BENDIX G-15

SERVICE MANUAL

MTA-2 MAGNETIC TAPE ACCESSORY

THE Bendix CORPORATION
BENDIX COMPUTER DIVISION

M T A - 2

M A G N E T I C T A P E A C C E S S O R Y

F O R T H E

B E N D I X G - 15

G E N E R A L P U R P O S E D I G I T A L C O M P U T E R

SERVICE MANUAL

PUBLICATION AET-05613

May 30, 1961

BENDIX COMPUTER DIVISION
THE BENDIX CORPORATION
5630 ARBOR VITAE STREET
LOS ANGELES 45, CALIFORNIA

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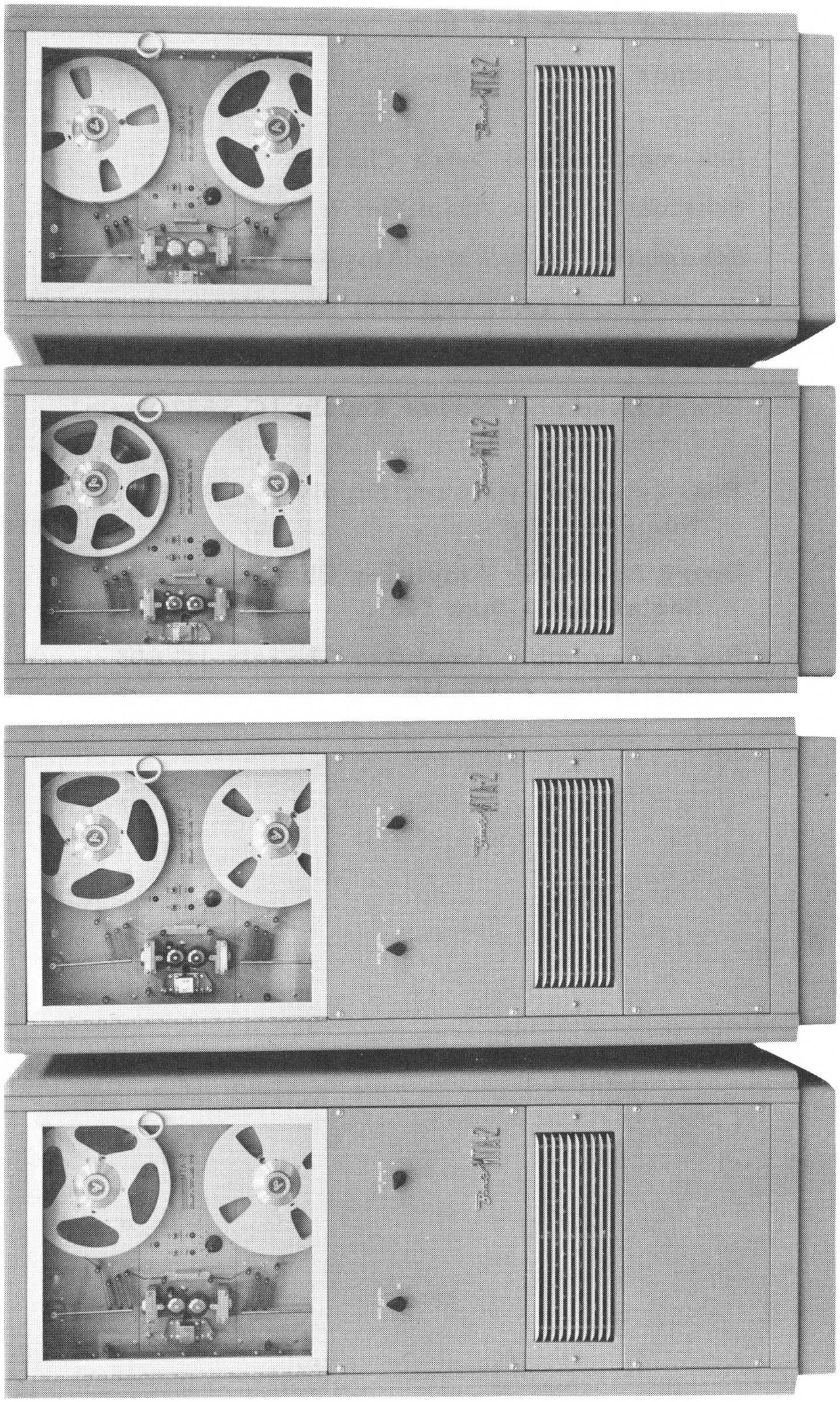


Figure 1-1. Four MTA-2 Magnetic Tape Units

SECTION I

INTRODUCTION

1.0 INTRODUCTION TO THE MTA-2

1.1 PURPOSE OF MAGNETIC TAPE UNITS

1.1.1 MAJOR FUNCTIONS OF A MAGNETIC TAPE UNIT

Magnetic tape units provide inexpensive, convenient and compact auxiliary storage. Some uses for magnetic tape are:

To hold library routines which may be read into the computer and executed under program control.

To hold large amounts of data which may be processed by the computer.

To hold intermediate results of computation which will be called back onto the memory drum when required by the program.

To hold the final results of computation for later type-out by the computer.

1.1.2 CAPABILITIES

One to four MTA-2 units may be connected to the computer; facilities are included for the unique addressing of each tape unit. Each interchangeable tape reel can hold 300,000 words.

Information is written or read in blocks of up to 108 words (one long memory line) in four word groups. The information on tape can be divided into file sections to facilitate searching. A file section may consist of any arbitrary number of blocks and is identified by a "file code".

Information may be written on tape or read from tape under computer control at an average rate of 433 characters per second. A character consists of four binary digits. The four "bits" may represent a decimal digit, if desired. Tape may be "searched" in both the forward and reverse directions, manually or under computer control, at an average rate of 2600 characters per second.

The MTA-2 is compatible with all other standard G-15 accessories; i.e., any other standard accessory may be connected to the computer at the same time as the MTA-2.

1.1.3 GENERAL OPERATION

Information which will be needed at a later time is written on magnetic tape with some form of identification within the block and a known check sum.

When the information is required, the tape is searched for the desired blocks.

The information is read back into the memory of the G-15, and verified by check-summing the block.

Computation may continue during the above operations as long as memory lines 19 and 23 are not used during read or write operations.

Identification and verification must be done by the program. There is no automatic checking.

A magnetic tape service routine is available (MTSR) in which identification, searching, and timing considerations are handled automatically.

1.2 FUNCTIONAL DESCRIPTION AND SPECIFICATIONS

1.2.1 ACCESSORY MTA-2 (See Figure 1-1)

The complete unit is 60 by 24 by 22 inches and weighs 175 lbs.

Power requirements are 115 volts, 60 cycles. Power consumption is .64 kva.

1.2.2 RECORDING AND TAPE SPECIFICATIONS

Forward search and reverse search speed is 45 inches per second. Reading and writing speed is 7 1/2 inches per second.

A 108 - word block is written in approximately 2 seconds, using 15 inches of tape. Recording density is 57 characters per inch.

Return-to-zero recording is used: magnetic saturation occurs in one direction.

Tape is one mil thickness mylar base, one-half inch wide by 3600 feet long on a reel of 10 1/2 inches maximum diameter (N. A. B. hub). The magnetic tape recommended is Instrumentation Type 159A made by Minnesota Mining and Manufacturing Company.

Maximum storage capacity is 300,000 words per reel, at 29 bits per word.

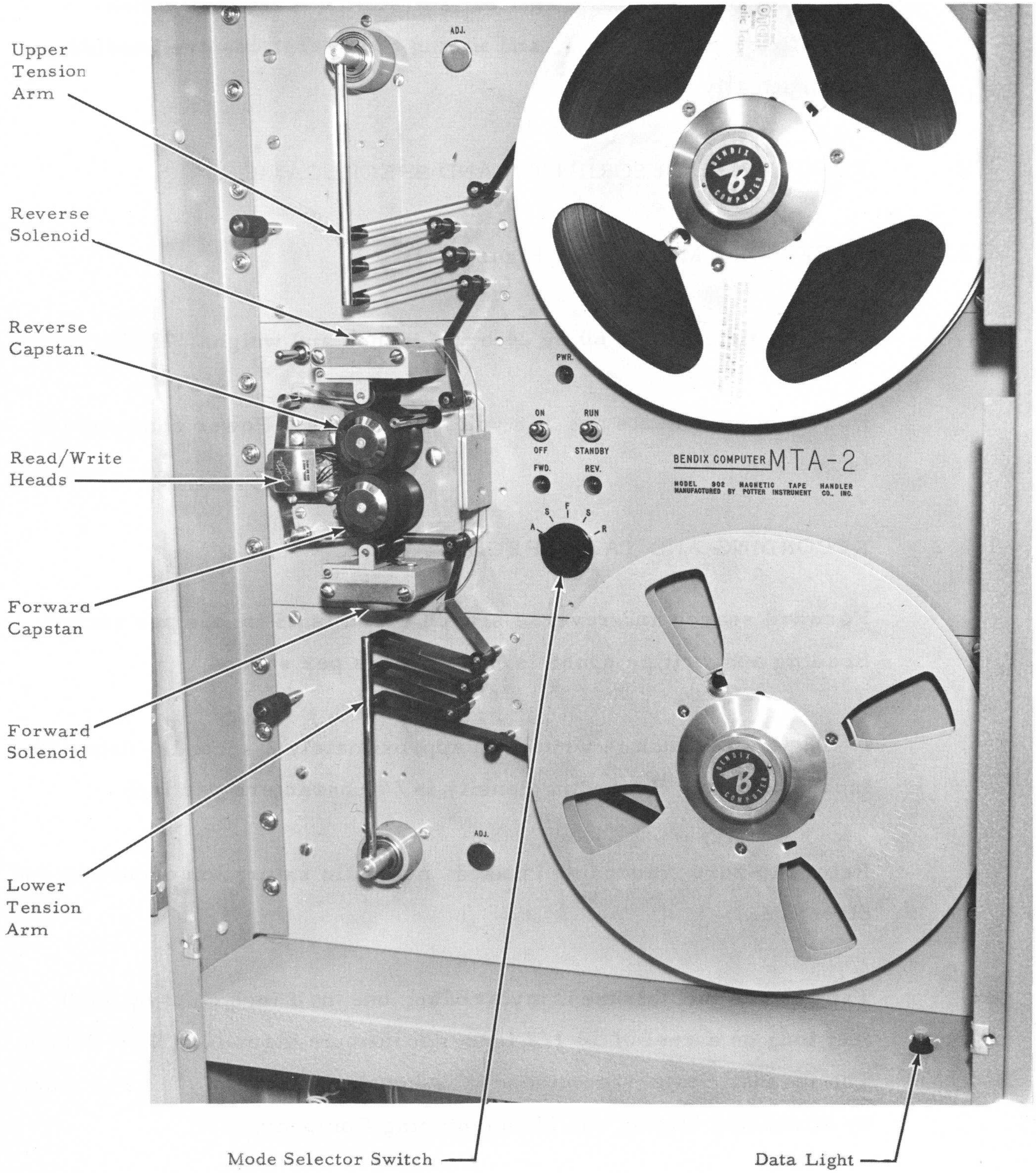


Figure 1-2.1 Tape Handler, Front View Serial 241 and Up

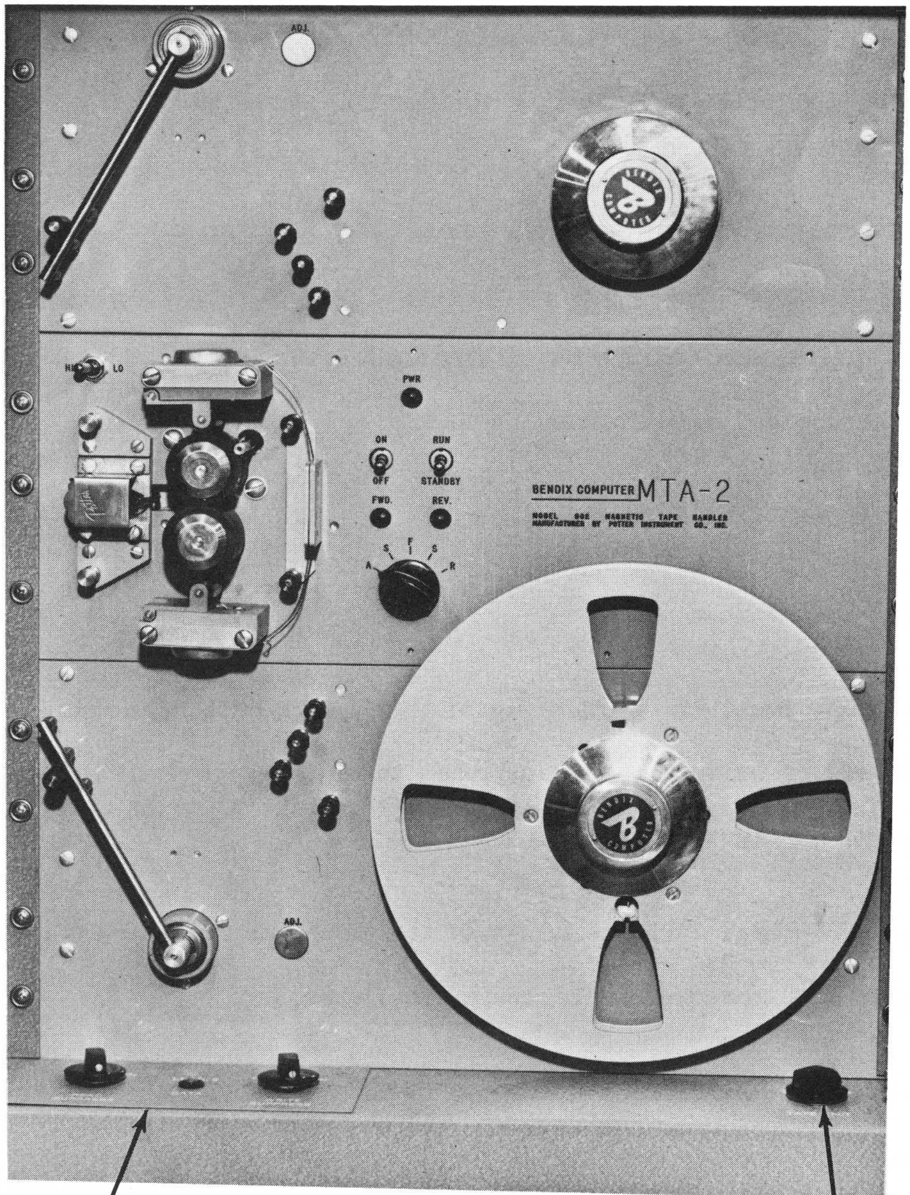


Figure 1-2.2 Tape Handler, Front View Serial 1 thru 240

The magnetic tape contains seven channels. Information is written or read from tape four bits at a time. The four bits are held in four parallel channels on the tape. The fifth tape channel holds a bit which specifies whether or not the first four channels hold numerical information or control bits. Control bits and the fifth channel bits are recorded automatically when required and need not be programmed. The sixth channel holds no information but is a shielding channel. Channel seven, which holds file codes, is referred to as channel six in the logical explanation.

1.2.3 TAPE HANDLER (See Figures 1-2, 1-3)

1.2.3.1 DRIVE CHASSIS

The tape handler is made up of three separate chassis. The drive chassis is in the center and does the actual work of moving the tape past the read/write heads.

The DC power requirements of the drive chassis are shared by the upper and lower servomechanism chassis.

There are two rubber-surfaced capstans situated near the read/write heads. A single two-speed induction motor drives both capstans continuously in opposite directions. Motor speed is controlled by the computer or by a manual switch.

A solenoid-operated pressure roller is mounted close to each capstan. The tape runs between one roller and its associated capstan, across the heads, and then between the other roller and its capstan. The upper or lower solenoid is energized by the computer or by a manual

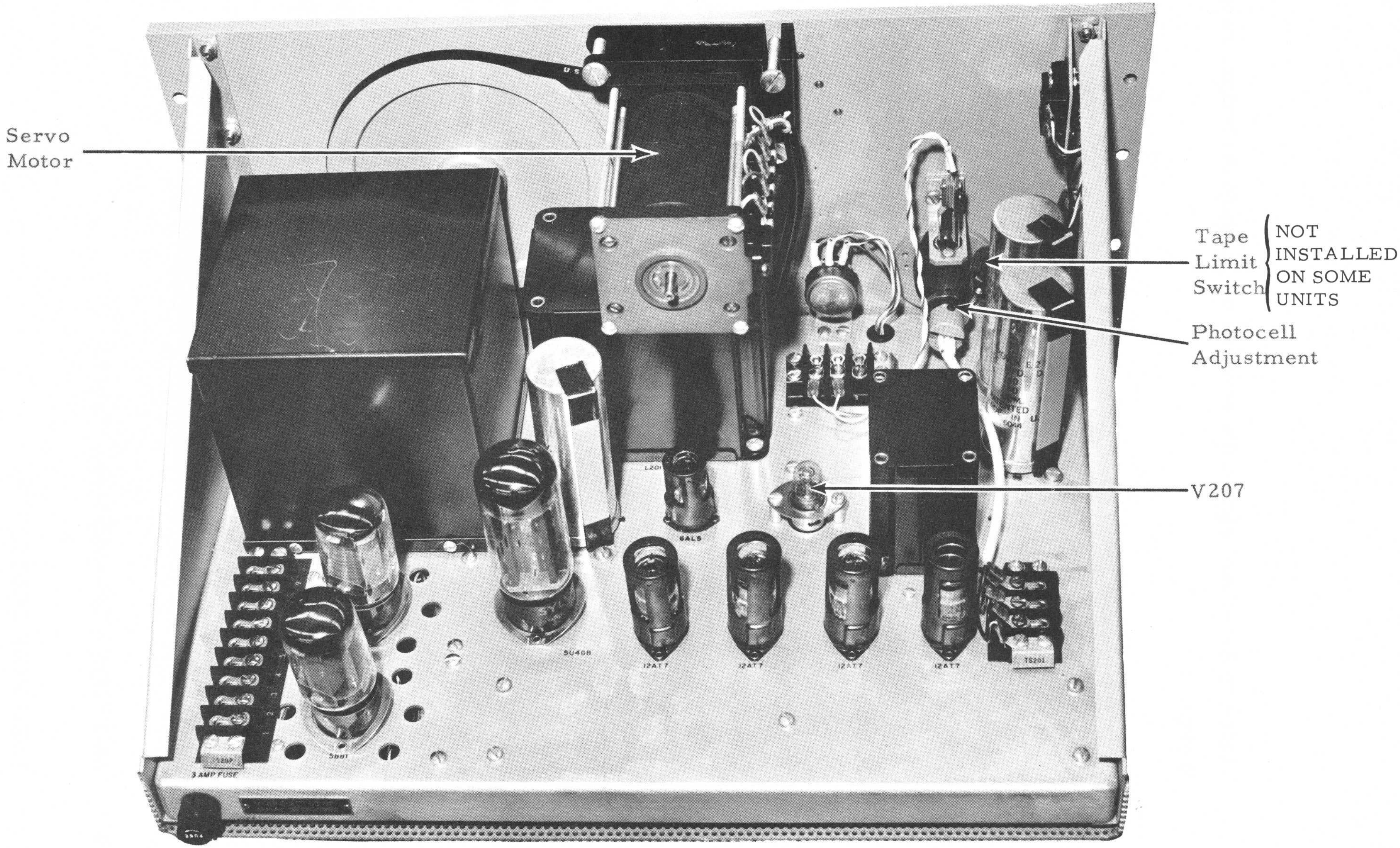


Figure 1-3. Lower Reel Chassis, Rear View

switch to drive the tape in the reverse or forward direction, respectively.

Tape flutter can cause the tape to leave the read/write head momentarily and thus produce errors. Therefore, damping pad assemblies are incorporated on tape guides adjacent to heads.

The read/write head has seven tracks, each .032 inches wide with .070 inch spacing. Gap width is .0004 inches. DC resistance is 28 ohms.

1.2.3.2 SERVOMECHANISM CHASSIS

There are two servo chassis: one above and one below the drive chassis. Their job is to supply the drive chassis with the tape and isolate the inertia of the supply reel from the capstans.

The tape runs from the supply/take-up reel, around the tension arm, and then to the drive chassis. When the drive chassis moves the tape, the tension arm is displaced. This signals the servomechanism as to which way to turn the tape reel.

Therefore, the computer does not control the tape reels directly, but merely causes the tape to be moved. Each servo chassis will automatically feed or take up tape as necessary.

Each chassis contains its own self-contained power supply.

1.2.4 AMPLIFIER CHASSIS (See Figure 1-4)

TAPE UNIT SELECTION

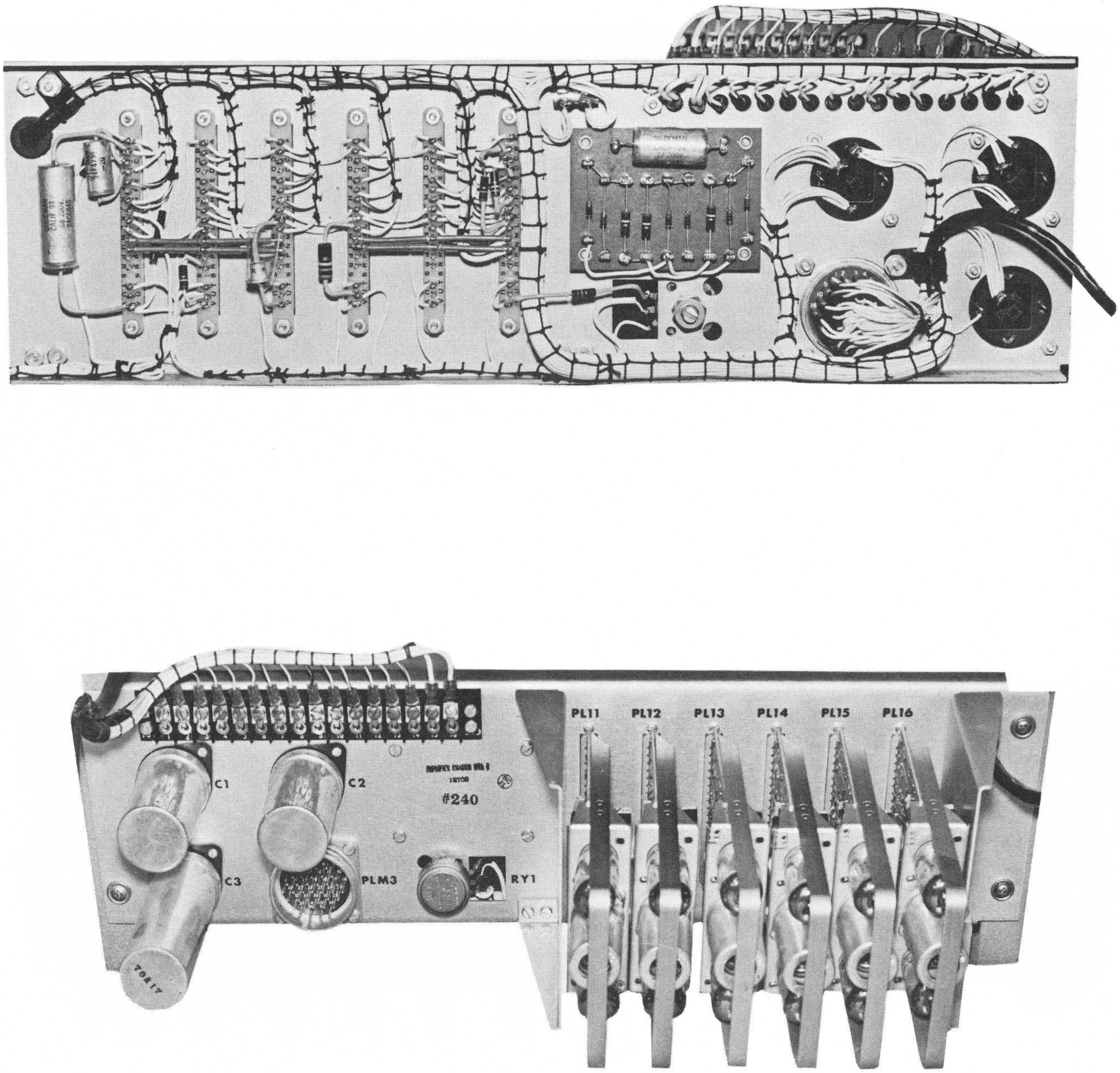


Figure 1-4.1 Amplifier Chassis, Serial 1 thru 240

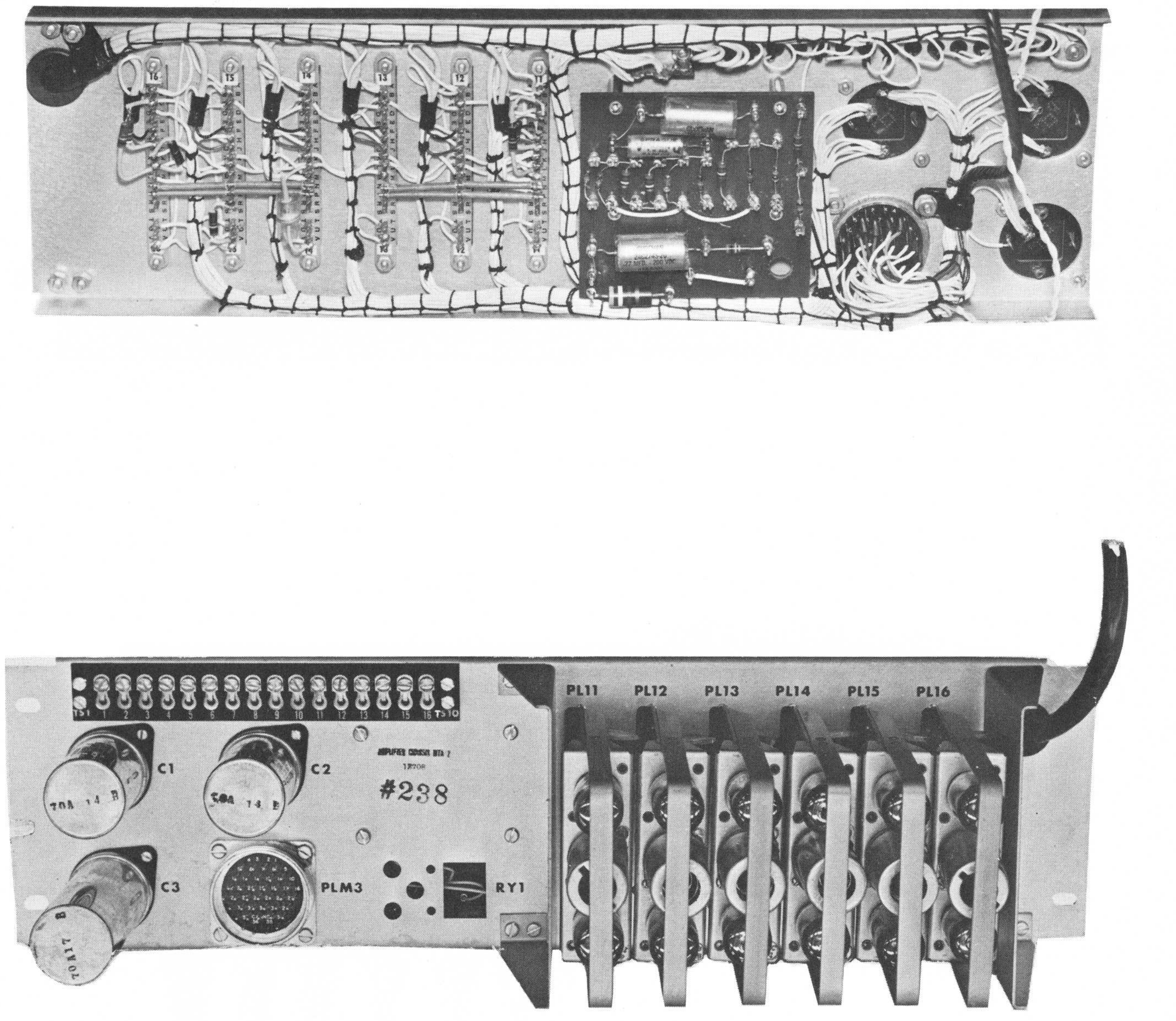


Figure 1-4. 2 Amplifier Chassis, Serial 241 and Up

On units serial number 241 and up, the UNIT SELECTOR switch is located on the front panel (Refer to Figure 3-1.) and is set by the operator to specify the number of the unit. The switch qualifies several gates through which the computer controls the MTA-2. On units serial number 1 thru 240, the UNIT SELECTOR switch is located on the apron just below the lower reel chassis, and operates as described above.

