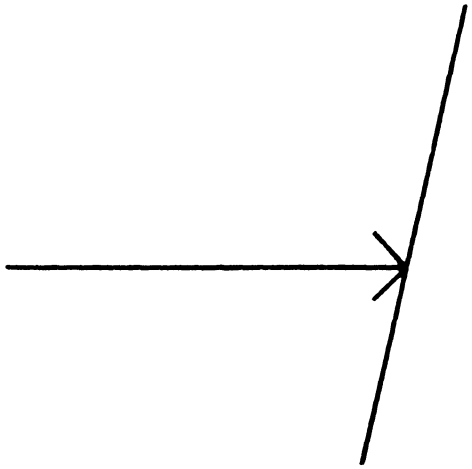
TALLY®

INSTRUCTION MANUAL

500 SERIES



TALLY®

INSTRUCTION MANUAL

500 SERIES

REVISION A OCT 1967

TALLY CORPORATION • 1310 MERCER STREET • SEATTLE, WASHINGTON 98109

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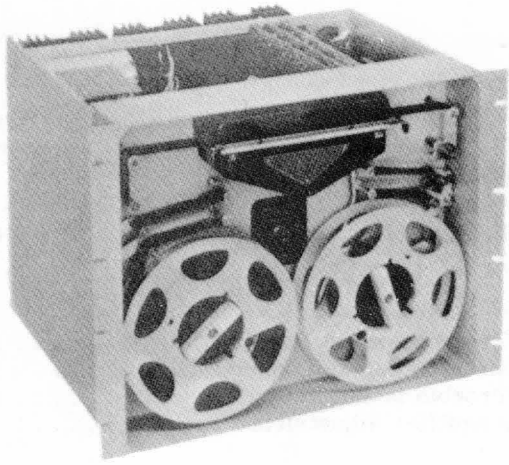
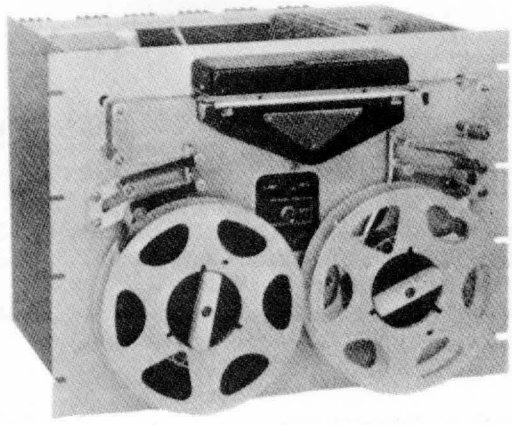
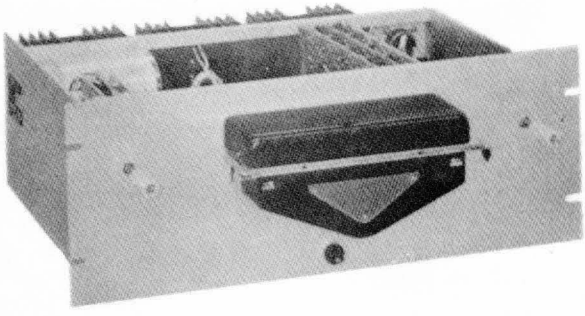


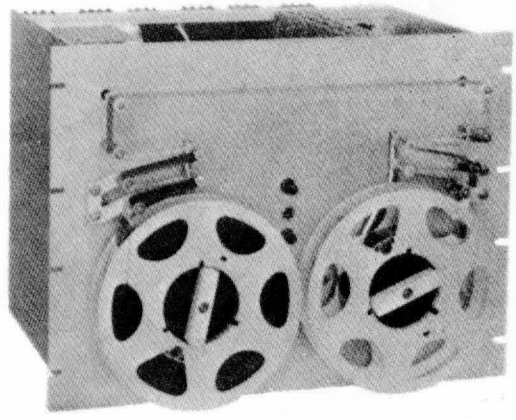
a. Model 500R



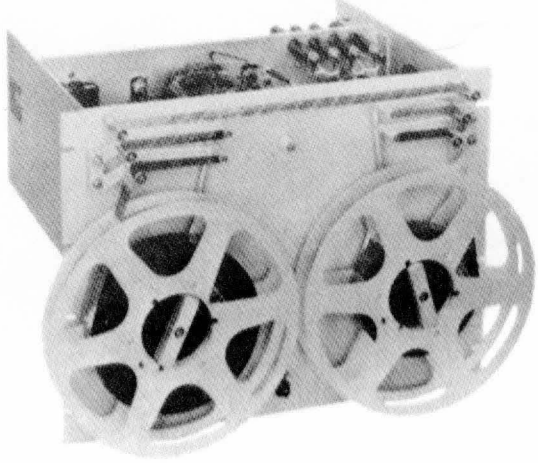
b. Model 500RF



c. Model 500T



d. Model 500S-8



e. Model 500S-10

Figure 1-1. Series 500 Tape Readers and Spoolers

SECTION I

GENERAL DESCRIPTION

1-1. INTRODUCTION.

The Tally Corporation 500 Series Tape Readers and Spoolers (figure 1-1) are a family of equipment which are different configurations of one basic unit--the Model 500R. The 500 Series tape readers are capable of reading 5, 6, 7 or 8-level perforated paper, paper-mylar or metallized mylar tapes at speeds up to 1000 characters per second. Tape is driven across the read head by means of a direct drive capstan using a printed motor. No pinch rollers, friction brakes, clutches or solenoids are used to move tape. A spring-loaded idler holds tape against a capstan which is connected directly to the shaft of a printed motor. Tape movement is in exact accordance with the rotation of the motor armature. The fast response of the printed motor and a proportional reel servo system permit a variety of reading operations to be performed by merely controlling the current applied to the motor terminals.

1-2. DESCRIPTION OF MODELS.

1-2-1. MODEL 500R. The Model 500R is a high-speed tape reader and spooler combination which is recessed mounted. The tape reader uses a printed motor, direct-drive capstan. The spooler uses a proportional reel servo system with printed motors. Tape may be read and wound bi-directionally. Eight-inch NARTB reels having a capacity of up to 1000 feet of 0.0025-inch tape are used on the spooler.

1-2-2. MODEL 500RF. The Model 500RF is identical to the Model 500R except that the reader and spooler are flush mounted rather than recessed.

1-2-3. MODEL 500T. The Model 500T is a reader only unit. It is similar to the reader section of the Model 500R.

1-2-4. MODEL 500S-8. The Model 500S-8 is a high-speed tape spooler using eight-inch reels. It is similar to the spooler section of the Model 500R.

1-2-5. MODEL 500S-10. The Model 500S-10 is a high-speed tape spooler, similar to the Model 500S-8 except that is uses 10-1/2 inch reels which provide storage of 2400 feet of 0.0025 tape.

1-3. SPECIFICATIONS.

The specifications for the different models are presented in tabular form as follows:

a. Table 1-1 Model 500R and Model 500RF

b. Table 1-2 Model 500T

c. Table 1-3 Model 500S-8 and Model 500S-10.

1-4. PHYSICAL DESCRIPTION.

All Series 500 Tape Readers and Spoolers are designed to be installed in a standard 19-inch equipment rack. Figures 1-2 through 1-6 provide outline drawings of the units.

TABLE 1-1. MODELS 500R AND 500RF SPECIFICATIONS

READING SPEED:

0 to 200 characters per second in the asynchronous (line-by-line) mode. Speed varies with the frequency of the start commands.

Up to 500 characters per second in the free-running (constant speed) mode. Reading speed may be set by a screwdriver adjustment at any required level between 100 and 500 characters per second.

1000 characters per second nominal in the Wind/Search mode.

READER OPERATION:

Bi-directional in all modes. All functions remotely controlled.

START TIME:

3.5 milliseconds after start command to reach the next character.

STOP DISTANCE:

On stop character (.046") at 200 characters per second. Before next character (.080") at 500 characters per second. Within 5 characters (.500") at 1000 characters per second.

OUTPUTS:

Output polarities available are shown below. Outputs are clamped at 10 volts up to 5 milliamperes. Voltage levels will decrease if additional current is drawn. Timing pulse duration is 35 ± 10 microseconds.

	Standard	Optional		
HOLE	-10V	+10V	0V	0V
NO HOLE	0V	0V	+10V	-10V
SPROCKET	-10V	+10V	0V	0V
TIMING PULSE	-10V	+10V	10V	0V

CONTROL LOGIC:

"START" 6 to 12 volt level or pulse. Minimum pulse width of 30 microseconds. Maximum pulse rise time of 2 microseconds.

"STOP" same as for "Start."

"FORWARD" (read or wind right) 6 to 12 volt level, 20 milliwatts maximum at 6 volts.

"REVERSE" (read or wind left) same as for "Forward."

"WIND/SEARCH" 6 to 12 volt level, 30 milliwatts maximum at 6 volts.

POWER REQUIREMENTS:

105 to 125 volts, single phase, 50-60 cps or 400 cps. Nominal power consumption is 350 watts.

TAPE COMPATIBILITY:

Paper, paper mylar or metalized mylar tapes with a maximum light transmission of 40% can be used. Tape can be 5, 6, 7 or 8 level, 11/16", 7/8" or 1" wide.

TAPE STORAGE:

Eight inch NARTB reels provided with captive knobs and expansion reel holders. Reel capacity is:

1000 feet of tape .0025" thick
650 feet of tape .0039" thick
550 feet of tape .0046" thick

REEL SERVO CONTROL:

Proportional reel servos vary the speed of the reel motors to meet the requirements of the capstan. Full servo control is maintained in the Wind/Search mode (1000 characters/second).

READ HEAD:

Code and sprocket hole outputs are provided by silicon solar cell photoelectric light sensors. The read head is protected against dirt build-up.

CODE HOLE AMPLIFIERS:

The code hole amplifiers are contained on plug-in printed circuit boards with individual gain controls for each channel.

CONNECTORS:

AC Input - 3 pin. Mating Connector MS3106A-14S-1S.
Control Input - 14 pin. Mating Connector MS3106A-20-27S.
Output - 10 pin. Mating Connector MS3106A-18-1P.

PROTECTIVE DEVICES:

Reel power supply - 8A fuse.

Reader power supply - 5A fuse.

No-Tape Switch - Reel and capstan drive become inoperative at end of reel or in case of tape breakage. A "No-Tape" signal is available in the Control Connector.

TEMPERATURE RANGE:

Operating temperature range 0°to 52°C. (32°to 125°F.).

DUTY CYCLE:

100% in any mode except maximum asynchronous rate. Duty cycle in this mode should be calculated by factory.

SERVICE LIFE:

10,000 hours, minimum life expectancy.

WEIGHT:

71 pounds.

TABLE 1-2. MODEL 500T SPECIFICATIONS

READING SPEED:

0 to 200 characters per second in the asynchronous (line-by-line) mode. Speed varies with the frequency of the start commands.

Up to 500 characters per second in the free-running (constant speed) mode. Reading speed may be set by screwdriver adjustment at any required level between 100 and 500 characters per second.

1000 characters per second nominal in the Wind/ Search mode.

READER OPERATION:

Bi-directional in all modes. All functions remotely controlled.

START TIME:

3.5 milliseconds after start command to reach the next character.

STOP DISTANCE:

On stop character (.046") at 200 characters per second. Before next character (.080") at 500 characters per second. Within 5 characters (.500") at 1000 characters per second.

OUTPUTS:

Output polarities available are shown below. Outputs are clamped at 10 volts up to 5 milliamperes. Voltage levels will decrease if additional current is drawn. Timing pulse duration is 35 ± 10 microseconds.

	Standard	Optional		
HOLE	-10V	+10V	0V	0V
NO HOLE	0V	0V	+10V	-10V
SPROCKET	-10V	+10V	0V	0V
TIMING PULSE	-10V	+10V	0V	0V

CONTROL LOGIC:

"START" 6 to 12 volt level or pulse. Minimum pulse width of 30 microseconds. Maximum pulse rise time of 2 microseconds.

"STOP" Same as for "Start".

"FORWARD" (read or wind right) 6 to 12 volt level, 20 milliwatts maximum at 6 volts.

"REVERSE" (read or wind left) same as for "Forward".

"WIND/SEARCH" 6 to 12 volt level, 30 milliwatts maximum at 6 volts.

POWER REQUIREMENTS:

105 to 125 volts, single phase. 50-60 cps or 400 cps. Nominal power consumption is 175 watts.

TAPE COMPATIBILITY:

Paper, paper mylar or metalized mylar tapes with a maximum light transmission of 40% can be used. Tape can be 5, 6, 7 or 8 level, 11/16", 7/8" or 1" wide.

READ HEAD:

Code and sprocket hole outputs are provided by silicon solar cell photoelectric sensors. The read head is protected against dirt build-up.

CODE HOLE AMPLIFIERS:

The code hole amplifiers are contained on plug-in printed circuit boards with individual gain controls for each channel.

CONNECTORS:

AC Input - 3 pin. Mating Connector MS3106A-14S-1S.
Control Input - 14 pin. Mating Connector MS3106A-20-27S.
Output - 10 pin. Mating Connector MS3106A-18-1P.

PROTECTIVE DEVICES:

Reader power supply protected by 5A fuse.

TEMPERATURE RANGE:

Operating temperature range 0° to 52°C. (32° to 125°F.).

DUTY CYCLE:

100% in any operating mode except maximum asynchronous rate. Duty cycle in this mode should be calculated by factory.

SERVICE LIFE:

10,000 hours, minimum life expectancy.

WEIGHT:

36 pounds.

TABLE 1-3. MODELS 500S-8 AND 500S-10 SPECIFICATIONS

TRANSPORT SPEED:

When used with Tally Corporation reading units, both models supply tape as required by the capstan at any speed up to 100 inches per second. The factory should be contacted for use with other equipement.

TAPE STORAGE:

8" and 10-1/2" NARTB reels provided with captive knobs and expansion reel holders have the following capacities:

500S-8	500S-10
1000' of .0025" tape	2400' of .0025" tape
650' of .0039" tape	1500' of .0039" tape
550' of .0046" tape	1300' of .0046" tape

REEL SERVO CONTROL:

Proportional reel servos vary the speed of the reel motors to meet the demands of the capstan. Servo control is maintained at all speeds.

PROTECTIVE DEVICES:

Fuse protects power supply. "No Tape" switch makes reel motors inoperative at end of reel or in case of tape breakage.

TEMPERATURE RANGE:

Operating temperature range of 0° to 52°C. (32° to 125°F.).

POWER REQUIREMENTS:

105 to 125 volts, single phase, 50-60 or 400 cps. Nominal power consumption for the 500S-8 is 225 watts. Nominal power consumption for the 500S-10 is 250 watts.

DUTY CYCLE:

100%.

SERVICE LIFE:

10,000 hours, minimum life expectancy.

WEIGHT:

500S-8: 37 pounds
500S-10: 55 pounds

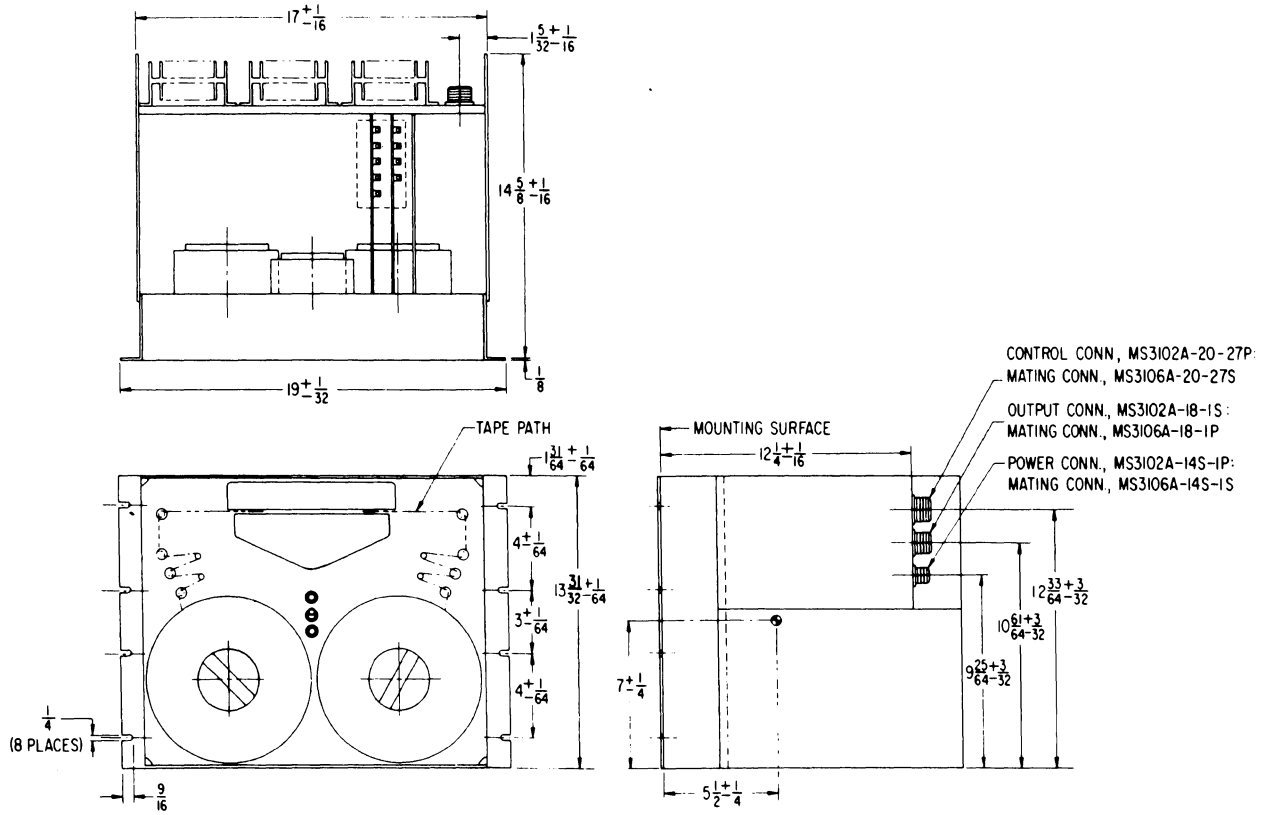


Figure 1-2. Model 500R Outline Drawing

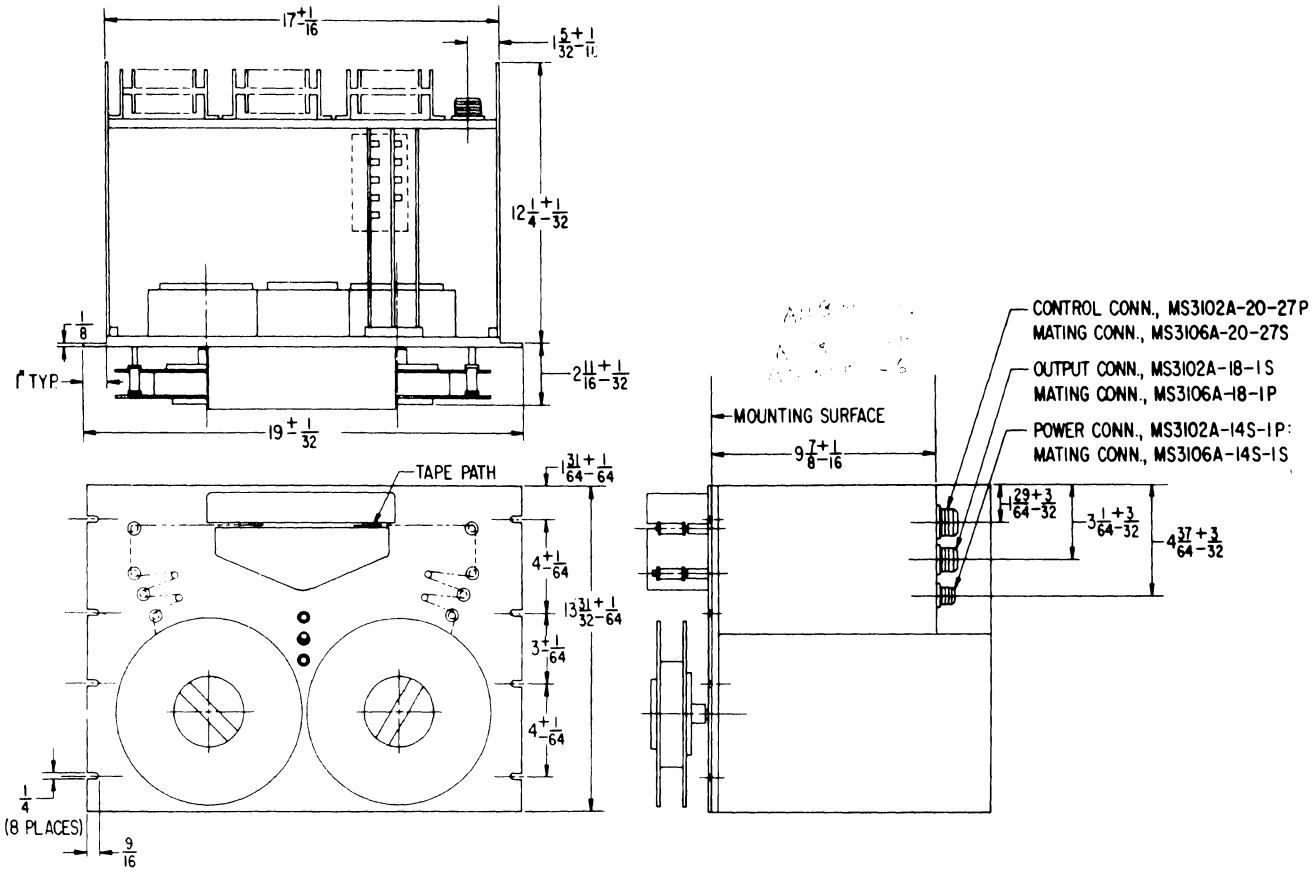


Figure 1-3. Model 500RF Outline Drawing

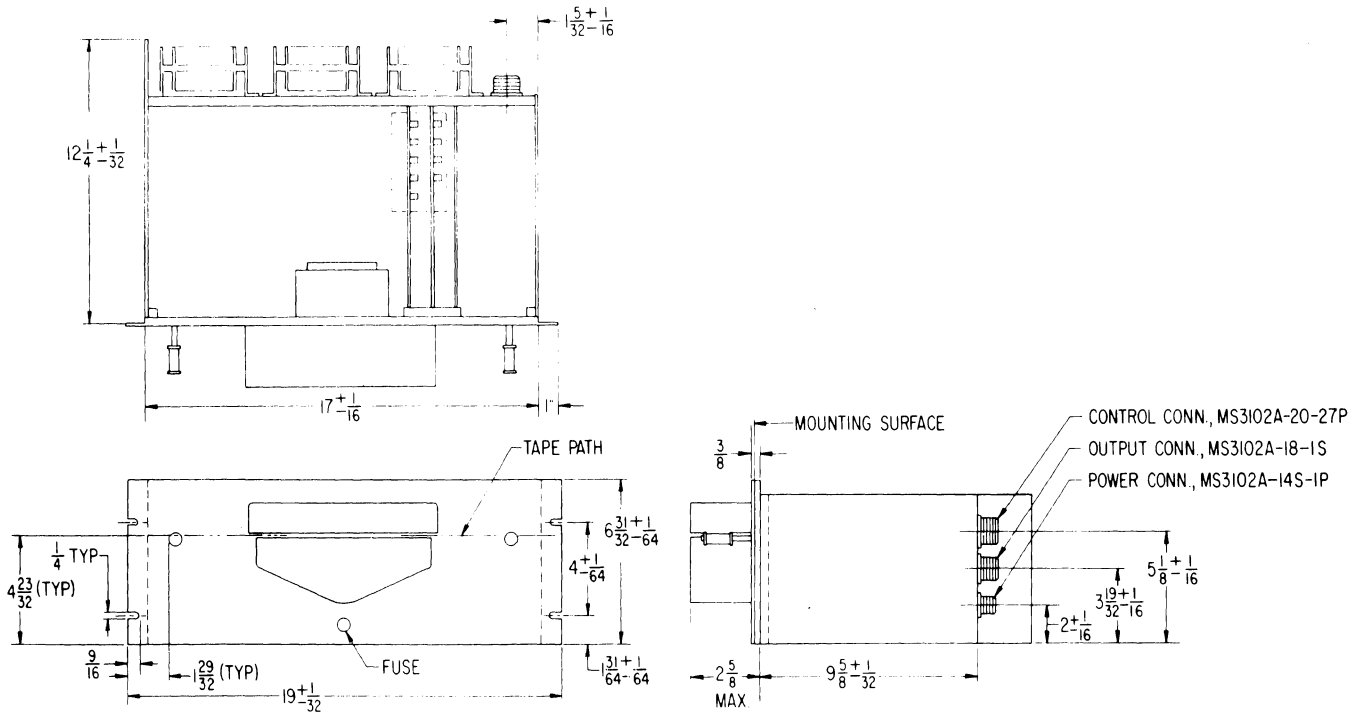


Figure 1-4. Model 500T Outline Drawing

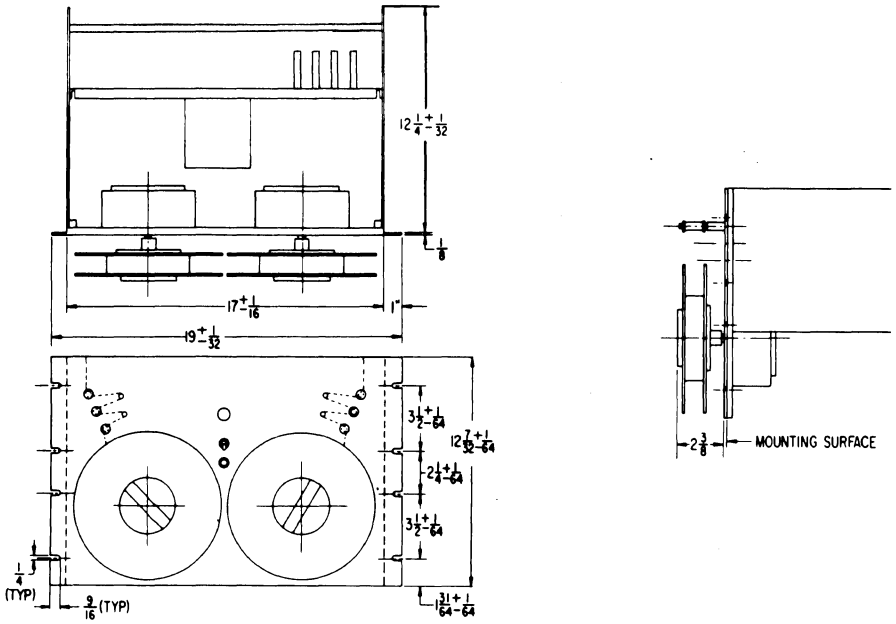


Figure 1-5. Model 500S-8 Outline Drawing

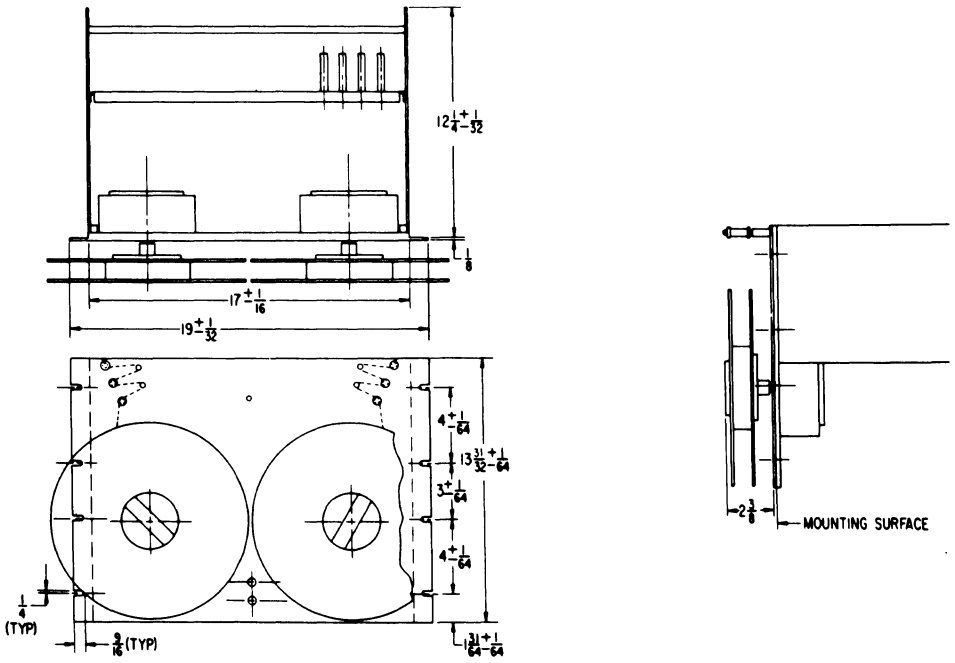


Figure 1-6. Model 500S-10, Outline Drawing

SECTION II

INSTALLATION

2-1. GENERAL.

This section describes the procedures for the proper installation of the equipment.

2-2. UNPACKING.

The unit is shipped in a reinforced packing case designed to protect it during shipment. The packing case is reusable and should be retained if reshipment is anticipated. To ensure that the equipment is not damaged when unpacked, use care. After unpacking, perform a visual inspection of the equipment to make certain no damage occurred during transit. If the equipment was damaged, Photocircuits Corporation should be notified immediately.

2-3. INSTALLATION PROCEDURE.

2-3-1. MECHANICAL. The unit is designed to be mounted in a standard 19-inch equipment rack. It is attached to the equipment rack using standard mounting hardware. Or, the unit may be mounted on drawer slides to facilitate servicing. Figure 2-1 shows a typical installation.

2-3-2. ELECTRICAL. The electrical installation consists of:

a. Connecting the external system cables to the equipment. Table 2-1 denotes the interface connections and signals.

b. Checking all internal connections to ensure that all plugs and printed circuit boards are securely seated in their jacks.

c. Performing the test procedure in paragraph 5-3.

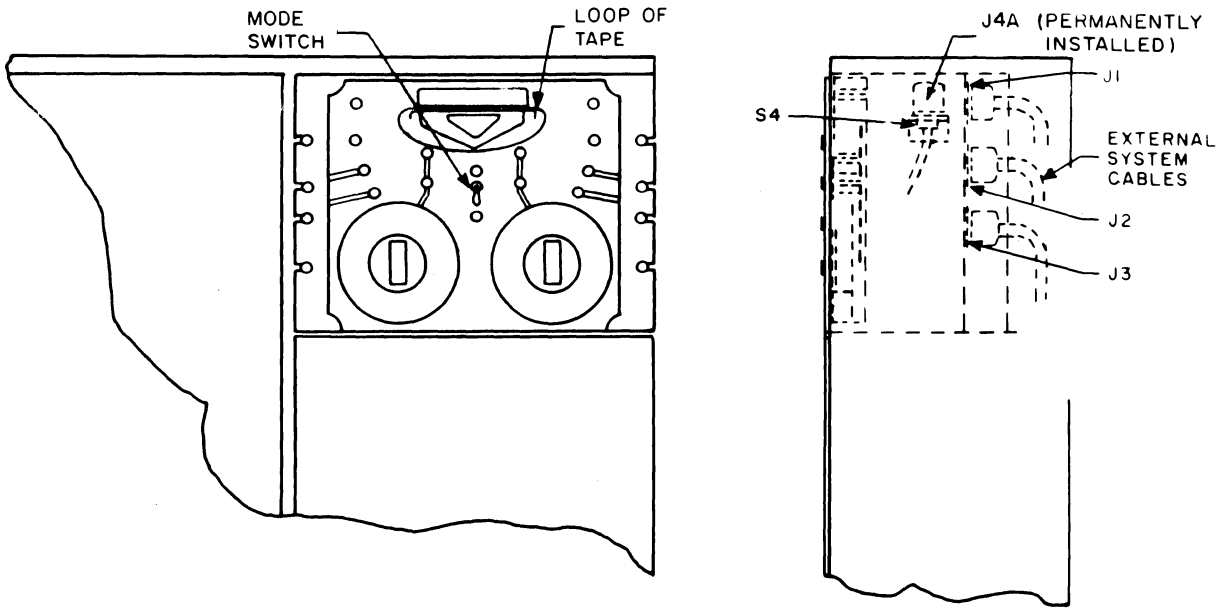


Figure 2-1. Installation Drawing (Typical)

TABLE 2-1. INTERFACE CONNECTIONS

Use	Connector and Pin	Signal
Power Input	J1-A	115 volt 60 cycle ac hot
	J1-B	115 volt 60 cycle ac return
	J1-C	Ground
Control	J2-A	Start input
	J2-B	Stop input
	J2-C	Sprocket output
	J2-D	No tape signal
	J2-E	Common
	J2-F	35-microsecond strobe pulse
	J2-I	Forward input
	J2-J	Reverse input
	J2-K	Wind input
	J2-N	-10 volt output
Amplifier Outputs	J3-A	Amplifier No. 1
	J3-B	Amplifier No. 2
	J3-C	Amplifier No. 3
	J3-D	Amplifier No. 4
	J3-E	Amplifier No. 5
	J3-F	Amplifier No. 6
	J3-G	Amplifier No. 7
	J3-H	Amplifier No. 8
	J3-I	Common
	J3-J	Sprocket

SECTION III

OPERATION

3-1. GENERAL.

This section describes the operating control and the operating procedure for the equipment.

