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DATATAPE®

13-501 TAPE TRANSPORT

OPERATION AND MAINTENANCE MANUAL

INSTRUMENTS DIVISION
360 Sierra Madre Villa, Pasadena, California 91109

BELL & HOWELL

This manual contains the operation and maintenance procedures for the Type 13-501 Tape Transport, with serial numbers 3001 through 3999.

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SECTION I

GENERAL DESCRIPTION

1-1. GENERAL.

1-2. This manual contains operation and maintenance instructions for the Bell & Howell Type 13-501 Magnetic Tape Transport. It includes installation instructions, operation instructions, theory of operation, and procedures for adjustment, alignment, calibration, and maintenance.

1-3. DESCRIPTION.

1-4. The 13-501 Tape Transport, shown in figure 1-1, is designed to handle either 1/2 inch or 1 inch wide magnetic tape at nine switch selectable bidirectional speeds of 240, 120, 60, 30, 15, 7.5, 3.75, 1.875, and 0.9375 inches per second.

1-5. The tape speeds are controlled by a phase lock (closed loop) servo system which compares signal frequencies from a reference generator with an optical tachometer that forms an intrinsic part of the capstan motor assembly.

1-6. The capstan is directly driven by a dc motor. A complete assembly consisting of the capstan, motor, tachometer, and flywheel controls all modes of tape handling: Fast Forward, Fast Reverse, Forward Run, Reverse Run, and Search. Search modes move tape at any preset speed within the range of 30 ips to 240 ips for quickly scanning data recorded on the tape.

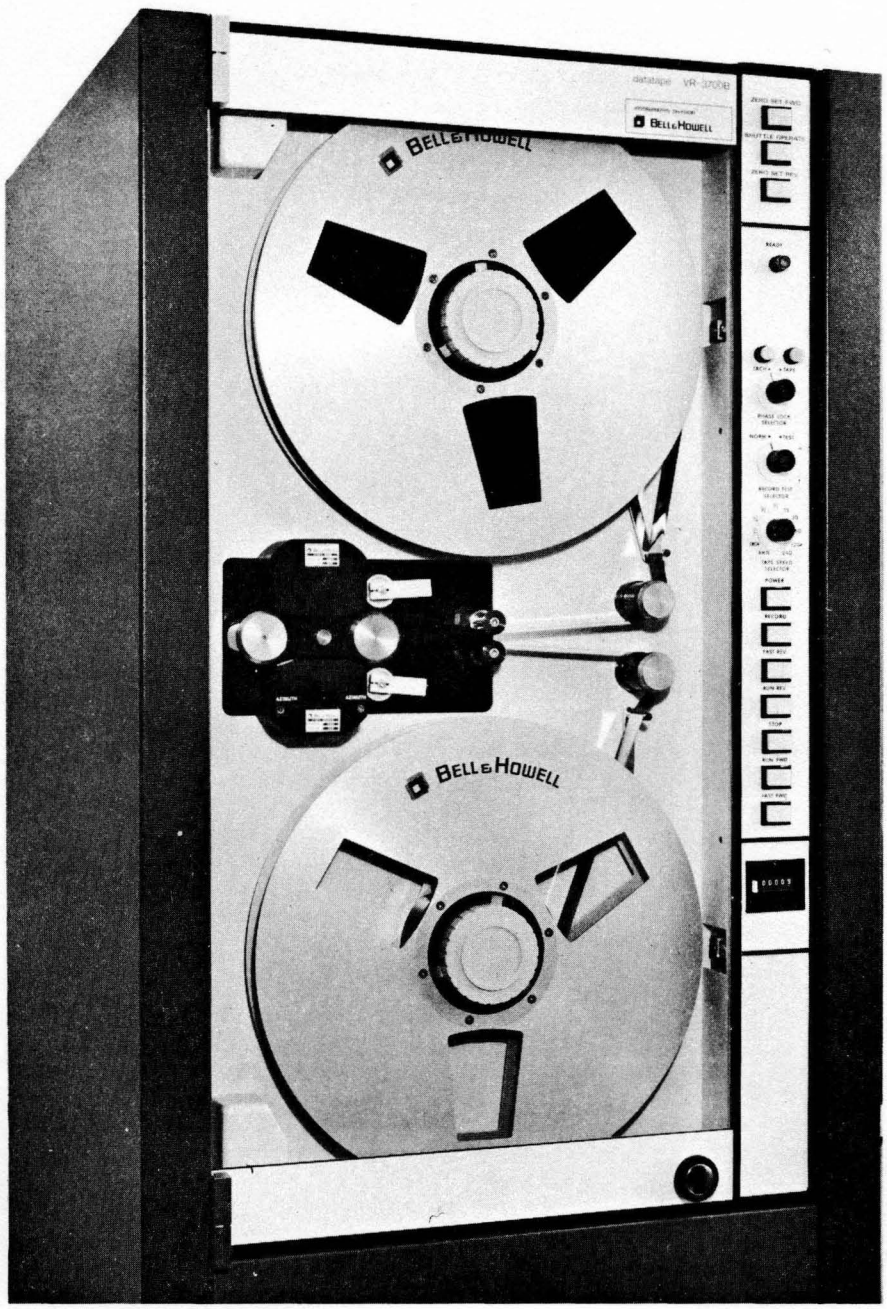
1-7. For gentle tape handling, dynamic braking is used to stop tape motion from all operating modes. After tape motion stops, or in the event of power failure, fail-safe mechanical brakes hold the reels stationary. A microswitch sensing circuit automatically stops tape motion if the tape becomes slack, or at end-of-tape conditions if the tape runs off the reel.

1-8. Adjustable photoelectric end-of-reel sensors are incorporated into the control logic to stop tape motion prior to end-of-tape. These sensors automatically stop the tape when the stack of tape on either reel reaches a level of approximately 1/8 to 1/16 inch. The supply end-reel sensor also controls a transfer circuit which operates only in the record mode. The transfer circuit provides contact closures to switch a standby or slave transport into the record mode when sequential operation of more than one system is desired.

1-9. The transport speed selection logic automatically switches the appropriate speed selective elements in the record/reproduce electronics and makes all of the changes which must be made with a change in tape speed.

1-10. When used in conjunction with the proper electronics, the tape transport will record and reproduce either direct or FM data signals on 7, 14, and up to 42 channels. The tape transport can be furnished with a shuttle control, footage counter, tape speed phase lock servo control, and/or a remote control unit for distant operation of the tape operating functions.

1-11. The record and reproduce head stacks are precision mounted on subplates and are fitted with plug-in connectors for easy replacement, with minimum or no adjustment.



2222-5

Figure 1-1. 13-501 Tape Transport

1-12. TYPICAL OPERATING CHARACTERISTICS.

1-13. This tape transport is designed to operate in a system having selected performance parameters as described in the manual for the record/reproduce system. Typical performance characteristics of the tape transport are summarized in table 1-1.

ITEM	CHARACTERISTIC
Power	105-125 vac rms, single phase, at 48-62 Hz; 240 vac rms optional on special order.
Tape	1/2 inch or 1 inch wide tape, 1 or 1 1/2 mil base mylar, or 1 1/2 mil base acetate.
Reels	Standard EIA reels to 15 inch diameter are accommodated. Bell & Howell precision reels recommended for proper operation.
Tape Speeds	9 bidirectional speeds, rotary switch selectable from front panel: 240, 120, 60, 30, 15, 7.5, 3.75, 1.875, and 0.9375 ips.
Tape Start Time	6 seconds maximum for 120 ips and 3 seconds at 60 ips and below, 105-125 vac with or without reproduce servo, to reach flutter specifications.
Tape Stop Time	4 seconds maximum for 120 ips and 2 seconds maximum for 60 ips or below, utilizing dynamic braking.
Tape Handling	The system will handle 1 inch, 1.0 or 1.5 mil mylar, or 1.5 mil acetate tape on 10 1/2, 14, or 15 inch diameter reels. Tension remains constant within 2 ounces throughout the reel of tape, during record or reproduce mode.
Fast Forward/Fast Reverse Rate	7200 feet in less than 5 minutes.
Tape Speed Accuracy	Average tape speed accuracy is within ±0.10% of the selected tape speed for all speeds of 120 ips through 1 7/8 ips when in the tach mode. Data and reference signals are reproduced with an accuracy of ±0.01% when recorded with reference frequencies (200 kHz at 120 ips, proportional at lower speeds) accurate to within 0.005%.

Table 1-1. Typical Performance Characteristics (Sheet 1 of 4)

<table>
<tr><th>ITEM</th><th>CHARACTERISTIC</th></tr>
<tr><td>Flutter (Cumulative Peak-to-Peak)</td><td>
<table>
<tr><th>Tape Speed (ips)</th><th>Flutter Bandwidth</th><th>% Flutter P-P</th></tr>
<tr><td>120</td><td>0.2 to 10 kHz</td><td>0.11</td></tr>
<tr><td>60</td><td>0.2 to 10 kHz</td><td>0.13</td></tr>
<tr><td>30</td><td>0.2 to 5 kHz</td><td>0.13</td></tr>
<tr><td>15</td><td>0.2 to 2.5 kHz</td><td>0.18</td></tr>
<tr><td>7 1/2</td><td>0.2 to 1.25 kHz</td><td>0.25</td></tr>
<tr><td>3 3/4</td><td>0.2 to 625 Hz</td><td>0.32</td></tr>
<tr><td>1 7/8</td><td>0.2 to 312 Hz</td><td>0.38</td></tr>
<tr><td>15/16</td><td>0.2 to 156 Hz</td><td>0.50</td></tr>
</table>
</td></tr>
<tr><td>Controls</td><td>Illuminated pushbuttons for RUN FORWARD, RUN REVERSE, RECORD, FAST FORWARD, FAST REVERSE, and POWER (push-ON, push-OFF). Rotary speed selector, phase lock selector (Tape/Tach), and record test selector are front panel located. Remote control of all operating modes via connection at the transport by use of accessory Bell & Howell Remote Control Unit, or equivalent.</td></tr>
<tr><td>Dynamic Skew</td><td>
<table>
<tr><th rowspan="2">Tape Speed (ips)</th><th colspan="3">Microseconds</th></tr>
<tr><th>(1) 0 to Peak</th><th>(2) 0 to Peak</th><th>(3) 0 to Peak</th></tr>
<tr><td>120</td><td>0.10</td><td>0.35</td><td>0.65</td></tr>
<tr><td>60</td><td>0.20</td><td>0.70</td><td>1.30</td></tr>
<tr><td>30</td><td>0.50</td><td>1.4</td><td>2.60</td></tr>
<tr><td>15</td><td>1.20</td><td>2.8</td><td>5.20</td></tr>
<tr><td>7 1/2</td><td>2.40</td><td>5.6</td><td>10.5</td></tr>
<tr><td>3 3/4</td><td>4.80</td><td>11.2</td><td>21.0</td></tr>
<tr><td>1 7/8</td><td>9.60</td><td>24.0</td><td>42.0</td></tr>
<tr><td>15/16</td><td>19.20</td><td>48.0</td><td>90.0</td></tr>
</table>
(1) Track to adjacent track in same head stack.
(2) Between outside tracks in same head stack — 1/2" tape.
(3) Between outside tracks in same head stack — 1" tape.
</td></tr>
<tr><td>Magnetic Heads:</td><td>The record and reproduce head stacks are precision mounted on plug-in subplates for easy replacement. Plug-in connector can facilitate head with up to 28 channels.</td></tr>
<tr><td>Head and Head Stack Configuration</td><td>Per IRIG 106-69.</td></tr>
</table>

Table 1-1. Typical Performance Characteristics (Sheet 2 of 4)

ITEM	CHARACTERISTIC
Magnetic Heads (Continued):	
Head Polarity	Per IRIG 106-69.
Head Azimuth	Record Head, factory set to better than ±1 minute of arc. Reproduce Head adjustable.
Head Life	In excess of 1000 hours.
Phase Lock Servo Drive	The Phase Lock Capstan Motor Control unit provides a closed loop servo operation for the dc capstan motor. This unit provides two modes of operation, tachometer and tape. When in the tachometer mode, the control servo uses the signal from the optical tachometer on the capstan drive assembly. The tachometer mode is used for initial recording. The optional tape control servo mode uses the prerecorded signal from the tape to establish highly accurate speeds and low time base error when reproducing tapes.
Time Base Error	Tape Speed (ips) / Control Reference (kHz) / TBE (microseconds) 120 / 200 / ±0.5 60 / 100 / ±0.5 30 / 50 / ±0.5 15 / 25 / ±1.0 7 1/2 / 12.5 / ±1.5 3 3/4 / 6.25 / ±3.0 1 7/8 / 3.125 / ±6.0 15/16 / 1.5625 / ±16.0
Fail-Safe	Capstan control is automatically returned to tach mode whenever tape signal is lost or when system is placed in record mode, regardless of position of mode selector switch. Respective tach and tape lamps light only when transport is up to speed and in servo locked operation.
External Signal	External reference frequencies may be inserted for variable speed control with inclusion of optional External Reference Kit.

Table 1-1. Typical Performance Characteristics (Sheet 3 of 4)

ITEM	CHARACTERISTIC
Data Channel	The servo control track may be used as a data channel when the optional bandpass filter card is included and provided none of the data is within one octave above or below the servo control frequency.
Operator Controls:	
Pushbutton Switches (Backlighted)	POWER - RECORD (interlocked with the RUN FWD or RUN REV) - RUN FORWARD - RUN REVERSE - STOP - FAST FORWARD - FAST REVERSE.
PHASE LOCK SELECTOR	Adjacent indicators glow when in phase lock (servo control from tachometer or recorded control channel).
RECORD TEST SELECTOR	Permits testing of record amplifiers and bias without moving tape.
TAPE SPEED SELECTOR	Selects speeds of 15/16 ips through 240 ips, remote, and search.
Circuit Breaker	Main power, with open and closed positions. Adjacent indicator glows when breaker is closed and power is on. Located on power supply chassis inside transport.
PEOT Control	Disables end-of-tape sensors. Switch is mounted on relay control chassis.
End-Reel Transfer	Transport provides contact closures to transfer the recording operation to a standby transport when the radial tape stack on the supply reel diminishes to 1/8 to 1/16 inch. Transport automatically stops about 30 seconds after transfer, providing overlap recording to preclude the loss of data. Switch is mounted on relay control chassis.
Dimensions and Weight	35" high by 24" deep by 23" wide; weight, 250 pounds.

Table 1-1. Typical Performance Characteristics (Sheet 4 of 4)

SECTION II

INSTALLATION

2-1. GENERAL.

2-2. This section contains tape transport unpacking, cable harness interconnection, and primary power connection. Also included are initial equipment turn-on and checkout instructions prior to tape transport system operation. When the tape transport requires specific installation and checkout procedures for a particular application, consult a Bell & Howell representative who will assist with the equipment installation. For tape transport alignment and calibration procedures, refer to Section V (Calibration and Maintenance). Section VII (Schematics) should be used as reference data when following the calibration and maintenance instructions of Section V.

2-3. The tape transport should be visually inspected for signs of damage from shipment. A thorough inventory is recommended to ascertain that no loose pieces are left in the packing material.

2-4. SHIPMENT.

2-5. The tape transport is shipped as part of the Bell & Howell Magnetic Tape Record/Reproduce System. All required interconnecting cables are installed at the factory before shipment. Refer to the System operation and maintenance manual for unpacking, installation, inspection, and equipment checkout in addition to following the installation procedures contained in this section.

2-6. TAPE TRANSPORT CABLE INSPECTION.

2-7. Referring to figure 2-1, inspect tape transport cable interconnections between panels for possible damage from shipment. Ascertain that all plugs mate firmly with their connectors and that terminal lug wire sets are connected to terminal strips. Refer to interconnecting cable diagram in Section VII for the routing sequence of cable harnesses.

2-8. PRIMARY POWER CONNECTIONS.

2-9. Ac power is applied to the tape system from a universal power connector on the back of the cabinet. Refer to the System operation and maintenance manual for identification of this connector. The tape transport receives it ac power at TB301 terminal strip mounted on the back side of the power supply panel (see figure 2-2).

2-10. The three power lines are connected to TB301 as follows:

a. Pin 21: 115 vac - 60 Hz (HOT - black wire).

b. Pin 20: 115 vac - 60 Hz (NEUTRAL - white wire).

c. Pin 19: Cabinet Ground (EXTERNAL GROUND - green wire).

2-11. PRIMARY POWER CHECKOUT.

2-12. The primary power is controlled by CB301 circuit breaker on the tape transport electronics panel and the POWER switch on the front control panel. An indicator lamp (DS301) adjacent to the circuit breaker indicates when the power is on.

2-13. Turn on CB301 and press the tape transport POWER switch. Check power light indicators to see that they remain on. Using a multimeter, measure tape transport power supply voltages listed in table 2-1. Terminal strips TB501, TB502, and TB503 are located adjacent to the upper reel motor. See figure 2-1.

TERMINAL BOARD	FROM PIN (HOT)	TO PIN (COMMON)	VOLTAGE MEASUREMENTS	TOLERANCE
TB501	14	12	-12 vdc	±10%
TB501	11	12	+12 vdc	±10%
TB501	2	3	+5 vdc	±10%
TB503	14	13	-20 vdc	±10%
TB503	12	13	+20 vdc	±10%
TB503	10	13	-28 vdc	See Note
TB502	9	TB503 13	+28 vdc	See Note

NOTE: The +28 vdc and the -28 vdc are unregulated and are therefore affected by ac line voltage and dc load current variations. These voltages, at no load conditions, can be as high as 33 vdc. Under heavy load conditions (such as capstan motor coming up to speed or reversing direction), these voltages can be as low as 22 vdc.

Table 2-1. Tape Transport Power Supply Voltage Measurements

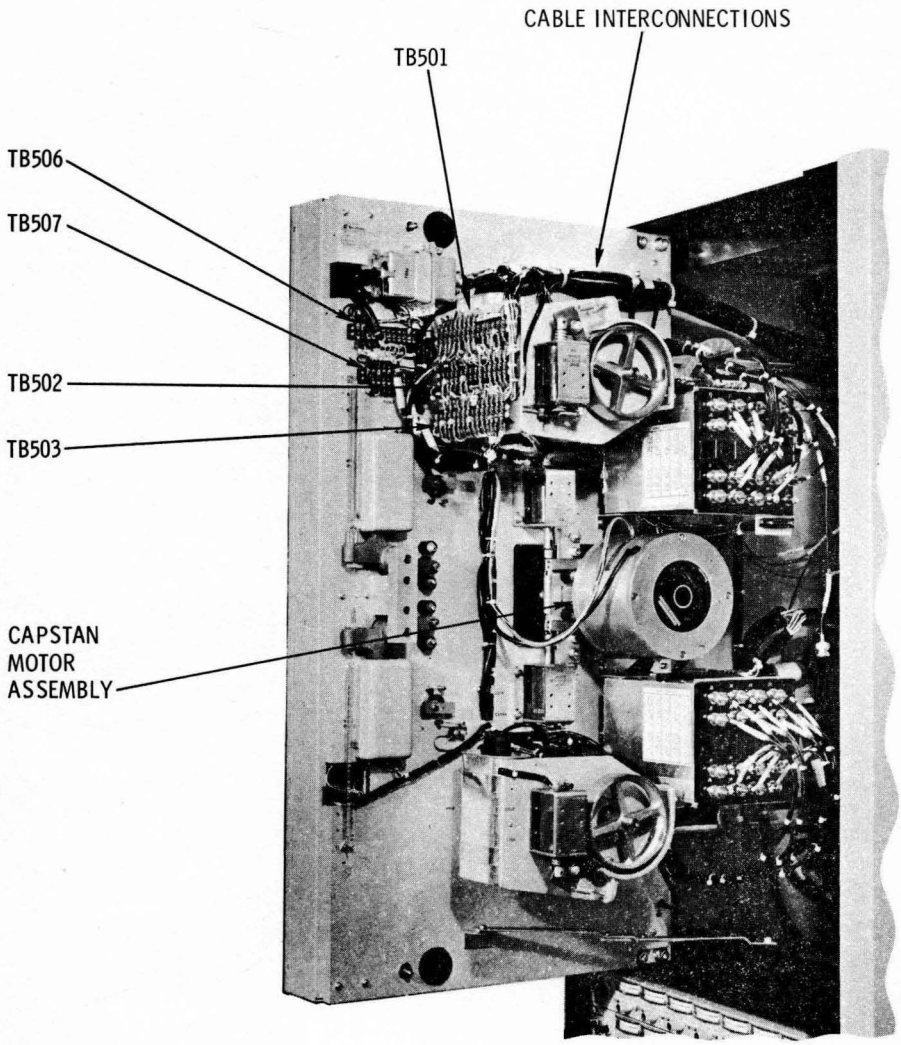


Figure 2-1. Location of Tape Transport Capstan Motor and Cable Routing Interconnections

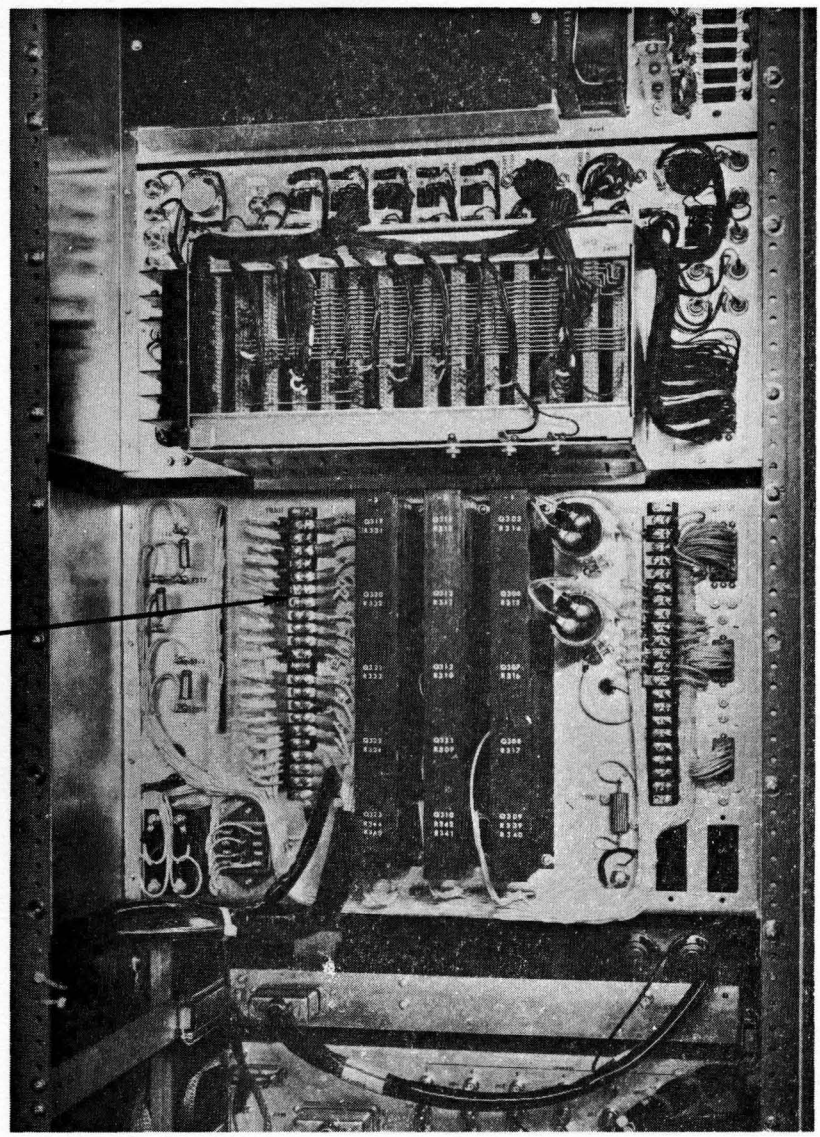


Figure 2-2. Tape Transport Power Supply Connections

SECTION III

OPERATION

3-1. GENERAL.

3-2. The 13-501 Tape Transport is factory calibrated and ready for operation after the equipment is installed per instructions given in Section II of this manual. Personnel unfamiliar with this tape transport should read the operating instructions contained in this section before attempting to place it in operation. For instructions pertaining to the operation of the overall Bell & Howell Magnetic Tape Record/Reproduce System, refer to the System operation and maintenance manual.

3-3. TAPE TRANSPORT ACCESSIBILITY.

3-4. All tape operational controls and indicator lights are accessible on the front control panel of the tape transport as shown in figure 3-1. All preset controls, fuses, photo end-of-tape (PEOT) switch, transfer switch, fast and search speed potentiometers, and auxiliary plug connections, are located on the electronics control panel shown in figure 3-2.

3-5. Access to the rear of the tape transport baseplate, and to the front of the electronics control panel, is available by swinging open the dust cover door and the transport baseplate on hinges located at the left-hand side of the transport. To swing open the transport baseplate release the two black knurled screw latches located at the extreme top and bottom corners of the transport plate, behind the dust cover. Once open, the elbow latch located at the bottom of the transport locks it open. To close the transport, press on the release button in the center of the latch, then swing the transport into the cabinet. Screw in the two latches to lock the transport in the closed position. Access to the rear sections of the electronics control panel can be obtained by opening the rear door of the cabinet.

3-6. CONTROLS AND INDICATORS.

3-7. Table 3-1 lists the tape transport controls and indicators, including their locations and functions. Figure 3-1 shows the front view of the 13-501 Tape Transport control panel, and figure 3-2 is a front view of the electronics control panel.

Note

Item numbers listed in table 3-1 correspond to index numbers shown in figures 3-1 and 3-2.

3-8. RECOMMENDED TAPE AND TAPE REELS.

3-9. The type of magnetic recording tape used with a magnetic tape system is an important factor in determining the overall performance of that system as well as the life of the magnetic heads. Frequency response, signal-to-noise ratio, and distortion, all of which are interdependent factors, are determined to a great extent by the electrical and mechanical characteristics of the type of magnetic tape used. Once a system has been adjusted using one type of tape, changing to the tape of another manufacturer and/or type will probably require readjustment of the system.

ITEM NO.	PANEL MARKING	REF DES	FUNCTION
1	POWER	S602 & DS601	Double action, push-on, push-off, back-lighted switch: Operates a relay which controls power to the tape transport. Indicator lights when POWER is on.
2	RECORD	S604 & DS602	Momentary action, pushbutton, back-lighted switch: Must be held in while appropriate run button is pushed to overcome interlock which protects against accidentally placing transport in RECORD mode of operation.
3	FAST REV	S605 & DS603	Momentary action, pushbutton, backlighted switch: Pressed to wind tape at high speed from lower reel to upper reel. Indicator lights when transport is in Fast Reverse.
4	RUN REV	S606 & DS604	Momentary action, pushbutton, backlighted switch: When pushed, tape motion at selected speed from lower reel to upper reel is established. Indicator lights when transport is in Run Reverse.
5	STOP	S607 & DS607	Momentary action, pushbutton, backlighted switch: When pressed, tape motion in any mode stops and indicator lights. Indicator lights any time transport power is on and the tape is not moving.
6	RUN FWD	S608 & DS605	Momentary action, pushbutton, backlighted switch: When pushed, tape motion at selected speed from upper reel to lower reel is established. Indicator lights when transport is in Run Forward.
7	FAST FWD	S609 & DS606	Momentary action, pushbutton, backlighted switch: Pressed to wind tape at high speed from upper reel to lower reel. Indicator lights when button is pushed.
8	READY	DS608	Indicator: Lights when tape is properly loaded on the transport, POWER switch is on, and RECORD TEST SELECTOR switch is in NORM position.
9	TACH/TAPE PHASE LOCK SELECTOR	S603, DS609 & DS610	Rotary toggle switch: Selects either servo control of the capstan motor controlled by TACHometer output, or by recorded frequency on TAPE. Appropriate indicator lights only when capstan has reached

Table 3-1. Controls and Indicators for the 13-501 Tape Transport (Sheet 1 of 3)

ITEM NO.	PANEL MARKING	REF DES	FUNCTION
			selected speed. If recorded frequency signal should be lost while operating in the TAPE mode, system will automatically switch to the TACH mode and the appropriate indicator will light.
10	NORM/TEST RECORD TEST SELECTOR	S601	Rotary toggle switch: TEST position is used to turn on the record amplifiers for testing purposes without moving the tape. In the TEST position, the transport is interlocked so that it will not operate in any mode. The READY indicator will not light, and since the capstan will not run, neither TACH nor TAPE indicator will light.
11	RMTE, SRCH, 15/16, 1 7/8, 3 3/4, 7 1/2, 15, 30, 60, 120, 240, TAPE SPEED SELECTOR	S610	Rotary selector, 11 position switch: Selects 15/16 to 240 ips speed, search (SRCH), or remote (RMTE) mode of operation of the tape transport. A transport when purchased has facilities for selecting any one of nine speeds.
12	ON ON OFF OFF	CB301	Circuit breaker switch: Controls ac power to system. Both sides of ac line are controlled by this switch, which will automatically trip OFF if overloaded.
13		DS301	Indicator neon: Main ac power indicator, lights when circuit breaker CB301 is ON and power is applied to the system.
14	FAST	R404	Resistor, variable: Sets the operating speed of the capstan motor in the FAST FWD or FAST REV modes of operation.
15	SEARCH	R403	Resistor, variable: Sets the capstan motor operating speed in the SRCH mode of operation when the RUN FWD or RUN REV buttons are pushed. Tentatively set at 180 ips, but variable by the operator.

Table 3-1. Controls and Indicators for the 13-501 Tape Transport (Sheet 2 of 3)

ITEM NO.	PANEL MARKING	REF DES	FUNCTION
16	PEOT	S401	Switch, toggle: Defeats, in the OFF position, the photo end-of-tape control and allows the tape to be completely used or rewound.
17	TRANSFER REV OFF FWD	S402	Switch, toggle: Selects the direction the tape transport will run if the TRANS switch is in any position other than OFF, and is connected as a slave tape system, on receiving the transfer command.
18	NORM. BW/2X BW	S301	Selects normal or 2 times bandwidth equalization.

Table 3-1. Controls and Indicators for the 13-501 Tape Transport (Sheet 3 of 3)

3-10. The quality and condition of the tape reels used on any tape transport have a significant effect on the quality of tape recordings and reproductions. Excessive unbalance or misalignment of the reels may cause mistracking of the tape or flutter, resulting in degradation of the accuracy of recorded signals. Any tape reels up to 15 inches in diameter with EIA hub dimensions will fit on the tape transport, but for best performance, Bell & Howell tapered precision reels are recommended. These reels incorporate features which promote maximum tape transport performance. Refer to the System operation and maintenance manual for recommended Bell & Howell precision reels and tapes.

3-11. DUST AND DIRT ACCUMULATION. To avoid dust contamination to the magnetic tape handling components of the tape transport, leave the dust cover closed whenever possible. As periodic inspection indicates, clean the head stacks, pinch rollers, and capstan shaft. See the preventive maintenance procedures in Section V of this manual.

3-12. Cleaning the tape transport components is important. Most tape manufacturers coat their tapes with a lubricant which gradually forms a coating on components coming in contact with the tape. Dirty pinch rollers or a dirty capstan shaft may cause loss of positive capstan control of the tape speed. Excessive tape deposits on the head stacks are detrimental to close tape-to-head contact and may cause excessive signal dropout as well as deterioration in the system's high frequency response.

3-13. DEMAGNETIZATION.

3-14. It is extremely important that tape transport components which come in contact with the tape, particularly the record and reproduce heads, do not become magnetized. Magnetized components degrade the system signal-to-noise ratio, cause excessive second harmonic distortion in recorded signals, and act to induce spurious flux fields in the magnetic tape. If the following precautions are observed, little difficulty should be encountered in this respect:

a. Do not remove record amplifiers from their mounting assembly while recording.

b. Do not saturate the record heads with abnormally high input signals or unbalanced pulses.

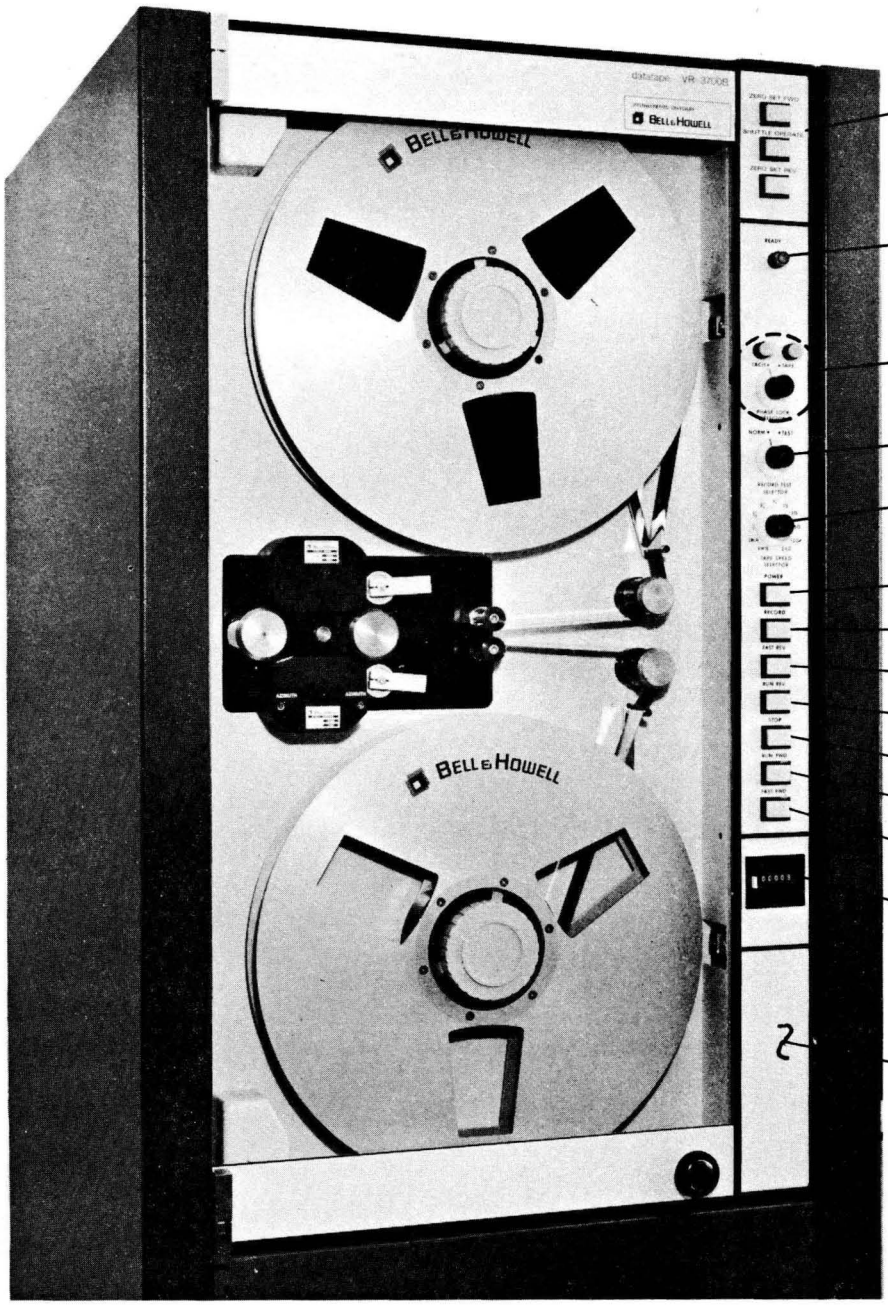


Figure 3-1. 13-501 Tape Transport Control Panel, Front View

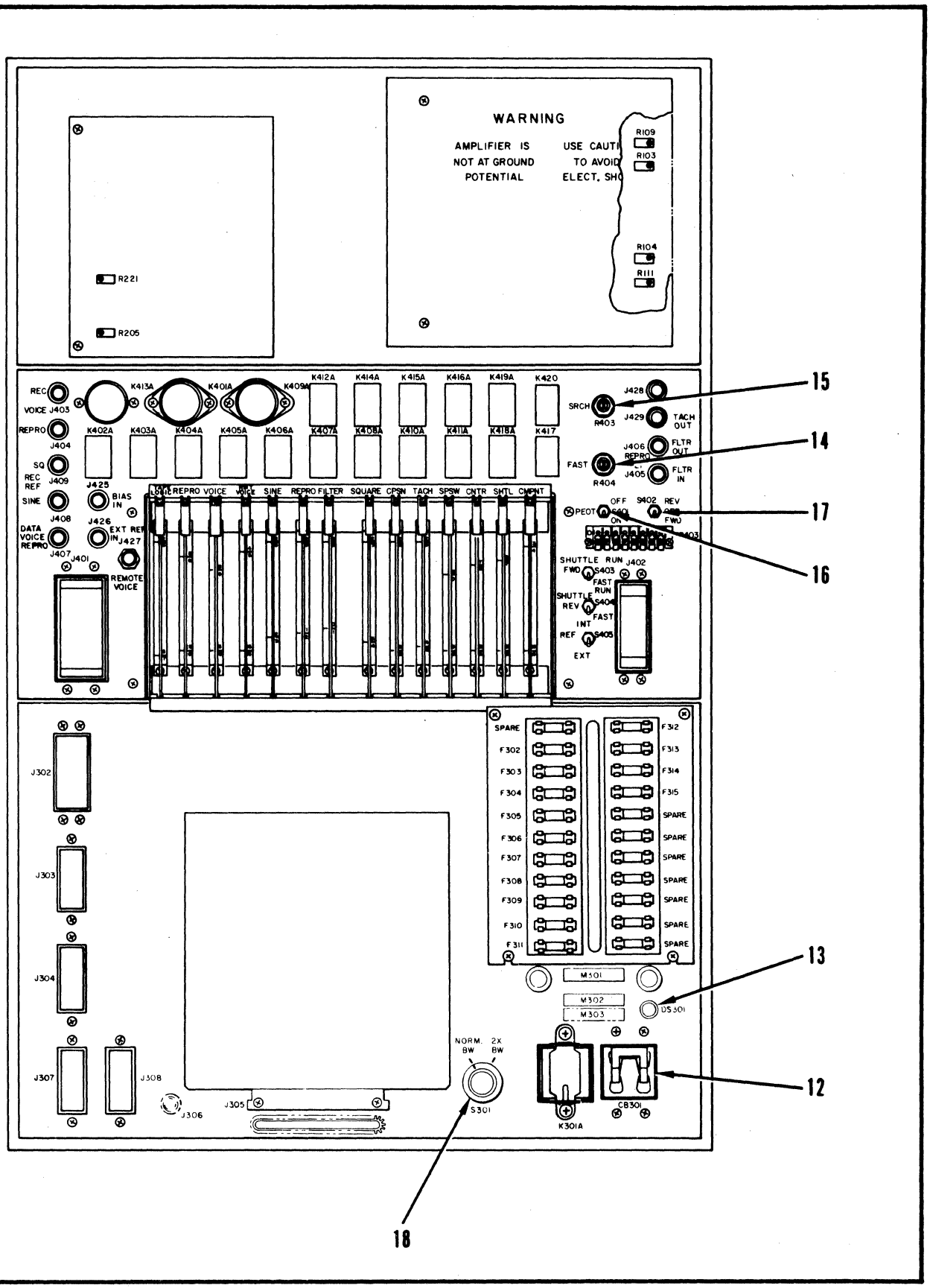


Figure 3-2. Tape Transport Electronics Control Panel, Front View

c. Do not connect an ohmmeter or any other dc measuring device or dc source across the head windings; the presence of the dc current will magnetize the heads and the dc current may be sufficient to damage the head windings.

d. Do not allow magnetized components to come in contact with the tape transport components.

e. Do not locate the equipment in strong electrical or magnetic fields.

f. As performance checks indicate, demagnetize the magnetic heads and any other applicable tape handling components with the tape transport power off during demagnetization.

3-15. INSTALLING TAPE REELS.

3-16. To install a tape reel onto the hub assembly, turn the knurled knob of the hub assembly fully counterclockwise, this will withdraw the three finger actuators into the hub assembly. Place the reel over the hub assembly and press firmly. Lock the reel onto the hub assembly by turning the knurled knob fully clockwise. Inspect the three finger actuators to make certain that they are holding the reel firmly in place. To remove the reel, turn the knob assembly counterclockwise and lift off the reel by pulling evenly away from the hub assembly.

3-17. TAPE THREADING.

3-18. Thread the magnetic tape onto the tape transport by following the procedures in sequential order as follows:

a. Place the supply reel (upper reel) of tape on the upper reel hub and lock in place so that the tape will feed from the top of the reel, from left to right.

b. Place the takeup reel (lower reel) on the lower reel hub and lock in place.

c. Pull approximately three feet of tape leader off the upper reel.

d. Thread the tape through the tape path as shown in figure 3-3.

e. Wrap the tape around the takeup reel (bottom reel) in a clockwise direction, and back off the leader until all slack is taken up.

f. Holding the tape end with an index finger, rotate the lower reel clockwise until the tape locks itself onto the reel with the overlap.

CAUTION

Do not let the tape double up under the first wrap around. That is, the leader should be flush against the inner hub of the lower reel so that there is no bump or bulge where the tape first starts to wrap onto the lower reel.

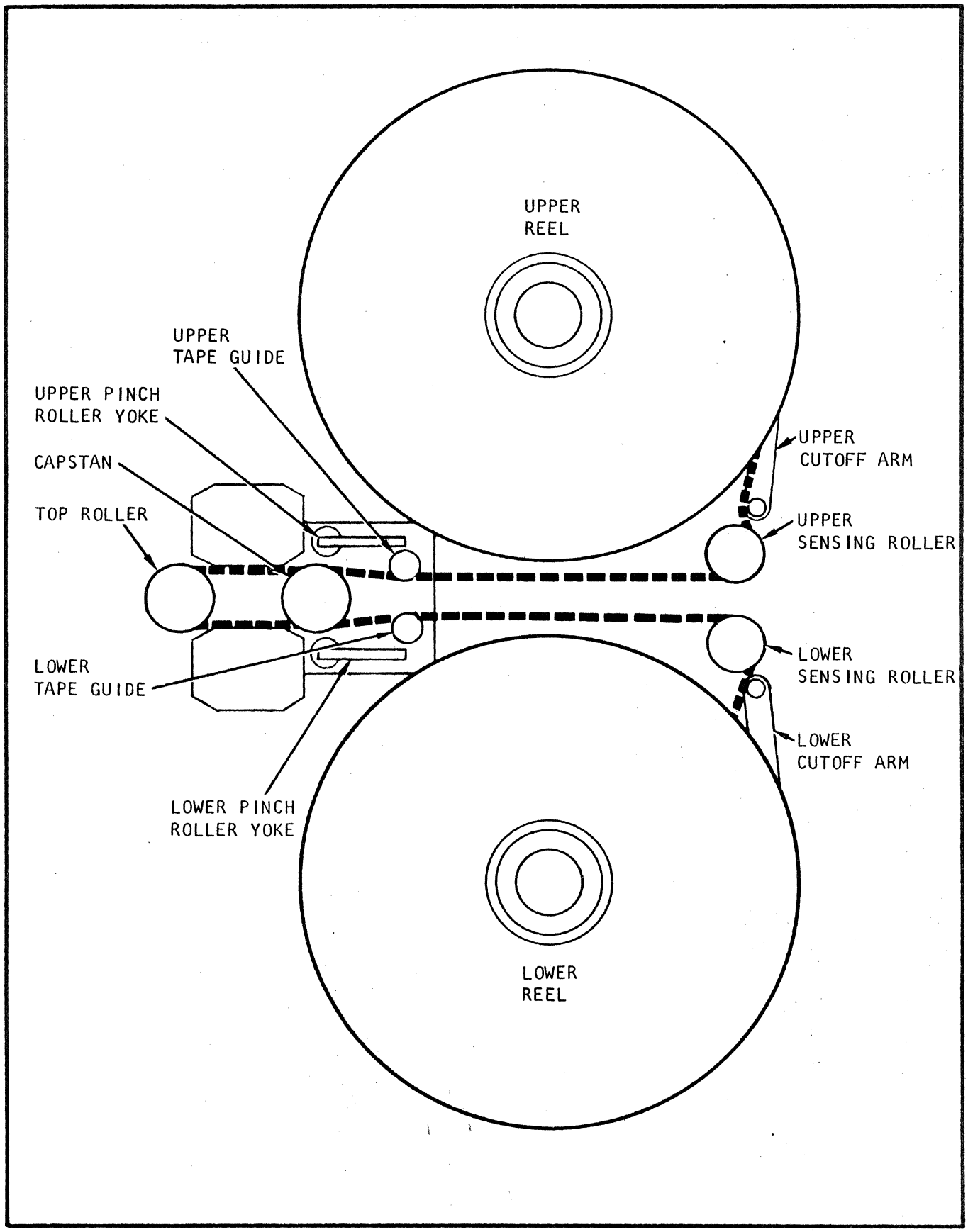


Figure 3-3. Tape Installation Threading Path

3-19. SAFETY INTERLOCKS AND EQUALIZATION CONTROL.

3-20. NO-TENSION/END-TAPE. The transport will not operate in any mode until tape is threaded. If tape goes slack while operating in any mode, the mechanical brakes will be automatically applied and all tape motion will stop. When tape has completely run off of either of the reels, the mechanical brakes will automatically operate to stop the reels.

3-21. PHOTO END-OF-TAPE. The tape transport automatically stops when the tape stack on either the upper reel or the lower reel diminishes to a radial stack of 1/16 to 1/8 inch. Once stopped by the end-of-tape sensors, the transport can be operated in any mode until all tape has been removed from the reel. The photo end-of-tape circuit may be defeated by setting the PEOT switch to OFF.

3-22. FAIL-SAFE MECHANICAL BRAKES. Power must be available to release the mechanical brakes. Therefore, if a power failure occurs during any of the operating modes, the brakes will be applied and automatically stop tape motion.

3-23. RECORD INTERLOCKS. Interlocks are provided to help prevent accidental double recording or partial tape erasure by inadvertently applying signals to the heads with the transport operating in a mode other than record. The record electronics are controlled by the tape transport and are turned on only when the transport is operated in the record mode. The RECORD switch is interlocked with the RUN switch so that both must be deliberately pressed and released to switch the transport into the record mode.

3-24. A RECORD TEST SELECTOR (NORM/TEST) switch is provided (located on the front control panel) to turn on the record electronics for testing purposes without operating the transport in the record mode. When this switch is set to TEST, the RECORD lamp on the transport lights, but the transport will not operate in any mode. The bias circuit is enabled when the record relay is energized. When the NORM/TEST switch is set to TEST, the bias circuit is enabled.

3-25. ELECTRONIC EQUALIZATION. The record electronics are turned on only in the record mode. The reproduce electronics are turned on in all modes. The transport speed selection circuits automatically switch the appropriate speed-selective elements into the electronics to correspond to the selected tape speed. Any exceptions to the above are discussed in the System manual. The NORM. BW/2X BW switch controls the equalization for 2X bandwidth heads.

3-26. SPEED SELECTION.

3-27. Any of the tape transport speeds may be selected by rotating the TAPE SPEED SELECTOR switch. Tape speeds may be changed during tape travel, allowing approximately a four-second delay for the tape to obtain the selected speed when switching between the lowest and highest tape speeds. When the FAST FWD speed is suddenly changed to FAST REV speed, approximately a twelve-second delay is required for the tape to obtain the selected speed.

3-28. MODE SELECTION.

3-29. Operating modes, except the record mode, are selected by pressing the appropriate button on the control panel. (Refer to table 3-1 for control functions.) The record mode is selected by holding down the RECORD pushbutton and, while it is depressed, actuating and releasing the RUN button, then releasing the RECORD button. The purpose of this required double action is to prevent any accidental recording which might occur during the playback of previously made recordings. (Such a double recording would destroy the original.)

3-30. When the tape transport is switched to different modes with or without passing through the stop mode, no tape damage will take place because of the interlocks and delays incorporated. The READY indicator light (green) remains on throughout tape transport operation.

3-31. STOP. At any time that it is desired to stop all tape motion, press the STOP button and the tape will rapidly and smoothly stop. Once stopped, the transport will remain in the standby condition, ready for the next command. Pressing the STOP switch when tape is traveling at the highest tape speed will require approximately five seconds for tape travel to stop. During this delay period, the tape transport will not start in the run or record modes. However, any of the other operating modes may be initiated in the normal way.

3-32. CHANGING TAPE WIDTH KITS.

3-33. The change from one tape width to another is accomplished by using tape width kits and magnetic head stacks equipped to handle 1/2 inch or 1 inch magnetic tape. Figure 3-4 shows the location of tape width components, and Section VI of this manual contains the assembly parts list for the tape width kits.

3-34. There are two basic tape width kits applicable to the 13-501 Tape Transport. The 13-414-2 Tape Width Kit is used for 1/2 inch wide tape and the 13-414-5 Tape Width Kit is used for 1 inch wide tape. The 7 channel record/reproduce head assemblies are used with 1/2 inch tape; the 14 channel record/reproduce head assemblies being used only with 1 inch tape.

3-35. The procedure for changing tape width replaceable components is as follows:

Note

Remove tape from the tape transport before beginning this procedure. It is not necessary to perform the operation in sequential order as listed below.

a. Remove socket screw from the center of the record head stack. Pull off head stack from precision plate assembly, using care not to damage mating plug receptacle located behind head stack. When installing new head stack, torque the socket screw to 10 inch-pounds. Repeat procedure for the reproduce head stack.

b. Remove socket screw from tape guide (located in center of guide), change tape guide and replace socket screw. Repeat procedure for other tape guide.

c. Remove socket screw from sensing roller shaft (located on the back side of tape transport handling plate at right angles to the shaft), change sensing roller and replace socket screw. Repeat procedure for other sensing roller.

d. Remove upper or lower tape reel per assembly instructions of paragraph 3-15. Remove snap-on plug from reel hub assembly. Rotate knob on reel hub assembly until three socket screws are visible through base hub assembly. Remove socket screws and replace reel hub assembly. Install plug and repeat procedure for other reel hub assembly.

3-36. After tape width components have been replaced, it is necessary to check the alignment of the tape guides and sensing rollers by running the tape at low speed in RUN FORWARD and RUN REVERSE. Adjust the position of the sensing rollers so that the tape stacks evenly, and does not curl up over the sensing roller guides. If the tape handling is correct

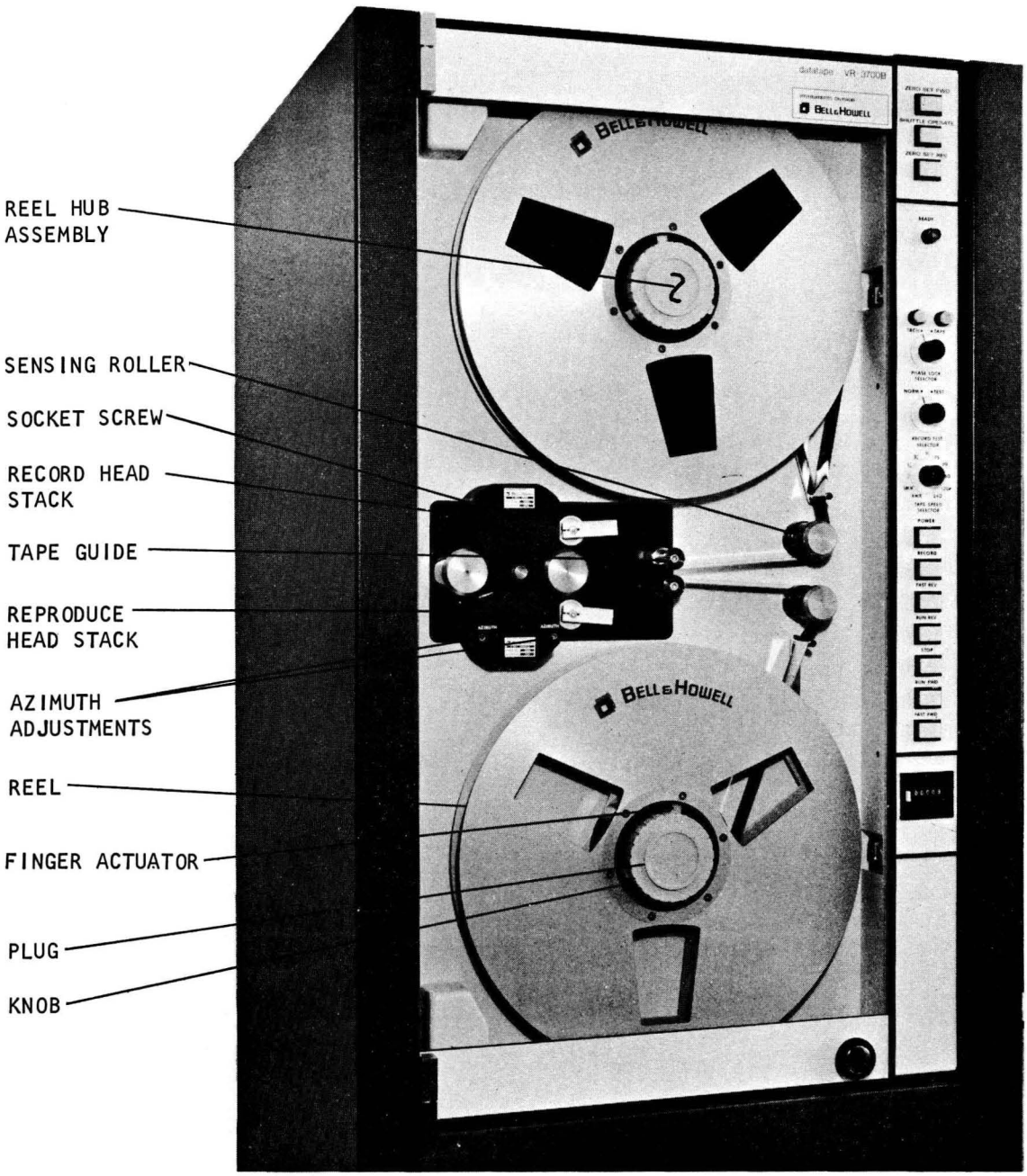


Figure 3-4. Tape Width Components

at low speed, check that it performs as well at high speed. Refer to Section V of this manual for tape tension adjustments and to the System operation and maintenance manual for head stack azimuth alignment procedures.

3-37. OPTIONAL CONTROL EQUIPMENT.

3-38. The 13-501 Tape Transport has the capability of including the following control equipment.

3-39. REMOTE CONTROL. In the RMTE position of the TAPE SPEED SELECTOR switch, control of the tape transport is transferred to a remote control station. The remote control unit is built to customer order and parallels the five operating mode controls so that the transport can be operated from a remote location.

3-40. PHASE LOCK SELECTOR. In the TAPE position of the PHASE LOCK SELECTOR switch, servo control of the capstan motor is referenced to a prerecorded signal on one data channel. Should the recorded signal fail, the transport will automatically reference the capstan servo to the sine wave generator, this condition being indicated by the light above the TACH position of the switch.

3-41. PHOTO END-OF-TAPE AND TRANSFER SWITCHES.

3-42. PHOTO END-OF-TAPE DEFEAT SWITCH. The photo end-of-tape has a defeat switch (S401) which, in the ON position, will allow the PEOT sensors to stop the transport prior to running out of tape. In the OFF position, the switch will override the PEOT sensors and allow the transport to run completely out of tape.

3-43. TRANSFER FUNCTION.

3-44. TRANSMITTING SYSTEM. When in the record mode of operation and the PEOT is activated, a contact closure is provided at TB403 between pins 2 and 3, and is applied to TB403-1 and -4 of the receiving system for record/transfer operation.

3-45. RECEIVING SYSTEM. Switch S402 on the receiving system determines whether, and in what direction (Record Forward or Record Reverse), the receiving system will move tape.

3-46. When S402 is in the OFF position, the receiving system will not accept the command from the transmitting system. When the transmitting system provides a contact closure, the receiving system will enter the record reverse mode when S402 is in the REV position, and the record forward mode when S402 is in the FWD position.

Note

Systems may be interconnected such that they will transfer back and forth between each other.

3-47. HEAD GEOMETRY.

3-48. Each head assembly contains two head stacks. One stack contains the odd numbered channels, and one the even numbered channels. As the type of stack used is determined by the system specifications, the head assembly information is in the System manual.

SECTION IV

THEORY OF OPERATION

4-1. GENERAL.

4-2. This section of the manual provides a functional description of the 13-501 Tape Transport. Block diagrams are included with the circuit descriptions as an aid to understanding the basic theory of tape transport operation. When troubleshooting or adjusting circuit components, it is advisable to use the drawings and schematics contained in Section VII and all applicable troubleshooting information contained in the System operation and maintenance manual.

4-3. Figure 4-1 is a block diagram of the 13-501 Tape Transport. The diagram contains all the basic functions of the transport logic which, for the purpose of explanation, are divided into four sections as follows:

a. Direction and Mode Control.

b. Tape Speed Selection and Control.

c. Tape Tension Control.

d. Power Supplies and Regulators.

These sections, and the components which they contain, are discussed in detail in the following paragraphs.

4-4. DIRECTION AND MODE CONTROL.

4-5. The description of the mode selections as discussed in the paragraphs below may be followed using figure 7-1, Schematic, Electronics and Relay Chassis; and figure 7-2, Interconnection Cable Diagram. Individual diagrams are also included within the text for each mode. These will be referenced in the discussion of the specific modes. Table 4-1 lists the specific purpose for each set of contacts of these relays. All relays within the electronics and relay chassis are of the 400 series. The text and the diagrams ignore the first one or two digits of each of the components. For example, K403A equals K3A, K410A equals K10A, etc. Indicators, switches, and other components in the control panel are of the 600 series. References to diodes in text are made to steering diodes, not suppression diodes.

4-6. The transport mode is controlled through pushbutton switches located on the transport control panel. These momentary action switches control relays within the electronics and relay chassis. Once a mode has been selected by pressing the appropriate button, if all the required conditions for establishing the mode have been met, a lock-up signal is sent back to the control panel backlighting the switch for the selected mode.

4-7. RUN FORWARD MODE.

4-8. Figure 4-2, Run Forward Mode - Flow Diagram, should be used in conjunction with the following discussion. The transport power supply supplies -28 vdc to the control panel from P302-T to P501-A and P501-B. From this point, the voltage is fed to TB503-10. If the end-of-tape switches, S501 and S502, are in their closed position (tape tension normal), the -28 volts will be applied via TB503-11 back to the control panel. The end-of-tape

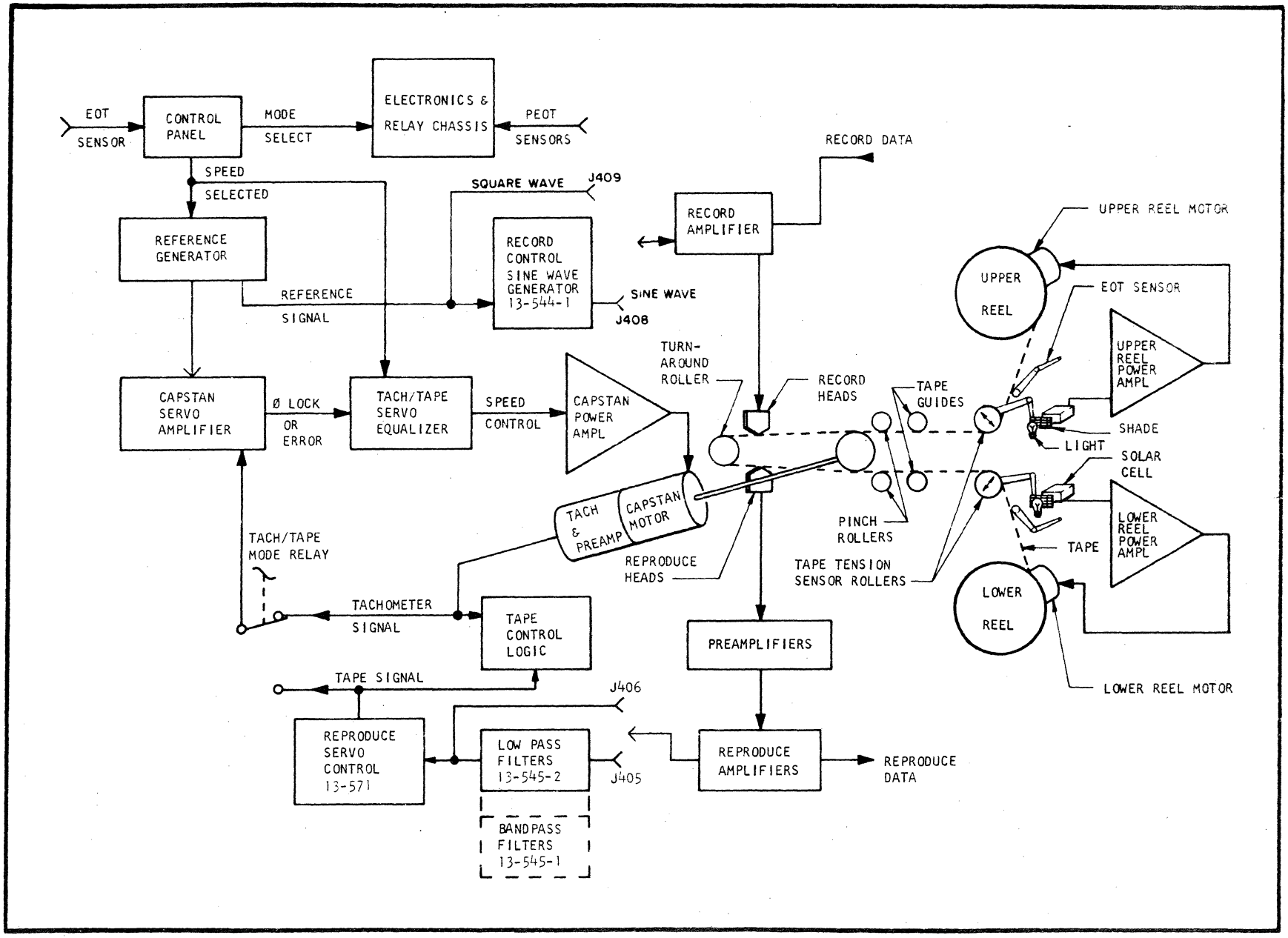


Figure 4-1. Functional Block Diagram

switches are located in the tape path, and will be opened only when tape tension is below acceptable limits. With normal tape tension, the -28 volts is available at P501-M on the control panel. With the RECORD TEST switch in the NORMAL position, -28 volts will be available at the TAPE SPEED SELECTOR switch S610A.

4-9. With the TAPE SPEED SELECTOR switch in any position except REMOTE, -28 volts is supplied to the STOP switch S607. The STOP switch is normally closed, allowing the -28 volts to reach the normally closed contacts of the FAST REVERSE switch S605. From this point the signal passes through to the normally closed contacts of the FAST FORWARD switch S609, and on to the normally open contacts of both the RUN FORWARD switch S608 and the RUN REVERSE switch S606.

4-10. When the RUN FORWARD switch is pressed, -28 volts is fed out of the control panel on P501-H. In parallel with this, power is applied to the run forward indicator DS605.

4-11. From P501-H the -28 volt signal is fed to the electronics and relay chassis at P401-8. Within the electronics and relay chassis, the -28 volt run forward command will cause four relays to energize. These relays are: the run forward relay K4, the run relay K10, the $\overline{\text{STOP}}$ relay K8, and the pinch roller and brake solenoid control relay K1. The run forward relay K4 is energized only by a run forward command. The run relay, the $\overline{\text{STOP}}$ relay, and the pinch roller and brake solenoid control relay will be energized by several other signals in addition to a run forward command.

4-12. The run forward command from the control panel into the electronics and relay chassis is a momentary signal and will continue only as long as the run forward switch S608 is closed. Therefore, a lock-up path is required to maintain the run forward mode once it has been initiated. This lock-up path is provided via the normally closed contacts of the fast reverse relay K7A3, the run reverse relay K5A3, the fast forward relay K6A4, and the contacts of the photo end-of-tape circuits, K11A and K12A1, and the normally open contacts of the run forward relay K4A3.

4-13. The run relay K10 is energized through diode CR6 by the run forward command. A run reverse command through diode CR2 will also energize K10.

4-14. The $\overline{\text{STOP}}$ relay K8 is energized by any one of the modes, except stop or remote. This is accomplished through diodes CR15 for run forward, CR17 for run reverse, CR7 for fast reverse, or CR8 for fast forward.

4-15. The pinch roller and brake solenoid control relay K1 is energized through normally closed contacts of the capstan motor ON relay K2A2. Energizing relay K1 causes the reel brakes to be released and the pinch roller to be pressed against the capstan. At the same time, the tape speed control loop will cause the capstan motor to turn. This will cause relay K2 to energize completing the lock-up path for relay K1 via its normally open contacts K1A1, and K2A1 of the capstan motor ON relay. The lock-up signal is connected via the end-of-tape switches from TB503-11 through P401-13. A parallel output is fed from relay K1 via P401-16 to the reel power amplifier J/P101-U. In the reel power amplifier, this signal will cause the reel power relay K101A to energize (see paragraph 4-129). When the capstan motor is not moving, relay K1 will also energize when the run forward, run reverse, fast forward, or fast reverse modes are initiated via relay contacts K2A2. Contacts K1A3 of the pinch roller and brake solenoid control relay K1 control application of power to the brake solenoids and pinch roller solenoids via TB503-2 and TB503-1. Once relay K1 is energized and locked-up, only a stop command will cause it to deenergize.

RELAY COIL	RELAY CONTACT A1	RELAY CONTACT A2	RELAY CONTACT A3	RELAY CONTACT A4
K401 *C4 All modes except STOP	n. o. C4 K401 Lock-Up through capstan motor sensor relay (K402A1)	n. o. C2 Head Time Meter through K410A2	n. o. C4 Pinch Roller and Brake Solenoid Control (energize solenoids)	n. o. C4 Connect capstan motor to capstan power amplifier n. c. C4 Short output of Capstan Power Amplifier when brakes are applied
K402 B4 Motion Relay Capstan Motor	n. o. C4 K401 Lock-Up of Pinch Roller and Brake Solenoid relay (K401)	n. c. C4 K401 Pick-Up (applies brakes when motor stops)	n. c. B3 Grounds CPA input n. o. B3 -12 v to K8A2 (n. c.) (power ampl)	n. c. C4 Pick-Up K418 (Reverse Direction) n. o. C4 K418 Hold
K403 D4 Record	n. o. D4 K403 Lock-Up to Record Hold bus	n. o. D2 Record Transfer to Slave Transport through K411A2 n. o.	n. c. C2 Enables energizing of Tape Mode relay (K415) when not in record	n. o. C2 Energizes Record Relay in Amplifiers
K404 D4 Run Fwd		n. c. C2 Enables Squelch output (with K405) when not in Run Fwd	n. c. D3 Fast Fwd, Run Rev Hold n. o. D3 Run Fwd Hold	n. c. C4 Fast Fwd Hold
K405 D4 Run Rev	n. c. C2 Enables Squelch output (with K404) when not in Run Rev	n. c. D4 Fast Rev Hold n. o. D4 Run Rev Hold	n. c. D3 Run Fwd Hold	n. c. D3 Fast Fwd Hold
K406 D4 Fast Fwd				n. o. D3 Fast Fwd Hold n. c. D3 Fast Rev, Run Rev, Run Fwd Hold

*Denotes location on schematic, figure 7-1.

Table 4-1. Electronics and Relay Chassis - Relay Contacts (Sheet 1 of 3)

RELAY COIL	RELAY CONTACT A1	RELAY CONTACT A2	RELAY CONTACT A3	RELAY CONTACT A4
K407 D4 Fast Rev	n. o. D4 Fast Rev Hold	n. c. D4 Run Rev Hold	n. c. D4 Run Fwd Hold	n. c. C3 Fast Fwd Hold
K408 C4 All modes except STOP	n. c. C4 Turns on Stop Light	n. c. B3 Connects K2A3 to CPA input n. o. B3 Connects servo output to CPA input	n. c. C3 Enables pick-up of K409 (reverse)	n. c. C3 Energizes K419 when any PEOT is sensed
K409 D3 Energized in STOP and all Reverse modes (REVERSE CMMD)	n. o. & n. c. C4 Reverse output of CPA for Fwd and Reverse modes	n. o. & n. c. C4 Reverse output of CPA for Fwd and Reverse modes	n. o. & n. c. B3 Enables Go-to-Stop relay (K416)	n. c. C4 Upper PEOT to PEOT sense relay (K419) n. o. C4 Lower PEOT to PEOT sense relay (K419)
K410 D3 Energized in all RUN modes	n. c. B3 Connects Fast Potentiometer to CPA Input n. o. B3 Connects Capstan Servo Ampl to CPA input	n. o. C4 Enables Head Time Meter (with K401, not Stop)	n. o. & n. c. C3 Selects 15 sec delay or direct PEOT stop	n. o. B3 Grounds Capstan Servo Amplifier Q10 emitter in Tape Control Logic
K411 C3 Energized in any PEOT mode (momentary)	n. c. C3 Mode Holding for run modes	n. o. D2 PEOT Transfer to Slave Transport		
K412 C3 Energized 15 seconds after K413	n. c. C3 PEOT Mode Holding for fast modes			
K413 C4 15 Second Time Delay	n. o. C3 Energizes K412 15 seconds after PEOT			

Table 4-1. Electronics and Relay Chassis - Relay Contacts (Sheet 2 of 3)

RELAY COIL	RELAY CONTACT A1	RELAY CONTACT A2	RELAY CONTACT A3	RELAY CONTACT A4
K414 B4 Search Mode	n. o. B3 Connects search voltage to CPA through K10A1, K16A1, and K8A2 n. c. B3 Connects servo output to CPA through K10A1, K16A1, and K8A2	n. o. B4 Feedback Control of CPA makes Ampl a voltage Amplifier		
K415 C2 TAPE mode	n. o. A3 Connects Tape input into Capstan Servo Ampl n. c. A3 Connects Tach input into Capstan Servo Ampl	n. o. C2 Lights Tape lamp n. c. C2 Lights Tach lamp	n. o. A3 Energizes K2001 and K2002 in tape mode	n. o. & n. c. C2 Reverts to Tach mode in the event Tape reference is lost
K416 B3 Go-to-Stop	n. o. B3 Connects stop voltage to CPA through K3A2 n. c. B3 Connects search, fast, or servo outputs to CPA through K8A2			n. o. B4 Closes on reverse command from forward mode. Switches circuit (R5 and CR6) in capstan motor power amplifier
K417 NOT USED				
K418 C4 REV DIRECTION (Run Reverse, Fast Reverse)	n. o. C4 Holds K418 through K402A4 n. o. contacts	n. o. C4 Holds K418 until K402 is energized	n. c. C3 Enables K409 (Rev Commanded) with K408 (Not Stop)	n. o. & n. c. B3 Steering contacts with K409A3 for K416 (go-to-stop). If command direction different from previous direction, machine goes to stop.
K419 C3 PEOT SENSE	n. o. C3 Enables K412 and energizes K411	n. o. C4 Provides PEOT lamp return		

Table 4-1. Electronics and Relay Chassis - Relay Contacts (Sheet 3 of 3)

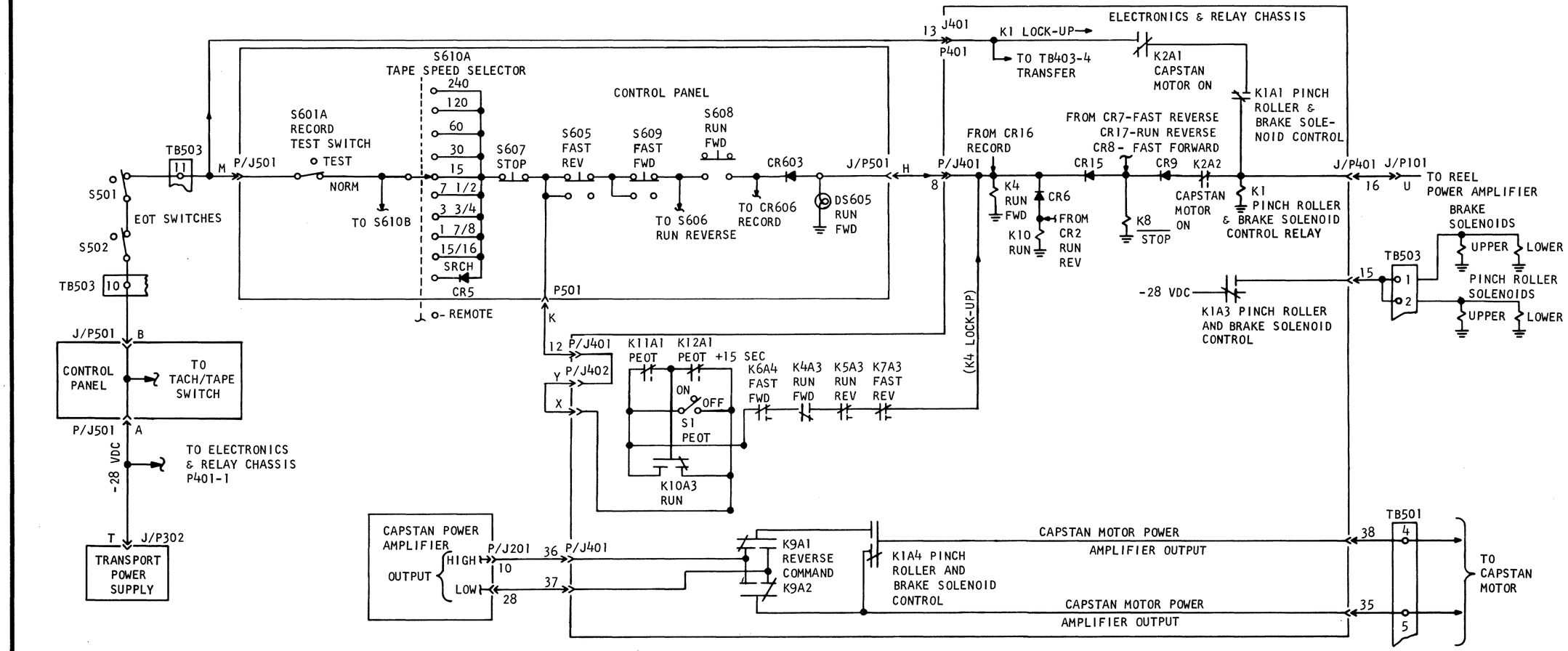


Figure 4-2. Run Forward Mode - Flow Diagram

4-16. The pinch roller and brake solenoid relay contacts K1A4 control the capstan power amplifier (CPA) output. The capstan power amplifier high (J201-10) and low (J201-28) outputs are coupled into the electronics and relay chassis via P401-36 and P401-37, respectively, and then coupled to contacts of the reverse command relay K9A1, and the contacts of the pinch roller and brake solenoid control relay K1A4. The normally closed position of K1A4 shorts out the input of the capstan motor (TB501-4 to TB501-5). When K1 is energized, contacts K1A4 connect the output of the capstan power amplifier to the capstan motor. The K9A1 and K9A2 contacts of the reverse command relay are connected to reverse the output polarity of the capstan power amplifier during a reverse mode.

