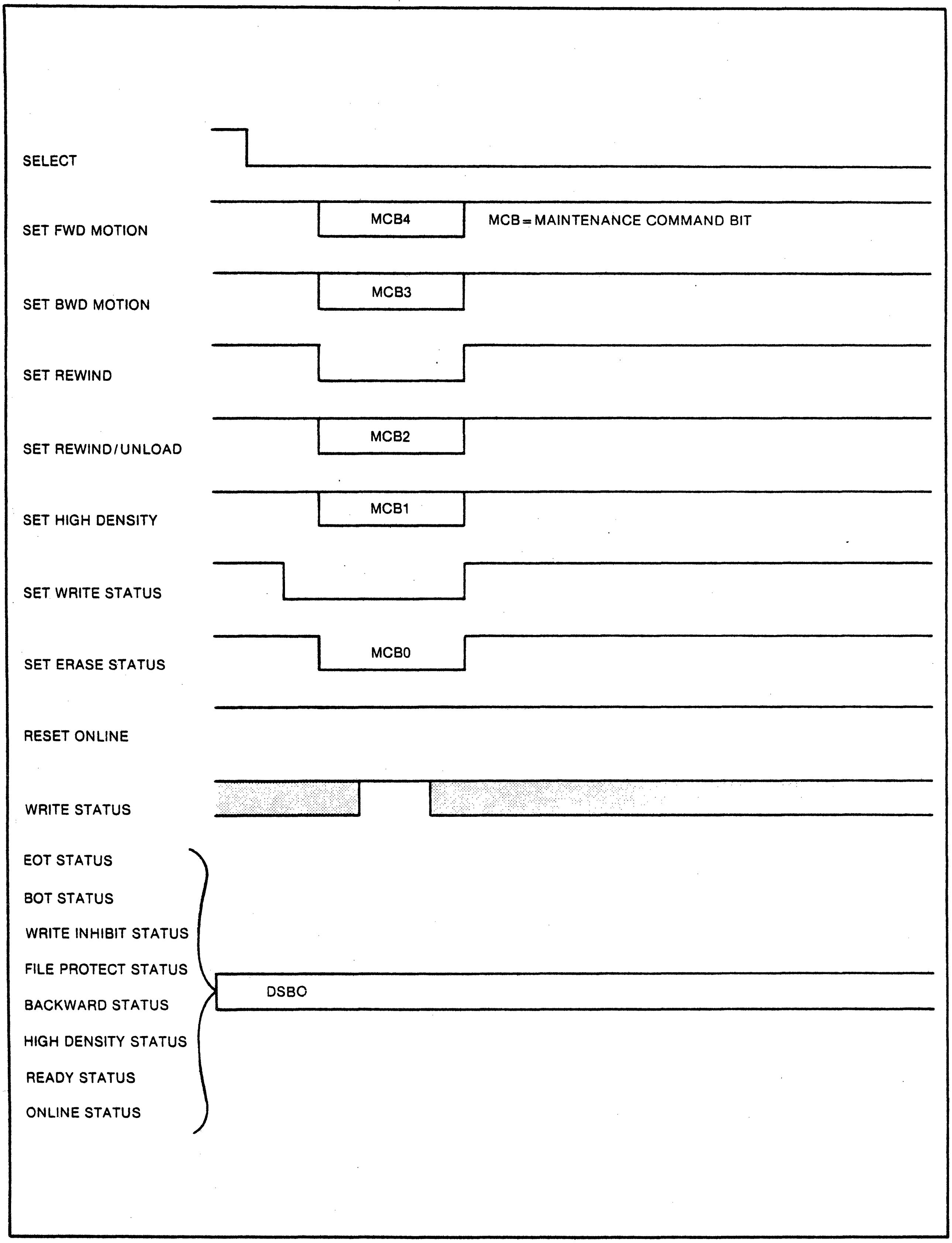


Figure 3-3. Set Diagnostic Command

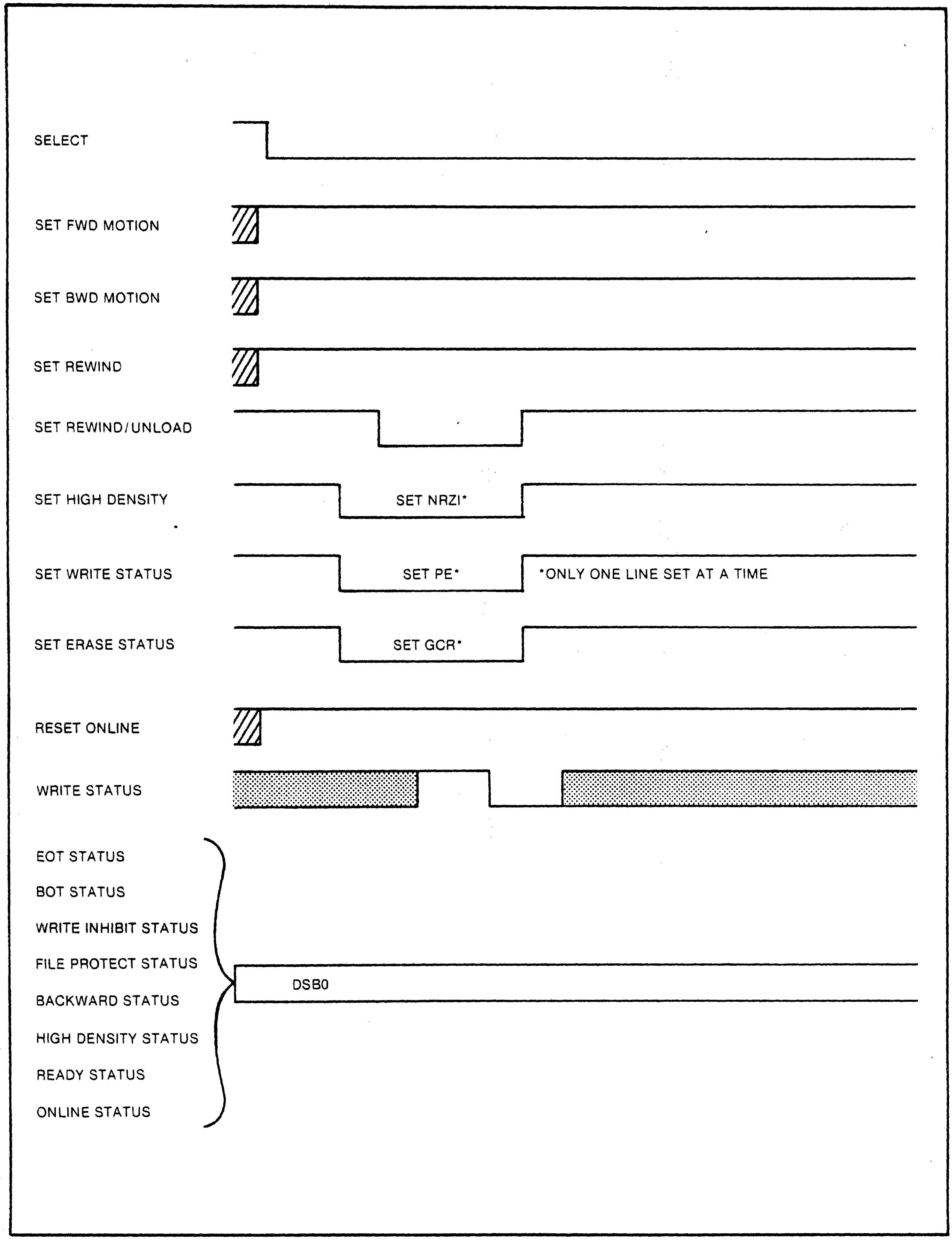


Figure 3-4. Density Mode Set

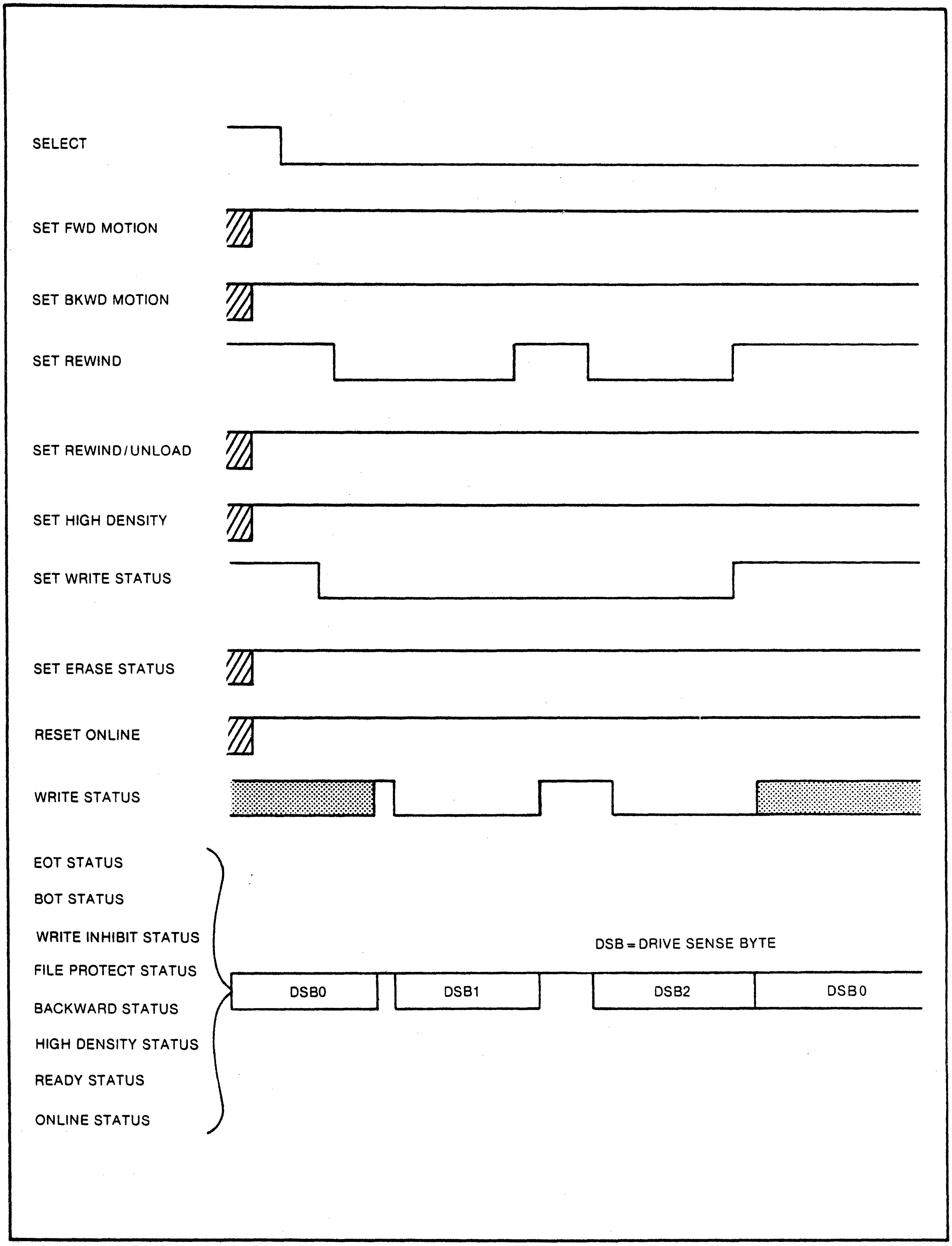


Figure 3-5. Diagnostic Sense Command

Table 3-1. Drive Sense Byte Decode/RAM Map

DRIVE SENSE BYTES	DRIVE SENSE BITS 7	6	5	4	3	2	1	0
DSB0	EOTS	BOTS	WNHB	PROS	BWDS	HDNS	RDYS	ONLS
DSB1	1	1	D1	D0	0	M2	M1	M0
DSB2	0	0	S1	S0	TSB	0	0	0
DSB3	← MACHINE CHECK ERROR CODE →							
DSB4	← ERROR CODE SUPPLEMENT →							
DSB5	← ERROR CODE SUPPLEMENT →							
DSB6	REEL REGISTER: BIAS	GRND	FILC	FILB	FILA	MACC	MACB	MACA
DSB7	CAPSTAN REGISTER: 0	0	0	CRDY	REW	FWD	GO	ENRL
DSB8	WRITE/ERASE REGISTER: ENST	FLPR	GTMW	MBTP	MLRC	MWRT	ERSE	WRTE
DSB9	2^7 ← TURNS COUNTER LOW → 2^0							
DSB10	2^{15} ← TURNS COUNTER HIGH → 2^8							
DSB11	MACHINE LATCH 4:			DROL	NRZI	HD2	HD1	IBGC
DSB12	INTERRUPT MASK: 0	DOOR	EOTD	FCLD	MCLD	EOT	BOT	SEL
DSB13	← TEMPORARY →							
DSB14	← UNIVERSAL DELAY COUNTER →							
DSB15	← UNIVERSAL DELAY COUNTER →							

3.2.4 DRIVE SENSE BYTE DEFINITIONS

3.2.4.1 Drive Sense Byte 0 (DSB0)

Drive Sense Byte 0 are the tape unit status output lines defined in Section 3.2.2.

3.2.4.2 Drive Sense Byte 1 (DSB1)

Bits 0,1,2 (M0,M1,M2) describe the tape unit operational capabilities. Refer to Table 3-2 for the decoding of the M bits.

Bit 3 is always ZERO. This differentiates the 1950 series tape units from the 4500 series tape units.

Bits 4,5 (D0,D1) describe the recording density to which the tape unit is presently set. The default recording density is PE. Refer to Table 3-3 for the decoding of the D bits.

Bits 6,7 are always ONE. They distinguish the 1950 (and 4500) series tape units from the 1920 series tape units.

Table 3-2. Tape Unit Capability Indication

M2	M1	M0	TU CAPABILITY
0	0	0	reserved
0	0	1	reserved
0	1	0	75 ips, PE/GCR
0	1	1	75 ips, PE/GCR/NRZI
1	0	0	125 ips, PE/GCR
1	0	1	125 ips, PE/GCR/NRZI
1	1	0	reserved
1	1	1	reserved

Table 3-3. Tape Unit Density Select Indication

D1	D0	TU MODE
0	0	not used
0	1	NRZI
1	0	PE
1	1	GCR

3.2.4.3 Drive Sense Byte 2 (DSB2)

Bits 0,1,2 are always ZERO.

Bit 3 (TSB) is the Tape Stop Bit.

Bits 4,5 (S0,S1) describe the status of the Density Select Latch (Logic Sheet JL071). Refer to Table 3-4 for the decoding of the S bits.

Bits 6,7 are always ZERO.

Table 3-4. Density Selection Decode

S1	S0	DENSITY SELECTION
0	0	Software Select
0	1	NRZI
1	0	PE
1	1	GCR

3.2.4.4 Drive Sense Byte 3 (DSB3)

Drive Sense Byte 3 contains the machine check code. For descriptions of the machine check codes, refer to Appendix A.

3.2.4.5 Drive Sense Bytes 4,5 (DSB4,DSB5)

Drive Sense Bytes 4 and 5 contain the machine check error code supplements described in the machine check code descriptions in Appendix A.

3.2.4.6 Drive Sense Byte 6 (DSB6)

Drive Sense Byte 6 reflects the status of the Reel Register (Logic Sheet JS051).

Bits 0,1,2 (MACA,MACB,MACC) are the machine reel command code. Refer to Table 3-5 for the decoding of the command bits. Refer to Section 4.5.1 for a description of how these bits are used.

Bits 3,4,5 (FILA,FILB,FILC) are the file reel command code. Refer to Table 3-5 for the decoding of the command bits. Refer to Section 4.5.1 for a description of how these bits are used.

Bit 6 (GRND) is a ONE if the reel motors are returned to ground for normal operating speeds; otherwise it is ZERO. Refer to Section 4.5.4.

Bit 7 (BIAS) is a ONE if the reel motors are returned to a 45 volt level for high speed rewind operation; otherwise it is ZERO. Refer to Section 4.5.4.

Table 3-5. Reel Command Decode

MACA FILA	MACB FILB	MACC FILC	COMMAND
0	0	0	Forward 1
0	0	1	Forward 2
0	1	0	Backward 1
0	1	1	Backward 2
1	0	0	Low Gain
1	0	1	High Gain
1	1	0	Null State
1	1	1	Rewind Gain

3.2.4.7 Drive Sense Byte 7 (DSB7)

Drive Sense Byte 7 reflects the status of the Capstan Register (Logic Sheet JL021).

Bit 0 (ENRL) = +Enable Reels
Bit 1 (GO) = +Go
Bit 2 (FWD) = +Forward
Bit 3 (REW) = +Rewind
Bit 4 (CRDY) = +Capstan Enable
Bits 5,6,7 are always ZERO

3.2.4.8 Drive Sense Byte 8 (DSB8)

Drive Sense Byte 8 reflects the status of the Write/Erase Register (Logic Sheet JL041).

Bit 0 (WRTE) = +Write Current
Bit 1 (ERSE) = +Erase Current
Bit 2 (MWRT) = +Maintenance Write Strobe
Bit 3 (MLRC) = +Maintenance LRC Strobe
Bit 4 (MBTP) = +Maintenance Write Bit P
Bit 5 (GTMW) = -Gate Maintenance Write
Bit 6 (FLPR) = -File Protect
Bit 7 (ENST) = +Enable TU Status

3.2.4.9 Drive Sense Bytes 9,10 (DSB9,DSB10)

Drive Sense Bytes 9 and 10 are the 16-bit capstan turns counter.

3.2.4.10 Drive Sense Byte 11 (DSB11)

Drive Sense Byte 11 reflects the status of Machine Latch 4 (Logic Sheet JL021).

Bit 0 (IBGC) = +IBG Count Enable
Bit 1 (HD1) = +High Density 1
Bit 2 (HD2) = +High Density 2
Bit 3 (NRZI) = +NRZI
Bit 4 (DROL) = +Degate Reset Online
Bits 5,6,7 are not used

3.2.4.11 Drive Sense Byte 12 (DSB12)

Drive Sense Byte 12 reflects the status of the Interrupt Mask (Logic Sheet JK081).

Bit 0 (SEL) = -Select
Bit 1 (BOT) = +BOT
Bit 2 (EOT) = +EOT
Bit 3 (MCLD) = -Machine Column Loaded Switch
Bit 4 (FCLD) = -File Column Loaded Switch
Bit 5 (EOTD) = -EOT Detected
Bit 6 (DOOR) = +Door Open
Bit 7 is not used

3.2.4.12 Drive Sense Bytes 13,14,15 (DSB13,DSB14,DSB15)

Drive Sense Bytes 13,14, and 15 are used for microprogram operations and may contain anything.

3.3 1952 INTERFACE

The 1952 (PE/NRZI) interface connections are shown in Figure 3-6. The tape unit and controller interface circuits are shown in Figure 3-7. The controller must use the circuits shown in the figure or use equivalent circuits. The maximum cable length from tape unit to controller is 20 feet (6 meters).

The asserted (low) level of the signals is 0 Vdc to 0.4 Vdc with a maximum noise level of 0.7 volts. The unasserted (high) level is 3.0 (±0.3) Vdc.

The resistive termination for each signal is 220 ohms to +5 Vdc and 330 ohms to ground. The termination includes a ground wire connected in both the tape unit and the controller.

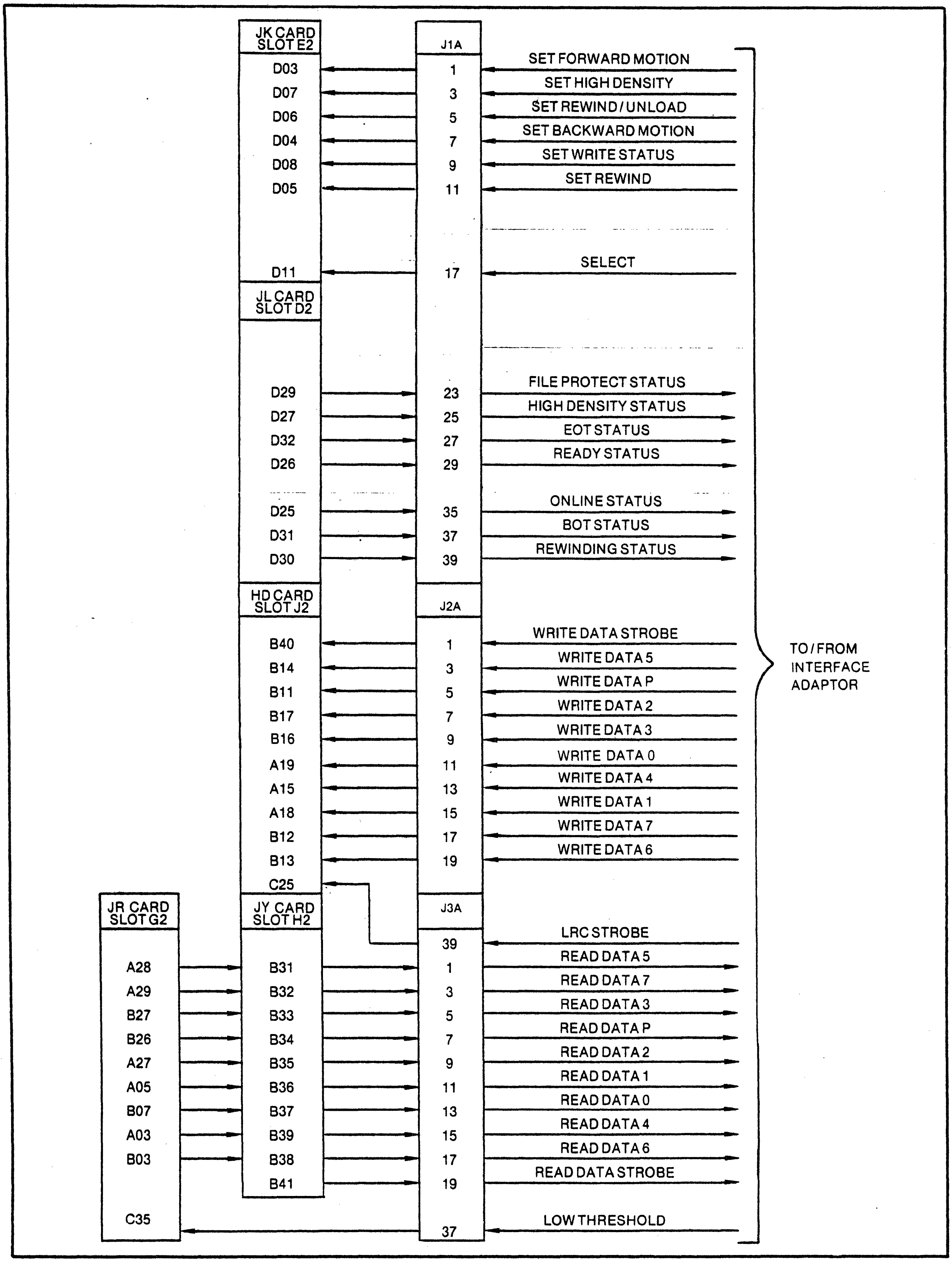


Figure 3-6. 1952 (PE/NRZI) Interface Connections

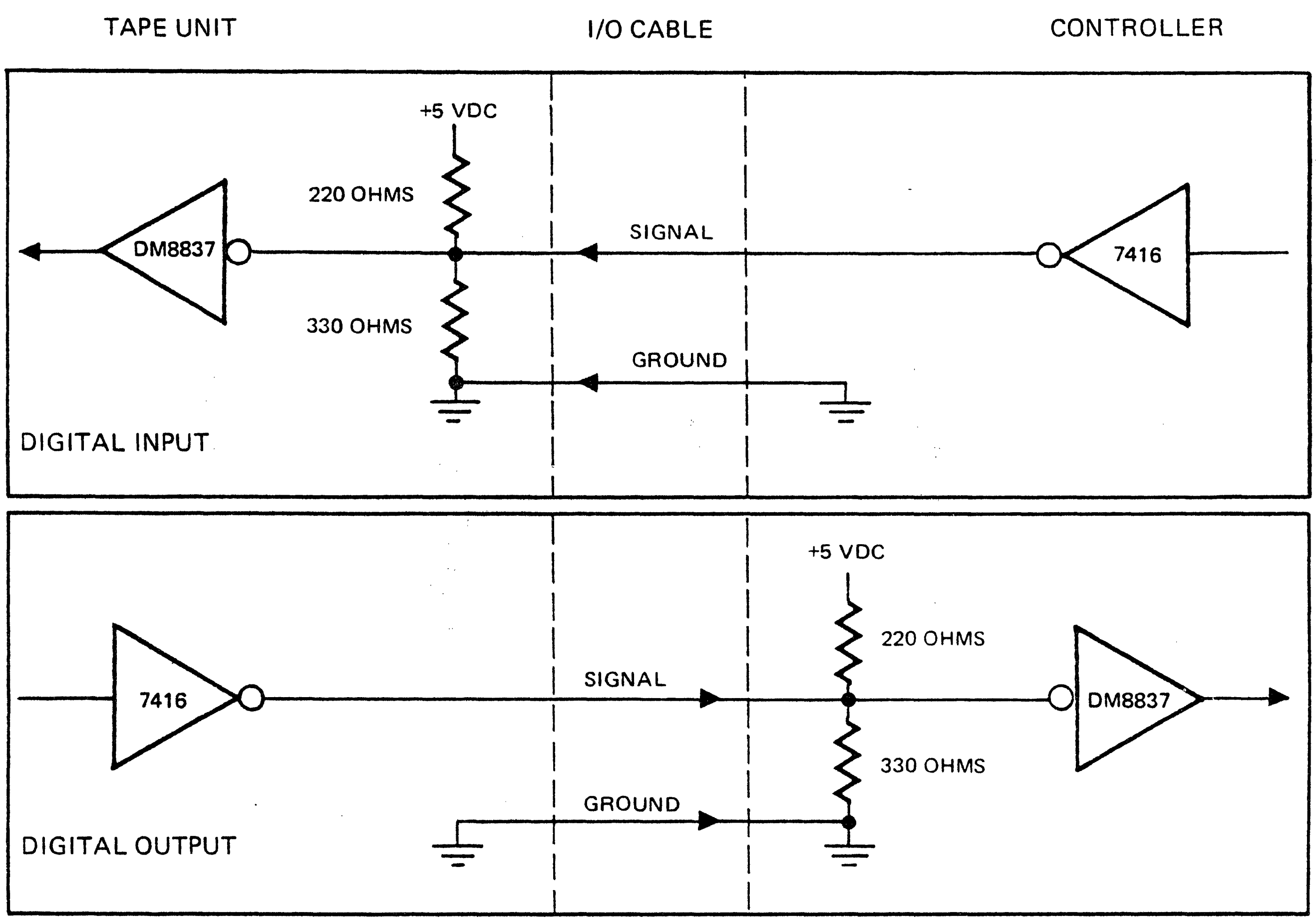


Figure 3-7. 1952 (PE/NRZI) Interface Circuits

3.3.1 1952 INPUT LINES

3.3.1.1 Select (SEL)

With the tape unit in Ready Status and Online Status, asserting the Select input command line allows all control and motion command input lines to be effective for the tape unit. All motion status output lines are valid only when Select is asserted.

Select may be asserted before or after the assertion of a motion command line but tape unit operation will begin upon the assertion of the later command. Select must remain asserted for the duration of a Set Forward Motion or Set Backward Motion command. If Select is reset before Set Forward Motion or Set Backward Motion, the operation will terminate. In this mode of operation Select acts as a start/stop line.

Select must remain asserted for a Set Rewind or Set Rewind/Unload command only until the command has been accepted, which is signaled when the tape unit resets the Ready Status output line.

3.3.1.2 Set Forward Motion (FWD)

When the Set Forward Motion input command line is asserted, it commands the tape unit to move tape forward at nominal speed. This line must remain asserted for the duration of the desired command operation length. The line is effective only if Select, Online Status, and Ready Status are asserted, and is ineffective if any other command operation (Set Backward Motion, Set Rewind, Set Rewind/Unload) is in progress.

3.3.1.3 Set Backward Motion (BWD)

When the Set Backward Motion input command line is asserted, it commands the tape unit to move tape backward at nominal speed. This line must remain asserted for the duration of the desired command operation length. The line is effective only if Select, Online Status, and Ready Status are asserted, and is ineffective if any other command operation (Set Forward Motion, Set Rewind, Set Rewind/Unload) is in progress.

A backward motion command operation automatically resets Write Status and Erase Status in the tape unit. The Set Write Status input control line is ineffective during a backward motion command operation.

3.3.1.4 Set Rewind (RWD)

When the Set Rewind input command line is asserted, it commands the tape unit to reset Ready Status and to rewind tape. When BOT is detected, the tape stops and Ready Status is set again. The line is effective only if Select, Online Status, and Ready Status are asserted and if tape is not already positioned at BOT. The line is ineffective if any other command operation (Set Forward Motion, Set Backward Motion, Set Rewind/Unload) is in progress.

Set Rewind should remain asserted until the command has been accepted by the tape unit, which is signaled when the tape unit resets Ready Status. Alternately, a pulse duration of 10 microseconds of Set Rewind and Select simultaneously is sufficient to ensure setting a rewind command.

A rewind command operation automatically resets Write Status and Erase Status and sets Backward Status in the tape unit.

3.3.1.5 Set Rewind/Unload (RWU)

When the Set Rewind/Unload input command line is asserted, it commands the tape unit to reset Ready Status, rewind tape to BOT, stop tape motion momentarily at BOT, and then unload all tape onto the file reel. The line is effective only if Select, Online Status, and Ready Status are asserted, and is ineffective if any other command operation (Set Forward Motion, Set Backward Motion, Set Rewind) is in progress.

Set Rewind/Unload should remain asserted until the command has been accepted by the tape unit, which is signaled when the tape unit resets Ready Status. Alternately, a pulse duration of 10 microseconds of Set Rewind/Unload and Select simultaneously is sufficient to ensure setting a rewind/unload command.

A rewind/unload command operation automatically resets Write Status and Erase Status and sets Backward Status in the tape unit.

The function of this line can be changed to Set Offline by a movable jumper. In this mode, the drive is placed offline but tape is not unloaded.

3.3.1.6 Set High Density (HDN)

To set the tape unit to PE mode for a write operation, the Set High Density input control line must be asserted when the Set Forward Motion input command is issued at BOT. Set High Density should remain valid during command initiation until the tape unit responds with the corresponding state of High Density Status. Alternately, a pulse duration of 10 microseconds following the assertion of Set Forward Motion is sufficient to ensure setting High Density Status. If this line is unasserted when the Set Forward command is issued at BOT, the tape unit will be set to NRZI mode.

To set the tape unit to PE for a read operation, the Set High Density line is asserted when either a Set Forward Motion or Set Backward Motion command is reset following an operation. For this to occur, Select must remain asserted past the reset of the motion command. If Set High Density is unasserted under these conditions, the tape unit will be set to NRZI mode.

3.3.1.7 Set Write Status (WRT)

To set the tape unit to Write Enable, the Set Write Status input control line must be asserted when the Set Forward Motion command is issued. Write Enable is reset by issuing Set Forward Motion with Set Write Status unasserted (Set Read Forward mode) or by issuing Set Backward Motion (Set Read Backward mode). This line is effective only if the tape unit File Protect Status output line is not asserted.

Set Write Status should remain asserted during command initiation until the tape unit responds with the corresponding state of Write Status. Alternately, a pulse duration of 10 microseconds of Set Write Status (with Set Forward Motion and Select asserted) is sufficient to ensure setting Write Enable.

The Write Status output line must be unasserted when a read-only command is to be initiated.

3.3.1.8 LRC Strobe (LRC)

The LRC Strobe input line is used with NRZI format write data to reset the internal tape unit data registers following the last character in the data block. It resets the polarity on tape to the IBG erase direction for all nine tracks.

3.3.1.9 Low Threshold (LTH)

The Low Threshold input line controls the threshold of detection when converting analog read data signal to a digital signal. Low Threshold is asserted during a read operation to recover drop out signal levels.

3.3.1.10 Write Data Strobe (WDS)

The Write Data Strobe input line is used to gate write data into the tape unit. The Write Data Strobe must have a duration of 1.0 microsecond minimum.

3.3.1.11 Write Data (WDP-WD7)

The nine Write Data input lines carry the data from the controller to the tape unit. When writing PE characters the tape unit must be in high density mode; when writing NRZI characters the tape unit must be in low density mode. PE mode Write Data must be valid a minimum of 0.5 microseconds before the assertion of the Write Data Strobe; NRZI mode Write Data must be valid a minimum of 1.5 microseconds before the assertion of the Write Data Strobe.

3.3.2 1952 OUTPUT LINES

All tape unit output status lines are valid only when the Select input line is asserted.

3.3.2.1 Ready Status (RDYS)

The Ready Status output line is asserted when the tape unit is able to operate with the controller, that is, when tape is loaded and the tape unit is not performing a rewind or rewind/unload operation. This line is controlled internally by the tape unit and is asserted following a tape load operation only after tape is positioned at BOT. The line is unasserted if tape is not loaded, if tape is being loaded or unloaded, or if a rewind or rewind/unload operation is in progress.

3.3.2.2 Online Status (ONLS)

The Online Status output line is asserted when the tape unit has been placed online by pressing the ONLINE switch on the operator panel and a load operation has been completed. Online Status may be reset by pressing the RESET switch on the operator panel.

3.3.2.3 Beginning of Tape Status (BOTS)

The Beginning of Tape Status output line is asserted when tape is positioned at the BOT marker. The line goes high when a Set Rewind/Unload or Set Forward Motion command is received from the controller.

3.3.2.4 End of Tape Status (EOTS)

The End of Tape Status output line is asserted when tape is positioned at or beyond the EOT marker. The line goes high when the trailing edge of the EOT marker is detected during a backward or rewind operation.

3.3.2.5 High Density Status (HDNS)

The High Density Status output line is asserted when the tape unit has been placed in PE mode by a Set High Density command. The line is unasserted when the tape unit is placed in NRZI mode. High Density Status is reset when the tape unit is powered up, when the tape unit is loaded or unloaded, and when the RESET switch on the operator panel is pressed.

3.3.2.6 File Protect Status (PROS)

The File Protect Status output line is asserted after a load operation is initiated if the file reel does not contain a write enable ring. The line is high when a write enable ring is present.

3.3.2.7 Rewinding Status

The Rewinding Status output line is asserted when the tape unit is performing a high speed rewind operation.

3.3.2.8 Read Data Strobe (RDS)

The Read Data Strobe gates the contents of the read output data buffer during a NRZI format read operation and is provided as an output signal to gate NRZI format read data into the controller. It has a pulse duration of 1.0 microsecond (nominal). The Read Data outputs are considered as a valid character only during the assertion of the Read Data Strobe.

3.3.2.9 Read Data (RBP-RB7)

The nine Read Data output lines carry the digitized data from the tape unit to the controller during a read or read-after-write operation.

3.3.2.10 +5VDC

The +5VDC output line provides the power required at the interface for use with multiple tape drive adaptors.

CHAPTER 4

FUNCTIONAL DESCRIPTION

4.1 INTRODUCTION

This chapter provides a functional description, or brief theory of the operations, of the following areas that comprise the functional units of the tape unit:

- Control Logic
- Data Handling Electronics
- Capstan Servo System
- Reels Servo System
- Operator Panel
- JJ Card
- Power Supply
- Pneumatics System
- Cooling

This chapter is a basic source of information to provide a working knowledge of tape unit operation. This information is necessary to determine if the tape unit is functioning properly. Thus, during troubleshooting, the information aids in the progression from symptom to problem to solution.

Figures 4-1A and 1B are block diagrams of the tape unit showing the interrelationships between the functional units. The block diagrams provide references to detailed block diagrams. The detailed diagrams provide references to specific logic sheets and also to selected IC locations on the printed circuit card.

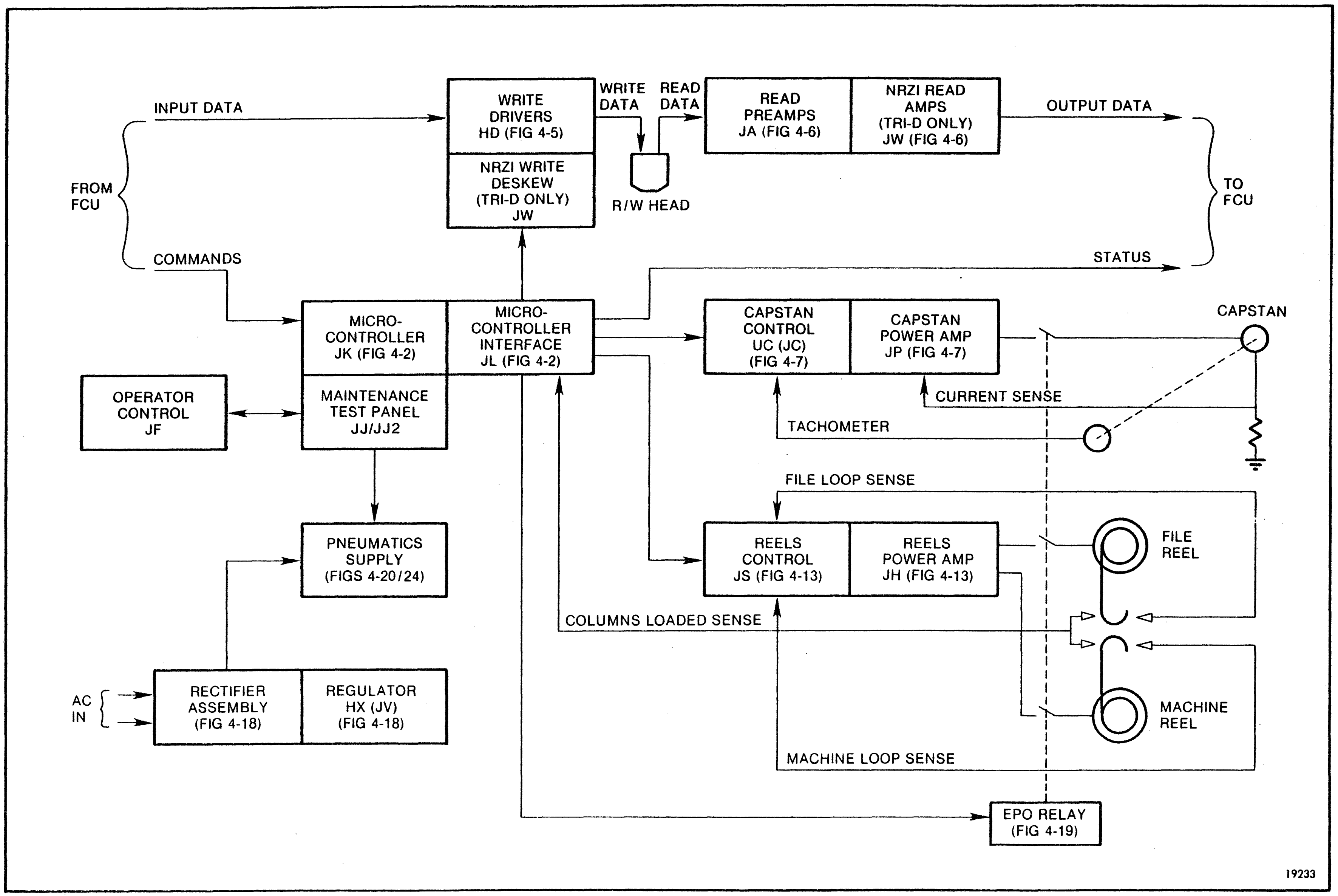


Figure 4-1A. 1951/1953 Tape Unit Block Diagram

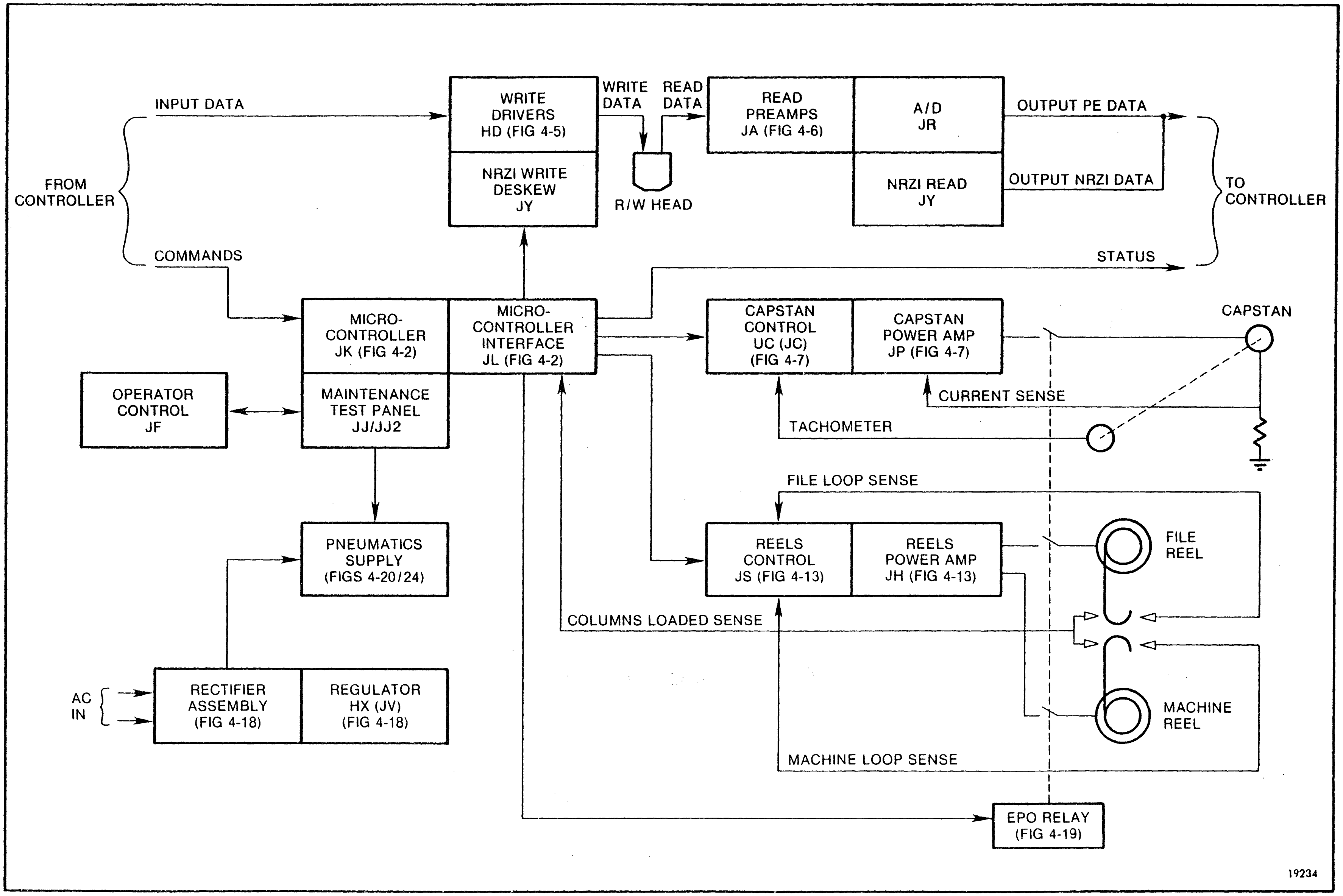


Figure 4-1B. 1952 Tape Unit Block Diagram

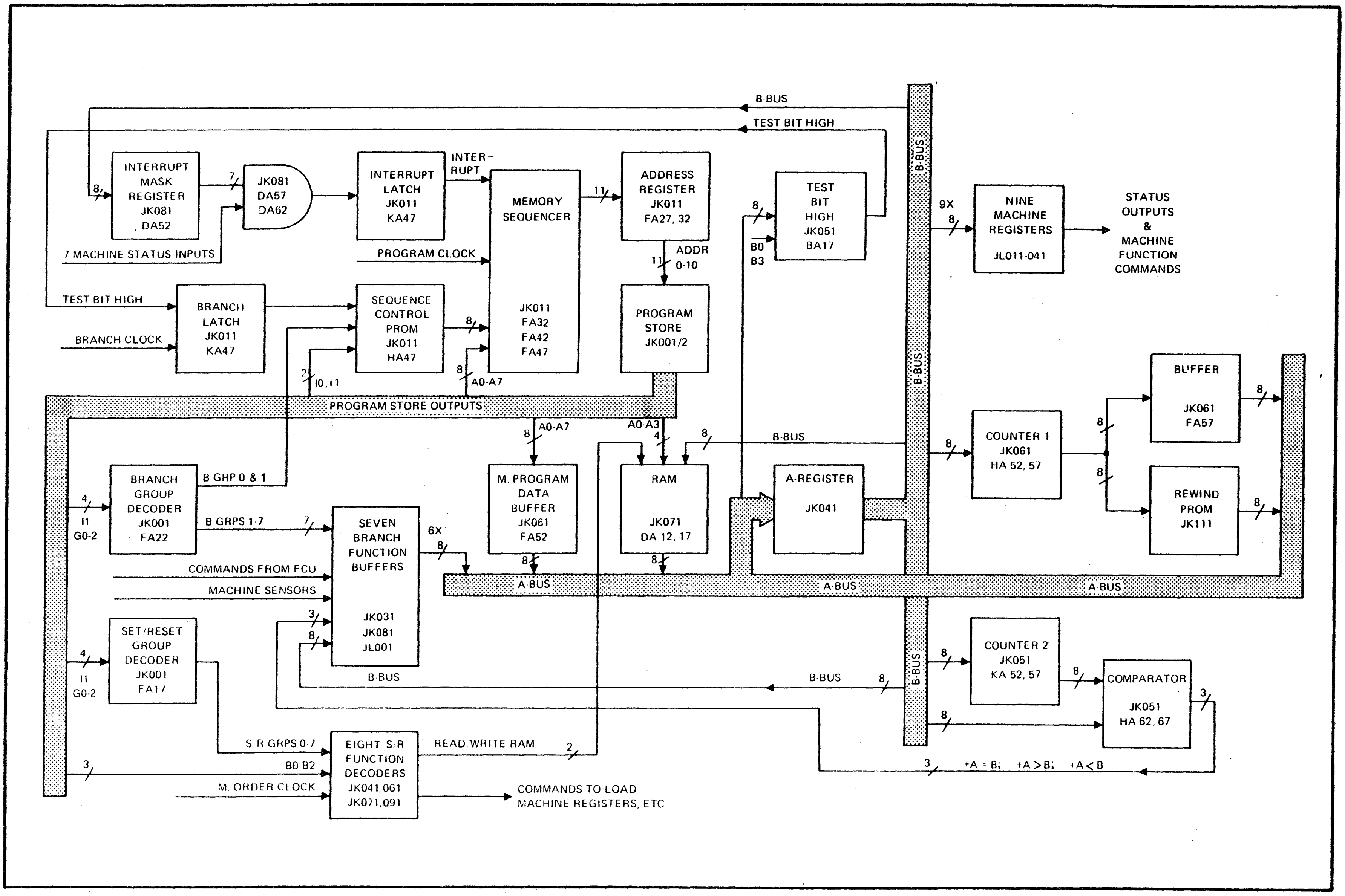


Figure 4-2. Microcontroller Logic

4.2 CONTROL LOGIC

The tape unit control logic is located on the JK and JL cards. The control logic communicates with the controller and the various subassemblies of the tape unit in order to maintain stable tape drive operation. The heart of the unit control logic is a microprogrammed controller, or "microcontroller," which monitors and directs the tape unit functions. Figure 4-2 is a block diagram of the microcontroller logic.

4.2.1 PROGRAM SEQUENCING

Inputs from the controller, the operator panel, the internal maintenance test panel, and the various tape drive sensors are used to make program branching decisions. Gated into tri-state buffers, these inputs are selected by the branch group decoder and placed on the A-bus. The test bit high circuit samples the A-bus, and the B-bits of the current instruction select one of the eight bits of the A-bus for test.

A branch can be made on either polarity of the tested bit. If the branch condition is not met, the address register steps to the next sequential address. If the branch condition is met, the address register is modified by the lower eight bits of the current instruction. (A list of the branch condition codes is included with the logic diagrams.)

Abnormal conditions in the operation of the tape drive that are detected by the various machine sensors can interrupt the normal sequencing of the program. These conditions are controlled by the interrupt mask.

4.2.2 PROGRAM FUNCTIONING

The program is stored in eight PROMs, each having a capacity of 1024 x 4 bits. The PROMs are cascaded to develop 16-bit words. The individual data bits of the word are identified by alphanumeric designations in which the letter prefix identifies the function of the bit.

The information in the selected program store address is used to provide instructions for subsequent operation. Bit I1 is used to select either a branch group or a set/reset (S/R) group. A branch group is enabled when bit I1 is low. The G-bits of the current instruction select one branch group decoder output line to enable one of the seven branch function buffers. The eight bits of information from that one buffer are placed on the A-bus. One of these bits is selected by the B-bits of the current instruction for testing by the test bit high circuit as described in Section 4.2.1.

An S/R group is enabled when bit I1 is high. The G-bits of the current instruction select one S/R group decoder output line to enable one of the eight S/R function decoders. One of the outputs of the selected S/R function decoders is chosen by the B-bits of the current instruction. Only two of these command outputs, Read Ram and Write Ram, are shown on the block diagram as these two are not explicit on Logic Sheet JK071 except as the outputs of the two OR gates following the S/R decoders. The other commands latch or reset the A-register; increment, decrement, or load from the B-bus counters 1 and 2; read the microprogram data buffer; or load any of the eight machine registers (or latches) from the B-bus.

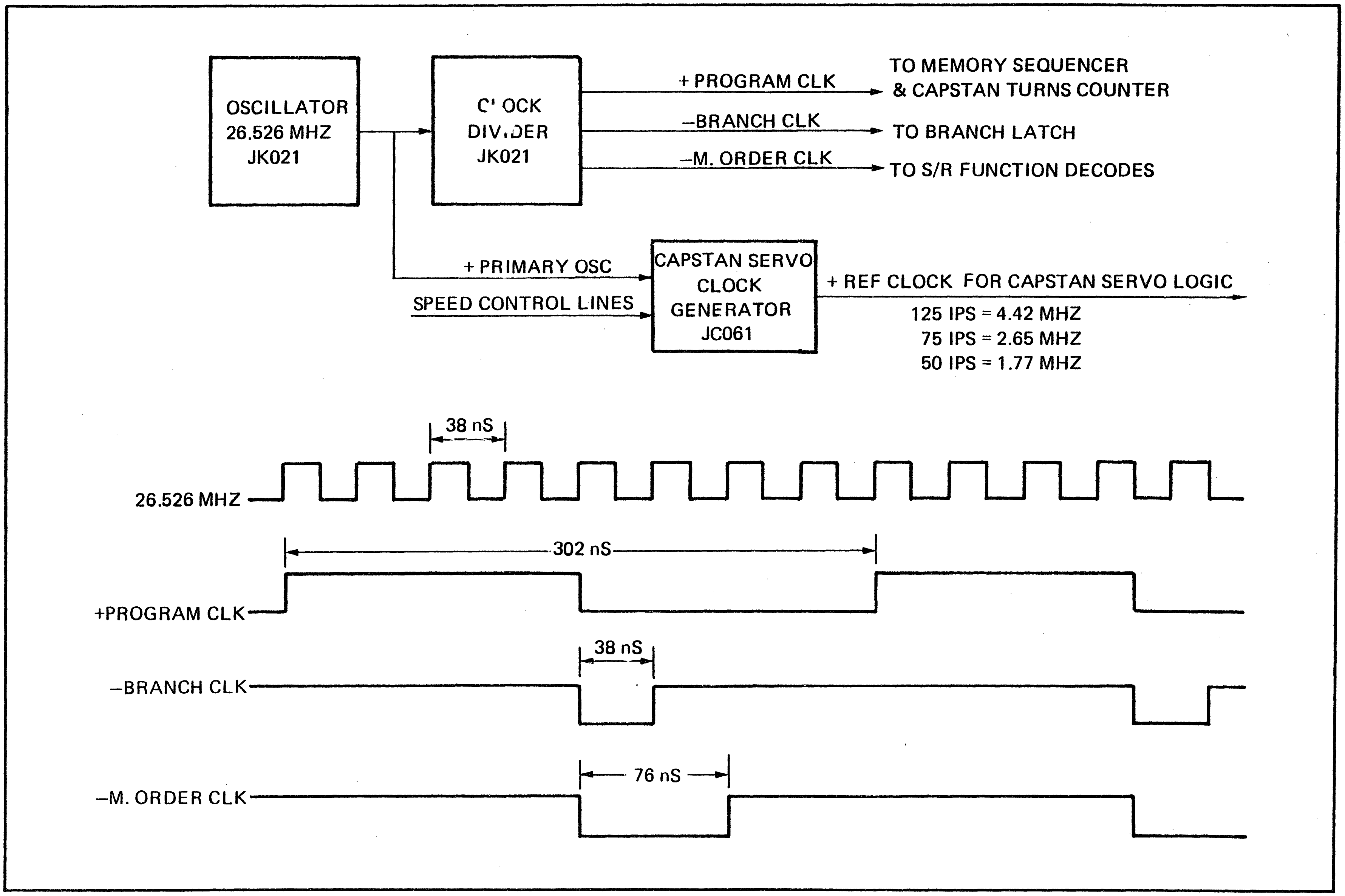


Figure 4-3. Clock Pulse

4.2.3 A-REGISTER

The A-register is the heart of the microcontroller. Upon S/R function decoder command, data on the A-bus is latched into the A-register and placed on the B-bus. The outputs to the A-bus are from tri-state buffers. When these buffers are not enabled, their outputs assume a neutral state to prevent interference with the outputs of the selected buffer on the A-bus. B-bus data is latched into counters 1 or 2, the comparator, one of the eight machine registers, or the RAM, as selected by the S/R function decoder. The B-bus data can also be latched into one of the seven branch function buffers so that the updated data is accessible to the A-bus for further bit testing if necessary at some later time.

4.2.4 TIMING

A 26.526 MHz oscillator and clock divider circuit are used to provide the timing of microcontroller operations. The three clocking signals are shown in Figure 4-3. The Program Clock to the memory sequencer initiates instruction fetch operations. The Branch Clock and Micro-order Clock both execute operations based on the instruction. These two clocks may be thought of as the same clock; they are of different widths only because of the requirements of the different circuits each services. The Primary Oscillator frequency is used by the capstan servo clock generator to produce a reference clock which is used by the capstan servo logic for controlling the velocity of the capstan.

4.2.5 INPUT/OUTPUT CONTROL

The method of receiving commands from the controller, the operator panel, and the internal maintenance panel and of providing status information to these same sources provides a model for understanding how the control logic also handles inputs from machine sensors and, subsequently, modifies machine operations. Refer to Figure 4-4. When the buffer is selected by the microprogram, the buffer data is placed on the A-bus. The results of the bit high test determine the program sequence to accomplish the command. Subsequent program instructions load the status registers, or latches, with status information from the B-bus. The registers provide the status information to the controller, the operator panel, and the maintenance test panel.

4.2.6 CAPSTAN TURNS COUNTER

The capstan turns counter maintains a record of the number of capstan revolutions beyond the BOT marker. The two outputs of the capstan digital tachometer, phase A and phase B, are input to the capstan turns counter. When the capstan is moving tape forward, tach phase A leads B, but phase B leads A when the capstan is moving tape backward. In this way the capstan turns counter can determine capstan direction. Forward motion from BOT increments the counter, backward motion decrements the counter. During a rewind operation, the counter ignores the tachometer phase differential and correctly assumes backward tape motion to decrement the counter. The counter output is used by the control logic to warn of the approach of the BOT marker. The warning provides sufficient time to ramp down the high speed rewind to nominal speed before BOT is reached.

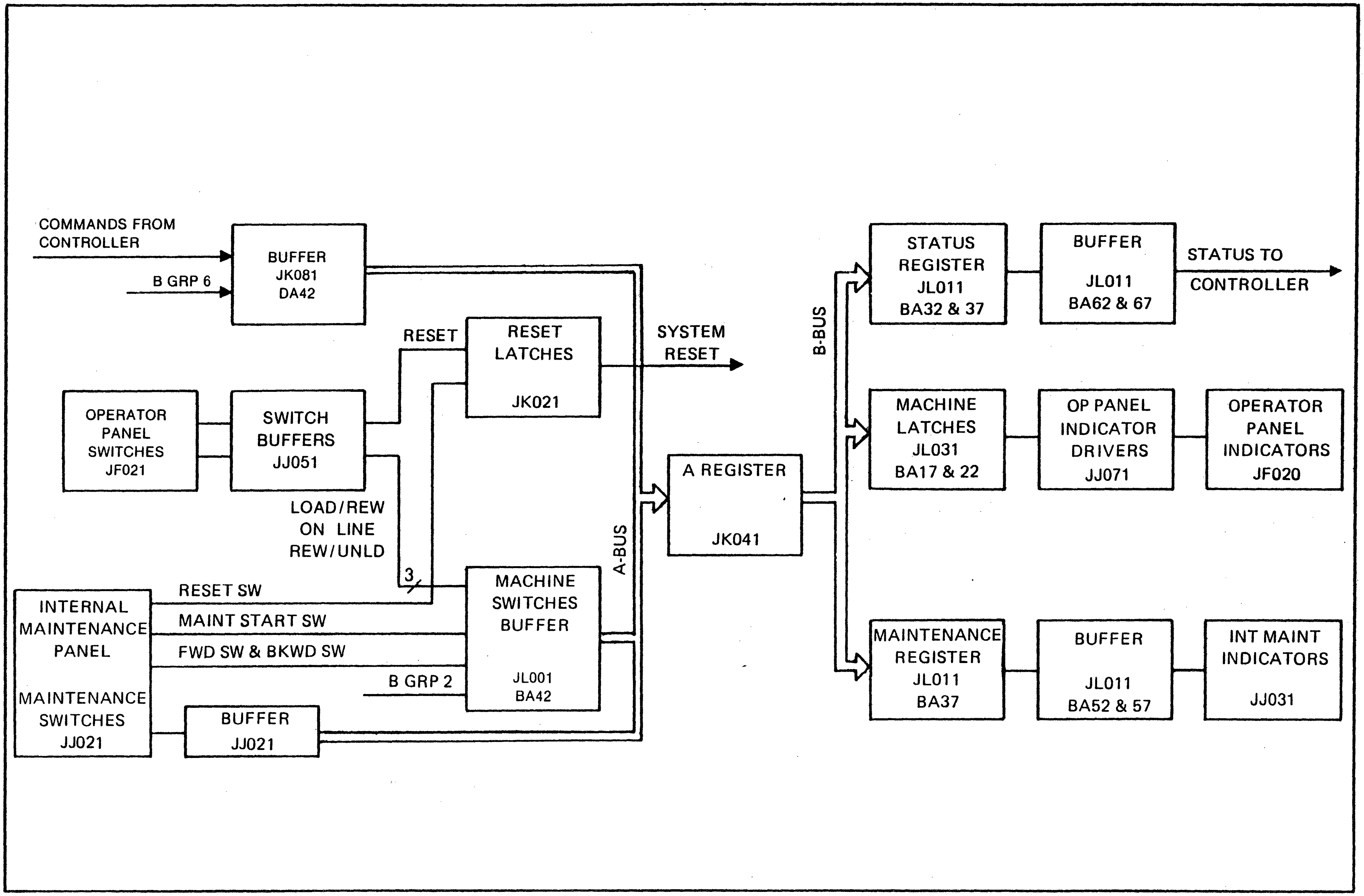


Figure 4-4. I/O Control Signal Flow

4.2.7 REWIND PROM

The rewind PROM is programmed to provide an incremented count to the capstan servo logic velocity register for the ramp up to rewind speed and a decremented count for the ramp down to the nominal speed. During a rewind operation, counter 1 addresses the rewind PROM once every 80 milliseconds to obtain the required output count.

