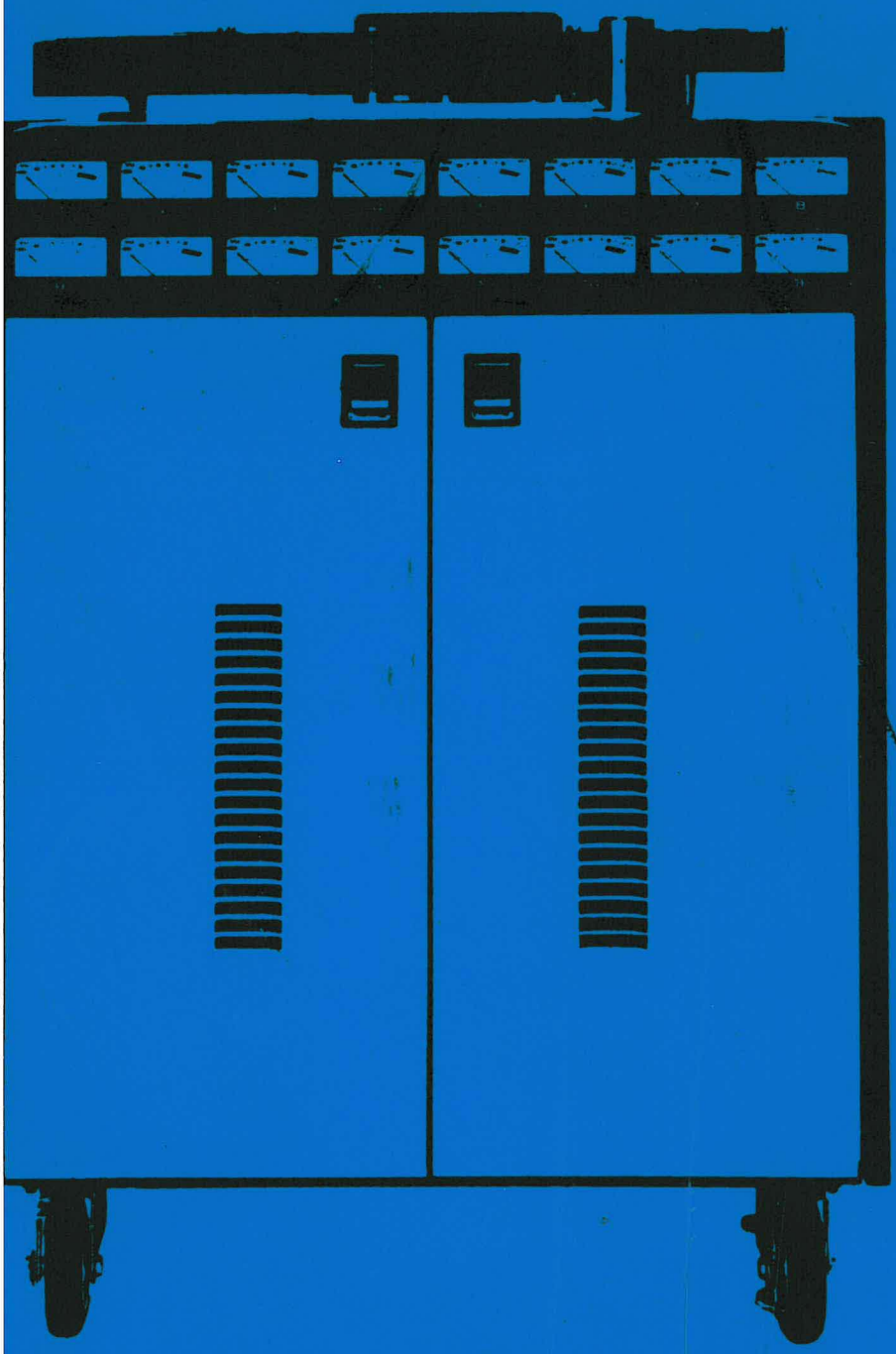
AMPEX

4890321

MM-1100



operation and maintenance

Catalog No. 4890321-05
Issued: September 1975

MM-1100
MULTICHANNEL RECORDER/REPRODUCER

OPERATION AND MAINTENANCE

THIS PACKAGE CONTAINS ALL PAGES

Requires Binder No. 4890321

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AMPEX CORPORATION
AUDIO-VIDEO SYSTEMS DIVISION

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MULTICHANNEL RECORDER/REPRODUCER

OPERATION AND MAINTENANCE

AMPEX CORPORATION
AUDIO-VIDEO SYSTEMS DIVISION

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AVSD TECHNICAL PUBLICATIONS

AMPEX CORPORATION 401 Broadway Redwood City, California 94063

PRINTED IN USA

INTRODUCTION

This manual, Catalog No. 4890321-05, provides operation and maintenance instructions for the Ampex Model MM-1100 Multichannel Tape Recorder/Reproducer, Ampex Part No. 4010210 versions -13 through -24. This manual supersedes earlier versions of the manual.

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MM-1100 Multichannel Recorder/Reproducer

SECTION 1

DESCRIPTION

GENERAL

This manual contains operation and maintenance instructions for the Ampex model MM-1100 Multichannel Tape Recorder/Reproducer, Ampex Part No. 4010210, versions -13 through -24. The standard model is available in 8, 16, or 24 channels, with operating speed pairs of 7.5-15 in/s or 15-30 in/s and operating in either the NAB or IEC (CCIR) standard. These configurations are summarized in Table 1-1.

The MM-1100 records on reels up to 16 inches in diameter and uses one-inch-wide tape on the 8-channel version and two-inch-wide tape on the 16- and 24-channel versions. Any machine can later be converted to an alternate configuration (for example, 16 to 24 channels) by installing a conversion kit.

Table 1-1. MM-1100 Configurations

AMPEX PART NO. 4010210	CHANNELS	TAPE SPEED PAIRS	STANDARD
-13	8	15-30	NAB
-14	16	15-30	NAB
-15	24	15-30	NAB
-16	8	15-30	IEC (CCIR)
-17	16	15-30	IEC (CCIR)
-18	24	15-30	IEC (CCIR)
-19	8	7.5-15	NAB
-20	16	7.5-15	NAB
-21	24	7.5-15	NAB
-22	8	7.5-15	IEC (CCIR)
-23	16	7.5-15	IEC (CCIR)
-24	24	7.5-15	IEC (CCIR)

The MM-1100 provides the capability of recording on one or more channels simultaneously or of monitoring a previously recorded channel while recording in synchronization on one channel or more. The selective synchronization (SEL SYNC*) feature is enabled by using the record head(s) of the prerecorded channel for playback.

The MM-1100 Recorder/Reproducer consists of a tape transport assembly; a transport control assembly; a frame assembly; a motor drive amplifier assembly; a head assembly; four electronics assemblies (for 16-channel systems); a control box assembly; a meter panel assembly; two power supplies; a fan assembly; an input/output connector panel assembly; an input/output adapter panel assembly; and a circuit breaker assembly. Connectors are used extensively between units to allow easy removal of components and assemblies.

TAPE TRANSPORT ASSEMBLY

The tape transport assembly, Figure 1-1, consists of supply and takeup reel assemblies; a capstan drive assembly; a capstan pinch roller assembly; a tension sensor assembly; an end-of-tape arm and housing assembly; a tape lifter assembly; and a tape timer assembly. Also mounted on the tape transport, but not considered part of the tape transport, are the erase, record, and reproduce heads comprising the head assembly.

Supply and Takeup Reel Assemblies

The supply and takeup reel assemblies each consist of a split-phase, four-pole, ac torque motor and brake assembly. The motors drive the tape reel turntables. A motor sense assembly is mounted on the bottom of the supply reel drive motor and shares the turntable shaft. These reel assemblies can be removed through the top of the transport deck for servicing.

Capstan Drive Assembly

The capstan drive assembly consists of a dc servo-controlled motor and a tachometer wheel. The shaft of the motor is the capstan for the tape transport. The tachometer wheel assembly consists of a pickup coil and inner and outer tachometer (gear) wheels mounted on the motor shaft and housing. The use of inner and outer tachometer wheels minimizes flutter introduced by tachometer irregularities.

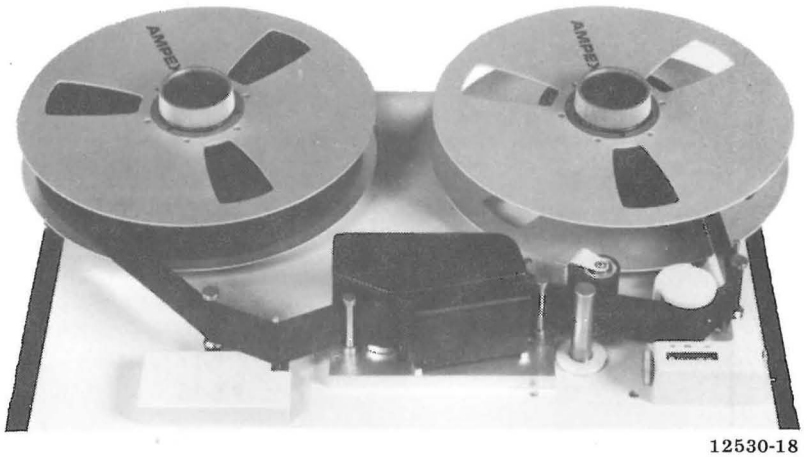

Figure 1-1. Tape Transport Assembly

*Trademark, Ampex Corporation

Capstan Pinch Roller

The capstan pinch roller consists of a solenoid-operated, shaft-mounted arm. The arm supports a rubber pinch roller fitted with ball bearings at each end of the pinch roller shaft. An adjustable pressure spring is used to maintain the necessary force of the pinch roller against the capstan.

Tension Sensor Assembly

The tension sensor assembly, located near the supply reel, consists of two selenium photovoltaic cells and an incandescent lamp mounted on a fixed bracket. The three active components are wired to a connector plug that interconnects with the transport harness. A moving window that is fixed to a tension arm in the tape path passes an amount of light proportional to the tape tension from the lamp to the photocells.

End-of-Tape Arm

The end-of-tape arm, located near the takeup reel, is contained in a housing and consists of a spring-loaded tension arm assembly fitted with a tape post at the free end. The shaft to which the tension arm is attached extends through the transport chassis to an arm which is mechanically coupled to a dashpot to dampen the return motion of the spring-loaded arm. The arm is also equipped with an actuator that trips a microswitch to signal that there is no tape pressure against the tension arm. A latch plate is also attached to the arm for ease of tape threading. When the operator places the tension arm in a full counter-clockwise position, the arm is held in place by a magnetic latch. Also the latch plate actuates a tape-threading switch which removes power from both reel motors.

Tape Lifter Assembly

The tape lifter assembly is a solenoid-operated, spring-return pivoted assembly. The tape lifter pins extend up through the head assembly mounting block and are moved forward of the head assembly when the solenoid is actuated. Unless defeated by the operator, the tape lifters function during the fast forward and rewind modes.

Tape Timer Assembly

The tape timer assembly consists of a tape-driven idler assembly attached to a mounting boss. The timer idler drives a gear train arrangement which, in turn, drives a mechanical time counter. The counter indicates tape travel time in hours, minutes, and seconds when the tape speed is 15 in/s. At a tape speed of 30 in/s, the indicated time must be divided by two to obtain actual playing time. For 7.5 in/s operation, the indicated time must be multiplied by two to obtain actual playing time.

TRANSPORT CONTROL ASSEMBLY

The transport control assembly is an enclosed chassis with a hinged lift-up cover, which contains two separate printed circuit board assemblies and an extender board. The transport control board and the capstan servo board plug into 56-pin connection receptacles J1 and J2, respectively. The extender board is stored in a spare receptacle (J3). The board receptacles are hard-wired to a connector cable harness that interconnects with the transport assembly, the electronics assemblies, the remote control connector on the input power panel, the local control box, and the capstan tachometer. The transport control assembly is mounted at the rear of the meter panel assembly adjacent to the local control box assembly.

MOTOR DRIVE AMPLIFIER ASSEMBLY

The motor drive amplifier (MDA) is a completely enclosed chassis that mounts on the right side of the rear panel. The MDA assembly contains a printed circuit board mounted on the chassis with six heatsinks for power transistors. A chassis connector is provided for interconnection of power and control signals. Three separate MDAs are enclosed; two for the reel motors and one for the capstan motor.

HEAD ASSEMBLY

Eight-track, 16-track, and 24-track head assemblies are available for use with the MM-1100. The

eight-track head assembly uses one-inch wide recording tape, and the 16- and 24-track heads use two-inch tape. Each head assembly contains three head-stack assemblies: the erase head, the record head, and the reproduce head. The record and reproduce head stacks are magnetically shielded with laminated mu-metal. A hinged head-shield cover is block-mounted in front of the record and reproduce heads. In addition, a precision tape guide is mounted adjacent to the erase head at one end of the assembly and adjacent to the reproduce head at the other end. The record and reproduce heads are identical and provide Sel-Sync response comparable to that of conventional reproduce heads. Figure 1-2 shows a 16-track head assembly.

ELECTRONICS ASSEMBLIES

Each electronics assembly (Figure 1-3) contains four bias, record, and reproduce amplifier printed wiring assemblies (PWAs) and four audio switching PWAs. Each audio switching PWA contains three 24-pin PWA receptacles. The bias/erase amplifier, record amplifier, and reproduce amplifier PWAs plug into the receptacles on the audio switching PWA. A 30-pin connector connects each audio switching PWA to the rest of the electronics. Three potentiometers and a switch on each audio switching PWA are mechanically coupled by shaft extenders to the front panel to provide switching and adjustment of Sel-Sync, reproduce, and record levels. Normally, the exposed shafts are recessed and can only be turned with a screwdriver. However, if desired, the shafts can be extended and knobs can be installed on them.

Each record and reproduce PWA contains a 10-pin PWA receptacle for a plug-in equalization PWA. The equalization PWAs plug in at right angles to the record and reproduce PWAs so that their adjustment controls are accessible at the front panel of the electronics assembly. The rear panel contains all necessary input/output connectors. Each electronics assembly (4 channels) has a 2A slow-blow fuse mounted on the rear of the assembly. This fuse protects the 39-volt supply. A line-bridging transformer is factory-installed in each input accessory socket on the rear panel of the electronics assembly.

CONTROL BOX ASSEMBLY

The control box assembly is a removable assembly that doubles as a remote control unit. The control box contains the controls and indicators for all operating functions of the recorder/reproducer. The SAFE/READY rocker switches are used to select desired channels for recording. Other control box assembly switches are: SEL SYNC/REPRO, INPUT MON/NORM MON, TAPE SPEED, LIFTER DEFEAT, RECORD, PLAY, REWIND, FAST FORWARD, and STOP. When the control

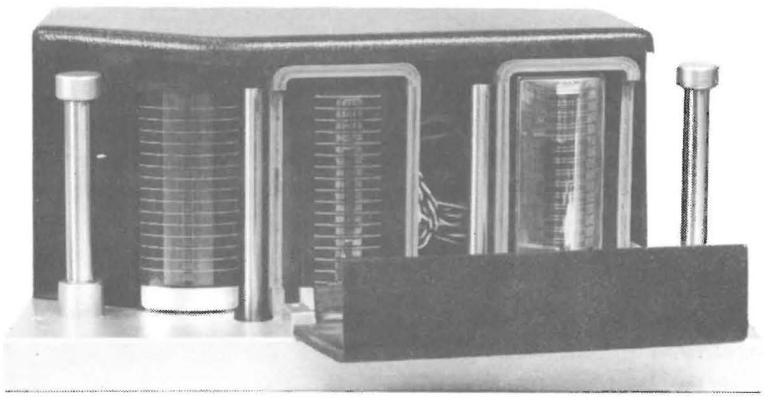

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Figure 1-2. 16-Track Head Assembly

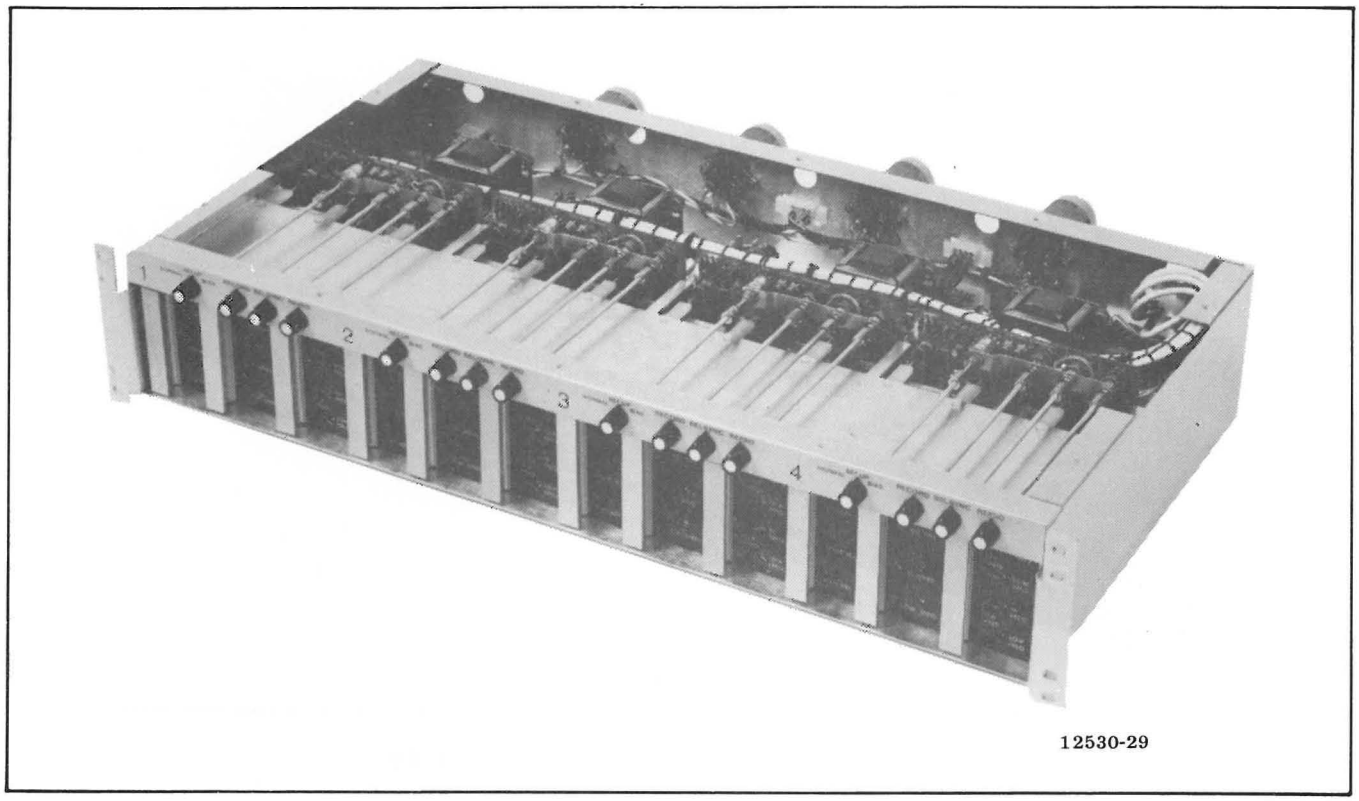


Figure 1-3. Electronics Assembly

box assembly is used as a remote control unit, it is connected by a cable assembly (not supplied) to the remote control connector on the input power panel on the rear of the recorder. Figure 1-4 shows a 16-channel version of the control box assembly.