4-17. RUN REVERSE MODE. (See figure 4-3, Run Reverse Mode - Flow Diagram.)

4-18. When run reverse mode is commanded from the RUN REVERSE switch (S606) on the control panel, a -28 vdc signal will be fed via CR602 to P501-D. This will cause illumination of the run reverse indicator (DS604). The signal from P501-D enters the electronics and relay chassis at P401-3 and causes the run reverse relay K5 to energize. The run relay K10, the $\overline{\text{STOP}}$ relay K8, and the reverse command relay K9 are energized via the diodes CR2, CR17, and CR11, respectively.

4-19. When the run reverse mode has been commanded from a stop condition, the reverse direction relay K18 will energize via the normally closed contacts of the capstan motor ON relay K2A4 and the diode CR18. Relay K18 locks itself up with the contacts K18A2 in parallel with K2A4. Contacts K2A4 will open when the capstan motor begins to turn. Relay K18 will remain energized as long as the transport is in a reverse mode.

4-20. If a reverse mode is commanded from a forward mode of operation, a different set of circumstances exists. First, the capstan motor must be commanded to stop, and once the stop mode has been attained, the run reverse is commanded from the stop condition. This is accomplished by use of the go-to-stop relay K16. Relay K16 is energized via contacts K18A4 of the reverse direction relay, and contacts K9A3 of the reverse command relay. On receipt of a reverse mode command, the reverse command relay K9 will energize immediately, changing the contact position of K9A3. This allows a ground to pass through the normally closed contacts of the reverse direction relay K18A4 through the normally open contacts of K9A3 to energize the coil of the go-to-stop relay K16.

4-21. Energizing the go-to-stop relay K16 causes -12 volts to be sent out to the capstan power amplifier (see figure 4-6). This will cause maximum deceleration of the capstan motor speed until a stop is reached. When the capstan motor stops, capstan motor ON relay K2 will deenergize and its contacts K2A4 will change position. This will allow the reverse direction relay K18 to energize through CR18. Relay K18 then locks itself up through its own contacts K18A2. As K18 energizes, contacts K18A4 change position, removing the ground to the go-to-stop relay K16. Relay K16 deenergizes, removing the -12 vdc input from the CPA. Relays K9 and K18 will remain in this state as long as a reverse mode of operation is enabled.

4-22. If a run forward or a fast forward command is issued during a reverse mode, the transport must go through a stop condition before entering a forward mode. Upon receipt of the momentary forward command from the control panel, the $\overline{\text{STOP}}$ relay will energize and interrupt the supply to the reverse command relay K9 with its contacts K8A3. With the reverse command relay K9 deenergized, the coil of the go-to-stop relay K16 is taken to ground via contacts K9A3 and contacts K18A4 of the energized reverse direction relay and contacts K10A4 of the energized run relay. This causes -12 volts to be sent to the capstan power amplifier which results in maximum deceleration of the capstan motor speed until stop is reached. The go-to-stop relay K16 will remain energized until the capstan motor stops, and

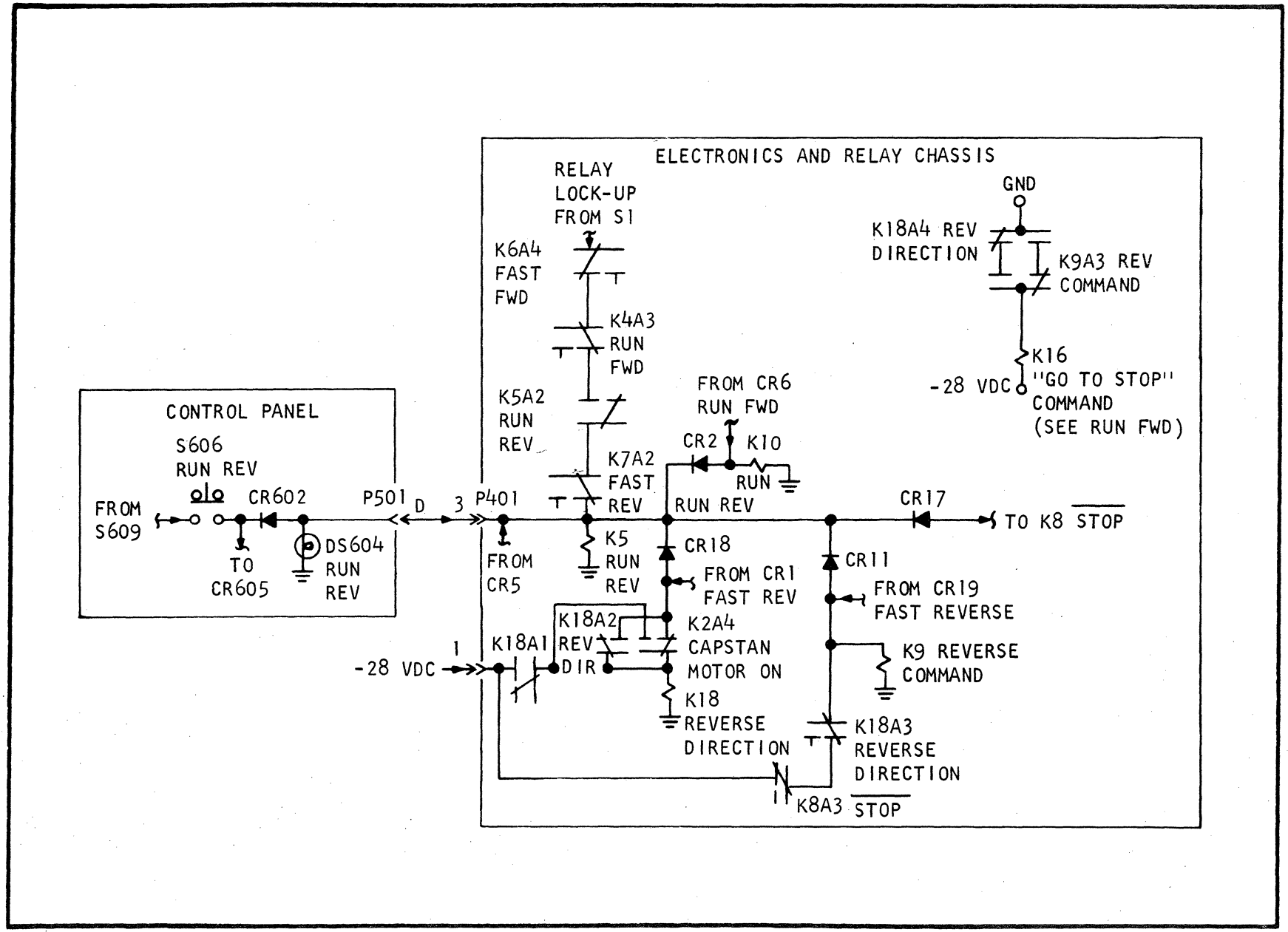


Figure 4-3. Run Reverse Mode - Flow Diagram

opens the capstan motor ON relay contacts K2A4. When K2A4 opens, the supply to the reverse direction relay K18 is interrupted, which in turn removes the ground from the go-to-stop relay K16 by its contacts K18A4. The transport is then ready to enter a forward mode.

4-23. FAST REVERSE MODE. (See figure 4-4, Fast Reverse Mode - Flow Diagram.)

4-24. In order to command a fast reverse mode, many of the conditions required for run forward mode must be satisfied. These conditions include the end-of-tape switches S501 and S502 being closed, the record test switch S601A being in the NORMAL position, the tape speed being selected, and the STOP switch S607 being in the normally closed position. Refer to figure 4-2, Run Forward Mode - Flow Diagram, for details.

4-25. Satisfaction of the conditions mentioned above will provide -28 vdc to the fast reverse switch S605 on the control panel. With the fast reverse switch pressed, a command is sent to P501-C, and the fast reverse indicator DS603, via diode CR601. The fast reverse command from the control panel enters the electronics and relay chassis at P401-2, where it energizes the fast reverse relay K7, the $\overline{\text{STOP}}$ relay K8, and the reverse command relay K9. The reverse direction relay K18 will also be energized via diode CR1, and the normally open contacts of the capstan motor ON relay K2A4, if the capstan motor is turning in the forward direction.

4-26. A lock-up path for the fast reverse relay K7 is provided through the PEOT relay contacts shown on the run forward mode diagram (figure 4-2), the normally closed contacts of the fast forward relay K6A4, the normally closed contacts of run forward relay K4A3, the normally closed contacts of the run reverse relay K5A2, and the normally open contacts of the fast reverse relay K7A1. This path locks up fast reverse mode and the fast reverse indicator DS603 on the control panel.

4-27. FAST FORWARD MODE. (See figure 4-5, Fast Forward Mode - Flow Diagram.)

4-28. Several of the conditions required for run forward must also be satisfied in order to initiate a fast forward mode. These include: End-of-tape switches S501 and S502 being closed; the control panel record test switch S601A in the NORMAL position; a tape speed selected, S610B; the STOP switch S607 in the normally closed position. With these conditions satisfied, -28 vdc is fed via the normally closed contacts of the fast reverse switch S605 to the normally open and normally closed contacts of the fast forward switch S609. With the fast forward switch S609 in the closed position, the -28 volts is fed through diode CR604 to the fast forward indicator DS606, and to P501-J. The fast forward command leaves the control panel via P501-J and enters the electronics and relay chassis at P401-10, where it energizes the fast forward relay K6. The fast forward command also energizes the $\overline{\text{STOP}}$ relay K8, and the pinch roller and brake solenoid control relay K1. A lock-up path is provided for the fast forward relay K6 via the normally open contacts of the fast forward relay K6A4, the normally closed contacts of the fast reverse relay K7A4, the normally closed contacts of the run reverse relay K5A4, and the normally closed contacts of the run forward relay K4A4. The signal used to lock-up the fast forward relay is provided from the control panel via PEOT relay contacts as shown in the run forward mode flow diagram, figure 4-2.

4-29. In the fast modes, forward or reverse, the voltage picked off the voltage divider network consisting of R4 and R7 substitute for the error signal from the capstan servo amplifier and will cause the capstan motor to attain a speed determined by the setting of variable resistor R4. This speed control voltage is connected into circuit by the normally closed contacts of the run relay K10A1.

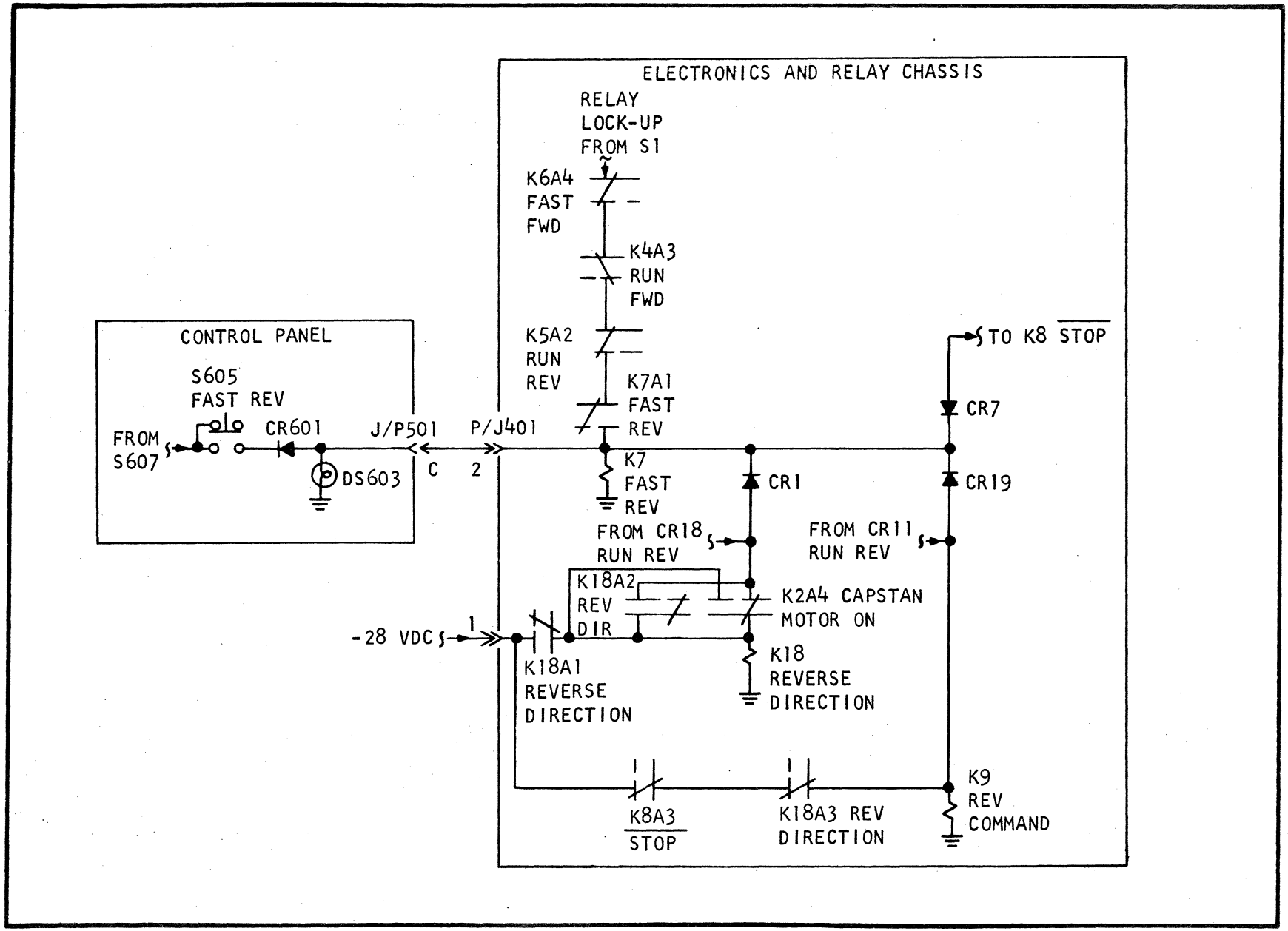


Figure 4-4. Fast Reverse Mode - Flow Diagram

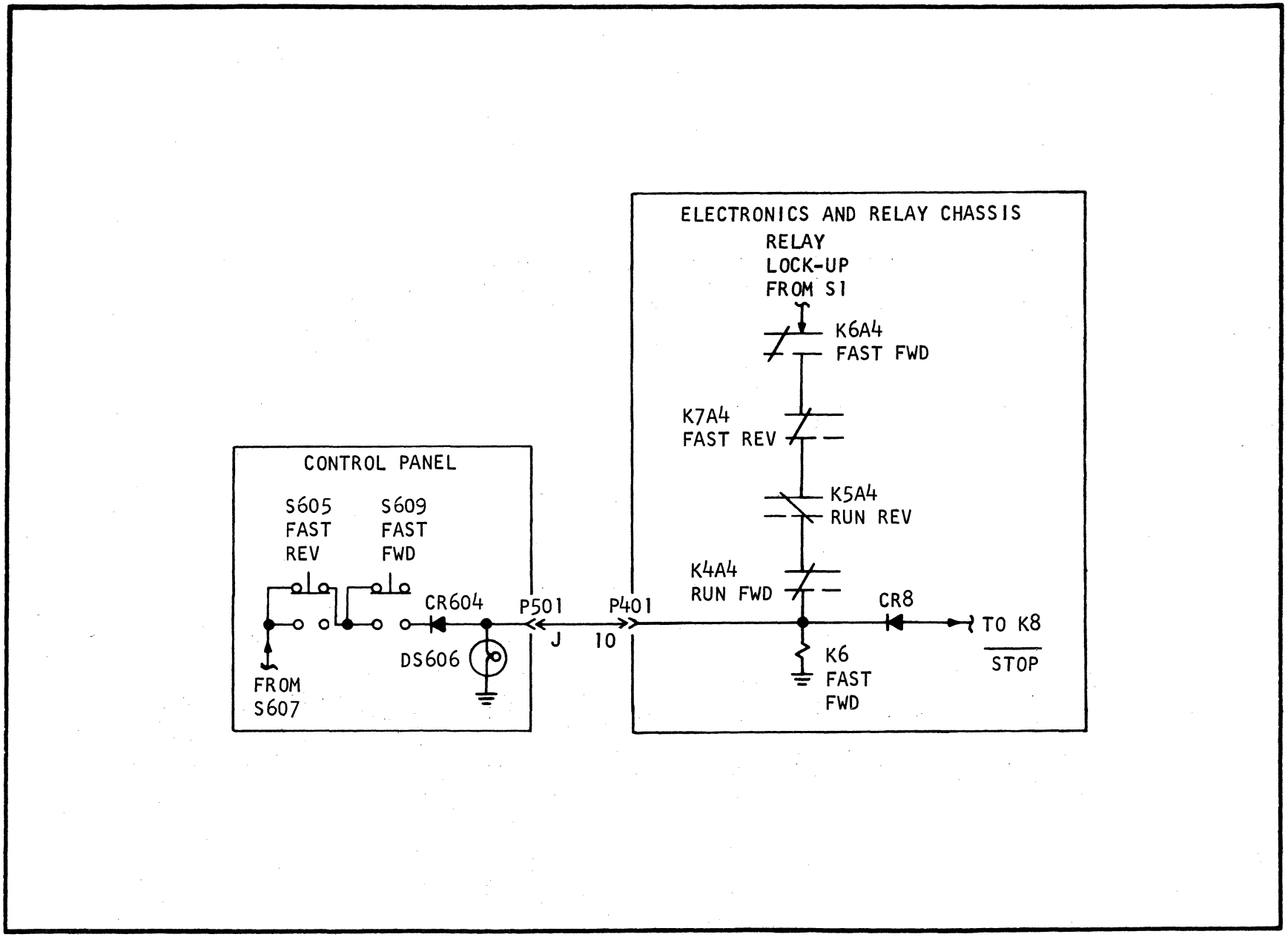


Figure 4-5. Fast Forward Mode - Flow Diagram

4-30. STOP MODE. (See figure 4-6, Stop Mode - Flow Diagram.)

4-31. When a stop command is made from any mode, the lock-up circuits to each of the mode relays (fast reverse K7, run reverse K5, run forward K4, and fast forward K6) are interrupted by the STOP switch on the control panel. The same lock-up circuits control the $\overline{\text{STOP}}$ relay K8 and the run relay K10 in all modes, as well as the reverse command relay K9 in the reverse modes.

4-32. The stop command will apply -12 volts to the input of the capstan power amplifier via the contacts of the now deenergized $\overline{\text{STOP}}$ relay K8A2 and the energized capstan motor ON relay K2A3 until the capstan motor stops, K2A3 opens, and applies a ground to the input of the capstan power amplifier.

4-33. When operating in a reverse mode, a stop command will cause the $\overline{\text{STOP}}$ relay K8 and the run relay K10 to deenergize, as before. However, the -12 volts will be applied to the capstan power amplifier via the go-to-stop relay K16A1, which must remain locked-up until the capstan has stopped. The reverse direction relay K18 will remain locked-up until the capstan motor stops and opens K2A4. With the reverse direction relay K18 energized, and the reverse command relay K9 deenergized, a lock-up circuit is formed for the go-to-stop relay K16, via the contacts K18A4 and K9A3, and this relay will remain locked-up until the capstan motor stops and deenergizes K18.

4-34. PHOTO END-OF-TAPE SENSOR CIRCUITS. (See figure 4-7, Photo End-of-Tape Sense - Flow Diagram.)

4-35. The transport power supply provides 28 volts ac via P/J302, TB503-7, and TB503-8 to the lower PEOT sensing diode V504 and the upper PEOT sensing diode V503. The 28 volt ac is also applied to the PEOT lamps, DS503 and DS504. The lamps and photodiodes are placed on the transport plate in such a manner that when the tape on the upper or lower reels decreases to a set amount, the respective photodiode senses enough light from the lamp to provide an output signal via TB503-6 or TB503-5 to the electronics and relay chassis. Within the electronics and relay chassis, the upper and lower PEOT signals are applied to the reverse command relay contacts K9A4.

4-36. If the transport is operating in a forward mode, the relay contacts will be as shown in the diagram. Sensing of the upper PEOT will cause a signal to be passed via TB503-5, P401-21, and the normally closed contacts of the reverse command relay K9A4 to energize the PEOT relay K19.

4-37. If the transport is operating in a reverse mode, sensing of the upper PEOT will have no effect on the PEOT relay K19, unless $\overline{\text{STOP}}$ relay contacts K8A4 are in the normally closed position. Contacts K8A4 are in the normally closed position only when the transport is stopped, in which condition the upper PEOT signal will pass through diode CR4 and the normally closed contacts of the $\overline{\text{STOP}}$ relay K8A4, energizing the PEOT relay K19. This assures that once the transport has stopped from sensing of the PEOT, the PEOT relay will remain energized.

4-38. Two different time reactions are required of the PEOT circuits. In the fast modes, instant response is required to an end-of-tape condition. In the run modes, 15 seconds delay is required. In both modes, momentary action relay circuits (K11A1 for the fast modes, and K12A1 for the run modes) initiate the stop circuits. The run relay contacts K10A3 select the required momentary PEOT relay contacts (see figure 4-2).

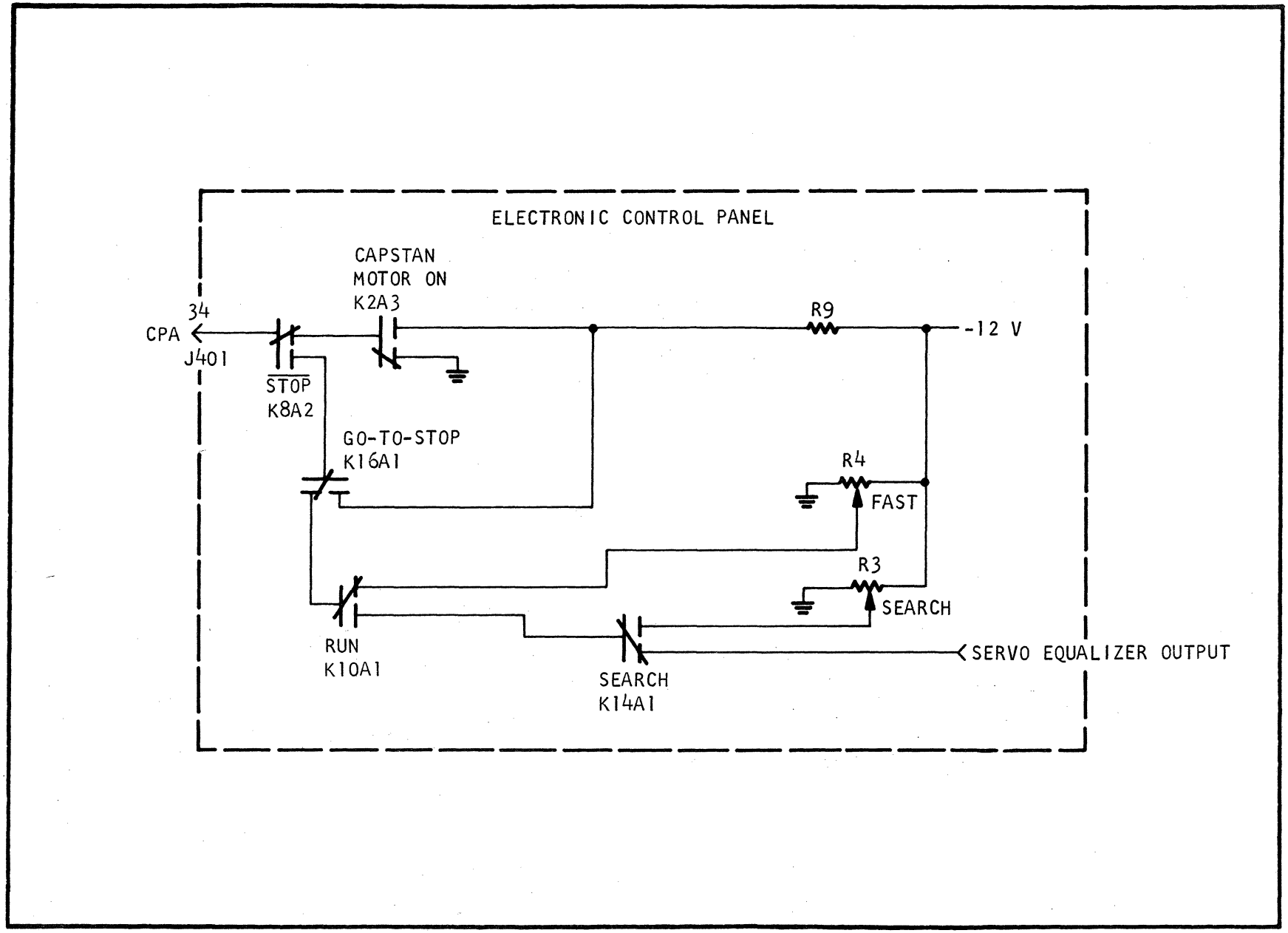


Figure 4-6. Stop Mode - Flow Diagram

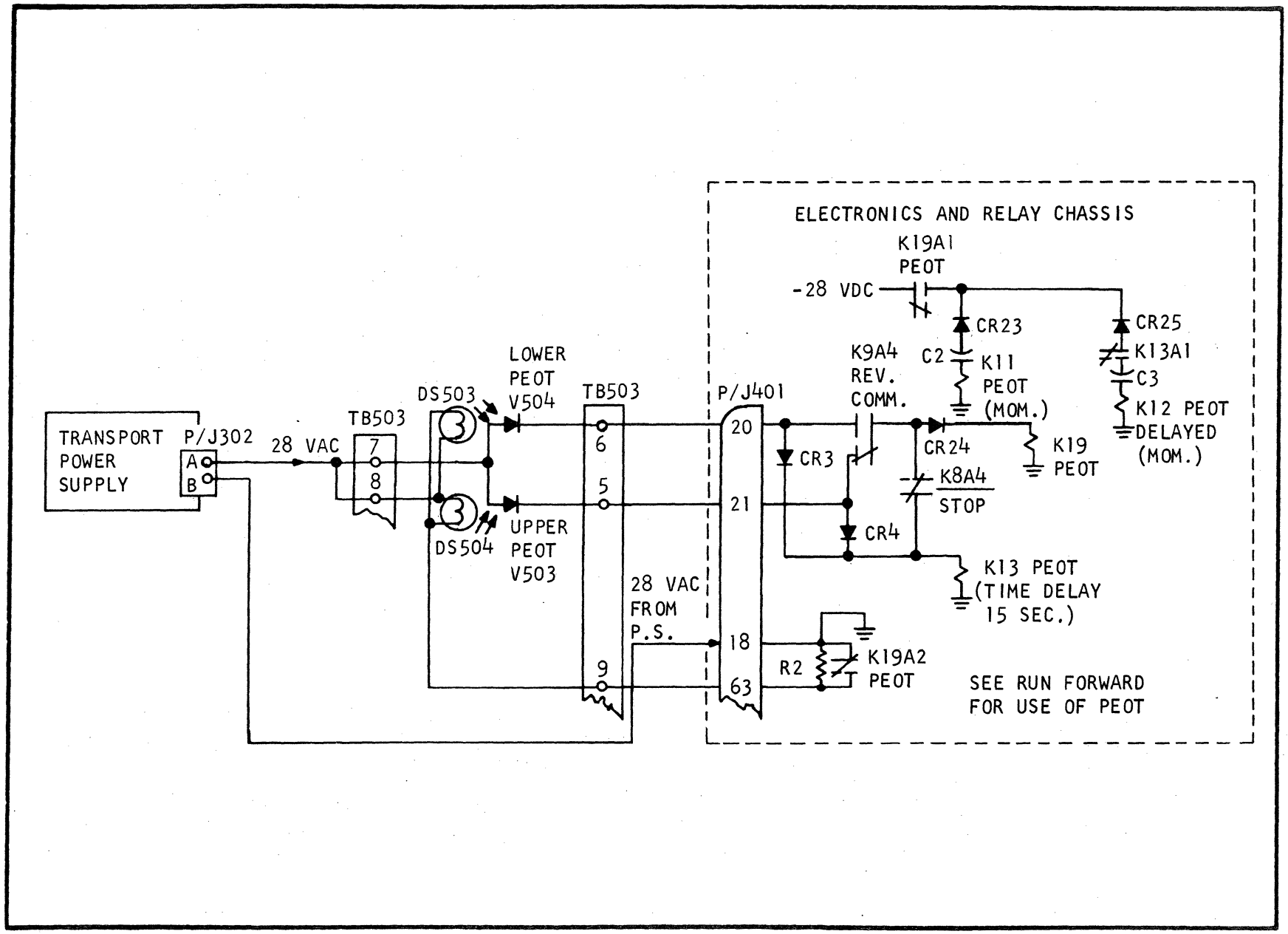


Figure 4-7. Photo End-of-Tape Sense - Flow Diagram

4-39. Contacts of the PEOT relay K19A1 allow -28 volts to be applied through diode CR23 and capacitor C2 to energize the momentary PEOT relay K11. The -28 volts, via K18A1, also passes through diode CR25, contacts K13A1 of the PEOT time delay relay, and capacitor C3 to energize the momentary PEOT delayed relay K12. Locking-up the PEOT relay K19 assures that the momentary PEOT relays K11 and K12 are energized only once.

4-40. The output of the upper and lower PEOT diodes will be a varying voltage, inversely proportional to the amount of tape left on the reel. The PEOT function occurs when enough current passes through the photodiode to cause the PEOT relay K19 to energize. Because the reel of tape may have a certain amount of eccentricity, it is possible that the output of the diode may vary slightly with each revolution of the tape reel. If no corrective action is taken, this would make it possible for the PEOT relay K19 to energize and deenergize at, or near, the threshold point of photo end-of-tape sensing. In order to avoid this possibility, at the first sensing of photo end-of-tape, PEOT relay contacts K19A2 will close, shorting the series resistor R2 of the photo lamp circuit. This will cause the lamp to brighten at the first sensing of photo end-of-tape, boosting the output from the photocell and ensuring that once relay K19 has been energized, it will not be deenergized by small variations in the amount of light received by the photodiode.

4-41. SEARCH MODE. (See figure 4-8, Search Mode - Flow Diagram.)

4-42. The search mode is commanded from the TAPE SPEED SELECTOR switch S610B on the control panel, in conjunction with the selection of a run forward or a run reverse mode. In order to initiate a search mode, the record test switch S601A must be in the NORMAL position, and the EOT switches S501 and S502 must be in their normal position as shown in the run forward mode flow diagram, figure 4-2. Upon selection of the search mode, -28 volts is fed through P501-Z into the electronics and relay chassis, via P401-50 and diode CR22, to the search relay K14. When the search relay K14 is energized, contacts K14A2 will close providing a ground through P401-48 to the capstan power amplifier at P/J201-16. In the capstan power amplifier, a ground at P/J201-16 will energize the relay K201A and change the capstan power amplifier into a current amplifier, thereby allowing the capstan motor to obtain a speed of approximately 180 ips.

4-43. Contacts K14A1 of the search relay are located in the capstan error circuits. When the search relay K14 is energized, the voltage divider network consisting of R3 and R8 provides an output via the normally open contacts of the search relay K14A1, through run relay normally open contacts K10A1, through go-to-stop relay normally closed contacts K16A1, to P401-34. The voltage picked off search potentiometer R3 simulates an error signal from the capstan servo amplifier and will cause the capstan motor to attain the search speed.

4-44. In the search mode, it is necessary to select either the run forward or the run reverse mode. Normally open contacts of the run relay K10A1 and the $\overline{\text{STOP}}$ relay K8A2, together with the normally closed contacts of the go-to-stop relay K16A1, are connected in series with the voltage from the search potentiometer R3 to form an interlock for the run and search modes.

4-45. RECORD MODE. (See figure 4-9, Record Mode - Flow Diagram.)

4-46. In order to select a record mode, it is necessary first to satisfy all the conditions for selecting a run forward or run reverse mode (see figure 4-2, Run Forward Mode - Flow Diagram). The run forward or run reverse command is fed to the record switch S604 through diodes CR606 or CR605, respectively. With the record switch S604 pressed, -28 volts is fed to the record test switch S601B. With the record test switch in the NORMAL position,

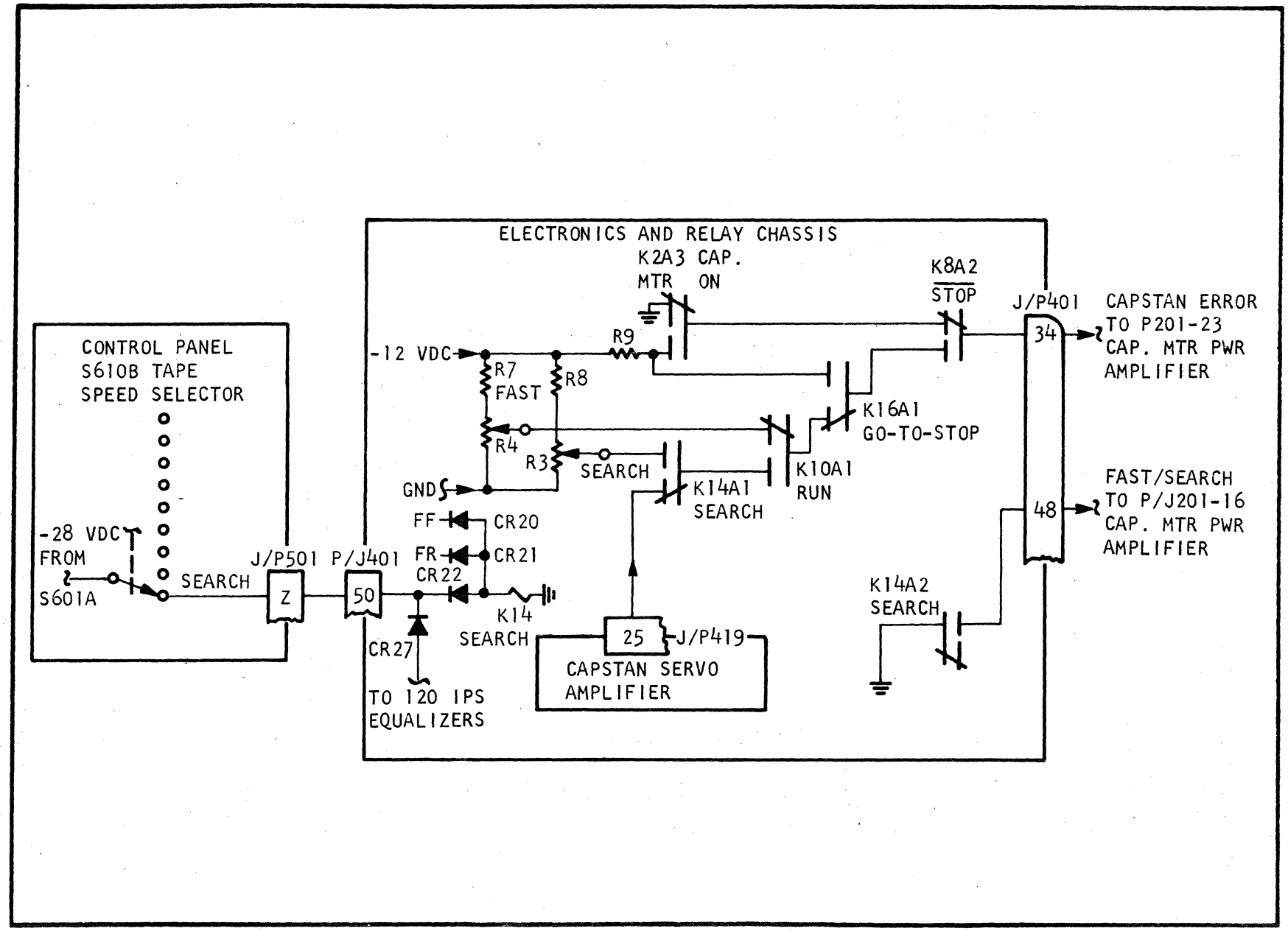


Figure 4-8. Search Mode - Flow Diagram

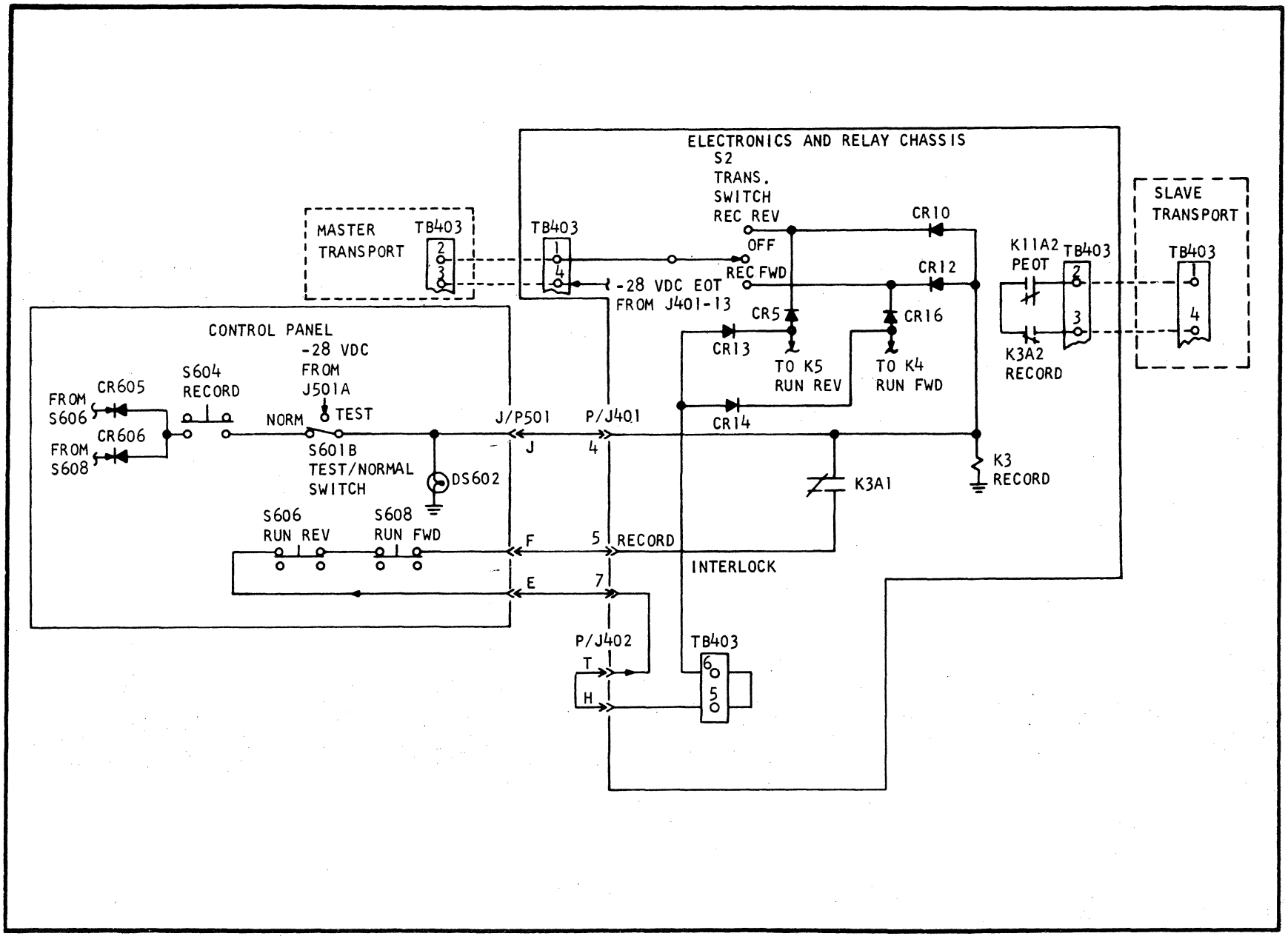


Figure 4-9. Record Mode - Flow Diagram

the -28 volts will cause the record indicator DS602 to illuminate. The record command is fed via P501-J to the electronics and relay chassis through P401-4 to energize the record relay K3. A lock-up path is provided via the normally open contacts of the record relay K3A1 and the normally closed positions of the run forward switch S608 and the run reverse switch S606. Due to the normally closed positions of the run reverse and run forward switches in the record relay lock-up path, the record mode must be initiated with a run forward or a run reverse mode, and any change in these modes will cause the record mode to drop out.

4-47. The record mode can also be initiated by use of the record test switch S601. Placing switch S601B in the TEST position, -28 volts is fed to the record indicator DS602, and via P501-J and P401-4, to the record relay K3. The other deck of switch S601A inhibits the selection of any other mode. This function allows the record heads and record amplifiers to be powered for test purposes without moving tape.

4-48. RECORD TRANSFER.

4-49. The 13-501 Tape Transport is capable of receiving and initiating commands from, and to, other transports in order to maintain a continuous record operation. When transports are connected in this manner, the master transport provides a circuit for the -28 volts from the slave transport through its terminal board TB403-2 and TB403-3. This allows -28 volts to be passed from the slave transport TB403-4 to the master transport TB403-3 and TB403-2, and back to the slave transport TB403-1. From this point, the -28 volts is applied to the transfer switch S2 in the electronics and relay chassis. If the transfer switch is in the REC FWD or REC REV position when the master transport senses photo end-of-tape (PEOT), a record forward or a record reverse operation will be initiated via the transfer switch, diode CR10 or CR12, and the record relay K3, in the slave transport.

4-50. Command signals will also be applied via diode CR5 to the run reverse relay K5, or via diode CR16 to the run forward relay K4. In this manner, before one transport is stopped due to end-of-tape, the second transport will begin recording. When the second transport reaches photo end-of-tape, it may perform a "master transport" function via TB403-3, the normally open contacts of record relay K3A2, normally open contacts of the PEOT relay K11A2, and TB403-2. With this loop, a complete circuit is provided for the -28 vdc from the slave transport, so that it may initiate a record forward or record reverse operation via its transfer switch S2.

4-51. TAPE SPEED, SELECTION AND CONTROL.

4-52. The transport has a closed loop servo system that controls the speed of the dc capstan motor. The transport has two modes of operation, tachometer and tape, controlled by the PHASE LOCK SELECTOR switch on the control panel. In the TACH position of the phase lock switch, the capstan motor forms part of a servo system in which the speed of the motor, as indicated by the tachometer, is compared to the frequency of a stable high frequency reference generator. The TACH mode is used for initial recording. The servo signal is recorded when initially recording data under the TACH mode. The tape then has the prerecorded servo signal that can be used for servo control during playback. In the TAPE position of the switch, the speed of the tape, as indicated by a prerecorded signal on one channel of the tape, is compared to the frequency of the reference generator. In this latter position, the speed of the tape is maintained to within ±0.02% of the speed at which the signal was recorded. Component parts of the transport system involved in the tape speed servo loop are as follows:

TACH	TAPE
Control Panel	Control Panel
Capstan Motor	Capstan Motor
Capstan Power Amplifier	Capstan Power Amplifier
Capstan Motor Tachometer	Reference Generator
Reference Generator	Capstan Servo Amplifier and Tape Control Logic
Capstan Servo Amplifier and Tape Control Logic	Tach/Tape Servo Equalizer
Tach/Tape Servo Equalizer	Direct Reproduce Amplifier
Voltage Regulator and Speed Switching Unit	Reproduce Servo Control
	Optional Low or Bandpass Filters
	Voltage Regulator and Speed Switching Unit

The relative positions of these components within the loop are shown in figure 4-10. The record and reproduce heads, the preamplifier, and the direct record and reproduce amplifiers are included in the tape speed control servo loop, but since they are described in their appropriate manuals, they are not discussed here.

4-53. SWITCH PANEL.

4-54. The transport switch panel serves as a central point for manually commanding the operation of the tape transport. Figure 7-3 is a schematic of the transport switch panel and may be used in following the description below. Components of the switch panel are of the 600 series; that is, S10 = S610, CR1 = CR601, etc.

4-55. The switch panel receives -28 vdc from the amplifier power supply by way of the electronics and relay chassis. Minus 28 volts is applied to the transport switch panel P601-A, and then to the TAPE SPEED SELECTOR switch S10B. The TAPE SPEED SELECTOR switch is capable of selecting speeds of 15,16, 1 7/8, 3 3/4, 7 1/2, 15, 30, 60, 120, or 240 ips. Search mode of approximately 180 ips, or remote control may also be selected from this switch. The output of the switch is fed to pins P601-a through P601-i, except pin e, and to pins P601-Y and P601-Z. The S10A1 deck of the tape speed control switch interlocks the speed select circuits in the remote position, so that the speed may only be selected from the remote station.

4-56. The -28 volts applied to the movable arm of S10B1 is applied to any of the 11 output functions. The 9 speed lines are wired to the voltage regulator and speed switching unit located in the electronics and relay chassis.

4-57. Switch S2 is a push-on, push-off alternate action switch for the power relay. Switch S1 is the TEST-NORMAL switch. In the TEST position, -28 volts is applied to the record relay through P601-j, permitting the record and bias signals to be tested at the record amplifiers. Switch S4, a momentary switch, when activated and with S1 in the NORMAL position will energize the record relay. Switches S5 through S8 are double pole-double throw switches for the run commands.

4-58. The speed of the capstan is directly proportional to the voltage applied to the capstan motor. Table 4-2 lists the voltage requirements of the capstan motor for the various tape speeds.

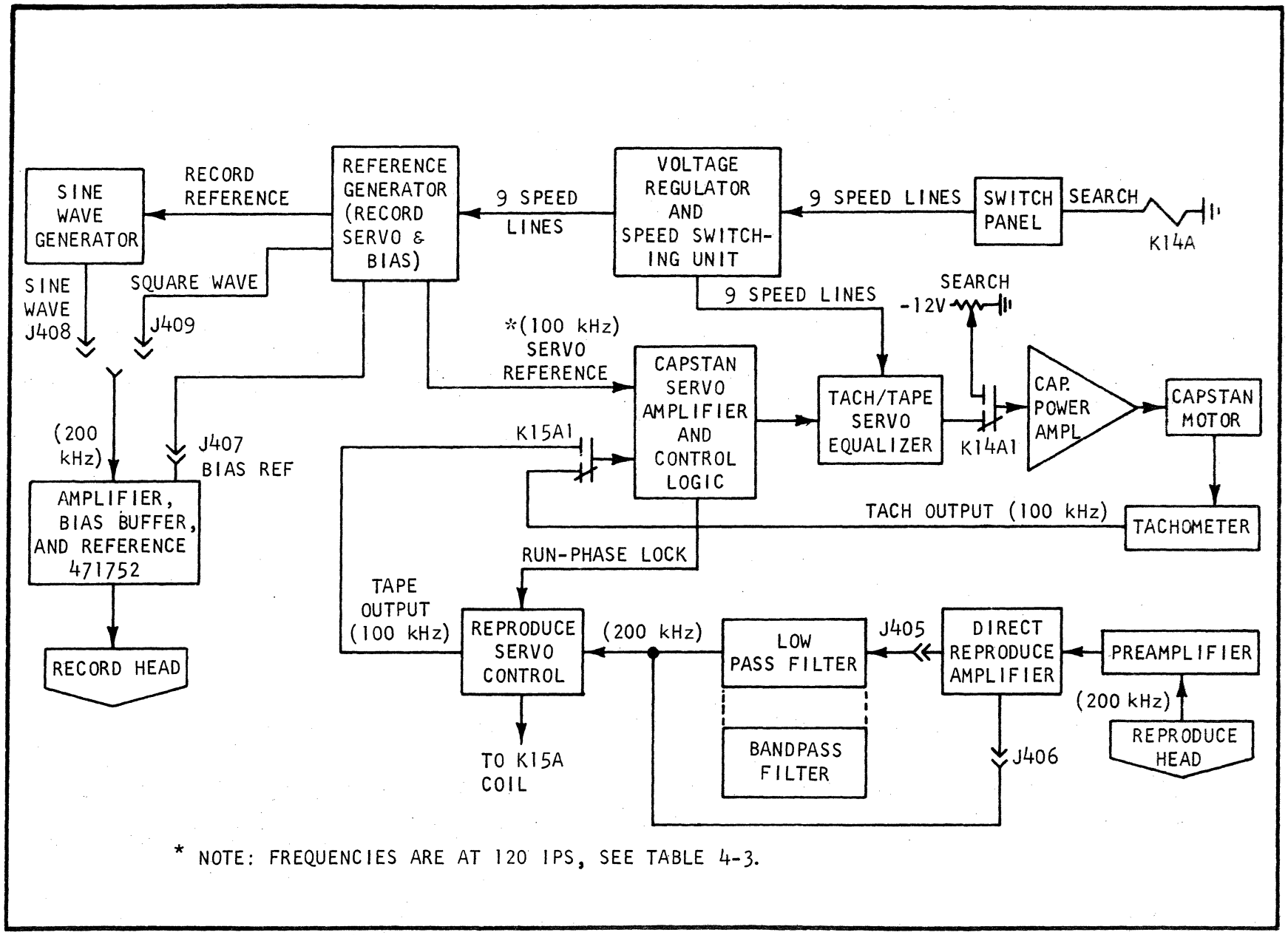


Figure 4-10. Tape Speed Control Servo Loop Block Diagram

TAPE SPEED	OUTPUT OF CAPSTAN POWER AMPLIFIER*
240 ips	+20.5 vdc
120 ips	+11.2 vdc
60 ips	+6.5 vdc
30 ips	+4.0 vdc
15 ips	+2.7 vdc
7 1/2 ips	+2.1 vdc
3 3/4 ips	+1.8 vdc
1 7/8 ips	+1.7 vdc
15/16 ips	+1.45 vdc
*NOTE: Measured at pin 4 TB501	

Table 4-2. Capstan Motor Control Voltages

4-59. SPEED SWITCHING AND VOLTAGE REGULATOR ASSEMBLY.

4-60. The speed switching and voltage regulator assembly serves two functions. First, to provide speed switching and, secondly, to reduce and regulate the + and -20 volts from the transport power to + and -12 volts. The + and -12 volts are used in the various electronics and relay chassis circuits. Figure 7-4 is a schematic of the assembly and may be used in following the description below. Components are of the 2100 series; that is, Q1 = Q2101, R1 = R2101, etc.

4-61. The speed switch assembly receives a -28 volt signal from the switch panel for any one of nine selectable speeds. This signal will energize the appropriate relay (K1 through K9) and, by the closure of the normally open set of contacts, apply a +12 volt signal to the reference generator, and other parts of the transport requiring tape speed signals.

4-62. The voltage regulator circuit receives + and -20 volts from the power supply from pins X and Z, respectively. These voltages are reduced and regulated to + and -12 volts.

4-63. Transistors Q1 and Q3 form a dc amplifier circuit. The output of Q3 is routed to J421-W, which goes to the base of the series regulator transistor mounted on the heat sink assembly (see figure 7-1). Any change in collector voltage of Q3 is sensed on the base of Q401 (mounted on the heat sink) and the conduction of Q401 is regulated so that the emitter voltage is a constant +12 volts. This voltage is returned to J421-16.

4-64. Transistors Q2 and Q4 operate as Q1 and Q3 except that the circuit configuration is to provide a regulated -12 volts off the collector of the series regulator transistor mounted on the heat sink.

4-65. CAPSTAN MOTOR POWER AMPLIFIER.

4-66. The purpose of the capstan motor power amplifier is to provide the power gain necessary for the servo control signal, received from the tach/tape servo equalizer, to drive the capstan motor. The description of the capstan motor power amplifier may be followed using block diagram, figure 4-11, and the schematics, figures 7-12 and 7-13. Components in the capstan motor power amplifier are of the 200 series; that is, TB1 = TB201, Q10 = Q210, etc. The schematics and the block diagram leave out the first one or two digits of each of the designations.

4-67. The capstan motor power amplifier is mounted above the electronics and relay chassis. Connections to this board are made via connector J201. The servo control input from the tach/tape servo equalizer enters the board through J201-23 and is amplified by a differential amplifier, consisting of Q2, Q3, and Q4. The output of the differential amplifier drives a complementary push-pull power amplifier, Q5 through Q14. The search and fast signals also enter the amplifier at J201-23 since all three signals are OR'd by relay contacts K10A1 and K14A1 mounted on the electronics and relay chassis.

4-68. The low side of the capstan motor signal is connected to ground through resistor R23. Resistor R23 provides a voltage feedback signal via resistor R19 to transistor Q2. This degenerative voltage feedback signal is used to stabilize the power amplifier operation. When a search or a fast mode has been initiated, a ground signal is applied to J201-16 of the capstan motor power amplifier to energize relay K1A. Switching the contacts of relay K1A3 changes the capstan motor power amplifier from a voltage to a current amplifier. This is accomplished by removing R19 from the feedback loop and inserting in its place variable resistor R21, and the diodes CR6 and CR7. The diodes are used for current limiting when a current of 9 amps or greater passes through resistor R23, at which level the diodes will exceed their forward voltage and clamp the base of Q2. The direction in which the capstan motor will turn is determined by relay K9A in the electronics and relay chassis. Relay K1A of the electronics and relay chassis ensures that the capstan motor is inactive whenever the brakes are engaged. See figure 4-2 and paragraph 4-16.

4-69. When a reverse mode is commanded from a forward mode, the go-to-stop relay K16 is energized. Relay contacts K16A4 close until the capstan motor stops. Relay K9 is energized in stop and all reverse modes. Relay contacts K16A4 switch potentiometer R5 and CR6 into the feedback circuit limiting the positive feedback current to the base of Q2. Thus, the gain of the amplifier is now controlled by this circuit. The stop time of the capstan motor is controlled by adjusting potentiometer R5. The positive potential on the base of Q2 is limited by CR7.

4-70. CAPSTAN MOTOR TACHOMETER.

4-71. Directly connected to the shaft of the capstan motor is a tachometer which senses the tape speed. The tachometer produces 4000 pulses for each revolution of the capstan motor. A preamplifier, which is an integral part of the capstan motor assembly, amplifies the output of the tachometer and provides an output of 0.3 volts peak-to-peak at 3.125 kHz, and not less than 0.15 volts at 100 kHz.

4-72. The sensing device is an accurate optical system mounted as an integral part of the motor and serves as a digital tachometer. It consists of a coded glass disc mounted on the motor shaft and a photoelectrical readout assembly including a lamp, lens, grating, solar cell array, and suitable mounting hardware.

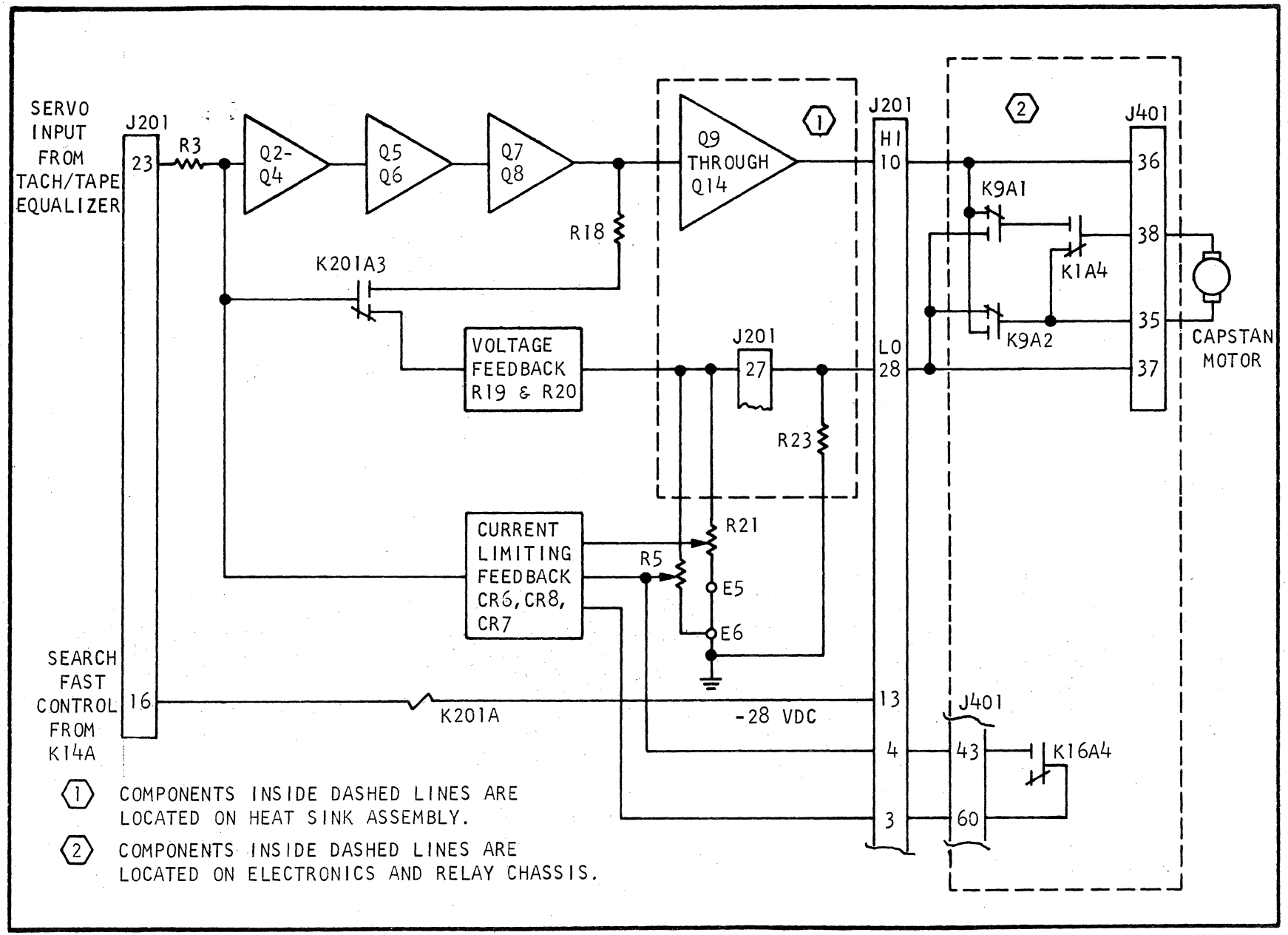


Figure 4-11. Capstan Motor Power Amplifier Block Diagram

4-73. The grating is a small glass section coded with the same information as that of the printed circuit motor disc. As the disc rotates with the motor shaft, the solar cell picks up the information generated by the lamp and the interference pattern set up between the disc and the stationary grating. The coding on the disc is in the form of a ring, within which are 4000 equally spaced radial, opaque lines. The digital tachometer output signal is accurately converted to a series of short duration pulses, giving a true indication of motor speed.

4-74. The output of the solar cell is a high impedance signal of 10 to 80 millivolts peak-to-peak, depending upon the motor speed and the optical system alignment. A dc coupled preamplifier, mounted on the motor case as part of the assembly, loads the output of the solar cell so that it operates as a linear current device with respect to light intensity, and provides a low impedance output at a minimum level of approximately 150 millivolts peak-to-peak.

4-75. At a tape speed of 120 ips, the output frequency from the tachometer is 100 kHz. The tachometer output at other tape speeds is directly proportional to this as shown by table 4-3. The output from the tachometer preamplifier is fed out of the capstan motor assembly at terminal board TB501-7. The signal is carried by the transport interconnecting cables to the electronics and relay chassis J401-27. From this point the signal is fed into the tape control logic J419-19. The signal is ac coupled by a 25 μf capacitor in the capstan servo amplifier from J419-19 to J419-A. From this point the tach signal is connected to the normally closed contacts of the tach/tape mode select relay K15. If the tach mode has been selected, K15 is deenergized and the tach signal is passed to J419-5 to be processed as explained in paragraph 4-87, Capstan Servo Amplifier and Control Logic.

4-76. The tape control logic uses the tachometer signal to determine if the capstan motor is rotating. This is explained in detail in paragraph 4-107, Tape/Tach Mode.

4-77. In the TACH position of the phase lock switch, servo control of the capstan motor compares the speed of the capstan, as indicated by the output of the tachometer with a reference frequency generated by a reference frequency generator, see table 4-3.

CAPSTAN SPEED	CAPSTAN SERVO/TACHOMETER REFERENCE FREQUENCY	RECORD REFERENCE FREQUENCY
240 ips	200/200 kHz	400 kHz
120 ips	100/100 kHz	200 kHz
60 ips	50/50 kHz	100 kHz
30 ips	25/25 kHz	50 kHz
15 ips	12.5/12.5 kHz	25 kHz
7 1/2 ips	6.250/6.250 kHz	12.5 kHz
3 3/4 ips	3.125/3.125 kHz	6.250 kHz
1 7/8 ips	1.562/1.562 kHz	3.125 kHz
15/16 ips	1562/781.25 Hz	1562 Hz

Table 4-3. Capstan Servo/Tachometer and Tape Servo Signal Frequencies

4-78. REFERENCE GENERATOR.

4-79. The reference generator consists of a 16 MHz oscillator, three frequency dividers, an 8-BIT binary counter, and output amplifiers. The reference generator has three outputs, bias reference, record servo reference, and capstan servo reference. Figure 4-12 is a block diagram and figure 7-5 is a schematic of the reference generator. Either of these diagrams may be used in following the descriptions in paragraphs below. All components in the generator are 1800 series. Therefore, R1 = R1801, Q1 = Q1801, etc.

4-80. The 16 MHz oscillator consists of a crystal Y1, an amplifier Z1, and associated RC network. Capacitor C1 is a trim capacitor and Z1 is a quadruple 2 input NAND gate. TP1 is used to test this 16 MHz frequency which is the input to Z2, a dual J-K master slave flip-flop.

4-81. Flip-flop Z2 has three outputs. The output of pin 13 is 8 MHz and is wired to E2, which is jumpered to E4 for standard units as shown in figure 7-4. The output of pin 9 is 4 MHz and is wired to E2. The output of pin 8 is also 4 MHz and is divided by two by Z12, and 2 MHz is available at E7. For bias frequencies other than 8 MHz, remove the jumper from E2 and jumper E1 to E4 for 16 MHz, or E3 to E4 for 4 MHz, or E7 to E4 for 2 MHz.

4-82. Integrated circuit Z3 is a symmetrical divide-by-ten counter. The input of 4 MHz is applied to pin 1 and a 400 kHz square wave is obtained at pin 12. This 400 kHz signal is used for the record reference of 240 ips operation and as the input to the 8-BIT binary counter.

4-83. Four bit binary counters Z4 and Z5 are linked together to form an 8-BIT binary counter. The output of Z4-12 is a 200 kHz signal used for the 120 ips record reference frequency. The successive stages of the binary counter are then divided by two until finally the output of Z5-11 is reached. The output of Z5-11 is the 1.562 kHz signal for the record reference frequency of 15/16 ips operation. These signals are fed to the NAND circuit.

4-84. The NAND circuits composed of Z8, Z9, and Z10 are also connected to the speed switching circuits located in J421 of the electronics and relay chassis. According to the selected speed, the appropriate NAND gate is enabled with a +12 volt input and the proper record servo reference frequency is fed to Q2. Transistors Q2 and Q3 form a transistor zener that limits the signal to a 7 volt swing. Transistors Q4 and Q5 are emitter followers and the output signal measured at TP3 will be approximately a 4.7 volt peak-to-peak square wave.

4-85. The output of Z11-8 is also fed to Z6-11 and Z7-5. Flip-flop Z7 output frequency is one-half the input. This signal is then fed to Z6-5 where it is enabled by all speeds, except 15/16 ips. For 15/16 ips operation, the output of Z6-4 is inhibited by the 15/16 ips command and at the same time Q1 is turned on thus enabling the output of Z6-13, which is then gated to the capstan servo output. For 15/16 ips operation, the capstan servo output frequency is the same as the 15/16 ips record servo reference frequency. For all other speeds, the capstan servo frequency is one-half the record reference frequency (refer to table 4-3).

4-86. The record control line enables Z6-10 output. This line is -28 volts whenever the transport is placed in the record mode of operation. Diode CR1 clamps this input to approximately zero volts, thus enabling Z6-10 to pass the bias frequency to the bias buffer amplifier.

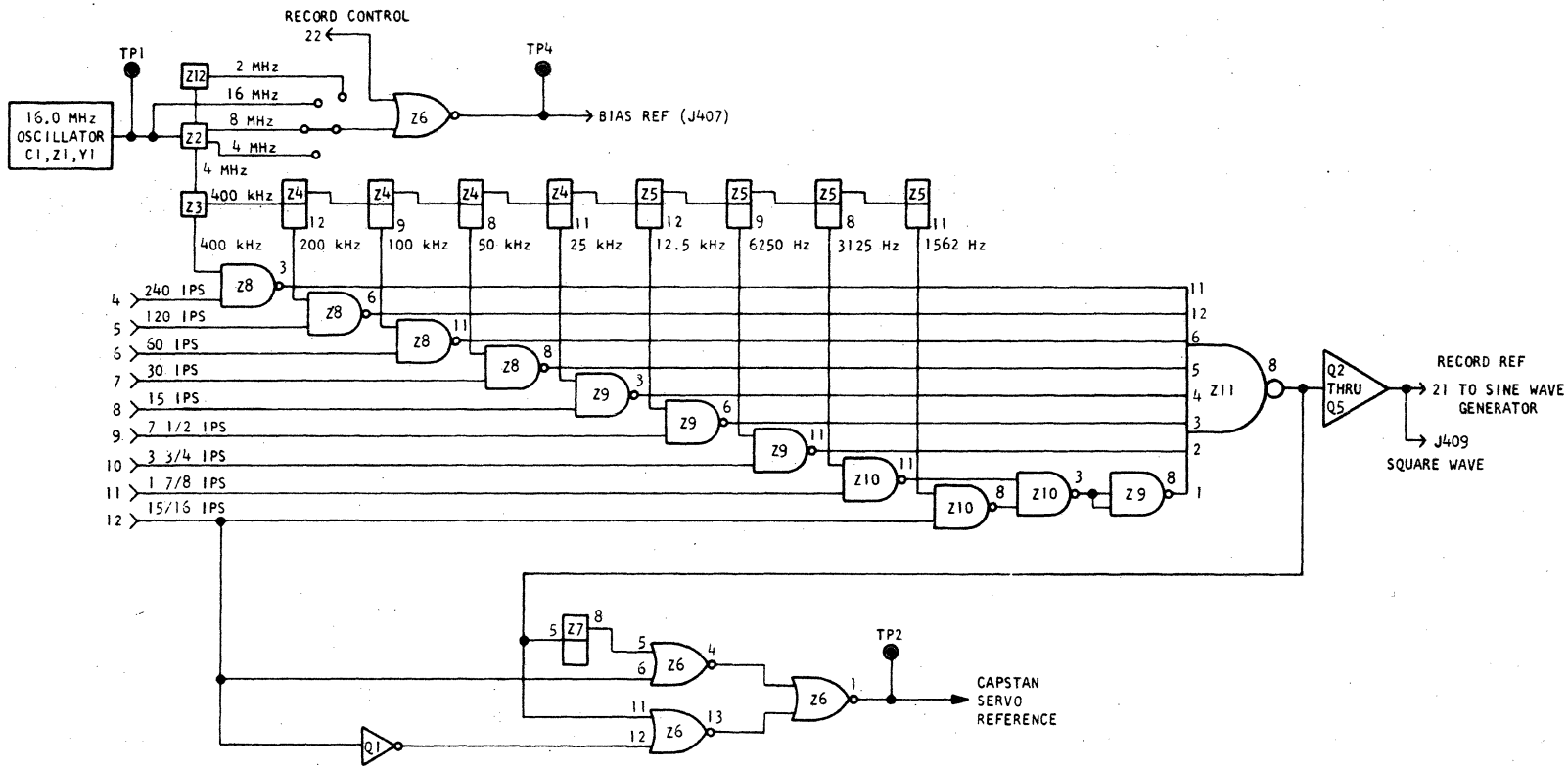


Figure 4-12. Reference Generator Block Diagram

4-87. CAPSTAN SERVO AMPLIFIER AND CONTROL LOGIC.

4-88. The capstan servo amplifier and control logic compares the servo feedback signal and the reference signal to determine the phase angle between the two and send the resultant information to the tach/tape servo equalizer.

4-89. The description of the capstan servo amplifier may be followed using either the block diagram, figure 4-13, or the schematic, figure 7-6. Also refer to figures 4-14 and 4-15, pulse timing within the capstan servo amplifier. Components of the capstan servo amplifier are of the 1900 series; that is, R1 = R1901, C1 = C1901, etc.

4-90. The servo amplifier can be divided into four sections: pulse amplifier, pulse separator, clock pulse generator, and up-down counter.

4-91. Incoming servo feedback pulses from the tachometer, or from a prerecorded tape, are amplified and limited by operational amplifier Z1. The incoming signal may be sampled for test purposes at test point TP1. The servo feedback signal is then inverted by Q12. Test point TP2 may be used to sample the signal as it appears at this point. The signal at TP2 goes to Z2-13 and Z6-12. The purpose of Z2, C19, and C20 is to double the input frequency. The output of Z2-10 is twice that frequency measured at TP2. This is fed to Z6-8. The logic of Z6-1, Z6-10, and Z6-13 gates the output of the frequency doubler into the pulse separator circuit for 15/16 ips operation and inhibits the frequency doubler circuit for all other speeds. It should be noted that the capstan servo reference input for 15/16 ips operation is not divided by two and this circuit compensates for that action by doubling the tach/tape signal. Therefore, the pulse comparison for the reference input at pin X to the output of Z6-1 will always be on a 1 to 1 ratio. Integrated circuit Z3 causes a negative pulse to be applied at Z7 each time a positive going servo feedback signal is received. This differentiating circuit feeding an inverter acts as a one-shot multivibrator. The resulting double inverted pulse out of Z3 will have a low duration of approximately 0.4 microsecond each time a positive-going servo feedback signal is received.

4-92. Z4 and Z5 form a pulse separator latch. The input to the latch at pin Z5-11 will be high except during the 0.4 microsecond following each servo feedback pulse. The latch will therefore follow the reference input at pin Z5-6 except when the reference pulse coincides with the feedback pulse at which time it will be delayed by 0.4 microsecond. This is to ensure that the reference pulse and the feedback pulse never reach the up-down counter simultaneously, see timing diagram, figure 4-14.

4-93. The reference pulse, gated by the pulse separator, inverted by Z5-1, triggers a 0.1 microsecond one-shot formed by Z4-6. This pulse is now ready for use as a clock pulse gated into the up-down counter by the NOR gate Z6-4, and as a reference pulse in the counter through control gates Z8 and Z9.

4-94. The servo pulse at Z6-1 triggers two consecutive one-shot circuits formed by Z3 to provide a 0.1 microsecond pulse and a delay of 0.4 microsecond. This pulse is now ready for use as a clock pulse to be gated into the up-down counter by the NOR gate Z6-4 and as the servo pulse in the counter through control gate Z7.

4-95. Two J-K flip-flops and their associated gates form the up-down counter. Each flip-flop has two logic inputs and a clock input. The output level is determined by the logic levels at the J and K inputs when the clock pulse arrives. The inputs must be of opposite logic levels, a high level at the set input will produce a high level at the 1 output. The logic levels do not change the state of the counter until the clock pulse arrives.