The microprogram provides that, during rewind, if a column vacuum sensor detects that the associated reel is not keeping pace with the tape in the column, counter 1 will select an address to decrement capstan velocity by one step. If the column sensor indicates that the associated reel is still falling behind, capstan velocity will be taken down another step, and so on until the reel has recovered the tape.

4.3 DATA HANDLING ELECTRONICS

The data handling electronics is responsible for the read and write operations performed in the tape unit. Figure 4-1 shows the data flow through the tape unit.

GCR and PE format write data from the controller is sent directly to the write drivers on the HD card but the NRZI format write data of a 1953 tape unit is skew compensated on the JW card prior to being sent to the write drivers. The write drivers develop current for the write heads which generate flux transitions on the tape. At the same time the full-width erase head is enabled to erase any data on tape before it passes over the write head.

The read head senses the magnetic flux transitions from the tape, and these data signals are amplified by the read amplifiers on the JA card. The 1951 PE/GCR analog read interface outputs are sent directly to the FCU. The 1953 tri-density analog read interface outputs are sent to the FCU through line drivers on the JW card where the amplitude of the NRZI format data is normalized.

The 1952 digital read interface outputs are converted on the JR card from the analog output of the JA card. The NRZI format data is detected and provided with a read strobe on the JY card.

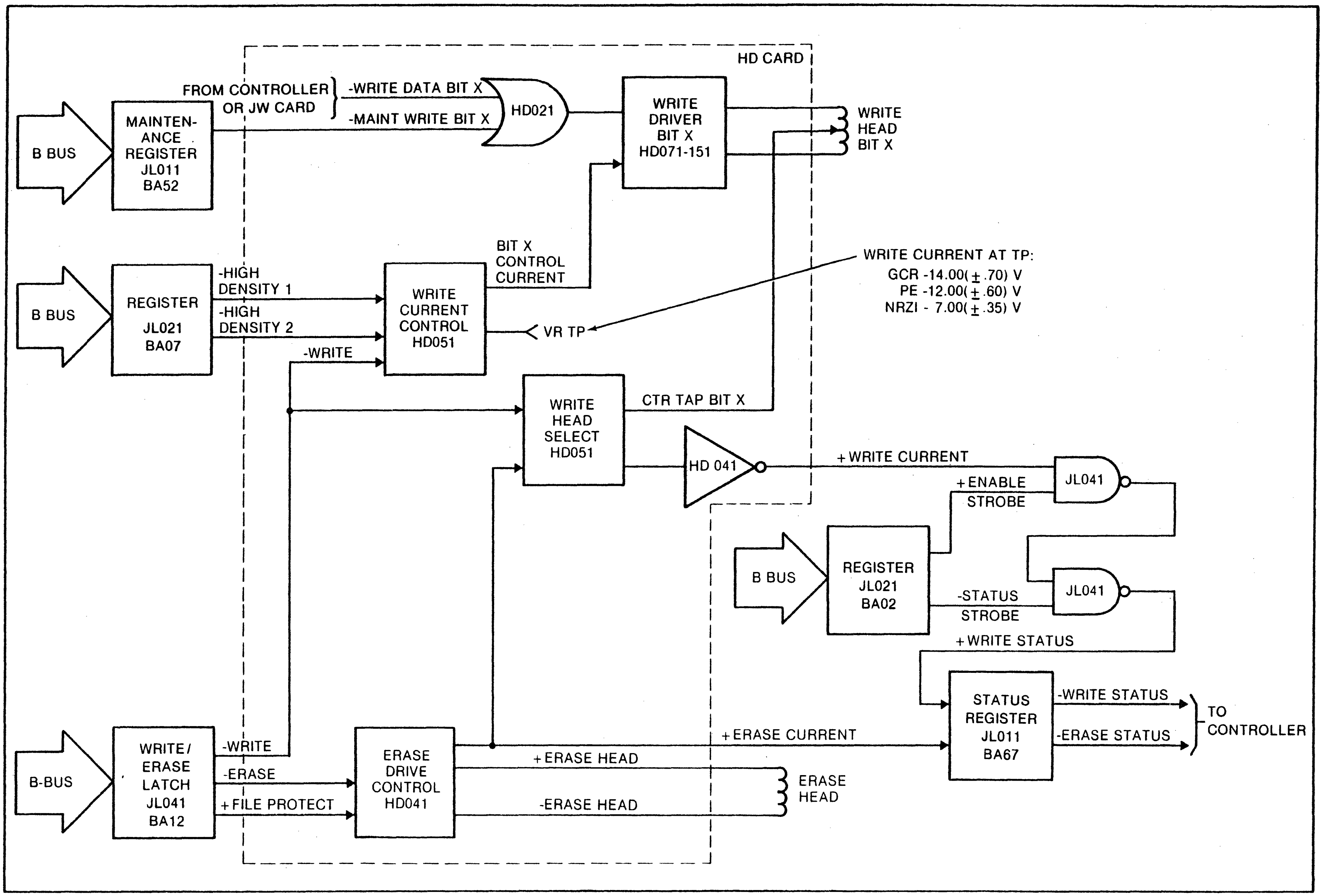


Figure 4-5. Write Driver

4.3.1 WRITE ELECTRONICS

The basic write electronics is located on the HD write driver card. Refer to Figure 4-5, the write electronics block diagram. Erase and write functions are controlled by enable signals from the control logic.

The write current control circuit establishes the proper write head current for the specific density to be recorded. The circuit is enabled by the -Write signal but is controlled by two -High Density signals. These signals are supplied by the microprogram according to the recording mode. Write current amplitude for the format to be recorded is established as a function of the two density control signals using the following scheme:

Format	-High Density 1	-High Density 2
GCR	low	high
PE	high	high
NRZI	high	low

The write head select circuits provide the nine channels of the write head with a center-tap current path for each one in order to enable these channels. All center taps, and thus all channels, are enabled simultaneously. The write head is enabled only when both the -Write and the -Erase signals are true (low). The Write Current output is used to produce the Write Status signal to the controller.

The erase drive control circuit provides erase head current during both write and erase-only operations. The erase head is enabled when the -Erase signal is true (low) but only if the file is not protected against erasure, that is, only if a write enable ring is installed in the file reel so that the +File Protect signal is false (low). The -Erase Current output signal is used to enable the write head select circuits and also to produce the Erase Status signal to the controller.

4.3.2 READ ELECTRONICS

All tape unit configurations utilize the JA read preamplifier card mounted on the deck casting. The line drivers nominally yield the levels indicated on the read electronics block diagrams, Figures 4-6A and 6B, when the information being read is consistently uniform in amplitude and density (as it is during a preamble). The PE analog data is normalized to 1.0 volt by pot adjustment on this card.

4.3.2.1 Analog Read Interface (1951/1953)

PE/GCR (1951) tape units utilize only the basic read circuitry. The analog read data outputs of the JA card line drivers are sent directly to the formatter control unit. The analysis and time-measurement of the read data is done in the formatter control unit. (The Model 1935 Formatter Control Unit FEMM, PN 9357, contains a description of the GCR format.)

In tri-density (1953) tape units, the analog read data outputs of the JA card are further amplified on the JW card. The NRZI data is normalized to 1.5 volt by pot adjustment on this card.

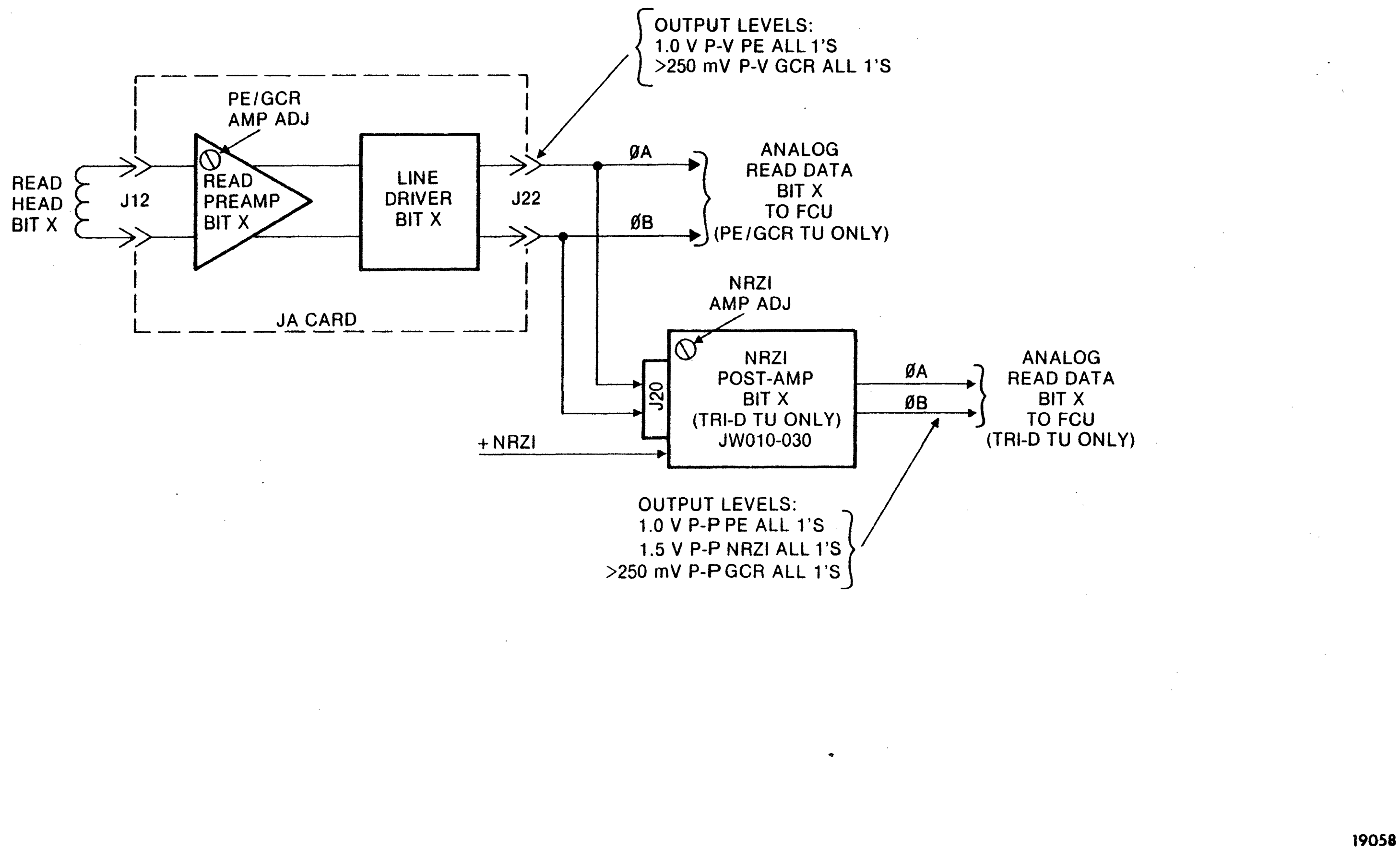


Figure 4-6A. 1951/1953 Read Electronics

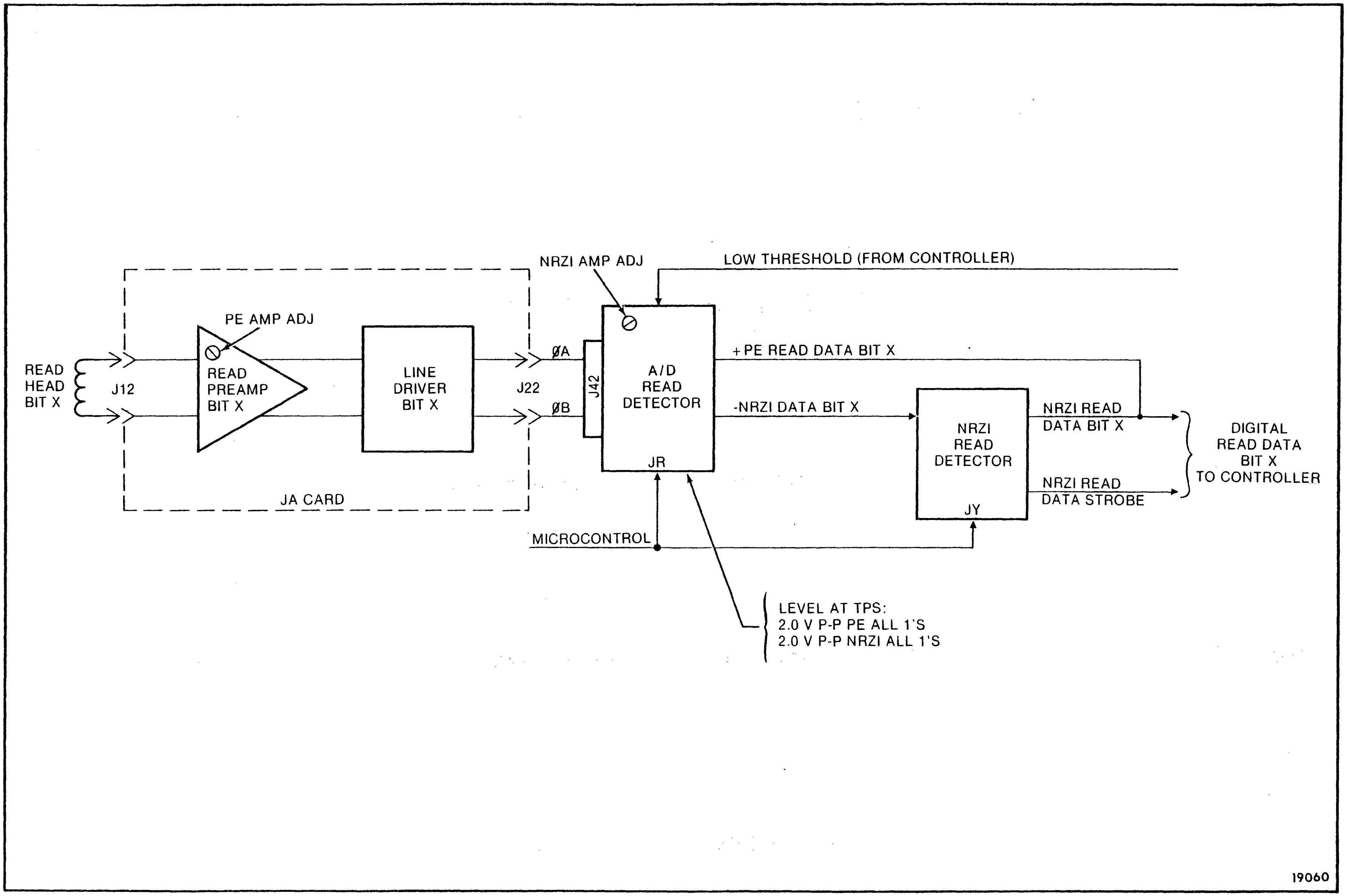


Figure 4-6B. 1952 Read Electronics

4.3.2.2 Digital Read Interface (1952)

In the PE/NRZI digital read interface (1952) tape unit, the analog signals from the JA card are sent to the JR card, which performs the analog-to-digital conversion.

The NRZI data, after A/D conversion and amplitude discrimination on the HR card, is sent to the JY card. The JY card performs NRZI read detection and outputs the NRZI data with a Read Data Strobe to the controller.

4.4 CAPSTAN SERVO SYSTEM

The capstan servo system includes either the UC or the JC capstan servo logic card, the JP capstan power amplifier card, and the capstan motor itself with its digital tachometer. Its purpose is to accelerate to, and maintain, a consistent rated tape speed across the read/write heads during a read or write operation, to permit no tape movement across the read/write heads during a stop, and to maintain a tape speed of 550 ips during rewind.

4.4.1 DIGITAL TACHOMETER

The digital tachometer monitors capstan velocity by generating two square wave outputs, phase A (ØA) and phase B (ØB), whenever the capstan motor is in motion. The period of the tachometer outputs is a function of capstan motor speed. Refer to Figure 4-7. These two tach signals are returned to the capstan control logic to permit capstan velocity correction during tape motion and to monitor tape position in the interblock gap (IBG).

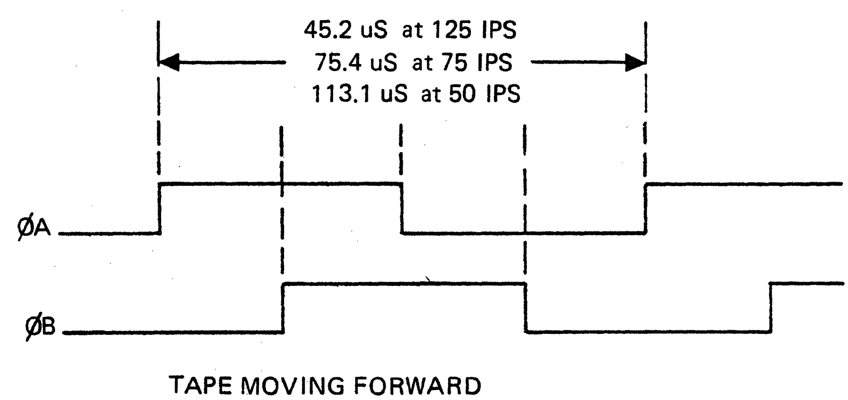


Figure 4-7. Tachometer Output

4.4.2 CAPSTAN CONTROL

Newer tape units utilize the UC capstan servo logic card; older tape units utilize the JC capstan servo logic card. A brief functional description of each of these cards is provided below. Figures 4-8A and 8B are block diagrams of the two capstan servo systems.

4.4.2.1 UC Card Capstan Control

The UC card is a micro-computer that consists of a Z-80B microprocessor, a 2K x 8-bit ROM, and registers for command input and status output. The card also contains the hardware to perform velocity and position decode to provide status for the microprocessor, and digital-to-analog conversion for the JP card to drive the capstan motor.

Capstan motion commands are sent from the JK card to two input registers on the UC card. Ready, Go, Forward, IBG Enable, and Power Safe signals are transmitted by individual lines and are loaded into the command registers. Incremental values used to accelerate or decelerate the capstan motor for rewind are loaded from the system bugs onto the UC card B-bus and then into the rewind register.

There are only two types of capstan motor status used by the microprocessor: velocity and position. Both types of status are determined using the phase A (ØA) and phase B (ØB) outputs of the digital tachometer. The velocity decode portion of the UC card counts the ØA pulses and stores the count in an eleven-bit register. A change in capstan speed causes a change of the value in the velocity decode register. An interrupt is then sent to the microprocessor which causes the microprocessor to examine command, rewind, or status registers for any new input.

Tape position is determined by using the ØA and the ØB phase relation and the value in the IBG counter. The values from the velocity and position registers are also placed on the UC card A-bus and are then sent to the JK card.

When the tape unit is first turned on, the Z-80B microprocessor enters an initialization routine where it starts the capstan motor current and, as soon as EPO is closed, positions the capstan motor and initializes its registers. The microprocessor then enters a waiting loop where it continues to check the position of the capstan motor and test the rewind, command, and status registers. After the microprocessor has reviewed and completed a Go command for either run forward or rewind, it enters a Stop Lock routine where it performs a wait loop, testing the position of the capstan motor and the contents of its registers.

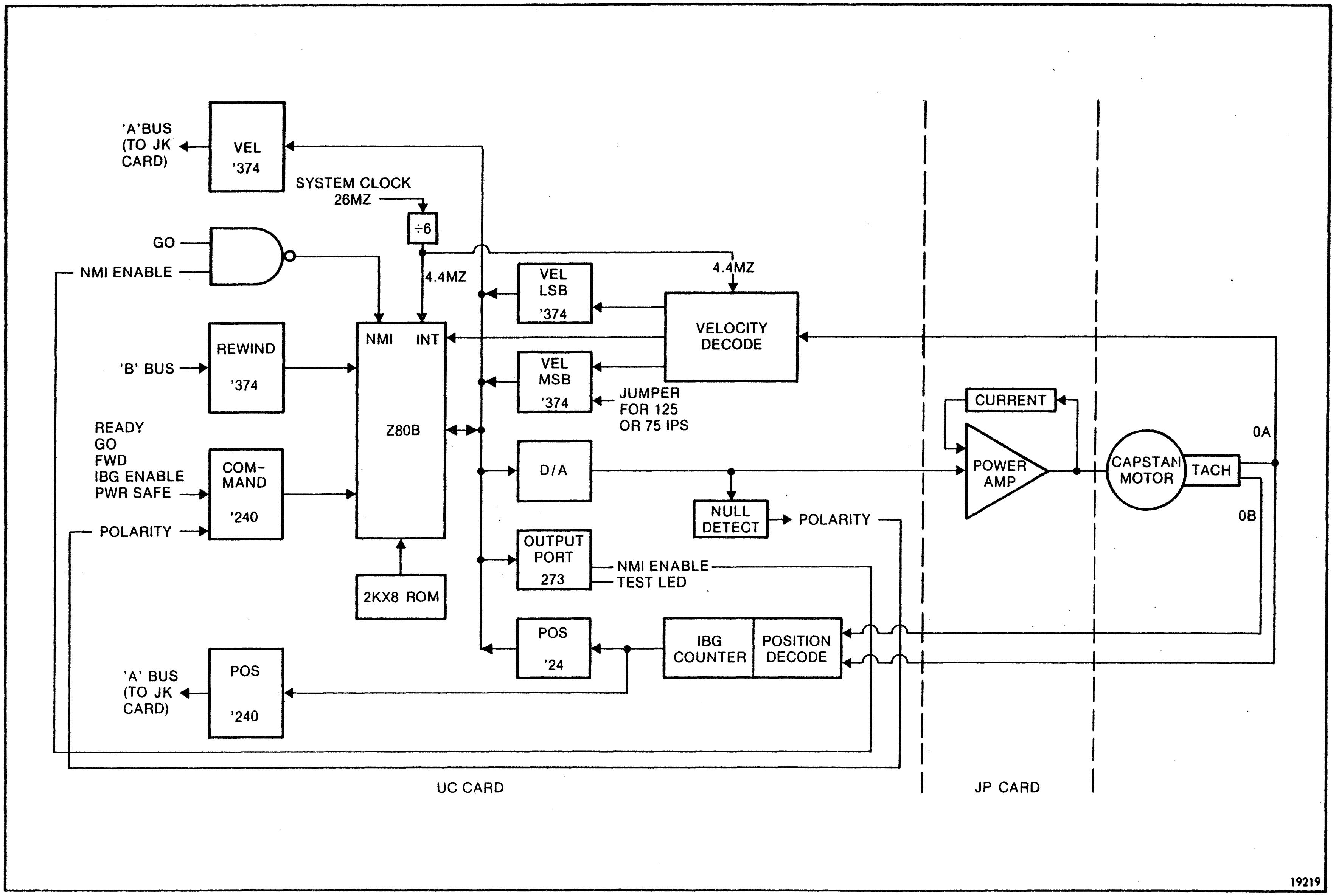


Figure 4-8A. Capstan Servo System With UC Card

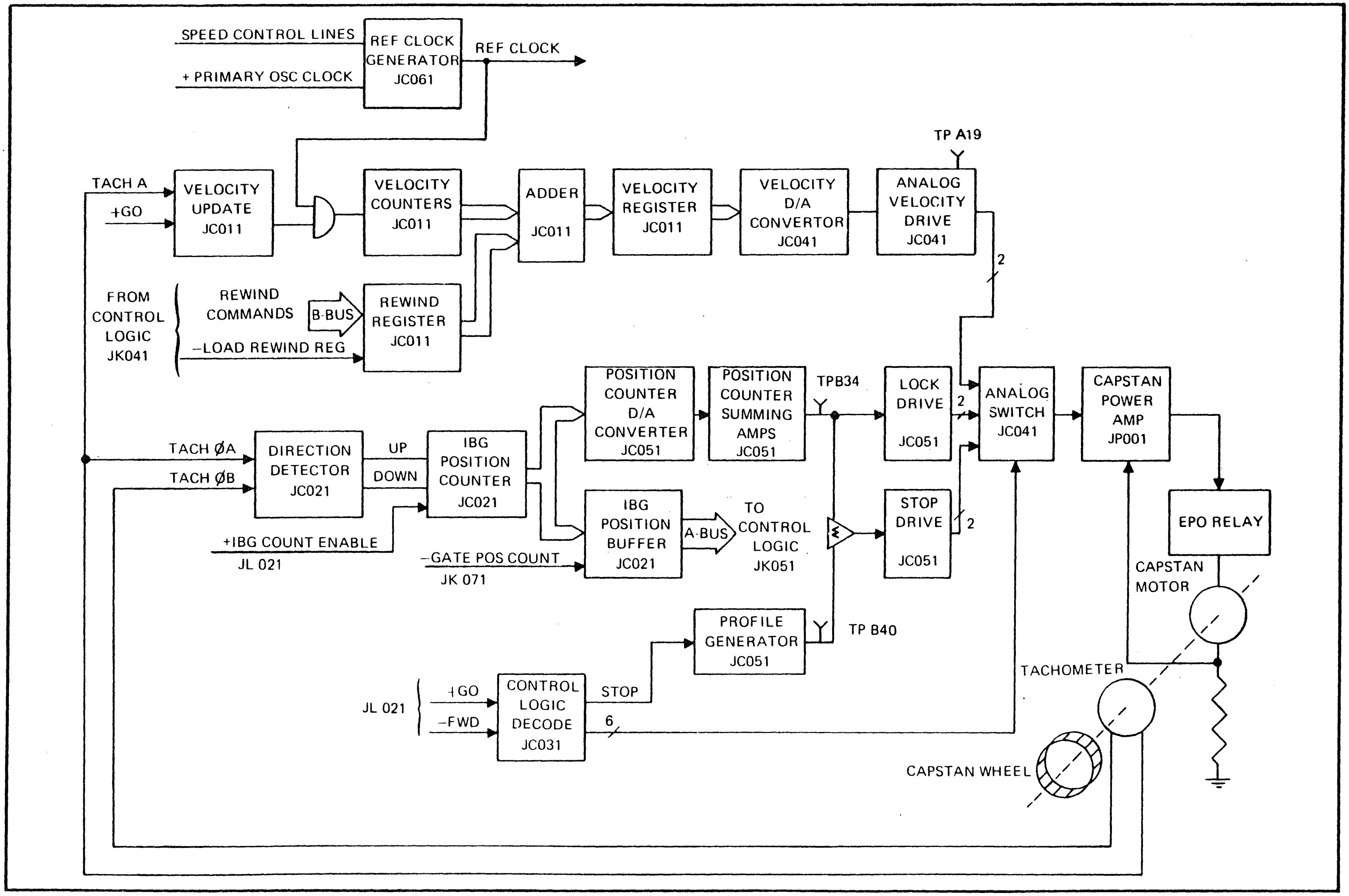


Figure 4-8B. Capstan Servo System With JC Card

4.4.2.2 JC Card Capstan Control

Run Mode. When tape is to move, the +Go signal enables the velocity update latches permitting the leading edge of each +Tach A pulse to generate four short pulses at the output of the 3-to-8 decoder (IC E03). Refer to Figure 4-9 and Logic Sheet JC011. The first pulse (E03, pin 10) resets the velocity update latch to disable the velocity counters by blocking the 4.42 MHz clock input. The second pulse (E03, pin 11) loads the velocity register with the last count in the velocity counters. The third pulse (E03, pin 12) clears the velocity counters. The fourth pulse (E03, pin 17) resets the velocity update latch to enable once again the velocity counters clock input. In this way the time between two successive +Tach ØA leading edges is measured in the velocity counters and recorded in the velocity register. The correct count in the velocity register is 196 when tape is moving at 125 ips. A higher count signifies that tape is moving slower than this rated speed.

The velocity register is monitored by the velocity digital-to-analog converter. The nominal count of 196 will produce 1.6 volts at TP A19 in order to maintain the velocity of the capstan motor.

Note that the velocity counters are preset to all ONEs (a count of 256) whenever the +Go signal is inactive, that is, when tape is not in motion. Thus, when a tape motion command is initiated, the first count into the velocity register is 256. This provides the capstan motor with its highest voltage which is required for acceleration.

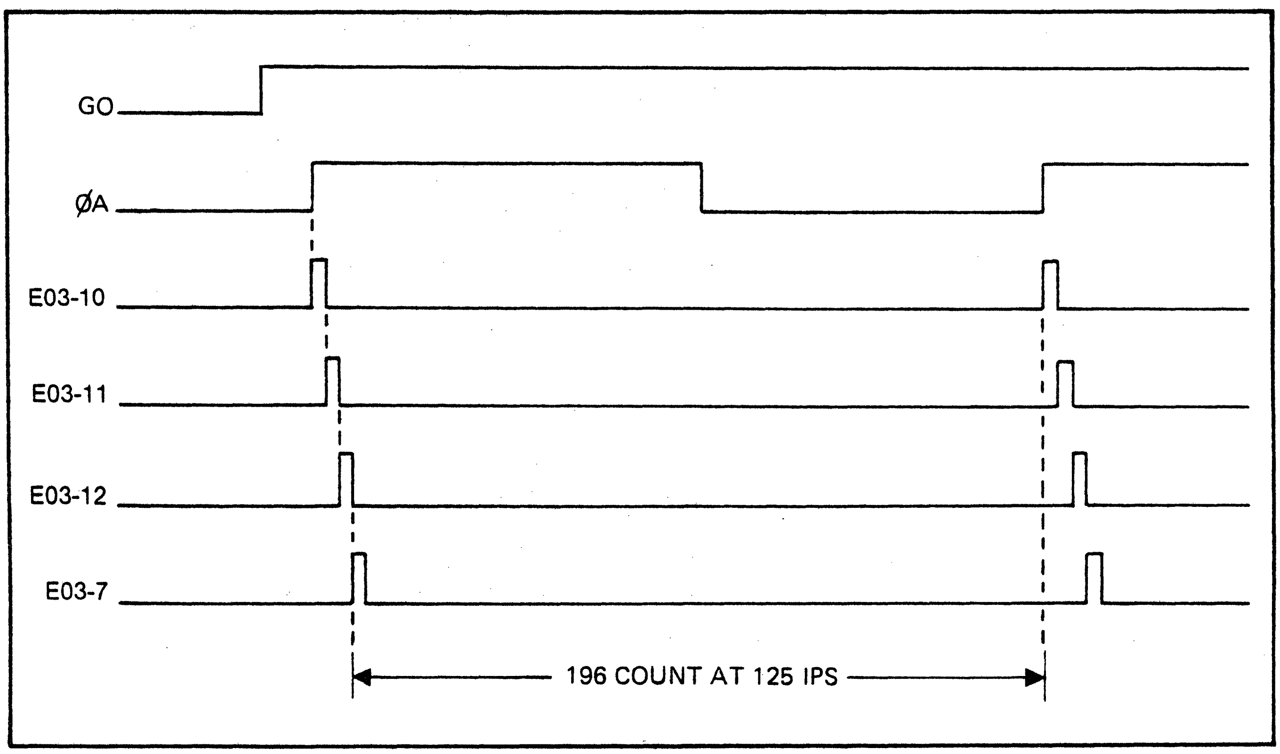


Figure 4-9. JC Card Velocity Update Decoder Timing

Stop Mode. The stop mode brings tape that is moving at 125 ips to a stop within 1.1 milliseconds. Refer to Figure 4-7 and Logic Sheet JC051. The -Stop pulse input to the profile generator opens the circuit path of the two 7.68K shunt resistors across the two .027 uf capacitors and these two caps begin to charge. The charging profile creates, at the output of the profile generator summing op amp (TP B40), the shape of the ideal capstan stop profile. Actual capstan performance, as measured at the output of the position counter (TP B34), is compared against this ideal. Refer to Figure 4-10. Any difference between the two signals will generate a capstan status signal at IC B06, pin 1: positive when capstan deceleration exceeds the ideal; negative when capstan deceleration is too slow. The negative level is used to produce a more positive +Stop Drive signal in order to correct capstan deceleration.

Lock Mode. The lock mode prevents tape motion across the read/write heads when the tape is stopped by detecting and correcting any tape creep. Whenever tape moves forward, tachometer ØA leads ØB, but ØB leads ØA whenever tape moves backward, thus the capstan direction detector latches can determine capstan direction. The direction of the last tape motion command, forward or backward, determines the direction detector outputs to the IBG position counter: count up when capstan direction corresponds to the last command, but count down when capstan direction is opposite to the last command.

When a stop motion command is received, the IBG position counter is enabled and preset to a predetermined count by the IBG Count Enable signal from the control logic. Any subsequent tape motion will generate a pulse to increment or decrement the preset count. The IBG position counter output is monitored by the IBG position count buffer and the contents of this buffer is sent to the control logic upon demand of the Gate Position Count signal.

The digital output of the IBG position counter is converted to analog. Refer to Logic Sheet JC051. The maximum count of 256 yields the maximum output voltage level (at IC C07, pin 14). A count of 128 yields one-half the maximum output which, in turn, yields 0 volts at TP B34. During lock mode, any deviation from 0 volts signifies tape creep and will adjust the two lock drive signals to return the tape to the count of 128.

Rewind. The rewind register receives its input from the control logic during a rewind operation. The control logic increments the rewind register in predetermined steps to provide a controlled ramp up from rated speed to 550 ips rewind speed in approximately seven seconds. The rewind register count is updated every 80 milliseconds. The output of the register is added to the count in the velocity counters. In this way counts higher than the nominal 196 are achieved in order to drive the capstan motor at the high velociy required for rewind. Figure 4-11 illustrates the rewind ramp profile. The control logic maintains a capstan turns count from BOT so that, as the tape approaches BOT, sufficient tape remains for the control logic to provide a controlled ramp down to rated speed. At BOT the servo logic performs the normal stop routine.

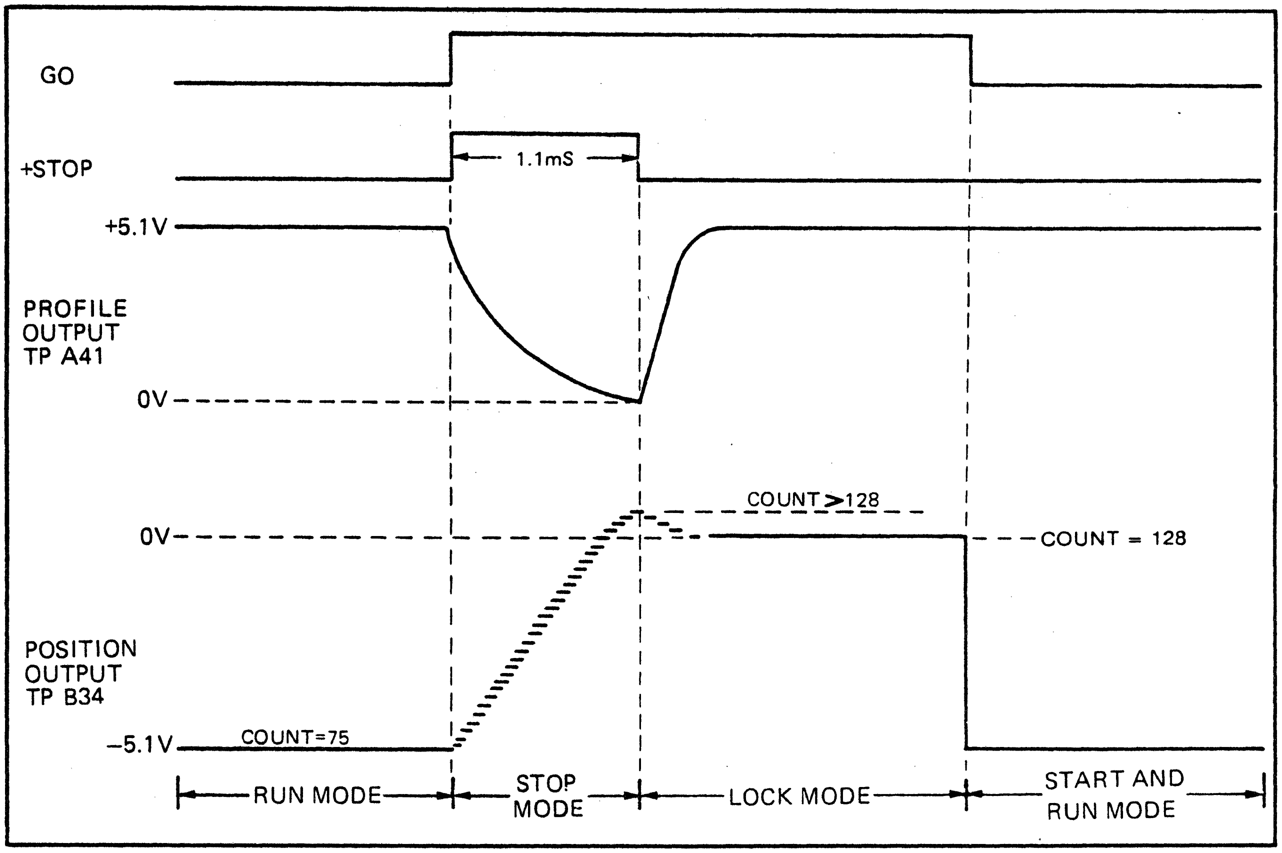


Figure 4-10. JC Card Profile Generator Timing

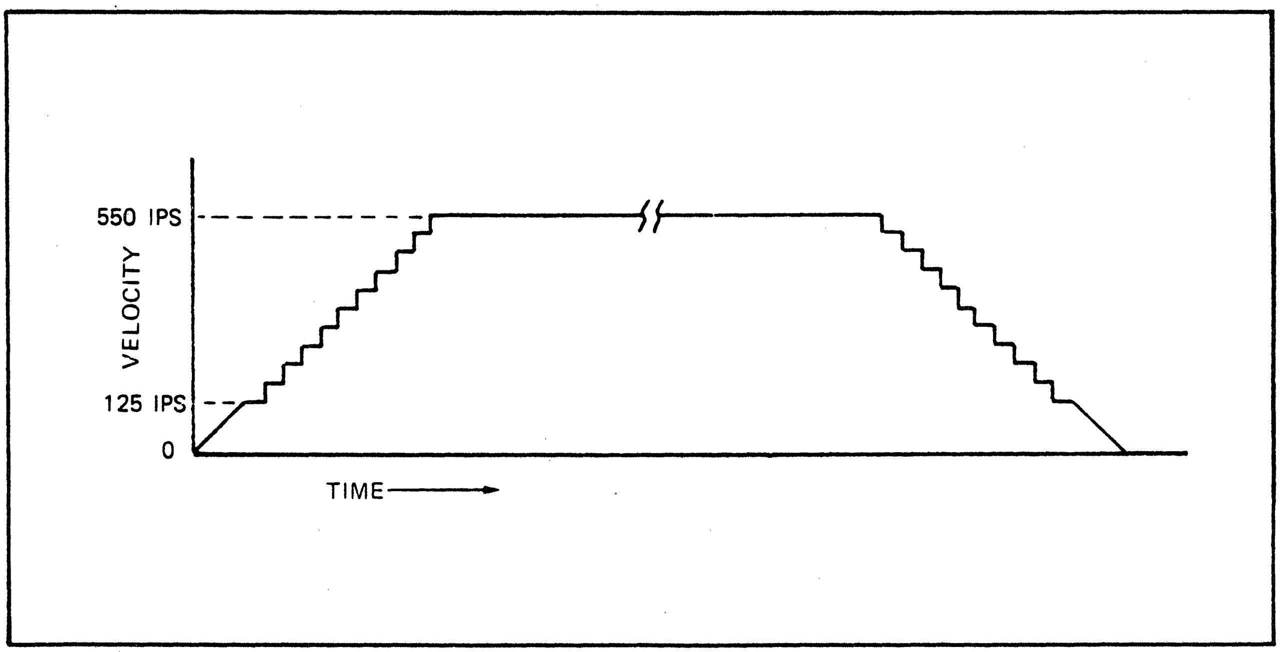


Figure 4-11. JC Card Rewind Profile

4.4.3 CAPSTAN POWER AMPLIFIER

The mode control signals at the analog switches select the appropriate drive signal to be applied through the capstan power amplifier on the JP card to drive the capstan motor. The capstan motor drive signal input to the power amp turns on either Q4 and Q8 to drive the motor clockwise (backward tape motion) or Q3 and Q7 to drive the motor counterclockwise (forward tape motion). Capstan motor current is sampled and fed back through the power amp to maintain a constant capstan velocity.

4.5 REEL SERVO SYSTEM

The reel servo system is comprised of the JS reel servo logic card, the JH reel power amplifier card, the two reel drive motors, and the column vacuum sensors. Figure 4-12 is a diagram of the reel servo system. The servo is zero referenced to a null with the tape loop positioned midway in the vacuum column. When the tape loop deviates from the null position, an error signal is developed by the column vacuum sensor. This error signal causes the amplifier to produce a correctional reel motor drive signal which drives the reel motor to correct the tape loop position in the vacuum column. Figure 4-13 is a block diagram of the reel servo logic.

4.5.1 DIRECTION AND GAIN SELECTION

The control logic provides to the reel control logic a Reels Enable signal and a Load Register signal in order to load B-bus data into the reels register. B-bus data is decoded into File and Machine Bits A, B, and C, as well as two signals used to select the reel motors return line. The File and Machine Bits are further decoded to select forward or backward tape direction and to select one of three gain select lines. The function table for this decoder is provided on Logic Sheet JS001.

The direction select lines provide for two speeds forward and two speeds backward for each reel. Table 4-1 shows how these two speeds in each direction are utilized during threading, loading, and unloading tape operations to manipulate the tape.

The gain select lines choose between three gain levels provided by the vacuum columns sensor amplifier. The output of the sensor amplifier is a function of the position of the tape loop in the column. The low gain output is selected during the stop condition and is used to prevent tape loop bobble in the vacuum columns. High gain is selected when the tape is moving at the rated speed. Rewind gain selection selects the highest gain output of the sensor amplifier and is used only during a high speed rewind operation.

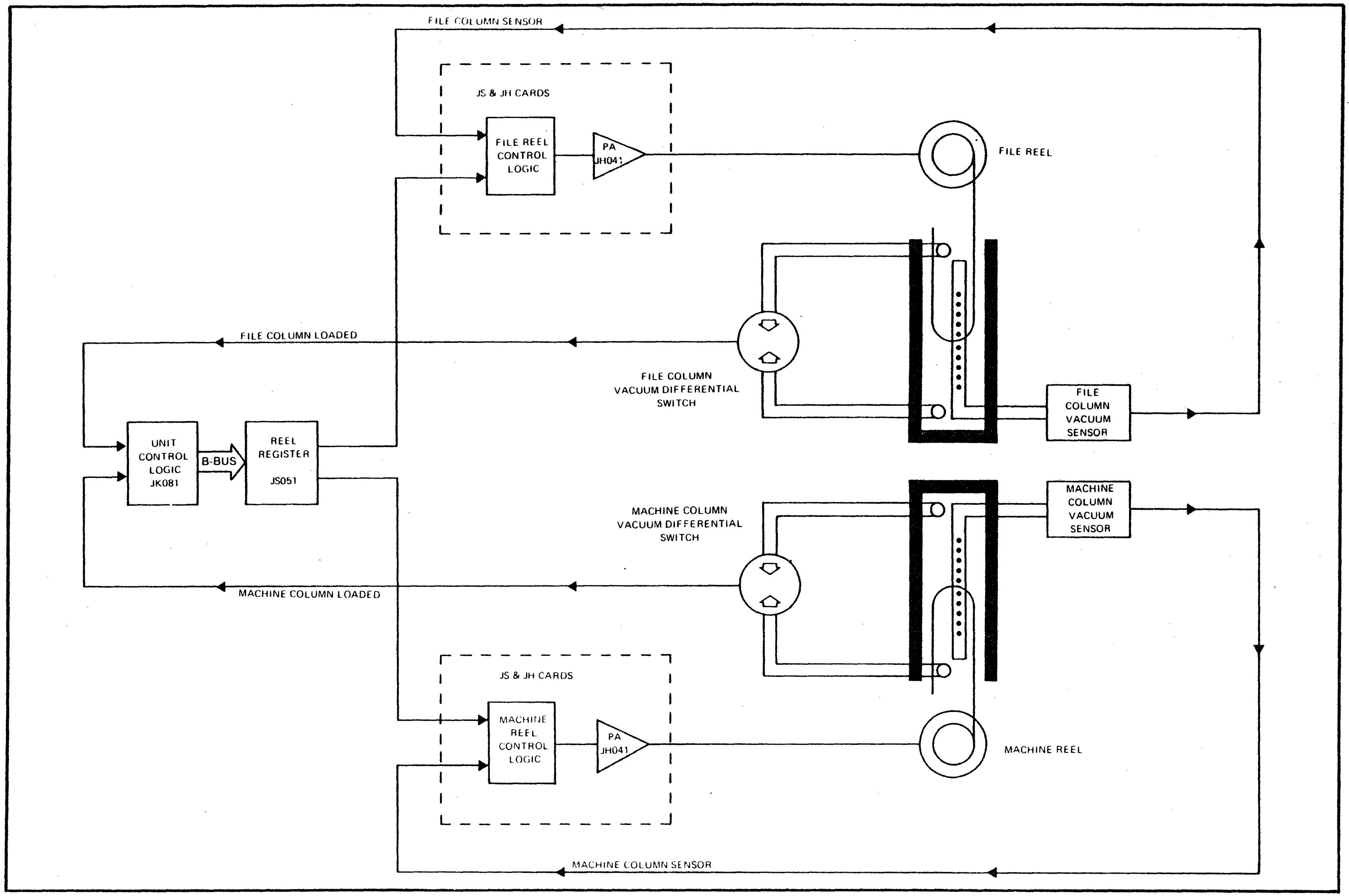


Figure 4-12. Reel Servo System

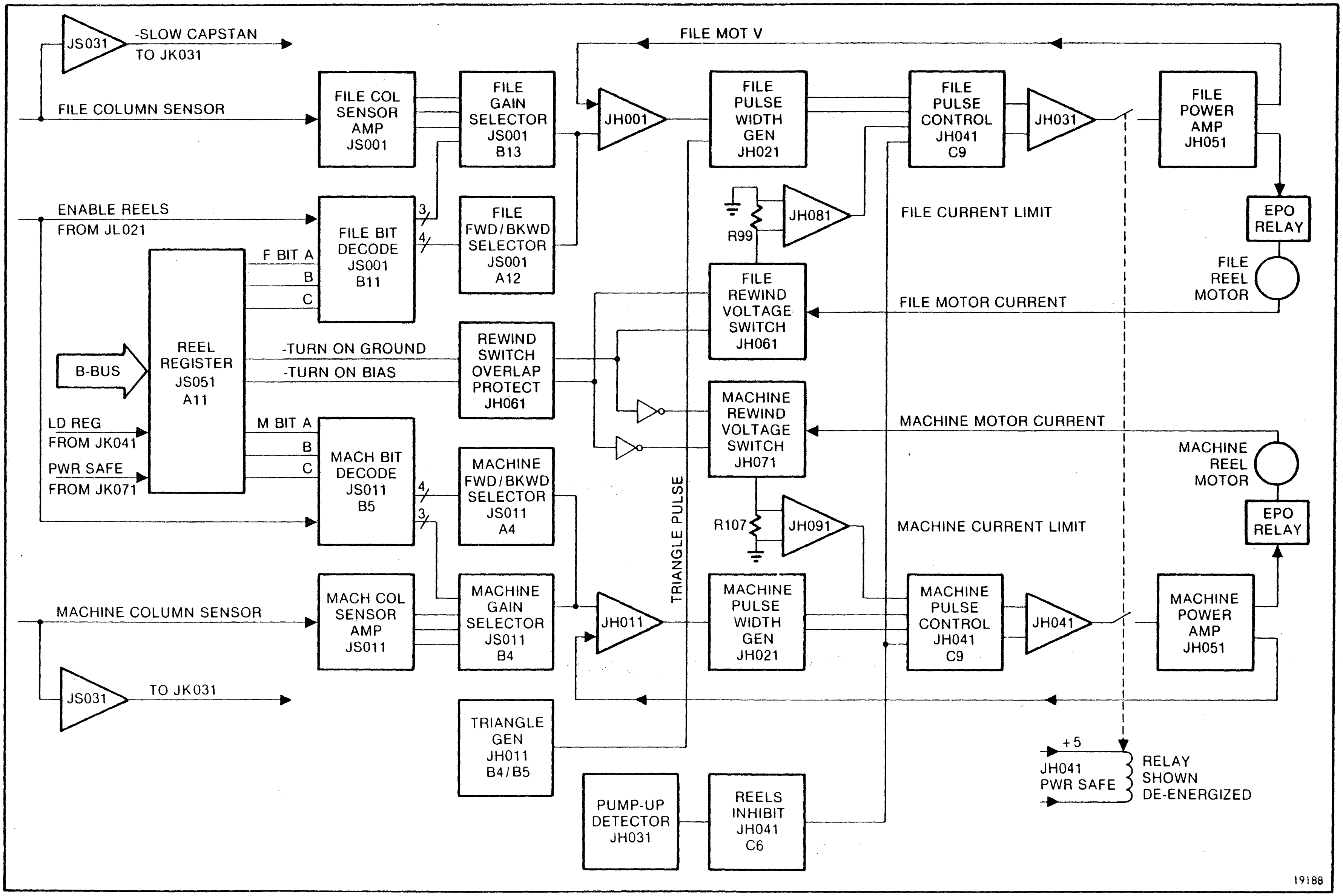


Figure 4-13. Reel Servo Logic

Table 4-1. Direction Select Signals

MODE	FILE REEL SIGNAL	MACH REEL SIGNAL	DURATION OF SIGNAL
Threading	Bkwd 1	none	Until tape leader end is adjacent to entrance of threading path
	Fwd 1	none	Until tape is detected at EOT/BOT sensor
	Fwd 2	Fwd 1	Until tape is present on machine reel hub and BOT marker is detected
Loading	none	Bkwd 1	Until tape loop is past machine column differential switch loop out position
	Fwd 1	none	Until tape loop is past file column differential switch loop out position
Unloading	none	Fwd 1	Until machine column is unloaded
	Bkwd 1	none	Until file column is unloaded
	Bkwd 1	Bkwd 1	Until tape is completely unloaded

4.5.2 PULSE WIDTH GENERATION

The triangle pulse generator produces a 900 Hz, 3 volt peak-to-peak triangle pulse that is centered on zero volts. This is biased to create a positive triangle waveform and a negative triangle waveform. The biased triangle signals enter a pair of comparators for each reel where they are compared with the error voltage for that reel. Using the file reel as an example, if the error is positive, the +Neg File Reel output will be pulsed high; if the error is negative, the +Pos File Pulse output will be pulsed high. These signals are gated by a 2-to-4 decoder and inverted to control the last stage of the pulse control amplifier. Thus, if the error signal is positive, the resultant output is a train of negative pulses that become increasingly shorter as the error voltage approaches zero. Refer to Figure 4-14. As the error voltage crosses zero, negative pulses are emitted 180 degrees out of phase on the triangle wave to ensure that sufficient time has elapsed for the positive drivers to turn off before the negative drivers turn on.

The output of the pulse control amplifier is switched through a reed relay prior to being input to the reel power amplifier. The Voltage Safe/Power Safe signal energizes the relay only under power safe conditions. As the power supply voltages are coming up to nominal level, or in the event of a power supply output failure for any reason, this relay is dropped out in order to remove the power amplifier input and thus prevent tape reel motion.

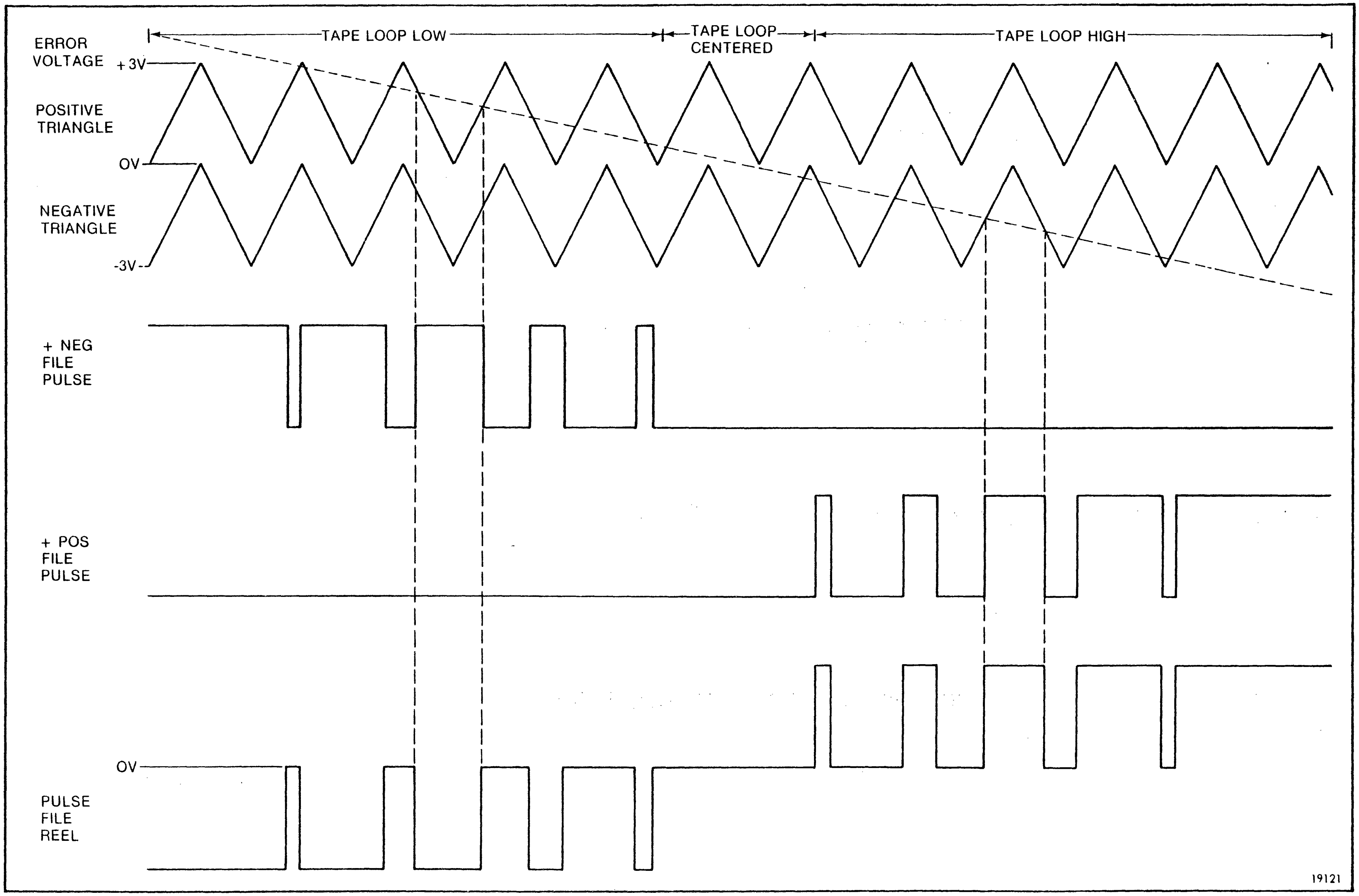


Figure 4-14. File Reel Servo Logic Signals

4.5.3 REEL POWER AMPLIFIER

The positive and negative excursions of the waveform from the pulse control amplifier alternately switch on the +45 and -45 volt circuits of the power amplifier.

The output of the power amplifier is switched through the emergency power off (EPO) relay (located in the power supply rectifier assembly) before this drive signal is applied to the reel motor. In the event of a vacuum failure detected by one of the vacuum differential switches, the EPO relay drops out to remove the drive signals from the reel motors and to short the motor armature leads through a 1 ohm resistor. This provides dynamic braking to stop reel motor motion immediately in order to protect the tape.

4.5.4 REWIND VOLTAGE SWITCH

The reel motor return line is returned to the rewind voltage switch. When the tape unit is operating at nominal speed the Turn On Ground signal returns the motor return line to 0 volts. However, when the tape unit is performing a high speed rewind, the Turn On Bias signal switches the motor return to a 45 volt level: the file reel motor to +45 volts; the machine reel motor to -45 volts. This is done in order to achieve the high speeds required for rewinding.

The rewind voltage switch circuit also provides a current across a .03 ohm current sense resistor which is monitored by the current limit circuits. In the event of an overcurrent condition (file reel: 25 amps; machine reel: 18 amps), the output of the limit circuits is used to disable the pulse control circuit. The resultant loss of the input to the power amplifier reduces current. When the current drawn drops to the lower limit (file reel: 21 amps; machine reel: 15 amps), the pulse control circuit is re-enabled. If the over-current condition recurs, the cycle is repeated, thus maintaining the current drawn by the reel motor within acceptable limits.

Additionally, the Rewind Switch is protected against having both drivers on simultaneously. An RC network delays the transition (high-to-low) of Schmitt-triggered NAND gates to allow 100 microseconds from the time Turn On Ground goes high to the time when Turn On Bias goes low.

4.5.5 PUMP UP DETECTION

If the operator turns the reels by hand when power is applied to them, the capacitors across the power supply can be charged above the transformer voltage. When this occurs, unsafe voltages can be applied to the drivers. To prevent this from occurring, the power supply capacitors are monitored and the drivers are disabled if the +45V supply exceeds +58 volts.

4.6 OPERATOR PANEL

The operator panel JF card, mounted on the back of the front door, contains the circuits that process the signals for the operator panel switches and indicators.

The JF card contains a voltage regulator that reduces the Standby power from the power supply to +11 volts (VDD) to provide the keep alive voltage for the switch circuits.

Operator commands entered through the operator panel switches are processed on the JF card by sequencing through a 3-bit shift register. Sequencing through the shift register eliminates switching noise and qualifies switch closures so they may be detected as valid input. The switch output signals from the JF card are active low, open-collector.

4.7 JJ/JJ2 CARD

The JJ/JJ2 card performs a variety of subsidiary functions in many areas:

- Operator Panel Lamp Drivers
- Operator Panel Switch Circuit Buffers
- Maintenance Test Panel Switches and Indicators
- Cartridge Opener Motor Driver
- Solenoid Drivers
- EOT/BOT LED Drivers
- EOT/BOT Marker Detection
- Power Safe Detection

Most of these circuits are straightforward, but the EOT/BOT circuits and the power safe detection circuits are of particular interest and these are described in detail. Instructions for the operation of the maintenance test panel are provided in Chapter 5.

4.7.1 EOT/BOT

The EOT/BOT circuits provide a pulsed drive to the EOT and BOT LED light sources and also provide EOT marker and BOT marker sensed indications. Figures 4-15A and 15B diagram the EOT and BOT circuits.