Read/Write Amplifiers

Each channel has a separate read/write amplifier. The amplifier packages for channels 1 through 6 plug into connectors PL11 through PL16 respectively on units serial number 241 and up. Writing is controlled manually by the WRITE CONTROL switch on the front panel (Refer to Figure 3-1). When in the "OFF" position, the computer can read but not write on that unit. When the WRITE CONTROL is "ON", the computer can both read and write on that unit. (Refer to Figure 3-7, for details on the control functions).

On units serial number 1 thru 240, writing is controlled manually by the WRITE SUPPRESS switch located on the apron just below the lower reel chassis. When in the "OFF" position, the computer can record on magnetic tape. Writing is blocked when the switch is in the "ON" position. (Refer to Figure 3-6).

1.2.5 POWER SUPPLY CHASSIS (See Figure 1-5)

The MTA-2 has a third power supply for the read/write amplifiers and also uses the +160v and -20v supplies from the G-15.

Three relays are mounted on the power supply chassis. The "STOP" relay is energized by the drive chassis. Its purpose is to inhibit reading and writing when the tape is not moving. The "FAST" relay is energized by the computer, and it switches the capstan motor to high speed for search operations.

The time delay relay (K201) is a thermal time delay which allows a 20 second filament warm up period for all read amplifiers before the application of D. C. power.

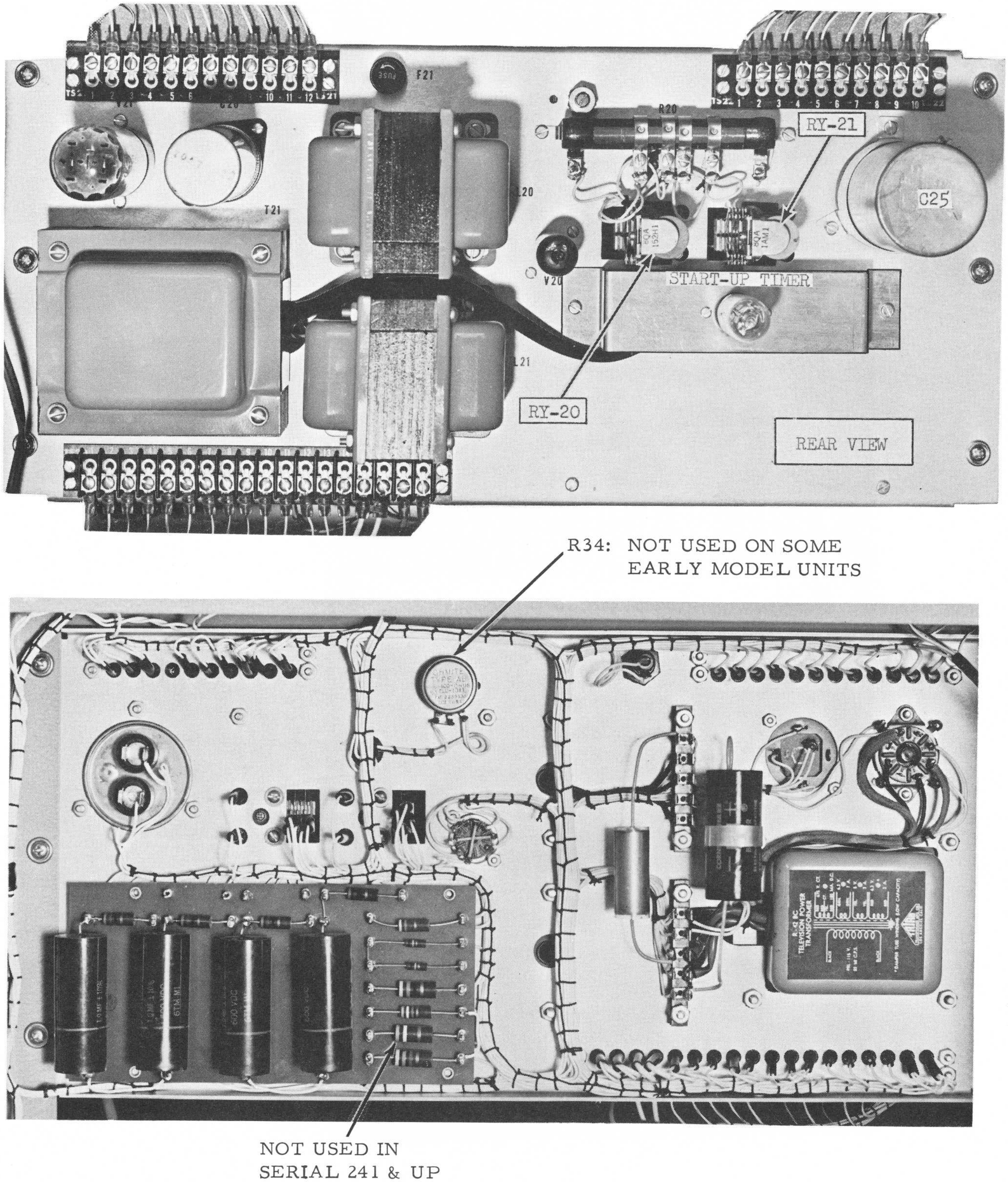


Figure 1-5. Power Supply Chassis, Serial 1 thru 240

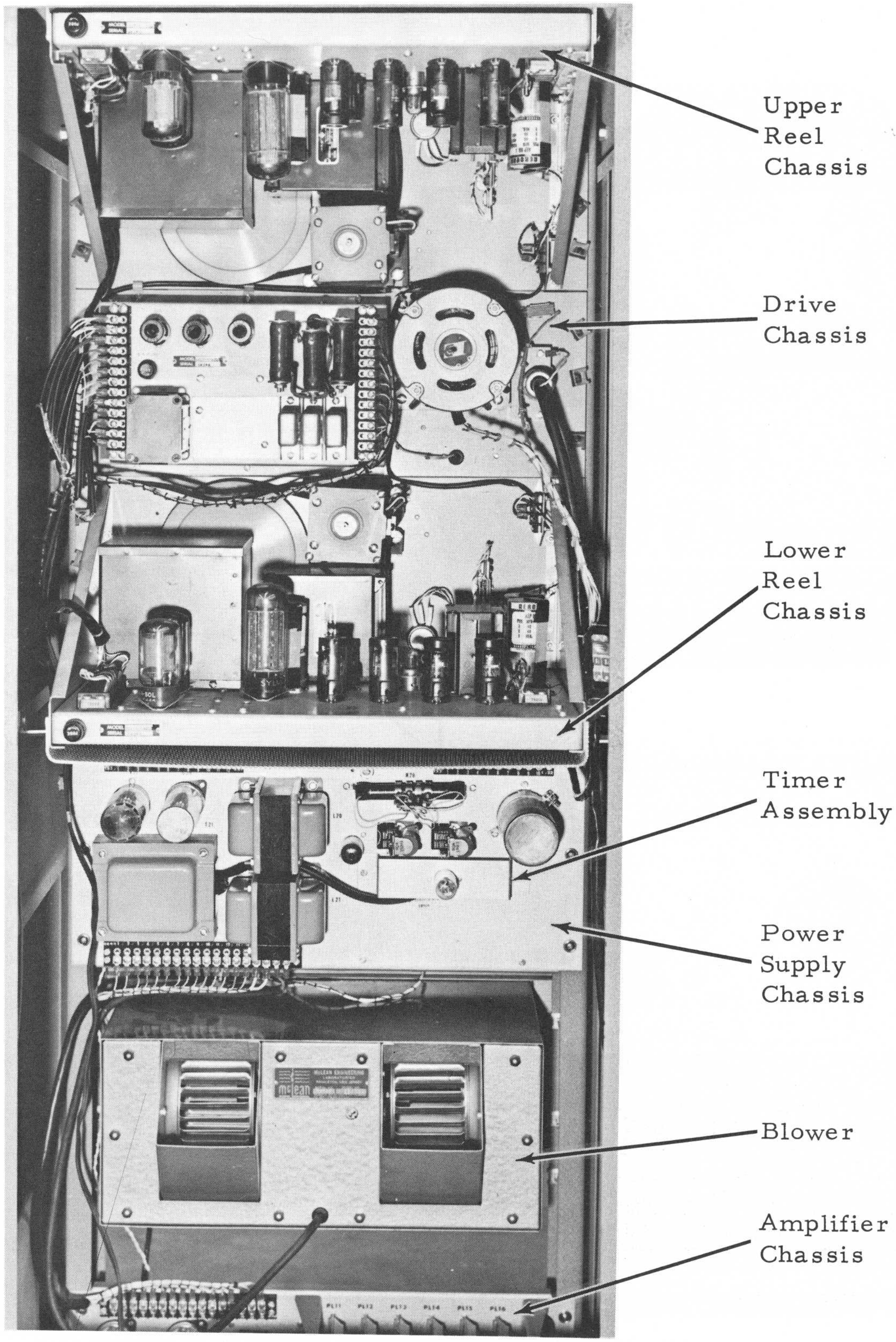


Figure 1-6. MTA-2, Rear View (Air Duct Assembly Removed)

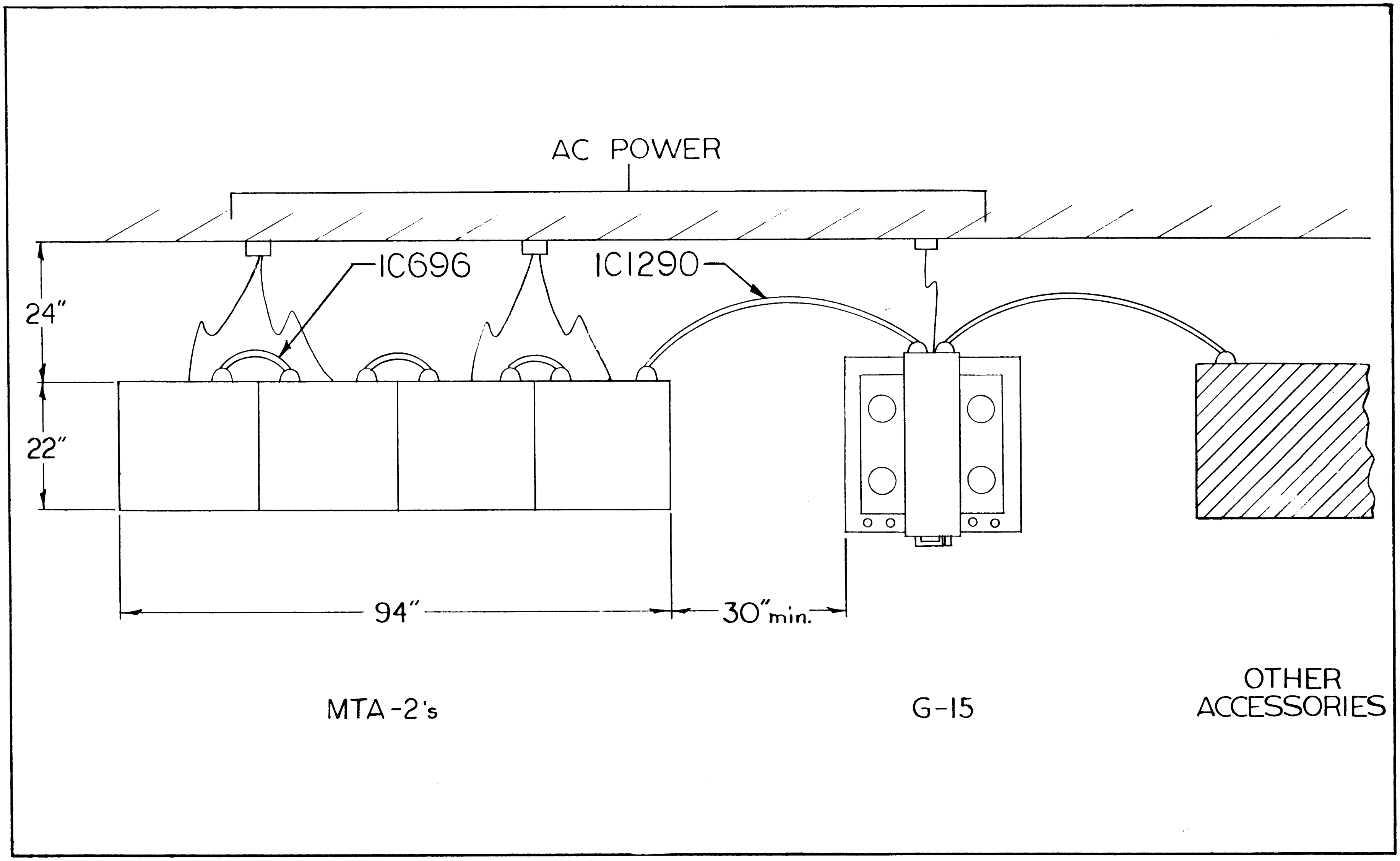


Figure 2-1. MTA-2 Placement (Typical) and Interconnections

SECTION II

INSTALLATION

2.0 INSTALLATION

2.1 UNCRATING AND INSPECTION

Remove packing material only at installation site. Remove crate and Pliofilm bag carefully. Pallet and Pliofilm bag should be saved in case it is necessary to move the machine at a later date. Ask the moving company to store them for you.

Check that all tubes and tube packages are seated in place. Check air filter. Check that all motors and rollers turn freely, and lubricate if necessary. (See paragraph 5.5.0, cleaning and lubrication).

2.2 INSTALLATION

2.2.1 PHYSICAL PLACEMENT (See Figure 2-1)

Each MTA-2 occupies a floor area 24 inches wide by 22 inches deep.

Two feet of clearance should be allowed behind the unit to permit opening rear doors for service.

Nothing should be placed on top of the MTA-2 as this will inhibit air flow.

2.2.2 AC POWER LINE

Connect each Accessory MTA-2 power cable to a 115 volt, 60-cycle outlet of at least 10-ampere capacity. (Do not use 115 volt receptacles in the back of the computer).

It is desirable that the power line be free of relatively large transients such as could be caused by switching inductive loads.

2.2.3 INTERCONNECTIONS (See Figure 2-1)

Connect the Accessory MTA-2 main cable to the receptacle in back of the computer labeled "Magnetic Tape". (A second tape unit to be used with the same computer is connected by plugging its cable into a receptacle in the first tape unit; similarly, a third tape unit is connected to the second and a fourth is connected to the third).

The standard length of the main cable is 10 feet, and the inter-connecting cables are 4 feet. However, a maximum total length of 40 feet for all cables is allowable.

2.3 INITIAL ADJUSTMENTS

For initial adjustments, refer to paragraph 5.2.1 through 5.5.0.

The test routines (Section 7) will be helpful for checking adjustments.

2.4 RECRATING FOR SHIPMENT

Obtain Pallet and Pliofilm bag which were removed at installation. If bag is damaged, obtain a new one from the Regional or home office. The crate and straps are not needed.

Mount the unit on the Pallet. Cover glass panel and front knobs with cardboard, and tape. Cover with Pliofilm bag.

Ship by moving van. Be sure that unit is covered with moving blankets and strapped to side of van.

SECTION III
THEORY OF OPERATION

3.0 THEORY OF OPERATION

3.1 REEL PANEL CHASSIS* (See Figure 1-3)

3.1.1 Major Components of the Reel Panel Chassis:

Reel panel - reel servo amplifier and power supply.
Reel drive assembly - servo motor, drive belt, reel hub, etc.

Tension arm assembly - tension arm, spring, photocell, etc.

Photocell exciter lamp.

Bias source for drive panel (-11v).

3.1.2 SERVOMECHANISM OPERATION

To maintain tape tension while the reel motors are accelerating, two tension arms are employed. These arms are located on the reel panels and control the reel servo amplifiers. In addition to their action during the starting and stopping, they also maintain fixed tape tension independent of reel rotational speed. Position of the tension arm is sensed photo-electrically by means of a dual photocell mounted in the shaft of the arm. The photocell is illuminated by a switchboard-type lamp operating at 40v AC. Movement of the arm away from the vertical position unbalances

* There are two reel panel chassis; upper and lower. However, since they are electrically identical, only the lower reel panel chassis will be discussed.

the light falling on the two halves of the photocell, resulting in a change in DC voltage input to the servo-amplifier.

The photocell is of the lead sulfite type which exhibits lowered resistance when exposed to light. When the light falling on the two halves is balanced, voltage at the common terminal (TS201-2), (Refer to Figure 8-2.) is half of the voltage applied to the cell or about 30v. Displacement of the arm will vary this voltage over an approximate range of ±4v.

The servo amplifier will sense the change of DC input and as a result of this change develop (by process of modulation, phase shift, and AC gain) a voltage of the following characteristics required by the servo motor to drive the tape reels:

(1) An amplitude proportional to the amount of arm deflection from centering. "Velocity & Torque Requirement".

(2) A phase displacement of this voltage either leading or lagging (reference 115v AC line used for motor excitation) by 90°. The leading or lagging characteristic dependent on either right hand or left hand deflection of tension arm from centering. "Direction of Rotation Requirement".

(3) Sufficient output power to drive motor. "Power Requirement".

Referring to Figure 3-2, Servo Amplifier Functional Diagram, it is shown that the voltage applied across the photocell is regulated for amplitude and AC ripple component reduction by V207 (NE17) a neon bulb which removes a major portion of the 120 cps power supply ripple which could cause undesired power dissipation in the servo motor windings. This DC error signal is then loaded by R202 and R201 (Refer to Figure 8. 2) to obtain the desired arm displacement versus photocell output characteristics. The signal then passes through the network R208 (3. 9 meg) and C201. This parallel combination of RC will phase shift any remaining 120 cps photocell output component by 90° and also provide a DC coupling for the photocell DC error signal.

The resultant component which is phase shifted by this circuitry is the 60 cps exciter lamp persistance characteristic and the 120 cps power supply component. The output of R208 and C201 at junction of R211 (220K) is the modulator input. The necessary function of R208 and C201 is as follows:

(1) Prevent all possible in phase (with 60 cps REF) components from getting into the modulator during diode cutoff state. In phase components (60-120 cps) other than DC or very low frequency AC signals generated by tension arm deflection rates would be "Demodulated" by the Modulator and the tension arm centering position would be subject to a change as a result of normal power supply ripple variations and AC line variations.

NOTE: WAVEFORMS HAVE NOT BEEN SHOWN TO THIS POINT AS THEY ARE NOT EASILY MADE WITH CONVENTIONAL SERVICE EQUIPMENT AND PROBLEMS CAUSED BY MODULATOR INPUT COMPONENTS WILL FOR THE MOST PART BE CORRECTED BY CIRCUIT ISOLATION PRACTICES AND CONVENTIONAL RESISTANCE MEASUREMENTS.

The modulator input at R211, Figure 3-2 △2, would now be essentially a constant positive DC voltage either increasing or decreasing in amplitude proportional to a positive (RH) or a negative (LH) deflection of the tension arm. The modulator must now perform the following functions:

(1) Produce a 60 cps voltage output whose amplitude is proportional to the tension arm displacement from centering (electronic null point of servo amplifier input which will not produce motor torque) position. It will then drive the high gain, phase shift, and power output stages following it.

(2) Have two distinct phase displaced output characteristics to determine the required direction of motor rotation for a positive or negative arm deflection. The modulator output is either in phase or 180° displaced (from 60 cps line voltage). This output voltage will in later stages be displaced 90° to determine a leading or lagging quadrant for correct motor directional rotation (CW or CCW).

Figure 3-5 Phase Relation Flow Chart will point out important phase relationships for typical operating points concerned.

Referring to Figure 3-4 Modulator Functional Diagram, the operation of the modulator is that of a half wave phase sensitive modulator. The modulator has three separate states, these are:

(1) Tape arm centered (NULL)

(2) Arm offset negative (left)

(3) Arm off-set positive. (right).

It is the output of the modulator that determines the direction in which the servo motor will turn (CW-NULL-CCW). In the following, the output wave form of the modulator for each of the three states will be developed and discussed.

Modulator output during null (servos stalled).

Referring to Figure 3-4, it should be noted that the modulator has been extracted from the Potter servo schematic and simplified for ease of explanation. The modulator output during null is shown in Figure 3-3, Photo A-1. All references are made against the voltage applied to the primary of the servo motor (EM/PRI).

Transformer T202 provides keying voltages, to V201-8 and V201-1, which are equal in amplitude but 180° out of phase with each other due to the center tap connection of Pins 6 and 3 (ofT202) going essentially to ground thru the centering control.

The center tap of T202 and the input of the modulator will be at equal DC potentials. This results in an AC current through the transformer, resistor (R213-R212) and diode loop only during the negative one-half cycle of T202-5. During this conduction period, a low impedance to T202 center tap exists at the junction of V201A and V201B (modulator output). As a result, any voltage introduced at the modulator input during this time is dropped across R211 and the modulator assumes the DC level at the center tap of T202. There will be a slight voltage drop across the tube (V201) which results in the wave form shown during time period 1 in Photo A-1, Figure 3-3.

R212 and R213 are used to limit conduction current.

During the positive half cycle of T202-5 the diodes are going thru cutoff. Since the tape arm is at null, the DC input to the modulator is equal to the center-tap of T202 (Pins 3 & 6) thus producing no useable output from the modulator (time period 2 Photo A-1 Figure 3-3).

Since both cycles of the AC voltage produced no output from the modulator, the servo remains in the stalled or null state.

Modulator output during tape arm shift right (positive).

In a positive shift of the arm, the input of the modulator becomes more positive than the center tap of T202. When V201A and V201B are cutoff the modulator output assumes the level of the modulator input due to R211. During cutoff, the modulator input voltage is quickly exceeded by the larger signal at T202-5 thus allowing the modulator output to rapidly assume the DC level of the modulator input. (Time Period 2, Photo A2, Figure 3-3). Remember that during the negative half cycle of T202-5 a short circuit condition will result (thru V201) and cause the modulator output to become the approximate value of the center tap of T202 (time period 1, Photo A2, Figure 3-3).

V201-B will be cutoff during the time the arm is in a positive shift.

The conduction of V201-A results in a 60 cycle component output from the modulator which is in phase with the servo primary voltage. (Photo A2, Figure 3-3).