The equipment is simple to operate. A single, three-position control (mounted on spooler section) commonly referred to as the Mode switch, is all the operator needs to be concerned with. The Mode switch performs the following functions:

Position	Description
READER ONLY (up)	This position is used when it is desired to use the reader as only a strip or loop reader. Spooler power is disabled and the "no-tape" circuitry is defeated.
LOAD (center)	This position is used when loading and removing tape.
READER/SPOOLER (down)	This position is used when it is desired to use both the reader and the spooler. Power is applied to spooler and the "no-tape" circuitry is enabled.

3-2. OPERATING PROCEDURE

3-2-1. TAPE LOADING (see figure 3-1).

a. Place mode switch in LOAD position.

b. Open head cover by pushing in on right lever, designated OPEN.

c. To adjust guide bar, depress bar and move bar in or out until indicator lines match desired position.

d. Install tape reel on left-reel holder and turn captive knob clockwise until snug.

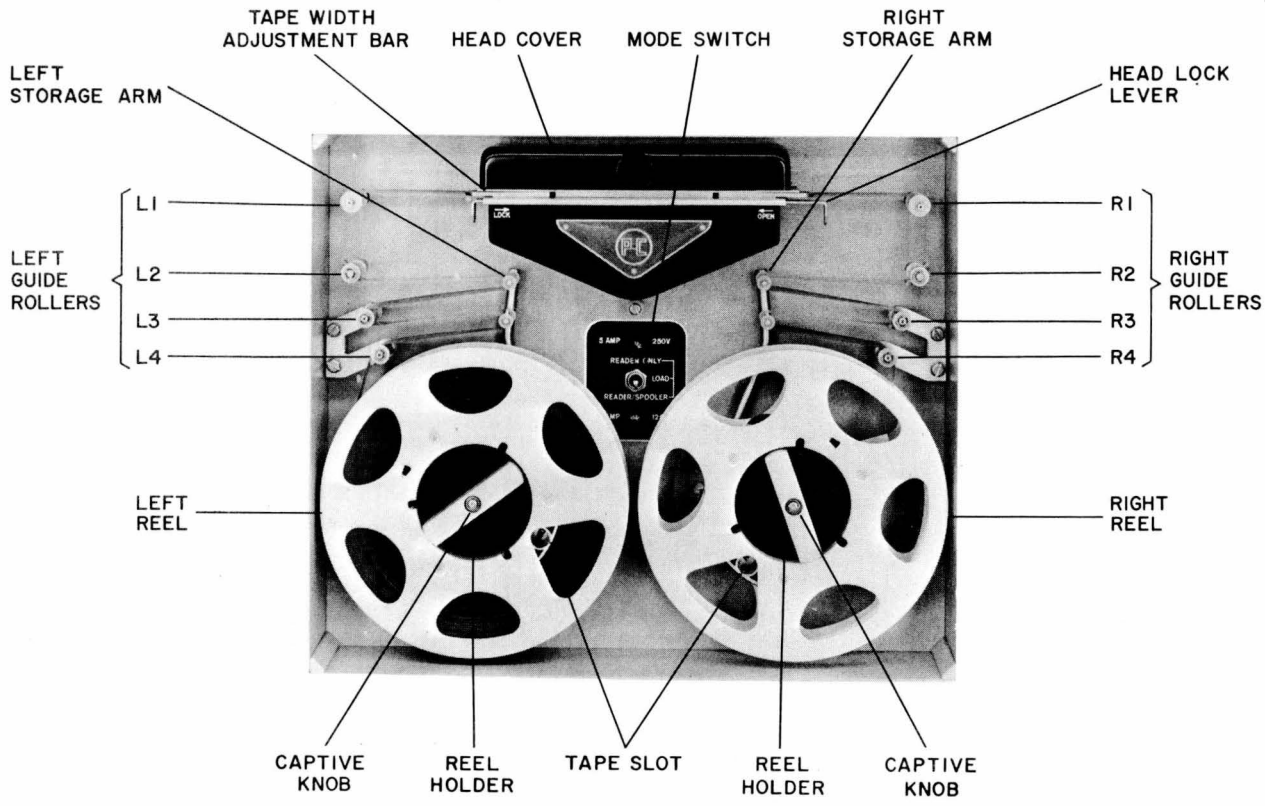


Figure 3-1. 500R Front View

e. Repeat step d to install tape reel on right-reel holder.

NOTE

Tape reels should be installed so that the sprocket channel is three data channels away from the front panel (see figure 3-2).

f. Pull tape from full reel directly to empty reel. Place end of tape in reel slot (figure 3-1).

CAUTION

Do Not permanently affix tape to either reel. Manually wind sufficient tape on empty reel for threading.

g. Insert tape into head.

h. Close head cover by pushing down and securing with left lever, designated LOCK.

i. Move tape back and forth in the direction of normal tape travel to ensure it moves freely.

j. Move left storage arm to extreme left position and thread tape from left reel between left storage arm rollers and left guide rollers (L1 through L4). Move left storage arm to right until stopped by tape.

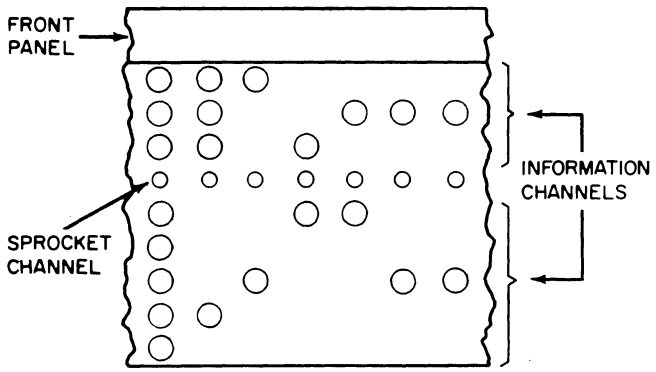


Figure 3-2. Proper Tape Orientation Through Reader

k. Move right storage arm to extreme right position and thread tape from right reel between the right storage arm and right guide rollers (R1 through R4). Move right storage arm to left until stopped by tape.

l. Manually rotate reel to position storage arm into center of its travel.

m. Place Mode switch in READER/SPOOLER position. This provides power to the reel servos.

3-2-2. TAPE READING. The tape reader is now ready for operation.

SECTION IV

THEORY OF OPERATION

4-1. GENERAL.

This section presents a block diagram and detailed circuit analysis of the Series 500 equipments.

4-2. BLOCK DIAGRAM ANALYSIS.

Functionally, the equipment is divided into a tape read, tape drive and reel servo system, as shown in figure 4-1. The tape read and tape drive systems comprise the tape reader section while the reel servo system along with the storage arms and reel motors comprise the spooler section. As described in Section I only the Models 500R and 500RF include both a tape reader and a spooler section.

4-2-1. TAPE DRIVE. Under control of the external equipment, the tape drive system will move tape bidirectionally. After tape is loaded, a start pulse and a direction signal from the external equipment initiates tape movement. The direction signal is applied via the input logic to the capstan servo amplifier. The capstan servo amplifier develops the drive voltage for the capstan motor. The motor accelerates and tape is moved across the (solar-cell) read head.

A dc tachometer attached to the motor shaft, develops a negative feedback signal which opposes the motor drive signal. This causes the amplifier to operate as a velocity servo. When a stop pulse is applied, the motor drive signal is removed and the tachometer feedback signal causes the capstan motor current to be reversed stopping the motor and tape.

4-2-2. TAPE READ. As tape is moved, the read head will detect the presence of code holes in the tape and generate shaped pulses. The read head will also detect the presence of the sprocket hole and generate a shaped pulse to the external system, which may be fed back to stop the reader.

4-2-3. REEL SERVO. Reel servo operation is initiated by a displacement of its storage arm. Each storage arm is mechanically coupled to a differential transformer which generates a voltage to control the direction and velocity of each reel motor. A safety feature is attached to both storage arms. This is a limit switch which will cause the reader to stop operation.

4-2-4. GENERAL DESCRIPTION OF SUBASSEMBLIES AND CIRCUITS. A brief description of the major subassemblies and circuits of the equipment is given in the following paragraphs.

a. Input Logic. The input logic receives all the external control signals (start, stop, forward, reverse and wind). It converts these inputs into control signals for the capstan servo amplifier.

b. Capstan Servo Amplifier. The capstan servo amplifier consists of a differential amplifier and a string of drivers and emitter followers divided into two sections. These circuits generate the capstan motor drive voltage for either direction of rotation.

c. Reel Servo. The reel servo consists of two identical servo systems, one for each reel. The reel servo will operate whenever there is tape motion in either direction. Its function is to provide continuous tension on the tape and pay-out and take-up of the tape, from the reels. It accomplishes this by sensing an angular displacement of its storage arm which is converted into a linear voltage. In standby, the storage arms remain within their null area. Tape motion causes a displacement from the null area which will drive the reel motor in either direction. The polarity of the displacement signal will determine the direction, and its amplitude will determine its velocity.

d. Read Head and Information Amplifiers. The read head consists of nine solar cells, one for each of the eight information amplifiers and one for the sprocket channel. There are eight channel amplifiers, all identical. They produce a level which is transferred to the external system whenever there is a hole in paper tape.

e. Sprocket Amplifier and Strobe Generator. This level is generated when a sprocket hole is detected by its solar cell. The level is also fed to a one shot multivibrator and amplifier which produces a 35 usec pulse which may be used as a strobe pulse.

f. Reel Power Supply. The reel power supply provides the necessary voltages used for operation of the reel servo. It consists of a full-wave rectifier, filter network and zener regulators, providing (+) and (-) 28 vdc unfiltered and (+) and (-) 14 vdc filtered and regulated.

g. Reader Power Supply. This supply provides necessary voltages for operation of the capstan servo amplifier, read head, hole amplifiers, and input logic. It consists of full-wave rectifier, filter network, and zener regulator providing (+) and (-) 10 vdc filtered and regulated and (+) and (-) 17 vdc filtered and unregulated.

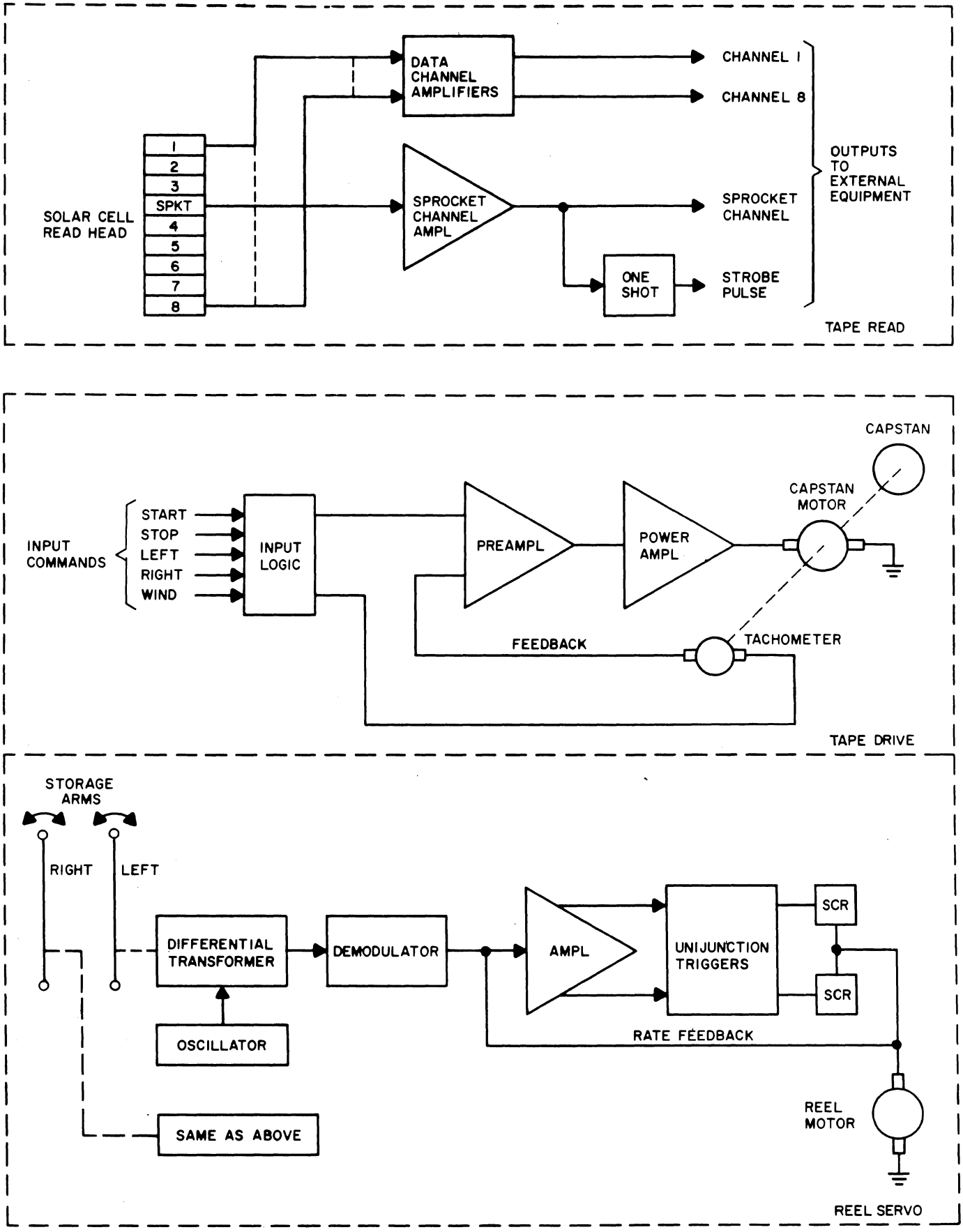


Figure 4-1. Functional Block Diagram

4-3. CIRCUIT ANALYSIS.

Since all models of the equipment operate similarly to the tape reader or spooler portions of the Model 500R only this unit is described in detail. While reading the circuit analysis, the schematic diagrams, figures 4-2 through 4-20 at the back of this section, for the different models and options should be used for reference. Refer to table 4-1 as an aid in locating the appropriate schematic diagrams for a particular equipment.

4-3-1. CAPSTAN SERVO AMPLIFIER BOARD. The capstan servo amplifier board is manufactured in two configurations: one for the standard negative logic reader and the other for the positive logic reader. The two boards are identical in all respects except for their transistor types. Only the standard negative logic board is described in the paragraphs which follow since the two boards are so similar.

The board is functionally divided into two sections: input logic and capstan servo amplifier. Each section is described separately below.

4-3-1-1. Input Logic. When a negative 6-volt pulse is applied to the start input, it causes the bistable multivibrator (flip-flop) consisting of transistors Q17 and Q18 to produce a (-) 10 vdc level which is coupled through R146 and CR41 to the base of transistor Q26 for left to right tape operation or R147 and CR40 to the base of transistor Q27 for right to left tape operation. Diodes CR38 and CR39 provide negative input coupling to the flip-flop. The flip-flop is returned to its normal state when a negative 6-volt level is applied to the base of the transistor Q18. Capacitor C19 and resistor R52 assure conduction of transistor Q18 during power turn-on prior to application of a start pulse to the flip-flop. This is in actuality an antistart circuit. The conduction level of transistor Q26 is variable and is determined by clamping diode CR45 and right Slew Speed Adjust R76. Adjustment of R76 sets the speed of the capstan motor. Clamping diode CR46 and left Slew Speed Adjust R77 perform the same function for transistor Q27. The reader now has been programmed for operation. Without a direction level to transistor Q22 or Q24, the input to Q26 and Q27 is clamped to ground through transistor switches Q23 and Q25. When a negative 6-volt forward level is applied to the base of transistor Q24, it will conduct, causing transistor switch Q25 to cut off. The input to transistor Q26 is no longer clamped and can now conduct, supplying an advance signal to the capstan servo amplifier. The operation of transistors Q22, Q23, and Q27 is identical for the reverse level.

To wind, a negative level is applied to transistor Q19, rather than a start signal, causing Q19 to saturate. Transistor Q20 will cut off, causing emitter follower Q21 to conduct. Depending on the required direction, conduction will be through R56, CR43, and R79 (wind right) or R63, CR44, and R80 (wind left). If wind left is desired, the conduction causes a voltage to appear at the base of Q27. The magnitude of the wind signal applied to transistors Q26 or Q27 is dependent upon resistors R56 and R63, and the input impedance of the capstan servo amplifier. Resistor R55 and capacitor C22 form a time constant which applies the base driving voltage to transistor Q21 slowly so the reel servos can follow the tape acceleration. Diode CR42 disconnects C22 when transistor Q20 is cut off. Should the tape break or if the end of the tape is reached, a NO-TAPE switch is activated by either of the tape storage arms. The switch removes the ground from transistors Q22 and Q24, causing them to cut off and clamp the inputs to transistors Q26 and Q27, and supplies NO-TAPE output to the external system.

4-3-1-2. Capstan Servo Amplifier. When emitter follower Q26 is caused to conduct by the input logic circuits, a negative signal is applied to Q29 of the differential amplifier, Q28 and Q29. This causes the differential amplifier to be unbalanced and the output from Q29 becomes more positive. This output is used to drive transistor Q30. Transistor Q30 drives a complementary symmetry stage consisting of transistors Q31 and Q33 which are reverse biased by resistors R102 and R103. This is done to ensure individual and not simultaneous operation. Capacitors C24, C25, and C26 provide filtering to any transients or oscillations that may develop. The output of Q30 is applied to the base of driver No. 1, Q31. Q31 is coupled to driver No. 2, Q32. Q32 is coupled to emitter follower Q35. Emitter follower Q35 drives parallel emitter followers Q36 and Q49. The output of emitter follower Q35 is sufficient to cause the parallel emitter followers Q36 and Q49, to saturate. The current through the motors is therefore a function of the supply voltage, the limiting and equalizing resistors, R110, R111, R136, and R137, and the motor resistance. The tachometer, G1, attached to the capstan motor shaft provides feedback through a filter and voltage divider network, C23, R95, and R96, to the base of Q28 of the differential amplifier. This input tends to oppose the signal on Q29, thereby reducing the output of Q29. The amplifier comes out of saturation and runs as a velocity servo.

The feedback from the tachometer voltage is fed through the voltage divider consisting of R95 and R96 to the differential amplifier. This causes a less positive signal from Q29 which is coupled to emitter follower Q30. This reduced signal causes the motor to drive at a constant speed. If the input to Q29 is removed, the feedback voltage causes a negative-going signal from Q29 which causes the other half of the amplifier to saturate and drive the motor to a stop. The current through the motor is therefore a function of the supply voltage, the limiting and equalizing resistors, R114, R115, R138, and R139, and the motor resistance. Resistors R104 and R105 form a feedback to driver No. 1, Q31, and driver No. 3, Q33. Potentiometer R91 is used to balance the differential amplifier under no signal conditions.

4-3-2. AMPLIFIER BOARDS NO. 1 AND NO. 2. Each tape reader contains two amplifier boards. Amplifier board no. 1 contains the amplifiers for tape channels 1, 2, 3, sprocket, and strobe circuit.

TABLE 4-1. EQUIPMENT SUMMARY CHART

Item	Assembly	Schematic Diagram	Figure No.	Description	Usable on Code *
Reader	-	10793	4-2	Used on negative logic or inverted negative logic readers	A, B, C
	-	10813	4-3	Used on positive logic or inverted positive logic readers	A, B, C
Capstan Servo Amplifier	10541	10805	4-4	Used on negative logic or inverted negative logic readers	A, B, C
	10747	10804	4-5	Used on positive logic or inverted positive logic readers	A, B, C
Amplifier Board #1	10543	10797	4-6	Negative logic amplifier (-10-volt hole; 0-volt no-hole)	A, B, C
	10847	10801	4-7	Inverted negative logic amplifier (0-volt hole; -10-volt no-hole)	A, B, C
	10758	10799	4-8	Positive logic amplifier (+10-volt hole; 0-volt no-hole)	A, B, C
	10743	10803	4-9	Inverted positive logic amplifier (0-volt hole; +10-volt no-hole)	A, B, C
Amplifier Board #2	10542	10798	4-10	Negative logic amplifier (-10-volt hole; 0-volt no-hole)	A, B, C
	10848	10802	4-11	Inverted negative logic amplifier (0-volt hole; -10-volt no-hole)	A, B, C
	10761	10800	4-12	Positive logic amplifier (+10-volt hole; 0-volt no-hole)	A, B, C
	10887	10749	4-13	Inverted positive logic amplifier (0-volt hole; +10-volt no-hole)	A, B, C
Spooler Chassis	-	10754	4-14	Used for 60 cycle line voltage operation with 8-inch reels	A, B, D
	-	10794	4-15	Used for 400 cycle line voltage operation with 8-inch reels	A, B, D
	-	10795	4-16	Used for 60 cycle or 400 cycle line voltage operation with 10-1/2 inch reels	E
Reel Servo Amplifier	10540	10751	4-17	Used for 60 cycle line voltage operation with 8-inch reels	A, B, D
	10846	10806	4-18	Used for 400 cycle line voltage operation with 8-inch reels	A, B, D
	10844	10807	4-19	Used for 60 cycle line voltage operation with 10-1/2 inch reels	E
	10845	10808	4-20	Used for 400 cycle line voltage operation with 10-1/2 inch reels	E

*KEY FOR USABLE ON CODE A = 500R B = 500RF C = 500T D = 500S-8 E = 500S-10

Amplifier board no. 2 contains the amplifiers for the remaining tape channels (4 through 8). The amplifiers for the information channels and the sprocket are identical.

Depending on the external logic requirements, amplifier boards for negative, inverted negative, positive or inverted positive logic may be supplied. Only the standard negative logic boards are described in the paragraphs which follow since all amplifiers are similar in constructions and operation.

4-3-2-1. Information Amplifiers. All eight information amplifiers are identical. The operation of the amplifier for tape channel 1 will be used in this discussion. When the presence of a hole is detected by the solar cell, a change in bias is produced at the base of transistor Q45 causing it to saturate and its collector to fall to approximately zero. The voltage divider of R130 and R131 causes the base of transistor Q46 to become negative, thus cutting it off. The collector of Q46 rises to (+) 10 vdc. The collector of Q46 is coupled to the base of transistor Q47, causing it to cut off. As the collector voltage of Q47 falls toward (-) 17 vdc, diode CR49 clamps the collector at (-) 10 vdc. This pulse is coupled to connector J3 for use in the external system. The operation is reversed when the hole is removed from over the solar cell. The threshold level for operation is variable and can be adjusted by R134.

4-3-2-2. Sprocket Amplifier and Trigger Generator. The operation of the sprocket amplifier is identical to that of the information amplifiers except that the output is fed to a trigger generator as well as to the external system. The output from the sprocket amplifier is fed to a one-shot multivibrator consisting of transistors Q42 and Q43. The timing of this generator is such that a 35-microsecond pulse is generated and coupled to the base of transistor Q44 and the collector of transistor Q51.

Prior to tape movement, transistor Q51 is conducting clamping the input of Q44 to common. Capacitor C35 is charged through R151 and Q51 to approximately -10 vdc from the collector of Q17. When a start pulse is applied to the input logic, the collector of Q17 goes to approximately zero. Capacitor C35 discharges through R151 and R152, causing transistor Q51 to cut off, allowing the output of the one-shot multivibrator to be coupled to the base of transistor Q44. The pulse is coupled to connector J2 for use by the external system as a system trigger. Diode CR56 provides low output impedance through transistor Q43 for no signal output conditions. Therefore, any signal applied to the trigger output is shunted to common. When Q17 is cut off, transistor Q51 acts as a clamp again.

4-3-3. READ HEAD. When a hole appears over the aperture of the solar cell, the light from the lamps causes the solar cell to produce a current which changes the bias on the input transistor of the associated amplifier.

4-3-4. LAMP CIRCUIT. Two lamps are used to produce the light intensity required by the solar cells to detect the presence of the hole over the aperture of the solar cells. Transistor Q48 provides regulated voltage for the lamps.

4-3-5. REEL SERVO AMPLIFIER BOARD. Each reader which is supplied with a spooler contains a reel servo amplifier board. The board may be supplied for either 60 or 400 cycle frequency operation.

The reel servo amplifier consists of two independent, but identical position servos. The direction and speed of the reel motor is determined by a displacement of the storage arm from its neutral position.

Differential transformers t_3 and t_4 in conjunction with CR16, CR15, CR14, and CR13 respectively, make up two full wave rectifiers. The direction and velocity of the reel motor is directly proportional to the polarity and amplitude of the signal. The differential transformers are driven by an astable multivibrator, consisting of Q1 and Q2. CR17 and CR18 are clamping diodes; and are utilized to prevent high negative transients.

Since the servos are identical this discussion will pertain to the right reel motor (M2).

A movement of the right storage arm (away from the center of the reader) will generate a negative voltage at the junction of CR13, R7, and C4 with respect to CR14, R6 and C3.

This negative potential is applied to the base of Q10 through R34, (Q8 and Q9 constitute a differential amplifier) which reduces the forward bias on Q10 and Q8. The differential amplifier becomes unbalanced. Q11 and Q12 are constant current amplifiers. Without an error voltage, Q8 and Q9 conduct all the current supplied by Q11 and Q12 respectively. C15 charges when the conduction of Q8 is reduced. The voltage across C15 rises linearly to the firing potential of the unijunction transistor Q15. C15 discharges through the primary of t_6 when the firing level of Q15 is reached. This causes a pulse to develop across the secondary, which appears across gate-cathode circuit of the silicon controlled rectifier (SCR32).

SCR32 conducts and applies a positive full wave rectified unfiltered sine wave to drive the motor (M2) in the counterclockwise direction. The amplitude of the cut-off bias on Q8 will determine how fast C15 will charge, thus firing Q15 and moving the motor. Damping for the servo system is provided directly from the motor. A small positive signal is fed back to the base of Q10 through R37, R38, C11, and C12. This signal prevents overshoot and oscillation of the motor.

Should the storage arm displacement be so slight that C15 does not charge up to the firing point of Q15, a synchronizing transistor Q52 will discharge C15. Negative full wave unfiltered sine waves are fed to the base of Q52 through a network consisting of R41, R40, C13, and CR34. The rectification in the base circuit causes conduction for a short period of time, during the positive half cycle. R47 is the resistor for Q8 and Q9. The total current supplied by Q11 passes through Q8. This bias on Q8 will determine the amount of charge on C15. If C15 does

not reach its firing level before the synchronizing pulse is generated, it will be discharged via Q52.

In the reverse direction the same principles apply. At the base of Q10 a positive signal is applied through R34. This will increase the drive on Q10, thus increasing the drive on Q8. This will decrease the current in Q9 thus charging C16. A pulse turns on SCR33 and applies power to the motor turning it in the clockwise direction. The operation for motor (M3) is the same using t_7 and t_8.

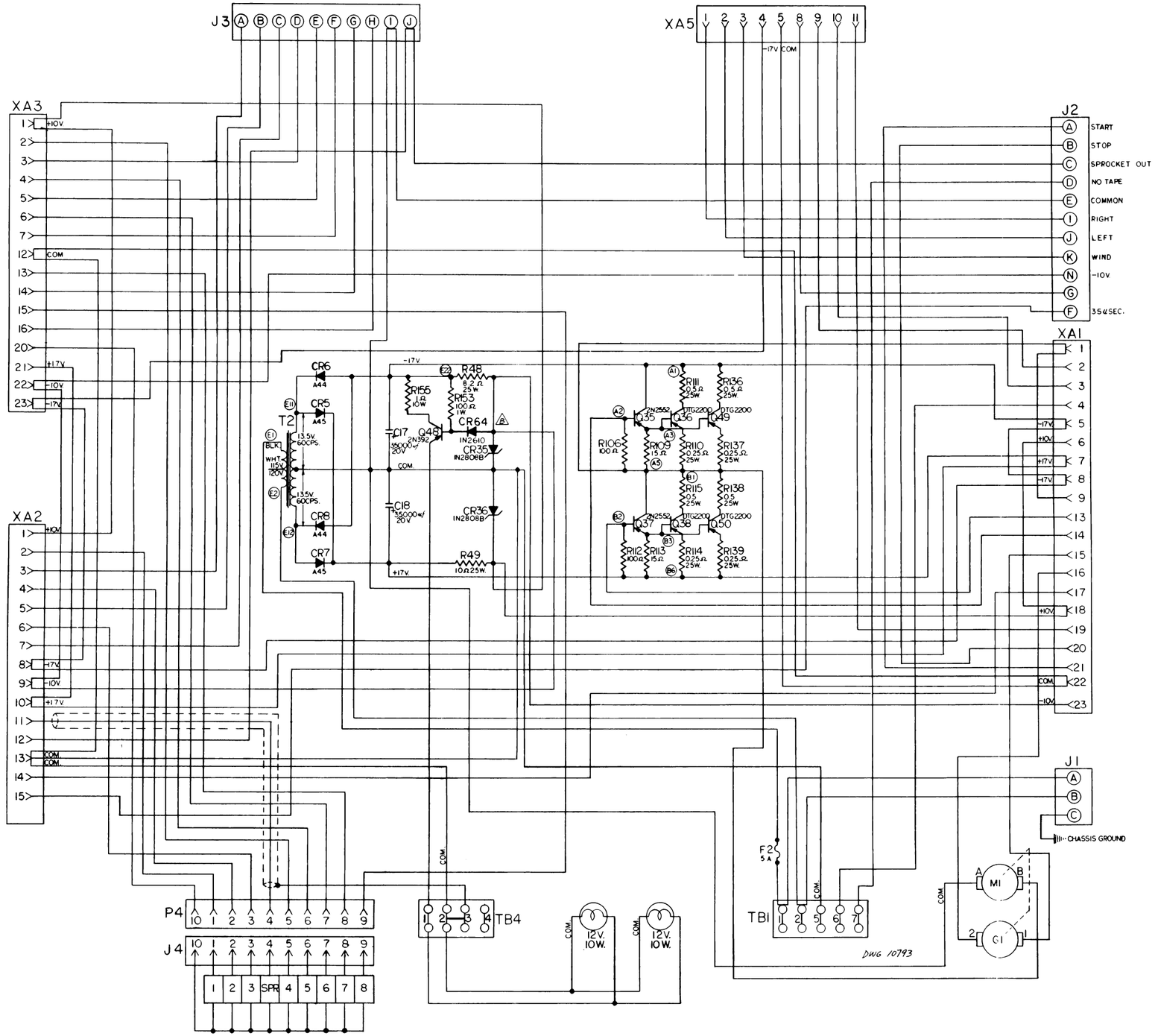
4-3-6. POWER SUPPLIES.

4-3-6-1. Reel Power Supply.

The input voltage (115 v 60 or 400 cps) is applied to transformer T1 where it is stepped down to 28 v peak on each side of the center-tapped secondary. Two center-tapped full-wave rectifiers consisting of CR1, CR2, CR3, and CR4 provide the (+) and (-) 28 vdc used to drive the reel motors and also feed the filter network. Resistors R1 and R2 provide a load to the full-wave rectifier. Diode CR9, capacitor C1, provide filtering for the + 14 volts. Diode CR10, capacitor C2, provide filtering for the -14 volts. Zener diodes CR11 and CR12 provide regulation.

4-3-6-2. Reader Power Supply.

The input voltage (115 v 60 or 400 cps) is applied to transformer T2 where it is stepped down to 19 v peak on each side of the center-tapped secondary and applied to full-wave rectifiers CR5 through CR8. The full-wave rectifiers provide (+) and (-) 17 vdc. The 17 vdc is filtered by C17 and C18. Resistors R48 and R49 drop the (+) and (-) 17 vdc producing (+) and (-) 10 vdc outputs regulated by CR35 and CR36.

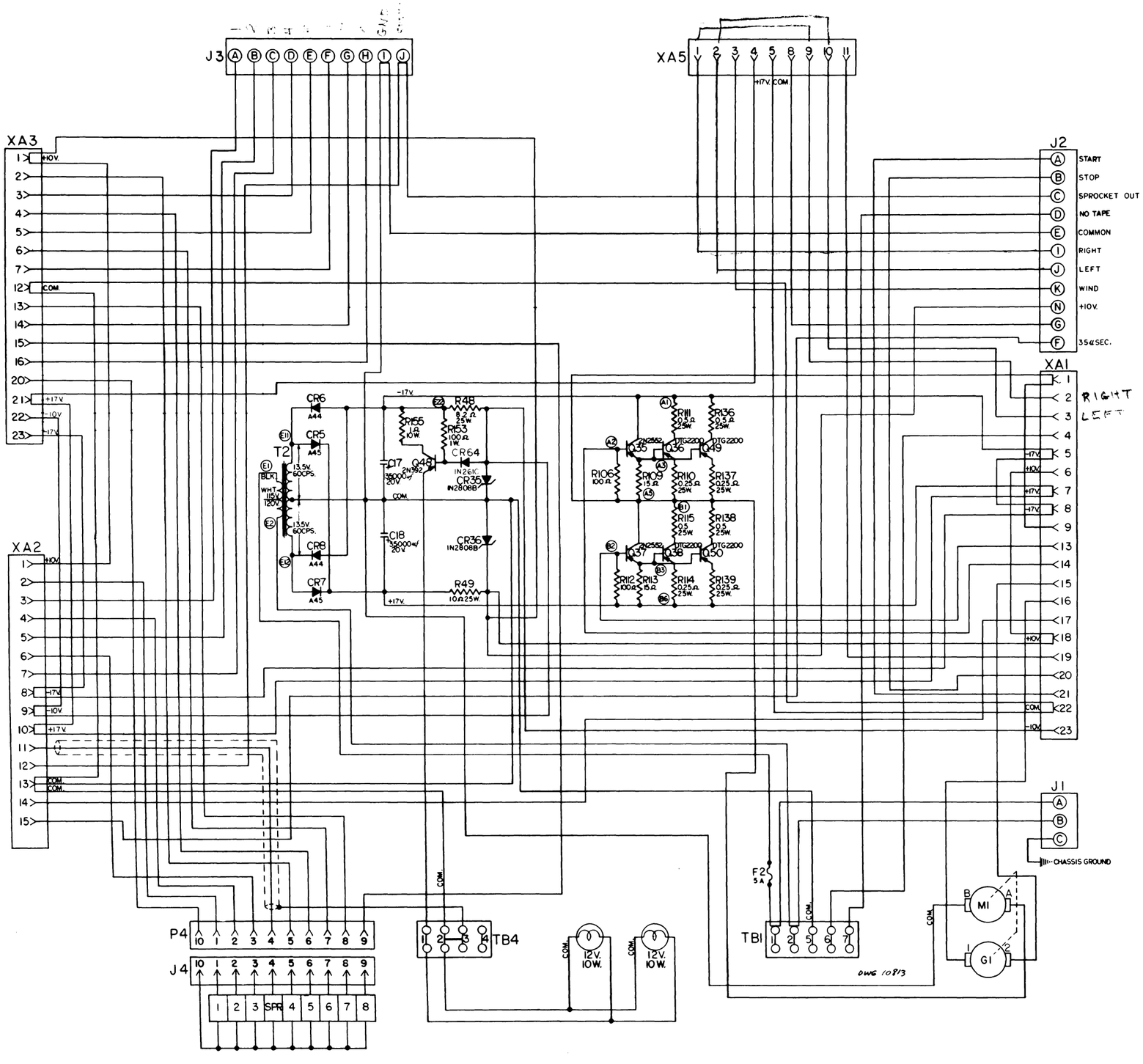


NOTES:

UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE ½ W.
2. ALL VOTAGES MEASURED WITH LINE AT 115V. USING 20,000 Ω/V. D.C. METER.