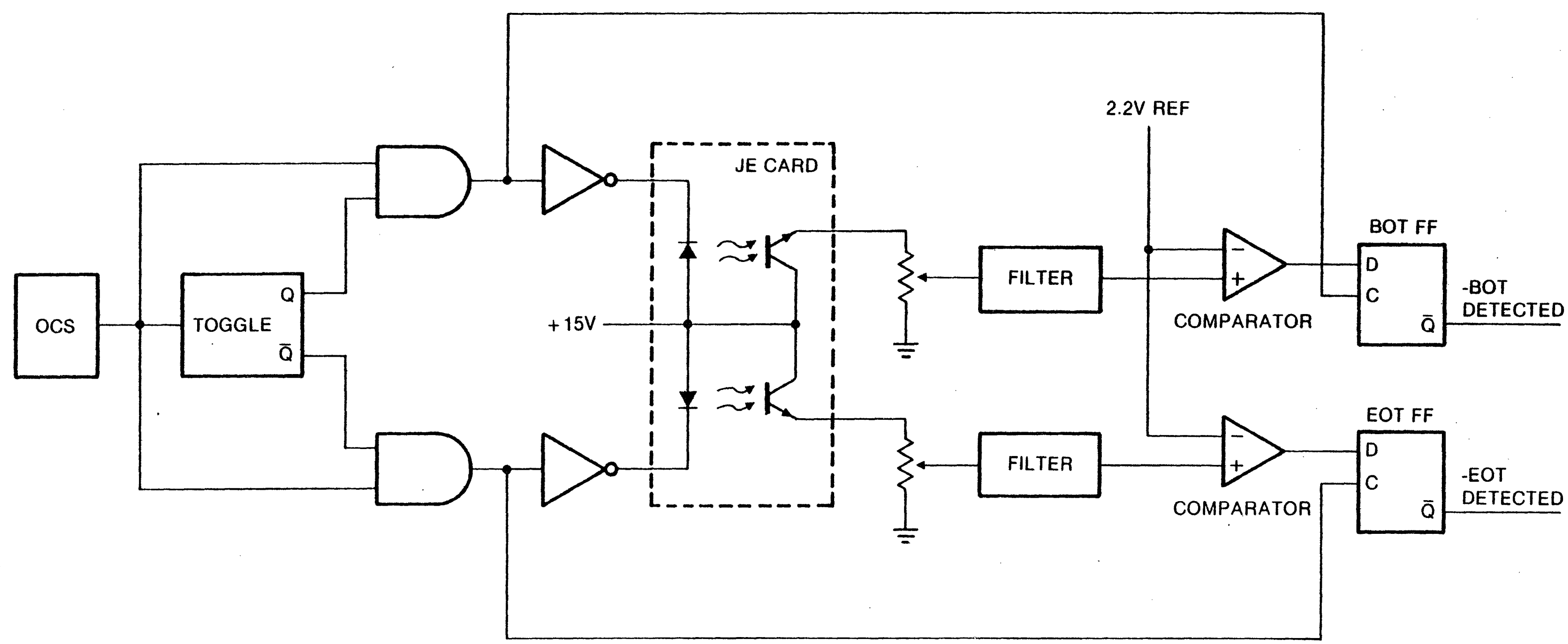


Figure 4-15A. EOT/BOT Circuits With JJ2 Card

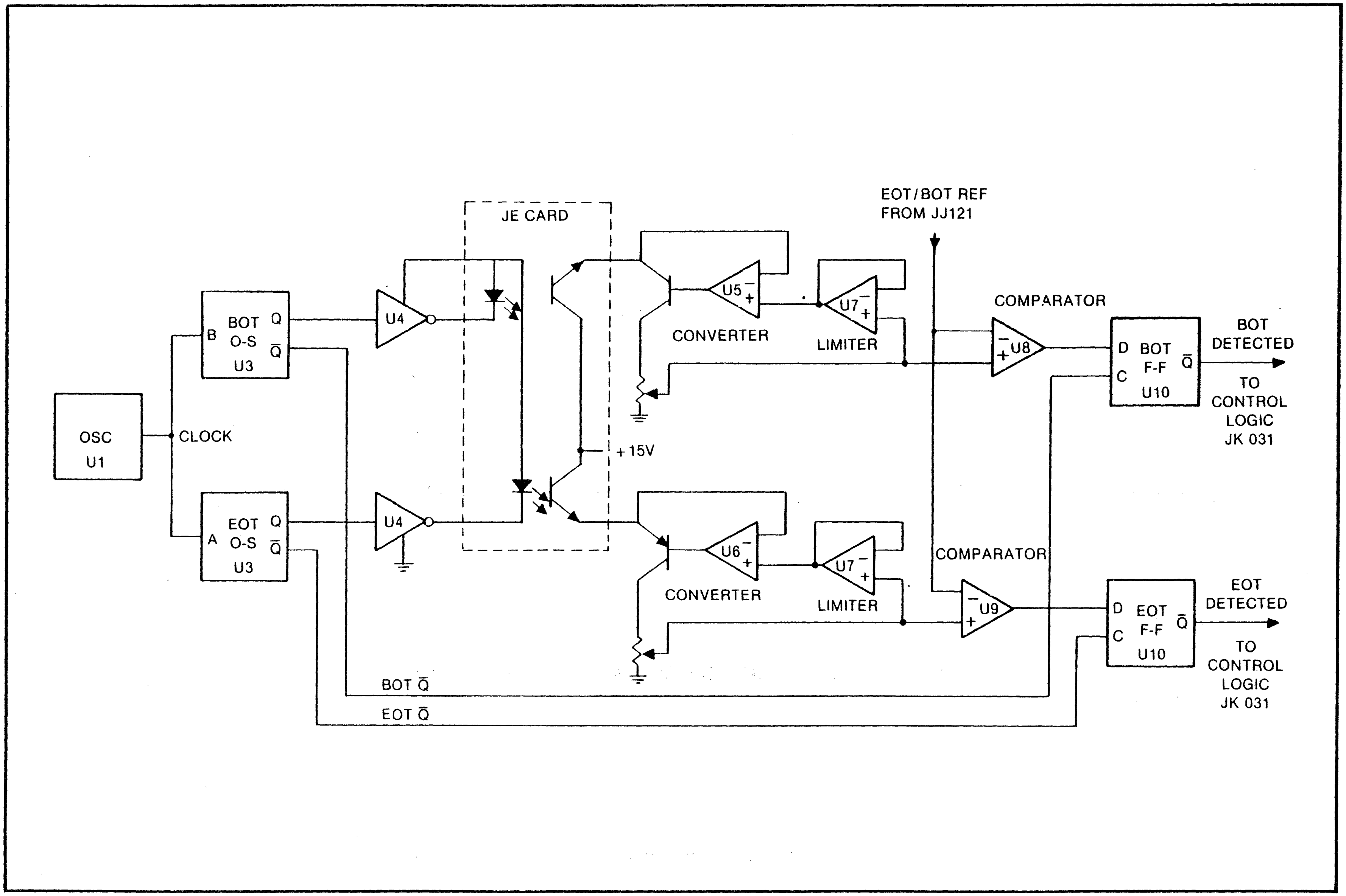


Figure 4-15B. EOT/BOT Circuits Diagram With JJ Card

4.7.1.1 EOT/BOT LED Drivers

An oscillator provides pulses that are 25 microseconds wide and spaced 500 microseconds apart. A toggle flip-flop and two AND gates alternately steer these pulses to the EOT and BOT LED drivers, thus each LED is pulsed every 1000 microseconds. Refer to Figures 4-16A and 16B. The EOT and BOT LEDs, as well as the associated phototransistors, are located in the EOT/BOT block on the small JE card.

4.7.1.2 EOT/BOT Detection

When a reflective tape marker reflects light from the LED to the associated phototransistor, current flows from the phototransistor through the adjustment potentiometer. The voltage produced across the potentiometer is filtered to remove high frequency noise and signals causes by constant ambient light. The filtered signal is then compared to a 2.2 volt reference and the comparator output is applied to the D input of the EOT or BOT detected flip-flop.

Each flip-flop is clocked at the end of its associated LED drive pulse. Since the LEDs are pulsed at different times, this method of clocking prevents light from the other LED from causing an erroneous detection signal.

4.7.1.3 Tape Present Detection

There is a reflector mounted in the tape path opposite the EOT/BOT block. With no tape in the threading path, both the EOT and BOT circuits provide detection signals. The control logic program samples both the EOT Detected and BOT Detected signals. If both signals are true, the program determines from this indication that there is no tape present in the tape path. Conversely, if either (or both) signal is false, the program takes this as the indication that tape is present.

4.7.2 POWER SAFE

The primary purpose of the power safe circuits is to monitor the +5 Vdc power supply output. If the +5 Vdc output fails, the reel and capstan circuits are immediately disabled and the control logic sequence is interrupted in order to protect both tape and data. Figures 4-17A and 17B are diagrams of the power safe circuits. In the following descriptions reference should be made to the JJ/JJ2 card logic sheets as well as the applicable block diagram.

The keep alive regulator provides an operating voltage for the power safe circuits for some time after the +5 Vdc power supply output has failed. The +26 Vdc and the Standby voltage are ORed into the keep alive regulator. In the case of a power supply failure not involving the standby power circuit, the Standby voltage is used to sustain the power safe circuits. In the event of an input power failure, the +26 Vdc power supply output is used to sustain the power safe circuits for as long as possible following the power failure.

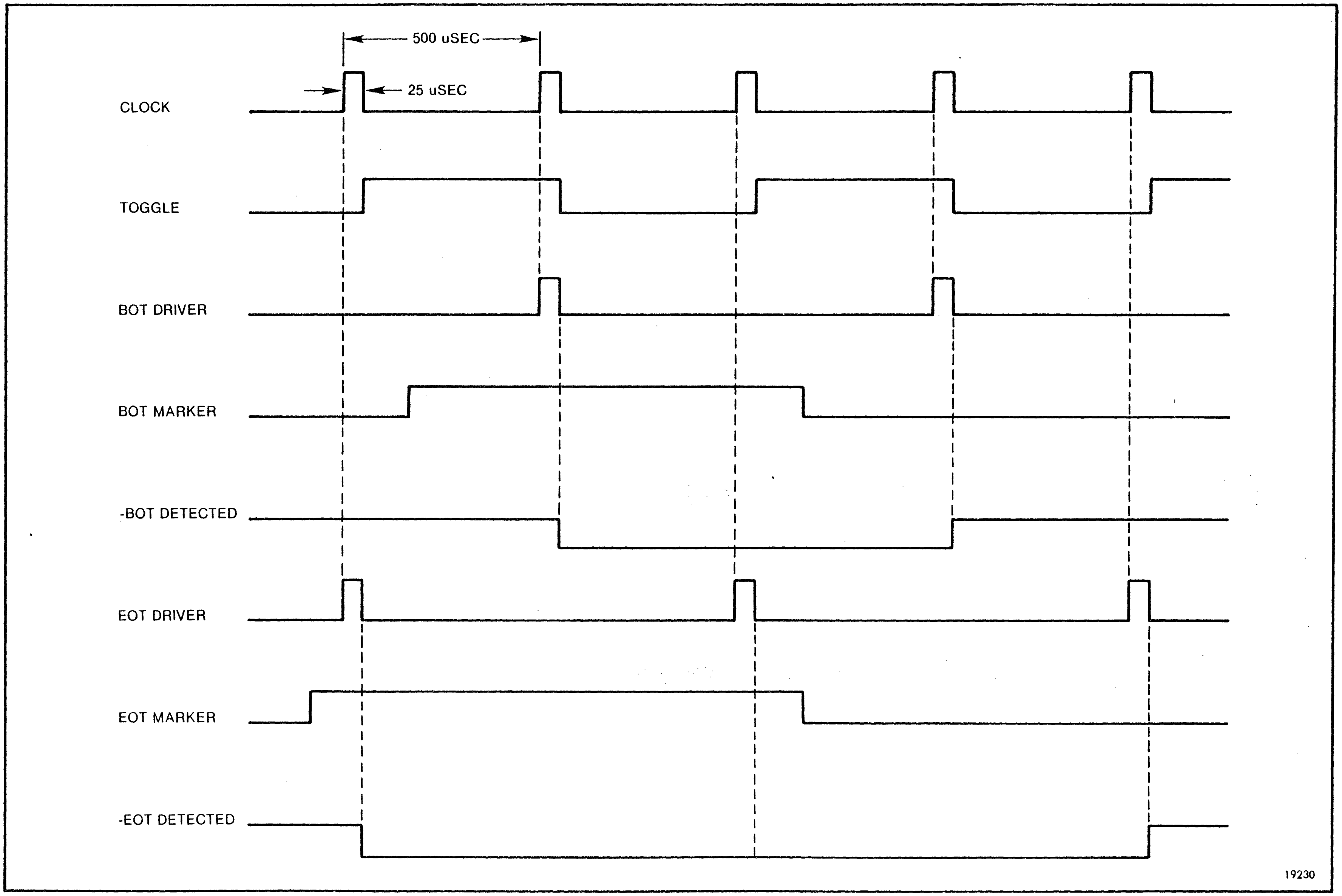


Figure 4-16A. JJ2 Card EOT/BOT Detection Timing

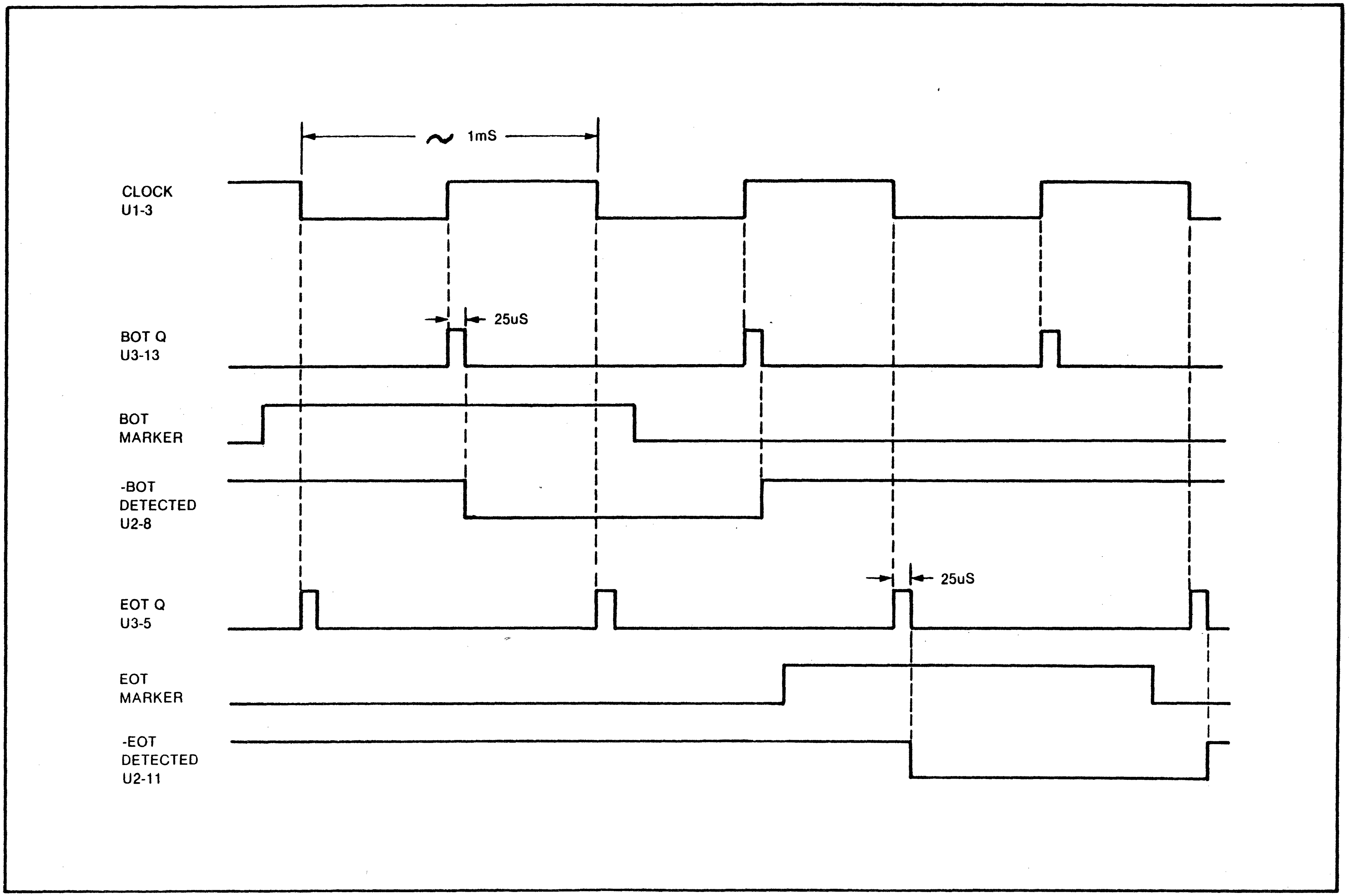


Figure 4-16B. JJ Card EOT/BOT Detection Timing

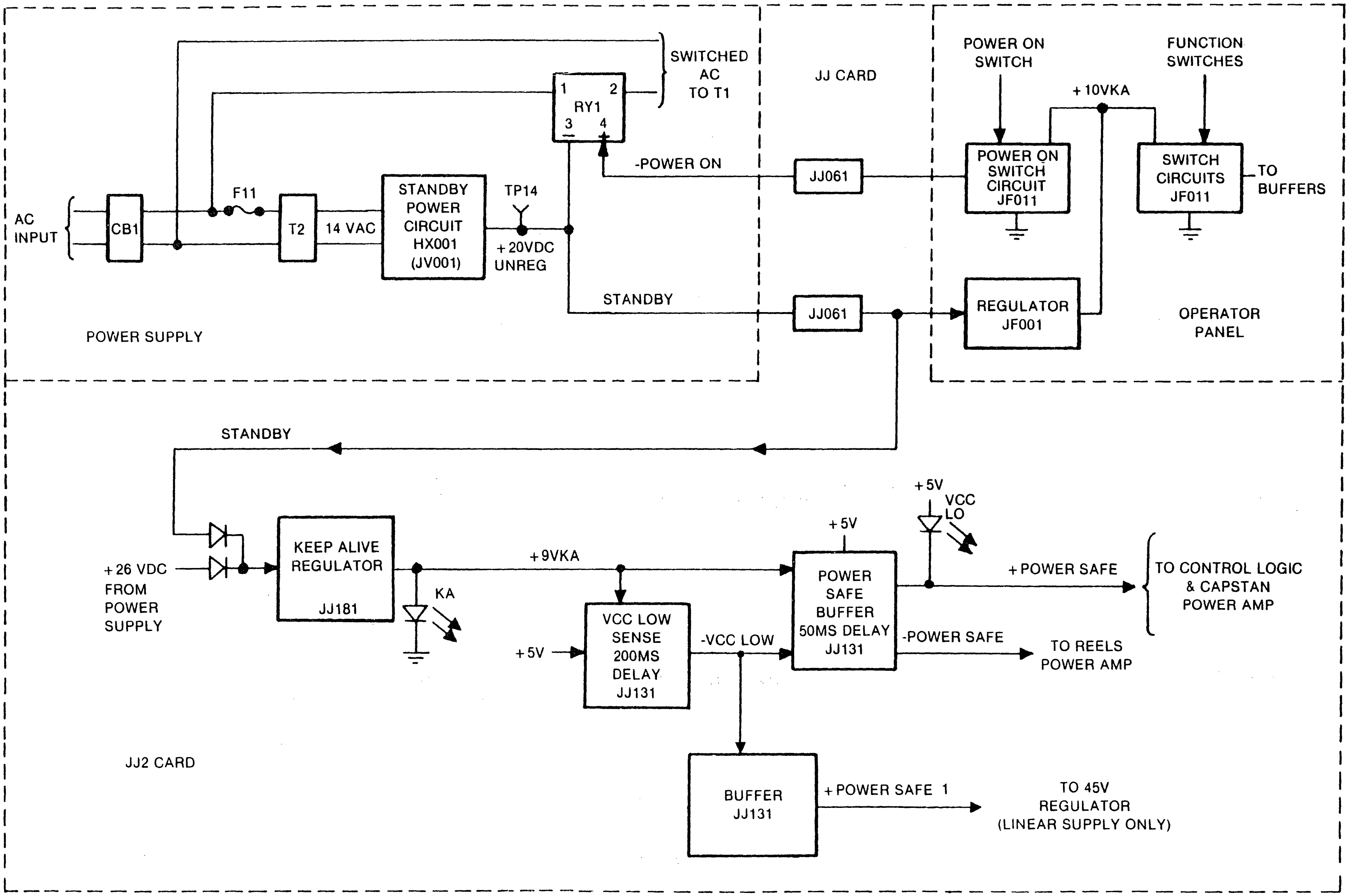


Figure 4-17A. Power Safe With JJ2 Card

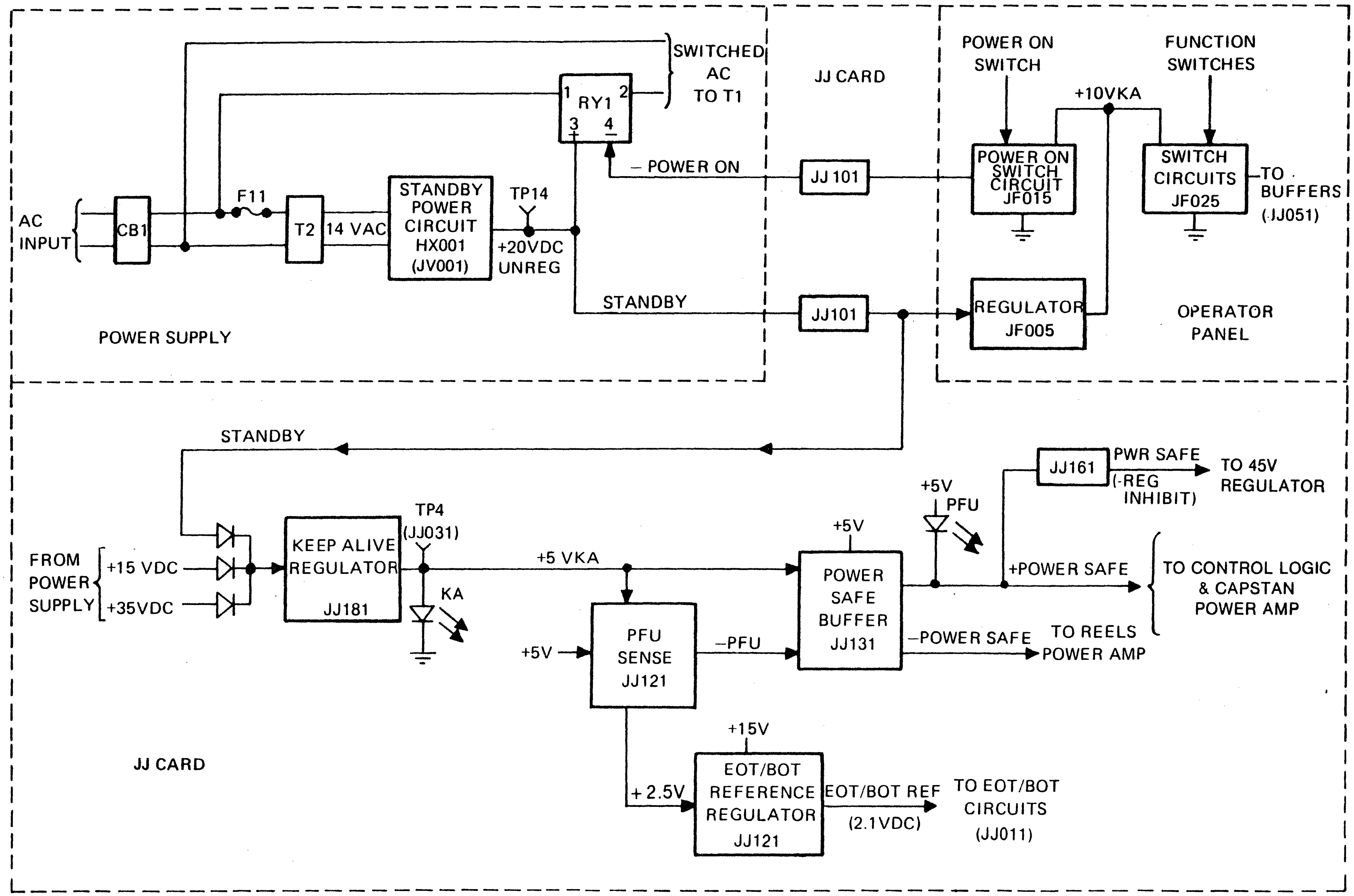


Figure 4-17B. Power Safe With JJ Card

On the JJ2 card, the VCC low sense circuit monitors the +5V power supply output. The +5V is divided between R166 and R167 and compared to the known 2.5V from U20. If the +5V supply falls below 4.7 volts, the -VCC Low signal drops. When +5V power is restored, the RC circuit of R166 and C2 requires that the +5V supply be up for 200 milliseconds before -VCC Low goes high. The +Power Safe 1 line goes high, enabling the ±45V reel supply to charge. 50 milliseconds after -VCC Low goes high, the +Power Safe line to the control logic goes high, and the -Power Safe line to the JH card goes low.

On the JJ card, the PFU (literally, "power fouled up") sense circuit monitors the +5 Vdc power supply output. The +5 Vdc is divided between R84 and R86 and compared with the known 2.5 volts from regulator U21. A drop in the +5 Vdc causes, within one microsecond, the -PFU signal to drop. Upon voltage recovery, the RC circuit of R91 and C76 requires that the +5 Vdc be up for 50 milliseconds before the -PFU signal goes high again.

4.7.3 EMERGENCY POWER OFF (EPO)

The Emergency Power Off (EPO) relay is controlled by one output of the JJ/JJ2 card. The relay quickly disconnects drive power from the reel and capstan motors and short the motor armatures to ground in the event of a vacuum failure. Refer to Figures 4-18A and 18B for diagrams of the EPO circuits.

Extreme positions of the tape loop in the vacuum columns are monitored by the vacuum differential switches which look for a difference in pressure between the two points it monitors in the columns. When this pressure differential fails, the vacuum differential switch sends a signal to the control logic which removes the power from the EPO relay. When the motor armatures are shorted to ground, the motors stop immediately in order to protect the tape.

The location of the EPO relay depends on the type of power supply used in a tape unit. For a ferro power supply, the EPO relay is mounted in a bracket on the top of the rectifier assembly. The EPO relay used with the optional linear power supply is mounted inside the power supply on the connector bracket.

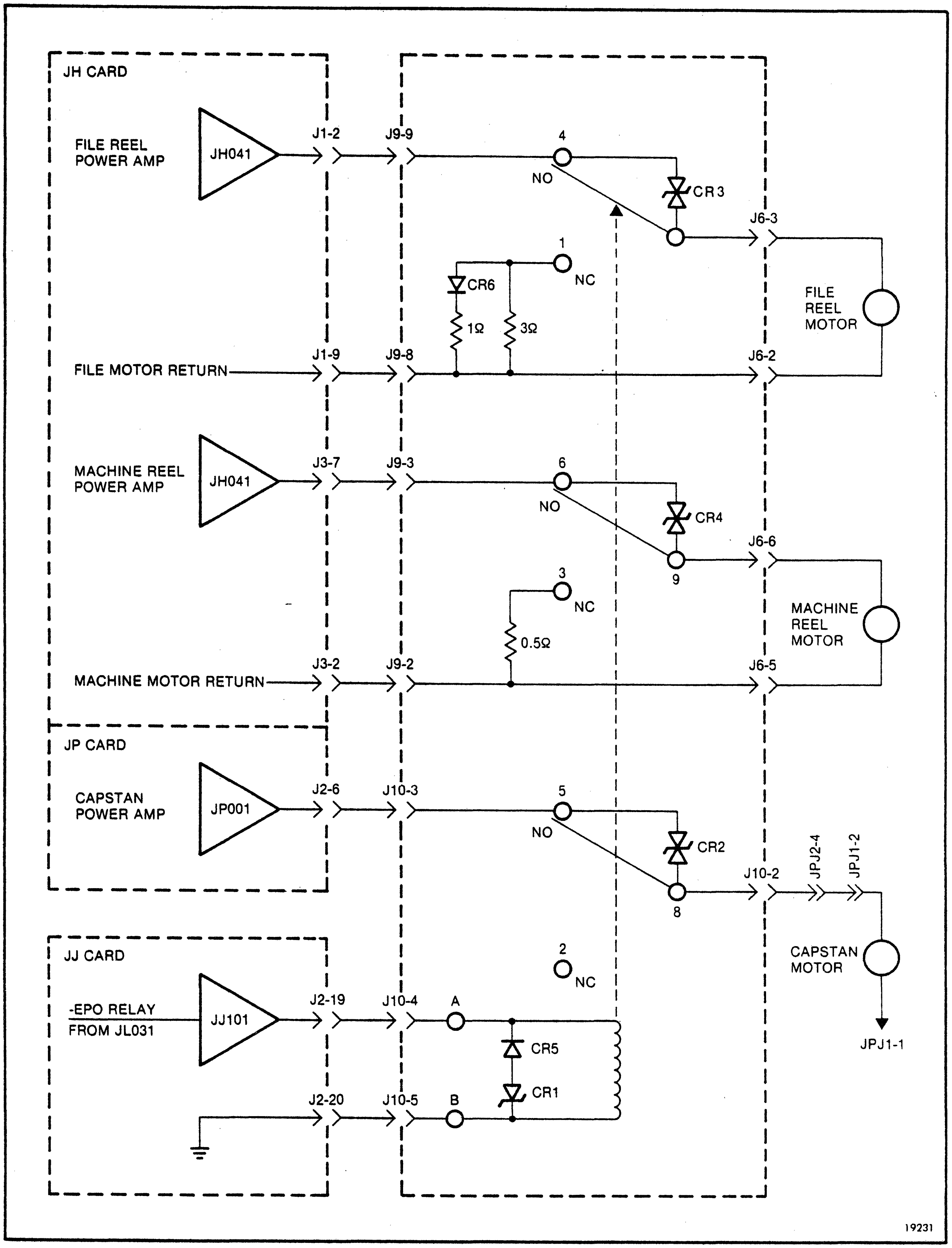


Figure 4-18A. Ferro PS EPO Circuit Diagram

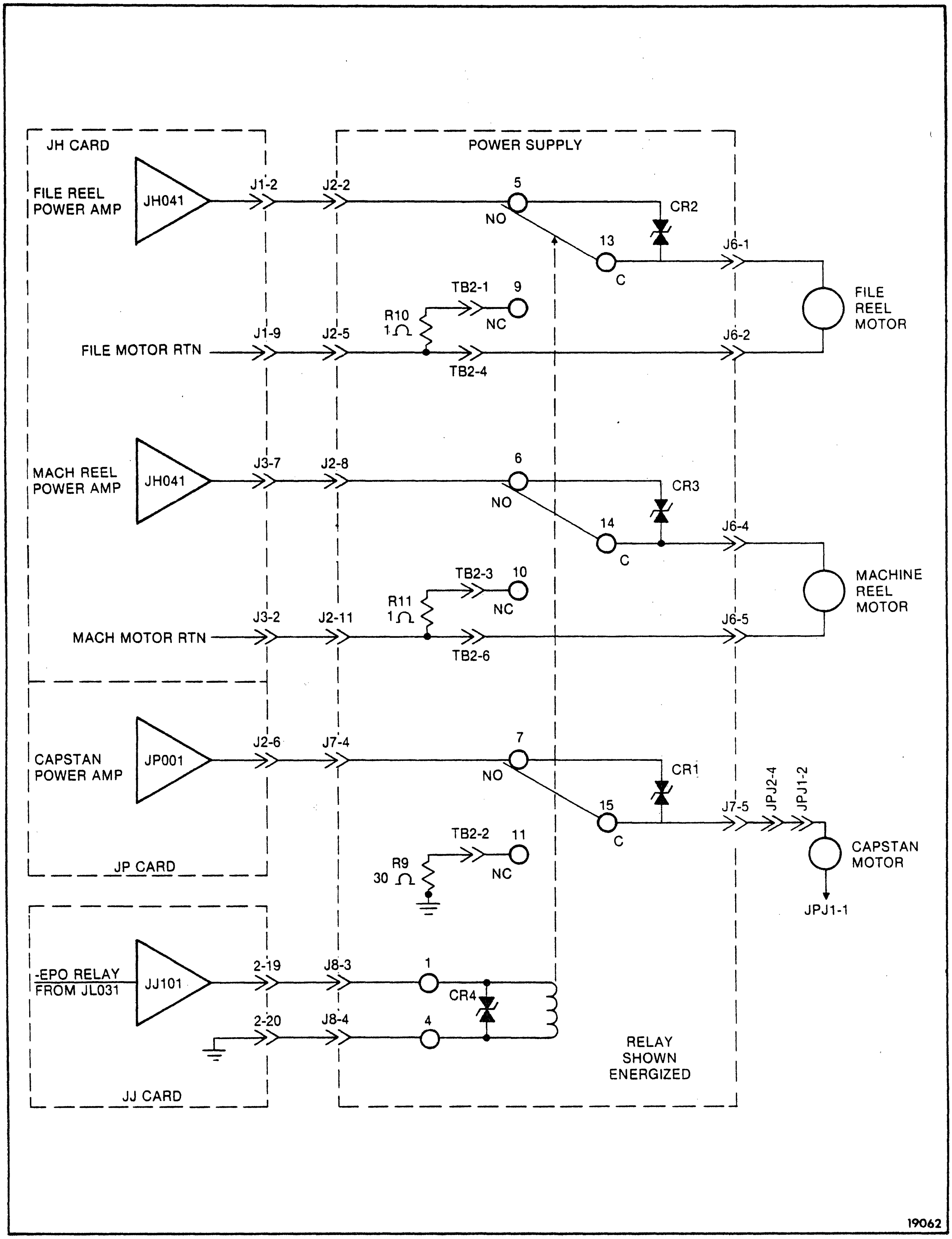


Figure 4-18B. Linear PS EPO Circuit Diagram

4.8 POWER SUPPLY

Two different types of power supplies are available: the standard ferro-resonant supply, and the optional linear supply. Both supplies consist of a rectifier assembly and a regulator card. The HX regulator card is used with ferro-resonant supplies; the JV regulator card with linear supplies.

4.8.1 RECTIFIER

The rectifier assembly receives AC input power and supplies the appropriate AC and DC voltages to the regulator card and the tape unit loads. Fault protection is provided by a circuit breaker in series with the AC input line and by fuses for each output.

Power on/off switching for the tape drive and pneumatics is controlled by two solid state relays. Circuit breaker CB1 applies power to auxiliary transformer T2 in order to provide a Standby voltage of approximately +20 volts. The operator panel POWER switch uses the Standby voltage to energize solid state relay RY1 which switches AC power to primary power transformer T1. This brings up the DC voltages. Refer to Figure 4-19A or 19B.

A second solid state relay RY2 switches AC power to the pneumatics drive motor and is controlled by the Pneumatics On/Off signal from the control logic.

4.8.2 REGULATOR

The regulator card (HX or JV), mounted on the rectifier assembly, receives rectified voltages from the rectifier assembly and provides regulated voltages to the logic electronics. Each of the voltage regulator circuits incorporates both current limiting and overvoltage functions.

In addition to voltage regulators, the regulator card contains the standby power circuit that is powered up whenever the power supply circuit breaker is closed with line voltage applied. The Standby output of the standby power circuits is +18 (4) volts. This provides power to relay RY1 to power up the tape unit. During machine operation, if Standby power should disappear, the tape unit is protected against damaging power-down by the diode OR arrangement of the power safe circuits on the JJ/JJ2 card as well as the HX (or JV) card. Refer to Figure 4-17A or 17B.

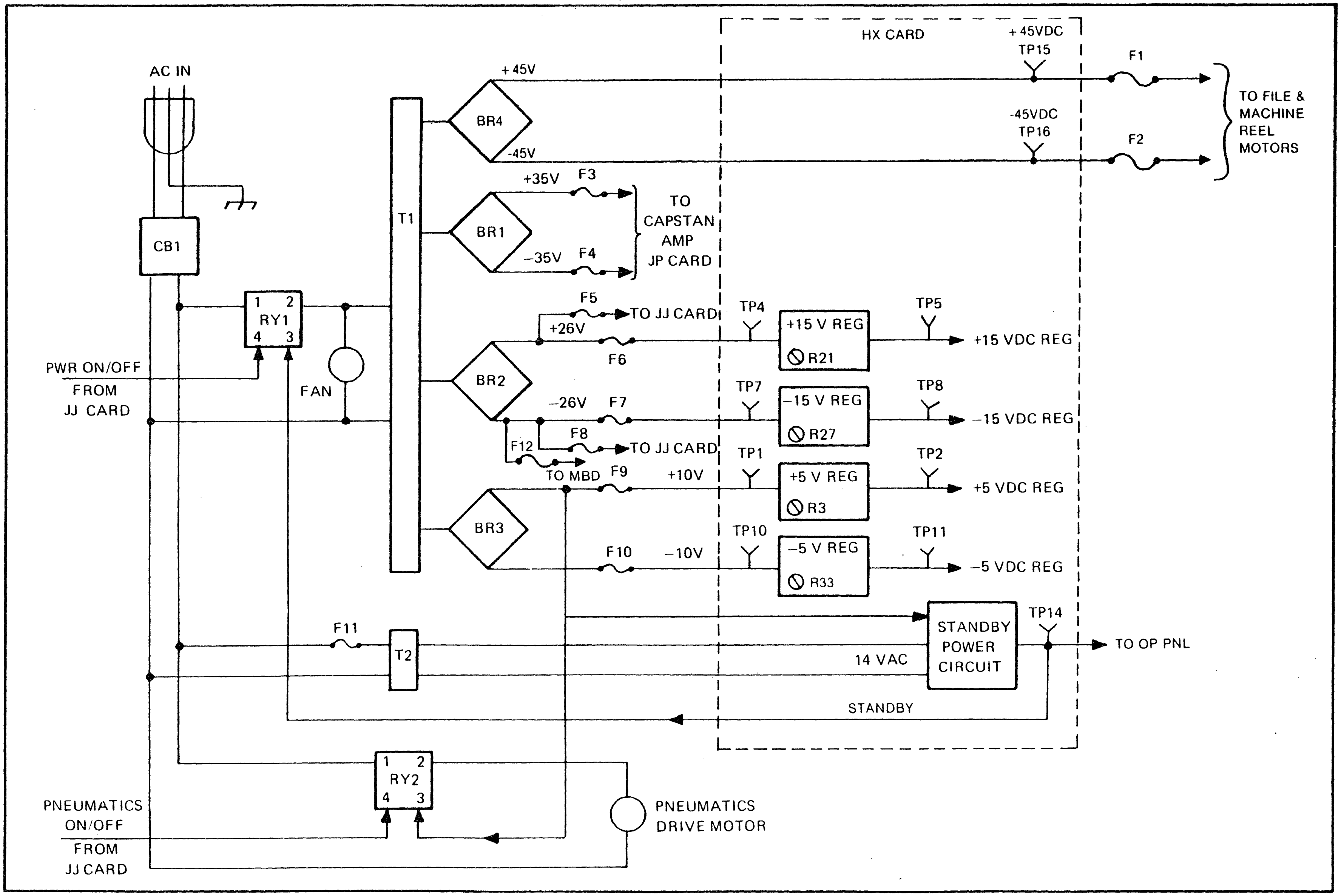


Figure 4-19A. Ferro Power Supply

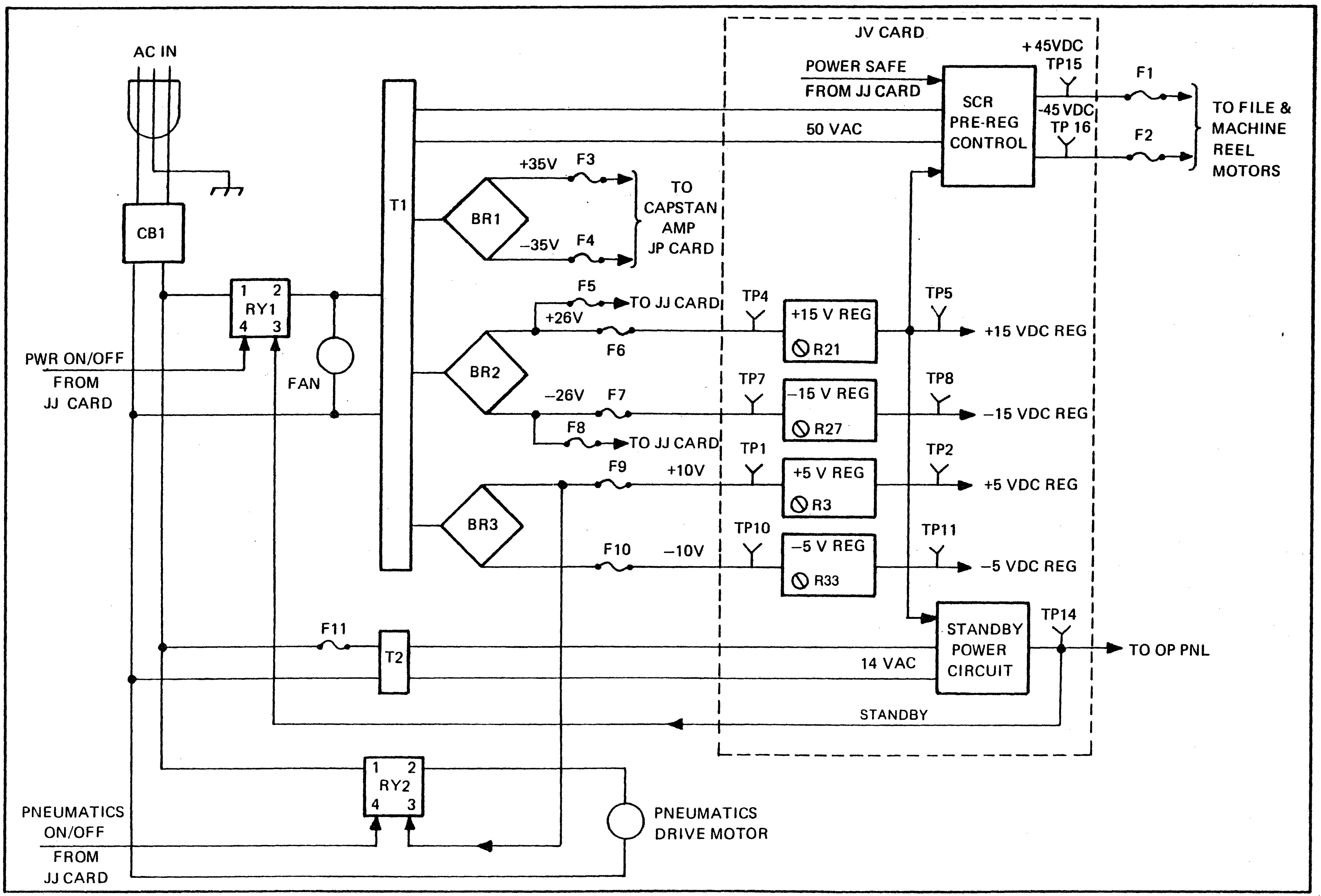


Figure 4-19B. Linear Power Supply

4.9 PNEUMATIC SYSTEM

The pneumatic system is comprised of a positive pressure air pump, a dual function vacuum blower, a motor that drives both of these, solenoid-actuated valves to direct and control the air and vacuum flow, and sensors to monitor the pressure levels. The system provides positive air pressure and vacuum to manipulate tape, to activate the transfer valve, and for cooling. Figures 4-20 through 4-24 diagram the pneumatic system and its operation.

4.9.1 PRESSURE

Positive air pressure, supplied by the air pump, is forced through a 0.3 micron filter and then routed to both the run solenoid valve and the thread solenoid valve. The run solenoid valve directs air pressure to the air bearings plenum during run operations. The thread solenoid valve directs air pressure to the threading plenum during tape loading operations and also supplies air pressure alternately to either end of the transfer valve air cylinder in order to actuate the vacuum transfer valve.

4.9.1.1 Thread Operation

When a tape threading operation (Figures 4-20 and 4-21) is initiated, the run solenoid is energized to close the normally-open valve to the air bearings plenum. The thread solenoid is energized to direct air to the left end of the transfer valve air cylinder where the pressure pushes the air cylinder piston to the right in order to direct vacuum to the machine reel hub duct. Initially in the thread mode (pre-thread mode), the high speed valve solenoid is energized to provide a bleed path for the air in the right end of the air cylinder.

Once the pneumatic transfer valve has completed its travel to the machine reel hub duct, the thread mode proper begins. The transfer solenoid is energized to open that valve to the threading pressure plenum. Air pressure in the plenum is applied to the cartridge restraints and threading channel to be used to direct the tape leader toward the machine reel hub.

4.9.1.2 Load Operation

A vacuum columns loading operation (Figures 4-22 and 4-23) is automatically initiated when the tape threading operation is completed, that is, when the tape has wrapped a few turns around the machine reel hub. The thread solenoid is de-energized in order to direct air to the right end of the transfer valve air cylinder where the pressure pushes the air cylinder piston to the left in order to direct vacuum to the columns plenum. Initially in the load mode (pre-load mode), the transfer solenoid is energized to provide a bleed path for the air in the left end of the air cylinder.

Once the pneumatic transfer valve has completed its travel to the columns plenum, the load mode proper begins. The transfer solenoid is de-energized. The high speed solenoid valve is energized to open the valve in order to apply air to the high speed foot. The run solenoid remains energized in order to inhibit air pressure to the air bearings.

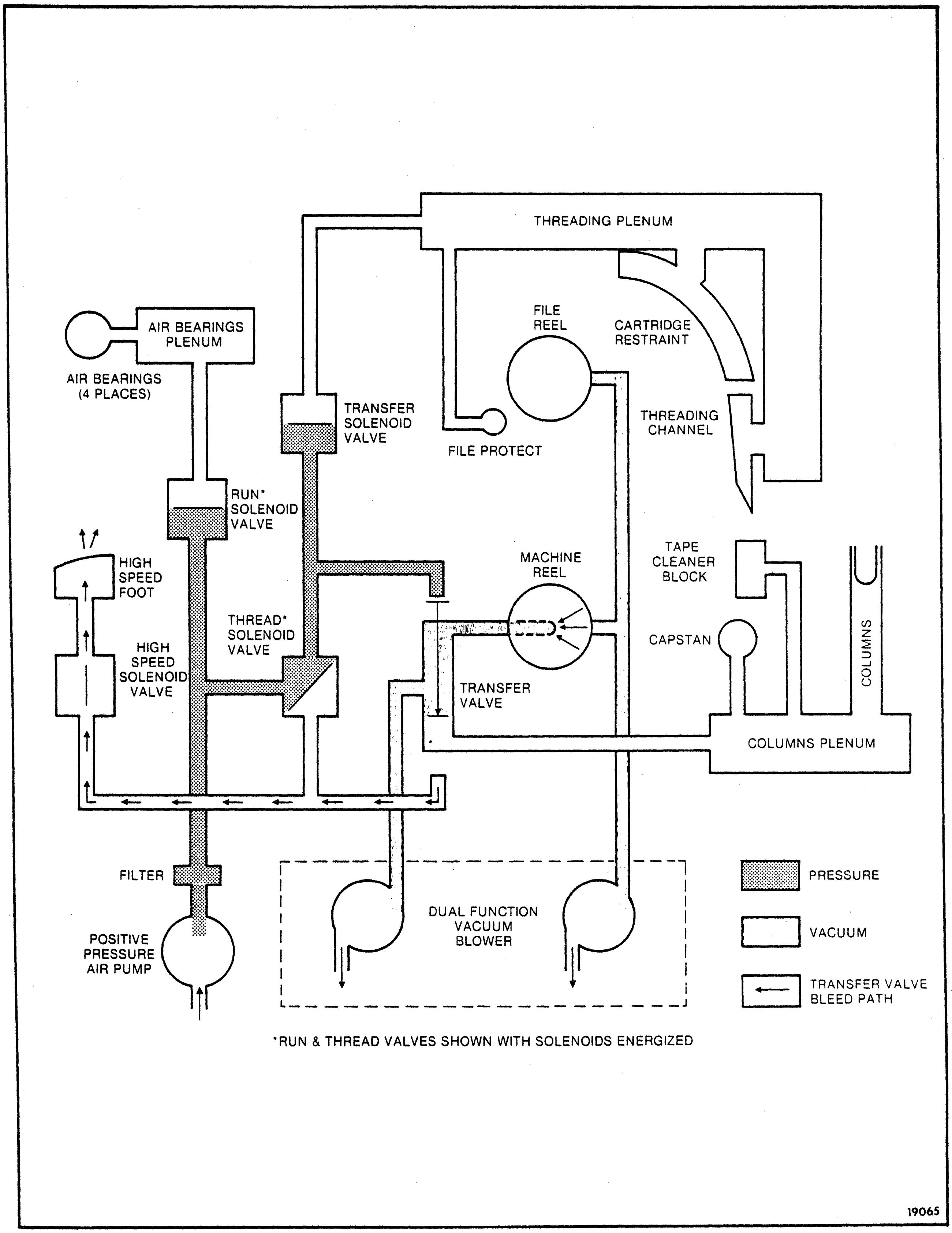


Figure 4-20. Pre-Thread Pneumatics

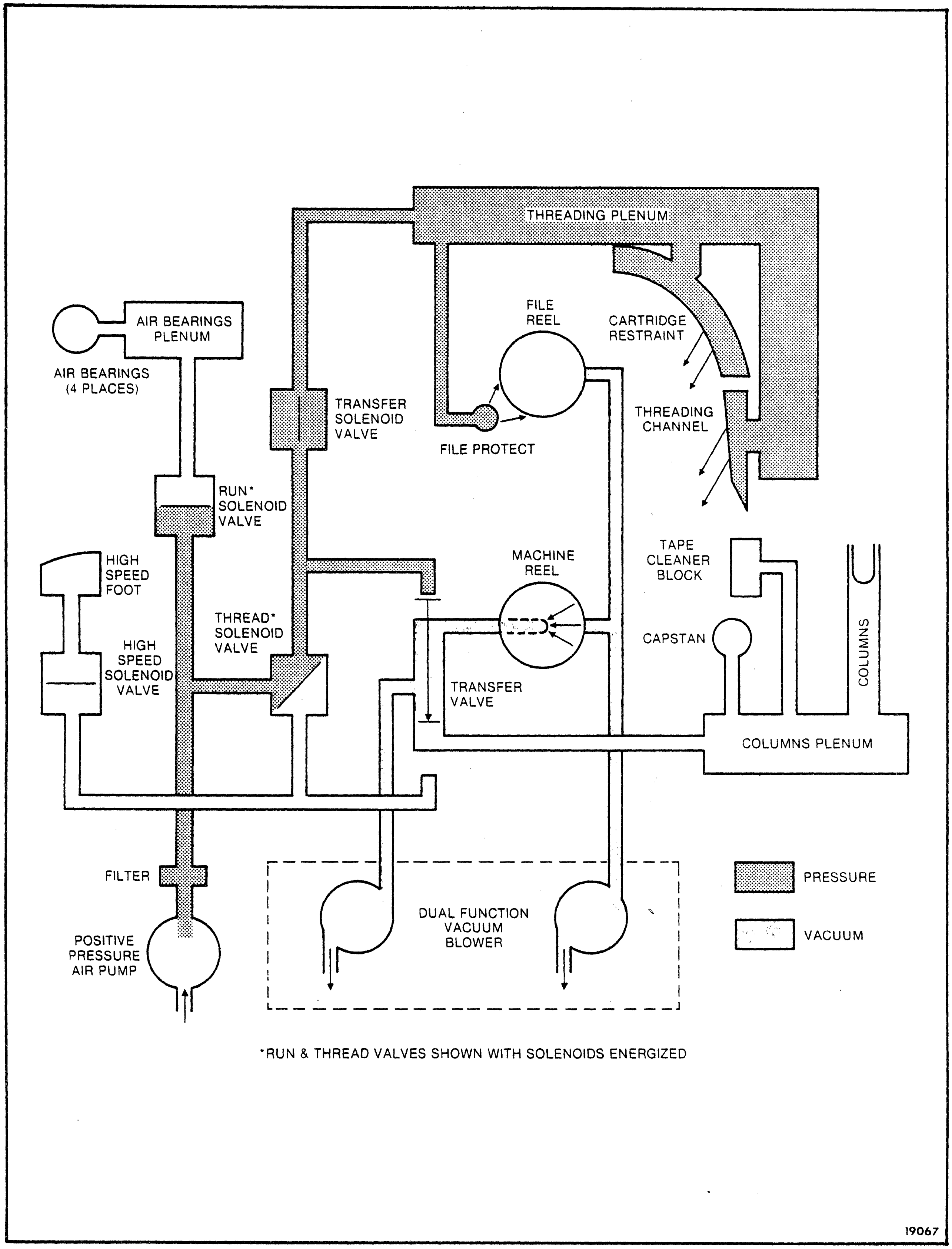


Figure 4-21. Thread Pneumatics

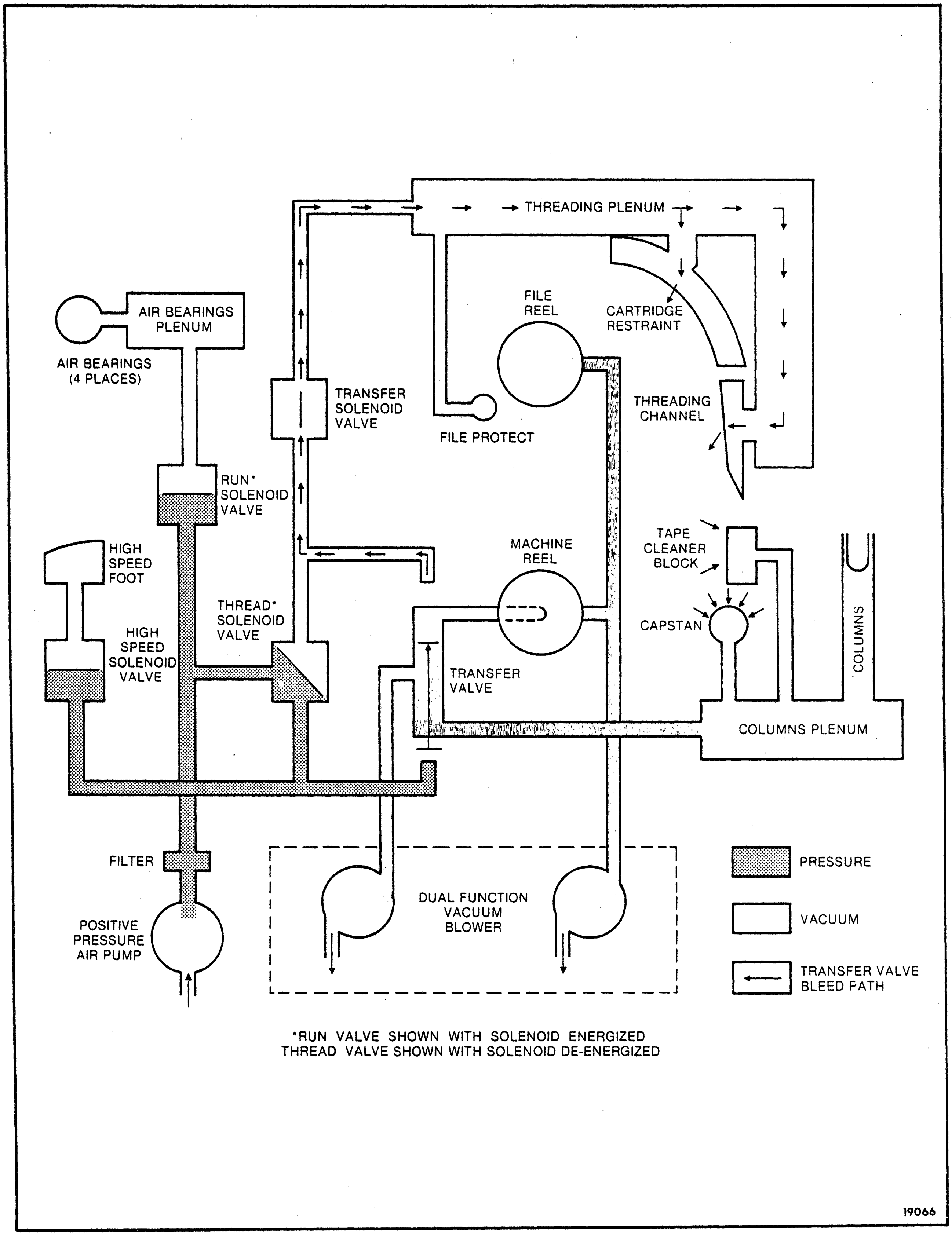


Figure 4-22. Pre-Load Pneumatics

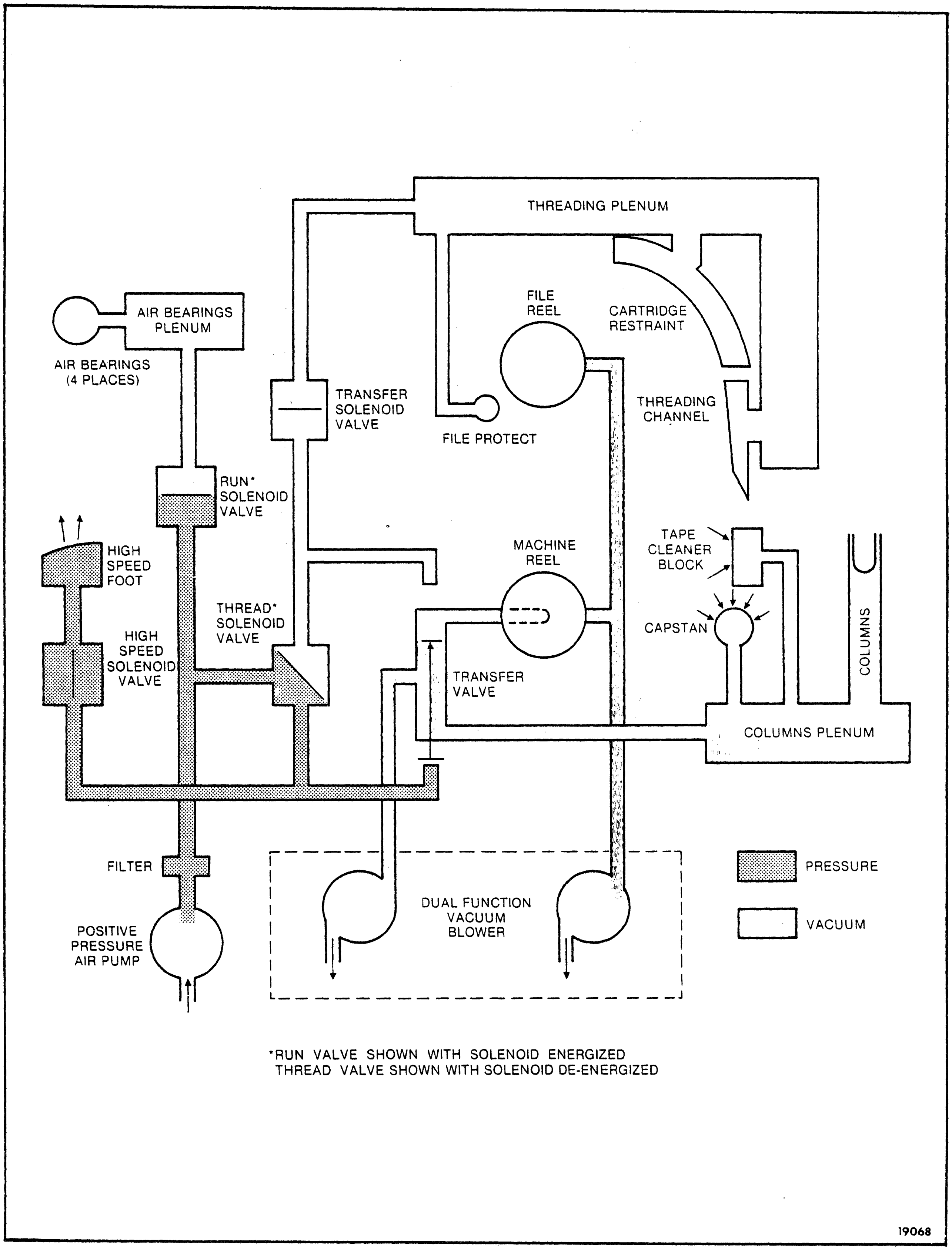


Figure 4-23. Load Pneumatics

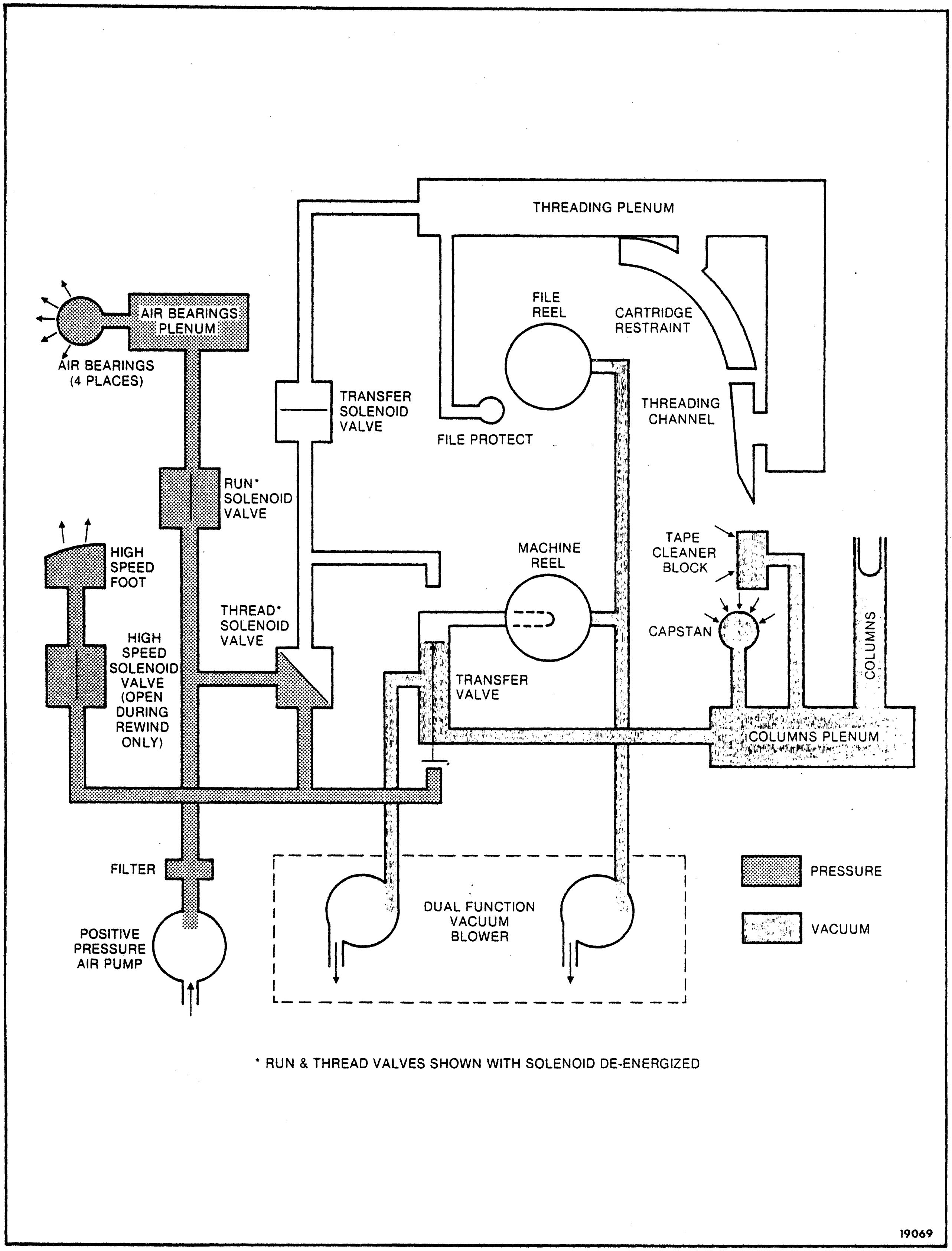


Figure 4-24. Run and Rewind Pneumatics

4.9.1.3 Run Operation

When a run operation (Figure 4-24) is initiated, the run solenoid is de-energized to open the valve to the air bearings pressure plenum. Air pressure is directed from the plenum through tubing to the air bearings where it escapes to provide an air cushion for the tape at strategic points in the tape path.