Modulator output during tape arm shift left (negative).

It should be noted that the modulator input (tape arm shift) voltage is never negative but does become less positive than the voltage at the center tap of T202. Thus it is expressed as a negative shift.

When the tape arm shifts negative, the voltage at the input of the modulator becomes less positive than the voltage at the center tap of T202. During the positive cycle of T202-5 both V201A and V201B are cutoff. At this instant, the modulator output will assume the level of the modulator input due to R211 (time period 2, Photo A3, Figure 3-3). As T202-5 goes negative, the modulator output is pulled to the DC level at the center tap of T202 due to the conduction of V201-A and V201-B (time period 1, Photo A5, Figure 3-3). As a result of the above, a 60 cps signal is produced by the modulator but 180° out of phase with the servo primary voltage.

The main point to remember about the modulator is that in essence the modulator output will equal the modulator input (DC level) during cutoff of V201 A & B. During conduction of V201 A & B, the modulator output will equal the voltage at T202 center tap (centering pot voltage).

The modulator output in its present form (ZERO or 180° phase displaced) even though amplified, would cause no (CW or CCW) motor rotation, but would only develop power losses in the motor primary windings. However, the modulator output will be amplified and phase displaced in V202 stages and the voltage output of V202-6 would be a voltage of either a leading or lagging (± 90°) quadrant. Comparing waveforms B and C of Figure 3-3 will clarify this function.

We now have a leading or lagging voltage component (± 90°) which can be power amplified and result in a (CW or CCW) motor rotation to satisfy the tape reel take up requirements.

A DC offset voltage is inserted into modulator to provide additional tape reserve on take up arms for a given tape motion (FWD or REV).

The remaining amplifier circuitry can be easily understood by the use of schematic drawing and waveforms of these stages.

3.2.0 MAJOR COMPONENTS ON THE DRIVE PANEL CHASSIS:

Stop-Forward-Reverse control thyratrons.

Switches and controls.

Drive motor.

Read/Write heads.

3.2.1 TAPE DRIVE OPERATION

Three type 2D21 thyratrons are used to control the capstan solenoids. These tubes are connected to provide three stable conditions with only one tube conducting at a time. The "Forward" thyratron V101 (Refer to Figure 8-1) controls the forward solenoid. V103 operates the "Reverse" solenoid, and V102 is the "Stop" thyratron. Under normal conditions when any of these three tubes fire, it will extinquish the others. Thus, only one tube is conducting at a time. This lockout feature reduces the possibility of engaging both "Forward" and "Reverse" solenoids simultaneously with probable damage to the tape. It is possible to reverse the direction of tape motion without pulsing the stop thyratron. This must be avoided by the programmer as damage to the tape may result. At least one drum cycle must elapse between changes of state of the thyratrons to allow time for the LCR circuits to stabilize.

When the Selector Switch (S103) is used for manual operation, V103 and V101 are disabled, and the corresponding solenoid currents flow through the switch. When S103 is rotated to an "S" position, a DC voltage is applied to the grid of the stop thyratron V102. This makes certain that the circuit will be in "Stop" when switching into "A" (automatic) position. Rapid solenoid action is obtained by discharging capacitors C102 and C109 through their respective thyratrons. These capacitors are charged to 380 volts DC, which is obtained from the B supply of the reel panels.

3.2.2 READ/WRITE AMPLIFIER

The data to be written comes from the G-15 through pins 3, 6, 9, 10, 13, and 15 of PL5 and is applied to the grid of V1-B of channels 1 through 5 respectively (Refer to Figures 8-4 and 8-5). Since these lines are active during any G-15 output, means must be provided in the MTA-2 to inhibit writing except when called for on that particular unit.

A "WRITE" signal is provided to control when writing is to take place. "WRITE" is applied to the grid of V1-A at each amplifier. V1-A is cathode-coupled to V1-B. When "WRITE" is at -5v the signal from the G-15 has control of V1-B. However, when "WRITE" is at +15v V1-B can never conduct since the clamp diode CR2 holds the grid of V1-B below zero volts and insures 15v cut-off bias.

The Write File Code signal comes from the G-15 through pin 15 of PL5 and is gated with MTU (the signal from the Unit Selector Switch) before being applied to the grid of V1-B of channel 6. The record signal to pin "B" of channel 6 is "WRITE 6" and should not be confused with the signal "WRITE".

Reference Figures 3-6 and 3-7 showing the amplifier control circuits for machine serial number effectivities.

A read head winding is connected to the grid of V2-A of each amplifier through a pulse transformer T1 (Refer to Figure 8-3), which gives a voltage gain of approximately three.

NOTE

> The read and write head windings are the same; that is, both reading and recording take place using the same winding on the head.

During write modes of operation, CR3, CR4 and R21 are utilized as voltage limiters as well as providing damping for T1 and the write head windings.

V2-A and V2-B are simple cathode-biased voltage amplifiers. A 12AY7 tube is used for low noise. The tube is shielded, and a good ground must be provided for the shield.

V3-A is a clipping stage, amplifying only negative-going input pulses. At zero signal, the plate of V3-A is at approximately -100 volts. A negative signal on the grid drives the plate positive. The signal at the junction of R16 and R20 will be clamped at zero volts by the diode CR1.

The plate of V3-A may be monitored at "Test Point R" of the package connector.

V3-B is a cathode-follower stage with the cathode returned to -20v, thereby setting the base line for the output signal. This cathode-follower can drive pull-down loads only.

Since the read amplifier remains connected to the Read/Write head during writing operations, the large signals present will saturate

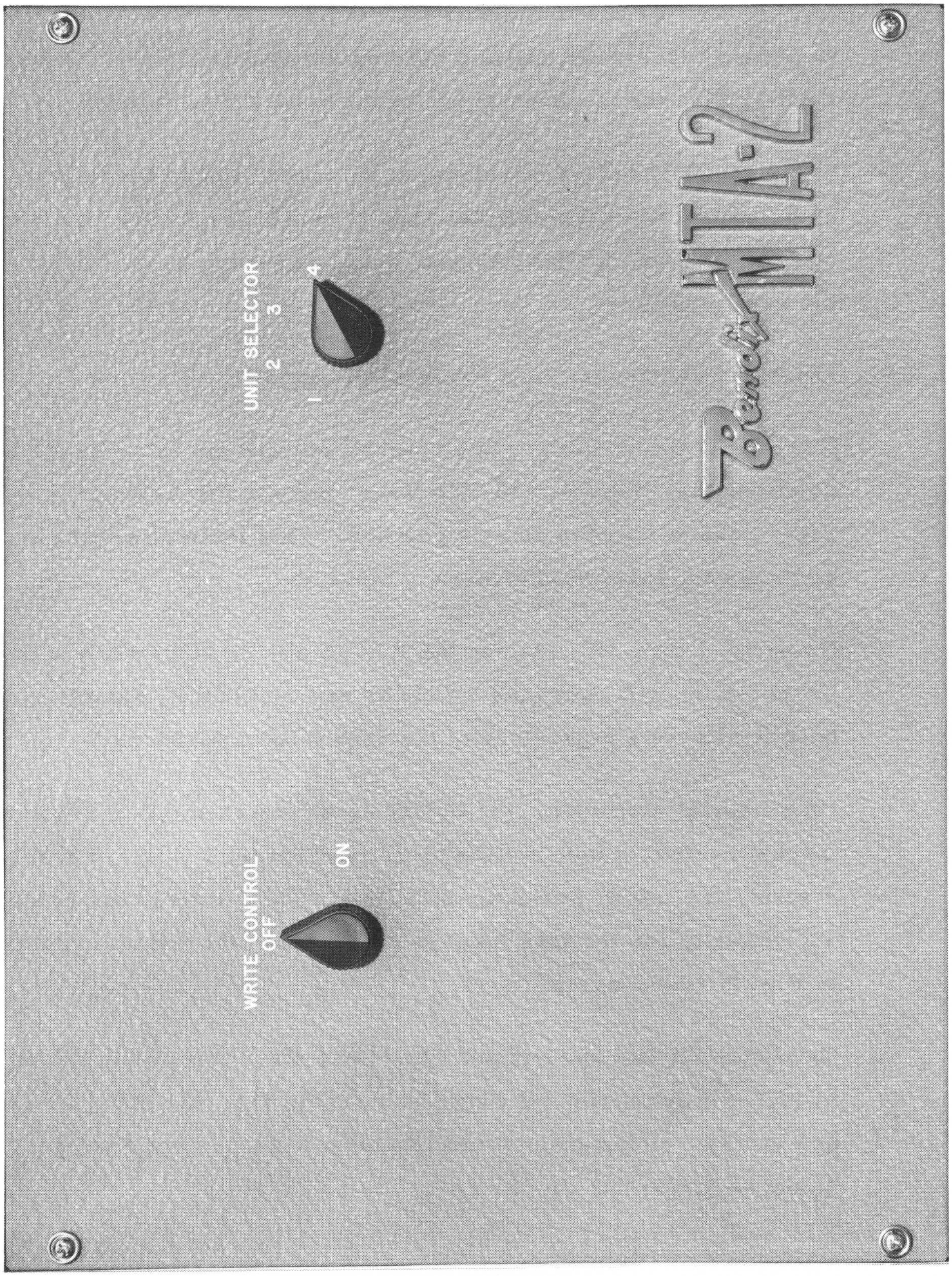


Figure 3-1. Front Panel Control, Serial 241 and Up

transformer T1 and capacitors C1 and C2. Therefore, some time is needed between writing and reading operations (16 ms) for recovery, plus the mechanical limitations of the tape handler.

The signal "READ" is connected to pin J and clamps the output at -20v, except when the selected tape is being moved under computer control, and will inhibit the read signal appearing at pin "T" of the read amplifier.

3.3.0 MANUAL CONTROLS (See Figures 3-6 and 3-7)

If the WRITE CONTROL switch (serial 241 and up) is in the "OFF" position, the "WRITE" and "WRITE 6" signals are held at +15 volts regardless of the stop relay's position. This inhibits writing at all times for protection of library tapes, etc.

On serial 1 thru 240, placing the WRITE SUPPRESS switch in the ON position, will cause the "WRITE" and "WRITE 6" signals to be held at +15 volts regardless of the stop relay's position.

On all serial machines, the MODE switch marked A S F S R is for manual control of tape motion (Refer to Figures 1-2.1). For G-15 control, the MODE switch must be in the "A" (automatic) position. To manually run the tape forward or reverse, the switch is turned to F or R respectively.

On serial 241 and up, any position (other than "A") of the MODE switch will automatically suppress reading, i.e. "READ" is held at -20 volts so that manual movement of tape does not give an output to the G-15.

Unlike serial 241 and up, serial 1 thru 240 has a separate switch for READ SUPPRESS. When the READ SUPPRESS switch in ON, "READ" is held at -20 volts thus blocking any output to the G-15.

On all serial machines, the UNIT SELECTOR switch selects the characteristic necessary for a G-15 command to affect the MTA-2 unit.

The HI-LO switch controls the speed of manual tape movement only. HI is 45 i.p.s., and LO is 7 1/2 i.p.s.

THE DATA light is mounted on an inside panel below the lower tape reel. It will glow whenever data is passing under the read/write heads. The DATA light monitors test point R of level five only.

3.3.1 G-15 INPUT-OUTPUT CONTROL

A complete description of the G-15 processes associated with MTA-2 operations can be found in the G-15 Technical Manual.

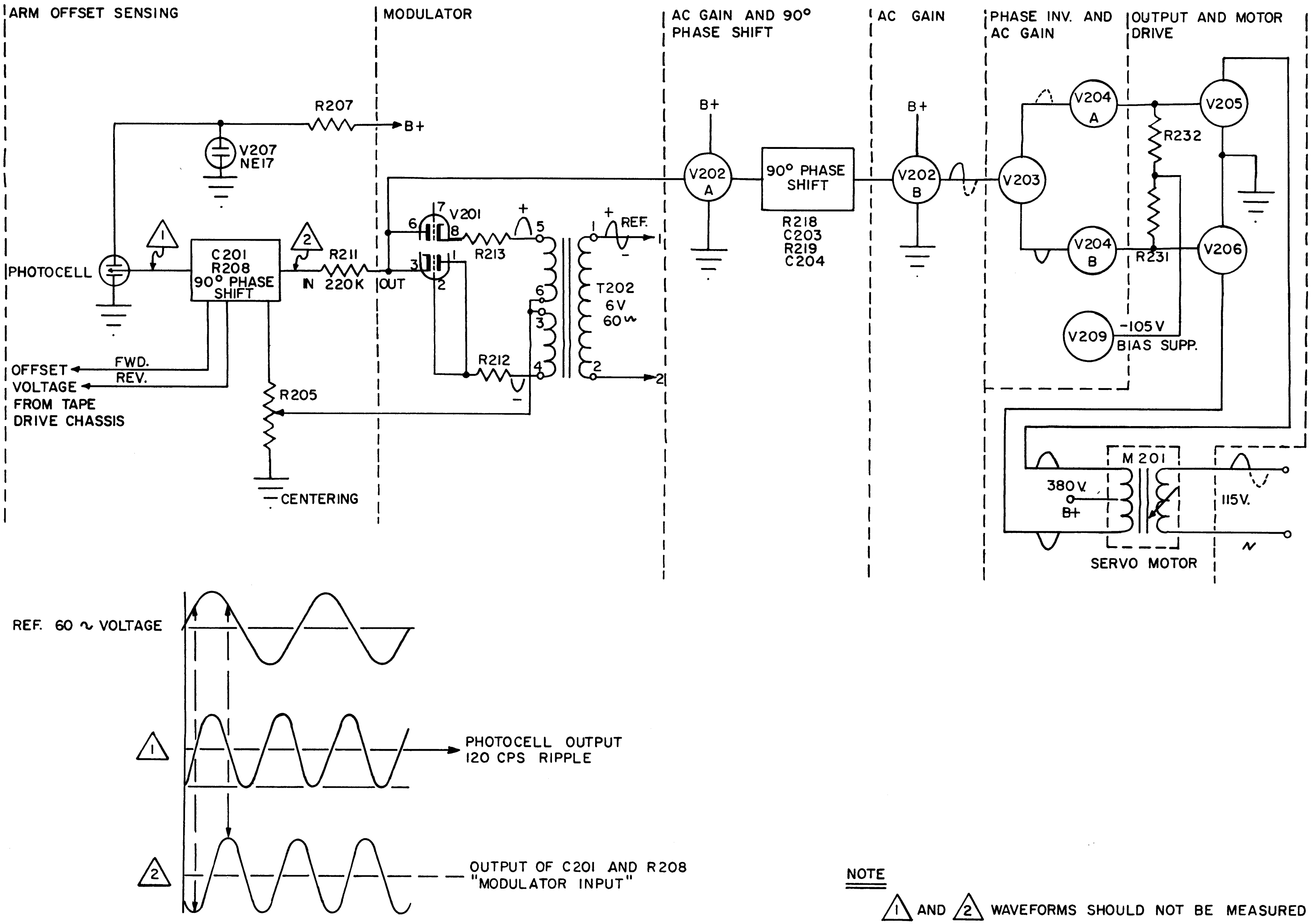


Figure 3-2 Servo Amplifier Functional Diagram

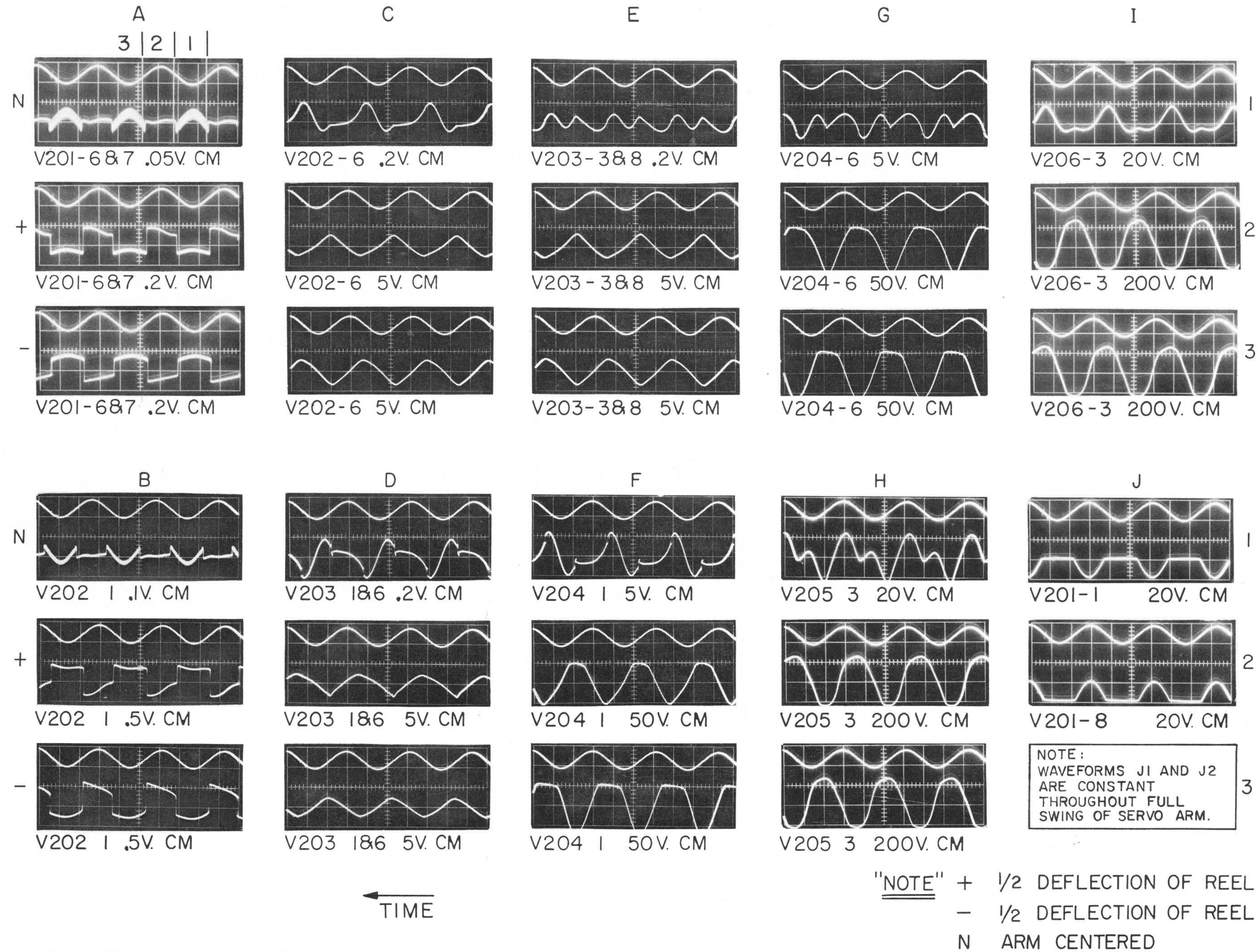


Figure 3-3 Servo Amplifier Waveforms

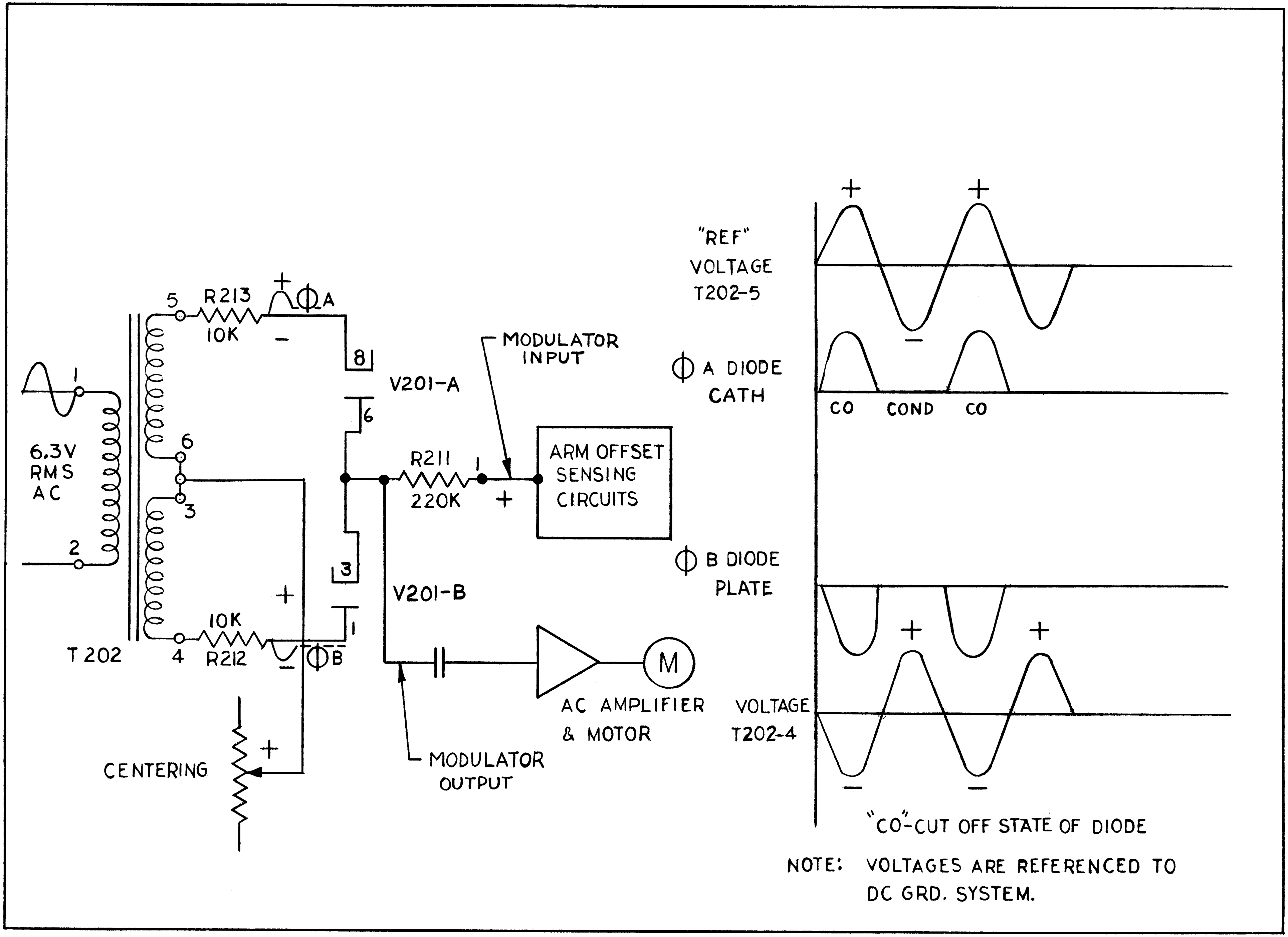
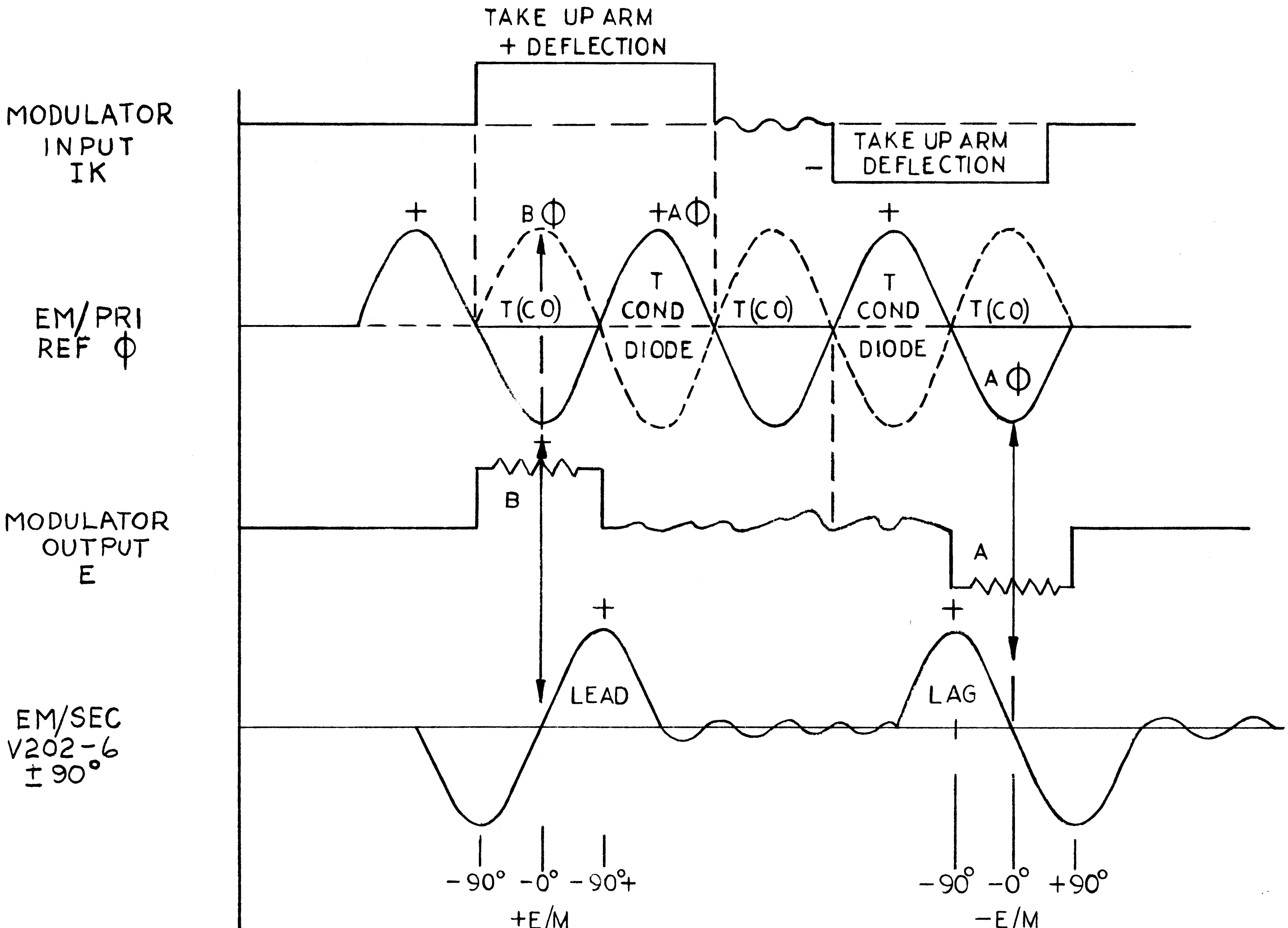


Figure 3-4 Modulator Functional Diagram



PERIODIC FUNCTIONS OF E/M DEVELOPED BY MODULATION OF ± INCREMENTS OF (IK) RESULTING IN (E) MODULATOR OUTPUT AND ± 90° (LEAD LAG VOLTAGE) (E/M) MOTOR OR V202 DEPENDENT ON REEL CHASSIS CONSIDERATION (UPPER OR LOWER).