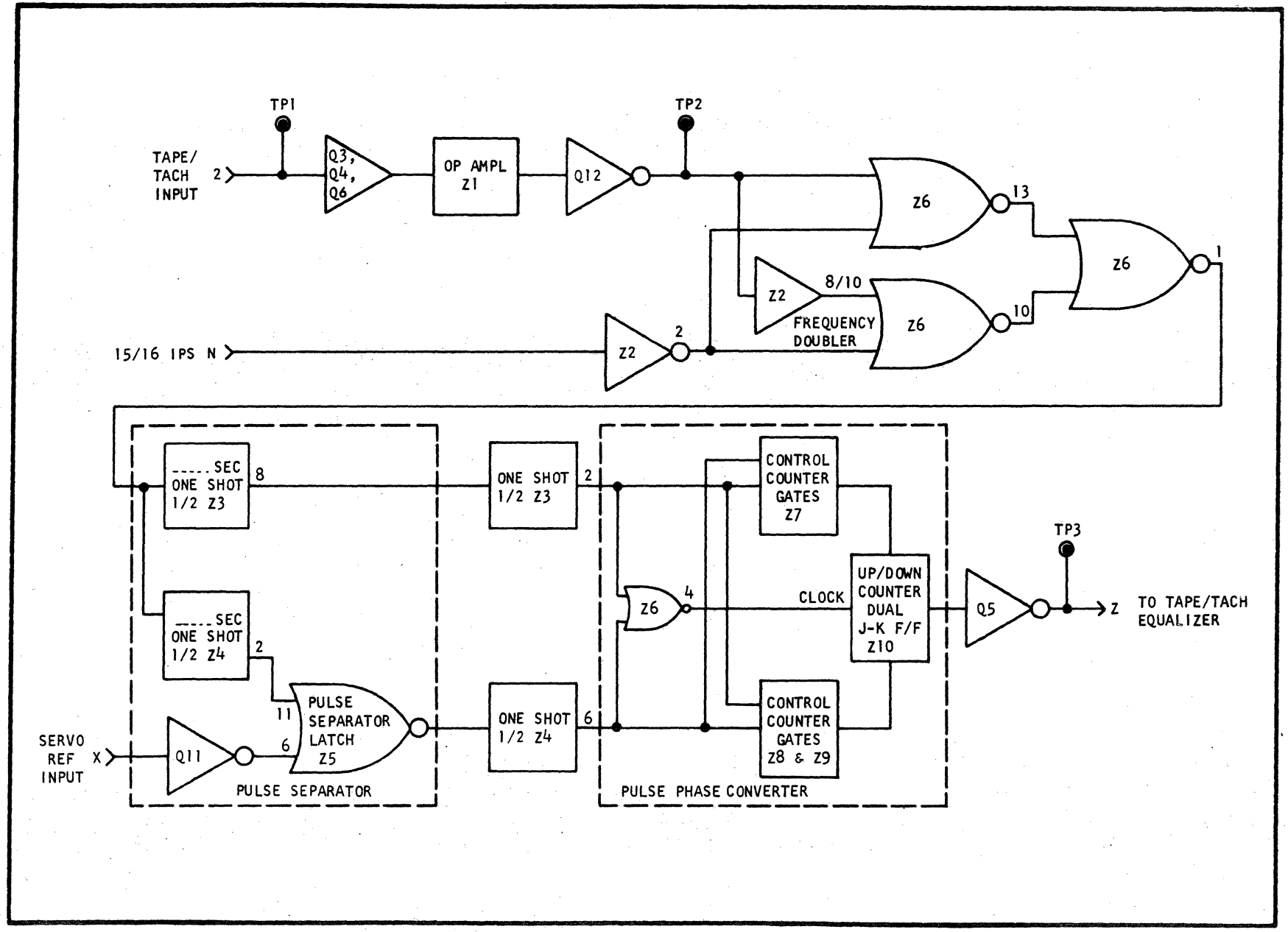


Figure 4-13. Capstan Servo Amplifier and Control Logic Block Diagram

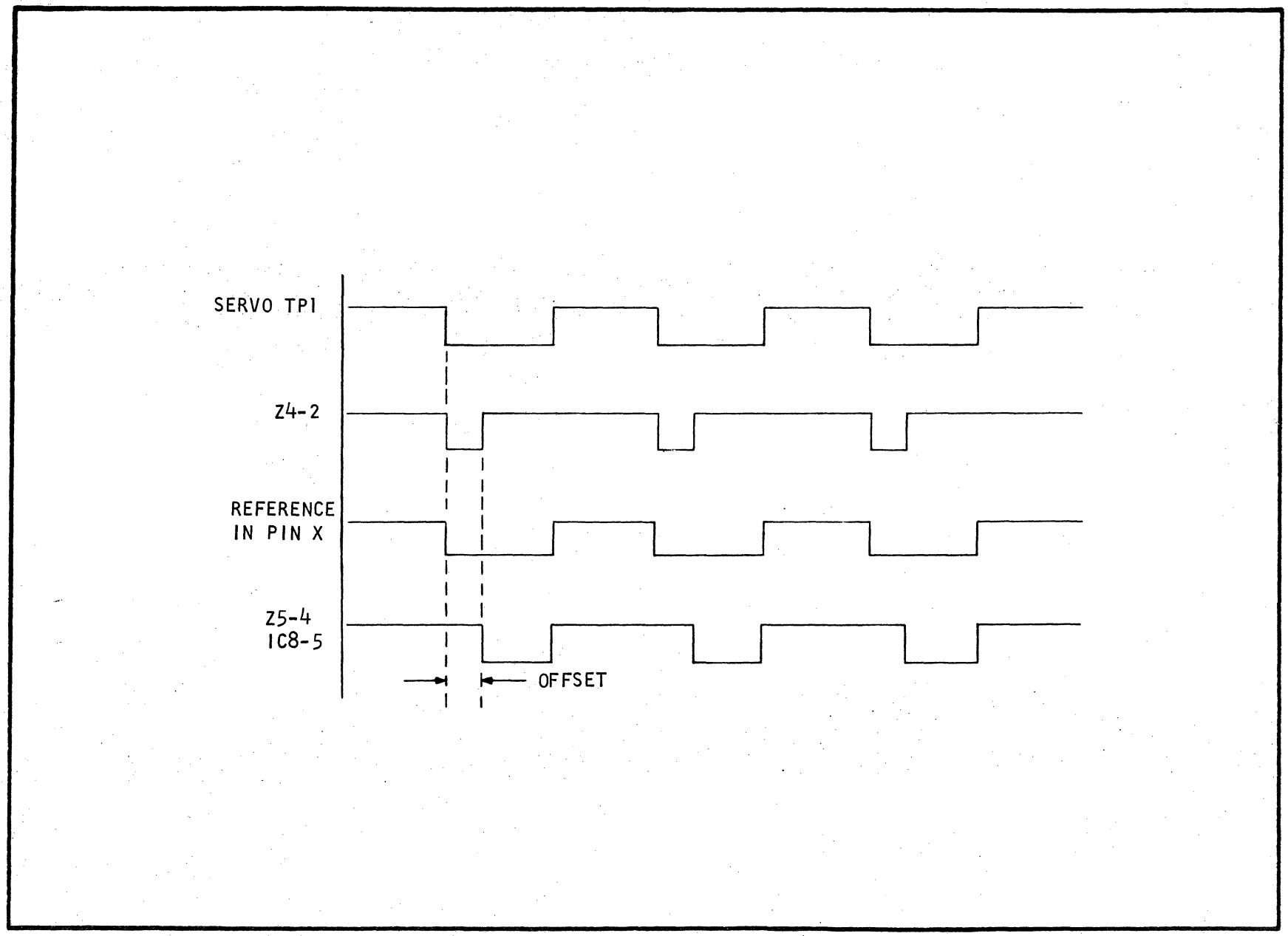


Figure 4-14. Pulse Separator Gate, Showing Effect of Coincident Pulses

4-96. The timing diagrams of figure 4-15 give the output levels of the two flip-flops for three conditions of input. One, when the pulse repetition frequency of the servo signal equals that of the reference signal. Two, when the repetition frequency of the servo signal exceeds that of the reference signal. Three, when the reference signal repetition frequency exceeds that of the servo signal. The resultant output level may be observed at test point TP3. In phase lock, the output will be a square wave. When more servo pulses are received than reference pulses, the tape needs to move slower, and the output will be low dc level. When more reference pulses are received than servo pulses, the tape needs to move faster, and the output will be high dc level.

4-97. The output of Z1 is also applied to the base of Q1 (see schematic, figure 7-6). Q1 and Q2 amplify the signal, CR3 and CR4 rectify the signal, and C13 integrates the result. This positive charge on C13 saturates Q7. The output of Q7 goes to pin $\overline{A}$ for the capstan STOP ground signal. This can be tested at TP5. The signal at TP5 will drive the base of Q9 negative, causing Q9 to saturate. This will cause a ground signal to be applied to pin $\overline{D}$, thus energizing relay K2A in the electronics and relay chassis. K2A is the capstan motor sensor relay.

4-98. Diodes CR1, CR2, capacitor C11, and transistor Q8 operate as do CR3, CR4, C13, and Q7 as above. The resultant signal can be measured at TP6. This signal will cause Q10 to saturate. Q10 is enabled by the ground signal for all run modes on pin $\overline{B}$. The output of Q10 goes to pin Y. The ground signal at pin Y enables the TAPE/TACH lamp and Q1607 in the reproduce servo control. Transistor Q1607 controls K15A, the tape mode relay.

4-99. TACH/TAPE SERVO EQUALIZER.

4-100. The tach/tape servo equalizer amplifies the output of the capstan servo amplifier and passes the resulting signal to the capstan power amplifier. The amount of amplification taking place in the tach/tape servo equalizer is determined by the tape speed selected and the mode (tach or tape) selected at the control panel. The operation of the tach/tape servo equalizer, as described in the paragraphs following, may be followed using the block diagram, figure 4-16, or the schematic, figure 7-7.

4-101. The tach/tape servo equalizer components are of the 2000 series. For example, C1 = C2001, and K2A = K2002A, etc. On the schematic and the block diagram, the first three digits are left off each of the components.

4-102. The incoming signal from the capstan servo amplifier (J420-22) is a square wave during phase lock operation; however, the frequency of the square wave will vary with different tape speeds. When capstan speed is above or below phase lock, a dc level will be fed into the tach/tape servo equalizer circuit. No gain equalization is required for these dc level inputs above or below phase lock. Equalization is required, however, for the square wave inputs due to the different input frequencies at various commanded tape speeds.

4-103. As shown by the block diagram, figure 4-16, control of the overall amplifier is accomplished by varying the feedback loop impedance of the operational amplifier Z3. During TAPE mode operation, the signal at pin 21 energizes K1A1 and K2A1. Energizing K1A1 closes the contacts in the amplifier feedback circuit and reduces the loop impedance by an amount dependent upon the selected speed and the associated transistors. Also at 15/16 ips, 1 7/8 ips, 3 3/4 ips, or 7 1/2 ips, one of the three transistors (Q1, Q2, or Q3) is taken into saturation by the positive command voltage. This will connect either C2, C3, or C4 to ground, reducing the resonant frequency of the filter network. This, in addition to switching in different resistance values by Q19, Q20, Q21, or Q22, accomplishes the equalization for the lower speeds. For tape speeds of 15 ips and above, one of the transistors Q14 through Q18 is selected to switch in the appropriate feedback resistance.

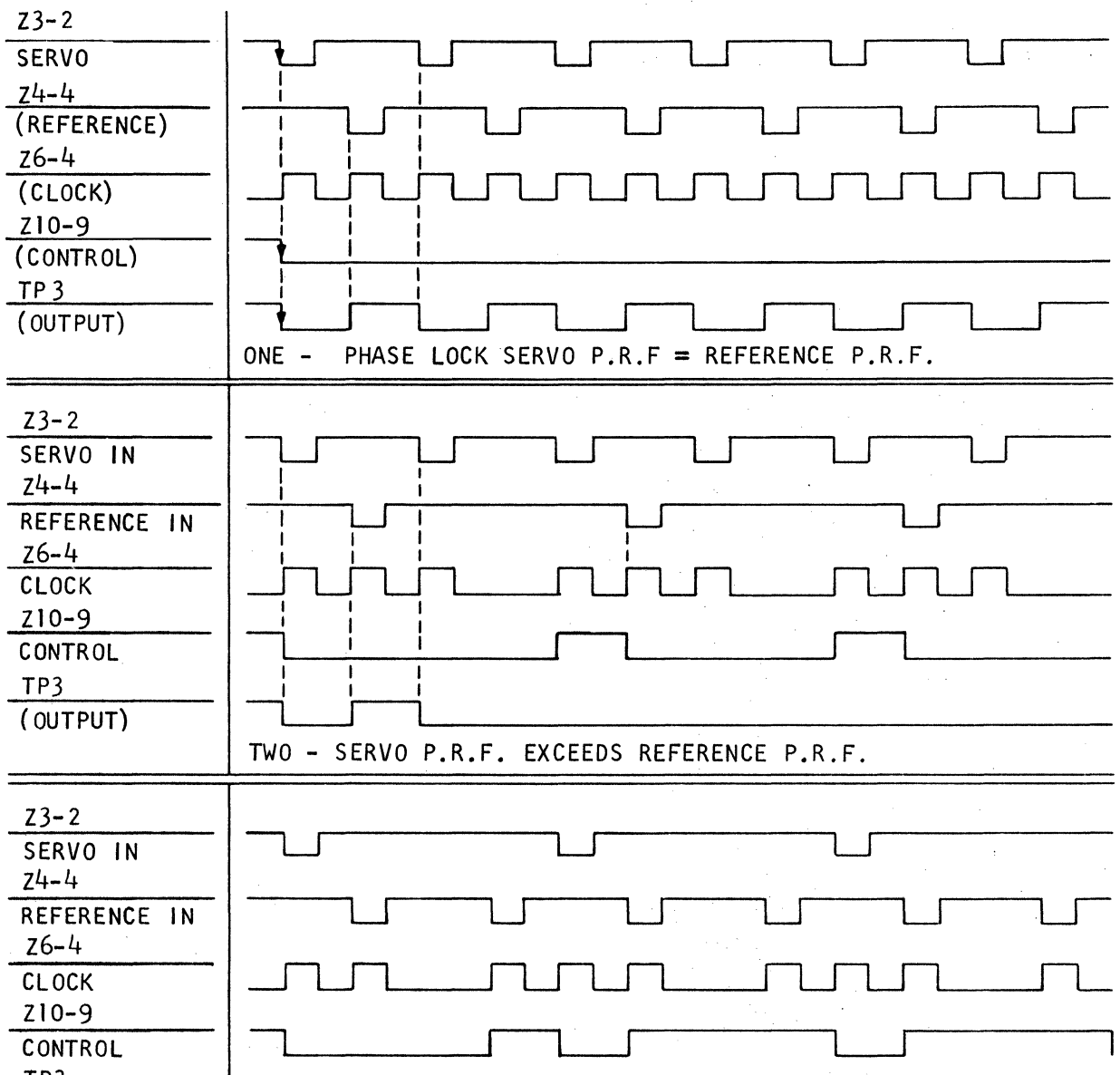


Figure 4-15. Capstan Servo Amplifier Timing Diagram

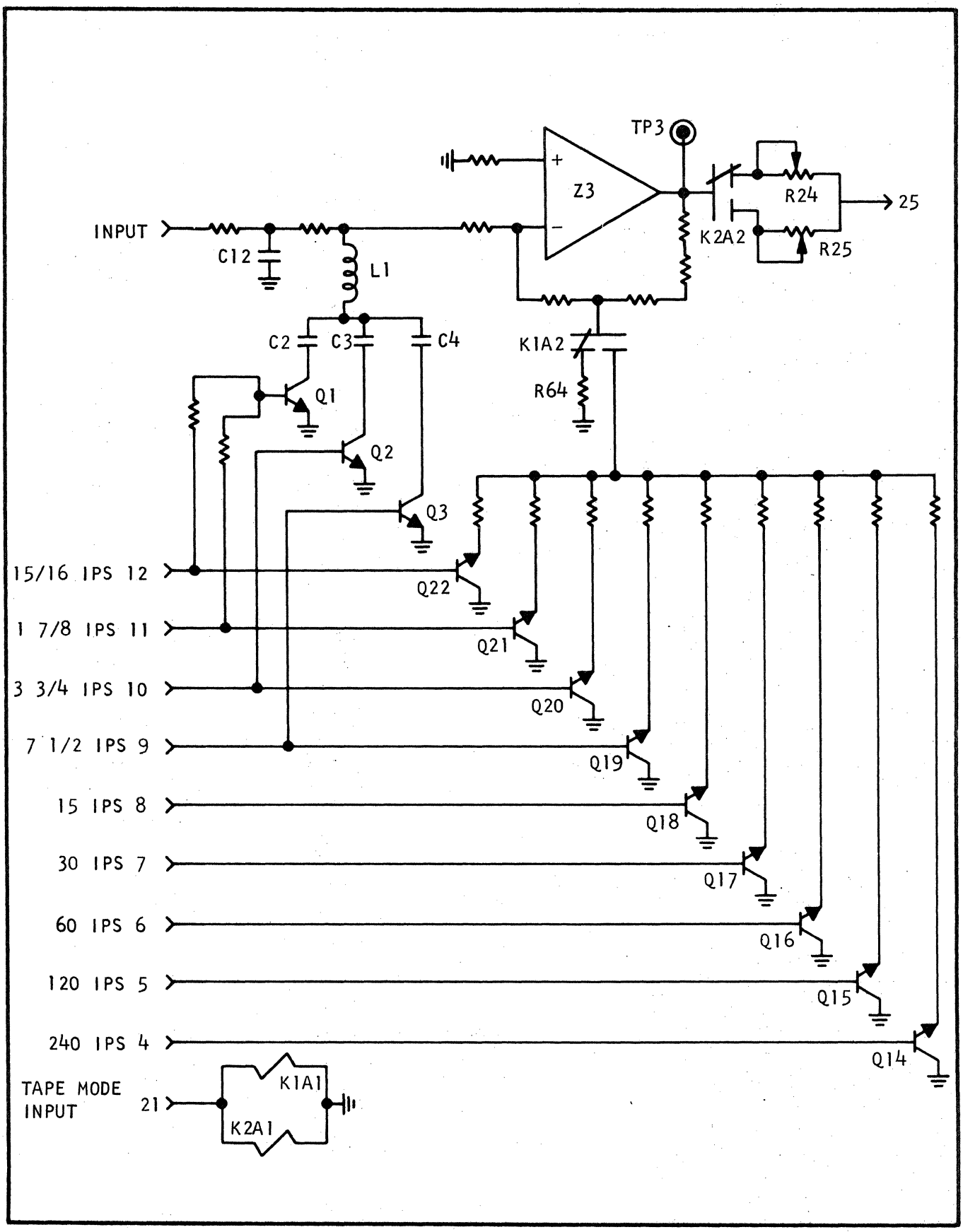


Figure 4-16. Tach/Tape Servo Equalizer Block Diagram

4-104. When the tach mode has been commanded, relays K1A1 and K2A1 will deenergize. Contacts 3 and 4 of K1A2 will place R64 in the feedback loop impedance and reduce the overall gain of the operational amplifier to approximately 1/4 the gain used in the tape mode.

4-105. The output level of the operational amplifier is controlled by either R24 or R25, according to the mode of operation. In the TAPE mode, R25 is adjusted so that the capstan will seek and maintain the requested speed without hunting or dropping off in speed. In the TACH mode, R24 is adjusted to accomplish this ANTI-HUNT feature. TP1 measures the input from the capstan servo amplifier and TP3 measures the output of the operational amplifier.

4-106. The output of the tach/tape servo equalizer is fed to J419-2 to interlock with the capstan servo card. The servo control signal is fed out on J419-25 of the capstan servo card through various relay contacts to the capstan power amplifier via J401-34.

4-107. TACH/TAPE MODE. (See figure 4-17, Tach/Tape Mode Control - Flow Diagram.)

4-108. The tach/tape phase lock switch S603 selects one of two capstan servo control systems. In the TACH position of the switch, the speed of the capstan motor is indicated by the output of the tachometer. In the TAPE position of the switch, the speed of the tape is indicated by a reproduction of a prerecorded signal on the tape. The mode of operation and the condition of phase lock are shown by illumination of the lamp immediately above the TACH or TAPE positions of the phase lock switch.

4-109. The tape mode relay K15, on the electronics and relay chassis, (figure 7-1) controls the input (tach or tape) to the capstan servo amplifier. K15 is enabled by the output AND gate in the reproduce servo control P416-17. A ground will be applied to the coil of K15 if the transport is in run and phase lock, and the reproduce signal is being received at the reproduce servo control P416-20. The other side of the tape mode relay coil K15 receives -28 vdc via the normally closed contacts of the record relay, K3A3, P401-22, P601-S, and the TAPE position of the PHASE LOCK SELECTOR switch S603, on the switch panel. The transport will operate in the tach mode, regardless of the position of the phase lock switch, if any one of the above conditions have not been met.

4-110. In the deenergized condition of the tape mode relay K15, the input to the capstan servo amplifier is connected to the tachometer via contacts K15A1, and the output of the tape control logic is connected to the tach indicator lamp via contacts K15A2. The tape control logic will provide a ground for the capstan motor ON relay K2 when it receives an input from the tachometer, and will provide a ground for the tach or tape lamps when the capstan is in phase lock. See figure 7-1.

4-111. During phase lock, the signal will apear as a square wave at test point TP6 in the capstan servo amplifier; at all other times, it will appear as a continuous dc level. From TP6 the signal is fed to a rectifier, filter and hold circuit, the purpose of which is to change the square wave into a positive dc level. The dc level inputs, which appear when operating above and below phase lock, will produce a zero voltage output from the rectifier, filter and hold circuit. The output during phase lock, after inversion by Q8, is ground, which is fed to transistor Q10. Transistor Q10 acts as an AND gate, and provides an output ground when the transport is in phase lock and in one of the run modes. The ground signal is received into the capstan servo amplifier during run modes via the normally open contacts of the run relay K10A4. The AND gate Q10 will make this ground signal available at P419-4 if the system is also in phase lock. From the capstan servo amplifier, the ground signal, indicating run and phase lock, is applied to the reproduce servo control P416-18, and via the tape mode relay contacts K15A2 to the control panel, where it illuminates the tach or tape indicator depending upon the position of contacts K15A2.

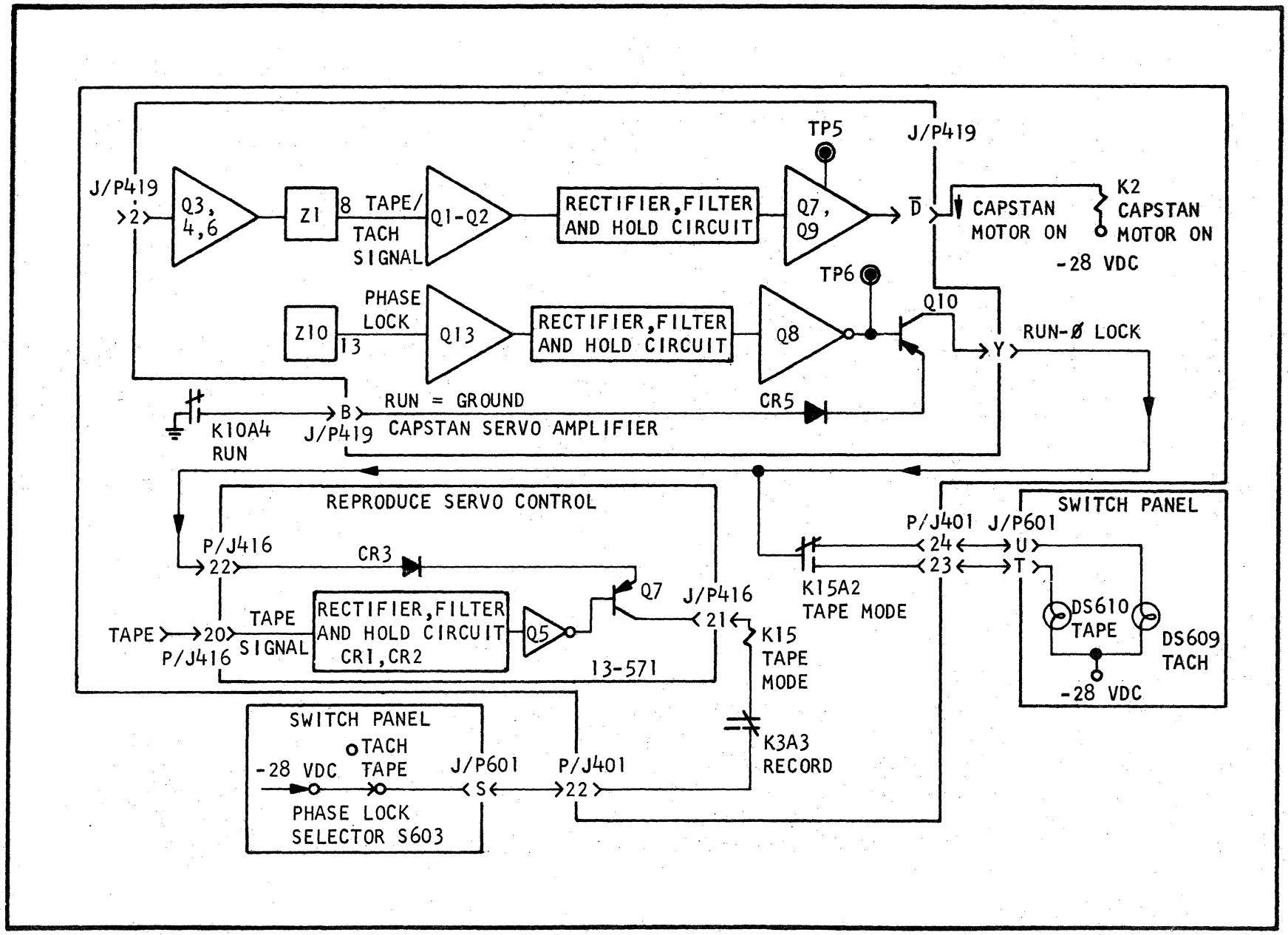


Figure 4-17. Tape/Tach Mode Control - Flow Diagram

4-112. To supply information to the control logic that the capstan is turning, the tachometer signal is fed into the capstan servo amplifier at P419-2. In the capstan servo amplifier, the signal, amplified by transistors Q1 and Q2, will appear at test point TP5 as a square wave. The frequency of this square wave is dependent upon the speed of the capstan motor. From test point TP5, the signal is converted to a positive dc level by a rectifier, filter and hold circuit. This positive dc level is amplified by Q7 and saturates Q9 to provide a low logic level at P419-d when the tachometer signal is being received. The output signal is used to energize the capstan motor ON relay K2. If the tachometer signals are not received at P419-2, the output from the rectifier, filter and hold circuit will be zero volts dc. This will not saturate transistor Q5, and the capstan motor ON relay K2 will remain in the deenergized condition.

4-113. When the tach mode has been selected, the output of the tachometer is directly coupled through normally closed contacts of the tach/tape mode relay K15A to the capstan servo amplifier. There it is compared with the reference frequency from the reference generator. The result of this comparison will create an error signal output or a phase lock indication. The error signal or phase lock indicator is fed out of the capstan servo amplifier to the tach/tape servo equalizer.

4-114. During tape mode operation, the indicator of tape speed is provided from an IRIG compatible reference signal prerecorded on one channel of the tape. The tape signal is supplied from the reproduce head to a reproduce preamplifier. From the reproduce preamplifier, the signal is fed to a direct reproduce amplifier where it is amplified to a usable level.

4-115. The IRIG compatible tape signal, reproduced from the tape as an indication of tape speed at the time of recording, is the product of a signal originating in the reference generator. The reference generator generates a reference frequency based on the tape speed selected at the control panel. At the same time, the reference generator provides a record reference output which is two times the frequency of the reference frequency signal. The record reference is fed to one of the direct record amplifiers, where it is recorded on one track of the magnetic tape. Any fluctuations in tape speed during the record cycle will be available to control tape speed during the reproduce cycle. In this manner, it is possible to reproduce data signals at the same speed as that at which they were recorded.

4-116. Optional filters are available for insertion into the signal path between the reference generator and the reference amplifier and bias buffer amplifier, and between the reproduce amplifier and the reproduce servo control. Wide band systems capable of recording frequencies of up to 1.5 MHz, or 2 MHz, have a low pass filter assembly (Bell & Howell Type 13-545-2) inserted in the signal path between the reproduce amplifier and the reproduce servo control as standard equipment.

4-117. TYPE 13-545-2 LOW PASS FILTER ASSEMBLY.

4-118. The Bell & Howell Type 13-545-2 Low Pass Filter Assembly consists of 9 parallel LC low pass filter networks, one for each tape speed (transistor Q1 and its associated parallel LC network are optional). The filter inputs are connected in parallel to the reproduce servo input J408 on the transport electronics and relay chassis. The outputs are controlled by individual transistor switches, the required filter being brought into circuit when the base circuit of its transistor switch is taken to -12vdc. The switch outputs are OR connected to an amplifier and an emitter follower stage, Q10 and Q11, the output of which is connected to J417-20 on the transport electronics and relay chassis and may be observed at test point TP2. See figure 7-8, Schematic, Reproduce Low Pass Filter.

4-119. TYPE 13-544-1 SINE WAVE GENERATOR.

4-120. The record sine wave generator (Bell & Howell Type 13-544-1) is a low pass filter assembly essentially identical to the Bell & Howell Type 13-545-2 Low Pass Filter Assembly described above, with the difference being in the pin connections to the filter input and output circuits. The input to the filter is obtained from the reference generator; the output of the generator is connected to J415 on the transport electronics and relay chassis. See figure 7-9, Schematic, Record Sine Wave Generator.

4-121. The record sine wave generator is required when the channel used for tape servo control is also required to record data at signal frequencies above the servo control frequency in a multiplex system. The record reference frequency is fed into the record sine wave generator as a square wave. In the sine wave generator, the fundamental sine wave is extracted by the filters before being applied to the record amplifier for multiplexing with the data signal.

4-122. Multiplexing of the servo and the data signals requires the use of a bandpass filter in the signal path between the reproduce amplifier and the reproduce servo control. The bandpass filter assembly is plugged into card holder J417, on the electronics and relay chassis, replacing the low pass filter in a wideband system.

4-123. TYPE 13-545-1 BANDPASS FILTER ASSEMBLY.

4-124. The Bell & Howell Type 13-545-1 Bandpass Filter Assembly contains nine module bandpass filter elements, one for each speed. The filter inputs are connected in parallel to the reproduce servo input J408 on the transport electronics and relay chassis. The outputs are controlled by individual transistor switches, the required filter being brought into circuit when the base circuit of its transistor switch is taken to -12 vdc. The switch outputs are OR connected to an emitter follower, the output of which may be observed at test point TP2. See figure 7-10, Schematic, Bandpass Filter.

4-125. REPRODUCE SERVO CONTROL.

4-126. Figure 4-18 is a block diagram of the reproduce servo control. A schematic of this assembly is shown in figure 7-11. The reproduce servo control receives its input from the filters in series with the reproduce amplifier or direct from the amplifier, depending on the type of system. The input is applied to a Schmitt trigger formed by the transistors Q2 and Q4. The Schmitt trigger converts the sine wave input into a square wave of the same fundamental frequency. The output from Q4 may be observed for test purposes at TP1. From this point, the output of Q2 is amplified by Q6 and differentiated by C8, then applied to the flip-flop contained in Z1. This flip-flop provides a divide-by-two function. The output, as seen at P416-23, will be a symmetrical square wave, one-half that of the input frequency.

4-127. The square wave tape signal, in addition to being fed to Z1, is applied to amplifier Q1. There the signal is amplified and passed via Q3, acting as a zener diode, to the sample and hold network consisting of C3, CR1, CR2, R17, C5, R22, and Q5. Transistor Q3 imposes a zener effect on the output of Q3, limiting the output to zero volts (low) and +2.1 volts (high). The square wave is fed through capacitor C3 to diodes CR1 and CR2. Capacitor C3, diodes CR1 and CR2 restore the square wave to a positive dc level, charging capacitor C5 to approximately +2.2 vdc. This voltage will be maintained as long as the signal is received. A positive voltage at C5 will cause transistor Q5 to saturate. When the tape signal is removed, capacitor C5 will discharge through R17, and Q5 will cut off. When transistor Q5 is

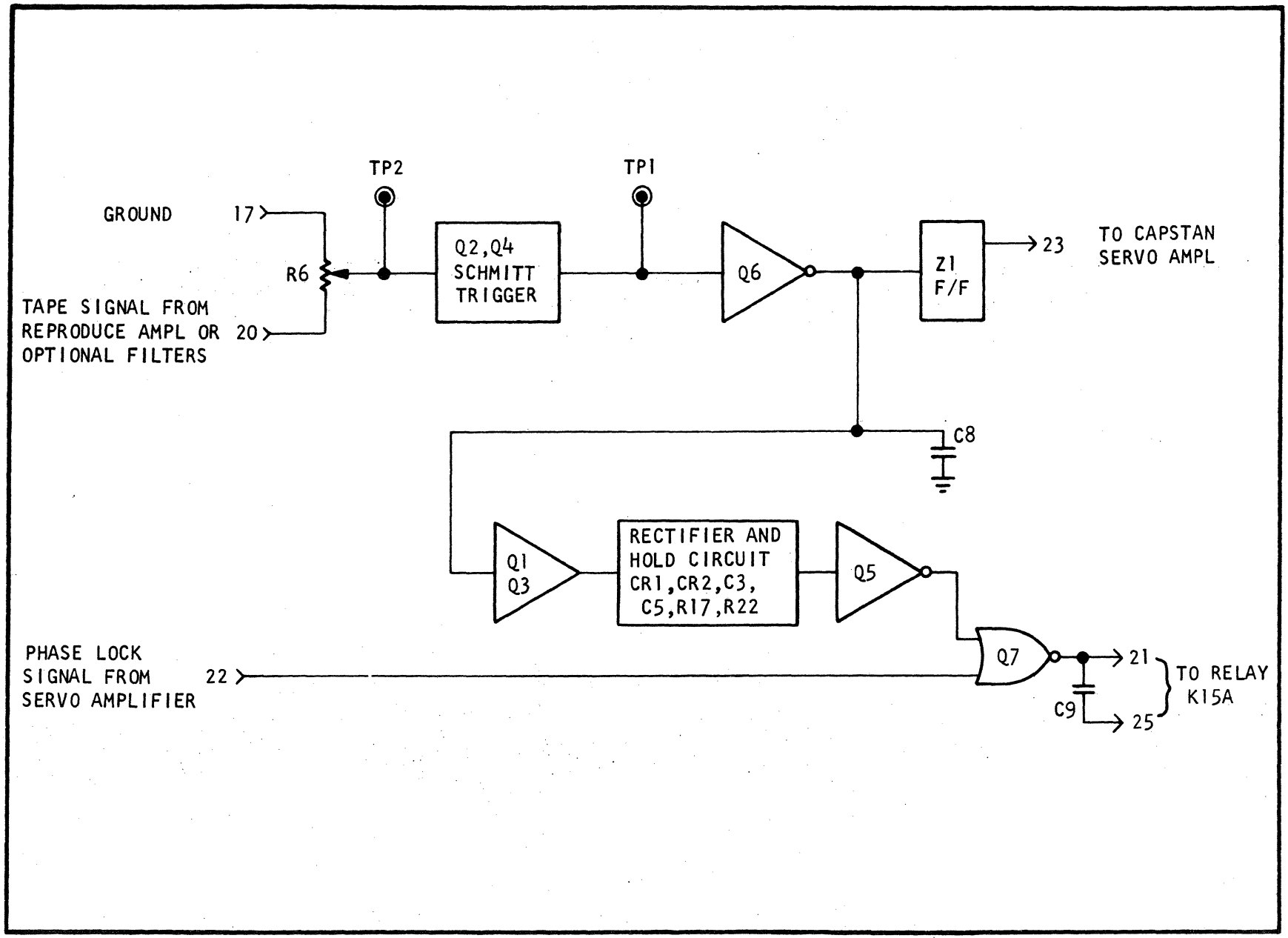


Figure 4-18. Reproduce Servo Control Block Diagram

in saturation, the voltage at the base of Q7 is negative, maintaining operation of that transistor. When Q5 is cut off, the voltage at the base of Q7 is slightly positive, and Q7 is cut off. The conduction of Q7 permits the tape mode relay K15A in the electronics and relay chassis to energize.

4-128. The input to the emitter of Q7, through CR3, will be at ground, if the system is in a run mode and phase lock has been achieved. If either of these conditions is not met, the input through P416-22 will be open. The output from Q7 through P416-21 is used to energize the tape mode relay K15A in the electronics and relay chassis. Other requirements must also be fulfilled before the tape mode relay can be energized. These requirements are discussed in detail in paragraph 4-109.

4-129. TAPE TENSION CONTROL.

4-130. Uniform tape tension is maintained during all modes of tape movement including fast modes and search. Components used in accomplishing this function are the upper and lower tape tension arms and rollers, the reel power amplifier, and the upper and lower reel motors. The description of the tape tension control loop in the paragraphs below may be followed using the block diagram, figure 4-19, or Reel Power Amplifier and Capstan Power Amplifier Partial Schematic, figure 7-13; Transport Reel Power Amplifier Schematic, figure 7-14, and Tape Transport Plate Schematic, figure 7-15. Components of the transport reel power amplifier are of the 100 series; for example, K1A = K101A, Q14 = Q114, etc.

4-131. The tape tension rollers are placed in the tape path in such a way that their position is a direct function of tape tension. Each roller is mounted on a spring loaded pivot arm which has a shutter vane attached. The placement of the shutter relative to the position of the solar cell controls the amount of light delivered to the cell. The output of the solar cell is an analog voltage directly proportional to tape tension. The output of each solar cell is coupled to the reel power amplifier, where each is used to modulate the 115 volt ac power applied to the respective upper and lower reel motors.

4-132. The reel motors are independent of each other, and each operates within its own servo loop. Since their functions and operations are identical, only the upper reel motor loop will be explained in detail.

4-133. The output of the solar cell (figure 7-15) is connected to one input of a differential amplifier consisting of Q1 and Q3 (figure 7-14). The other input to this differential amplifier is a feedback signal provided by Q5 in the modulator. The output from the differential amplifier is applied to the modulator Q5 and Q7. The modulator is a differential amplifier which uses the unfiltered 60 cycle supply, from a full wave bridge rectifier, as a power supply.

4-134. The base of transistor Q7 in the modulator receives a steady dc voltage from the zener diodes VR1 and VR2 filtered by C1 and C2. A portion of the output from the modulator is fed back to transistor Q3 in order to maintain a stable operation. Resistors R19 and R17, and capacitor C7 provide phase correction to the feedback signal. The output from the modulator is fed to the base of Q9. This signal is in the form of a full wave rectified, unfiltered, 120 cycle waveform, having an amplitude directly proportional to the output of the solar cell.

4-135. The differential amplifier Q9 and Q11 drives the two emitter follower stages Q13 and Q15. The voltage at the base of Q11 is a feedback voltage developed across R48 in series with the load. The emitter follower stages Q13 and Q15 drive three power amplifiers connected in parallel, Q17, Q19, and Q21 (figure 7-13).

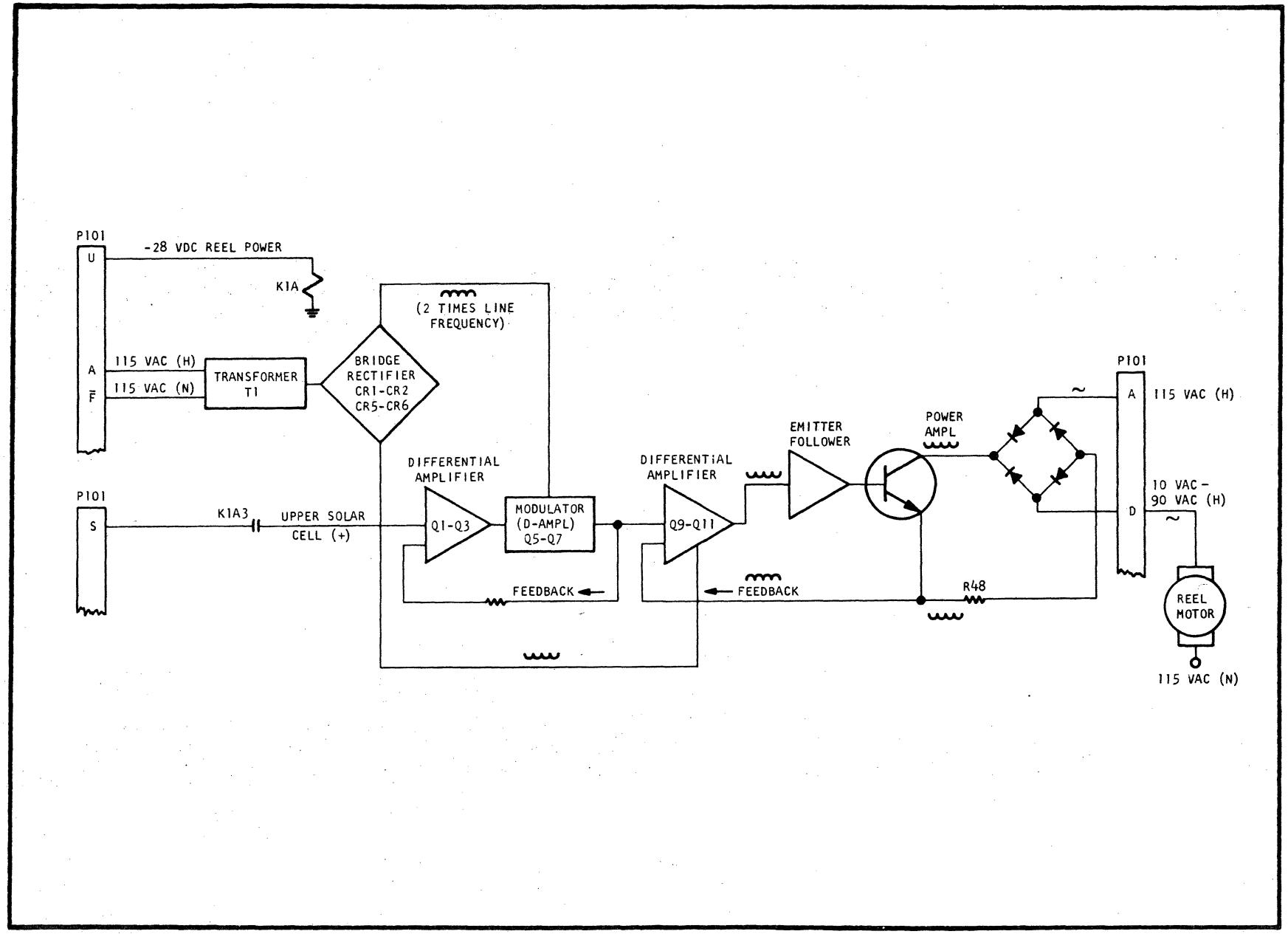


Figure 4-19. Transport Reel Power Amplifier (Upper) Block Diagram

4-136. The power amplifier forms a variable impedance in series with a diode bridge and the reel motor. The modulated input to the power amplifier is in phase with the supply from the reel motor after rectification by the diodes. The current through the reel motor is directly proportional to the output of the tape tension sensors.

4-137. Relay K1A is energized by -28 vdc reel power. Both upper and lower solar cell inputs pass through normally open contacts of this relay. The -28 vdc to K1A is supplied from the electronics and relay chassis when a run or a fast mode is enabled.

4-138. TRANSPORT POWER SUPPLY.

4-139. In following the discussion of the transport power supply in the paragraphs below, refer to figure 7-16, Schematic, Transport Power Supply. Components of this unit are of the 300 series. The first one or two digits are ignored in the description and on the schematic.

4-140. The transport power supply provides five different levels of dc, and three separate ac supplies, from a 115 vac primary power source.

4-141. With 115 vac applied between TB301-20 and TB301-21, circuit breaker CB1 controls the power to the transport and to the system cabinet TB301-4. The circuit breaker light DS301 illuminates when the circuit breaker is closed. No ac power is available to the tape transport until the POWER button on the control panel is pressed. When the POWER button on the control panel is pressed, ac neutral is applied to one side of the power relay K1A. The other side of the power relay coil receives 115 vac direct from the circuit breaker. Relay K1A applies 115 vac to the primary power transformer T1, and also via an 8 amp fuse F2, to the reel power amplifier.

4-142. Dc power is provided by three separate stabilized supply circuits: one for the ±28 vdc supply, one for the ±20 vdc supply, and one for the +5 vdc supply. The input to the ±28 vdc supply is 34 vac, supplied by power transformer T1. The 34 vac is applied to a bridge rectifier (CR3-CR6). Dc from the bridge rectifier provides the ±28 vdc output voltage.

4-143. The ±28 vdc Supply. The ±28 vdc is developed across the bridge rectifier CR3 through CR6. The +28 vdc is applied via a 7.5 amp fuse F4 to J2-W, -S. The -28 vdc is applied via a 3 amp fuse F5 and normally open contacts of the power relay K1A2 to J2-V, -T.

4-144. The ±20 vdc Supply. The ±20 vdc supply is developed across the bridge rectifier formed by CR7 through CR10. There are two sections in the voltage regulator to provide the positive and negative output voltages. There are only minor differences between the two sections. Each section consists of a reference voltage circuit, differential amplifier, current amplifier, series regulator, and voltage adjust.

4-145. If the regulated output voltage drops due to a load increase, the bias on the comparison amplifier increases causing less conduction. This lowers the bias to the base of the current amplifier, which also lowers the bias to the series regulator resulting in increased conduction and restores the regulated output to the desired level. Should the load decrease, causing an increase of the regulated output voltage, just the opposite of the preceding action would take place.

4-146. The preceding is true for both the positive and negative sections of the regulator. There are internal differences between the two, made necessary because of the polarity difference of the two outputs. Both circuits are discussed further in greater detail.

4-147. Regulator Negative Voltage Section. The -20 vdc is regulated by reference voltage circuit VR1, the differential amplifier Q2 and Q4, current amplifier Q10, series power regulator Q11 through Q14, and associated components.

4-148. Reference Voltage Circuit. A dropping resistor R4 provides 6.2 vdc to zener diode VR1. Through the action of VR1, a stable reference voltage is developed. The reference voltage circuit provides the base of reference amplifier Q2 with a constant voltage.

4-149. Differential Amplifier. This circuit is comprised of reference amplifier Q2 and comparison amplifier Q4. The base of comparison amplifier Q4 is connected to the output of the series regulator via R3. The bias of Q4 corresponds to any variation of the regulated output. Assume that the regulated output becomes less negative. Bias of Q4 decreases, collector voltage goes more negative as a result of less conduction through Q4, and emitter voltage is less negative due to less voltage drop across R7. The emitters of Q4 and Q2 are connected together. Therefore, as emitter voltage becomes less negative, effectively, the bias on Q2 increases even though the reference voltage does not change. Transistor Q3 conducts harder, causing the collector voltage to go less negative.

4-150. Current Amplifier. The current amplifier Q10 is biased by the output voltage of reference amplifier Q2. If the voltage applied to the base of Q10 decreases, or becomes less negative, then bias decreases and allows Q10 to conduct harder. This, in turn, causes the emitter voltage to decrease.

4-151. Series Regulator. Series regulator transistors Q11 through Q14 control the output voltage of the regulator at -20 volts dc. The regulator transistors are controlled by the action of Q10. If the emitter voltage of Q10 becomes less negative, then the transistors Q11 through Q14 conduct harder and voltage dropped across the series regulator decreases. This results in restoring the regulator output voltage to its proper level.

4-152. Regulator Positive Voltage Section. The +20 vdc is regulated by a reference voltage circuit, a differential amplifier Q3 and Q15, current amplifier Q9, series power regulator Q5 through Q8, and their associated components.

4-153. Reference Voltage Circuit. A dropping resistor R3 and diodes CR13 and CR14 provide a stable reference bias voltage for transistor Q3.

4-154. Differential Amplifier. This circuit is comprised of reference amplifier Q3 and comparison amplifier Q15. The reference voltage is applied to the emitter of Q3. The collector of Q3 is connected to the base of current amplifier Q9 and through R13 to the collector of differential amplifier Q15. In this way any change in the collector voltage of Q3 or Q15 will affect the bias of current amplifier Q9. Transistor Q15 is biased by the regulated output voltage. If the output voltage decreases, bias on Q15 increases, causing less conduction, and an increase of positive voltage on the collector of Q15.

4-155. Current Amplifier. The base of transistor Q9 is connected to the collector of transistors Q3 and Q15. Any variation in the collector voltage of these transistors will, therefore, affect the bias of transistor Q9. If the bias voltage should increase, becoming more positive, then the emitter voltage will also go more positive. The emitter of transistor Q9 is connected to the base of the series regulator transistors Q5 through Q8.

4-156. Series Regulator. Series regulator transistors Q5 through Q8 control the output voltage of the regulator at +20 volts dc. The regulator transistors are controlled by the action of Q9. If the emitter voltage of Q9 becomes more positive, then Q5 through Q8 conduct harder and voltage dropped across the series regulator decreases. This results in restoring the regulator output to its proper level.

4-157. The +5 vdc Supply. This supply is similar to the ±20 vdc supply circuits described in the above paragraphs. The +5 vdc supply consists of the following circuits: rectifier, constant current source, reference voltage, differential amplifier, current amplifier, series regulator, overload protection circuit, and voltage adjust.

4-158. Rectifier Circuit. The +5 vdc is supplied by the secondary winding of the transformer T1 and diodes CR11 and CR12. The +5 vdc supply is fed to the collector circuit of the series regulator.

4-159. Constant Current Source Circuit. This circuit consists of zener diode VR3 and transistor Q16. The +20 vdc power supply is the current source. Transistor Q16 is held on by VR3. Zener diode VR3 supplies a stable reference voltage to the base of Q16. Transistor Q16 provides the current source for current amplifier Q23.

4-160. Reference Voltage Circuit. The reference voltage circuit consists of zener diode VR4, resistors R26, R28, potentiometer R27, and reference amplifier Q17. Zener diode VR4 maintains stable reference voltage (6.2 v) at one side of potentiometer R27. This circuit provides the base of reference amplifier Q17 with a constant voltage.

4-161. Differential Amplifier. This circuit is comprised of reference amplifier Q17 and comparison amplifier Q18. The base of comparison amplifier Q18 is connected to the output of the series regulator, thus the bias of Q18 responds to any variation of the regulated output. Assume that the regulated output becomes less positive: Bias of Q18 decreases, collector voltage goes more positive as a result of less conduction through Q18, and emitter voltage is less positive due to less voltage drop across R30. The positive collector voltage of Q18 forward biases current amplifier Q23. When potentiometer R27 is adjusted, it changes the bias on the reference amplifier Q17. Assume that potentiometer R27 is turned clockwise (toward ground) making the base of Q17 more negative: The emitters of Q18 and Q17 are connected together; therefore, as the emitter voltage becomes more negative, effectively, the base of Q18 becomes more positive. The collector of comparison amplifier Q18 becomes more negative.

4-162. Current Amplifier. The current amplifier Q23 is biased by the output voltage of Q18. Any variation in the collector voltage of Q18 will affect the bias of transistor Q23. If the bias should increase, becoming more positive, then the emitter voltage will also go more positive. The emitter of transistor Q23 is connected to the base of series regulator transistors Q19 through Q22.

4-163. Series Regulator. The +5 vdc voltage supply is connected to the collector of series regulator transistors Q19 through Q22. Any change of bias on these transistors will have an effect on the output current. The +5 vdc output is applied via 7.5 amp fuse F12 to J2-K and -X, via 7.5 amp fuse F13 to J3-T, and F14 to J4-T.

4-164. Overload Protection Circuit. The overload protection circuit consists of SCR Q1 and Q24 and associated components. If the voltage from the series regulator increases above the +5 volts, it forward biases the emitter of Q24. When Q24 starts to conduct, the voltage from the junction of R36 and R37 is fed back to the gate of SCR Q1. When this feedback voltage reaches 1.2 volts, the SCR will fire, shorting the output of the power supply to ground and blowing fuse F3.

4-165. The 28 vac Supply. The transport power supply also provides a 28 vac output from transformer T1 to illuminate the upper and lower PEOT lamps on the transport. The output is provided from transformer T1 via 2 amp fuse F15 to the electronics and relay chassis.

4-166. REGULATOR ASSEMBLY AND SPEED SWITCHING UNIT. The voltage regulator supplies a regulated ±12 volt power to the electronic cards that plug into the electronics control panel. The assembly also supplies regulated ±12 volts to the shuttle and -12 volts to the CPA and preamplifier assembly. The schematic for this assembly is figure 7-4.

4-167. The switching unit consists of a series of nine relays, one for each transport speed. The rotary tape speed selector switch on the control panel has a setting for each tape speed. When the tape speed selector switch is set to the desired tape speed, -28 vdc is applied to the applicable relay on the switching unit. Through the closed contacts of the relay, regulated +12 volts is applied to the applicable speed line to the electronic cards in the electronics control panel.

4-168. RUNNING TIME METERS.

4-169. Two time meters are located at the front center of the transport power supply, to record the number of hours that power is applied to the transport (and system), and the number of hours the transport is in a run mode (pinch rollers engaged). The transport, or system, power meter M301 is connected between TB301-1 and TB301-3 on the transport power supply chassis. The meter registers from the moment the circuit breaker CB301 is closed, and the power button S602 is pressed energizing the power relay K301. The head time meter M302 is used to record the hours of head use, and registers when the run relay K410 and the $\overline{\text{STOP}}$ relay K8 are energized. M302 is connected across the 115 vac supply by the normally open contacts of K410A2 and K401A2.

4-170. NORM. BW/2X BW SWITCH.

4-171. The NORM. BW/2X BW switch allows the operator to select normal equalization, used with standard heads; or 2 times equalization, used with double bandwidth heads. This switch is located on the front of the power supply plate assembly near the bottom.

SECTION V

CALIBRATION AND MAINTENANCE

5-1. GENERAL.

5-2. Maintenance on the 13-501 Tape Transport should be performed only by qualified technicians and personnel familiar with this type of equipment. The maintenance information contained in this section consists of preventive maintenance, mechanical alignment procedures, calibration procedures, and troubleshooting and corrective maintenance for maintaining optimum equipment performance.

5-3. ACCESS. Access to most components of the tape transport is available from the front with the dust cover opened and the tape transport baseplate extended to the forward position as shown in figures 5-1 and 5-2. Opening the rear door will allow access to the back of the electronics control panel as shown in figure 5-3.

5-4. Most major assemblies which comprise the tape transport mount on a 0.66 inch thick aluminum plate which serves as a stable reference mounting surface. This aluminum plate is referred to as the tape transport baseplate. These assemblies are mounted to the baseplate on studs which extend from the rear of the baseplate or are bolted to the baseplate by threaded holes in the baseplate or in the assembly.

5-5. PREVENTIVE MAINTENANCE.

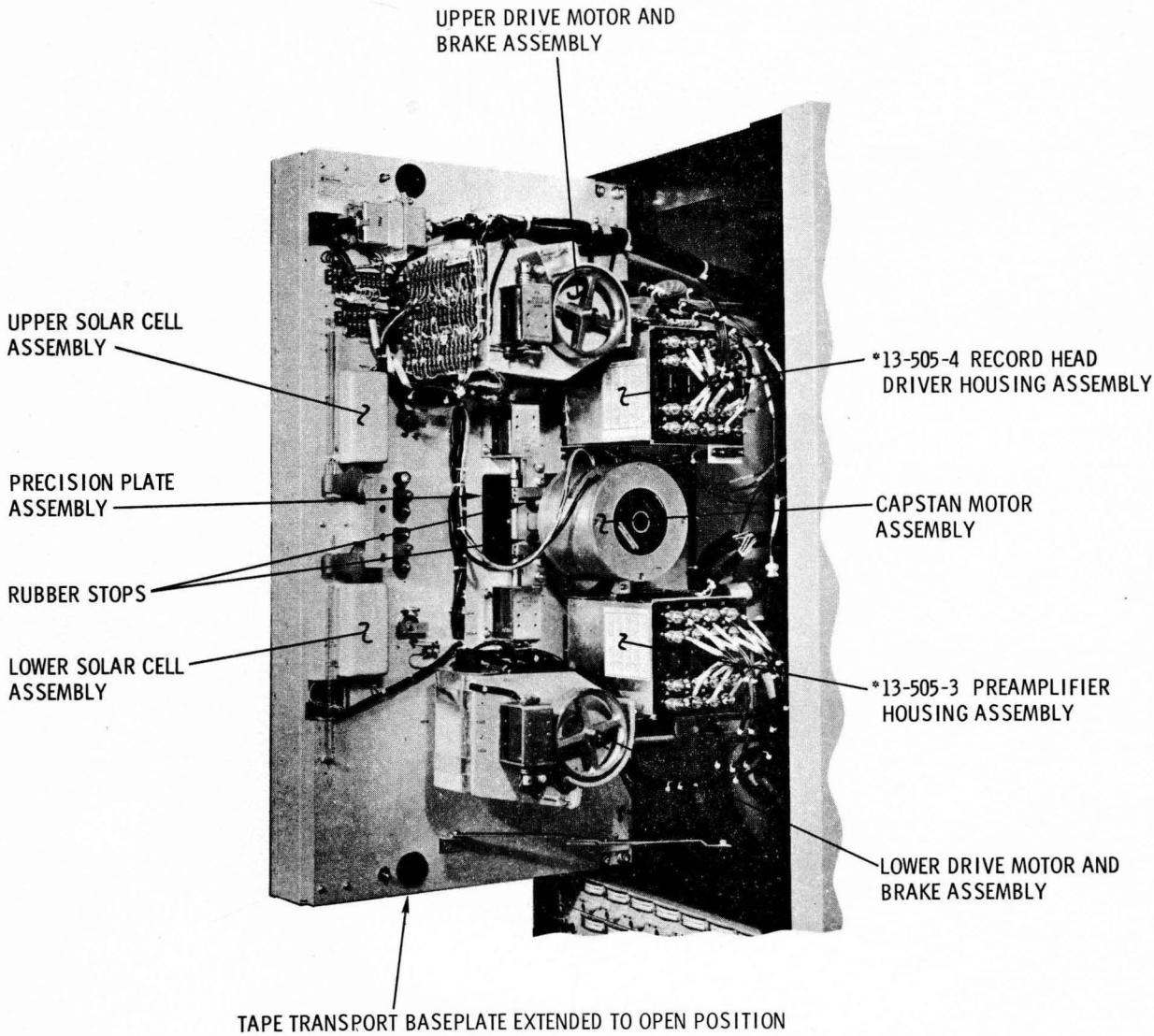
5-6. The scheduling of preventive maintenance is related to the operating environment and the use to which the equipment is subjected. Table 5-1 describes the scheduling of the preventive maintenance of the transport. The preventive maintenance schedule given in table 5-1 assumes that the equipment is used under laboratory conditions, 8 hours per day. Under more adverse environmental conditions, or longer periods of use, it may be necessary to increase the frequency of the preventive maintenance procedures. When performing the preventive maintenance procedures, replace, repair, or adjust, as applicable, any assembly or component found defective or inoperative.

5-7. FUSES AND CIRCUIT BREAKERS. A blown fuse or a tripped circuit breaker will often be a symptom of circuit trouble elsewhere. These components should be replaced and troubleshooting continued until the primary cause of a circuit failure has been found and corrected. Table 5-2 lists the 13-501 Tape Transport power circuit breaker and the transport fuses, all of which are located on the electronics control panel as shown in figure 5-2.

5-8. TRANSPORT MECHANICAL ALIGNMENT PROCEDURES.

5-9. This part of Section V describes mechanical alignment of the tape transport to be used when parts are replaced or corrective maintenance is required. Each alignment adjustment is described in detail, but maintenance personnel need only follow those procedures required to complete the adjustment. It should be noted that these adjustments are not required under normal operating conditions, except as indicated in the preventive maintenance procedures. When performing an alignment adjustment, proceed with caution so as not to disturb any other adjustment already in calibration.

5-10. Tools and materials required to perform the mechanical alignment procedures are listed in table 5-3.



NOTE: ASSEMBLY AND AMPLIFIERS DESCRIBED IN SEPARATE COMPONENT MANUALS.

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Figure 5-1. Tape Transport (Rear View)

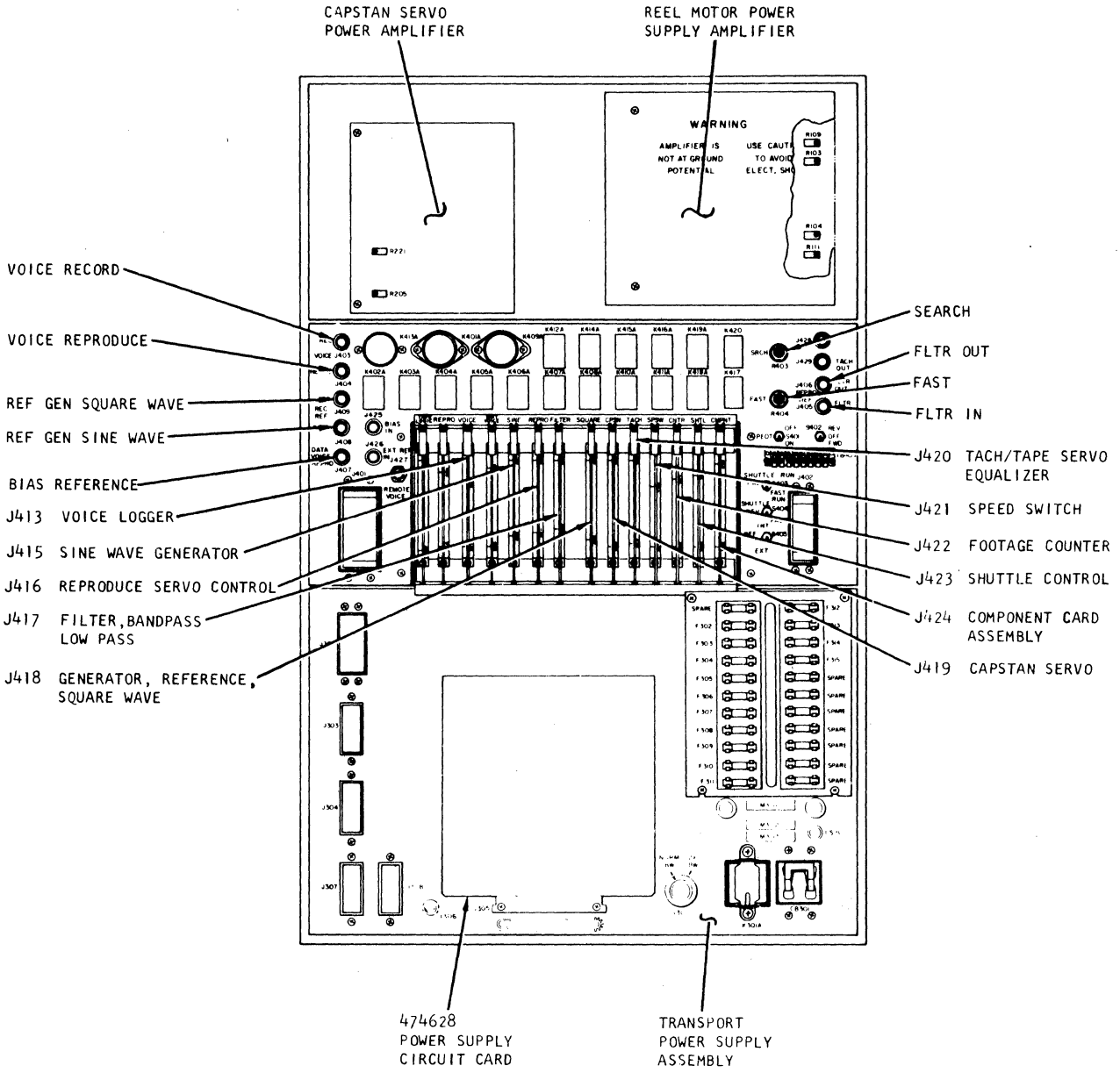


Figure 5-2. Front View, Transport Electronics

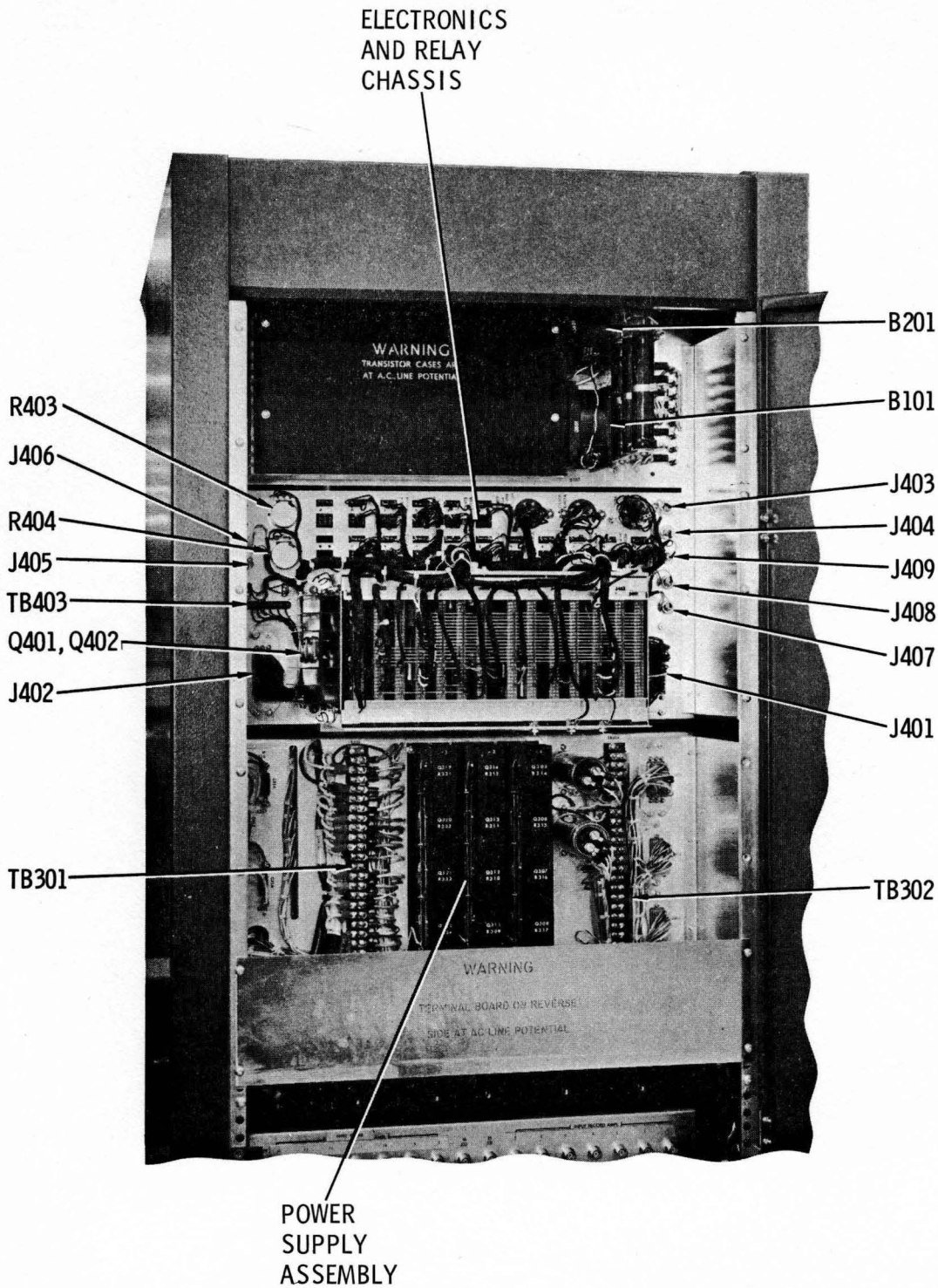


Figure 5-3. Rear View, Transport Electronics

TYPE OF PREVENTIVE MAINTENANCE	SCHEDULE	PROCEDURE
Clean the magnetic head stacks and tape handling surfaces.	Daily	Carefully remove head shield and clean all surfaces contacted by the tape using a cotton swab moistened, not saturated, with DuPont Freon TF. Be careful not to scratch or mar the surface of the components, and be sure to remove all excess fluid after cleaning. NOTE: Freon TF is a DuPont product and is available from Bell & Howell (part number 216196) or from any of DuPont's Freon Solvent Sales Agencies. Freon TF is nontoxic and nonflammable. Do not use carbon tetrachloride, alcohol, trichloroethylene, or any cleaning agent which might be detrimental to the tape or tape handling surfaces. Dirty tape may also be cleaned with Freon TF.
Demagnetize the magnetic head stacks, and tape handling components mounted on the precision plate assembly.	As determined necessary by performance checks.	One symptom of magnetized heads or tape handling components is excessive second harmonic distortion and/or noise present in data reproduced from the tape which cannot be attributed to the electronics. The head stacks can be demagnetized by using a portable hand degausser as follows: Turn the degausser on and move it in a circular motion around the heads and components for about 15 seconds. Continue the circular motion and slowly pull the degausser away from the transport until the degausser is at least three feet from the transport and then turn the degausser 90° away from the transport and turn the power off. Better results can be obtained when demagnetizing the heads by removing the entire head assembly from the transport before exposing it to the field of the degausser. Never turn a degausser off while some component is in its field or the inductive surge will set up a field of single polarity and remagnetize the component.

Table 5-1. Preventive Maintenance Procedures and Scheduling (Sheet 1 of 4)

TYPE OF PREVENTIVE MAINTENANCE	SCHEDULE	PROCEDURE
Operate the transport through its various modes and check for proper tape handling characteristics.	30 days	Observe the tape travel over each of the rollers and guides in the reverse and forward run modes, inspect the tape edges for any tendency to ride up on the guide groove sides. Make certain that the tape edges are even and that the tape moves in a smooth straight line with no tendency to shift from side to side.
Indicator lights.	30 days	Operate the transport through its various modes and check the indicator lights, inside the control switches, the READY indicator light, and the TACH/TAPE indicator lights.
Source lamps for the photo end-of-tape (PEOT) sensors.	30 days	The light source lamps for the PEOT sensors are located on the tape transport baseplate adjacent to each tape reel. To replace a light source lamp, remove the cover surrounding the lamp lens for access to the lamp holder. Operate the transport in the reverse and forward run modes and verify that the transport will automatically stop shortly before each end of the tape.
DS501 and DS502 (solar cell illumination).	30 days	The indicators are located behind each solar cell in the arm/solar cell assembly. Verify that the lamps are illuminated when the transport power is on.
Check tape tension.	30 days	Refer to paragraph 5-66 for method of measurement.
Check pinch roller pressure.	30 days	Refer to paragraph 5-13 for method of measurement.

Table 5-1. Preventive Maintenance Procedures and Scheduling (Sheet 2 of 4)

TYPE OF PREVENTIVE MAINTENANCE	SCHEDULE	PROCEDURE
Remove dust and other foreign particles from the transport assembly.	30 days	Open the tape transport and rear door, and clean out the transport cabinet using low-pressure air, then carefully wipe off the components with a clean cloth.
Visual checks.	3 months	Open the tape transport and open the rear door of the cabinet. Visually check all electrical and mechanical components and connections for signs of deterioration or defects. Replace or repair any components or connections found defective.
Transport power supply voltage levels.	3 months	Make measurement on transport power supply circuit card assembly (see figure 5-2). MEASURE AT / VOLTAGE / ADJUST TP4 / +20 vdc / R20 TP5 / -20 vdc / R21 TP6 / +5 vdc / R27
Check reel power amplifier alignment.	3 months	Refer to paragraph 5-60.
Check fast adjustment.	3 months	Refer to paragraph 5-70.
Check search adjustment.	3 months	Refer to paragraph 5-73.
Reference generator gain adjustment and frequency check.	3 months	Refer to paragraph 5-75.

Table 5-1. Preventive Maintenance Procedures and Scheduling (Sheet 3 of 4)

TYPE OF PREVENTIVE MAINTENANCE	SCHEDULE	PROCEDURE
Check capstan start/ stop time.	3 months	Refer to paragraph 5-77.
Check capstan servo logic adjustment.	3 months	Refer to paragraph 5-81.
Check the static brake adjustment and the brake lining.	6 months	Refer to paragraph 5-23.
Inspect interconnecting cables for signs of damaged insulation.	6 months	Open the tape transport and inspect cables to be sure that they are not binding between the baseplate and cabinet. (See figure 5-1.) Cable insulation that has been pinched or cut should be carefully inspected and repaired. Refer to cable diagrams in Section VII when troubleshooting for possible electrical continuity breaks.
Lubrication.	Not required	All components are lubricated and sealed at the factory and further lubrication is not required for the life of the assemblies.

Table 5-1. Preventive Maintenance Procedures and Scheduling (Sheet 4 of 4)

REFERENCE DESIGNATION	CAPACITY AND TYPE	CIRCUIT PROTECTED
CB301	25 amp circuit breaker	System Power
F301	Spare	
F302	8 amp, 125 v, 3 AG, QA	115 vac Reeling Servos
F303	20 amp, 32 v, 3 AG, MA	Input to the +5 vdc Series Regulator
F304	7.5 amp, 32 v, 3 AG, MA	+28 vdc
F305	7.5 amp, 32 v, 3 AG, MA	-28 vdc
F306	3 amp, 250 v, 3 AG, QA	+20 vdc Transport
F307	3 amp, 250 v, 3 AG, QA	+20 vdc Ampl Mtg
F308	3 amp, 250 v, 3 AG, QA	+20 vdc Ampl Mtg
F309	3 amp, 250 v, 3 AG, QA	-20 vdc Transport
F310	3 amp, 250 v, 3 AG, QA	-20 vdc Ampl Mtg
F311	3 amp, 250 v, 3 AG, QA	-20 vdc Ampl Mtg
F312	7.5 amp, 32 v, 3 AG, MA	+5 vdc Transport
F313	7.5 amp, 32 v, 3 AG, MA	+5 vdc Ampl Mtg
F314	7.5 amp, 32 v, 3 AG, MA	+5 vdc Ampl Mtg
F315	2 amp, 250 v, 3 AG, QA	28 vac supply
F316 thru F322	Spares	

Table 5-2. Tape Transport Circuit Breaker and Fuses

EQUIPMENT	USE
Allen Wrench Set	General.
Phillips Screwdriver	General.
Johannsen Block (Jo-block), 0.644 inch thick	Reel hub adapter alignment.
Standard Screwdriver	Tape tension servo adjustment.
Needle Nose Pliers	End-of-tape sensing adjustment.

Table 5-3. Tools and Materials (Sheet 1 of 2)

EQUIPMENT	USE
Small open-end wrench set, or small adjustable wrench	Brake strap adjustment.
Shim stock, 3/32 inch thick	Pinch roller adjustment. Brake strap adjustment.
Tape Tension Gage: Bell & Howell Type 12-902, or equivalent	Brake strap adjustment.
Spring Scale, 10 pounds	Pinch roller adjustment.
Straightedge	Reel hub adapter adjustment.
Blueing Compound: Hi-Spot Dyken, or equivalent	Pinch roller alignment.
Masking Tape, 1/2 inch	Brake strap adjustment.

Table 5-3. Tools and Materials (Sheet 2 of 2)

5-11. Refer to figure 5-4 for a rear view of the tape transport plate. Many of the components used for transport mechanical alignment are identified by index numbers in this illustration.

5-12. SERVO ARM ADJUSTMENTS. Move one of the tape tension arm shafts (item 1) up and down to the end of travel and listen for metal-to-metal contact. If the shaft is striking the tape transport plate at the upper or lower extremes of the clearance hole, loosen the appropriate rubber stop with an Allen wrench. Rotate the rubber stop just to the point where the tape tension arm shaft is stopped before striking the transport plate. Holding the rubber stop in this position, tighten the Allen head screw.

Note

Do not overcompensate with the rubber stop. When properly aligned, the tape tension arm should have a maximum travel up and down without striking the transport clearance hole edges.

5-13. PINCH ROLLERS. Loosen the four Allen head screws holding each pinch roller solenoid. Move the pinch roller solenoids toward each other as far as the screw slots will allow. Tighten one screw to hold each solenoid in place.