During a high speed rewind operation, the high speed solenoid is energized to open the valve in order to apply air to the high speed foot. The foot is forced out into the tape path to hold tape away from the read/write head. The air pressure escapes from the face of the foot providing an air cushion that holds tape away from the foot itself.

4.9.1.4 File Protect Switch

The file protect switch monitors the back pressure in the file protect air pressure supply line. If a write enable ring is installed in the tape reel, there is a higher pressure in the supply line than there is when the air is able to flow out through an empty write enable ring groove, that is, when a write enable ring is not installed. The switch sends the back pressure level signal to the control logic.

4.9.1.5 Cartridge Present Switch

The cartridge present switch monitors the back pressure in the air pressure supply line to a point on the left-hand cartridge restraint. A high back pressure indicates that a cartridge, rather than an open tape reel, is installed and this information is sent to the control logic. With no cartridge, the control logic will direct the file reel to turn forward (CW) to thread the end of the tape leader into the threading path.

4.9.2 VACUUM

Vacuum, provided by the dual function blower, is routed through the tubing on the left side of the frame weldment to both reel motors in order to provide reel motor cooling at all times when the pneumatics system is powered up. Vacuum provided by the blower and routed directly to the vacuum transfer valve is switched between threading and loading operations.

During a threading operation the transfer valve directs vacuum to the machine reel hub in order to capture the tape leader. During columns loading and run operations the transfer valve directs vacuum to the columns vacuum plenum. This plenum supplies vacuum to the columns and also, through tubing, to the capstan wheel and the tape cleaner.

4.9.2.1 Leader Sense Switch

When a threading operation is initiated, the vacuum provided to the machine reel is also directed to the tape leader sense port in the threading channel. If an open tape reel is installed, as the file reel turns backward (CCW), this vacuum pulls the tape leader from the reel and the leader covers the port thus increasing the vacuum pressure in the port vacuum supply line. The rotating file reel soon pulls the end of the leader from the port and the vacuum pressure in the port vacuum supply line drops. The leader sense switch in the port vacuum supply line detects these changes in vacuum pressure and signals the control logic. The control logic interprets the drop in vacuum pressure following the rise in vacuum pressure as the position of the tape leader end. The control logic permits the file reel to turn backward another quarter turn and then commands the file reel to turn forward (CW) in order to thread the end of the tape leader into the threading path.

If a tape cartridge is installed, the leader sense switch is effectively disabled by the presence of the cartridge but the cartridge present switch signals the control logic to perform the cartridge present sequence to thread the tape leader.

4.9.2.2 Machine Reel Loaded Switch

During a tape threading operation, when the vacuum provided at the machine reel hub has drawn the tape end to the hub and tape has wrapped around the hub, the tape itself stops air flow through the hub. Sealing the hub increases the vacuum within the pneumatic duct to the hub. The machine reel loaded switch detects this change in vacuum and signals the control logic that the threading operation is complete. The control logic initiates the load operation by changing the position of the vacuum transfer valve to remove the vacuum from the machine reel hub and apply it to the vacuum columns.

When a mid-tape load is initiated, the machine reel loaded switch indicates that tape is wrapped on the reel but vacuum is not transferred to the columns until the reels have established full control of the tape. The machine reel remains stationary as the file reel turns counterclockwise, pulling tape out of the columns. When all tape is removed from the columns, the tape activates the tension switch located below the read/write head. At this time the file and machine reels turn clockwise to ensure a positive wrap on the machine reel. Only then is vacuum transferred to the columns and the columns loaded. When the columns are loaded, the tape is searched backward for BOT.

4.9.2.3 Column Vacuum Sensors

Each of the two column vacuum sensors monitor the tape loop position within a vacuum column. During a load operation, as the vacuum in the columns draws the tape into the columns, the tape itself, as it travels past the row of small vacuum ports down the inside of the columns, causes column vacuum to change. The change in column vacuum is monitored by the column sensors to provide analog tape loop position information to the reel servo system.

During a run operation the sensors continue to monitor the tape loop positions as a function of the vacuum levels. This information is sent to the microcontroller in order to maintain the loops in the center of the columns.

4.9.2.4 Column Loaded Switches

The two column loaded switches are vacuum differential detectors. Each switch monitors two points in a vacuum column: a point near the top of the column and a point near the bottom. When tape is in a column, there is a difference in the vacuum level at these two points. During the tape loading operation the switches signal the control logic when the tape loops are into the columns. The reel servo is activated when the tape is in both columns.

During run operations, the column loaded switches function as tape safety monitors. They look for a difference in air pressure between the two points each monitors in the columns. An extreme position of the tape loop in a vacuum column (either 'topped out' or 'bottomed out') negates the pressure difference between the two monitor points. When this occurs, the associated column loaded switch sends a signal to the control logic to interrupt normal operation and stop tape motion immediately.

4.10 COOLING

Vacuum provided by the pneumatics supply is used to draw cool air through the two reel motors. This vacuum is routed through the tubing of the left side of the frame weldment itself. This vacuum is also routed through the upper left tubing of the weldment to the vacuum plenum located above the heat sinks of the reels servo power amplifier JH card and the capstan servo power amplifier JP card. Here again the vacuum is used to draw cool air through the heat sinks.

CHAPTER 5

MAINTENANCE

5.1 INTRODUCTION

This chapter provides information in the following areas:

- Preventive Maintenance
- Maintenance Test Panel
- Adjustment and Alignment

Preventive Maintenance includes those procedures to be performed by trained personnel. (Maintenance performed by the operator is covered in Chapter 1.)

The capabilities and operation of the internal maintenance test panel are described and descriptions of the available maintenance programs are provided.

The Adjustment and Alignment Procedures provided in this chapter are to be done at initial installation, periodically thereafter to ensure proper operation, and at times when the tape unit does not perform according to specifications. Should there be a defective part, Chapter 6 provides instructions for changing all field replaceable parts.

5.2 PREVENTIVE MAINTENANCE

Daily cleaning and maintenance to be performed by the operator is described in Chapter 1. The following is the routine preventive maintenance to be performed by trained personnel.

5.2.1 MONTHLY MAINTENANCE (INSPECTION AND CLEANING)

1. With power off, check file reel hub for free operation. Thoroughly clean as necessary.
2. With power disconnected, inspect pneumatics drive belt for folds or cracks and replace belt if defective. (Refer to Section 6.7.2 for replacement procedure.)
3. Remove and clean the double hump guide and air bearing guide components. (Refer to Sections 6.3.8 and 6.3.9 for removal procedures.) Inspect the double hump guide and ceramic flanges for undue wear.
4. Remove cleaner block. (Refer to Section 6.3.5 for removal procedures.) Thoroughly clean the block with transport cleaning fluid. Check block for damage in the form of scratches or grooves in the cleaner surface and replace block if damaged. Ensure vacuum holds tape against cleaner after installation.
5. With power on, check cooling fan for proper operation.

6. Check file protect mechanism for proper operation.
7. Check rewind for proper operation. Check rewind time. Check for stagger wrap on the file reel after the rewind operation.
8. Check high speed rewind foot for proper operation.
9. Run all tape unit diagnostics.

5.2.2 QUARTERLY MAINTENANCE (ADJUSTMENTS)

1. With power disconnected, check pneumatics drive belt tension and adjust as necessary. (Refer to Section 5.4.2 for procedure.)
2. With power on, check power supply output levels and adjust as necessary. (Refer to Section 5.4.1 for procedure.)
3. Check pneumatics operating levels and adjust as necessary. (Refer to Section 5.4.3 for procedure.)
4. Illuminate each operator panel indicator and verify that both lamps under each lens is operating. Replace defective lamps by removing the JJ card to gain access to the indicator lamps.
5. Check EOT/BOT sensor adjustment and adjust as necessary. (Refer to Section 5.4.4 for procedure.)
6. Check reel servo operating levels and adjust as necessary. (Refer to Section 5.4.5 for procedures.)
7. Check capstan velocity and ramp. (Refer to Section 5.4.6 for procedure.)
8. Inspect tape path for proper tracking. (Refer to Section 5.4.7.1 for detailed procedure.
9. Check read/write head for proper alignment and adjust skew as necessary. (Refer to Sections 5.4.8 and 5.4.9 for procedures.) (These checks are crucial if capstan realignment was required in the preceding step.)
10. Check read output amplitudes. (Refer to Section 5.4.10 for procedures.)

5.2.3 SEMIANNUAL MAINTENANCE

1. Replace the pneumatics pressure pump input air filter. The input filter has a replaceable foam core which is accessed by snapping off the plastic lid of its container.
2. Replace the pneumatics output air filter. This is a canister filter with a replaceable core which is accessed by unscrewing the body of the canister from the lid. Then unscrew the core for removal.

5.3 MAINTENANCE TEST PANEL

On the JJ/JJ2 card in the logic card cage is a manual entry maintenance test panel (see Figures 5-1A and 1B). The panel serves as an offline maintenance tool. It can be used to condition the tape unit for the performance of adjustment procedures and as an aid in troubleshooting.

Operation of the tester has been kept simple by minimizing the number of controls. There are two 3-position, center-off, toggle switches: the first, Maintenance Start/Reset is used to initiate, cycle through, or reset a maintenance program; Forward/Backward, is used to select the direction of the capstan.

There are two sets of eight miniature rocker (or DIP) switches. The Maintenance Control switches include the three Program Select switches that are used to select a specific maintenance program. The Write Bits/Reel Control switches are used to select reel control codes when the reels test program is selected and also to select write bits during a write test. Note that the parity write bit switch is one of the Maintenance Control switches. The ON position of a DIP switch is regarded as a logical ONE; the OFF position, a logical ZERO.

Eight LED indicators display various maintenance test information as described in the following procedures. If a machine check is detected during normal tape operations, these indicators display a machine check code (refer to Appendix A).

5.3.1 TEST PANEL OPERATION

5.3.1.1 Read Test Procedure

To read tape using the test panel, place the tape unit offline, set Maintenance Control write/read switch to the OFF position, select the appropriate density by setting Maintenance Control density switches (D1 and D0) according to the scheme defined in Table 5-1 and press the Forward/Backward switch to the desired tape direction.

Table 5-1. Density Selection

DENSITY	MAINTENANCE CONTROL SW D1	D0	WRITE PATTERN
NRZI	0	1	800 frpi
PE	1	0	3200 frpi
GCR	1	1	9042 frpi

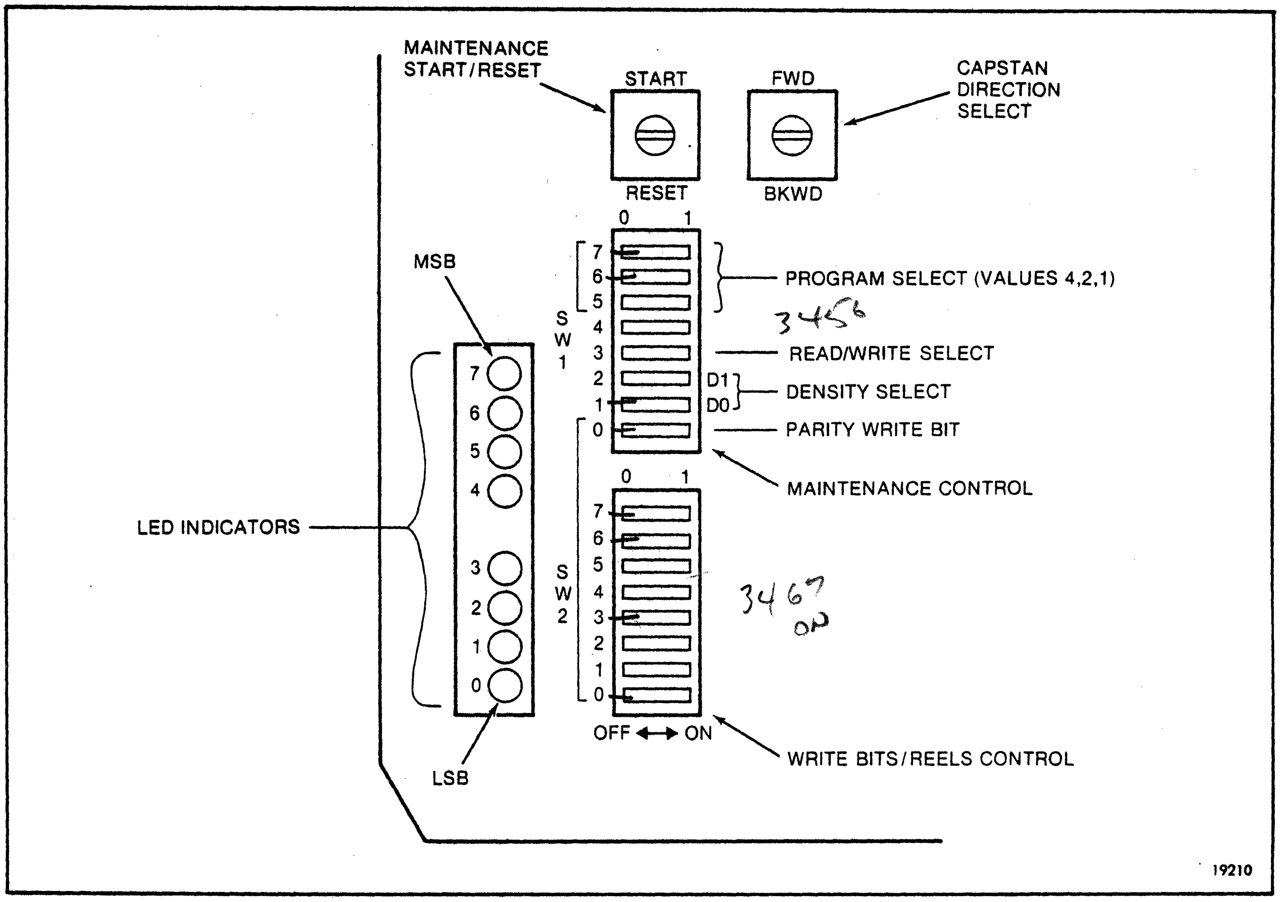


Figure 5-1A. Maintenance Test Panel on JJ2 Card

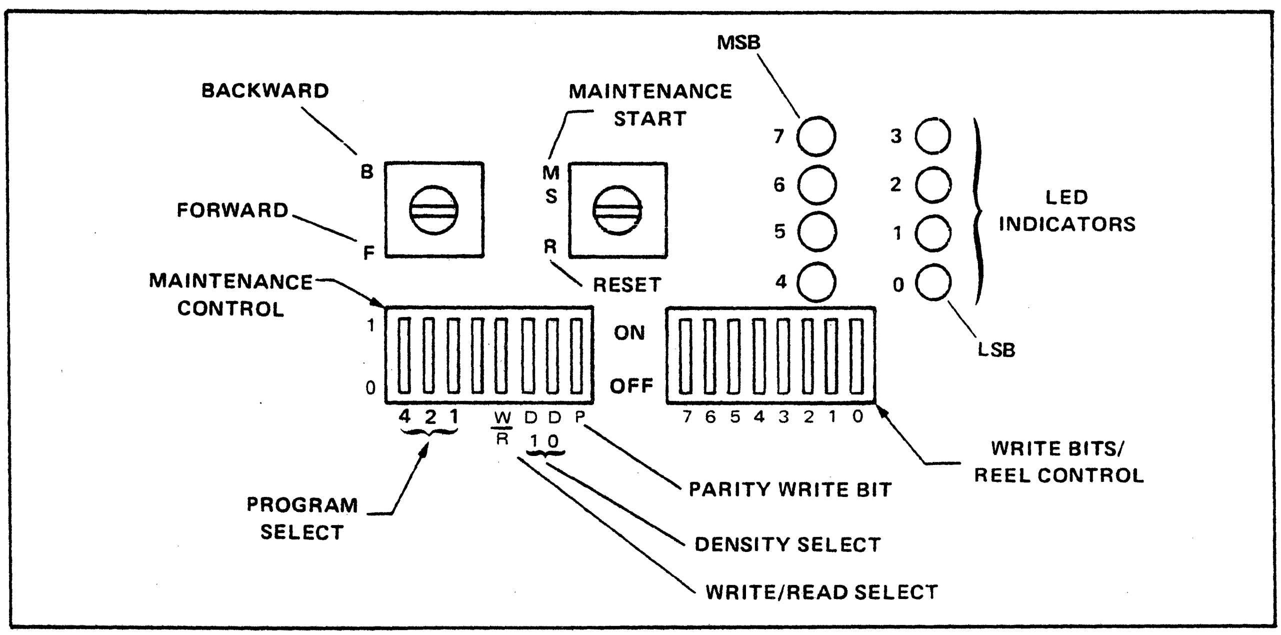


Figure 5-1B. Maintenance Test Panel on JJ Card

5.3.1.2 Write Test Procedure

To place the tape unit in the write mode using the test panel, place the tape unit offline, set Maintenance Control read/write switch to the ON position, and select the desired recording density by setting Maintenance Control density switches (D1 and D0) according to the scheme defined above for the Read Test. Use the nine Write Bit switches to select the tracks for recording. Ensure that the tape is not file protected and press the Forward/Backward switch to FORWARD. The LED indicators display the numbers of the tracks being recorded. Each track is recorded at the maximum flux reversal rate for that density (GCR = 9042 frpi; PE = 3200 frpi; NRZI = 800 frpi).

5.3.1.3 Maintenance Program Procedure

To utilize the test panel to perform one of the special maintenance programs described below in Section 5.3.2., place the tape unit offline and load or unload tape as required by the program. Enter the program number in binary form in the three Program Select switches. Actuate the Maintenance Start switch and the program begins. Use the Forward/Backward switch to select tape or capstan direction.

To halt any routine, press either the test panel Reset switch or the RESET switch on the operator panel.

The selection of an undefined test program results in a no-op.

5.3.2 MAINTENANCE PROGRAMS

5.3.2.1 Pneumatics Test/Program 0, Without Tape Loaded

Actuating the Maintenance Start switch a number of times brings up various pneumatics conditions (refer to Table 5-2). The cycle is repetitive but the program may be exited at any time by actuating the Reset switch. The number of switch actuations, and thus the state of the pneumatics, is displayed on the LED indicators.

Table 5-2. Pneumatics Test Program

MAINTENANCE SWITCH ACTUATION (TIMES)	PNEUMATICS CONDITION	RUN* VALVE SOLENOID	THREAD VALVE SOLENOID	TRANSFER VALVE SOLENOID	HIGH SPEED VALVE SOLENOID
1	THREAD	ON	ON	ON	OFF
2	LOAD	ON	OFF	OFF	OFF
3	RUN	OFF	OFF	OFF	OFF
4	REWIND	OFF	OFF	OFF	ON

* The Run Valve is a normally open valve; when the solenoid is energized, air flow to the air bearings is shut off.

5.3.2.2 **Reels Test/Program 1, Without Tape Loaded**

Actuating the Maintenance Start switch initiates reel motion according to the scheme provided in Table 5-3. Note: Rewind speeds are not possible using this program.

Table 5-3. Reel Control Selection

REEL REG BIT	RTN BIAS	MTR GND	FILE C	REEL B	BITS A	MACH C	REEL B	BITS A
REEL CNTL SW	7	6	5	4	3	2	1	0
NULL	X	X	1	1	0	1	1	0
FORWARD	X	X	0	0	0	0	0	0
BACKWARD	X	X	0	1	0	0	1	0

5.3.2.3 **Capstan Test/Program 4, Without Tape Loaded**

Actuating the Maintenance Start switch energizes the EPO relay to enable the capstan. Capstan motion is initiated when the direction is selected by actuating the Forward/Backward switch: forward for capstan motion counterclockwise (CCW), backward for capstan motion clockwise (CW).

5.3.2.4 **PROM EC Level/Program 5, Without Tape Loaded**

Actuating the Maintenance Start switch displays, on the LED indicators, the EC level of the microcontroller PROMs. The first actuation displays a hexadecimal F and the first (most significant) digit of the EC number. A second actuation displays the second and third digits of the EC number. A third actuation displays the fourth and fifth (least significant) digits of the EC number.

5.3.2.5 **Test RAM/Program 7, With or Without Tape Loaded**

Actuating the Maintenance Start switch once reads the data stored in address 0 of the RAM and displays this data on the maintenance test panel LED indicators. Subsequent actuation of the switch reads the data stored in subsequent RAM locations until all 16 address locations have been read. Further switch actuation repeats the cycle through the RAM addresses.

When the Maintenance Start switch is actuated and held, the four most significant LED indicators display a hexadecimal F. The four least significant LED indicators display the address location. When the switch is released, the data in that address is displayed. The program may be reset to address 0 at any time by actuating the Reset switch.

Table 3-1 is a map of the RAM locations. Because the number of capstan turns from BOT may be very high, two address locations (Capstan Turns Counter Low and Capstan Turns Counter High) are required to contain the capstan turns count.

5.3.2.6 **Start-Stop/Program 0, With Tape Loaded**

Actuate the Maintenance Start switch and then use the Forward/Backward switch to select tape direction. Go Up and Go Down intervals are 5 milliseconds each.

5.3.2.7 **Shoeshine/Program 1, With Tape Loaded**

Actuating the Maintenance Start switch initiates the shoeshine routine. If Reel Control switch 0 is OFF, tape motion intervals are approximately 400 milliseconds forward and 275 milliseconds backward with pauses of approximately 140 milliseconds. If Reel Control switch 0 is ON, tape motion intervals are decreased to approximately 280 milliseconds forward and 140 milliseconds backward with pauses of approximately 16 milliseconds. When EOT is reached, tape automatically rewinds to BOT and the shoeshine routine automatically restarts.

5.3.2.8 **Capstan Velocity/Program 2, With Tape Loaded**

Actuate the Maintenance Start switch and use the Forward/Backward switch to select capstan direction. The results of the capstan velocity measurement are displayed on the LED indicators according to the scheme defined in Table 5-4. There is no capstan velocity adjustment.

Table 5-4. Capstan Velocity Indication

LED	7	6	5	4	3	2	1	0	
CORRECT	1	1	1	1	1	1	1	1	(FF)
FAST	1	1	1	1	0	0	1	1	(F3)
SLOW	1	1	1	1	0	0	0	0	(F0)

5.3.2.9 **Capstan Ramp/Program 3, With Tape Loaded**

Actuate the Maintenance Start switch and use the Forward/Backward switch to select capstan direction. The results of the ramp speed measurement are displayed on the LED indicators according to the scheme defined in Table 5-4 for Capstan Velocity. There is no capstan ramp adjustment.

5.3.2.10 **Write Feed-Through/Program 4, With Tape Loaded**

Actuating the Maintenance Start switch causes an all ones data pattern to be written in the tracks defined by the Write Bit switches. There is no tape motion. Data is written in the current density. Density switches D0 and D1 do not affect this program.

5.4 ADJUSTMENT AND ALIGNMENT

The following adjustment and alignment procedures are to be performed periodically (quarterly) to ensure the precise operation of the tape unit. They are referenced in the Quarterly Maintenance checks. Adjustments that need to be performed only when encountering specific problems or when replacing parts are provided as a part of the removal and replacement procedures (Chapter 6).

5.4.1 POWER SUPPLY CHECKS AND ADJUSTMENTS

The power supply output voltage levels should be checked with the ac input voltage level at nominal. Tape should be loaded but not in motion.

The power supply has four adjustable voltage outputs: +5, +15, -15 and -5 volts. There is no sequence in which the voltages must be adjusted. Be aware that the +15 and -15 volts can be adjusted into a limit condition, in which case the power supply must be turned off for approximately 2.5 minutes in order to reset. The maladjusted voltage adjustment must be backed off (CCW) before power is reapplied. (Before applying power to a replacement regulator card, turn all adjustment pots fully counterclockwise.)

Check the voltage levels shown in Table 5-5 (except -5 volts) at any card slot of the card cage motherboard (MBD) and adjust as necessary. Adjusting the +15 volts will change the +45 volt outputs. Refer to Figures 5-2A and 2B for the adjustment locations. Figure 5-2C is a diagram of the motherboard at the back of the logic card cage. Use any ground (GND) pin on the motherboard.

Table 5-5. Adjustable Power Supply Outputs

VOLTAGE	TEST POINT	ADJ	MAX RIPPLE
+5 (±0.1)	MBD Pin A1	R3	50 mV P-P
+15 (±0.3)	MBD Pin A20	R21	150 mV P-P
-15 (±0.3)	MBD Pin A22	R27	150 mV P-P
-5 (±0.1)	MBD H2 Pin A24	R33	50 mV P-P

The +26 and -26 volts (from which the +15 and -15 volt outputs are derived) can be checked on the HX (JV) card at TP 4 and TP 7, respectively. They are non-adjustable and unregulated but should be within 21 to 30 volts.

The +10 and -10 volts (from which the +5 and -5 volt outputs are derived) can be checked on the HX (JV) card at TP 1 and TP 10, respectively. They are non-adjustable and unregulated but should be within 9 to 15 volts.

The Standby voltage output is not adjustable. Check it on the HX (JV) card at TP 14 for +18 (±4) volts.

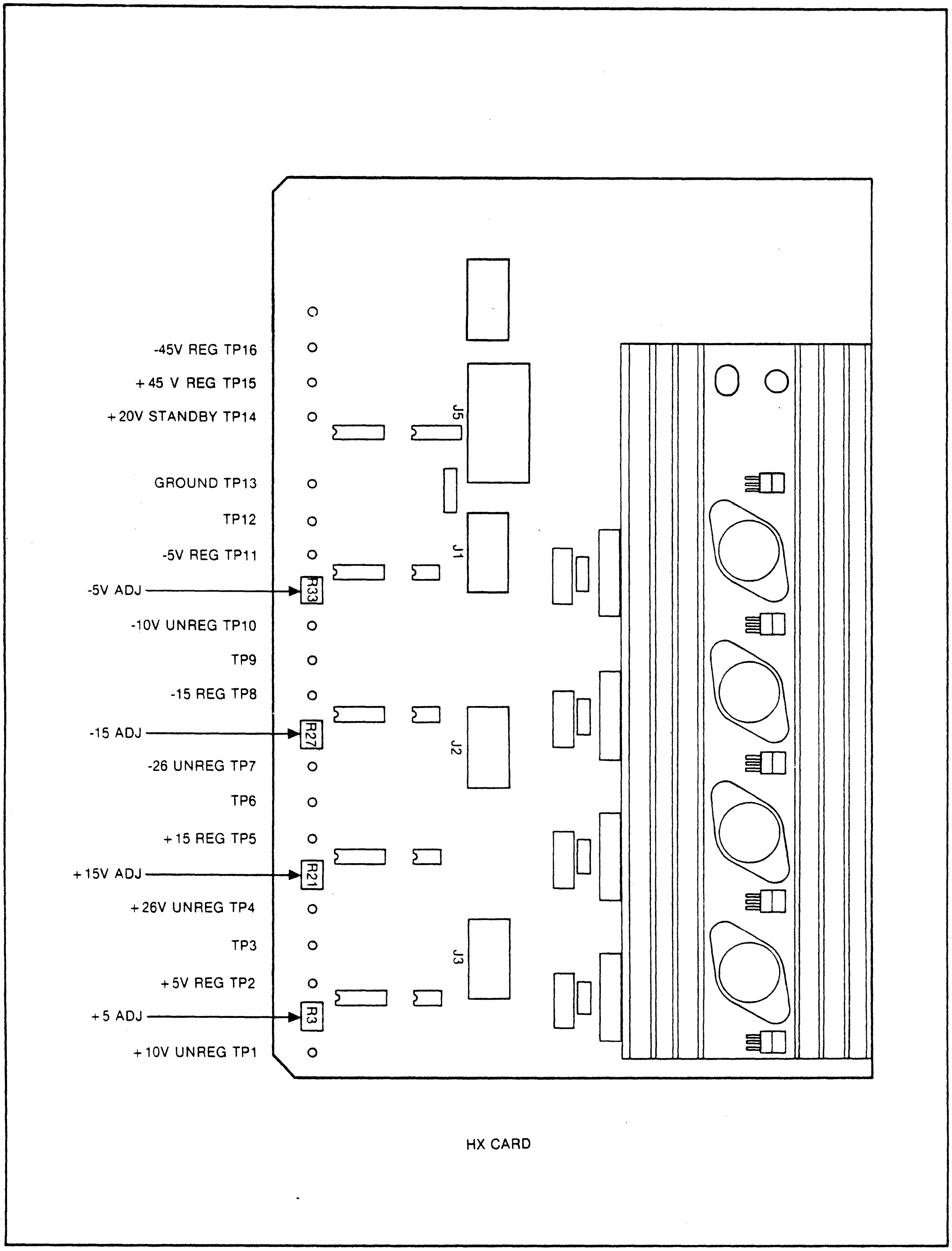


Figure 5-2A. Power Supply Test Points and Adjustments on HX Card

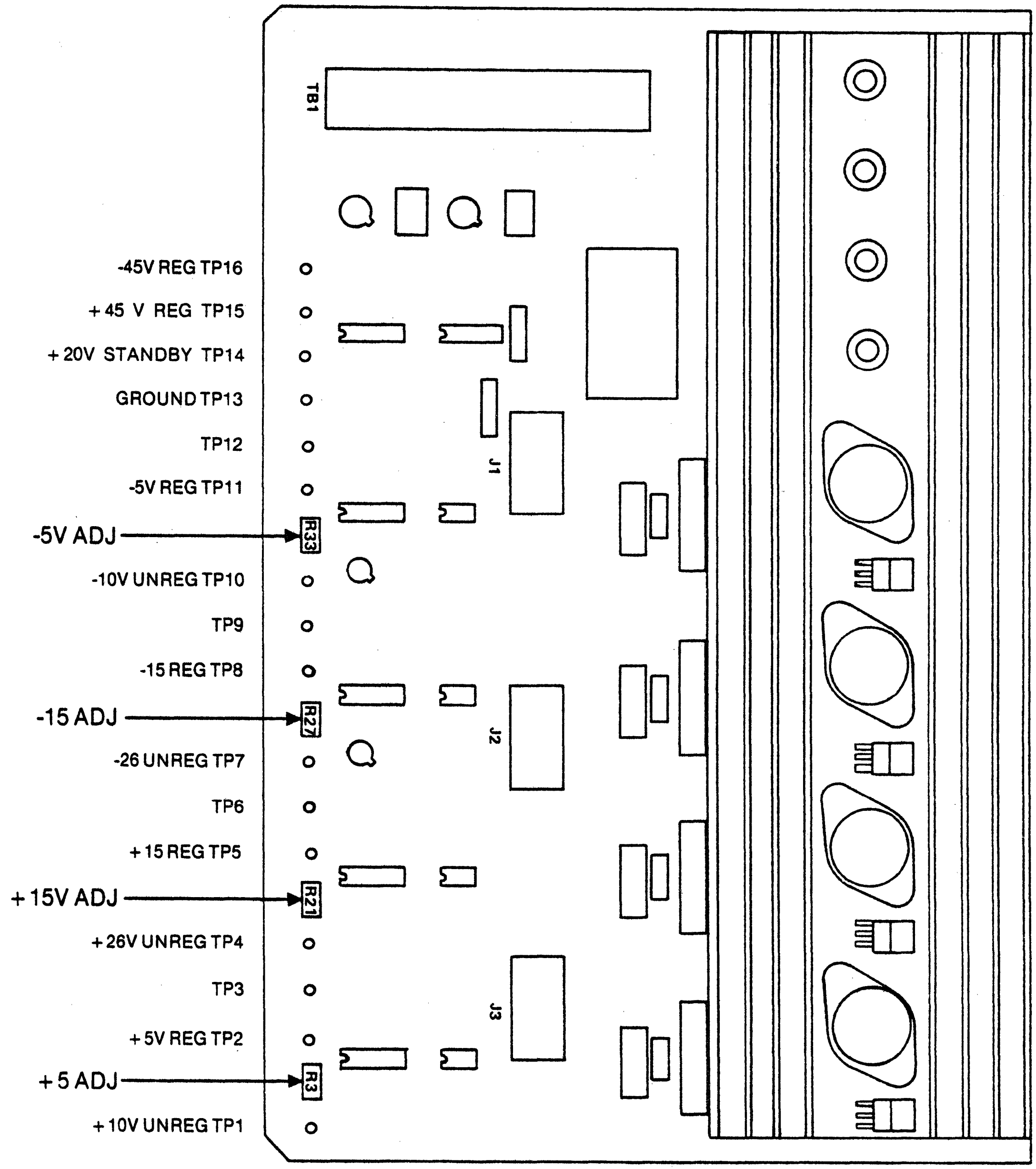
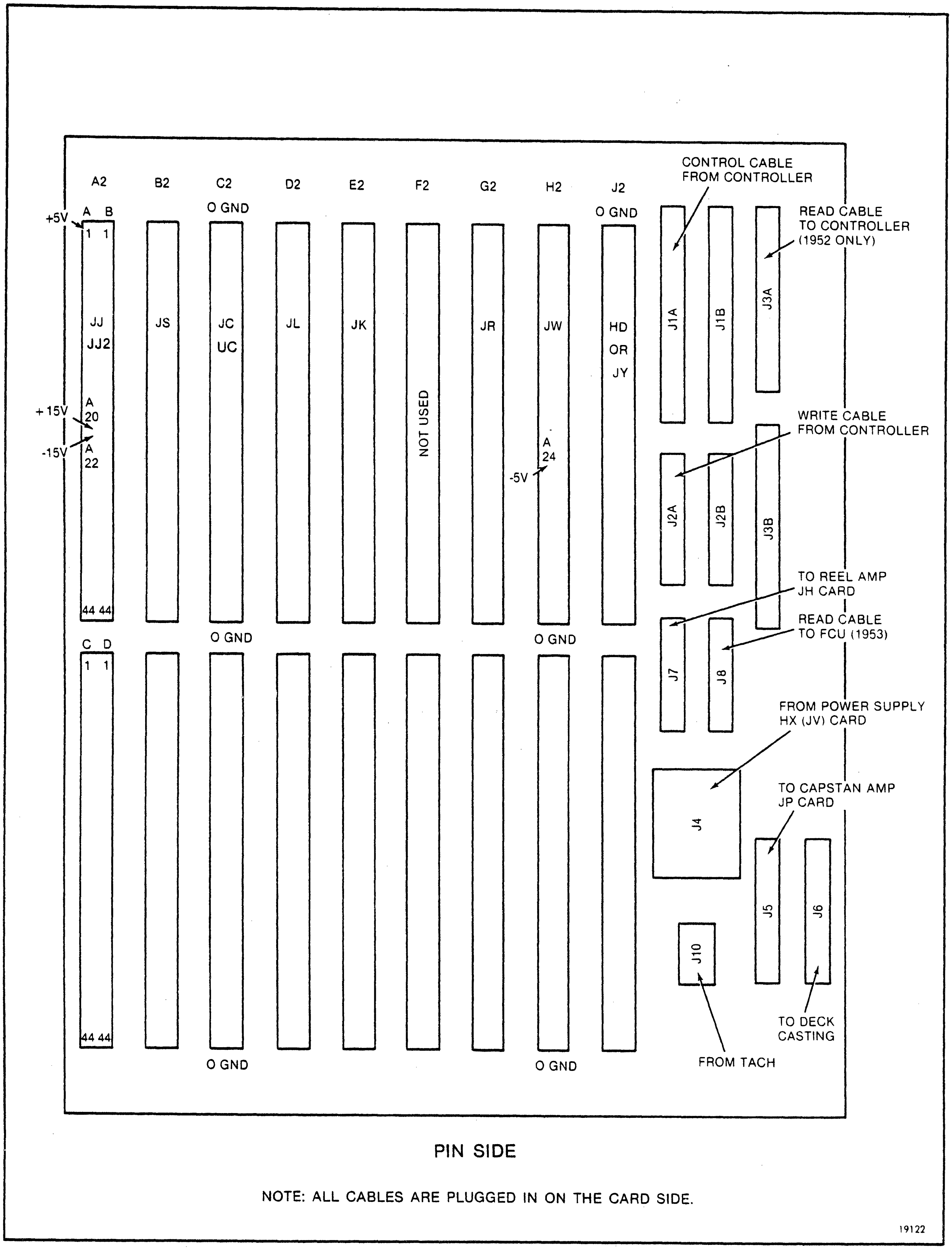


Figure 5-2B. Power Supply Test Points and Adjustments on JV Card



NOTE: ALL CABLES ARE PLUGGED IN ON THE CARD SIDE.

Figure 5-2C. Card Cage Motherboard (Rear View)

The +45 and -45 volts are non-adjustable power supply outputs that are used to drive the reel motors. Check them on the HX (JV) card:

+45	(±5)	HX (JV) TP 15
-45	(±5)	HX (JV) TP 16

The +35 and -35 volts are non-adjustable, unregulated power supply outputs that are used to drive the capstan motor. To monitor these voltages, remove connector P2 from the JP card and check them on the connector plug.

+35	(±7)	P2-6
-35	(±7)	P2-4

The following +5 and -5 volts are derived on the JS card from the +15 and -15 volt power supply outputs and are not adjustable:

+5	(±0.1)	MBD B2 Pin A19	50 mV max ripple
-5	(±0.1)	MBD B2 Pin A24	50 mV max ripple

5.4.2 PNEUMATICS DRIVE BELT TENSION ADJUSTMENT

1. Disconnect power from tape unit.
2. Remove the six screws securing the pneumatics belt guard to the pneumatics assembly mounting bracket.
3. Place a tension meter (STC PN 0157) on the pneumatics drive belt as shown in Figure 5-3.
4. The tension meter indication should be 14 to 16 pounds on each of the two belts.
5. To adjust the belt tension, loosen, but do not remove, the three capscrews securing either the vacuum blower mounting plate or pressure pump mounting plate, as appropriate (see Figure 5-4). Use the appropriate tension screw to adjust the belt to the proper tension and tighten the capscrews to secure the mounting plate. Recheck the belt tension.
6. Install the pneumatics belt guard.

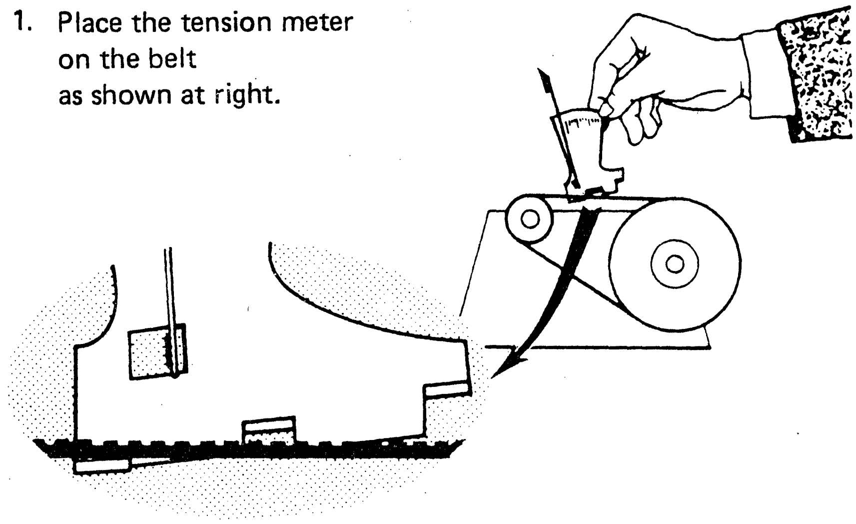
5.4.3 PNEUMATICS LEVELS ADJUSTMENT

In the following pneumatics levels adjustment procedures, refer to Figure 5-5 for the locations of the test points and adjustments on the back of the deck casting.

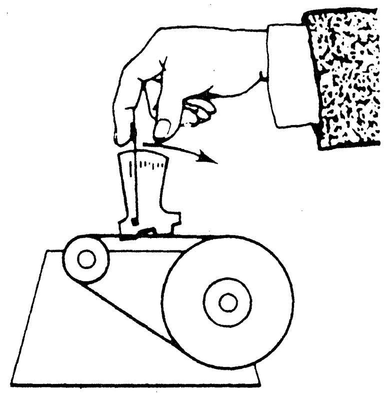
5.4.3.1 Run Pneumatics

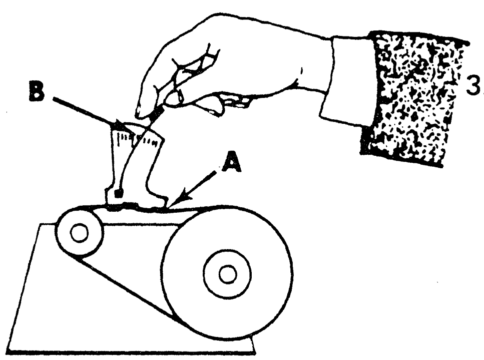
1. Column Vacuum. Perform this adjustment with tape loaded in the columns and tape stopped at BOT. Connect a slack tube manometer or Magnehelic gauge at the column vacuum test point. The vacuum level at the test point should be 40 (±1) inches of water pressure.

1. Place the tension meter on the belt as shown at right.



2. With the forefinger on the spring tip, pull the spring in the direction shown at right.





3. When the right hand tab of the tension meter just touches the top of the belt (A), read the belt tension (on the left edge of the spring) in pounds on the scale (B).

Figure 5-3. Belt Tension Meter

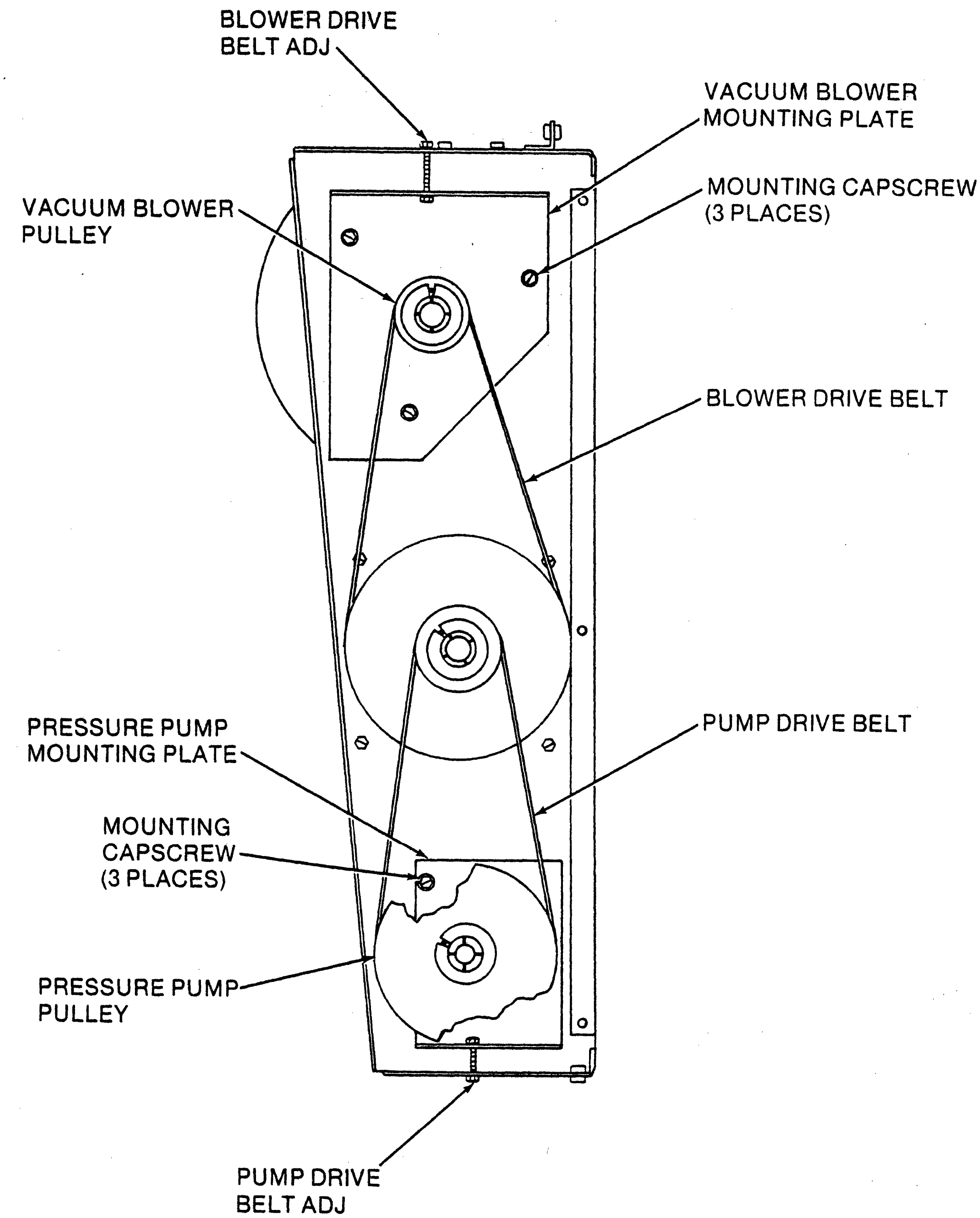


Figure 5-4 . Pnuematics Drive Belt Tension Adjustment

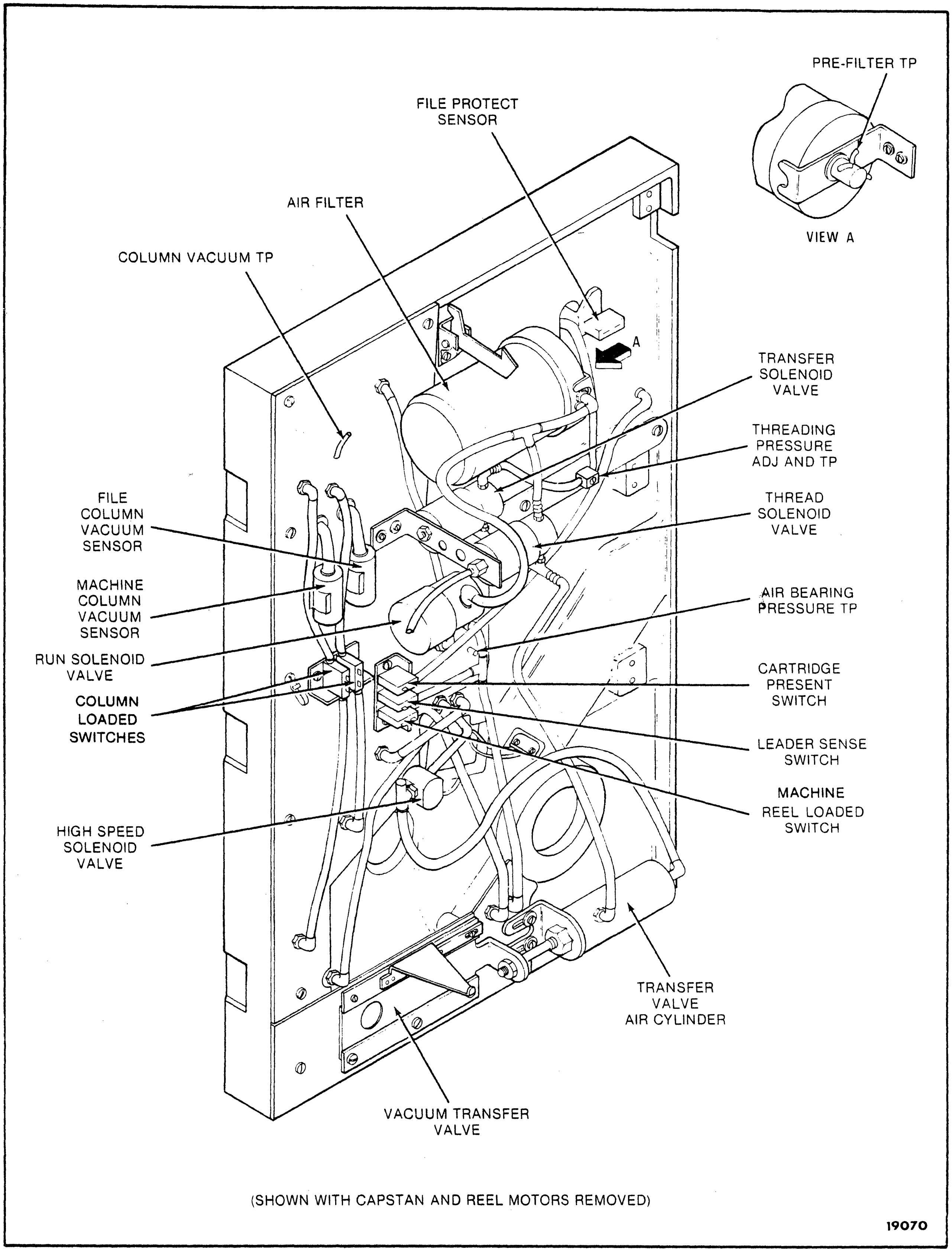


Figure 5-5. Pneumatics Components Locations

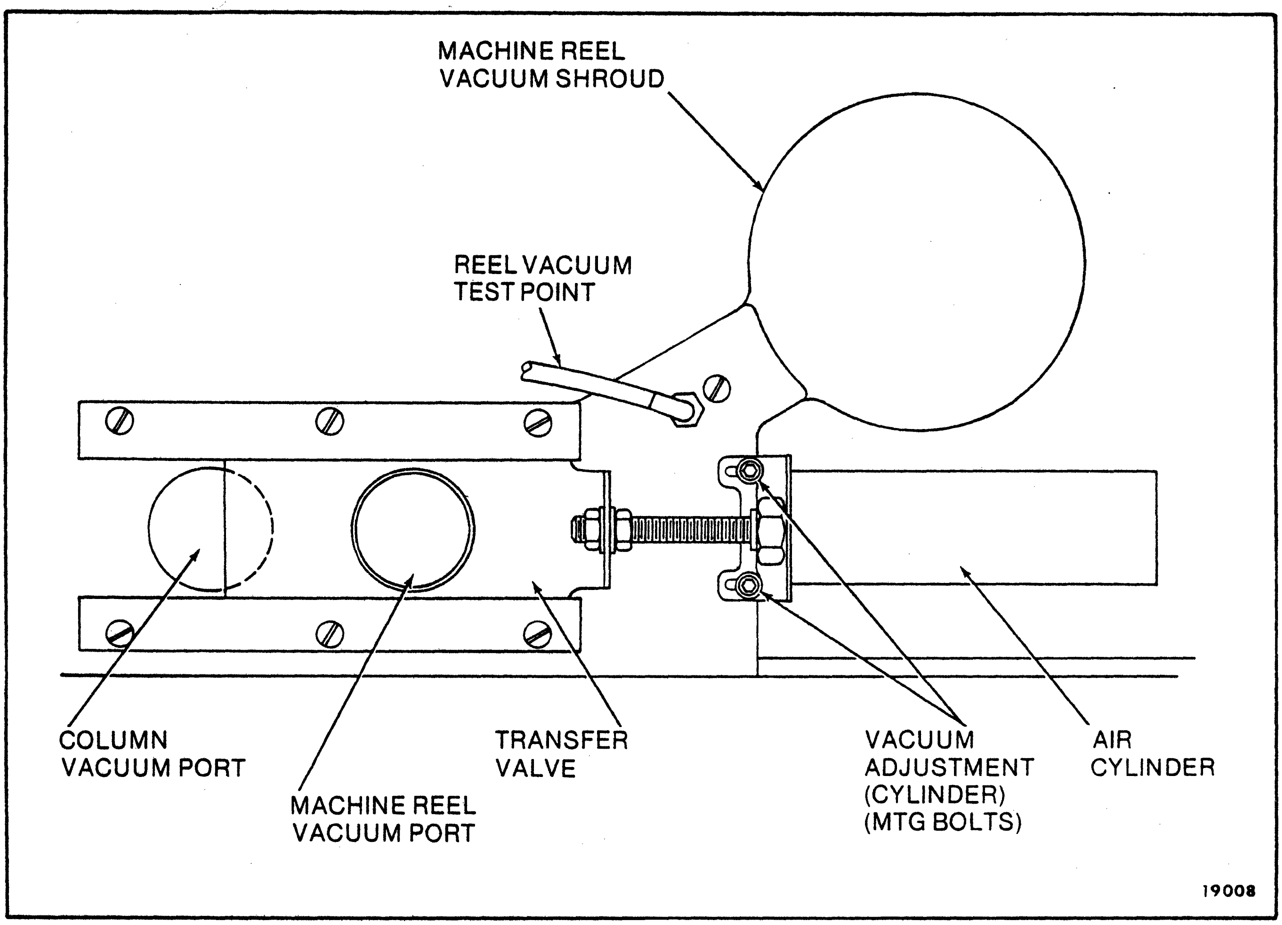


Figure 5-6. Transfer Valve Adjustment

To adjust the vacuum level, loosen the transfer valve air cylinder mounting bolts (see Figure 5-6). Slide the air cylinder laterally to increase or decrease the amount of transfer valve aperture over the column vacuum port, as necessary. Tighten the cylinder mounting bolts with the cylinder in the new position and recheck the vacuum level. Check transfer valve alignment and freedom of movement.

2. Air Bearing Pressure. Perform this adjustment with tape still loaded in the columns and tape stopped at BOT. Install the manometer or Magnehelic gauge at the air bearing pressure test point. The pressure level at the test point should be a minimum of 65 inches of water pressure. The level is not adjustable.

If the pressure level is low, the pressure level may be checked, for troubleshooting purposes, ahead of the air filter at the test point shown in view A of Figure 5-5. The pressure at this test point is typically 90 to 98 inches of water.

5.4.3.2 Thread Pneumatics

1. Threading Pressure. Use maintenance program 0, without tape and with no cartridge installed, and bring up the thread pneumatics condition by actuating the maintenance Start switch once. Connect a manometer or Magnehelic gauge at the threading adjustment test point. Adjust the threading pressure valve for a pressure level of 25 (± 1) inches of water at the test point.

2. Machine Reel Hub Vacuum. Continue to use maintenance program 0, without tape, in the thread pneumatics condition. Remove the tubing from the machine reel loaded sensor to use as a test point for the manometer or Magnehelic gauge. The vacuum level at the test point should be 27 to 33 inches of water without tape wrapped on the machine reel; a minimum of 45 inches of water with tape wrapped on the machine reel.

   If the vacuum level is not within tolerance, refer to Section 6.5.4 for the adjustment procedure.