Figure 3-5 Phase Relation Flow Chart

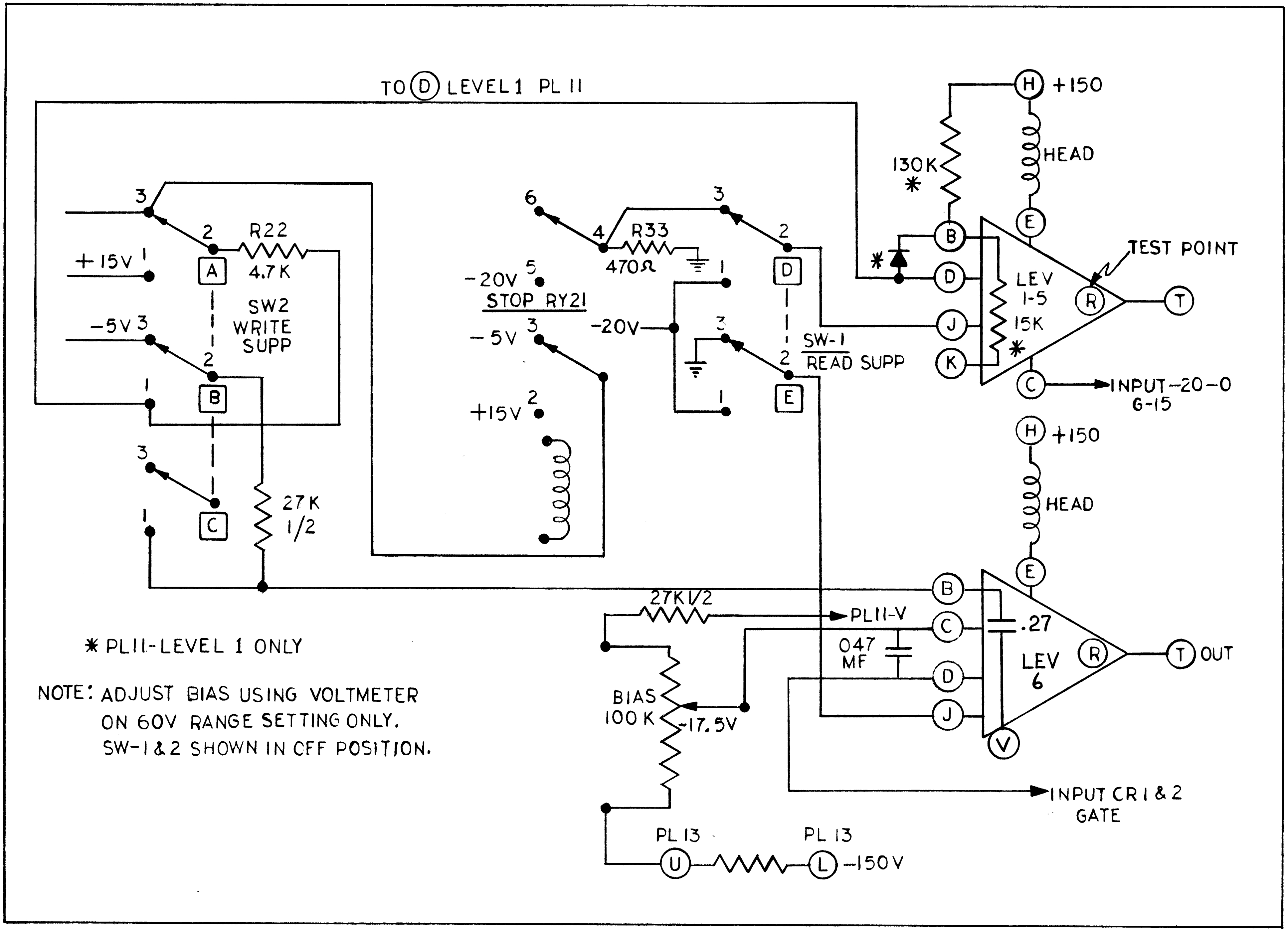
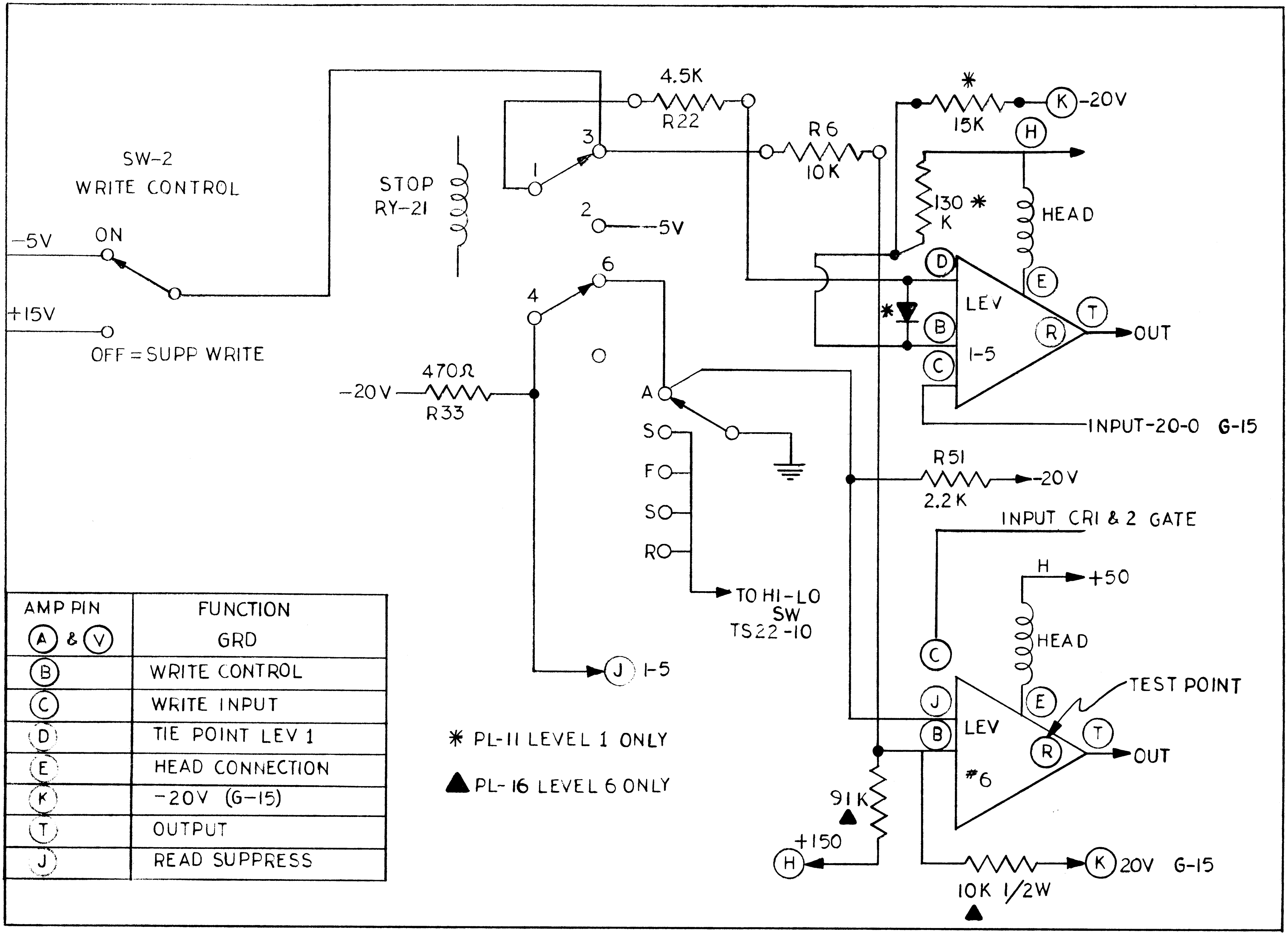


Figure 3-6 Amplifier Control Serial No. 1 thru 240



AMP PIN	FUNCTION
(A) & (V)	GRD
(B)	WRITE CONTROL
(C)	WRITE INPUT
(D)	TIE POINT LEV 1
(E)	HEAD CONNECTION
(K)	-20V (G-15)
(T)	OUTPUT
(J)	READ SUPPRESS

* PL-11 LEVEL 1 ONLY

▲ PL-16 LEVEL 6 ONLY

Figure 3-7 Amplifier Control Serial No. 241 & Up

SECTION IV

TESTS AND TROUBLE SHOOTING PRACTICES

4.0 This section describes the practices and methods which may be used in approaching problems concerning the MTA-2 magnetic tape reader. The approach taken to a particular difficulty will depend entirely upon that difficulty. No specific test can in all cases be defined as referring to a particular problem. A complete diagnostic routine called Madder, available from Applications Department and containing 14 separate tests will help in evaluating the problem. Reference should be made to the Madder routines whenever possible for correlation to electrical tests and failure of these diagnostic routines.

4.1 SERVOMECHANISM

It will be found that the performance of the servomechanism take-up system will cause very few problems involving dynamic performance of the tape machine when using the MADDER diagnostic routine. Tests were conducted running these Madder routines. It was found that even with a 50 percent loss of servo torque developed at the motor there were no failures in the dynamic tests which simulated actual tape operation. The major problems encountered in the servo take-up system will involve almost complete loss of take-up ability or a low frequency noise or jitter appearing with the tape unit in a quiescent position. Most of the above problems may be quite easily diagnosed and corrected for by using or referring to the Potter Manual for the 902 tape handler. The following items will be of additional help and may be used in trouble shooting the above areas.

4.1.1 Problems involving inadequate torque on take-up reels may be further evaluated by performing servo motor phase tests described in Figure 4-1. Assuming that the normal 400 volt a. c. voltage is available to the motor the phase test will determine whether the servo amplifier is producing the correct leading or lagging voltage for the normal motor torque requirements. This test should be used before replacing motor to improve servo take-up torque conditions.

4.1.2 The low frequency static noise or jitter which is frequently evident on servo reels is aggravated mainly by poor mounting rigidity of exciter lamps and photo cell mountings. Other conditions which may produce jitter are heater cathode leakage of vacuum tube circuitry, and intermittent conditions in the modulator transformer.

4.1.3 Reference may also be made to waveforms presented in Section 3 which may be used to further evaluate problems concerning servo and take-up system performance. CAUTION: It must also be kept in mind that the neon regulator NE-17 used in the regulation of photo cell voltage may be inserted into its socket in a reverse direction which would produce a 75-volt voltage across photo cell rather than a 60-volt level which is the normal required level for adequate servo response.

4.1.4 It might be well to mention that many servo motor problems, which are electrical in nature, may be caused by excessively high voltage across the motor when the tape is not in motion. During this condition (NULL) there should be approximately 100 volts rms across the servo motor. If the voltage during null becomes too high, large heat losses will be developed in the secondary and will destroy the servo. The servo motor is designed for 150 MA maximum d. c. current.

4.1.5 The normal torque developed at the tape reel, when deflected to its maximum magnitude by the tension arm, is approximately 1.5 to 2 pounds when measured at a 4 inch distance from the center of the reel.

4.1.6 The following mechanical conditions may also contribute to tape reel static stability problems.

(1) Loose or worn tension arm drive belts.

(2) Tension arm bearings that are binding.

(3) Servo motor bearing end play - This may be detected by getting the reel into oscillation while tape is stopped, and then with a pointed scribe (soldering aid) apply light pressure to motor shaft centering hole. If oscillation of reel stops, excessive motor end play is evident.

(4) Loose motor to belt coupling hardware.

4.2 TAPE DRIVE SYSTEM

The tape drive system consists essentially of the Potter tape drive chassis and the power supply chassis. The components on the power supply chassis which would affect tape drive conditions are relays RY20 and RY21. The major problems encountered when running the MADDER, or other routines, will be caused by incorrect tape motion as a result of poor tape drive performance. An exception to this would be in the case of very marginal read amplifier characteristics which are easily detected by simple read and write tests executed by the MADDER routine test No. 7. This test has been coded by programming such that it does not require extremely good tape drive performance.

4.2.1 The predominant problems which would result in very poor or inadequate tape motion will be discussed as follows and appropriate tests outlined.

4.2.2 Capstan Pinch Roller Settings - These adjustments will provide for adjusting the pinch roller solenoids in such a manner that a stop time of the tape itself would be completed in approximately 6 ms. Use the MADDER instructions for producing either forward or reverse tape motion under G-15 control, at intervals of 8 drum cycles. Mount a special 10 kc test tape on the tape handler. This tape, provided by Customer Engineering, has three channels recorded on it as shown below.

10 KC Level 5 for Capstan Adjustments

250 CPS Level 1 & 6 For Head Alignment

4.2.3 Remove the read amplifier from level 6 and connect an oscilloscope and jumper lead as shown in Figure 4-2, Pinch Roller Profile Test. With the tape unit in the Automatic mode, type in "Enable SC2F" computer to Go. This will produce a forward motion of the tape at 8 drum cycle intervals. With the scope triggering on the positive edge of the Stop signal from the G-15, a pattern representing the actual physical stopping time of the tape would be obtained. It will be noted that the speed of the transport has been made a constant 45 inches per second by the jumper added according to Figure 4-2.

The stopping time of this profile pattern will first be adjusted without damping pads contacting the tape.

This undamped profile should stop in approximately 8 ms. Damping pad contact with tape should be such that it will decrease to 6 ms, this difference being taken up equally by upper and lower damping pads.

4.2.4 The solenoid adjustments described above are made by loosening one of the mounting screws for the solenoid being adjusted and moving the pinch roller either toward or away from the capstan roller.

After adjusting the correct stop profile for any solenoid, the tape slippage should be checked by placing a finger on the tape guides adjacent to the read head. Light finger pressure should result in no indication of tape slippage as indicated by tension arm deflection or visual slippage conditions.

4.2.5 It should be kept in mind that any of the above tests will be affected by broken or damaged solenoid return springs or mechanical binding of pinch roller striker plate support bearings. It is recommended that if at all possible, a person who has been instructed by factory personnel be on hand for the first attempt at these adjustments.

There is no start time adjustments necessary since the major portion of the inertial loading problems have been accounted for in the stop adjustments. The start time will actually be approximately 3 ms if measured.

4.2.6 Typeouts indicated by the MADDER routine will, for a large part, be caused by relay drop out time considerations and read amplifier characteristics.

4.2.7 Head Alignment - Head alignment may be performed as outlined by Customer Engineering on existing instruction, or those described in Section V of this manual.

4.2.8 Relay Timing - The drop out time of relay 20 will be found most critical in the tape motion typeouts of MADDER routines. Of particular note would be test 6.

Relay 20 should be adjusted such that only about 15 thousandths of an inch deflection of the normally open contact can be observed when manually operating the relay. Relay 21, the Stop relay, will as a general rule give very little trouble, except due to mechanical breakage or coil malfunction, which directly affects the tape drive system. (Coil malfunction being a leakage to ground path which would affect the thyratron operation).

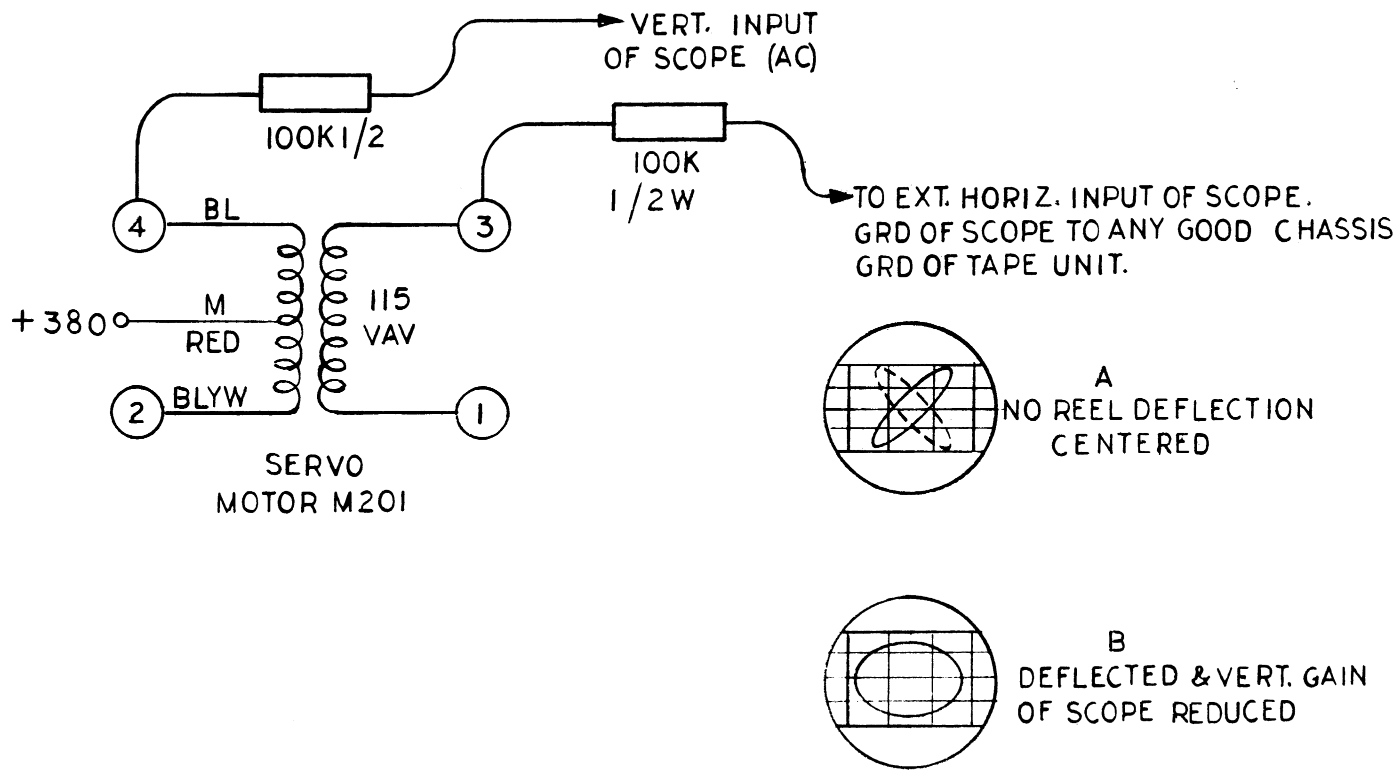
4.2.9 Read Amplifier - Read amplifier circuitry problems may be generally placed in two categories. The first of which is a failure to read or write data from the G-15 correctly. The general performance of this read/write characteristic may be observed by oscilloscope observations of test point R and read amplifier output pin T of read amplifier package. The other problem which will be found with read amplifier circuitry will be that of a sensitivity to transients which are normally generated in the relay thyratron and pinch roller solenoid operations. These transients should not appear in the output of a normal functioning read/write amplifier. Their appearance in any particular amplifier is usually due to regeneration or microphonics caused by components of the read amplifier. If microphonics are suspected, the following technique may be used to detect them.

4.3.1 Use the MADDER routine tape motion provided by "Enable SC2F" for forward tape motion at 8 drum cycle intervals and observe

4.3.1 Use the MADDER routine tape motion provided by "Enable SC2F" for forward tape motion at 8 drum cycle intervals and observe all of the test point R outputs on an oscilloscope. The transient sensitivity of individual amplifiers could then be seen. This test should be performed with an erased or clean tape in the forward direction of the tape reels.

4.4.0 <u>DRIVE CHASSIS PERFORMANCE</u>

Failure of MADDER tests involving rapid thyratron transfer may be further evaluated by observing wave form shown in Figure 4-3. Static measurements are also shown. Failure of R-L-C-components of drive chassis will result in extreme variations in this time constant waveform.



1- CONNECT SCOPE AS SHOWN ABOVE WITH ALL POWER TO MTA-2 OFF AND G-15 CABLE REMOVED.

2- TURN TAPE UNIT ON WITH A TAPE MOUNTED ON REELS.

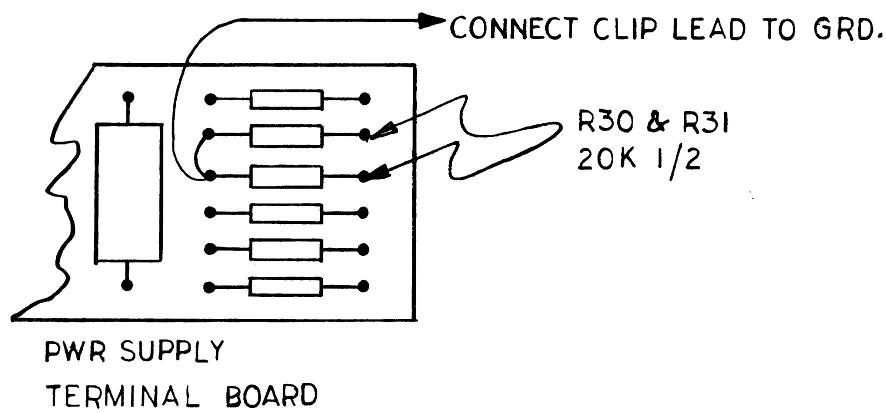
3- ADJUST HORIZ. (EXT.) & VERT. GAINS OF SCOPE TO PRODUCE A PATTERN SIMILAR TO A.

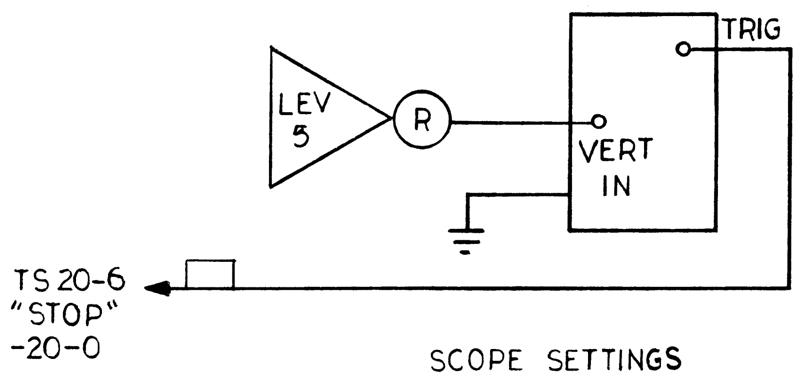
4- DEFLECT TAPE REEL OF MOTOR UNDER TEST 1/4 OF FULL DEFLECTION.

5- ADJUST VERT. GAIN TO PRODUCE A PATTERN SIMILAR TO B.

6- A NEAR CIRCULAR PATTERN WILL INDICATE $\pm 90°$ PHASE RELATION REQUIRED BY SERVO MOTOR.

Figure 4-1 Servo Motor Phase Test





SCOPE SETTINGS

50 V/CM AC

1 MS/CM

EXT TRIG +

ANY VERTICICAL POSITIONING OR AMPLITUDE DESIRED FOR BEST OBSERVATION OF STOPPING TIME.