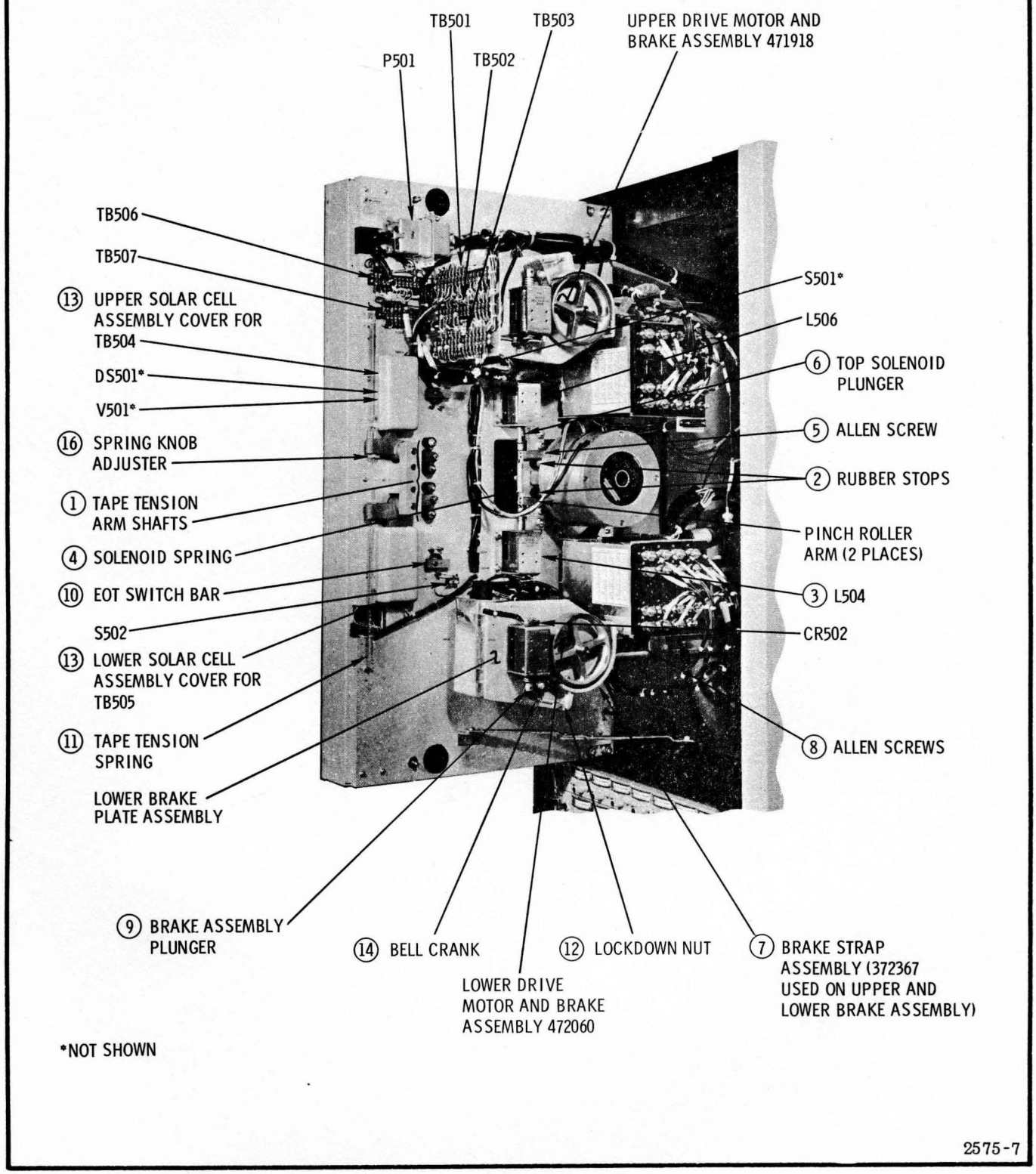


Figure 5-4. Tape Transport Baseplate (Rear View)

Note

This procedure is required if a major adjustment is necessary. For preventive maintenance, refer to paragraphs 5-21 and 5-22 only.

5-14. Loosen the Allen head screws on the two rubber stops (item 2) and rotate them away from the pinch roller arms.

5-15. Remove solenoid return spring (item 4) and slightly loosen the Allen head screw (item 5) on the pinch roller arm (i.e., let the arm move the pinch roller up and down but leave the shaft loose enough so that it will slip in the clamp if pressure is applied).

5-16. Lift the top solenoid plunger (item 6) until it bottoms in the solenoid and the pinch roller just touches the capstan. Make certain that all free travel is removed from the mechanical linkage of the solenoid plunger and the spring, and that there is no tension on the spring. Tighten the Allen head screw (item 5) that secures the pinch roller shaft to the arm of the capstan pinch roller.

Note

Make sure the pinch roller yoke is free in the bushing but excessive end-play is not present.

5-17. Repeat procedures of paragraph 5-16 for the lower solenoid.

5-18. Replace the solenoid return spring (item 4) and slide both solenoids to approximately the center of their screw slots. Tighten one screw on each solenoid to hold it securely in place.

5-19. Place a 3/32 inch shim between the capstan and the upper pinch roller and hold the pinch roller snug against the shim. Loosen the rubber stop with an Allen head wrench and rotate the stop until it is holding the pinch roller firmly against the shim. Tighten the rubber stop and remove the shim.

5-20. Repeat the above procedure for the bottom pinch roller.

Note

When properly aligned, the upper and lower pinch rollers should be approximately 3/32 inch above and below the capstan.

5-21. Using the 10 pound spring scale, check the pressure required to lift the pinch rollers off the capstan while holding the solenoid plunger bottomed in the solenoid.

5-22. Adjust the solenoid slightly up or down until five pounds (±1/2 pound) is required to lift the pinch rollers. Tighten all four Allen head screws on both solenoids when they are properly aligned.

5-23. BRAKE STRAP ASSEMBLY. Loosen the two Allen head screws (item 8) holding the lower brake strap assembly (item 7).

5-24. Push the lower brake assembly plunger (item 9) in until it bottoms in the solenoid.

Note

To avoid misalignment due to slack in the mechanical linkage between the bell crank, brake strap assembly, and solenoid plunger, be sure to push only against the brake assembly plunger (item 9) and not against the bell crank.

5-25. Using the 3/32 inch shim stock, push against the brake material forcing the brake band against the brake shoe assembly all along the inside diameter. Tighten the two Allen screws and release the brake plunger.

5-26. If the reel brake tension needs to be adjusted, loosen the lockdown nut (item 12) on the brake plate assembly and adjust the spring tension screw to provide more or less tension as required. The mechanical brake band hold back tension on the reels should be 32 ounces, as measured two inches from the center of the hub. The upper reel is tested in the clockwise direction, the lower reel in the counterclockwise direction.

5-27. Install an old reel of tape onto the appropriate reel mounting assembly and form a small loop in the end of the tape as shown in figure 5-5. Hook a 2 pound spring scale to end of tape (in the loop) and pull slowly on the scale with a constant force until reel begins to rotate. Record the reading of the scale.

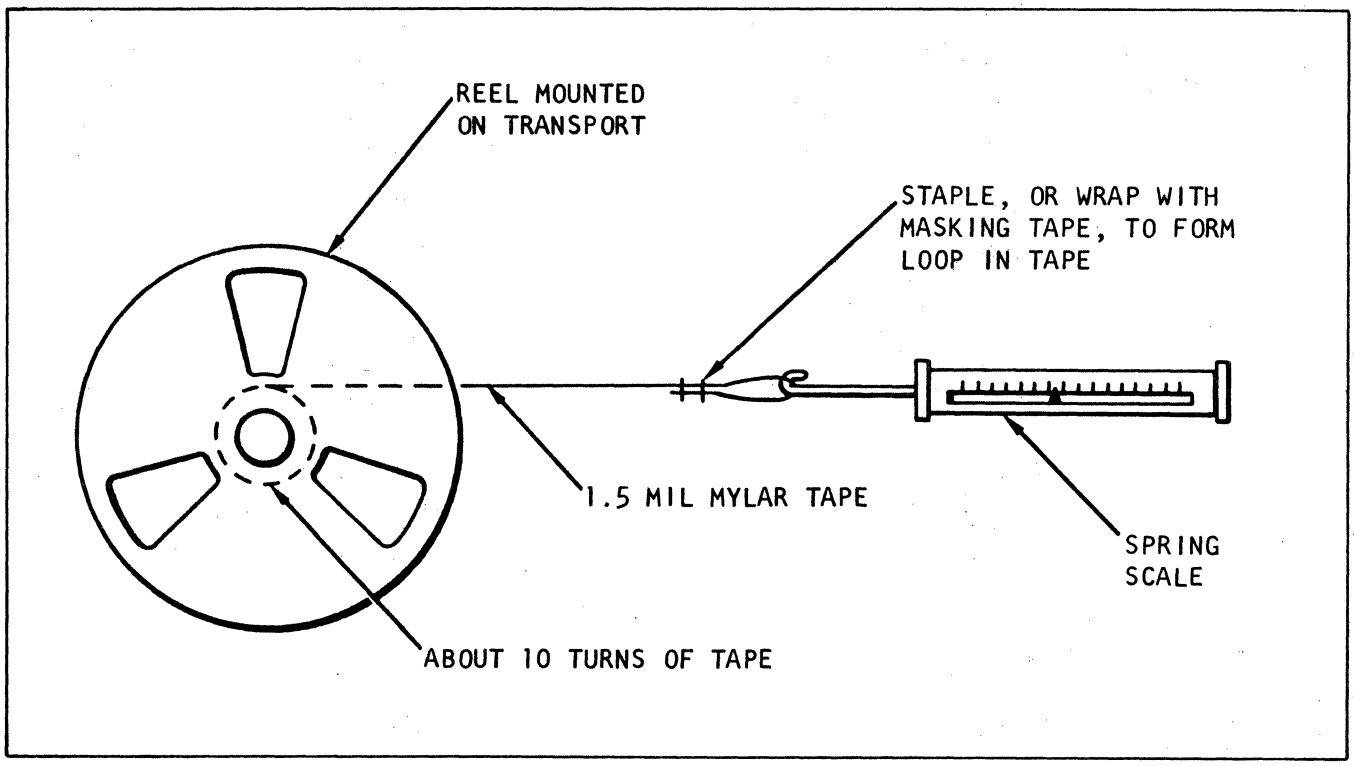


Figure 5-5. Measuring Brake Force

5-28. When proper brake tension is obtained on the lower reel, tighten the lockdown nut (item 12, figure 5-4).

5-29. Repeat the procedures in paragraphs 5-23 through 5-28 for the upper brake strap assembly.

5-30. END-OF-TAPE SWITCHES. Check that both microswitches (S501 and S502) are engaged when end-of-tape (EOT) sensing arms are unloaded (i.e., no tape threaded on the tape transport).

5-31. If either switch is not engaged, tighten the spring tension on the EOT switch bar (item 10) until the minimum pressure is achieved that assures switch closure every time.

5-32. The spring tension is adjusted by hooking the spring on a different post, thereby coiling the spring tighter. Use the needle nose pliers to grasp the spring.

5-33. Coiling the top spring counterclockwise increases the spring tension. Coiling the bottom spring clockwise increases the spring tension.

Note

It may be necessary to move the spring hook more than three posts (i.e., more than one revolution). If, however, the switch will still not reliably engage after tightening the spring more than two revolutions, try to adjust the microswitch throw arm by loosening the Phillips head mounting screws and, if necessary, by bending the switch actuator arm slightly with a pair of pliers.

5-34. TAPE TENSION SERVO ASSEMBLIES. Remove the plastic dust covers from the upper and lower tape tension arm sensing transducer assemblies (item 13).

5-35. Check the position of the upper lamp in reference to its white diffusion shade. If the lamp is not 1/8 inch (±1/32 inch) from the diffusion shade, bend the lamp assembly mounting bracket slightly.

5-36. Make certain the lamp filament is positioned so that the brightest portion of light is centered on the silver strip of the sensor transducer. If the light is not centered, it may be necessary to loosen the holding screw and move the lamp holder.

5-37. While holding the upper tape tension arm assembly at maximum spring tension, check the movable shade to allow about 1/8 inch of the transducer sensor to remain exposed to the diffused light when the shade is at maximum travel.

5-38. If the movable shade must be adjusted, loosen the two Phillips head screws holding the shade and slide the shade in the direction required to obtain proper alignment. When properly aligned, tighten the screws.

5-39. Repeat paragraphs 5-35 through 5-38 for the lower tape tension servo sensor assembly. When both upper and lower assemblies are aligned, replace the two dust covers.

5-40. REEL HUB ADAPTERS. The two reel hub adapters are precision-aligned at the factory to close tolerances and should be changed only when the installation of a new reel motor makes it necessary.

5-41. These adapters are brass slit rings located behind the reel hub assemblies on the front of the tape transport.

5-42. When installation of a new reel motor makes it necessary to adjust the location of these adapters, proceed with instructions in paragraphs 5-44 and 5-45.

5-43. ALIGNMENT OF REEL HUB ADAPTERS. (See paragraph 5-40 before continuing.)

5-44. A Johannsen block (Jo-block), 0.644 inch thick, and a straightedge are required to align the reel hub adapters.

5-45. Place the Jo-block on the precision head plate and, holding the straightedge flat against the Jo-block, slide the hub adapter out until it contacts the straightedge. When properly aligned, tighten the two Allen head screws that secure the reel hub adapter to the reel motor shaft.

5-46. PINCH ROLLER ALIGNMENT. The pinch rollers are adjustable so that they can be precisely aligned parallel to the capstan shaft. As shown in figure 5-6, there are two adjustment points.

5-47. The first adjustment point is the hole through the end of the pinch roller shaft. It can be rotated back and forth to move the back end of the pinch roller (the end closest to the precision plate) up and down with respect to the capstan.

5-48. The second adjustment point is the knurled knob located at the front of the rubber pinch roller. By rotating this knob, the front end of the pinch roller can be moved toward or away from the capstan in a horizontal plane.

5-49. A convenient method for checking the parallelism of the pinch roller with respect to the capstan is to coat the capstan with a blueing compound: Hi-Spot Dyken, or equivalent, can be used. Spread the blueing compound thinly over the surface of the capstan on which the pinch roller rides. Manually pull the solenoid plunger down to engage the pinch roller to the capstan. Release the solenoid and observe the shape of the mark printed on the capstan by the pinch roller.

5-50. Figure 5-7A illustrates some of the patterns that may be printed on the capstan. These patterns indicate the direction in which the correction for parallelism must be made. Loosen the capscrews, clamping the pinch roller shaft to the yoke, and adjust as necessary to obtain the correct pattern. When properly set, secure the capscrews and clean the blueing compound off the capstan and the pinch rollers.

5-51. If new pinch rollers are to be installed, place the adjustment points in the null position prior to installation. The null position for the two adjustments is with the adjustment hole in the end of the pinch roller shaft parallel to the slot in the yoke and the punch mark on the knurled knob vertically above the center of the pinch roller. This is shown in figure 5-7B. When making the final adjustments, deviation from the null position should not exceed ±13° for either adjustment point.

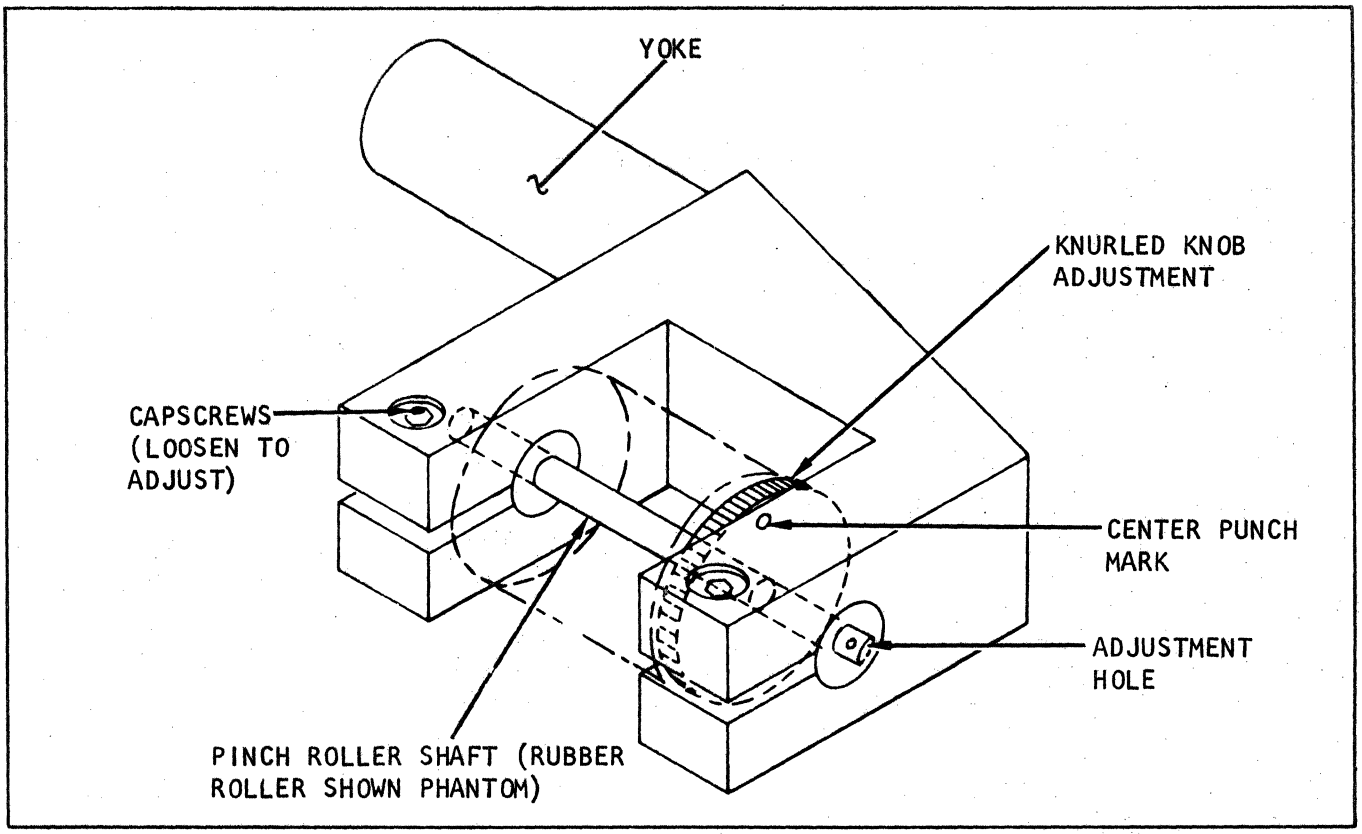


Figure 5-6. Pinch Roller Alignment Adjustment Points

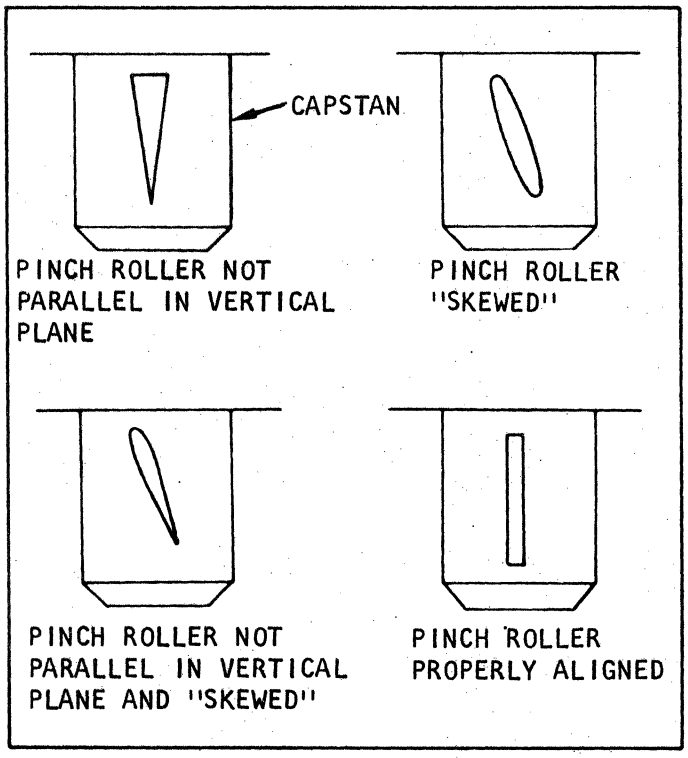


Figure 5-7A. Pinch Roller Alignment Patterns on Capstan

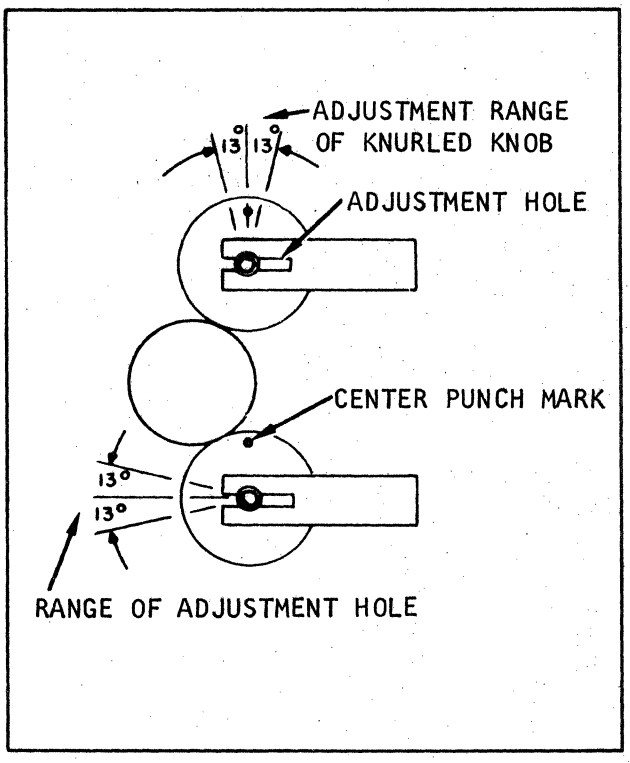


Figure 5-7B. Null Position of Pinch Roller Adjustment Points

5-52. This completes the mechanical alignment of the 13-501 Tape Transport. If major realignment of one or more of the mechanical assemblies has occurred, it would be advisable to recheck the procedures performed before continuing to the electrical checkout of the tape transport.

5-53. CALIBRATION.

5-54. The tape transport calibration procedures include preliminary setup procedures which are to be used if the equipment has been repaired and requires recalibration. Normally, the procedures given in paragraph 5-55 are not required when performing a periodic check of a particular circuit.

CAUTION

Do not perform the adjustments indiscriminately. Adjust only when conclusively determined necessary. Before starting the adjustments, make certain that all of the mechanical adjustments and settings are correct.

5-55. PRELIMINARY SETUP PROCEDURES.

5-56. To realize their full usefulness, the procedures given below assume that the transport is to be completely adjusted. If only "touch up" of one or more adjustment controls is required, it will be necessary to modify the procedure to suit the particular application. Also, the procedures cover the full capability of the transport and all of the possible standard accessories; therefore, disregard the portions which do not apply to your particular transport or tape system. The following potentiometers should be set as follows before attempting a complete realignment of the electronics for the 13-501 Tape Transport. For "touch up" adjustment, refer to the applicable paragraph and set up the test equipment as required. Table 5-4 contains a list of equipment necessary for calibration of the transport.

EQUIPMENT	USE
Volt-Ohm-Meter: Triplett 630, or equivalent	General.
Tape Tension Gage: Bell & Howell Type 12-902, or equivalent	Tape tension.
Electronic Counter: Hewlett-Packard 5326, or equivalent	Fast adjust. Search adjust. Reference generator frequency.
AC Voltmeter: Hewlett-Packard 400FL, or equivalent	Reference generator gain. Servo record adjust. Servo reproduce adjust.

Table 5-4. Test Equipment and Instruments for Maintenance
(Sheet 1 of 2)

EQUIPMENT	USE
Oscilloscope: Tektronix 545B/1A1, or equivalent	Capstan start/stop time adjust. Capstan servo logic.
Bourns Trimpot tool, or equivalent	Adjusting potentiometers.
Phillips screwdriver, medium	General.
Standard screwdriver	General.
Allen wrench set	General.

Table 5-4. Test Equipment and Instruments for Maintenance
(Sheet 2 of 2)

Note

See figures 5-1, 5-2, 5-3, and 5-8 for component and assembly locations.

a. Set SEARCH (R403) and FAST (R404) potentiometers to midrange (the slot approximately vertical).

b. Set R109, R103, R111, and R104 on the reel power amplifier fully counterclockwise and then advance them 12 revolutions in a clockwise direction.

c. Set R221 on the capstan power amplifier board fully counterclockwise and then advance the potentiometer 5 revolutions clockwise.

d. Set R2024 to 1.65K ohms, and R2025 to 2.0K ohms, respectively, on the tach/tape servo amplifier board.

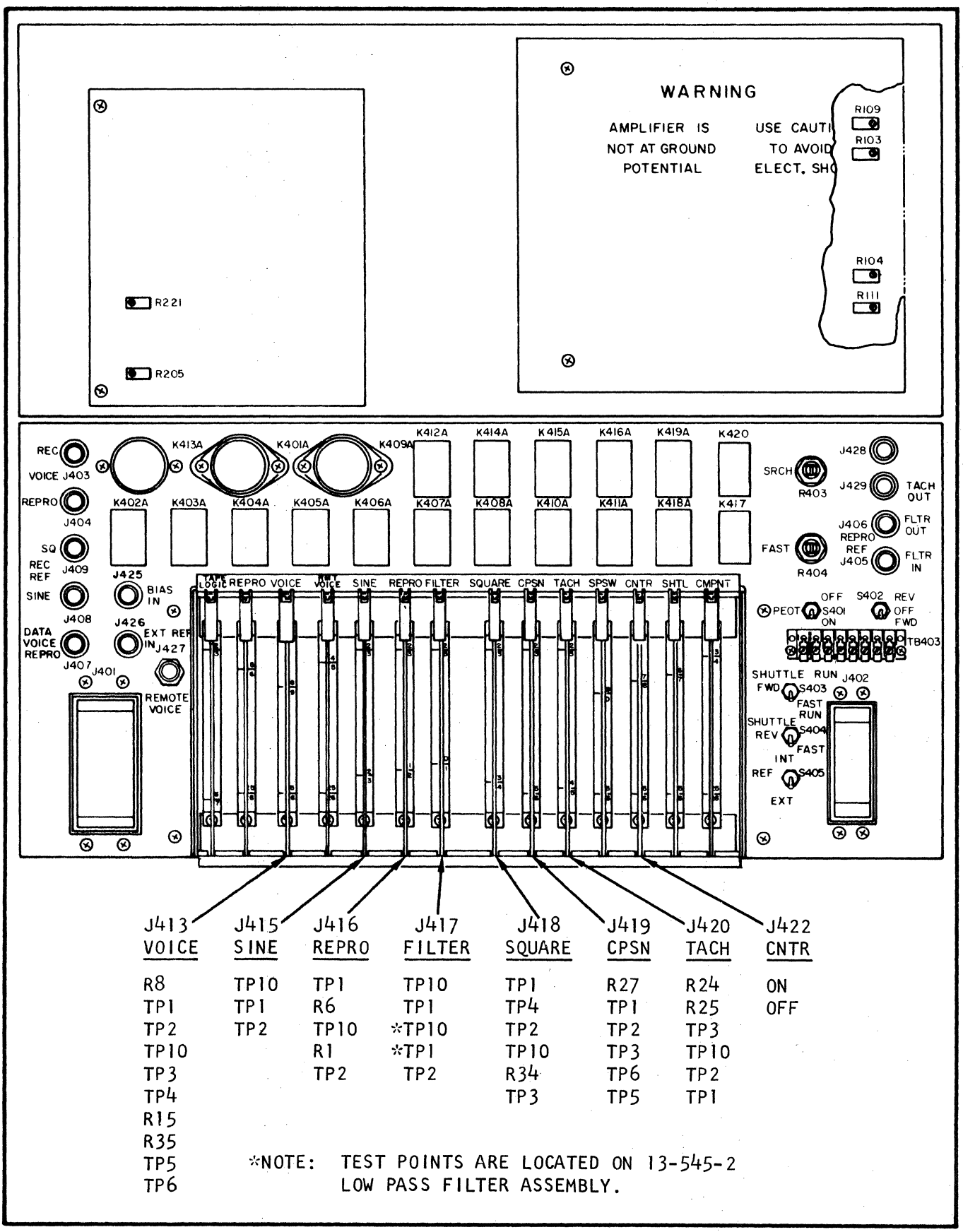
e. Set R1834 of the reference generator board fully counterclockwise and then advance the potentiometer 12 revolutions clockwise.

f. Set R1606 of the reproduce servo control board fully counterclockwise and then advance the potentiometer 12 revolutions clockwise.

5-57. This completes the initial electrical setup procedures for a totally misaligned tape transport assembly.

5-58. With ac power applied to the system and circuit breaker CB301 ON, the main power indicator lamp DS301 should be lit.

5-59. Load a reel of tape on the tape transport by using the two tape guides as shown in figure 5-9.



J413 VOICE	J415 SINE	J416 REPRO	J417 FILTER	J418 SQUARE	J419 CPSN	J420 TACH	J422 CNTR
R8	TP10	TP1	TP10	TP1	R27	R24	ON
TP1	TP1	R6	TP1	TP4	TP1	R25	OFF
TP2	TP2	TP10	*TP10	TP2	TP2	TP3	
TP10		R1	*TP1	TP10	TP3	TP10	
TP3		TP2	TP2	R34	TP6	TP2	
TP4				TP3	TP5	TP1	
R15							
R35							
TP5							
TP6							

*NOTE: TEST POINTS ARE LOCATED ON 13-545-2 LOW PASS FILTER ASSEMBLY.

Figure 5-8. Transport Electronics Adjustment Locations

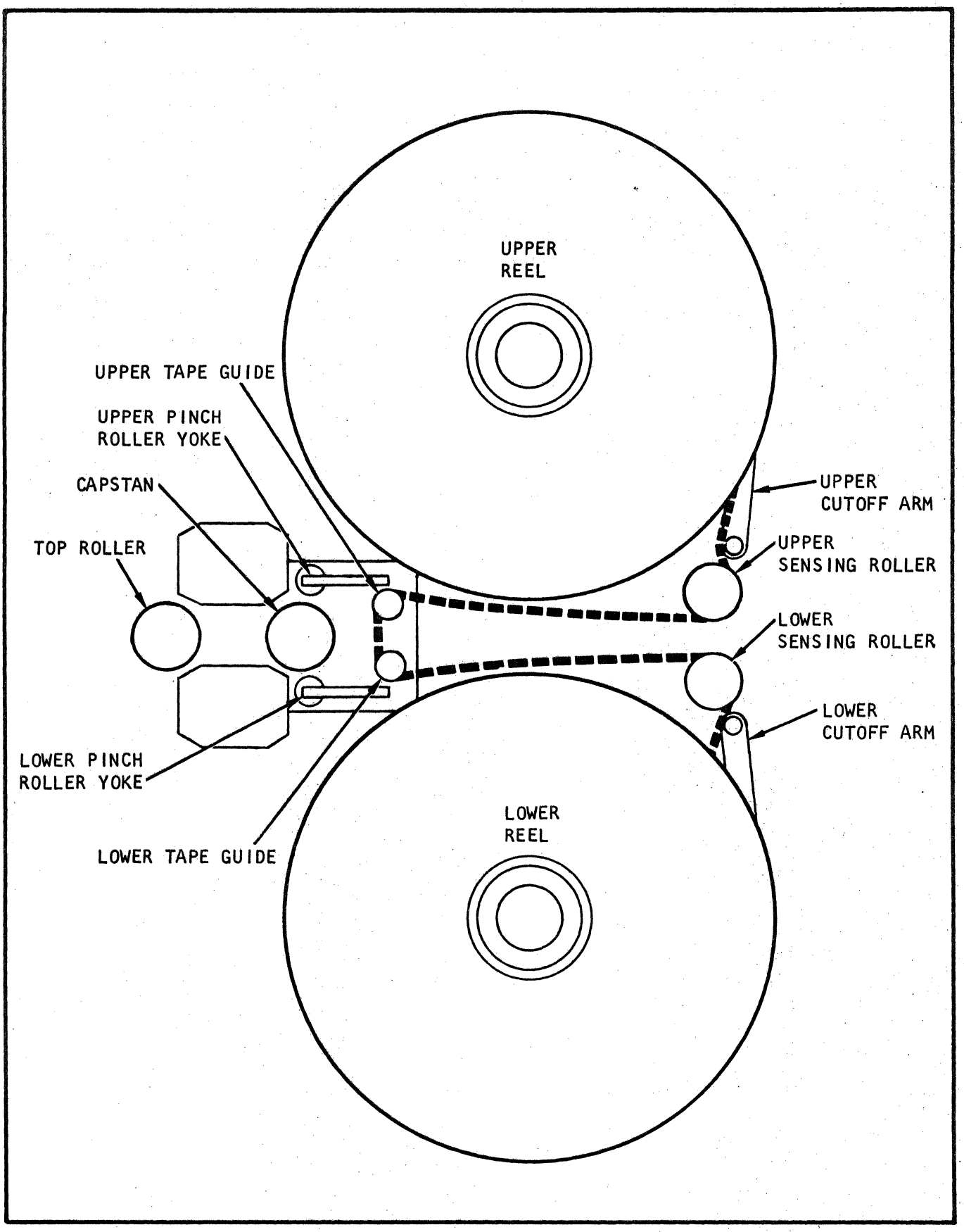


Figure 5-9. Tape Threading Path for Test Procedure

5-60. REEL POWER AMPLIFIER ALIGNMENT. Set tape transport on a low speed (1 7/8 or 3 3/4 ips) and press either the RUN FWD or RUN REV button. Connect a multimeter (set on AC 300 volt scale) between pins 2 and 3 on TB502.

CAUTION

Use only multimeter with 5000 ohms-per-volt sensitivity on ac range. Make initial voltage measurement connections with multimeter on AC 300 volt scale to ensure that meter will not be damaged.

5-61. With the upper reel motor stalled, push the upper tape tension sensing roller upward (toward the upper reel, i.e., minimum light to the solar cell) and adjust R109 for 15 vrms. Make potentiometer adjustments using the Bourns Trimpot tool.

5-62. While holding the upper tape reel and pushing the upper tape tension sensing roller downward (away from the upper reel; i.e., maximum light to the solar cell), adjust R103 for 95 vrms.

Note

Potentiometers R109 and R103 are interacting; readjustment may be required.

5-63. Set the meter back to the 300 volt scale and move the leads to pins 4 and 6 of TB502.

5-64. While holding the lower reel motor in the stalled position, move the lower tape tension sensing roller to a maximum downward position (toward the lower reel) and adjust R111 for 15 vrms.

5-65. Push the lower tape tension sensing roller up and away from the lower reel. While keeping the reel from moving, adjust R104 for 95 vrms.

Note

Potentiometers R111 and R104 are interacting; readjustment of each may be required before final adjustment. Press the STOP pushbutton.

5-66. TAPE TENSION.

5-67. With magnetic tape loaded and threaded on the tape transport in the conventional manner (figure 3-3) and the system running at 15 ips in the RUN FWD direction, measure the tape tension between the upper tape tension sensing roller and the fixed tape guide adjacent to it, using a Bell & Howell Type 12-902 Tape Tension Gage (or equivalent).

5-68. For 1 inch tape, the tension should be 10 ±1 ounces. If adjustment is necessary, screw the knurled thumb screw (item 16 of figure 5-4) in or out as required to increase or decrease the tension, respectively. An Allen head setscrew must be loosened before the thumb screw can be moved. Retighten this setscrew after completing the adjustment.

5-69. Repeat procedures in paragraphs 5-67 and 5-68 for the lower reel tape tension. Tape tension must remain within ±1 ounce under beginning, middle, and end reel conditions.

5-70. FAST ADJUST. Thread the tape as shown in figure 5-9 and connect an electronic counter (Hewlett-Packard 5326, or equivalent) to TP2 (red) on the capstan servo amplifier board plugged into J419 on the electronics and relay chassis.

5-71. Press either FAST FWD or FAST REV button and observe the electronic counter readout.

5-72. Adjust R404 until the electronic counter reads 250 kHz ±2 kHz. This will allow the tape transport to wind or rewind 7200 feet of tape in less than 5 minutes. Press the STOP pushbutton.

Note

This is an open loop control. The adjustment should be made slowly to allow the capstan to obtain speed.

5-73. SEARCH ADJUST. With an electronic counter connected to TP2 (red) of J419, set the TAPE SPEED SELECTOR switch to the SRCH position and press either RUN FWD or RUN REV button. Adjust R403 to read 150 kHz ±5% on the electronic counter. This setting will correspond to 180 ips tape speed.

Note

This is an open loop control. The adjustment should be made slowly to allow the capstan to obtain speed. This is merely a convenient setting, and any speed desirable within the range of 30 ips (25 kHz) to 180 ips (150 kHz) can be used for the search mode of operation.

5-74. Disconnect the counter from TP2 of J419. Press the STOP button.

5-75. REFERENCE GENERATOR GAIN ADJUST AND FREQUENCY CHECK. Connect an ac voltmeter between J409 and ground on the electronics and relay chassis. Switch the transport to 15 ips. Adjust R1834 of the reference generator for a reading of 0.18 volt rms indicated on the voltmeter.

5-76. Connect an electronic counter at J409 and check that the Reference Frequency Generator output frequency agrees with those listed in table 5-5 for each speed selected. Use a Hewlett-Packard Type 5326 Electronic Counter, or equivalent. If, at 240 ips, the output at J409 is not 400 kHz ±0.005% (±20 Hz), adjustment of C1801 on the Reference Frequency Generator is required. Use Extender Card, Bell & Howell part number 472149-1, to gain access to this component.

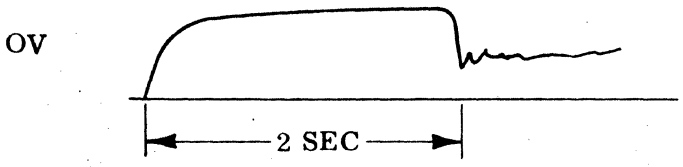
5-77. CAPSTAN START/STOP TIME ADJUSTMENT. Connect an oscilloscope to TB501, pin 4.

5-78. Set transport speed selector switch to 60 ips.

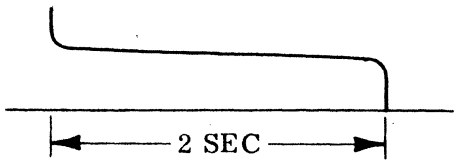
TAPE SPEED SELECTOR SWITCH POSITION	OUTPUT FREQUENCY AT J409 IN kHz
240	400
120	200
60	100
30	50
15	25
7 1/2	12.5
3 3/4	6.25
1 7/8	3.125
15/16	1.5625

Table 5-5. Tape Speed in ips Versus Reference Frequency Generator Output

5-79. Press RUN switch. Adjust R221, as necessary, to obtain the 2.0 second start time. Turning R221 clockwise will decrease the start time. The oscilloscope display should be as shown below:



5-80. While running at 60 ips, press STOP switch. Readjustment of the trigger level may be necessary to obtain the oscilloscope display. Adjust R205, as necessary, to obtain a 2.0 second stop time. The oscilloscope display should be as shown below.



5-81. CAPSTAN SERVO LOGIC ADJUST. Connect an oscilloscope to TP2 (see J419, figure 5-7).

5-82. Set transport speed selector switch to 15/16 ips.

5-83. Press the RUN switch.

5-84. Monitor TP2, if necessary, adjust R1927 to achieve square wave symmetry.

5-85. SERVO RECORD ADJUSTMENT. Connect a coaxial cable between J409 on the electronics and relay chassis and J4 on the bias buffer (see figure 5-10).

5-86. Connect a coaxial cable between J2 on the bias buffer and the head driver channel used for the servo control signal (channel 27 on a 1 inch wide tape).

5-87. Switch the transport phase lock switch to TACH position. Select the tape speed required, and place the transport in the RECORD mode.

5-88. Adjust the output of the reference generator R1834 (mounted on the reference generator assembly) to provide an output of 10 db below normal record level as defined in Section V, Calibration and Maintenance, in the System manual.

5-89. SERVO REPRODUCE ADJUSTMENT. Servo control of the VR-3700B System necessitates the use of the 13-545-2 Low Pass Filter or the 13-545-1 Bandpass Filter Assembly in series with the input to the reproduce servo control amplifier (see figure 5-10).

5-90. Connect the output of the applicable reproduce amplifier to J405 on the electronics and relay chassis.

5-91. Switch the transport phase lock switch to the TAPE position, and reproduce the recording made in TACH mode in paragraphs 5-85 through 5-88. Adjust the output of the applicable reproduce amplifier, R2, to give 1 volt peak-to-peak (0.3 volt rms) into the filter assembly measured at TP1.

5-92. Connect oscilloscope to TP2 on reproduce servo control assembly and adjust R1601 for 1 volt peak-to-peak (0.3 volt rms). Reconnect oscilloscope to TP1, adjust R1606 for a symmetrical square wave.

5-93. SERVO CONTROL MULTIPLEX. To use the control channel as a data channel for frequencies above the constant amplitude control frequency, it is necessary to multiplex the data and the servo control signals.

Note

The frequency of the data signal must be not less than one octave above or below the record reference frequency given in table 5-5.

5-94. MULTIPLEX RECORD. Multiplex record requires the use of a sine wave generator (Bell & Howell 13-544-1, part number 471633-1) in series with the output of the reference generator. The sine wave generator is inserted into card holder J415 on the electronics and relay chassis.

5-95. The output of the sine wave generator is taken by a coaxial cable from J408 on the electronics and relay chassis to J4 servo reference input on the bias buffer.

5-96. The record data signal is taken by a BNC cable from the applicable channel record amplifier to J3 on the bias buffer. The bias signal is taken by a coaxial cable from J407 to J1 on the bias buffer.

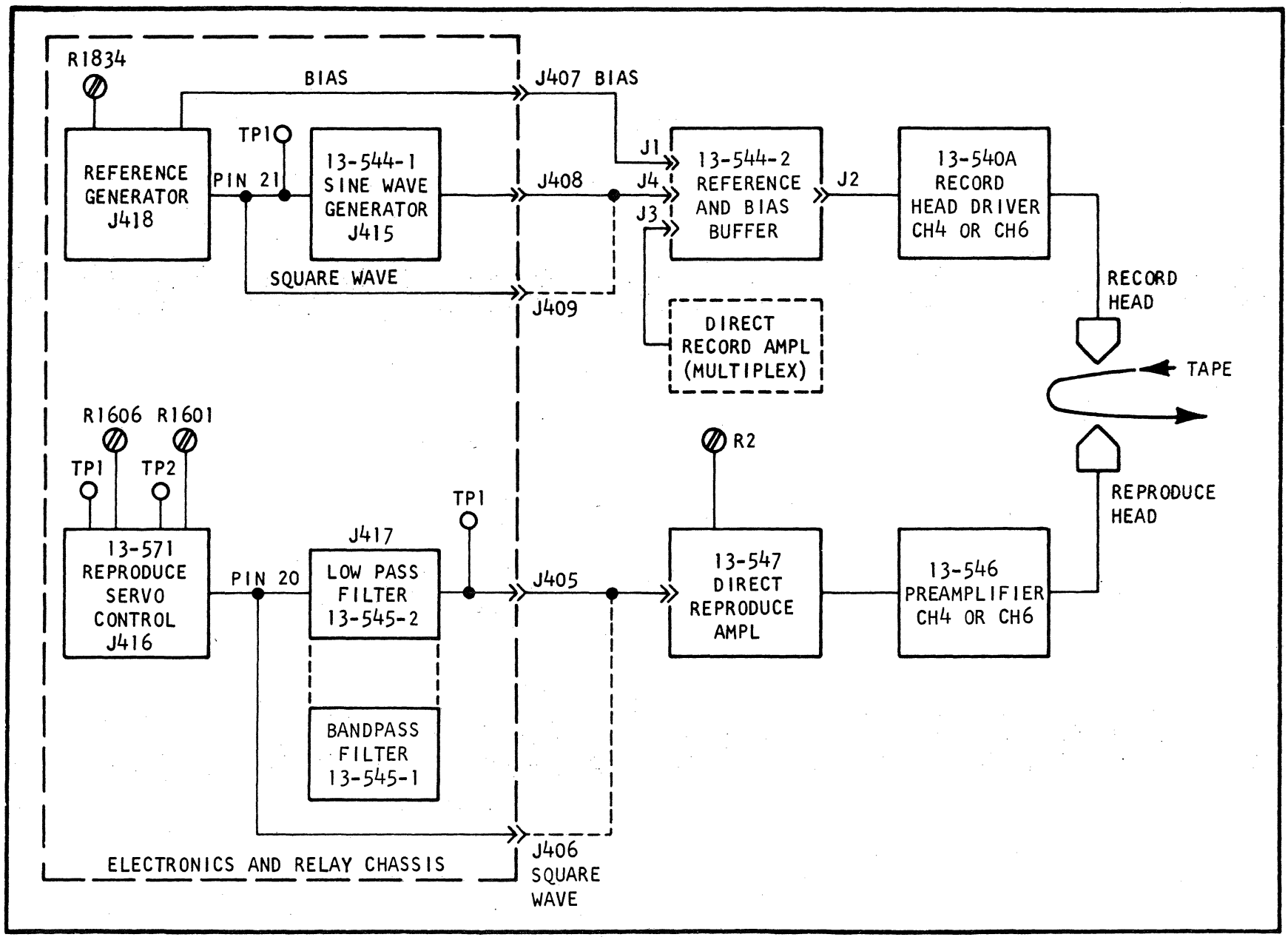


Figure 5-10. Servo Record and Reproduce Adjustment

5-97. The combined output is taken by a coaxial cable from J2 on the bias buffer to the jack on the record driver used for recording the multiplex signal.

5-98. Switch the transport phase lock switch to the TACH position. Select the tape speed required and place the transport in the RECORD mode.

5-99. Adjust R1834 on the reference generator assembly to provide an output of 10 db below normal record level as defined in Section V, Calibration and Maintenance, in the System manual.

5-100. Set the data record level by adjusting R2, in the direct record amplifier, to 1 db below normal record level as defined in Section V, Calibration and Maintenance, in the System manual.

5-101. MULTIPLEX REPRODUCE. Servo control from a multiplex signal requires the use of a Bell & Howell 13-545-1 Bandpass Filter Assembly, part number 471622-1, in series with the input to the reproduce servo control amplifier.

Note

In a multiplex system, the bandpass filter is used in place of the 13-545-2 Low Pass Filter, and plugs into card holder J417 on the electronics and relay chassis.

5-102. Connect a coaxial cable between J405 on the electronics and relay chassis and the applicable channel on the reproduce amplifier mounting assembly.

5-103. Switch the transport phase lock switch to the TAPE position, and reproduce the recordings made in paragraphs 5-94 to 5-100. Adjust the input to the reproduce servo control (R1601) to give 1 volt peak-to-peak (0.3 volt rms) measured at test point TP2 in the reproduce servo control.

5-104. Adjust R1606 in the reproduce servo control assembly to give a symmetrical square wave, observed at test point TP1 (brown) in the reproduce servo control assembly.

5-105. UPPER PHOTO END-OF-TAPE ALIGNMENT. Remove the magnetic tape and both reels from the transport, and remove the dust cover (on the upper left-hand side of the front of the transport) that covers the photo end-of-tape (PEOT) lamp assembly. Two Phillips head screws hold this cover in place.

5-106. Place a piece of masking tape over the lower PEOT sensor opening on the control panel to block out the light beam from the lower PEOT lamp assembly.

Note

Figure 5-11 illustrates the items referenced in the following paragraphs on the PEOT alignment procedures.

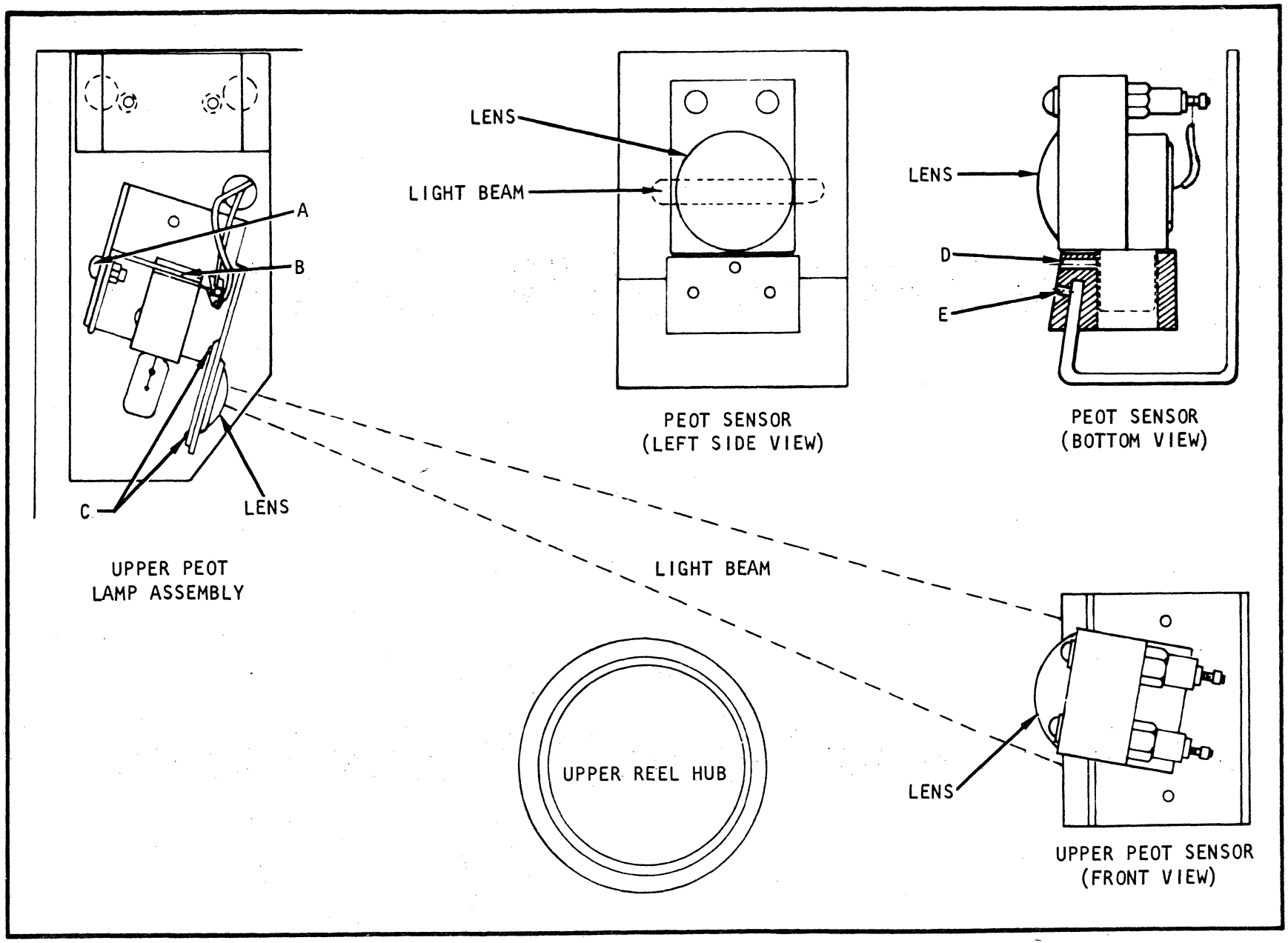


Figure 5-11. PEOT Lamp and Sensor Alignment

5-107. Place a thumb over the upper PEOT sensor lens and note whether the PEOT lamps dim. If the brightness does not change (i.e., dim), the optics are misaligned and paragraphs 5-108 through 5-112 should be followed. If the lamps dim when the light path is broken by the thumb, the optical alignment of the upper PEOT is correct and paragraphs 5-108 through 5-112 can be bypassed and the lower PEOT alignment can be checked starting with paragraph 5-113.

5-108. PEOT ALIGNMENT. Remove the dust cover (on the upper left-hand side of the front of the transport) that covers the PEOT lamp assembly. Two Phillips head screws hold this cover in place.

5-109. Loosen the Allen head screw (item A) holding the lamp socket assembly. Slide the lamp assembly up and down until both lamps brighten. Find the area (upper and lower limit of travel) where the lamps stay bright, and set the upper lamp assembly in the middle of this area. Tighten the Allen head screw holding the socket assembly.

Note

If, regardless of where the lamp assembly is positioned, the lamps do not brighten, use a small flashlight (pen-light) to excite the upper PEOT sensor. If, when the flashlight beam strikes the PEOT sensor, both lamps brighten, the upper PEOT sensor assembly is functioning properly. If, however, the lamps do not brighten when the flashlight beam strikes the upper sensor, the PEOT sensor is defective and must be replaced before continuing with the alignment procedures.

5-110. If, after establishing that the sensor is functioning properly, the lamps still will not brighten when the lamp assembly is moved up or down, check the focus of the beam.

5-111. When properly focused, a narrow beam approximately 2 1/2 inches long should be centered on the PEOT sensor lens as shown in figure 5-11, PEOT SENSOR (FRONT VIEW). If the beam is diffused, the focus can be adjusted by carefully bending the lamp socket assembly with a pair of needle nose pliers (between items A and B). A slight movement of the bulb closer to, or further from, the lamp assembly lens will image the filament on the PEOT sensor lens. If the lamps do not brighten after the focus has been completed, the problem is either the alignment of the lamp assembly lens or the sensor assembly lens.

5-112. If, when the lamp beam is focused, it is not centered on the sensor lens, the beam can be adjusted by the two screws holding the lens to the assembly (item C). The angle of viewing of the sensor assembly lens can also be adjusted by loosening the Allen head set-screw (item D) that holds the sensor assembly and pivoting the assembly on its axis.

5-113. LOWER PHOTO END-OF-TAPE ALIGNMENT. After the upper PEOT lamp and sensor assemblies are aligned, remove the tape from the bottom PEOT sensor and place it over the upper PEOT sensor assembly opening on the control panel.

5-114. The lower PEOT lamp and sensor assemblies can be aligned in the same manner as the upper PEOT assemblies, by following paragraphs 5-107 through 5-112 and replacing all references to upper PEOT assemblies with lower PEOT lamp or sensor assemblies.

5-115. PEOT CUTOFF POINT ADJUSTMENT. If it is desirable to change the amount of tape left on either the upper or lower tape reel at the point of PEOT cutoff, loosen the two Allen head screws (item E) holding the sensor assembly on its mounting bracket. The sensor assembly can be moved up or down to increase or decrease the amount of tape left on the reel at the time of PEOT cutoff.

Note

The increase or decrease in the size of the tape stack at time of cutoff is equal to 1/2 the distance the sensor is moved.

5-116. Moving the sensor up or down will not affect the PEOT alignment since the sensor should still be viewing the narrow light beam.

5-117. This completes the alignment and adjustment of the PEOT lamp and sensor assemblies. Remove the masking tape and replace the two dust covers that cover the lamp assemblies. Place a reel of tape on the transport and thread it in the normal manner.

5-118. POWER SUPPLY. If repair of the power supply is required, remove the front plate assembly. The power supply cable harness is long enough that the power supply front plate assembly can be placed in front of the power supply for maintenance. All dc power supply parts are accessible when the front plate assembly is removed. The ac power supply is mounted in the base of the system cabinet.

5-119. OPTIONAL RECORD HEAD MONITORING CAPABILITY. An optional accessory to the tape transport is a record head test cable assembly (Bell & Howell part number 475158) and companion jack assembly J7. The test cable is eight feet long, allowing placement of monitoring equipment adjacent to the tape system. This optional cable assembly allows monitoring the input data and bias signal to each record head channel.

5-120. TROUBLESHOOTING AND CORRECTIVE MAINTENANCE.

5-121. Troubleshooting and corrective maintenance on the 13-501 Tape Transport requires familiarization with the mechanical operations as well as a thorough understanding of the principles of operation. Before attempting to make any tape transport alignment adjustments or component replacements, maintenance personnel are urged to study the Theory of Operation in Section IV. Schematics and cabling diagrams contained in Section VII also prove helpful during circuit analysis, tracing signals between components and interconnecting assemblies, establishing test points, obtaining the location of electrical alignment adjustments, and understanding the functional description of the tape transport.

5-122. Test equipment used to perform the electrical alignment between calibration points should have an accuracy equal to or greater than the accuracy required for tape transport maintenance. Visual inspection should include observation of mechanical parts in motion to obtain indications of how the parts are functioning. In some cases, an explanation of a maintenance problem becomes apparent only after the cause has been found. Table 5-6 lists common tape transport faults and possible causes which may be encountered during the transport of tape. Symptoms and possible causes for signal faults are listed in table 5-7.

SYMPTOM	POSSIBLE CAUSES
No tape movement	1. Tape not properly threaded (especially, not through end-of-tape cutoff assembly). 2. If remote control unit is not used, jumper plug (J402) not properly installed. 3. RECORD TEST SELECTOR switch not set to NORM. 4. No output from tachometer. 5. Faulty end-of-tape circuit. 6. Faulty capstan motor.
Erratic tape motion	1. Faulty motor or motor control circuit. 2. Faulty reeling motor. 3. Faulty brake, brake solenoid, or solenoid energizing circuit.
Tape movement at wrong speed (in any RUN mode)	1. Faulty speed selection circuit.
Tape slack between capstan and either reel	1. Faulty reeling motor. 2. Reel power amplifier faulty or misadjusted. 3. Faulty solar cell or lamp in tape tension servo sensor.
Improper speed in RUN mode	1. Faulty speed control servo.
Tape breaking, any mode	1. Bad tape. 2. Faulty static brakes.
Loop throwing on starting any RUN or FAST mode	1. Reel servo control misalignment. 2. Capstan motor acceleration too fast.
NOTE: If tape movement is exceptionally fast in the selected direction of tape movement, the fault is that of no tachometer signal to the phase lock servo circuit. If tape movement is exceptionally fast in the opposite direction to that selected, the fault is that of no reference signal to the phase lock servo circuit.	

Table 5-6. Tape Movement Faults and Possible Causes (Sheet 1 of 2)

SYMPTOM	POSSIBLE CAUSES
Loop throwing when stopping from any mode	1. Capstan stop detector faulty. Note: When actuating stop command, pinch rollers will deactivate and brakes will be applied.
Faulty tape stacking, any mode	1. Faulty reel or reels. 2. Faulty tape. 3. Rollers not properly aligned.
Mistracking, any mode	1. Faulty reel or reels. 2. Pinch roller not properly aligned. 3. Other rollers not properly aligned.

Table 5-6. Tape Movement Faults and Possible Causes (Sheet 2 of 2)

SYMPTOM	POSSIBLE CAUSES
No signal or weak signal	1. Dirty head. 2. Faulty head (open winding, shorted gap). 3. Faulty preamplifier or amplifier. 4. Faulty signal wiring. 5. Faulty amplifier power supply. 6. Faulty power wiring. 7. Faulty monitor equipment (giving indication of no signal or weak signal when signal actually is normal). 8. Magnetized head.
Dropouts of portions of signal	1. Dirty tape. 2. Dirty head.

Table 5-7. Signal Faults and Possible Causes (Sheet 1 of 2)

SYMPTOM	POSSIBLE CAUSES
Distorted signal (even harmonic distortion)	1. Magnetized head.
Periodic distortion or interference (synchronized with rotation of roller)	1. Magnetized roller.
Noise (on FM data)	1. Flutter in tape transport. 2. Carrier record level not properly set. 3. Reproduce amplifier not properly terminated.

Table 5-7. Signal Faults and Possible Causes (Sheet 2 of 2)

5-123. REPAIR.

5-124. Repair of this magnetic tape record/reproduce equipment should be undertaken only by technicians experienced in the maintenance of instrumentation grade tape equipment. The printed circuit boards should be repaired only by personnel experienced in printed wiring techniques. It is recommended that repair be limited to replacement of defective components and adjustment of controls.

5-125. Be sure that replacement parts are of the correct type and value, and that they are known to be good. When removing and replacing defective components, be careful not to burn or damage the surrounding circuit parts, particularly on printed circuit boards. When installing a new part, place it in the exact position as the one replaced and, after replacement, inspect the circuit board for evidence of cold solder joints, solder splashes, and insecurity of mounting.

5-126. PARTS IDENTIFICATION. Components of the tape transport are illustrated in Section VI of this manual, showing locations and part designations. The parts list in Section VI itemizes the component parts in the assembly and provides a Bell & Howell part number for each.

5-127. FIELD REPAIR SERVICE.

5-128. Regular scheduled maintenance service is available from the Bell & Howell Instruments Division Sales and Service Office on a contract basis. If immediate service is required, it may be obtained on an emergency basis. Every effort is made to furnish the needed repair as soon as possible. For a complete description of Bell & Howell's maintenance service plans and their costs, contact the Instruments Division Sales and Service Office.

5-129. FACTORY REPAIR SERVICE.

5-130. If desired, instruments (or major assemblies) may be returned to the factory for repair. When an instrument or assembly is returned:

a. Indicate the symptom of defect. State as completely as possible, both on an instrument tag and on the order form, the nature of the problem encountered. Too much information is far better than too little. If the trouble is intermittent, please be specific in describing the instrument's performance history.

b. Give special instructions. If any changes in the instrument or assembly have been made, and it is desired to retain the modified form, please indicate this specifically.

c. State the desired invoicing procedure. In the first correspondence, indicate whether repair work may begin immediately with billing in accordance with the standard pricing system or whether Bell & Howell should secure prior approval of the price before proceeding with the repair. The price will be the same in both cases, but any delay will be minimized by permission to start work immediately. The order acknowledgment copy will, of course, always show the price.

d. Pack securely and label. Proper packaging saves money. The small amount of extra care and time it takes to cushion a part or instrument properly may prevent costly damage while in transit. Make certain that the address is both legible and complete; failure to do so often results in needless delay. Address all shipments and correspondence to:

Bell & Howell
Instruments Division
360 Sierra Madre Villa
Pasadena, California 91109
Attention: Repair Department

e. Show return address on repair correspondence. Please indicate clearly the exact address to which the equipment should be returned after repair is completed. All shipping costs will be borne by the owner of the equipment, not by Bell & Howell.

SECTION VI

PARTS LISTS

6-1. GENERAL.

6-2. Appropriate parts lists and illustrations for the 13-501 Tape Transport follow the instructions given below. A list of major assemblies is tabulated in table 6-1. The parts lists include the Bell & Howell Instruments Division part number, description, figure and index and/or schematic reference symbol, and where applicable, the manufacturer's or military part number for each component. Manufacturers are identified in the parts lists by code number in accordance with the Federal Supply Code for Manufacturers, Cataloging Handbook H4-2, and as listed in table 6-2. The components are illustrated in figures 6-1 through 6-31.

6-3. ORDERING REPLACEMENT PARTS.

6-4. Parts should be ordered through the nearest Bell & Howell Instruments Division Sales and Service Office. Price and delivery information on parts or complete instruments may be obtained there also. To assist in making this contact, a list of Sales and Service Offices is included in the front of this manual. Bell & Howell recommends that whenever possible, and particularly when an instrument is used in a critical application, the user maintain a minimum stock of spare parts. Instruments Division has specialized personnel ready to assist the user in making a selection of spares at any time. The same personnel are also ready and able to prepare or quote on the preparation of illustrated parts breakdowns (IPB's), provisioning parts breakdowns (PPB's), and other parts documentation that might be required.

6-5. When ordering parts, the following information should always be supplied to the field office engineers:

a. A description of the part or assembly, obtained from the parts list.

b. The Bell & Howell part or assembly number, also on the parts list, or on the component itself.

c. The figure and index, and/or reference symbol, given on the applicable diagram and on the parts list.

d. The part or type number of the major assembly, shown on the instrument nameplate.

e. The production serial number, also on the nameplate.

f. The Bell & Howell register number applying to the complete system or order.

ASSEMBLY	B&H PART NO.	PARTS LIST PAGE NUMBER
Tape Transport Assembly	476373	6-11
Reel Hub Adapter	252641	6-12
Transport Plate	471626	6-12
Precision Plate Assembly	471624	6-15
Lamp Unit, Sensor Assembly	471628-2	6-17
Drive Motor and Brake Assembly (Lower)	472060	6-20
Drive Motor and Brake Assembly (Upper)	471918	6-23
Electronics Components Assembly	471746	6-25
Control, Tape Tension, Installation	471629	6-25
Control Panel Assembly	471630	6-27
CPA and Reel Power Amplifier Assembly	471627	6-31
Capstan Servo Power Amplifier	472022-1	6-35
Reel Motor Power Amplifier	472090-1	6-37
Electronics and Relay Chassis Assembly	471623	6-40
Circuit Card Assembly	471616-1	6-43
Voltage Regulator and Speed Switching	472061-1	6-46
Capstan Servo Ampl and Tape Control Logic	472066-1	6-46
Tach/Tape Servo Equalizer	472193-1	6-50
Reference/Square Wave Generator	472075-1	6-53
Power Supply Assembly, DC	476379	6-57
Transistor Assembly, Heat Sink	472483	6-60
Circuit Card Assembly, Power Supply	475950-1	6-63
Power Supply Assembly, AC	476342	6-65
Diode and Transistor Assembly	472166	6-67
Tape Transport Assembly, Accessories		
Circuit Extender Card, Electronics and Relay Chassis	472149-1	6-71
Circuit Extender Card, Preamplifier Mounting Assembly	472155-1	6-71
*Type 13-545-1 Bandpass Filter Assembly	471622-1	6-73
*Type 13-545-2 Low Pass Filter Assembly	471636-1	6-76
Type 13-544-1 Record Sine Wave Generator	471633-1	6-79
Type 13-571 Reproduce Servo Control	471609-1	6-82
Tape Width Kits	373000-2, -5	6-84

*Only one assembly is used in J417.