5.4.3.3 Pneumatics Switches

The pneumatics switches are factory set and resetting the switching levels should not be attempted in the field. Table 5-6 shows the correct settings of the pneumatics switches and the pneumatics levels each switch monitors. To troubleshoot, verify the pneumatics levels by attaching a manometer or Magnehelic gauge in place of the questionable switch. Replace the switch if it is not correctly set.

Table 5-6. Pneumatics Switch Settings

SWITCH	SETTING (Inches H_2O)	PNEUMATIC LEVELS AT SWITCH (Inches H_2O)
File Protect PN 00000201	0.5	Minimum pressure with write ring = 1 Maximum pressure without write ring = 0
Cartridge Present PN 10076120	8	Minimum pressure with cartridge = 12 Maximum pressure without cartridge = 2
Leader Sense PN 10076158	20	Minimum vacuum with leader present = 30 Maximum vacuum with no leader = 18
Machine Reel Loaded PN 10076165	38	Minimum vacuum with tape = 45 Maximum vacuum without tape = 33

5.4.4 EOT/BOT SENSOR ADJUSTMENT

Perform these EOT/BOT sensor adjustments without tape in the threading channel. Refer to Figures 5-7A and 7B for the locations of the test points and adjustments on the JJ (or JJ2) card.

1. Connect an oscilloscope channel 1 to TP BA on the JJ/JJ2 card and connect channel 2 to TP EA. Set vertical scale to 1 volt/division and horizontal scale to 1 millisecond/division.
2. If the EOT/BOT assembly has the tape-not-present reflector as an integral part of the assembly, skip to step 5.
3. Remove the threading channel, loosen the tape-not-present assembly attachment screw, and slide the plate as close as possible to, but remaining square to, the edge of the threading channel. Tighten the attachment screw and reinstall the threading channel.

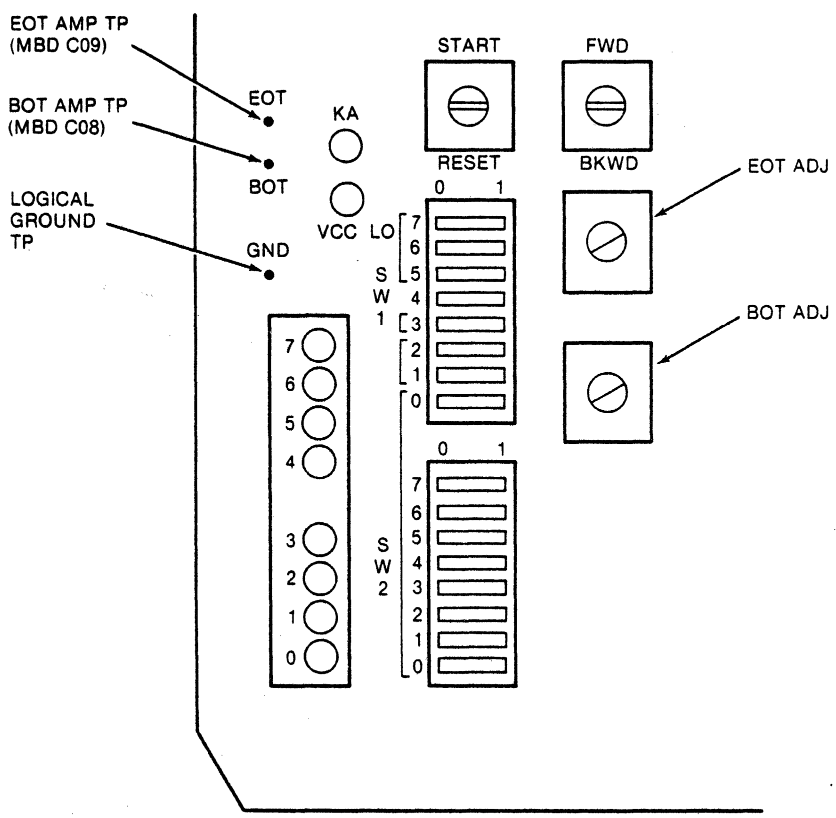


Figure 5-7A. JJ2 Card Test Points and Adjustments

4. Loosen the EOT/BOT sensor block mounting screw and rotate the sensor block to obtain the maximum pulsed signal voltage from both signals. Tighten the sensor block mounting screw to secure the sensor block in this position and ensure that the signal levels have not changed.

5. Adjust the BOT pot until the amplitude of the leading edge of the BOT pulsed signal (channel 1) is 3 (±0.3) volts.

6. Adjust the EOT pot until the amplitude of the leading edge of the EOT pulsed signal (channel 2) is 3 (±0.3) volts.

7. Load a test tape and verify the EOT and BOT sensing operations.

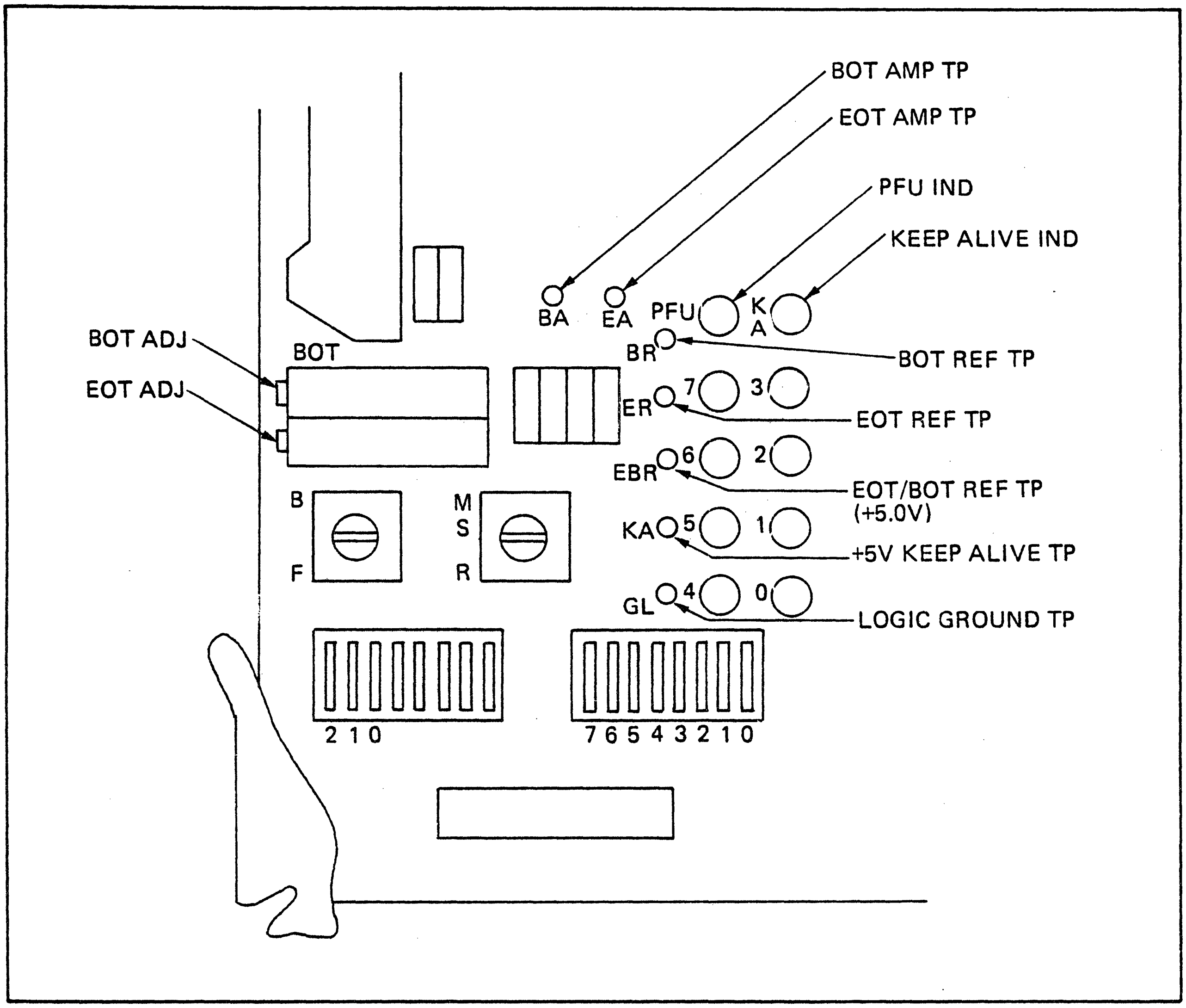


Figure 5-7B. JJ Card Test Points and Adjustments

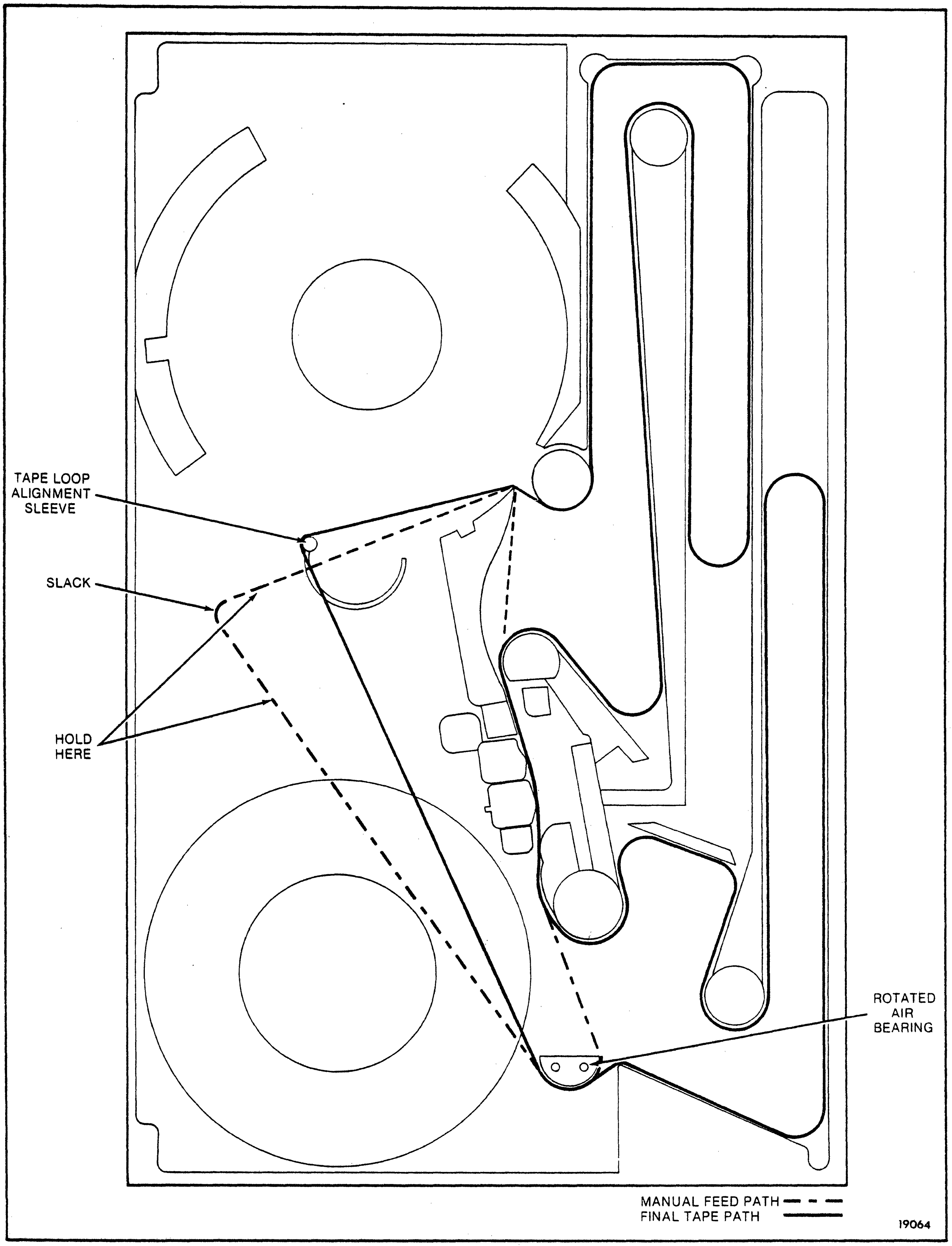


Figure 5-8. Tape Loop Path

5.4.5 REEL SERVO ADJUSTMENTS

In all of the following reel servo adjustment procedures, refer to Figure 5-9A or 9B for the locations of the test points and adjustments. Figure 5-9A shows the older JH card; Figure 5-9B shows the new JH card.

5.4.5.1 Preliminary Reels Null Adjustment

1. Use maintenance test panel program 1 without tape loaded, set the Reel Control switches for a null condition (36 hex), and actuate the Maintenance Start switch.
2. Adjust pot FNA on the JH card until there is no file reel motion.
3. Adjust pot MNA (FNB on the older JH card) until there is no machine reel motion.
4. Proceed to the following Column Vacuum Sensor Adjustment procedure.

5.4.5.2 Column Vacuum Sensor Adjustment

The column vacuum sensor adjustments and the following reel null/gain adjustments may be performed using either a tape loop or a reel of work tape however the set-up procedure is slightly different for each of these.

Tape Loop Set-Up. The tape loop, STC PN 4012191-01, is a 134-inch length of half-inch magnetic recording tape with its ends spliced together. Refer to Figure 5-8 when installing the tape loop.

Condition the tape deck for the tape loop by removing the half-moon air bearing near the machine reel, rotating the bearing a half turn (180 degrees), and securing it in place with its hardware. Slip a tape loop alignment sleeve, STC PN 4012371-01, over the cartridge opener arm.

If the tape loop alignment sleeve is not available, it is still possible to use the 134-inch tape loop. Do not rotate the half-moon air bearing. Loop the tape around the machine reel rather than the cartridge opener arm. The disadvantage of this method is that the tape will creep and require manual holding as the adjustments are made.

Manually thread the tape loop over the top of the threading channel, down through the threading path, and under the rotated half-moon air bearing. With the left hand, hold the tape loop slack like reins to the left of the threading path. Close and secure the column door.

Set maintenance program 0 in the test panel Program Select switches. Actuate the test panel Start switch once to bring up threading pneumatics and once again to bring up loading pneumatics. At this time column vacuum will exert a strong pull on the tape loop. Do not lose control of the tape loop, but carefully allow the column vacuum to feed the tape loop into the columns. Loop the tape around the alignment sleeve on the cartridge opener arm.

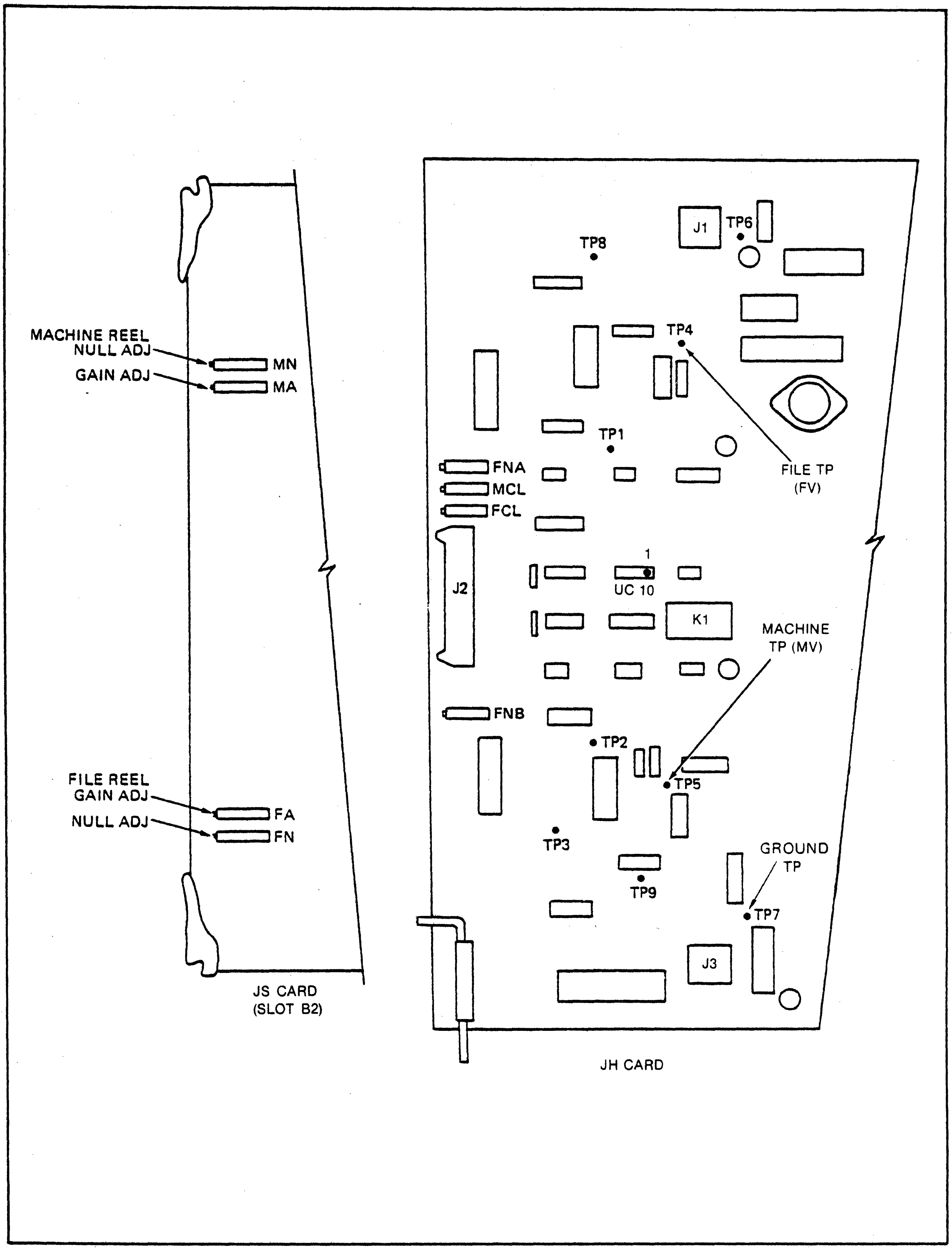


Figure 5-9A. Reel Servo Test Points and Adjustments (Old)

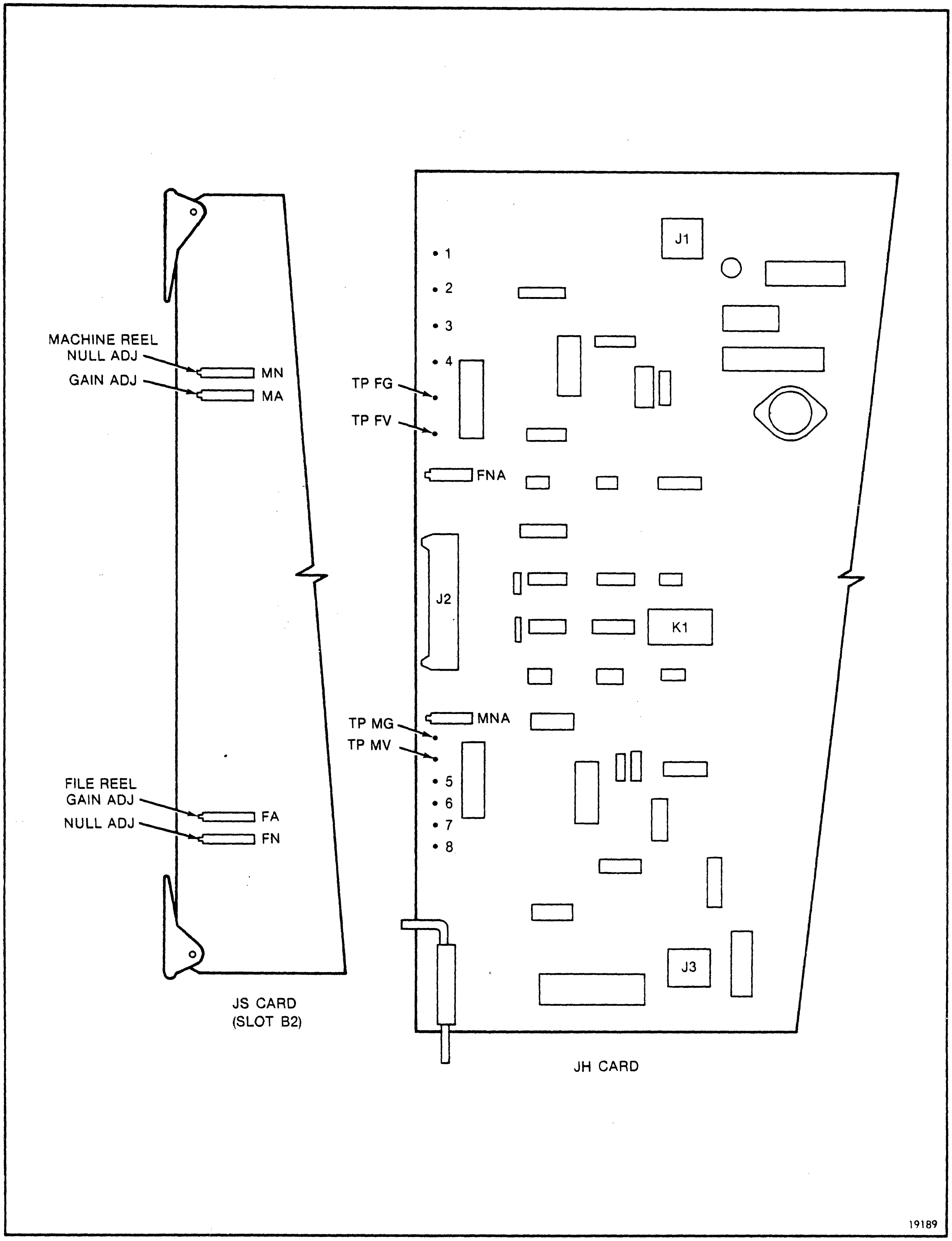


Figure 5-9B. Reel Servo Test Points and Adjustments (New)

Work Tape Set-Up. Mount a reel of work tape. Disconnect the capstan motor and both reel motors at their respective Molex connectors. Set maintenance program 0 in the test panel Program Select switches. Actuate the test panel Start switch once to bring up threading pneumatics. Manually turn the file reel clockwise (CW) to permit the tape to feed through the threading path and wrap several times around the machine reel hub. Actuate the test panel Start switch again to bring up load pneumatics. Manually turn the file reel clockwise (CW) to permit the tape to load into the vacuum columns. Use masking tape to secure each reel to the column door in order to maintain the tape loops in the columns in position.

Procedure.

1. Push and hold the test panel Backward switch in the up position, toggle the Start switch a third time, then release the Backward switch. This brings up the high-gain run pneumatics.

2. Manually position the file column tape loop such that the bottom of the tape loop is level with the center dot on the deck casting column bar.

3. Correct the ground of a voltmeter to any ground pin on the motherboard.

4. Use the voltmeter to monitor the File Reel Sensor signal at pin B2D26 on the motherboard. The voltage at this point should be 0 (±0.2) volts.

5. To adjust the older column vacuum sensor (style A; see Figure 5-10), loosen the fine adjust locking screw on the side of the file column sensor. Adjust the null fine adjustment screw for a null (zero volts). Tighten the locking screw while ensuring that the null is maintained. If the fine adjustment is insufficient, loosen the two coarse adjust locking screws and move the sensor end plate in or out very slightly to vary the fine adjust range as required. Tighten the two locking screws and fine adjust the sensor again.

   To adjust the new column vacuum sensor (style B; see Figure 5-10), adjust the null pot for a null (zero volts).

6. Manually position the machine column tape loop such that the bottom of the tape loop is level with the center dot on the deck casting column bar.

7. Use the voltmeter to monitor the Machine Reel Sensor signal at pin B2B34 on the motherboard. The voltage at this point should be 0 (±0.2) volts.

8. Adjust the machine column vacuum sensor as described in step 5 for the file column vacuum sensor.

9. Proceed to the following File Reel Null/Gain Adjustments.

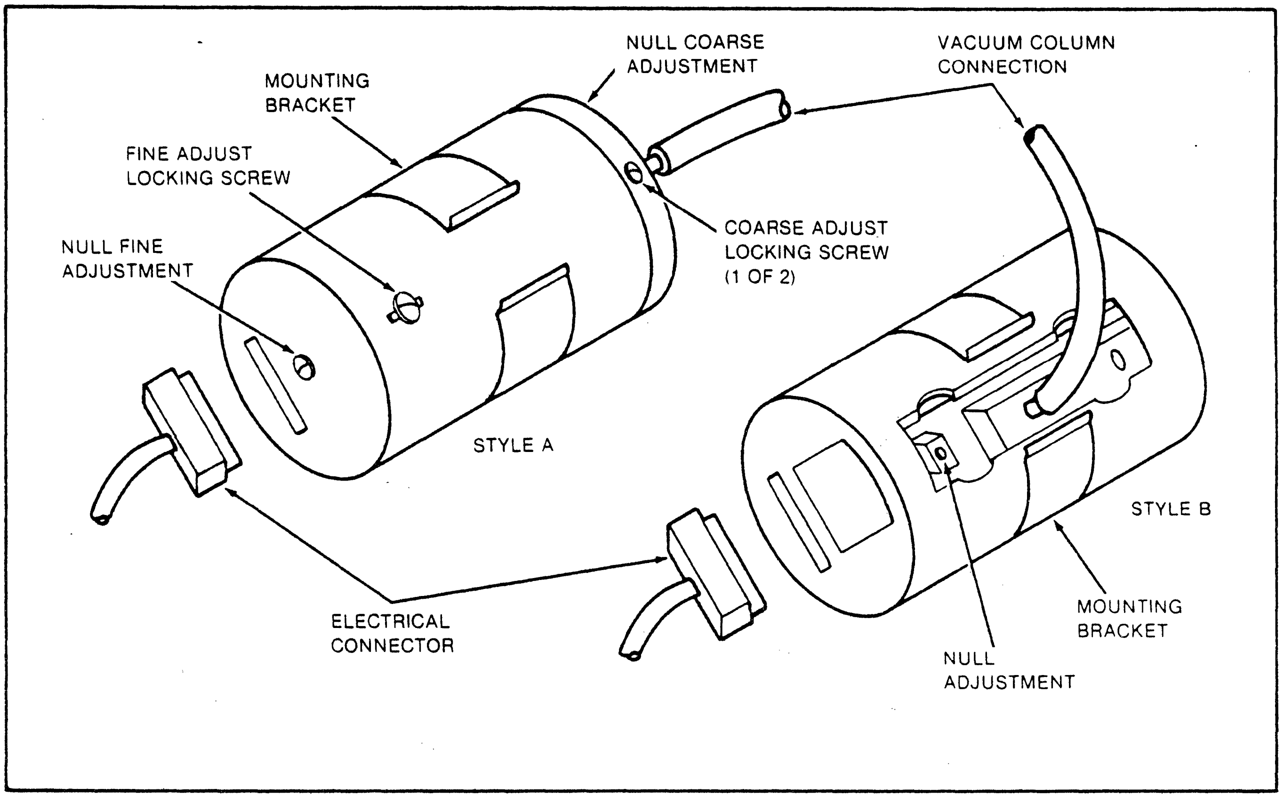


Figure 5-10. Column Vacuum Sensor Adjustment

5.4.5.3 File Reel Null/Gain Adjustments

Continue to use the set-up described in Section 5.4.5.2.

1. Connect the ground of a voltmeter to TP FG on the new JH card (TP 7 on the older JH card).
2. Use the voltmeter to monitor TP FV on the new JH card (TP 4 on the older JH card).
3. Manually position the file column tape loop such that the bottom of the tape loop is level with the center dot on the deck casting column bar.
4. The level at the test point should be 0 ($\pm$0.1) volts. Adjust pot FN on the JS card.
5. Manually position the file column tape loop such that the loop is approximately 1 inch below the upper loop out hole.
6. Adjust pot FA on the JS card for +21 to +22 volts at the test point.
7. Manually position the file column tape loop such that the loop is approximately 1 inch above the lower loop out hole.

8. The level indication at the test point should be a minimum of -21 volts, but not exceed -24 volts. If this level is out of tolerance, repeat steps 5 through 8.

9. Proceed to the following Machine Reel Null/Gain Adjustments.

5.4.5.4 Machine Reel Null/Gain Adjustments

Continue to use the set-up described in Section 5.4.5.2.

1. Connect the ground of a voltmeter to TP MG on the new JH card (TP 7 on the older JH card).

2. Use the voltmeter to monitor TP MV on the JH card (TP 5 on the older JH card). (On the older JH cards, use extreme care when attaching the voltmeter probe to TP 5 to prevent shorting to nearby components.)

3. Manually position the machine column tape loop such that the bottom of the loop is level with the center dot on the deck casting column bar.

4. The level at the test point should be 0 ($\pm$0.1) volts. Adjust pot MN on the JS card.

5. Manually position the machine column tape loop such that the loop is approximately 1 inch below the upper loop out hole.

6. Adjust pot MA on the JS card for +21 volts to +22 volts at the test point.

7. Manually position the machine column loop such that the loop is approximately 1 inch above the lower loop out hole.

8. The level indication at the test point should be a minimum of -21 volts, but not exceed -24 volts. If this level is out of tolerance, repeat steps 5 through 8.

9. If using a tape loop, actuate the test panel Reset switch and remove the tape loop. Remove the alignment sleeve and restore the half-moon air bearing to its proper position.

   If using a work tape, actuate the test panel Reset switch. Manually rotate the machine reel clockwise to pull all tape from the vacuum columns. Reconnect the capstan motor and both reel motors.

5.4.6 CAPSTAN CHECKS

1. To check capstan velocity, use maintenance program 2 with tape loaded (Section 5.3.2.8).

2. To check the capstan ramp speed, use maintenance program 3 with tape loaded (Section 5.3.2.9).

5.4.7 CAPSTAN ALIGNMENT (TAPE TRACKING)

Correct alignment of the capstan assembly ensures that the tape tracks properly across the face of the read/write head. This can be determined by the way the tape tracks across the double hump tape guide. There must be no distortion of tape in the tape channel due to tape creeping up the outer or inner flanges of the tape guide. This procedure also accomplishes coarse skew adjustment.

1. Remove the outside flange from the double hump guide.
2. If the tape unit has NRZI capability: At the back of the deck casting, remove the pneumatics tubing from the high speed foot solenoid that supplies air to the NRZI fitting on the restraint plenum. Attach the tubing to the air bearing pressure test point so that air is supplied to the guides and the ceramic flanges are pushed against the deck. Refer to Figure 5-11.
3. Load a good work tape on the tape unit. Use maintenance program 1 to perform 400 millisecond forward and backward read operations (shoe shine).
4. Ensure that the tape does not make excessive contact with the inner flange of the double hump guide such that tape deformation could occur and that tape does not track over the front edge of the guide. Ensure also that there is no visible tape flutter.

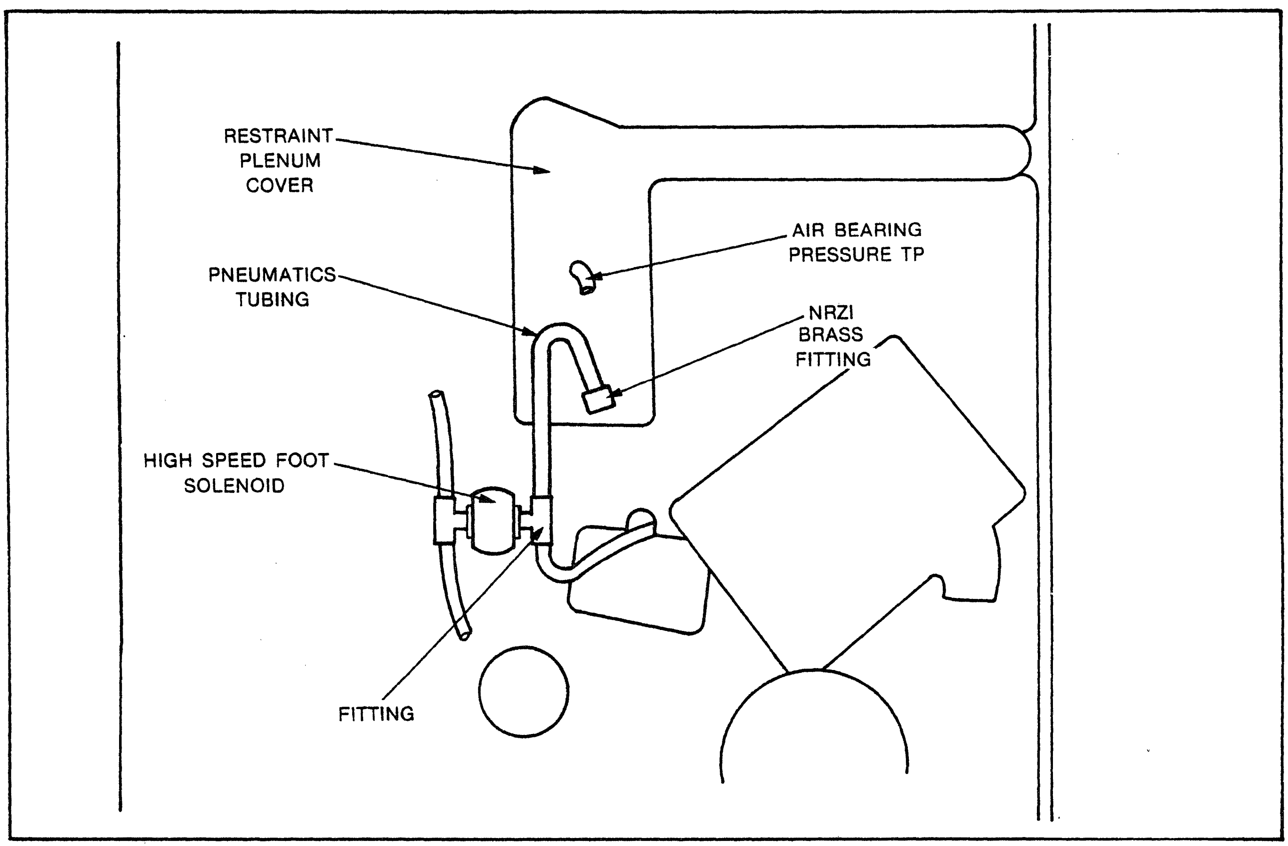


Figure 5-11. NRZI Guides Pneumatics

5. If tracking appears satisfactory, reinstall the outside flange of the double hump guide. Use a dental mirror and flashlight to observe tape tracking under the outside flange. Again ensure that tape does not make excessive contact with the outside flange such that tape deformation could occur. If tape tracking is still satisfactory, restore the pneumatics tubing on the high speed foot solenoid valve fitting and perform the Read/Write Head Alignment procedure (Section 5.4.8).

   If tape tracking is not satisfactory and the capstan setting tool shown in Figure 5-12 is available, proceed to step 6.

   If tracking is not satisfactory and the capstan setting tool is not available, skip to step 18.

6. Unload the work tape and remove power from tape unit.

7. Remove the capstan bar and the components of the double hump guide.

8. Remove the capstan wheel (refer to para. 6.5.1, steps 2 and 3, for the removal procedure).

9. Zero the indicator on the capstan setting tool (STC PN 4015508-01).

10. Mount the capstan setting tool on the capstan motor shaft as shown in Figure 5-12.

11. Turn all three adjustment nuts the same amount until the indicator is again zeroed.

12. Monitor the indicator dial while rotating the motor shaft and indicator through a minimum of 180 degrees of arc. The indicator should show a range of variation no greater than 0.001 inch through the arc. Adjust the capstan motor mounting nuts as necessary.

13. Remove the capstan setting tool from the capstan motor shaft.

14. Reinstall the capstan wheel. (Refer to Section 6.5.1, steps 5 and 6, for the installation procedure.)

15. Reinstall the capstan bar and the components of the double hump guide with the exception of the outer ceramic flange. (Refer to Sections 6.3.12 and 6.3.8 for the installation procedures.)

16. Ensure that the capstan does not rub on the capstan vacuum shroud and that there is at least .009 inches clearance (the thickness of a data card) between the capstan and the capstan bar and double hump guide.

17. Load the work tape and use maintenance program 1 to perform 400 millisecond forward and backward read operations (shoeshine).

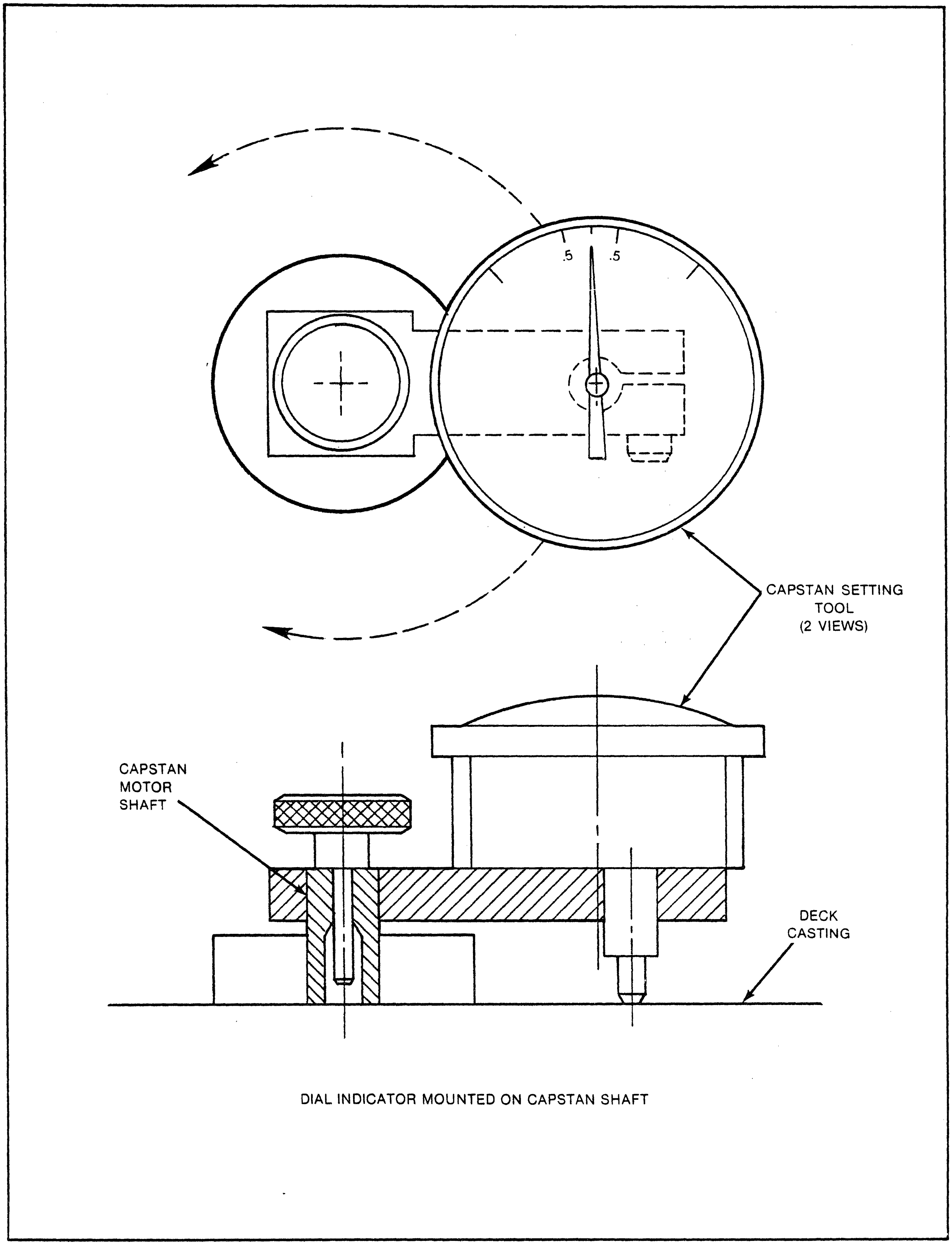


Figure 5-12. Capstan Alignment (Sheet 1 of 2)

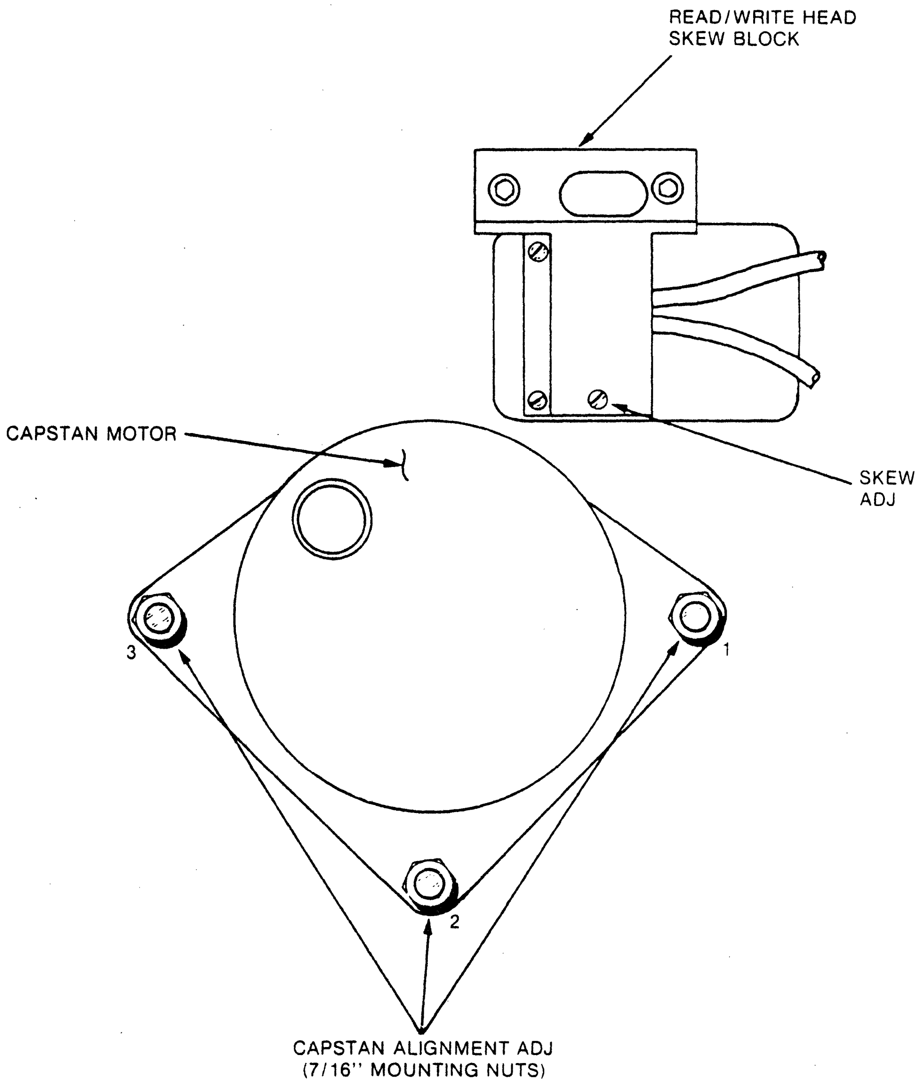


Figure 5-12. Capstan Alignment (Sheet 2 of 2)

18. Check tape tracking and adjust the capstan motor mounting nuts as required (refer to Table 5-7).

19. Tracking is satisfactory when there is no visible tape flutter, the tape does not make excessive contact with the inner flange of the double hump guide such that tape deformation could occur, and the tape does not track over the front edge of the guide.

20. Once tracking is satisfactory, reinstall the outside flange of the double hump guide. Use a dental mirror and flashlight to observe tape tracking under the outside flange. Ensure that the tape does not make excessive contact with the outside flange such that tape deformation could occur.

21. Again ensure that the capstan does not rub on the capstan vacuum shroud and that there is .009 inches clearance between the capstan and the capstan bar and double hump guide.

22. On a NRZI tape unit, restore the pneumatics tubing on the high speed foot solenoid valve fitting.

23. Perform the following Read/Write Head Alignment procedure.

Table 5-7. Tape Tracking Adjustments

CONDITION	ADJUSTMENT
Tape tracks over front edge of tape guide during both forward and backward operation	Turn adjustment nut 3 counterclockwise (CCW) in quarter-turn increments
Tape distortion from excessive contact with rear flange of tape guide during both forward and backward operation	Turn adjustment nut 3 clockwise (CW) in quarter-turn increments
Tape tracks over front edge of tape guide during forward operation	Turn adjustment nut 1 counterclockwise (CCW) in quarter-turn increments
Tape makes excessive contact with rear flange of tape guide during forward operation	Turn adjustment nut 1 clockwise (CW) in quarter-turn increments
Tape tracks over front edge of tape guide during backward operation	Turn adjustment nut 1 clockwise (CW) in quarter-turn increments
Tape tracks over rear edge of tape guide during backward operation	Turn adjustment nut 1 counterclockwise (CCW) in quarter-turn increments

5.4.8 READ/WRITE HEAD ALIGNMENT

For accurate recording and retrieval of data, the alignment of the read/write head is extremely important. For NRZI-coded data, the alignment is critical.

5.4.8.1 Mechanical Read Skew Adjustment and Measurement

1. Disconnect the write head cable plug (P8) from the HD card edge connector.

2. Load a master skew tape without a write enable ring. The skew tape should comply with STC skew tape specification 4611. Ideally this tape has all tracks written in perfect alignment. (Never high speed rewind a master skew tape.)

3. If the analog read data signals are not accessible elsewhere, such as at the 1935 FCU motherboard, disconnect the read data cable plug (P22) from the read preamp card (JA) to gain access to the analog read data signals at the connector (refer to Figure 5-13).

4. Connect an oscilloscope to the read preamp (JA card) outputs of the two outside tracks (4 and 5). Refer to Figure 5-13. Take care to monitor phase A of both signals. Set scope display mode to chop and both channel polarities to positive. Trigger the scope positive on track 4.

   All of the read/write head alignment measurements and adjustments involve examining the timing relationship between slopes of the analog signals at the AC zero voltage reference point. Set scope display for optimum readout resolution. (Refer to Figure 5-14.)

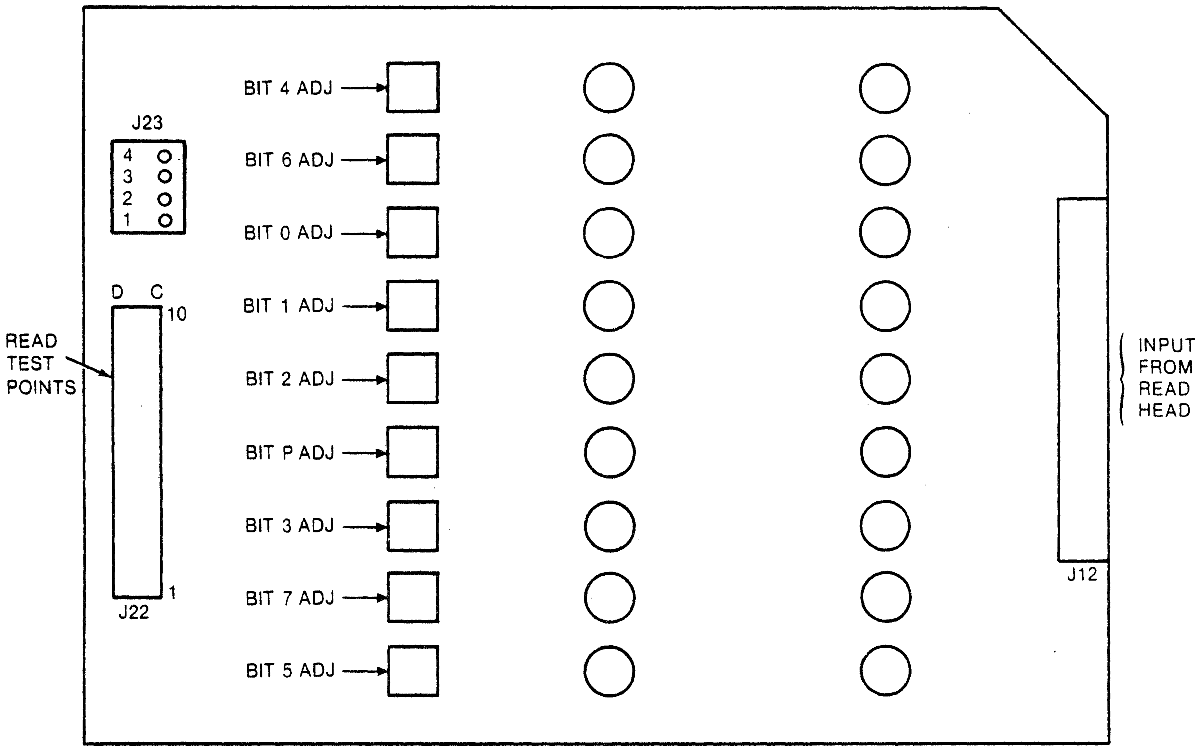
   If the signals are not readily discernible (that is, sinusoidal and approximately 750 millivolts peak-to-peak single-ended signal amplitude, non-clipped), the preamplifier gain should be adjusted by turning the corresponding track potentiometer on the JA card.

5. Set the maintenance test panel Density Select switches to NRZI if the tape unit has NRZI capability. This will engage the NRZI guides. If the tape unit does not have NRZI capability, set the Density Select switches to PE.

6. Read Forward Static Skew Adjustment. Initiate a read forward operation. Use the skew block adjustment screw (see Figure 5-12) to adjust the read/write head until the positive slopes of the two tracks coincide. Track 5 will have some amount of dynamic skew (± timing jitter). Average the jitter to determine the slope measurement point relative to time. Check that alignment is not greater than two bytes by examining the alignment of the other tracks relative to track 4. The positive slope of any other track should coincide with the positive slope of track 4 within the limits of step 7.

J23 PREAMP POWER CONN

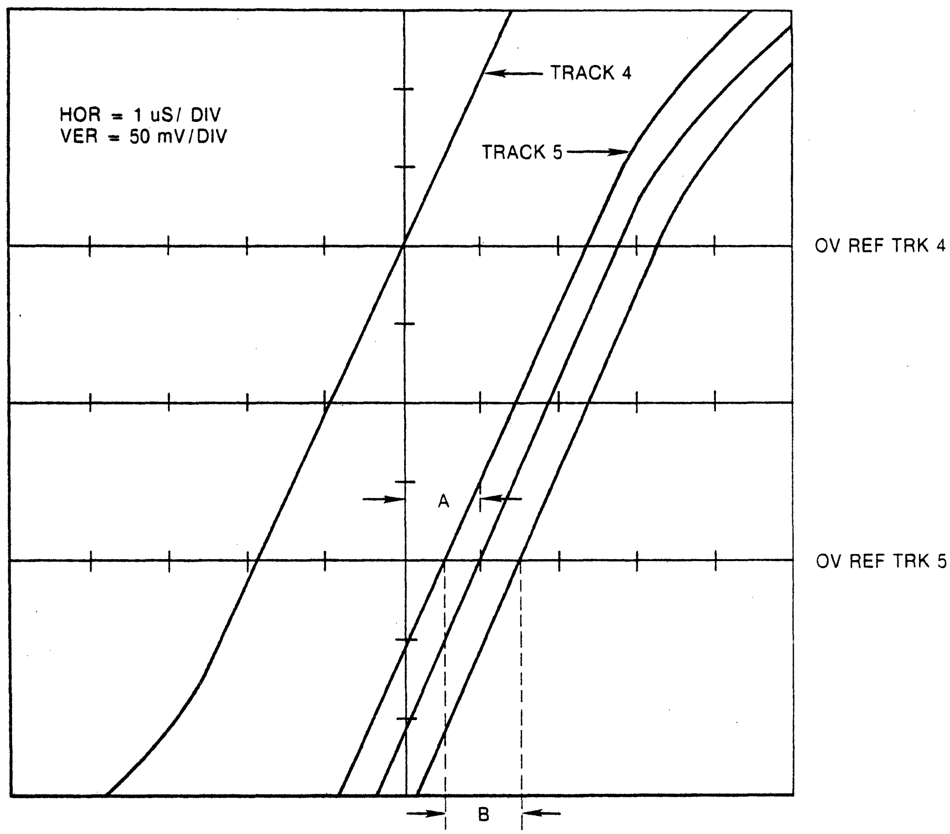
PIN 4	-5V
PIN 3	Not Used
PIN 2	GND
PIN 1	+5V



LOGICAL TRACK (BIT)	5	7	3	P	2	1	GND	0	6	4
PHASE A TEST POINT	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
PHASE B TEST POINT	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10

19240

Figure 5-13. Read Preamp Adjustment Locations (JA Card)



EXAMPLE OF MEASUREMENTS AT 125 IPS:
A = STATIC READ SKEW = 1.0 USEC (5 LAGGING 4)
B = DYNAMIC READ SKEW = 1.0 USEC (JITTER ON 5)

Figure 5-14. Skew Measurements

7. Read Gap Scatter Measurement. Continue the read forward operation. Measure the maximum skew (time difference between the most leading and most lagging positive slopes of phase A of any two tracks). This is most efficiently done by locating the most leading and most lagging track relative to track 4. The maximum skew between these two tracks must be within the tolerance shown below for the rated drive speed. (If these limits are exceeded, the read/write head may require replacement.)

   125 ips skew ⩽ 0.6 microseconds
   75 ips skew ⩽ 1.0 microseconds
   50 ips skew ⩽ 1.5 microseconds

8. PE Read Forward Static Skew Measurement.

   This measurement is only performed when the tape unit has NRZI capability (NRZI guides which are retracted in PE/GCR modes). On non-NRZI tape units, skew will have been adjusted to zero in step 6 in PE mode.

   Set the Density Select switches to PE and continue the read forward operation. The maximum skew between the two outside tracks (4 and 5) must be within the tolerance shown below for the rated drive speed. (If these limits are exceeded, a tape path alignment problem exists.)

   125 ips skew ⩽ 1.8 microseconds
   75 ips skew ⩽ 3.0 microseconds
   50 ips skew ⩽ 4.5 microseconds

9. Read Backward Skew Measurement. Initiate a read backward operation and measure the skew between the two outside tracks (4 and 5). The skew between the two signals must be within the tolerance below for the rated drive speed and tape unit density capability.

   Tape unit with NRZI capability in NRZI mode:

   125 ips skew ⩽ 0.6 microseconds
   75 ips skew ⩽ 1.0 microseconds
   50 ips skew ⩽ 1.5 microseconds

   Tape unit with NRZI capability in PE mode:

   125 ips skew ⩽ 3.6 microseconds
   75 ips skew ⩽ 6.0 microseconds
   50 ips skew ⩽ 9.0 microseconds

   Tape unit without NRZI capability in PE mode:

   125 ips skew ⩽ 1.8 microseconds
   75 ips skew ⩽ 3.0 microseconds
   50 ips skew ⩽ 4.5 microseconds

   If these limits are not obtainable, a tracking (capstan alignment) adjustment may be required. Ideally, with the tape unit in shoeshine operation, an iterative adjustment between the forward static skew (step 6) and the capstan alignment should develop zero forward and backward static skew. (Refer to Section 5.4.7 and use adjustment nut 3 for this purpose.)

10. Read Forward Dynamic Skew Measurement. Initiate a read forward operation and measure the dynamic skew (timing jitter) on track 5 while syncing the scope on track 4. Use the following measurement technique:

    a. Sync the scope on track 5 and measure the timing width of scope trace at AC zero voltage point.

    b. Sync scope on track 4 and measure the total time width (jitter) of track 5 scope trace at AC zero voltage point.

    c. The dynamic skew is equal to the measurement of step b minus the measurement of step a.

    The forward dynamic skew must be within the tolerance shown below for the rated drive speed.

    Tape unit with NRZI capability in NRZI mode: (If these limits are exceeded, a NRZI guide problem may exist.)

    125 ips skew ⩽ 0.6 microseconds
    75 ips skew ⩽ 1.0 microseconds
    50 ips skew ⩽ 1.5 microseconds

    Tape unit in PE mode:

    125 ips skew ⩽ 1.4 microseconds
    75 ips skew ⩽ 2.3 microseconds
    50 ips skew ⩽ 3.5 microseconds

11. Read Backward Dynamic Skew Measurement. Initiate a read backward operation and measure the dynamic skew on track 5 while syncing on track 4. Use the same measurement technique described in step 10. The read backward dynamic skew must be within the tolerance shown below for the rated drive speed.

    Tape unit with NRZI capability in NRZI mode:

    125 ips skew ⩽ 0.9 microseconds
    75 ips skew ⩽ 1.5 microseconds
    50 ips skew ⩽ 2.3 microseconds

    Tape unit in PE mode:

    125 ips skew ⩽ 1.8 microseconds
    75 ips skew ⩽ 3.9 microseconds
    50 ips skew ⩽ 4.5 microseconds

12. Unload, but do not high speed rewind, the master skew tape and reconnect the write head cable plug (P8) on the HD card edge connector.

13. Perform the following Bit Position check procedure.

5.4.8.2 Bit Position Check

1. Reconnect the write data cable plug (P8) on the HD card edge conenctor.
2. Load a reel of blank tape with a write enable ring installed.
3. From BOT, write 3200 frpi (all ONEs in PE format) on a!! tracks for about 10 seconds.
4. Use Magna-See to develop two feet of the recorded tape.
5. Use a magnifier (jeweler's loupe) with a reticle scale to inspect the developed tape. The distance from the edge of tape to the edge of the outside track (track 1) should be 0.007 (±0.003) inches and the distance from the edge of tape to the edge of the inside rack (track 9) should be 0.007 (±0.005) inches. Refer to Figure 5-15.
6. Bit position is set in STC manufacturing; these specifications should be attainable. In case of inability to meet these specifications, the manufacturer should be contacted and STC Field Bill 67535 (EC 44370) may be ordered.
7. Proceed to the following Write Skew Alignment procedure.

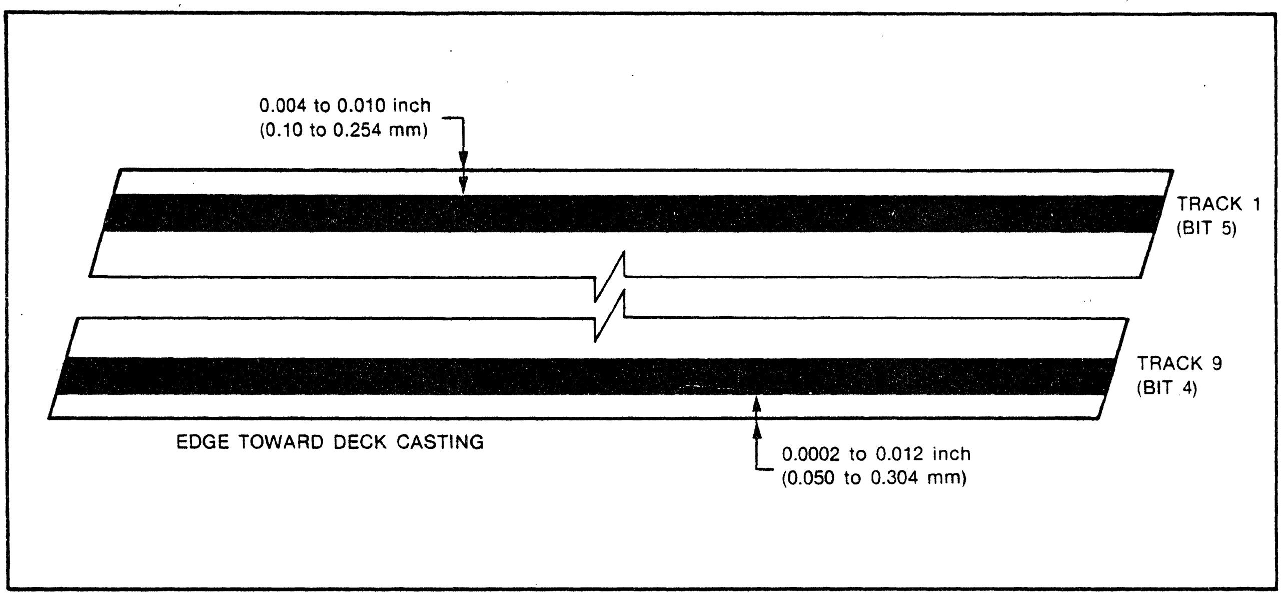


Figure 5-15. Bit Position Check

5.4.9 WRITE SKEW ALIGNMENT

5.4.9.1 Write Static Skew Check

1. Load a scratch tape with a write enable ring installed.
2. Use the maintenance test panel to write all ONEs in PE format on all tracks.
3. Initiate a forward write operation.
4. Use an oscilloscope to monitor the read preamp (JA card) outputs. (Refer to Figure 5-12 for the test point locations.) Measure the maximum skew (time difference between the most leading and the most lagging track). This is most efficiently done by locating the most leading and lagging tracks relative to track 4. The maximum skew must be within the tolerance shown below for the rated drive speed. (If these limits are exceeded, the read/write head may require replacement.)