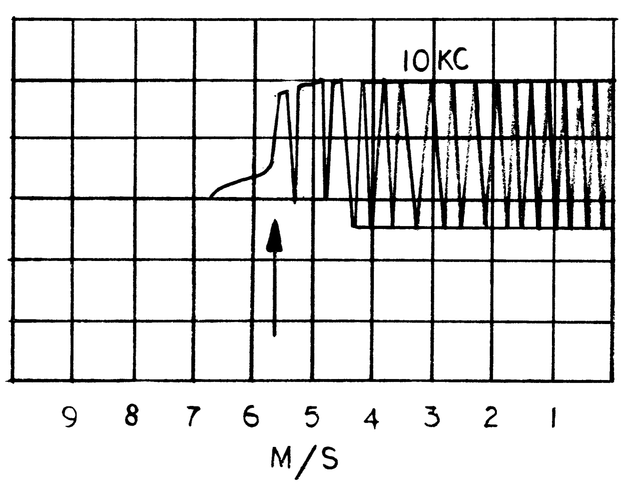
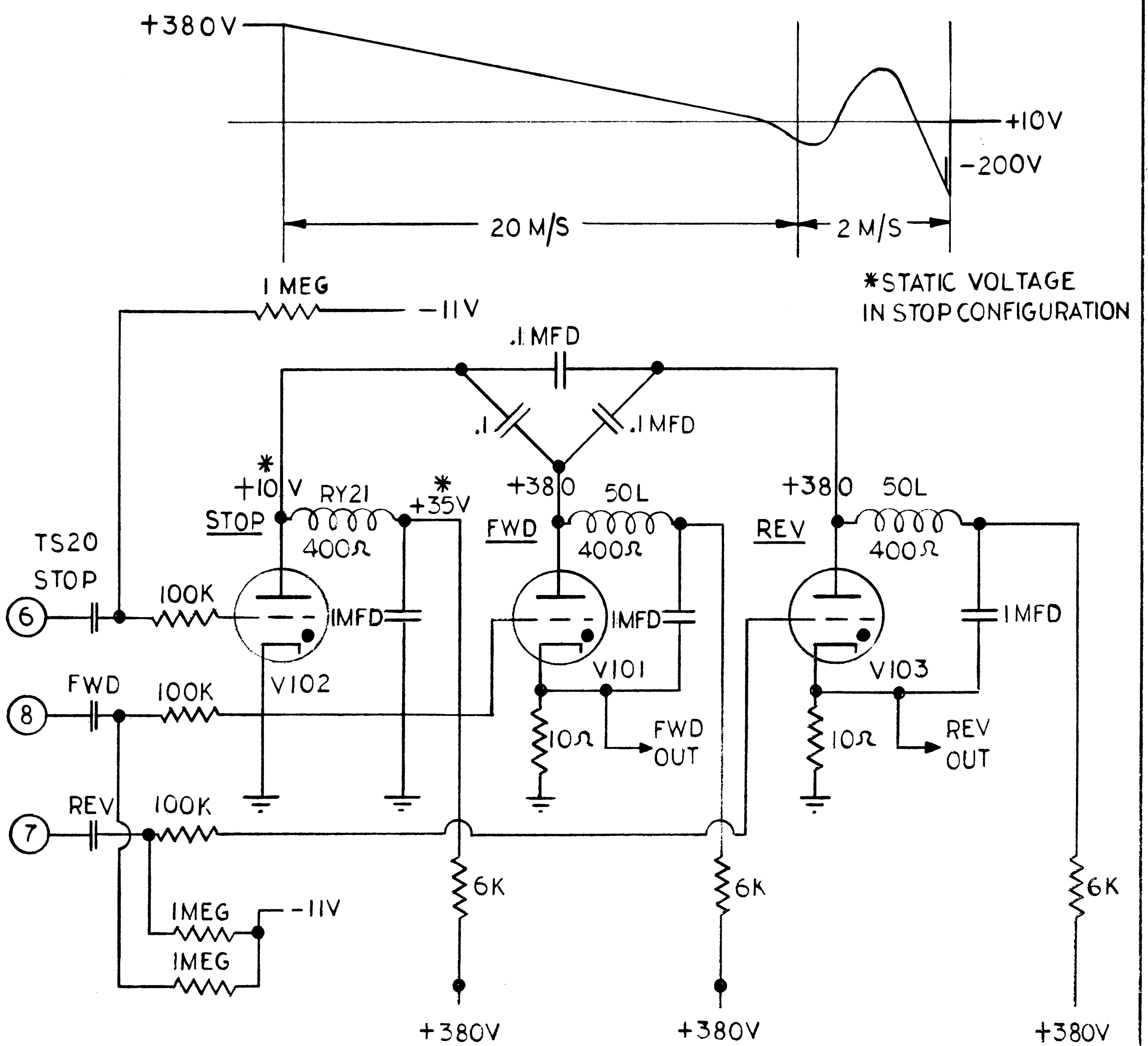


Figure 4-2 Pinch Roller Profile Test



WAVE FORM TAKEN OF STOP THYRATRON PLATE WITH SCOPE TRIGGERING ON TS20-8 FWD-TAPE MOTION PROVIDED BY (S) C2F USING MADDER ROUTINES. THE WAVE FORM REPRESENTS THE EXTINGUISHING TIME REQUIRED OF ANY OF THE 3 THYRATRONS WHICH MAY BE OBSERVED BY CHANGING THE SCOPE CONNECTIONS.

Figure 4-3 Thyratron Wave Form

SECTION V

MAINTENANCE AND ADJUSTMENTS

5.0 MAINTENANCE AND ADJUSTMENTS

5.1 SERVOMECHANISM

5.1.1 REEL DRIVE BELTS

Belt Adjustment

The tape reels are driven by means of V belts. These belts are located just behind the reel panels. Belt tightness may be adjusted by loosening mounting screws of reel motor mount and sliding motor and mount. For lowest belt wear, the loosest belt adjustment which does not allow slippage when the tape is instantaneously reversed at search speed should be used. Too loose a belt will cause the servo to oscillate.

Belt Replacement

Loosen belt adjustment and remove belt from large pulley first by rotating reel shaft. Then slip belt off motor pulley. Install new belt by slipping over motor pulley first then rolling onto reel shaft pulley. Small scales of belt material may flake off the new belt during the first few hours of operation.

5.1.2 NEON VOLTAGE REGULATORS

The DC supply to the photocell is regulated by a type NE17 neon lamp. The lamp (V207, V307) should be inserted in its socket such that the center glows, not the ring. Remove bulb and rotate 180° and reinstall if the ring glows. The photocell supply voltage can be measured between points 1 and 3 of TS201/TS301 and should be approximately 60v (pin 1 is position). Replace the lamp if the voltage is not correct.

5.1.3 TENSION ARM ADJUSTMENTS

The tension arm carries three rollers which must be parallel to the three fixed rollers on the panel. The tension arm is held by one set screw and may be twisted so that the tape runs evenly around the rollers. The screwdriver adjustments marked ADJ on the front panel are only for fine centering adjustments of the arm. For larger adjustments the photocell should be rotated. With power on and tape stationary, manually rotate the reel. When released, it should return the arm to the vertical position, midway between the extreme limits of travel.

The take-up arm spring tension should be 6-8 ounces as measured from the outermost roller. If the spring tension is less than 6 ounces there will be slack tape on the take-up arm during high speed operation. The spring tension may be adjusted as follows:

(1) Loosen and remove the photocell

(2) Loosen set screw on end of shaft and remove take-up arm by inserting allen wrench in its place to prevent unwinding of tension spring.

(3) Rotate the shaft 360° and reinsert the arm by holding shaft with pliers to prevent spring from unwinding.

(4) Tighten allen screw and recheck tension.

(5) The shaft cannot be rotated in 180° increments because there is only one hole in the shaft for the light source to illuminate the photo cell. There will be a tension increase of 2 ounces for each full turn of shaft.

5.1.4 PHOTOCELLS

Photocell Replacement

The photocells are located in the tension arm shafts. They may be removed by loosening the recessed-head set screw in the cap on the rear of the shaft. When replacing a photocell, care must be taken to see that the coated side of the bulb faces the lamp and that the black lead on the socket is toward the right side of the panel as viewed from the rear.

Photocell Adjustment

Hold the tension arm vertical and, with the power on, rotate the photocell so that the output voltage is half of the supply voltage. These voltages can be measured at TS201 (and TS301). Pin 3 is ground. Pin 1 is the supply voltage (approximately 60v), and pin 2 is the photocell output (approximately 30v).

5.2.0 SFRVOAMPLIFIER

5.2.1 SERVOAMPLIFIER GAIN CHFCK

With the machine ready for operation, and the function switch at Stop, manually rotate the reel away from balance and observe motor voltages. The AC voltage across the signal winding (terminals 2 and 4) of the servo motor should be less than 120v at balance and at least 370v at full deflection. If measured voltages differ substantially from this, a tube check should be made. If tube replacement does not restore gain, refer to troubleshooting information in the Potter Model 902 Instruction Manual and Section IV of this manual.

CAUTION

The 380v DC supply plus the 370v peak AC signal gives a peak voltage of 750v.

5.2.2 SERVO-MOTOR DC CURRENT

WARNING

The motors are rated for 150ma maximum. If over 100ma at balance position, check photocell alignment. The DC current through the servo motor can be measured by inserting a milliammeter in series with terminal M on the motor.

If this does not reduce the current enough, parallel the bias resistors (R232 and R234) with 100 K resistors. Check servo response for instantaneous reversal of tape at high speed after adding the resistors. The tension arms should never reach their travel limits.

5.3.0 TAPE DRIVE MECHANISM (See Figures 1-2 and 1-3)

5.3.1 PINCH-ROLLER ADJUSTMENT

The pinch-roller assemblies are attached to the panel by means of two screws. Brackets are slotted to permit adjustment of pressure of the pinch-roller against the capstan. This adjustment should be made as outlined in Section IV, Paragraph 4.2.2 and 4.2.3 of this manual. This adjustment should only be required after replacing worn or defective solenoids, pinch rollers or capstan rollers. The normal increments of wear or change of transport performance (which may be detected by running the MADDER routines) may in most cases be corrected by using the following procedures:

(a) Run Test 7 of MADDER routines several times to be certain that read/write circuitry is operating correctly. Observe test points "R" & "T" of all levels with oscilloscope for normal patterns as well as transient sensitivity.

(b) Run Test V of MADDER routines and if a typout occurs (4XXV) immediately after the reverse search portion of test (before read), the stopping time of the reverse solenoid must be decreased or the pressure of the damping pads must be increased. Very slight increments of increasing pad pressures will generally result in successful runs of Test V

(c) Run Test 6 of MADDER routines. If no error typouts occur the reverse tape motion stop timing will be correct. If a 3.01.6 typout occurs decrease damping pad pressures until Test 6 passes. Recheck Test 11 (V) and repeat procedures (b) & (c) until Tests 11 and 6 are passing. "Note" noisy nylon rollers on tape guides may cause intermittent failure of Test 6.

(d) Run Test w of MADDER routines. If typouts occur proceed as follows: Mark the lower pinch roller assembly such that the amount of adjustment toward the capstan may be observed. Adjust lower capstan in approximately fifteen thousandths of an inch increments until test W will run correctly. The forward tape motion stop timing will then be correct.

5.3.2 CAPSTAN PRESSURE ADJUSTMENT

The lower (Forward) capstan is friction-driven by the upper (Reverse) capstan. Position of the upper capstan is adjustable to assure proper contact with drive motor pulley and lower capstan. The adjustment is made while in Standby by loosening locking screws and applying finger pressure. Lightest pressure at which capstans will run tape without slippage should be used. Readjustment of upper pinch-roller may be necessary after this adjustment.

5.4 HEAD ALIGNMENT (See Figure 1-2. See also Policy & Procedure No. 226)

5.4.1 TEST TAPE

A standard test tape should be used for head alignment. This tape is available from the regional office. It consists of a high quality tape on which data is written on an MTA-2 which is defined as the standard. This assures that a tape recorded on one MTA-2 can be read on any other MTA-2.

5.4.2 LATERAL ALIGNMENT

Connect an oscilloscope to pin 6 V2 on the channel one Read/Write amplifier. Trigger internally or on pin R of the package. With the G-15 reading the tape, use light pressure with fingers to slide the tape which is passing over the heads toward or away from panel while watching signal amplitude on the oscilloscope. Level one is utilized to prevent errors due to azimuth angle. If amplitude decreases in both directions, alignment is correct. If adjustment is necessary, remove head mount from panel and adjust the two set screws (facing panel) to move head in the appropriate direction. Replace head mount and repeat above procedure. Also, check the other data channels.

5.4.3 AZIMUTH ALIGNMENT

Trigger oscilloscope on Pin R of PL16 and observe the outputs of channels six and one simultaneously. If a dual trace oscilloscope is not available, connect a 100k ohm resistor to channel 6 and a 100k ohm resistor to channel 1. Connect the oscilloscope probe to the junction of the two resistors. Adjust head azimuth (two top screws on head mount) so that channels one and six are exactly in phase with each other.

5.4.4 LATERAL ALIGNMENT WITHOUT STANDARD TEST TAPE

Using a good quality tape, record several blocks of all z's. Interchange the top and bottom reels, and make the lateral adjustment as in 5.4.2, except that it is only necessary to move the head approximately half of the distance indicated. Repeat as necessary, recording new data each time.

5.4.5 AZIMUTH ALIGNMENT WITHOUT STANDARD TEST TAPE

Install the tape with the shiny side toward the head, and record several blocks of z's. Reinstall the tape in the normal fashion and adjust as in 5.4.3, except that levels three and six must be used. Again, it is only necessary to move the head approximately half of the indicated amount. Repeat the entire procedure until proper alignment is achieved.

5.5.0 CLEANING AND LUBRICATION

The heads and other surfaces over which the tape passes should be cleaned with alcohol at least once every eight hours of operation. Do not use any abrasive material or other type of solvent except special products for this purpose, as damage to the heads and rubber surfaces may result.

Lubricate the nylon rollers with an extremely small amount of general purpose "Lubriplate". See the Potter manual for lubrication procedure for the motors.

The tape-handling mechanism should be dusted carefully at least once a week.

The blower filter should be inspected regularly and replaced when dirty. A clogged filter can cause overheating, resulting in malfunction and possible damage to the servo motors.

5.6.0 POWER SUPPLY CHASSIS (See Figure 1-5)

Time Delay Relay (K201)

Failure of the time delay relay will result in the loss of all power supply voltages. Before replacing the time delay relay the voltage should be checked at pin 1 and 6 of K201 (115 VAC).

In the event of power supply failure the following should also be checked.

(a) F21 1/2 amp SB fuse

(b) V21 rectifier tube

5.6.1 VOLTAGE ADJUSTMENT

If it becomes necessary to adjust the power supply voltages, first measure between the +150 and the -150 supplies. If the difference is not 300v, the trouble lies ahead of the voltage divider network. Make all divider adjustments with the power off. The zero volt point must be correct before other adjustments can be accurately made. In later model units, a potentiometer is provided for fine adjustment of the -5v supply.

5.7.0 RELAY TIMING

Pull-in time of the "Fast" relay is not critical. However, drop-out time must be less than 50ms so that the capstan motor has time to slow down between a search and a read or write operation. A total of 450ms is allowed for the motor to drop from high to low speed. Pull-in time for the "stop" relay is critical, since the "read" and "write" signals must be stable at Ov and -5v, respectively, by the time data is reached.

5.8 AMPLIFIER CHASSIS (See Figure 1-4)

5.8.1 READ/WRITE PACKAGE

The test point of each channel (pin R) should be checked with an oscilloscope at least once a week. With the tape running at low speed the signal should go down to at least -95 volts and be at least 150 micro-seconds wide. With the tape stopped and the oscilloscope set for a vertical sensitivity of approximately 1 volt per centimeter, the test points should be checked for noise. If a channel is found to have a noise level of over 2 volts pp, the 12AY7 should be replaced, If this fails to reduce the noise, the two 5965's should be replaced, one at a time. If this fails, the package should be replaced. Noise on all channels would indicate tape wear or poor de-gaussing.

The test described in Section IV, Paragraph 4.3.1, may also be used in locating noise problems which are caused by transient sensitivity of amplifiers.

5.8.2 BIAS SETTING POTENTIOMETER

On Machine Serial No. 1 through 240, the bias potentiometer located below the terminal board of the amplifier chassis should be adjusted to -17.5 volts at PL16-C and measured with respect to ground.

5.8.3 DATA LIGHT

The Data light is resistance coupled to level 5 test point "R" and will reliably indicate presence of level 5 data. No adjustments are provided for varying intensity of indicator.

5.9.0 TEST ROUTINES AND TROUBLE SHOOTING

A comprehensive diagnostic routine referred to as Applications project 170 has been included in Section 7.0. This routine will aid in locating marginal problems. It should be pointed out that the program is written around tight timing to aid in locating of marginal problems.

SECTION VI

PROGRAMMING AND OPFRATION

6.0 PROGRAMMING

6.1 THE READING AND WRITING PROCESSES

From a programming standpoint, the read and write processes for magnetic tape are essentially the same as the read and punch processes for paper tape. The read processes are identical, using the same G-15 hardware and entering data into memory in the same manner. The "magnetic tape write" process is similar to the paper tape punch process, the differences being that (1) "magnetic tape write" uses Short Line 23 for fast access buffer storage and (2) the format is fixed.

For details, see sections on read-in control and read-out control in the G-15 Operating Manual.

In all cases, the characteristic (C) of a command designates the magnetic tape unit on which the command is to operate. (Characteristic O is used for tape unit number four).

6.1.2 THE SET READY COMMAND DOES NOT ALWAYS IMMEDIATEFLY SET READY!

In all IN/OUT cases other than MAG SEARCH REVFRSE (04) and GATE TYPE IN (12), READY will not necessarily rise until the second TO following execution of the SET READY command due to the action of the OD flip-flop. Therefore in determining how soon an IN/OUT command can be executed after a SET READY command, the above-mentioned delay must be taken into account.

6.2 COMMANDS AVAILABLE FOR MTA-2 OPERATION

6.2.1 WRITE ON MAGNETIC TAPE w00 N C 01 31

The contents of Line 19 are written on magnetic tape. Condensed format (space, 29 digits, reload) is automatic, and no format is necessary in Line 02. When Line 19 is empty, a stop code is written instead of a reload code, and the computer returns to the READY state.

If this command follows a "Search Magnetic Tape" command for any unit, at least 16 drum cycles must elapse after the READY state is reached before the "Write" command is given.

If this command follows an earlier "Write on Magnetic Tape" command, at least one drum cycle must elapse after the READY state is reached before the "Write" command is given.

After the execution of the "Write on Magnetic Tape" command, at least four drum cycles must elapse after the READY state is reached before calling for ANY input operation.

6.2.2 READ MAGNETIC TAPE L_2 N C 13 31

Tape is run in the forward direction and is read into Line 19 until a STOP code appears on the tape. File codes on the tape have no effect.

If this command follows a "Search Magnetic Tape" command for any tape unit, at least 16 drum cycles must elapse after the computer reaches the READY state before the "READ" command is given.

If this command follows a "Write on Magnetic Tape" command or a "Write File Code" command, at least four drum cycles must elapse after the READY state is reached before the "Read" command is given.

No delay is necessary after the READY state is reached when following a "Read" command with any other input or output operation.

6.2.3 WRITE FILE CODE L_5 N C 30 31

A file code is written on the tape in a separate channel reserved for this purpose. The tape does not move and nothing in memory is affected.

This command should be preceded by a series of commands which move the tape slightly in order to provide leader ahead of the file code. The command sequence to be used will depend upon the amount of leader required.

If a single file code is to be written between blocks the "WRITE-SET READY" sequence should be used. It will provide approximately 1/2 inch of leader.

If successive file codes are to be written with no data blocks between them the "READ-SET READY" sequence must be used. It will provide approximately one inch of leader. If file codes are closer together than one inch, subsequent search operations involving those codes will be marginal.

"WRITE - SET READY" or NORMAL LEADER" SEQUENCE (1/2 inch)

EXAMPLE:

L	T	N	C	S	D	executed at
L	w00	70	C	01	31	Write (word 00 of drum cycle n)
70	w69	68	0	00	31	Set Ready (word 69 of drum cycle n+1)
68	73	N	C	30	31	Write file code (words 69-72 of drum cycle n+2)

Tape start signal is at word 00 of drum cycle n

Tape stop signal is at word 00 of drum cycle n+2

The above is only an example. The same results can be obtained provided the following rules are followed:

1. The SET READY command can be executed any time within drum cycle in n or n+1; no matter where it is executed within this period, the READY signal will rise at word 00 of drum cycle n+2 and will cause the tape to stop.

2. The WRITE FILE CODE command must not be executed prior to word 50 of drum cycle n+2, otherwise the tape might still be in motion at the time of execution, with the result that the file code will be improperly written and a subsequent search for it will be marginal.

It is convenient to execute the SET READY command late during drum cycle n+1 in order to sufficiently delay the WRITE FILE CODE command without requiring any additional commands for delay purposes.

"READ-SET READY" or SUCCESSIVE FILE CODE "LEADER"

SEQUENCE (1 inch)

EXAMPLE:

L	T	N	C	S	D	executed at
17	15	14	C	13	31	Read (word 18 of drum cycle n thru word 14 of drum cycle n+1)
14	w14	11	0	00	31	Set Ready (word 14 of drum cycle n+3)
11	10	60	0	00	00	Delay (word 10 of drum n+5)
60	65	N	C	30	31	Write File Code (words 61-64 of drum cycle n+5)

Tape start signal is at word 18 of drum cycle n

Tape stop signal is at word 00 of drum cycle n+5

The READY signal, which stops the tape, rises after the second TO following the execution of the SET READY command, hence in the above example the tape drive is energized for 4 drum cycles and 91 word times, or approximately 140 ms. This will provide approximately 1.05 inches of leader.

The following rules apply to writing routines to provide at least one inch of leader.

1. If execution of the READ command is started prior to word 30 of drum cycle n, SET READY can be executed any time during drum cycle n+3, and the WRITE FILE CODE command can be executed as early as word 50 of drum cycle n+5 (but no earlier!)... or

2. If execution of the READ command is started after word 30 of drum cycle n, SET READY can be executed any time during drum cycle n+4, and the WRITE FILE CODE command can be executed as early as word 50 of drum cycle n+6 (but no earlier!).

3. Additional leader can be obtained by delaying the SET READY

command additional drum cycles relative to the READ command. Leader will be increased by approximately .22 inches for each additional drum cycle. The WRITE FILE CODE command must never be executed prior to word 50 of the second drum cycle following that in which SET READY is executed in this sequence.

In both sequences above the OD flip-flop is set, hence Line 19 will be precessed by 4 words.

The WRITE FILE CODE command does not use the input-output hardware of the G-15.

After the execution of the WRITE FILE CODE command at least four drum cycles must elapse before calling for any other input or output operation.

6.2.4 SEARCH MAGNETIC TAPE FORWARD L_1 N C 05 31

The tape is run forward at high speed until a file code appears. The tape stops in front of the block following the file code. The information on the tape is not entered into memory, and Lines 19 and 23 are unaffected.

If this command follows a "Write on Magnetic Tape" command, at least four drum cycles must elapse after the READY state is reached before the "Search" command is given.

If this command follows a "Write File Code" command, at least four drum cycles must elapse after execution of the file code command before the "Search" command is given.

WARNING

The "Search Magnetic Tape" operations are not reliable when searching for a file code which is very near to the starting position. If the first file code is within the same leader, (ie within 1/2 inch of the starting position) the tape may stop on it or go on to the next file code. This condition should be avoided.

If a file code has just been written and the tape has not been moved, a "Search" command with $T=L_1$ will move the tape to the next file code since the file code detection gate is disqualified by the execute state (DS . S1) in the G-15.

6.2.5 SEARCH MAGNETIC TAPE REVERSE L_1 N C 04 31

This command is identical to "Search Magnetic Tape Forward" except that the tape is run in the reverse direction.

If the file code was written using the series of commands given under "Write File Code" the tape will stop in the blank area between blocks of information.

If the file code was written without leader, the tape will stop within the data block preceding the file code. This procedure is not recommended.

6.2.6 REVERSE READ FOR STOP CODE

This is a sequence of commands which will cause the tape to move in a reverse direction until a valid stop code is encountered. The tape will overshoot the stop code by a minimum of 1/4 inch since OC1 will be down and the [STOP] $_{OB}$ · Ⓢ combination cannot fire the STOP thyratron. READY will do so after the second "TO" following [STOP] $_{OB}$ · Ⓢ. This feature permits the sequence outlined in 6.2.7.

If it is known that the tape is positioned in leader, the following sequence should be used:

CASE 1:	L	L_2	L_2	C	04	31	Rev. Search
	L_2	L_4	N	0	12	31	Gate Type In

The above sequence will detect the adjacent stop code.

If it is known that the tape is positioned in data, or if the tape position is unknown, the following sequence must be used:

CASE 2:	L	L_1	L_1	C	04	31	Rev. Search
	L_1	L_3	N	0	12	31	Gate Type In

If the tape is positioned at the trailing edge of a data block, this sequence will miss the stop code it is adjacent to and read the next valid stop code. If it is in leader, it may or may not pick up the first stop code. In any case, it will always stop at a valid stop code.

One drum cycle delay is required after READY prior to execution of the next magnetic tape command in both cases above.

6.2.7 SPECIAL FORWARD READ FOR STOP CODE

A "Reverse Read for Stop Code" leaves the tape positioned in data. The following sequence must be used to move the tape forward before giving the regular "Read" command:

L	L_{70}	L_{70}	C	05	31	Fwd Search
L_{70}	L_{72}	N	0	12	31	Gate Type In

The tape stops in leader following the first valid stop code. This sequence may be used whenever the tape is positioned in data or the tape position is unknown. Any "Search" command may be given when the tape is positioned in data.

6.3 TAPE POSITIONS POSSIBLE

Figure 6-1 pictorially represents the various conditions normally encountered on magnetic tape. These are:

(1) leader between blocks without file codes.

(2) leader preceding a file code.

(3) file code without preceding leader.

(4) adjacent file codes.

The methods of reaching each location are also tabulated, i. e:

Points B, D, J, N are at the edge of the preceding data block and are reached via the Write, Read, and Special Forward Read commands only.