Table 6-1. List of Assemblies

CODE	MANUFACTURER
00213	Sage Electronics Corporation Rochester, New York
01121	Allen-Bradley Company Milwaukee, Wisconsin
01295	Texas Instruments, Incorporated Semiconductor-Components Division Dallas, Texas
02288	Allied Control Company, Incorporated Plantsville, Connecticut
02735	RCA Corporation Solid State Division Somerville, New Jersey
03296	Nylon Molding Corporation Springfield, New Jersey
03508	General Electric Company Semiconductor Products Department Syracuse, New York
03797	Eldema Division Genisco Technology Corporation Compton, California
03938	Armstrong Cork Company Lancaster, Pennsylvania
04009	Arrow-Hart, Incorporated Hartford, Connecticut
04191	Photocircuits Corporation Los Angeles, California
04713	Motorola Semiconductor Products, Incorporated Phoenix, Arizona
04810	Ashland Electric Products, Incorporated Long Island City, New York
05397	Union Carbide Corporation Materials System Division Cleveland, Ohio

Table 6-2. List of Manufacturers (Sheet 1 of 6)

CODE	MANUFACTURER
05478	Omark Industries, Incorporated Portland, Oregon
06416	Pacific Resistor Company Tarzana, California
06540	Amatom Electronic Hardware Division Mite Corporation New Rochelle, New York
07088	Kevin Electric Company Van Nuys, California
07707	United Shoe Machinery Corporation Fastener Division Shelton, Connecticut
08289	Delbert Blinn Company, Incorporated Pomona, California
08742	ACDC Electronics, Incorporated Oceanside, California
09214	General Electric Company Semiconductor Products Department Auburn, New York
11237	CTS Keene, Incorporated Paso Robles, California
14026	Spatron, Incorporated Alhambra, California
14752	Electro Cube, Incorporated San Gabriel, California
16758	General Motors Corporation Delco Radio Division Kokomo, Indiana
22753	UID Electronics Corporation Hollywood, Florida
24546	Corning Glass Works Bradford, Pennsylvania
25504	Rotary Components Glendora, California
25677	Fairchild Systems Technology Division Fairchild Camera and Instrument Corporation Sunnyvale, California

Table 6-2. List of Manufacturers (Sheet 2 of 6)

CODE	MANUFACTURERS
26014	Helicoil Corporation Electroforming Division Danbury, Connecticut
27014	National Semiconductor Corporation Santa Clara, California
28478	Deltrol Controls Corporation Milwaukee, Wisconsin
31433	Union Carbide Corporation Material Systems Division Greenville, S. Carolina
42451	Union Carbide Corporation Carbon Products Division New York, New York
43334	General Motors Corporation New Departure-Hyatt Bearings Division Sandusky, Ohio
46343	Pemco Corporation Baltimore, Maryland
56289	Sprague Electric Company North Adams, Massachusetts
63743	Ward Leonard Electric Company Mount Vernon, New York
70563	Amperite Company Union City, New Jersey
71366	Bunting Brass and Bronze Company Toledo, Ohio
71744	Chicago Miniature Lamp Works Chicago, Illinois
71984	Dow Corning Corporation Midland, Michigan
72136	Electro Motive Manufacturing Company, Incorporated Willimantic, Connecticut
72259	Nytronics, Incorporated Pelham Manor, New York

Table 6-2. List of Manufacturers (Sheet 3 of 6)

CODE	MANUFACTURER
72982	Erie Technological Products, Incorporated Erie, Pennsylvania
73734	Federal Screw Products, Incorporated Philadelphia, Pennsylvania
74193	Heinemann Electric Company Trenton, New Jersey
74868	Bunker-Ramo Corporation Amphenol RF Division Danbury, Connecticut
74970	E. F. Johnson Company Waseca, Minnesota
75382	Kulka Electric Corporation Mount Vernon, New York
75915	Littelfuse, Incorporated Des Plaines, Illinois
76854	Oak Manufacturing Co. Division Oak Electro/Netics Corporation Crystal Lake, Illinois
77969	Rubbercraft Corporation of California, Ltd. Torrance, California
78488	Stackpole Carbon Company St. Marys, Pennsylvania
79136	Waldes Kohinoor, Incorporated Long Island City, New York
80183	Sprague Products Company North Adams, Massachusetts
80223	United Transformer Company New York, New York
80294	Bourns, Incorporated Riverside, California
80539	Standard Pressed Steel Company Santa Ana, California
81312	Litton Industries, Incorporated Winchester Electronics Division Oakville, Connecticut
81349	Military Specifications

Table 6-2. List of Manufacturers (Sheet 4 of 6)

CODE	MANUFACTURER
81483	International Rectifier Corporation Los Angeles, California
82877	Rotron, Incorporated Woodstock, New York
83125	Nytronics, Incorporated Capacitor Division Darlington, S. Carolina
84830	Lee Spring Company, Incorporated Brooklyn, New York
86684	RCA Corporation Electronic Components Harrison, New Jersey
86928	Seastrom Manufacturing Company, Incorporated Glendale, California
91506	Augut, Incorporated Attleboro, Massachusetts
91637	Dale Electronics, Incorporated Columbus, Nebraska
91663	Armel Electronics, Incorporated North Bergen, New Jersey
94222	Southco, Incorporated Lester, Pennsylvania
95238	Continental Connector Corporation Woodside, New York
95263	Leecraft Manufacturing Company, Incorporated Long Island City, New York
96733	San Fernando Electric Manufacturing Company San Fernando, California
96918	Kings Electronics Company Microwave Division Tuckahoe, New York
97197	Edmund Scientific Corporation Barrington, New Jersey
98376	Zero Manufacturing Company Burbank, California

Table 6-2. List of Manufacturers (Sheet 5 of 6)

CODE	MANUFACTURER
98278	Microdot, Incorporated South Pasadena, California
98410	ETC, Incorporated Cleveland, Ohio
98978	International Electronic Research Corporation Burbank, California
99942	Globe-Union, Incorporated Centralab Semiconductor Division El Monte, California

Table 6-2. List of Manufacturers (Sheet 6 of 6)

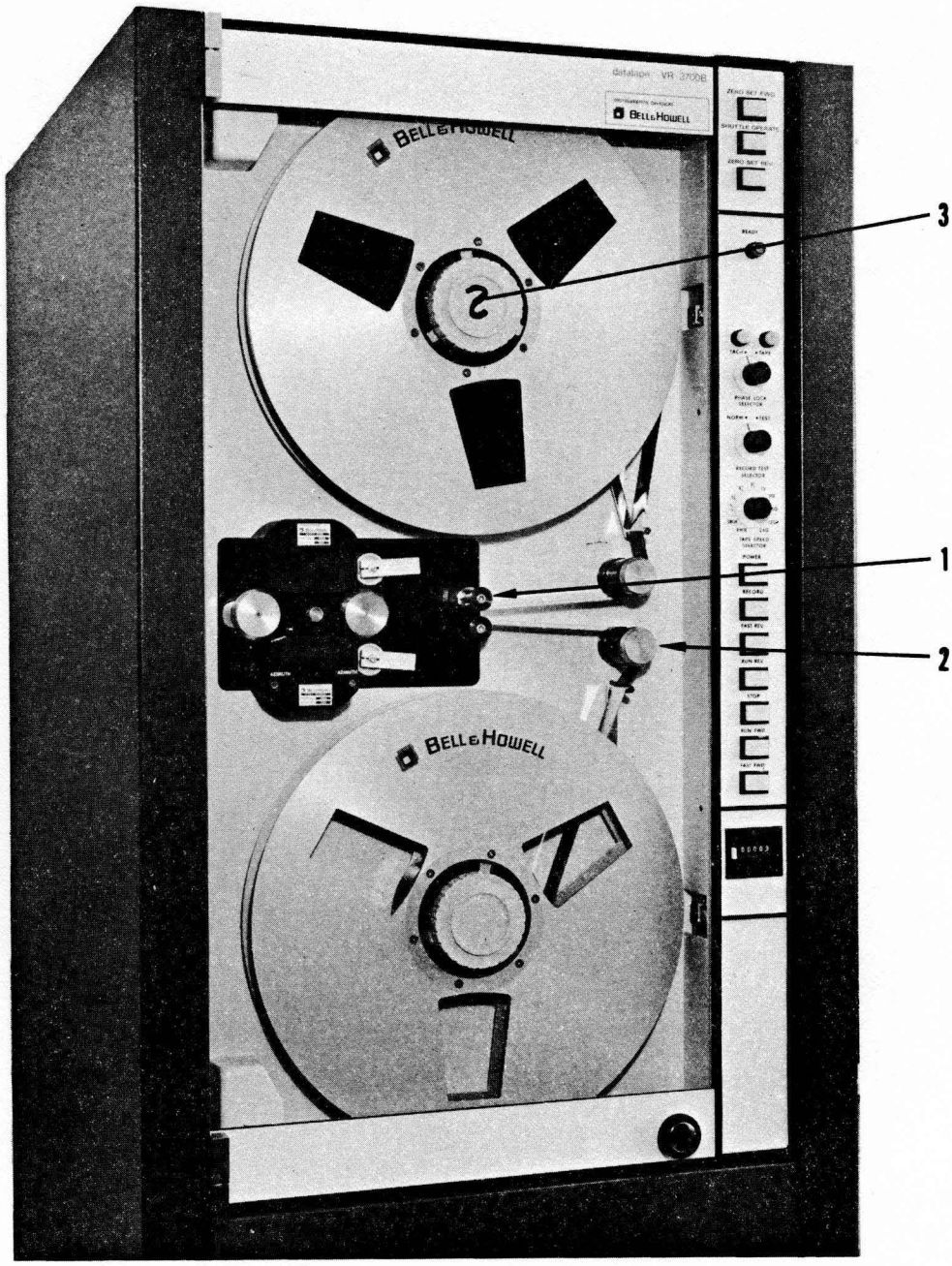
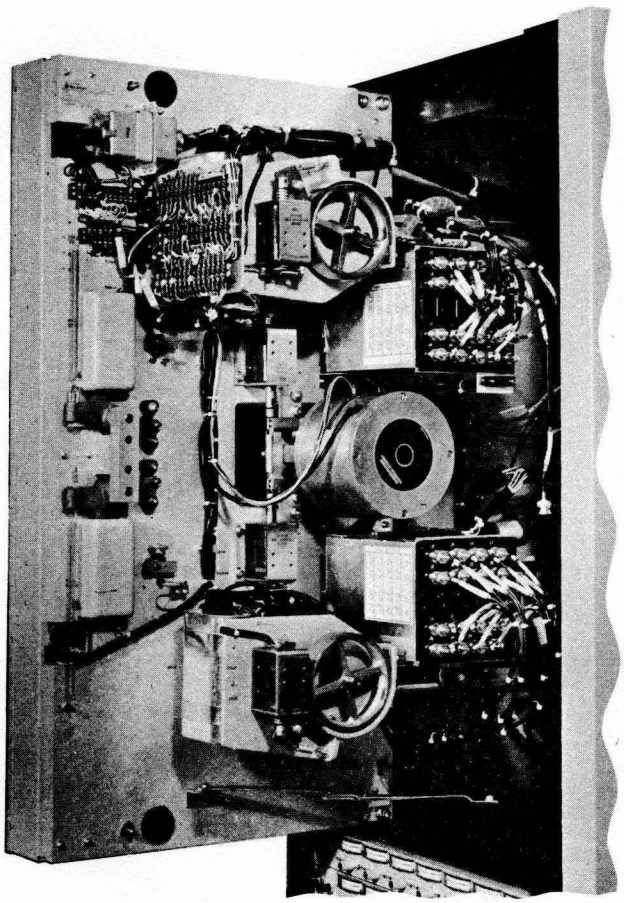


Figure 6-1. Tape Transport, Front View



2575-7

Figure 6-2. Tape Transport, Rear View

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 1 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	476373	Tape Transport Assembly	1	6-1,6-2		
2	471759	Transport Cable, interconnection	1			
3	210156-1	Conn, 34-contact (socket)	1	J501	81312	XAC-34S-F2516
4	204902-4	Contact, socket	2		81312	100-1014S
5	204902-5	Contact, socket	3		81312	100-1016S
6	204902-6	Contact, socket	25		81312	100-1020S
7	205299-6	Conn, 75-contact (socket)	1	P401	81312	XAC-75S-C1305
8	204902-4	Contact, socket	8		81312	100-1014S
9	204902-5	Contact, socket	24		81312	100-1016S
10	204902-6	Contact, socket	43		81312	100-1020S
11	210156-5	Conn, 34-contact (pin)	1	P302	81312	XAC-34-C1306
12	204902-2	Contact, pin	19		81312	100-1016P
13	204902-3	Contact, pin	19		81312	100-1020P
14	204876-4	Conn, 26-contact (socket)	1	P202	81312	XAC-26S-C1406
15	204902-6	Contact, socket	9		81312	100-1020S
16	204902-5	Contact, socket	15		81312	100-1016S
17	126716-174	Cable, RG/U	A/R		74868	RG174/U
18	19362-A/R	Sleeving, black	A/R			
19	70104-222	Wire, shielded	A/R			
20	471876-1699	Wire, #16 AWG, white	A/R			
21	471876-1893	Wire, #18 AWG, wht w/orn tracer	A/R			
22	471876-2200	Wire, #22 AWG, blk	A/R			
23	471876-1822	Wire, #18 AWG, red	A/R			
24	471876-1800	Wire, #18 AWG, blk	A/R			

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 2 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	9774-44	Lug, terminal	29			
2	156071-1	Lug, terminal	18			
3	471876-2222	Wire, #22 AWG, red	A/R			
4	157942-A/R	Insulation, sleeving	A/R			
5	471876-2244	Wire, #22 AWG, yel	A/R			
6	70052-212	Cord, nylon	A/R			
7	252641	Reel Hub Adapter	2			
8	471626	Transport Plate	1			
9	248096-8	Bearing, flanged	2		71366	FL26-6
10	70077-0528	Washer, flat, brass	2			
11	201804-5319	Insert, stud	12			
12	248728	Bushing, adapter	2			
13	248731-2	Screw Latch Assembly	2			
14	205442	Screw, mounting	1			
15	205843	Washer, retainer	2			
16	251751	Spring	1			
17	372331-1	Nut, sheet spring	1		94222	17-10015-13
18	129766	Bumper, rubber	2		77969	6371
19	125113-1	Brace, folding	1			
20	370446	Bracket, diode, sensor	2			
21	202519	Light, diode sensor assy	2			
22	246410	Block, sensor	1			
23	202521	Lens	1			
24	246424	Rectifier, sil, cont, light act.	1	V503 or V504	09214	L9A
25	128544	Terminal, insul	2			

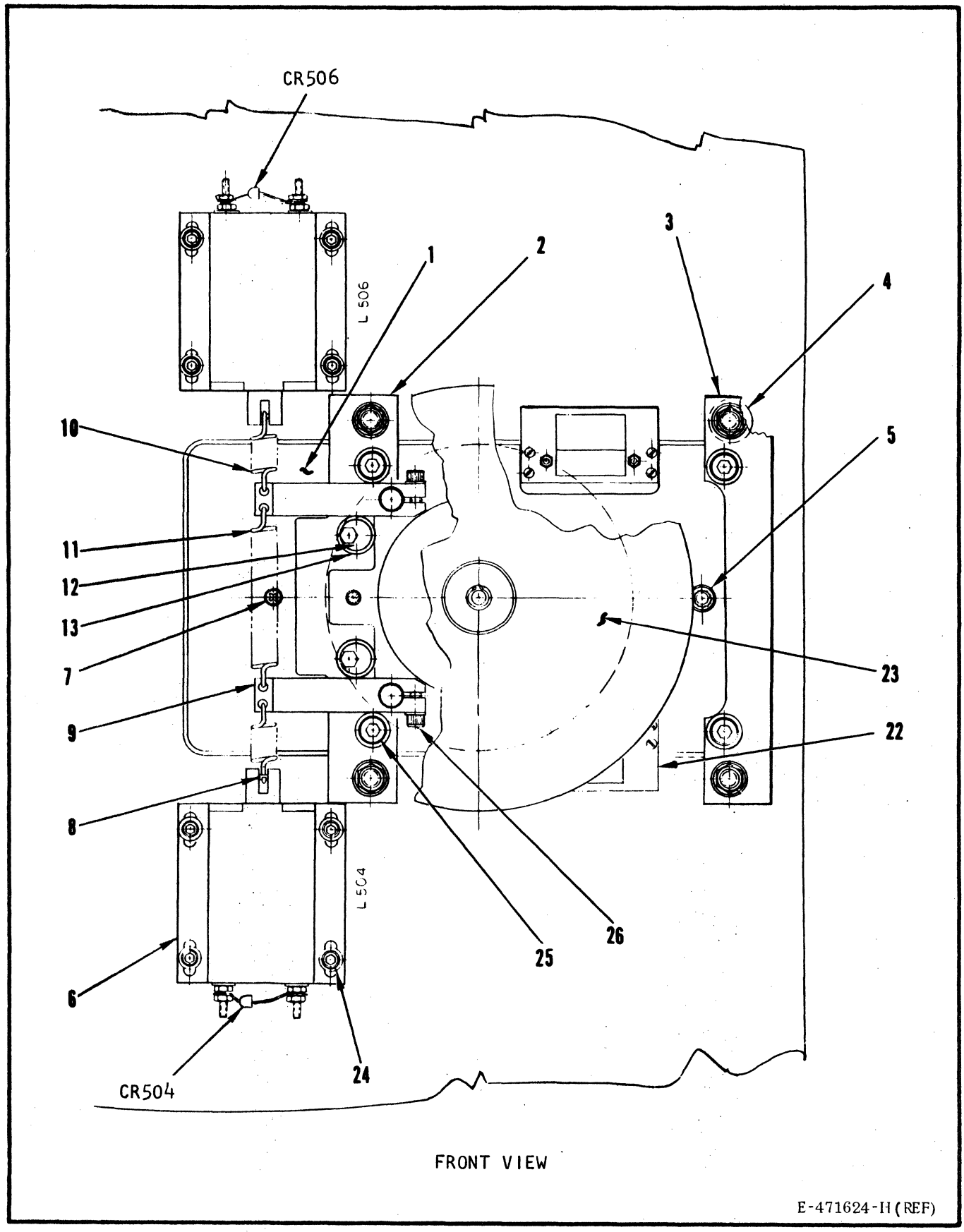


Figure 6-3. Precision Plate Assembly (Sheet 1 of 2)

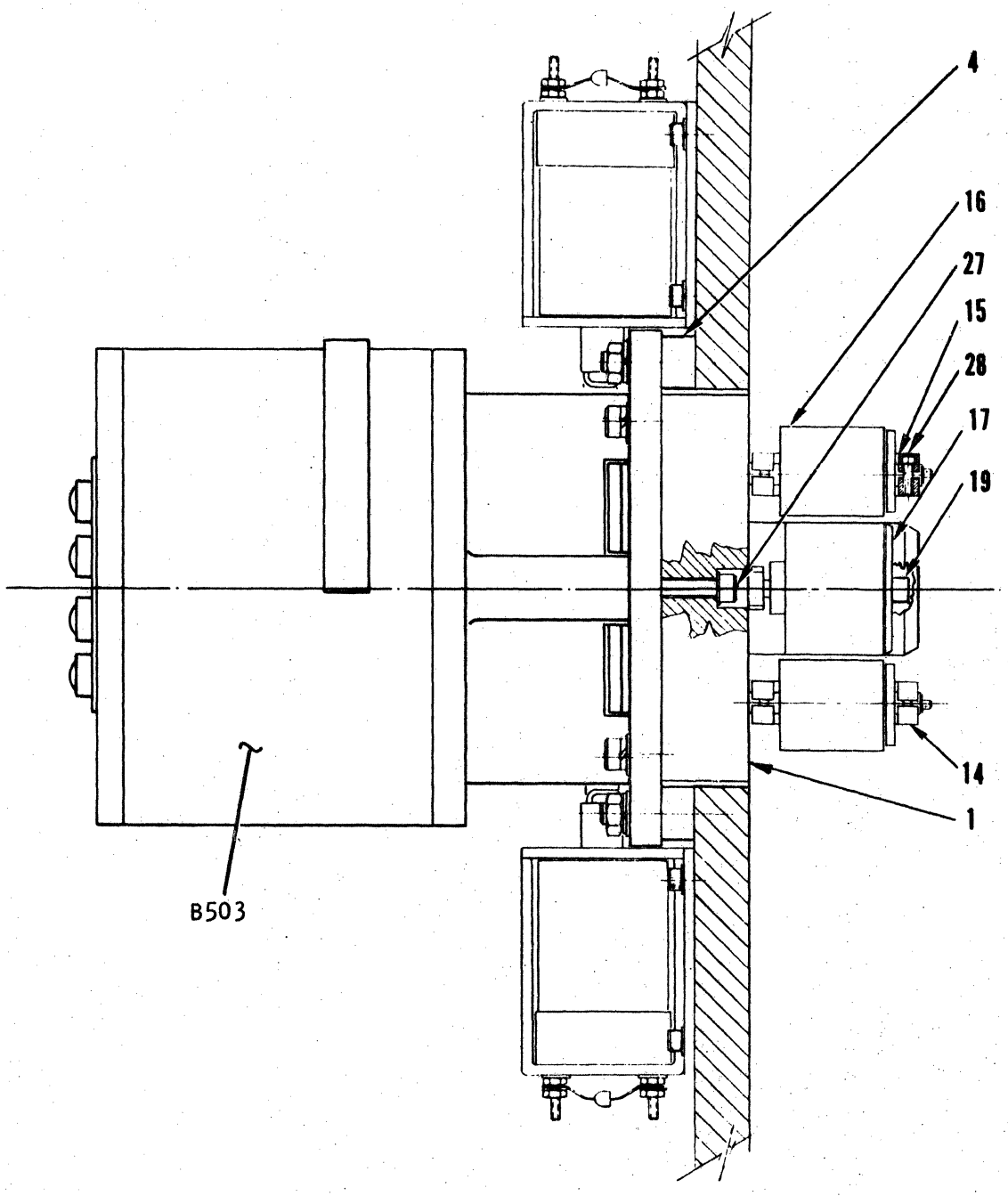
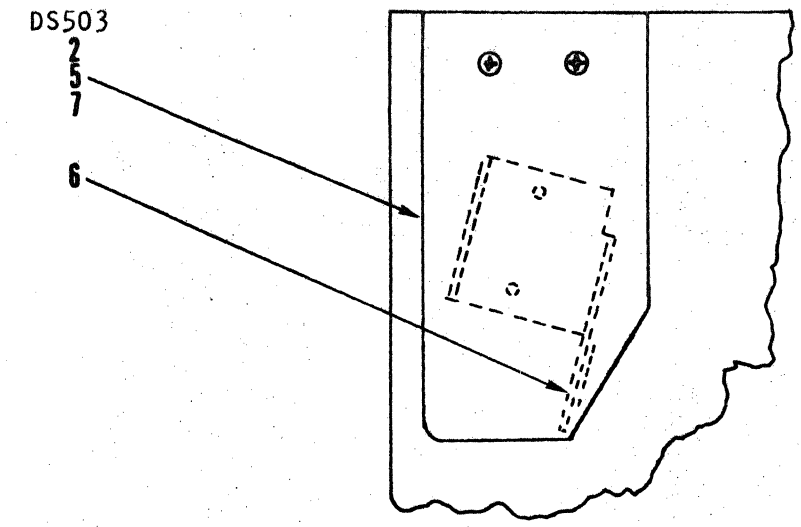


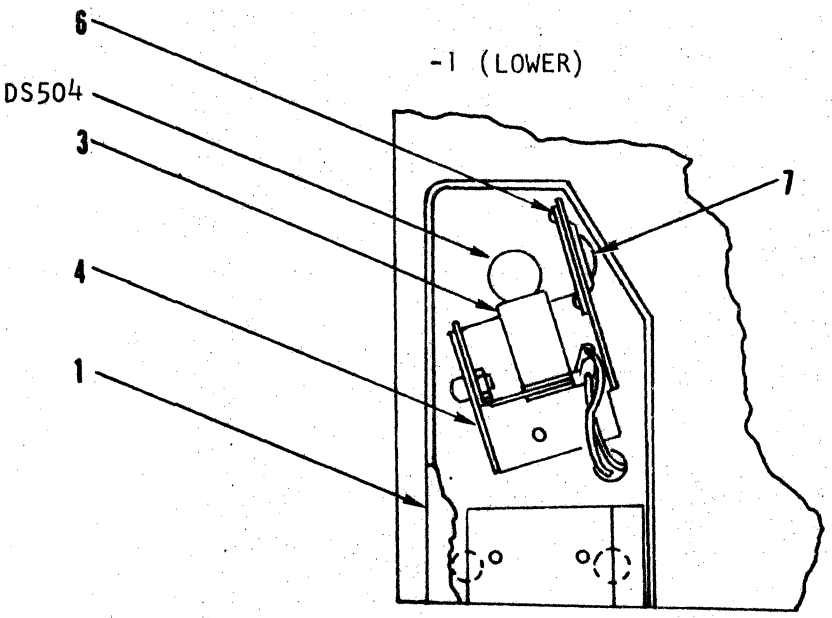
Figure 6-3. Precision Plate Assembly (Sheet 2 of 2)

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 3 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	375182	Cover, safety	1			
2	202314	Bracket, sensor	2			
3	70041-30	Link, terminal (jumper)	6		75382	600
4	370452	Bracket, conn, mtg	2			
5	370644	Block, hinge	2			
6	371763-1201	Terminal Board	1	TB506	07859	33012
7	371763-1001	Terminal Board	1	TB507	07859	33010
8	471574	Rail, rear	2			
9	471624	Precision Plate Assy and Instr	1	6-3		
10	379815	Precision Plate Subassy	1	6-3/1		
11	196996	Sleeve Bearing, pinch roll.	2			
12	43460-741	Insert #1/4-20	4		26014	1185-4CNX 5/8
13	43460-551	Insert #10-32	8		26014	1191-3CNX .570
14	205305-12	Pin, str hdls	5			
15	476578	Motor, dir current, capstan	1	B503	04191	00-01219-010
16	379835	Screw, cap, soc hd	4	6-3/27		
17	125519-16	Screw, hex hd, #6-32 x 1	2			
18	379817	Block, anti-wrap	1	6-3/19		
19	198539-5	Nut, int wrench	1	6-3/5		
20	215143	Label, flywheel	1	6-3/23		
21	127851-1	Bar, mtg	1	6-3/3		
22	379816	Bar, mtg	1	6-3/2		
23	128012	Spacer, precision plate	4	6-3/4		
24	127850	Mounting Plate, solenoid	2	6-3/6		



-2 (UPPER)



-1 (LOWER)

D-471628 (REF)

Figure 6-4. Lamp Sensor Assembly

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 4 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	196774	Solenoid, elec, pinch roller	2	L504, 506	28478	D-70 Modified
2	70131-0063	Pin, spring	2	6-3/8		
3	372295-1	Semicond Diode	2	CR504, 506	04713	1N4002
4	379819	Link, pinch roller	2	6-3/9		
5	129890	Spring	2	6-3/10		
6	250466-4	Spring	1	6-3/11	84830	LE-037D-8
7	128787	Core, limit, stop	2	6-3/12		
8	128786	Tubing, rubber neoprene	2	6-3/13		
9	371979	Bracket, conn, mount	1	6-3/22		
10	202280-1	Yoke, pinch roller (upper)	1	6-3/15		
11	202280-2	Yoke, pinch roller (lower)	1	6-3/14		
12	202282	Pinch Roller Assembly	2	6-3/16		
13	70072-302	Screw, soc hd, #8-32 x 3/8	8	6-3/24		
14	70072-507	Screw, soc hd, #1/4-20 x 1	4	6-3/25		
15	175431-0222	Screw, binder hd, #4-40 x 1 1/4	1	6-3/7		
16	70072-303	Screw, soc hd, #8-32 x 1/2	2	6-3/26		
17	70072-102	Screw, soc hd, #4-40 x 3/8	4	6-3/28		
18	474652	Top Roller Assembly	1	6-3/17	25504	RC-3222
19	471628-2	Lamp Unit Sensor Assy	1	6-4		
20	471744-2	Cover, lamp unit sensor	1	6-4/2		
21	471923-1	Box, aluminum	1			
22	19785-23	Lamp	1	DS503	71744	1829
23	370641-1	Socket, lamp	1	6-4/3		
24	371558-2	Bracket, lamp and lens holder	1	6-4/5		

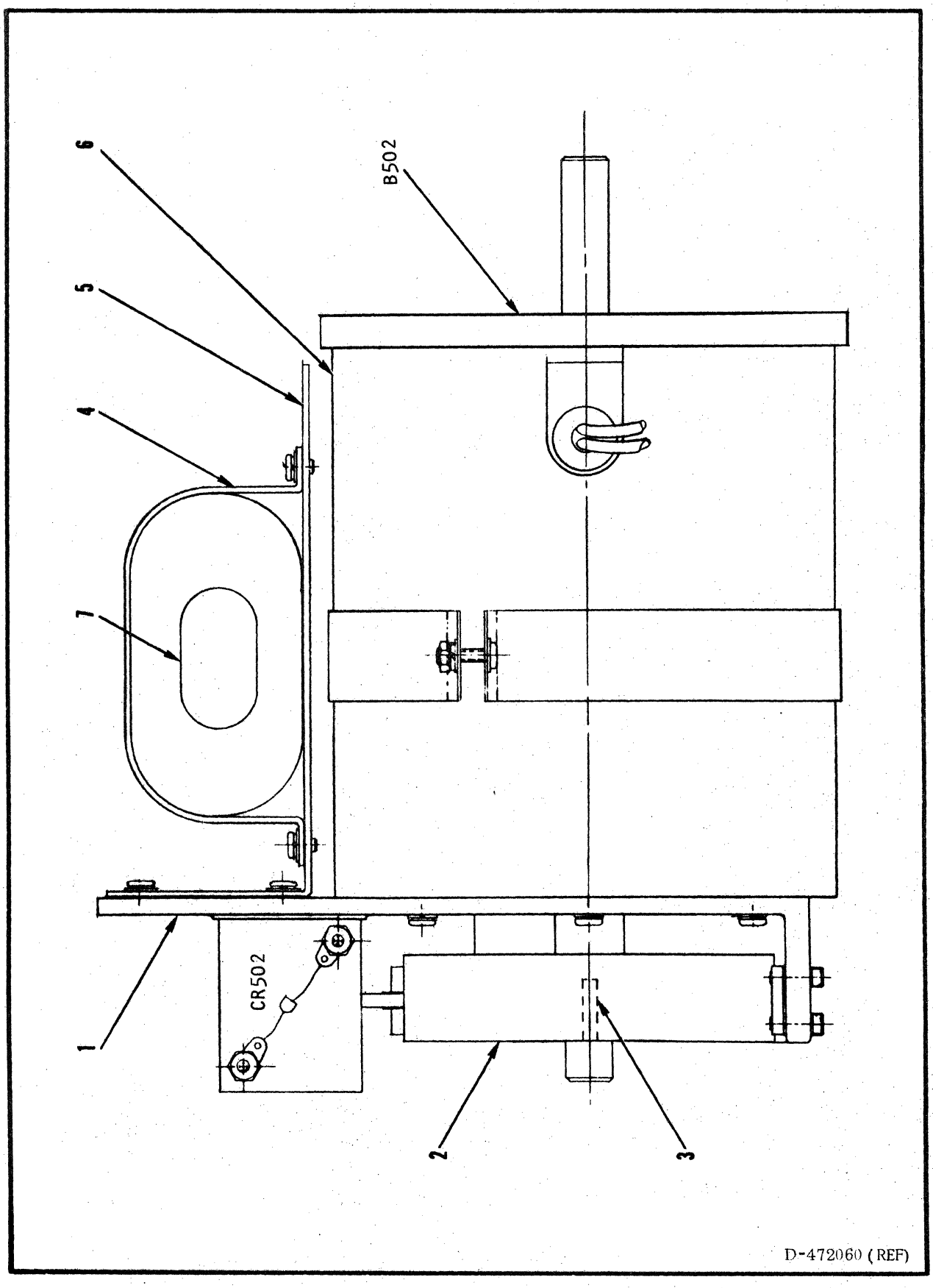
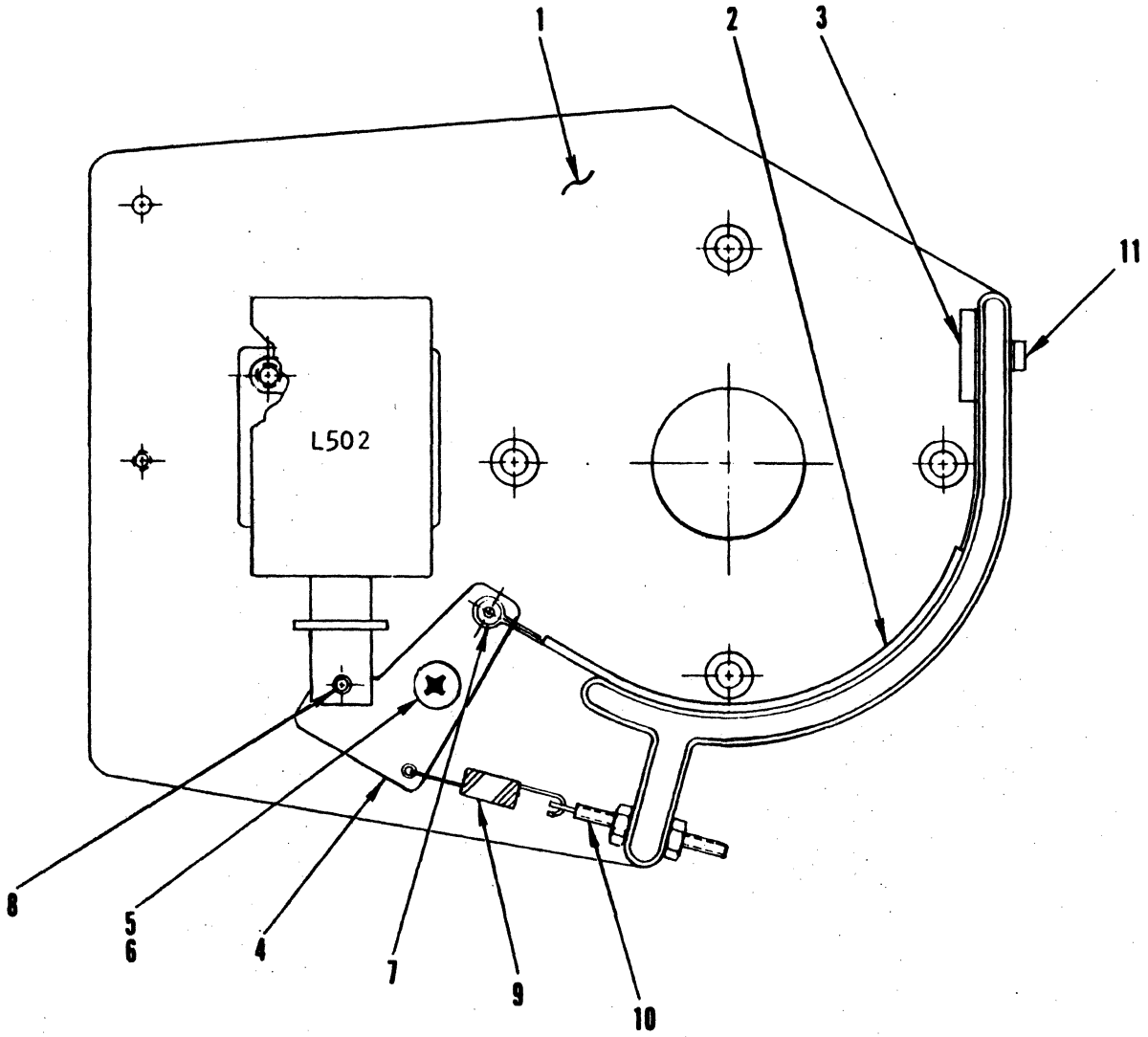


Figure 6-5. Lower Reel Drive Motor



C-472057 (REF)

Figure 6-6. Lower Brake Plate Assembly

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 5 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	370642	Retainer, lens	1	6-4/6		
2	128425-1	Lens, double convex	1	6-4/7	97197	94191
3	471628-1	Lamp Unit Sensor Assy Instr	1			
4	471744-1	Cover Assembly (Lower)	1	6-4/1		
5	471923-1	Box, aluminum	1			
6	19785-23	Lamp	1	DS504	71744	1829
7	370641-1	Socket, lamp	1	6-4/1		
8	371558-1	Bracket, lamp and lens holder	1	6-4/4		
9	370642	Retainer, lens	1	6-4/6		
10	128425-1	Lens, double convex	1	6-4/7	97197	94191
11	472060	Drive Motor and Brake Assy (Lower)	1	6-5		
12	372275	Motor, induction reel	1	B502	04810	A96UKP-2
13	472057	Brake Plate Assy (Lower)	1	6-5/1, 6-6		
14	472051	Brake Plate (Machined)	1	6-6/1		
15	372367	Brake Strap Assy	1	6-6/2		
16	201587	Strap, brake	1			
17	371690-2	Sheet, cork and rubber	1		03938	NC-733
18	42785	Plate, nut	1	6-6/3		
19	22628-74	Pin, spring, 3/16 x 3/4	1	6-6/7	80539	CD-1R3
20	22628-32	Pin, spring, 1/8 x 1/2	1	6-6/8	80539	CD-1R3
21	42786	Arm, actuator	1	6-6/4		
22	124862	Solenoid, elec, brake	1	L502	28478	D-70 Modified
23	70072-202	Screw, cap, #6-32 x 3/8	2	6-6/11		
24	42788	Spacer, actuator	1	6-6/6		

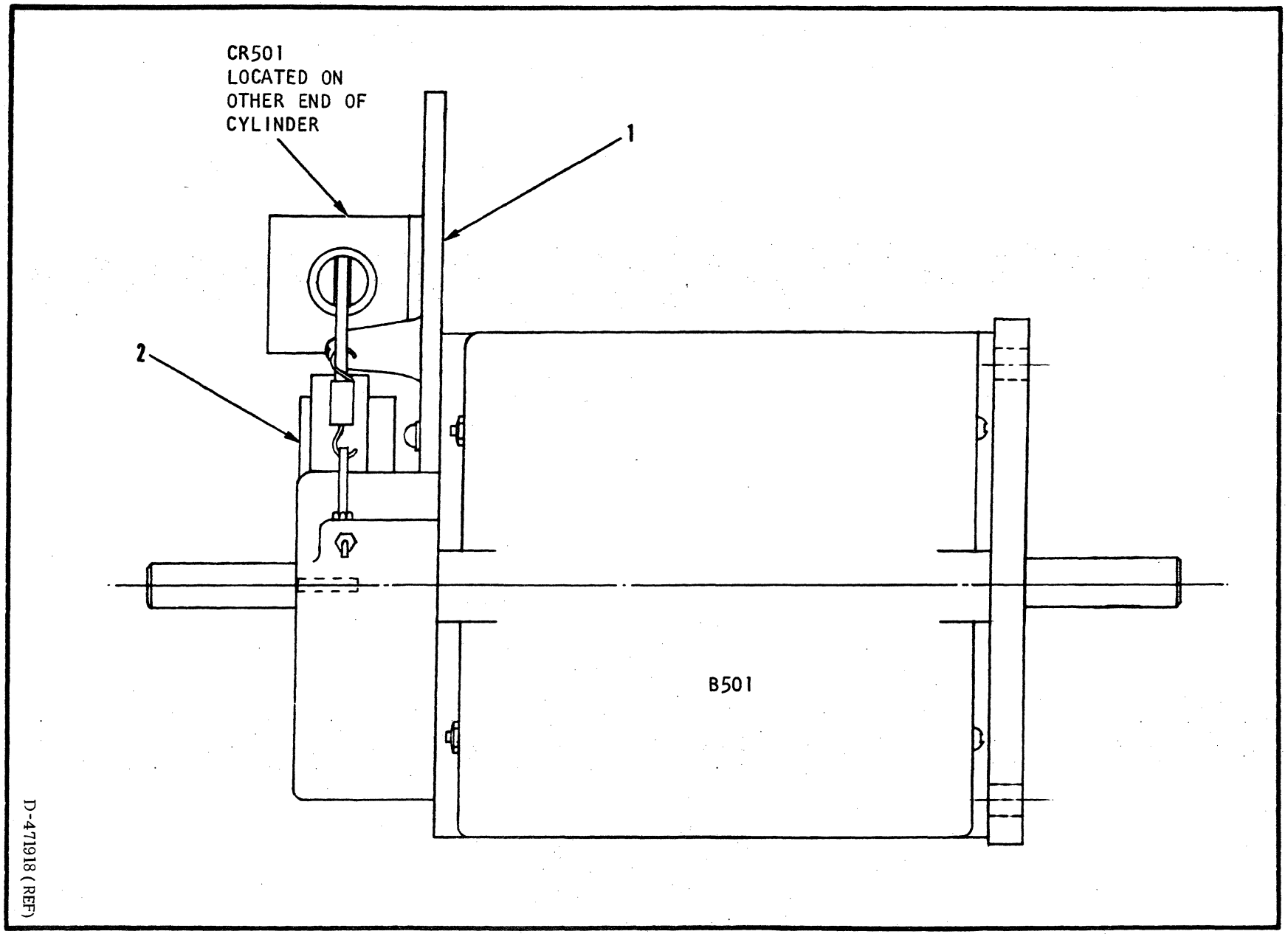


Figure 6-7. Upper Reel Drive Motor

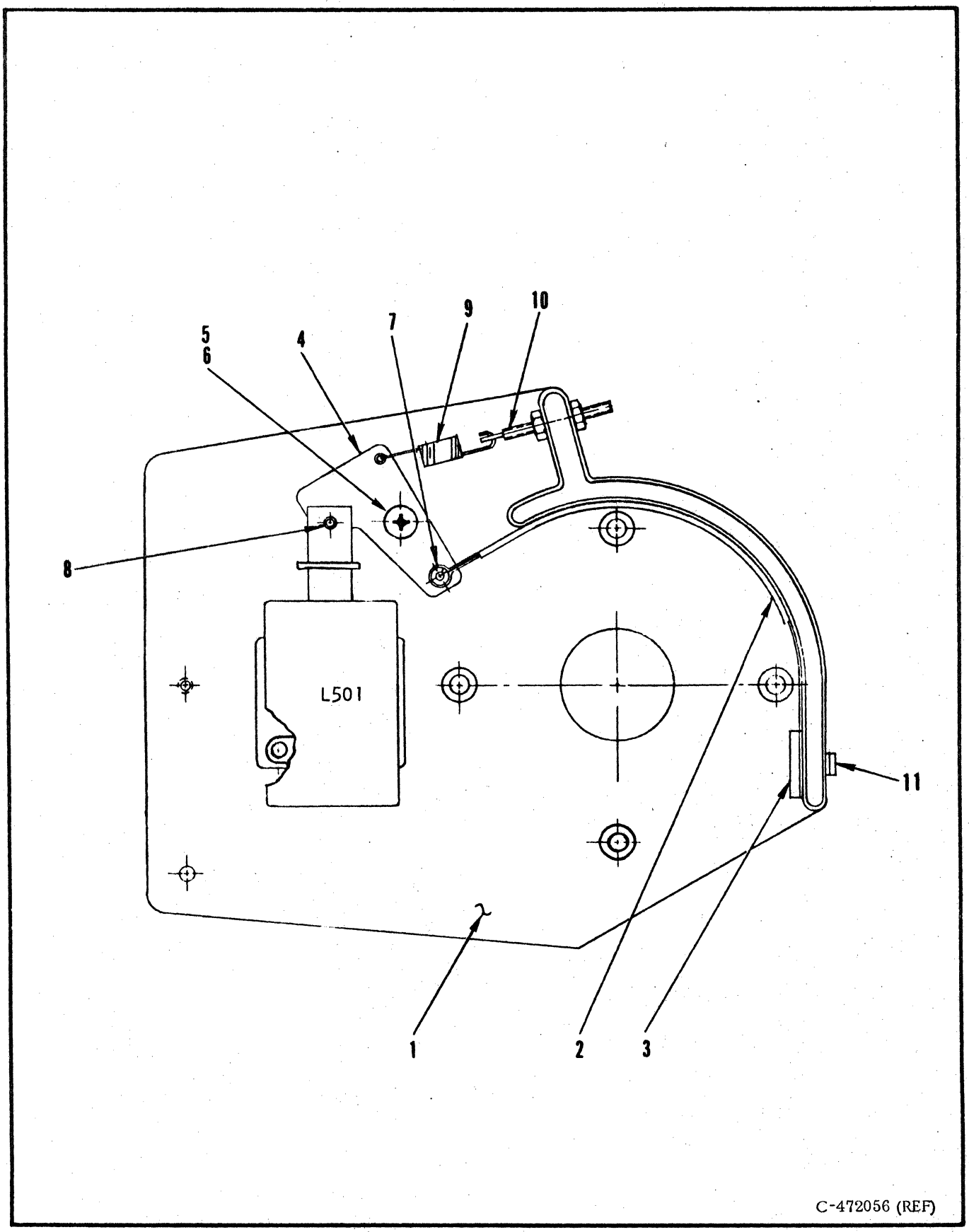


Figure 6-8. Upper Brake Plate Assembly

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 6 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	157118	Washer, spring	2	6-6/5		
2	42545	Spring, hel, tens.	1	6-6/9		
3	472007-0002	Bolt, spade	1	6-6/10	73734	FSP-2214-W
4	372848	Bracket	1	6-5/5		
5	9647-11	Pem, nut	4		46384	CL-832-2
6	372295-1	Diode	1	CR502	04713	1N4002
7	472059	Brake Drum	1	6-5/2		
8	472058	Drum, brake (casting)	1			
9	70073-72	Setscrew, #10-32 x 3/16, cup pt	1			
10	42797-2	Key, square	1	6-5/3		
11	471943-0330	Cap., 30 μf ±10%, 370 vac	1	C502	80183	200P1921
12	198943	Cap, safety, cap. term.	1	6-5/7	80183	301-66
13	248325-1	Retainer, cap, loop	2	6-5/4	80183	3-36-162
14	214602	Shield Assy	1	6-5/6		
15	213136	Shield, motor	1			
16	213137	Clamp, shield	1			
17	471918	Drive Motor and Brake Assy (Upper)	1	6-7		
18	372275	Motor, induction, reel	1	B501	04810	A96UKP-2
19	472056	Brake Plate Assy (Upper)	1	6-7/1, 6-8		
20	472052	Brake Plate (Machined)	1	6-8/1		
21	372367	Brake Strap Assy	1	6-8/2		
22	201567	Strap, brake	1			
23	371690-2	Sheet, cork and rubber	1		03938	NC-733
24	42785	Plate, nut	1	6-8/3		

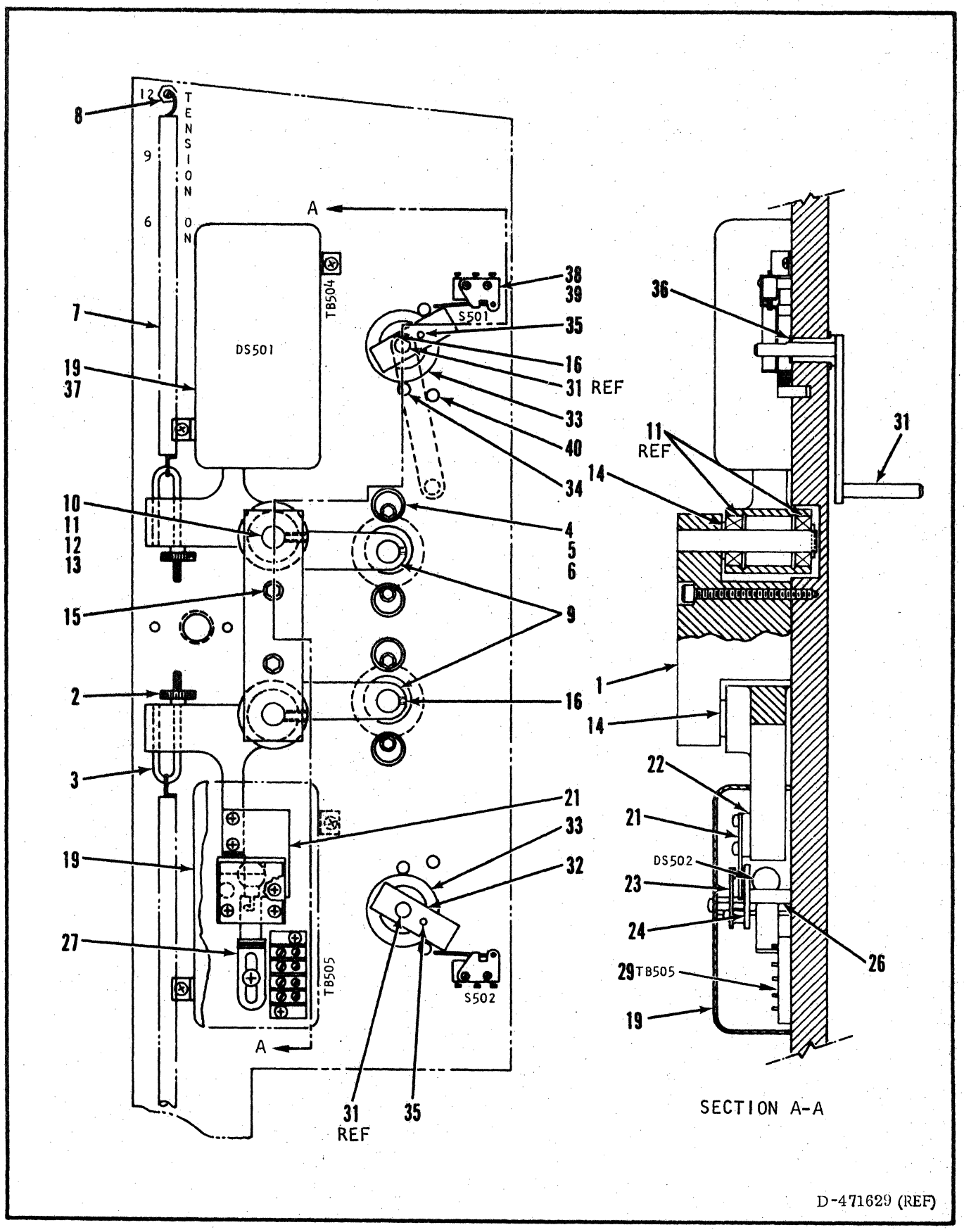


Figure 6-9. Tape Tension Control

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 7 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	42786	Arm, actuator	1	6-8/4		
2	124862	Solenoid, elec, brake	1	L501	28478	D-70 Modified
3	42788	Spacer, actuator	1	6-8/6		
4	157118	Washer, spring	2	6-8/5		
5	22628-74	Pin, spring, 3/16 x 3/4	1	6-8/7	80539	CD-1R3
6	22628-32	Pin, spring, 1/8 x 1/2	1	6-8/8	80539	CD-1R3
7	70072-202	Screw, cap, #6-32 x 3/8	2	6-8/11		
8	42545	Spring, hel, tens.	1	6-8/9		
9	472007-0002	Bolt, spade	1	6-8/10	73734	FSP-2214-W
10	372295-1	Diode	1	CR501	04713	1N4002
11	472059	Brake Drum	1	6-7/2		
12	472058	Drum, brake (casting)	1			
13	70073-72	Setscrew, #10-32 x 3/16, cup pt	1			
14	42797-2	Key, square	1			
15	128011	Spacer, drive motor	8			
16	471746	Electronics Components Assy	1			
17	471747	Bracket	1			
18	471943-0330	Cap., 30 μf ±10%, 370 vac	1	C501	80183	200P1921
19	198943	Cap, safety, cap. term.	1	(C501)	80183	301-66
20	471879-1401	Terminal Board	3	TB501, 502, 503	98410	37014
21	248325-1	Retainer, cap, loop	2		80183	3-36-162
22	471629	Control, tape tension	1	6-9		
23	372081	Support, tnsn cont lvr	1	6-9/1		
24	472048	Lever, tnsn cont (mach)	2	6-9/9		

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 8 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	128935	Bearing, ball, annular	4	6-9/11	43334	77R6XR 1266E
2	128763	Shaft, straight, grooved	2	6-9/10		
3	23973-15	Ring, retaining, int	4	6-9/12	79136	5000
4	21891-13	Ring, retaining, ext	2	6-9/13	79136	5100
5	128208	Shim	2	6-9/14	86928	5700-28-10
6	128787	Stop, tnsn cont lvr	4	6-9/5		
7	128786	Tubing, rubber	4	6-9/6	77969	Blk-50-60 Shore
8	129505	Spring, hel, ext	2	6-9/7		
9	472007-0001	Bolt, spade	2	6-9/8	73734	FSP-2214-W
10	371918-1	Semicond Device Photo Insul (Upper)	1	6-9/37		
11	371917	Insulator, plate	1			
12	371032-2	Semicond Diode	1	V501	99942	HR-1094-2
13	17484-117	Resiweld Adhesive	A/R			
14	371918-2	Semicond Device Photo Insul (Lower)	1	6-9/23		
15	371917	Insulator, plate	1			
16	371032-2	Semicond Diode	1	V502	99942	HR-1094-2
17	17484-117	Resiweld Adhesive	A/R			
18	371919	Filter, light	2	6-9/24		
19	251898-509	Post, elec-mech	2		06540	9532-C
20	6888-65	Spacer, sleeve	4	6-9/26		
21	370641-2	Lampholder, angle mount	2	6-9/27		
22	40623-1	Lampholder	2		95263	7-13
23	19785-2	Lamp	2	DS501, 502	71744	53

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 9 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	371763-0401	Terminal Board	2	TB504,505	98410	3304
2	372084	Hook, fxd, hel, spring	2	6-9/3		
3	472150	Knob, spring adjust	2	6-9/2		
4	70072-206	Screw, cap, #6-32 x 7/8	4	6-9/4		
5	70072-309	Screw, cap, #8-32 x 1 1/2	2	6-9/15		
6	19544-101	Setscrew, #4-40 x 1/8, cup pt	4	6-9/16		
7	471945	Cover, solar cell	2	6-9/19	98376	SR6874
8	371942	Shutter, photo semicond	2	6-9/21		
9	371940	Spacer, plate	2	6-9/22		
10	472126	Cutoff Arm Assy	2	6-9/31		
11	471743	Bar, actuator, elec, sw	2	6-9/32		
12	70087-7	Switch, SPDT	2	S501,502	91929	11SM1T
13	42848	Adapter, sw actuator	2	6-9/38		
14	6888-68	Spacer, sleeve, 3/16 dia x 1/4 lg	4	6-9/39		
15	43135	Spring, spiral, torsion	2	6-9/33		
16	70131-64	Spring, spiral, torsion	2	6-9/35		
17	70131-132	Spring, spiral, torsion	2	6-9/34		
18	70131-136	Spring, spiral, torsion	4	6-9/40		
19	471630	Control Panel Assembly	1			
20	471589-1	Bracket, angle	1			
21	127949-3	Nut, self-clinch	3		46343	F-440-1
22	471906-8	Nut, floating, self-clinch	2		46343	AC-440-2
23	471589-2	Bracket, angle	1			
24	127949-3	Nut, self-clinch	3		46343	F-440-1

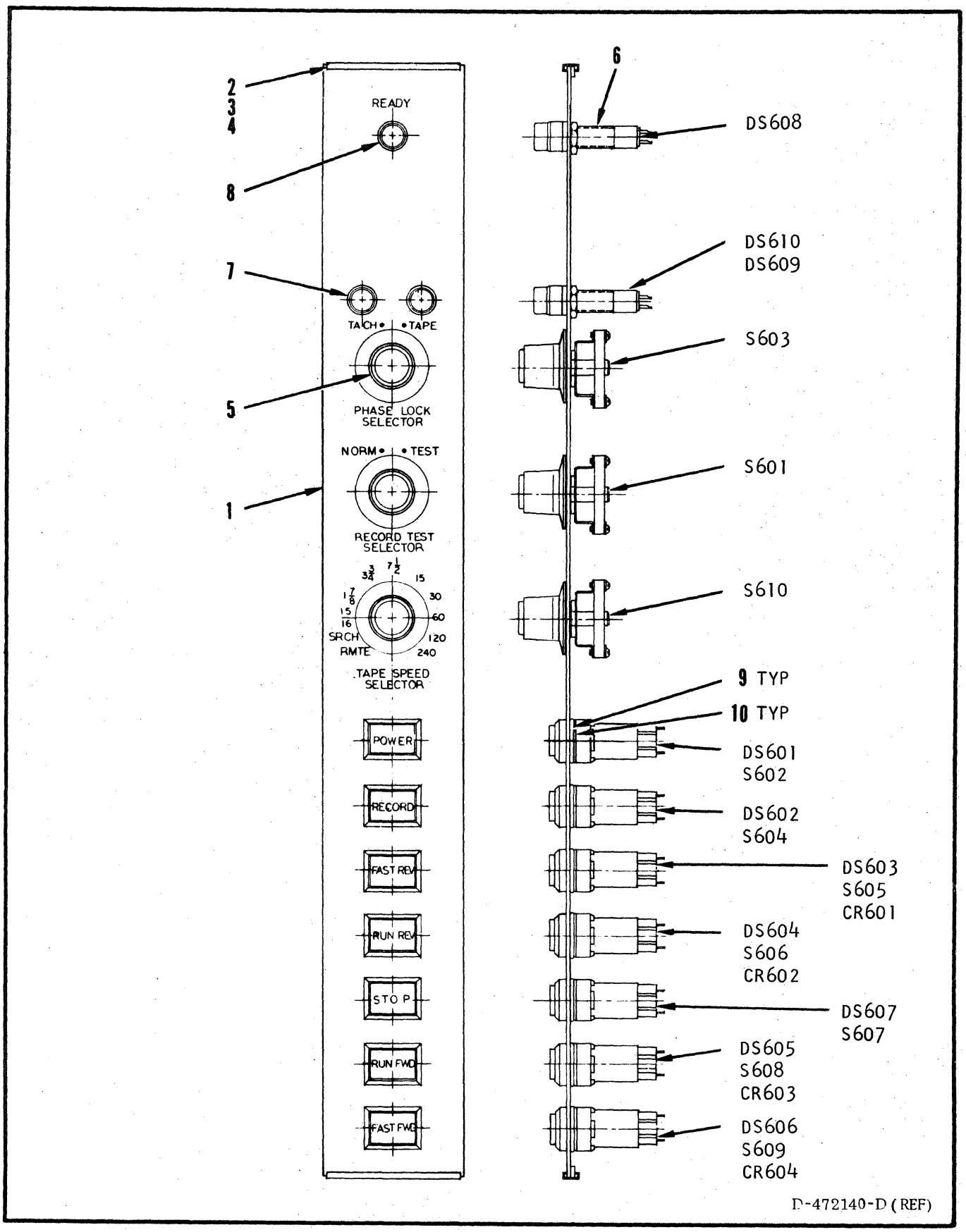


Figure 6-10. Switch Panel Assembly

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 10 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	471906-8	Nut, floating, self-clinch	2		46343	AC-440-2
2	472133	Molding, metal, front	2			
3	474853	Component Board Assembly	1			
4	474852	Board, mtg, component	1			
5	251898-114	Post, elec-mech, #4-40	2		06540	9533B-B-0440
6	7138-2015	Res, 200Ω ±5%, 1/2 w	7	R601 thru R607	78488	RC20GF201J
7	372295-1	Semicond Diode	6	CR601 thru CR606	04713	1N4002
8	472138	Panel, blank, footage counter assy	1			
9	471591	Panel, blank, footage counter	1			
10	472134	Spacer, plate	1			
11	472137	Moulding, trim	1			
12	17484-117	Resiweld Adhesive	A/R			
13	474641	Spacer	2			
14	471593	Panel, blank, voice	1			
15	472139	Panel, blank, shuttle	1			
16	472140-1	Switch Panel Assembly	1	6-10		
17	476601	Panel, switch	1	6-10/1		
18	472134	Spacer, plate	2	6-10/2		
19	472137	Moulding, trim	2	6-10/3		
20	17484-117	Resiweld Adhesive	A/R	6-10/4		
21	372532-12	Knob, skirted	3	6-10/5		
22	252090	Switch, rotary, 2 pole, 2 pos	2	S601, 603	11237	55565
23	370752-0006	Switch, rotary, 2 pole, 11 pos	1	S610	11237	X500693

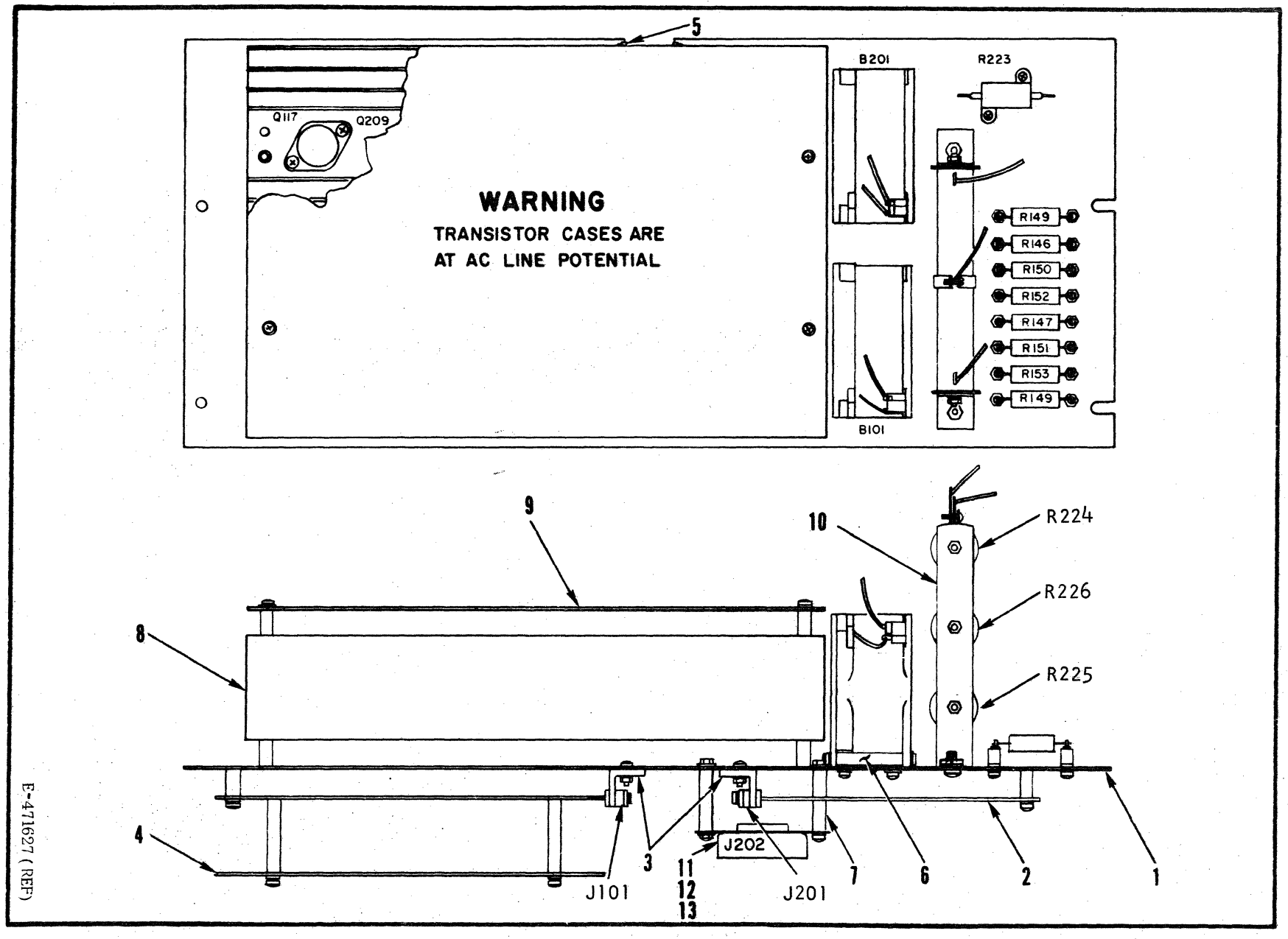
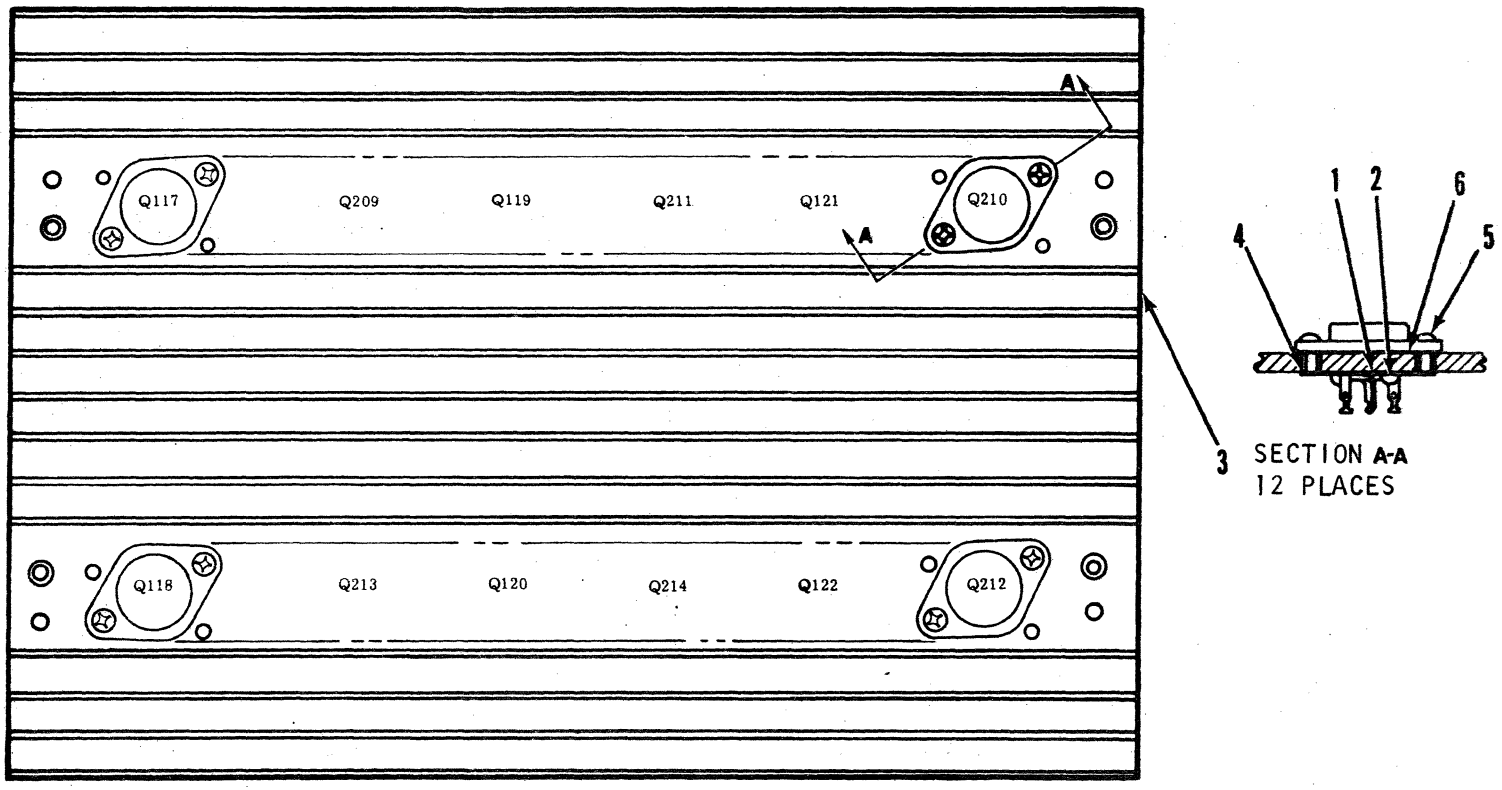


Figure 6-11. Capstan Reel Power Amplifier

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 11 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	201345-1000	Holder, lamp	3	6-10/6		
2	201345-5000	Lens Cap Assy (green)	1	6-10/8		
3	201345-5001	Lens Cap Assy (cloudy)	2	6-10/7		
4	201345-0006	Lamp, incandescent (28 v)	3	DS608, 609, 610		
5	15882-0046	Packing	7	6-10/9		
6	475666-9536	Washer, flat	7	6-10/10	86928	5710-9536
7	471876-2200	Wire, elec, 22 AWG	A/R			
8	475094-1	Switch, push (lens removed)	6	S604 thru S609		
9	475094-4	Switch, push (lens removed)	1	S602		
10	475094-0012	Lens Cap, STOP	1	6-10		
11	475094-0013	Lens Cap, RECORD	1	6-10		
12	475094-0016	Lens Cap, POWER	1	6-10		
13	475094-0017	Lens Cap, FAST REV	1	6-10		
14	475094-0018	Lens Cap, RUN REV	1	6-10		
15	475094-0019	Lens Cap, RUN FWD	1	6-10		
16	475094-0020	Lens Cap, FAST FWD	1	6-10		
17	19785-32	Lamp, 28 v	Ref	DS601 thru DS607		
18	210156-5	Conn, 34 contact	1	P601	81312	XAC-34-P-C1306
19	204902-3	Contact, pin	31		81312	100-1020P
20	246448-1	Lock-strap	1			
21	471627	CPA and Reel Power Amplifier Assy	1	6-11		
22	471722	Chassis, elec, equip	1	6-11/1		
23	251898-539	Post, elec-mech	4		06540	9537C-SS-0440
24	249641-27	Post, elec-mech	4			



D-472054 (REF)

Figure 6-12. Heat Sink Assembly

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 12 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	14477-12	Standoff, insulator	16		98278	6175-C
2	375828-0904	Post, elec-mech	2		06540	9745-A-0440
3	370930-2	Fan, axial	2	B101, 201	82877	SP2A2
4	70017-3183	Res, 0.31Ω ±3%, 25 w	1	R223	00213	RH25GR31H
5	471753-0001	Resistor Assembly	1	R224, 225, 226	63743	70/50A1
6	196678-1	Res, 1.0Ω ±5%, 50 w	Ref			
7	378237	Bracket Assy, res	Ref			
8	252656	Block, fan mtg	4			
9	70026-28	Res, 2Ω ±1%, 5 w	6	R146, 147, 150, R151, 152, 153	06416	5A2R0F
10	70026-15	Res, 0.5Ω ±1%, 5 w	2	R148, 149	06416	5AR50F
11	48977-3	Grommet, caterpillar	A/R		03296	NMCG51H
12	204876-8	Conn, 26 contact	1		81312	XAC-26P-F2016
13	204902-2	Contact, pin, 16 GA	13	J202	81312	100-1016P
14	204902-3	Contact, pin, 20 GA	9		81312	100-1020P
15	471876-1899	Wire, insul, 18 AWG	A/R			
16	471876-2299	Wire, insul, 22 AWG	A/R			
17	471738	Bracket, conn, mtg	4	6-11/3		
18	471872	Conn, prt ckt	2	J101, 201	95238	K600-128-28XA
19	472049	Cover, transistor mount	1			
20	472054	Transistor Assy, heat sink	1	6-12		
21	472053	Transistor Mount, heat sink	1	6-12/3		
22	475685	Transistor	6	Q117 thru Q122	16758	DTS430
23	372401-3	Transistor	6	Q209 thru Q214	02735	2N3773

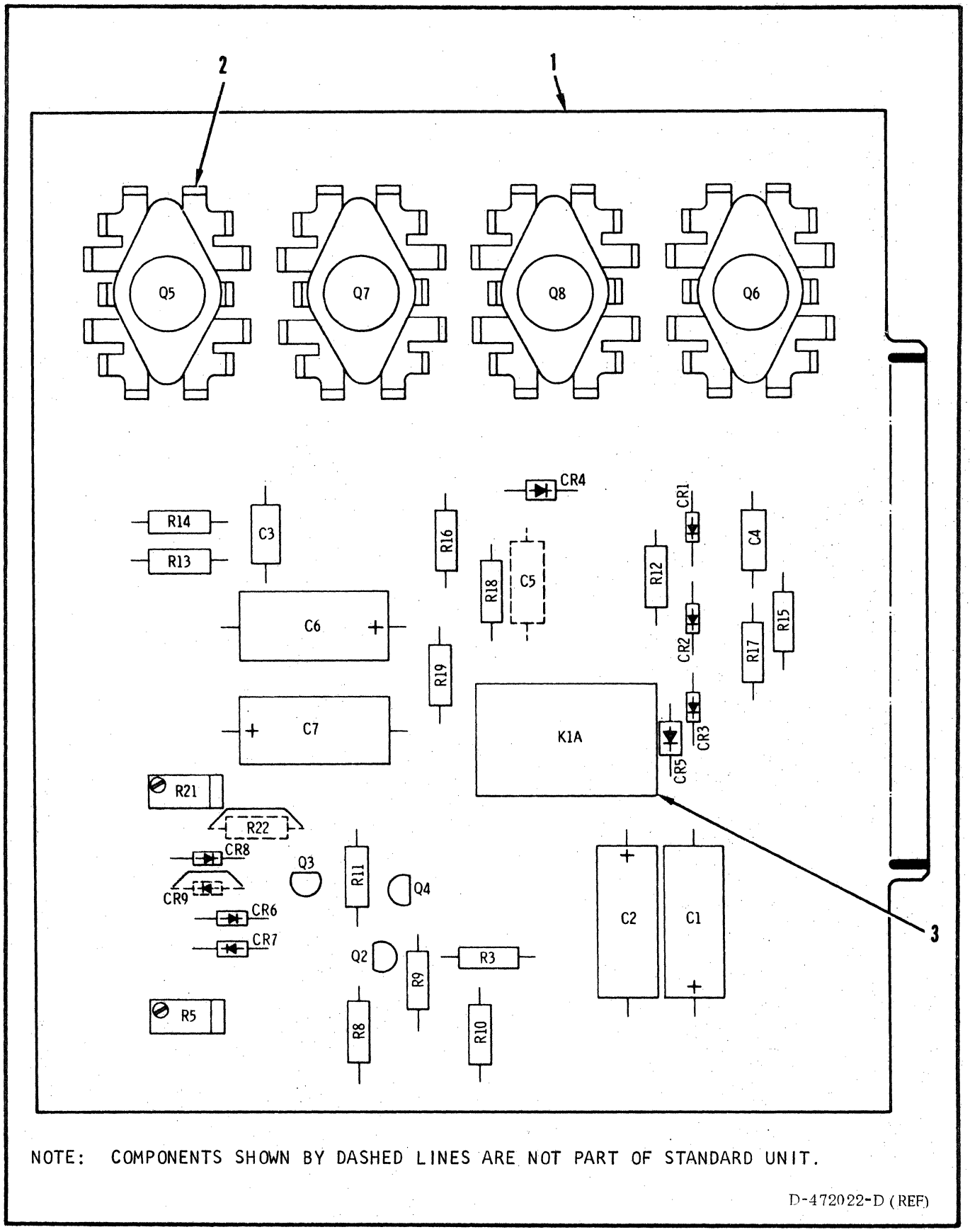
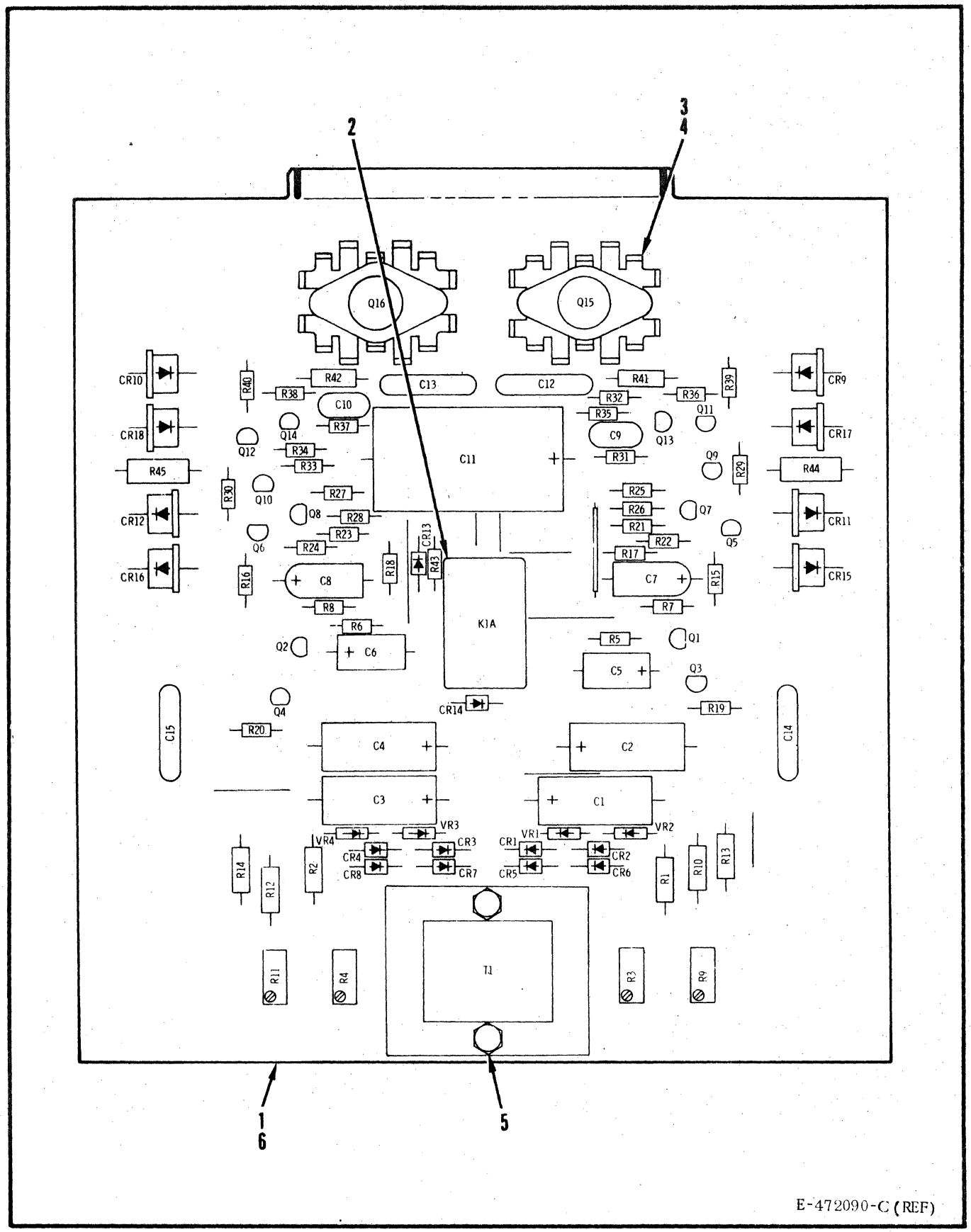


Figure 6-13. Capstan Servo Power Amplifier

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 13 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	247804-1	Socket, power transistor (TO-3)	12	6-12/1	22753	PTS-1
2	248422-0010	Insulator, transistor mtg	24	6-12/4	08289	TW-145-185
3	157117-1653	Screw, #6-20 x 5/8	24	6-12/5		
4	211943	Semicond Compound	A/R			
5	248422-0001	Insulator, transistor mtg	12	6-12/6	08289	DM101
6	363627-0004	Rivet, aluminum	24	6-12/2	07707	MS20600-AD 44ABS
7	471478-2299	Wire, insul, 22 AWG	A/R			
8	471876-1899	Wire, insul, 18 AWG	A/R			
9	471876-1699	Wire, insul, 16 AWG	A/R			
10	471876-1499	Wire, insul, 14 AWG	A/R			
11	472022-1	Capstan Servo Power Ampl	1	6-11/2, 6-13		
12	472022	Printed Wiring Bd	1	6-13/1		
13	7138-1025	Res, 1K ±5%, 1/2 w	2	R3, 11	78488	RC20GF102J
14	7138-2425	Res, 2.4K ±5%, 1/2 w	1	R8	78488	RC20GF242J
15	7138-3925	Res, 3.9K ±5%, 1/2 w	1	R9	78488	RC20GF392J
16	7138-4725	Res, 4.7K ±5%, 1/2 w	1	R10	78488	RC20GF472J
17	7138-1325	Res, 1.3K ±5%, 1/2 w	1	R13	78488	RC20GF132J
18	7138-2725	Res, 2.7K ±5%, 1/2 w	1	R12	78488	RC20GF272J
19	7138-1505	Res, 15Ω ±5%, 1/2 w	1	R14	78488	RC20GF150J
20	7138-4705	Res, 47Ω ±5%, 1/2 w	1	R15	78488	RC20GF470J
21	7138-2405	Res, 24Ω ±5%, 1/2 w	2	R16, 17	78488	RC20GF240J
22	7138-3025	Res, 3K ±5%, 1/2 w	1	R19	78488	RC20GF302J
23	7138-1235	Res, 12K ±5%, 1/2 w	1	R18	78488	RC20GF123J



E-472090-C (REF)

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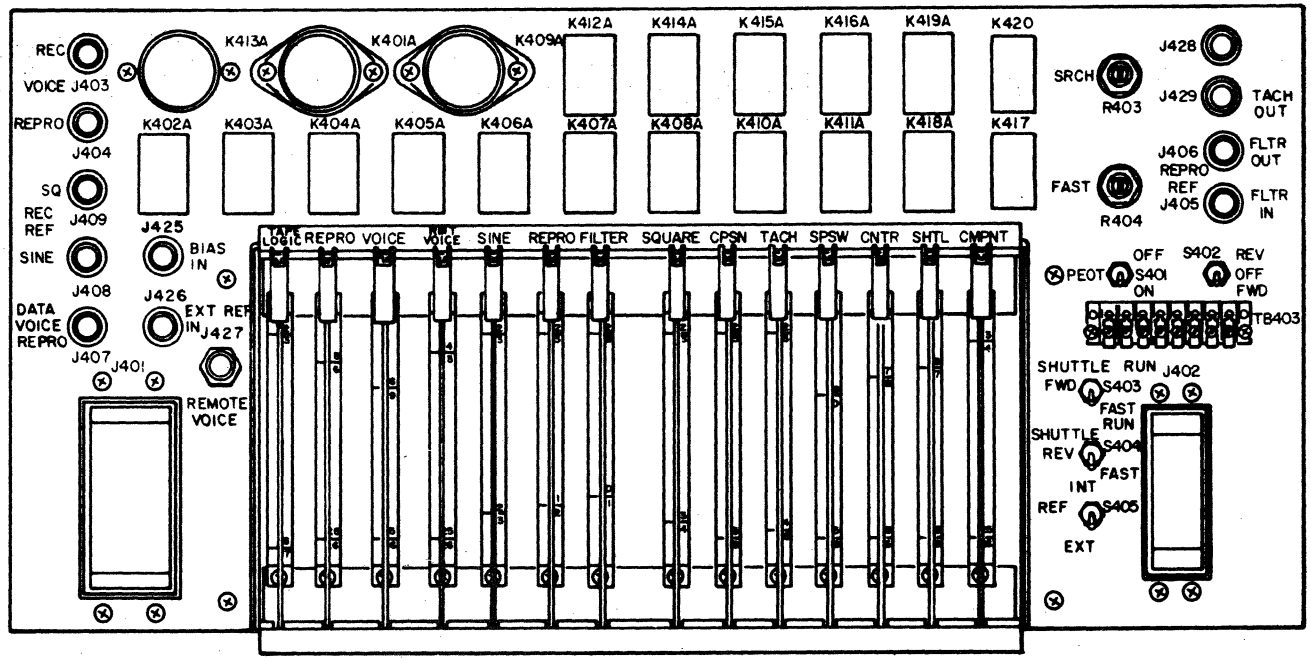
Figure 6-14. Reel Motor Power Amplifier

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 14 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	248322-1	Res, var, 100Ω ±10%, 1/2 w	2	R5, 21	80294	3257W-1-101
2	471930-0004	Cap, 25 μf +75 -10%, 25 v	2	C6, 7	56289	500D256G025CB7
3	471930-0007	Cap, 25 μf +75 -10%, 50 v	2	C1, 2	56289	500D256G050CC7
4	215095-182	Cap, 0.0022 μf ±10%, 200 v	1	C3	56289	192P22292
5	215095-142	Cap, 0.001 μf ±10%, 200 v	1	C4	56289	192P10292
6	246954	Semicond Diode	6	CR1, 2, CR3, 6, CR7, 8	03508	1N4154
7	372295-1	Semicond Diode	2	CR4, 5	04713	1N4002
8	372469-1	Transistor, PNP	2	Q5, 8	04713	2N3740
9	246014-2	Transistor, NPN	2	Q6, 7	02735	2N3054
10	253082-4	Transistor, NPN	3	Q2, 3, 4	04713	2N3904
11	211943	Semicond Compound	A/R	(Q5 thru Q8)	71984	340
12	199951	Relay, armature	1	K1A	02288	T-154X-368
13	197593-1	Socket, relay	1	6-13/3	02288	30055-4
14	374795	Heat Sink	4	6-13/2	98978	LB66B1B
15	472090-1	Reel Motor Power Ampl	1	6-11/4, 6-14		
16	472090	Printed Wiring Bd	1	6-14/1		
17	249641-8	Post, elec-mech	Ref		06540	9549B-SS-0440
18	7138-1025	Res, 1K ±5%, 1/2 w	4	R1, 2, R13, 14	78488	RC20GF102J
19	7138-1535	Res, 15K ±5%, 1/2 w	2	R10, 12	78488	RC20GF153J
20	7138-2015	Res, 200Ω ±5%, 1/2 w	2	R41, 42	78488	RC20GF201J
21	7139-1035	Res, 10K ±5%, 1 w	2	R44, 45	78488	RC32GF103J
22	471922-1002	Res, 10Ω ±2%, 1/4 w	1	R43	24546	C4-100G