Figure 4-2. Reader Chassis, Negative or Inverted Negative Logic, Schematic Diagram

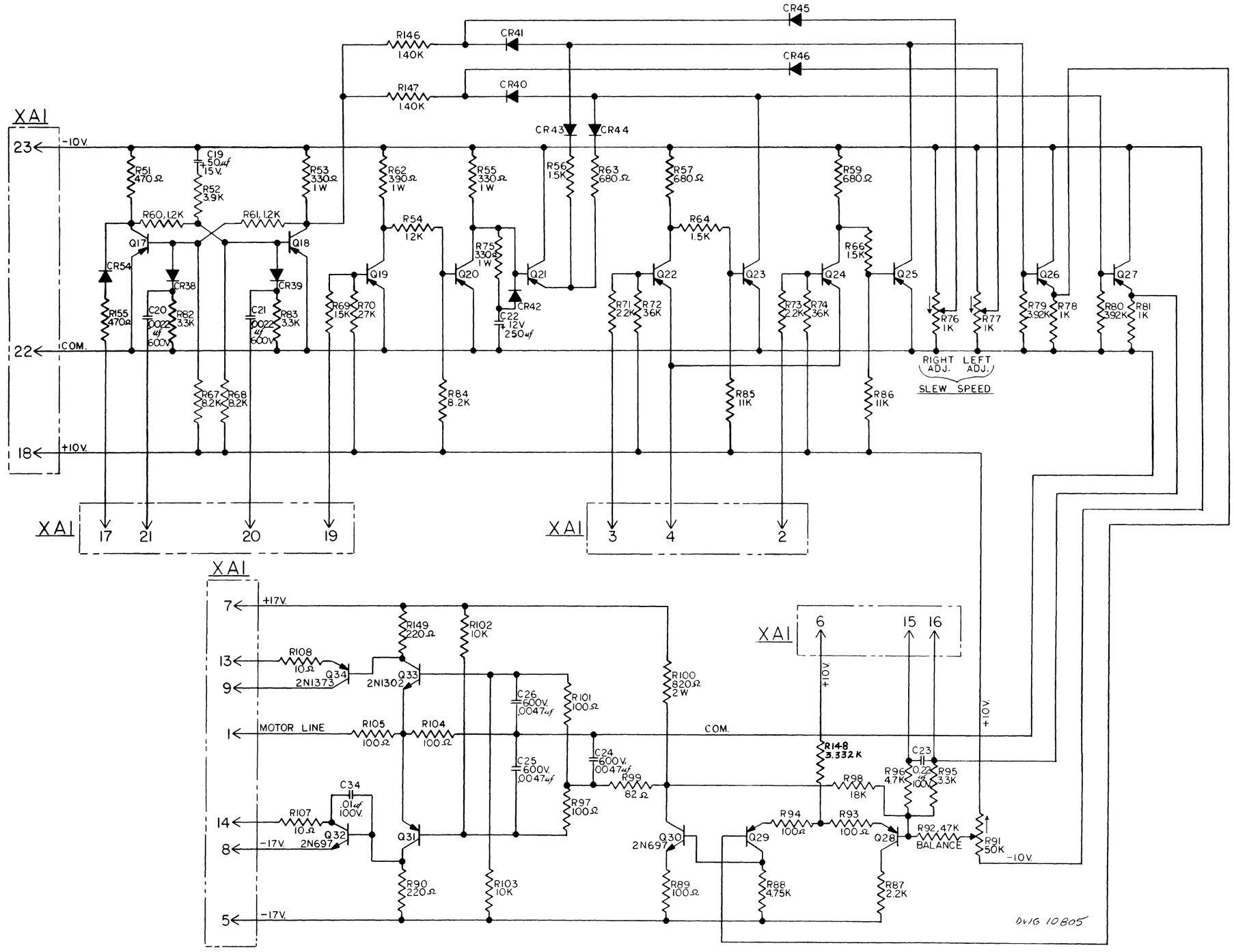


NOTES:

UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE ½ W.
2. ALL VOTAGES MEASURED WITH LINE AT 115V. USING 20,000 Ω/V. D.C. METER.

Figure 4-3. Reader Chassis, Positive or Inverted Positive Logic, Schematic Diagram



NOTES:
1. CLOCKWISE ROTATION OF POTENTIOMETERS VARIES RESISTANCE AS INDICATED BY ARROWS.
2. ALL VOLTAGES MEASURED WITH LINE AT 115 V., A.C.; USING 20,000 Ω/V, D.C.-METER & 5,000 Ω/V, A.C.-METER. UNLESS OTHERWISE SPECIFIED
3. ALL RESISTORS ARE ½ W.
4. ALL TRANSISTORS ARE 2N1303.
5. ALL DIODES ARE IN483B.

Figure 4-4. Capstan Servo Amplifier, Negative or Inverted Negative Logic, Schematic Diagram

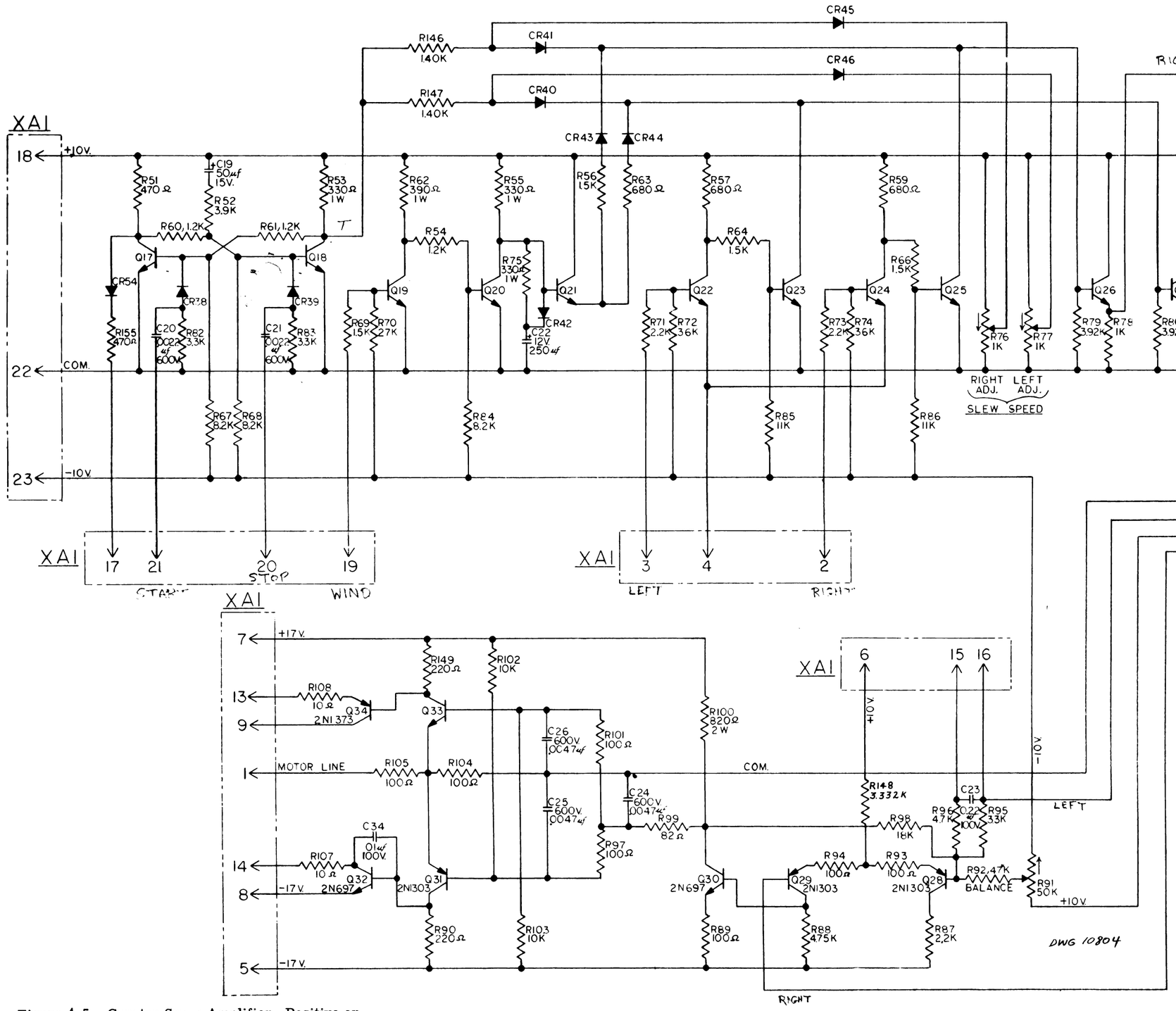
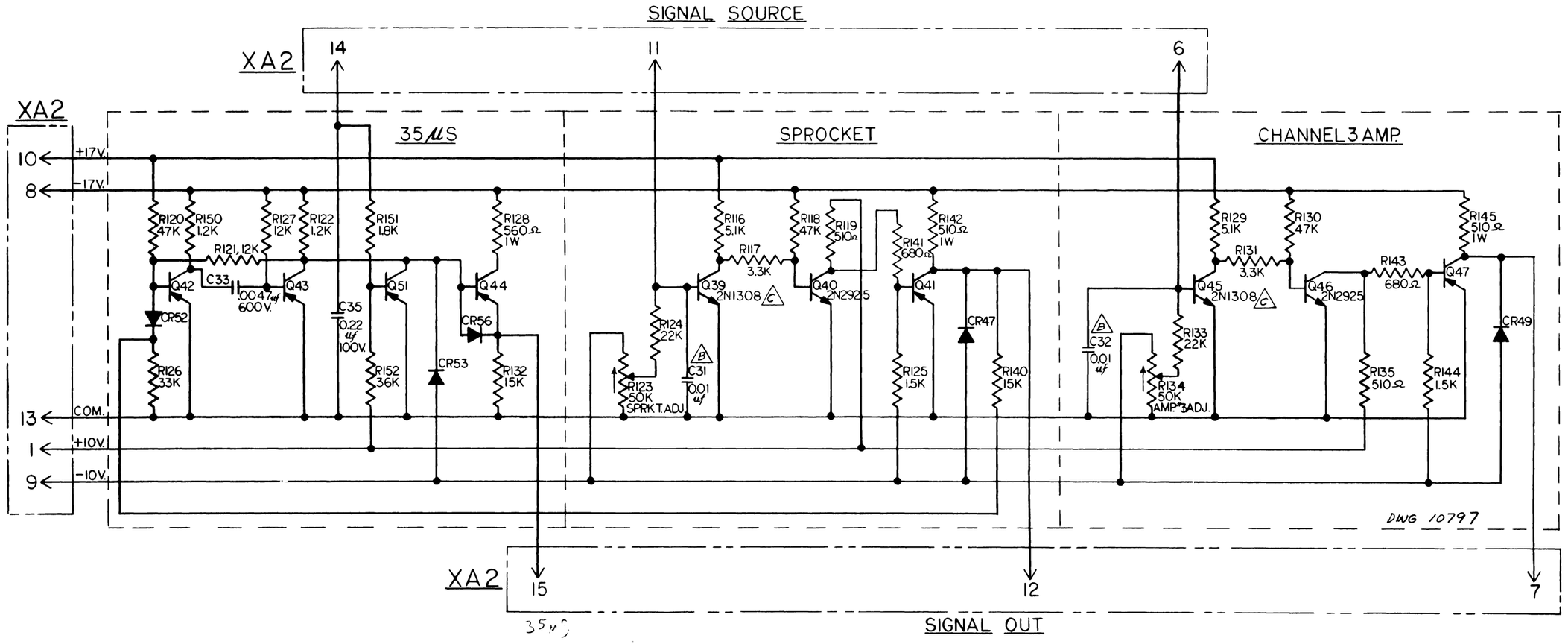
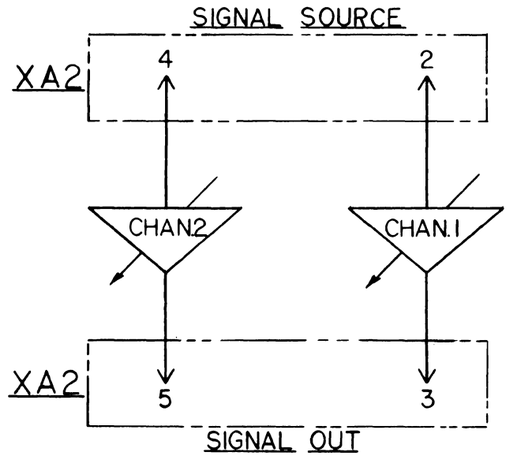


Figure 4-5. Capstan Servo Amplifier, Positive or Inverted Positive Logic, Schematic Diagram

NOTES:

1. CLOCKWISE ROTATION OF POTENTIOMETERS VARIES RESISTANCE AS INDICATED BY ARROWS.
2. ALL VOLTAGES MEASURED WITH LINE AT 115 V, A.C.; USING 20,000 Ω/V., DC.-METER & 5000 Ω/V, AC-METER. UNLESS OTHERWISE SPECIFIED —
3. ALL RESISTORS ARE ½ W.
4. ALL TRANSISTORS ARE 2N1302.
5. ALL DIODES ARE IN483B.

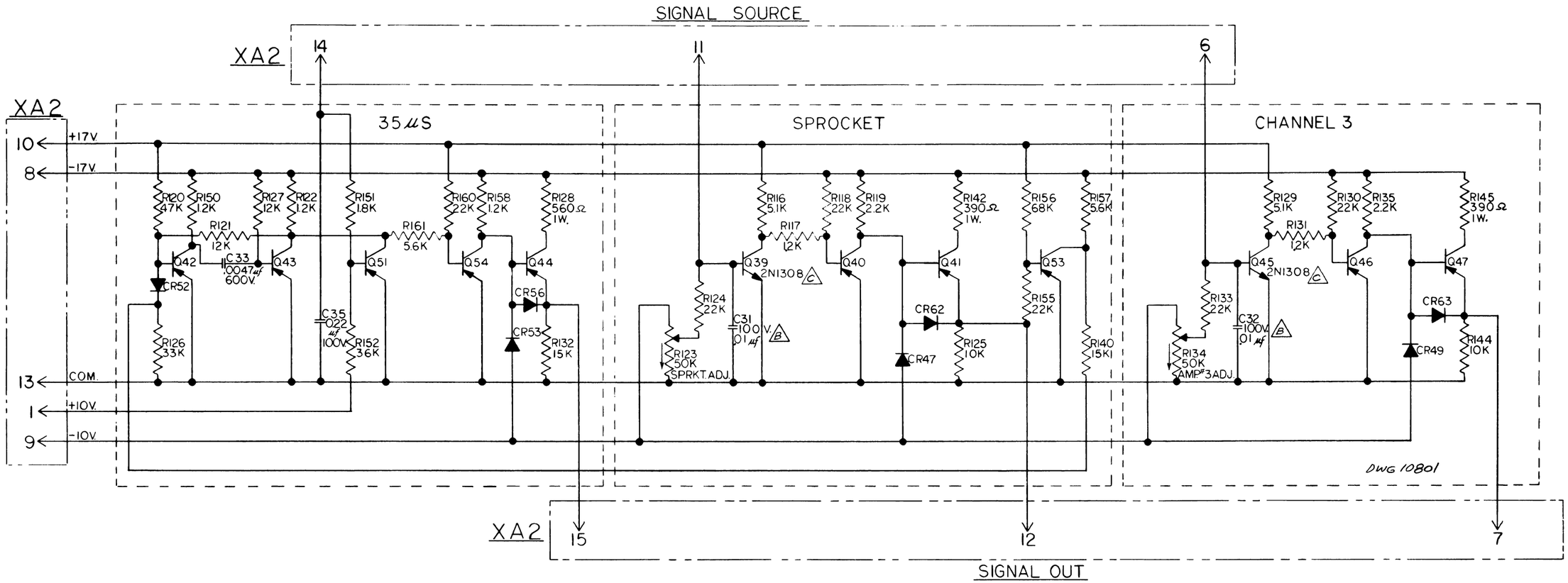




NOTES:

1. CHANNEL "3" IS TYPICAL FOR CHANNELS "2" & "1".
2. ALL VOLTAGES MEASURED WITH LINE AT 115 V., A.C.; USING 20,000 Ω/V, D.C.-METER & 5,000 Ω/V, A.C.-METER.
3. CLOCKWISE ROTATION OF POTENTIOMETERS VARIES RESISTANCE AS INDICATED BY ARROWS. UNLESS OTHERWISE SPECIFIED —
4. ALL FIXED RESISTORS ARE 1/2 W.
5. ALL DIODES ARE IN483B.
6. ALL TRANSISTORS ARE 2N1303.
7. (B) ALL CAPACITORS ARE 100 V.

Figure 4-6. Amplifier Board No. 1, Negative Logic, Schematic Diagram



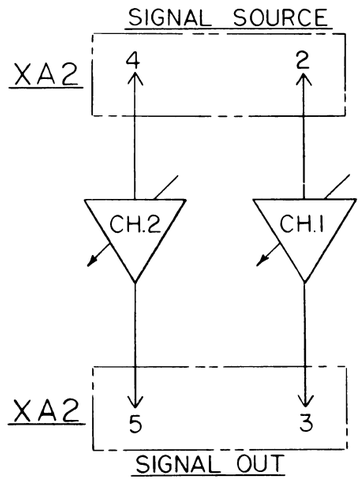
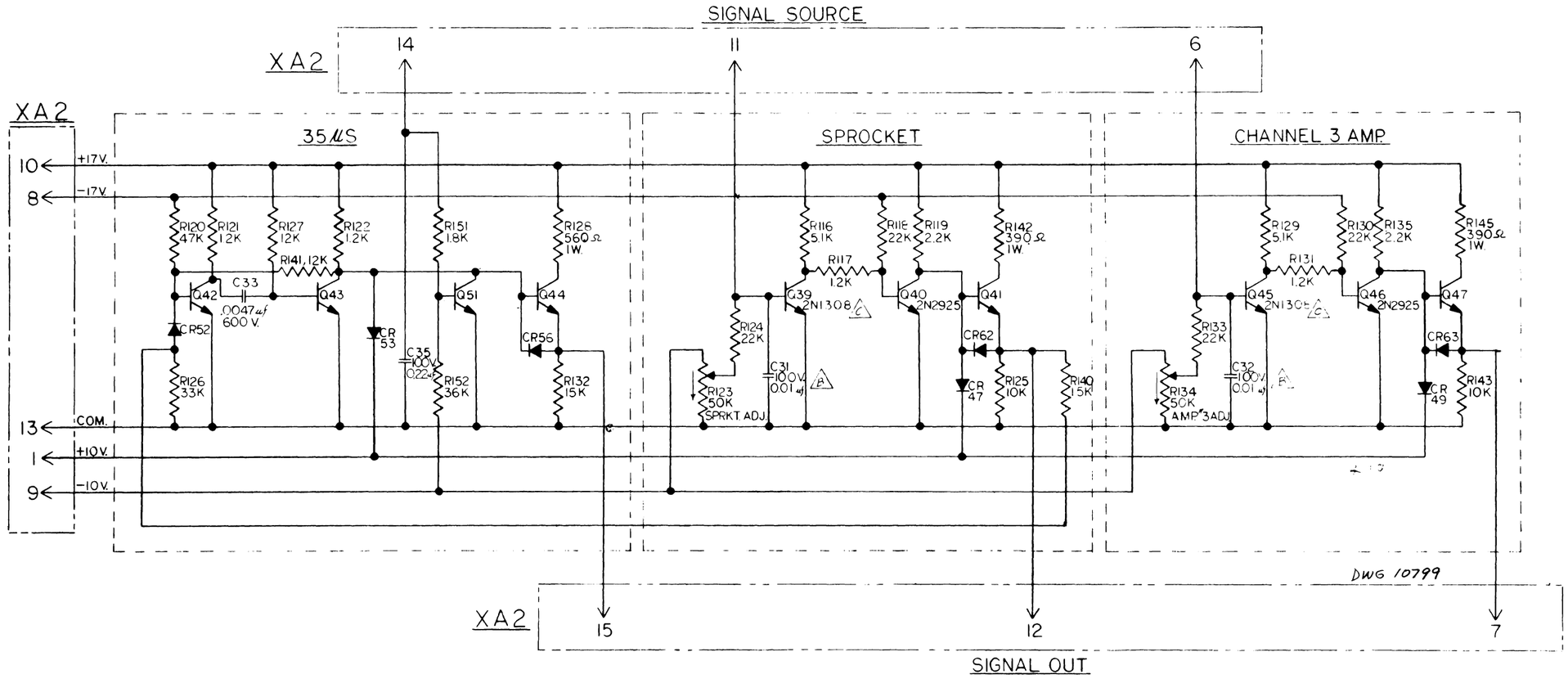
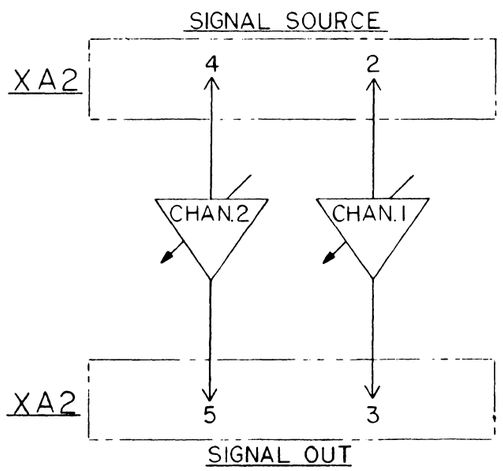


Figure 4-7. Amplifier Board No. 1, Inverted Negative Logic, Schematic Diagram

NOTES:
1. CHAN. 3 IS TYP. FOR CHAN'S. 2 & 1.
2. ALL VOLTAGES MEASURED WITH LINE AT 115 V., A.C.; USING 20,000 Ω/V, D.C.-METER & 5,000 Ω/V, A.C.-METER.
3. CLOCKWISE ROTATION OF POTENTIOMETERS VARIES RESISTANCE AS INDICATED BY ARROWS. UNLESS OTHERWISE SPECIFIED –
4. ALL RESISTORS ARE ½ W.
5. ALL TRANSISTORS ARE 2N1303
6. ALL DIODES ARE IN483B.

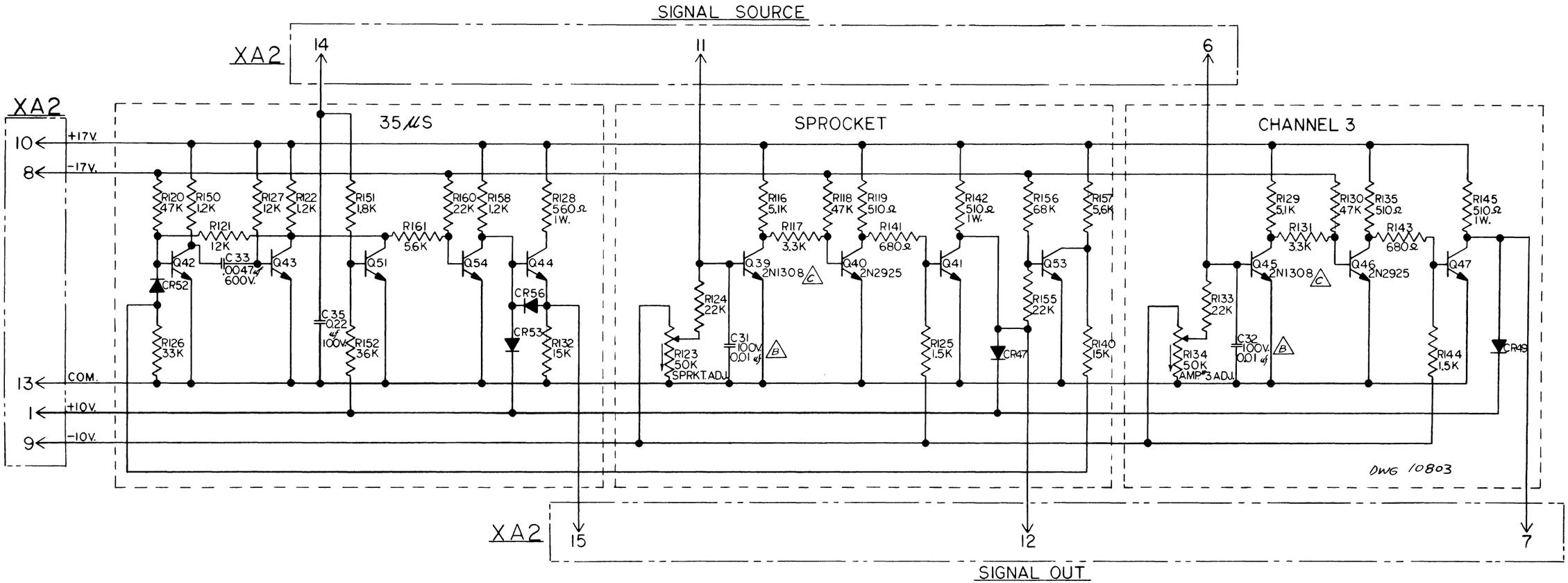


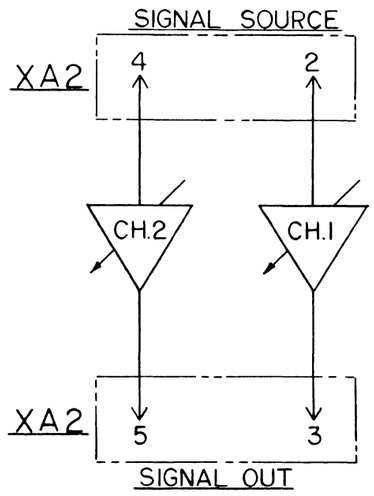


NOTES:

1. CHAN. 3 IS TYP FOR CHAN'S. 2 & 1.
2. CLOCKWISE ROTATION OF POTENTIOMETERS VARIES RESISTANCE AS INDICATED BY ARROWS.
3. ALL VOLTAGES MEASURED WITH LINE AT 115 V., A.C.; USING 20,000 Ω/V., DC.-METER & 3000 Ω/V., AC. METER. UNLESS OTHERWISE SPECIFIED —
4. ALL RESISTORS ARE 1/2 W.
5. ALL TRANSISTORS ARE 2N1302.
6. ALL DIODES ARE IN483B.

Figure 4-8. Amplifier Board No. 1, Positive Logic, Schematic Diagram





NOTES:
1. CHAN. 3 IS TYP. FOR CHAN'S. 2 & 1.
2. ALL VOLTAGES MEASURED WITH LINE AT 115 V., A.C.; USING 20,000 Ω/V., D.C.-METER & 5,000 Ω/V., A.C.-METER.
3. CLOCKWISE ROTATION OF POTENTIOMETERS VARIES RESISTANCE AS INDICATED BY ARROWS. UNLESS OTHERWISE SPECIFIED –
4. ALL RESISTORS ARE ½ W.
5. ALL TRANSISTORS ARE 2N1302.
6. ALL DIODES ARE 1N483 B.

Figure 4-9. Amplifier Board No. 1, Inverted Positive Logic, Schematic Diagram

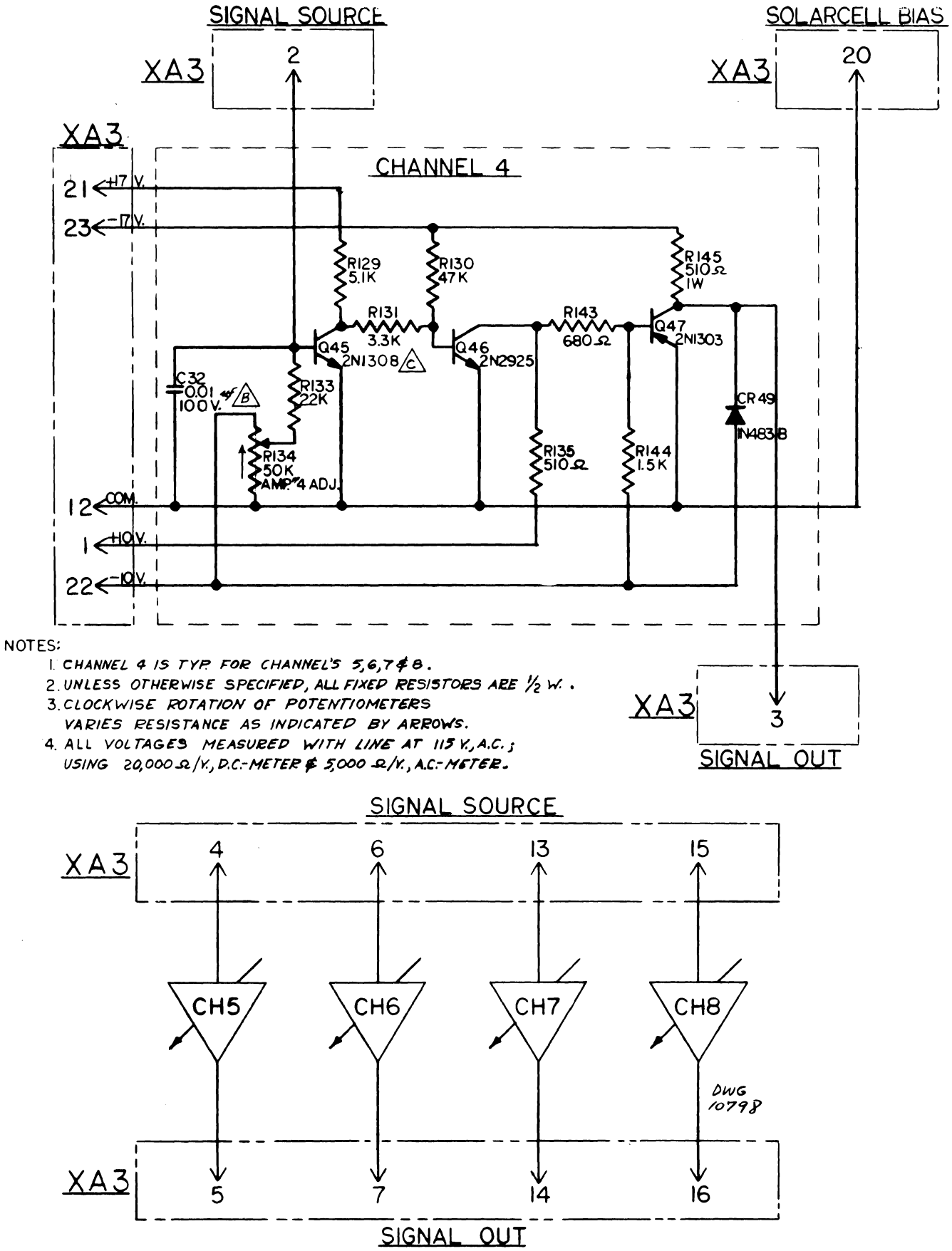
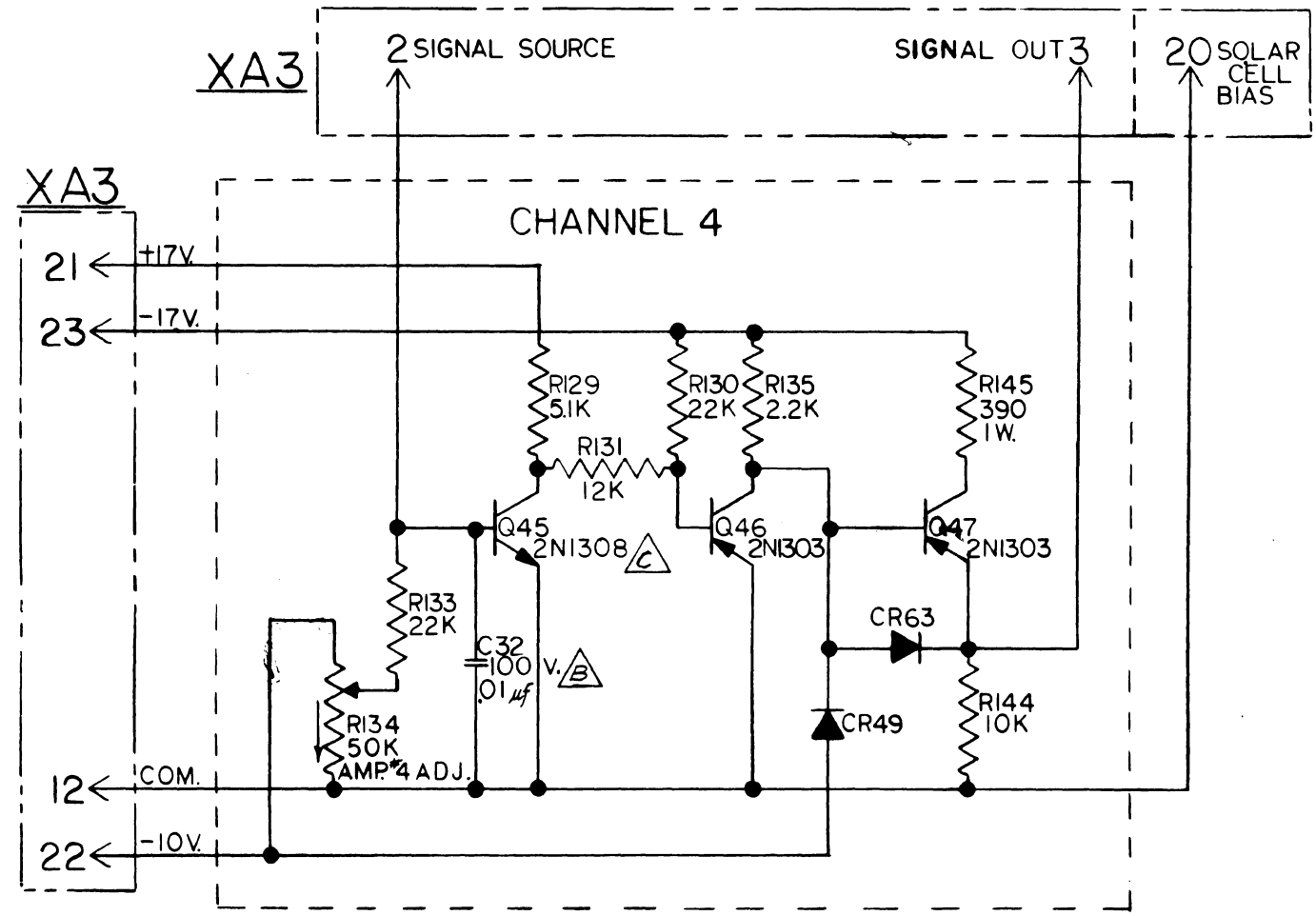


Figure 4-10. Amplifier Board No. 2, Negative Logic, Schematic Diagram



NOTES:

1. CHAN. 4 IS TYP. FOR CHAN'S. 5, 6, 7 & 8.
2. CLOCKWISE ROTATION OF POTENTIOMETERS VARIES RESISTANCE AS INDICATED BY ARROWS.
3. ALL VOLTAGES MEASURED WITH LINE AT 115 V., A.C.; USING 20,000 Ω/V., D.C. METER & 5,000 Ω/V., A.C. METER. UNLESS OTHERWISE SPECIFIED —
4. ALL RESISTORS ARE 1/2 W.
5. ALL DIODES ARE IN483 B.