METER PANEL ASSEMBLY

The meter panel assembly contains a vu meter for each channel. The meter panel tilts into three different positions, the last of which is with the meters tilted down for lamp replacement. A cable harness provides interconnection to the electronics assembly.

POWER SUPPLIES

A 15/27-volt power supply and a 39-volt power supply are mounted on the rear panel of the recorder, with the 39-volt supply at the bottom. Basically, each power supply consists of a transformer, filter capacitors, transistors with heatsinks, a regulator board, and output connections. In addition, the 39-volt supply contains a bias/erase oscillator for the electronics. The main difference between the units is the regulator printed wiring assembly, which plugs into the power supply chassis.

ACCESSORIES

Available optional accessories are listed in Table 1-2.

SPECIFICATIONS

Specifications for the MM-1100 are presented in Table 1-3. These specifications are subject to change without notice or obligation.

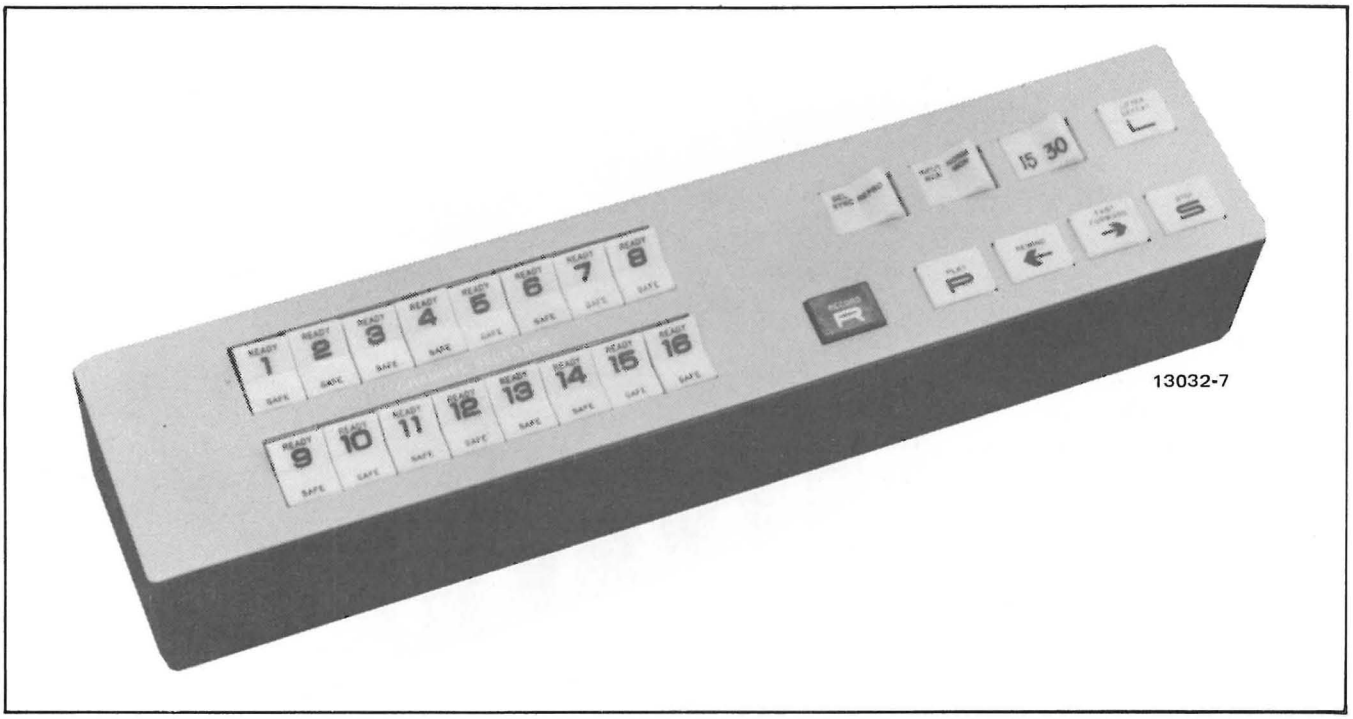


Figure 1-4. 16-Channel Control Box Assembly

Table 1-2. Optional Accessories

AMPEX PART NO.	DESCRIPTION
4850154-01	2-Inch to1-Inch Tape Conversion Kit
4020334-01	8-Track Head Assembly
4020372-01	16-Track Head Assembly
4850155-01	MM-1100 8-Track to 16-Track Conversion Kit (factory installed)
4850156-01	MM-1100 16-Track to 24-Track Conversion Kit (factory installed)
4952348-02	Remote Control Cable
4050646-23	Transport Control Box
4010243-01	Search to Cue
4010231-02	Search and Cue
4010241-01	Auditec II
4020391-09	Sync Lock
4010166-01	Edit Code Generator
4010168-01	Wide Range Synchronizer
4010169-01	Dual Cue Controller
4010187-01	Edit Code Reader
4010235-01	Edit Code Restorer
4050739-02	WBP-2 SMPTE Wideband Preamplifier
4010217-01	VS-10 Variable Speed Oscillator
4010217-02	VS-10 Variable Speed Oscillator With Readout

Table 1-2. Optional Accessories (Continued)

AMPEX PART NO.	DESCRIPTION
4010236-01	PURC (Pick-Up Recording Capability) Accessory Kit
4010233-01	Video Layback Head Kit
4850158-01	Complete MM-1100 Spare Parts Kit
	Extender Boards for Circuit Boards
4020151-04	Reproduce
4020152-02	Record
4020153-03	Bias (Standard)
4020153-04	Bias (PURC)
4020154-01	Power Supply
4050695-02	Capstan Servo and the Transport Control

Table 1-3. Specifications

TAPE WIDTHS

1 inch for 8-track systems
2 inch for 16 or 24-track systems

TAPE SPEEDS

7.5 and 15 in/s or
15 and 30 in/s

REEL SIZE

7-inch to 16-inch reel diameters with NAB hubs

INPUTS

20-kilohm balanced input. Accepts line levels from -17 dBm to produce recommended operating level

OUTPUTS

600-ohm load balanced or unbalanced with nominal output level of +4 dBm and maximum output of +27 dBm nominal. Clip level +28 dBm

EQUALIZATION

Automatically switched with speed change, using NAB plug-in equalization circuits. [IEC (CCIR) plug-in circuits available on order]

ELECTRONICS

All electronics are solid-state. Plug-in printed circuit boards for record, reproduce, equalization, and bias/erase amplifiers

POWER SUPPLIES

39-Vdc regulated (audio-signal system)
+27-Vdc, +15-Vdc, and +5-Vdc regulated (servo and control system)

Table 1-3. Specifications (Continued)

OVERALL FREQUENCY RESPONSE, SEL-SYNC AND REPRODUCE MODES

30 in/s:

±2 dB, from 50 Hz to 18 kHz

15 in/s:

±2 dB, from 30 Hz to 15 kHz

7.5 in/s:

±2 dB, from 40 Hz to 15 kHz (Not applicable to Sel-Sync mode.)

SIGNAL-TO-NOISE RATIO

Using Ampex 406 tape or equivalent at 7.5, 15 or 30 in/s:

8 or 16 channels, 63 dB; 24 channels, 58 dB; peak record level to unweighted (30 Hz to 18 kHz) noise; includes bias, erase, and reproduce amplifier noise. (Peak record level corresponds to a tape flux of 520 nWb/m)

Using Ampex 434 tape or equivalent at 7.5, 15 or 30 in/s:

8 or 16 channels, 60 dB; 24 channels, 55 dB; peak record level to unweighted (30 Hz to 18 kHz) noise; includes bias, erase, and reproduce amplifier noise. (Peak record level corresponds to a tape flux of 370 nWb/m)

THIRD HARMONIC DISTORTION

7.5, 15, or 30 in/s:

1000 Hz

1. Using Ampex 406 tape or equivalent, ≤1.0% at recorded flux level 3 dB above 185 nWb/m (Ampex operating level)
2. Using Ampex 434 tape or equivalent, ≤1.0% at recorded flux level of 185 nWb/m (Ampex operating level)

EVEN ORDER HARMONIC DISTORTION

At 1000 Hz, ≤0.3% at a recorded level corresponding to 6 dB above a tape flux of 185 nWb/m

BIAS/ERASE FREQUENCY

150 kHz ±2%

ERASE DEPTH

At 1000 Hz, peak record level signal erased to −75 dB minimum on channel(s) selected

FLUTTER

7.5, 15, or 30 in/s:

0.08% peak weighted per ANSI S4.3/DIN 45507, in a band 0.5 to 200 Hz, while reproducing a 3150 Hz signal. (0.08% NAB unweighted; 0.1% peak unweighted)

Table 1-3. Specifications (Continued)

CROSSTALK

–50 dB minimum for 8 or 16 channels at 500 Hz
–45 dB minimum for 24 channels at 500 Hz

TIMING ACCURACY

±0.1% (1.8 seconds in a 30-minute record time) for tape recorded, rewound, and reproduced on the same unit

TAPE POSITION INDEX

Reads hours, minutes, and seconds, with repeat accuracy of ±0.1% at 15 in/s

TAPE SPEED ACCURACY

Within ±0.05% from beginning to end of reel. Tape speed unaffected by line voltage or line frequency fluctuations (per NAB Standard on Magnetic Recording and Reproduction, 1965, Section 2.02.01)

CAPSTAN REFERENCE OSCILLATOR

±0.01%, 0° C to 65° C

HEADS

8-, 16-, and 24-track tape stacks are non-adjustable precision-mounted

START TIME

Rated speed within 1.0 second at 30 in/s speed
Rated speed within 0.5 second at 7.5 or 15 in/s speed

REWIND TIME

2.0 minutes for 10.5-inch reel of 1.5-mil tape

POWER REQUIREMENTS

105 to 125 Vac, 48 to 62 Hz

MM-1100-8	0.8 kVA maximum	without accessories
MM-1100-16	1.0 kVA maximum	
MM-1100-24	1.2 kVA maximum	

SECTION 2
INSTALLATION

EQUIPMENT SITING

The installation site for the MM-1100 should be free of strong electromagnetic and electrostatic fields which could interfere with or degrade system operation. The environment should be reasonably dust-free; ambient temperature should be from 32 to 122 degrees F (0 to 50 degrees C); relative humidity should be 10 to 90 percent; and no less than six inches of ventilation space should be left behind the machine. The system requires 28 by 27 inches of floor space, plus access and reel clearances.

UNPACKING

Upon receipt, examine the shipping crate for any signs of damage. Unpack the equipment and inspect for physical damage. Check the packing list to determine that all items have been received. Immediately report any damages (retain the shipping carton) or shortages to the Ampex distributor and the transportation company. Remove all materials (adhesive tape, rubber bands, etc.) used to secure tape-handling and other moving components during shipment.

POWER REQUIREMENTS

The MM-1100 requires 115 volts at 50 or 60 Hz. Power is connected by a grounding-type (three-prong) plug.

WARNING

BE SURE THE POWER PLUG IS PROPERLY GROUNDED BY MEANS OF THE CENTER PRONG.

CABLE CONNECTIONS

Audio signals are connected to and from the MM-1100 by the rear panel connectors shown in Figure 2-1. The connectors are three-conductor XLR-type. Female connectors are used for input signals, and male connectors are used for output signals. The mating plugs are user-supplied, XLR-type and should be used with shielded-pair audio cable to provide input and output connections to the MM-1100. Refer to Table 1-3 for input and output level and impedance specifications.

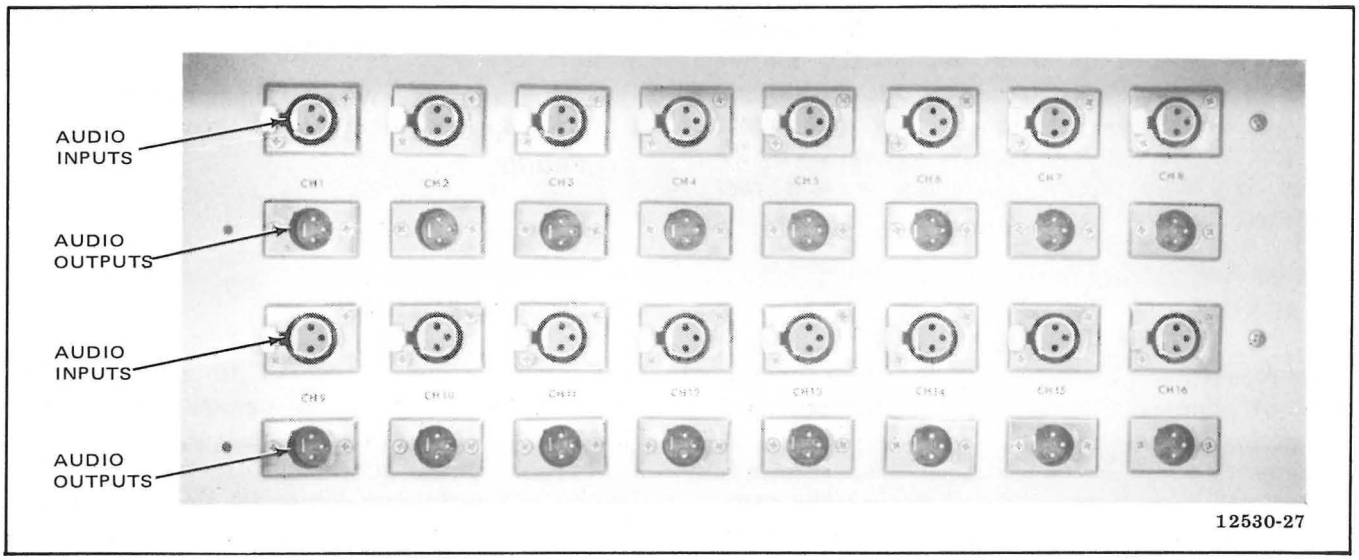


Figure 2-1. MM-1100 Input and Output Connectors

SECTION 3

OPERATION

CONTROLS AND INDICATORS

Operator controls and indicators are provided on the system control box, the individual electronics assemblies, and the meter panel (see Figure 3-1). The control box is shown and described in Table 3-1. The electronics controls are shown and described in Table 3-2.