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 15 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	471922-1012	Res, 100Ω ±2%, 1/4 w	2	R32, 34	24546	C4-101G
2	471922-1022	Res, 1K ±2%, 1/4 w	8	R7, 8, 22, R24, 35, 37, R39, 40	24546	C4-102G
3	471922-1032	Res, 10K ±2%, 1/4 w	2	R31, 33	24546	C4-103G
4	471922-1532	Res, 15K ±2%, 1/4 w	4	R26, 28, 36, R38	24546	C4-153G
5	471922-2212	Res, 220Ω ±2%, 1/4 w	2	R17, 18	24546	C4-221G
6	471922-5112	Res, 510Ω ±2%, 1/4 w	2	R5, 6	24546	C4-511G
7	471922-5122	Res, 5.1K ±2%, 1/4 w	2	R29, 30	24546	C4-512G
8	471922-6802	Res, 68Ω ±2%, 1/4 w	2	R15, 16	24546	C4-680G
9	471922-6812	Res, 680Ω ±2%, 1/4 w	2	R25, 27	24546	C4-681G
10	471922-6822	Res, 6.8K ±2%, 1/4 w	2	R19, 20	24546	C4-682G
11	471922-7522	Res, 7.5K ±2%, 1/4 w	2	R21, 23	24546	C4-752G
12	248322-1	Res, var, 100Ω ±10%, 1/2 w	2	R9, 11	80294	3257W-101
13	248322-7	Res, var, 500Ω ±10%, 1/2 w	2	R3, 4	80294	3257W-501
14	48191-9	Cap, 250 μf +250 -10%, 50 v	1	C11	56289	TVA-1312
15	70094-51	Cap, 820 pf ±5%, 300 v	2	C9, 10	72136	DM15F821J0300 WV5CR
16	471930-0006	Cap, 100 μf +75 -10%, 25 v	4	C1 thru C4	56289	500D107G025DD7
17	95222-106	Cap, 4 μf +75 -10%, 50 v	2	C5, 6	56289	30D405G050BA4
18	202970-15	Cap, 0.1 μf +80 -10%, 500 v	4	C12 thru C15	56289	41C92
19	374986-160	Cap, 27 μf ±10%, 20 v	2	C7, 8	05397	K27C20K
20	246008-0922	Diode, zener, 15 v ±10%	4	VR1 thru VR4	04713	1N965A



D-471549 (REF)

Figure 6-15. Electronics and Relay Chassis

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 16 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	251210-13	Semicond Diode	8	CR9 thru CR12, CR15 thru CR18	04713	1N4721
2	372295-1	Semicond Diode	10	CR1 thru CR8, CR13, 14	04713	1N4002
3	252501-4	Transistor, PNP	4	Q5 thru Q8	04713	2N3906
4	253082-4	Transistor, NPN	10	Q1 thru Q4, Q9 thru Q14	04713	2N3904
5	372908-1	Transistor, NPN	2	Q15, 16	04713	2N3738
6	374795	Heat Sink	2	6-14/3	98978	L366B1B
7	211943	Semicond Compound	A/R	6-14/4		
8	252916	Transformer	1	T101		
9	6888-61	Spacer, sleeve, #4 x 1/2 lg	2	6-14/5		
10	199951	Relay, armature, 4 PDT	1	K101A	02288	T-154X-368
11	197593-1	Socket, relay	1	6-14/2	02288	30055-4
12	9916-22	Wire, solid, copper, #22 AWG	A/R	6-14/6		
13	70078-2209	Insulation, sleeving, Teflon	A/R			
14	374854-1	Cover, safety	1			
15	471623	Electronics and Relay Chassis Assy	1	6-15		
16	471548	Chassis, elec-equip	1			
17	127949-5	Nut, self-clinch, flush	4		46343	F-632-1
18	371713-10	Stud, weld	4		05478	10207-S632-3 STL
19	471549	Nomenclature	Ref			
20	471872	Conn, edge, 28 contact	14	J411 thru J424	95238	K-600-128-28XA
21	474635	Key, polarizing	28			

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 17 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	205299-3	Conn, 75 contact	1	J401	81312	XAC-75P-F2016
2	204902-3	Contact, pin	59		81312	100-1020P
3	204902-2	Contact, pin	10		81312	100-1016P
4	204902-1	Contact, pin	3		81312	100-1014P
5	371763-0804	Terminal Barrier	1	TB403	98410	33008
6	126732-31	Conn, BNC	7	J403 thru J409	96918	KC-79-46
7	199951	Relay	15	K402 thru K408, K410, 411, 412, K414, 415, 416, K418, 419	02288	T-154X-368
8	197593	Socket, relay	15		02288	30055-2
9	201815-1	Relay, 4 PDT	2	K401A, 409A	02288	MHY0-12D-26.5 VDC
10	201816-26	Socket, relay	2	(K401A, 409A)	91663	HRP-2M
11	200483-1	Switch, thermostatic	1	K413A	70563	12N015 12.6V
12	197594-6	Socket, tube	1	(K413A)	74868	77-MIP-8
13	204877-7	Conn, 42 socket	1	J402	81312	XAC-42S-F2016
14	204902-6	Contact, socket	26		81312	100-1020S
15	204902-5	Contact, socket	1		81312	100-1016S
16	372295-1	Diode	16	CR401 thru CR416	04713	1N4002
17	205653	Switch, SPDT	1	S401	04009	TS-3
18	205653-1	Switch, SPDT	1	S402	04009	TC3
19	70033-1021	Res, var, 1K ±10%, 2 w	2	R403, 404	01121	Type JL
20	9774-A/R	Lug, terminal	6			
21	474631	Transistor Assembly, heat sink	1			

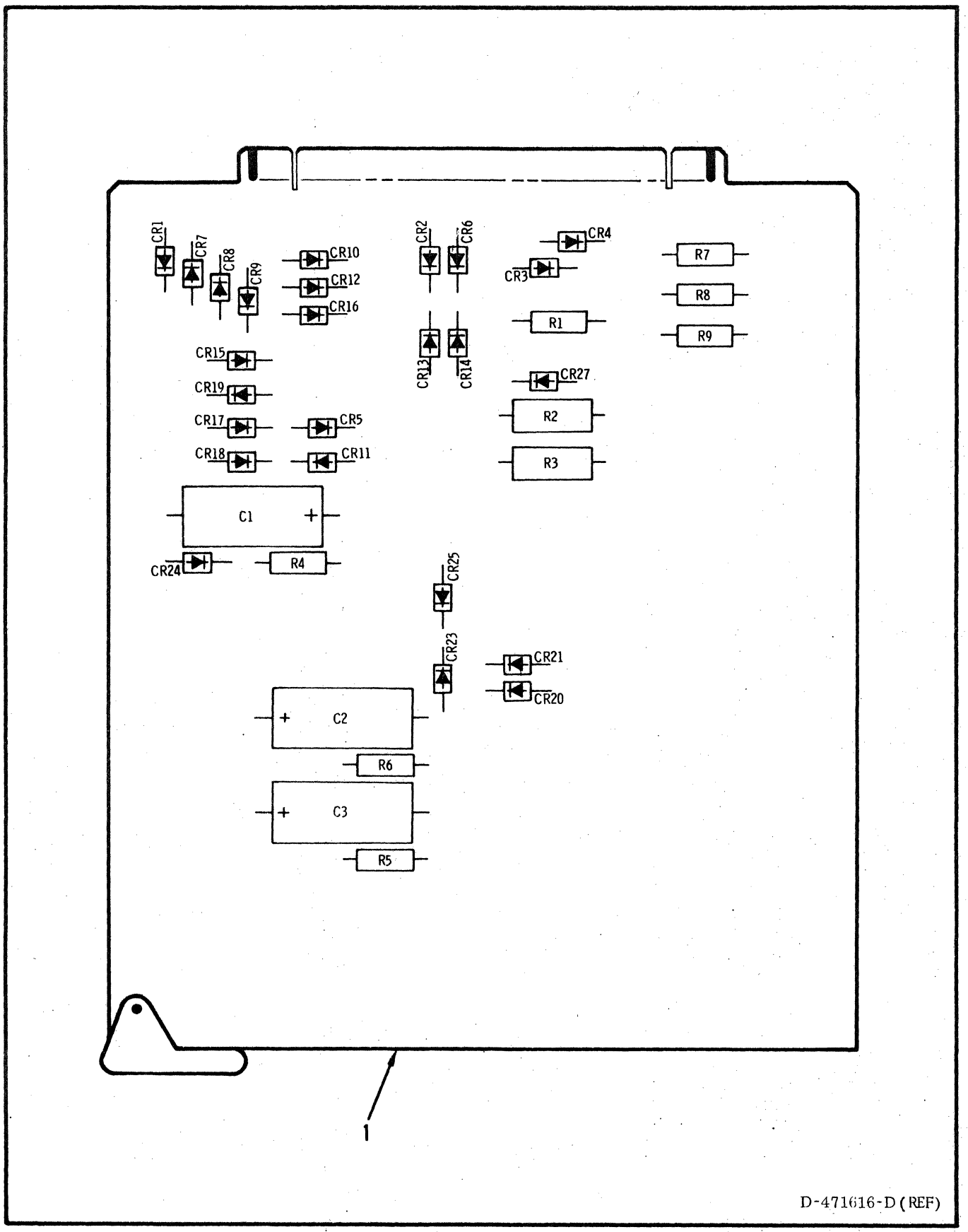
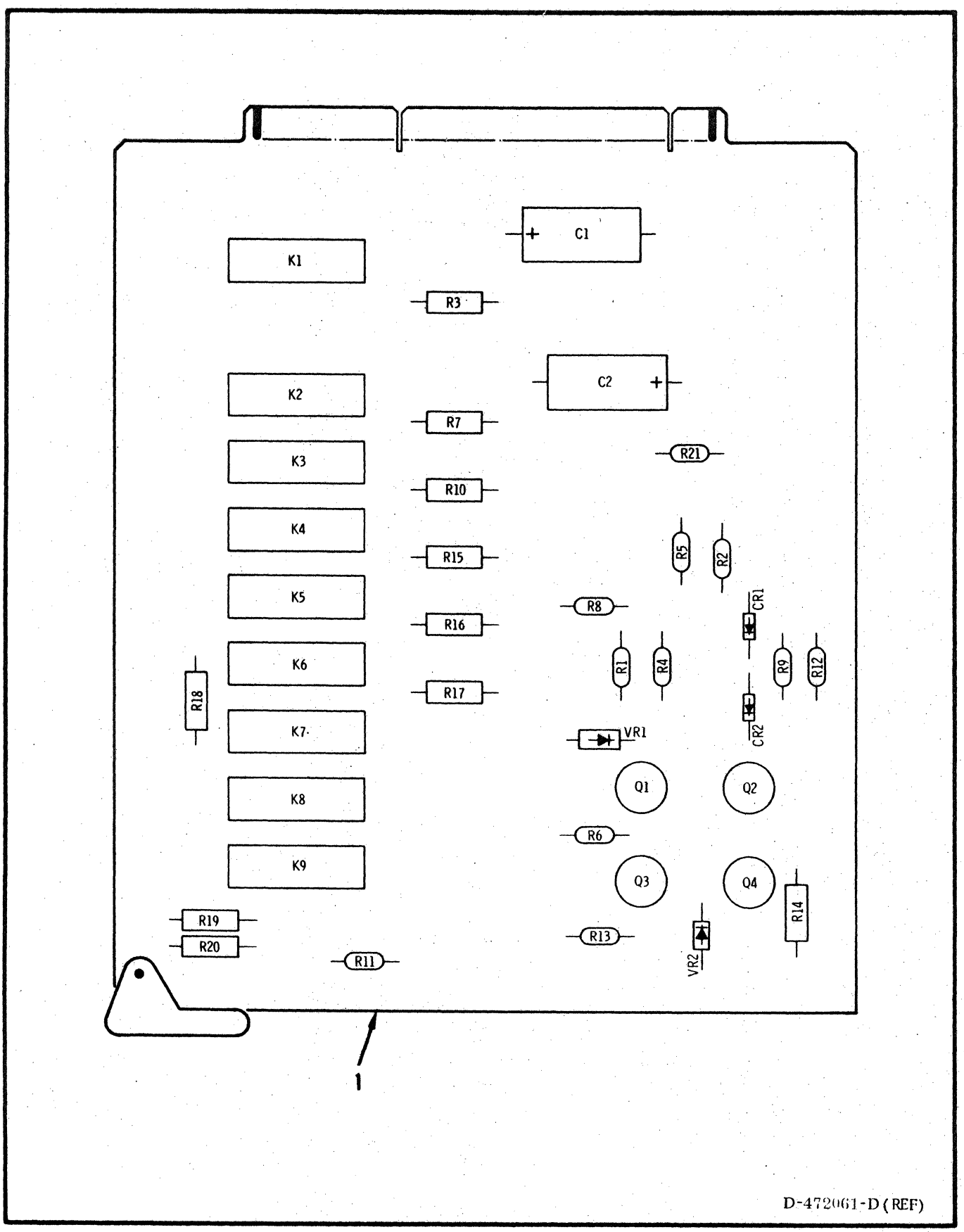


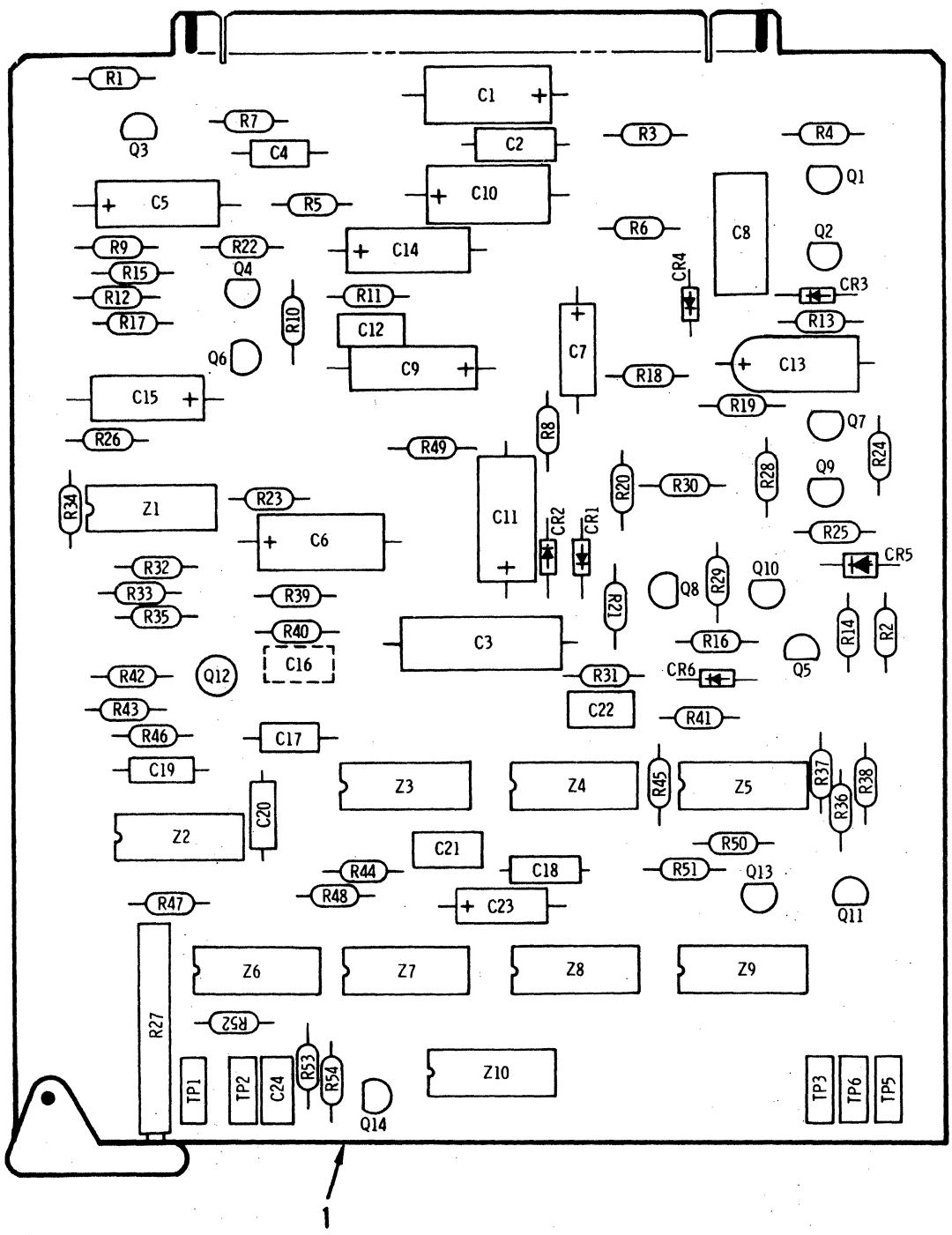
Figure 6-16. Circuit Card Assembly

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 18 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	472079	Transistor Mount, heat sink	1			
2	472464-0004	Transistor	2	Q401, 402		
3	247804-1	Socket, transistor (TO-3)	2			
4	70017-5093	Res, 5.0Ω ±3%, 25 w	2	R401, 402	91637	RH25-G-5R0-H
5	211943	Semicond Compound	A/R			
6	248422-0001	Insulator, transistor mtg	2			
7	248422-0010	Insulator, transistor mtg	4			
8	157117-1653	Screw, self-tap	4			
9	471876-2299	Wire, elec, 22 AWG	A/R			
10	472164	Dummy Conn, plug	1	P402		
11	204877-5	Conn, 42 contact	1		81312	XAC-42P-C1306
12	471876-A/R	Wire, elec, 22 AWG	A/R			
13	204902-3	Contact, pin	4	(P402)	81312	100-1020P
14	471616-1	Circuit Card Assy	1	6-16		
15	471616	Printed Wiring Bd	1	6-16/1		
16	7139-1015	Res, 100Ω ±5%, 1 w	2	R2, 3	78488	RC32GF101J
17	7138-2705	Res, 27Ω ±5%, 1/2 w	1	R1	78488	RC20GF270J
18	7138-2445	Res, 240K ±5%, 1/2 w	2	R5, 6	78488	RC20GF244J
19	7138-1015	Res, 100Ω ±5%, 1/2 w	1	R4	78488	RC20GF101J
20	7138-2025	Res, 2K ±5%, 1/2 w	2	R7, 8	78488	RC20GF202J
21	7138-3925	Res, 3.9K ±5%, 1/2 w	1	R9	78488	RC20GF392J
22	372295-1	Semicond Diode	26	CR1 thru CR25, 27	04713	1N4002
23	95222-114	Cap, 50 μf +75 -10%, 50 v	3	CR1, 2, 3	56289	30D506G050DD4



6-44 Figure 6-17. Voltage Regulator and Speed Switching Assembly



NOTE: COMPONENTS SHOWN BY DASHED LINES ARE NOT PART OF STANDARD UNIT.

D-472066-F (REF)

Figure 6-18. Capstan Servo Amplifier and Tape Control Logic

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 19 of 34)

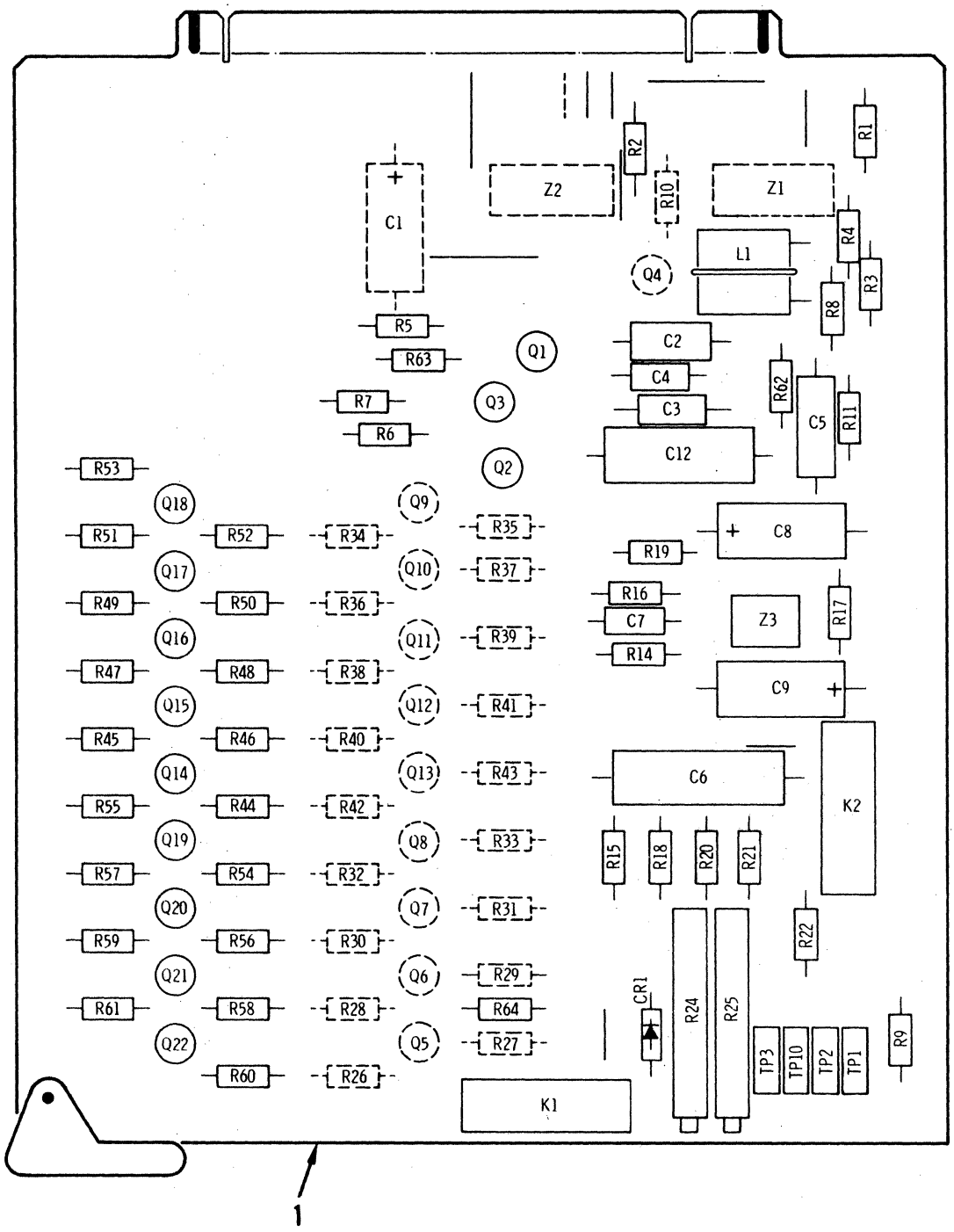
ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	472061-1	Voltage Regulator and Speed Switching	1	6-17		
2	472061	Printed Wiring Bd	1	6-17/1		
3	471922-1822	Res, 1.8K ±2%, 1/4 w	2	R1, 2	24546	C4-182G
4	7138-1025	Res, 1K ±5%, 1/2 w	9	R3, 7, R10, 15, R16, 17, R18, 19, R20	78488	RC20GF102J
5	471922-1522	Res, 1.5K ±2%, 1/4 w	3	R4, 5, R8	24546	C4-152G
6	471922-5612	Res, 560Ω ±2%, 1/4 w	1	R6	24546	C4-561G
7	471922-5102	Res, 51Ω ±2%, 1/4 w	1	R9	24546	C4-510G
8	471922-2212	Res, 220Ω ±2%, 1/4 w	3	R11, 12, R21	24546	C4-221G
9	471922-2412	Res, 240Ω ±2%, 1/4 w	2	R13, 14	24546	C4-241G
10	246954	Diode	2	CR1, 2	03508	1N4154
11	205933-1	Diode, zener, 6.2 v ±5%	1	VR1	04713	1N821
12	378979-0007	Diode, zener, 5.6 v ±5%	1	VR2	04713	1N4734A
13	471927	Transistor, NPN	3	Q1, 3, Q4	04713	2N2219
14	471927-02	Transistor, PNP	1	Q2	04713	2N2905
15	246626-1	Relay, subminiature, 15 v	9	K1 thru K9	07088	Type CIC
16	471930-0003	Cap, 100 μf +75 -10%, 16 vdc	2	C1, 2	56289	500D107G016DC7
17	472066-1	Capstan Servo Ampl and Tape Control Logic	1	6-18		
18	472066	Printed Wiring Bd	1	6-18/1		

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 20 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	471922-1022	Res, 1K ±2%, 1/4 w	19	R1, 2, R7, 8, R13, R17 thru R21, R24, 25, R32, 35, R36, 43, R51, 53, R54	24546	C4-102G
2	471922-1032	Res, 10K ±2%, 1/4 w	5	R3, 5, R15, 26, R39	24546	C4-103G
3	471922-5122	Res, 5.1K ±2%, 1/4 w	5	R4, 14, R30, 38, R40	24546	C4-512G
4	471922-4322	Res, 4.3K ±2%, 1/4 w	1	R52	24546	C4-432G
5	471922-8212	Res, 820Ω ±2%, 1/4 w	1	R6	24546	C4-821G
6	471922-2032	Res, 20K ±2%, 1/4 w	1	R9	24546	C4-203G
7	248935-1	Integrated Ckt	1	Z1	86684	CA3030
8	471940	Integrated Ckt	3	Z2, 3, Z4	01295	7405
9	471939	Integrated Ckt	3	Z5, 6, Z7	01295	7402
10	471934	Integrated Ckt	2	Z8, 9	01295	7400
11	471950	Integrated Ckt	1	Z10	01295	7473
12	204749-8	Jack, horiz, brn	1	TP1	74970	105-758
13	204749-2	Jack, horiz, red	1	TP2	74970	105-752
14	204749-6	Jack, horiz, orn	1	TP3	74970	105-756
15	204749-4	Jack, horiz, grn	1	TP5	74970	105-754

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 21 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	204749-10	Jack, horiz, blu	1	TP6	74970	105-760
2	471922-2022	Res, 2K ±2%, 1/4 w	6	R10, 16, R28, 29, R37, 49	24546	C4-202G
3	471922-3312	Res, 330Ω ±2%, 1/4 w	1	R11	24546	C4-331G
4	471922-1532	Res, 15K ±2%, 1/4 w	1	R12	24546	C4-153G
5	471922-7502	Res, 75Ω ±2%, 1/4 w	2	R22, 23	24546	C4-750G
6	471922-4722	Res, 4.7K ±2%, 1/4 w	1	R31	24546	C4-472G
7	471922-5112	Res, 510Ω ±2%, 1/4 w	1	R47	24546	C4-511G
8	471922-7532	Res, 75K ±2%, 1/4 w	1	R33	24546	C4-753G
9	70083-4345	Res, 430K ±5%, 1/4 w	1	R34	01121	RC07GF434J
10	471922-6212	Res, 620Ω ±2%, 1/4 w	5	R41, 44, R45, 46, R48	24546	C4-621G
11	471922-4312	Res, 430Ω ±2%, 1/4 w	2	R42, 50	24546	C4-431G
12	378771-10	Res, var, 10K ±10%, 1 w	1	R27	80294	3059Y-1-103
13	471930-0004	Cap, 25 μf +75 -10%, 25 vdc	1	C1	56289	500D256G025CB7
14	471930-0001	Cap, 25 μf +75 -10%, 16 vdc	4	C5, 9, C14, 15	56289	500D256G016BB7
15	471930-0002	Cap, 50 μf +75 -10%, 16 vdc	3	C6, 10, C11	56289	500D506G016CB7
16	374986-234	Cap, 39 μf ±20%, 15 vdc	1	C13	05397	K39C15K
17	215095-592	Cap, 0.01 μf ±10%, 80 vdc	1	C2	56289	192P1039R8
18	215095-442	Cap, 0.33 μf ±10%, 80 vdc	1	C3	56289	192P3349R8
19	215095-472	Cap, 0.22 μf ±10%, 80 vdc	1	C8	56289	192P2249R8
20	215095-152	Cap, 0.0012 μf ±10%, 200 vdc	1	C18	56289	192P12292
21	215095-162	Cap, 0.0015 μf ±10%, 200 vdc	2	C19, 20	56289	192P15292



NOTE: COMPONENTS SHOWN BY DASHED LINES ARE NOT PART OF STANDARD UNIT.

D-472193-B(REF)

Figure 6-19. Tach/Tape Servo Equalizer

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 22 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	471863-9	Cap, 33 μf ±20%, 15 vdc	2	C7, 23	42451	T320C336M015AS
2	215095-112	Cap, 560 pf ±10%, 200 vdc	1	C4	56289	192P56192
3	215095-102	Cap, 470 pf ±10%, 200 vdc	1	C17	56289	192P47192
4	199985-10	Cap, 22 pf ±5%, 500 vdc	1	C12	72136	DM10C220J0500 WV4CR
5	199985-34	Cap, 200 pf ±5%, 500 vdc	2	C21, 22	72136	DM10F201J0500 WV4CR
6	199985-28	Cap, 110 pf ±5%, 500 vdc	1	C24	72136	DM10E111J0500 WV4CR
7	246954	Diode	5	CR1, 2, CR3, 4, CR6	03508	1N4154
8	372295-1	Diode	1	CR5	04713	1N4002
9	253082-4	Transistor, NPN	4	Q1, 4, Q7, 8	04713	2N3904
10	252501-4	Transistor, PNP	5	Q2, 3, Q6, 9, Q10	04713	2N3906
11	471926	Transistor, NPN	5	Q5, 11, Q12, 13, Q14	04713	2N2369
12	212457-1	Relay, miniature, 12 v	1	K1		
13	472193-1	Equalizer, tach/tape servo	1	6-19		
14	472193	Printed Wiring Bd	1	6-19/1		
15	471922-1022	Res, 1K ±2%, 1/4 w	2	R9, 22	24546	C4-102G

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 23 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	471922-4702	Res, 47Ω ±2%, 1/4 w	2	R2, 19	24546	C4-470G
2	471922-1032	Res, 10K ±2%, 1/4 w	6	R1, 4, R8, 11, R18, 20	24546	C4-103G
3	471922-4732	Res, 47K ±2%, 1/4 w	1	R62	24546	C4-473G
4	471922-6222	Res, 6.2K ±2%, 1/4 w	13	R5, 6, R7, 44, R46, 48, R50, 52, R54, 56, R58, 60, R63	24546	C4-622G
5	471922-2222	Res, 2.2K ±2%, 1/4 w	1	R64	24546	C4-222G
6	471922-2032	Res, 20K ±20%, 1/4 w	1	R17	24546	C4-203G
7	471922-3042	Res, 300K ±2%, 1/4 w	1	R16	24546	C4-304G
8	471922-3022	Res, 3K ±2%, 1/4 w	1	R21	24546	C4-302G
9	471922-1332	Res, 13K ±2%, 1/4 w	2	R14, 15	24546	C4-133G
10	471922-6812	Res, 680Ω ±2%, 1/4 w	6	R3, 45, R47, 49, R51, 53	24546	C4-681G
11	471922-1222	Res, 1.2K ±2%, 1/4 w	1	R59	24546	C4-122G
12	471922-6822	Res, 6.8K ±2%, 1/4 w	1	R61	24546	C4-682G
13	471922-9112	Res, 910Ω ±2%, 1/4 w	2	R55, 57	24546	C4-911G
14	378771-9	Res, var, 5K ±10%, 1 w	1	R24	80294	3059Y-1-502
15	378771-10	Res, var, 10K ±10%, 1 w	1	R25	80294	3059Y-1-103
16	471930-0002	Cap, 50 μf +75 -10%, 16 vdc	2	C8, 9	56289	500D506G016CB
17	215095-632	Cap, 0.027 μf ±10%, 80 vdc	1	C2	56289	192P2739R8

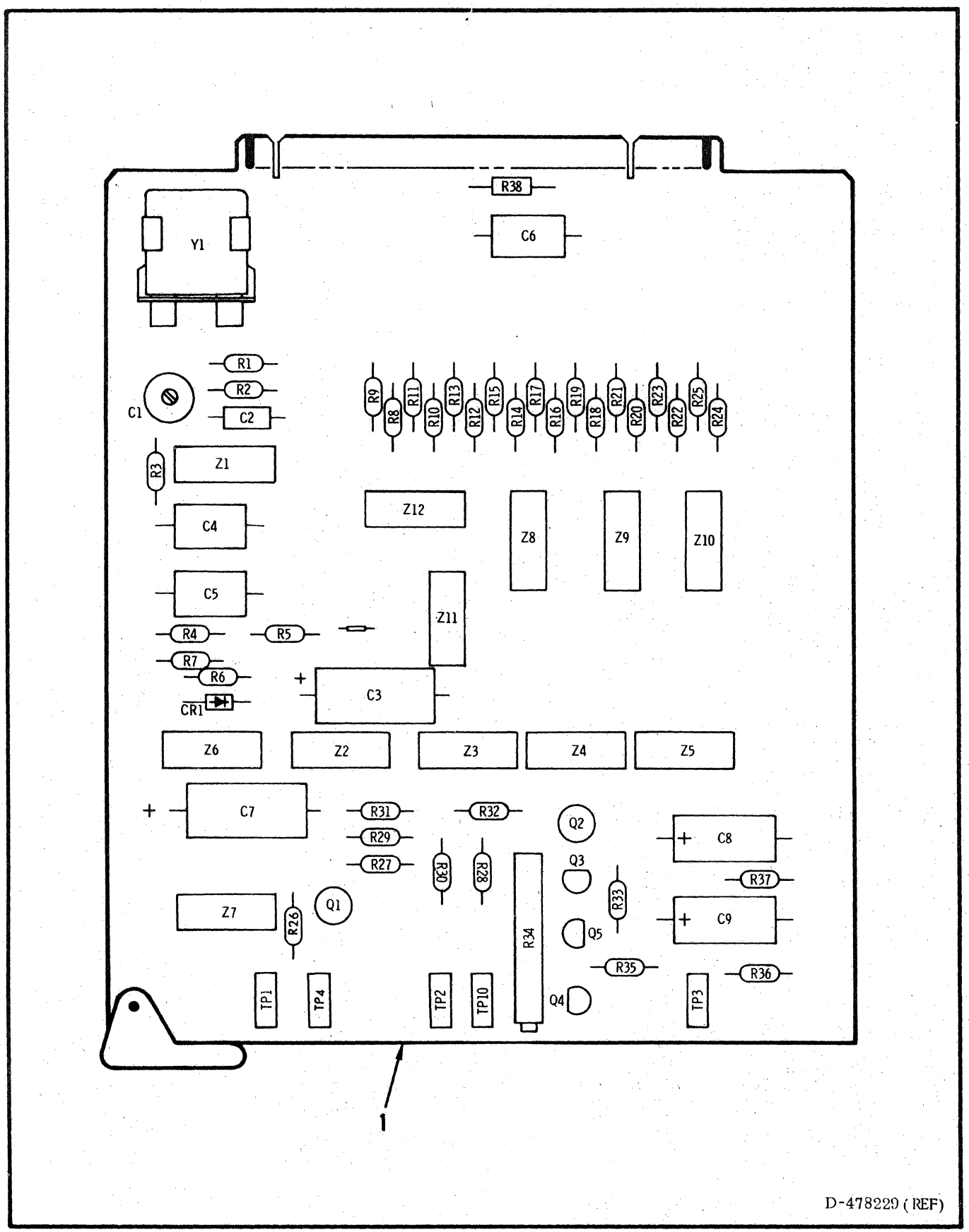


Figure 6-20. Reference/Square Wave Generator

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 24 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	215095-562	Cap, 0.0056 μf ±10%, 80 vdc	1	C3	56289	192P5629R8
2	215095-152	Cap, 0.0012 μf ±10%, 200 vdc	1	C4	56289	192P12292
3	215095-662	Cap, 0.047 μf ±10%, 80 vdc	1	C5	56289	192P4739R8
4	215095-482	Cap, 0.27 μf ±10%, 80 vdc	1	C12	56289	192P2749R8
5	215095-432	Cap, 0.0022 μf ±10%, 80 vdc	1	C7	56289	192P2229R8
6	202785-4012	Cap, 1.0 μf ±10%, 100 vdc	1	C6	14752	141A
7	246954	Diode	1	CR1	03508	1N4154
8	471926	Transistor, NPN	3	Q1, 2, Q3	04713	2N2369
9	471472	Transistor, NPN	9	Q14 thru Q22	04713	2N3947
10	471957	Integrated Ckt	1	Z3	27014	L14741CN
11	254168-3	Inductor, 0.4 Hy ±3%	1	L1	80223	MI-2
12	246626-2	Relay, subminiature	2	K1, 2	07088	C1C
13	204749-8	Jack, horiz, brn	1	TP1	74970	105-758
14	204749-2	Jack, horiz, red	1	TP2	74970	105-752
15	204749-6	Jack, horiz, orn	1	TP3	74970	105-756
16	204749-3	Jack, horiz, blk	1	TP10	74970	105-753
17	478229-1	Ref/Sq Wave Generator	1	6-20		
18	478229	Printed Wiring Bd	1	6-20/1		
19	471922-7522	Res, 7.5K ±2%, 1/4 w	1	R5	24546	C4-752G
20	471922-2212	Res, 220 Ω ±2%, 1/4 w	2	R1, 2	24546	C4-221G

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 25 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	471922-2402	Res, 24Ω ±2%, 1/4 w	1	R3	24546	C4-240G
2	471922-1022	Res, 1K ±2%, 1/4 w	16	R4,7, R9,11, R13,15, R17,19, R21,23, R25,28, R29,31, R32,36	24546	C4-102G
3	471922-4712	Res, 470Ω ±2%, 1/4 w	10	R8,10, R12,14, R16,18, R20,22, R24,27	24546	C4-471G
4	471922-1032	Res, 10K ±2%, 1/4 w	1	R37	24546	C4-103G
5	471922-3022	Res, 3K ±2%, 1/4 w	1	R6	24546	C4-302G
6	471922-2022	Res, 2K ±2%, 1/4 w	2	R30,33	24546	C4-202G
7	471922-7502	Res, 75Ω ±2%, 1/4 w	1	R35	24546	C4-750G
8	378771-10	Res, var, 10K ±10%, 1 w	1	R34	80294	3059Y-1-103
9	471922-5122	Res, 5.1K ±2%, 1/4 w	1	R26	24546	C4-512G
10	471922-3912	Res, 390Ω ±2%, 1/4 w	1	R38	24546	C4-391G
11	215095-142	Cap, 0.001 μf ±10%, 200 vdc	1	C2	56289	192P10292
12	215095-492	Cap, 0.1 μf ±10%, 80 vdc	3	C4,5, C6	56289	192P1049R8
13	471930-0003	Cap, 100μf +75 -10%, 16 vdc	2	C3,7	56289	500D107G016DC7
14	471930-0002	Cap, 50 μf +75 -10%, 16 vdc	2	C8,9	56289	500D506G016CB7
15	374550-2	Cap, var, 9-35 pf	1	C1	72982	538-011
16	246954	Diode	1	CR1	03508	1N4154

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 26 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	372115-5	Crystal, 16.00 MHz	1	Y1		
2	198660	Socket Assy, crystal	1	(Y1)	91506	8000-AG10-1
3	253082-4	Transistor, NPN	1	Q4	04713	2N3904
4	252501-4	Transistor, PNP	2	Q3, 5	04713	2N3906
5	471926	Transistor, NPN	2	Q1, 2	04713	2N2369
6	471933	Integrated Ckt	1	Z1	01295	SN74H00N
7	471950	Integrated Ckt	3	Z2, 7, Z12	01295	SN7473N
8	471951	Integrated Ckt	1	Z3	01295	SN7490N
9	471952	Integrated Ckt	2	Z4, 5	01295	SN7493N
10	471934	Integrated Ckt	3	Z8, 9, Z10	01295	SN7400N
11	471938	Integrated Ckt	1	Z11	01295	SN7430N
12	471939	Integrated Ckt	1	Z6	01295	SN7402
13	204749-2	Jack, tip, horiz, red	1	TP2	74970	105-752
14	204749-3	Jack, tip, horiz, blk	1	TP10	74970	105-753
15	204749-6	Jack, tip, horiz, orn	1	TP3	74970	105-756
16	204749-7	Jack, tip, horiz, yel	1	TP4	74970	105-757
17	204749-8	Jack, tip, horiz, brn	1	TP1	74970	105-758
18	9916-22	Wire, elec, 22 AWG	A/R			
19	70078-2209	Insulation, sleeving	A/R			
20	472132-3	Cable Assy, spec, prp, elec	2			
21	126716-174	Cable, RG/U	A/R			
22	126732-54	Conn, BNC	2			

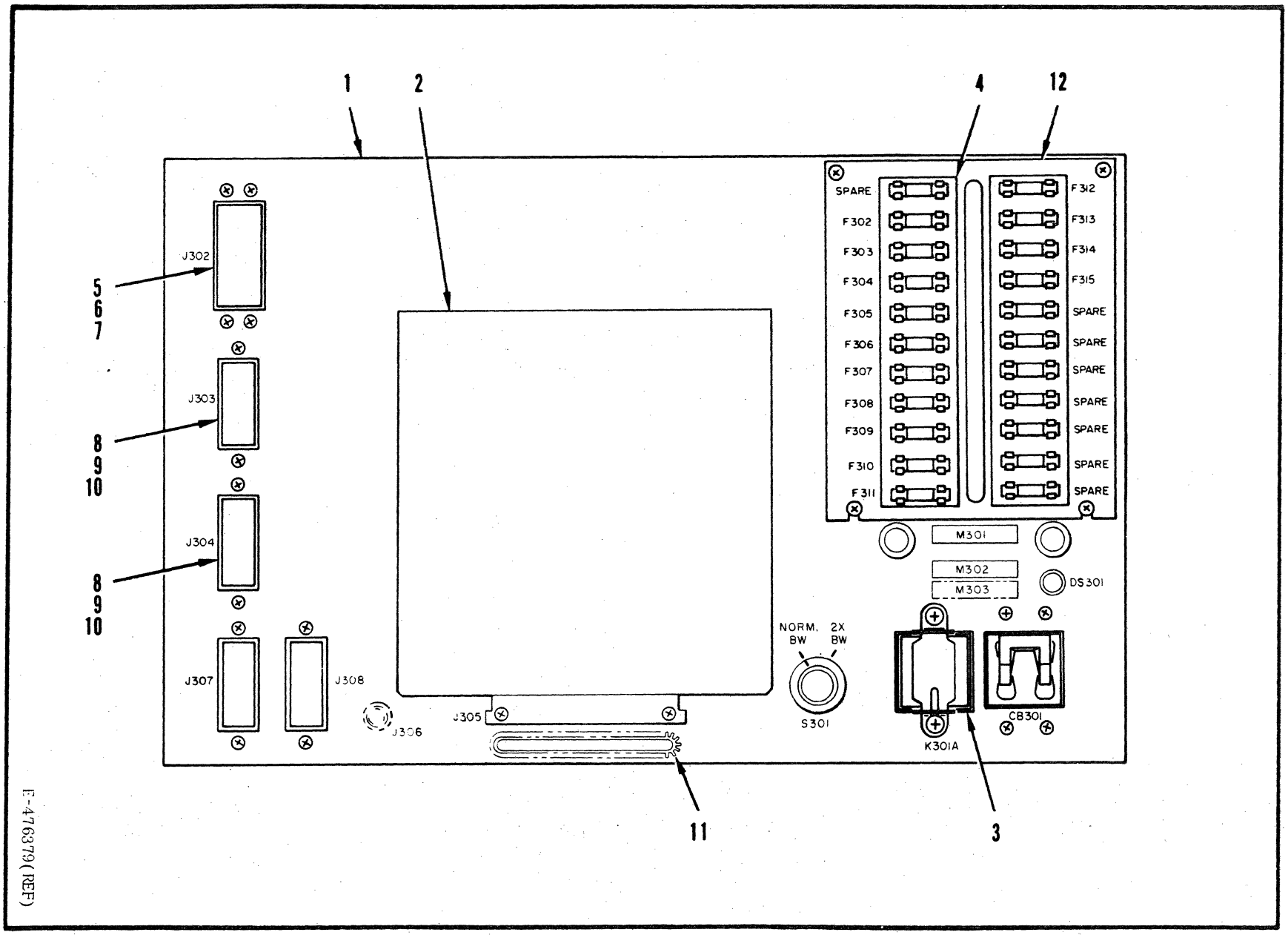
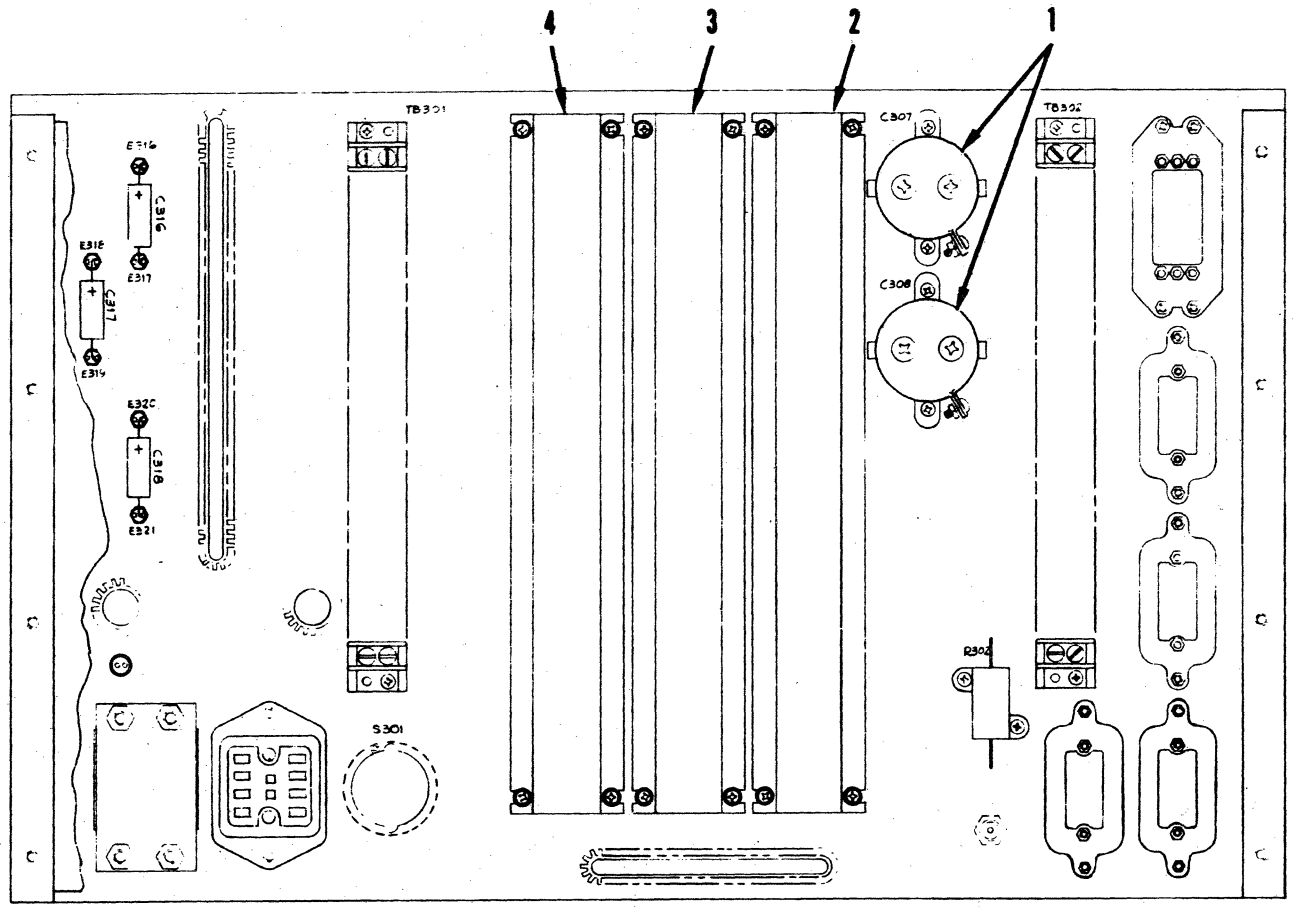


Figure 6-21. Plate Assembly, Power Supply, Front View

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 27 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	200710-1	Tag, blank, cable	2			
2	126732-0014	Adapter, conn	1			
3	476379	Power Supply Assembly, DC	1	6-21, 6-22		
4	475950-1	Circuit Card Assy	1	6-21/2, 6-23		
5	475891	Plate, elec pwr supply	1	6-21/1		
6	42828-25	Circuit Breaker, DP 25 amp	1	CB301	74193	Model AM33
7	128681-29	Light Ind, neon	1	DS301	03797	BG3-CC-5-150K
8	203295-2	Relay, DPDT	1	K301A	76854	WU115A3
9	204264	Socket, relay	1	6-21/3	76854	WPS-C
10	472329-0002	Indicator, elapsed time, 2000 hrs	1	M302		
11	472329-0003	Indicator, elapsed time, 5000 hrs	1	M301		
12	16656-5	Fuse, 20 amp, 32 v, 3 AG, MA	1	F303	75915	307020
13	16656-20	Fuse, 8 amp, 125 v, 3 AG, QA	1	F302	75915	312008
14	16656-2	Fuse, 7.5 amp, 32 v, 3 AG, QA	5	F304, 305, 312, F313, 314		
15	16656-16	Fuse, 3 amp, 250 v, 3 AG, QA	6	F306 thru F311	75915	312003
16	16656-15	Fuse, 2 amp, 250 v, 3 AG, QA	1	F315	75915	312002
17	471879-2101	Terminal Board	2	TB301, 302	98410	37001
18	474632-0012	Jumper, terminal strip	1	(TB302)	75382	600RJ
19	70017-5013	Res, 500Ω ±3%, 25 w	1	R302	91637	RH25G501H
20	199001-23	Mounting, fuse (11)	2	6-21/4	75915	357012
21	475928	Rail, power supply mounting	2			



E-476379 (REF)

Figure 6-22. Plate Assembly, Power Supply, Rear View

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 28 of 34)

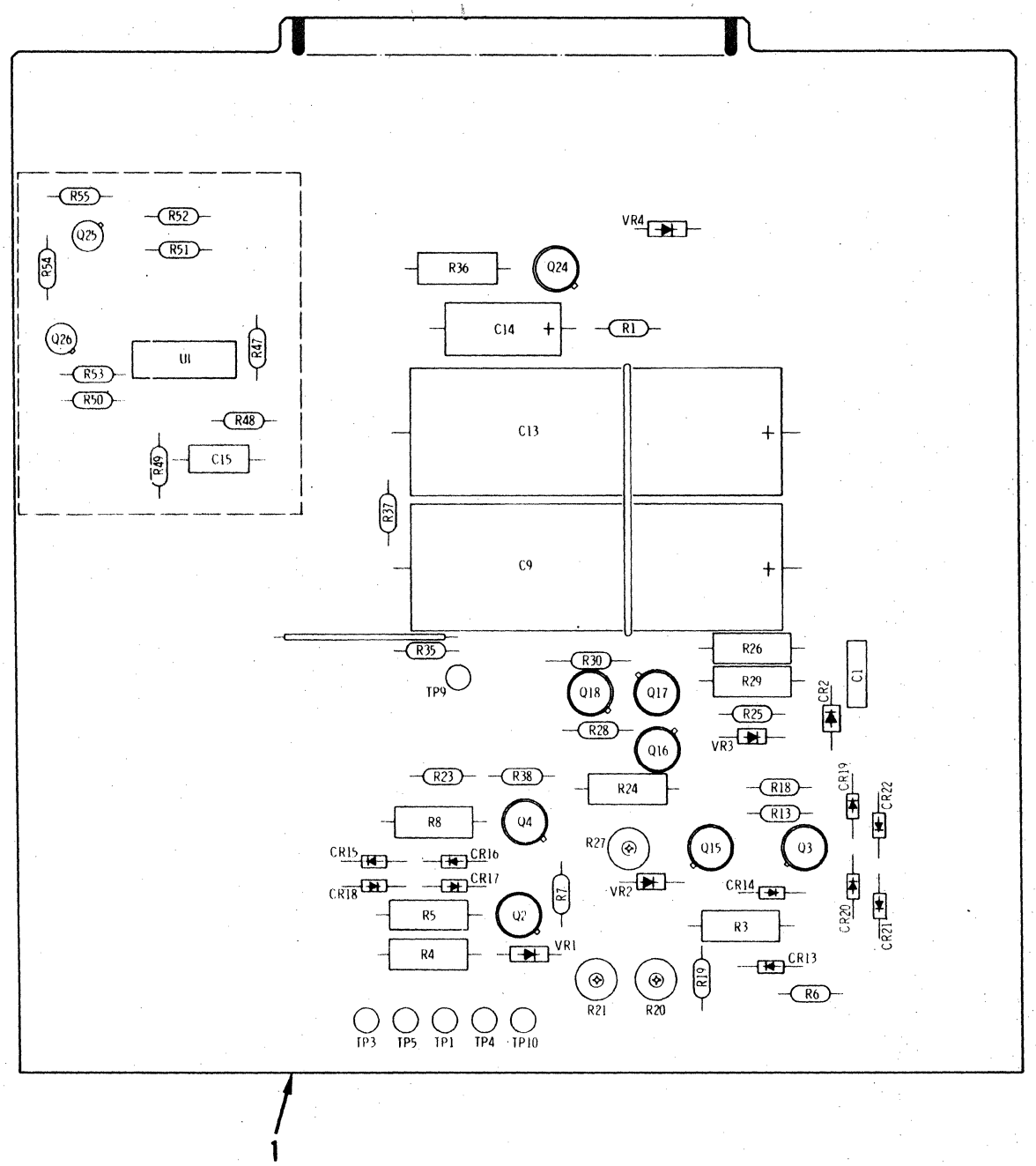
ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	210156-7	Conn, 34 socket	1	6-21/5	81312	XAC-34S-F2016
2	204902-5	Contact, socket, 16 GA	20	6-21/6	81312	100-1016S
3	204902-6	Contact, socket, 20 GA	11	6-21/7	81312	100-1020S
4	204876-7	Conn, 26 socket	1	6-21/8	81312	XAC-26S-F2016
5	204902-5	Contact, socket, 16 GA	6	6-21/9	81312	100-1016S
6	204902-6	Contact, socket, 20 GA	11	6-21/10	81312	100-1020S
7	204876-7	Conn, 26 socket	1	6-21/8	81312	XAC-26S-F2016
8	204902-5	Contact, socket, 16 GA	6	6-21/9	81312	100-1016S
9	204902-6	Contact, socket, 20 GA	11	6-21/10	81312	100-1020S
10	48977-3	Grommet, caterpillar	A/R	6-21/11		
11	475935	Shield, fuse	1	6-21/12		
12	471876-1499	Wire, elec, 14 AWG	A/R			
13	471876-1699	Wire, elec, 16 AWG	A/R			
14	471876-1899	Wire, elec, 18 AWG	A/R			
15	471876-2299	Wire, elec, 22 AWG	A/R			
16	372295-3	Diode	1	CR301	04713	1N4004
17	205894-259	Cap, 8200 μf +75 -10%, 25 vdc	2	C307, 308	56289	36D822G025
18	471930-0007	Cap, 25 μf +75 -10%, 50 vdc	3	C316, 317, 318	56289	500D256G050CC7
19	374384-4710	Connector, receptacle	1	J305		
20	471876-1299	Wire, elec, 12 AWG	A/R			
21	205764-15	Retainer, cap	2	6-22/1	56289	4586-97A
22	14477-0004	Terminal, stud	6	E316 thru E321		

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 29 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	472483-1	Transistor Assy, heat sink	1	6-22/2		
2	472412-1	Transistor Mount, heat sink	1			
3	247804-1	Socket, pwr transistor	5	(Q305 thru Q309)	22753	PTS-1
4	248422-0010	Insulator, transistor mtg	10		08289	TW145-185
5	248422-0001	Insulator, transistor mtg	5		08289	DM-101
6	157117-1653	Screw, pan hd, #6-20 x 5/8	10			
7	211943	Semicond Compound	A/R		71984	340
8	14477-6	Insulator, standoff #4-40	4		81312	750
9	7138-1025	Res, 1K ±5%, 1/2 w	1	R339	78488	RC20GF102J
10	7138-1015	Res, 100Ω ±5%, 1/2 w	1	R340	78488	RC20GF101J
11	246014-3	Transistor, NPN	5	Q305 thru Q309	02735	2N3055
12	70025-307	Res, 0.2Ω ±3%, 3 w	4	R314 thru R317	91637	Type RS2B
13	9916-14	Wire, elec, copper, 14 AWG	A/R			
14	70058-229	Wire, elec,22 AWG	A/R			
15	70058-149	Wire, elec,14 AWG	A/R			
16	472483-2	Transistor Assy, heat sink	1	6-22/3		
17	472412-2	Transistor Mount, heat sink	1			
18	247804-1	Socket, pwr transistor	5	(Q310 thru Q314)	22753	PTS-1
19	248422-0010	Insulator, transistor mtg	10		08289	TW145-185
20	248422-0001	Insulator, transistor mtg	5		08289	DM-101
21	157117-1653	Screw, pan hd, #6-20 x 5/8	10			
22	211943	Semicond Compound	A/R		71984	340

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 30 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	14477-6	Insulator, standoff #4-40	4		81312	750
2	7138-1015	Res, 100Ω ±5%, 1/2 w	1	R341	78488	RC20GF101J
3	7138-1025	Res, 1K ±5%, 1/2 w	1	R342	78488	RC20GF102J
4	246014-3	Transistor, NPN	5	Q310 thru Q314	02735	2N3055
5	70025-307	Res, 0.2Ω ±3%, 3 w	4	R309 thru R312	91637	Type RS2B
6	9916-14	Wire, elec, copper, 14 AWG	A/R			
7	70058-229	Wire, elec, 22 AWG	A/R			
8	70058-149	Wire, elec, 14 AWG	A/R			
9	472483-3	Transistor Assy, heat sink	1	6-22/4		
10	472412-3	Transistor Mount, heat sink	1			
11	247804-1	Socket, pwr transistor	5	(Q319 thru Q323)	22753	PTS-1
12	248422-0010	Insulator, transistor mtg	10		08289	TW145-185
13	248422-0001	Insulator, transistor mtg	5		08289	DM-101
14	157117-1653	Screw, pan hd #6-20 x 5/8	10			
15	211943	Semicond Compound	A/R		71984	340
16	14477-6	Insulator, standoff #4-40	4		81312	750
17	7138-1015	Res, 100Ω ±5%, 1/2 w	1	R343	78488	RC20GF101J
18	7138-1025	Res, 1K ±5%, 1/2 w	1	R344	78488	RC20GF102J
19	246014-3	Transistor, NPN	5	Q319 thru Q323	02735	2N3055
20	70025-307	Res, 0.2Ω ±3%, 3 w	4	R331 thru R334	91637	Type RS2B
21	9916-14	Wire, elec, copper, 14 AWG	A/R			
22	70058-229	Wire, elec, 22 AWG	A/R			
23	70058-149	Wire, elec, 14 AWG	A/R			



NOTE: COMPONENTS WITHIN DASHED BOX ARE NOT PART OF STANDARD UNIT.

E-475950-B (REF)

Figure 6-23. Circuit Card, Power Supply

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 31 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	475950-1	Circuit Card Assy, pwr supply	1	6-23		
2	475950	Printed Wiring Bd	1	6-23/1		
3	471922-2002	Res, 20Ω ±2%, 1/4 w	1	R1	24546	C4-200G
4	7139-3025	Res, 3K ±5%, 1 w	2	R3,4	78488	RC32GF302J
5	7139-8215	Res, 820Ω ±5%, 1 w	2	R5,8	78488	RC32GF821J
6	471922-6802	Res, 68Ω ±2%, 1/4 w	1	R6	24546	C4-680G
7	471922-3912	Res, 390Ω ±2%, 1/4 w	1	R7	24546	C4-391G
8	471922-1022	Res, 1K ±2%, 1/4 w	1	R13	24546	C4-102G
9	471922-1222	Res, 1.2K ±2%, 1/4 w	2	R18,23	24546	C4-122G
10	471922-4712	Res, 470Ω ±2%, 1/4 w	2	R19,38	24546	C4-471G
11	7139-6815	Res, 680Ω ±5%, 1 w	1	R24	78488	RC32GF681J
12	471922-5112	Res, 510Ω ±2%, 1/4 w	3	R25,28,35	24546	C4-511G
13	7139-7515	Res, 750Ω ±5%, 1 w	1	R26	78488	RC32GF751J
14	7139-4315	Res, 430Ω ±5%, 1 w	1	R29	78488	RC32GF431J
15	471922-1512	Res, 150Ω ±2%, 1/4 w	1	R30	24546	C4-151G
16	7139-1015	Res, 100Ω ±5%, 1 w	1	R36	78488	RC32GF101J
17	471922-1012	Res, 100Ω ±2%, 1/4 w	1	R37	24546	C4-101G
18	366427-5	Res, var, 200Ω ±20%, 0.5 w	3	R20,21,27	80294	3339P-1-201
19	202790-6	Cap, 0.01 μf ±20%, 500 vdc	1	C1	56289	55C32
20	251304-6	Cap, 5000 μf +75 -10%, 10 vdc	2	C9,13	56289	39D508G010HP4
21	471930-0003	Cap, 100 μf +75 -10%, 16 vdc	1	C14	56289	500D107G015DC7
22	372295-3	Diode	1	CR2	04713	1N4004

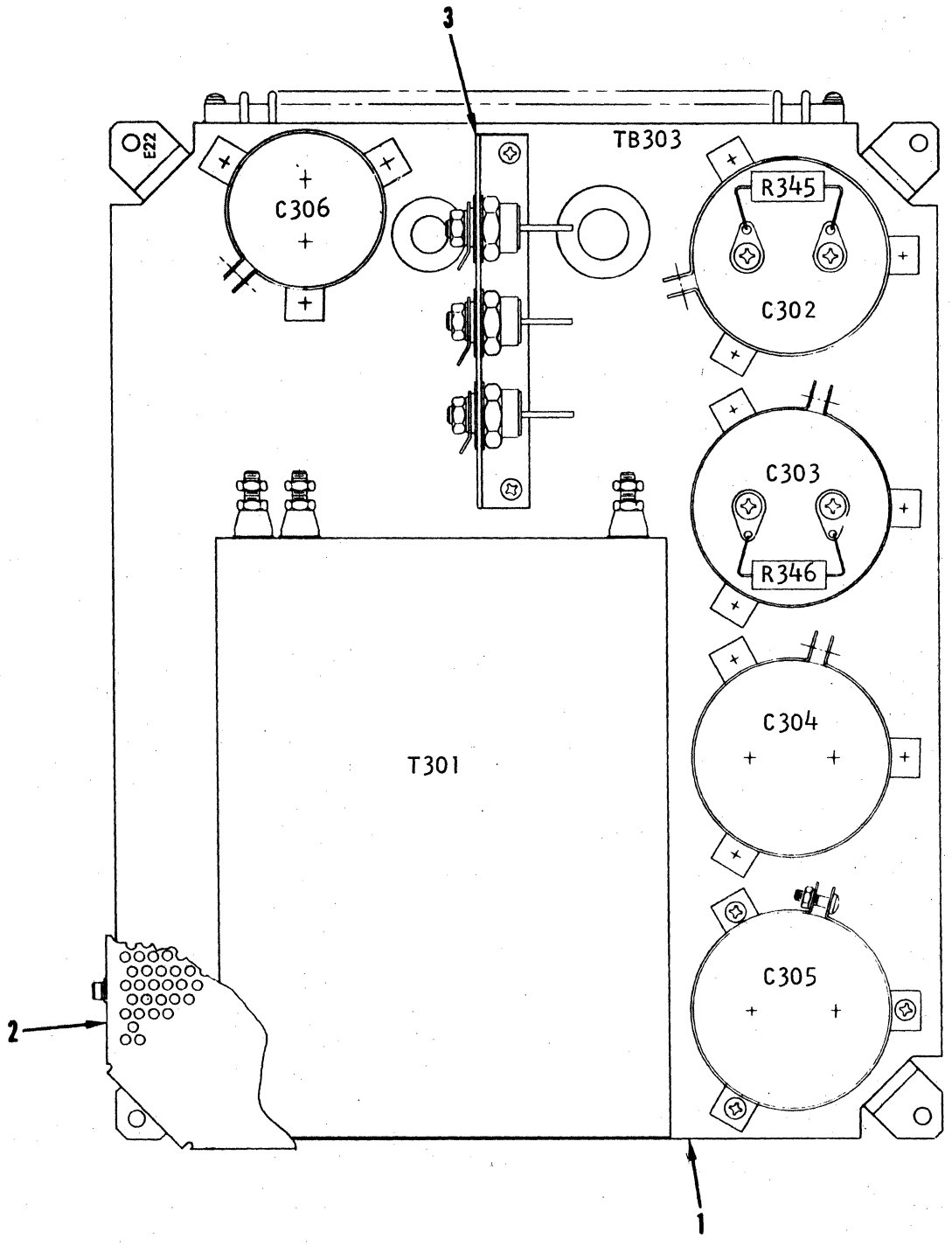


Figure 6-24. Power Supply Assembly, AC

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 32 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	246954	Diode	10	CR13 thru CR22	03508	1N4154
2	205933-1	Diode, zener, 6.2 v ±5%	2	VR1,4	04713	1N821
3	378979-0007	Diode, zener, 5.6 v ±5%	1	VR2	04713	1N4734A
4	378979-0014	Diode, zener, 11 v ±5%	1	VR3	04713	1N4741A
5	471925	Transistor, PNP	5	Q2,3,4, Q16,24	04713	2N2905
6	471927	Transistor, NPN	3	Q15,17,18	04713	2N2219
7	376087-1	Jack, tip, horiz, brn	1	TP1	74970	105-858
8	376087-3	Jack, tip, horiz, orn	1	TP3	74970	105-856
9	376087-4	Jack, tip, horiz, yel	1	TP4	74970	105-857
10	376087-5	Jack, tip, horiz, grn	1	TP5	74970	105-854
11	376087-6	Jack, tip, horiz, blu	1	TP6	74970	105-860
12	376087-10	Jack, tip, horiz, blk	1	TP10	74970	105-853
13	9916-22	Wire, elec, 22 AWG	A/R			
14	70078-2209	Insulation, slvg, elec, Teflon	A/R			
15	476342	Power Supply Assy, AC	1	6-24		
16	475890	Chassis, power supply	1	6-24/1		
17	475974	Cover, power supply	1	6-24/2		
18	471947	Transformer, power, step-down	1	T301	14026	TCS10877
19	472166	Diode and Transistor Assy		6-24/3		
20	205894-0257	Capacitor, 25,000 μf +75 -10%, 40 vdc	4	C302,303, C304,305	56289	36D253G040

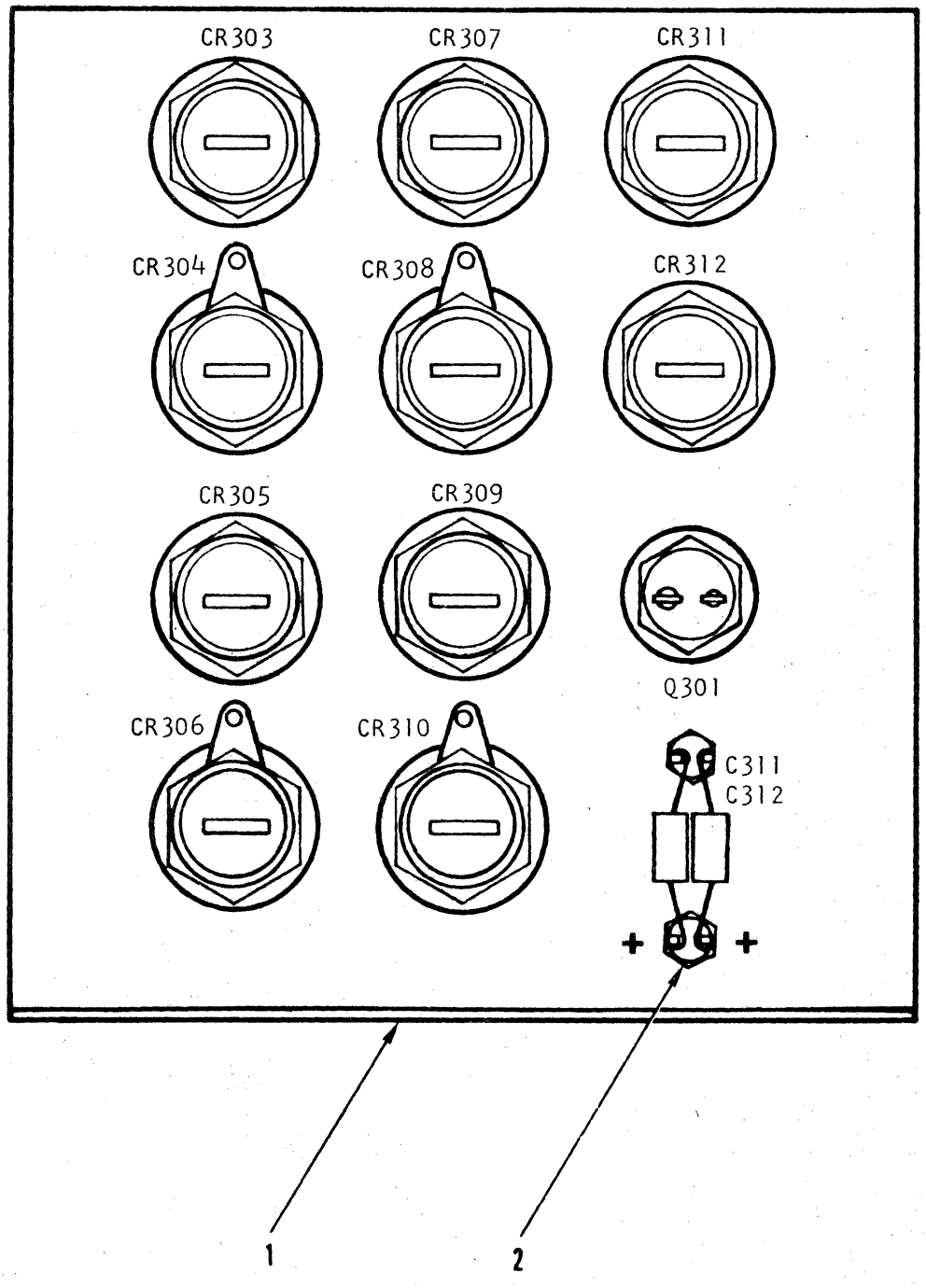


Figure 6-25. Diode and Transistor Assembly, Power Supply

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 33 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	205894-0258	Capacitor, 31,000 μf +75 -10%, 15 vdc	1	C306	56289	36D313G015
2	205764-0018	Retainer, capacitor	4	(C302,303, C304,305)	83125	362-3
3	205764-0017	Retainer, capacitor	1	(C306)		
4	173754-0026	Resistor, 400Ω ±5%, 5 w	2	R345,346	56289	453E401J
5	471879-2105	Terminal Board	1	TB303	07859	37421
6	471876-1499	Wire, elec, stranded, 14 AWG	A/R			
7	471876-1299	Wire, elec, stranded, 12 AWG	A/R			
8	471876-1899	Wire, elec, stranded, 18 AWG	A/R			
9	70072-0101	Screw, cap, soc hd, #4-40 x 1/4	4			
10	7127-0031	Lug, solder	4			
11	6887-0145	Grommet, rubber	1			
12	6887-0062	Grommet, rubber	1			
13	472166	Diode and Transistor Assy	1	6-24/3, 6-25		
14	472414	Heat Sink, elec, elect comp	1	6-25/1		
15	14477-6	Insulator, standoff #4-40	2	6-25/2	81312	756
16	372847-5	Diode	10	CR303 thru CR312	81483	40HF10
17	471942	Rectifier, silicon controlled	1	Q301	03508	Type C-38A
18	471863-1	Cap, 33 μf ±20%, 6 vdc	2	C311,312	31433	T320B336-M06AS
19	70058-149	Wire, elec, 14 AWG	A/R			
20	70058-189	Wire, elec, 18 AWG	A/R			

Table 6-3. Parts List for the 13-501 Tape Transport (Sheet 34 of 34)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	475298	Shield Assy, head	1			
2	476390	Cable Assy, power supply (TB301, TB303)	1			
3	475937-1	Assembly Instruction, obs window	Ref			
4	472144	Frame, trans mtg, flush mt	1			
5	475927-1	Window, observation	1			
6	478996	Frame, upper, obs window	1			
7	475002	Extrusion (17")	A/R			
8	475133	Frame, lower, obs window	1			
9	475002	Extrusion (17")	A/R			
10	19784-56	Tape, foam, vinyl 1/4 x 3/8 wide	A/R			
11	472446	Fastener, pawl	1			
12	474645	Hinge, half, upper trans frame	1			
13	474639	Hinge, half, lower trans frame	1			
14	474640-1	Hinge, half, obs window, upper frame	1			
15	474640-2	Hinge, half, obs window, lower frame	1			
16	212498-26	Washer	2			
17	129966	Bearing, pivot	1			