   125 ips skew ⩽ 1.8 microseconds
   75 ips skew ⩽ 3.0 microseconds
   50 ips skew ⩽ 4.5 microseconds

5. If the tape unit has NRZI capability, proceed to the following Write Deskew Adjustment procedure.

   If the tape unit does not have NRZI capability, perform the Read Amplitude Adjustment procedure (Section 5.4.10).

5.4.9.2 NRZI Write Deskew Adjustment

1. Locate the NRZI deskew adjustment potentiometers. For an analog tape unit (Tri-Density), they are located on the JW card (refer to Figure 5-16A). For a digital interface tape unit (PE/NRZI), they are located on the JY card (refer to Figure 5-16B).
2. Adjust the write deskew pots of all tracks to minimum delay by turning each pot counterclockwise (CCW) 20 turns.
3. Use the maintenance test panel to write all ONEs in NRZI format on all tracks.
4. Initiate a forward write operation.
5. Use an oscilloscope to monitor the read preamp (JA card) outputs. (Refer to Figure 5-12 for test point locations.) Sync the scope on track 4 and locate the most lagging track.
6. Sync the scope on the most lagging track. Adjust the positive slope of all other tracks to coincide with the positive slope of the most lagging track by turning the corresponding write deskew pot clockwise (CW).
7. Perform the following Read Amplitude Adjustment procedure.

READ AMPLITUDE TEST POINTS		
TRACK (BIT)	PHASE A MBD TP	PHASE B MBD TP
4	H2B04	H2B05
6	H2B08	H2B09
0	H2B12	H2B13
11	H2B14	H2B15
2	H2B26	H2B27
P	H2B30	H2B31
3	H2B34	H2B35
7	H2B36	H2B37
5	H2B40	H2B41

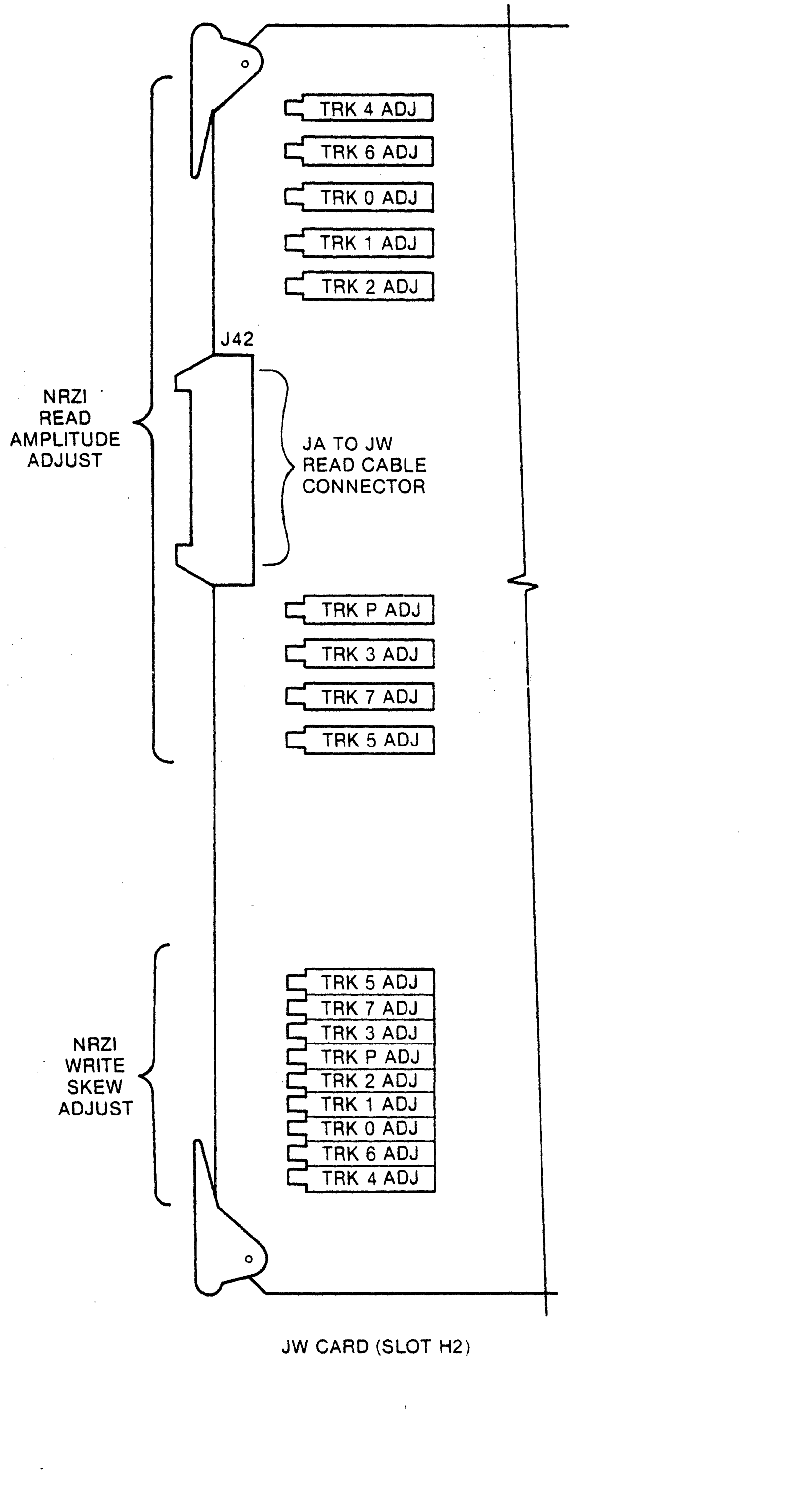


Figure 5-16A. Analog Interface NRZI (1953) Adjustments

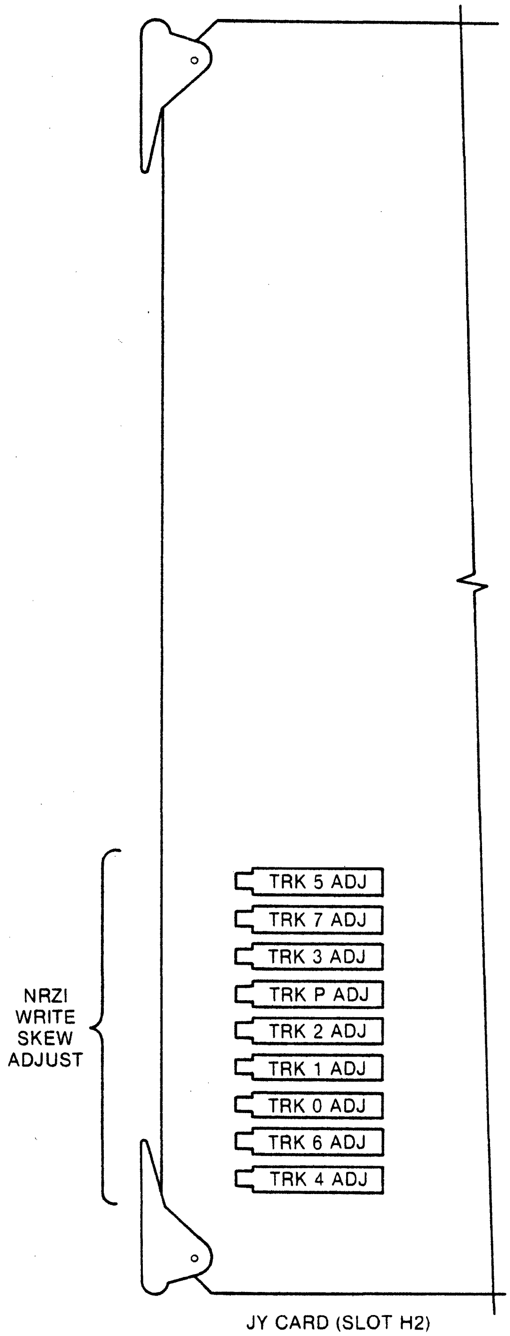


Figure 5-16B. Digital Interface NRZI (1952) Adjustments

5.4.10 READ AMPLITUDE ADJUSTMENTS

The read amplitude adjustment procedures vary with the configuration of the tape unit. Perform the one appropriate procedure for the configuration of the tape unit from the three procedures provided below. For analog read interface, assure each line is loaded with 56 ohms as shown in Figure 3-2. If no load is available, all adjustments and measurements should be 10% higher.

5.4.10.1 1951 (PE/GCR) TU Analog Read Interface

1. Load a standard amplitude tape with a write enable ring installed.
2. Disconnect the write cable from motherboard connector J2A.
3. Use the maintenance test panel to write 3200 frpi (all ONEs in PE format) on all tracks.
4. Use an oscilloscope to monitor the read preamplifier (JA card) outputs. (Refer to Figure 5-12.)
5. Set the signal amplitude of each track to 1.0 volt (measured peak-to-valley differentially) by adjusting the corresponding pot on the JA card.
6. Perform a read backward operation. The PE signal amplitudes should be 1.0 volt (±15%) on all tracks.
7. Write 9042 frpi (all ONEs in GCR format) on all tracks on the same tape.
8. The GCR signal amplitudes at the preamp output should be greater than 300 millivolts on all tracks while writing. (If the outside tracks, 4 or 5, are low, tape may have edge damage.
9. Perform three read passes on the tape.
10. On the third read forward pass, measure the preamp output levels. The amplitude should be 90% or greater of the amplitudes measured in step 8 for each track. (If the read forward amplitude is less than 90%, something in the tape path has become magnetized. Two possibilities are: the write head, if the degauss function is not working; or the tape cleaner blade.)
11. Perform a read backward operation and measure the preamp output levels. The amplitude should be greater than 250 millivolts.
12. The read forward to read backward amplitude ratio on each track should be 0.8 minimum to 1.2 maximum.
13. Reconnect the write cable to motherboard connector J2A.
14. Proceed to the Read/Write Noise Checks (Section 5.4.11).

5.4.10.2 1953 (Tri-Density) TU Analog Read Interface

1. Load a standard amplitude tape with a write enable ring installed.
2. Disconnect the write cable from motherboard connector J2A.
3. Use the maintenance test panel to write 3200 frpi (all ONEs in PE format) on all tracks.
4. Use an oscilloscope to monitor the JW card read output signals. Refer to Figure 5-16A for the test point locations. Use any ground pin on the motherboard.
5. Set the signal amplitude of each track to 1.0 volt (measured peak-to-valley differentially) by adjusting the corresponding pot on the JA card. (Refer to Figure 5-12.)
6. Perform a read backward operation. The PE signal amplitudes should be 1.0 volt (±15%) on all tracks.
7. Write 800 frpi (all ONEs in NRZI format) on all tracks on the same tape.
8. Set the NRZI signal amplitude of each track to 1.5 volts by adjusting the corresponding pot on the JW card. (Refer to Figure 5-16A.)
9. Write 9042 frpi (all ONEs in GCR format) on all tracks on the same tape.
10. The GCR signal amplitudes at the JW card outputs of all tracks should be greater than 300 millivolts. (If the outside tracks, 4 or 5, are low, tape may have edge damage.)
11. Perform three read passes on the tape.
12. On the third read forward pass, measure the JW card output levels. The amplitude should be 90% or greater of the amplitudes measured in step 10 for each track. (If the read forward amplitude is less than 90%, something in the tape path has become magnetized. Two possibilities are: the write head, if the degauss function is not working; or the tape cleaner blade.)
13. Perform a read backward operation and measure the JW card output levels. The amplitude should be greater than 250 millivolts.
14. The read forward to read backward amplitude ratio on each track should be 0.8 minimum to 1.2 maximum.
15. Reconnect the write cable to motherboard connector J2A.
16. Proceed to the following Read/Write Noise Checks.

5.4.10.3 1952 (PE/NRZI) TU Digital Read Interface

1. Load a standard amplitude tape with a write enable ring installed.
2. Disconnect the write cable from motherboard connector J2A.
3. Use the maintenance test panel to write 3200 frpi (all ONEs in PE format) on all tracks.
4. Use an oscilloscope to monitor the test points of the JR card. (Refer to Figure 5-17 for the test point locations.)
5. Set the signal amplitude of each track to 2.0 volts (measured peak-to-valley) by adjusting the corresponding pot on the JA card. (Refer to Figure 5-12.)
6. Perform a read backward operation. The PE signal amplitudes should be 2.0 volts (+15%) on all tracks.
7. Write 800 frpi (all ONEs in NRZI format) on all tracks on the same tape.
8. Set the NRZI signal amplitude of each track to 2.0 volts (measured peak-to-valley) by adjusting the corresponding pot on the JR card. (Refer to Figure 5-16.)
9. Reconnect the write cable to motherboard connector J2A.
10. Proceed to the following Read/Write Noise Checks (Section 5.4.11).

5.4.11 READ/WRITE NOISE CHECK

The following read/write noise measurements can only be accomplished when the measurement system bandwidth is limited to 5 MHz. All measurements are made at the JA preamp outputs and measured peak-to-peak differentially with maximum read-out resolution. Use X1 probes. (Refer to Figure 5-12 for test point locations.)

5.4.11.1 White Noise

Perform this check without tape loaded with the tape drive at rest. White noise is the noise associated only with the read electronics. The noise is composed of a continuous spectrum and no discrete frequencies should be apparent. The total width of the scope trace is the measurement of the white noise after subtracting the width of the scope trace when measuring across ground. The white noise should not exceed the maximum indicated in Table 5-8.

If the white noise exceeds the limit, one amplifier stage within the differential read channel may have a single-ended input or output. To check this, read a NRZI-written tape and monitor the inputs and outputs of each stage for the track under test.

If any discrete frequencies are noticeable, something is oscillating. Check the JA preamp power with the scope for low frequency oscillations. For frequency oscillations greater than 1 MHz, it is probably the JA card.

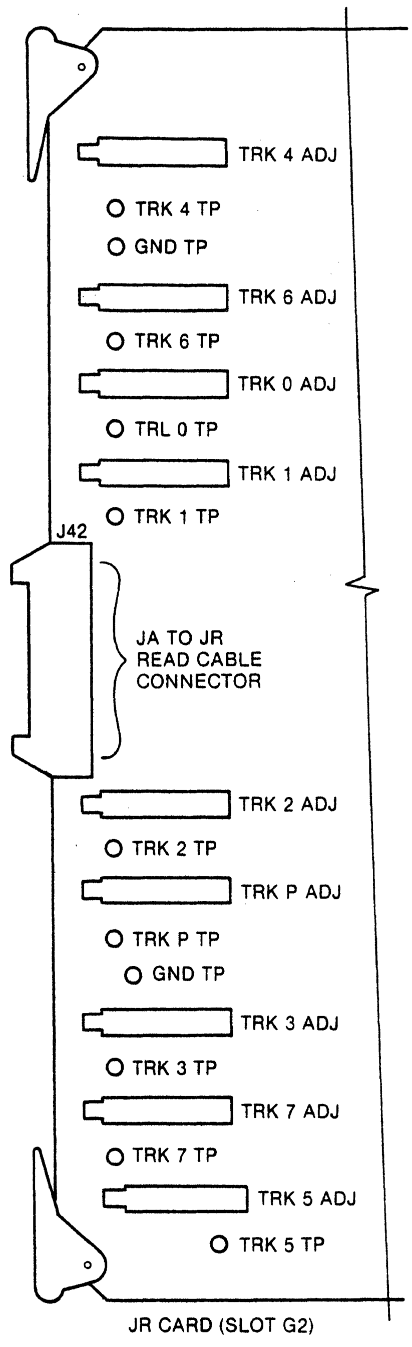


Figure 5-17. Digital Read (1952) Adjustments

Table 5-8. Maximum White Noise and Feed-Through

SPEED	WHITE NOISE	FEED-THROUGH
125 ips	6 mV	50 mV
75 ips	10 mV	84 mV
50 ips	15 mV	125 mV

5.4.11.2 Feed-Through Noise

Feed-through noise is coupled from the write head to the read head during a write operation. To measure feed-through, use the Write Feedthrough maintenance program 4 with tape loaded (Section 5.3.2.10). The feed-through signal, after subtracting the total scope trace width measured in the White Noise check, should not exceed the maximum indicated in Table 5-8.

If the feed-through noise exceeds the limit, check that the 1000 pf feed-through capacitor from read/write head to deck casting is properly connected.

NOTE

This feed-through test requires tape loaded and reel motors powered. If noise is observed while in read mode (tape loaded but write drives not turned on), it may be from the reel motor system. EMI noise frequencies will probably be in the 10 KHz to 50 KHz range.

5.4.11.3 Electromagnetic Interference (EMI)

EMI is the noise of electromagnetic field imposed on the read channel by other functions within the tape unit, primarily the reel and capstan motors in operation. To measure EMI, perform a read forward operation on an erased tape and then perform a read backward operation. The EMI noise should be less than 10 mV for either direction of tape motion, after subtracting the total scope trace width measured in the White Noise check.

5.4.11.4 Read Crosstalk Noise

Crosstalk noise is associated with coupling between read tracks. To measure crosstalk, perform a PE write operation in all tracks except the track under test. Read tape backwards over the area just recorded. The crosstalk noise should be less than 10 mV, after subtracting the total scope trace width measured in the Electromagnetic Interference (EMI) check.

5.4.11.5 Residual Read Data

During an erase operation both the erase head and the write head are erasing tape (also during a write operation in the interblock gap). To measure the residual, perform a PE format write operation in all tracks, then turn off all write data switches and perform a write (erase) operation over the previously recorded area of tape. The residual signal will be at data frequency. The residual data signal should be less than 10 mV, after subtracting the total scope trace width measured in the Electromagnetic Interference (EMI) check.

CHAPTER 6

REMOVAL AND REPLACEMENT

6.1 INTRODUCTION

This chapter provides procedures for the removal and replacement of the field replaceable parts. They are logically arranged by location and/or function under the following major headings:

- Front Door
- Deck Casting, Front
- Deck Casting, Rear
- Capstan and Reels Systems
- Power Supply
- Pneumatics Supply

6.2 FRONT DOOR

6.2.1 WINDOW CYLINDER REPLACEMENT

1. Remove power from tape unit.
2. Ensure that the window is in the fully open position.
3. Remove the pneumatics tubing from the bottom of the window cylinder (see Figure 6-1).
4. Loosen the lock nut at the top of the cylinder rod and rotate the rod until it is free of the cylinder rod angle. Take care to prevent the window from falling.
5. Hold the cylinder upright and remove the two screws securing the cylinder strap. Remove the strap and the cylinder.
6. Install the replacement window cylinder by reversing this procedure.
7. Check the operation of the replacement window cylinder.

6.2.2 WINDOW ASSEMBLY REPLACEMENT

1. Perform the preceding window cylinder removal procedure.
2. Hold the window assembly in place and remove the screws securing the window to the window chassis slide (see Figure 6-1). Remove the window assembly from its track.

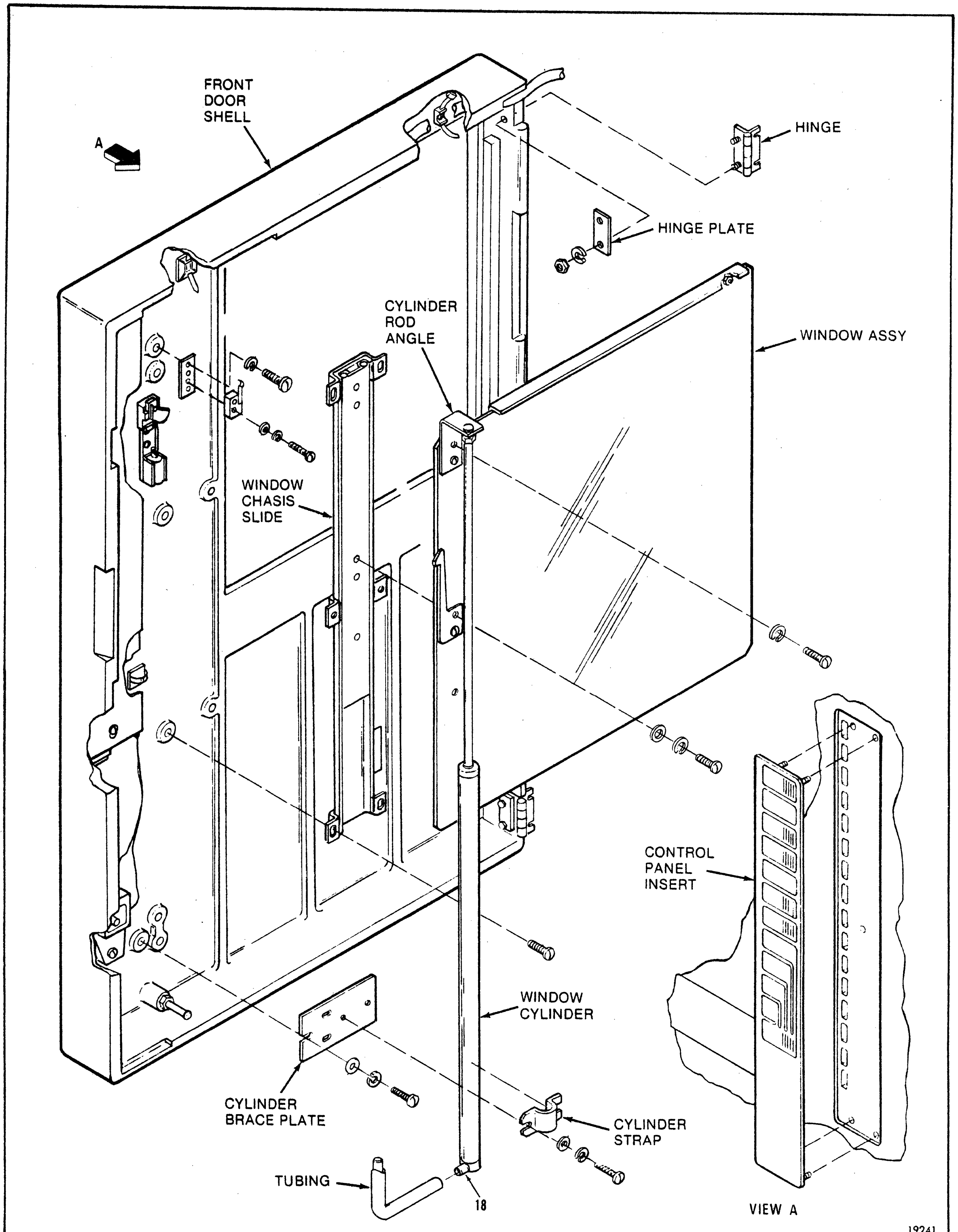


Figure 6-1. Front Door Assembly

3. Install the replacement window assembly by reversing this procedure and the window cylinder replacement procedure.
4. Check the operation of the replacement window assembly.

6.2.3 WINDOW CHASSIS SLIDE REPLACEMENT

1. Perform both of the preceding removal procedures: window cylinder and then window assembly.
2. Hold the window chassis slide in place and remove the six screws securing it to the front door shell.
3. Install the replacement window chassis slide by reversing this procedure and both the window assembly and the window cylinder replacement procedures.
4. Check the operation of the replacement window chassis slide.

6.3 DECK CASTING, FRONT

6.3.1 COLUMN DOOR REPLACEMENT

1. Open the front door and unlatch the column door.
2. Hold the column door in place and, beginning with the lowest hinge, remove the six screws securing the three column door hinges to the side of the deck casting (see Figure 6-2).
3. With the column door assembly on a bench, remove the screws and hardware securing the hinges and the center guide to the columns door.
4. Use the original mounting hardware to install the hinges and the center guide on the replacement column door.
5. Use the original hinge mounting hardware to secure the column door to the deck.
6. To adjust the column door, loosen the column door mounting hinges both at the side of the deck casting and on the front of the column door. Position the door such that the plastic triangle in the column door snugs up against the air bearing as shown in Figure 6-3. Tighten the hinge mounting screws. Any gap between the door and the column bars will be taken up by the column vacuum itself.
7. To check the vacuum seal, place a strip of magnetic tape between the column door and the deck casting at several points around the perimeter of the door. There should be drag on the tape when it is pulled out.

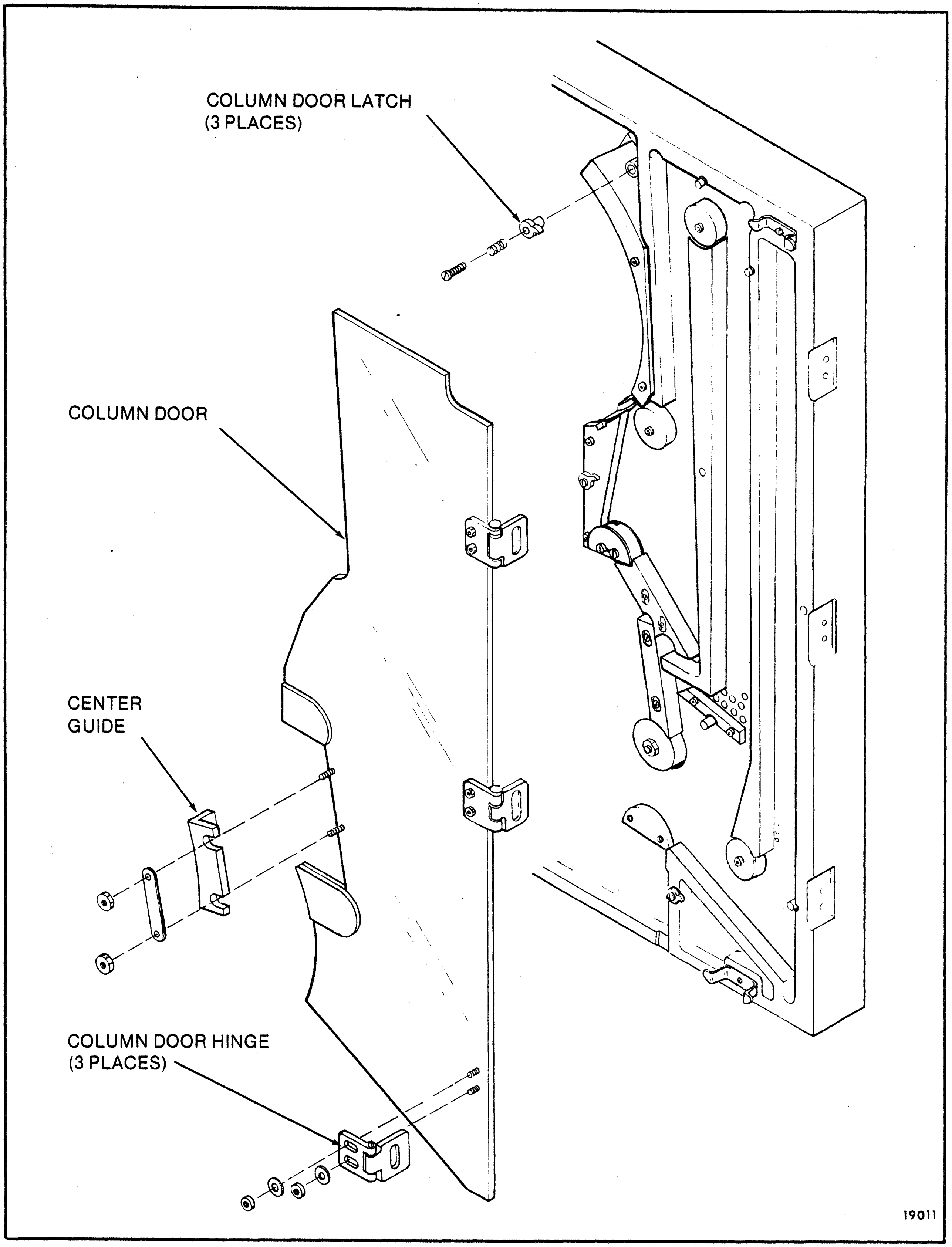


Figure 6-2. Column Door

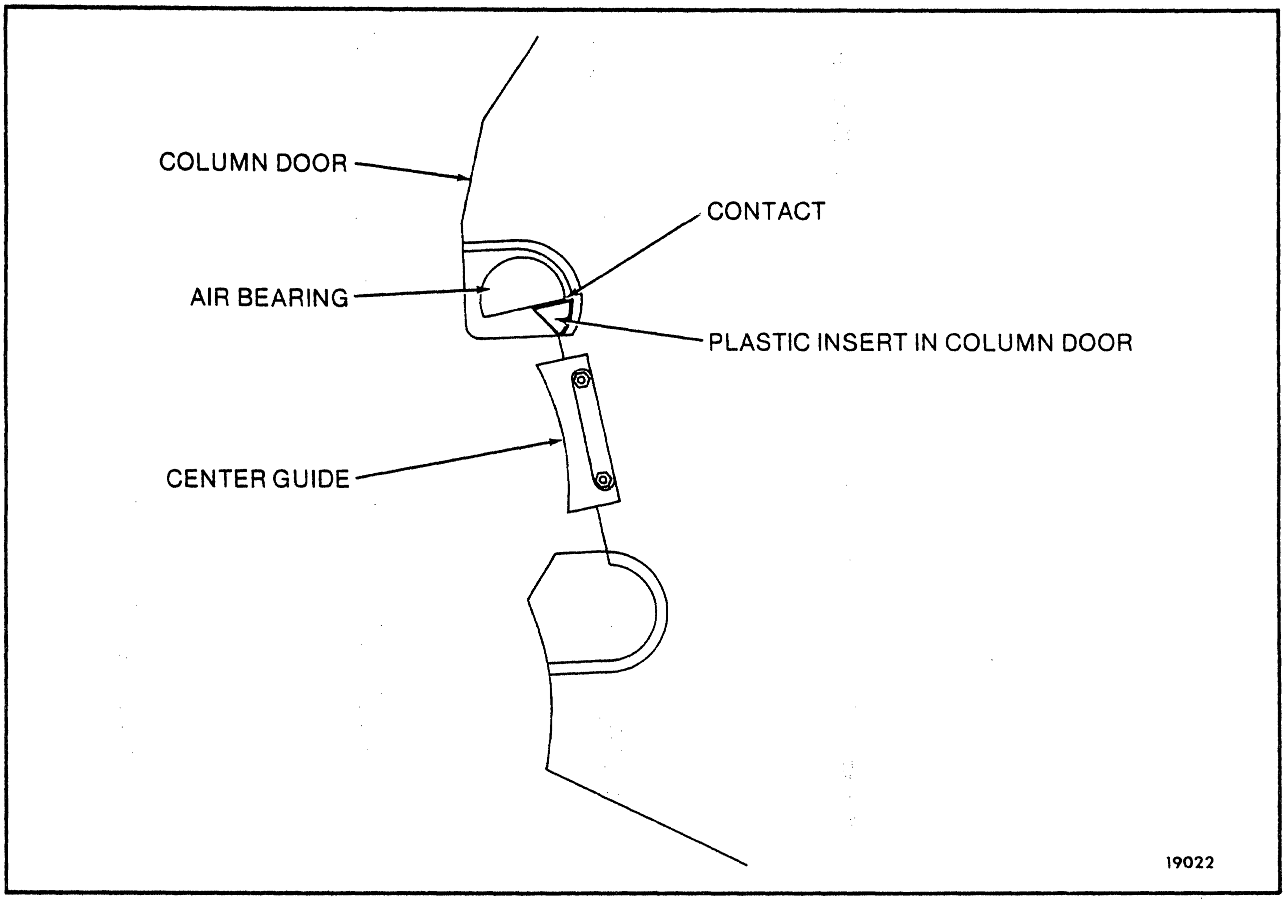


Figure 6-3. Column Door Adjustment

6.3.2 CARTRIDGE RESTRAINT SEAL REPLACEMENT

1. Slip a small screwdriver under either end of the plastic rim of the restraint seal. Take care not to damage the foam rubber gasket under the seal.
2. Pry the seal from the cartridge restraint.
3. Snap the replacement seal into place.

6.3.3 CARTRIDGE RESTRAINTS REPLACEMENT

1. Unload the tape unit and remove the file reel.
2. Remove power from tape unit.
3. Mark the position of the appropriate restraint on the front of the deck deck in order to correctly align the replacement restraint.
4. Hold the cartridge restraint in place and remove the restraint mounting bolts (see Figure 6-4).
5. Ensure that the replacement cartridge restraint is properly aligned and use the original mounting screws to secure the restraint to the deck. Tighten the mounting screws until just snug to prevent damage to the restraint.
6. Check tape unit operation, especially tape threading of both cartridge and open reel tape.

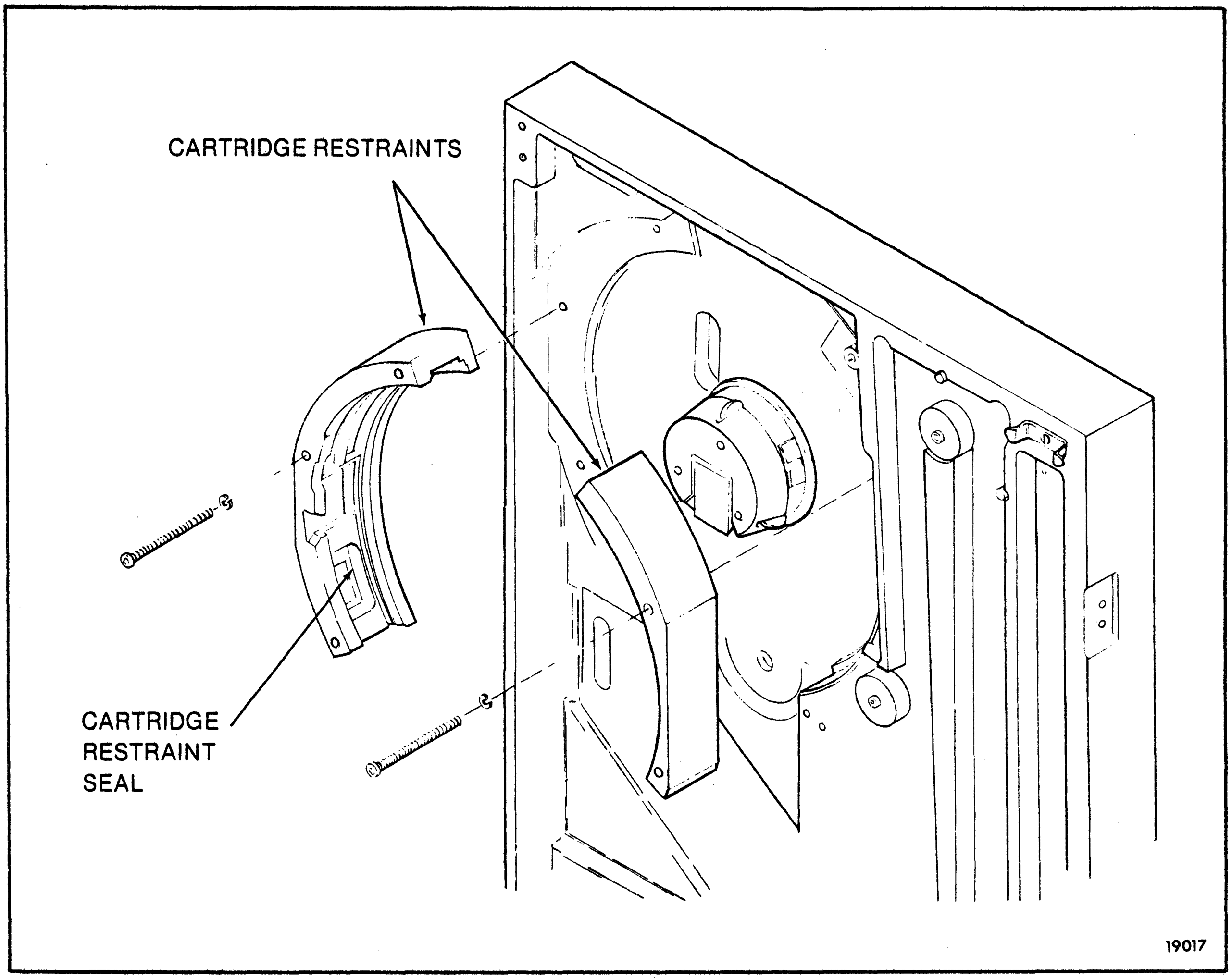


Figure 6-4. Cartridge Restraints

6.3.4 EOT/BOT SENSOR REPLACEMENT

1. Remove power from tape unit.
2. Disconnect the electrical connector from the EOT/BOT sensor circuit card at the back of the deck casting.
3. Remove the EOT/BOT sensor mounting screw on the front of the tape deck and remove the sensor assembly which includes the sensor circuit card (see Figure 6-5).
4. Use the original mounting hardware to secure the replacement EOT/BOT sensor assembly to the deck. Tighten the mounting screws until just snug (10 inch-pounds torque) to prevent damage to the plastic housing.
5. Connect the electrical connector to the sensor circuit card.
6. Perform the EOT/BOT Sensor Adjustment procedure (Section 5.4.4).
7. Check tape unit operation, especially BOT and EOT sensing.

6.3.5 CLEANER BLOCK REPLACEMENT

1. Remove power from tape unit.
2. Remove the decorative cover.
3. Remove the cleaner block mounting screw and pull the cleaner block out from the deck casting (see Figure 6-5).
4. Use the original mounting hardware to secure the replacement cleaner block to the deck. Tighten the mounting screws until just snug (10 inch-pounds torque) to prevent damage to the plastic housing.
5. Check tape unit operation and ensure that cleaner block vacuum holds tape against the cleaner block during both forward and backward operations.
6. Reinstall the decorative cover.

6.3.6 HIGH SPEED FOOT REPLACEMENT

1. Remove power from tape unit.
2. Remove the decorative cover.
3. Remove the two high speed foot mounting screws (see Figure 6-5).
4. Pull the high speed foot assembly out from the deck casting and remove the foot assembly pneumatics tubing.
5. Connect the high speed foot pneumatics tubing to the replacement high speed foot assembly.

6. Use the original mounting hardware to secure the replacement high speed foot to the deck. Tighten the mounting screws until just snug (10 inch-pounds torque) to prevent damage to the plastic housing.

7. Check that the foot does not contact the tape under normal forward and backward operations.

8. Manually actuate the high speed foot and check that the tape clears the read/write head. Use the foot mounting screws to adjust the foot as necessary to ensure that the actuated foot holds tape clear of the head.

9. Reinstall the decorative cover.

10. Check tape unit operation, especially tape position during a high speed rewind operation.

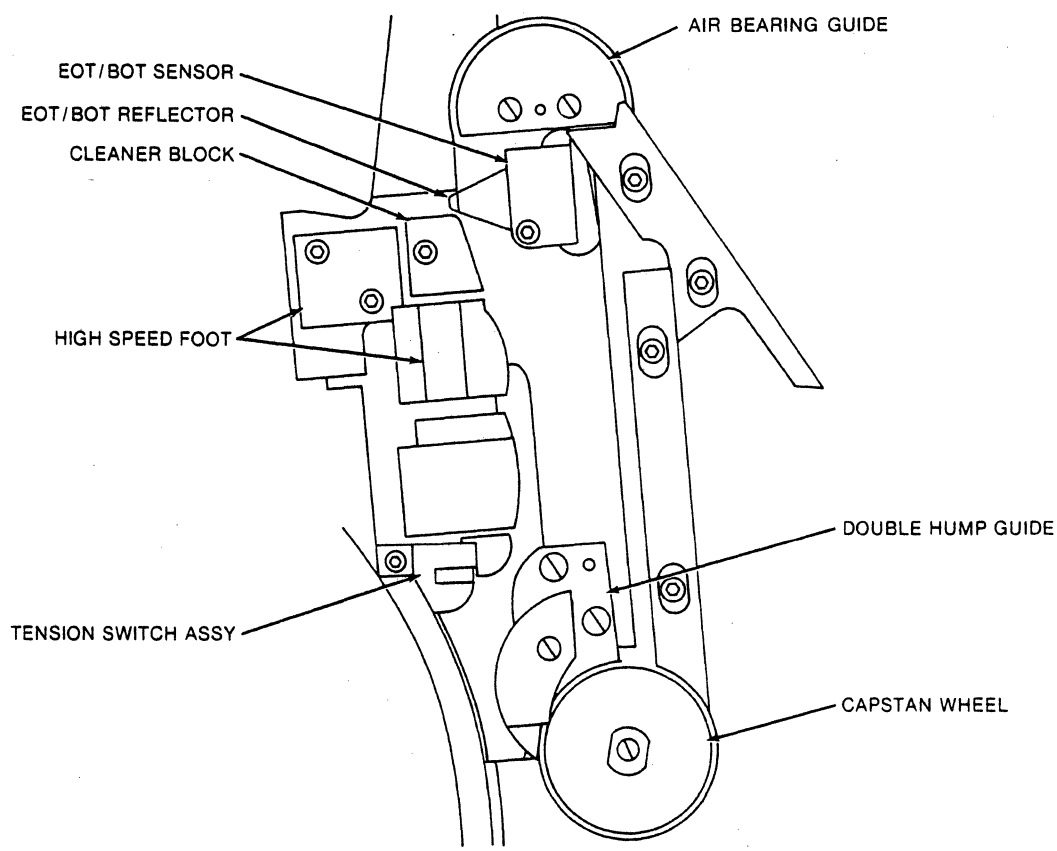


Figure 6-5. Tape Threading Path

6.3.7 TENSION SWITCH ASSEMBLY REPLACEMENT

1. Remove power from tape unit.
2. Remove the decorative cover.
3. Disconnect the leads to the tape tension microswitch on the assembly.
4. Remove the tension switch assembly mounting screw and remove the assembly (see Figure 6-5).
5. Use the original mounting hardware to secure the replacement tension switch assembly to the deck.
6. Connect the leads to the replacement tape tension microswitch.
7. Reinstall the decorative cover.
8. Check tape unit operation.

6.3.8 DOUBLE HUMP GUIDE REPLACEMENT

1. Remove power from tape unit.
2. Remove the double hump guide mounting screws. Carefully remove the guide and its associated front and rear flanges (see Figure 6-6).

   If the tape unit has NRZI capability, remove the pneumatics tubing from the guide and install it on the replacement guide. Ensure that the shims and spring remain on the dowel pin in the deck.
3. Use the original hardware to mount the replacement double hump guide. Take care to ensure that the flanges are correctly installed with the beveled edges facing inside toward the face of the guides. Tighten the mounting screws until just snug (10 inch-pounds torque) to prevent damage to the flanges. If the tape unit has NRZI capability, verify that the retractable flange moves freely (approximately .005 inches) between the double hump guide and the deck.
4. Check for 0.009 inch clearance between the guide and the capstan wheel. A standard data processing card may be used to make this check.
5. Check that the tape tracks properly across the face of the replacement guide.

6.3.9 AIR BEARING GUIDE REPLACEMENT

1. Remove power from tape unit.
2. Remove the air bearing guide mounting screws. Carefully remove the guide and its associated front and rear flanges (see Figure 6-6). If the tape unit has NRZI capability, ensure that the shims and spring remain on the dowel pin in the deck.
3. Use the original hardware to mount the replacement guide. Ensure that the flanges are correctly installed with the beveled edges facing inside

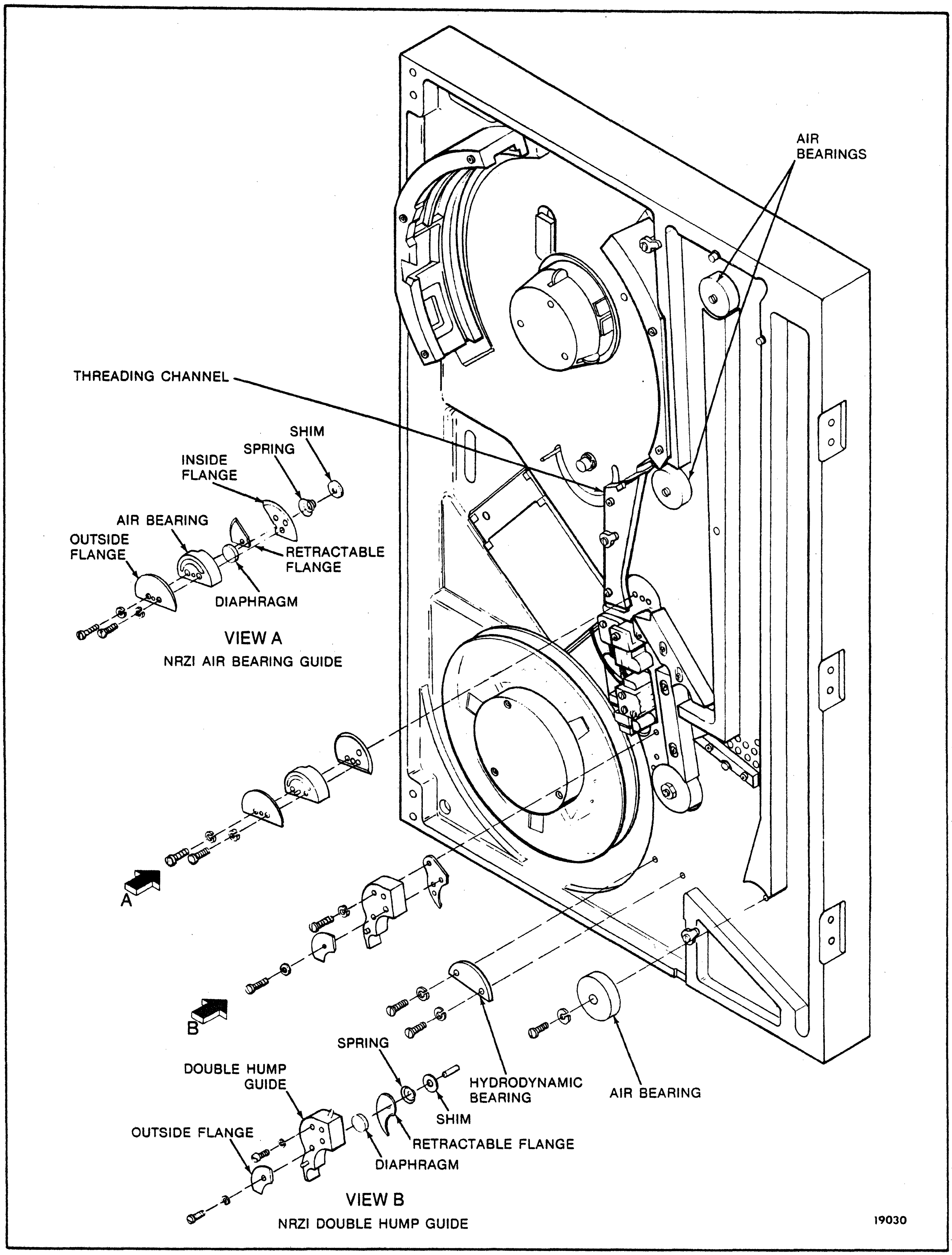


Figure 6-6. Air Bearings Assembly

toward the face of the air bearing guide.Tighten the mounting screws until just snug (10 inch-pounds torque) to prevent damage to the flanges. Verify that there is contact between the guide and the stubby bar as shown in Figure 6-7.

4. Check that tape tracks properly across the face of the replacement guide.

6.3.10 AIR BEARING REPLACEMENT

1. Remove power from tape unit.
2. Remove the screw(s) securing the appropriate air or hydrodynamic bearing and carefully remove the air bearing.
3. Use the original hardware to mount the replacement air bearing.

6.3.11 THREADING CHANNEL REPLACEMENT

1. Remove power from tape unit.
2. Remove the two threading channel mounting screws and the channel (see Figure 6-6).
3. Use the original hardware to mount the replacement threading channel.
4. Remove the column door latch from the original threading channel and install it on the replacement channel.
5. Because the threading channel assembly includes the EOT/BOT reflector, the EOT/BOT Sensor Adjustment procedure (Section 5.4.4) should be performed.
6. Check tape unit operation, especially tape threading and BOT/EOT sensing.

6.3.12 COLUMN BARS REPLACEMENT

1. Remove power from tape unit.
2. Remove the mounting hardware securing the appropriate column bar (stubby bar, double stubby bar, or capstan bar) and remove the bar (see Figure 6-7).
3. Use the original hardware to hold (but not secure) the replacement bar.
4. The double stubby bar requires no special positioning and may be secured at this time.
5. If the capstan bar is replaced, it is necessary to loosen (but not to remove) the stubby bar mounting screws. Position the capstan bar such that (first) the lower end is 0.009 inch from the capstan wheel and (second) in contact with the file column bar. Secure the capstan bar mounting screws when the bar is in the correct position.

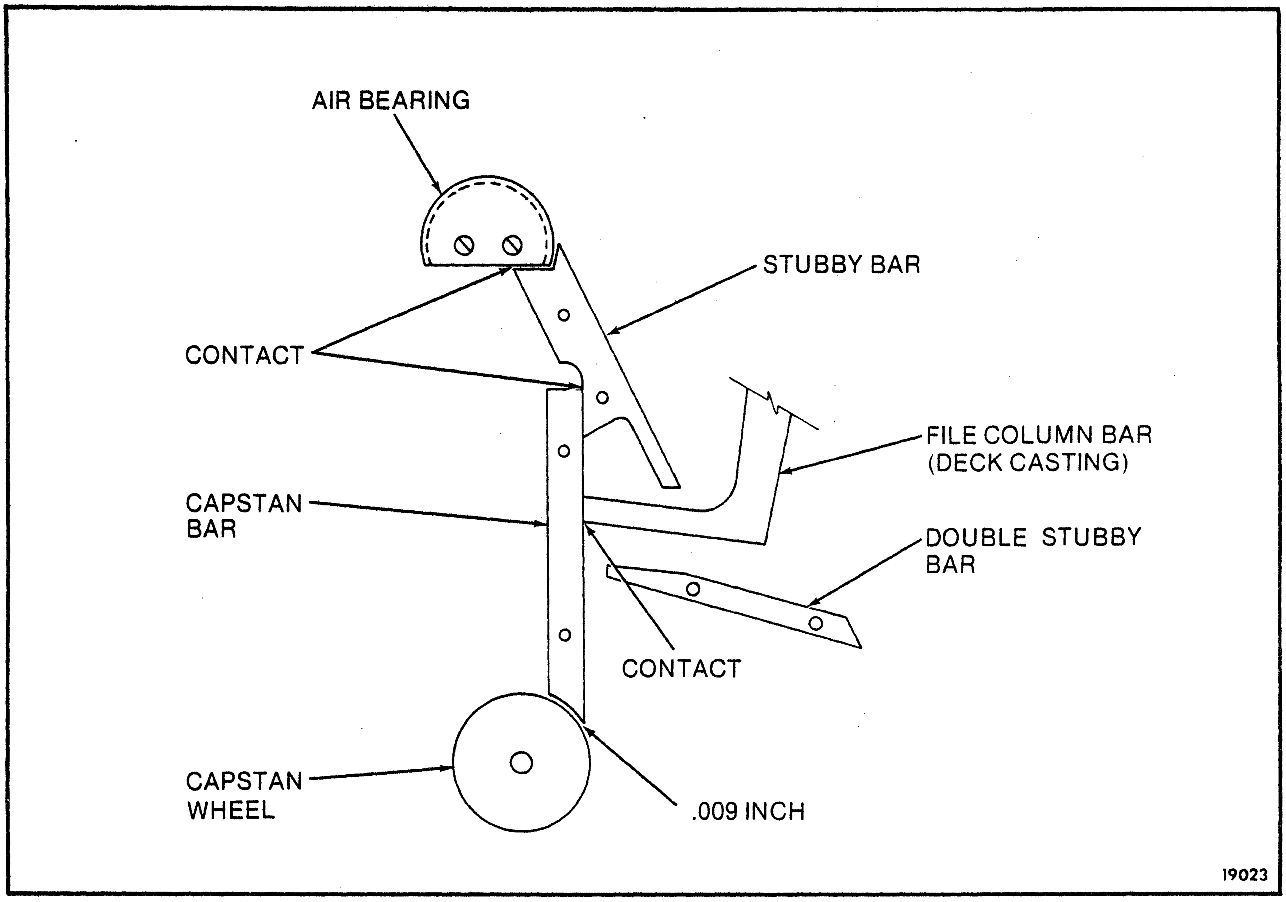


Figure 6-7. Column Bars

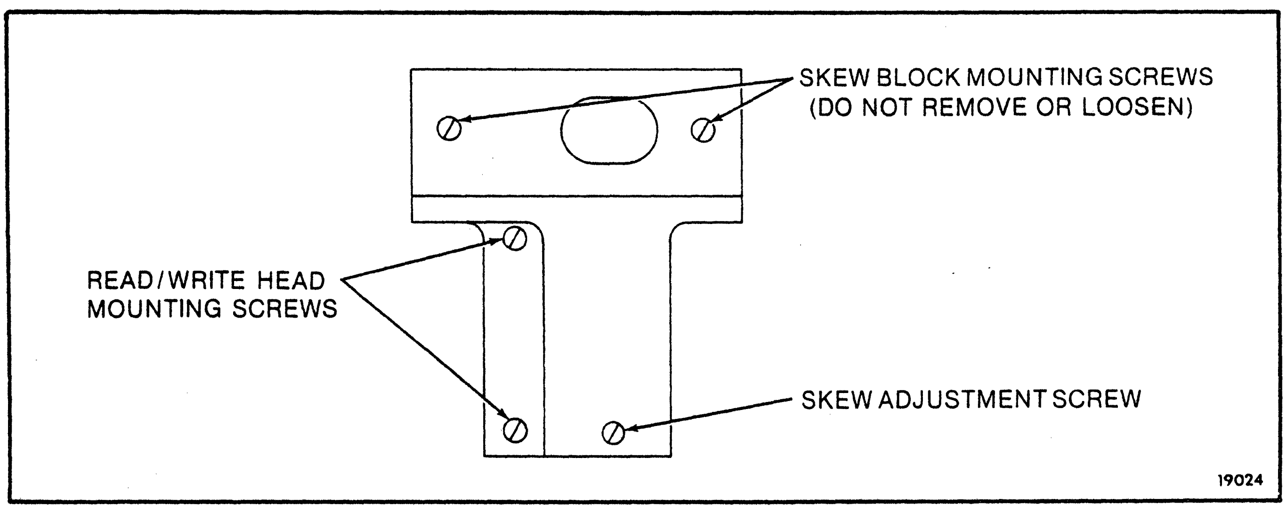


Figure 6-8. Read/Write Head Skew Block (Rear View)

6. Position the stubby bar such that (first) the upper end is in contact with the air bearing and (second) the lower end is in contact with the capstan bar. Secure the stubby bar mounting screws when the bar is in the correct position.

7. Check tape unit operation.

6.3.13 READ/WRITE HEAD REPLACEMENT

1. Disconnect power from tape unit.
2. Remove the decorative cover.
3. Cover the read/write head surface with a piece of gauze and tape it in place. Adhesive bandage is ideal for this purpose.
4. Disconnect the write head cable plug (P8) from the HD card edge connector.
5. Remove the screw securing the tape tension switch assembly (located directly under the read/write head) and pull the switch assembly free of the locating pin.
6. Remove the feed-through capacitor assembly spade lug from the bottom of the read/write head by loosening the screw securing the capacitor assembly to the head.
7. Remove the screws securing the P12 connector to the back of the deck casting and pull P12 free of the JA read preamp card.

CAUTION

Do not loosen or remove the skew block mounting screws.

8. Hold the read/write head in place and, at the back of the deck casting remove the two brass screws that secure the head to the skew block (see Figure 6-8).
9. Carefully remove the read/write head assembly from the front of the deck casting, sliding the write and read head cables through the opening in the deck casting.

CAUTION

The read and write head cables are vulnerable where they connect to the write head; take care not to damage these cables when removing or replacing the head assembly.

10. Install the replacement read/write head assembly by reversing this procedure. Make certain that the head is secure on the skew block.
11. Use a lint free cloth moistened with transport cleaning fluid to clean the replacement read/write head.
12. Perform the Read/Write Head Alignment procedure (Section 5.4.8) and the Read Amplitude Adjustment procedure (Section 5.4.10).

6.4 DECK CASTING, REAR

6.4.1 CARTRIDGE OPENER ASSEMBLY REPLACEMENT

1. Disconnect power from tape unit.
2. Disconnect the cartridge opener drive motor and the switch leads cable plugs.
3. Remove the cartridge opener assembly mounting capscrew accessible from front of deck casting and remove the assembly (see Figure 6-9). Take care not to lose the drive belt.
4. Loop the drive belt around the flywheel and insert the drive motor shaft of the replacement assembly through the belt.
5. Slightly squeeze the assembly to compress the belt tension spring in order to position the assembly for mounting. Use the original hardware to secure the assembly mounting plate.
6. Connect the cartridge opener drive motor and the switch leads at the cable plugs.
7. To adjust the cartridge opener switch, loosen the switch mounting screws. Rotate the flywheel fully CCW such that the opener arm contacts the arm stop and the switch actuating dowel is in the switch area. Position the switch such that the activating dowel activates the switch just as the opener arm contacts the stop. Tighten the switch mounting screws. Rotate the flywheel to check that the switch is not over-actuated, causing binding or switch deformation.
8. Check the operation of the replacement cartridge opener.

6.4.2 CARTRIDGE OPENER DRIVE BELT REPLACEMENT

1. Disconnect power from tape unit.
2. Remove the cartridge opener assembly mounting capscrew (see Figure 6-9) and remove the assembly. Remove the drive belt.
3. Loop the replacement belt around the flywheel and insert the drive motor shaft through the belt loop.
4. Slightly squeeze the assembly to compress the belt tension spring in order to position the assembly for mounting. Use the original hardware to secure the assembly mounting plate.
5. Check the operation of the cartridge opener with the replacement drive belt installed.