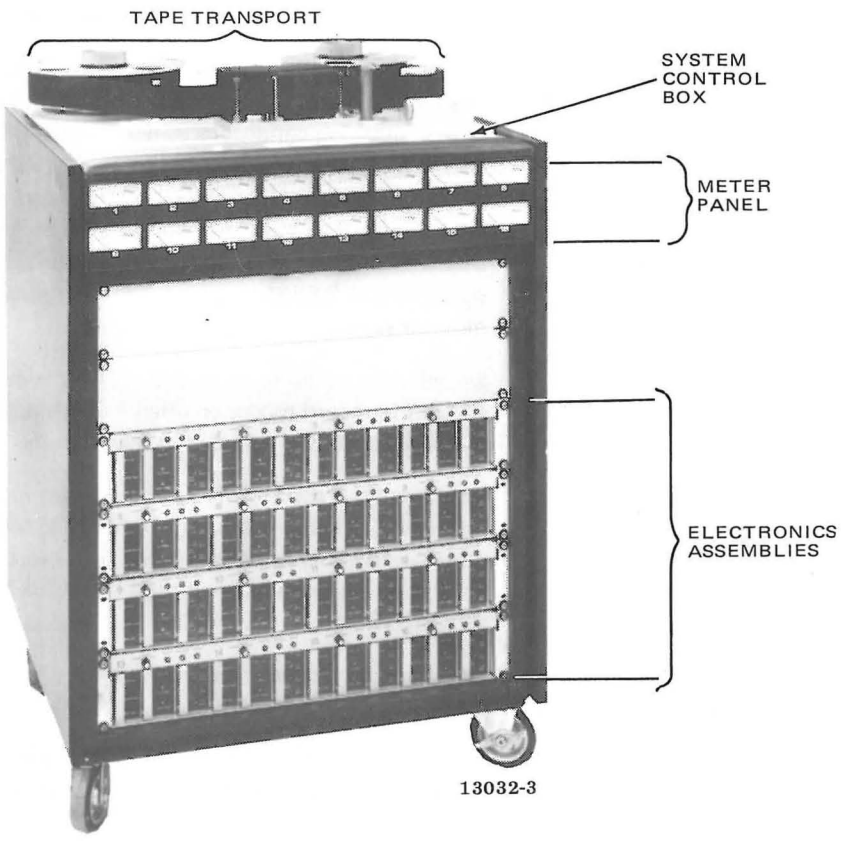
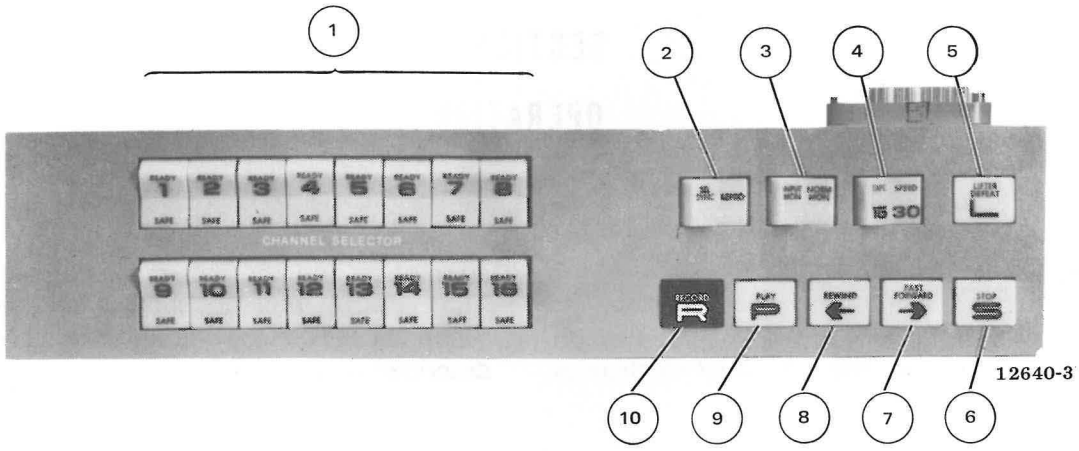


Figure 3-1. Location of System Components

Table 3-1. System Control Box, Controls and Indicators

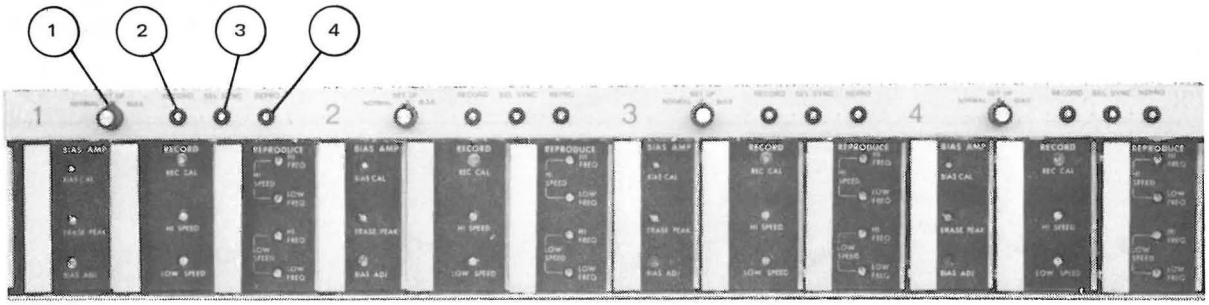


ITEM NO.	DESCRIPTION	FUNCTION
1	READY/SAFE rocker switches	Switches permit channel selection for recording. In READY, switches enable recording on corresponding channel. In SAFE, no recording is permitted on corresponding channel.
2	SEL SYNC/REPRO rocker switch	Switch selects either record heads or reproduce heads to reproduce audio for monitoring. However, the switch is active only when one of the following conditions is met: (1) INPUT MON/NORM MON switch is in NORM MON position, or (2) INPUT MON/NORM MON switch is in INPUT MON position and the READY/SAFE switches for the monitored channels are in SAFE position. In SEL SYNC position, the record heads reproduce the monitor signal; and in REPRO position, the reproduce heads supply the monitor signal.
3	INPUT MON/NORM MON rocker switch	Switch only active when READY/SAFE switch set to READY, and not in record mode; or when NORMAL/SET UP/BIAS switch is set to SET UP, and in record mode. When active, INPUT MON position causes record input(s) to be connected to audio output(s), and NORM MON position causes reproduced audio to be connected to audio output(s). Vu meters monitor audio output(s) with NORMAL/SET UP/BIAS switch set to NORMAL or SET UP.
4	TAPE SPEED 15/30 or 7.5/15 rocker switch	Switch permits selection of tape speed.
5	LIFTER DEFEAT push-button switch	Switch defeats operation of tape lifters so that tape may be monitored during fast forward and rewind modes and lifted from the heads in play and stop modes.
6	STOP pushbutton switch	Switch stops transport from any operating mode. Also used to halt recording of all channels without stopping the transport if RECORD pushbutton is held while STOP pushbutton is momentarily pressed.

Table 3-1. System Control Box, Controls and Indicators (Continued)

ITEM NO.	DESCRITPION	FUNCTION
7	FAST FORWARD push-button switch	Switch causes tape to move forward rapidly.
8	REWIND pushbutton switch	Switch causes tape to rewind rapidly.
9	PLAY pushbutton switch	Switch places system in reproduce mode.
10	RECORD pushbutton switch	When pressed simultaneously with PLAY pushbutton switch, switch places system in record mode. Only those channels with their READY/SAFE switches set to READY will record; those with switch in SAFE position will reproduce using head selected by SEL SYNC/NORMAL switch.

Table 3-2. Electronics Module Controls



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ITEM NO.	DESCRIPTION	FUNCTION
1	NORMAL/SET UP/BIAS switch	Switch used in conjunction with SAFE/READY and INPUT MON/NORM MON switches. Refer to INPUT MON/NORM MON switch in Table 3-1 for information about NORMAL and SET UP positions. BIAS position same as SET UP position except vu meter monitors bias signal in record mode.
2	RECORD control	Control adjusts level of signal being recorded.
3	SEL SYNC control	Control adjusts level of reproduced signal when SEL SYNC/ REPRO switch is in SEL SYNC position (Sel Sync mode).
4	REPRO control	Control adjusts level of reproduce signal when SEL SYNC/ REPRO switch is in REPRO position (normal reproduce mode.

OPERATING PROCEDURES

Making a Recording — Without Sel Sync

To make a recording without using the Sel Sync feature, proceed as follows:

1. If necessary, clean and demagnetize the tape path as described in the Maintenance section.

2. To apply power to the system, set POWER switch to ON.

3. If not previously done, calibrate the reproduce amplifier as described in the Maintenance section.

4. Move end-of-tape tension arm counterclockwise to the latched position for ease of tape threading and to remove power from the reel motors.

5. Thread a bulk-erased reel of tape onto the transport (Figure 3-2), close head gate, and then release end-of-tape tension arm from the latched position.

NOTE

It is good practice to bulk-erase all tape prior to using it for recording.

6. On the system control box:

   a. Set the TAPE SPEED switch to the desired recording speed.

   b. Set the INPUT MON/NORM MON switch to NORM MON.

   c. Set the SEL SYNC/REPRO switch to REPRO.

   d. Set the READY/SAFE switches of those channels to be recorded to the READY position; set all others to SAFE.

7. Open the front cabinet doors and set the NORMAL/SET UP/BIAS switch of the channels to be recorded to the SET UP position.

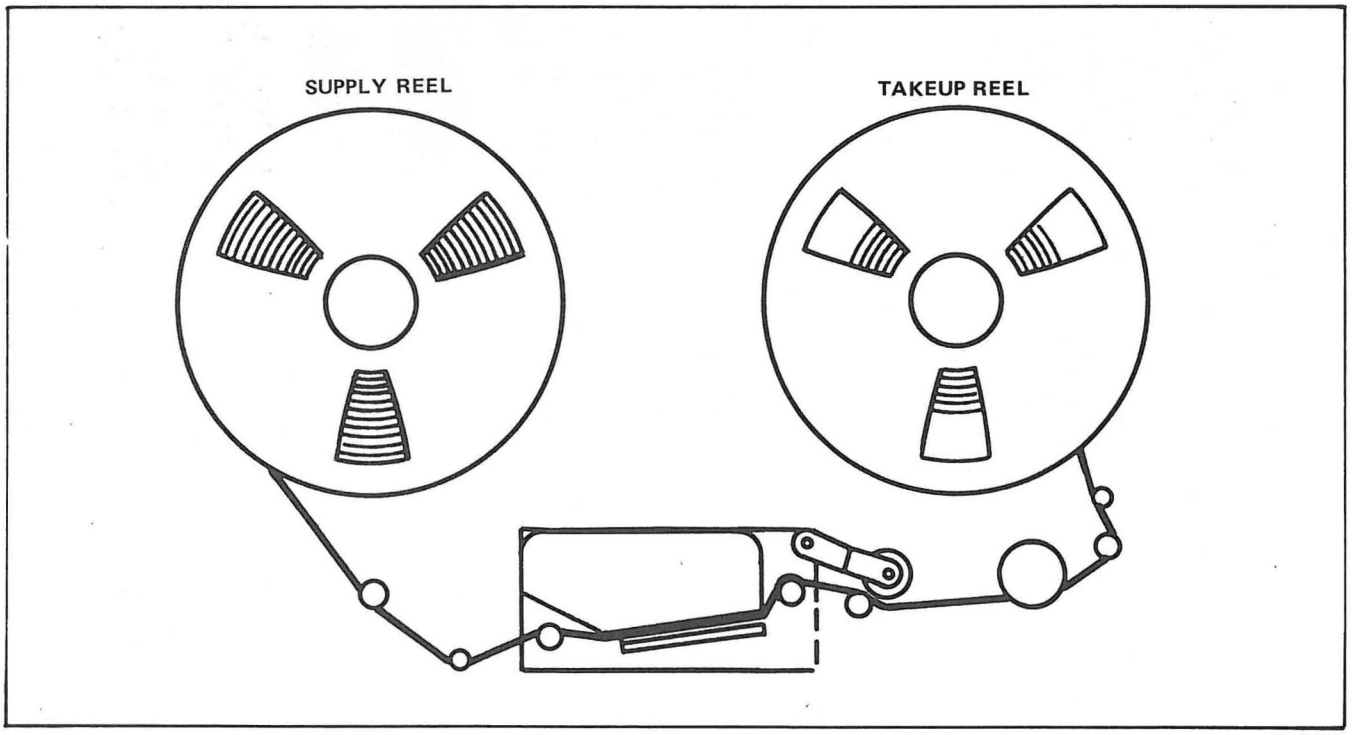


Figure 3-2. Tape Threading Path

8. With the audio sources connected to the appropriate channel inputs, perform a test or rehearsal run by simultaneously pressing the PLAY and RECORD switches. During this test run, adjust the appropriate individual RECORD level controls (on the electronics assemblies) to obtain audio peaks of 0 vu on the corresponding vu meters.

9. When each of the RECORD level controls has been properly adjusted, press the STOP switch to halt the transport.

10. On the electronics modules, set the NORMAL/SET UP/BIAS switches to NORMAL.

11. Re-cue the tape at the beginning and initiate the record mode by pressing the PLAY and RECORD switches simultaneously.

12. The record mode can be halted by any of the following methods:

    a. To halt recording on all channels without stopping the transport, hold the RECORD switch and momentarily press the STOP switch.

    b. To halt recording on one channel or more, place the corresponding READY/SAFE switch(es) in the SAFE position.

    c. To halt the transport, press the STOP switch.

Making a Recording — With Sel Sync

The main function of the Sel Sync feature is to enable the recording of material precisely in step with previously recorded material. In conventional multi-track recorder/reproducer systems, the different physical locations of the record and reproduce heads along the tape path cause a timing error between material being reproduced on one channel and material being recorded on another. This setup is shown in the upper diagram of Figure 3-3 where the material is recorded a fraction of a second before it is reproduced. The result is that the listener who is reproducing one channel while recording another in step, finished with the newly recorded track slightly behind the previously recorded track. (See center diagram of Figure 3-3.)

The solution to this problem is the Sel Sync mode of operation. As shown in the lower diagram of

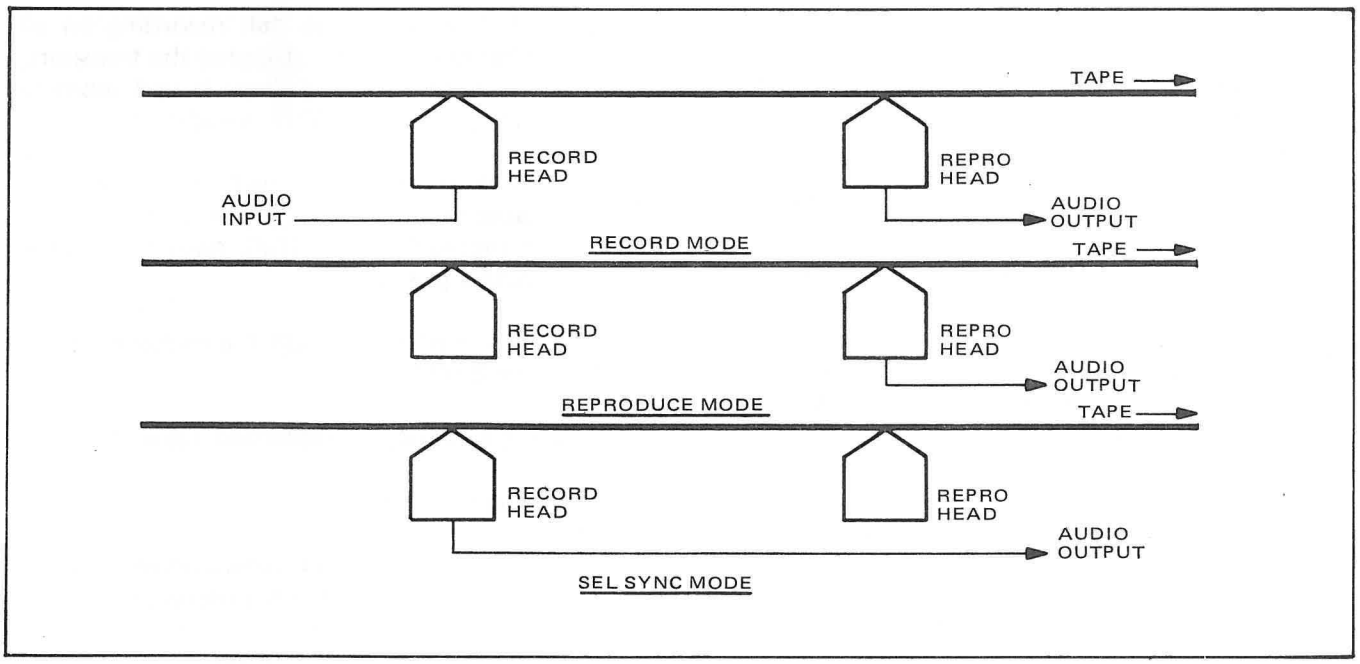


Figure 3-3. Head Usage for Different Operating Modes

Figure 3-3, a channel placed in the Sel Sync mode causes the previously recorded audio to be reproduced by the record head and fed to the audio output, thereby eliminating the timing error caused by a displaced reproduce head. When a prerecorded channel is monitored in this mode, the listener can record on another channel (or channels) while maintaining synchronism.

To make a recording using the Sel Sync feature, proceed as follows:

1. If necessary, clean and demagnetize the tape path as described in the Maintenance section.

2. To apply power to the system, set POWER switch to ON.

3. If not previously done, calibrate the reproduce amplifier as described in the Maintenance section.

4. Move end-of-tape tension arm counterclockwise to the latched position for ease of tape threading and to remove power from the reel motors. Thread the master tape onto the transport (Figure 3-2), close the head gate, and then release the end-of-tape tension arm from the latched position.

5. On the system control box:

   a. Set the TAPE SPEED switch to the desired recording speed.

   b. Set the INPUT MON/NORM MON switch to NORM MON.

   c. Set the SEL SYNC/REPRO switch to SEL SYNC.

   d. Set the READY/SAFE switches of the channel(s) to be recorded to the READY position; set all others to SAFE.

6. Connect monitoring facilities (headphones or loudspeaker) to the outputs of the channel(s) to be monitored. Refer to Table 1-3 for output specifications.

7. Open the front cabinet doors and set the NORMAL/SET UP/BIAS switches of the channel(s) to be recorded to the SET UP position.

8. With the audio sources connected to the appropriate channel inputs, perform a test or rehearsal run by simultaneously pressing the PLAY and RECORD switches. During this test run, adjust the appropriate individual RECORD level controls (on the electronics assemblies) to obtain audio peaks of 0 vu on the corresponding vu meters.

9. When each of the RECORD level controls has been properly adjusted, press the STOP switch to halt the transport.

10. On the electronics assemblies, set the NORMAL/SET UP/BIAS switches to NORMAL.

11. Re-cue the tape at the beginning of the master tape and initiate the recording mode by simultaneously pressing the PLAY and RECORD switches. In this mode, the audio being recorded is in exact sync with that being reproduced.

12. The record mode can be halted by any of the following methods:

    a. If it is desired to halt recording on all channels without stopping the transport, hold the RECORD switch and momentarily press the STOP switch.

    b. If it is desired to halt recording on a selected channel(s), place the corresponding READY/SAFE switch(es) in the SAFE position.

    c. If it is desired to halt the transport, press the STOP switch.

Reproducing a Previously Recorded Tape

Reproduce tape as follows:

1. If necessary, clean and demagnetize the tape path as described in the Maintenance section.

2. To apply power to the system, set POWER switch to ON.

3. Thread the tape to be reproduced onto the transport as shown in Figure 3-2, and close the head gate.

4. On the system control box:

   a. Set the TAPE SPEED switch to the required tape speed.

   b. Set the INPUT MON/NORM MON switch to NORM MON.

   c. Set the SEL SYNC/REPRO switch to REPRO.

   d. Set all READY/SAFE switches to SAFE.

   e. Press the PLAY switch.

5. Adjust the appropriate REPRO level controls (on the electronics assemblies) to obtain the desired audio level.

6. Press the STOP switch to terminate the reproduce operation. If the tape supply is exhausted before the operator halts operation, the transport will automatically halt.

Fast Winding

For tape editing or cueing, the tape is rapidly wound by pressing the REWIND or FAST FORWARD switch. The switches can be pressed alternately without first stopping tape motion. When the desired point on the tape is reached, press the STOP switch to halt the tape. If the tape runs off either reel, the transport will automatically stop. The REWIND and FAST FORWARD switches can be pressed while in the record or reproduce modes without first stopping the tape. However, the PLAY switch must be pressed in order to enter the record mode (i.e., pressing the PLAY and RECORD switches simultaneously).