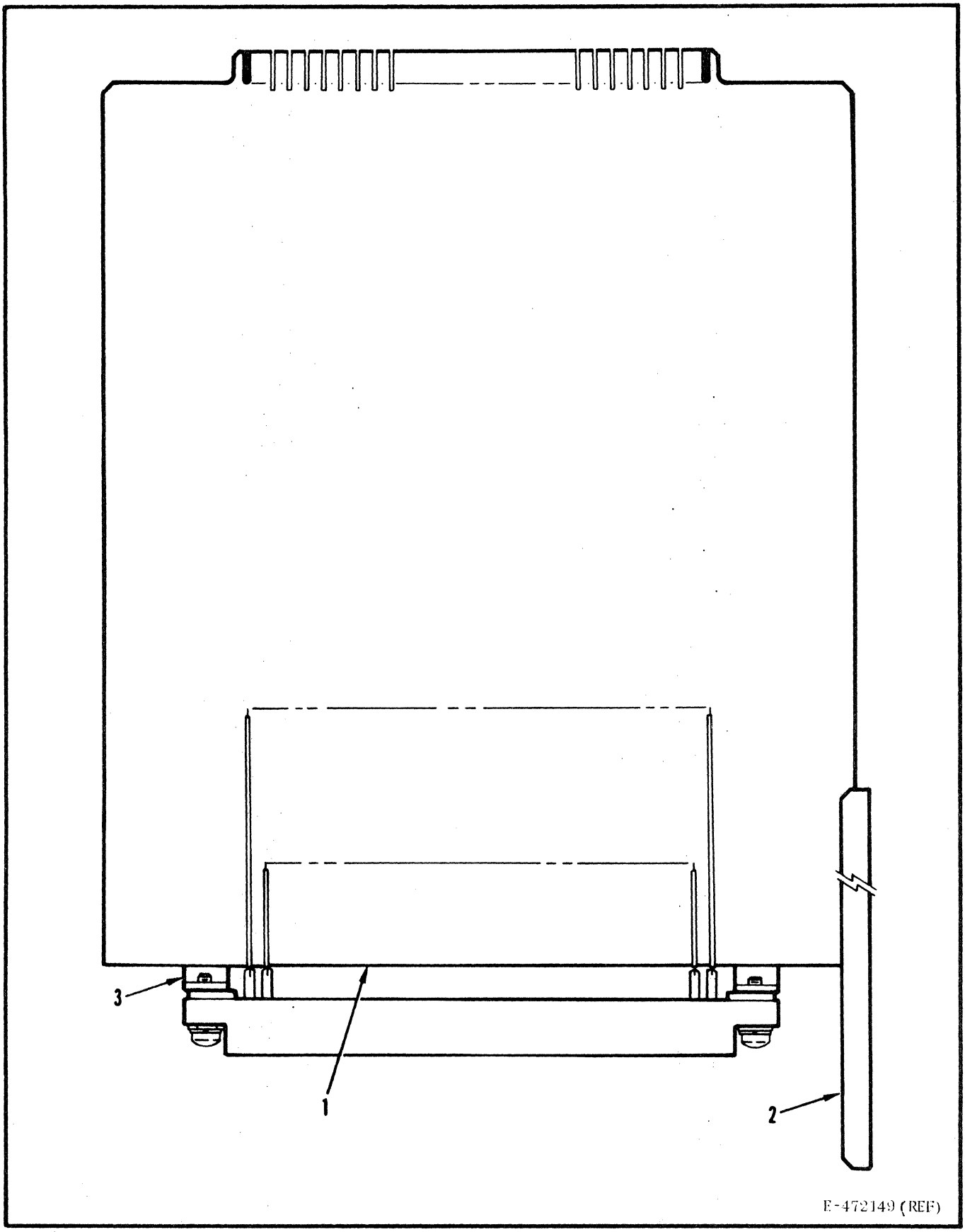


Figure 6-26. Circuit Extender Card, Electronics and Relay Chassis

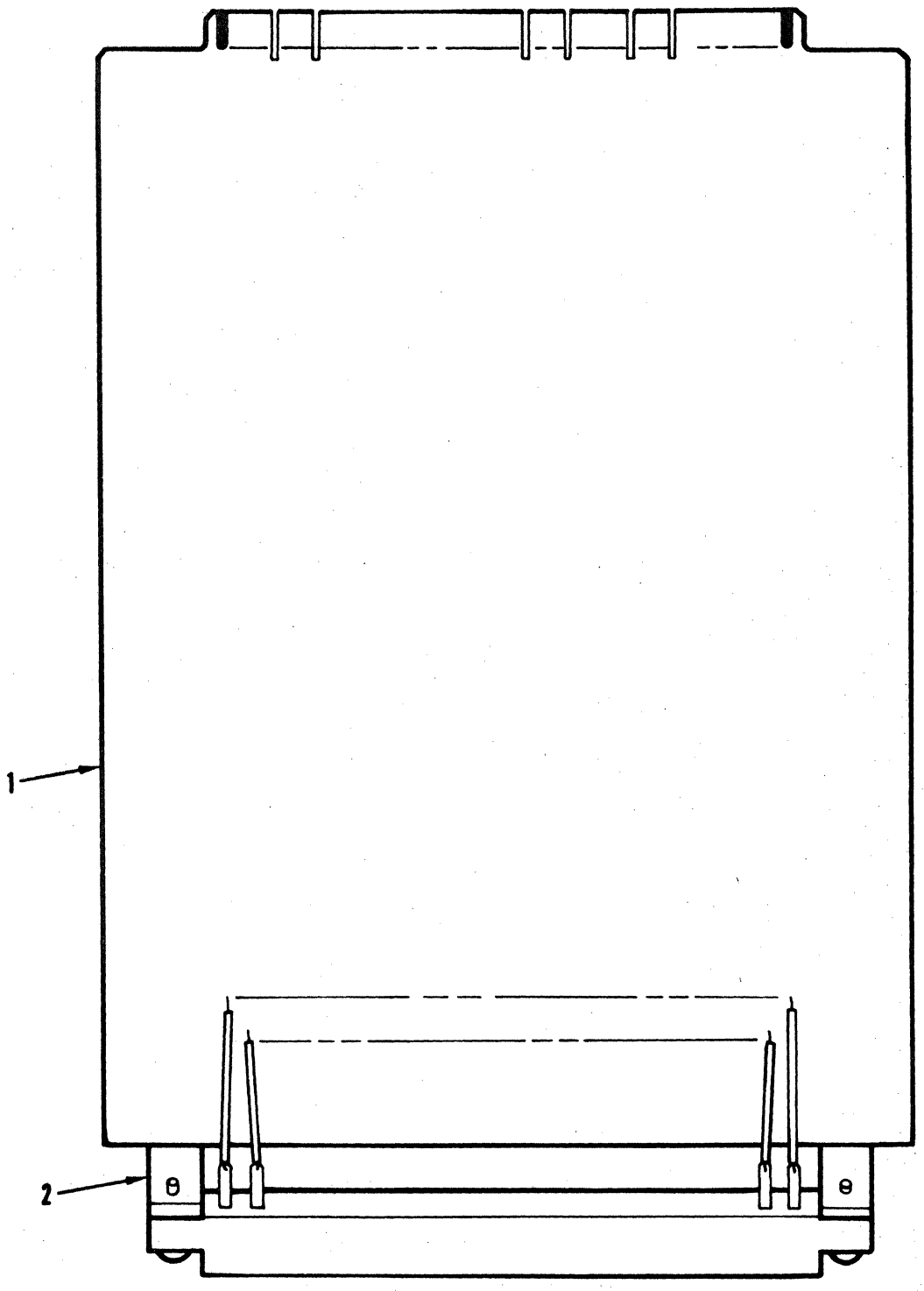


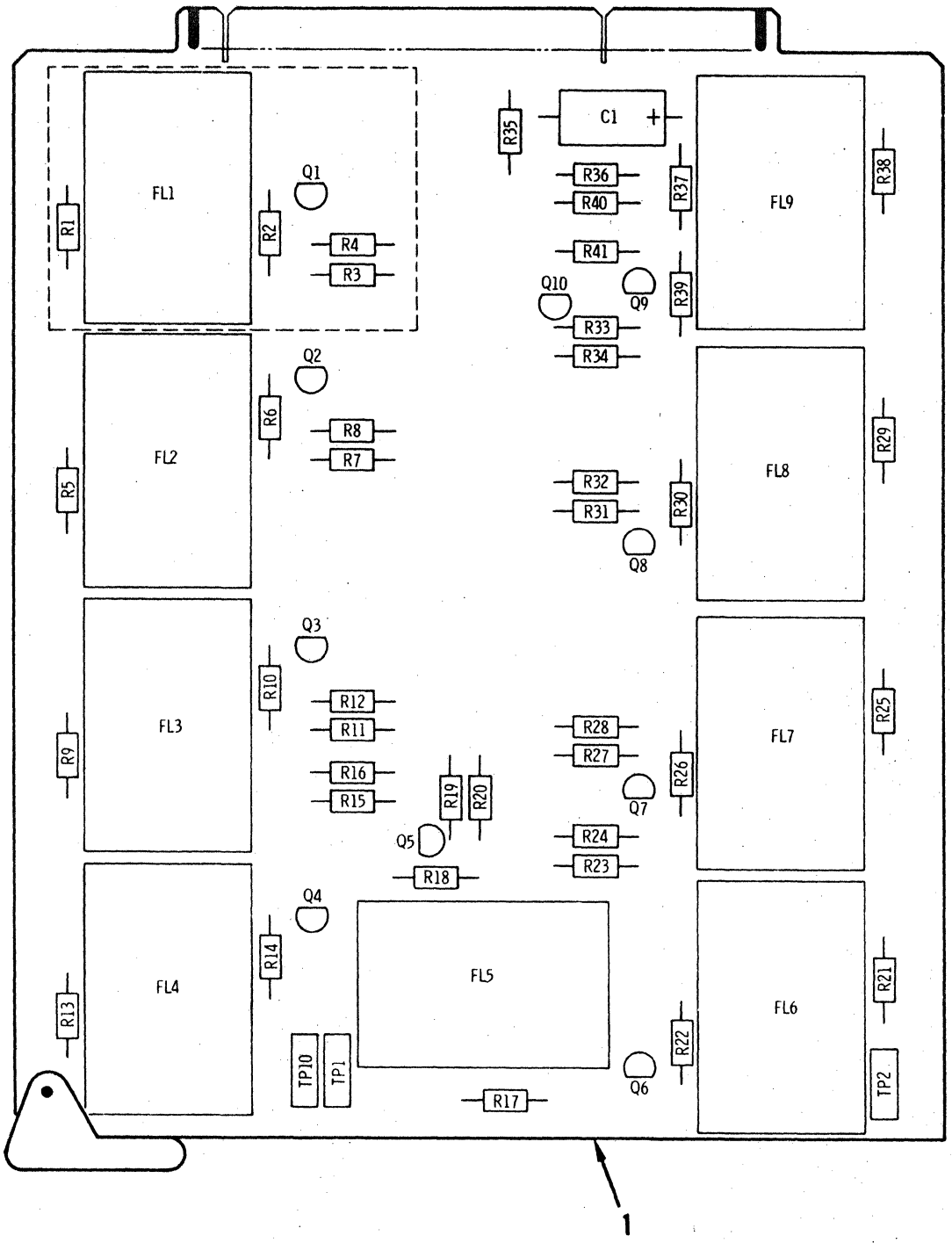
 Figure 6-27. Circuit Extender Card, Preamplifier Mounting Assembly

Table 6-4. Parts List for the Electronics and Relay Chassis Circuit Extender Card

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	472149-1	Ckt Extender Card, elec and rly chas	1	6-26		
2	474636	Schematic	Ref			
3	472149	Printed Wiring Bd	1	6-26/1		
4	471889	Bracket, elec, edge, conn	2	6-26/3		
5	471890	Support, ckt ext card	1	6-26/2		
6	471478-2299	Wire, elec, 22 AWG	A/R			
7	471872	Conn, rcpt, elec	1	J1	95238	K600-128-28XA

Table 6-5. Parts List for the Preamplifier Mounting Assembly Circuit Extender Card

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	472155-1	Ckt Extender Card, preamp mtg assy	1	6-27		
2	472159	Schematic	Ref			
3	472155	Printed Wiring Bd	1	6-27/1		
4	472157	Bracket, elec, edge, conn	2	6-27/2		
5	471478-2299	Wire, elec, 22 AWG	A/R			
6	471872	Conn, rcpt, elec	1	P1	95238	K600-128-28XA



NOTE: COMPONENTS WITHIN DASHED BOX ARE NOT PART OF STANDARD UNIT.

D-471622-B (REF)

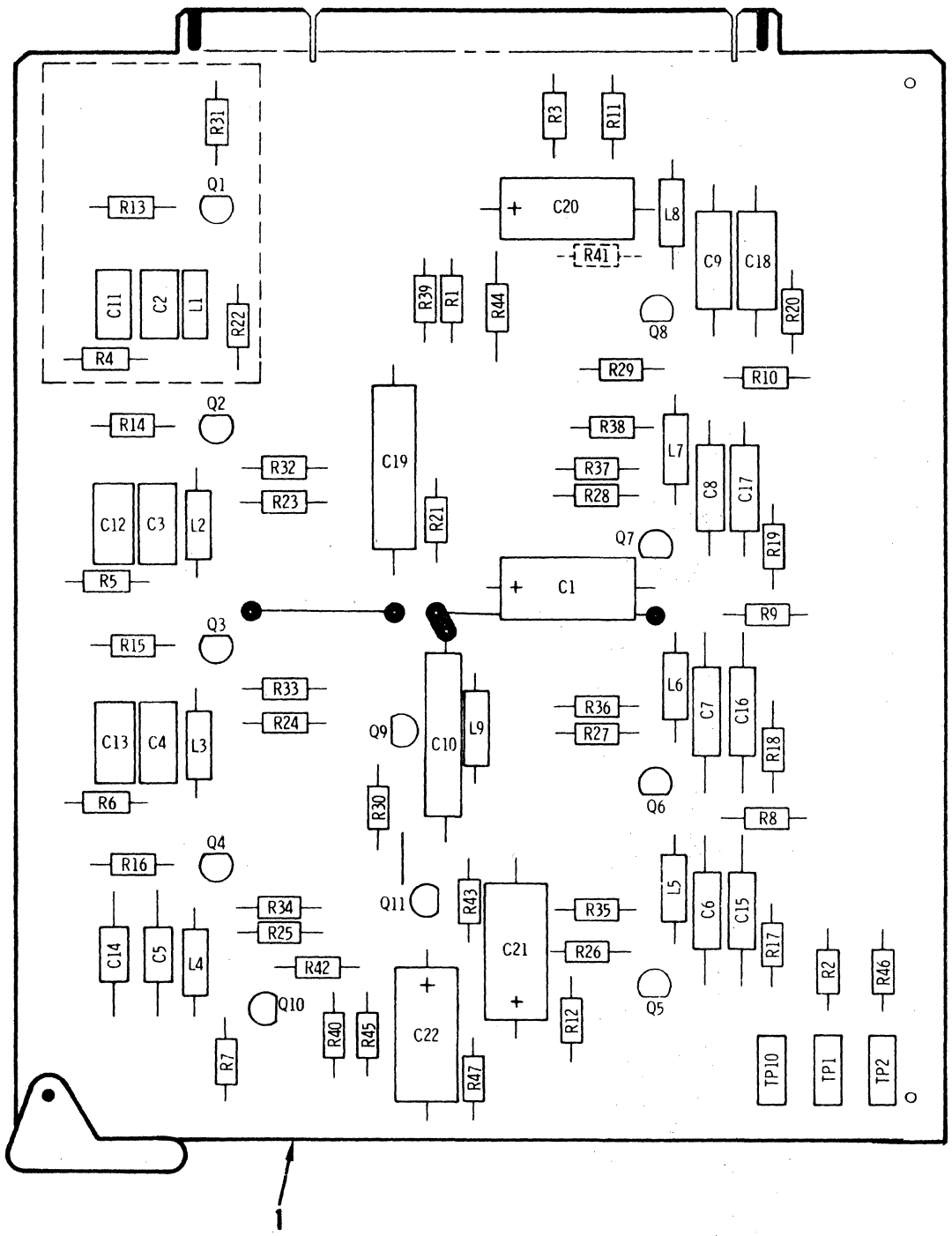
Figure 6-28. 13-545-1 Bandpass Filter Assembly

Table 6-6. Parts List for the 13-545-1 Bandpass Filter (Sheet 1 of 2)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	471622-1	Bandpass Filter Assembly	1	6-28		
2	471603	Schematic	Ref			
3	471622	Printed Wiring Board	1	6-28/1		
4	471922-5612	Res, 560Ω ±2%, 1/4 w	8	R5, 9, R13, 17, R21, 25, R29, 38	24546	C4-561G
5	471922-2032	Res, 20K ±2%, 1/4 w	9	R6, 10, R14, 18, R22, 26, R30, 34, R39	24546	C4-203G
6	471922-2042	Res, 200K ±2%, 1/4 w	8	R7, 11, R15, 19, R23, 27, R31, 40	24546	C4-204G
7	471922-7532	Res, 75K ±2%, 1/4 w	8	R8, 12, R16, 20, R24, 28, R32, 41	24546	C4-753G
8	471922-1022	Res, 1K ±2%, 1/4 w	1	R33	24546	C4-102G
9	471922-1222	Res, 1.2K ±2%, 1/4 w	1	R35	24546	C4-122G
10	471922-1012	Res, 100Ω ±2%, 1/4 w	1	R36	24546	C4-101G
11	471922-1032	Res, 10K ±2%, 1/4 w	1	R37	24546	C4-103G
12	95222-71	Cap, 10 μf +75 -10%, 16 v	1	C1	56289	30D106G016BA2
13	253082-4	Transistor, NPN	9	Q2 thru Q10	04713	2N3904
14	371915-7	Filter, bandpass, 200 kHz	1	FL2	08742	34367
15	371915-1	Filter, bandpass, 100 kHz	1	FL3	08742	34361

Table 6-6. Parts List for the 13-545-1 Bandpass Filter (Sheet 2 of 2)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	371915-2	Filter, bandpass, 50 kHz	1	FL4	08742	34362
2	371915-3	Filter, bandpass, 25 kHz	1	FL5	08742	34363
3	371915-4	Filter, bandpass, 12.5 kHz	1	FL6	08742	34364
4	371915-5	Filter, bandpass, 6.25 kHz	1	FL7	08742	34365
5	475599-1	Filter, bandpass, 3.2 kHz	1	FL8		
6	475599-2	Filter, bandpass, 1.6 kHz	1	FL9		
7	9916-22	Wire, elec, 22 AWG	A/R			
8	204749-8	Jack, tip, horiz, brn	1	TP1	74970	105-758
9	204749-2	Jack, tip, horiz, red	1	TP2	74970	105-752
10	204749-3	Jack, tip, horiz, blk	1	TP10	74970	105-753



NOTE: COMPONENTS SHOWN BY DASHED LINES ARE NOT PART OF STANDARD UNIT.
COMPONENTS WITHIN DASHED BOX ARE NOT PART OF STANDARD UNIT.

D-471636-C (REF)

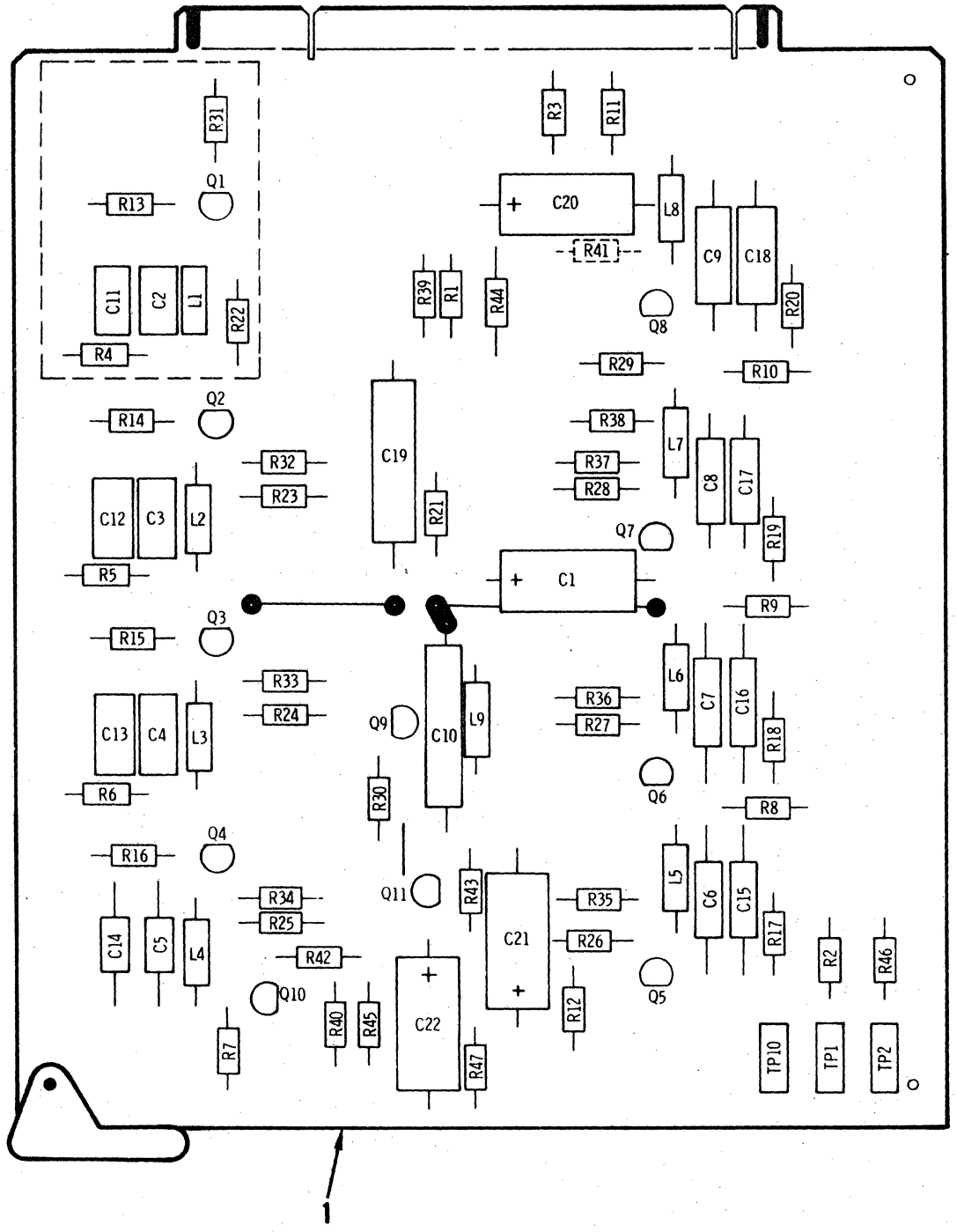
Figure 6-29. 13-545-2 Low Pass Filter Assembly

Table 6-7. Parts List for the 13-545-2 Low Pass Filter (Sheet 1 of 2)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	471636-1	Low Pass Filter Assembly	1	6-29		
2	471602	Schematic	Ref			
3	471636	Printed Wiring Bd	1	6-29/1		
4	471922-5102	Res, 51Ω ±2%, 1/4 w	2	R1, 3	24546	C4-510G
5	471922-2022	Res, 2K ±2%, 1/4 w	6	R5 thru R10	24546	C4-202G
6	471922-2222	Res, 2.2K ±2%, 1/4 w	6	R14 thru R19	24546	C4-222G
7	471922-2042	Res, 200K ±2%, 1/4 w	8	R23 thru R30	24546	C4-204G
8	471922-1022	Res, 1K ±2%, 1/4 w	3	R2, 11, R46	24546	C4-102G
9	471922-1122	Res, 1.1K ±2%, 1/4 w	1	R20	24546	C4-112G
10	471922-1032	Res, 10K ±2%, 1/4 w	2	R40, 47	24546	C4-103G
11	471922-3022	Res, 3K ±2%, 1/4 w	1	R42	24546	C4-302G
12	471922-9112	Res, 910Ω ±2%, 1/4 w	1	R43	24546	C4-911G
13	471922-1522	Res, 1.5K ±2%, 1/4 w	1	R45	24546	C4-152G
14	471922-7532	Res, 75K ±2%, 1/4 w	8	R32 thru R39	24546	C4-753G
15	471922-5612	Res, 560Ω ±2%, 1/4 w	2	R12, 21	24546	C4-561G
16	7138-5125	Res, 5.1K ±5%, 1/2 w	1	R44	78488	RC20GF512J
17	70094-42	Cap, 390 pf ±5%, 500 v	2	C3, 12	72136	DM15F391J
18	70094-51	Cap, 820 pf ±5%, 300 v	2	C4, 13	72136	DM15F821J
19	215095-172	Cap, 0.0018 μf ±10%, 200 v	2	C5, 14	56289	192P18292
20	215095-212	Cap, 0.0039 μf ±10%, 200 v	2	C6, 15	56289	192P39292

Table 6-7. Parts List for the 13-545-2 Low Pass Filter (Sheet 2 of 2)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	215095-252	Cap, 0.0082 μf ±10%, 200 v	2	C7,16	56289	192P82292
2	215095-512	Cap, 0.018 μf ±10%, 80 v	2	C8,17	56289	192P1839R8
3	215095-502	Cap, 0.68 μf ±10%, 80 v	2	C9,18	56289	192P6839R8
4	95222-77	Cap, 50 μf +75 -10%, 16 v	3	C1,20, C21	56289	30D506G016CB2
5	129274-112	Cap, 0.27 μf ±10%, 50 v	2	C10,19	96733	Type MS6
6	374986-0056	Cap, 0.47 μf ±10%, 35 v	1	C22		
7	253082-4	Transistor, NPN	10	Q2 thru Q11	04713	2N3904
8	212624-1119	Inductor, 3,300 μh ±5%	1	L2	72259	Type SWD
9	212624-1115	Inductor, 6,800 μh ±5%	1	L3	72259	Type SWD
10	212624-1112	Inductor, 12,000 μh ±5%	1	L4	72259	Type SWD
11	212624-1108	Inductor, 27,000 μh ±5%	1	L5	72259	Type SWD
12	212624-1105	Inductor, 47,000 μh ±5%	1	L6	72259	Type SWD
13	212624-1101	Inductor, 100,000 μh ±5%	3	L7 thru L9	72259	Type SWD
14	204749-8	Jack, horiz, brn	1	TP1	74970	105-758
15	204749-2	Jack, horiz, red	1	TP2	74970	105-752
16	204749-3	Jack, horiz, blk	1	TP10	74970	105-753
17	9916-22	Wire, elec, 22 AWG	A/R			



NOTE: COMPONENTS SHOWN BY DASHED LINES ARE NOT PART OF STANDARD UNIT.
COMPONENTS WITHIN DASHED BOX ARE NOT PART OF STANDARD UNIT.

D-471633-C (REF)

Figure 6-30. Record Sine Wave Generator

Table 6-8. Parts List for the 13-544-1 Record Sine Wave Generator (Sheet 1 of 2)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	471633-1	Record Sine Wave Generator	1	6-30		
2	471601	Schematic	Ref			
3	471633	Printed Wiring Bd	1	6-30/1		
4	471922-5102	Res, 51Ω ±2%, 1/4 w	2	R1, 3	24546	C4-510G
5	471922-2022	Res, 2K ±2%, 1/4 w	6	R5 thru R10	24546	C4-202G
6	471922-2222	Res, 2.2K ±2%, 1/4 w	6	R14 thru R19	24546	C4-222G
7	471922-2042	Res, 200K ±2%, 1/4 w	8	R23 thru R30	24546	C4-204G
8	471922-1022	Res, 1K ±2%, 1/4 w	3	R2, 11 R46	24546	C4-102G
9	471922-1122	Res, 1.1K ±2%, 1/4 w	1	R20	24546	C4-112G
10	471922-1032	Res, 10K ±2%, 1/4 w	2	R40, 47	24546	C4-103G
11	471922-3022	Res, 3K ±2%, 1/4 w	1	R42	24546	C4-302G
12	471922-9112	Res, 910Ω ±2%, 1/4 w	1	R43	24546	C4-911G
13	471922-1522	Res, 1.5K ±2%, 1/4 w	1	R45	24546	C4-152G
14	471922-7532	Res, 75K ±2%, 1/4 w	8	R32 thru R39	24546	C4-753G
15	471922-5612	Res, 560Ω ±2%, 1/4 w	2	R12, 21	24546	C4-561G
16	7138-5125	Res, 5.1K ±5%, 1/2 w	1	R44	78488	RC20GF512J
17	70094-42	Cap, 390 pf ±5%, 500 v	2	C3, 12	72136	DM15F391J
18	70094-51	Cap, 820 pf ±5%, 300 v	2	C4, 13	72136	DM15F821J
19	215095-172	Cap, 0.0018 μf ±10%, 200 v	2	C5, 14	56289	192P18292
20	215095-212	Cap, 0.0039 μf ±10%, 200 v	2	C6, 15	56289	192P39292

Table 6-8. Parts List for the 13-544-1 Record Sine Wave Generator (Sheet 2 of 2)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	215095-252	Cap, 0.0082 μf ±10%, 200 v	2	C7,16	56289	192P82292
2	215095-512	Cap, 0.018 μf ±10%, 80 v	2	C8,17	56289	192P1839R8
3	215095-502	Cap, 0.068 μf ±10%, 80 v	2	C9,18	56289	192P6839R8
4	95222-77	Cap, 50 μf +75 -10%, 15 v	4	C1,20, C21,22	56289	30D506G016CB2
5	129274-112	Cap, 0.27 μf ±10%, 50 v	2	C10,19	96733	Type MS6
6	253082-4	Transistor, NPN	10	Q2 thru Q11	04713	2N3904
7	212624-1119	Inductor, 3,300 μh ±5%	1	L2	72259	Type SWD
8	212624-1115	Inductor, 6,800 μh ±5%	1	L3	72259	Type SWD
9	212624-1112	Inductor, 12,000 μh ±5%	1	L4	72259	Type SWD
10	212624-1108	Inductor, 27,000 μh ±5%	1	L5	72259	Type SWD
11	212624-1105	Inductor, 47,000 μh ±5%	1	L6	72259	Type SWD
12	212624-1101	Inductor, 100,000 μh ±5%	3	L7,8,9	72259	Type SWD
13	204749-8	Jack, horiz, brn	1	TP1	74970	105-758
14	204749-2	Jack, horiz, red	1	TP2	74970	105-752
15	204749-3	Jack, horiz, blk	1	TP10	74970	105-753

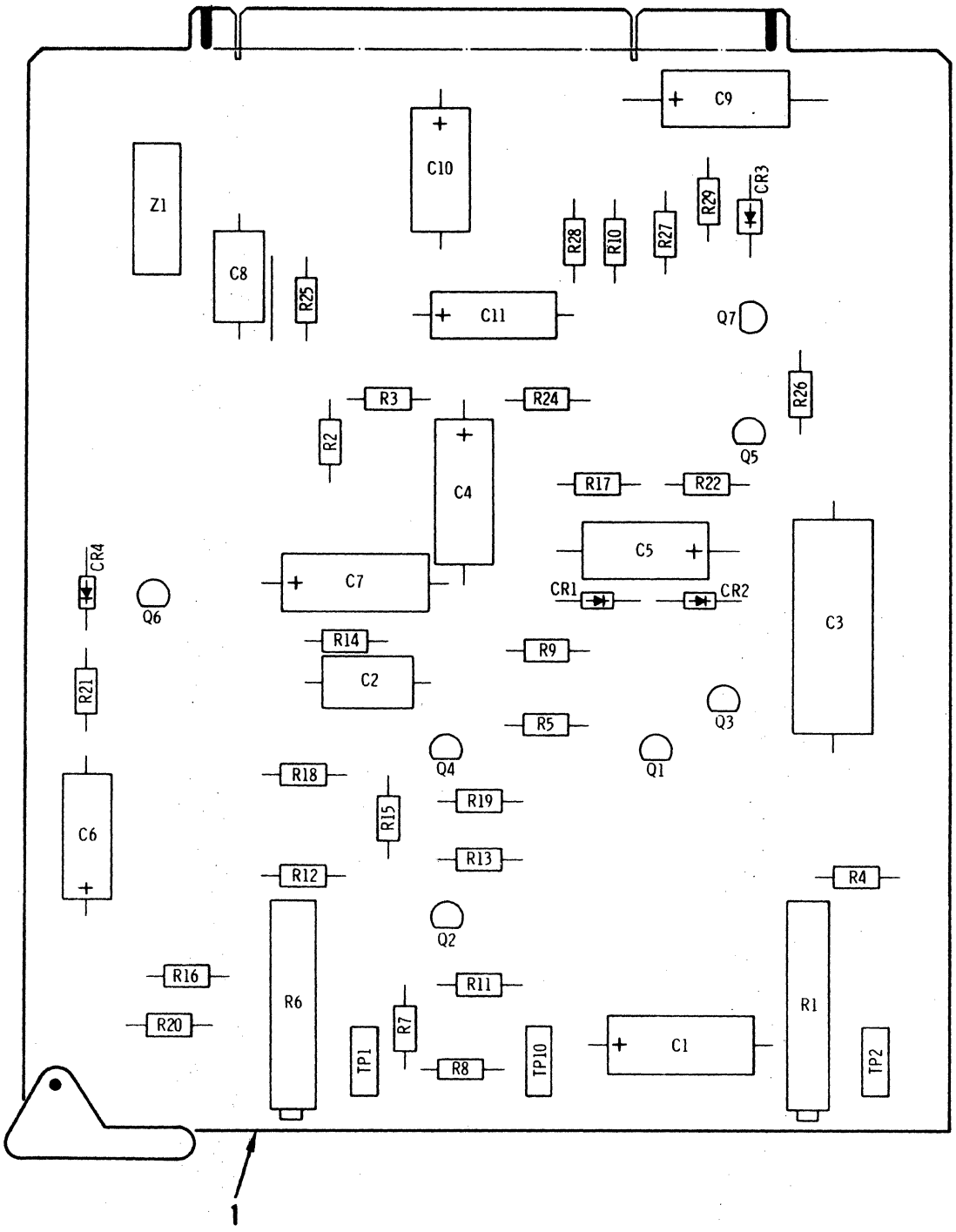


Figure 6-31. Reproduce Servo Control

Table 6-9. Parts List for the 13-571 Reproduce Servo Control (Sheet 1 of 2)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	471609-1	Reproduce Servo Control	1	6-31		
2	471608	Schematic	Ref			
3	471609	Printed Wiring Bd	1	6-31/1		
4	471922-5612	Res, 560Ω ±2%, 1/4 w	1	R8	24546	C4-561G
5	471922-2032	Res, 20K ±2%, 1/4 w	2	R7, 11	24546	C4-203G
6	471922-5112	Res, 510Ω ±2%, 1/4 w	2	R12, 16	24546	C4-511G
7	471922-8212	Res, 820Ω ±2%, 1/4 w	1	R9	24546	C4-821G
8	471922-1032	Res, 10K ±2%, 1/4 w	2	R14, 18	24546	C4-103G
9	471922-5122	Res, 5.1K ±2%, 1/4 w	1	R19	24546	C4-512G
10	471922-1022	Res, 1K ±2%, 1/4 w	8	R14, 15, R17, 20, R22, 24, R25, 28	24546	C4-102G
11	471922-1012	Res, 100Ω ±2%, 1/4 w	3	R2, 3, R27	24546	C4-101G
12	471922-3322	Res, 3.3K ±2%, 1/4 w	1	R10	24546	C4-332G
13	471922-2022	Res, 2K ±2%, 1/4 w	2	R21, 26	24546	C4-202G
14	471922-7512	Res, 750Ω ±2%, 1/4 w	1	R13	24546	C4-751G
15	471922-3302	Res, 33Ω ±2%, 1/4 w	1	R15	24546	C4-330G
16	471922-5102	Res, 51Ω ±2%, 1/4 w	1	R29	24546	C4-510G
17	127978-20	Res, var, 5K ±10%, 1/2 w	1	R6	80294	Type 275
18	127978-18	Res, var, 1K ±10%, 1/2 w	1	R1	80294	Type 275
19	471930-0001	Cap, 25 μf +75 -10%, 16 v	2	C6, 11	56289	500D256G016BB7
20	471930-0005	Cap, 50 μf +75 -10%, 25 v	3	C1, 4, 7	56289	500D506G025CC7

Table 6-9. Parts List for the 13-571 Reproduce Servo Control (Sheet 2 of 2)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	471930-0002	Cap, 50 μf +75 -10%, 16 v	1	C10	56289	500D506G016CB7
2	471930-0010	Cap, 10 μf +75 -10%, 50 v	2	C5, 9	56289	500D106G050CB7
3	39412-205	Cap, 20 μf ±5%, 500 v	1	C2	81349	CM15C200J
4	39412-1205	Cap, 120 μf ±5%, 500 v	1	C8	81349	CM15E121J
5	72000-113	Cap, 0.33 μf ±10%, 200 v	1	C3	56289	Type 155P
6	246954	Diode	3	CR1, 2, CR4	03508	1N4154
7	372295-1	Diode	1	CR3	04713	1N4002
8	253082-4	Transistor, NPN	5	Q1, 2, Q4, 5, Q6	04713	2N3904
9	252501-4	Transistor, PNP	2	Q3, 7	04713	2N3906
10	471950	Integrated Ckt	1	Z1	04713	SN7473N
11	204749-1008	Jack, tip, horiz, brn	1	TP1	74970	105-758
12	204749-1003	Jack, tip, horiz, blk	1	TP10	74970	105-753
13	204749-1002	Jack, tip, horiz, red	1	TP2	74970	105-752
14	9916-22	Wire, elec, 22 AWG	A/R			
15	472132-2	Cable Assembly, spec prp	1			
16	126716-174	Cable, radio frequency (80")	A/R			
17	126732-54	Conn, plug, elec	2		96918	KC-59-154
18	200710-1	Tag, blank, cable	2			
19	129309-1	Adapter, conn	1		74868	31-008

Table 6-10. Parts List for 1/2-inch and 1-inch Tape Width Kits

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	373000-2	Tape Width Kit (1/2" tape)	1			
2	370713-2	Guide, tape	2	6-1/1		
3	15966-460	Screw, cap #10-32 x 1 3/4"	2			
4	202230-2	Roller Assembly, sensing	2	6-1/2		
5	212541-2	Reel Hub Assembly	2	6-1/3		
6	476412-15	Reel, precision	1			
7	373000-5	Tape Width Kit (1" tape)	1			
8	370713-5	Guide, tape	2			
9	15966-460	Screw, cap #10-32 x 1 3/4"	2			
10	202230-5	Roller Assembly, sensing	2			
11	212541-5	Reel Hub Assembly	2			
12	245068-7	Reel, precision	1			

SECTION VII

DRAWINGS AND SCHEMATICS

7-1. GENERAL.

7-2. This section contains 13-501 Tape Transport schematics which are referenced throughout the manual. Each drawing or schematic is identified by a figure number.

7-3. A list of the diagrams included in this section can be found in the List of Illustrations at the front of this manual.

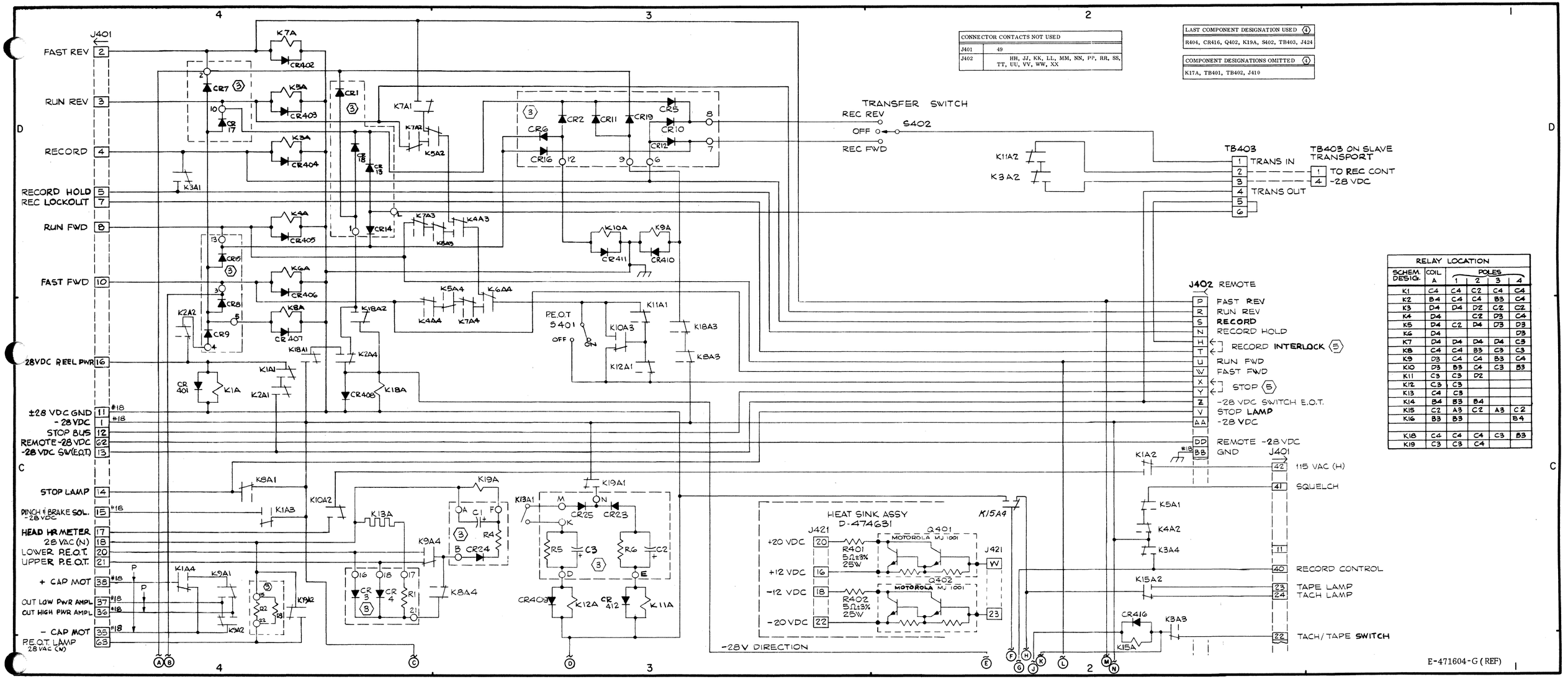


Figure 7-1. Schematic, Electronics and Relay Chassis (Sheet 1 of 2) 7-3/7-4

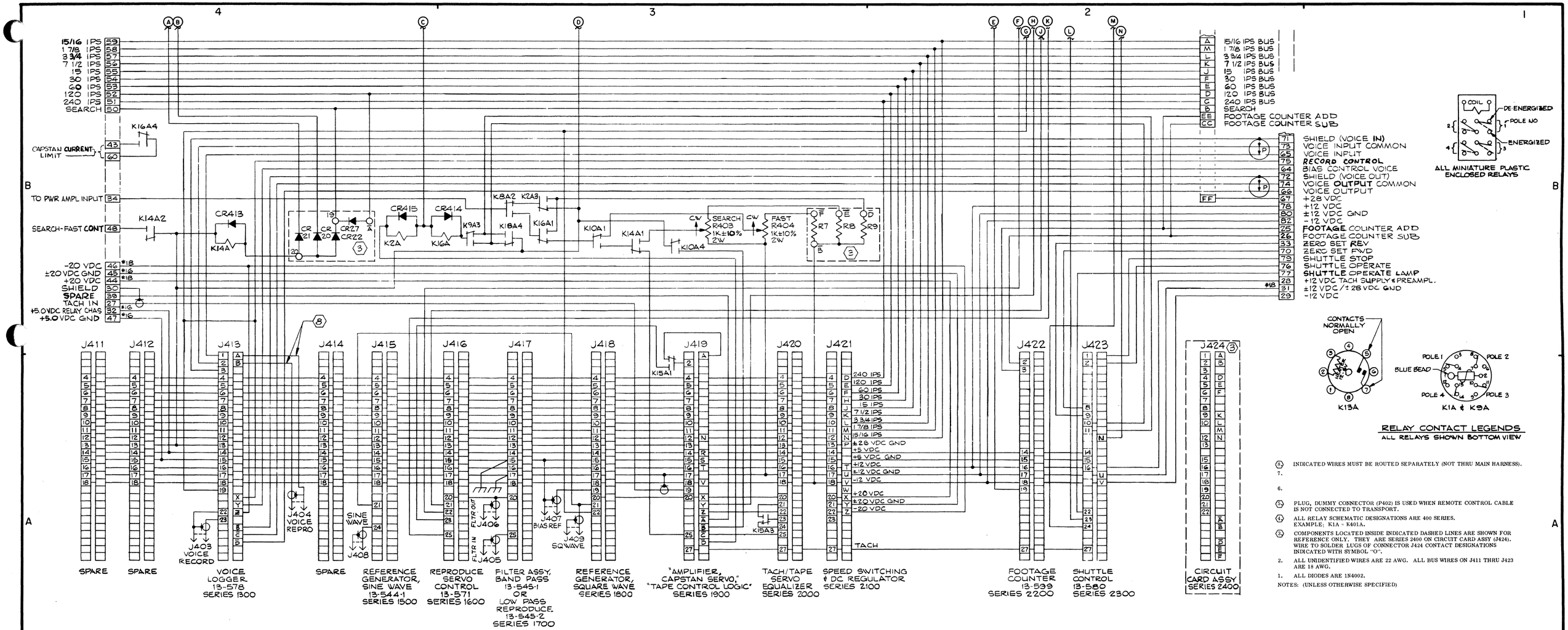
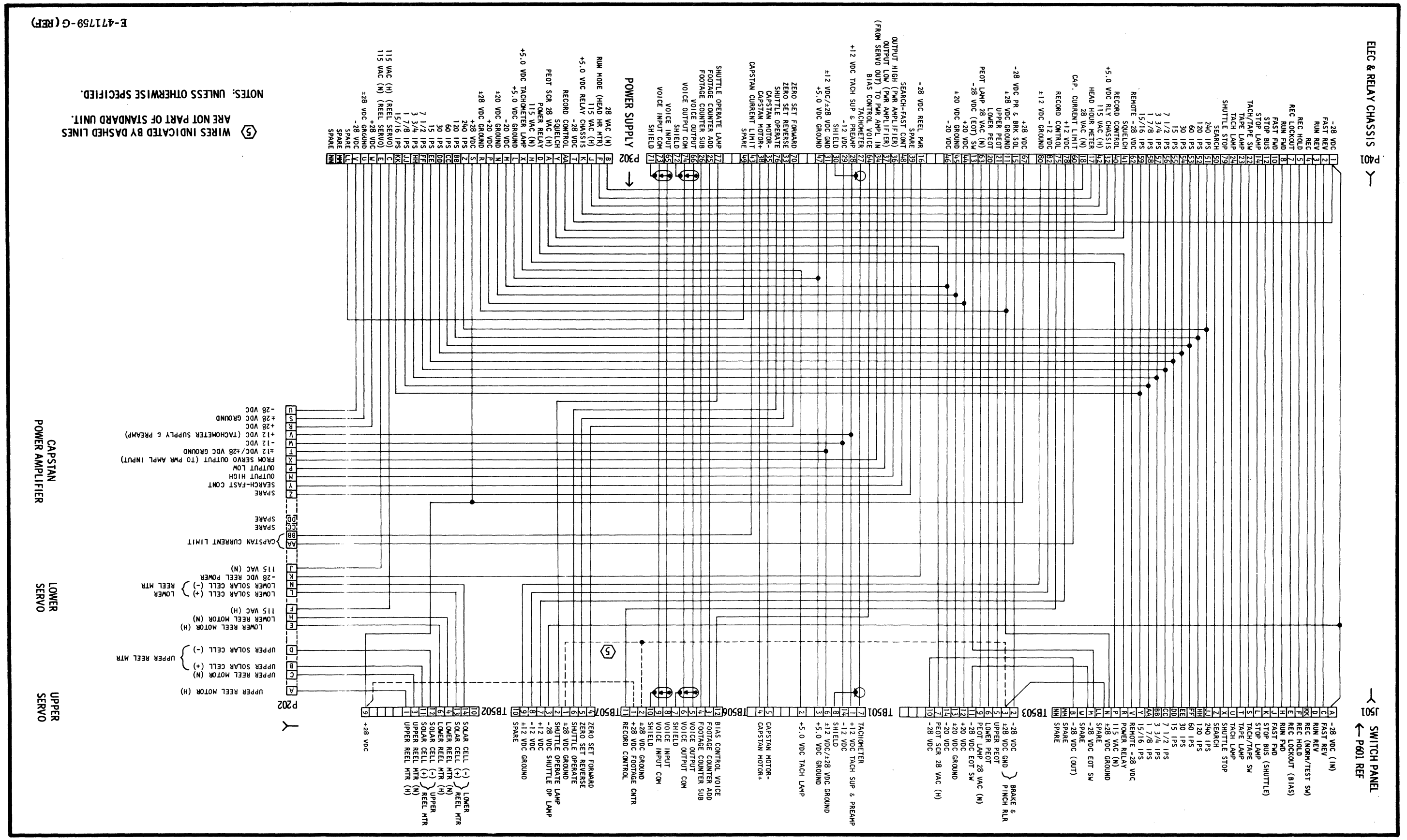
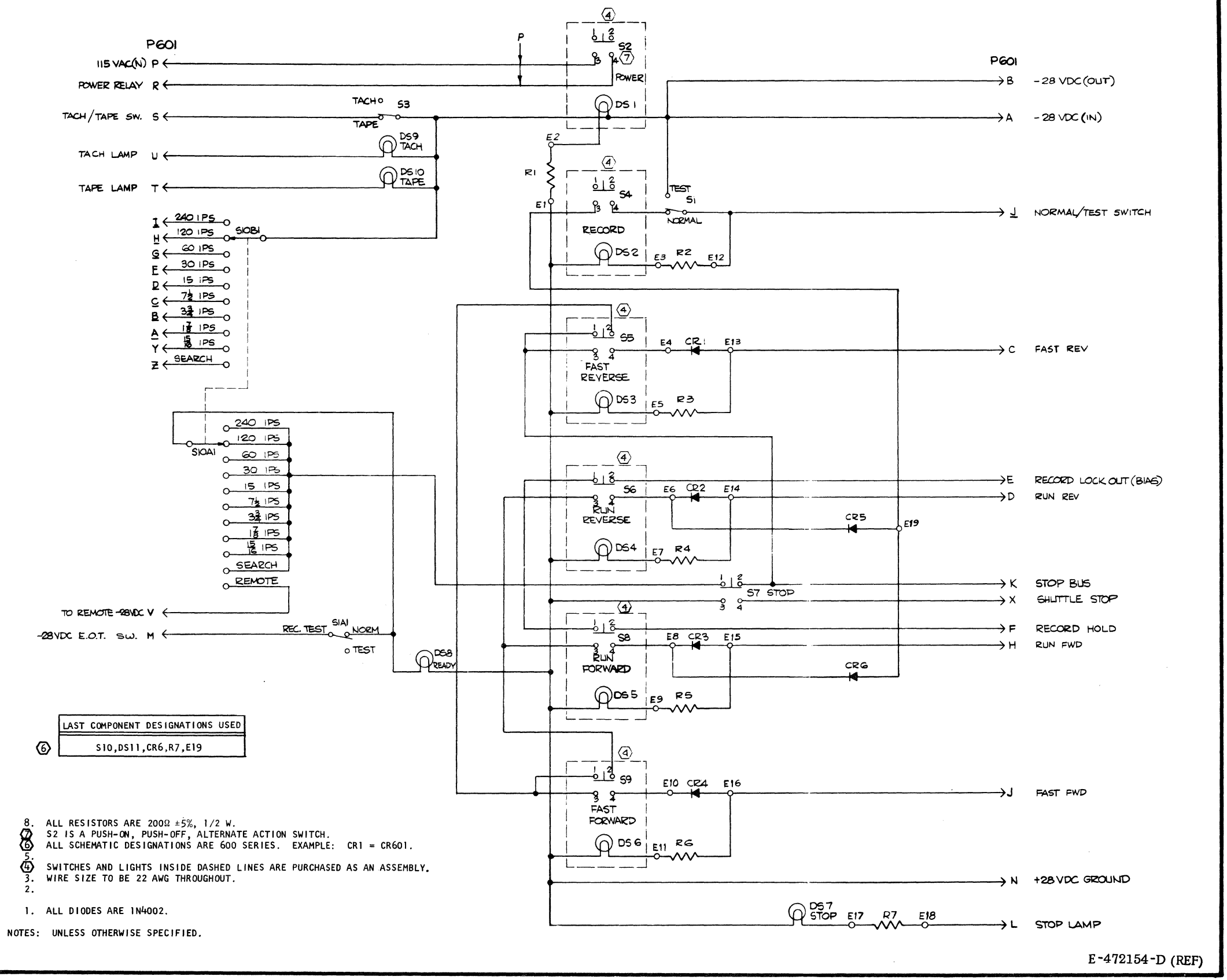


Figure 7-1. Schematic, Electronics and Relay Chassis (Sheet 2 of 2)

Figure 7-2. Interconnection Cable Diagram





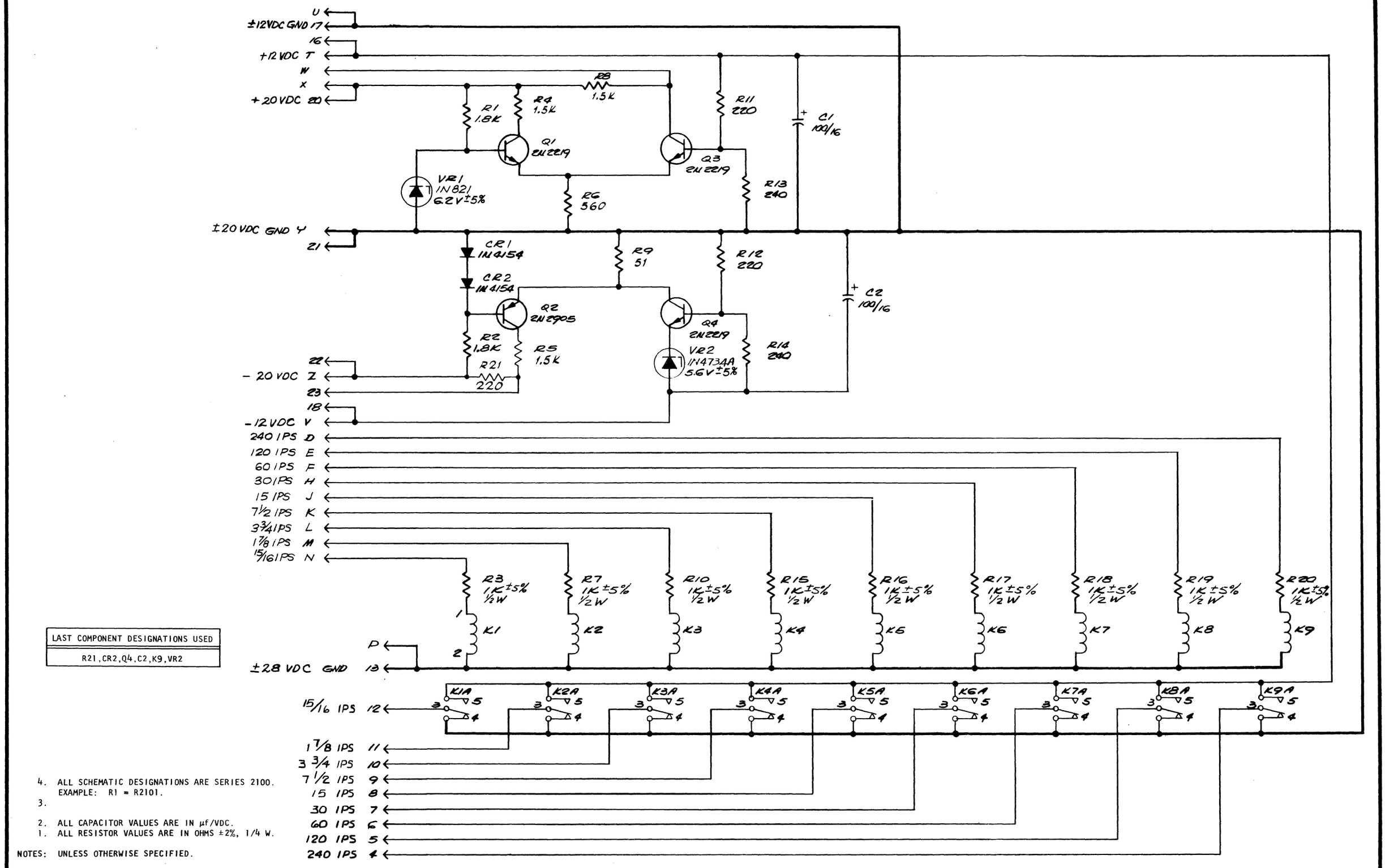
LAST COMPONENT DESIGNATIONS USED
⑥ S10,DS11,CR6,R7,E19

8. ALL RESISTORS ARE 200Ω ±5%, 1/2 W.
⑦ S2 IS A PUSH-ON, PUSH-OFF, ALTERNATE ACTION SWITCH.
⑥ ALL SCHEMATIC DESIGNATIONS ARE 600 SERIES. EXAMPLE: CR1 = CR601.
5.
④ SWITCHES AND LIGHTS INSIDE DASHED LINES ARE PURCHASED AS AN ASSEMBLY.
3. WIRE SIZE TO BE 22 AWG THROUGHOUT.
2.
1. ALL DIODES ARE 1N4002.

NOTES: UNLESS OTHERWISE SPECIFIED.

E-472154-D (REF)

Figure 7-3. Schematic, Tape Transport Switch Panel



LAST COMPONENT DESIGNATIONS USED
R21, CR2, Q4, C2, K9, VR2

4. ALL SCHEMATIC DESIGNATIONS ARE SERIES 2100. EXAMPLE: R1 = R2101.
3.
2. ALL CAPACITOR VALUES ARE IN µf/VDC.
1. ALL RESISTOR VALUES ARE IN OHMS ±2%, 1/4 W.

NOTES: UNLESS OTHERWISE SPECIFIED.

D-472064-B (REF)

Figure 7-4. Schematic, Voltage Regulator Assembly and Speed Switching Unit 7-11/7-12

LAST COMPONENT DESIGNATIONS USED
R38, C9, CR1, Q5, Z12, Y1, TP10, E7
COMPONENT DESIGNATIONS OMITTED
TP5 THRU TP9

TP1 (BRN)
RECORD CONTROL 22
R5 7.5K
TP4 (YEL)
R4 1K
R6 3K
R7 1K
19 BIAS REF
TP10 (BLK)
E5 (6) E6
R27 470
R29 1K
R28 1K
R30 2K
TP2 (RED)
R31 1K
Q1 2N2369
R26 5.1K
20 CAPSTAN SERVO OUT
C2 .001±10% 200VDC
R1 220
R2 220
C1 9-35pf
Y1 16.000MHz
R2 24
C4 0.1±10% 80VDC
C5 0.1±10% 80VDC
E1 E2 E3 E4 (7) E7
CR1 1N4154
R38 390
C7 100 +75% -10% 16VDC
+5V GND 15
+5VDC 14
C3 100 +75% -10% 16VDC
C6 0.1±10% 80VDC
16 +12VDC
C8 50 +75% -10% 16VDC
R33 2K
2N3904 Q4
TP3 (ORN)
R35 75
R36 1K
Q5 2N3906
C9 50 +75% -10% 16VDC
R37 10K
REC SERVO REF
R32 1K
Q2
Q3
R34 10K±10% 1W
2N2369
2N3906
17 ±12V GND
R8 470
R10 470
R12 470
R14 470
R16 470
R18 470
R20 470
R22 470
R24 470
R9 1K
R11 1K
R13 1K
R15 1K
R17 1K
R19 1K
R21 1K
R23 1K
R25 1K
4 240 IPS
5 120 IPS
6 60 IPS
7 30 IPS
8 15 IPS
9 7½ IPS
10 3¾ IPS
11 1⅞ IPS
12 15/16 IPS

74H00 (Z1) (5)
7400 (Z8, Z9, Z10) (4)
7402 (Z6) (4)
7430 (Z11) (4)
7473 (Z2, Z7, Z12)
7490 (Z3)
7493 (Z4, Z5)

(7) 8MHz BIAS FREQUENCY JUMPERED AS SHOWN (E2 TO E4) FOR STD UNIT. FOR OTHER FREQUENCIES, REMOVE EXISTING JUMPER AND JUMPER E1 TO E4 FOR 16 MHz OR E3 TO E4 FOR 4MHz.

(6) E5 & E6 SHOW FULL CAPABILITIES OF UNIT AND ARE NOT PART OF STD UNIT.

(5) Z1 HAS PIN 7 CONNECTED TO +5VDC GND.

(4) Z6, 8, 9, 10 & 11 HAVE PIN 14 CONNECTED TO +5VDC AND PIN 7 CONNECTED TO +5VDC GND.

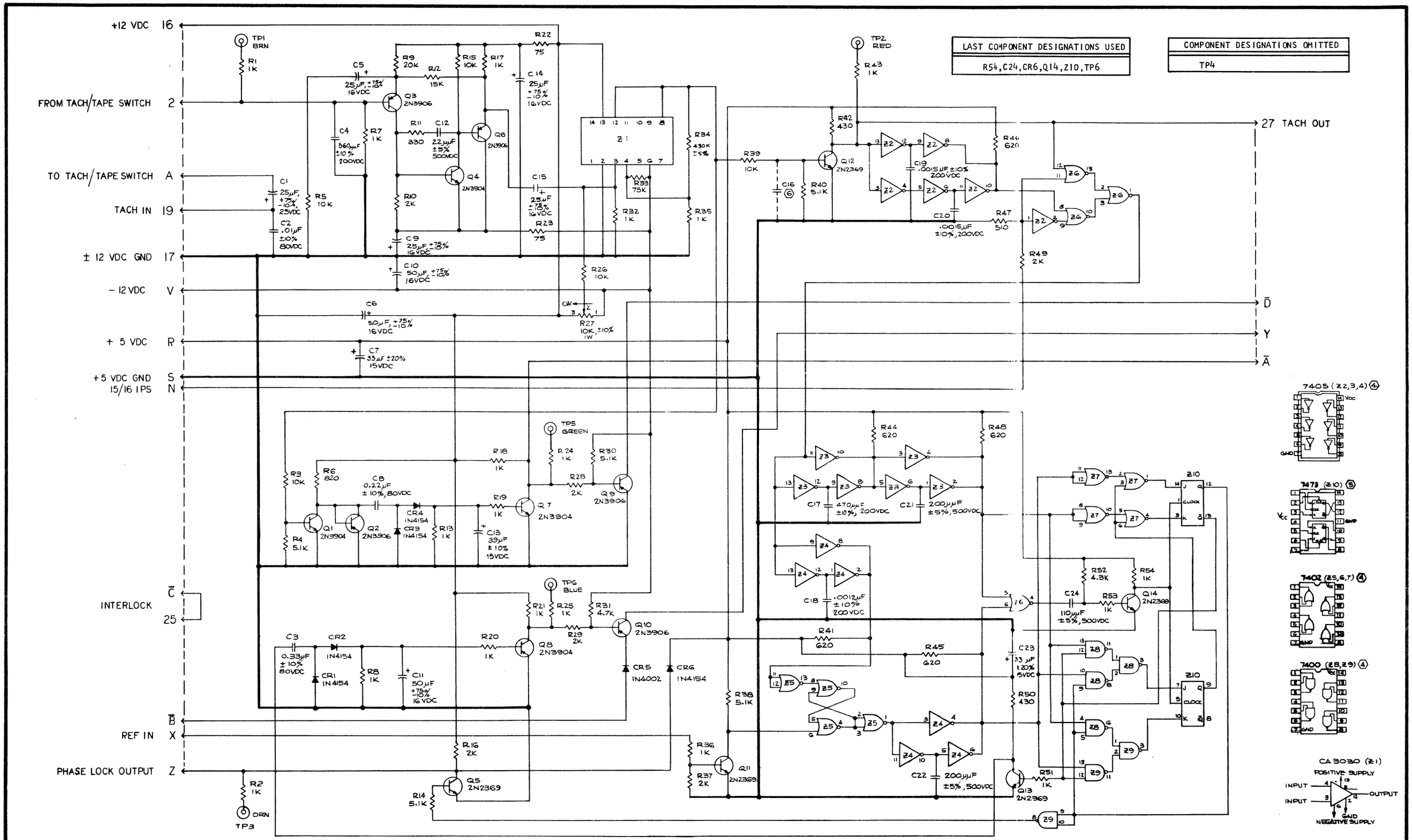
3

2. COMPONENT DESIGNATIONS ARE IN THE 1800 SERIES. **EXAMPLE: R1 = R1801.**
1. ALL RESISTOR VALUES ARE IN OHM ±2%, 1/4W.

NOTES:

D-478230 (REF)

Figure 7-5. Schematic, Reference/Square Wave Generator



3. ALL SCHEMATIC DESIGNATIONS ARE SERIES 1900. EXAMPLE: R1 = R1901.
2.
1. ALL RESISTOR VALUES ARE IN OHMS ±2%, 1/4 W.

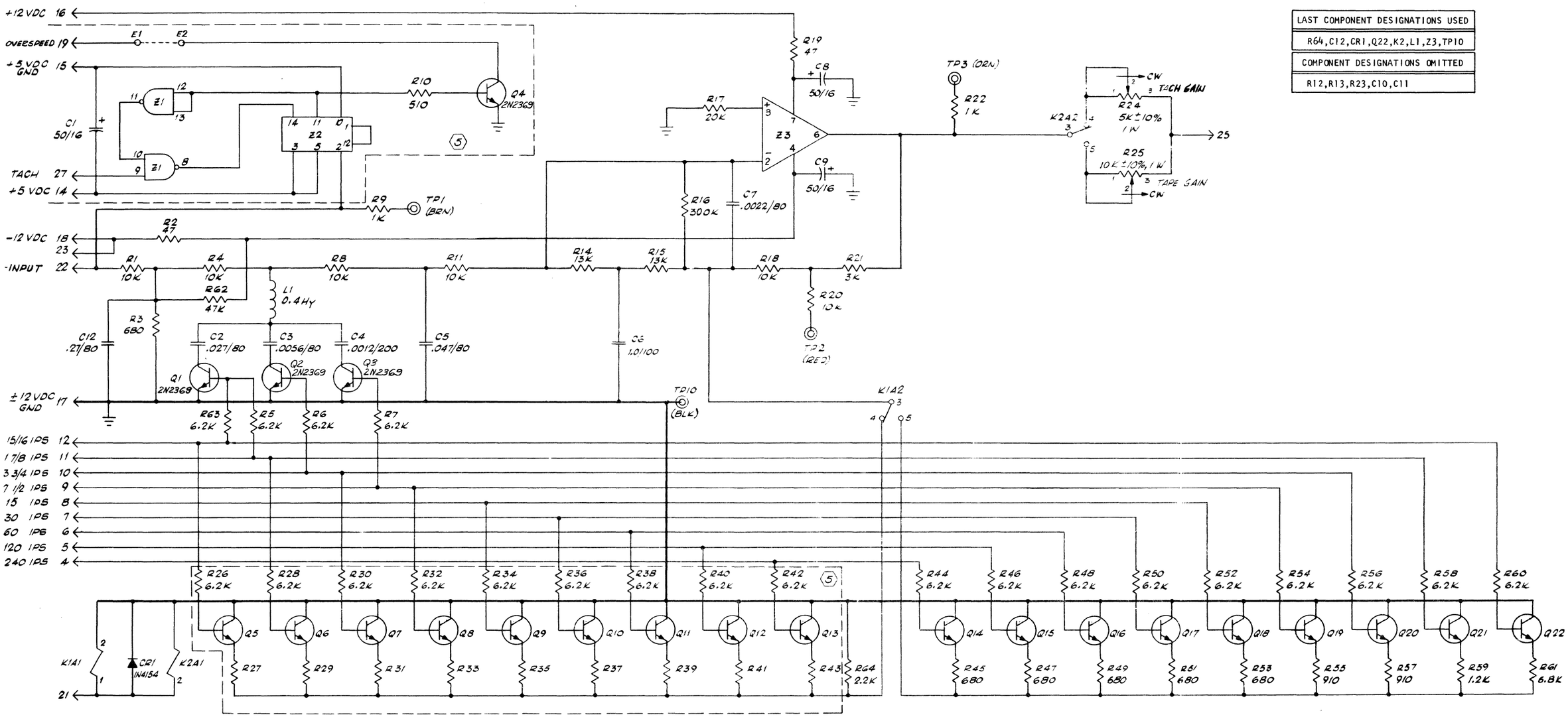
NOTES: UNLESS OTHERWISE SPECIFIED.

(6) C16 IS NOT USED ON STANDARD UNIT.
(5) Z10 HAS PIN 4 CONNECTED TO +5 VDC AND PIN 11 CONNECTED TO +5 VDC GND.
(4) Z2 THRU 9 HAVE PIN 14 CONNECTED TO +5 VDC AND PIN 7 CONNECTED TO +5 VDC GND.

E-472067-C (REF)

Figure 7-6. Schematic, Capstan Servo Amplifier and Tape Control Logic

LAST COMPONENT DESIGNATIONS USED
R64,C12,CR1,Q22,K2,L1,Z3,TP10
COMPONENT DESIGNATIONS OMITTED
R12,R13,R23,C10,C11



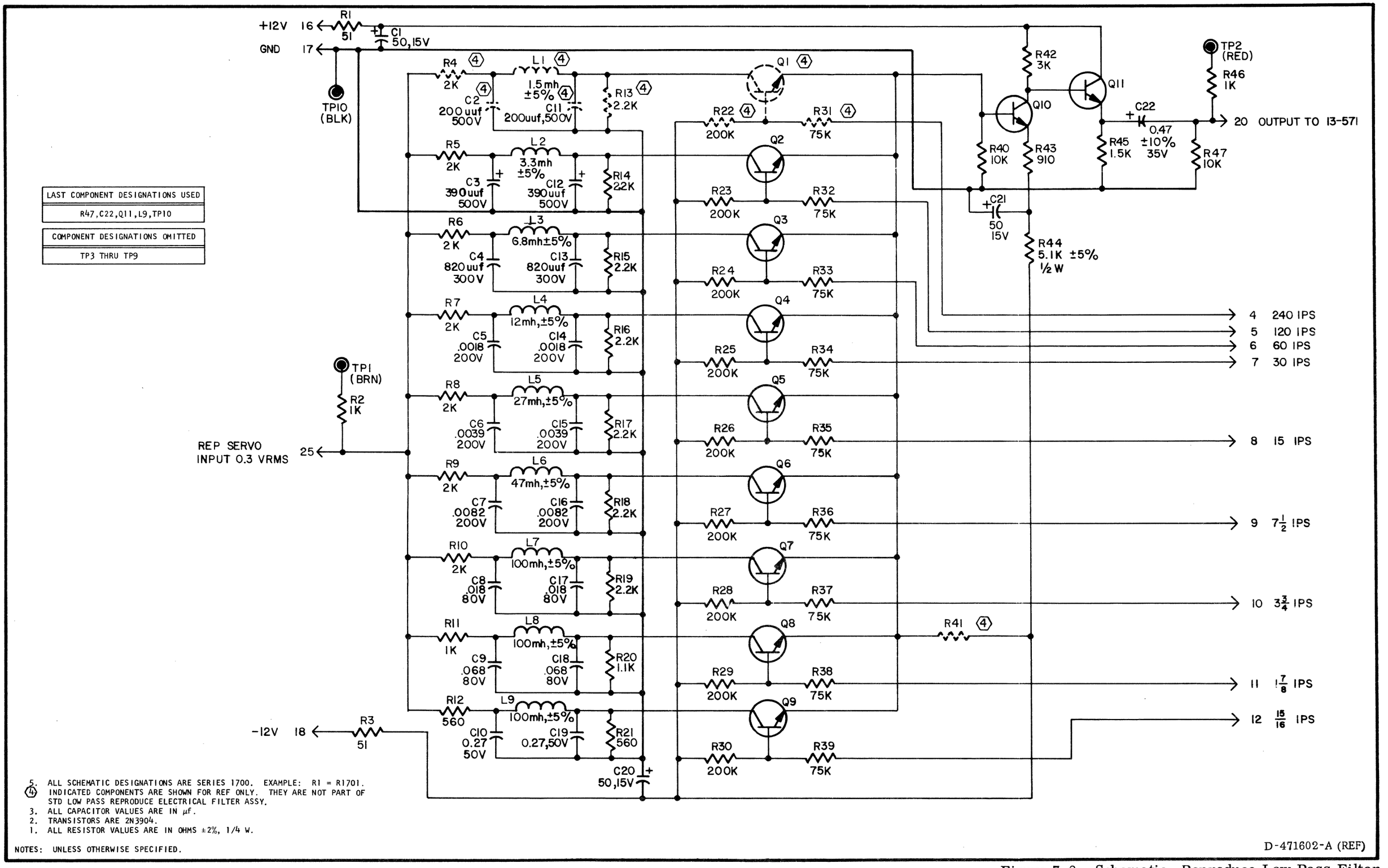
(5) COMPONENTS SHOWN ENCLOSED IN DASHED LINES ARE NOT NORMALLY USED AND SHOW FULL CAPABILITIES OF PW BOARD.

4. ALL COMPONENT DESIGNATIONS ARE 2000 SERIES. EXAMPLE: R1 = R2001.
3. ALL TRANSISTORS ARE 2N3947.
2. ALL CAPACITORS ARE IN MICROFARADS/VDC.
1. ALL RESISTORS ARE IN OHMS ±2%, 1/4 W.

NOTES: UNLESS OTHERWISE SPECIFIED.