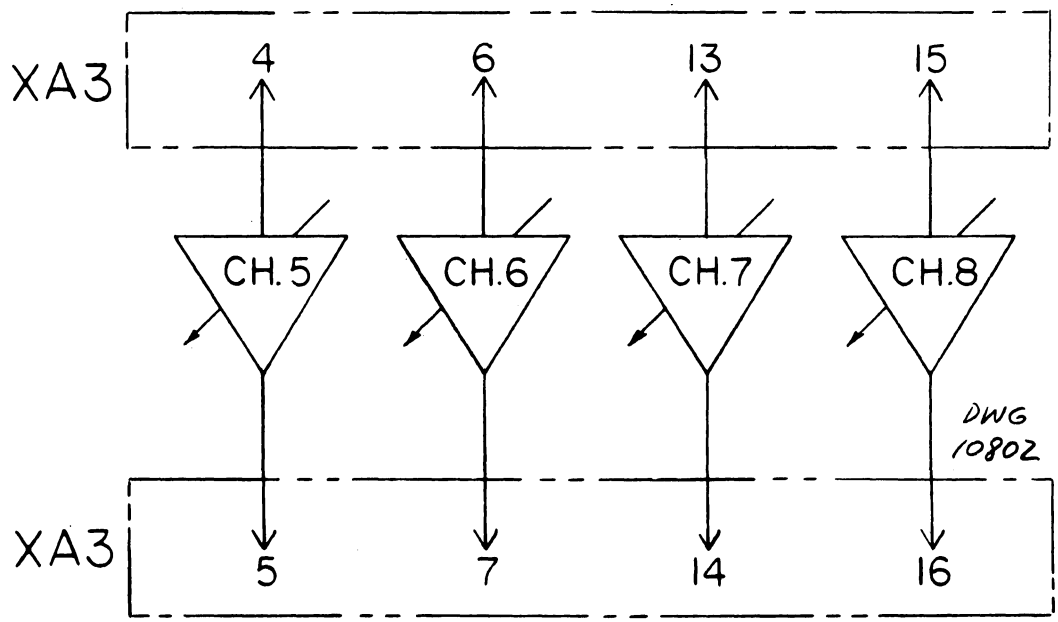


Figure 4-11. Amplifier Board No. 2, Inverted Negative Logic, Schematic Diagram

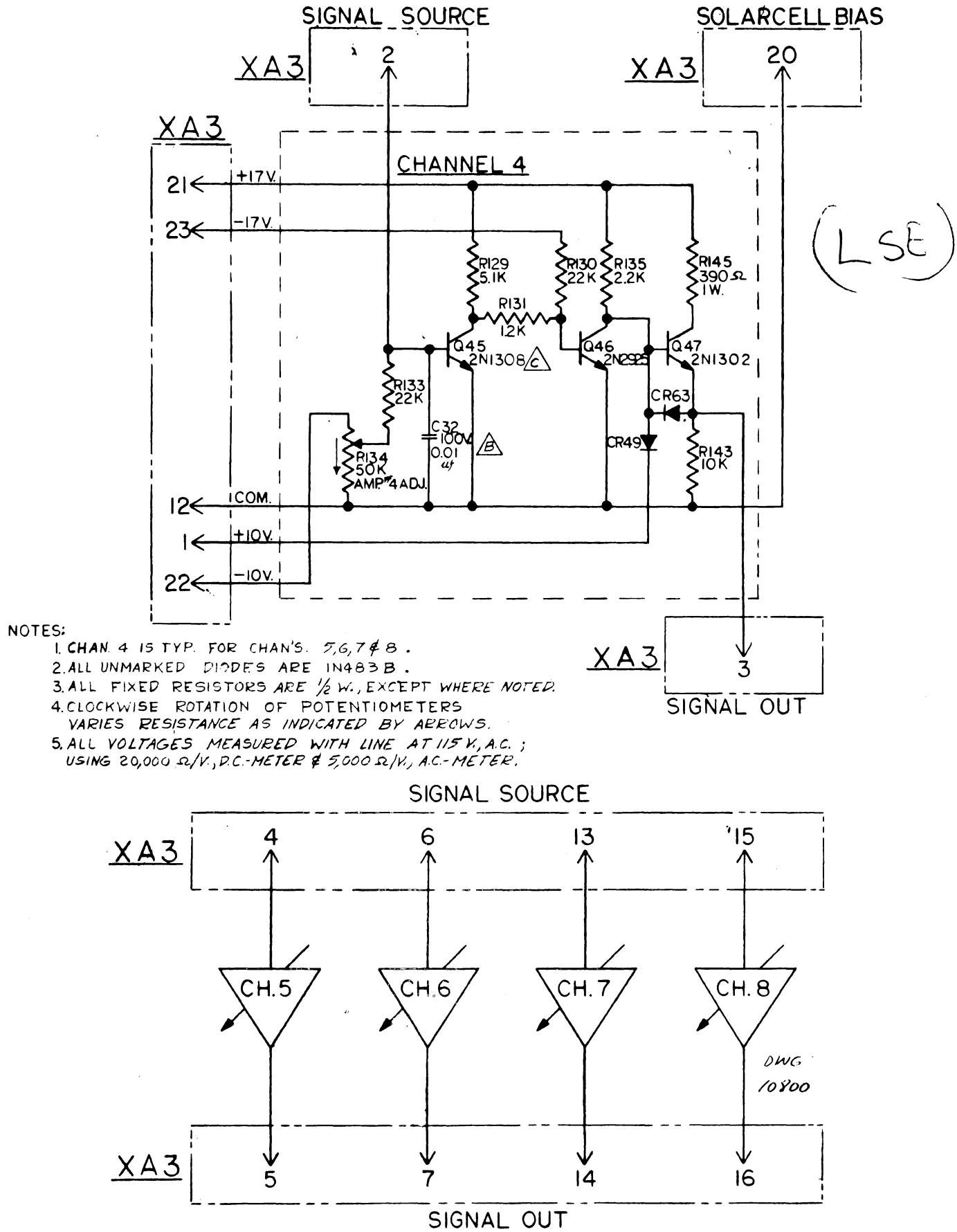
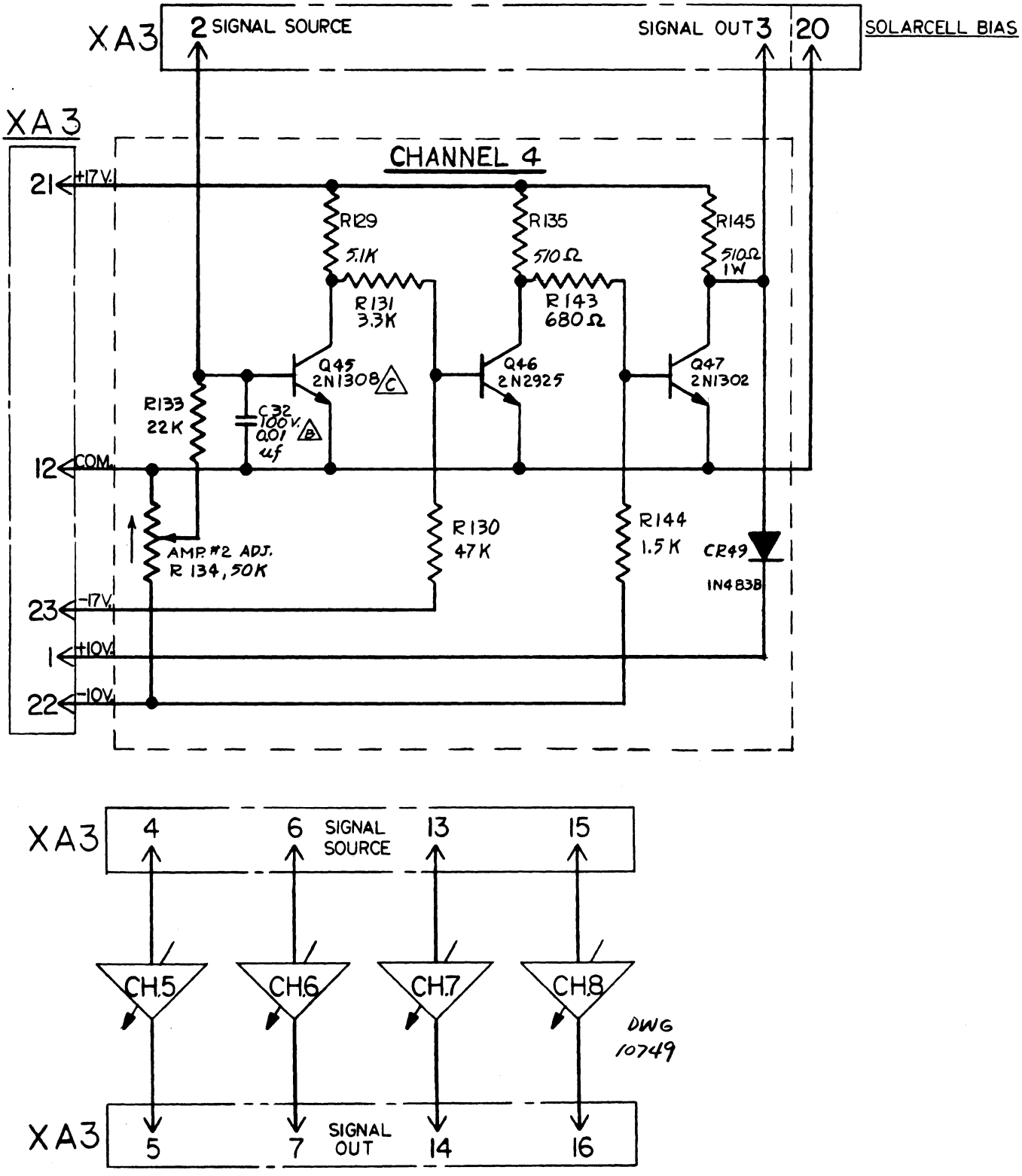


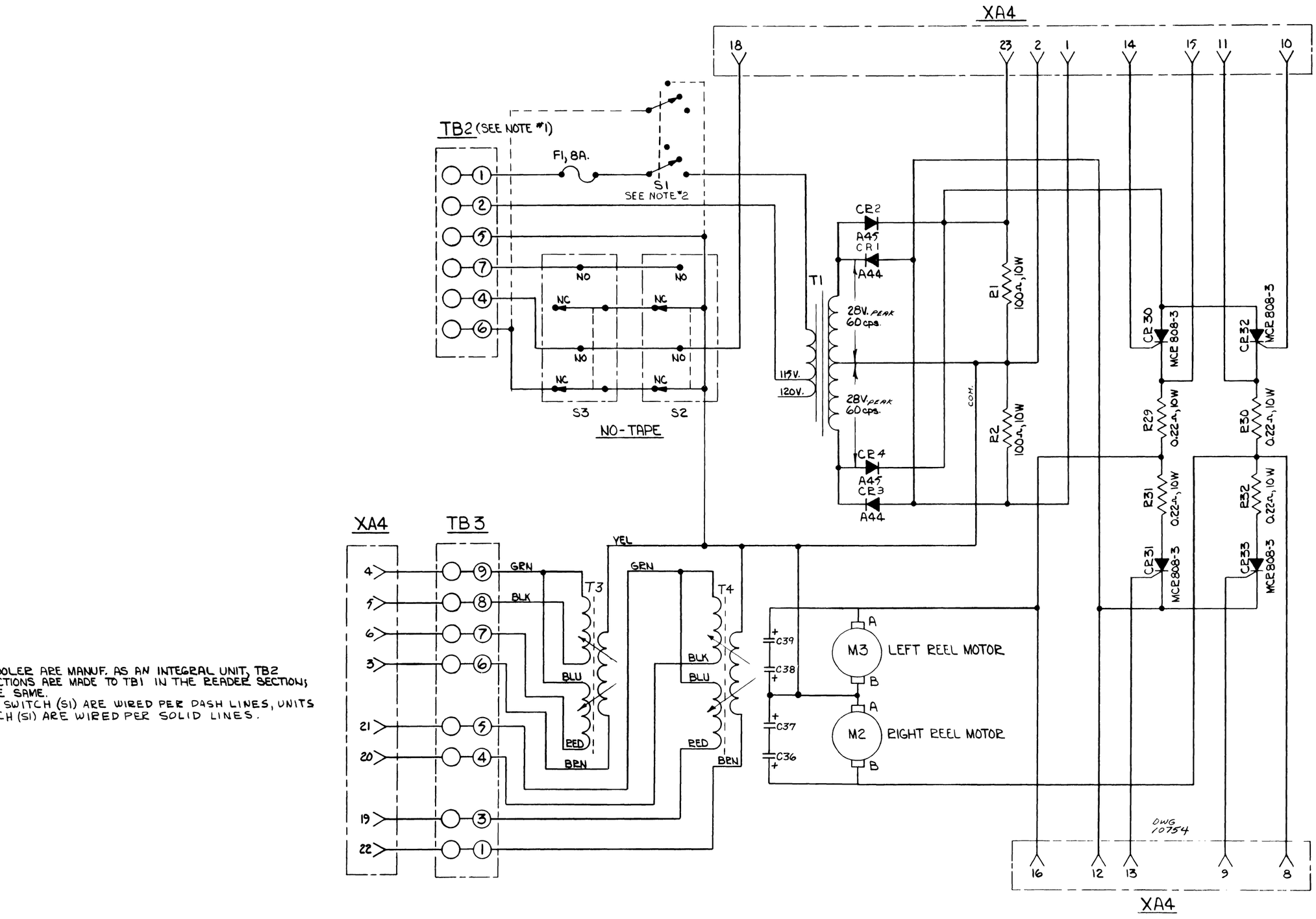
Figure 4-12. Amplifier Board No. 2, Positive Logic, Schematic Diagram



NOTES:

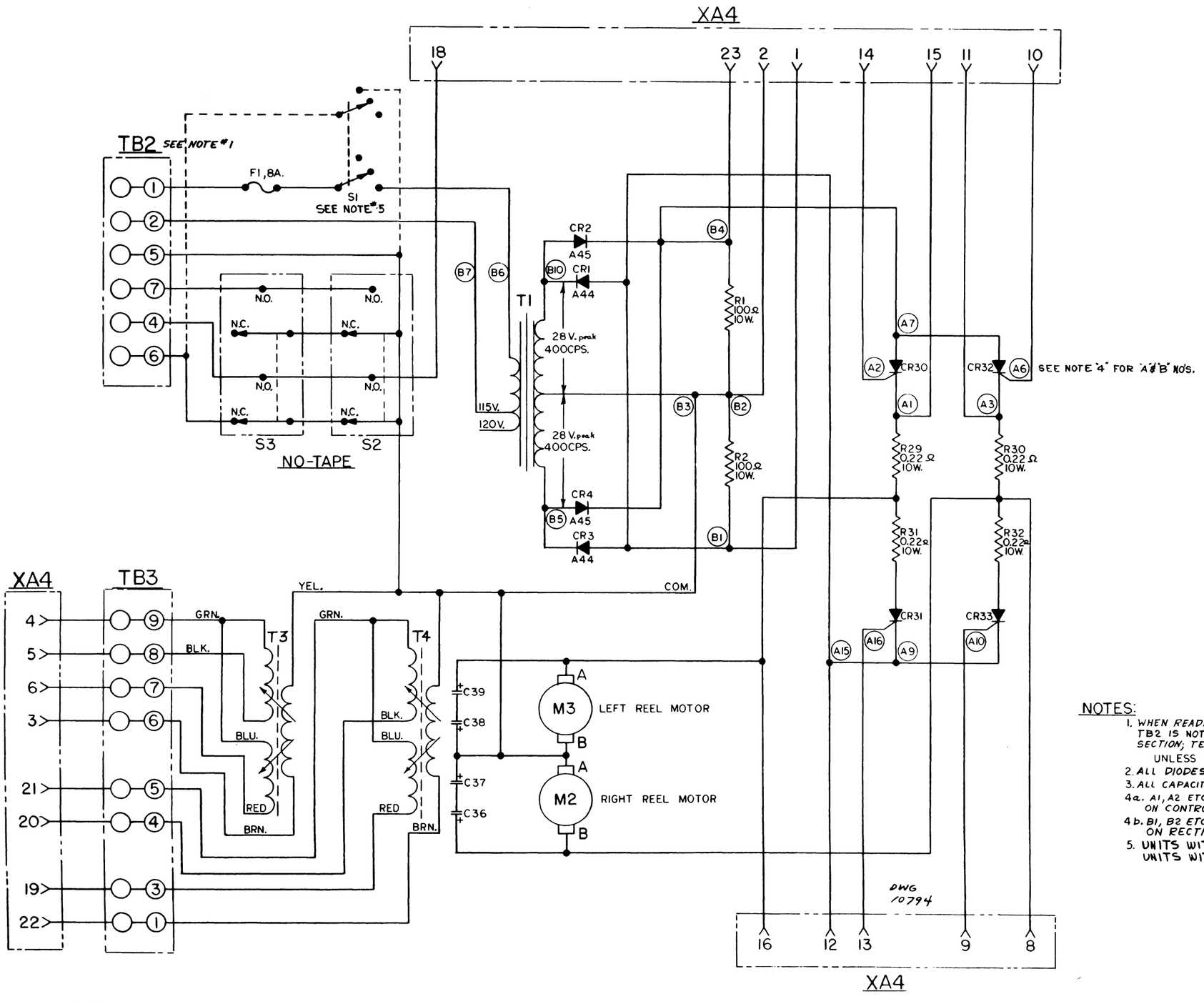
1. CHAN. 4 TYP. FOR CHAN'S. 5, 6, 7 & 8.
2. ALL FIXED RESISTORS ARE ½ W., EXCEPT WHERE NOTED.
3. CLOCKWISE ROTATION OF POTENTIOMETERS VARIES RESISTANCE AS INDICATED BY ARROWS.
4. ALL VOLTAGES MEASURED WITH LINE @ 115 V. A.C.; USING 20,000 Ω/V. D.C. METER AND 5,000 Ω/V. A.C. METER.

Figure 4-13. Amplifier Board No. 2, Inverted Positive Logic, Schematic Diagram



NOTES:
1. WHEN READER & SPOOLER ARE MANUF. AS AN INTEGRAL UNIT, TB2 IS NOT USED. CONNECTIONS ARE MADE TO TB1 IN THE READER SECTION; TERM. NO. REMAIN THE SAME.
2. UNITS WITH DPDT SWITCH (S1) ARE WIRED PER DASH LINES, UNITS WITH SPST SWITCH (S1) ARE WIRED PER SOLID LINES.

Figure 4-14. Spooler Chassis, 60 Cycle, 8-Inch Reels, Schematic Diagram



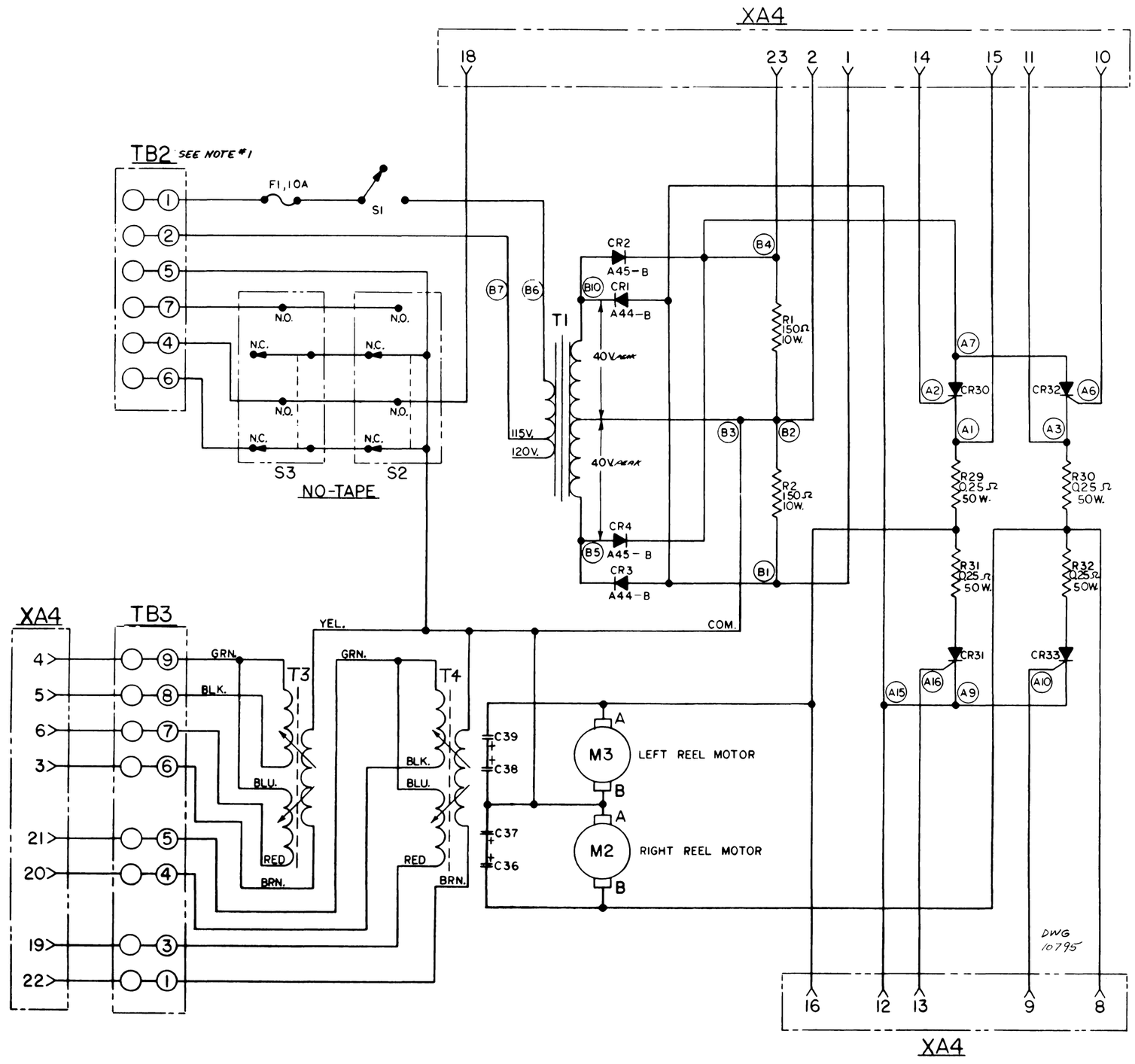
NOTES:

1. WHEN READER & SPOOLER ARE MANUF. AS AN INTEGRAL UNIT, TB2 IS NOT USER CONNECTIONS ARE MADE TO TB1 IN THE READER SECTION; TERM. NO'S. REMAIN THE SAME.

   UNLESS OTHERWISE SPECIFIED —

2. ALL DIODES ARE MCR 808-3
3. ALL CAPACITORS ARE 1000 μf, 50 V.
4a. A1, A2 ETC. DESIGNATIONS APPEAR AS E1, E2 ETC. TERMINALS ON CONTROL RECTIFIER ASSY'S., SPOOLER.
4b. B1, B2 ETC. DESIGNATIONS APPEAR AS E1, E2 ETC. TERMINALS ON RECTIFIER ASSY'S., SPOOLER.
5. UNITS WITH DPDT SWITCH(S1) ARE WIRED PER DASH LINES, UNITS WITH SPST SWITCH(S1) ARE WIRED PER SOLID LINES.

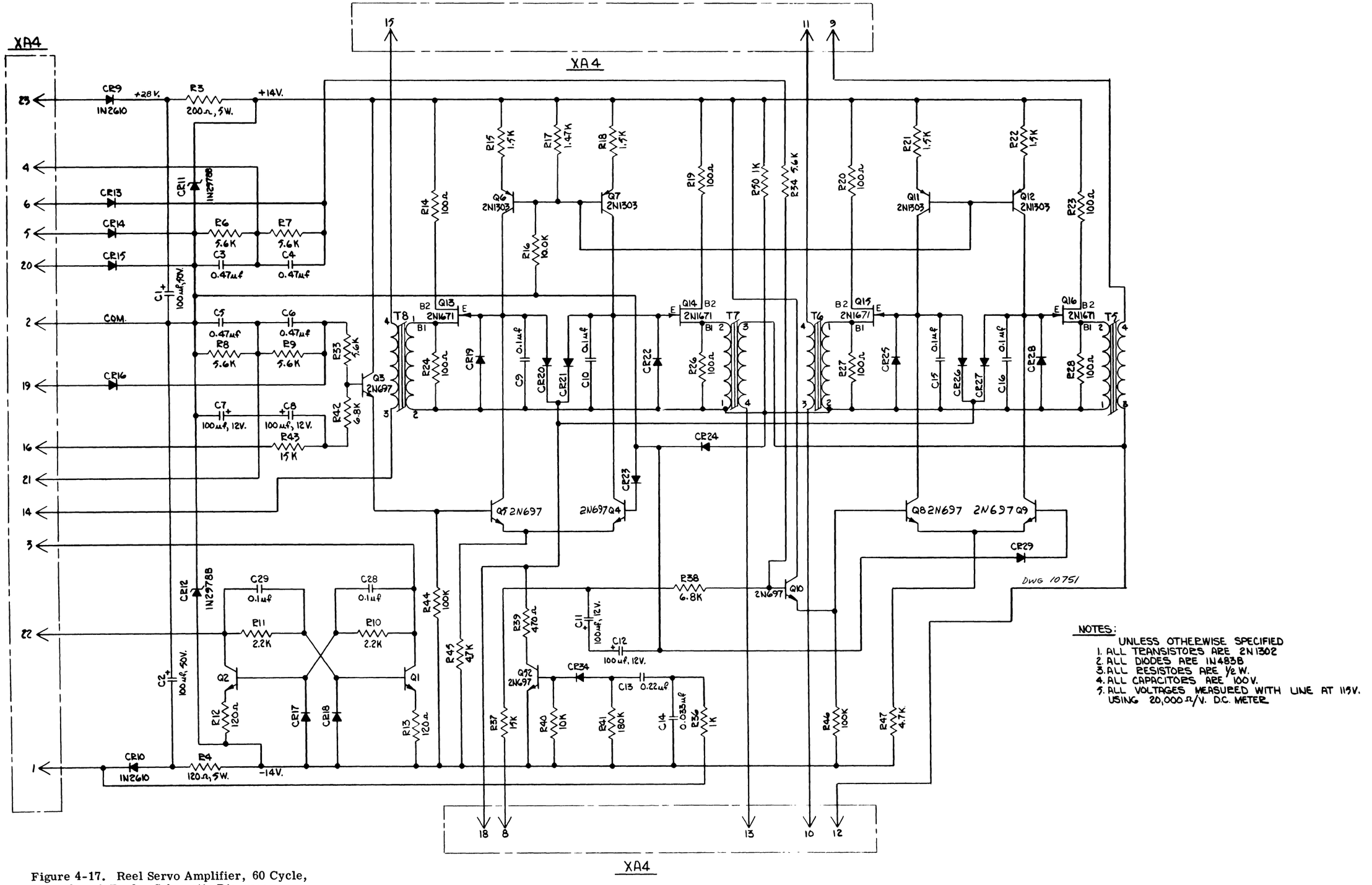
Figure 4-15. Spooler Chassis, 400 Cycle, 8-Inch Reels, Schematic Diagram



NOTES:

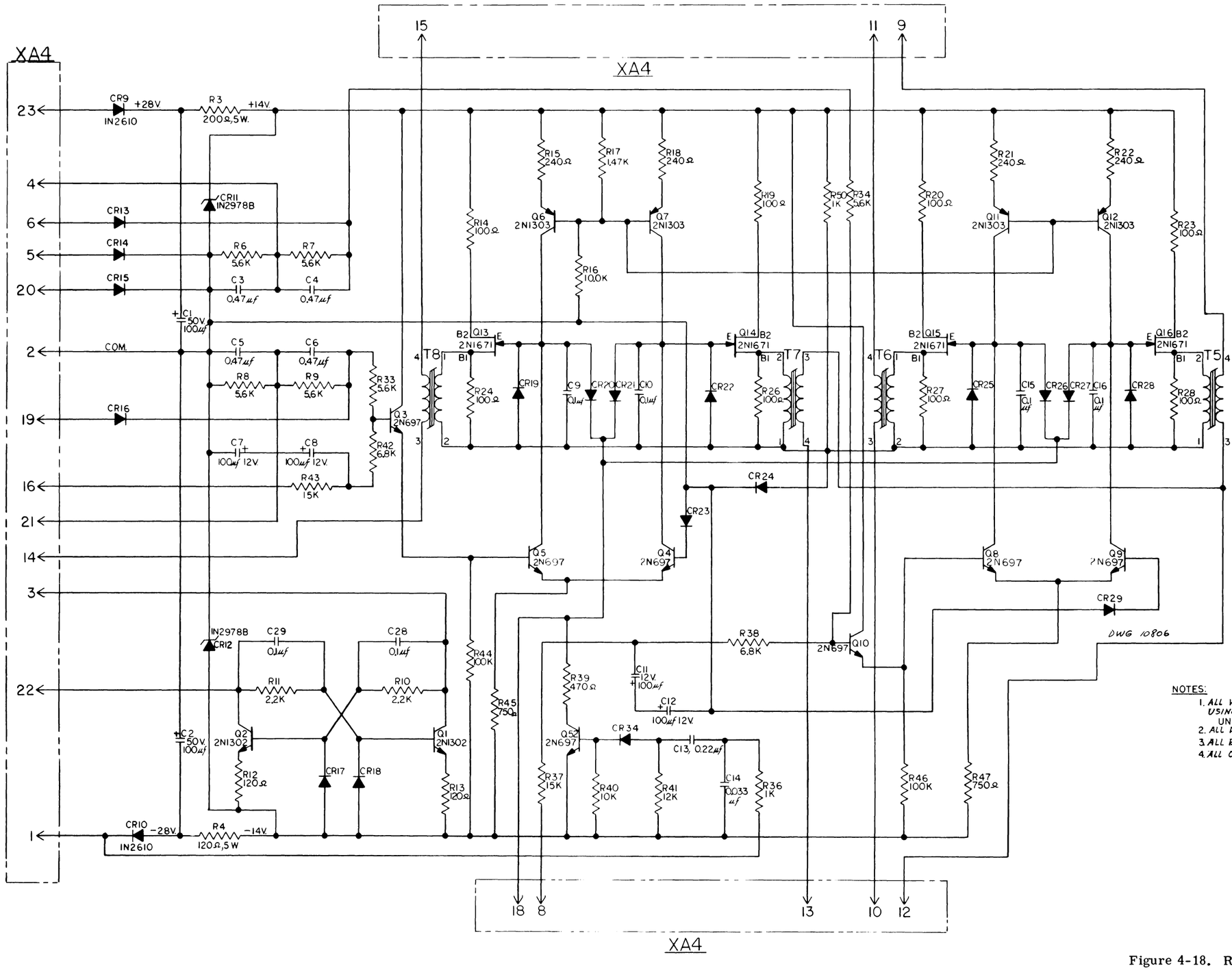
1. WHEN READER & SPOOLER ARE MANUF. AS AN INTEGRAL UNIT, TB2 IS NOT USED CONNECTIONS ARE MADE TO TB1 IN THE READER SECTION; TERM. NO'S. REMAIN THE SAME.
   UNLESS OTHERWISE SPECIFIED —
2. ALL DIODES ARE MCR 808-4
3. ALL CAPACITORS ARE 1000 μf, 50 V.