A tape-lifter mechanism, which automatically lifts the tape off the heads during fast winding, can be prevented from operating by means of the LIFTER DEFEAT switch. Holding the LIFTER DEFEAT switch permits monitoring of the reproduced audio during the fast wind modes for cueing purposes. It is good practice to avoid unnecessary use of this feature to minimize head wear. Alternatively, during play or stop modes, holding the LIFTER DEFEAT switch causes the tape to be lifted away from the heads.

SECTION 4

THEORY OF OPERATION

This section contains block-diagram and detailed circuit descriptions for the electronic and electrical circuits of the MM-1100 Recorder/Reproducer. Block diagrams, simplified schematics, complete schematics, and timing diagrams support the text to provide rapid understanding of the MM-1100 circuitry. A note on each simplified schematic lists the complete schematic from which the simplified schematic was taken. As the theory of operation of the 7.5-15 in/s and 15-30 in/s versions are similar, only the 15-30 in/s version is discussed except where noted in the text.

AUDIO ELECTRONICS

One recording mode and two reproducing modes are possible with the MM-1100 Recorder/Reproducer. Selection of these modes principally involves circuitry in the control box assembly and on the transport control, audio switching, bias/erase amplifier, record amplifier, and reproduce amplifier printed wiring assemblies. Operation of the transport control circuitry and some of the control box circuitry is described in the *Transport Control* text. The remaining record/reproduce circuitry is described in the following paragraphs.

Recording

One channel or more of the MM-1100 can be set up for recording. The following text discusses the recording circuitry for one typical channel. Recording on any channel is initiated by:

a. Setting TAPE SPEED switch to 15 or 30 (in/s) position.

b. Setting INPUT MON/NORM MON switch to NORM MON position.

c. Setting READY/SAFE switch of desired channel to READY position.

d. Setting NORMAL/SET UP/BIAS switch of desired channel to SET UP position.

e. Simultaneously pressing RECORD and PLAY switches.

As shown in Figure 4-1, setting the TAPE SPEED switch to 15 (in/s) lights the 15(in/s) lamp and applies a positive level to transistor Q23, and a ground to transistor Q24. Transistors Q23 and Q24 are located on the transport control PWA. Resistor R36 and capacitor C22 in the base circuit of Q23 and R41 and C23 in the base circuit of Q24 attenuate switching transients produced by the TAPE SPEED switch, and cause Q23 and Q24 to turn on and off slowly. Transistor Q23 is turned on by the positive level at its base, and Q24 is turned off by the ground at its base. Turning on Q23 turns on transistor pair Q22, which inhibits the high-speed record-equalizer amplifier on the record amplifier PWA and enables the low-speed equalizer feedback path on the reproduce amplifier. (See Figures 4-1 and 4-2.) Turning off Q24 turns off transistor pair Q25, which enables the low-speed record-equalizer amplifier and inhibits the high-speed feedback path on the reproduce amplifier. Conversely, setting the TAPE SPEED switch to 30 (in/s) causes the low-speed record-equalizer amplifier and feedback path to be inhibited and the high-speed amplifier and feedback path to be enabled.

Setting the NORM MON/INPUT MON switch to NORM MON position lights the NORM MON lamp and makes a positive level available to transistor Q6 on the audio switching PWA. Transistor Q6 is turned on by the positive level, which turns off Q5. Turning off Q5 back biases transistor Q8, causing relay K3 to be de-energized. With K3 de-energized,

contact set 11—12 of K3 connects the input stages of the reproduce amplifier to the output stages (see Figures 4-1 and 4-2). Consequently, the audio output for the channel selected for recording is derived from tape rather than the record input. Setting the READY/SAFE switch (Figure 4-1) to READY turns off the SAFE lamp, allows the NORM MON/INPUT MON switch to control relay K3, and allows the record mode to be entered. Capacitor C1 shunts switching transients to ground.

Setting the NORMAL/SET UP/BIAS switch to SET UP prevents the record signals from the transport-control logic from energizing relay K3. Therefore, during setup, the audio reproduced from tape is fed to the vu meter and output connector.

Simultaneously pressing the RECORD and PLAY pushbuttons causes a negative-going pulse to be applied to pin D of the READY/SAFE switch and a low level to be applied to pin C. The negative-going pulse is routed to relay K2 (Figure 4-2) and to relay K1 (Figure 4-1) of the audio switching PWA. Relay K1 energizes immediately, and K2 energizes after a delay determined by resistor R14 and capacitor C7. Resistors R13 and R14 and capacitor C7 cause K2 to be turned on and off slowly to prevent noise in the audio output. When contact set 15—16 of K1 closes, the low level at pin C of the READY/SAFE switch is applied to relay K4; to relay K1 via diode CR3; and to relay K2 via diodes CR3, CR9, and CR7, resistors R14 and R13, and transistor Q7.

The low level passed by contact set 15—16 of K1 also turns off transistor Q1. Diode CR2 passes the high level at the collector of Q1 to the base of transistor Q3, turning Q3 on. In turn, transistors Q2 and Q4 are turned on. Turning on Q2 applies a positive level to the bias/erase amplifier, turning it on and allowing the bias and erase signals to be distributed to the record and erase heads and metering circuitry (when selected). Capacitor C1 shunts noise signals to ground, and diode CR4 suppresses inductive transients produced by relay K1.

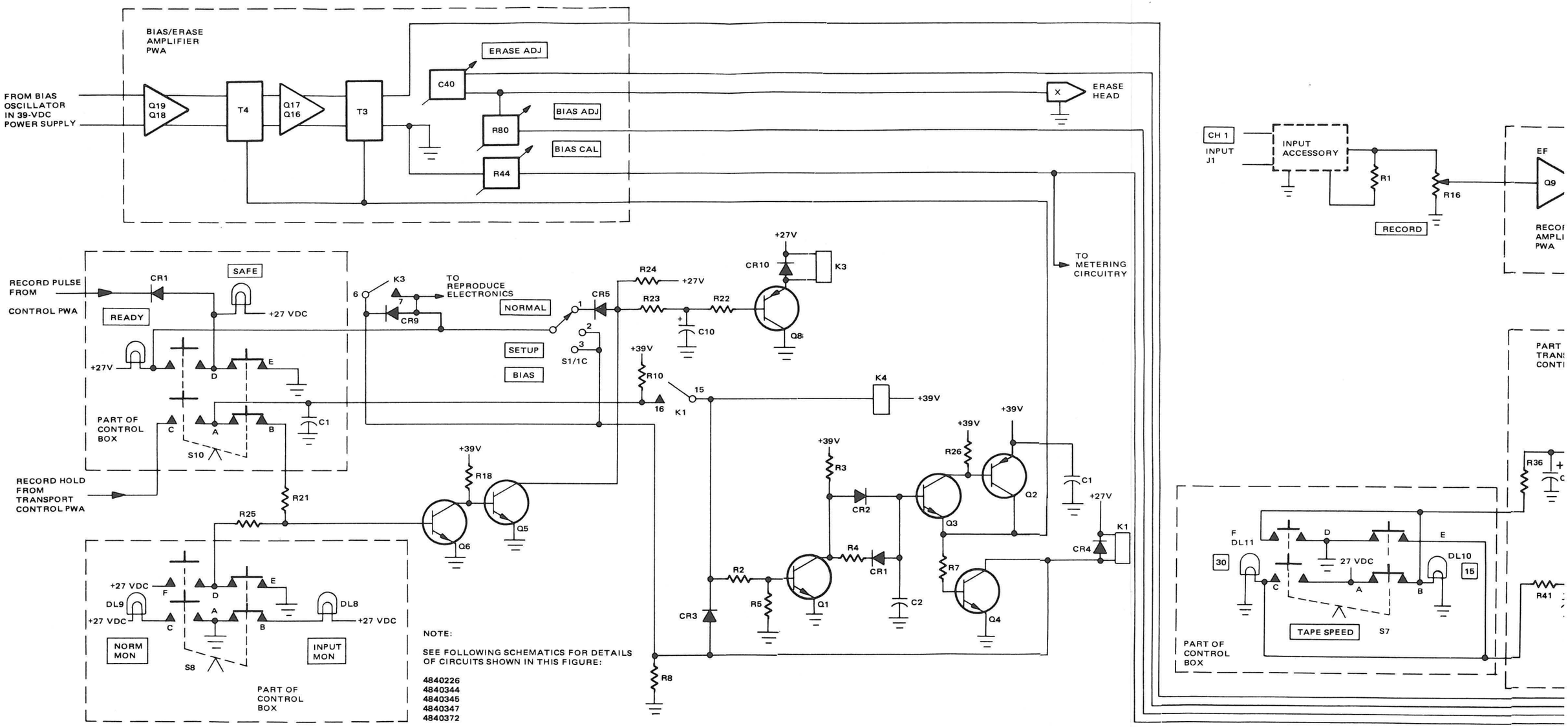
Contact sets 9—10, 12—13 and 6—7 of relay K1 are also closed when K1 is energized; and contact set 3—1 of relay K4 is closed when K4 is energized. Closing contact set 3—1 of K4 connects the output of the record amplifier to bias trap L1-C5. Closing contact sets 12—13 and 6—7 of K1 connects the output of the bias trap to the record head. Closing contact set 9—10 of K1 connects the bias signal to the record head and NORMAL/SET UP/BIAS switch, and connects the erase signal to the erase head. Closing contact sets 12—13, 6—7, and 15—16 of K2 connects the reproduce head to the input of the reproduce amplifier and connects REPRO control R19 into the reproduce circuit. This control is normally set during maintenance and is not adjusted when setting up for recording.

With all connections discussed in the previous paragraphs made, the audio to be recorded is coupled through the input accessory to the RECORD control. The audio taken from the RECORD control is amplified and equalized by the record amplifier and fed to the record head.

Simultaneously, the record audio is sensed by the reproduce head, amplified and equalized by the reproduce amplifier, and fed to the audio output circuitry and the vu meter. In typical operation, the RECORD level control is set at this time to obtain audio peaks of 0 vu on the vu meter.

Once the RECORD level control is properly set, the tape is normally recued, the NORMAL/SET UP/BIAS switch is set to NORMAL, and the RECORD and PLAY pushbuttons are simultaneously pressed. Recording then proceeds in the manner discussed in the previous paragraphs except for the events described below.

With the NORMAL/SET UP/BIAS switch set to NORMAL, relay K3 is energized by a record-pulse signal from the transport control PWA. Capacitor C10 and resistors R22 and R23 form a delay circuit that causes relay K3 to be slowly turned on and off to prevent noises in the audio output. When K3 energizes, contact set 6—7 closes, allowing the record pulse to be applied to relay K1. In addition, contact sets 9—10 and 12—13 of K3 close and connect the input audio signal to the output stages of the reproduce amplifier. Relay K3 is energized first to allow contact sets 9—10 and 12—13 of K3 to make before recording is begun to keep switching noises from being recorded. From this point on, circuit action is the same as that described for the record mode with the NORMAL/SET UP/BIAS switch set to SET UP.


BIAS/ERASE AMPLIFIER PWA
FROM BIAS OSCILLATOR IN 39-VDC POWER SUPPLY
Q19
Q18
T4
Q17
Q16
T3
C40
ERASE ADJ
R80
BIAS ADJ
R44
BIAS CAL
X
ERASE HEAD
TO METERING CIRCUITRY
RECORD PULSE FROM CONTROL PWA
CR1
SAFE
READY
+27 VDC
+27V
D
E
C
A
B
C1
PART OF CONTROL BOX
S10
RECORD HOLD FROM TRANSPORT CONTROL PWA
R21
R25
K3
6
7
CR9
TO REPRODUCE ELECTRONICS
NORMAL
SETUP
BIAS
1
2
3
S1/1C
CR5
R24
+27V
R23
R22
CR10
K3
C10
Q8
+39V
R10
15
16
K1
K4
+39V
R18
Q5
Q6
+27 VDC
F
DL9
DL8
NORM MON
INPUT MON
S8
PART OF CONTROL BOX
NOTE:
SEE FOLLOWING SCHEMATICS FOR DETAILS OF CIRCUITS SHOWN IN THIS FIGURE:
4840226
4840344
4840345
4840347
4840372
R8
+39V
R3
CR2
R4
CR1
R2
R5
Q1
CR3
C2
R7
Q3
R26
Q2
C1
+27V
CR4
K1
Q4
CH 1
INPUT J1
INPUT ACCESSORY
R1
R16
RECORD
EF
Q9
RECOR AMPLI PWA
PART TRANS CONTI
R36
R41
F
DL11
D
E
30
27 VDC
DL10
15
C
A
B
TAPE SPEED
S7
PART OF CONTROL BOX

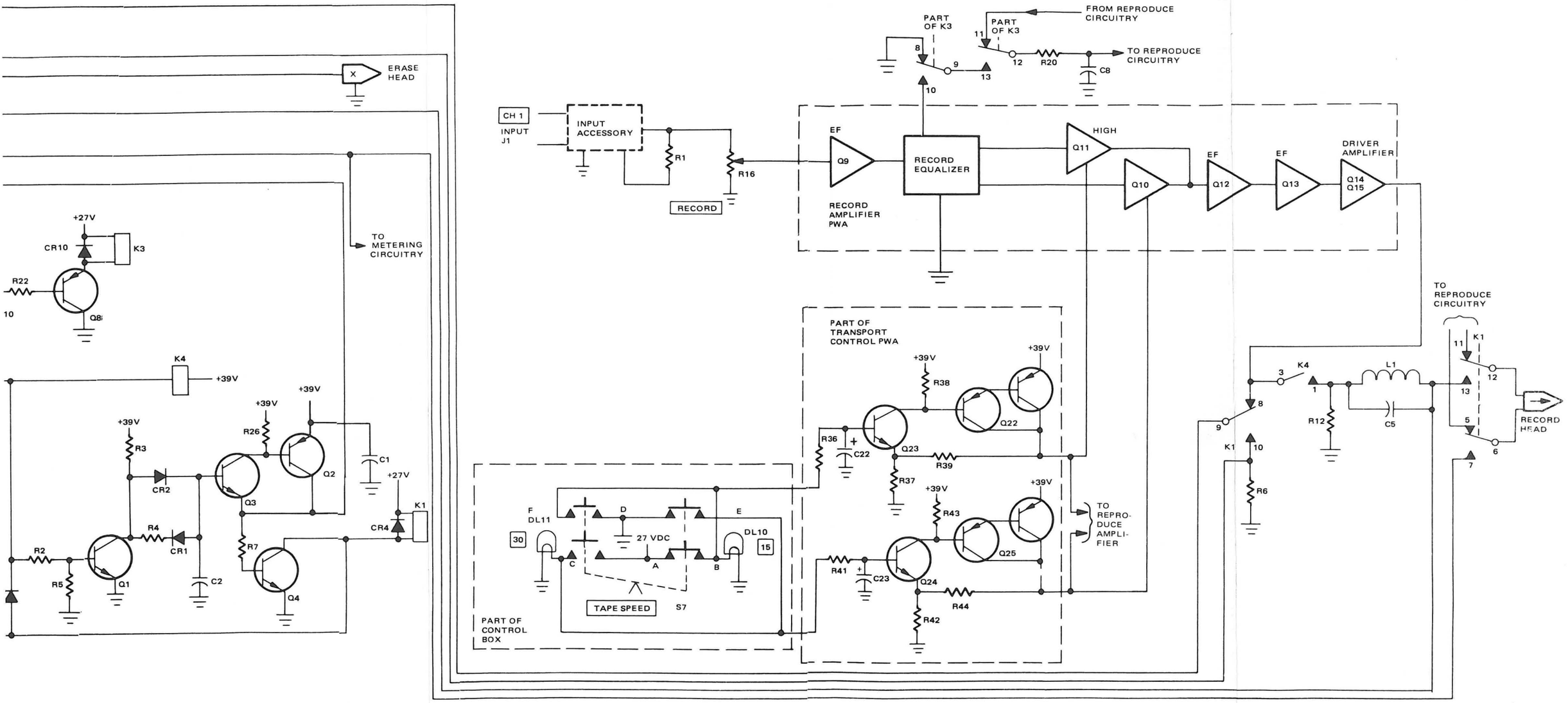
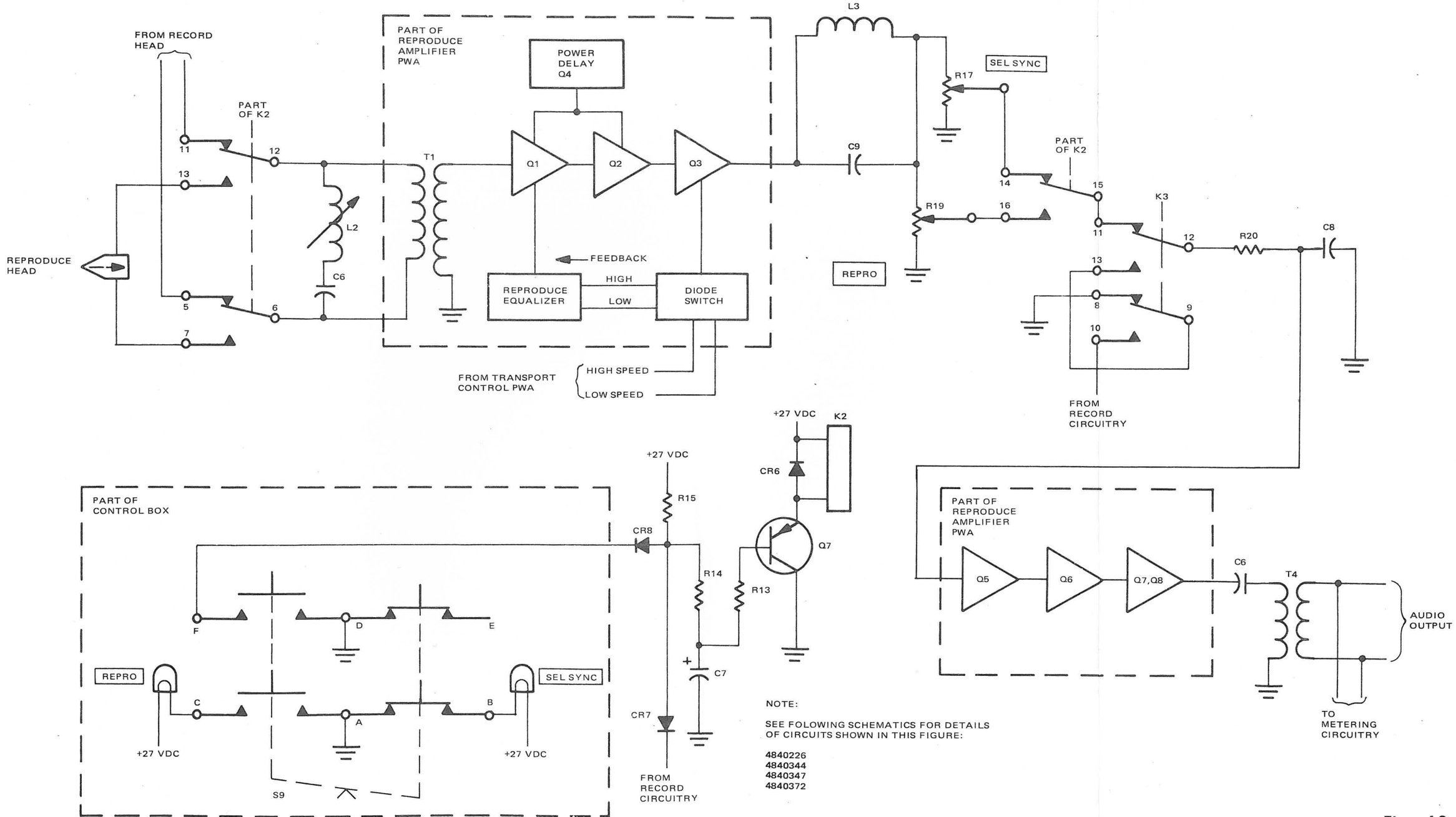