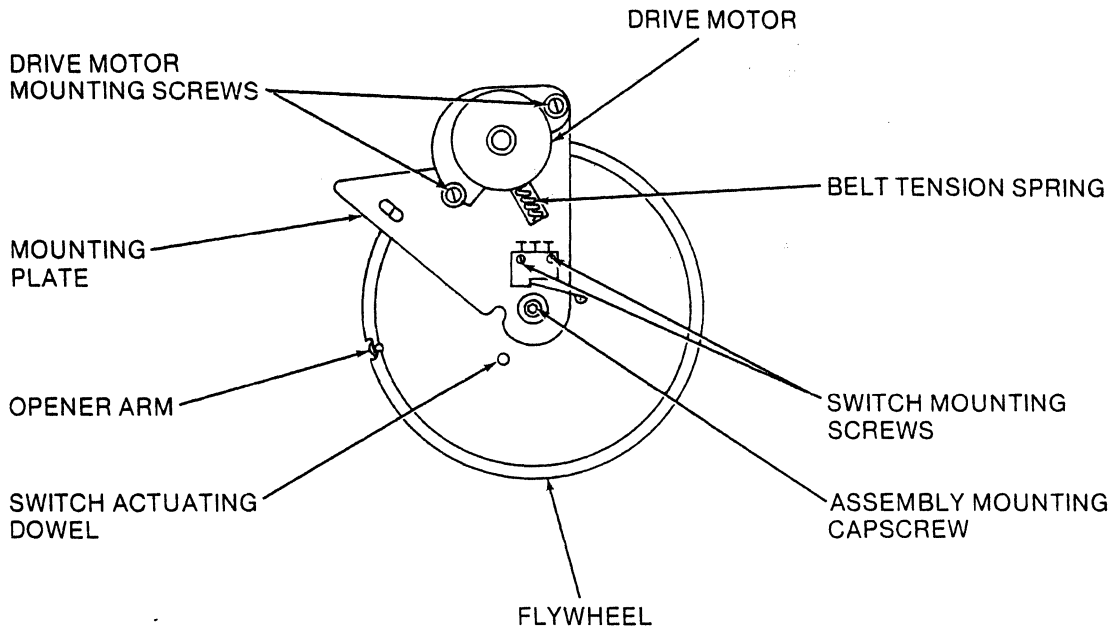


Figure 6-9. Cartridge Opener

6.4.3 COLUMN VACUUM SENSOR REPLACEMENT

1. Remove power from tape unit.
2. Disconnect the electrical connector and the pneumatics tubing from the appropriate column vacuum sensor and remove the sensor from its mounting bracket.
3. Install the replacement column vacuum sensor in the mounting bracket and connect the pneumatics tubing and the electrical connector.
4. Perform the Reel Servo Adjustments procedure (Section 5.4.5).

6.4.4 FILE PROTECT ASSEMBLY REPLACEMENT

1. Disconnect power from tape unit.
2. Disconnect the pneumatic tubing and the cable plug from the file protect assembly.
3. Remove the two screws securing the file protect assembly to the deck casting and remove the assembly.
4. Install the replacement file protect assembly by reversing this procedure.
5. Check the operation of the file protect feature.

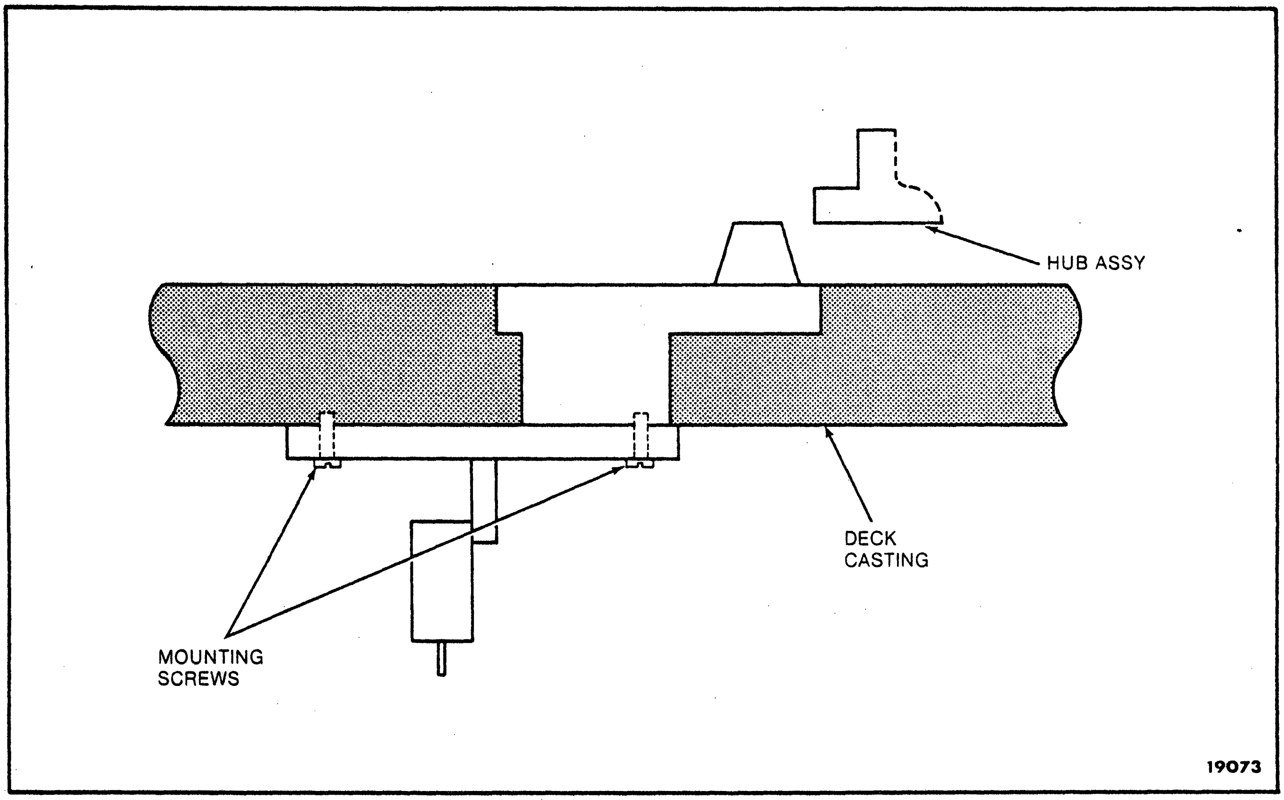


Figure 6-10. File Protect Sensor Alignment

6.5 CAPSTAN AND REELS

6.5.1 CAPSTAN REPLACEMENT

1. Disconnect power from tape unit.

CAUTION

Do not touch the outer, or tape-containing, surface of the capstan with the bare hand as the surface is sensitive to contamination. Use a lint-free cloth when handling the capstan and then grip only the hub.

2. Use capstan wrench (STC PN 4012674-01) or an 11/32 open-end wrench on the flats of the capstan hub to hold the capstan while removing the mounting screw from the end of the capstan motor shaft.

3. Remove the capstan by pulling it straight off the motor shaft.

NOTE

If the capstan is not free, use capstan removal tool (STC PN 4012380-01) to pull the capstan. Take care during removal not to nick or hit the capstan.

4. Mount the replacement capstan by carefully pushing on the hub of the capstan until it stops against the shoulders of the motor shaft.

5. Install the original self-aligning mounting screw and flat washer in the capstan bore. Use the capstan wrench or the 11/32 open-end wrench on the flats of the capstan hub to hold the capstan while tightening the mounting screw. Ensure that the capstan is secure (18 inch-pounds torque).

6. Ensure that the replacement capstan does not rub on the capstan vacuum shroud. Ensure that there is 0.009 inch clearance between the capstan and the capstan column bar and also between the capstan and the double hump guide.

7. Perform the Capstan Alignment (Tape Tracking) procedure (Section 5.4.7) and the Read/Write Head Alignment procedure (Section 5.4.8).

6.5.2 CAPSTAN MOTOR REPLACEMENT

1. Disconnect power from tape unit.
2. Remove the capstan wheel. (Refer to Section 6.5.1, steps 2 and 3 for the removal procedure.)
3. Remove the vacuum hose from the capstan motor by loosening the hose clamp and sliding the hose off the fitting.
4. Disconnect the capstan motor leads cable plug.
5. Disconnect the tachometer leads cable plug (P10) from the card cage.
6. Support the capstan motor and remove the three capstan mounting nuts. Pull the motor free of the mounting studs. Do not remove the spring washers from the mounting studs.
7. Use the original mounting nuts to secure the replacement capstan motor on the mounting studs (see Figure 6-11). Tighten the nuts completely and then loosen each nut one-half turn to prepare the motor for capstan alignment.
8. Connect the motor and tachometer leads at the cable plugs and install the capstan vacuum hose on the replacement motor.
9. Perform the Capstan Alignment procedure (Section 5.4.7). The capstan setting tool must be used.
10. Perform the Read/Write Head Alignment procedure (Section 5.4.8).

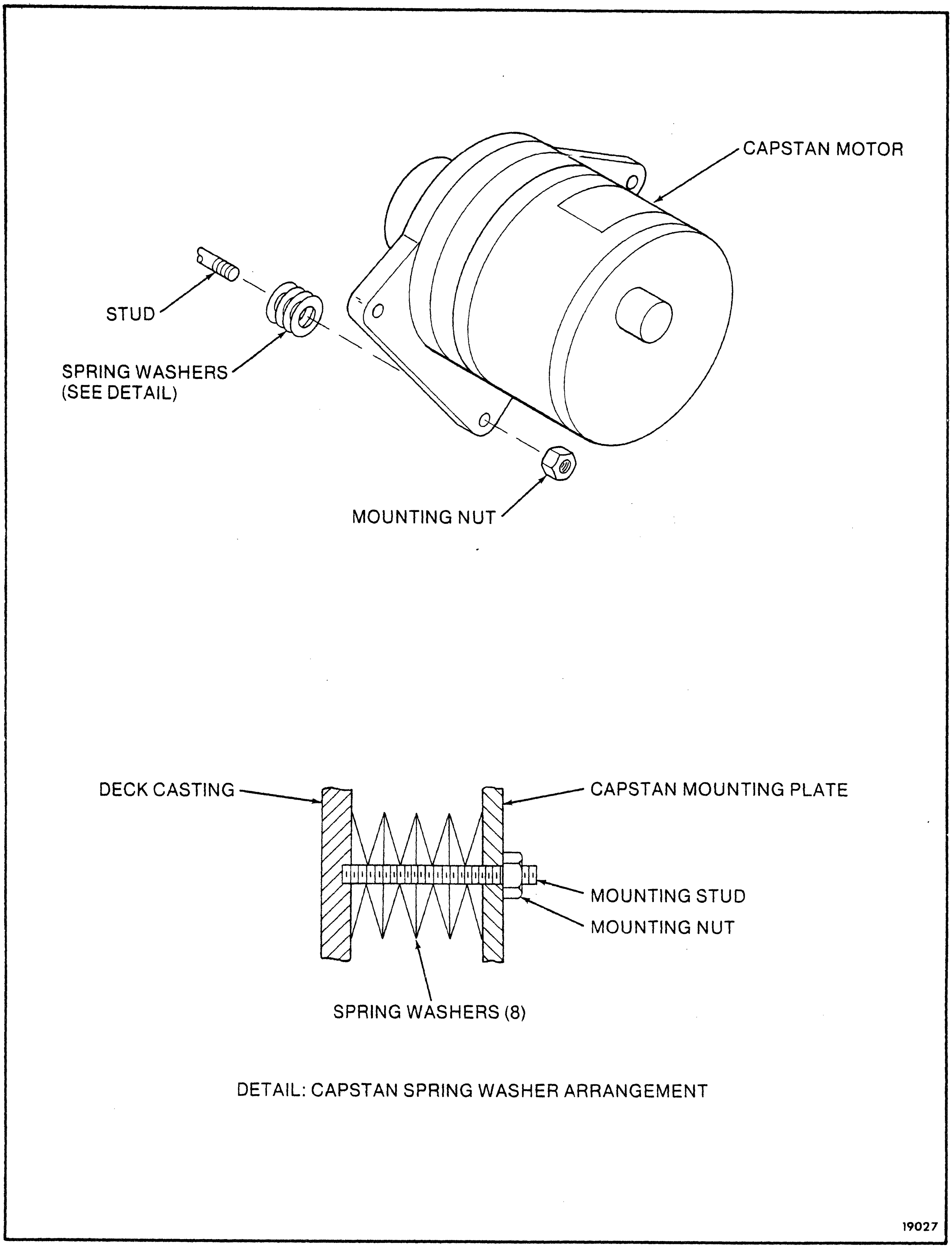


Figure 6-11. Capstan Motor Mounting

6.5.3 FILE REEL HUB REPLACEMENT

6.5.3.1 Manual File Reel Hub Replacement

1. Unload tape and remove the file reel.
2. Disconnect power from tape unit.
3. Loosen the hub clamp with the clamp screw and slide the hub free of the motor shaft (refer to Figure 6-12A). Take care not to lose the spring inside the hub shaft.
4. Remove the spring from inside the shaft of the removed file reel hub. It will fall out. Drop the spring down the inside of the shaft of the replacement file reel hub.
5. Position the replacement file reel hub on the motor shaft such that the inner flange of the hub is 0.642 (+.005, -.000) inches from either of the two reference pads. Hub position tool, STC PN 4012477-01, is available to facilitate this procedure.
6. Tighten the hub clamp screw while maintaining the hub position. Make certain that the hub clamp is secure (130 inch-pounds torque).
7. Remove the three hub cap mounting screws from the original file reel hub to remove the cap, and install the cap on the replacement hub. Tighten the hub cap mounting screws until just snug to prevent damage to the hub cap. Note that the hub latch must be in the open position in order to remove and to install the hub cap.
8. With power on, check the file reel hub for tape rubbing against the reel flanges, as well as runout and wobble.

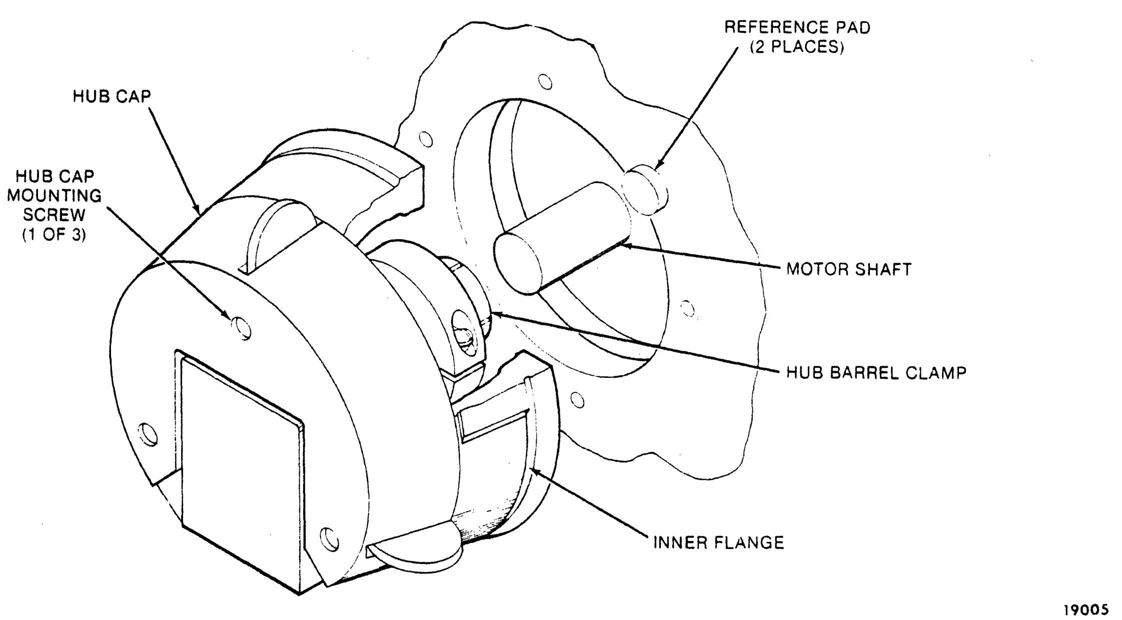


Figure 6-12A. Manual File Reel Hub

6.5.3.2 Optional Automatic File Reel Hub Replacement

1. Unload tape and remove tape reel.
2. Disconnect power from tape unit.
3. Remove the three screws securing the hub cap on the file reel hub and remove the cap.
4. At the back of the file reel motor, hold the pilot spindle with a 9/16-inch wrench and remove the jam nut. (Refer to Figure 6-12B).
5. Hold the file reel hub and use the wrench to thread the connecting rod out of the pilot spindle.
6. Loosen the hub clamp screw (3/16-inch hex) and slide the hub and connecting rod free of the motor shaft.
7. Position the replacement file reel hub on the motor shaft such that the inner flange of the hub is 0.643 (+.005,-.000) inches from either of the two reference pads. Hub position tool, STC PN 4012477-01, is available to facilitate this procedure.
8. Tighten the hub clamp screw while maintaining the hub position. Make certain that the hub clamp is secure (130 inch-pounds torque).
9. Slip the connecting rod assembly through the file reel hub and the motor shaft.
10. Thread the connecting rod into the pilot spindle.
11. Use the wrench to tighten the pilot spindle until the surface of the file reel hub cone is 0.500 (±.005) inches from the inside surface of the hub. Refer to Figure 6-12B, Exhibit A.
12. Hold the pilot spindle with the wrench and thread the jam nut tight against the spindle.
13. Reinstall the hub cap on the replacement file reel hub. Tighten the hub cap mounting screws until just snug to prevent damage to the hub cap.
14. With power on, mount a reel of tape and check the file reel hub for tape rubbing against the reel flanges as well as runout and wobble.

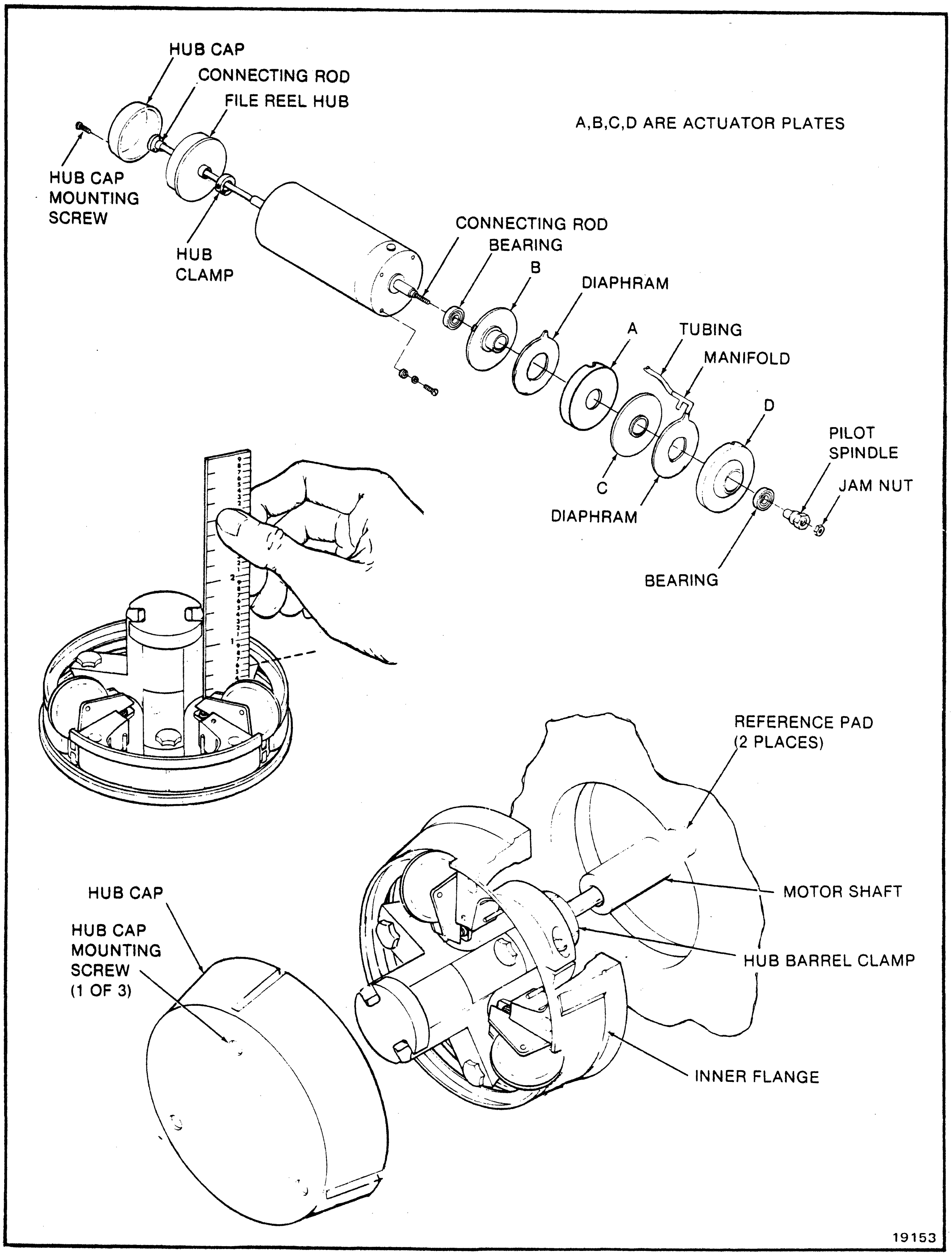


Figure 6-12B. Automatic File Reel Assembly

6.5.3.3 Automatic File Reel Hub Actuator Diaphram Replacement

1. Perform the removal steps of the Automatic File Reel Hub Replacement procedure.
2. Slide the actuator from the file reel motor shaft and carefully separate the plates of the file reel hub actuator to free the rubber diaphrams. (Refer to Figure 6-12B.)
3. Remove the appropriate diaphram from the manifold.
4. Carefully push the replacement diaphram on the manifold until the diaphram tubing extends above the barb on the manifold.
5. Replace the diaphrams between the actuator plates. Slide the actuator on the file reel motor shaft. Take care so that the diaphrams will not be pinched.
6. Perform the replacement steps of the Automatic File Reel Hub Replacement procedure.

6.5.4 MACHINE REEL ASSEMBLY REPLACEMENT

1. Check that the column vacuum is within the specification (Section 5.4.3.1).
2. Unload tape and remove power from tape unit.
3. Remove the three screws securing the machine reel hub cap and remove the hub cap and outer flange (see Figure 6-13).
4. Loosen the hub barrel clamp screw (3/16-inch hex) and slide the machine reel free of the motor shaft.
5. Position the replacement machine reel hub on the motor shaft as close as possible to the deck casting without rubbing on the casting.
6. Tighten slightly, but do not secure, the hub barrel clamp such that the clamp applies some pressure on the motor shaft but does not prevent the hub from sliding under pressure.
7. Use a machine reel position tool (STC PN 4012381-01) by backing out the positioning tool center screw as far as possible and installing the tool on the machine reel in the place of the hub cap.

   If a machine reel position tool is not available, it is still possible to properly position the machine reel. Install the outer flange and hub cap at this time.
8. With power on, use maintenance program 0 (without tape) and bring up the thread pneumatics mode by actuating the maintenance Start switch only once.

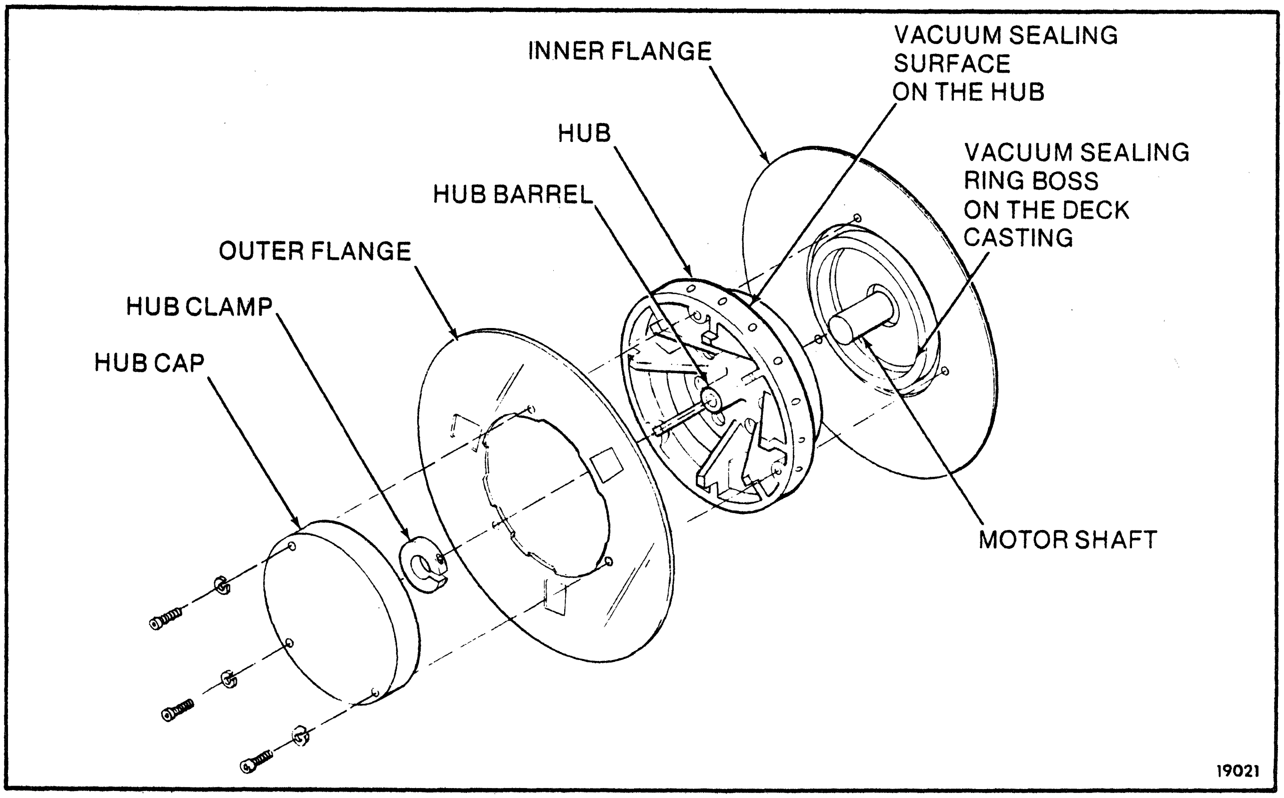


Figure 6-13. Machine Reel Assembly

9. Remove the pneumatics tubing from the machine reel loaded sensor to use as a vacuum level test point for a slack tube manometer or Magnehelic gauge (refer to Figure 5-5).

10. Turn the positioning tool center screw clockwise until it contacts the motor shaft. Further turning pulls the machine reel hub away from the deck casting. Continue turning until there is 27 to 33 inches of water vacuum at the test pont.

    If the machine reel positioning tool is not being used, manually slide the machine reel slightly out from (or in toward) the deck casting until there is 27 to 33 inches of water vacuum at the test point.

11. Without changing the position of the hub on the motor shaft, remove the positioning tool (or hub cap) and secure the hub barrel clamp screw. Check that the hub does not rub on the deck casting.

12. Install the outer flange and hub cap and recheck the vacuum. The vacuum level should still be within the specifications of step 10.

13. Reinstall the pneumatics tubing on the machine reel loaded sensor.

14. With power on, monitor the voltage at the output terminal of the machine reel loaded sensor. Verify that the level changes from +5 to 0 volts when recording tape is wrapped around the machine reel hub and returns to +5 volts when the tape is removed.

15. Mount a reel of tape and check for runout, wobble, or tape rubbing against either flange of the machine reel.

6.5.5 REEL MOTOR REPLACEMENT

1. Disconnect power from tape unit.
2. Perform the removal steps of either the File Reel Hub Replacement procedure (Section 6.5.3) or the Machine Reel Assembly Replacement procedure (Section 6.5.4), as appropriate.
3. Disconnect the reel motor leads cable plug.
4. Support the reel motor and remove the four motor mounting bolts on the front of the deck casting.
5. Use the original hardware to mount the replacement reel motor. Tighten the motor mounting bolts securely (40 inch-pounds torque).
6. Connect the reel motor leads at the cable plug.
7. Perform the replacement steps of either the File Reel Hub Replacement procedure or the Machine Reel Assembly Replacement procedure, as appropriate.

6.6 POWER SUPPLY

6.6.1 POWER SUPPLY ASSEMBLY REMOVAL

1. Disconnect power from tape unit.
2. Disconnect all cable connectors on the power supply connector bracket and connector plugs P1 and P5 on the power supply access panel (see Figure 6-14).

   If the HX regulator card is used, disconnect plugs HXP2, and P3 and P6 on the power supply wiring harness. Disconnect all cable connectors on the JP and JH cards and carefully remove the cards. Disconnect all cable connectors on the EPO card.

   If the JV regulator card is used, disconnect plug JVP2 and P3 on the power supply wiring harness. Disconnect all cable connectors on the JP and JH card and carefully remove the cards.
3. On tape units that use the HX card, disconnect the harness from the capacitors on the lower pneumatics assembly support and remove the rear capacitor.

   On tape units that use the JV card, remove the regulator card cooling fan from the rear of the lower pneumatics assembly support bracket.
4. Open the power supply access panel by loosening the two slot-head screws on the power supply connector bracket and pulling the top of the access panel forward. The access panel is hinged on the bottom.

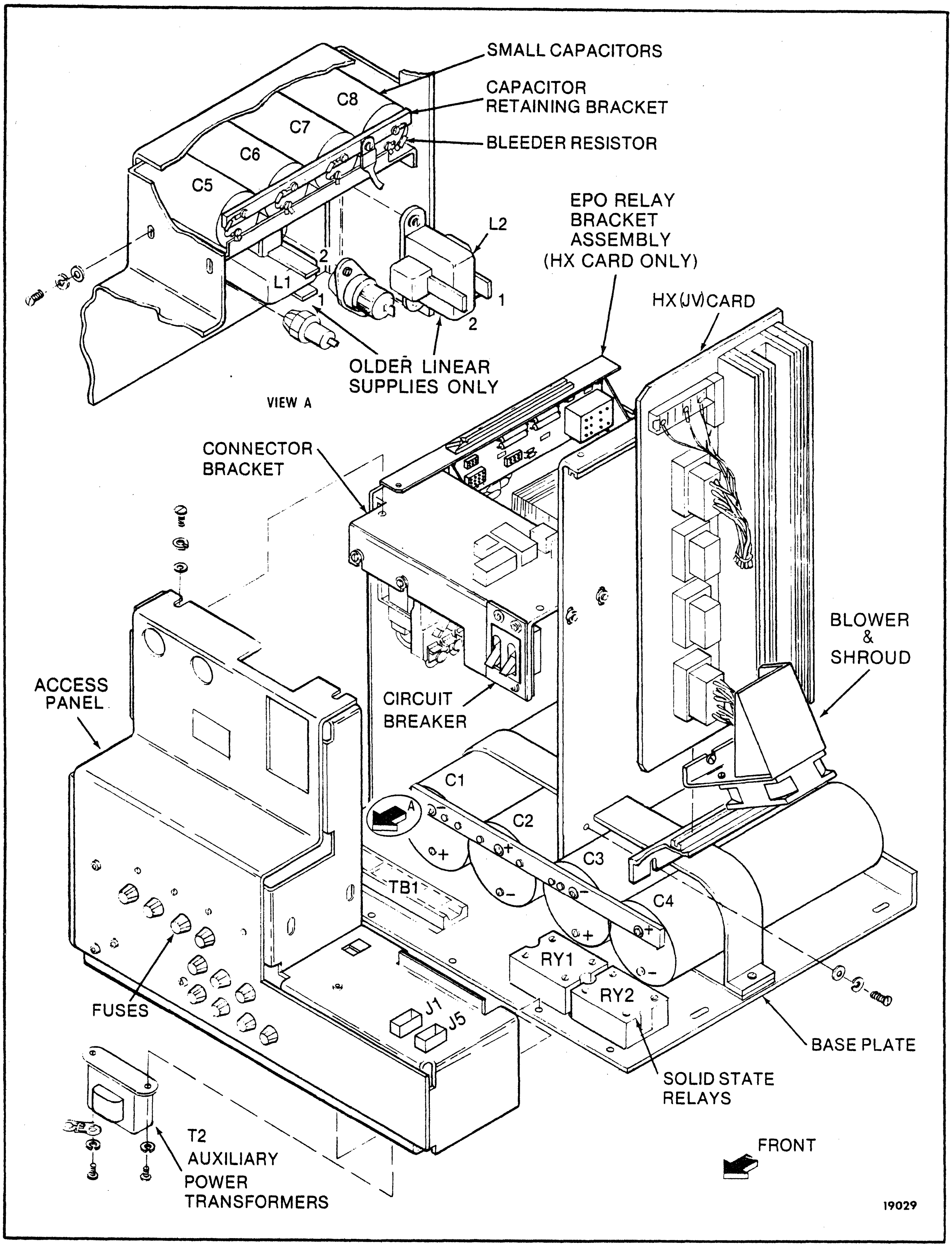


Figure 6-14. Power Supply Assembly (Sheet 1 of 2)

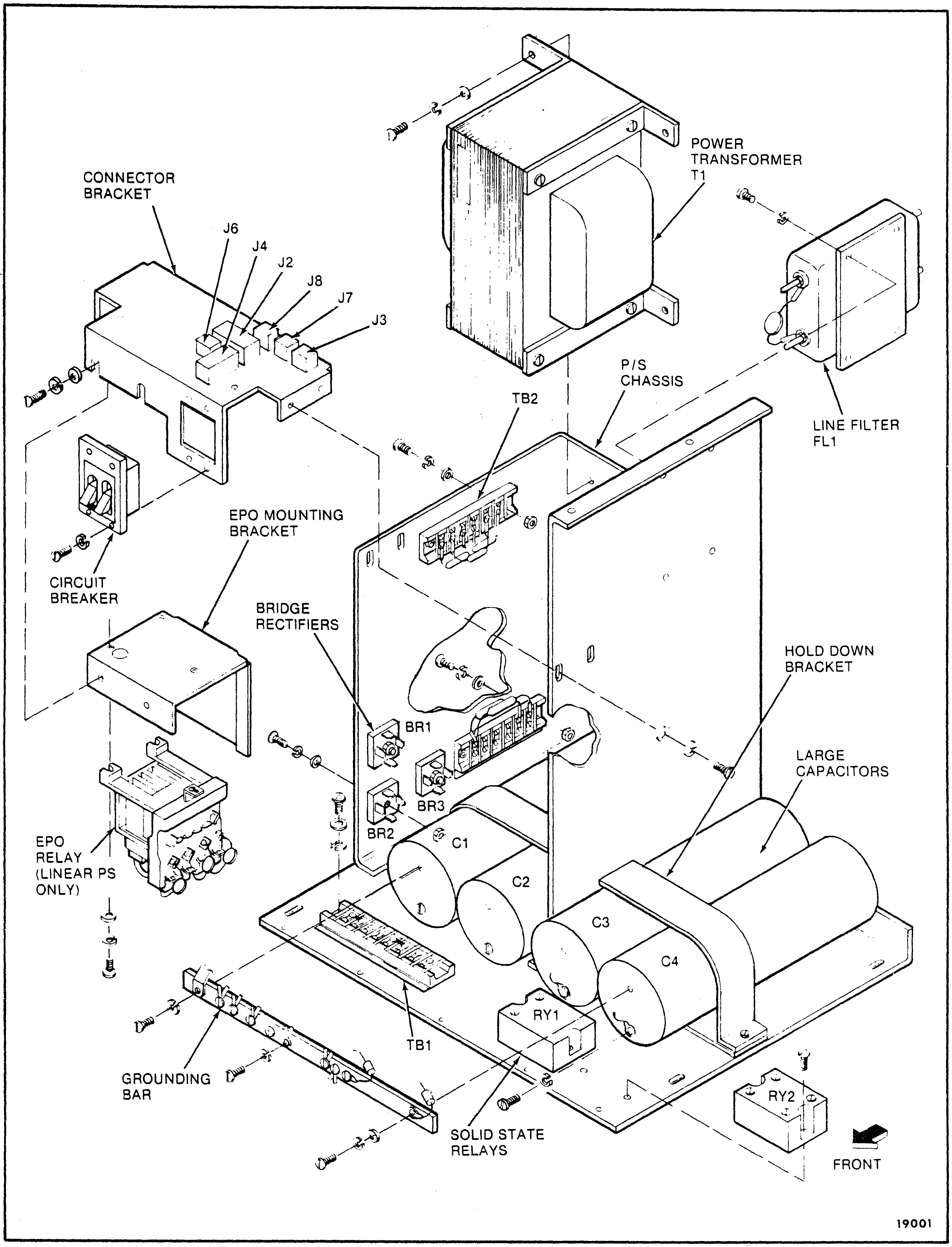


Figure 6-14. Power Supply Assembly (Sheet 2 of 2)

5. Remove the two power supply mounting screws at the front of the power supply. One screw is in the front right corner of the base plate near solid state relay RY2; the other screw is in the front left corner of the base plate near terminal board TB1.

6. Swing the access panel up to the closed position and tighten the two slot-head screws to hold the panel in position.

7. Close and secure the deck casting.

CAUTION

Because the power supply acts as counterweight for the deck, it is important that the deck casting be closed and secured to the frame before attempting to remove the power supply and during the time the power supply is removed.

8. Gain access to the back of the tape unit and remove the power supply mounting screw at the rear of the power supply. The screw is located in the front left corner of the base plate (as viewed from the rear) near capacitor C4.

WARNING

The power supply is heavy, approximately 85 pounds (40 kilograms). Use sufficient personnel when moving the power supply.

9. Remove the power supply assembly from the tape unit by lifting the power supply over the tape unit frame and out the back of the tape unit. Ensure that the power cord will not restrict or hamper the removal of the power supply.

10. Install the power supply by reversing this procedure.

6.6.2 CIRCUIT BREAKER REPLACEMENT

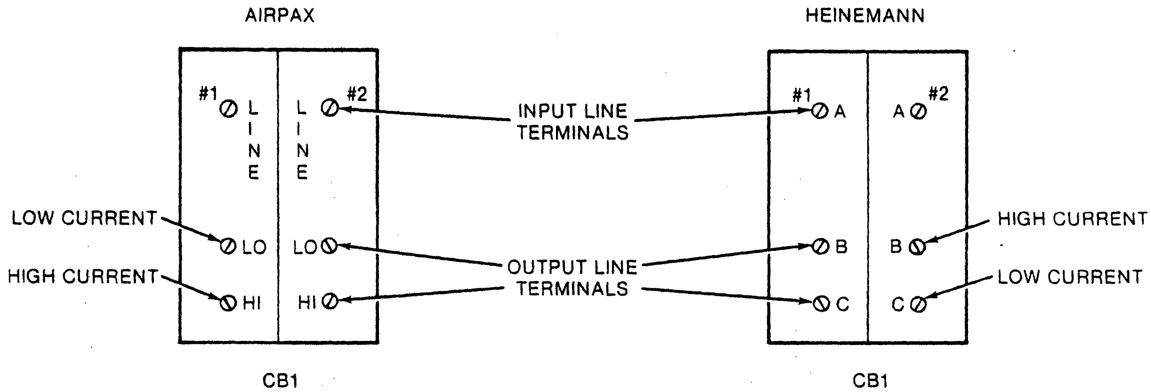
1. Disconnect power from tape unit.

2. Open the power supply access panel.

3. Remove the four circuit breaker mounting screws on the connector bracket.

4. Disconnect the leads to the circuit breaker by removing the nuts and lockwashers securing the leads.

5. Install the replacement circuit breaker by reversing this procedure. Refer to Figure 6-15 for a diagram of the lead connections.



LINE VOLTAGE	BREAKER OUTPUT CONNECTIONS
120 V	HI OR B
208 V	LO OR C
220 - 240 V	LO OR C

POWER SUPPLY	INPUT LINES SIDE 1	SIDE 2	OUTPUT LINES SIDE 1	SIDE 2
FERRO 60 Hz	21	22	11,23	5,16,17,18
FERRO 50 Hz	18	19	11,20	5,14,15
LINEAR 60/50 Hz	21	22	11,23	5,16,18

19242

Figure 6-15. Circuit Breaker (Rear View)

6.6.3 FUSEHOLDER REPLACEMENT

1. Disconnect power from tape unit.
2. Open the power supply access panel.
3. Disconnect the two slip-on connectors on the appropriate fuseholder.
4. Remove the nut securing the appropriate fuseholder to the access panel.
5. Mount and secure the replacement fuseholder and connect the two slip-on connectors.
6. Install a fuse of correct value, size, and type in the replacement fuseholder.
7. Close the access panel and secure it with the screws on the connector bracket.
8. Check power supply functions (refer to Section 5.4.1) and tape unit operation.

6.6.4 SOLID STATE RELAY REPLACEMENT

1. Disconnect power from tape unit.
2. Open the power supply access panel.
3. Disconnect the leads to the appropriate solid state relay by removing the screws securing the leads.
4. Remove the two mounting screws that secure the appropriate relay.
5. Install the replacement solid state relay by reversing this procedure. During replacement, ensure that there is sufficient thermal joint compound present between the relay and the chassis. Refer to Figure 6-16 for a diagram of the lead connections.

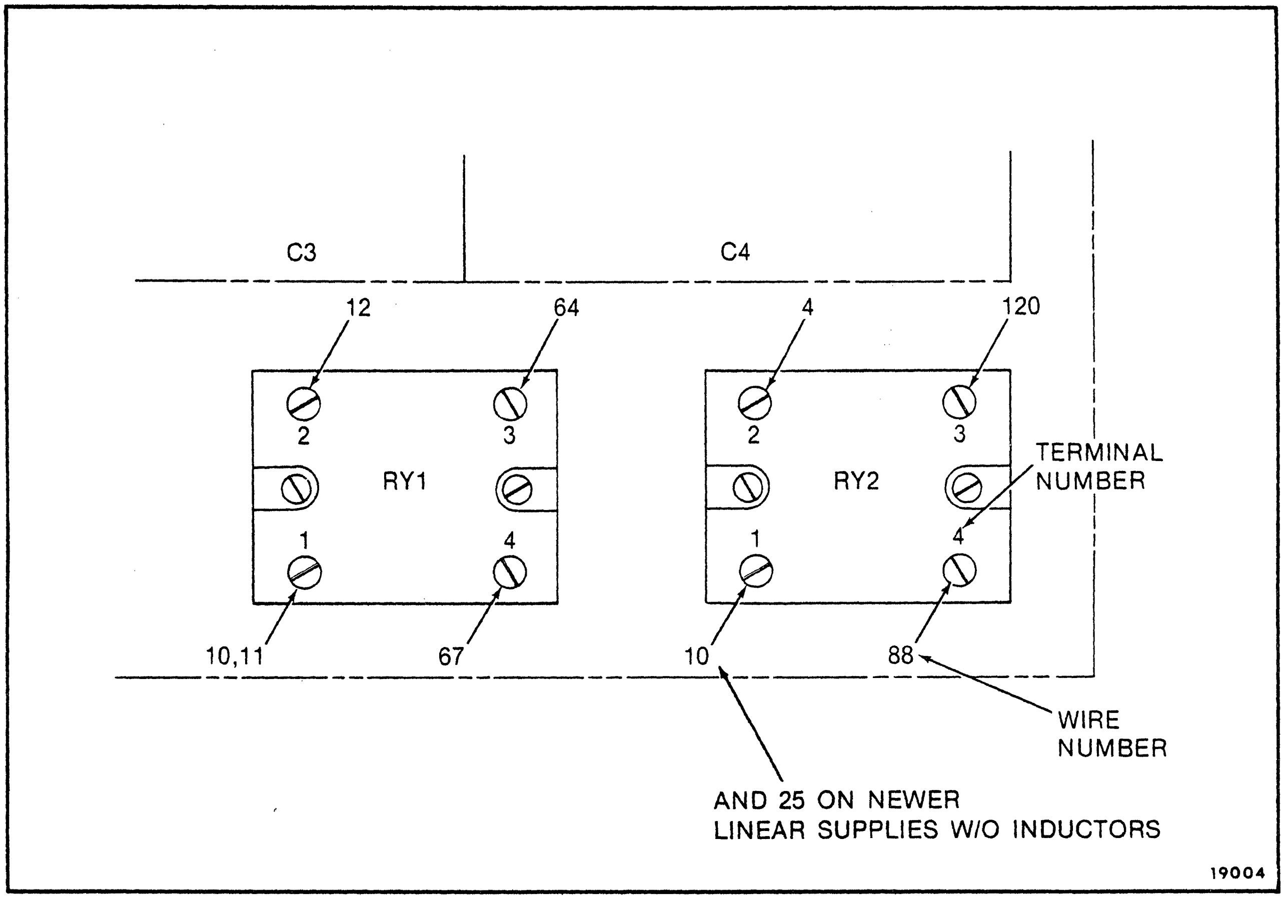


Figure 6-16. Solid State Relays

6.6.5 EPO RELAY REPLACEMENT

6.6.5.1 Ferro PS EPO Relay

1. Disconnect power from the tape unit.
2. Disconnect all cable connectors on the JP and JH cards and carefully remove the cards.
3. Disconnect all cable connectors on the EPO card.
4. Remove the two adjustment screws on the front of the EPO assembly bracket.
5. Loosen the mounting screws securing the rear of the EPO assembly bracket and remove the bracket from the tape unit.
6. Remove the EPO card from the assembly bracket and install the replacement EPO card (see Figure 6-17A).
7. Reinstall the EPO assembly bracket and install the rear mounting screws. Do not tighten the rear screws completely, the bracket must be left loose to allow for adjustment.
8. Insert the JP card and adjust the EPO assembly bracket so that the JP card can slide freely, but is held securely.
9. Tighten the rear mounting screws and the front adjustment screws.
10. Replace the JH card and reconnect all cables.

6.6.5.2 Linear PS EPO Relay

1. Perform the Power Supply Assembly Removal procedure (Section 6.6.1).
2. With the power supply on a bench, open the power supply access panel.
3. Remove terminal board TB2 from the power supply chassis by removing the terminal board mounting hardware. Do not disconnect the leads attached to the terminal board.
4. At the front of the power supply connector bracket, remove the EPO relay assembly by loosening the two EPO relay mounting bracket screws. The relay assembly will drop down from the connector bracket.
5. Remove the EPO relay fro the relay mounting bracket by loosening the three screws securing the relay to the bracket. Slide the relay out from under the screwheads to release the relay.
6. Remove the components and leads on the relay terminals by removing the terminal screws.
7. Install the replacement EPO relay by reversing this procedure. Refer to Figure 6-17B for a diagram of the lead connections.

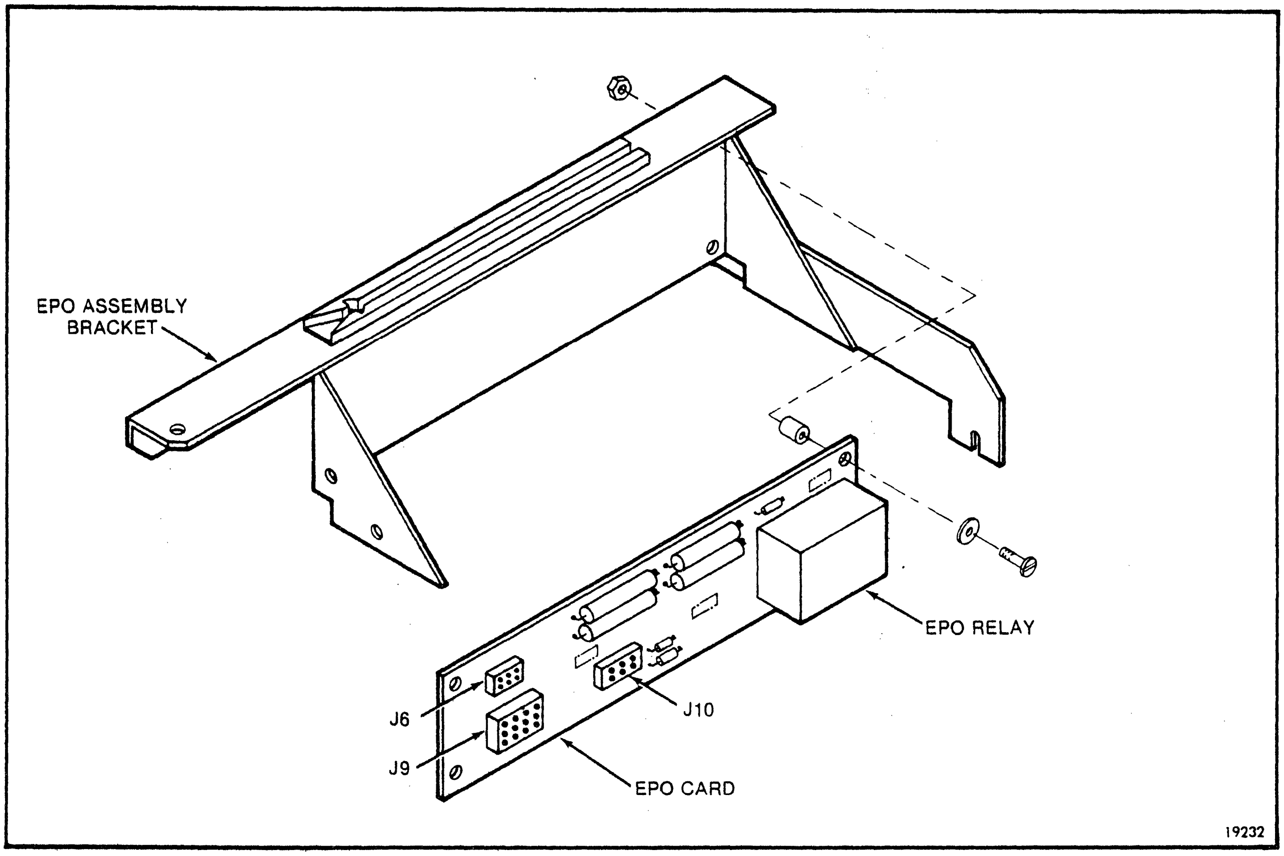


Figure 6-17A. Ferro PS EPO Relay

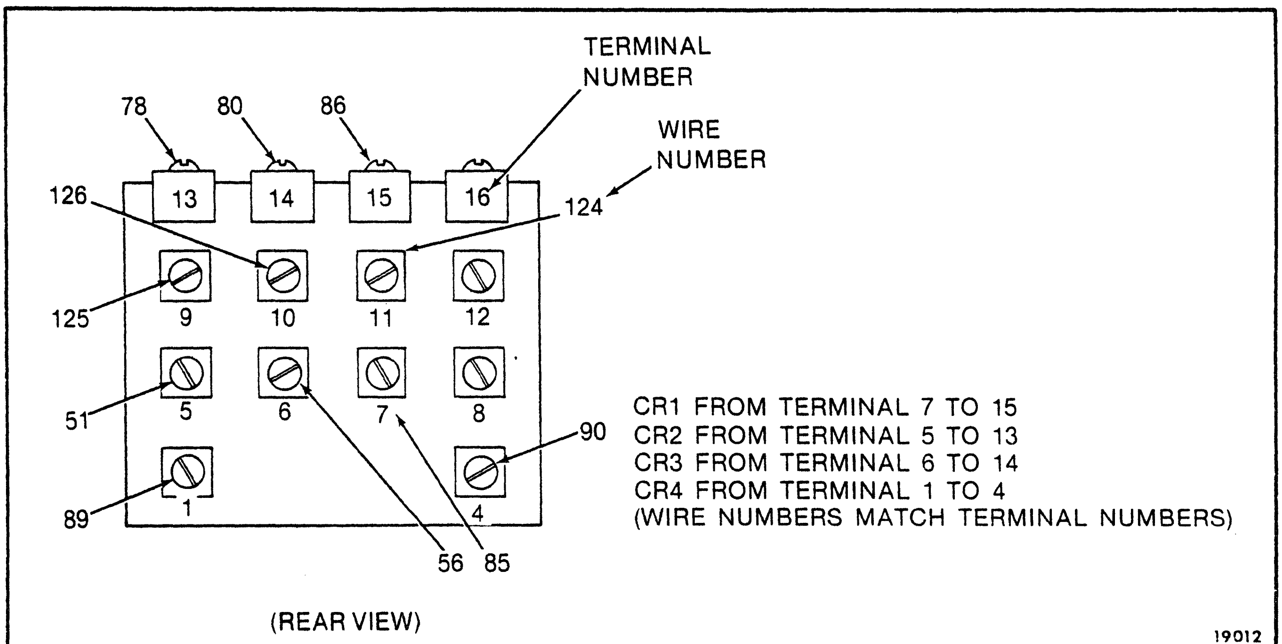


Figure 6-17B. Linear PS EPO Relay

6.6.6 BRIDGE RECTIFIER REPLACEMENT

1. Perform the Power Supply Assembly Removal procedure (Section 6.6.1).
2. With the power supply on a bench, open the power supply access panel.
3. Remove the lead slip-on connectors from the terminals of the appropriate bridge rectifier.
4. Remove the mounting hardware from the appropriate rectifier.
5. Install the replacement bridge rectifier by reversing this procedure. During replacement, ensure that there is sufficient thermal joint compound present between the bridge rectifier and the chassis. Refer to Figure 6-18 for a diagram of the bridge rectifier lead connections. Note that the 'AC' terminals on each rectifier are interchangeable, thus the leads to the 'AC' positions may be interchanged.

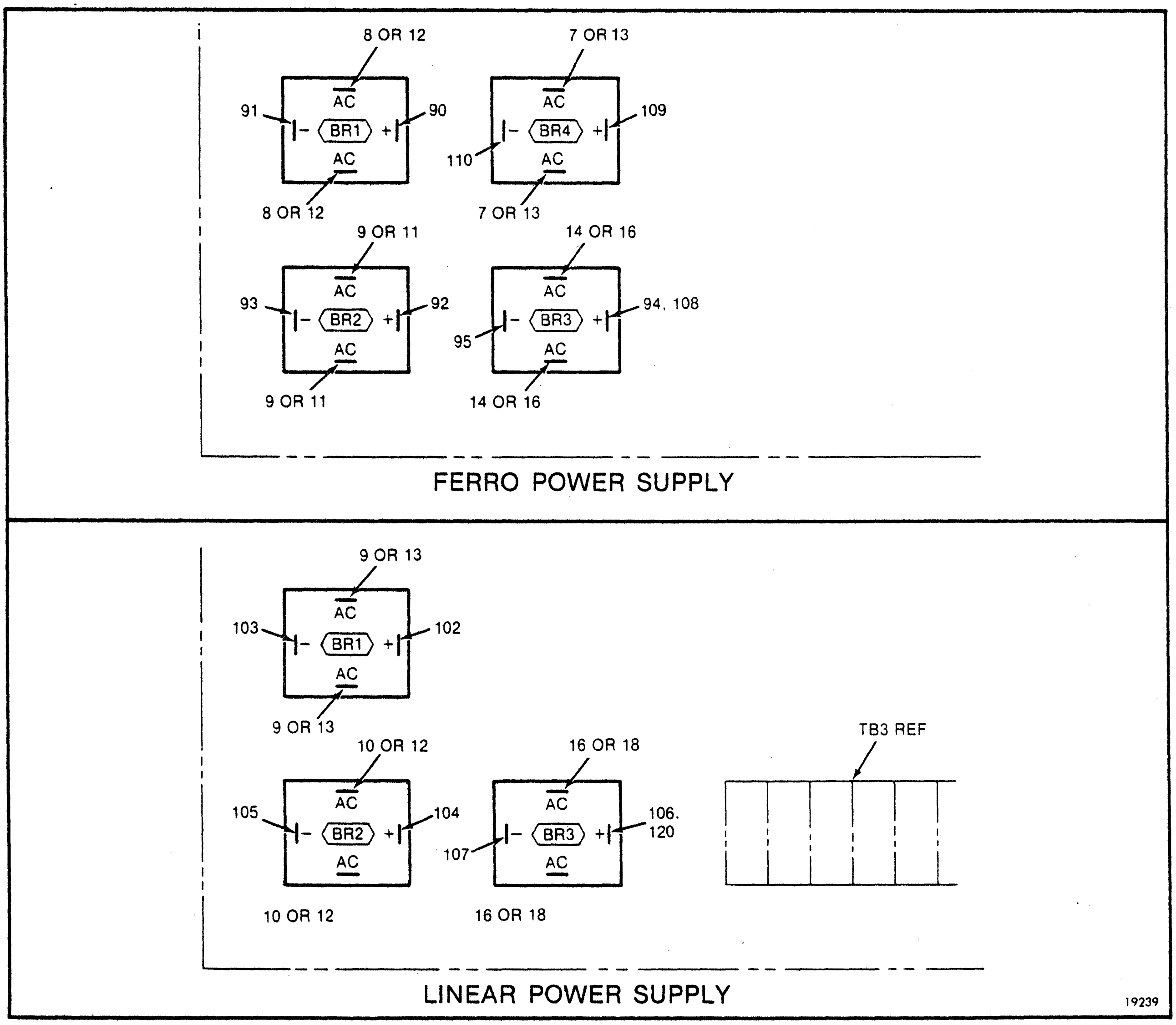


Figure 6-18. Bridge Rectifiers

6.6.7 LARGE FILTER CAPACITOR REPLACEMENT

The large filter capacitors are those that are located on the bottom of the power supply.

1. Perform the Power Supply Assembly Removal procedure (Section 6.6.1).
2. With the power supply on a bench, open the power supply access panel.
3. At the front of the large capacitors, disconnect the end of the two bleeder resistors attached to the capacitor grounding bar by loosening the mounting screws and removing the resistor lead from the screw.
4. Remove the four screws securing the capacitor grounding bar to the capacitors and remove the bar. It is not necessary to remove the leads attached to the grounding bar in order to remove the capacitors.
5. Remove the bleeder resistor (on linear power supplies) and leads on the appropriate capacitor by removing the terminal screw.
6. Remove the appropriate capacitor retaining bracket by removing the bracket mounting screw and then remove the appropriate capacitor.
7. Install the replacement capacitor by reversing this procedure. Before attaching the leads and grounding bar to the capacitor, verify that the capacitor orientation is correct to ensure correct polarity connections (refer to Figure 6-19A). Also refer to the figure for a diagram of the capacitor lead connections.