Points A, C, and I are in data and were reached by the Reverse Read sequence.

Point H is in data and was reached by the Reverse Search when no leader precedes the file code. This case should not be allowed to occur.

Points E and K are in leader and were reached by the Reverse Search when leader preceded the file code.

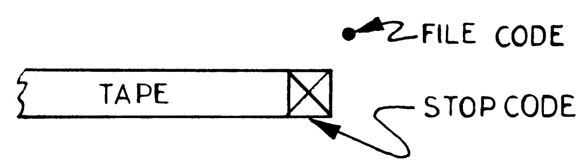
Points G, K and M are in leader and were reached by the Forward Search.

This covers all of the normal cases.

POINTS	REACHED BY
B, D, J, N	WRITE, READ
A, C, I	REVERSE READ FOR STOP CODE *
E, H, K	REVERSE SEARCH FOR FILE CODE
G, P, M	FORWARD SEARCH FOR FILE CODE
F	WRITE FILE CODE WITH NORMAL LEADER
L	WRITE FILE CODE WITH LONG LEADER
J	FILE CODE WRITTEN WITHOUT LEADER (NOT RECOMENDED)

* OVERSHOOTS BY MINIMUM OF .225 INCHES.

LEGEND



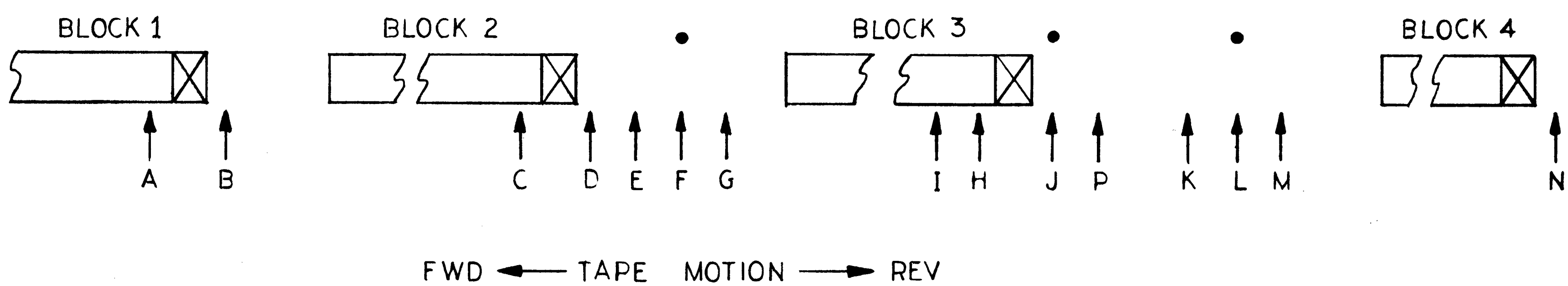


Figure 6-1 Pictorial Representation of Tape Conditions

6.4 MISCELLANEOUS PROGRAMMING

Cases arise when unusual uses are made of FILE CODES. Volumes would be required to explain every possible case. The following facts should be born in mind when using the FILE CODE system:

1) The tape unit must be stopped when a FILE CODE is written.
2) The FILE CODE detection circuit is insensitive during the time the FILE CODE SEARCH command is in the EXECUTE state. Hence, the T number may be used as a means of discrimination as follows:

   $T = L_1$ ignores file codes for the first drum cycle.

   $T = L_2$ detects file codes as soon as tape is in motion.
3) A FILE CODE SEARCH operation (FORWARD or REVERSE) will involve tape speeds that vary between 7 1/2 and 45 inches per second, hence the amount of tape passing the head in a given period of time during search operations will vary with durations of the searches and the durations of the intervals between searches. In round numbers, the tape can accelerate from 7-1/2 to 45 inches per second in 2 seconds will decelerate from 45 to 7 1/2 inches per second in 1/2 second. For example, six drum cycles worth of leader produced by a READ-SET READY sequence would pass the head in one drum cycle when searching at 45 inches per second. This suggests that one inch of tape between consecutive file codes is not enough to assure one drum cycle of time elapsing between the reading of a search command and the time at which the FILE CODE is detected. A "T" number of L_2 would be required in such a case if the capstan speed were to approach 45 inches per second during the search.

6.5 MANUAL OPERATION OF TAPE UNIT (See Figure 1-2)

6.5.1 TURNING UNIT ON AND OFF

To turn on tape unit, first set Run-Standby switch to Standby, and set Mode switch at S. Turn Power switch ON, and wait several minutes. Standby switch may now be turned to Run, and Mode switch turned to A or used to move tape manually as desired.

To turn unit off, set Run-standby switch at Standby and set Mode switch at S. Turn Power switch OFF.

6.5.2 TAPE THREADING PROCEDURE

Set Run-Standby switch at Standby and mode switch at S. Place a full reel of tape on upper hub, and an empty reel on lower hub. Be sure reels are seated properly and that knurled knobs are firmly tightened.

Thread tape as shown in figure 6-2.

6.5.3 DATA LIGHT*

When moving the tape manually, the data light will glow when data is passing the Read/Write head. Manual searching in this manner can be done even while other tape units are in use by the G-15.

The data light will also glow when tape is moved under G-15 control. During writing operations, the glow will be much brighter than at other times.

*Serial No. 241 and modified machines only.

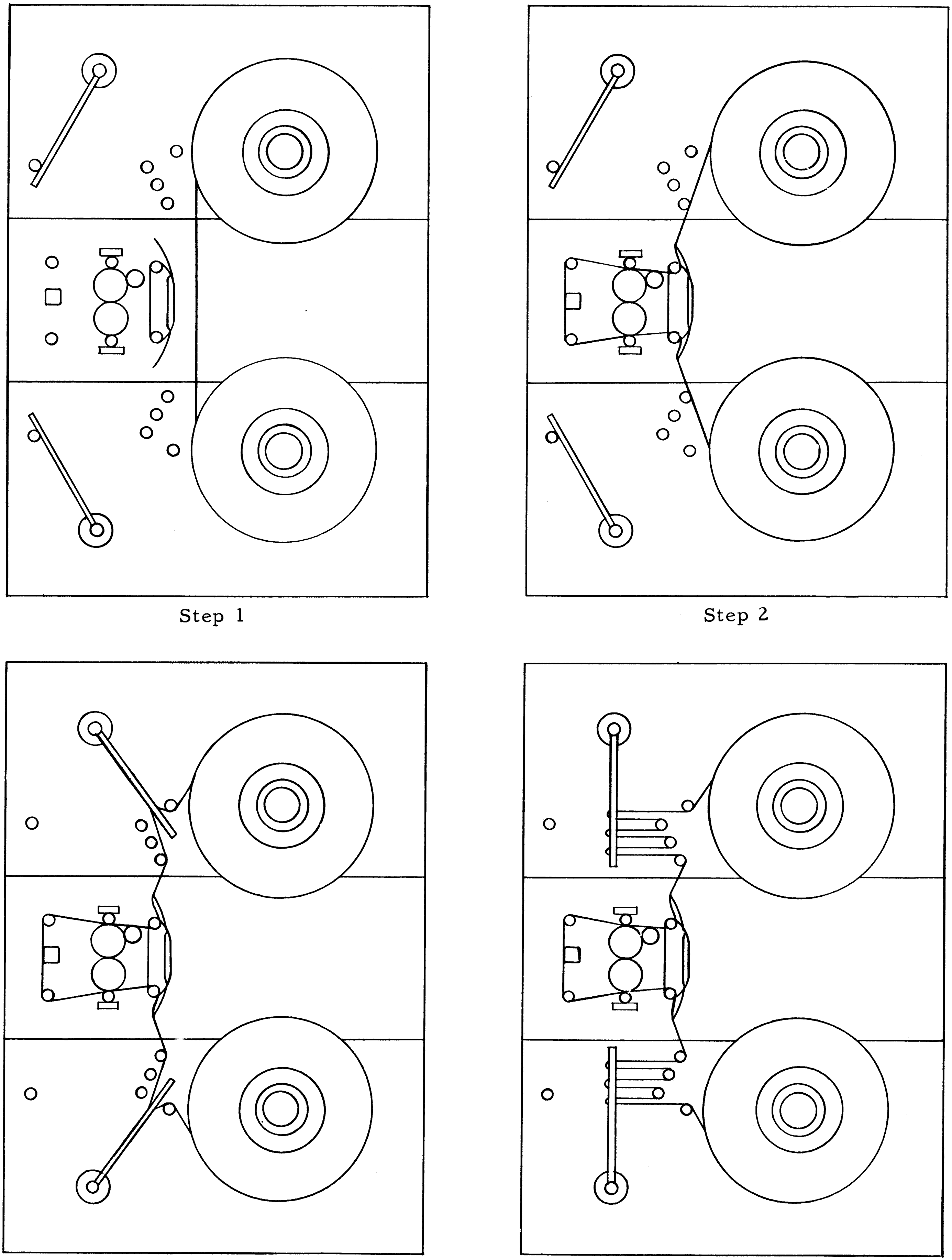


Figure 6-2 Tape Threading Procedure

6.5.4 MODE SWITCH (See also Section 3.3.0)

The Mode switch is used by the operator to move the tape manually in the forward (F) or reverse (R) direction.

The Mode switch must be in the automatic (A) position for G-15 control.

6.5.5 HI-LO SWITCH

The HI-LO switch determines the tape speed when moving the tape manually. HI is 45 i.p.s and LO is 7 1/2 i.p.s.

The HI-LO switch has no effect when in automatic operation.

6.5.6 UNIT SELECTOR SWITCH

The Unit Selector switch is located on the front of the MTA-2.* This switch selects the address of the particular tape unit.

When any magnetic tape operation command is given, only the tape unit with the Unit Selector switch set to the characteristic of the command will respond.

* Serial No. 241 and subsequent. On earlier models, the Unit Selector switch is located inside the glass door, lower right.

6.5.7 WRITE CONTROL SWITCH**

The Write Control switch is also located on the front of the MTA-2. This switch determines whether or not writing can take place on the particular unit.

If the Write Control switch is ON, the G-15 is allowed to write on that tape. If Write Control is OFF, the G-15 is not allowed to write. This can be used to protect library routines, programs, and data which must be saved. Write File Code is also suppressed.

If the Write Control is OFF and a Write command is given, the tape will be moved and Line 19 will be cleared, but the information on the tape will not be altered.

** Serial No. 241 & subsequent.

MOVE TAPE		COMMAND STRUCTURE		OPERATION
FROM	TO			
B F L	D J N	L	w 00 N C 01 31	Write on Magnetic Tape - The contents of Line 19 is written on tape.
B D, E, F, G J, K, L, M	D J N	L	L_2 N C 13 31	Read Magnetic Tape - Data is read from tape into Line 19.
–	–	L	L_5 N C 30 31	Write File Code - A file code is written in channel 6. The tape does not move.
A, B F, G	G P	L	L_1 N C 05 31	Search Forward - The tape is moved forward at high speed to next file code.
H, I, J N	E K	L	L_1 N C 04 31	Search Reverse - The tape is moved in reverse at high speed to next file code.
B D, E, F, G J, K, L, M	A C I	L L_2	L_2 L_2 C 04 31 L_4 N 0 12 31	Reverse Read for Stop (Case 1) - Reads in reverse to stop code. Must start in blank tape.
C, D E, F, G, H I, J K, L, M, N	A C I	L L_1	L_1 L_1 C 04 31 L_3 N 0 12 31	Reverse Read for Stop (Case 2) - Reads in reverse to stop code. Permits starting in data.
A C H, I	B D J	L L_{70}	L_{70} L_{70} C 04 31 L_{72} N C 13 31	Special Forward Read - To follow Reverse Read. Permits starting in data.

Figure 6-3 G-15 Commands for MTA-2

COMMAND TO BE GIVEN	MINIMUM WAIT TIME IN DRUM CYCLES WHEN FOLLOWING:						
	READ FWD REV	WRITE	WRITE FILE CODE	SEARCH (Fwd. or Rev.)	TYPE IN	ANY OTHER INPUT	ANY OTHER OUTPUT
READ (Fwd. or Rev.)	0 1 AFTER READY	4 AFTER READY	4	16* AFTER READY	3 AFTER READY	0 AFTER READY	1 AFTER READY
WRITE	—	1 AFTER READY	0	16* AFTER READY	3 AFTER READY	0 AFTER READY	1 AFTER READY
WRITE FILE CODE	—	50 WT AFTER READY	—	—	0	0 AFTER READY	0
SEARCH (Fwd. or Rev.)	0 1 AFTER READY	4 AFTER READY	4	1 AFTER READY	3 AFTER READY	0 AFTER READY	1 AFTER READY
SET READY	—	—	—	1	—	—	—
ANY OTHER INPUT	0 1 AFTER READY	4 AFTER READY	4	1 AFTER READY	3 AFTER READY	—	—

* This delay must follow a search operation on ANY tape unit in the system.

Figure 6-4 Waiting Times (Between Commands)

SECTION VII

TEST ROUTINES & SCHEMATICS

7.0 TEST ROUTINES & SCHEMATICS

7.1 INTRODUCTION

This test routine is designed primarily for use by those doing preventive maintenance and repair work on the MTA-2 accessory. MADDER provides a number of tests not available in A. S. P. 161, and also uses coding techniques designed to accentuate more marginal conditions in the MTA-2. The MADDER package consists of a control section and sixteen (16) separate tests. Provision is made for executing fourteen tests sequentially, starting from any test or for entering any selected test to isolate failures.

7.2 DESCRIPTION OF INDIVIDUAL TESTS

Test 1, 2 and 3 check the write file code and search for file code operations.

TEST 1 requires visual observation. It maximizes tension arm swing and will show up poorly adjusted servo-mechanisms. If the tension arms approach within 1/2" of the stops, the servo should be adjusted. The program also checks for extraneous file codes caused by level 5 - level 6 cross-talk or relay noise. An error type-out will also occur if excessive tape drift occurs, or if the "write file code - search for file code" combination does not work normally.

Special attention is directed to the severity of the strain imposed by this test and thus it is suggested that this test be used sparingly.

TEST 2 checks the reliability of the forward and reverse search operations. Twenty-five (25) file codes are written, searched for, and counted. If more or less than twenty-five (25) file codes are detected, an error type-out will occur.

TFST 3 only differs from TEST 2 in the respect that a short leader is used.

Test 4, 5, 6 and 7 check various aspects of the read - write combinations.

TFST 4 checks for detection of extraneous stop codes and reloads. A large block of data containing neither stop codes nor reloads is written and then read in both the forward and reverse directions. If extraneous stop codes or reloads are detected, or if real stop codes are missed, an error type-out will occur.

TFST 5 Checks for reliability of stop code detection. Twenty-five (25) stop codes are written, then read and counted. If more or less than 25 stop codes are detected, an error type-out will occur. If the stop code fails to cause a reload, an error type-out will occur.

TFST 6 checks for reliability of reload detection. A block of data containing 138 reloads is written, then read, and the reloads counted. If more or less then 138 are detected, an error type-out will occur.

TEST 7 <u>checks writing and reading of all levels.</u> A block is written for each of the first four levels containing data only on that level. A fifth block is written containing data on all levels. The blocks are then read and characteristic type-outs will occur in the event of dropped input or extraneous input. Special note should be made of the paragraphs preceding the table of type-outs which refer to this test.

Tests 8, 9, and u check the reverse search for stop code and special forward search for stop code operations as explained in Technical Applications Memorandum 59. A check of search for close file codes is also included in each test.

TEST 8 <u>checks the reverse search for stop code</u> sequence that should detect the first stop code. If this stop code is missed, an error type-out will occur.

TEST 9 <u>checks the reverse search for stop code</u> sequence that should miss the first stop code and <u>stop on the second</u>. If the first stop code is detected, an error type-out will occur.

TEST u <u>checks the forward search for stop code</u> following a reverse search for stop code. If the stop code is not detected, an error type-out will occur.

Test v and w check for problems associated with reads following searches: too slow capstan deceleration or solenoid drop-out.

TEST v <u>checks read following a reverse search.</u> If the block is read incorrectly, an error type-out will occur.

TEST w checks read following a forward search. If the block is read incorrectly, an error type-out will occur.

Tests x and y check for problems associated with inputs after write or write file code.

TEST x writes data, then gates input. If any extraneous signals are detected, an error type-out will occur.

TEST y writes a file code, then gates input. If any extraneous signals are detected, an error type-out will occur.

In addition to these fourteen tests are tests on FORWARD AND REVERSE MOTION for which type-out do not occur.

FORWARD MOTION With Compute switch off and Enable switch on, type Ⓢ c2f. Turn Enable switch off, Compute switch to Go. The unit will alternately search forward and set ready at eight (8) cycle intervals.

REVERSE MOTION Ⓢ c5f under the same conditions will search reverse and set ready at eight (8) cycle intervals.

The above two tests are used with a special recorded 10 KC tape for the purpose of adjusting the start and stop times of the transport pinch rollers.

7.3 OPERATING INSTRUCTIONS

Unlike the Magnetic Tape Test Routine (A.S.P. 161), MADDER does not use a file system. Tapes for this test should not contain data for later retrieval by PROMPT, MTSR, MTUR, or any other program.

Since MADDER causes the magnetic tape unit to operate under marginal conditions, it is advisable to use a good tape. If the unit performs satisfactorily, the production tape should also be checked to test its worthiness.

Before the routine is used, it is advisable to read the description of each test. It is unlikely that all tests will be needed in testing for specific failures. In particular, test one(1) should be used sparingly inasmuch as it imposes a severe strain on the mechanisms involved.

Because the majority of the tests involve extreme dynamics, it is suggested that the unit be given adequate time to warm up or that tests such as four (4), six (6), seven (7), eleven (v) or twelve (w) be attempted initially.

7.3.1 PROCEDURE:

1. Place the MADDER magazine on the photoreader. Set the "tape unit number" switch to one (1) on the unit to be tested.
2. Turn Compute switch off and Enable switch on. Type p.
3. When photoreader light goes out, move Enable switch to OFF and Compute switch to GO.
4. Wait until the photoreader light remains out and the input-output neons attain a steady "twelve" or gate type-in configuration. T is automatically set to one (1). (If it is desired to begin with another test, Go to Step 6.)

5. Type N, C. R.

The computer will execute each test starting at T, N times. If no error is detected, the computer will ring the bell once and proceed to the next test. If an error is detected, a characteristic type-out (described in an accompanying table) will occur and testing will be resumed.

After the last test (fourteen or y) has been completed successfully, 0. 00. 0 will be typed out and the routine will loop to test one (1).

To recover operating control in order to restart a test or to begin at a desired test:

6. Turn the Compute switch off and Enable switch on, type Ⓢ cf.

7. Turn the Enable switch off and Compute switch to Go.

8. Type T, tab where T is the number (from 1 to y) of the first test to be executed. WAIT UNTIL THE NEONS RETURN TO A GATE TYPE-IN CONFIGURATION. Go to Step 5.

If it is desired to loop a test indefinitely, the Punch switch should be turned on. Centering the Punch switch will permit the routine to proceed to the next test.

7.4 ERROR TYPE-OUTS

Following is a table of error type-outs from which the sources of failures can be localized. The last digit of each error type-out is the number of the test in which the error occurred.

It has been pointed out previously that the tests need not be run sequentially beginning with test one (1). If test seven (7) is used initially; the error type-outs can be misleading unless the following notes are considered.

A 1. zz. 7 type-out may be the result of a bad package one (1) <u>or</u> a bad package three (3). Before changing packages it may prove profitable to run test five (5). This test writes, then searches for 25 stop codes. A bad package three (3) will certainly fail this test. A 1. zz. 7 type-out followed by a successful run of test five (5) would indicate that package one (1) is indeed imperfect.

A 2. zz. 7 type-out may be the result of a bad package two (2) <u>or</u> a bad package five (5). Before changing packages it may prove profitable to run either test v or test w. . These tests write, then read a program line. The results are then compared with the original program line in memory. A bad package five (5) should certainly fail this test. A 2. zz. 7 type-out followed by a successful run of test v (or w) would indicate that package two (2) is at fault.

ERROR TYPE-OUTS

TEST	TYPE-OUT	ERROR		POSSIBLE CAUSES
1	. 5. xx. 1 . 4. xx. 1	Forward Search Reverse Search	Extraneous file code	Level 5-6 cross-talk, Relay noise, Amplifier oscillation.
	. 0. 00. 1	File code missed		Bad package in level 6
	. 5. zz. 1 . 4. zz. 1	Forward Search Reverse Search	Excessive Drift	Poorly adjusted solenoids
2	. 5. HH. 2 . 4. HH. 2	Forward Search Reverse Search	HH (in hex) file codes missed	Low gain level 6 amplifier
	-. 5. HH. 2 -. 4. HH. 2	Forward Search Reverse Search	HH (in hex) extra file codes detected	Relay noise, amplifier oscillation
3	. 5. HH. 3 . 4. HH. 3	Forward Search Reverse Search	HH (in hex) file codes missed	Low gain level 6 amplifier, excessive solenoid drop-out time.

ERROR TYPE-OUTS

TEST	TYPE-OUT	ERROR	POSSIBLE CAUSES
3	-5.HH.3 -4.HH.3	Forward Search / Reverse Search } HH (in hex) extra file codes detected	Relay noise, amplifier, oscillation.
4	3.00.4 2.00.4	Read / Rev. Sear. Stop Code } Stop Code missed	Level 3 amplifier weak, level 1, 2, 4 or 5 amplifier oscillating.
	3.xx.4 2.xx.4	Read / Rev. Sear. Stop Code } Extraneous reload detected	Level 5 amplifier weak, level 1 or 3 amplifier oscillating.
	3.zz.4 2.zz.4	Read / Rev. Sear. Stop Code } Extraneous stop code detected	Level 5 amplifier weak, level 3 amplifier oscillating.
5	.3.HH.5	HH (in hex) stop codes missed on read	Level 3 amplifier weak, level 5 amplifier oscillating.
	.3.HH.5	HH (in hex) extra stop codes detected on read	Relay noise, level 3 amplifier oscillating.
	.3.xx.5	Reload with stop code not performed	G-15 failure
6	.3.HH.6	HH (in hex) reloads missed on read	Level 1 or 3 weak, head wear problems, level 5 amplifier oscillating.
	-.3.HH.6	HH (in hex) extra reloads detected on read	Relay noise
7	L.xx.7	Extraneous input detected on level L in write-read operation	Bad package, head problems, relay noise.
	L.zz.7	Bit dropped on level L, in write-read operation	Bad package, head problems (See notes on p. 7)
8	2.xx.8	First stop code missed on reverse search for stop code	Solenoid drop-out time too fast, pick up time too fast, type drift, weak amplifiers.

ERROR TYPE-OUTS

TEST	TYPE-OUT	ERROR	POSSIBLE CAUSE
8	2. zz. 8	File code missed on forward search	
9	2. xx. 9	First stop code not skipped on Rev. Sear. stop code	Solenoid drop-out time too slow, pick up time too slow, tape drift.
	2. zz. 9	Near-by file missed, forward search	Tape drift, solenoid drop-out time too slow.
u	3. xx. u	Stop code missed, on forward search for stop code	G-15 (ECO 1096 not correct) Amplifiers
v	4. xx. v	Read error following reverse search	Solenoid drop-out time too slow, capstan deceleration too slow.
w	5. xx. w	Read error following forward search	Solenoid drop-out time too slow, capstan deceleration too slow.
x	1. xx. x	Spurious input after write	Amplifier desaturation too slow, relay noise.
y	1. xx. y	Spurious input after write file code	Amplifier desaturation too slow and excessive cross-talk.
	0. 00. 00	No error	Last test completed.