Figure 4-16. Spooler Chassis, 60 or 400 Cycle, 10-1/2-Inch Reels, Schematic Diagram



NOTES:
UNLESS OTHERWISE SPECIFIED
1. ALL TRANSISTORS ARE 2N1302
2. ALL DIODES ARE 1N483B
3. ALL RESISTORS ARE ½ W.
4. ALL CAPACITORS ARE 100 V.
5. ALL VOLTAGES MEASURED WITH LINE AT 115V. USING 20,000 Ω/V. D.C. METER

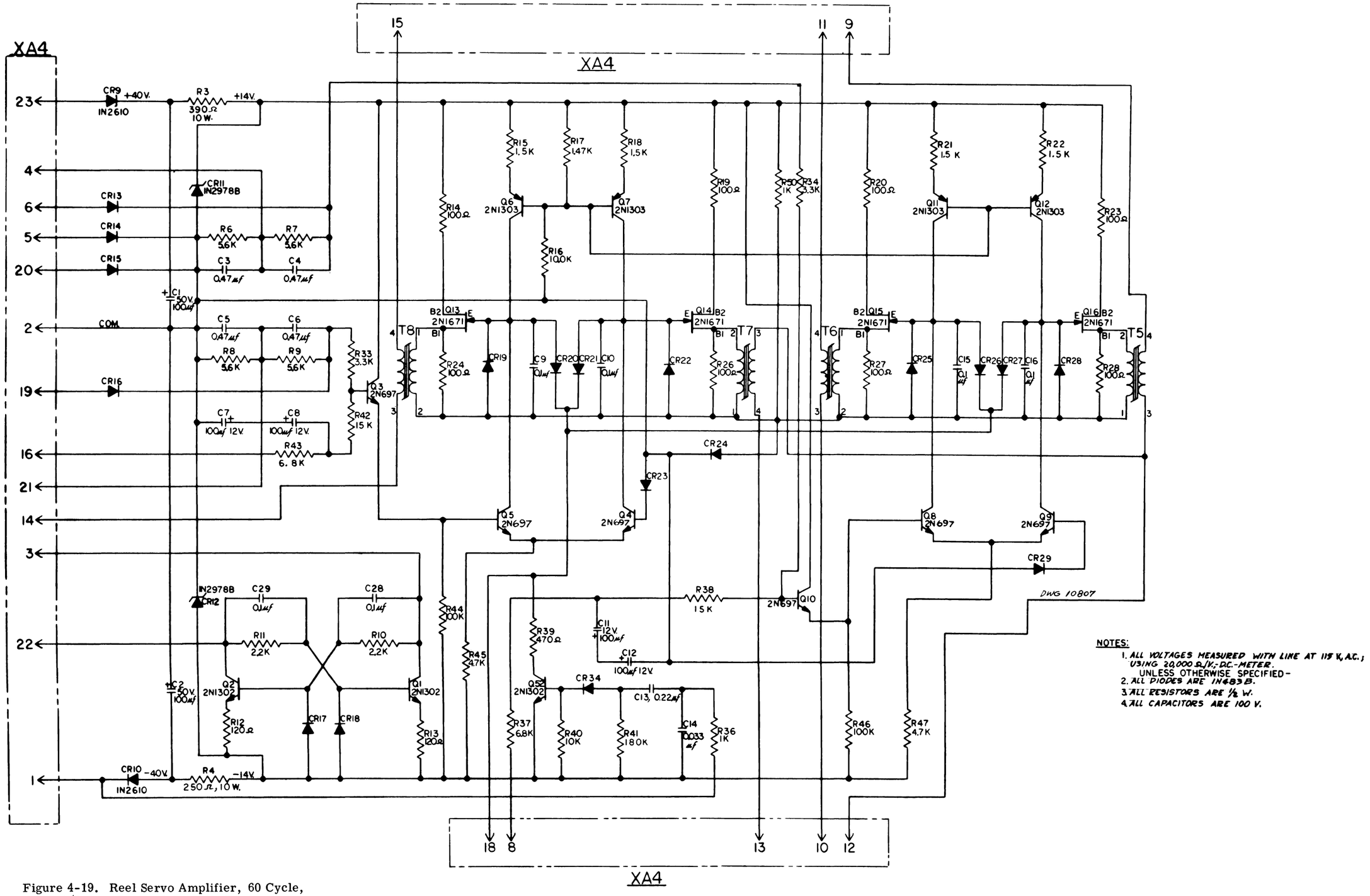
Figure 4-17. Reel Servo Amplifier, 60 Cycle, 8-Inch Reels, Schematic Diagram



NOTES:

1. ALL VOLTAGES MEASURED WITH LINE AT 115 V, A.C.; USING 20,000 Ω/V, D.C.-METER. UNLESS OTHERWISE SPECIFIED -
2. ALL DIODES ARE IN483B.
3. ALL RESISTORS ARE ½ W.
4. ALL CAPACITORS ARE 100 V.

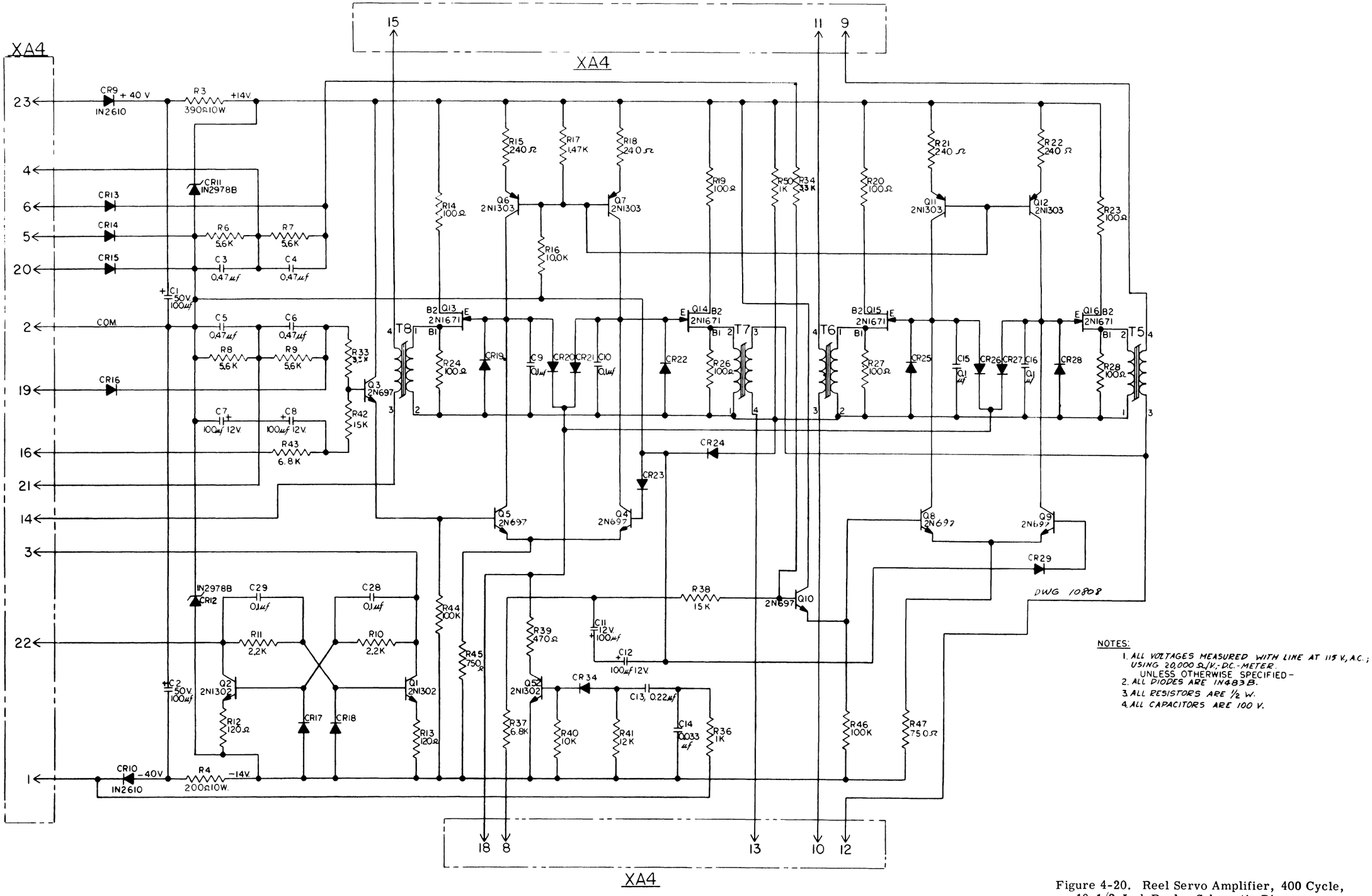
Figure 4-18. Reel Servo Amplifier, 400 Cycle, 8-Inch Reels, Schematic Diagram



NOTES:

1. ALL VOLTAGES MEASURED WITH LINE AT 115 V, A.C.; USING 20,000 Ω/V, D.C.-METER. UNLESS OTHERWISE SPECIFIED-
2. ALL DIODES ARE IN483B.
3. ALL RESISTORS ARE ½ W.
4. ALL CAPACITORS ARE 100 V.

Figure 4-19. Reel Servo Amplifier, 60 Cycle, 10-1/2-Inch Reels, Schematic Diagram



NOTES:

1. ALL VOLTAGES MEASURED WITH LINE AT 115 V, A.C.; USING 20,000 Ω/V. DC METER. UNLESS OTHERWISE SPECIFIED -
2. ALL DIODES ARE IN483B.
3. ALL RESISTORS ARE ½ W.
4. ALL CAPACITORS ARE 100 V.

Figure 4-20. Reel Servo Amplifier, 400 Cycle, 10-1/2-Inch Reels, Schematic Diagram

SECTION V

MAINTENANCE

5-1. GENERAL.

This section describes the preventive maintenance, corrective maintenance and adjustment procedures required to maintain the equipment in good operating condition. Table 5-1 itemizes the test equipment which is required to carry out the instructions in this section.

5-2. PREVENTIVE MAINTENANCE.

5-2-1. PERIODIC INSPECTION. An overall visual inspection of the equipment is recommended immediately before being put into service and whenever a malfunction is suspected. Such an inspection involves the examination of the electrical wiring, connectors, operation of controls, loose components and mechanical parts for wear.

5-2-2. CLEANING. As part of the reader maintenance schedule, it is recommended that the following be performed to enhance trouble-free performance.

a. All surfaces which come in contact with tape should be cleaned every 40 hours of operation. These include the read head, storage arm and guide rollers. Clean these items with a tissue or cotton swab dampened with Trichlorethelene.

b. Periodically, wipe the front-panel and chassis with a clean, lint-free cloth to remove dust accumulation.

5-2-3. LUBRICATION. No lubrication is required since all motors have sealed ball bearings and moving parts are permanently oiled.

5-3. PERFORMANCE TEST.

Once every three months as normal preventive maintenance or whenever the equipment is suspected of marginal operation, the performance test which follows should be performed.

5-3-1. TEST SETUP.

a. Install a test tape, prepared in accordance with figure 5-1, using the procedures given in Section III.

TABLE 5-1. TEST EQUIPMENT REQUIRED

Nomenclature		Remarks
Item	Designation	
Oscilloscope	Tektronix 545A	Or equivalent
Oscilloscope Plug-In	Tektronix CA	Or equivalent
Test Tape	Test aid	Local manufacture, see figure 5-1
Adapter Cable	Test aid	Local manufacture, see figure 5-3
Power Source	-	115v 60 or 400 cps at 750 watts
Variac	-	Capable of handling 95v to 130v at 750 watts
Force Gage	-	0-5 lbs
Pulse Generator	HP 211A	Or equivalent
Matrix Adapter	Test aid	Local manufacture, see figure 5-4
±6 Volt Power Supply	Test aid	-
Multimeter	Simpson 260	Or Equivalent
Template	Test Aid	Local manufacture, see figure 5-30

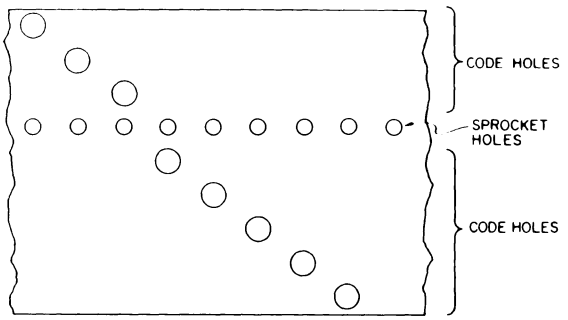


Figure 5-1. Tape - Performance Test

b. Connect the test equipment to the tape reader as shown in figure 5-2. The adapter cable and matrix adapter should be fabricated as shown in figures 5-3 and 5-4, respectively. Table 5-2 gives the connections to the matrix adapter.

NOTE

The test procedures and waveforms in this section are for a standard negative logic reader. For an inverted negative, or inverted positive logic reader, refer to the appropriate schematic diagram for polarity of voltage levels.

TABLE 5-2. MATRIX ADAPTER CONNECTIONS

Terminal	Destination
1	Cable adapter post P3-A and oscilloscope sync input.
2	Cable adapter post P3-B.
3	Cable adapter post P3-C.
4	Cable adapter post P3-D.
5	Cable adapter post P3-E.
6	Cable adapter post P3-F.
7	Cable adapter post P3-G.
8	Cable adapter post P3-H.
9	Oscilloscope trace A input.

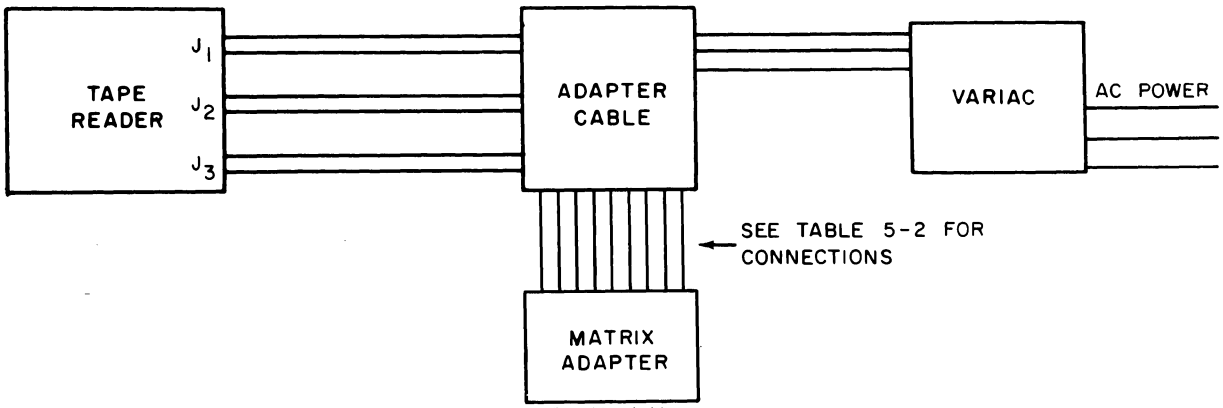


Figure 5-2. Test Set-Up

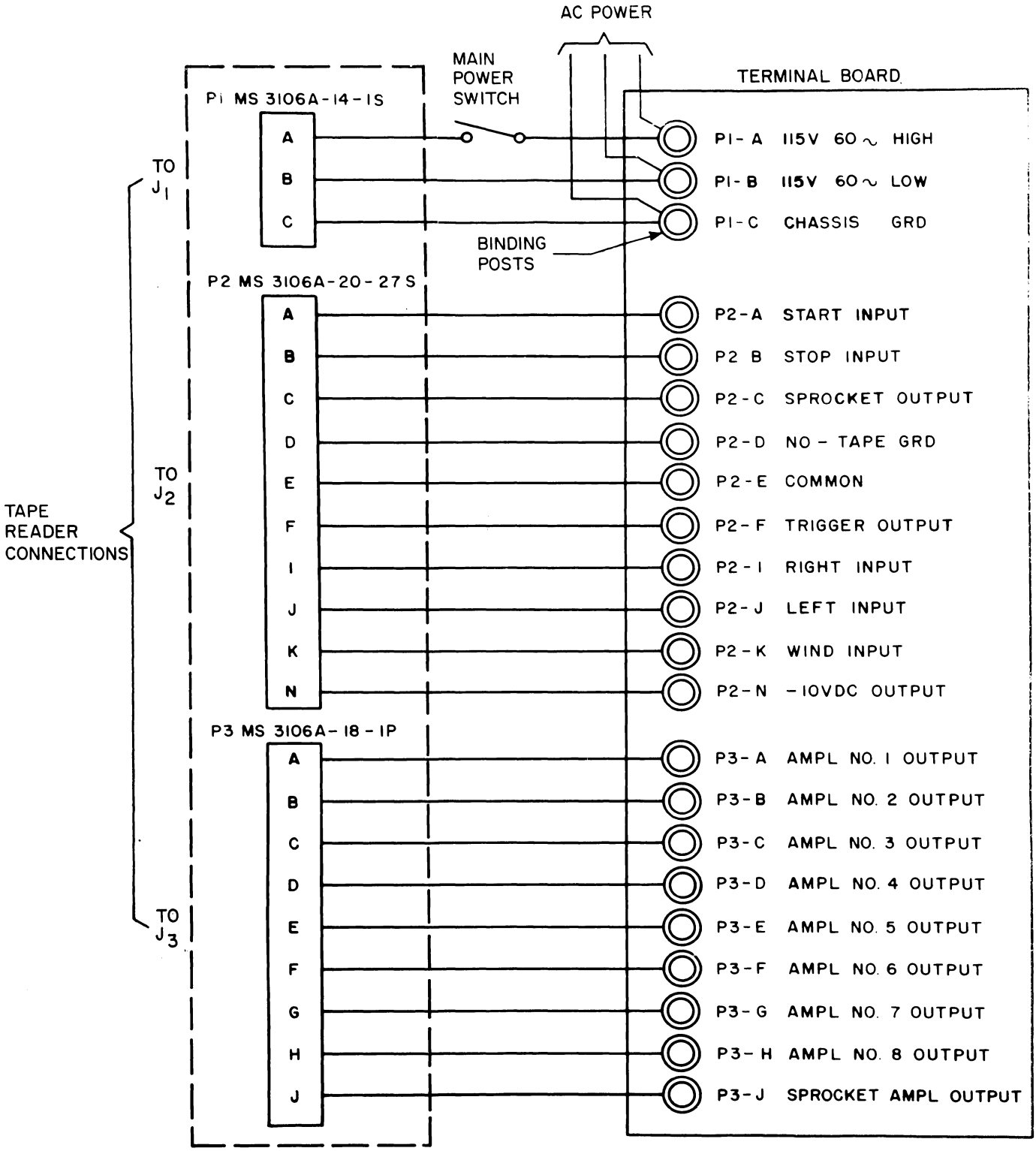


Figure 5-3. Adapter Cable, Schematic Diagram

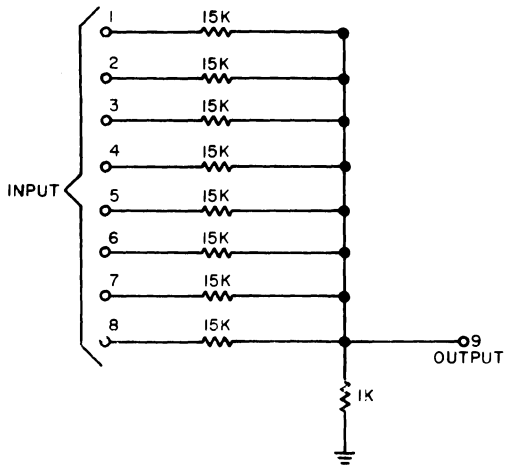


Figure 5-4. Matrix Adapter, Schematic Diagram

5-3-2. TEST PROCEDURE

NOTE

If problems are encountered during test, refer to corrective maintenance paragraph 5-4.

5-3-2-1. Slew.

a. Apply 115 volt, 60 or 400 cycle, single phase ac to posts P1-A and P1-B of the adapter cable.

b. Connect the B trace input of the oscilloscope (Tektronix 545A) to post P2-F of the adapter cable.

c. Place the front-panel Mode switch in the READER/SPOOLER position.

d. Connect the pulse generator to post P2-A and a -6 vdc level to post P2-I of the adapter cable.

e. Set the pulse generator to produce a -6 vdc, 30-microsecond wide pulse and observe that the tape moves to the right.

f. Check the oscilloscope presentation. Waveforms shown in figure 5-5 should be observed.

g. Remove -6 vdc level at P2-I, and apply to P2-J, observing that the tape moves to the left. Repeat step f.

h. Remove the -6 vdc level from P2-J.

5-3-2-2. Wind.

a. Apply a -6 vdc level to posts P2-I and P2-K of adapter cable. Observe that tape moves to the right.

b. Observe the waveform on oscilloscope. Repetition rate of pulses should be 1000 characters per second ± 10%.

c. Remove -6 vdc level at P2-I and allow reel servos to stabilize. Connect -6 vdc to P2-J, and observe that the tape moves to the left.

d. Repeat step b.

e. Remove all signal inputs.

f. Place Mode switch in LOAD position and adapter power switch in OFF position.

5-3-2-3. Step.

a. Connect posts P2-B and P2-C on the adapter cable together.

b. Place adapter cable power switch in the ON position.

c. Place Mode switch in READER/SPOOLER position.

d. Set the pulse generator to produce a -6 vdc, 30-microsecond wide pulse.

e. Connect the pulse generator to post P2-A of the adapter cable.

f. Apply a -6 vdc level to post P2-I. Tape should move to right.

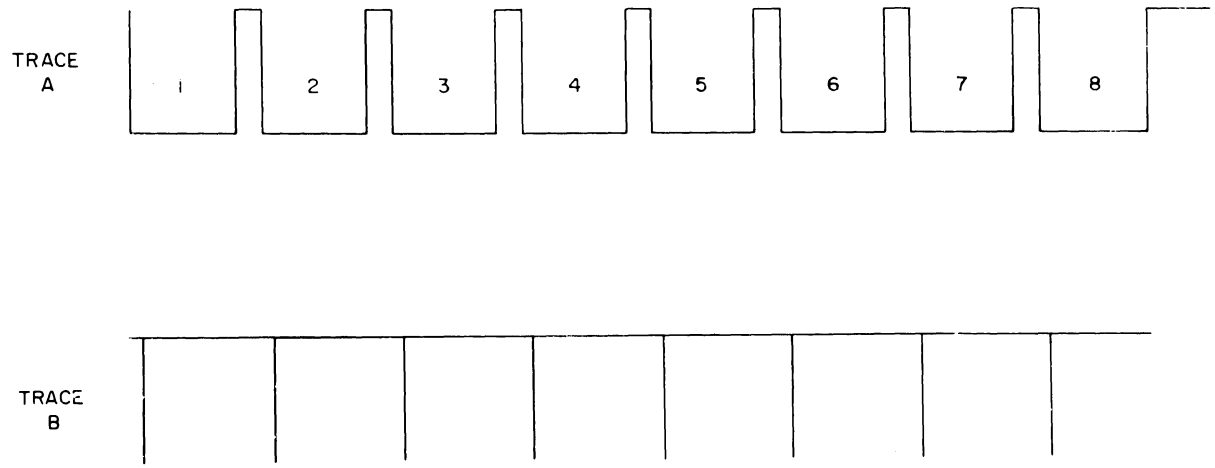


Figure 5-5. Slew Test Waveforms

g. Vary the pulse repetition rate of the output of the pulse generator between 0 and 200 pps.

h. Observe trace B figure 5-5. The repetition rate should be the same as the pulse generator.

i. Remove -6 vdc level from post P2-I and connect to post P2-J on adapter cable. Tape should move to left.

j. Repeat steps g and h.

k. Disconnect pulse generator and -6 vdc level from P2-J.

l. Place adapter power switch to the OFF position.

m. Place Mode switch in LOAD position.

n. Remove ac power and disconnect adapter cable.

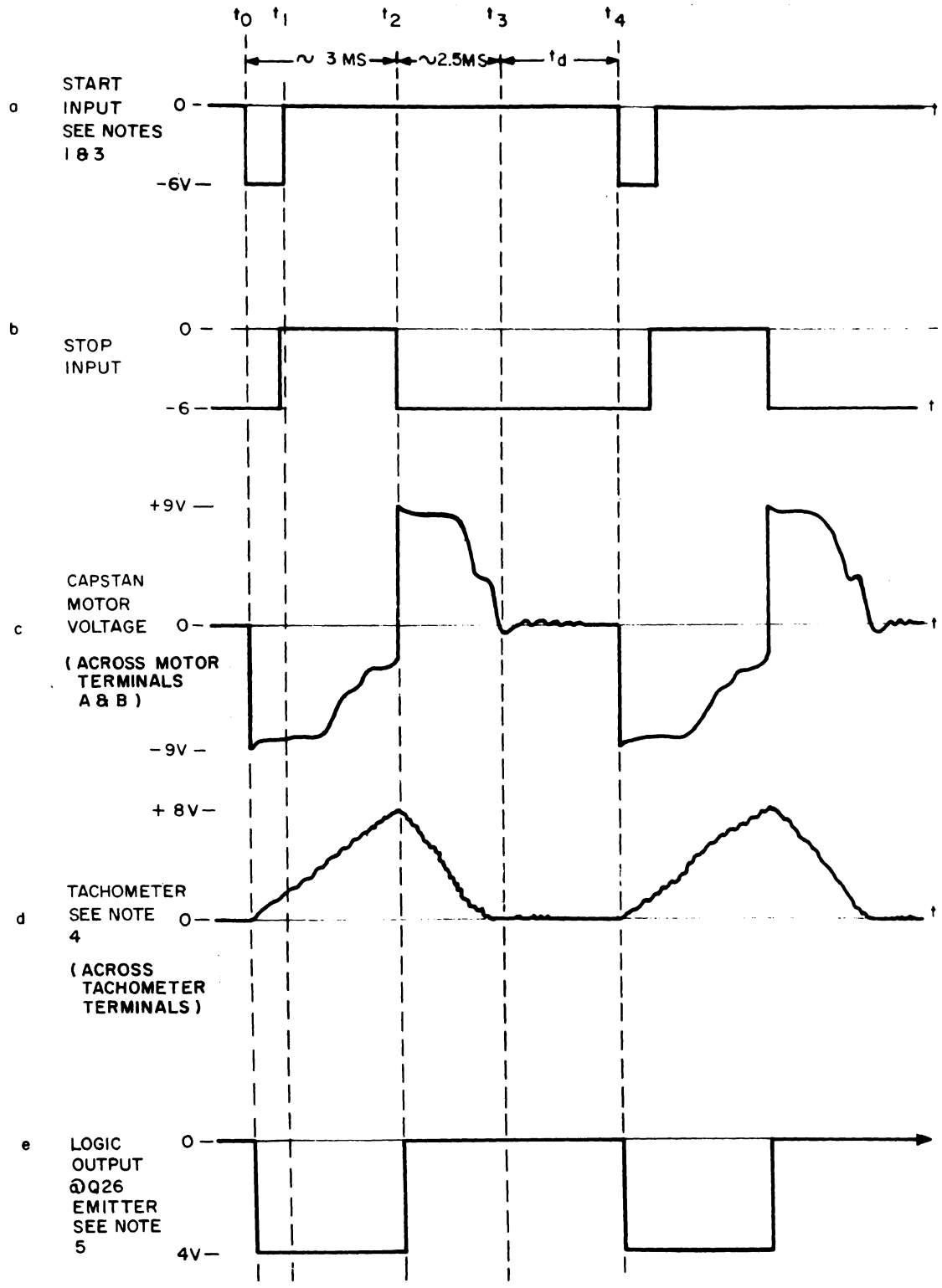
5-4. CORRECTIVE MAINTENANCE.

The tape reader has been thoroughly tested by the manufacturer. When properly installed and with periodic preventive maintenance performed as outlined, the tape reader will provide many hours of reliable operation. In the event of a failure, refer to table 5-3, trouble isolation guide.

If it becomes necessary to troubleshoot the equipment, the trouble isolation guide, table 5-3, should be used as a guide in localizing a trouble. Use the waveforms given in figure 5-6 as a further aid in localizing defective components.

TABLE 5-3. TROUBLE ISOLATION GUIDE

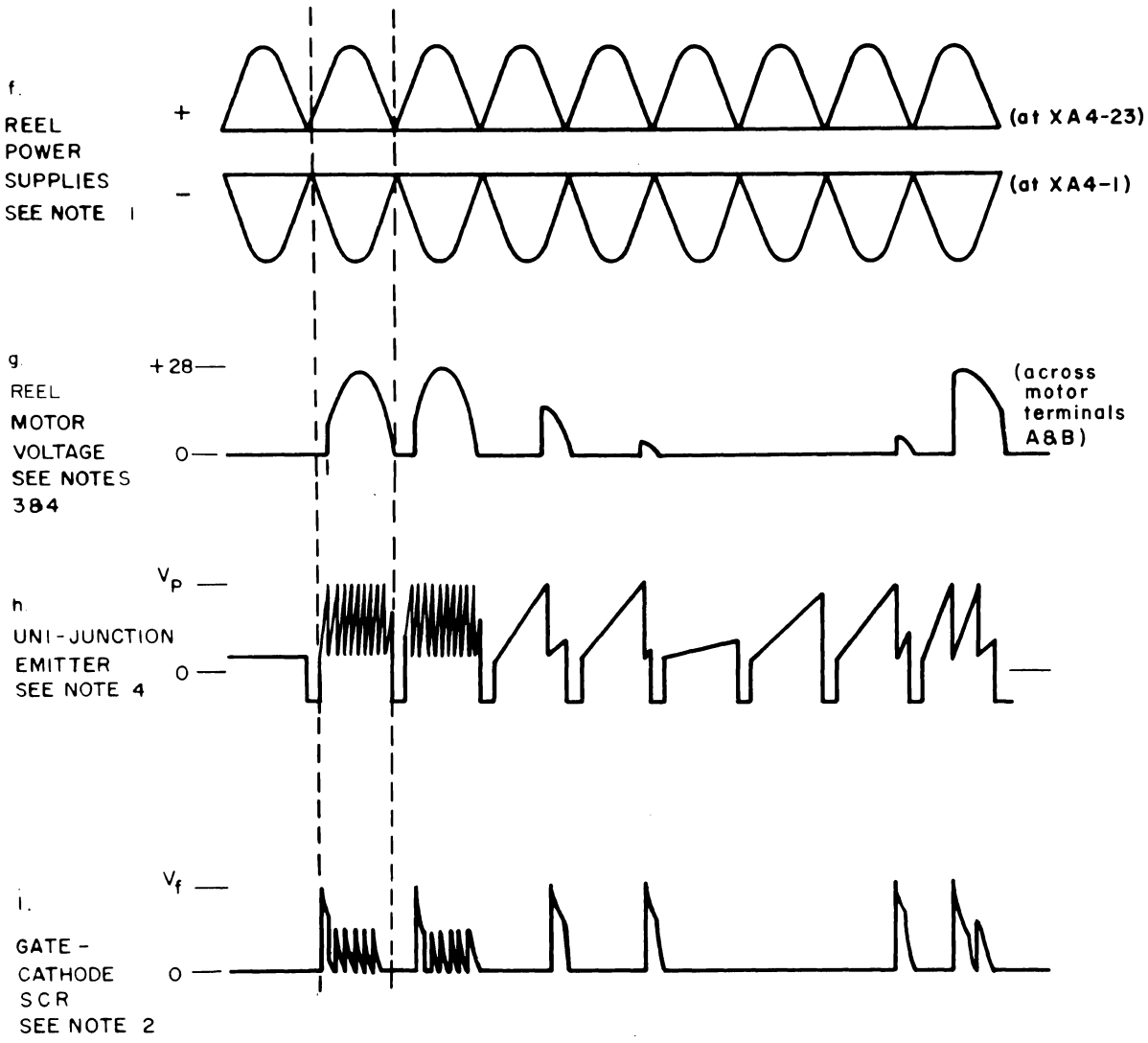
Symptom	Trouble Area	Possible Cause
Capstan motor will not rotate in either direction.	Input logic or capstan servo amplifier	Reader power supply, P4A not installed, motor defective, no-tape switch defective or capstan servo amplifier board defective.
Capstan motor will rotate in only one direction.	Input logic or capstan servo amplifier	Incorrect input command or capstan servo amplifier board defective.
Capstan motor creeps.	Input logic or capstan servo amplifier	R91, Balance Adj, on capstan servo amplifier improperly adjusted.
Motor rotates at very high speed.	Input logic or capstan servo amplifier	Tachometer defective or shorted semiconductor on capstan servo amplifier or heat sinks.
No output.	Channel amplifier	Lamp in head defective, solar cell damaged, amplifier board defective.
Constant output.	Channel amplifier	Amplifier board defective.
Erratic output.	Channel amplifier	Misaligned or defective tape, intermittent defective component on amplifier board.
No strobe pulse.	Channel amplifier	Amplifier board defective.
Reel motor will not rotate in either direction.	Reel servo	Blown fuse, no-tape switch defective, defective motor.
Reel motor will rotate in only one direction.	Reel servo	SCR open.
Motor is on continuously.	Reel servo	Reel servo amplifier board defective, shorted SCR, defective linkage between storage arm and differential transformer.