Figure 4-1.
Audio Switching, Record Mode, Simplified Schematic



NOTE:

SEE FOLOWING SCHEMATICS FOR DETAILS OF CIRCUITS SHOWN IN THIS FIGURE:

4840226
4840344
4840347
4840372

Figure 4-2.
Audio Switching Reproduce Mode, Simplified Schematic

When the MM-1100 Recorder/Reproducer is switched from the record mode to another mode of operation, relays K1, K2, and K3 and the bias/erase amplifier are de-energized slowly to minimize popping and other undesirable results of switching transients. Capacitor C7 and resistor R13 slow the dropout time of K2, and C10 and R22 slow K3. Resistor R4, capacitor C2, and diodes CR1 and CR2 function to retard the turnoff time of transistor Q3. When the low-level record-hold signal is removed from the base of transistor Q1, Q1 is turned on. As a result, diode CR2 is back biased, forcing C2 to discharge through R4 and CR1. Consequently, transistors Q2, Q3, and Q4 are slowly turned off, as are relay K1 and the bias/erase amplifier. Slowly turning off the bias/erase amplifier and K1 prevents the contacts of K1 from transferring while appreciable bias current is present, thus preventing pops from being recorded.

Reproducing Without Sel Sync

One channel or more of the MM-1100 can be set up for reproducing. The following text discusses the reproduction circuitry for one typical channel. Reproducing from any channel is initiated by:

a. Setting TAPE SPEED switch to 15 or 30 (in/s) position.

b. Setting SEL SYNC/REPRO switch to REPRO.

c. Setting READY/SAFE switch to SAFE.

d. Pressing PLAY pushbutton.

Operation of TAPE SPEED switch is discussed in the *Recording* text. Setting the SEL SYNC/REPRO switch to REPRO lights the REPRO lamp and grounds the base of transistor Q7, causing it to conduct and energize relay K2 (see Figure 4-2). Energizing K2 makes the connection between pins 12 and 13, 6 and 7, and 15 and 16 of relay K2. Consequently, the reproduce head is connected to the reproduce amplifier and the REPRO control is connected into the reproduce circuitry. Audio signals sensed by the reproduce head are amplified and equalized by the reproduce amplifier. Potentiometer R19 (REPRO control) is adjusted during maintenance to provide the proper audio output level. Inductor L2 and capacitor C6 form a series resonant circuit that is adjusted to resonate at the bias-signal frequency while material is being recorded on another channel or other channels. Therefore, any bias signal picked up by the reproduce head is shorted and prevented from reaching the reproduce amplifier. Capacitor C9 and inductor L3 form a parallel resonant circuit that is also resonant at the bias signal frequency. Thus, any residual bias signal is blocked by C9 and L3 before it reaches the REPRO and SEL SYNC level controls. Capacitor C8 shunts unwanted high-frequency signals to ground.

Reproducing with Sel Sync

Reproducing recorded material (on any channel) using Sel Sync is very similar to reproduction without Sel Sync except that the audio signal is taken from the record head instead of the reproduce head, and the SEL SYNC level control (R17) is used rather than the REPRO control (R19). In Sel Sync operation, the REPRO/SEL SYNC switch is set to the SEL SYNC position. As a result, the SEL SYNC lamp is turned on, and relay K2 is de-energized. Consequently, contact sets 11–12 and 5–6 of K2 connect the record head to the input of the reproduce amplifier, and contact set 14–15 selects the SEL SYNC control. Two different reproduce level controls (i.e., R17 and R19) are required because the output levels of the record and reproduce heads may be different.

Metering Circuitry

Typical metering circuitry is shown in Figure 4-3 and includes decks 2C and 3C of a NORMAL/SET UP/BIAS switch (S1), a vu meter, resistor R11, and a BIAS CAL control (R44). This circuitry is typical for all audio channels of the MM-1100 Recorder/Reproducer. In the NORMAL or SET UP position, switch S1 connects the secondary of the audio output transformer to the vu meter for that channel. In the BIAS position, switch S1 connects the vu meter across the BIAS CAL control for that channel. This control is in series with the winding of the record head for that channel. Thus, the voltage developed across the BIAS CAL control and the resulting vu meter indication are proportional to the bias-signal current passing through the record head. The BIAS CAL control is used to calibrate the vu meter during maintenance.

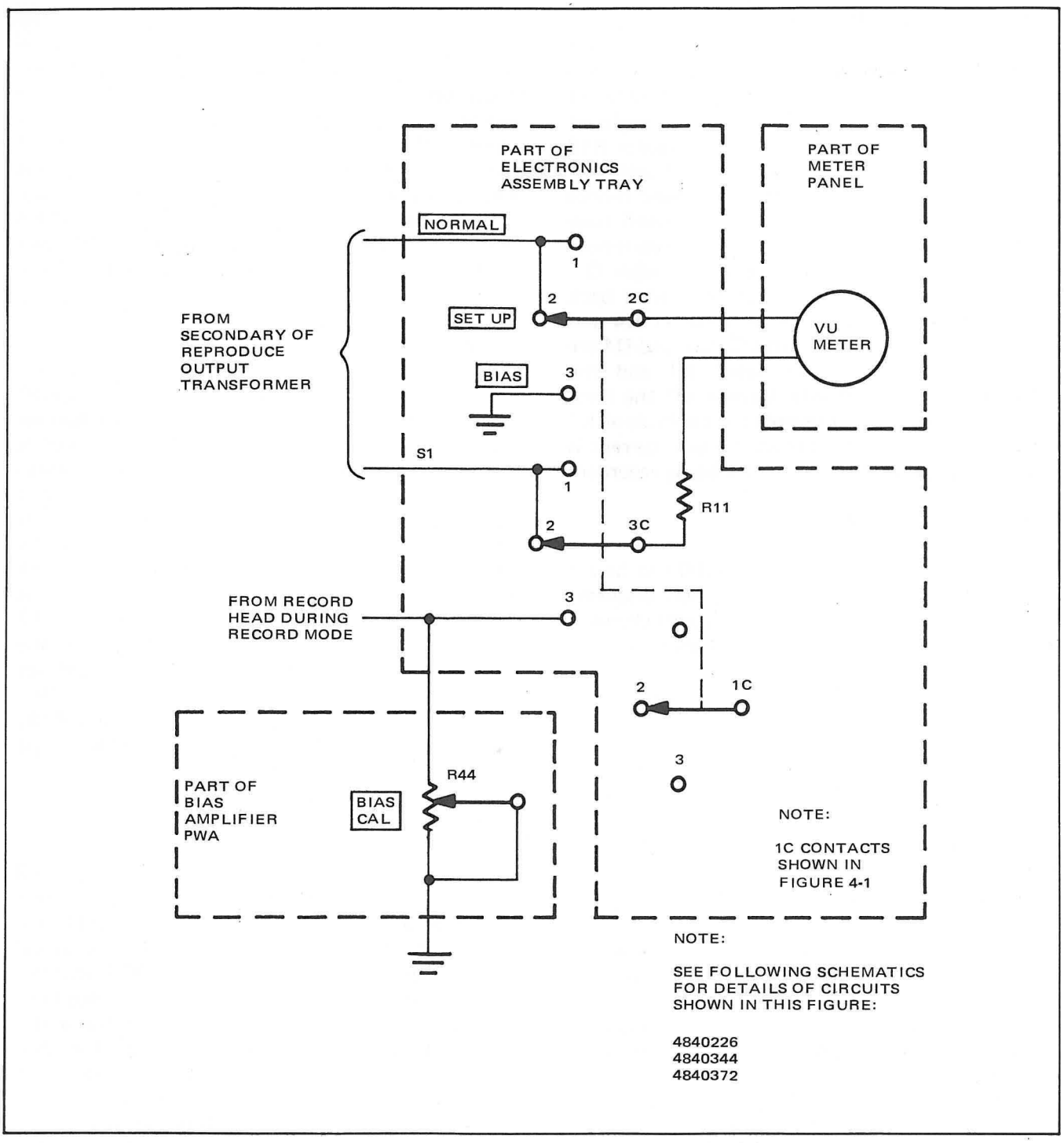


Figure 4-3. Metering Circuitry, Simplified Schematic

Bias/Erase Amplifier

Schematic 4840330 (7.5-15 in/s) and schematic 4840372 (15-30 in/s) show the circuitry of the bias/erase amplifier. This amplifier receives a 150-kHz bias/erase signal from the bias/erase oscillator on the 39-Vdc regulator/oscillator PWA whenever the MM-1100 Recorder/Reproducer is turned on.

Essentially, the bias/erase amplifier consists of two cascaded push-pull amplifiers and three adjustments. Operating power for the amplifiers is received via a transistor switch on the audio switching PWA. This switch applies power to the bias/erase amplifiers only when the record mode is selected.

The signal from the bias/erase oscillator is applied to the bases of transistors Q18 and Q19. Each transistor drives one half of the primary winding of transformer T4. The signal taken from the center-tapped secondary of T4 is used to drive a second push-pull transistor/transformer stage (Q16, Q17, T3). Both amplifier stages operate at clipping level.

The signal taken from the secondary of T3 is routed through relay contacts on the audio switching PWA and capacitor C40 (ERASE ADJ) to the erase head, and through capacitor C39 and potentiometer R80 (BIAS ADJ) to the record head. The other side of the record-head winding is connected through potentiometer R44 (BIAS CAL) to ground.

Capacitor C40 (ERASE ADJ) is adjusted to resonate with the inductance of the erase head winding to provide maximum sinusoidal current through the winding. Potentiometer R80 is used to adjust the level of bias current, and potentiometer R44 is used to calibrate the vu meter for bias-signal monitoring.

Resistors R83 and R87 are biasing resistors, and capacitors C42 and C45 are tuning capacitors. Capacitors C41, C43 and C44 are signal decouplers for the input power line.

Record Amplifier

Schematic 4840330 (7.5-15 in/s) and schematic 4840372 (15-30 in/s) show the circuitry of the record amplifier. Capacitor C24 couples the input audio signal to the base of transistor Q9. Transistor Q9 and associated components form an emitter-follower circuit that provides high input impedance for the input circuit and low-impedance drive to the record-equalizer circuit. Capacitor C52 couples the signal taken from the emitter of Q9 to potentiometer R108. The signal taken from the wiper of R108 is routed to the output stages of the reproduce amplifier in the normal record and input monitoring modes of operation.

15-30 In/s Equalization. The signal from Q9 is also connected to the 30-in/s and 15-in/s equalizer circuits. For NAB equalization, capacitors C53 and C57 and resistors R51 and R109 form the 15-in/s high-frequency equalizer network; and C54 and R52 form the 30-in/s high-frequency equalizer for 17.5-μs equalization. The output of the 15-in/s equalizer is applied to the base of transistor Q10, and the 30-in/s equalizer signal is applied to the base of transistor Q11.

For the NAB circuit, capacitor C25 provides low-frequency equalization for 15-in/s operation. However, the corresponding capacitor (C27) in the 30-in/s circuit is disabled by C56 during 30-in/s operation. Consequently, low-frequency boost is not provided for 30-in/s recording. No low-frequency boost is provided for the IEC or 17.5-μs circuits because capacitor 11C55 shorts C25 and 11C56 shorts C27.

7.5-15 In/s Equalization. Capacitor C53 and resistor R51 form the 7.5-in/s high-frequency equalizer network. The output of the 7.5-in/s equalizer is applied to the base of Q10, and the output of the 15-in/s equalizer is applied to Q11.

For the NAB circuit, capacitor C25 provides the low-frequency equalization for 7.5-in/s operation. Capacitor C25 in the 7.5-in/s circuit or C27 in the 15-in/s circuit is disabled by C55 or C56 (record equalizer 4020269-03) during 7.5-in/s or 15-in/s IEC operation.

Output Stage. Transistors Q10 and Q11 form the 15-in/s and 30-in/s or 7.5-in/s and 15-in/s equalizer amplifiers, respectively. The setting of the TAPE SPEED switch determines which of these amplifiers is enabled and which is inhibited. To inhibit amplifier Q10, a high positive level is applied to pin 5 of the record amplifier. Resistor R57 and capacitor C26 delay the voltage rise at the junction of resistors R55 and R56. Delaying the voltage rise causes transistor Q10 to turn off slowly and thus avoids switching transients. Conversely, amplifier Q10 is enabled when a low level is applied to pin 5. Amplifier Q11 is turned off and on in a similar manner.

Capacitor C30 couples the output of amplifier Q10 or Q11 to the base of transistor Q12. Transistors Q12 and Q13 and associated components form two cascaded emitter-follower circuits. These circuits provide the high signal current required for the output amplifier stage.

The output driver stage consists of transistors Q14 and Q15 and associated components. Transistor Q15 is an active collector resistance for Q14, thus allowing high recording current to be obtained. Capacitor C31 keeps signals at the base and emitter of Q15 in phase (i.e., bootstrapped), which causes the amplifier to have a high output impedance in the audio-frequency range. This high output impedance minimizes the effect of a variable load caused by the change in the record-head impedance over the audio spectrum.

Reproduce Amplifier

Schematic 4840330 (7.5—15 in/s) and schematic 4840372 (15—30 in/s) show the circuitry of the reproduce amplifier. Transformer T1 couples the audio output of the reproduce head or record head (in Sel Sync mode) to the base of transistor Q1. Transistor Q1 and associated components form a common-emitter amplifier. Base bias for Q1 is derived from the dc voltage developed across resistor R4, and capacitor C1 prevents signal degeneration. Transistor Q2 and associated components form another common-emitter amplifier. This amplifier receives its signal input from the collector of Q1 and, in turn, drives the base of transistor Q3. The dc feedback is coupled from the collector of Q2 through resistors R2 and R3 to the base circuit of Q2. Capacitor C2 decouples the function of R3 and R2 to signal ground, C4 prevents high-frequency oscillation of stage Q2, and C5 minimizes signal degeneration in the emitter circuit of Q2.

Collector voltage for Q1 and Q2 is switched on and off by transistor stage Q4. The turn on of Q4 is delayed by R38 and C8 when power is applied to the reproduce amplifier PWA. Consequently, amplifiers Q1 and Q2 are slowly brought into operation when power is first applied. Slowly turning on these amplifiers minimizes transient noise in the output audio signal and violent movement of the vu meter needle.

Transistor Q3 and associated components form an emitter-follower circuit. This circuit provides the low-impedance drive for the reproduce equalizer and the base circuit of transistor Q5. The reproduce equalizer is situated in a feedback path that interconnects the emitter of Q3 with the emitter of Q1.

High-speed or low-speed equalization is selected by control voltages that are applied to diodes CR1 and CR2. These voltages are controlled by the TAPE SPEED switch. When a high voltage is applied to pin M and a low voltage to pin N, diode CR1 is forward biased and CR2 is reverse biased. Thus, the audio signal taken from the emitter of Q3 is routed through C6, CR1, C3, R104, R103, R102, C50 and R101 to the emitter of Q1. Conversely, when CR1 is turned off and CR2 is turned on, the feedback path is via C6, CR2, C17, R107, R106, C51, R105, and R101. Potentiometers R104 and R102 are used to adjust the high-speed frequency response, and R107 and R105 are adjustments for the low-speed frequency response.

The output of emitter-follower Q3 is coupled through capacitor C7, circuitry on the audio switching PWA, and capacitor C11 to the base of transistor Q5. Capacitor C10 attenuates unwanted high frequencies, and C12 decouples the base-bias network of Q5.

Transistor Q5 and associated components form a common-emitter amplifier. The output of stage Q5

is directly coupled to common-emitter amplifier Q6, which drives complementary-amplifier Q7—Q8. Capacitor C14 enhances the dc voltage (hence current) available to the base circuit of transistor Q8 and, therefore, allows the output signal at pin 5 to swing almost to 39 volts without clipping. Resistor R25 couples feedback from the signal output line to the emitter of Q5. Resistors R26 and R25 set the overall ac gain of the amplifier formed by transistors Q5 through Q8 and associated components.