7.5 CHECK SUMS

MADDER

Loader	0000000
L00	00000x0
L01	00000x1
L02	00000x2
L03	00000x3
L04	00000x4
L05	00000x5

7.6 MADDER TAPE MOTION.

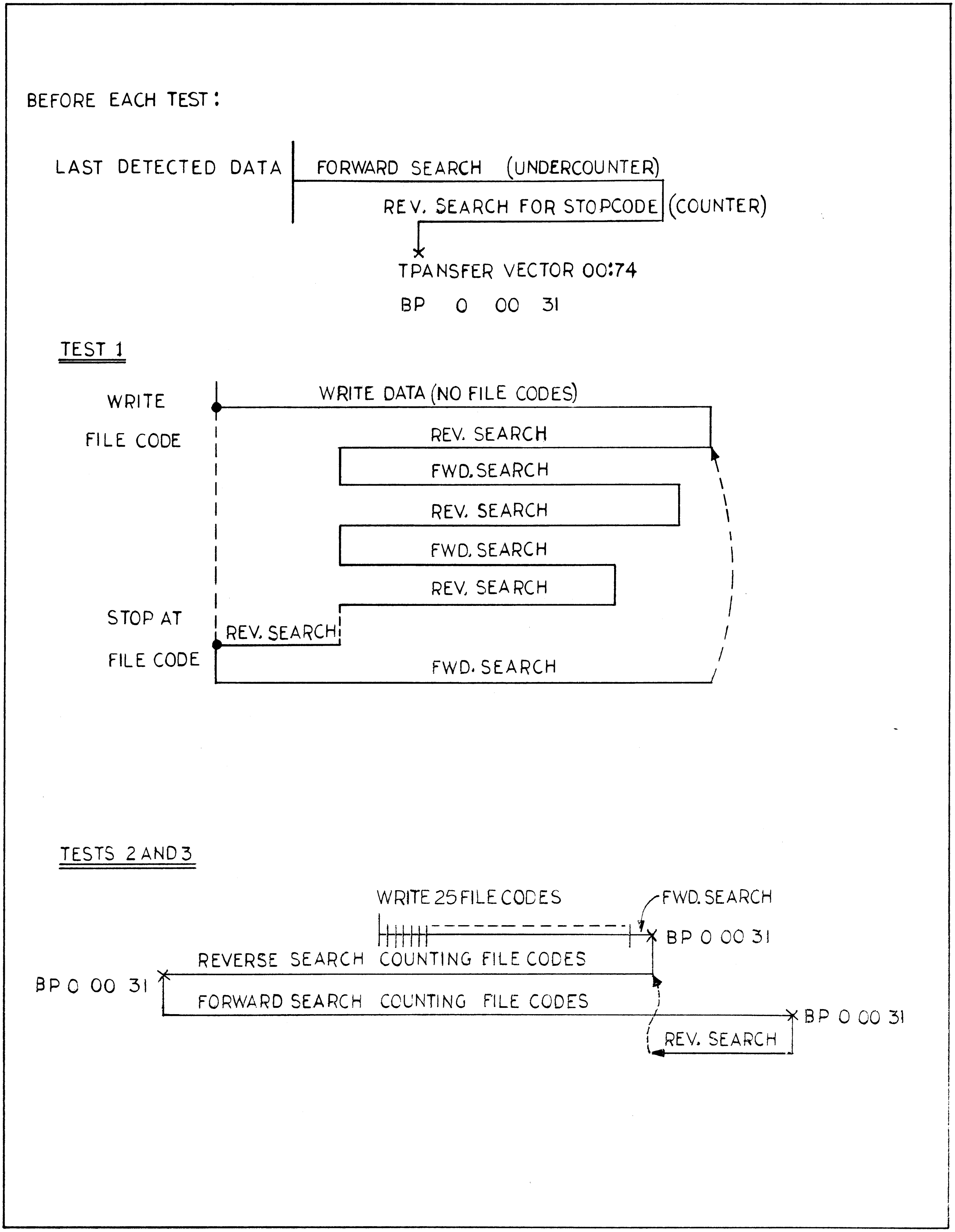


Figure 7-1 Madder Test 1, 2 & 3

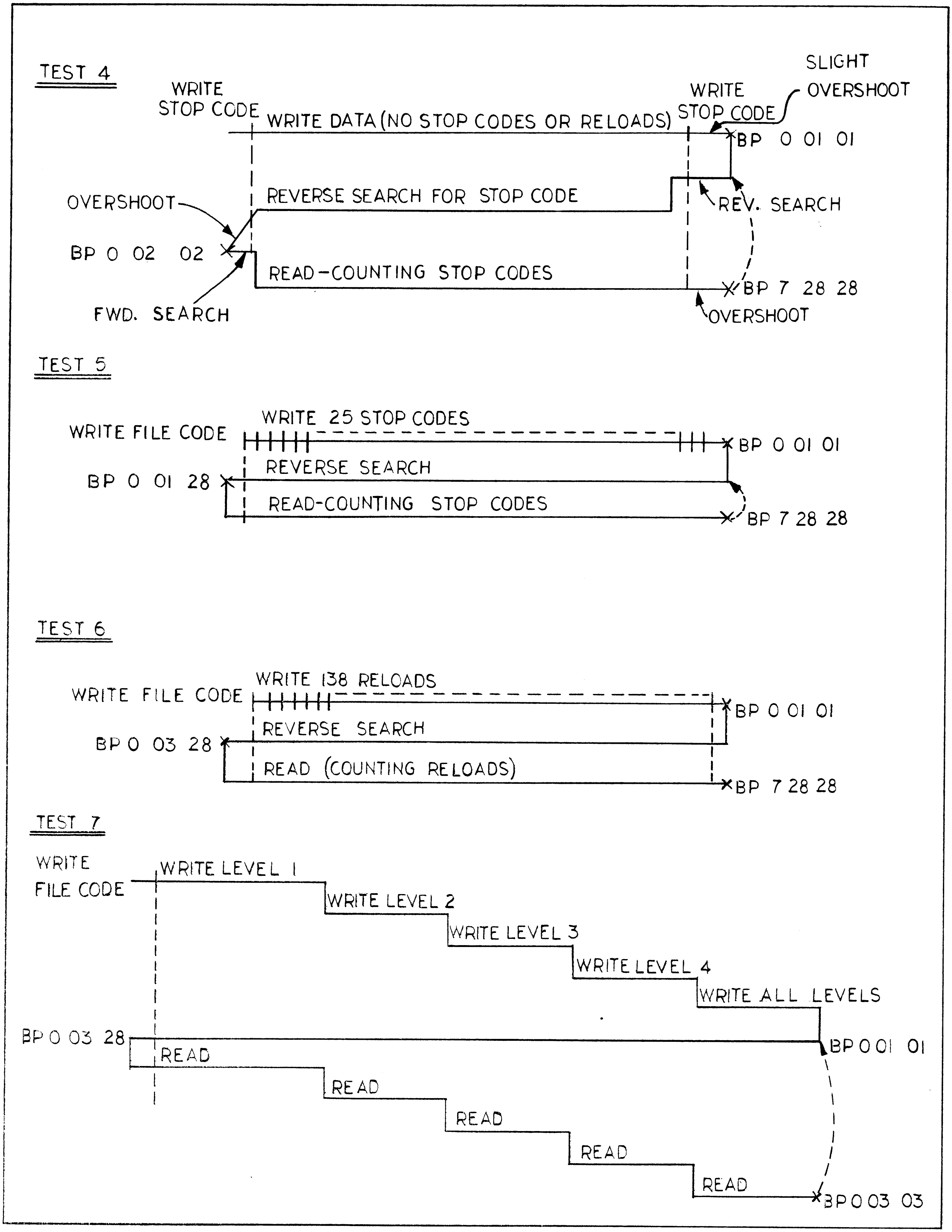


Figure 7-2 Madder Tests 4, 5, 6 & 7

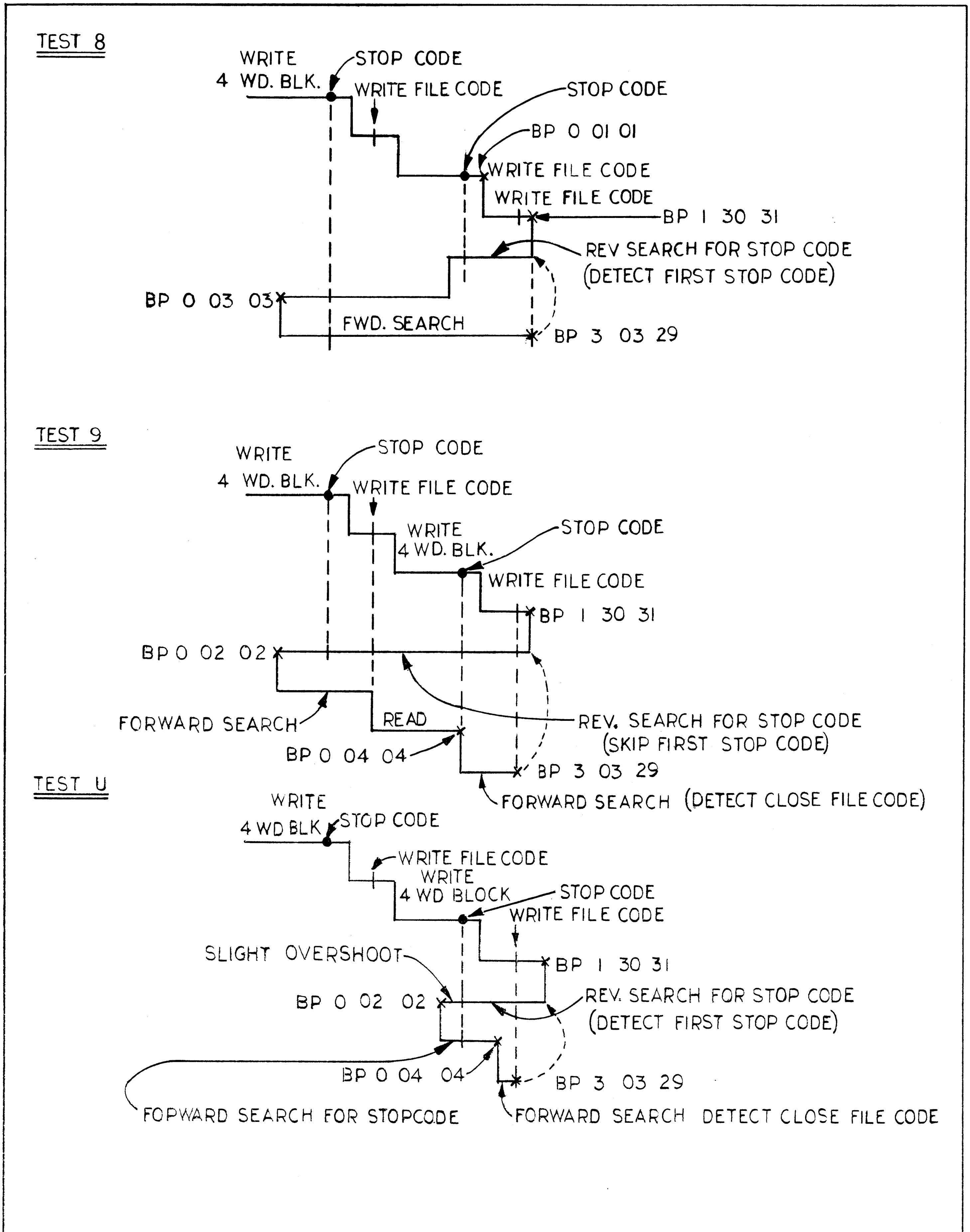
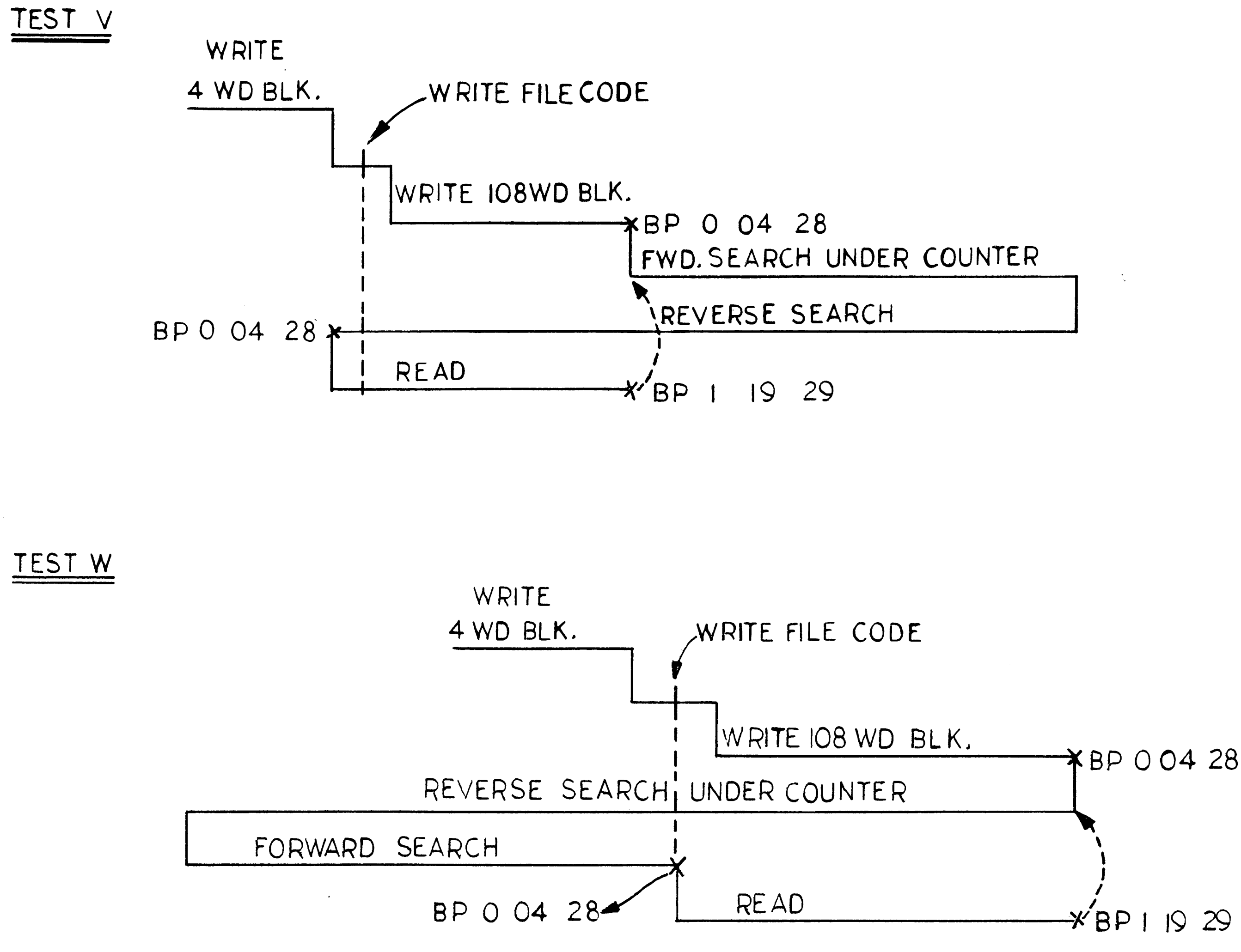


Figure 7-3 Madder Tests 8, 9 & u



TESTS X & Y DO NOT DEPEND ON TAPE MOTION

X INDICATES POSITION OF BREAKPOINTS. BP FOLLOWED BY 3 NUMBERS INDICATES NECN CONFIGURATION.

SC2F PRODUCES FORWARD MOTION AT 8 CYCLE INTERVALS.

SC5F PRODUCES REVERSE MOTION AT 8 CYCLE INTERVALS.