NOTES

1. Start pulse duration 30 usec min.
2. Reader operated in the line-by-line mode. Rep. rate approx. 100 char/sec. Direction is right.
3. td is dwell time. td is a function of rep. rate.
4. Tach waveform taken across the tach terminals with scope or reader common isolated.
5. Read left output similar at Q27 emitter. Levels are a function of slew speed adjustments and the input impedance of the differential amplifier.

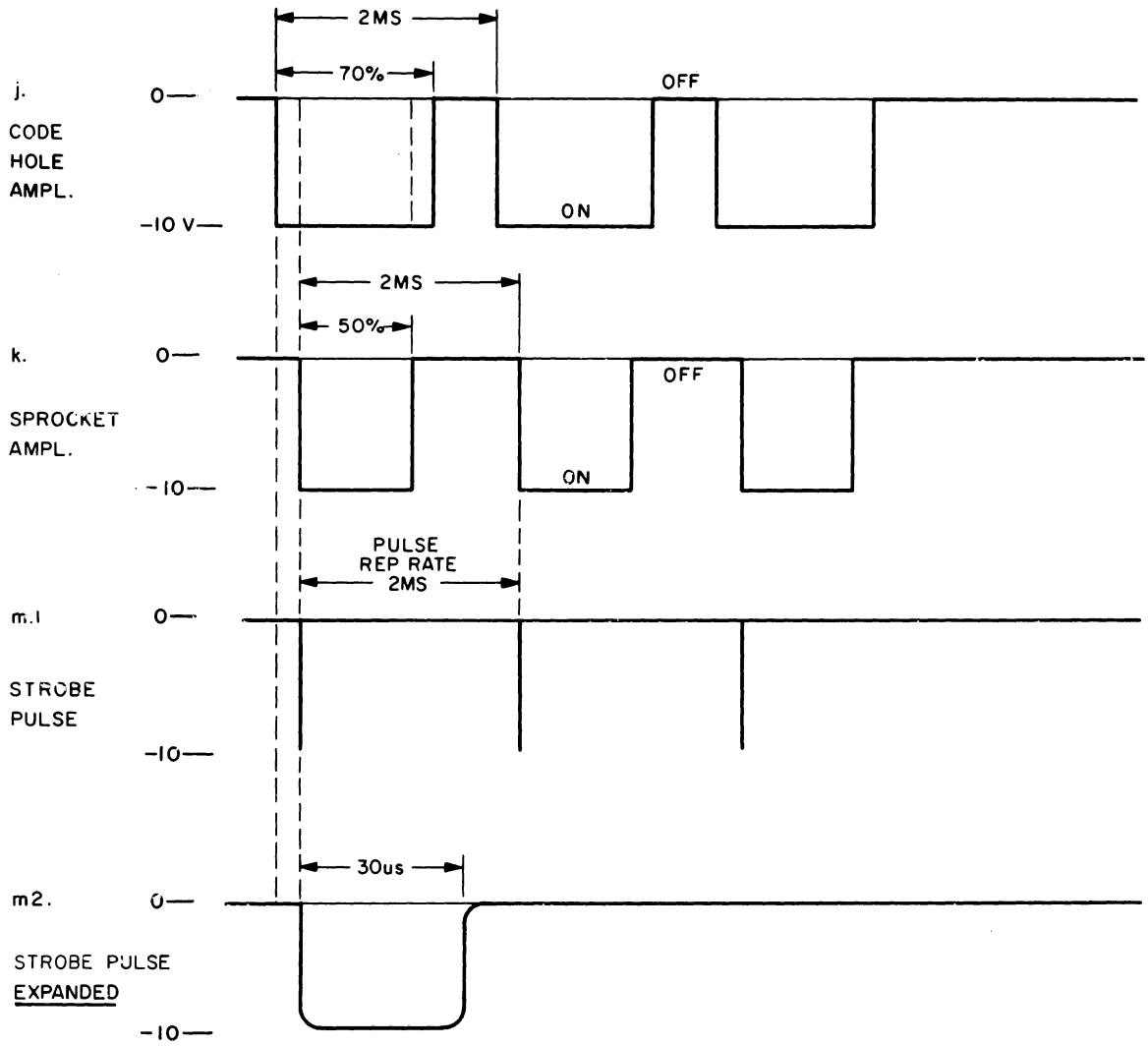
Figure 5-6. Circuit Waveforms (Sheet 1 of 3)



NOTES

1. Reel power supplies are + and - 28 volt peak fullwave rectified unfiltered.
2. SCR gate - cathode waveform measured with oscilloscope or reader common isolated from ground. Scope ground is attached to the cathode, gate is high.
3. Motor voltage may be + or - depending on required direction of rotation.
4. Unijunction emitter and motor voltage waveforms depict condition for several different firing angles as required by storage arm position.

Figure 5-6. Circuit Waveforms (Sheet 2 of 3)



NOTE

Amplifier waveforms taken in slewing mode at approximately 500 char/sec. They are approximate and should be adjusted for optimum reader operation. Taken with pink paper tape with a light transmission of approximately 30 percent. The percentage-on times will change with tape of other opacities.

Figure 5-6. Circuit Waveforms (Sheet 3 of 3)

5-5. MECHANICAL ADJUSTMENTS.

5-5-1. HEAD ADJUSTMENTS. (See figure 5-7). The head adjustments should be performed whenever a component of the head assembly is replaced or whenever trouble isolation indicates that the head assembly may be misadjusted. The head adjustments consist of positioning the reader lamps, idler position adjustment for proper tape tracking, idler pressure adjustment and tape hold-down spring adjustment.

5-5-1-1. Reader Lamp Adjustment. This adjustment describes how to position the reader lamps over the solar-cell aperture.

a. Remove top cover from reader head by pushing the cover back and lifting up.

b. Remove the reflector plate, located above the lamps.

c. Position the two lamps by moving their sockets so that their filaments are directly over the solar-cell aperture and their glass envelopes are approximately 1/4-inch from the surface of the tape guiding block.

5-5-1-2. Tape Tracking Adjustment (Idler Position). This adjustment describes how to position the idler so that tape tracking through the reader is correct. It is performed in two phases: preadjustment and final adjustment. The preadjustment is performed by rotating (by hand) the capstan wheel and checking the tape tracking. Final adjustment is performed with external electrical commands.

a. Preadjustment (Power OFF).

(1) Load a tape loop into the reader head as illustrated in Section II, figure 2-1.

(2) Remove top and bottom covers from reader.

(3) Rotate capstan wheel in one direction. Note how sprocket channel on tape passes over the sprocket aperture.

(4) Reverse rotation of capstan wheel and note how sprocket channel passes over the sprocket aperture. Tracking is correct when there is no change in the position of the sprocket with respect to the aperture as the direction of tape travel is changed. If tracking is incorrect continue with step (5) through (9). If tracking appears to be correct, proceed directly to final adjustment, paragraph b.

(5) Loosen the two Number 4-40 screws on top of the idler spring mounting block (figure 5-7).

(6) The idler wheel adjusting screw is used to position the idler wheel for proper guiding. Clockwise rotation of this screw moves the idler wheel towards the front panel; while conversely, counterclockwise rotation of the screw moves the idler wheel away from the front panel.

NOTE

Minute position changes of the idler wheel have a large affect on tape guiding--the adjustment should be made with care.

(7) After adjusting the idler wheel, tighten the screws on top of the idler spring mounting block.

(8) Manually rotate the capstan wheel and check the tape tracking. This procedure may have to be performed several times before the best tape tracking is obtained.

(9) Attention: If proper tape tracking is not obtained, insert template (figure 5-30) to check the distance between the rear and front guides. When the head is correctly aligned, the template will not move and the aperture holes of all channels will be visible. If misaligned, loosen hinge locking nuts and position the front guide snug against the template and lock.

b. Final Adjustment (Power ON).

(1) Apply proper external control signals to cause tape to slew.

(2) Check for proper tracking by changing direction of tape several times while observing position of holes in tape with respect to aperture. Correct adjustment of the idler position is apparent when there are no perceptible changes in the position of the holes with respect to the aperture as the direction of tape travel is changed.

(3) If change is noted adjust idler position as described in the preadjustment procedures above.

5-5-1-3. Idler Pressure Adjustment. This adjustment describes how to adjust the idler pressure. The idler pressure should be approximately 2.0±0.2 pounds when the idler roller just breaks away from the capstan wheel. It is checked and adjusted as follows:

a. Remove the reader top cover by pushing in and lifting up.

b. Attach force gage to idler roller in such a manner as to pull idler roller away from capstan wheel.

c. Pull idler roller away from capstan wheel with force gage and check that the gage indicates a force of 2.0 pounds at point when roller breaks away from capstan wheel.

d. If adjustment is required, adjust idler pressure adjusting screw, figure 5-7.

5-5-1-4. Tape Hold-Down Spring Adjustment. With the read head closed, there should be approximately 0.004-inch clearance between the bottom of the spring and the head plate. A piece of ordinary paper may be used to check this adjustment. The spring should be adjusted (by forming) so that it just touches the paper. UNDER NO CIRCUMSTANCES should the spring exert any pressure against the bottom plate with the head closed.

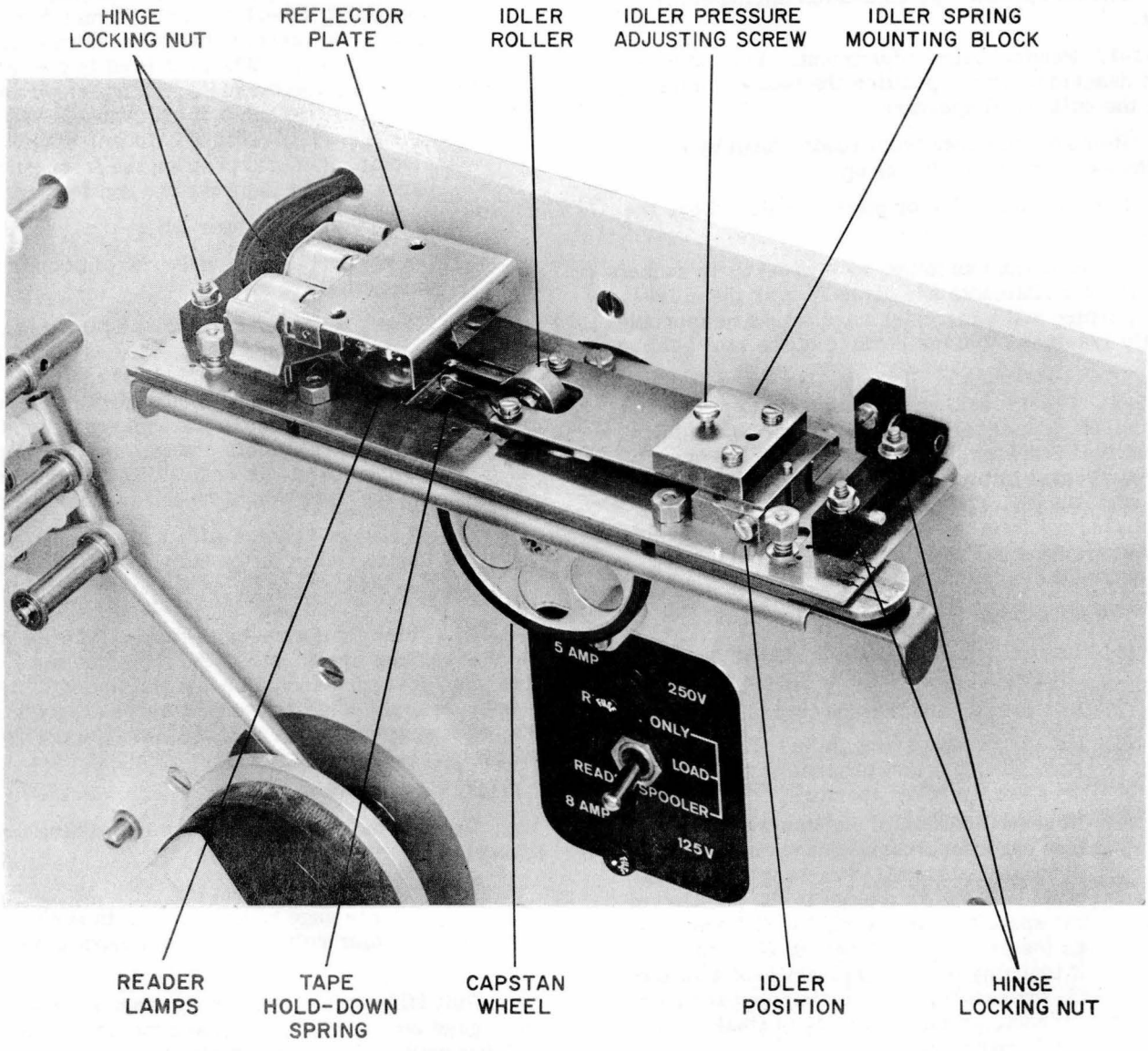


Figure 5-7. Read Head, Covers Removed

5-5-2. STORAGE ARM TENSION (POWER OFF). This procedure is applicable to both left and right storage arms. Their respective tension adjustment screws are located in figure 5-8.

a. Remove tape reels.

b. Move storage arm to approximately center position of its travel and attach force gage indicated in figure 5-8.

c. Check force gage for approximately 0.5 pound and adjust if necessary. To adjust push in respective adjustment screw and turn clockwise for increased tension and counterclockwise for decreased tension. Remove screwdriver and adjustment screw disengages from spring automatically.

d. Remove force gage.

5-5-3. STORAGE ARM DEADBAND (DIFFERENTIAL TRANSFORMER) (POWER ON). (See figures 5-9 and 5-14.) This procedure is applicable to both left and right differential transformers. It is best performed with the reader on a bench and on its side.

a. Install reel of test tape as described in Section III.

b. Place Mode switch in READER/SPOOLER position. Left and right tape reels may possibly move, but will stop when left and right storage arms reach their respective neutral positions.

c. Loosen clamp holding transducer body.

d. Move transducer body either in or out until storage arm is moved to approximately center position.

e. Tighten clamp.

f. Place Mode switch in LOAD position.

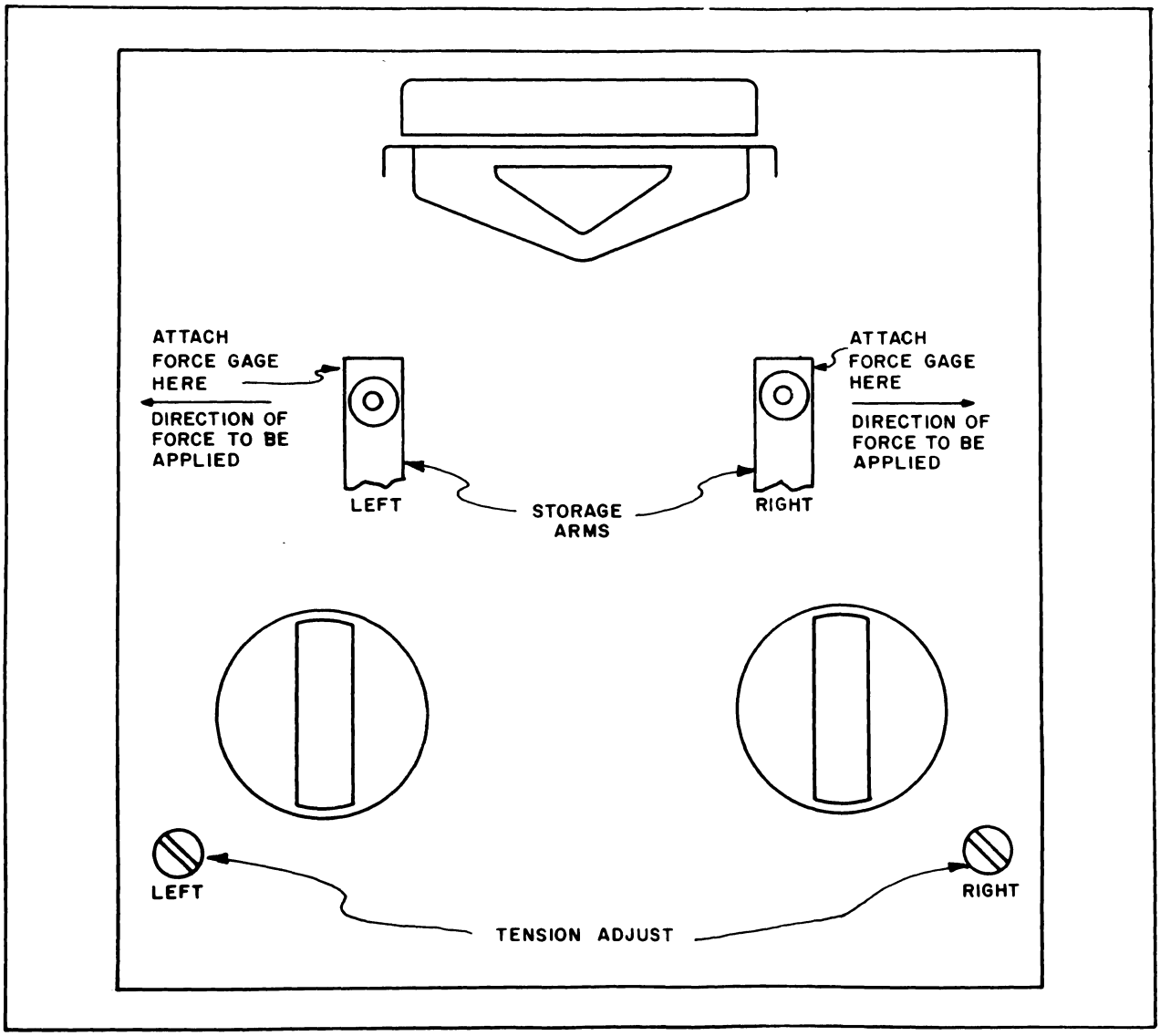


Figure 5-8. Storage Arm Tension Adjust

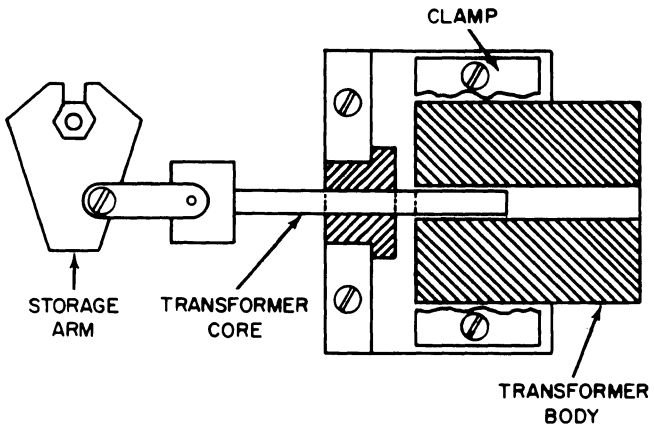


Figure 5-9. Transducer Mounting

5-5-4. NO-TAPE SWITCH ADJUSTMENT (POWER OFF). Each no tape switch should be adjusted so that it will trip when its associated storage arm is 3/16 ± 1/16 inch from its center stop. (Figure 5-12). The switch is adjusted by forming its actuator arm. (Figure 5-14). This adjustment should be checked when moving the arm from its center position towards its stop.

5-6. ELECTRICAL ADJUSTMENTS.

5-6-1. CAPSTAN SERVO BALANCE (See figure 5-10).

a. Connect adapter cable to tape reader (Figure 5-2).

b. Apply 115 volt ac power to posts J1-A and J1-B of adapter cable.

c. Place Mode switch in READER position and adapter cable power switch ON.

d. With no input applied, connect the VOM between the junction of resistors R99, R100, and R98 on the capstan servo amplifier board and common. Using lowest dc volts scale on VOM adjust potentiometer R91 for a reading of approximately zero volts. This adjustment is for capstan servo balance ONLY, and should not be used for any other purpose.

5-6-2. SLEW SPEED ADJUST. (See figures 5-6m, i and 5-10.)

a. Connect adapter cable to tape reader (Figure 5-2).

b. Install tape as outlined in Section III.

c. Apply 115 volt ac to posts J1-A and J1-B of adapter cable and place adapter cable switch to ON.

d. Place Mode switch in READER/SPOOLER position.

e. Connect oscilloscope to post J2-F and common.

f. Apply a -6 vdc level to post J2-I.

g. With pulse generator, apply a -6 vdc, 30-microsecond wide pulse to post J2-A. Tape moves forward.

h. Adjust right slew potentiometer (R76) for the desired slew rate as indicated on the oscilloscope by a pulse presentation of repetition rate equal to the slew speed desired. (See figure 5-6m, i.) (Maximum 500 characters per second.)

i. Remove -6 vdc level from post J2-I and connect to post J2-J. Tape will slew reverse.

j. Repeat step h, adjusting left slew potentiometer (R77).

5-6-3. CODE HOLE AND SPROCKET AMPLIFIER ADJUSTMENT. (Figure 5-10.) Since there are a wide variety of tapes with large variations in light transmission, it may be necessary to readjust the channel amplifiers when tapes are changed. The equipment comprises nine amplifiers, eight for the code holes and one for the sprocket channel. The amplifiers for channels 1, 2, 3 and sprocket are located on amplifier board No. 1 while amplifier board No. 2 contains the amplifiers for channels 4 through 8.

The amplifiers are adjusted by monitoring the sprocket and code channel while the reader is slewing a test tape that contains all holes punched (figure 5-11) and setting the on-off ratio (figure 5-6j) of the output signals. An oscilloscope, such as a Tektronix 545 with a type CA plug-in, is recommended to be used. The oscilloscope will be used in the chopped mode and with vertical amplifier No. 1 connected to the code hole amplifier and vertical amplifier No. 2 connected to the sprocket hole amplifier. The oscilloscope should be synchronized from the channel being adjusted.

Proper adjustment of the code hole amplifier gives a duty cycle of 60 to 75% on (1.2 to 1.5 milliseconds out of 2.0 milliseconds for a 500 character per second slew speed). The sprocket amplifier should be adjusted for a 50% duty cycle (1 millisecond on for a 500 character per second slew speed).

The above times are for a 500 character per second slew rate. For other slew rates, the times for the sprocket and code hole amplifiers may be found by multiplying the duty cycle by the slew speed (in time per character).

NOTES

(1) Regardless of percentage on-time for data and sprocket channels, the criterion for proper adjustment is that the leading edge of all data channels must reach their level and stabilize prior to a sprocket level change.

(2) The sprocket pulse width must be sufficient to operate reliably at all tape speeds, including wind.

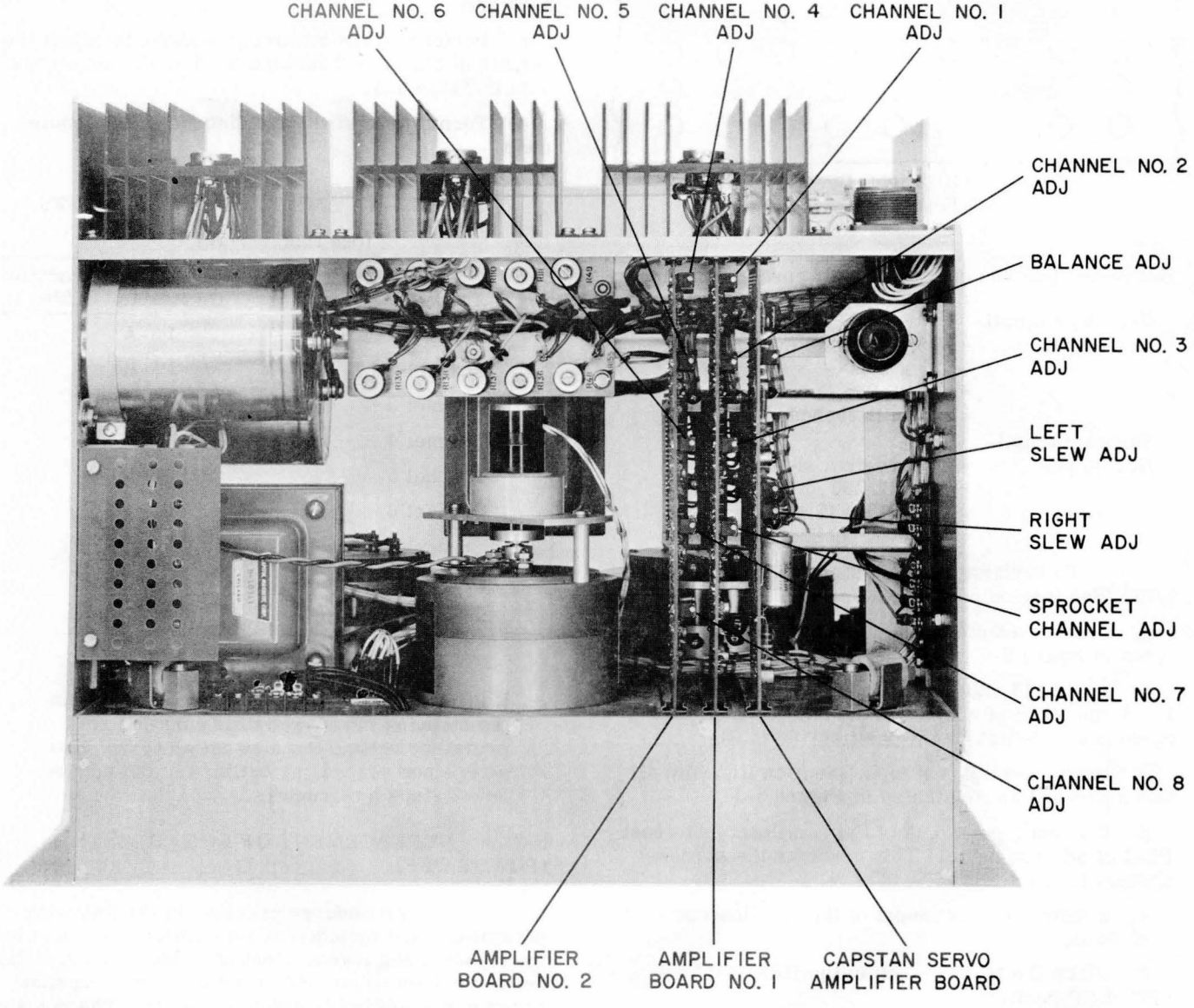


Figure 5-10. Capstan Servo and Amplifier Adjustments

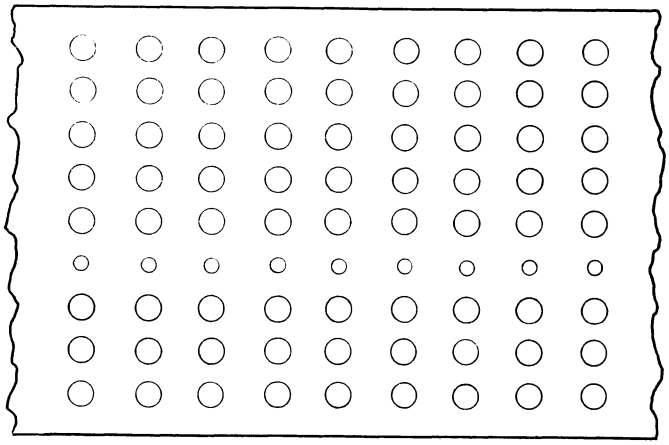


Figure 5-11. Eight-Level Tape, All Holes Punched

Example: (for 200 characters per second reader)

Code hole amplifier output = Duty cycle x slew speed
= .70 x 1/200
= .70 x .005 (5 milliseconds)
= 3.5 milliseconds

Sprocket amplifier output = Duty cycle x slew speed
= .50 x 1/200
= .50 x .005 (5 milliseconds)
= 2.5 milliseconds

To perform this adjustment, proceed as follows: (See figures 5-6j, 5-6k and 5-10.)

a. Connect adapter cable to tape reader as indicated in figure 5-3.

b. Apply 115 volt ac power to equipment via posts P1-A and P1-B of adapter cable and place adapter cable power switch in ON position.

c. Load a reel of test tape, (Section III); with all holes punched as illustrated in Figure 5-11.

d. Connect input No. 2 of the oscilloscope to post P3-J of adapter cable. This connects the sprocket channel to input No. 2.

e. Connect the sync input of the oscilloscope to post P3-J.

f. Place the Mode switch in the READER/ SPOOLER position.

g. Connect the -6 vdc power supply to P2-I of the adapter cable.

h. Connect the pulse generator to post P2-A and set to generate -6 vdc, 30-microsecond wide pulse. The reader will begin to slew tape.

i. Adjust the slew speed as outlined in paragraph 5-6-2, steps h through j, for a slew speed of 500 characters per second.

j. Adjust oscilloscope for a sweep of 1 millisecond per cm.

k. Obtain sprocket output of 50% on and 50% off by adjusting sprocket channel potentiometer (R123) of sprocket amplifier (see figures 5-6j and 5-10).

l. Operate oscilloscope in chopped mode.

m. Connect input No. 1 and sync input of oscilloscope to post P3-A of adapter cable.

n. Both the sprocket and channel 1 should be displayed.

o. Adjust channel 1 potentiometer (R134) for a pulse output of 70% on and 30% off (see figures 5-6k and 5-10).

p. Perform steps m through o above to adjust the outputs of channels 2 through 8. Use the connection data in Table 5-4.

q. Turn all power off and disconnect test equipment.

TABLE 5-4. AMPLIFIER ADJUSTMENTS

(See figure 5-10)

Amplifier	Oscilloscope Connection On Adapter Cable
Channel 1	P3-A
Channel 2	P3-B
Channel 3	P3-C
Channel 4	P3-D
Channel 5	P3-E
Channel 6	P3-F
Channel 7	P3-G
Channel 8	P3-H
Sprocket Channel	P3-J

NOTE (Stepping Adjustment)

If the tape reader must stop on character in the stepping mode, reliability may be improved by setting the slew speed to 350 characters per second, as outlined in paragraph 5-5-2 steps h through j.

5-7. REPLACEMENT OF COMPONENTS (POWER OFF).

The procedures provided in the following paragraphs are included to aid service personnel in the removal and replacement of reader lamps, solar cells, reel servo motors, capstan wheel, capstan servo motor assembly and tachometer. The remaining replaceable components of the equipment, require no other special attention beyond normal good practice when replaced.

5-7-1. READER LAMP REPLACEMENT. To remove and replace a reader lamp proceed as follows: (Figures 3-1 and 5-7.)

a. Remove the top cover of reader head by pushing back and lifting up.

b. Remove the lamp reflector plate.

c. To remove defective lamp from its socket, push in and turn counterclockwise.