TRANSPORT CONTROL

End-of-Tape/Stop Logic

Figure 4-4 shows a simplified schematic of the end-of-tape and stop logic. These logic circuits are discussed in the following paragraphs.

End-of-Tape Logic. When the tape-threading switch is opened, or the tape supply is exhausted causing the end-of-tape sensor switch to open, a high level occurs at the input of inverters A16-6 and A5-8. The resulting low at the output of inverter A16-6 reverse biases the base/emitter junctions of transistor pair Q17, which de-energizes the brake solenoids of the supply and takeup reels. De-energizing the solenoids allows the spring-loaded brake shoes to stop both reels.

The low level developed at the output of inverter A5-8 is routed through diodes CR10 and CR2 to the stop logic (next paragraph), and is sent to the end-of-tape, reel-motor control circuitry. This circuitry causes the motor drive amplifiers for the supply and takeup motors to produce equal low-level outputs. Consequently, the reel-drive motors produce negligible torque while they are stopped and braked. (Refer to *Tape-Tension Control Circuitry/End-of-Tape* paragraph.)

Stop Logic. Assuming that there is adequate tape supply and that the tape is in motion, pressing the STOP pushbutton grounds the cathode of diode CR17 (local control) or CR18 (remote control) and initiates the tape-stopping sequence. In either case, a low level is applied to inverter A13-4 and record flip-flop A9-8/A10-8. (Refer to the *Record Logic* paragraphs for details of record logic.)

Providing the RECORD pushbutton is not depressed, diode CR21 is reverse biased, causing a high level to be applied to pin 5 of NAND gate A7-6. This high level is NANDed with the high output of inverter A13-4, which forces the output of NAND gate A7-6 to a low level. Stop flip-flop A7-8/A14-6 is set by the low level regardless of what other mode (e.g., fast forward) is currently selected. Setting the flip-flop causes a high level to be applied to pin 12 of flip-flop A3-8/11 and pin 1 of NAND gate A3-3.

Flip-flop A3-8/11 is set (pin A3-11 high) when flip-flop A7-8/A14-6 is reset (pin 8 low) by signals from the fast-forward, rewind, and play logic. (These signals are discussed in the *Fast-Forward, Rewind* and *Play Logic* paragraphs.) In order for the tape to be in motion, flip-flop A3-8/11 must already be set at the time flip-flop A7-8/A14-6 is set. Therefore, high levels are present at pins 1 and 2 of NAND gate A3-3. These high levels force the output of NAND gate A3-3 low, which causes the drive-to-stop logic to generate signals that begin slowing the tape reels toward a full stop.

When the tape reels stop, both motion-sensor switches open and cause high levels to be impressed at pins 12 and 13 of NAND gate A7-11. In turn, NAND gate A7-11 develops a low output that resets flip-flop A3-8/11. Resetting flip-flop A3-8/11 inhibits NAND gate A3-3, which produces a high level output that turns off the drive-to-stop logic.

The high and low outputs of flip-flop A3-8/11 are also sent to the record logic and the stop takeup, supply-gain, and stop-supply control circuits of the tape-tension control circuitry. A high level at pin A3-11 prevents recording until the tape has stopped. A low level at pin A3-11 causes the tape-tension control circuitry to produce the signals necessary for correct tape tension in the stop mode.

A special feature of the stop logic is that it is possible to interrupt recording and still keep the tape in motion at the selected recording speed. To select this special feature, the STOP pushbutton must be momentarily pressed while the RECORD pushbutton is held down. The low level from the STOP switch resets the record flip-flop (*Record Logic* paragraphs), and the low level from the

RECORD pushbutton inhibits NAND gate A7-6. Inhibiting this NAND gate prevents flip-flop A7-8/A14-6 from being set by the signal from the STOP switch. Therefore, the tape remains in motion at the selected speed while the record mode is inhibited. When selecting this special feature, the stop pushbutton must be released before the RECORD pushbutton; otherwise, the stop mode will be initiated. Both the RECORD and PLAY pushbuttons must be simultaneously depressed to re-enter the record mode.

Another feature of the stop logic ensures that the stop mode is selected when the tape machine is turned on. The time constant of capacitor C19 and resistor R33 is long in comparison to similar RC circuits in the fast-forward, rewind, play, and record logic (e.g., R34, C20). This long time constant causes pin 3 of inverter A13-4 to remain low for a relatively long period after the tape machine is turned on. Consequently, the tape machine is switched to the stop mode and held there until power-supply voltages have stabilized and spurious mode-selection signals have dissipated.

Stopping can also be initiated by the end-of-tape logic. When the end-of-tape condition is sensed, diode CR2 passes a low-level signal that sets stop flip-flop A7-8/A14-6 regardless of the mode of operation currently selected. Consequently, the tape-stopping sequence is initiated, and the tape is ultimatedly brought to a halt.

Fast-Forward Logic

The fast-forward mode is initiated by pressing the FAST FORWARD pushbutton, which grounds the cathode of diode CR19 (local control) or CR23 (remote control) (see Figure 4-5). In either case, a low level is impressed at pin 5 of fast-forward flip-flop A1-6/A2-6 and is sent to the reset inputs of the rewind, stop, play, and record flip-flops and to the play logic. (Refer to the *Rewind Logic, End-of-Tape/Stop Logic, Play Logic*, and *Record Logic* paragraphs.)

Flip-flop A1-6/A2-6 is set by the low at pin A1-5 and develops a high level at pin A1-6 and a low level at pin A2-6. The low level is inverted into a high level by inverter A13-12, which turns on transistor Q13. Turning on Q13 completes the circuit for the FAST FORWARD indicator, causing it to light. The high level at pin A1-6 is supplied to pin 1 of NAND gates A6-3 and A1-3.

Flip-flop A1-8/11 and NAND gates A6-3 and A1-3 form a logic circuit that detects whether the record mode is selected or the tape is stopped. The intent of this logic is to prevent the tape from being rapidly accelerated to the fast-forward speed if the FAST FORWARD pushbutton is pressed while material is being recorded. A sudden transition from recording speed to fast-forward speed could cause popping or other noises in the recording.

Flip-flop A1-8/11 is held reset (pin A1-8 high) while recording. Therefore, if the fast-forward mode is selected while recording, the high level from pin A1-8 and the high level from pin A1-6 force the output of NAND gate A1-3 low. This low level enables the drive-to-stop logic. (Refer to *Drive-to-Stop Logic* paragraph.) As soon as the tape stops, a low level from the motion-sense logic (*End-of-Tape/Stop Logic* paragraph) is impressed at pin A1-13. This low level sets flip-flop A1-8/11, which inhibits NAND gate A1-3 and enables NAND gate A6-3. Consequently, the drive-to-stop logic is inihibited, a tape-lift signal is generated, and the F FWD SUPPLY and SUP GAIN controls are enabled. Enabling these controls causes the tape to be accelerated to the fast-forward speed.

If the tape is stopped at the time the fast-forward mode is selected, flip-flop A1-8/11 is set (pin A1-11 high). As a result, NAND gate A6-3 is immediately enabled, and the tape is accelerated to the fast-forward speed.

Rewind Logic

The rewind mode is initiated by pressing the REWIND pushbutton, which grounds the cathode of diode CR15 (local control) or CR16 (remote control) (see Figure 4-6). In either case, a low level is impressed at pin 1 of rewind flip-flop A7-3/A2-8 and is also sent to the reset inputs of the stop, play, and record flip-flops and play logic. (Refer to the *End-of-Tape/Stop Logic, Play Logic* and *Record Logic* paragraphs.)

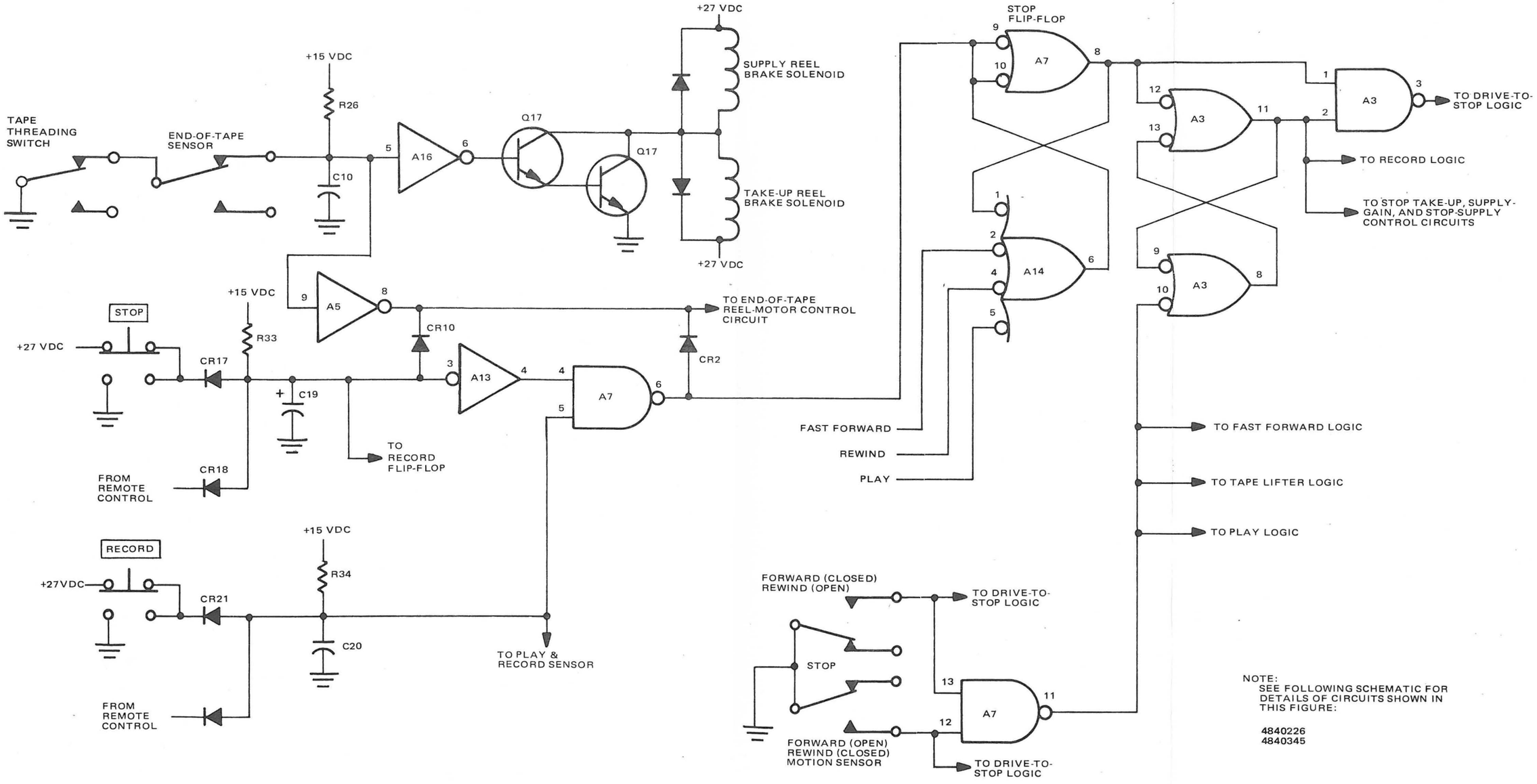


Figure 4-4.
End-of-Tape and Stop Logic, Simplified Schematic

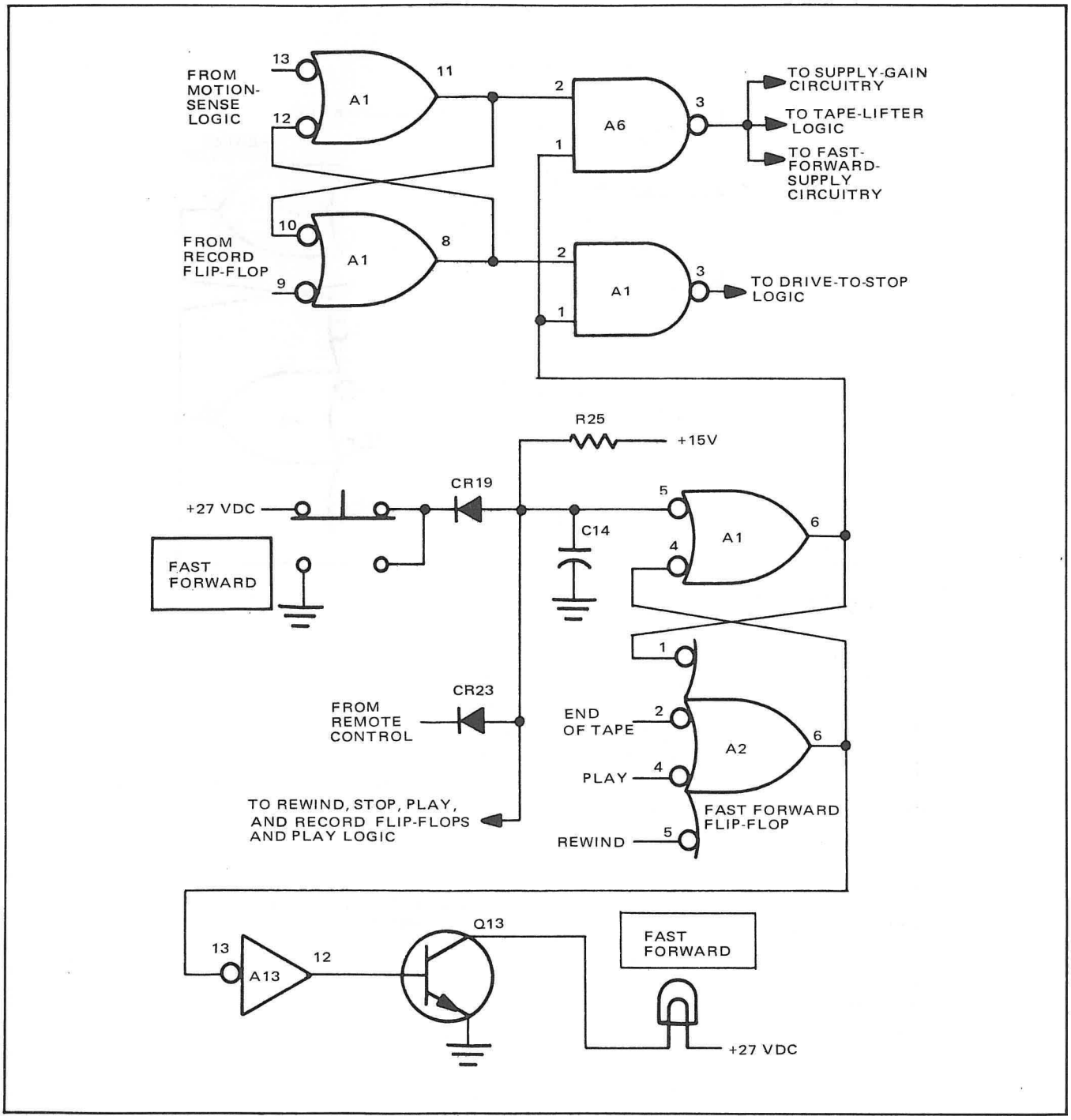


Figure 4-5. Fast-Forward Logic, Simplified Schematic

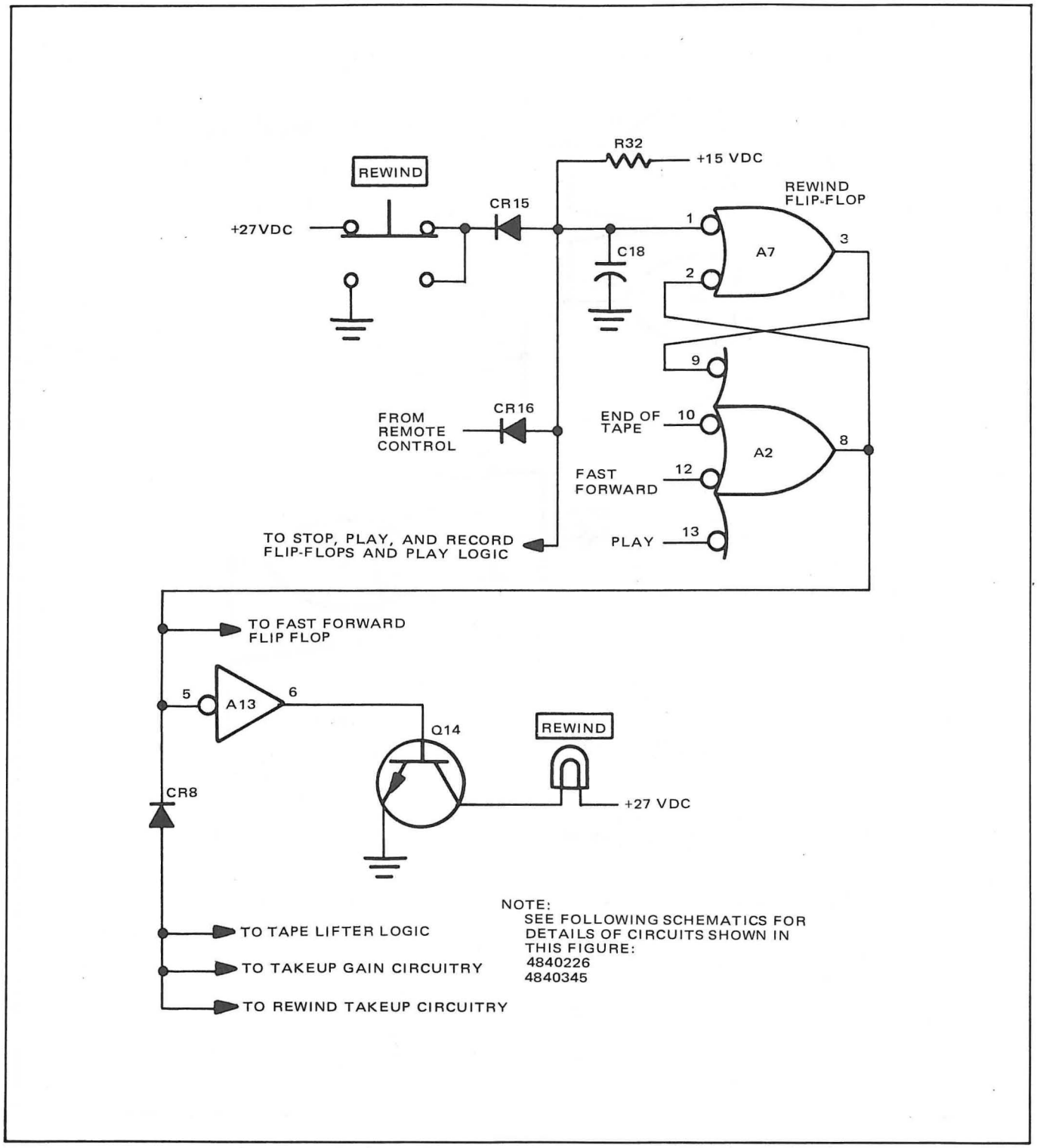


Figure 4-6. Rewind Logic, Simplified Schematic

Flip-flop A7-3/A2-8 is set by the low at pin A7-1 and develops a low level at pin A2-8. This low level is inverted into a high level by inverter A13-6, which turns on transistor Q14. Turning on Q14 completes the circuit for the REWIND indicator, causing it to light.