Figure 7-4 Madder Tests v and w

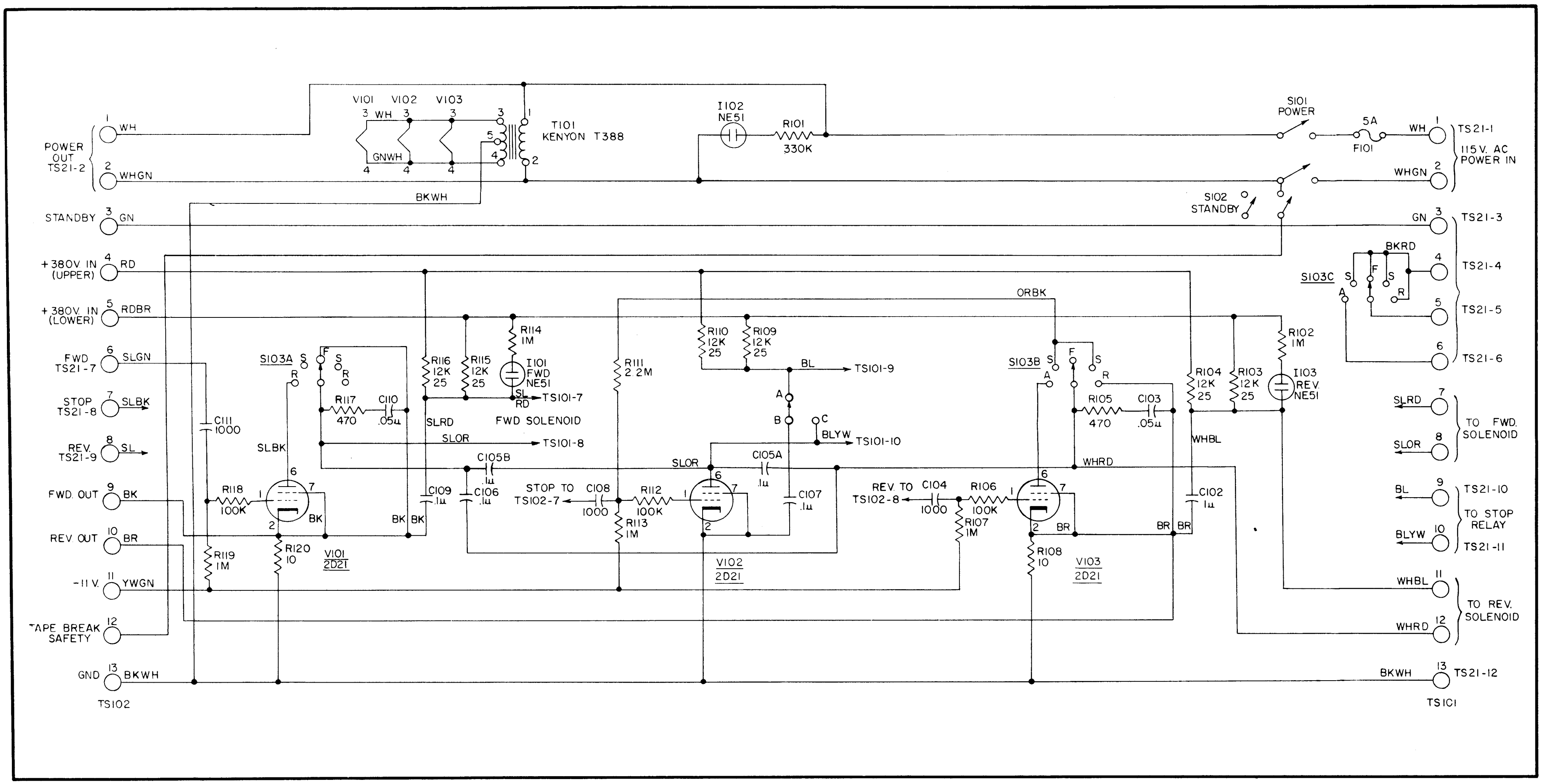


Figure 8-1 Schematic, Servo Drive Chassis

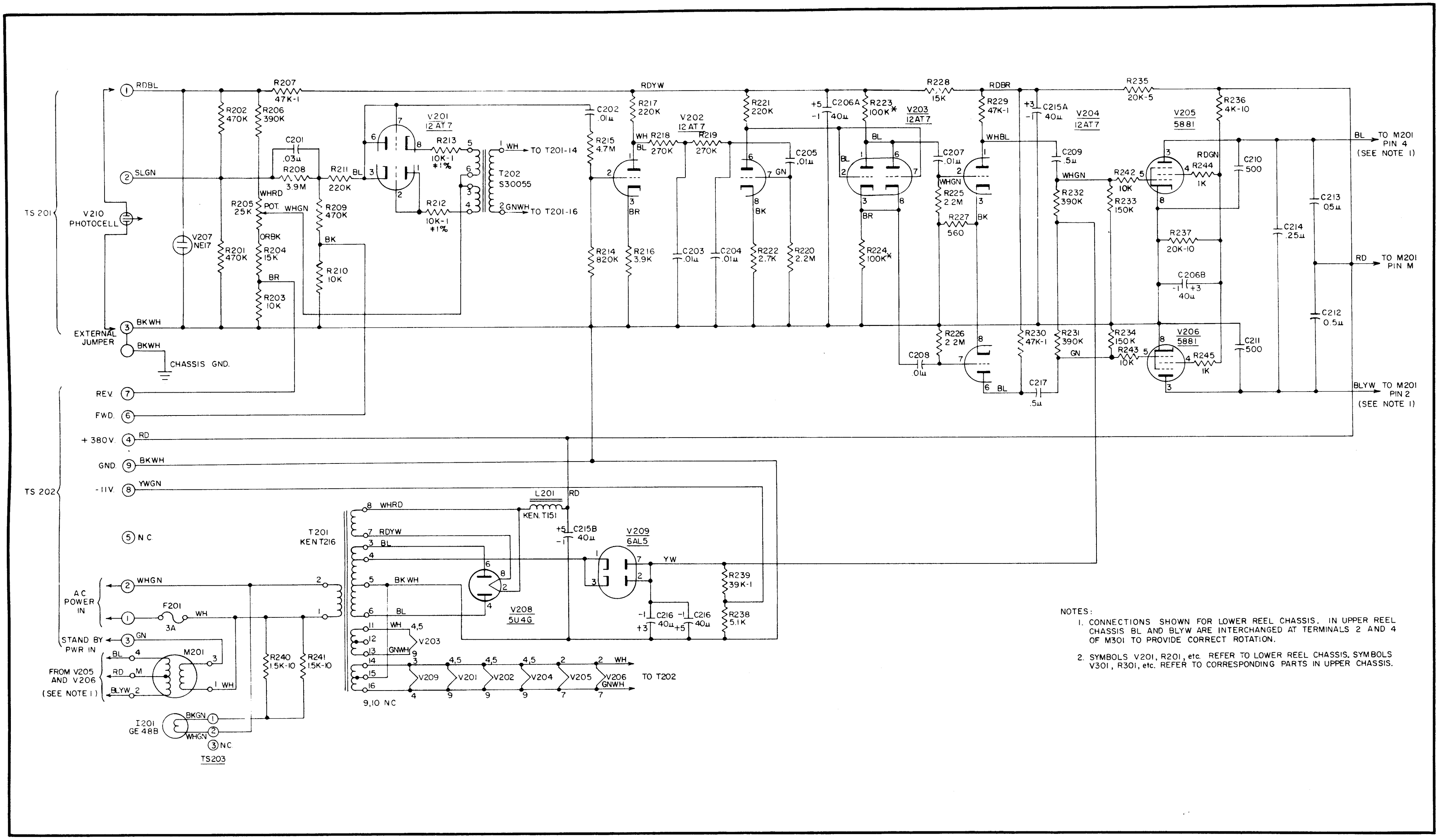


Figure 8-2 Schematic, Servo Amplifier & Reel Chassis

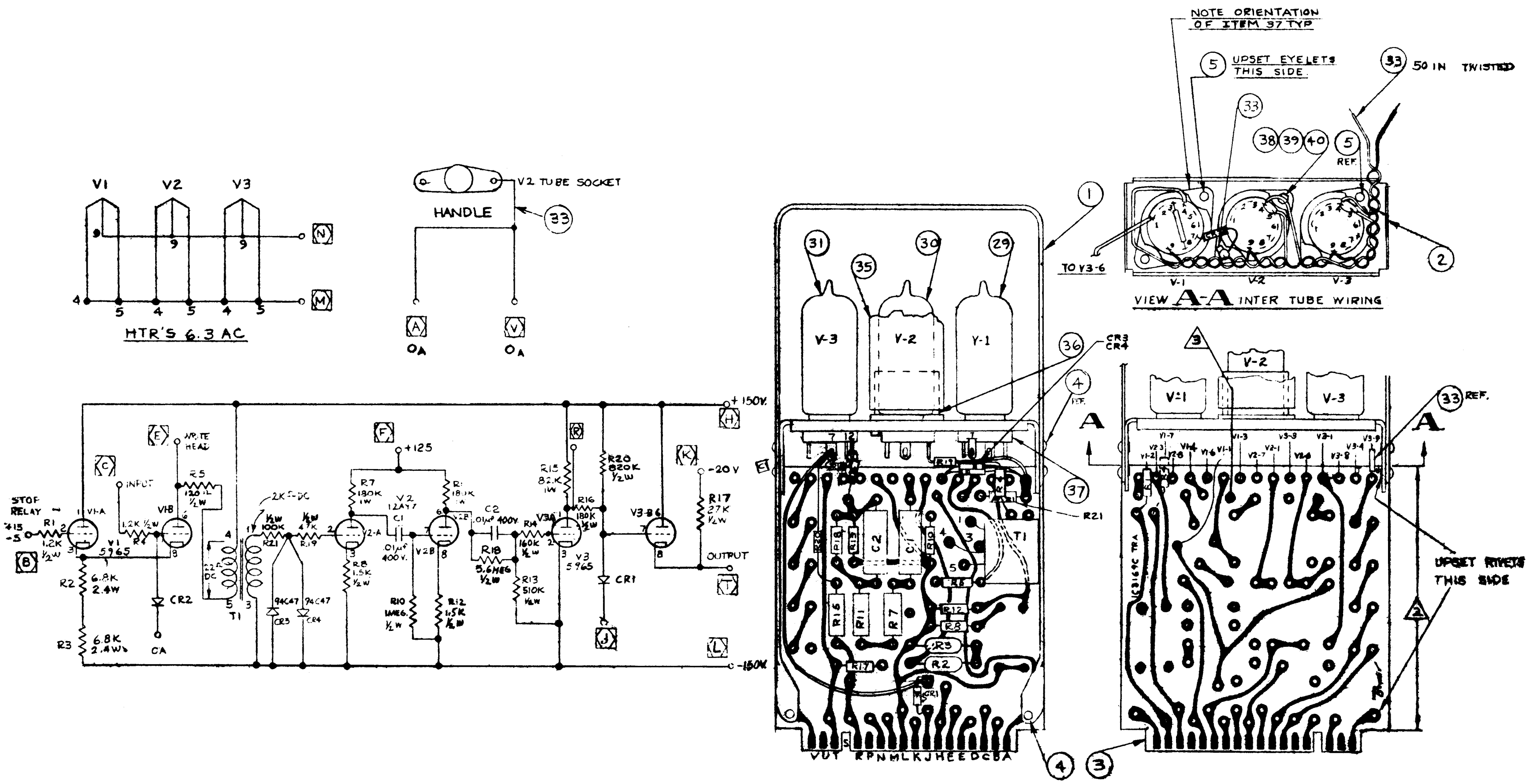
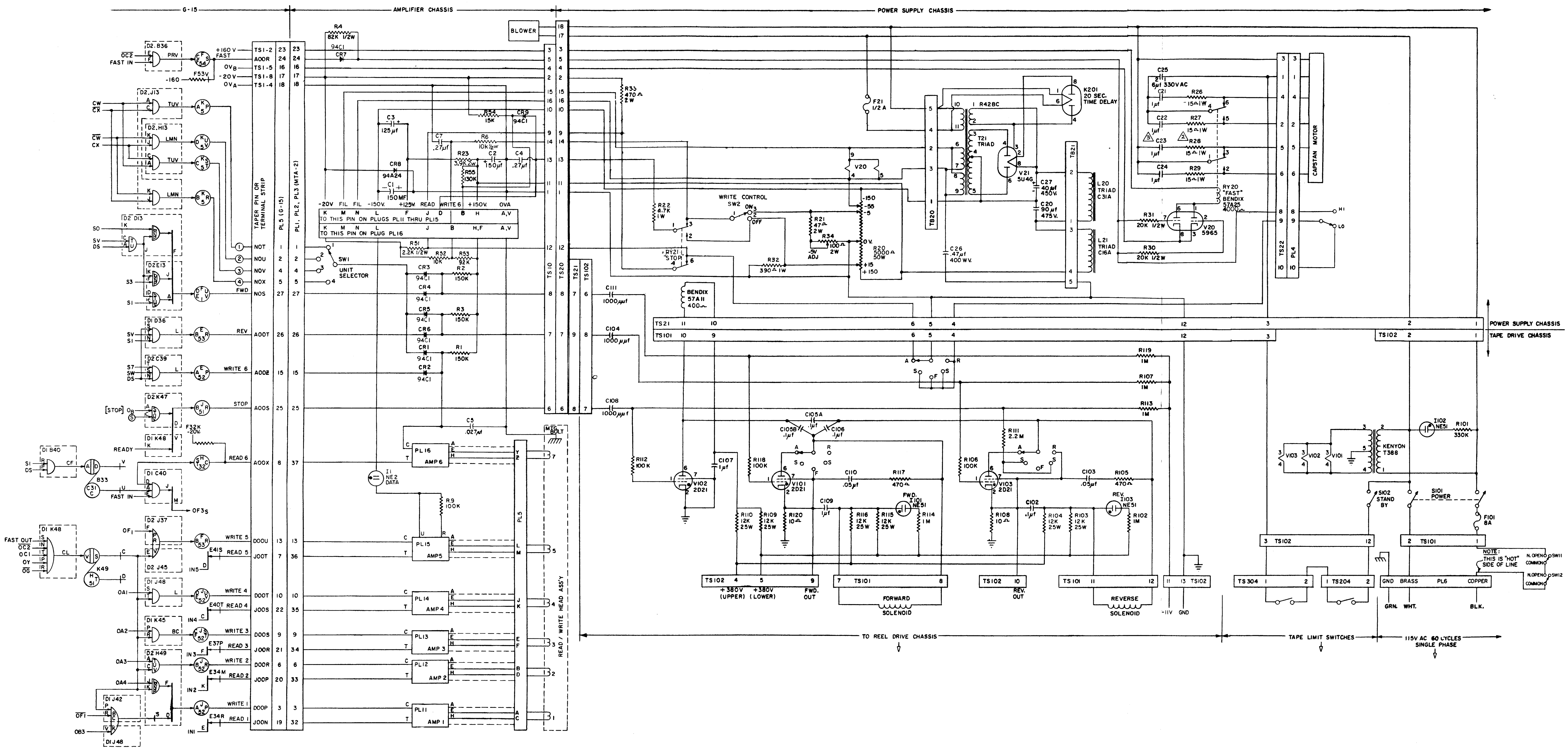


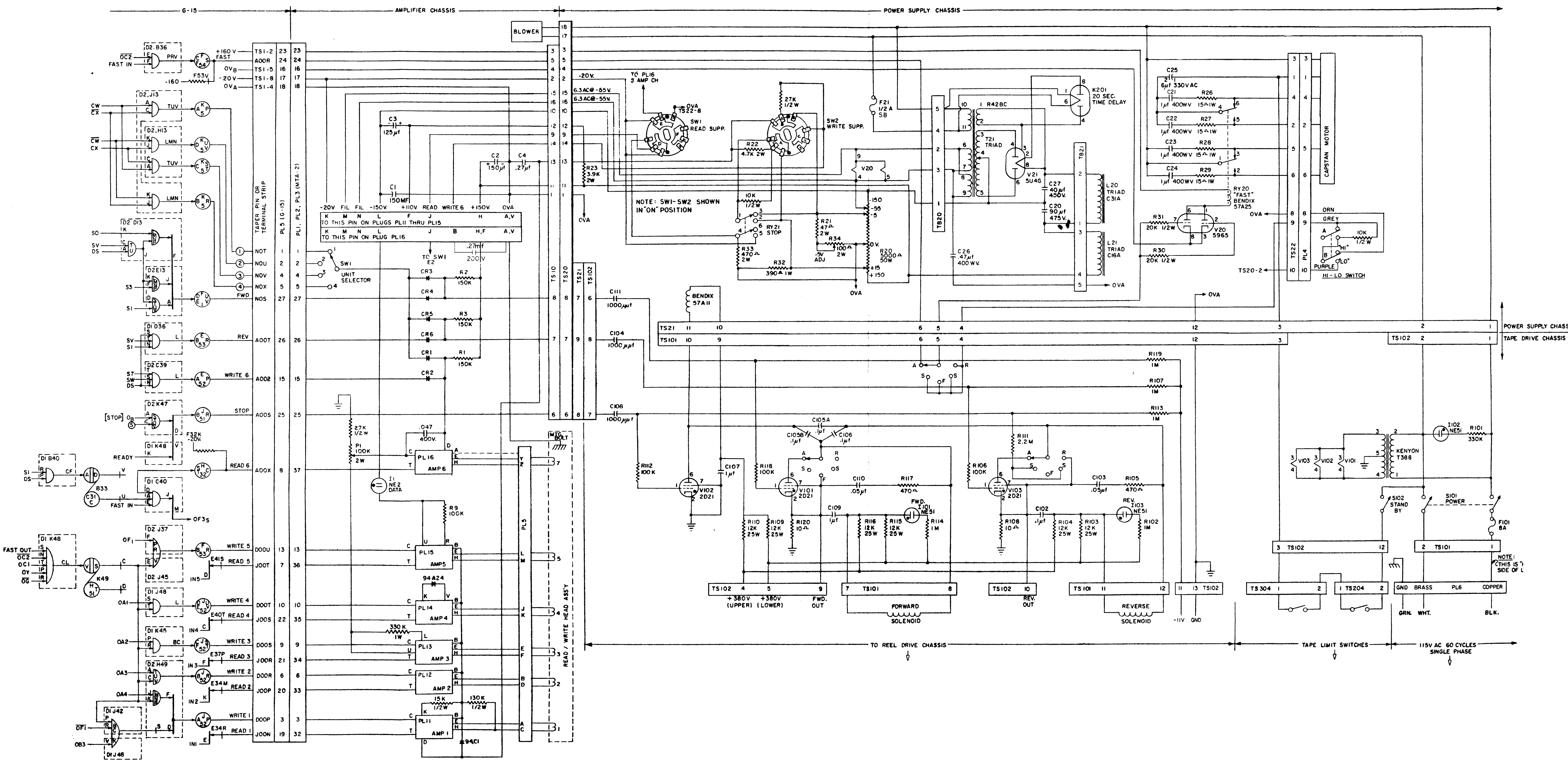
Figure 8-3 Schematic, Read/Write Amplifier 1C 3169



NOTES:

1. ALL RESISTORS 1/2W ± 5 PRCT. UNLESS NOTED.
2. R26 THRU R29 15Ω 1W
3. C21 THRU C24 1µf 600WV
4. ALL PINS ON PL3 NOT SHOWN ARE CONNECTED TO OVA FOR SHIELDING.

Figure 8–4 Schematic, MTA–2 (3D872) Serial No. 241 and Up



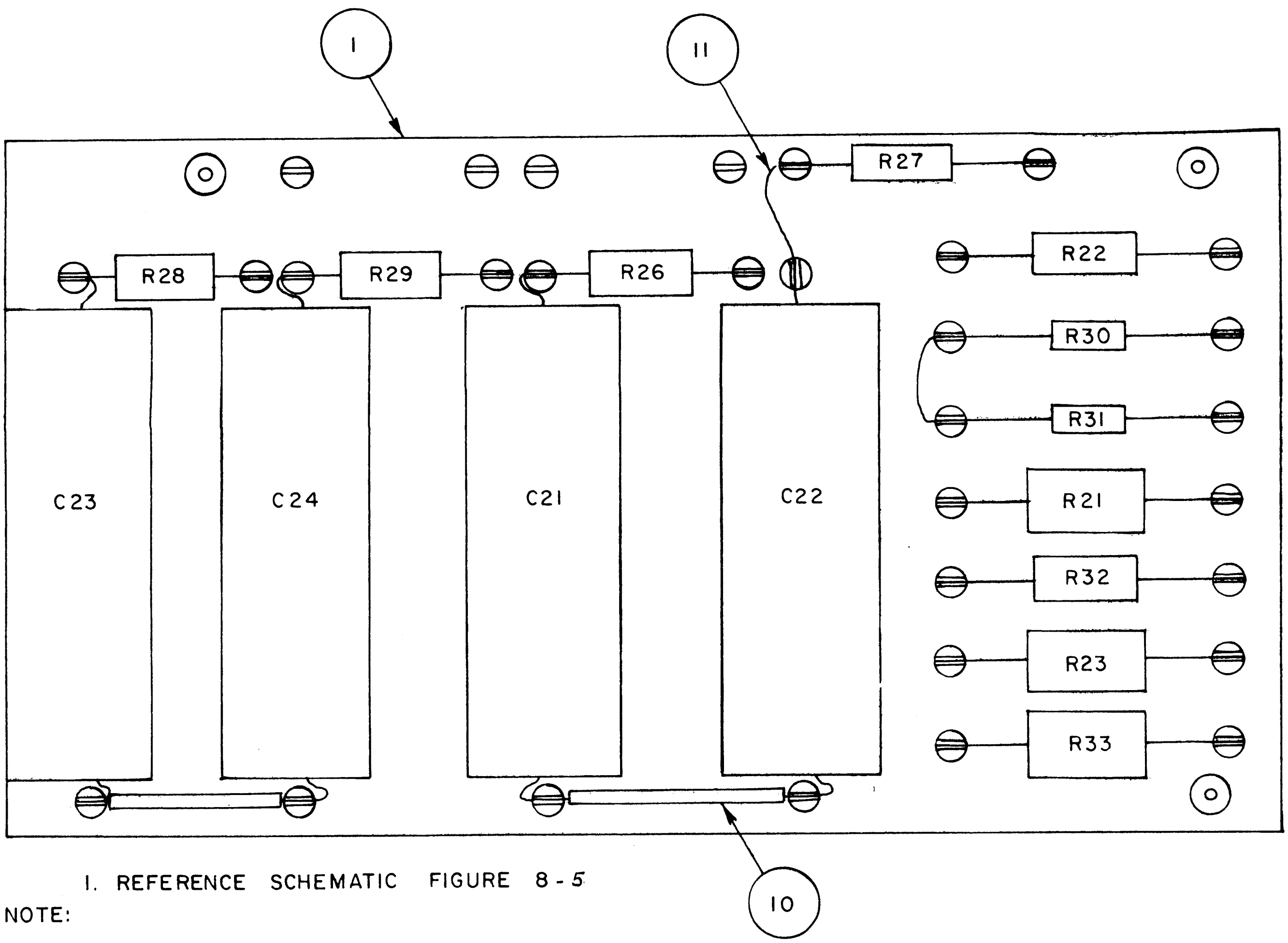
2. ALL PINS ON PL3 NOT SHOWN ARE CONNECTED TO OV_A. FOR SHIELDING.

1. ALL RESISTORS 1/2W ± 5 PRCT. UNLESS NOTED.

NOTES:

Figure 8-5 Schematic MTA-2 (3E 1184) Serial No. 1 thru 240

ITEM NO.	CIRC. SYM.	NO. REQ.	PART NO.	DESCRIPTION
1		1	1C687	Board Ass'y – Terminal
2	C21–C24	4	73A43A	Capacitor – 600 v.
3	R30, R31	2	80C10–203B	Resistor – 1/2w, 5 Prct.
4	R26–R29	4	80C13–150B	Resistor – 1w, 5 Prct.
5	R32	1	80C13–391B	Resistor – 1w, 5 Prct.
6	R22	1	80C13–472B	Resistor – 1w, 5 Prct.
7	R23	1	80C15–391B	Resistor – 2w, 5 Prct.
8	R21	1	80C15–470B	Resistor – 2w, 5 Prct.
9	R33	1	80C15–471B	Resistor – 2w, 5 Prct.
10		–	67C60–024C	Wire–Elect. Strd. Insul.
11		–	67C73–024B	Wire–Elect. Solid Bare



NOTE:
1. REFERENCE SCHEMATIC FIGURE 8-5

Figure 8-6 Board Assembly Power Supply 1C 3527 Serial No. 1 thru 240

ZONE	ITEM NO.	CIRC. SYM.	NO. REQ.	PART NO.	DESCRIPTION
	1		1	1C687	BOARD ASSY-TERMINAL
	2	C21, C22, C23, C24	4	73A43A	CAPACITOR-600 VOLTS
	3	R21	1	80C15-470B	RESISTOR-2W 5 PRCT
	4	R22	1	80C13-472B	RESISTOR-1W 5 PRCT
	5				
	6	R33	1	80C15-471B	RESISTOR-2W 5 PRCT
	7	R26	1	80C13-150B	RESISTOR-1W 5 PRCT
	8	R27	1	80C13-150B	
	9	R28	1	80C13-150B	
	10	R29	1	80C13-150B	RESISTOR-1W 5 PRCT
	11	R30	1	80C10-203B	RESISTOR 1/2W 5 PRCT
	12	R31	1	80C10-203B	RESISTOR 1/2W 5 PRCT
	13	R32	1	80C13-391B	RESISTOR 1W 5 PRCT
	14				
	15				
	16		-	67C73-024B	WIRE-ELECT SOLID BORE
	17		-	67C60-024C	WIRE-ELECT STRD INSUL

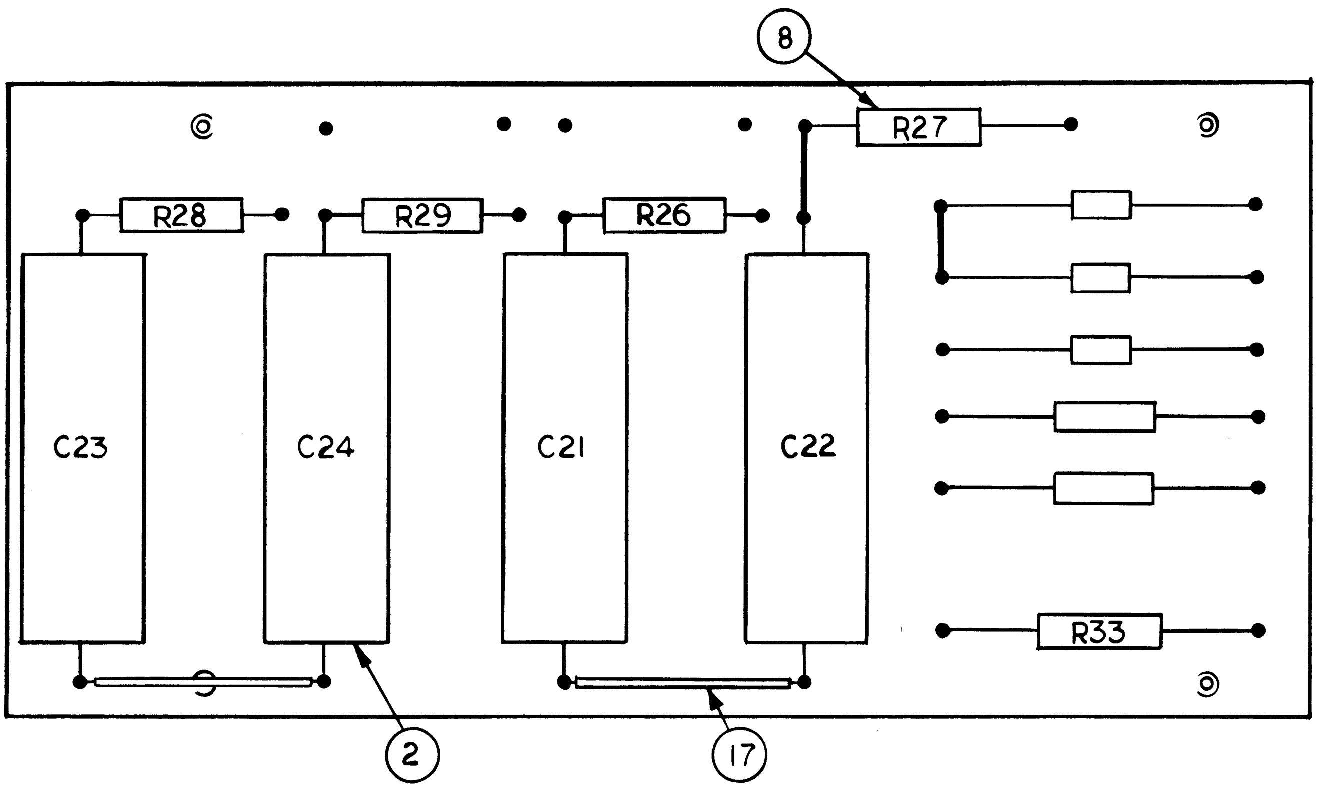
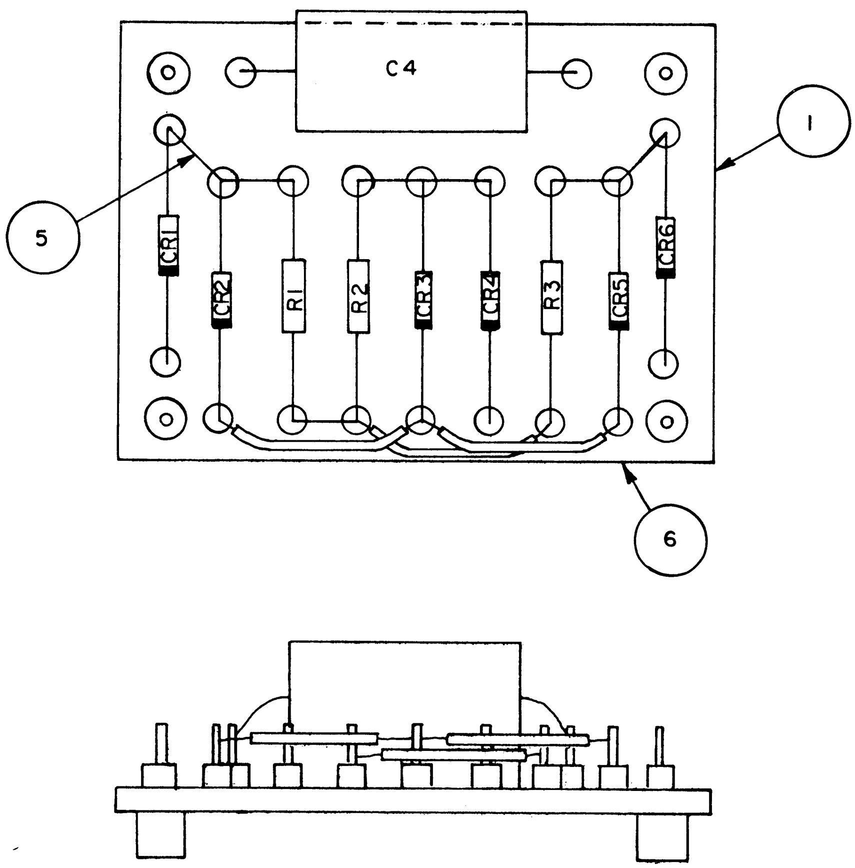


Figure 8-7 Board Assembly Power Supply 1C 694 Serial No. 241 & Up

ITEM NO.	CIRC. SYM.	NO. REQ.	PART NO.	DESCRIPTION
1		1	1B3528	Board Ass'y – Ampl. Term
2	C4	1	73C3–274C	Capacitor
3	CR1–CR6	6	91C1C	Diode–Germanium G. P.
4	R1–R3	3	80C10–154B	Resistor, 1/2w, 5 Prct.
5		–	67C73–024B	Wire–Elect. Solid Bare
6		–	67C69–024C	Wire–Elect. Solid Insul.



1. REFERENCE SCHEMATIC FIGURE 8-5

NOTE :

Figure 8-8 Board Assembly Amplifier Chassis 1B 3526 Serial 1 thru 240

ITEM NO.	CIRC. SYM.	NO. REQ.	PART NO.	DESCRIPTION
1		1	1B685	Board Ass'y - Ampl. Term
2	C4& C7	2	73C3-274C	Capacitor
3	CR1	1	94C1C	Diode - Germanium G. P.
4	CR2	1	94C1C	Diode - Germanium G. P.
5	CR3	1	94C1C	Diode - Germanium G. P.
6	CR4	1	94C1C	Diode - Germanium G. P.
7	CR5	1	94C1C	Diode - Germanium G. P.
8	CR6	1	94C1C	Diode - Germanium G. P.
9	R1	1	80C10-154B	Resistor, 1/2w, 5 Prct.
10	R2	1	80C10-154B	Resistor, 1/2w, 5 Prct.
11	R3	1	80C10-154B	Resistor, 1/2w, 5 Prct.
12			67C73-024B	Wire-Elect. Solid Bare
13			67C69-024C	Wire-Elect. Solid Insul.
14	C5	1	73C3-273C	Capacitor
15	R4	1	80C10-823B	Resistor 1/2w, 5 Prct.
16				
17	R6	1	80C10-103B	Resistor 1/2w, 5 Prct.
18				
19				
20	CR7	1	94C1C	Diode - Germanium G. P.
21	R23	1	80C15-392B	Resistor, 2w, 5 Prct.

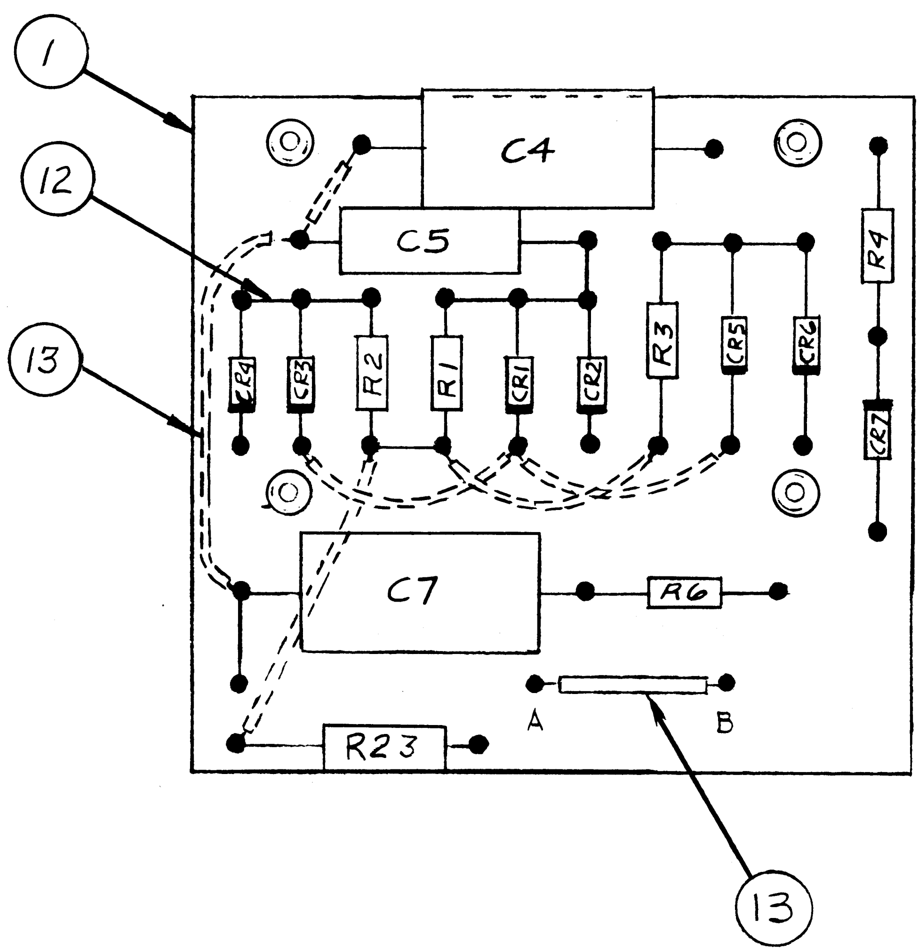


Figure 8-9 Board Assembly Amplifier Chassis 1C693 Serial No. 241 & Up

Bendix Computer Division
LOS ANGELES 45, CALIFORNIA

THE Bendix CORPORATION

AET-05613-1
March '62