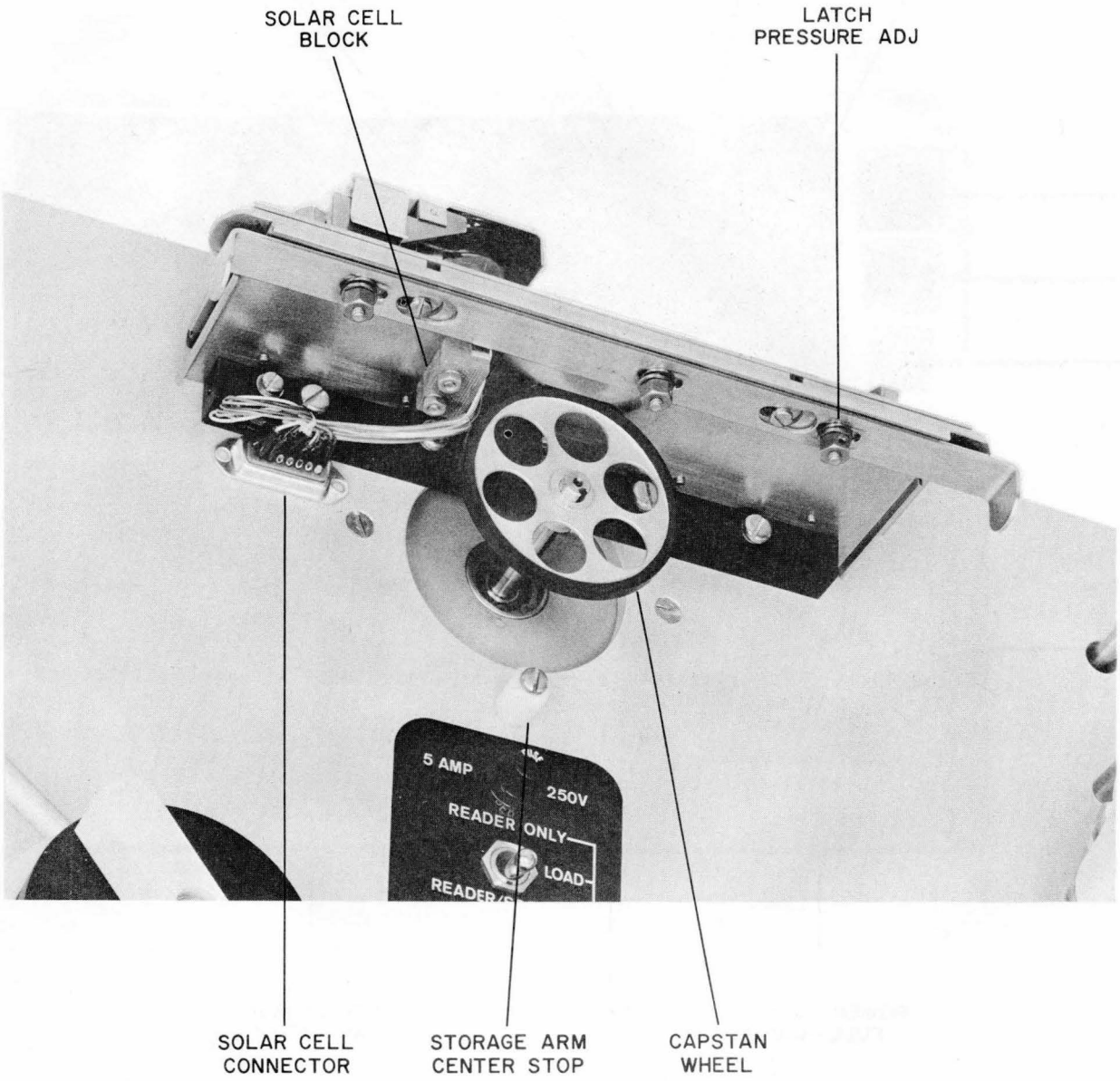


Figure 5-12. Reader Head, Bottom View

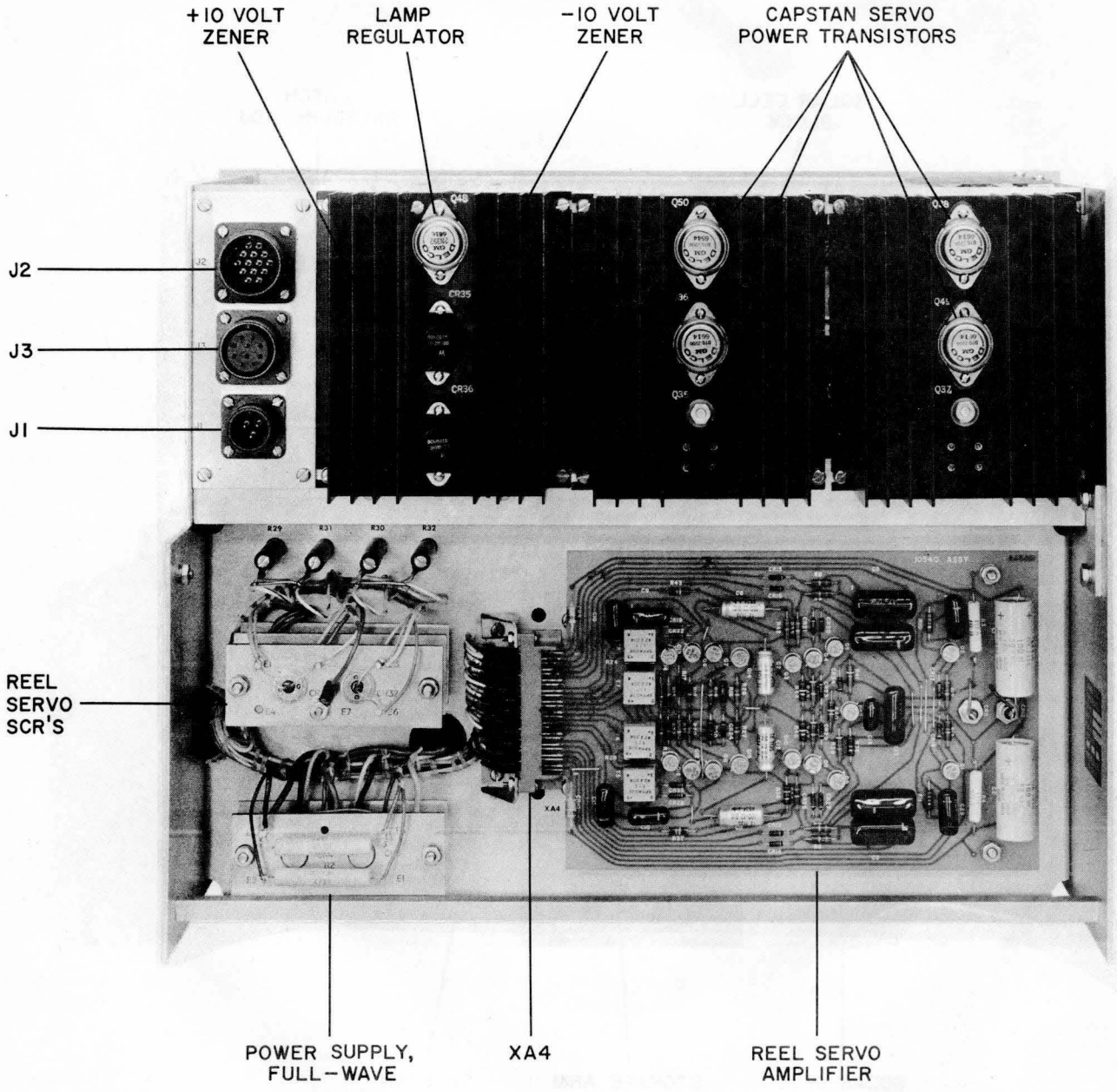


Figure 5-13. 500R, Rear View

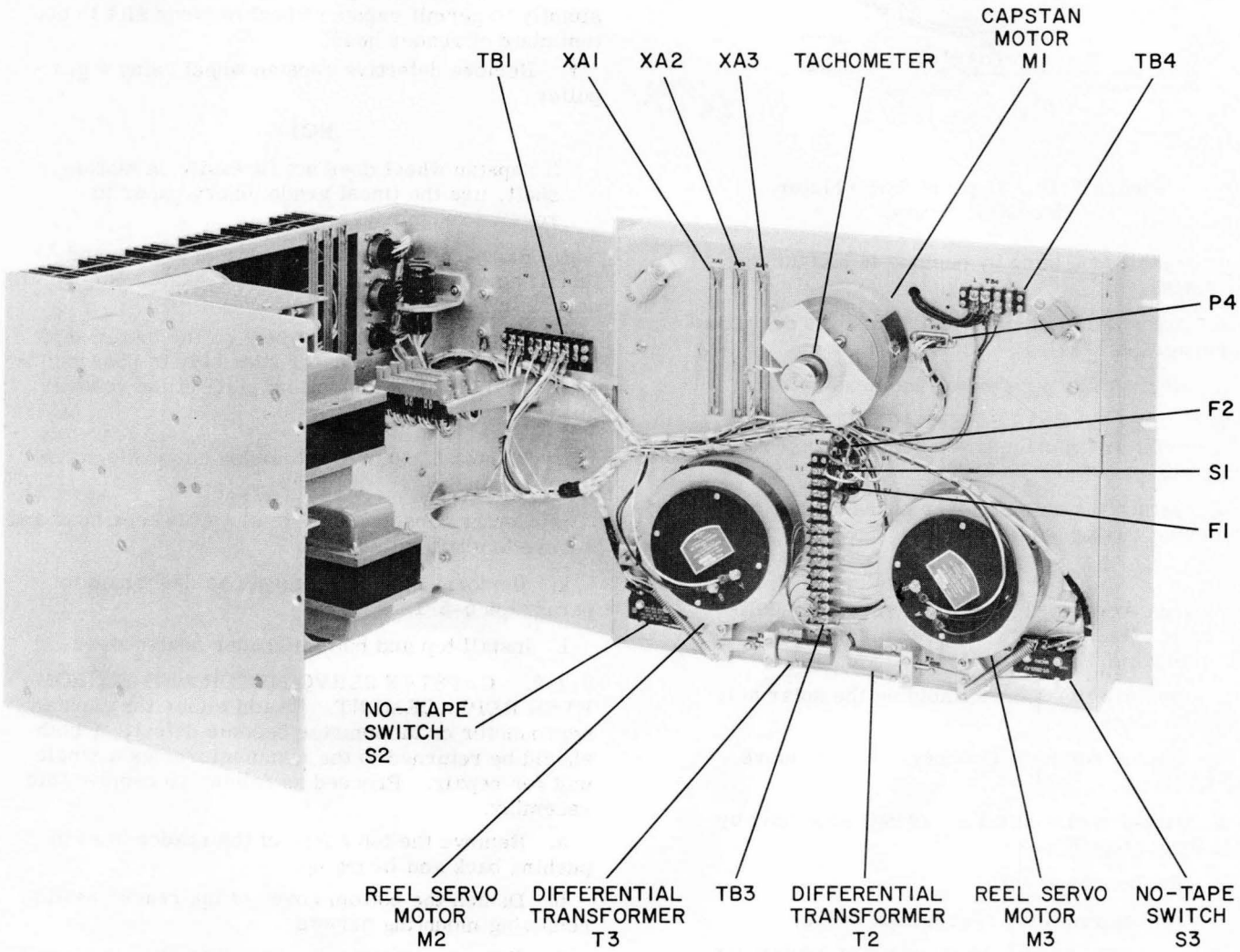


Figure 5-14. Front Panel, Rear View

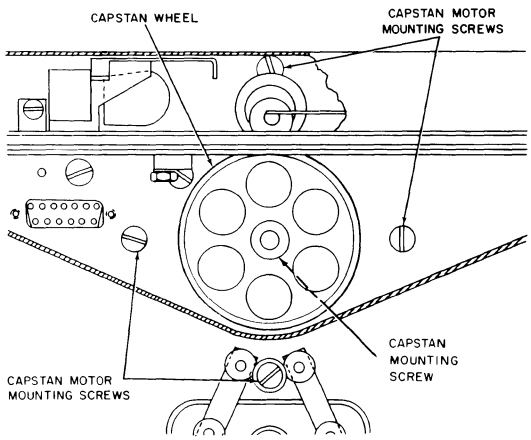


Figure 5-15. Capstan Servo Motor, Mounting Screws

d. Install new lamp by pushing in and turning clockwise.

e. Adjust position of lamp filament as described in paragraph 5-5-1-1.

f. Replace lamp reflector and head cover.

5-7-2. SOLAR CELLS REPLACEMENT. The solar cells are replaced as a complete unit as follows: (Figure 5-12.)

a. Detach the bottom cover of the reader head by removing mounting screws.

CAUTION

Leads to solar cell assembly are very delicate. Use extreme care when removing and replacing.

b. Remove the two nuts holding the solar cell block in place.

c. Unplug solar cell connector and remove cable clamp.

d. Mount replacement solar cell assembly by following steps b and c.

e. Replace head cover.

f. Adjust amplifier (Paragraph 5-6-3).

5-7-3. REEL SERVO MOTOR REPLACEMENT. Both reel servo motors (left and right) are replaced in an identical manner as follows: (Figure 5-14).

a. Disconnect electrical connections to the motor and tag leads for future identification.

b. Remove four motor mounting screws located on the front panel.

c. Remove defective motor and hub and install new assembly.

d. Reconnect electrical connections to the appropriate motor terminal.

5-7-4. CAPSTAN WHEEL REPLACEMENT. (Figure 5-15.) To remove the capstan wheel, the capstan servo motor assembly must be loosened and raised in order for the capstan wheel to clear slot in bottom plate of reader head. Proceed as follows:

a. Remove the top cover of the reader head by pushing back and lifting up.

b. Detach the bottom cover of the reader head by removing mounting screws.

c. Remove screw holding capstan wheel to motor shaft.

d. While holding the capstan servo motor assembly (figure 5-14), loosen screws attaching it to front panel (figure 5-15).

e. Raise rear of capstan servo motor assembly slightly to permit capstan wheel to clear slot in bottom plate of reader head.

f. Remove defective capstan wheel using a gear puller.

NOTE

If capstan wheel does not fit easily on motor shaft, use the finest grade emery paper to remove rough edges.

g. Raise rear of capstan motor assembly and install new capstan wheel on motor shaft. Do not secure to shaft.

h. Position the capstan wheel on the motor shaft and lower the capstan motor assembly to position the wheel in the slot in the bottom plate of the reader head.

i. Tighten capstan servo motor assembly screws to front panel.

j. Center capstan wheel in slot of reader head and secure to shaft with screw.

k. Perform head adjustments as described in paragraph 5-5-1.

l. Install top and bottom reader head covers.

5-7-5. CAPSTAN SERVO MOTOR AND TACHOMETER REPLACEMENT. Should either the capstan servo motor or tachometer become defective, both should be returned to the manufacturer as a single unit for repair. Proceed as follows to remove this assembly:

a. Remove the top cover of the reader head by pushing back and lifting up.

b. Detach the bottom cover of the reader head by removing mounting screws.

c. Remove capstan wheel as described in steps c through f of paragraph 5-7-4.

d. Remove defective assembly by removing mounting screws and leads.

e. Insert shaft of new capstan servo motor assembly through hole in panel.

f. Install capstan wheel on motor shaft. Do not secure to shaft with screw.

g. Perform steps h, i and j of paragraph 5-7-4.

h. Reconnect electrical connections to capstan servo motor assembly and tachometer.

i. Perform head adjustments as described in paragraph 5-5-1.

j. Replace top and bottom reader screws.

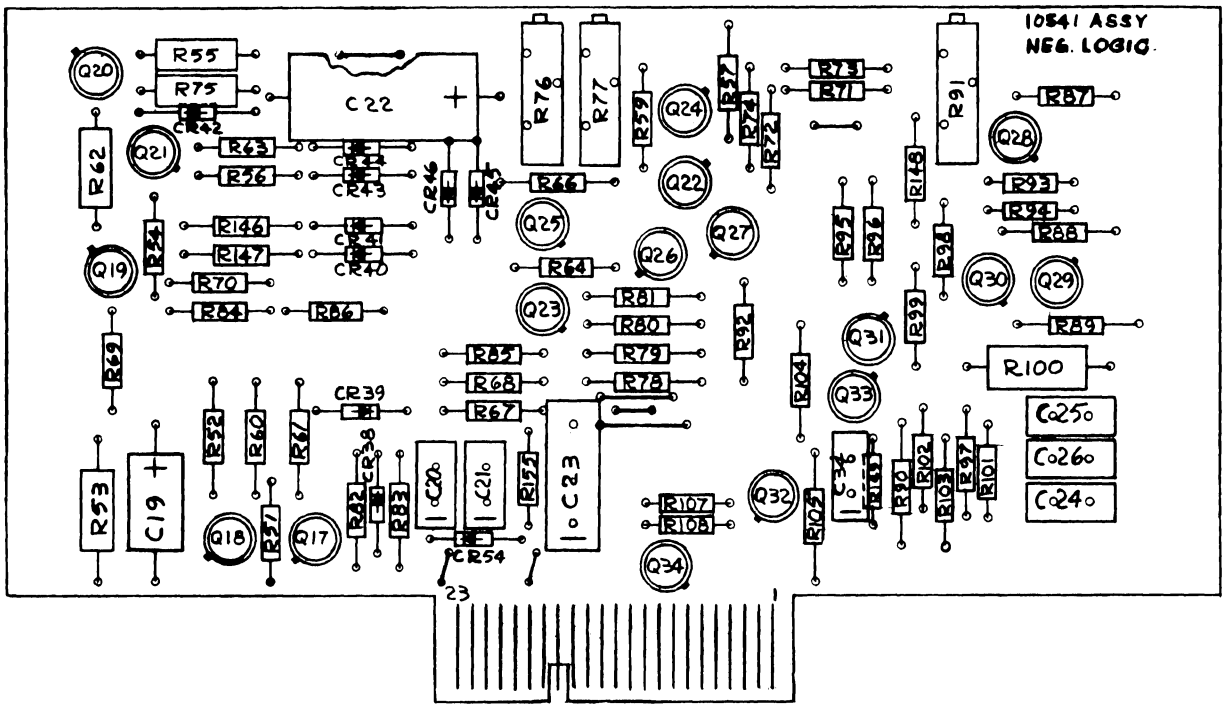


Figure 5-16. Capstan Servo Amplifier Board, Part No. 10541

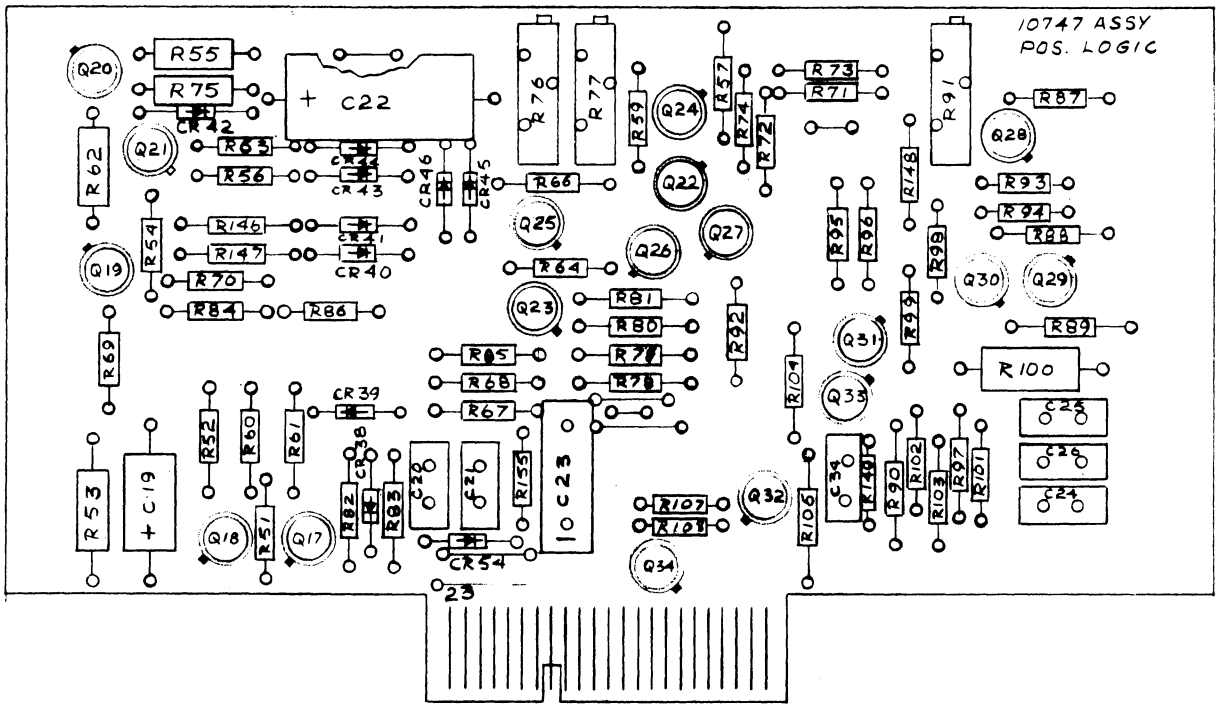
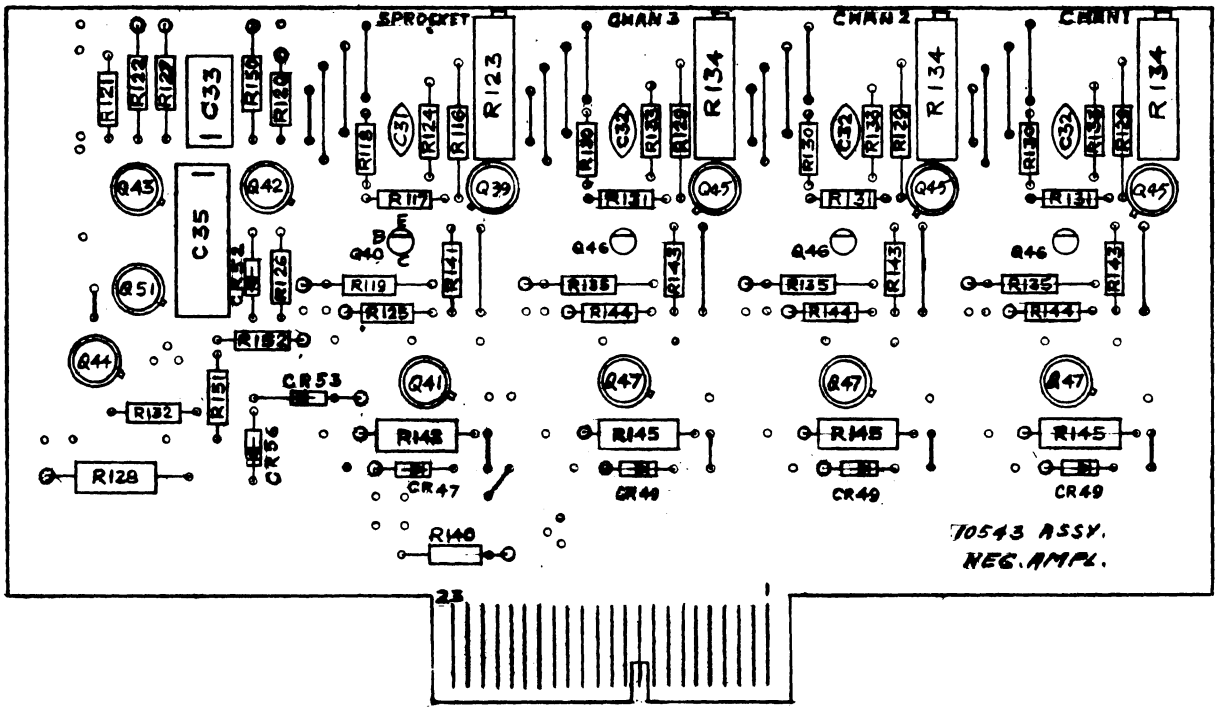
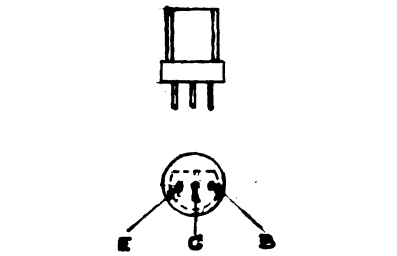


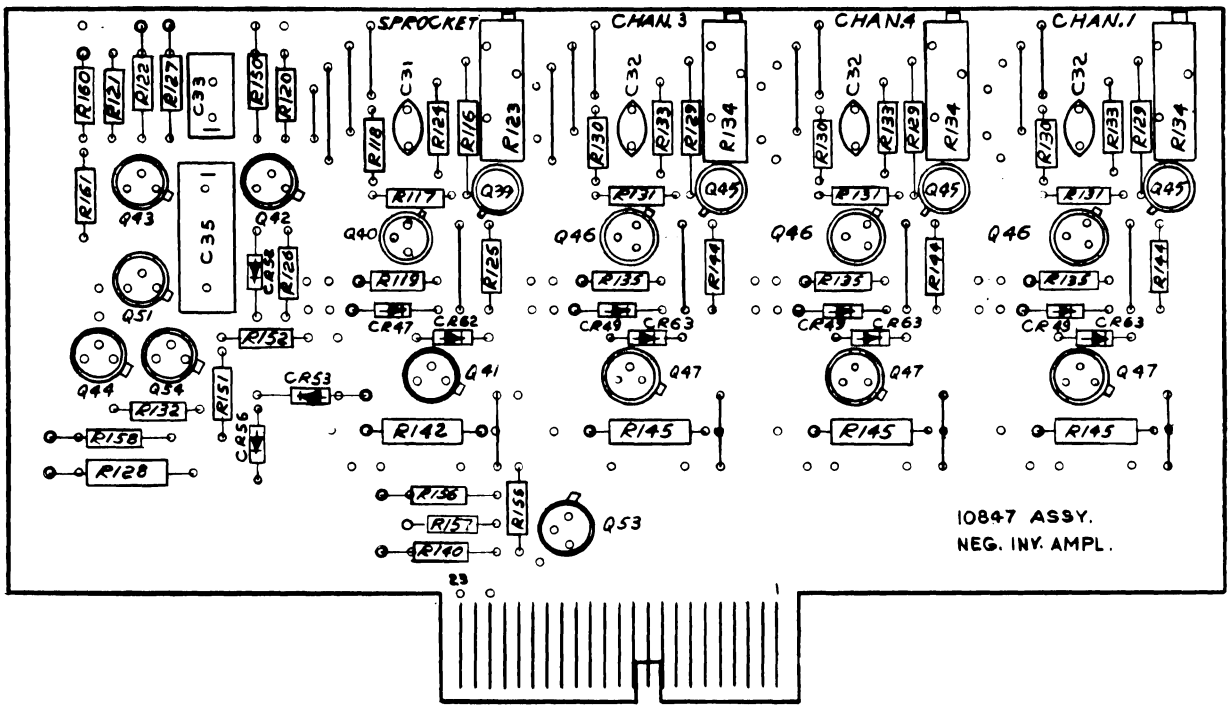
Figure 5-17. Capstan Servo Amplifier Board, Part No. 10747





MTG. CONFIGURATION
FOR 2N2925 TRANSISTOR
SCALE 2:1

Figure 5-18. Amplifier Board No. 1, Part No. 10543



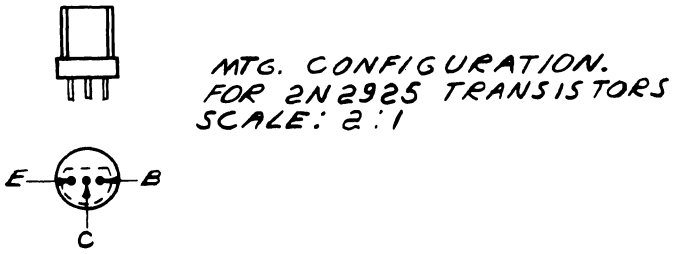
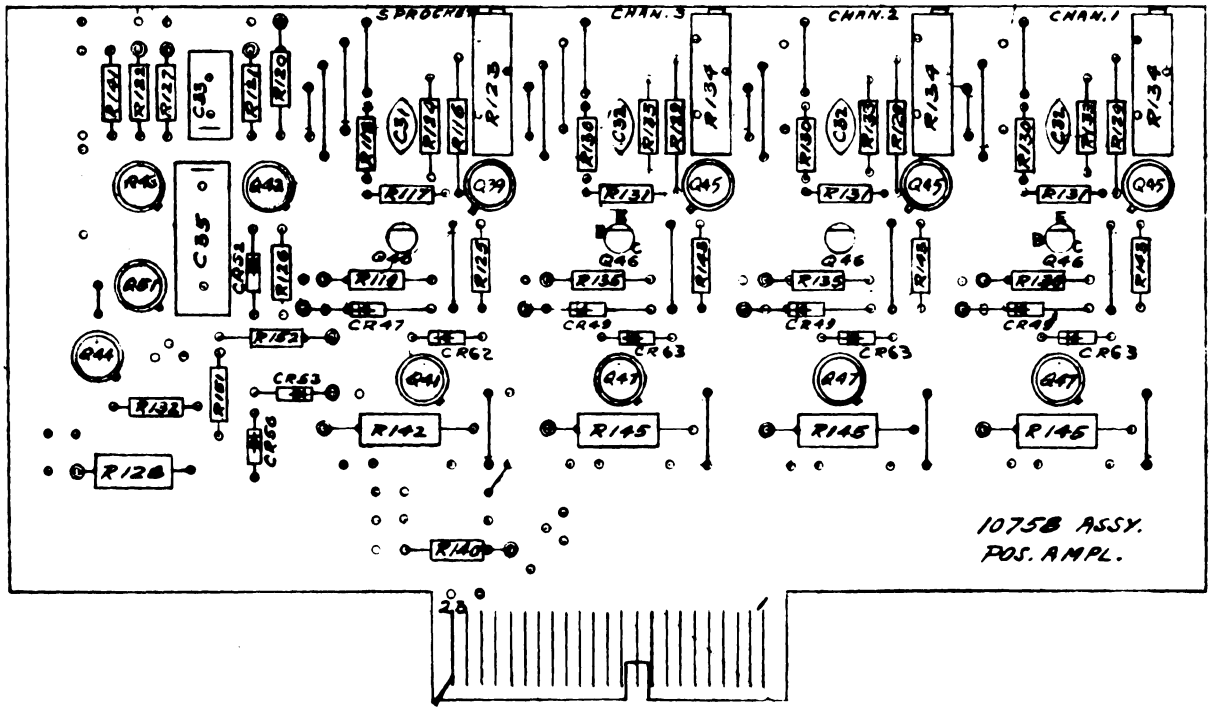
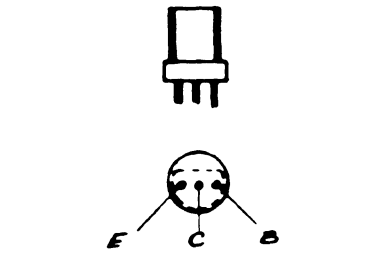


Figure 5-19. Amplifier Board No. 1, Part No. 10847

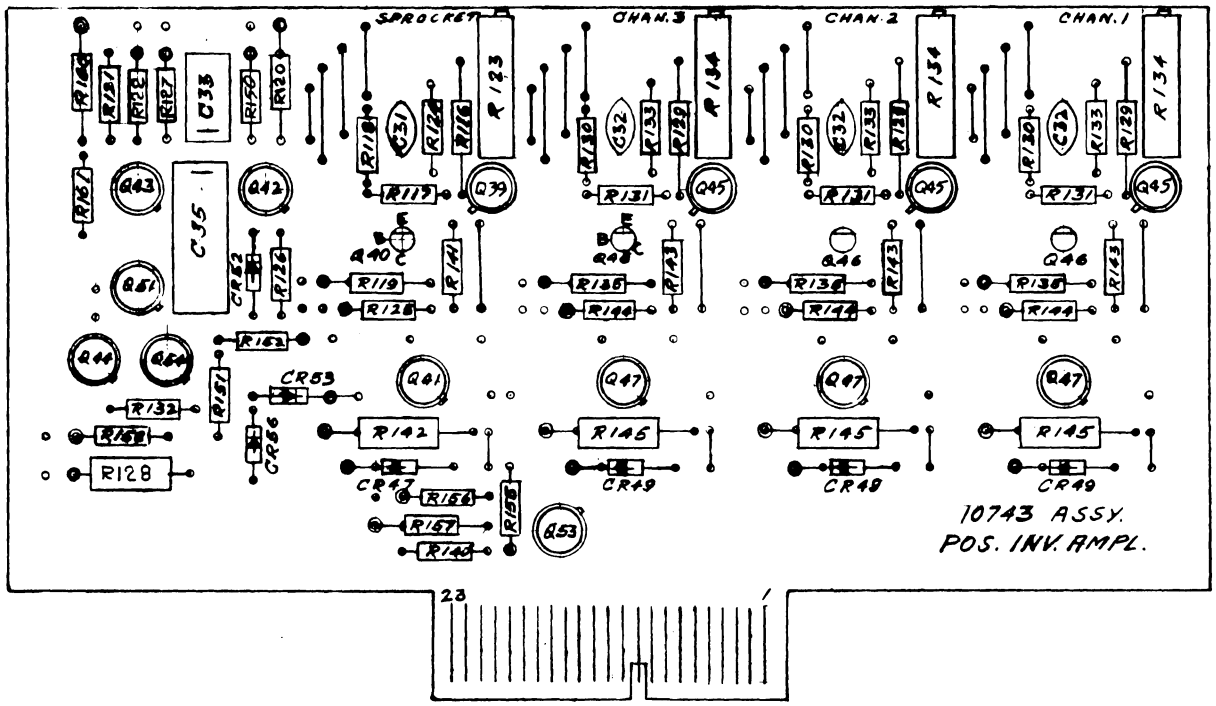
(LSE)





MTG. CONFIGURATION
FOR 2N2925 TRANSISTOR
SCALE 2:1.