The low level at pin A2-8 is also supplied to the reset input of the fast-forward flip-flop and enables the tape-lifter logic, T-UP GAIN control and the REW TAKE-UP control. Resetting the fast-forward flip-flop prevents the simultaneous selection of the fast-forward and rewind modes. Enabling the T-UP GAIN and REW TAKE-UP controls initiates tape rewinding. Diode CR8 prevents the drive-to-stop logic from erroneously setting rewind flip-flop A7-3/A2-8 or resetting fast-forward flip-flop A1-6/A2-6.

Play Logic

Figure 4-7 shows the control logic for the play and record modes. Pressing the PLAY pushbutton forward biases diode CR13, causing a low level to be applied to pin 9 of inverter A13-8. Alternately, the play mode can be initiated by grounding the cathode of diode CR14, using a remote-control unit. Providing the STOP, FAST FORWARD, or REWIND pushbutton is not depressed, the output of NAND gate A14-8 is forced low by the high output of inverter A13-8. The low level at A14-8 resets the fast forward, rewind, and stop flip-flops and sets play flip-flop A3-6/A9-6.

The low level developed at pin A9-6 of the play flip-flop is inverted by inverters A5-10 and A5-6. Transistor Q21 is turned on by the high output of inverter A5-6 and completes the circuit to lamp DL4, thus lighting the PLAY indicator. Simultaneously, the high output of inverter A5-10 is applied to flip-flop A6-8/11 and NAND gate A6-6.

If the tape is in motion when the play mode is selected, the level at pin 8 of flip-flop A6-8/11 is high. Thus, the high output of inverter A5-10 forces the output of NAND gate A6-6 low. This low level enables the drive-to-stop logic, causing the tape to be brought to rest. Once the tape is stopped, the motion sensor resets (pin A6-8 low) flip-flop A6-8/11. The low level at pin A6-8 is applied to NAND gate A6-6, inverter A18-3, gate A15-3, diode CR12, the play supply, supply-gain, and play-takeup control circuits and the tape-lifter logic. (The function of NAND gate A15-3 is discussed in the *Record Logic* paragraphs.)

Pin 6 of NAND gate A6-6 is forced high by the low output of flip-flop A6-8/11, thus disabling the drive-to-stop logic. Inverter A18-3 output is a high level that enables the capstan servo. At the same time, the low level applied to the play supply, supply-gain, and play-takeup control circuits enables these circuits to cause the proper tape tension for the play mode. In addition, the low level applied to the tape-lifter logic allows the tape to be brought in contact with the heads. Capacitor C12 delays the low level passed by diode CR12. When the low is impressed at pin 12 of inverter A15-11, pin A15-11 goes high and turns on transistor pair Q15, which energizes the pinch-roller solenoids and causes the tape to be pulled at the proper speed. The delay provided by C12 permits the capstan to come to speed before the pinch roller is actuated. In addition, the delay also prevents the pinch roller from being rapidly moved in and out if the play or record mode is rapidly alternated with the stop mode. If the tape is at rest when the play mode is selected, flip-flop A6-8/11 is already reset, and the play mode is entered immediately.

Record Logic

The record mode is a variation of the play mode. Hence, as shown in Figure 4-7, the record and play logic circuits are interrelated.

To select the record mode, both the PLAY and RECORD pushbuttons must be simultaneously depressed or simultaneous low levels must be supplied to the remote-control inputs (CR14, CR22). All of the logic discussed in the *Play Logic* paragraph functions exactly the same way in both the play and record modes. The low level developed at the output of NAND gate A14-8 is inverted by inverter A13-10 and applied to pin 9 of NAND gate A15-8. Inverter A16-8 inverts the low level passed by diode CR21 or CR22, causing NAND gate A15-8 to develop a low level at its output. This low level is inverted by inverter A16-4, and the resulting high level is applied to pin 5 of gate A15-6.

If the tape is moving when the record mode is selected, high levels are present at pins 1 and 2 of gate A15-3. (Refer to *Stop Logic* and *Play Logic* paragraphs.) These high levels force the output of gate A15-3 low. In turn, this low-level output inhibits gate A15-6. When the tape stops, low levels are applied to pins 1 and 2 of gate A15-3, forcing the output of the gate to a high level. This high level and the high level present at pin 5 of gate A15-6 force the output of the gate to a low level that is applied to inverter A16-12 and record flip-flop A9-8/A10-8.

Inverter A16-12 develops a high-level output that turns on transistor pair Q19, thus sending a record-pulse signal to the SAFE/READY switches. When the SAFE/READY switch for a particular channel is set to READY, the channel is enabled for recording, and the READY indicator is lighted.

Record flip-flop A9-8/A10-8 is set (pin A9-8 low) by the low-level output from NAND gate A15-6. Inverter A16-2 inverts the low-level output from flip-flop A10-8/A9-8, and the resulting high level turns on transistor Q20. Turning on Q20 completes the circuit for lamp DL5, thereby lighting the RECORD indicator. Similarly, inverter A16-10 inverts the low level from A10-8/A9-8 and turns on transistor pair Q18. The low output (record hold) of Q18 is sent to the SAFE/READY switches. To ensure that the fast-forward mode is cancelled before entering the record mode, the low output of the record flip-flop is also used to reset the fast-forward flip-flop.

Drive-to-Stop Logic

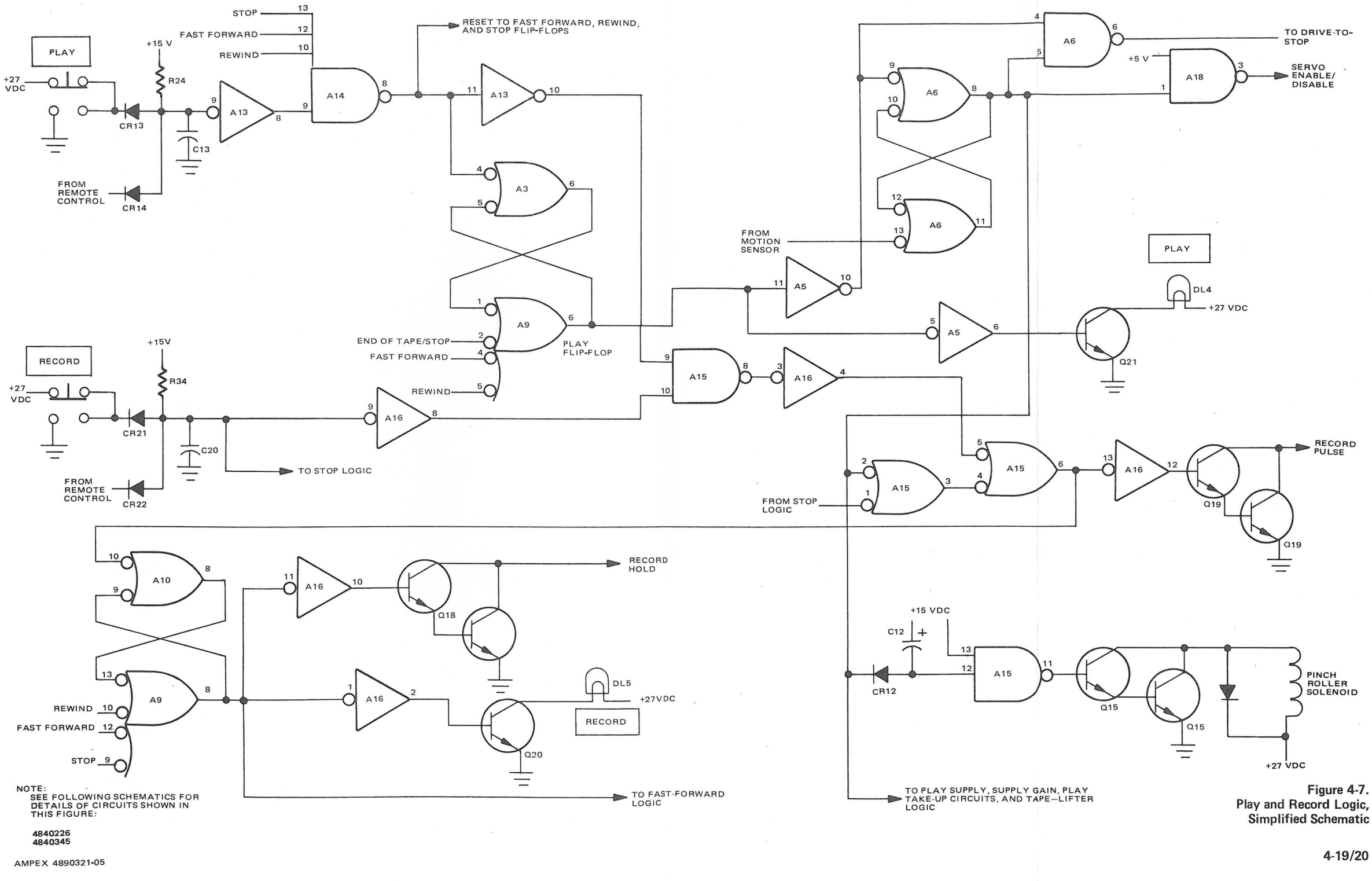
The drive-to-stop logic (Figure 4-8) causes full power to be applied to the reel motor that is supplying hold-back tension when transferring from any mode to stop, from any tape-motion mode to play or record mode, or from record mode to fast-forward mode. Once the tape is at reset, the drive-to-stop logic allows the logic of the selected mode to control tape motion.

Stopping. When the tape is in motion and the stop mode is selected or the tape supply is exhausted (end of tape), a low level is applied to pin 10 of NAND gate A8-8. In turn, the resulting high level developed at pin A8-8 is applied to pin 12 of NAND gate A8-11 and pin 2 of NAND gate A8-3. If the tape is being rewound, the tape-motion sensor grounds pin 1 of NAND gate A8-3, inhibiting the gate. At the same time, the tape-motion sensor supplies an open (high) to pin 13 of NAND gate A8-11. Consequently, the output of NAND gate A8-11 is forced low. This low level initiates the fast-forward mode (*Fast-Forward Logic* paragraph), sets (pin A10-3 high) flip-flop A10-3/6, and forces the output of NAND gate A8-6 high. (Flip-flop A10-3/6 and NAND gate A8-6 are discussed in the *Tape-Lifter Logic* paragraph.) Placing the tape transport in the fast-forward mode offsets the tape motion imparted by the rewind mode, thus slowing tape motion toward stop.

If the tape is moving forward (i.e., fast-forward, play, or record mode), the tape-motion sensor grounds pin 13 of NAND gate A8-11, inhibiting the gate. Simultaneously, the tape-motion sensor supplies an open (high) to pin 1 of NAND gate A8-3, forcing the output of the gate low. This low level initiates the rewind mode (*Rewind Logic* paragraph) and forces the output of NAND gate A8-6 high. (NAND gate A8-6 is discussed in the *Tape-Lifter Logic* paragraphs.) Placing the tape transport in the rewind mode offsets the tape motion imparted by the forward mode, thus slowing tape motion toward stop.

When the tape stops, both motion-sensing switches open, forcing the output of NAND gate A7-11 low. This low level causes the end-of-tape/stop logic (*End-of-Tape/Stop Logic* paragraphs) and the fast-forward logic (*Fast-Forward Logic* paragraphs) to apply a high level to pin 10 of NAND gate A8-8, and also causes the play logic (*Play Logic* paragraphs) to apply a high level to pin 9 of NAND gate A8-8. These high levels force the output of NAND gate A8-8 low, which inhibits NAND gates A8-11 and A8-3. Consequently, either the fast-forward or rewind mode is cancelled and NAND gate A8-6 (*Tape-Lifter Logic* paragraphs) is enabled.

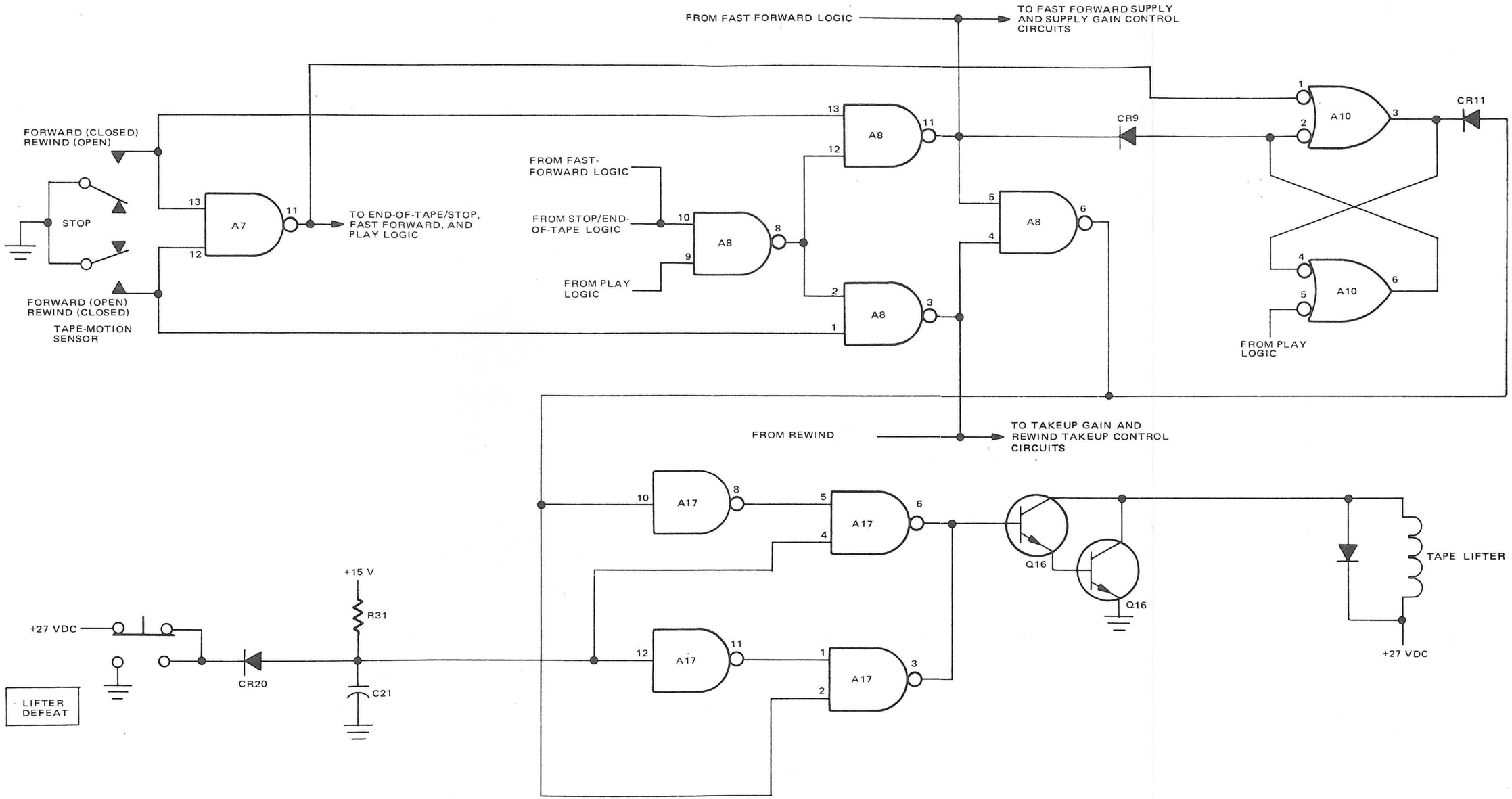
Record to Fast Forward. To prevent extraneous noise from being recorded when the fast-forward mode is selected during the record mode, the transport control logic causes the tape to be brought to a stop before accelerating to fast-forward speed. Accordingly, a low-level taken from the fast-forward logic is applied to pin 10 of NAND gate A8-8 when the fast-forward mode is



NOTE:
SEE FOLLOWING SCHEMATICS FOR DETAILS OF CIRCUITS SHOWN IN THIS FIGURE:

4840226
4840345

Figure 4-7.
Play and Record Logic, Simplified Schematic



NOTE:
SEE FOLLOWING SCHEMATICS FOR DETAILS OF CIRCUITS SHOWN IN THIS FIGURE:

4840226
4840345

Figure 4-8.
Drive-to-Stop and Tape-Lifter Logic, Simplified Schematic

selected while recording. This low level causes the drive-to-stop logic to perform in the same manner as when a low level is received from the end-of-tape/stop logic while the tape is moving forward. (Refer to *Stopping* paragraphs.)

Tape-Motion Mode to Play or Record. When the tape is in motion and either the play or record mode is selected, the transport control logic causes the tape to be brought to a stop before entering the play or record mode. Therefore, a low level taken from the play logic is applied to pin 9 of NAND gate A8-8 when the play or record mode is selected while the tape is in motion. This low level causes the drive-to-stop logic to perform in the same manner as when a low level is received from the end-of-tape/stop logic while the tape is in motion in either direction. (Refer to *Stopping* paragraphs.)