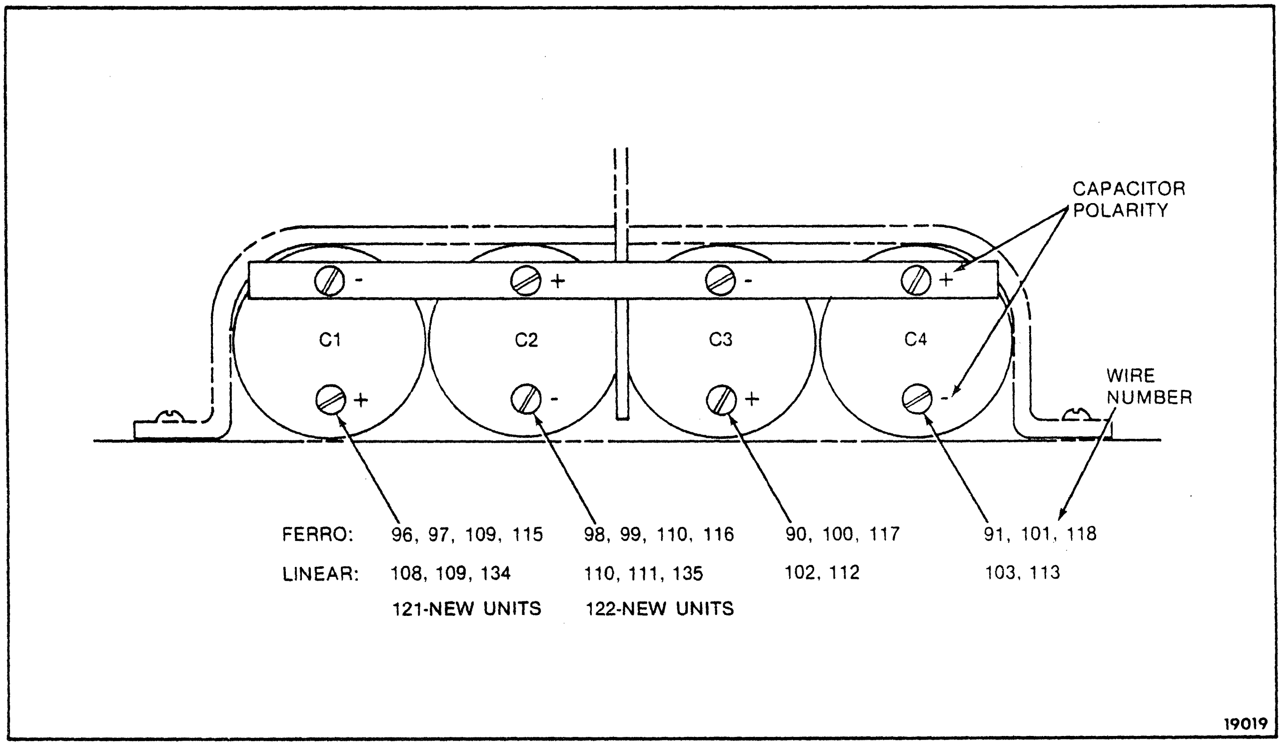


Figure 6-19A. Large Filter Capacitors

6.6.8 SMALL FILTER CAPACITOR REPLACEMENT

The small filter capacitors are those that are located on the inside of the power supply access panel.

1. Perform the Power Supply Assembly Removal procedure (Section 6.6.1).
2. With the power supply on a bench, open the power supply access panel.
3. At the inside of the power supply access panel, disconnect the end of the bleeder resistors attached to the capacitor grounding bar by loosening the mounting screws and removing the resistor lead from the screw.
4. Remove the four screws securing the capacitor grounding bar to the capacitors and remove the bar.
5. Release the capacitors from the capacitor retaining bracket by loosening or removing the four screws securing the retaining bracket. Two screws are on the right side of the access panel; two screws are on the left side of the access panel. Slide the retaining bracket free of the capacitors.
6. Remove the bleeder resistor and leads on the appropriate capacitor by removing the terminal screw.
7. Install the replacement capacitor by reversing this procedure. Before attaching the leads and grounding bar to the capacitor, verify that the capacitor orientation is correct to ensure correct polarity connections (refer to Figure 6-19B). Also refer to the figure for a diagram of the capacitor lead connections.

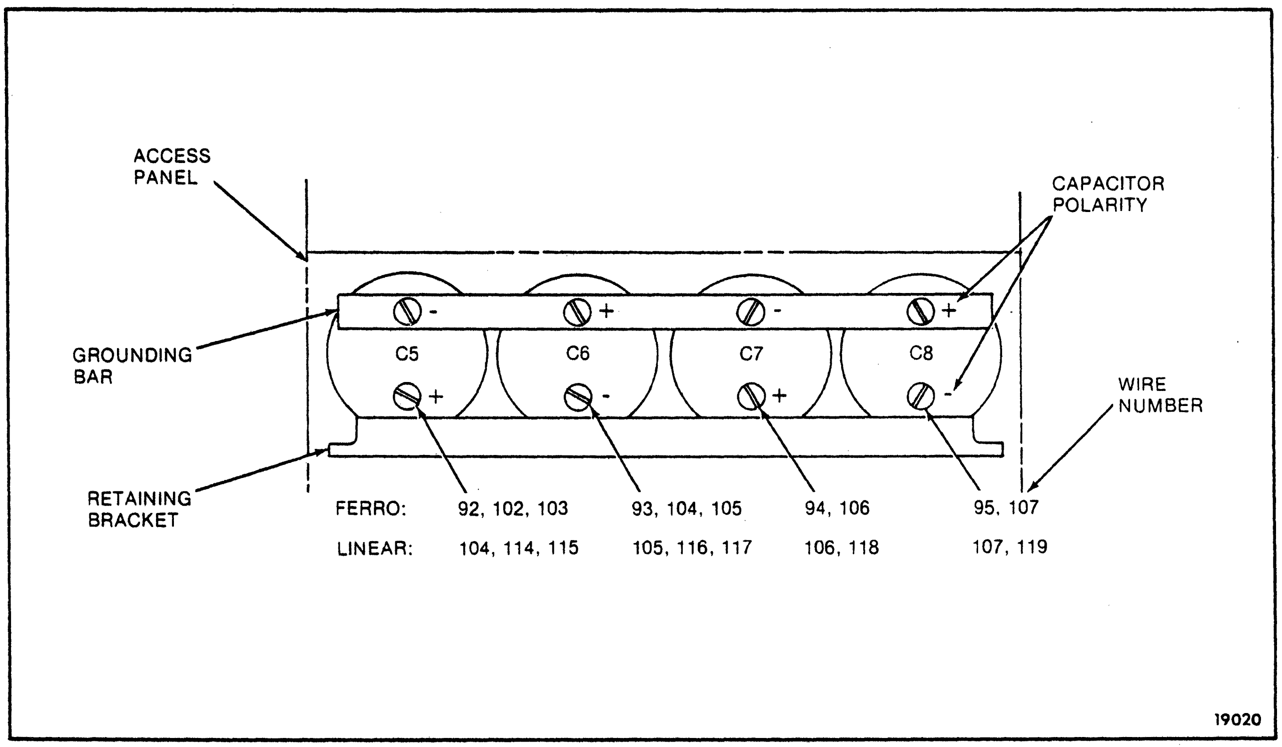


Figure 6-19B. Small Filter Capacitors

6.6.9 LINE FILTER REPLACEMENT

1. Perform the Power Supply Assembly Removal procedure (Section 6.6.1).
2. With the power supply on a bench, discharge all leads of the line filter to the center ground terminal or metal case; the filter can hold a charge at line potential.
3. Disconnect the leads attached to the line filter by removing the nuts securing the leads to the line filter studs.
4. Remove the four mounting screws securing the line filter to the power supply chassis and remove the filter.
5. Install the replacement line filter by reversing this procedure. Refer to Figure 6-20 for a diagram of the line filter leads connections.

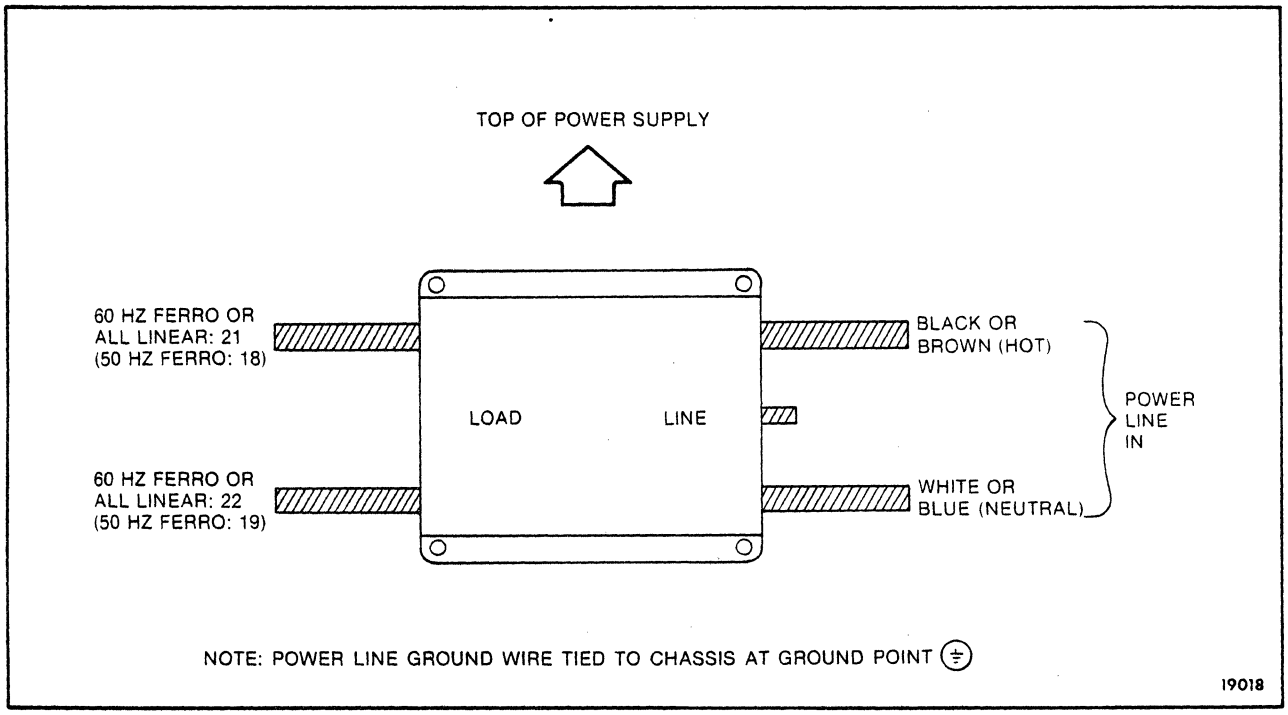


Figure 6-20. Line Filter

6.6.10 POWER TRANSFORMER REPLACEMENT

1. Perform the Power Supply Assembly Removal procedure (Section 6.6.1).

2. With the power supply on a bench, perform the preceding line filter removal procedure.

3. Disconnect all of the power transformer wire harness leads from their destinations. Refer to Table 6-1 for a table of the lead destinations.

   It may be useful to remove the connector bracket mounting screws and to pull the bracket forward out of the way.

5. Verify that the wires in the transformer wiring harness will not hinder the removal of the transformer. Check for cable clamps, wires wrapped around components, etc.

WARNING

The power transformer is heavy, approximately 55 pounds (25 kilograms). Exercise caution when lifting the transformer.

6. While supporting the transformer, remove the four transformer mounting bolts and lift the transformer straight up out of the power supply.

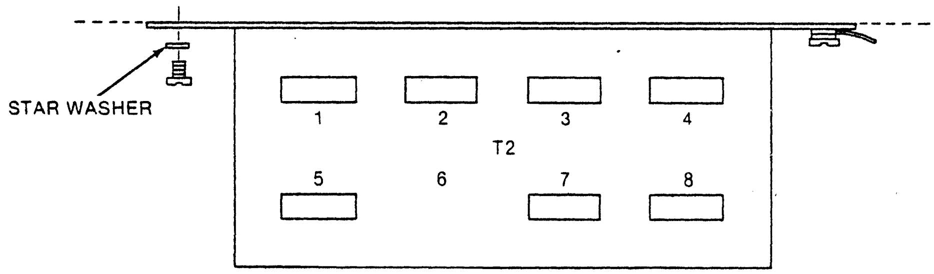
7. Install the replacement power transformer by reversing this procedure.

Table 6-1. Power Transformer Connections

WIRE NO.	60 Hz FERRO COMPONENT	50 Hz FERRO COMPONENT	LINEAR COMPONENT
1	TB1-1	TB1-1	TB1-5
2	TB1-3	TB1-5	TB1-3
3	TB1-5	TB1-6	TB1-1
4	TB1-2	TB1-7	TB1-6
5	TB1-4		TB1-4
6	TB1-6		TB1-2
7	BR4-AC	BR4-AC	TB1-7
8	BR1-AC	BR1-AC	
9	BR2-AC	BR2-AC	BR1-AC
10	CAP GND BAR	CAP GND BAR	BR2-AC
11	BR2-AC	BR2-AC	CAP GND BAR
12	BR1-AC	BR1-AC	BR2-AC
13	BR4-AC	BR4-AC	BR1-AC
14	BR3-AC	BR3-AC	
15	CAP GND BAR	CAP GND BAR	TB1-8
16	BR3-AC	BR3-AC	BR3-AC
17	C9	C9	CAP GND BAR
18	C9	C9	BR3-AC

6.6.11 AUXILIARY TRANSFORMER REPLACEMENT

1. Perform the Power Supply Assembly Removal procedure (Section 6.6.1).
2. With the power supply on a bench, open the power supply access panel.
3. Remove the lead slip-on connectors from the terminals of the auxiliary transformer.
4. Remove the mounting hardware from the auxiliary transformer and remove the transformer.
5. Install the replacement auxiliary transformer by reversing this procedure. During replacement it is important that the star lockwasher be used between the mounting screw and transformer on the side without the wire lug. Refer to Figure 6-21 for a diagram of the auxiliary transformer lead connections.



TERMINAL NUMBER	WIRE NUMBER		
	60 Hz FERRO	50 Hz FERRO	LINEAR
1	13,14	13	13,14
2	15	7*	15,16
3	7	7*	
4	17	14	
5	9	9	9
6			
7			
8	8	8	8

* Jumper between Terminals 2 and 3

19006

Figure 6-21. Auxiliary Transformer

6.6.12 INDUCTOR REPLACEMENT (LINEAR PS ONLY)

Older linear power supplies are equipped with inductors; newer supplies are not.

1. Perform the Power Supply Assembly Removal procedure (Section 6.6.1).
2. With the power supply on a bench, open the power supply access panel.
3. Disconnect the leads to the appropriate inductor by removing the screws from the inductor terminals.
4. Remove the mounting hardware from the appropriate inductor and remove the inductor.
5. Install the replacement inductor by reversing this procedure. Refer to Figure 6-22 for a diagram of the inductor lead connections.

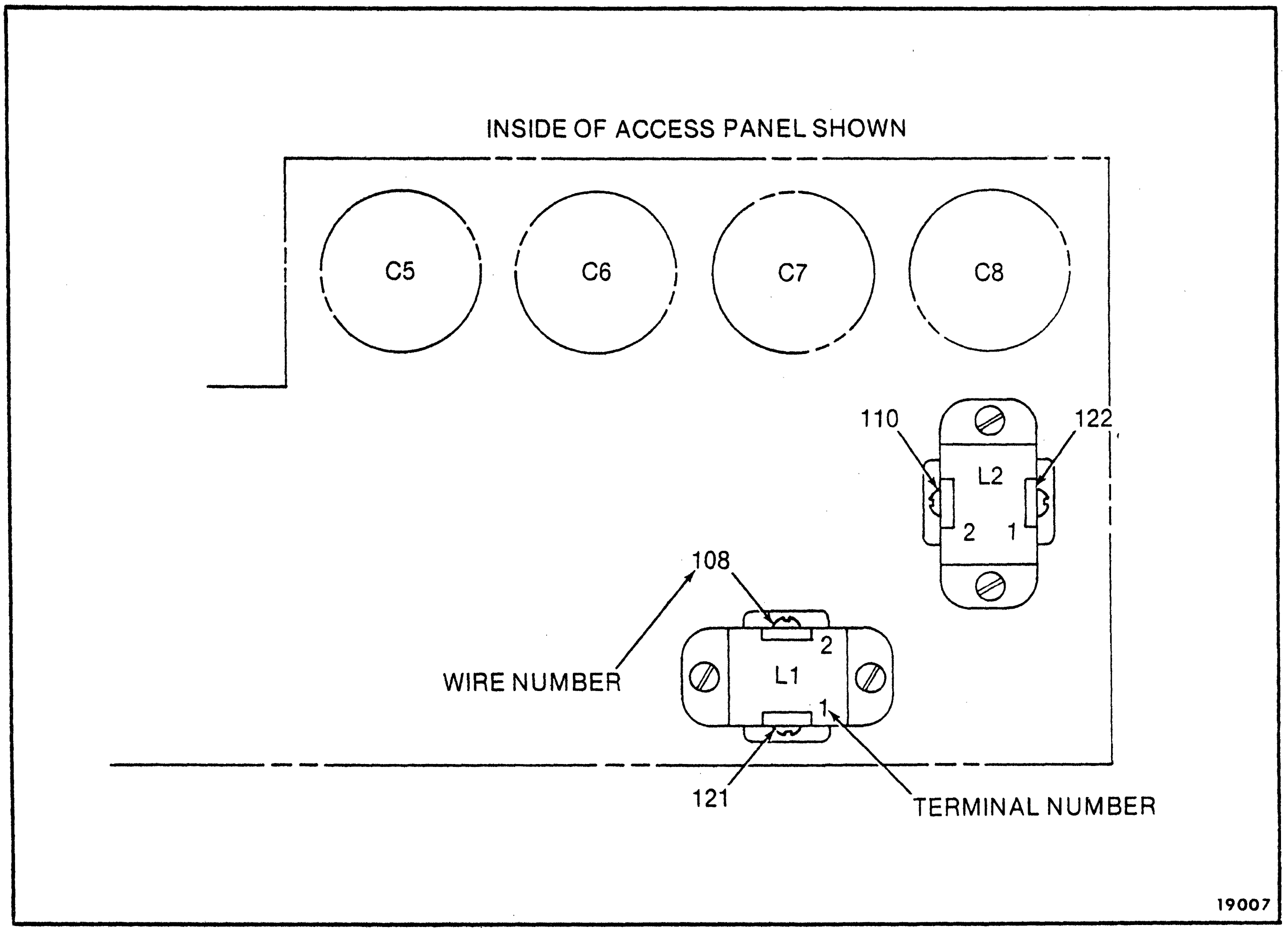


Figure 6-22. Inductors

6.7 PNEUMATICS SUPPLY

6.7.1 PNEUMATICS ASSEMBLY REMOVAL

1. Disconnect power from tape unit.
2. Loosen the screws securing the pneumatics belt guard to the pneumatics assembly mounting bracket and remove the guard.
3. Disconnect cable plug J5 from the power supply connector bracket.
4. Gain access to the rear of the tape unit and disconnect the pressure tubing from the pressure pump fitting.
5. Disconnect the vacuum hose from the rear of the vacuum blower.
6. Disconnect the exhaust hoses from the side of the vacuum blower.
7. At the front of the pneumatics assembly, remove the two large mounting screws securing the bottom of the pneumatics bracket to the frame bracket.

WARNING

The pneumatics assembly is heavy, approximately 45 pounds (20 kilograms). Exercise caution when moving the pneumatics assembly.

8. While supporting the pneumatics assembly, remove the two mounting screws securing the top of the pneumatics bracket to the tape unit frame.
9. Remove the pneumatics assembly from the tape unit and place it on a bench.
10. Install the pneumatics assembly by reversing this procedure.

6.7.2 PNEUMATICS DRIVE BELTS REPLACEMENT

1. Disconnect power from tape unit.
2. Loosen the screws securing the pneumatics belt guard to the pneumatics assembly mounting bracket and remove the guard.
3. Loosen, but do not remove, the three capscrews securing either the vacuum blower or pressure pump, as appropriate (see Figure 6-23).
4. Loosen the appropriate tension screw (supplying tension to the mounting plate) sufficiently to remove the belt from the pulley.

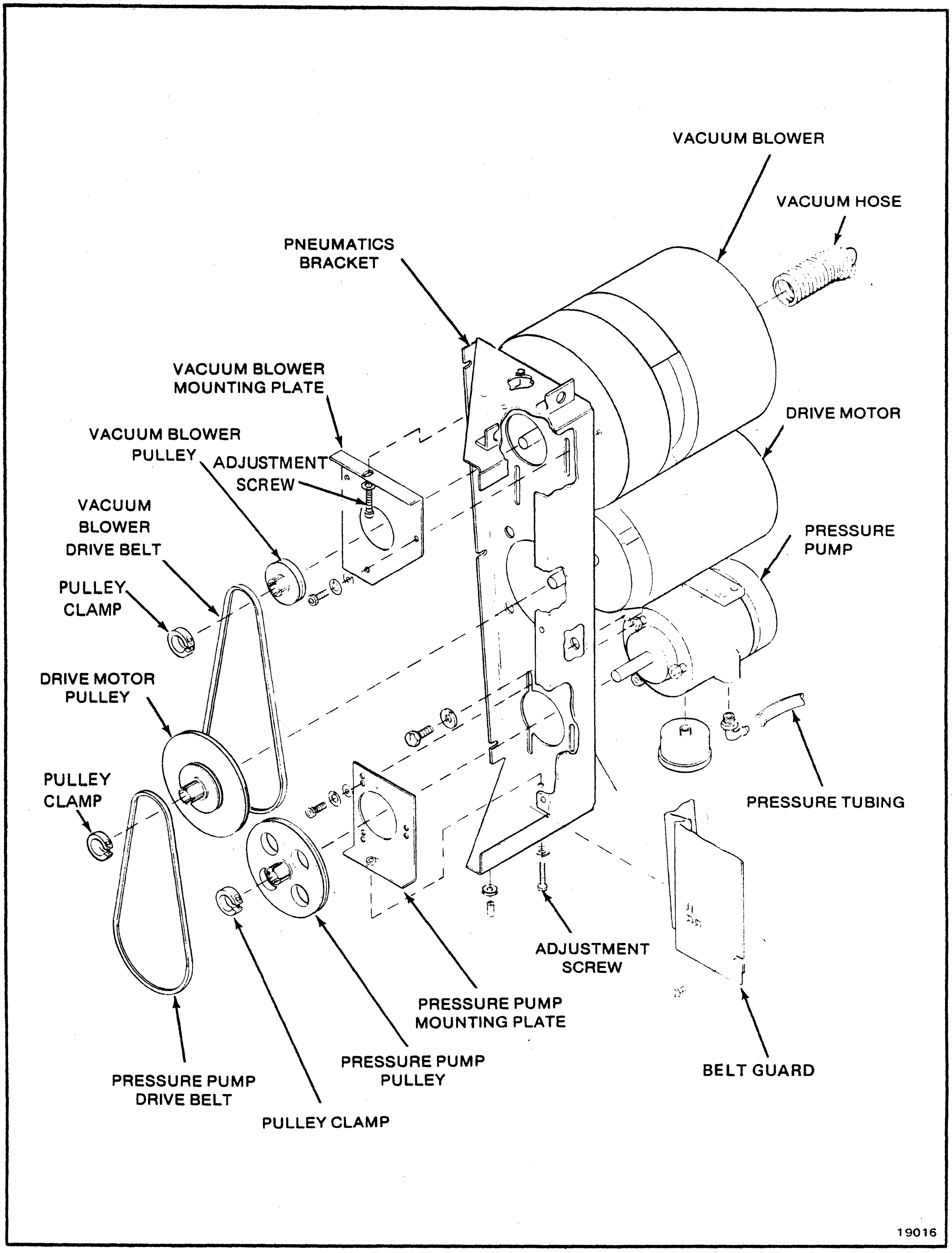


Figure 6-23. Pneumatics Assembly

5. Loop the replacement belt around the pulleys.

NOTE

If the vacuum blower belt is being replaced, make certain that the belt is replaced on the correct vacuum blower pulley flange: the large flange is for low altitude environments, that is, less than 1100 feet (335 meters); the small flange is for high altitude environments, that is, between 1100 and 6000 feet (335 and 1830 meters).

The vacuum blower drive belt is driven off the large flange of the drive motor pulley; the pressure pump belt is driven off the small flange of the drive motor pulley.

6. Use the appropriate tension screw to tighten the replacement drive belt to 12 to 14 pounds and tighten the capscrews to secure the mounting plate.
7. Reinstall the pneumatics belt guard.
8. Check pneumatics supply functions and check tape unit operation.
9. After 15 minutes running time, recheck drive belt tension by performing the Pneumatics Drive Belt Tension Adjustment procedure (Section 5.4.2).

6.7.3 PNEUMATICS PULLEY ALIGNMENT

1. Disconnect power from tape unit.
2. Loosen the screws securing the pneumatics belt guard to the pneumatics assembly mounting bracket and remove the guard.
3. Perform the pneumatics drive belt removal procedure (Section 6.7.2, steps 3 and 4).
4. Make certain that the pneumatics drive motor, pressure pump, and vacuum blower are firmly secured.
5. Verify that the distance between the pneumatics mounting bracket and the inner surface of the drive motor pulley is 0.40 (±.03) inches.
6. Loosen the pressure pump pulley clamp screw and slide the pressure pump pulley toward the pressure pump as far as possible.
7. Position one end of a straight edge flat on the outer surface of small flange of the drive motor pulley (see Figure 6-24).
8. Position the other end of the straight edge over the outer surface of the pressure pump pulley flange and slide the pump pulley away from the pump until the outer surface of the pump pulley touches the straight edge.

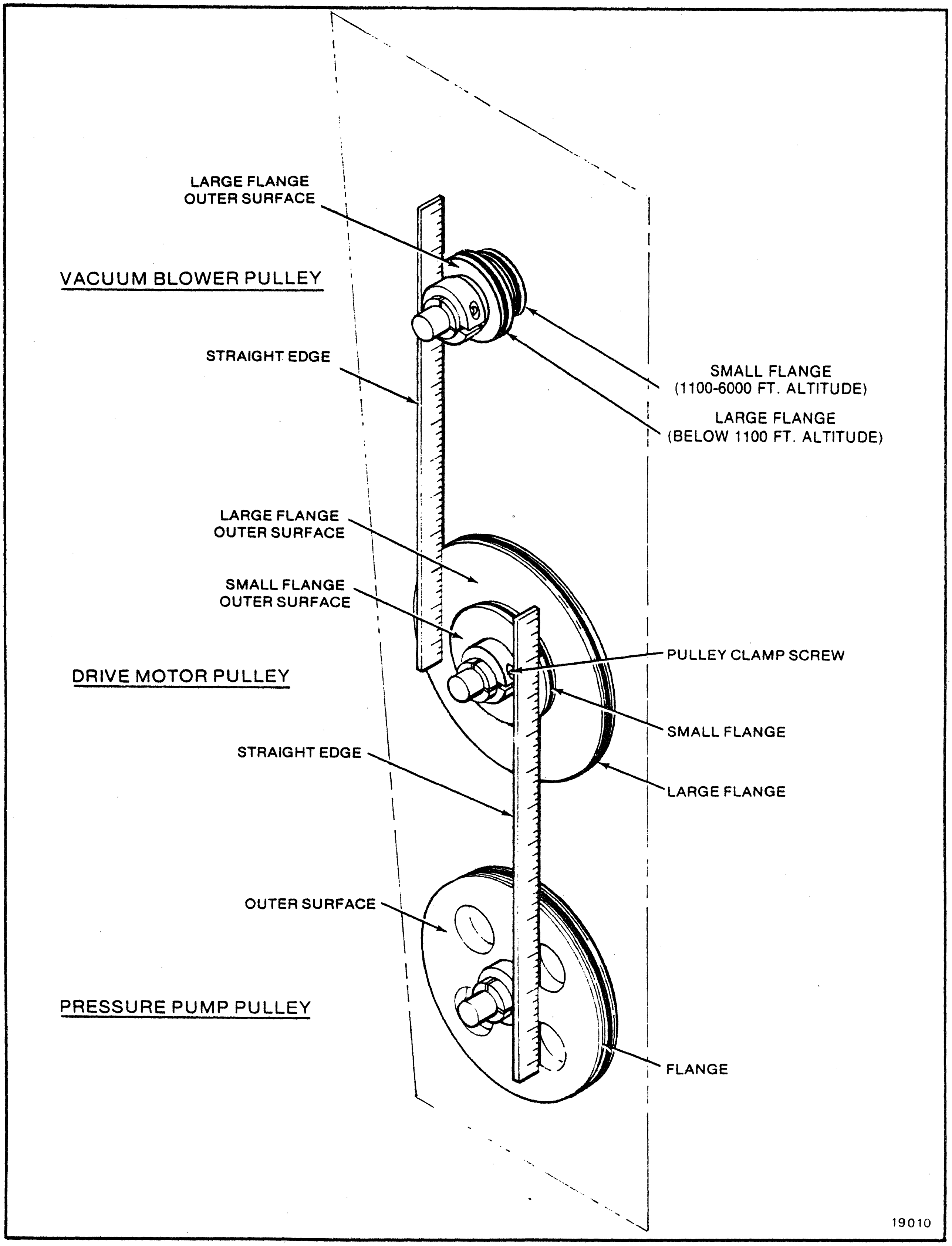


Figure 6-24. Pneumatics Pulley Alignment

9. Tighten the pump pulley clamp screw to secure the pulley in position.

10. Loosen the vacuum blower pulley clamp screw and slide the vacuum blower pulley toward the blower as far as possible.

11. Position one end of a straight edge over either the outer surface of the large flange of the ***drive motor*** pulley (for low altitude environments) or the outer surface of the small flange of the ***drive motor*** pulley (for high altitude environments). Refer to Figure 6-24.

12. Position the other end of the straight edge over the outside (large) flange of the vacuum blower pulley and slide the blower pulley away from the blower until the outside flange of the blower pulley touches the straight edge.

13. Tighten the vacuum blower pulley clamp screw to secure the blower pulley in position.

14. Perform the Pneumatics Drive Belts Replacement procedure (Section 6.7.2, steps 5 through 9).

6.7.4 PNEUMATICS VACUUM BLOWER REPLACEMENT

1. Perform the Pneumatics Assembly Removal procedure (Section 6.7.1).

2. With the pneumatics assembly on a bench, perform the pneumatics drive belt removal procedure (Section 6.7.2, steps 3 and 4) to remove the vacuum blower drive belt.

3. Remove the vacuum blower pulley from the vacuum blower shaft by loosening the pulley clamp screw and sliding the pulley free of the shaft (see Figure 6-23).

4. Note the orientation of the vacuum blower to the pneumatics mounting bracket in order to correctly position the vacuum blower upon installation.

5. While supporting the vacuum blower, remove the three screws securing the blower to its mounting plate.

6. Remove the muffler from the original blower and install the muffler on the replacement vacuum blower.

7. Use the original mounting hardware to mount the replacement vacuum blower. Ensure that the vacuum blower mounting plate is correctly positioned (see Figure 6-23).

8. Perform the Pneumatics Pulley Alignment procedure (Section 6.7.3).

9. Perform the Pneumatics Drive Belt Tension Adjustment procedure (Section 5.4.2).

10. Install the pneumatics supply by reversing the Pneumatics Assembly Removal procedure.

11. Check the pneumatics supply functions (refer to Section 5.4.3), listen for unusual noise from the pneumatics supply, and check tape unit operation.

6.7.5 PNEUMATICS PRESSURE PUMP REPLACEMENT

1. Perform the Pneumatics Assembly Removal procedure (Section 6.7.1).
2. With the pneumatics assembly on a bench, perform the pneumatics drive belt removal procedure (Section 6.7.2, steps 3 and 4) to remove the pressure pump drive belt.
3. Remove the pressure pump pulley from the pressure pump shaft by loosening the pulley clamp screw and sliding the pulley free of the shaft (see Figure 6-23).
4. Note the orientation of the pressure pump to the pneumatics mounting bracket in order to correctly position the pressure pump upon installation.
5. While supporting the pneumatics pressure pump, remove the three screws securing the pump to its mounting bracket.
6. Use the original hardware to mount the replacement pressure pump. Ensure that the pressure pump mounting plate is correctly positioned (see Figure 6-23).
7. Perform the Pneumatics Pulley Alignment procedure (Section 6.7.3).
8. Perform the Pneumatics Drive Belt Tension Adjustment procedure (Section 5.4.2).
9. Install the pneumatics supply by reversing the Pneumatics Assembly Removal procedure.
10. Check the pneumatics supply functions, listen for unusual noise from the pneumatics supply, and check tape unit operation.

6.7.6 PNEUMATICS DRIVE MOTOR REPLACEMENT

1. Perform the Pneumatics Assembly Removal procedure (Section 6.7.1).
2. With the pneumatics assembly on a bench, perform the pneumatics drive belt removal procedure (Section 6.7.2, steps 3 and 4) to remove both drive belts.
3. Remove the pneumatics drive motor pulley from the motor shaft by loosening the pulley clamp screw and sliding the pulley free of the shaft (see Figure 6-23).
4. Note the orientation of the drive motor to the pneumatics mounting bracket in order to correctly position the drive motor upon installation.
5. While supporting the motor, remove the four screws securing the motor to the mounting bracket.

6. Use the original mounting hardware to mount the replacement drive motor.
7. Perform the Pneumatics Pulley Alignment procedure (Section 6.7.3).
8. Perform the Pneumatics Drive Belt Tension Adjustment procedure (Section 5.4.2).
9. Install the pneumatics supply by reversing the Pneumatics Assembly Removal procedure.
10. Check the pneumatics supply functions (refer to Section 5.4.3), listen for unusual noise from the pneumatics supply, and check tape unit operation.

APPENDIX A

MACHINE CHECK CODES

The following machine check codes are displayed in the maintenance test panel LED indicators upon determination of the associated fault. These codes are valid only when a machine check condition is indicated by the flashing of the operator panel RESET indicator.

Supplemental information is available for some codes as described below. This information should be retrieved from the indicated RAM location (via maintenance program 7) while the machine condition is current. A reset, from either the operator panel or the maintenance test panel, will reinitialize the tape unit and the fault code and other RAM contents will be lost.

CODE (HEX) DESCRIPTION

POWER-UP FAILURES

03 CRY1, BRW1, CRY2, or BRW2 on after counters cleared.

04 Counters cleared and loaded to 0 but A-REG not equal to B indicated.

05 CNTR2 decremented from 0; BRW2 not detected or other conditions changing.

06 CNTR2 decremented from 0 (=FF hex), A-REG=0; comparator outputs incorrect.

07 CNTR1 read failure indicated by comparator output.

08 CNTR2 increment failure based on comparator output.

09 CNTR2 increment failure based on CRY2/BRW2 outputs.

0A CNTR1 increment failure based on CRY1/BRW1 outputs.

0B CNTR2 loaded from A-REG (=FF hex); comparator shows A not equal to B.

0C CNTR1/CNTR2 did not overflow (CRY=1) when incremented from FF hex.

0D Both counters loaded to 55 hex; CNTR1 read back. Comparator shows A not equal to B.

0E Both counters loaded to AA hex; CNTR1 read back. Comparator shows A not equal to B.

12 Utility PROM (rewind profile) addressing or contents compare failure.

13 See Code 12.

18 Diagnostic register (JL card) load/read or DIAG6, DIAG7 branch condition failure.

19 See Code 18.

1C 16-Byte RAM failed load/compare.

2E Based on branch conditions, interrupt did not occur when expected. RAM4 contains failing interrupt mask as follows:

Bit 0	Not selected
Bit 1	BOT
Bit 2	EOT
Bit 3	Machine column not loaded
Bit 4	File column not loaded
Bit 5	Not EOT
Bit 6	Not interlocked

2F Based on branch conditions, interrupt occurred when not expected. See Code 2E for RAM4 contents.

30 REV/CNT (turns counter) should not be on after initialization.

31 FWD/REV (turns counter) should not be on after initialization.

32 Diagnostic turns counter increment enabled via DGREG; 799 (decimal) tach pulses simulated. REV/CNT should not be asserted yet.

33 After 800 (decimal) diagnostic turns count increments, REV/CNT not set.

34 After 800 (decimal) diagnostic turns count increments, FWD/REV not set.

35 After REV/CNT seen (both FWD and BKWD counters overflowed), FWD counter was reset, REV/CNT should not have reset. This indicates no output from BKWD counter.

36 FWD/REV output not cleared following command.

37 REV/CNT output not cleared following reset of both FWD and BKWD counters.

38 1000 (decimal) turns count increments did not produce REV/CNT output.

39 1000 (decimal) turns count increments did not produce FWD/REV output.

3A Reset of BKWD counter cleared FWD/REV output.

3B Following reset of FWD and BKWD counters, REV/CNT remained asserted.

3C Following reset of FWD and BKWD counters, FWD/REV remained asserted.

3E Online latch not reset after power-up or manual reset.

3F TU/INIT latch not set following power-up.

THREAD FAILURES: PRE-PNEUMATICS

40 Pneumatic switch(es) asserted before blower/pump on. RAM4 indicates failing switch as follows. Note: Bit 2 should be ON; all others should be OFF in the no-error condition.

Bit 0	File protect
Bit 1	Cartridge present
Bit 2	File column loop position sensor; SLW DWN CAP output
Bit 3	Mach column loop position sensor; SLW DWN CAP output
Bit 4	Machine reel loaded
Bit 5	Machine column loaded
Bit 6	File column loaded
Bit 7	Leader position switch (closed) window

41 Interlock switch (door not closed).

42 Pre-load capstan check failure; no TACHØA and/or TACHØB.

43 Capstan was driven forward; tachs indicate backward phasing.

44 Counter 2 not incrementing from TACHØA.

45 Capstan was driven backward; tachs indicate forward phasing.

46 Counter 2 incremented from TACHØA after disabled.

48 Cartridge open not indicated.

49 Cartridge open indicated following closing.

THREAD FAILURES: POST-PNEUMATICS

4A Tape tension switch on without machine reel loaded.

4B EOT and/or BOT on with machine reel loaded (mid-tape load).

4D EOT and/or BOT off during autoload (RAM5 = 1; leader present detected) or cartridge load (RAM5 = 6).

THREAD FAILURES: FILE REEL MOTION

50 Open reel thread failure: failed to detect tape leader during five reel revolutions.

51 Open reel thread failure: failed to detect tape leader in thread path (EOT and BOT off).

THREAD FAILURE: FILE/MACH REEL MOTION

56	Machine reel loaded timeout.
57	Tape tension not detected during forward motion.
59	No BOT marker detected in 30-foot search.
5A	Machine column loading timeout.
5B	Post-machine column loading pneumatic switch(es) incorrect. RAM4 (expected 20 hex) indicates failure as defined for Code 40.
5C	File column loading timeout.
5E	Based on branch conditions following columns loaded, interrupt did not occur when expected. RAM4 contains failing interrupt mask as defined for Code 2E.
5F	Based on branch conditions following columns loaded, interrupt occurred when not expected. RAM4 contains failing interrupt mask as defined for Code 2E.

COLUMN FAULT INTERRUPTS

61	Machine column not loaded.
62	File column not loaded.

APPENDIX B

SPECIAL TEST EQUIPMENT, TOOLS, AND SUPPLIES

The following lists special test equipment, tools, and supplies for maintaining the 1950 Series Tape Units.

ITEM	PART NUMBER	FUNCTION
Belt Tension Meter	STC 0157	Belt tension adjust
Pressure/Vacuum Meter 0-100 inches H_2O	Magnehelic 2100	Pneumatics levels adjust
Tape Loop (134 inches) (optional)	STC 4012191-01	Reel servo adjust
Tape Loop Alignment Sleeve (optional)	STC 4012371-01	Reel servo adjust
Capstan Setting Tool	STC 4015508-01	Capstan alignment
Skew Tape	STC 10631	R/W Head Alignment
Standard Amplitude Tape	STC 4012021-02	Read amplitude adjust
Magna-See Tape Developer	Sound Craft	Bit position check
Jeweler's Loupe (optional)	Bauch&Lomb 81-34-35	Bit position check
Capstan Removal Tool	STC 4012380-01	Capstan replacement
Capstan Wrench (optional)	STC 4012674-01	Capstan replacement
File Reel Hub Position Tool	STC 4012477-01	File reel hub replacement
Machine Reel Position Tool (optional)	STC 4012381-01	Machine reel replacement
Transport Cleaning Fluid	STC 6167	Tape path cleaning
Hub Cleaning Fluid	STC 12120	File reel hub cleaning
Lint-Free Cloth	STC 6168	Tape path cleaning
Foam-Tipped Swabs	STC 11698	Tape path cleaning

APPENDIX C

VOLTAGE AND FREQUENCY CONVERSIONS

C.1 INTRODUCTION

The 1950 Series Tape Units are designed to operate over a wide range of input line voltages and frequencies and can be converted from one input configuration to any other configuration within the range. This appendix explains what changes are to be made in the event a conversion is necessary and provides procedures for the field conversion of a tape unit.

C.2 VOLTAGE CONVERSION

The 1950 Tape Unit has, as standard, either a 60 Hz ferro power supply, designed to operate using 120, 208, 220, or 240 Vac, or a 50 Hz ferro power supply designed to operate using 220 or 240 Vac. The optional linear power supply will operate over a frequency range of 47 to 63 Hz and a voltage range of 120 to 240 Vac. Two different motors are used to drive the vacuum blower and pressure pump on the pneumatics assembly: General Electric and Gould. Both motors are rated at 3/4 hp and are capable of utilizing input voltages of 102 to 132 or 216 to 254 Vac and input frequencies of 60 Hz or 50 Hz.

A change in the input line voltage requires the power supply to be modified by resetting the voltage range of the power supply auxiliary transformer, rewiring circuit breaker CB1, and rewiring terminal block TB1. In addition, the pneumatics motor must be rewired.

C.2.1 POWER SUPPLY VOLTAGE CONVERSIONS

1. Disconnect power from the tape unit.

2. Open the power supply access panel. This will expose auxiliary power transformer T2, circuit breaker CB1, and transformer terminal board TB1. Refer to Figure C-1.

3. Set the auxiliary power transformer for the correct voltage. On most power supplies (except 50 Hz ferro) this is accomplished by setting switch S1 to either the 120 V or 240 V position. However, some early linear power supplies do not have switch S1 so that the auxiliary power transformer must be rewired to convert it. Figure C-2 shows the auxiliary power transformer T2 wired for 120 V, the conversion to 240 V, and schematic representations for both wirings. It should be cautioned that the wiring harness may not be labeled as shown in the figure. What is important is that the wiring for the 120 V power supply connects the auxiliary power transformer windings in parallel and the wiring for the 240 V power supply connects the windings in series.

4. Remove circuit breaker CB1 from the power supply by removing the four screws holding it in place. Pull the breaker out so that the terminals are accessible.

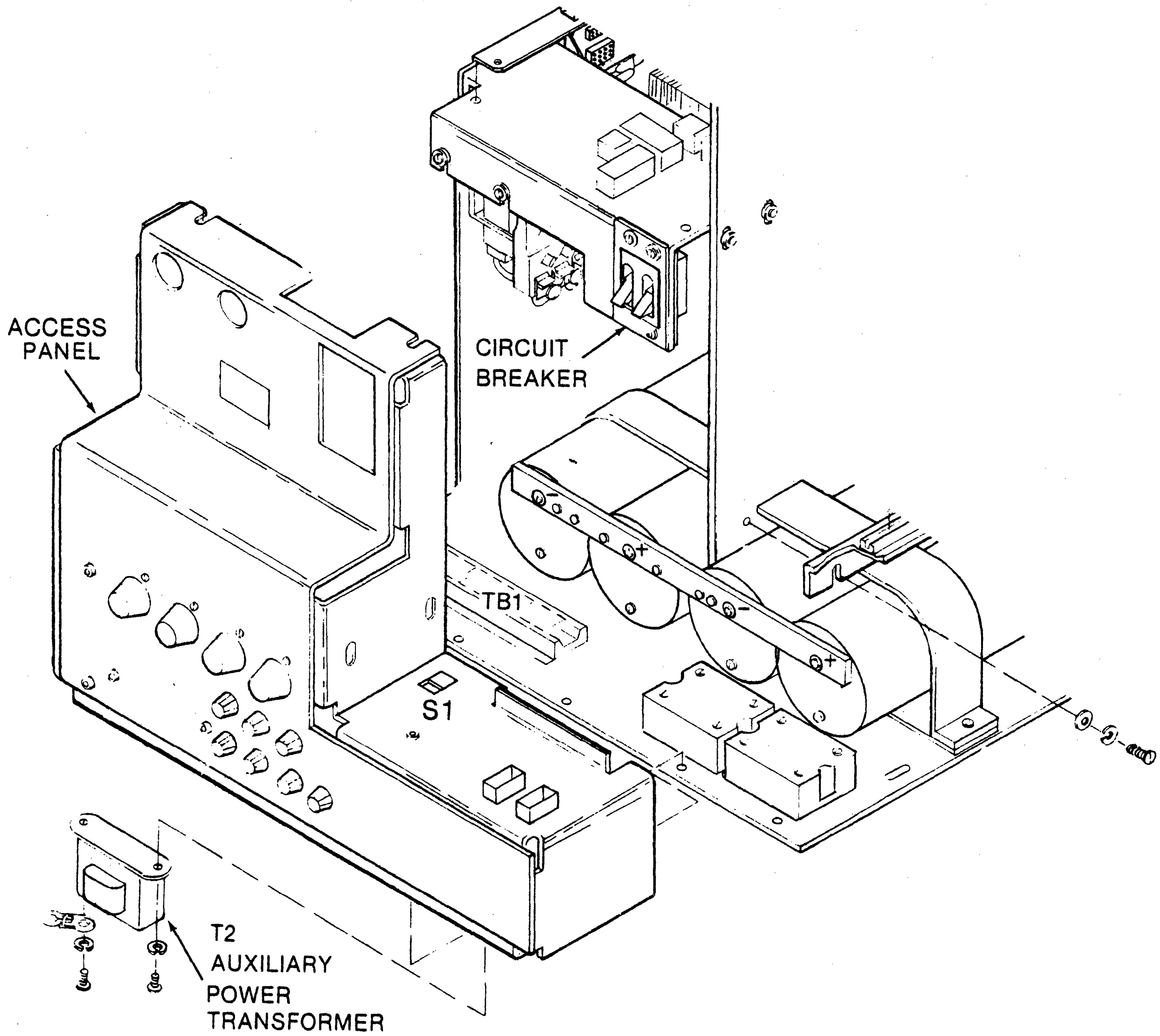


Figure C-1. Power Supply Components Locations

5. Referring to Figure C-3, rewire circuit breaker CB1 for the proper operating range. Note that circuit breakers from two different manufacturers are used and that each type of circuit breaker has output connections physically opposite the other. Figure C-3 lists the proper connections for the line voltage ranges and shows the connection locations on the two different circuit breakers.

6. Attach the circuit breaker to the connector panel.

7. Rewire transformer terminal block TB1 for the correct operation. Table C-1 lists the primary inputs, TB1 jumper locations, and the primary incoming AC voltage connection on TB1 for the ferro and linear power supplies.

8. Close and secure the power supply access panel taking care not to pinch or damage any wires.

9. Remove the line cord and replace it with one appropriate to the installation.

C.2.2 PNEUMATICS MOTOR VOLTAGE CONVERSION

1. Disconnect power from the tape unit.

2. Gain access to the rear of the tape unit and remove the cover plate from the rear of the pneumatics drive motor.

3. Referring to Figure C-4, rewire the pneumatics drive motor for the correct operation. For the General Electric motor, two small jumpers must be relocated. For the Gould motor, two leads must be plugged onto different terminals.

4. Replace the cover plate on the pneumatics drive motor.

C.3 FREQUENCY CONVERSION

A change in input line frequency will require replacing the ferro power supply because each ferro transformer can operate at only one frequency. The procedure for replacing the power supply is explained in Section 6.6.1. The linear power supply, however, is not effected by changing the frequency of the input line. The only effect a frequency change has on the pneumatics motor is to change its rotational speed. To accomodate the change in rotational speed, the drive pulley on the motor must be exchanged for one with the appropriate diameter. Motors running on 60 Hz input use a 4.562 inch diameter pulley while motors running on 50 Hz use a 5.474 inch diameter pulley. The procedure for changing the pneumatics pulley is explained in Section 6.7.6.

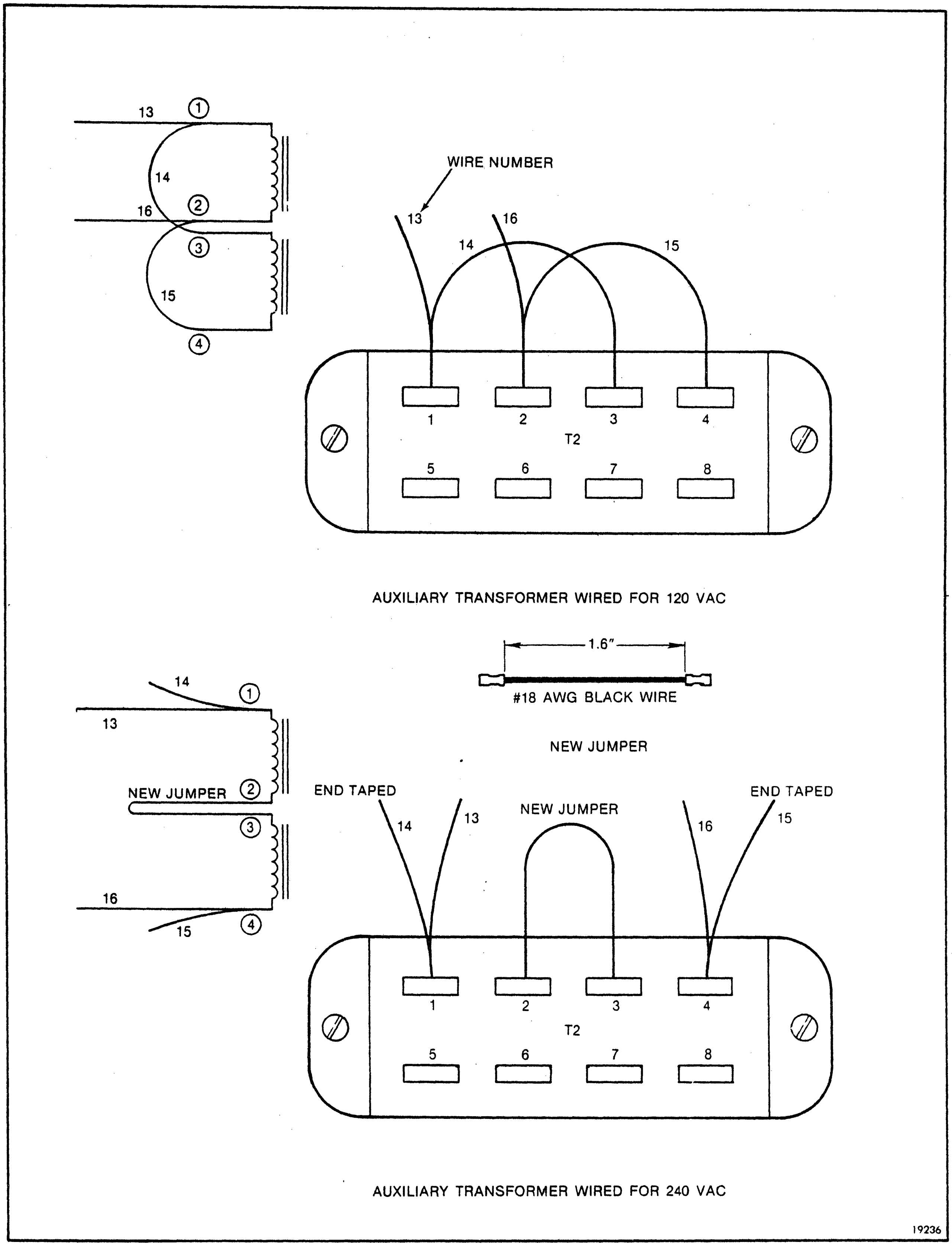
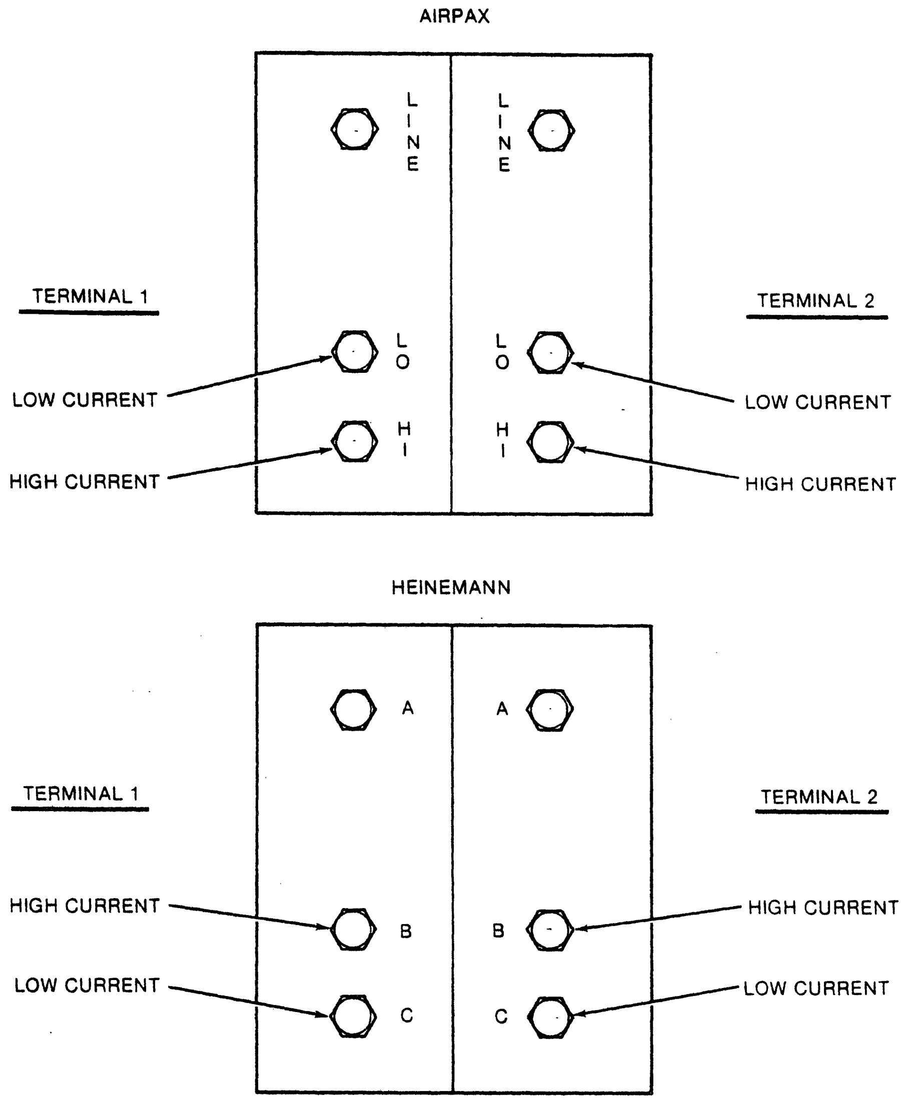


Figure C-2. Auxiliary Transformer Wiring



LINE VOLTAGE	BREAKER OUTPUT CONNECTIONS (FERRO AND LINEAR)
120 V	HI OR B
208 V	LO OR C
220 V/240 V	LO OR C

19237

Figure C-3. Circuit Breaker Wiring

Table C-1. Power Transformer Connections

	FERRO 60 Hz TRANSFORMER CONNECTIONS TBI	
PRIMARY INPUT	JUMPER BETWEEN	CONNECT INCOMING PRIMARY TO
120 V	1 & 2, 5 & 6	6
208 V	2 & 3, 4 & 5	4
220 V	2 & 3	6
240 V	2 & 5, 7 & 8	6

	FERRO 50 Hz TRANSFORMER CONNECTIONS TBI	
PRIMARY INPUT	JUMPER BETWEEN	CONNECT INCOMING PRIMARY TO
220 V	1 & 2, 7 & 8	6
240 V	1 & 2, 7 & 8	7

	LINEAR TRANSFORMER CONNECTIONS TBI	
PRIMARY INPUT	JUMPER BETWEEN	CONNECT INCOMING PRIMARY TO
120 V	1 & 2, 5 & 6	5
208 V	2 & 3	4
220 V	2 & 3	6
240 V	2 & 5	6

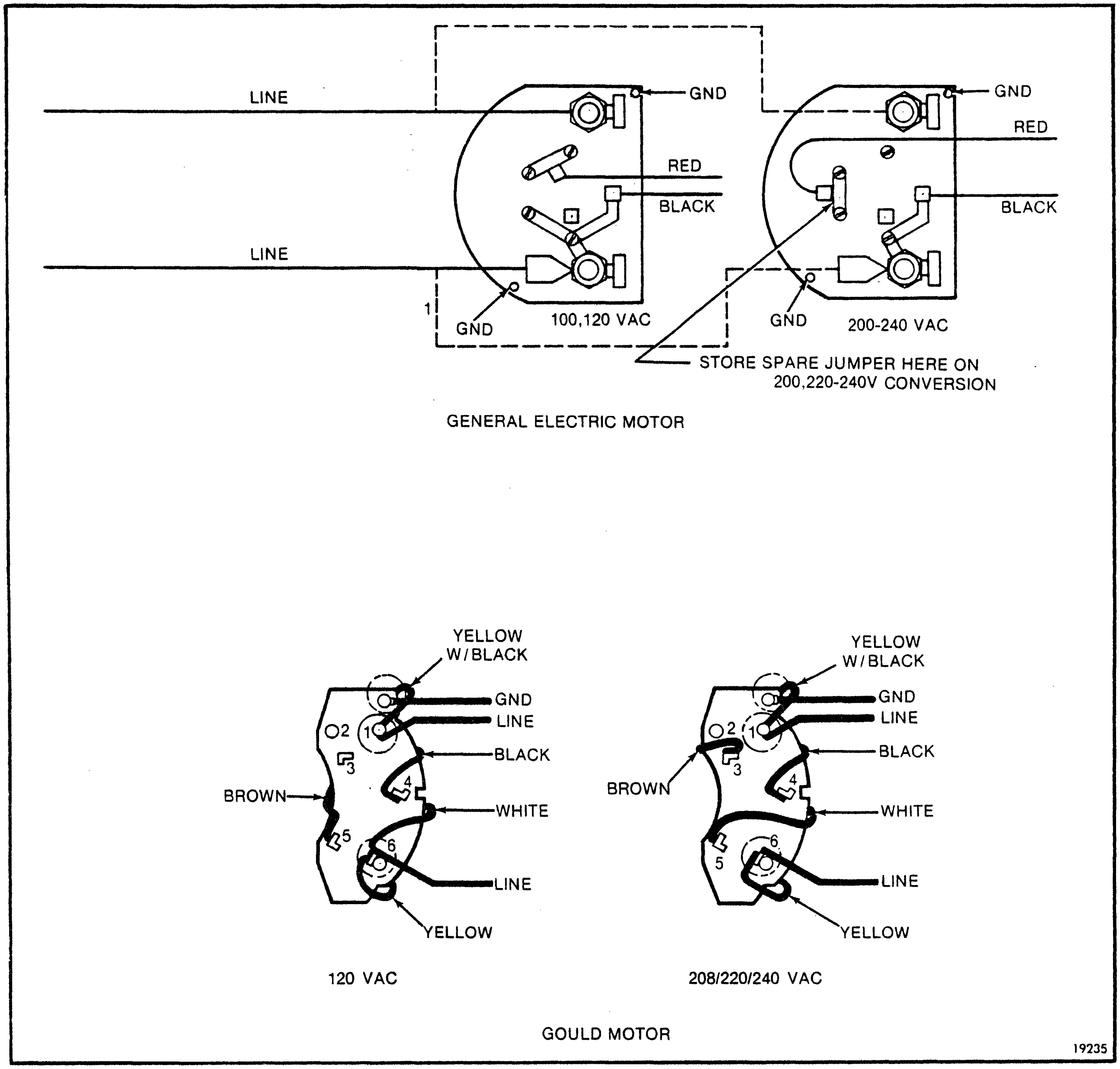


Figure C-4. Pneumatics Motor Wiring

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