Figure 5-20. Amplifier Board No. 1, Part No. 10758



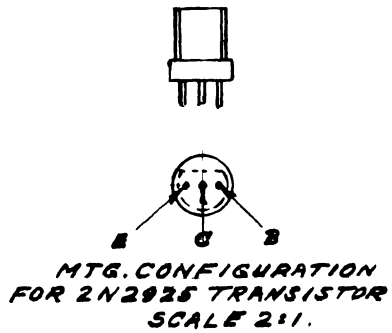
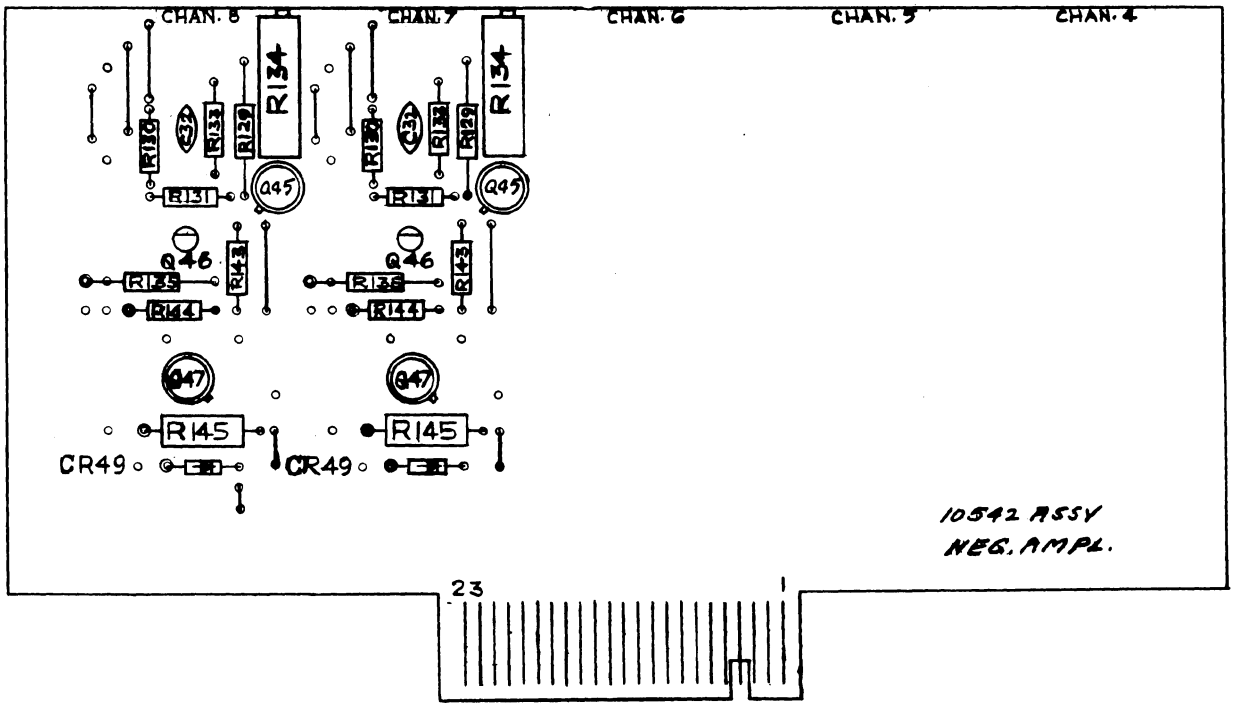


Figure 5-21. Amplifier Board No. 1, Part No. 10743



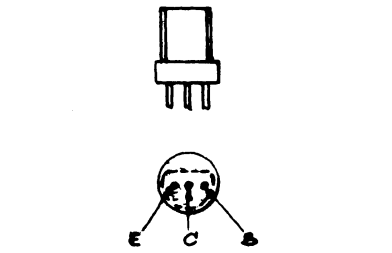
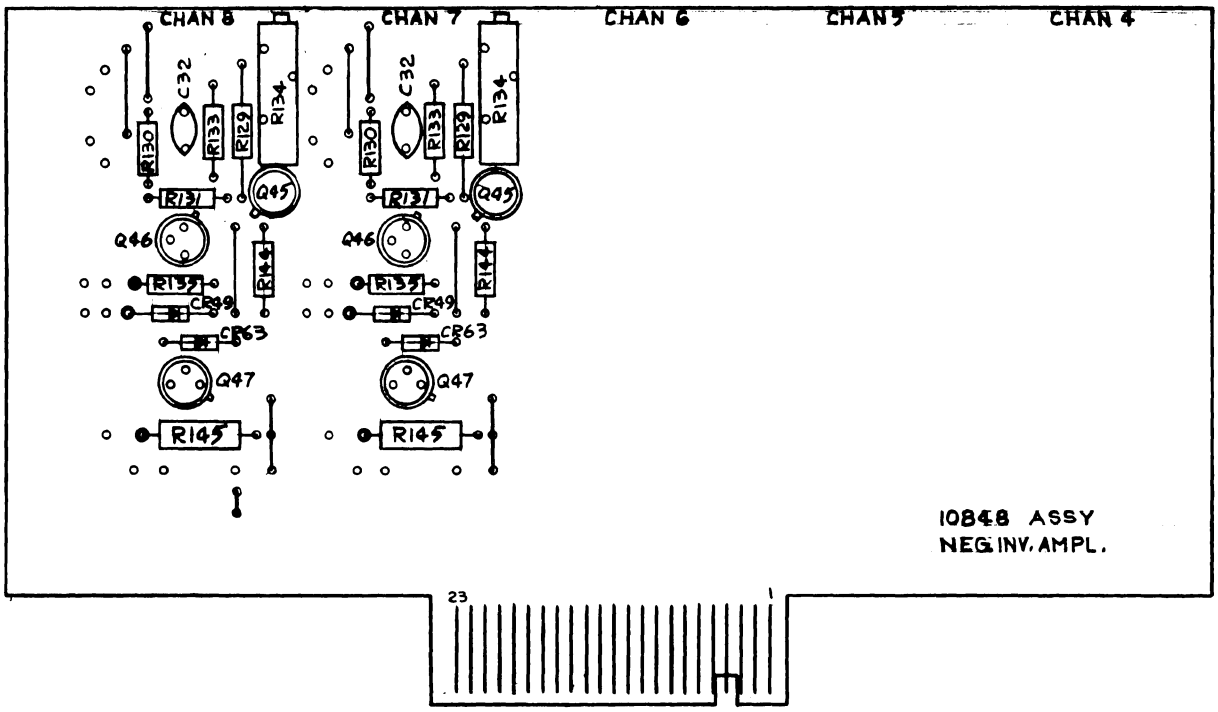
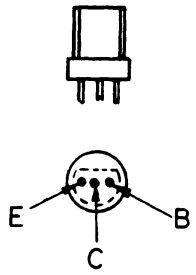


Figure 5-22. Amplifier Board No. 2, Part No. 10542

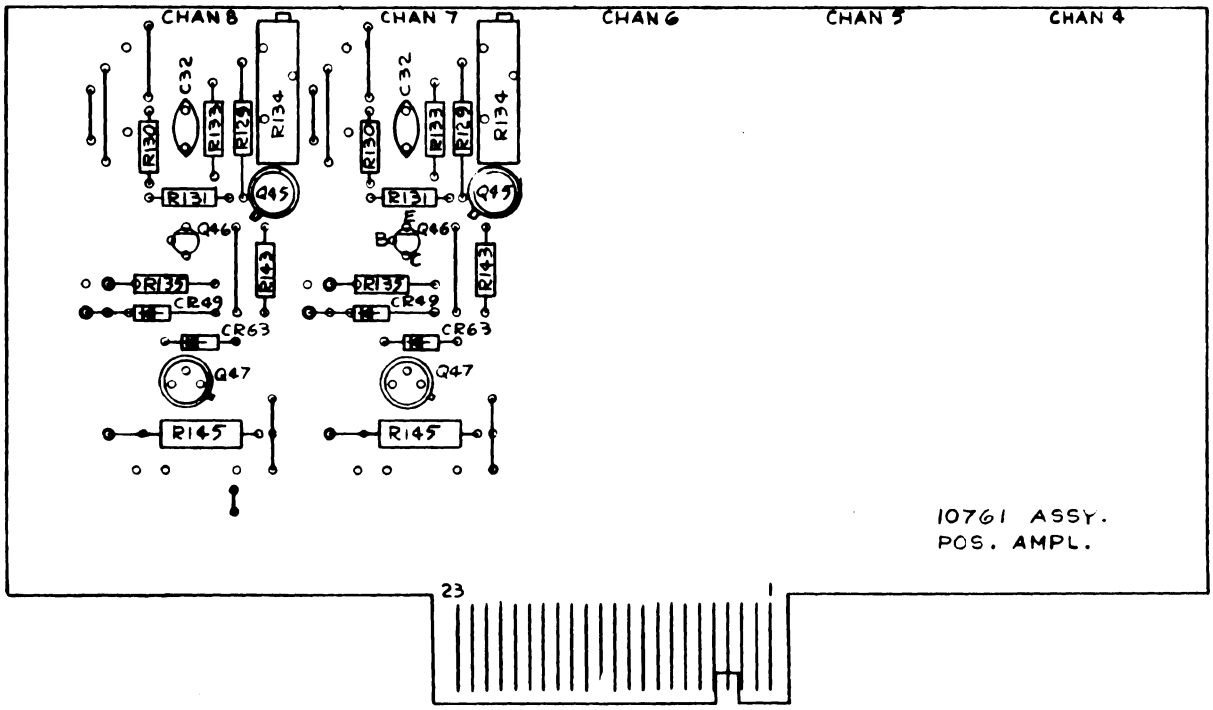


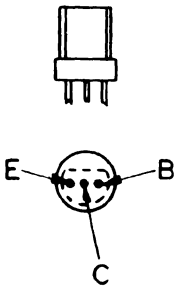


MTG. CONFIGURATION FOR:
2N2925 TRANSISTORS.
SCALE: 2:1

Figure 5-23. Amplifier Board No. 2, Part No. 10848

LSE





MTG. CONFIGURATION FOR:
2N2925 TRANSISTORS
SCALE: 2:1

Figure 5-24. Amplifier Board No. 2, Part No. 10761

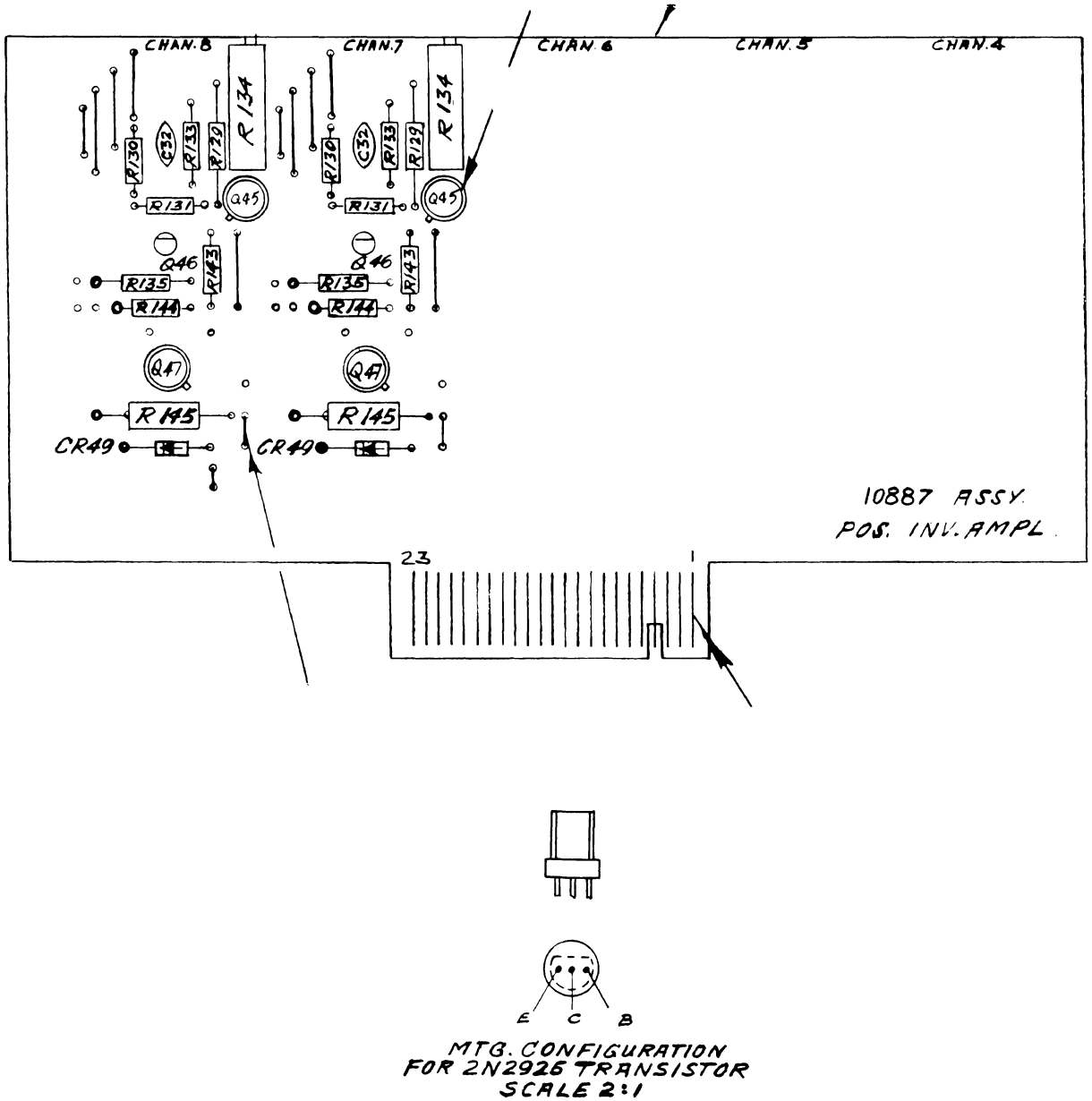


Figure 5-25. Amplifier Board No. 2, Part No. 10887

LSE

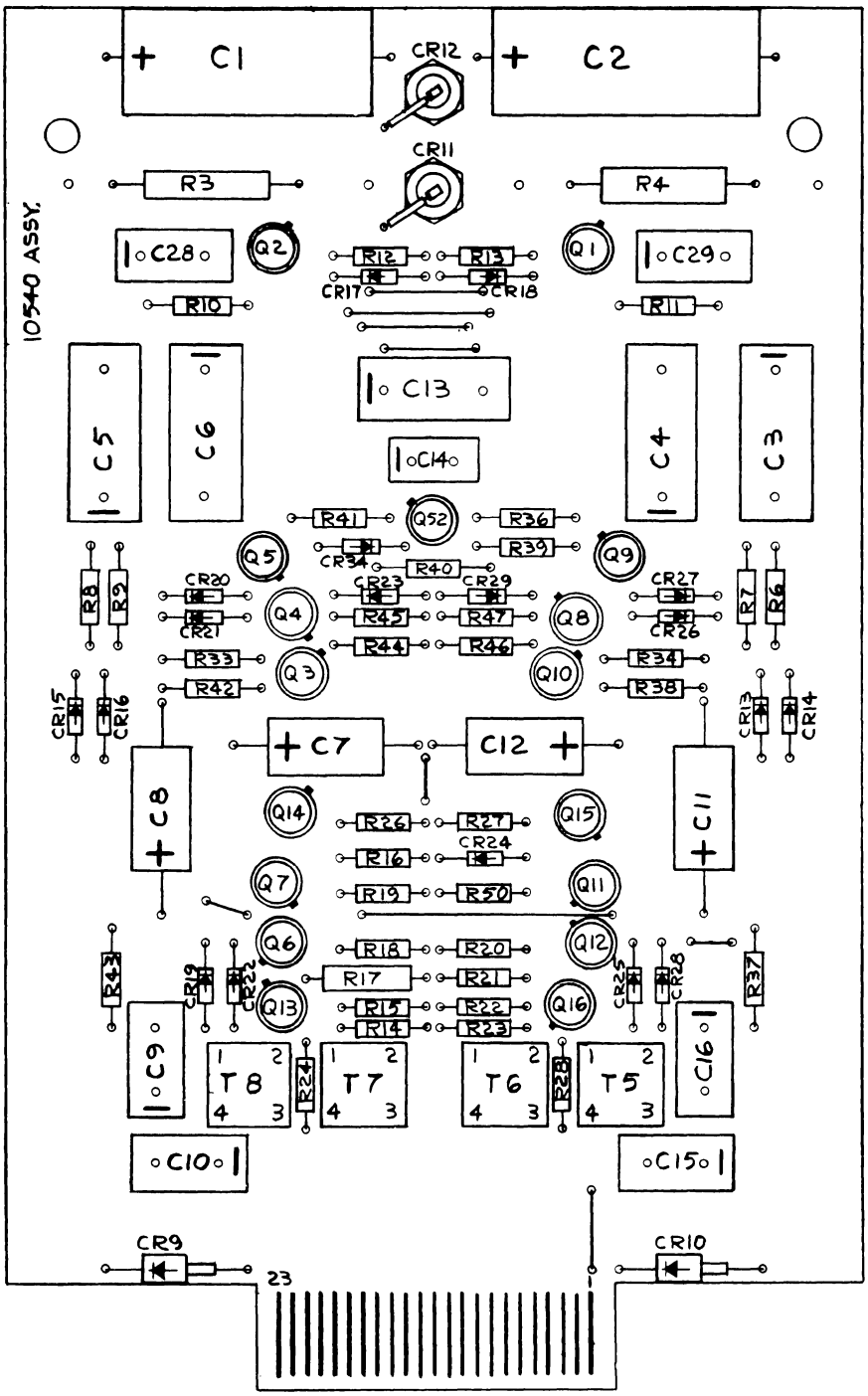


Figure 5-26. Reel Servo Amplifier, Part No. 10540

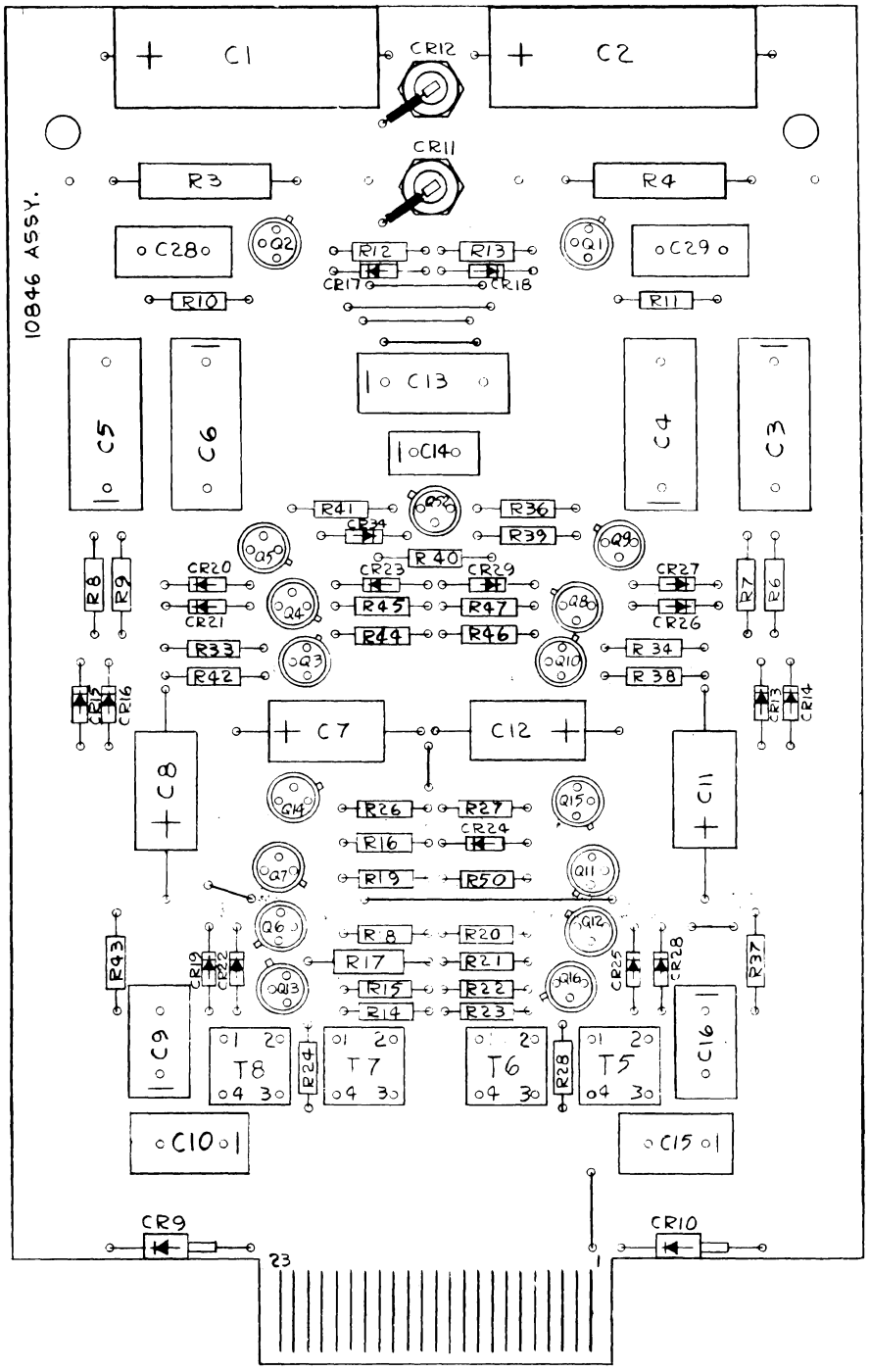


Figure 5-27. Reel Servo Amplifier, Part No. 10846

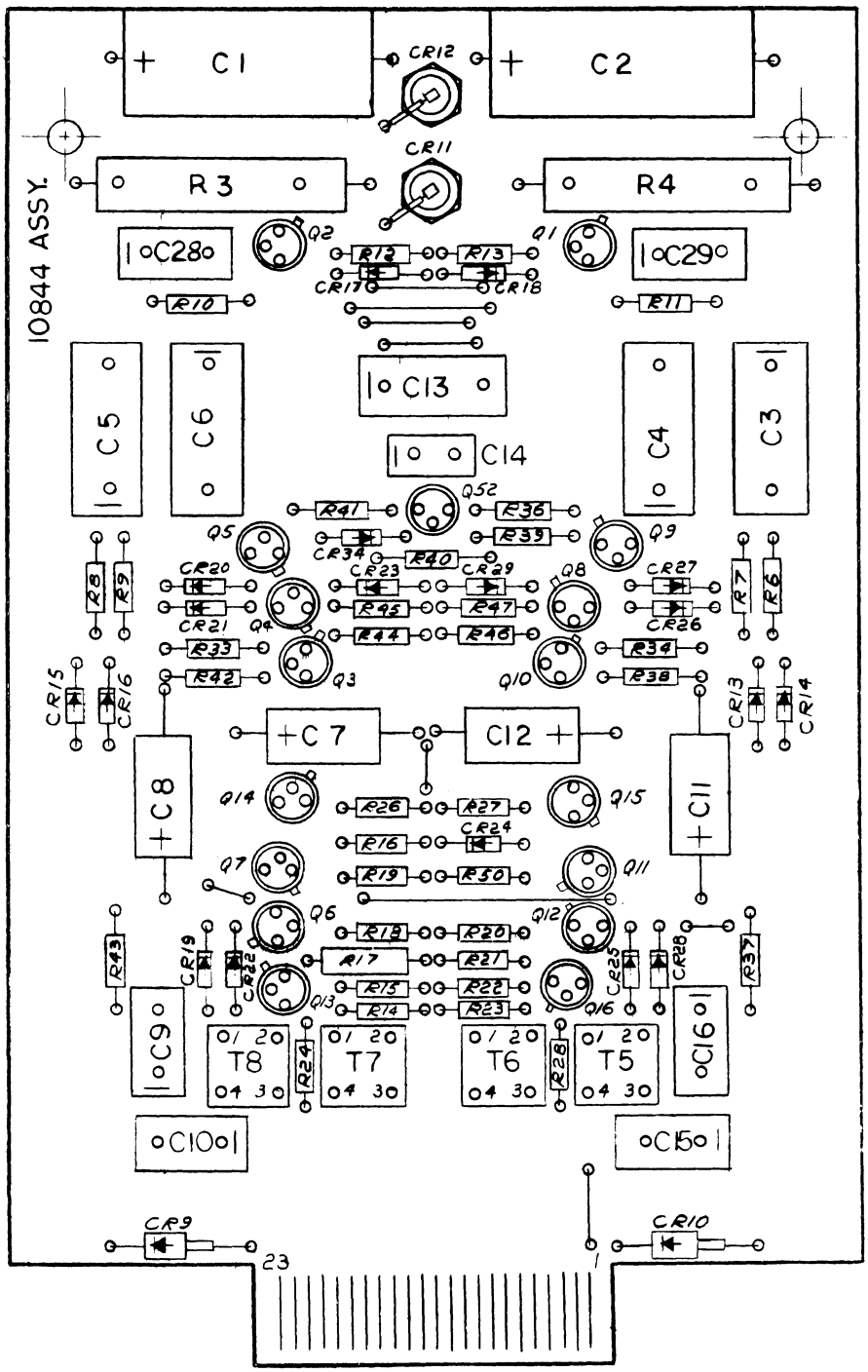


Figure 5-28. Reel Servo Amplifier, Part No. 10844

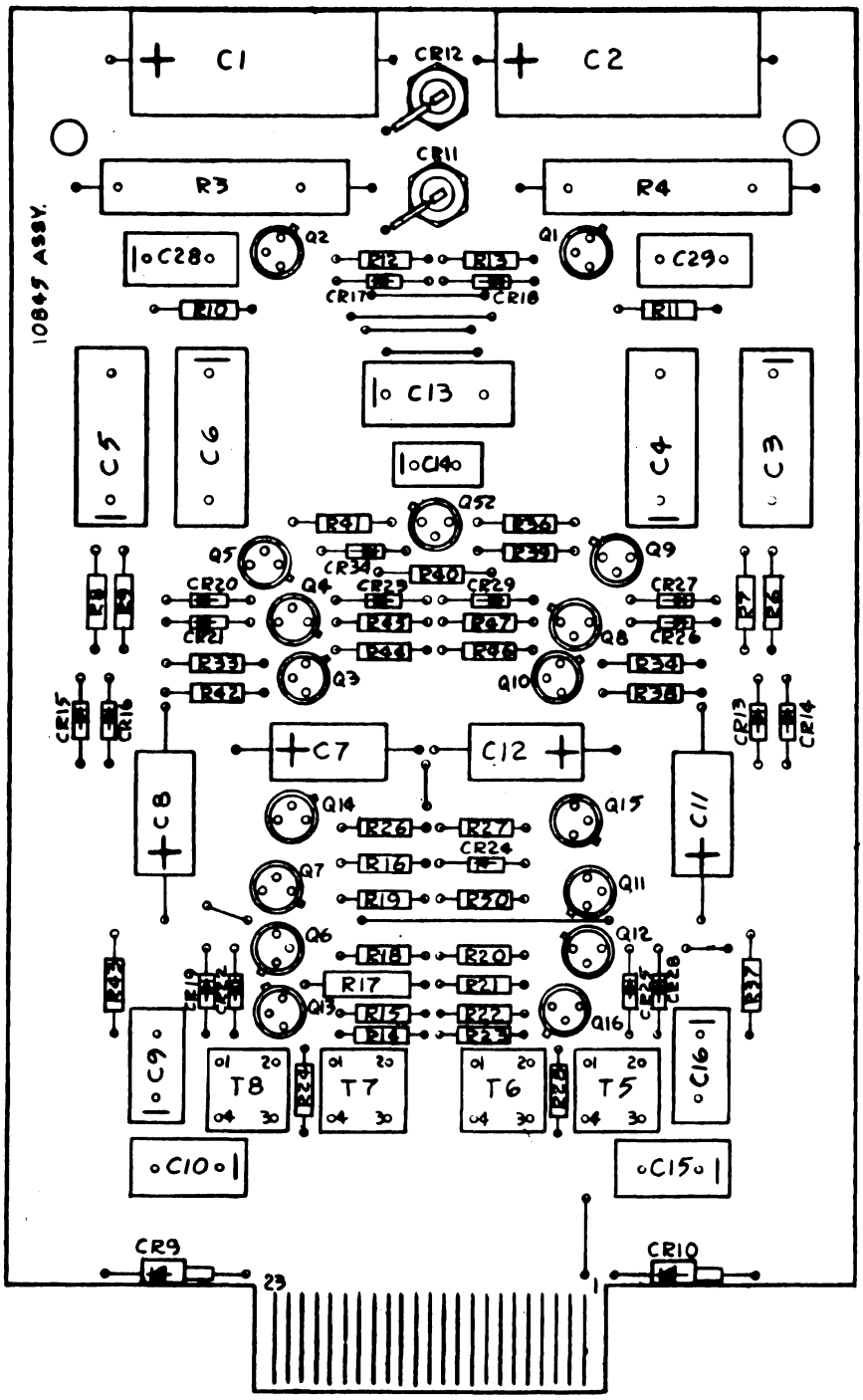


Figure 5-29. Reel Servo Amplifier, Part No. 10845

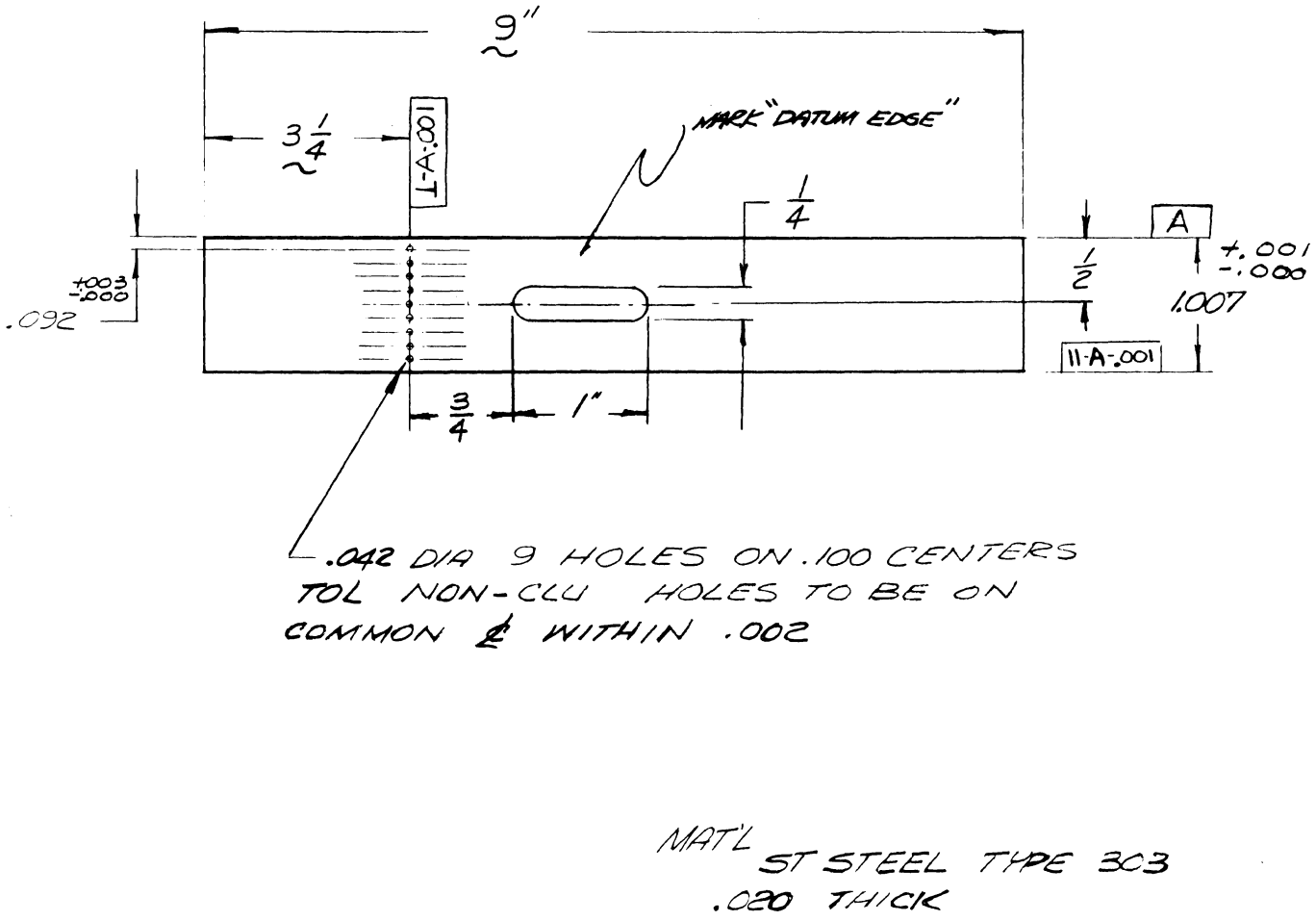


Figure 5-30. Template for Tape Tracking Adjustment

SECTION VI

RECOMMENDED SPARE PARTS LIST

6-1. As part of its continuing efforts towards improving and expanding field support activities, Tally has developed a series of corrective and preventive maintenance programs which provide varying degrees of spare parts coverage. Designed to serve as a guide for customer service and procurement personnel, who are intimately concerned with maintenance of Tally equipment, these programs offer several levels of parts coverage.

Level 1 parts are those recommended by Tally to be inventoried as minimum to insure maximum equipment operating time. The first level includes those parts that, due to their nature or application are most subject to damage or wear. In our opinion, these parts are best inventoried "on site" thereby providing a measure of immediate support capability.

Level 2 contains additional mechanical and electrical parts and, together with Level 1, is intended to provide the greatest extent of detail parts coverage practical. This level of sparing provides at least one each of all electronic and mechanical parts that are subject to damage or wear. Included in this group are parts normally classified as "random failures."

It is recommended that this level of sparing be accomplished by those organizations wishing to afford themselves maximum equipment operating time.

"LEVEL 1"

DESCRIPTION	PART NUMBER	NO./UNIT
Lamp, 2 pcs	GE-1004	2
Capstan Wheel	10164	1
Aluminum reels, 8"	33B093-1	2
Aluminum reels, 10-1/2"	10514	2
Storage arm assy., left	10447-1	1
Storage arm assy., right	10447-2	1
Microswitch	DT2RV3A7	2
Roller	10395	6
Transistor	2N1303	4
Transistor	DTG-2200	4
Transistor	2N697	4
Transistor	IN483B	4
Ring, hub	10132	2
Rectifier assy., top	10367	1
Rectifier assy., bottom	10368	1
Rectifier assy., bottom	10369	1
Rectifier assy., top	10370	1
Control rect. assy., bottom	10371	1
Control rect. assy., middle	10372	1
Control rect. assy., top	10373	1
Control rect. assy., bottom 10-1/2"	10836	1
Control rect. assy., middle 10-1/2"	10837	1
Control rect. assy., top 10-1/2"	10838	1
Rectifier assy., bottom 10-1/2"	10839	1
Rectifier assy., top 10-1/2"	10840	1

"LEVEL 2"

DESCRIPTION	PART NUMBER	NO./UNIT
Code Hole Amplifier No. 1	10543	1
Code Hole Amplifier No. 2	10542	1
Capstan Amplifier	10541	1
Reel Servo Amplifier	10540	1
Reel Motor Assy. & hub	10345	1
Solar Cell Assembly	10790	1
Differential Transformer	10818	1
Capstan Motor Assembly (includes tachometer)	10449	1

NOTES

1. Small electronic components should be obtained locally although they are available from Photocircuits if necessary.
2. The parts in general are for a negative logic and 60 cycle tape reader. To ensure proper part compatibility, spare parts order must be accompanied by model number, serial number, and specification number if applicable.

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