D-472196-A (REF)

Figure 7-7. Schematic, Tach/Tape Servo Equalizer



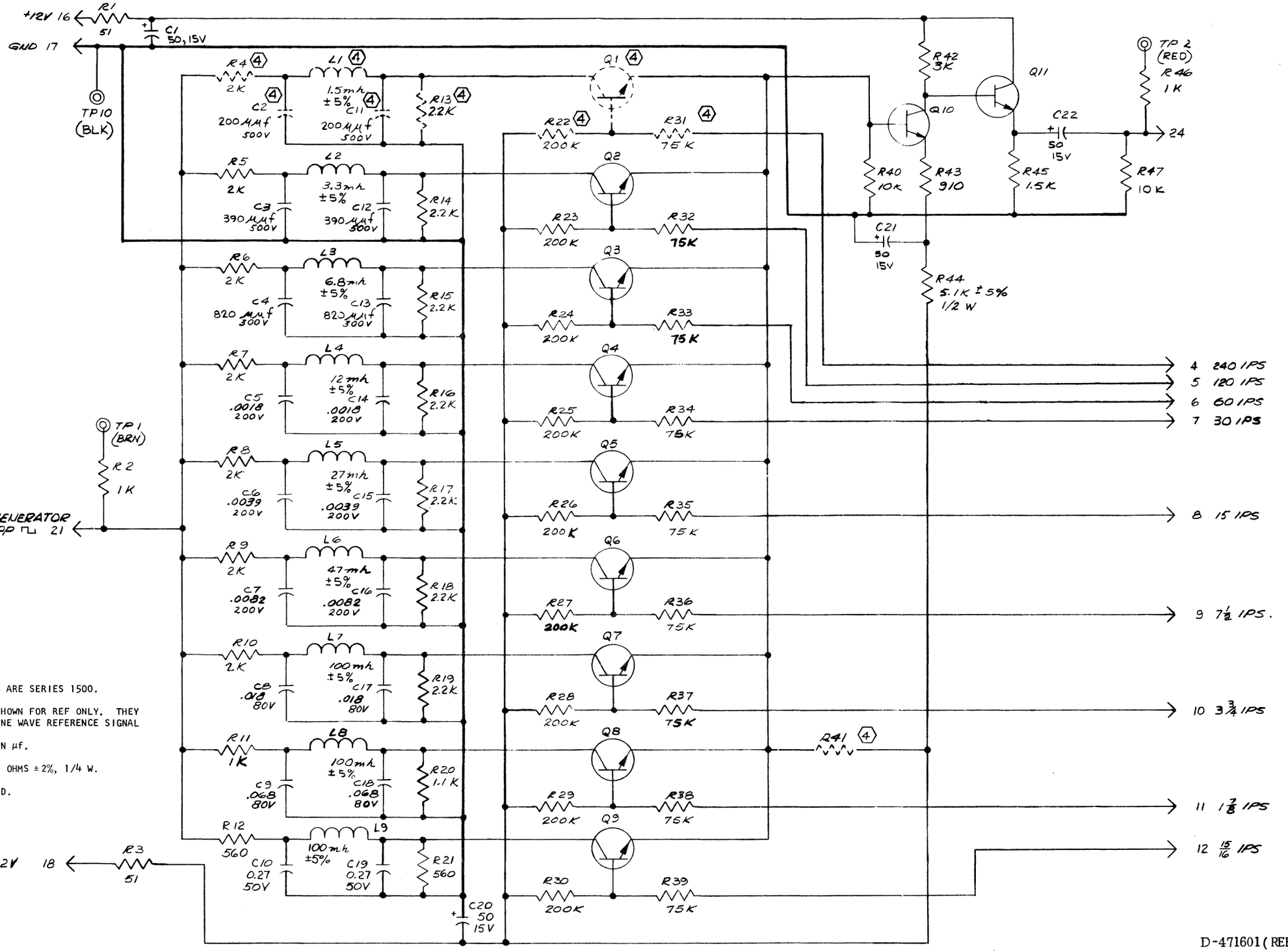
5. ALL SCHEMATIC DESIGNATIONS ARE SERIES 1700. EXAMPLE: R1 = R1701.
④ INDICATED COMPONENTS ARE SHOWN FOR REF ONLY. THEY ARE NOT PART OF STD LOW PASS REPRODUCE ELECTRICAL FILTER ASSY.
3. ALL CAPACITOR VALUES ARE IN μf.
2. TRANSISTORS ARE 2N3904.
1. ALL RESISTOR VALUES ARE IN OHMS ±2%, 1/4 W.

NOTES: UNLESS OTHERWISE SPECIFIED.

D-471602-A (REF)

Figure 7-8. Schematic, Reproduce Low Pass Filter

LAST COMPONENT DESIGNATIONS USED	COMPONENT DESIGNATIONS OMITTED
R47, C22, Q11, L9, TP10	TP3 THRU TP9

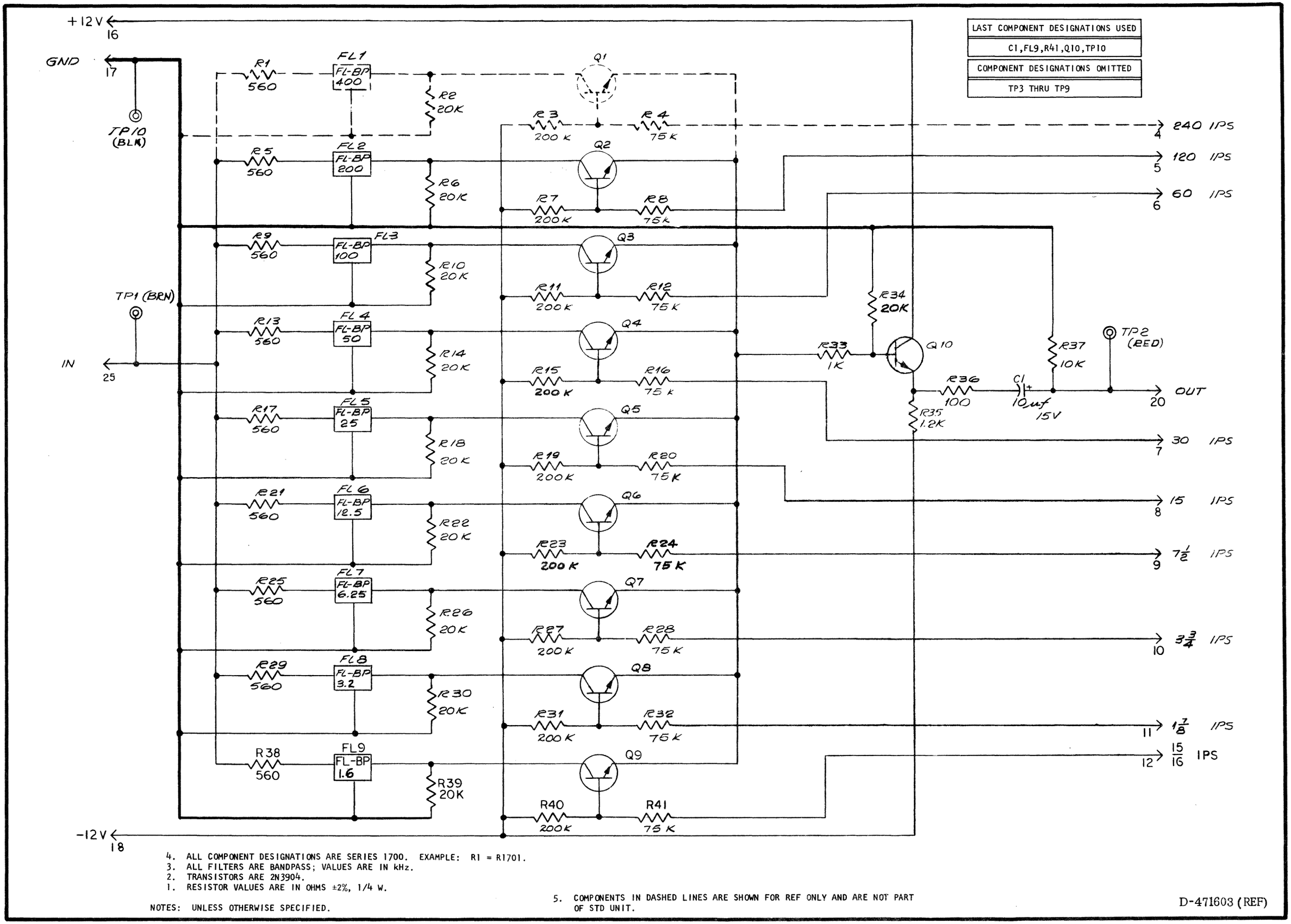


5. ALL SCHEMATIC DESIGNATIONS ARE SERIES 1500. EXAMPLE: R1 = R1501.
(4) INDICATED COMPONENTS ARE SHOWN FOR REF ONLY. THEY ARE NOT PART OF THE STD SINE WAVE REFERENCE SIGNAL GENERATOR.
3. ALL CAPACITOR VALUES ARE IN μf.
2. TRANSISTORS ARE 2N3904.
1. ALL RESISTOR VALUES ARE IN OHMS ±2%, 1/4 W.

NOTES: UNLESS OTHERWISE SPECIFIED.

D-471601 (REF)

Figure 7-9. Schematic, Record Sine Wave Generator



4. ALL COMPONENT DESIGNATIONS ARE SERIES 1700. EXAMPLE: R1 = R1701.
3. ALL FILTERS ARE BANDPASS; VALUES ARE IN kHz.
2. TRANSISTORS ARE 2N3904.
1. RESISTOR VALUES ARE IN OHMS ±2%, 1/4 W.

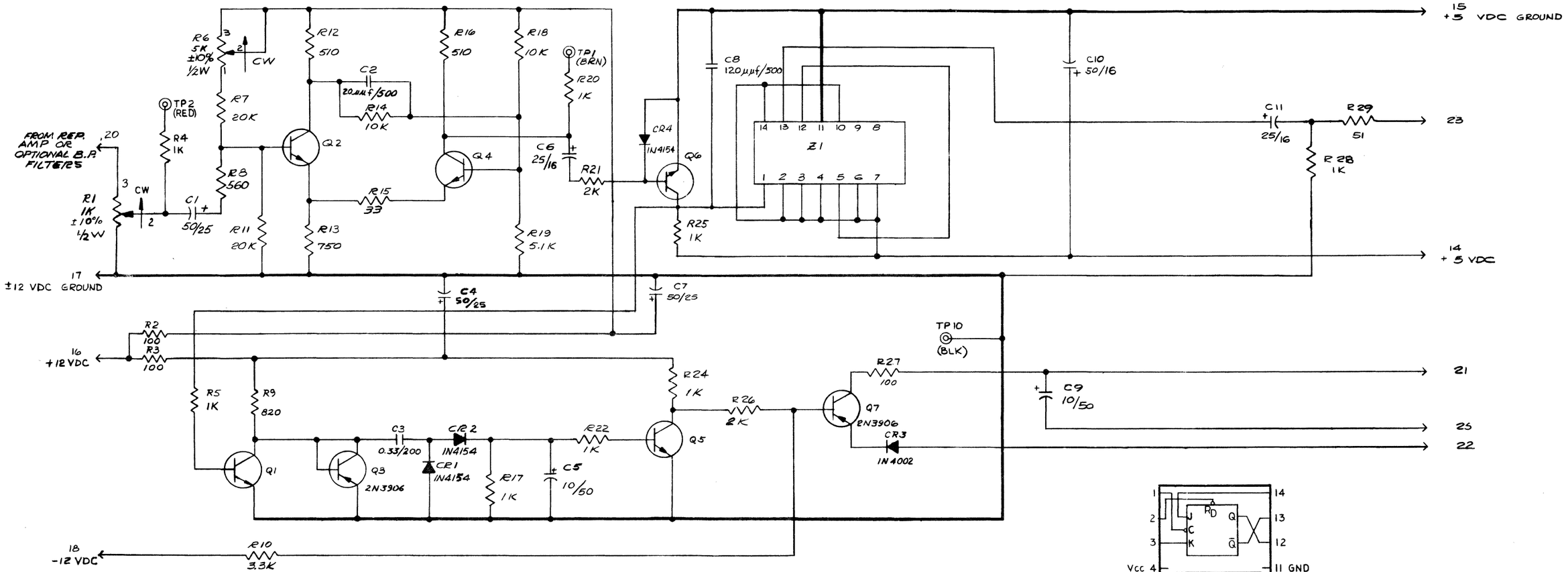
NOTES: UNLESS OTHERWISE SPECIFIED.

5. COMPONENTS IN DASHED LINES ARE SHOWN FOR REF ONLY AND ARE NOT PART OF STD UNIT.

D-471603 (REF)

Figure 7-10. Schematic, Bandpass Filters

LAST COMPONENT DESIGNATIONS USED
R29,Q7,C11,CR4,Z1,TP10
COMPONENT DESIGNATIONS OMITTED
TP3 THRU TP9,R23



4. ALL SCHEMATIC DESIGNATIONS ARE SERIES 1600. EXAMPLE: R1 = R1601.
3. ALL CAPACITOR VALUES ARE IN µf/VDC.
2. ALL RESISTOR VALUES ARE IN OHMS ±2%, 1/4 W.
1. ALL TRANSISTORS ARE 2N3904.

NOTES: UNLESS OTHERWISE SPECIFIED.

D-471608-B (REF)

Figure 7-11. Schematic, Reproduce Servo Control

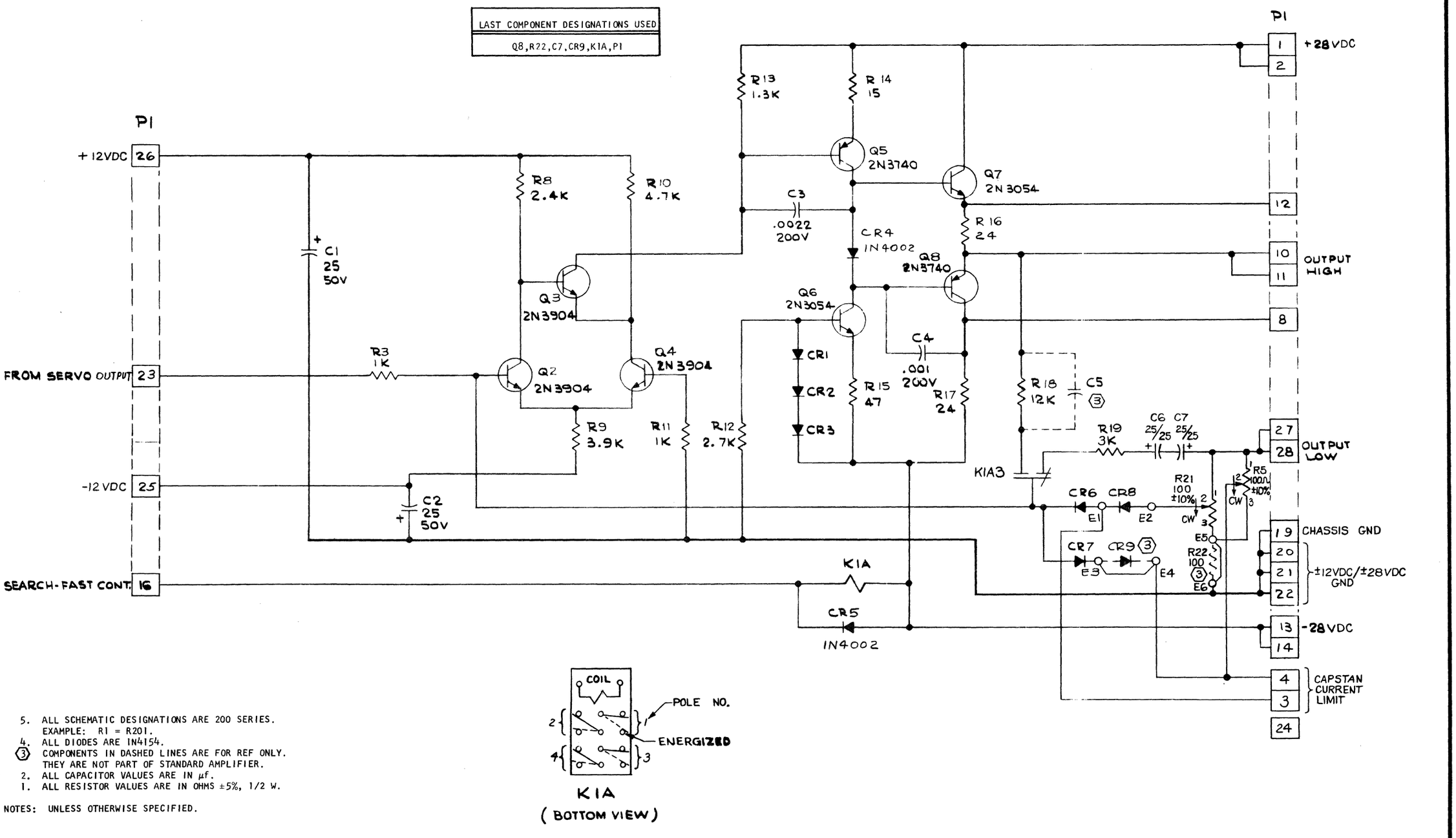


Figure 7-12. Schematic, Capstan Power Amplifier

LAST COMPONENT DESIGNATIONS USED
B201, R226, Q214

LAST COMPONENT DESIGNATIONS USED
B101, R153, Q122

J202 ← J201

AA — CAPSTAN CURRENT LIMIT — 3
BB — CAPSTAN CURRENT LIMIT — 4
R — +28 VDC — 2
+28 VDC REF — 1
X — #22 FROM SERVO OUT — 23
Z — #22 SPARE — 24
W — #22 −12 VDC — 25
V — #22 +12 VDC — 26

J101 >

J
L
H
E
A — 115 VAC (H) REF
C — 115 VAC (H) REF
D — UPR REEL MOT(H)
E — UPR REEL MOT(N)
P — ±12VDC/±28VDC GND
C — 115 VAC (N) REF
D — LWR REEL MOT(N)
B — LWR REEL MOT(H)
F — 115 VAC (N)
B — 115 VAC (H)
Y
W
F — UPPER SOLAR CELL(−) #22
S — UPPER SOLAR CELL (+) #22
T — LWR SOLAR CELL(+) #22
Z — LWR SOLAR CELL(−) #22
U — −28VDC REEL POWER
X
A

P — OUTPUT LOW — 28
M — OUTPUT HIGH — 10
OUTPUT HIGH(REF) — 11
12
8
CHASSIS GND — 19
S — ±12VDC/±28VDC GND — 22
T — ±12 VDC/±28VDC GND — 21
OUTPUT LOW REF — 27
−28VDC REF — 14
±12VDC/±28VDC GND(REF) — 20
−28 VDC — 13
Y — SEARCH-FAST CONT #22 — 16

A
C
H
E
J
F
U
D
B
L
N
K

Q117 DTS430 — R146 2Ω, ±1% 5W
Q119 DTS 430 — R150 2Ω, ±1% 5W
Q121 DTS 430 — R152 2Ω, ±1% 5W
R148 0.5Ω, ±1% 5W

Q209 2N3773
Q211 2N3773
Q214 2N3773
R224 1.0Ω 50W
Q213 2N3773
R226 1.0Ω 50W
Q210 2N3773
Q212 2N3773
R225 1.0Ω 50W
R223 0.31Ω ±3% 25W

B101
B201

Q118 DTS 430 — R147 2Ω, ±1% 5W
Q120 DTS 430 — R151 2Ω, ±1% 5W
Q122 DTS 430 — R153 2Ω, ±1% 5W
R149 0.5Ω, ±1% 5W

REEL POWER AMPL

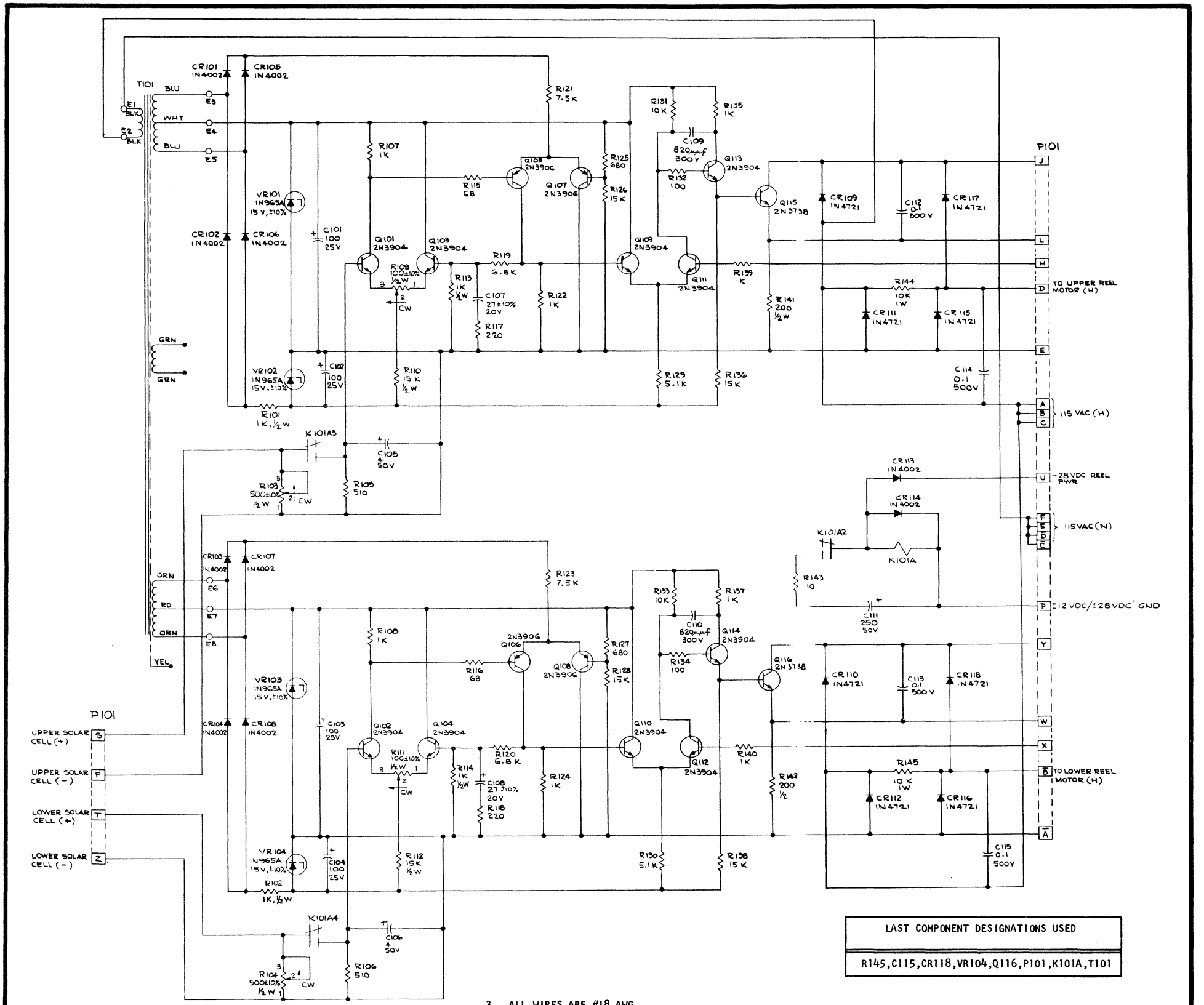
CAPSTAN POWER AMPL

1. ALL WIRES ARE 18 AWG.

NOTES: UNLESS OTHERWISE SPECIFIED.

D-471745-B (REF)

Figure 7-13. Schematic, Reel Power Amplifier and Capstan Power Amplifier Heat Sink Components 7-29/7-30



LAST COMPONENT DESIGNATIONS USED
R145,C115,CR118,VR104,Q116,P101,K101A,T101

3. ALL WIRES ARE #18 AWG.
2. CAPACITOR VALUES ARE IN μf.
1. ALL RESISTOR VALUES ARE IN OHMS ±2%, 1/4 W.

NOTES: UNLESS OTHERWISE SPECIFIED.

E-471720-A (REF)

Figure 7-14. Schematic, Reel Power Amplifier

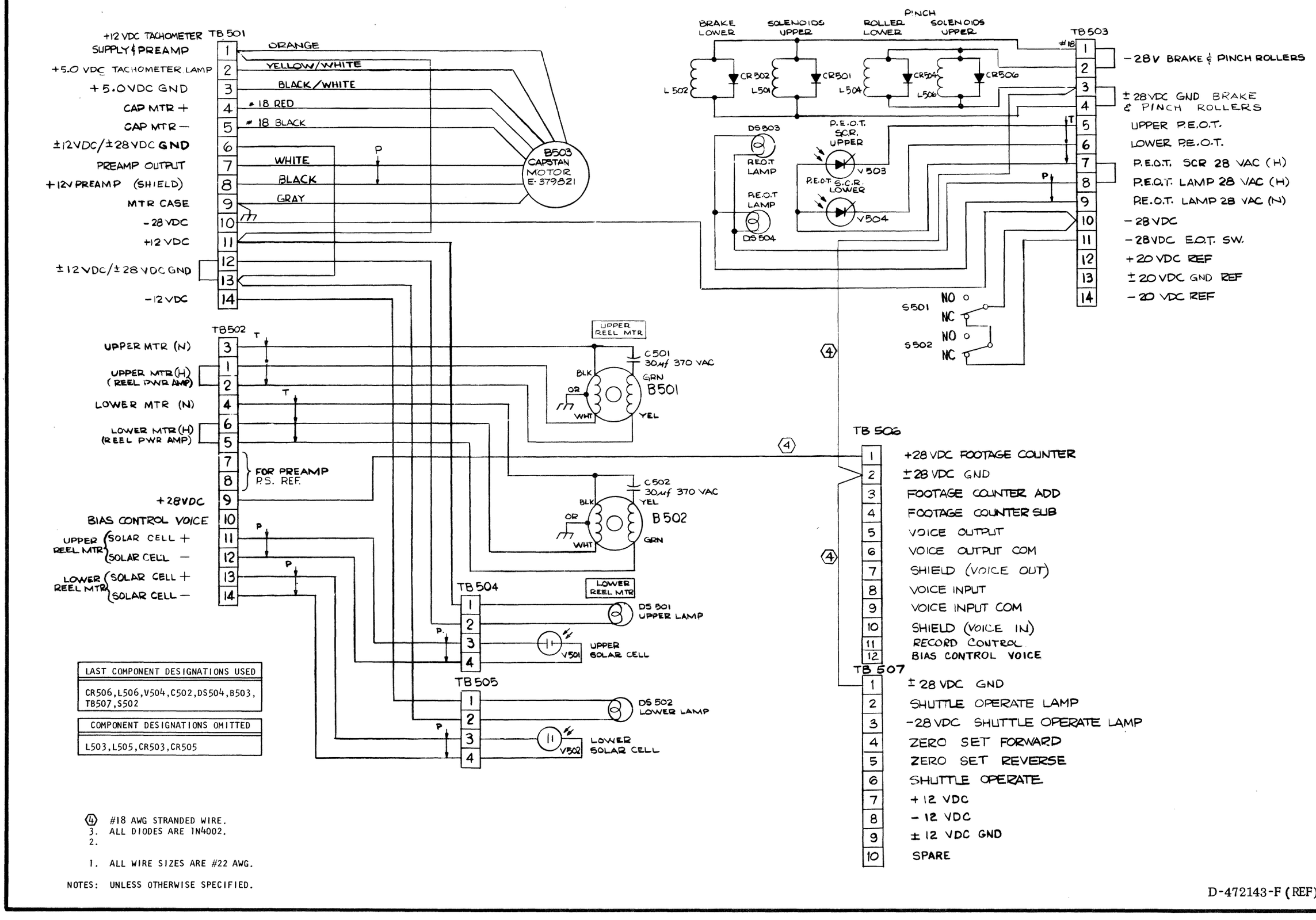
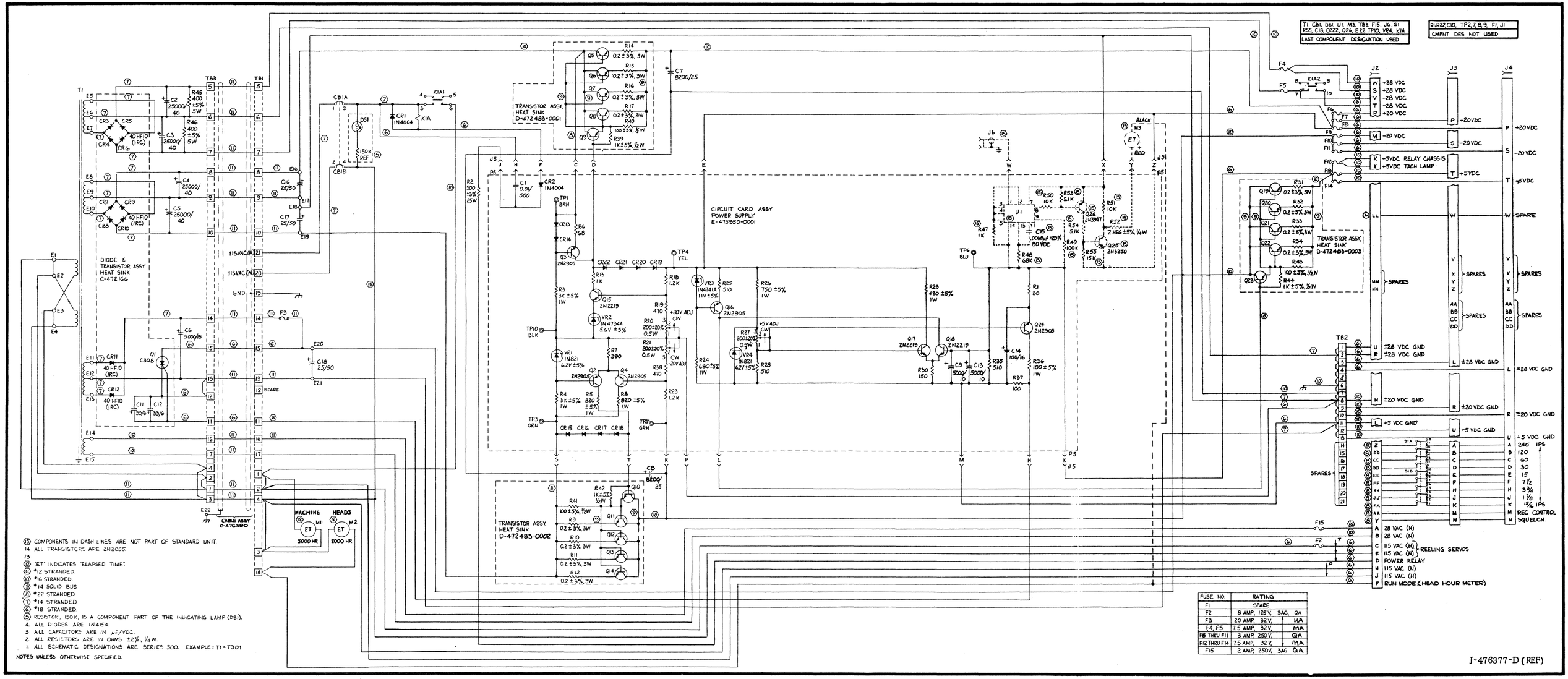


Figure 7-15. Schematic, Tape Transport Plate



FUSE NO.	RATING
F1	SPARE
F2	8 AMP, 125 V, 3AG, QA
F3	20 AMP, 32 V, MA
F4, F5	7.5 AMP, 32 V, MA
F6 THRU F11	3 AMP, 250 V, QA
F12 THRU F14	7.5 AMP, 32 V, MA
F15	2 AMP, 250V, 3AG QA

(15) COMPONENTS IN DASH LINES ARE NOT PART OF STANDARD UNIT.
14. ALL TRANSISTORS ARE 2N3055.
13.
(12) "ET" INDICATES "ELAPSED TIME".
(11) #12 STRANDED.
(10) #16 STRANDED.
(9) #14 SOLID BUS
(8) #22 STRANDED.
(7) #14 STRANDED.
(6) #18 STRANDED.
(5) RESISTOR, 150K, IS A COMPONENT PART OF THE INDICATING LAMP (DS1).
4. ALL DIODES ARE 1N4154.
3. ALL CAPACITORS ARE IN μF/VDC.
2. ALL RESISTORS ARE IN OHMS ±2%, ¼W.
1. ALL SCHEMATIC DESIGNATIONS ARE SERIES 300. EXAMPLE: T1 = T301
NOTES UNLESS OTHERWISE SPECIFIED.

J-476377-D (REF)

Figure 7-16. Schematic, Power Supply

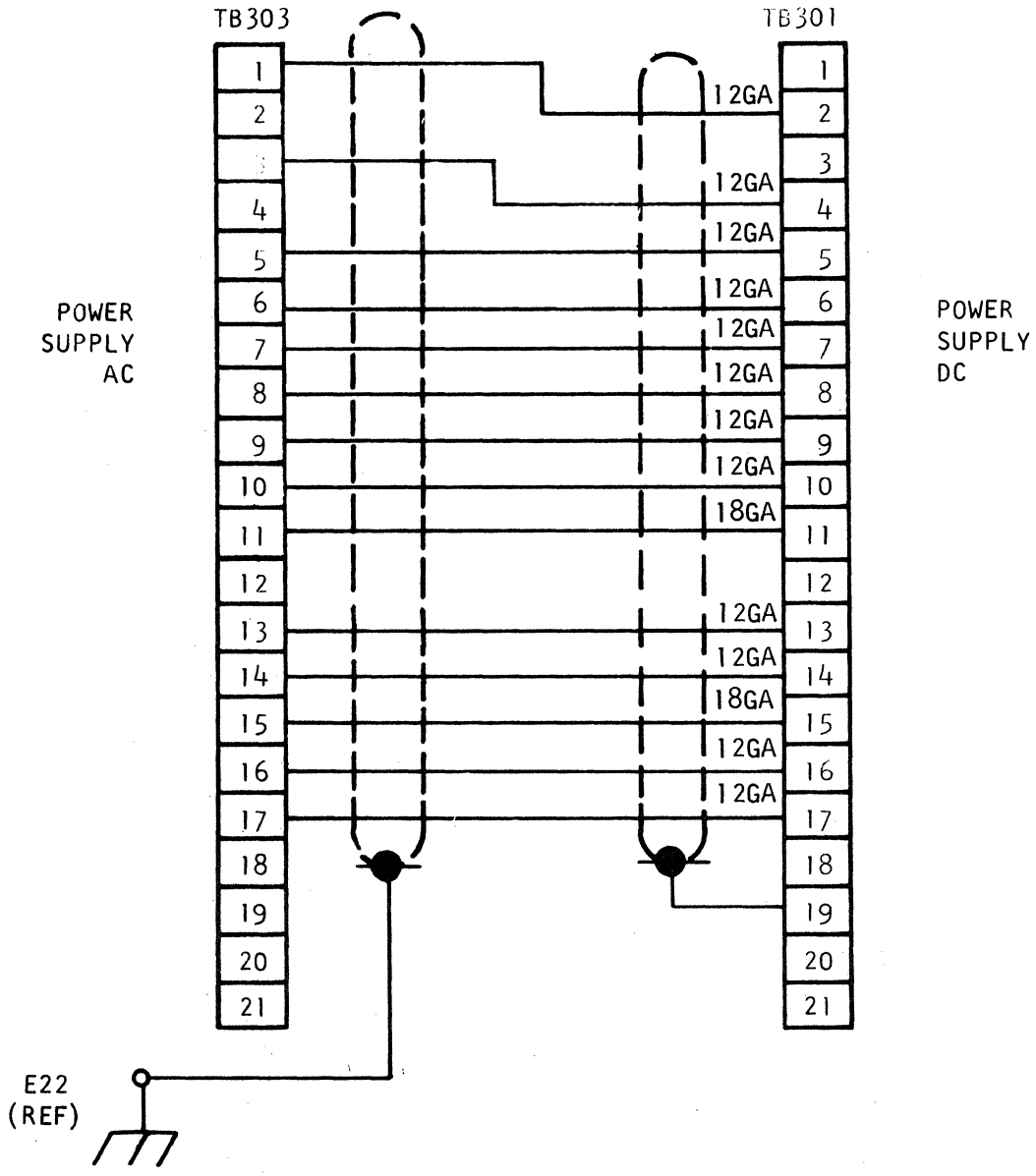
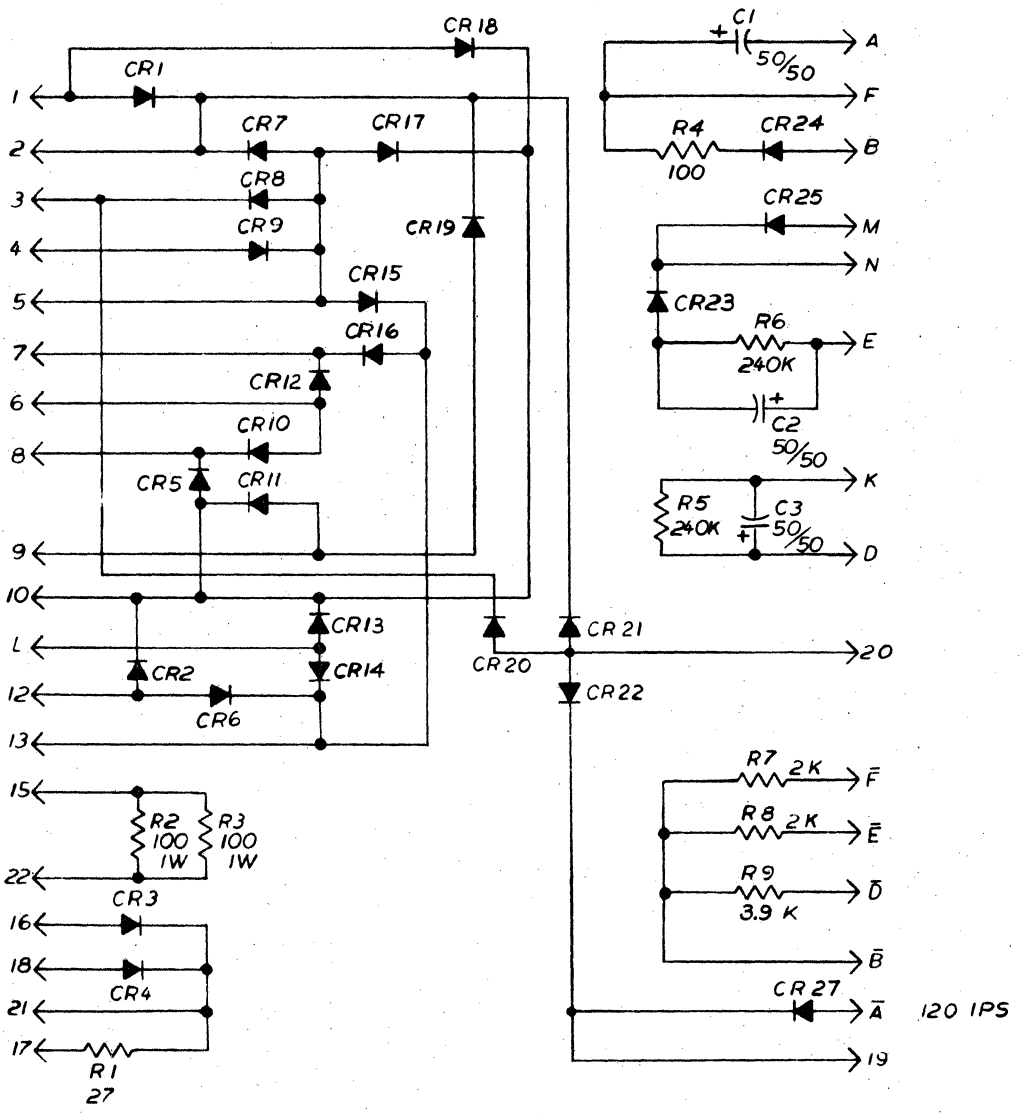


Figure 7-17. Cable Assembly, AC Power Supply TB303 to DC Power Supply TB301

LAST COMPONENT DESIGNATION USED	COMPONENT DESIGNATION NOT USED
R9, CR27, C3	CR26



4. ALL COMPONENT DESIGNATIONS ARE SERIES 2400. EXAMPLE: R1 - R2401
3. ALL DIODES ARE 1N4002.
2. ALL CAPACITORS ARE IN μf, +75 -10% VDC.
1. ALL RESISTORS ARE IN OHMS, ±5%, 1/2 W.

NOTES:

C-471619-B (REF)

Figure 7-18. Schematic, Circuit Card Assembly

SECTION VIII

ACCESSORIES

8-1. GENERAL.

8-2. In this section a description is given of accessories that are available for use with the 13-501 Tape Transport. Generally these accessories are factory installed, however, field installation is possible for most accessories, and advice should be obtained from the local Bell & Howell Sales and Service Office.

8-3. THE TYPE 13-599 FOOTAGE COUNTER, PART NUMBER 476680.

8-4. The footage counter is an accessory of the 13-501 Tape Transport, used to count the footage of tape passing the capstan from any required starting point, and to keep a record of the tape position with reference to that starting point.

8-5. OPERATION.

8-6. To start a count of the tape footage passing the capstan, it is necessary to reset the counter to zero by pressing the reset button on the front of the counter and switching on the counter electronics; switch S1 located on the counter circuit board inserted in J422 of the electronics and relay chassis.

8-7. The counter will operate in both the forward and the reverse directions depending on the direction of tape movement, and will therefore add or subtract to represent the relative footage of tape that has passed the capstan since resetting the counter to zero. The counter is accurate to within one foot or ±5% (whichever is greater) cumulative for each reversal of tape movement.

8-8. PHYSICAL DESCRIPTION.

8-9. The footage counter consists of three assemblies; a driver printed circuit board (figure 8-1), a footage counter printed circuit board (figure 8-2), and a bidirectional electromechanical counter. The footage counter printed circuit board is inserted into J422 of the electronics and relay chassis. The electromechanical counter and driver printed circuit board are mounted at the bottom of the control panel.

8-10. The footage counter cable and wiring diagram are shown in figure 8-3.

8-11. CIRCUIT DESCRIPTION.

8-12. Refer to schematic diagrams, figures 8-4 and 8-5, for the following description of the footage counter. The output of the capstan motor tachometer preamplifier is applied to the footage counter at pin 27. The output of the tachometer preamplifier provides 10,000 pulses per foot of tape travel. These pulses are counted down by a series of divider circuits, to provide one pulse per foot of tape travel.

8-13. The divider circuits consist of four divide-by-ten circuits, which provide one pulse per foot of tape travel (in either direction) at the output at Z4-12.

8-14. The output of the divider circuits is differentiated by C2 and R1 and used to trigger the one-shot made up of Q1, Z6-2, Z6-12 and associated components.

8-15. The counter wheels are activated by two electromagnetic coils, one to subtract and one to add. Each coil is energized by a driver transistor, Q2 and Q3, respectively. The back EMF from the add and subtract coils is suppressed by diodes CR1, CR2, and zener diode VR2.

8-16. The add forward circuit is enabled by the positive (high) input at Z5-13, -12. Diode CR1 blocks the positive voltage from ground. A low out of Z5-11 inhibits the NAND gate Z5-6 thus inhibiting the subtract circuit. The low from Z5-11 is also applied to Z5-9, -10. This produces a high at add gate Z5-2 enabling the add circuit. Thus the pulses from the one-shot will be routed to the add circuit.

8-17. The reverse direction of the counter originates from a contact closure in the tape transport. Reverse direction relay K418 in the transport provides -28 volts at pin 19. The negative voltage input at NAND gate Z5-13, -12 is pulled to ground through the jumper between R3 and R4 and through diode CR1. This produces a high at Z5-11. A high at subtract gate Z5-5 enables the subtract circuit. Thus the pulses from the one-shot will be routed to the subtract circuit. Notice that a high at Z5-11 is transmitted to a low, through Z5-8, at add gate Z5-3. This inhibits the add gate.

8-18. Switch S1 is an ON-OFF switch in the output line from the divider circuits (Z1, Z2, Z3, Z4).

NOTE

Switch S1 does not control the -12 volt supply, or the +5 volt supply to the micrologic circuits. To interrupt these supplies it is necessary to press the transport POWER button.

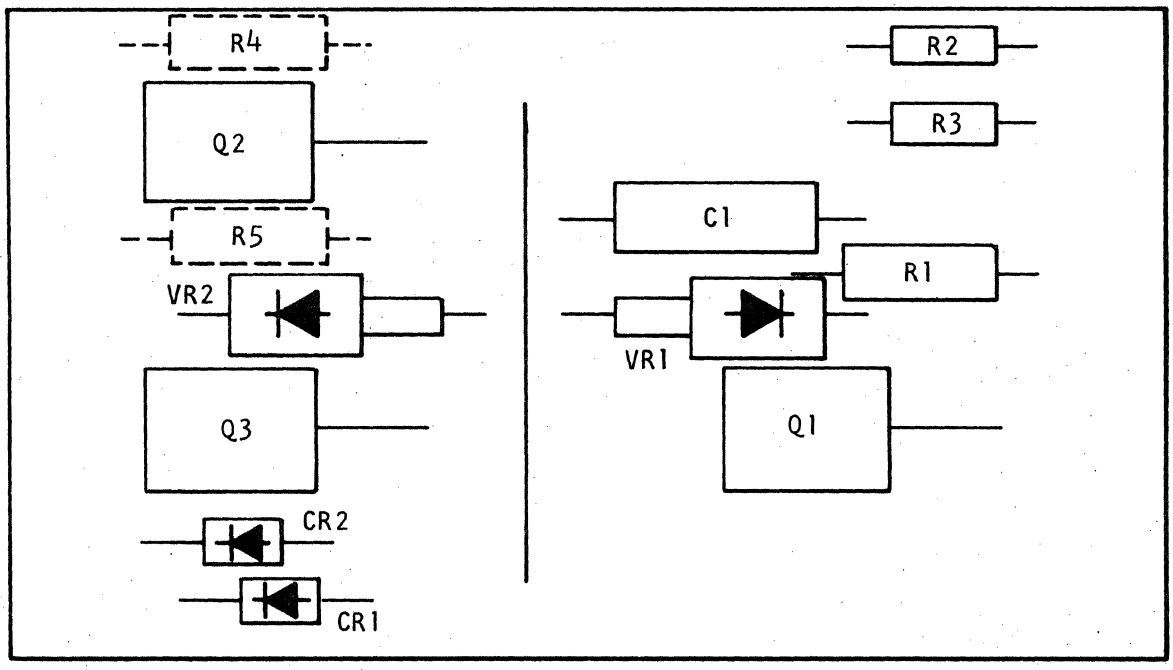
8-19. A list of manufacturers, accessories, is given in table 8-1. The parts list for the footage counter is tabulated in table 8-2.

CODE	MANUFACTURER
01295	Texas Instruments, Incorporated Semiconductor-Components Division Dallas, Texas
03508	General Electric Company Semiconductor Products Department Syracuse, New York
04713	Motorola Semiconductor Products, Incorporated Phoenix, Arizona
05397	Union Carbide Corporation Materials Systems Division Cleveland, Ohio

Table 8-1. List of Manufacturers, Accessories (Sheet 1 of 2)

CODE	MANUFACTURER
24546	Corning Glass Works Bradford, Pennsylvania
28222	Kessler-Ellis Products Company Atlantic Highlands, New Jersey
56289	Sprague Electric Company North Adams, Massachusetts
73842	Goodyear Tire and Rubber Company Akron, Ohio
78488	Stackpole Carbon Company St. Marys, Pennsylvania
79727	Continental-Wirt Electronics Corporation Philadelphia, Pennsylvania
88245	Litton Precision Products, Incorporated Useco Div., Litton Industries Van Nuys, California

Table 8-1. List of Manufacturers, Accessories (Sheet 2 of 2)

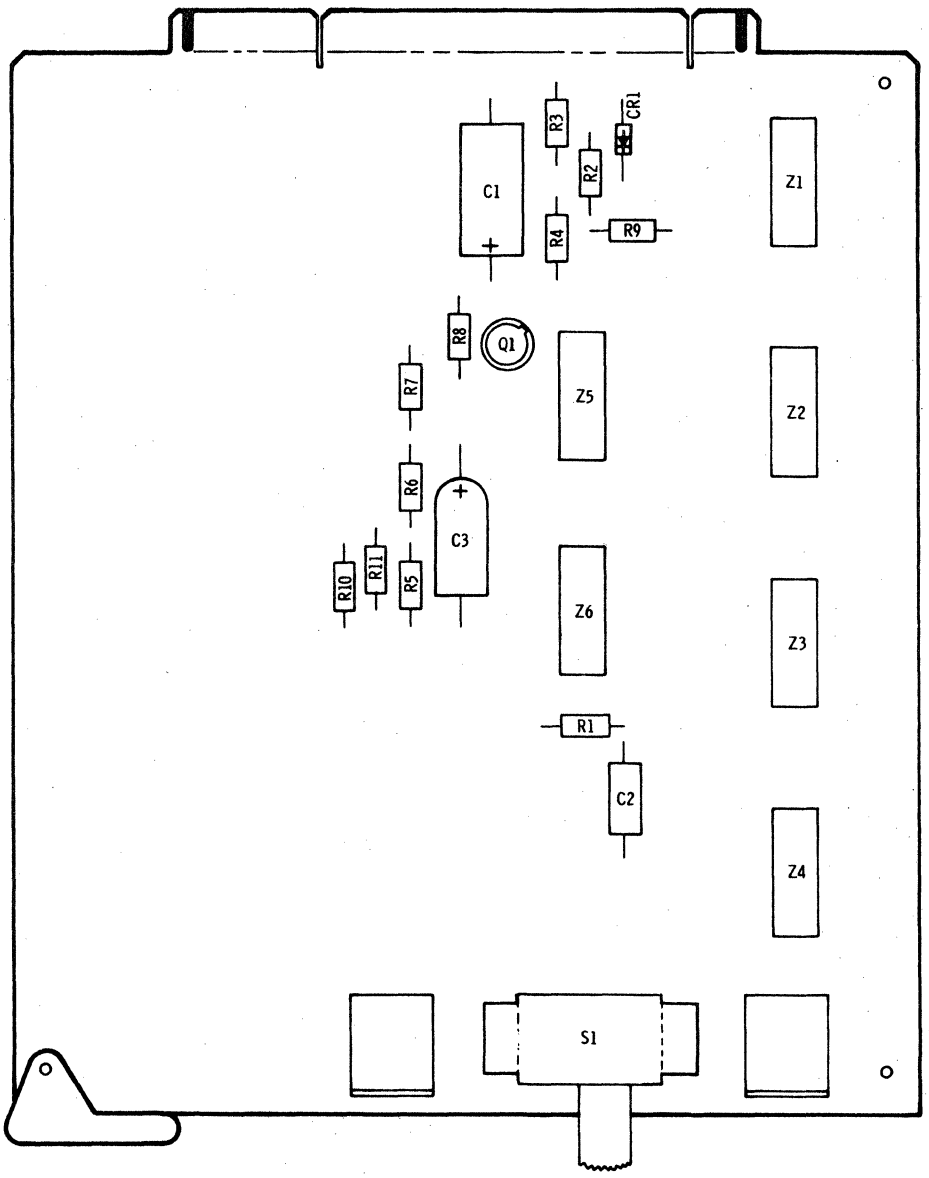


C-476666 (REF)

Figure 8-1. Driver, Footage Counter

Table 8-2. Parts List for the 13-599 Footage Counter (Sheet 1 of 3)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	476680	Footage Counter Assy	1			
2	471605	Wiring Diagram	Ref			
3	472141	Cable, footage counter	1			
4	471876-2299	Wire, insul, 22 AWG	A/R			
5	156071-1	Terminal, lug	4			
6	200710-1	Tag, blank, cable	1			
7	19362-15	Insulation, sleeving, elect.	A/R			
8	472136	Front Panel Assy	1			
9	471585	Panel, front	1			
10	371713-11	Stud, weld	2			
11	375056-1	Counter, elect.	1	M1	28222	ED15-11
12	471584	Bracket, footage counter pc bd	1			
13	472137	Moulding, trim	1			
14	472134	Spacer, plate	1			
15	17484-0121	Resiweld, adhesive	A/R			
16	471876-2299	Wire, insul, 22 AWG	A/R			
17	476666-0001	Driver, footage counter	1	8-1		
18	476665	Schematic	Ref			
19	476666	Printed Wiring Bd	1			
20	41532-3	Lug, spade miniature	7			
21	7138-3915	Res, 390Ω ±5%, 1/2 w	1	R1	78488	RC20GF391J
22	471922-5602	Res, 56Ω ±2%, 1/4 w	2	R2,3	24546	C4-560G



D-472181-F (REF)

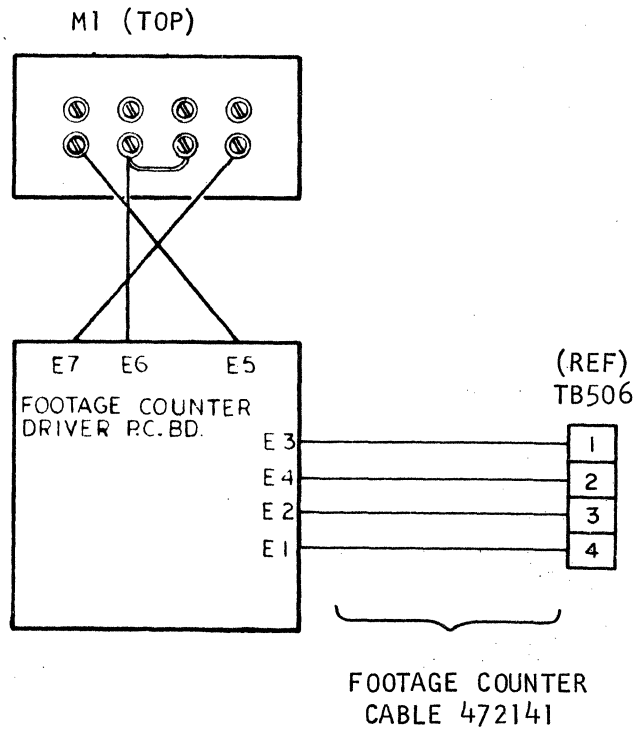
Figure 8-2. Printed Circuit Board, Footage Counter

Table 8-2. Parts List for the 13-599 Footage Counter (Sheet 2 of 3)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	215095-262	Cap, 0.01 μf ±10%, 200 v	1	C1	56289	192P10392
2	372295-1	Diode	2	CR1,2	01295	1N4002
3	212158-86	Diode, zener, 24 vdc ±5%	1	VR1	04713	1N3029B
4	212158-9	Diode, zener, 15 vdc ±20%	1	VR2	04713	1N3024
5	373762-3	Transistor, NPN	3	Q1,2,3	04713	2N4923
6	70155-285	Screw, pan hd, #4-40 x 3/8 lg	3			
7	9916-22	Wire, elec, 22 AWG	A/R			
8	472181-1	Footage Counter	1	8-2		
9	472184	Schematic	Ref			
10	472181	Printed Wiring Bd	1			
11	471922-1812	Res, 180Ω ±2%, 1/4 w	1	R1	24546	C4-181G
12	471922-6222	Res, 6.2K ±2%, 1/4 w	1	R2	24546	C4-622G
13	471922-1032	Res, 10K ±2%, 1/4 w	1	R3	24546	C4-103G
14	471922-1012	Res, 100Ω ±2%, 1/4 w	1	R4	24546	C4-101G
15	471922-1222	Res, 1.2K ±2%, 1/4 w	1	R5	24546	C4-122G
16	471922-2222	Res, 2.2K ±2%, 1/4 w	1	R6	24546	C4-222G
17	471922-6212	Res, 620Ω ±2%, 1/4 w	1	R7	24546	C4-621G
18	471922-1022	Res, 1K ±2%, 1/4 w	1	R8	24546	C4-102G
19	471922-1232	Res, 12K ±2%, 1/4 w	1	R9	24546	C4-123G
20	471922-1512	Res, 150Ω ±2%, 1/4 w	2	R10,11	24546	C4-151G
21	471930-0003	Cap, 100 μf +75 -10%, 16 v	1	C1	56289	500D107G016DC7
22	215095-592	Cap, 0.01 μf ±10%, 80 v	1	C2	56289	192P1039R8

Table 8-2. Parts List for the 13-599 Footage Counter (Sheet 3 of 3)

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	374986-0308	Cap, 39 μf ±10%, 10 v	1	C3	05397	K39C10K
2	471951	Integrated Ckt	4	Z1 thru Z4	01295	SN7490N
3	471934	Integrated Ckt	1	Z5	01295	SN7400N
4	471940	Integrated Ckt	1	Z6	01295	SN7405N
5	375126	Switch, DPDT, rt angle	1	S1	79727	G-350-PC-DPDT
6	474971-1	Plate, instr (on)	1			
7	474971-2	Plate, instr (off)	1			
8	246954	Diode	1	CR1	03508	1N4154
9	471472	Transistor, NPN	1	Q1	04713	2N3947
10	17484-91	Adhesive, Pliobond	A/R		73842	#30



B-471605-B (REF)

Figure 8-3. Footage Counter Wiring Diagram

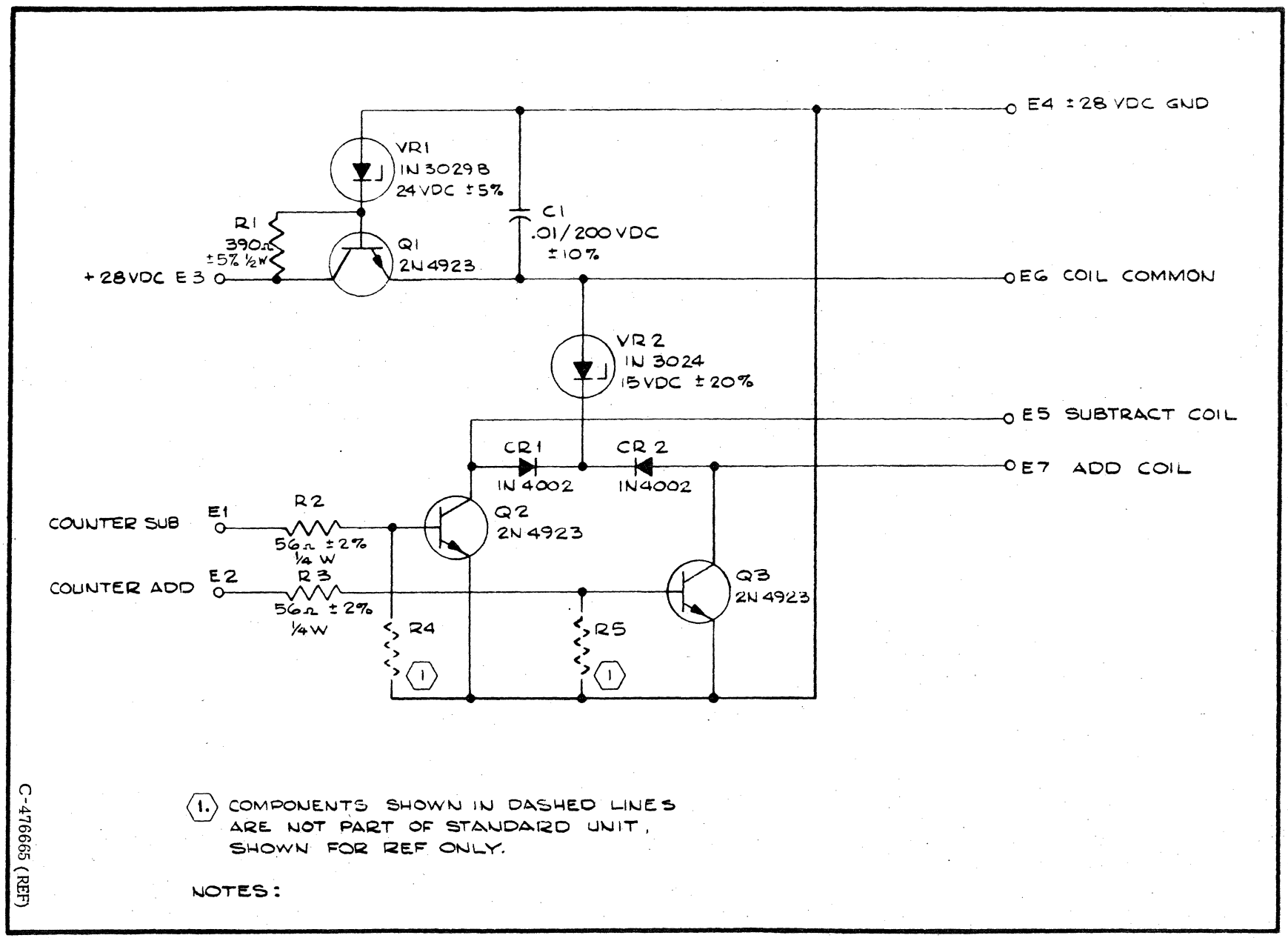
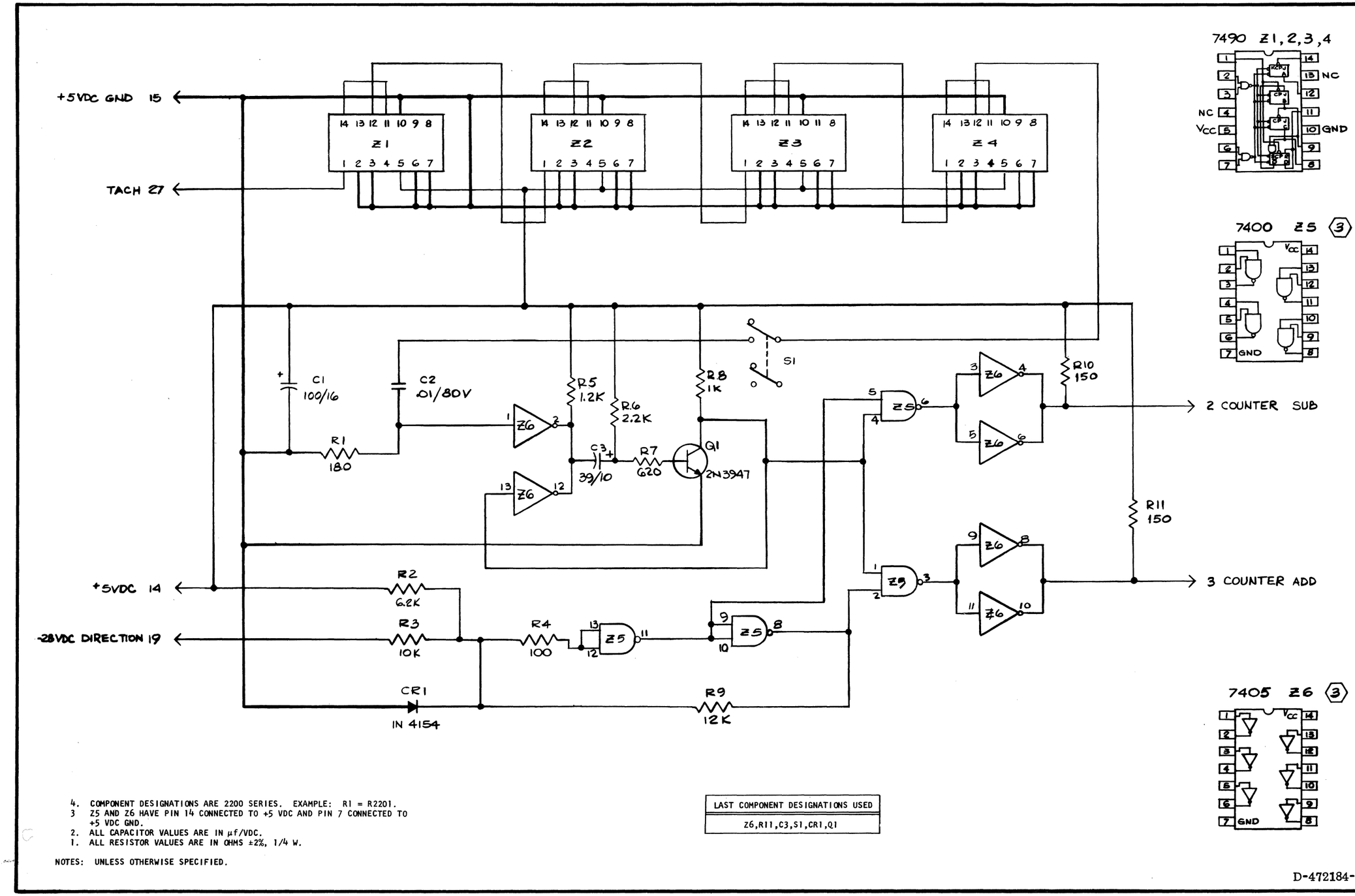


Figure 8-4. Schematic, Footage Counter Driver



4. COMPONENT DESIGNATIONS ARE 2200 SERIES. EXAMPLE: R1 = R2201.
3 Z5 AND Z6 HAVE PIN 14 CONNECTED TO +5 VDC AND PIN 7 CONNECTED TO +5 VDC GND.
2. ALL CAPACITOR VALUES ARE IN μf/VDC.
1. ALL RESISTOR VALUES ARE IN OHMS ±2%, 1/4 W.

NOTES: UNLESS OTHERWISE SPECIFIED.

LAST COMPONENT DESIGNATIONS USED
Z6,R11,C3,S1,CR1,Q1

D-472184-C (REF)

Figure 8-5. Schematic, Footage Counter

992616-0003

VR-3700B
MAGNETIC TAPE
RECORDER/REPRODUCER

OPERATION AND MAINTENANCE MANUAL

INSTRUMENTS DIVISION
360 Sierra Madre Villa, Pasadena, California 91109



BELL & HOWELL

The modification required to the standard manual on Register No. B-15075 is not complete at this date, but will be shipped separately as soon as possible.

INSTRUMENTS DIVISION
360 Sierra Madre Villa, Pasadena, California 91109
BELL & HOWELL

TYPE VR-3700B MAGNETIC TAPE RECORDER/REPRODUCER

13-501 TAPE TRANSPORT

1-1. GENERAL.

1-2. This addendum contains information which should be added to the operation and maintenance manual for the Type 13-501 Tape Transport. This manual is a component manual for the VR-3700B Magnetic Tape Recorder/Reproducer.

1-3. EFFECTIVITY.

1-4. This addendum makes the 13-501 Tape Transport manual, Bell & Howell part number 992602-0003, compatible with equipment bearing serial numbers 3015, 3016, 3017, 3063, 3065, 3066, 3069, 3070, 3078, and 3080.

1-5. INSTALLATION.

1-6. This information should be added to Section II, Installation, of the 13-501 Tape Transport manual: The capstan motor is mounted on the back of the tape transport precision plate assembly. Figure 2-1 in the tape transport manual illustrates the capstan motor location.

1-7. SHIPMENT.

1-8. The following figure A-1 illustrates the Location of the Tape Transport Capstan Flywheel. Figure A-2 illustrates the Capstan Flywheel Installation. The capstan flywheel must be removed and packaged in a separate container when the tape system is shipped.

CAUTION

Failure to remove the capstan flywheel before shipping will cause damage to the capstan shaft.

1-9. To gain access to the capstan motor, open the transport cover door. Release the two black knurled screw latch assemblies located at the extreme top and bottom right-hand corners of the transport plate.

1-10. The capstan flywheel is secured to the capstan motor shaft by an Allen screw. The Allen screw is retained in the flywheel by a washer and a retaining ring in such a manner that when the Allen screw is backed out, it will separate the flywheel from the capstan shaft. When installing or removing the flywheel, do not remove the washer or the retaining ring. The Allen wrench will fit through the hole in the washer. Install the capstan flywheel as follows:

a. When installing the capstan flywheel on the capstan motor shaft, screw the Allen screw into the end of the capstan motor shaft. Using a torque wrench, tighten to 14 ±1 inch-pounds of torque.

b. When removing the capstan flywheel, back out the Allen screw and the self-pulling feature will remove the flywheel from the capstan motor shaft.

1-11. PARTS LIST.

1-12. Change the parts list, table 6-3, in Section VI as follows:

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG. REF
On page 6-15, delete:				
15	476578	Motor, dir current, capstan	1	B503
On page 6-15, add:				
15	379821	Motor, dir current, capstan	1	B503

1-13. SCHEMATIC.

1-14. Capstan motor 379821 is electrically the same as 476578, thus figure 7-15, Schematic, Tape Transport Plate, applies.

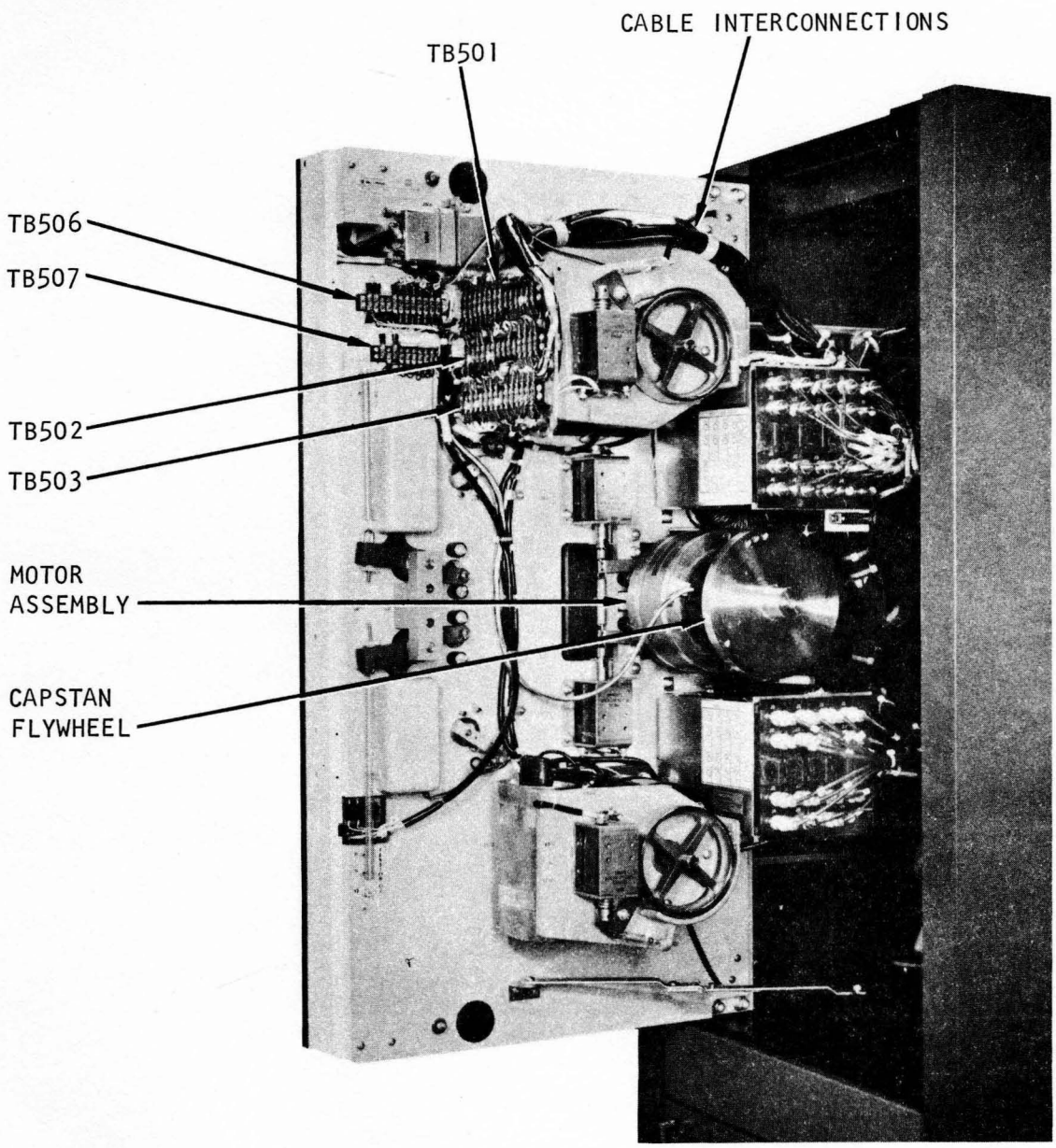


Figure A-1. Location of Tape Transport Capstan Flywheel and Cable Routing Interconnections

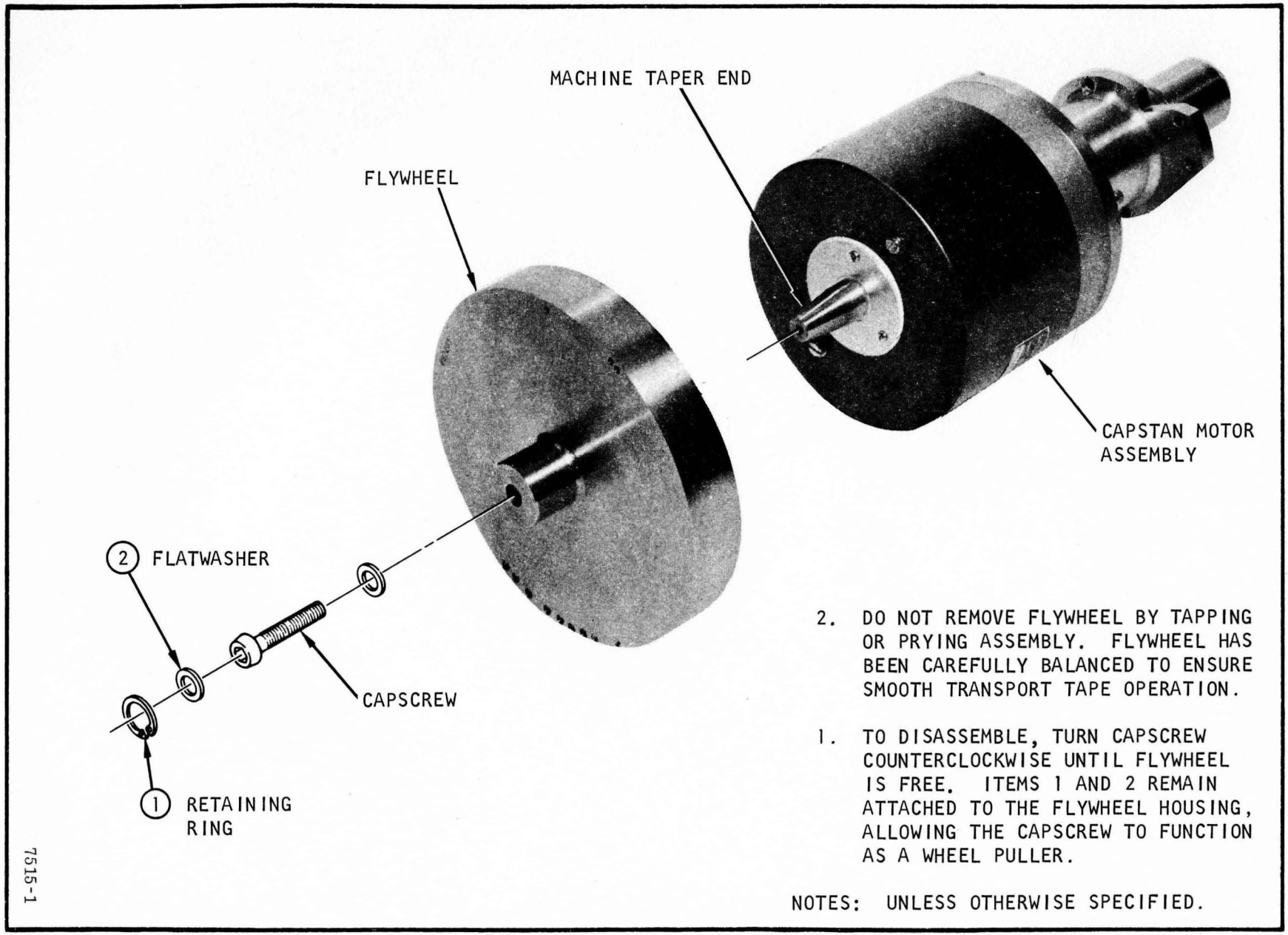


Figure A-2. Capstan Flywheel Installation