Tape-Lifter Logic

The tape-lifter logic (Figure 4-8) causes the tape to be placed against or lifted from the heads, depending on the mode of operation. In normal operation, the tape is placed against or lifted from the heads automatically. Using the LIFTER DEFEAT pushbutton, the tape can be moved opposite to the position selected by the automatic circuitry. That is, if the tape is away from the heads, pressing the LIFTER DEFEAT pushbutton causes the tape to be placed against the heads. Conversely, if the tape is against the heads, pressing the LIFTER DEFEAT pushbutton causes the tape to be lifted from the heads.

Tape Stopped. When the tape is stopped, the outputs of NAND gates A8-3 and A8-11 are high and the output of NAND gate A7-11 is low. The low output of NAND gate A7-11 holds flip-flop A10-36 reset (pin A10-3 high) and, therefore, prevents the flip-flop from influencing the logic.

The output of NAND gate A8-6 is forced low by the high outputs of NAND gates A8-3 and A8-11. This low level is inverted by inverter A17-8, causing a high level to be impressed at pin 5 of NAND gate A17-6. Providing the LIFTER DEFEAT pushbutton is not depressed, pin 4 of NAND gate A17-6 is also high. Therefore, the output of NAND gate A17-6 is forced low, which turns off transistor pair Q16. Turning off Q16 opens the circuit to the tape-lifter circuitry, causing the tape to be moved to the heads.

Fast Forward Initiation. When the fast-forward mode is selected or the tape is being driven to stop from the rewind direction of travel, a low level is applied to pin 5 of NAND gate A8-6 and to pin 2 of flip-flop A10-3/6. If play mode was the previous mode of operation, flip-flop A10-3/6 is reset (pin A10-3 high) by the low level impressed at pin A10-2. Resetting flip-flop A10-3/6 prevents it from affecting the operation of the tape-lifter logic. However, the low level applied to pin 5 of NAND gate A8-6 drives pin A8-6 high. Inverter A17-8 inverts this high level, causing a low level to be impressed at pin 5 of NAND gate A17-6. Providing the LIFTER DEFEAT switch is not depressed, the low level at pin A17-5 drives pin A17-6 high, which turns on transistor pair Q16. Turning on Q16 completes a circuit to the tape-lifter circuitry, causing the tape to be lifted away from the heads.

Rewind Initiation. When the rewind mode is selected or the tape is being driven to stop from the forward direction of travel, a low level is applied to pin 4 of NAND gate A8-6. As a result, NAND gate A8-6 produces a high-level output that causes the tape to be lifted from the heads in the same manner as described in the *Fast-Forward Initiation* paragraph.

Play Record Initiation. When the play or record mode is selected, a low level is applied to pin A10-5, causing flip-flop A10-3/6 to be set (pin A10-3 low). Inverter A17-8 inverts this low level, causing a high level to be impressed at pin 5 of NAND gate A17-6. Providing the LIFTER DEFEAT pushbutton is not depressed, a high level is also present at pin A17-4. Consequently, a low level is developed at the output of NAND gate A17-6 that turns off transistor pair Q16. Turning off Q16 opens the ground circuit of the tape-lifter circuitry, allowing the tape to be brought in contact with the heads.

Lifter Defeat Logic. If the automatic tape-lifter logic has caused the tape to be raised from the heads, transistor pair Q16 is forward biased and conducting. Pressing the LIFTER DEFEAT pushbutton applies a low level to pin A17-4 and to pin 12 of inverter A17-11. In turn, inverter A17-11 applies a high level to pin 1 of NAND gate A17-3. A high level is also present at pin A17-2 because of the high-level output from NAND gate A8-6. Therefore, the output of NAND gate A17-3 is forced low, turning off transistor pair Q16. Turning off Q16 disables the tape-lifter circuitry, allowing the tape to be brought in contact with the heads.

If the automatic tape-lifter logic has caused the tape to be contacting the heads, transistor pair Q16 is reverse biased and, therefore, turned off. Pressing the LIFTER DEFEAT pushbutton applies a low level to pin A17-12 and to pin 4 of NAND gate A17-6. As a result, a high level is applied to transistor pair Q16, turning on the transistors. With Q16 conducting, the tape-lifter circuitry is enabled, causing the tape to be moved away from the heads.

Tape-Tension Circuitry

Figure 4-9 shows the tape-tension control, stabilizer unit, and motor drive amplifier circuitry. The tape-tension control circuitry receives error signals from the tape-tension sensor assembly; control signals from the stop, end-of-tape, play/record, fast-forward, rewind and drive-to-stop logic; and a ground from a jumper on the erase head connector when two-inch tape is used. In turn, the tape-tension control circuitry furnishes low-level drive signals through the stabilizer unit to the takeup and supply motor drive amplifier (MDA).

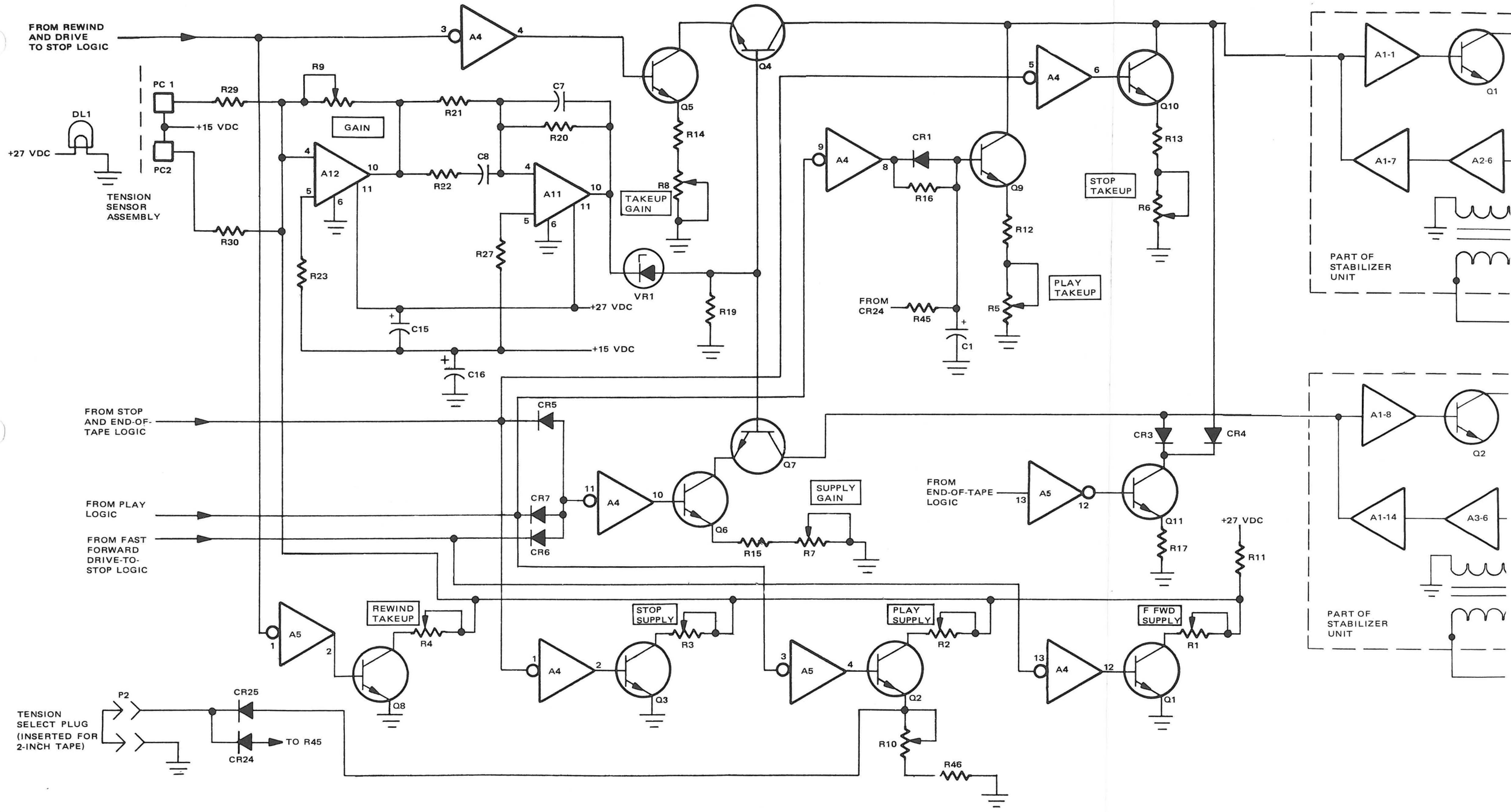
Tension Error Amplifier. The error signals developed by photo-cells PC1 and PC2 of the tension sensor assembly are coupled to the input (pin A12-4) of a two-stage tension-error amplifier. Amplifier gain is determined by the setting of potentiometer R9. Potentiometers R1 through R4 and R10 are used to set the quiescent operating point of the amplifier. Potentiometer R9 is always active in the amplifier circuit, but potentiometers R1 through R4 and R10 are switched in and out of the circuit in accordance with tape-tension requirements. The output of the error amplifier is coupled through level-shifter VR1/R19 to the bases of common-emitter amplifiers Q4 and Q7.

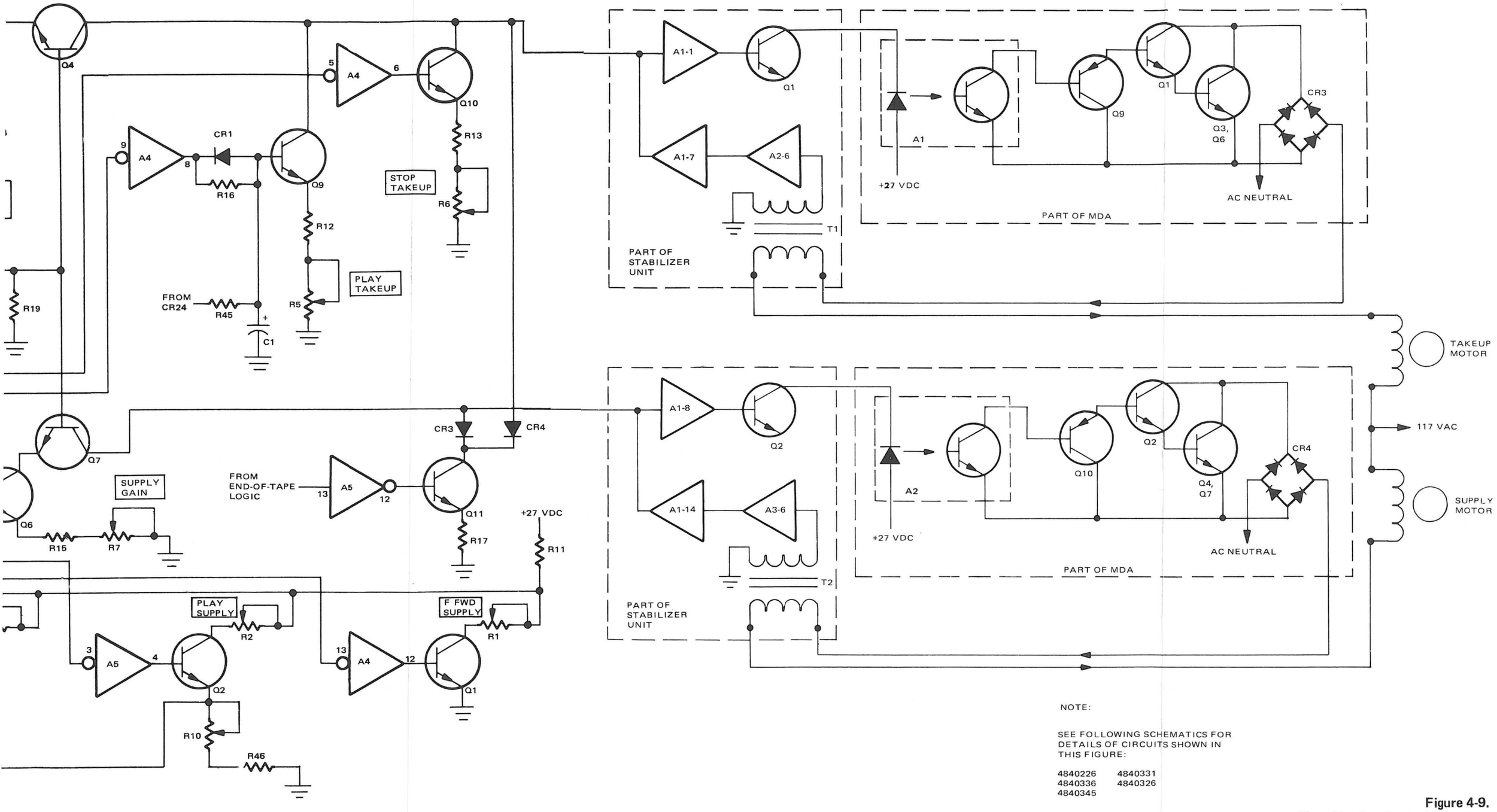
The gain of amplifier Q4 is determined by the setting of potentiometer R8. Similarly, the gain of amplifier Q7 is determined by the setting of potentiometer R7. These potentiometers are switched in and out of the tension-error amplifier circuits in accordance with the mode of operation.

Stabilizer Unit. The output of error signal amplifiers Q4 and Q7 is modified by the stabilizer unit and applied to photocouplers A1 and A2 of the MDA assembly (refer to *Motor Drive Amplifier* paragraphs). The stabilizer unit counteracts the effects of changing ac power and temperature variations to provide better control of the supply and takeup ac motors. This is accomplished by continuously monitoring the current drawn through each motor and correcting the takeup and supply error signals. The stabilizer unit contains identical takeup and supply circuitry and therefore only the takeup circuitry is described.

Transformer T1, in series with the MDA and the takeup motor, provides an ac signal that is dependent upon the amount of current being drawn through the motor. This ac signal is sent to operational amplifier-rectifier A2-6 that provides a full-wave rectified signal proportional to the amplitude of the ac input signal. The high gain of the operational amplifier-rectifier greatly reduces the turn-on delay associated with conventional diode rectification. The rectified signal, which is a feedback signal proportional to the amount of motor current, is buffered by A1-7 and applied to the input of mixer amplifier A1-1. The feedback signal is subtracted from the takeup error signal and is routed from the collector of Q1 to photocoupler A1 in the MDA assembly.

Play or Record Mode. When the play or record mode is selected, a low level developed by the play logic (*Play Logic* paragraphs) is applied to inverters A4-8, A4-10, and A5-4. In turn, these inverters supply high levels to transistors Q9, Q6, and Q2, respectively. Transistors Q6 and Q2 turn on immediately, but the turn on of Q9 is delayed by R16 and C1. As a result, the light-emitting diode in the takeup photocoupler (A1) is cut off momentarily causing the takeup motor to develop full


FROM REWIND AND DRIVE TO STOP LOGIC
FROM STOP AND END-OF-TAPE LOGIC
FROM PLAY LOGIC
FROM FAST FORWARD DRIVE-TO-STOP LOGIC
TENSION SENSOR ASSEMBLY
DL1
+27 VDC
PC 1
PC2
+15 VDC
R29
R30
R9
GAIN
R21
C7
R20
C8
R22
A12
A11
A4
A5
R23
R27
C15
C16
+27 VDC
+15 VDC
VR1
R19
TAKEUP GAIN
R8
R14
Q5
Q4
CR5
CR7
CR6
Q7
Q6
R15
R7
SUPPLY GAIN
REWIND TAKEUP
R4
Q8
STOP SUPPLY
R3
Q3
PLAY SUPPLY
R2
Q2
F FWD SUPPLY
R1
Q1
CR1
R16
Q9
R12
R5
PLAY TAKEUP
FROM CR24
R45
C1
Q10
R13
R6
STOP TAKEUP
FROM END-OF-TAPE LOGIC
Q11
R17
+27 VDC
R11
CR3
CR4
R10
R46
TENSION SELECT PLUG (INSERTED FOR 2-INCH TAPE)
P2
CR25
CR24
TO R45
A1-1
Q1
A1-7
A2-6
PART OF STABILIZER UNIT
A1-8
Q2
A1-14
A3-6
PART OF STABILIZER UNIT



NOTE:

SEE FOLLOWING SCHEMATICS FOR DETAILS OF CIRCUITS SHOWN IN THIS FIGURE:

4840226 4840331
4840336 4840326
4840345

Figure 4-9.
Tape-Tension Control Circuitry, Simplified Schematic

torque for starting (boost torque). Turning on Q6 enables and sets the gain of amplifier Q7, and turning on Q2 sets the gain of the tension error amplifier.

When Q9 turns on, a constant current is supplied to the light-emitting diode in photocoupler A1. As a result, a constant drive is furnished by the takeup MDA to the takeup motor. A varying drive, determined by the tension-sensor assembly, is amplified by the tension-error amplifier and amplifier Q7 and supplied to photocoupler A2 of the supply MDA. In turn, the supply MDA controls the holdback torque of the supply motor to establish the proper tape tension.

Rewind. When the rewind mode is selected or the drive-to-stop logic automatically selects rewind, a low level is furnished to inverters A4-4 and A5-2. The resulting high levels produced by these inverters turn on transistors Q5 and Q8, respectively.

Turning on Q5 enables and sets the gain of amplifier Q4, and turning on Q8 sets the gain of the tension error amplifier. Because amplifier Q7 is not enabled, no drive is applied to the light-emitting diode in photocoupler A2 of the supply MDA assembly. With the light-emitting diode cut off, the supply MDA supplies full driving power to the supply motor, causing it to develop full torque. Consequently, the tape is rapidly wound onto the supply reel. Proper tape tension is maintained by the error signal from the tension-sensor assembly. This signal is amplified by the tension error amplifier and amplifier Q4 and used to control the takeup MDA, which, in turn, controls the holdback torque of the takeup motor.

Fast Forward. When the fast-forward mode is selected or the drive-to-stop logic automatically selects fast forward, a low level is furnished to inverters A4-10 and A4-12. The resulting high levels produced by these inverters turn on transistors Q6 and Q1, respectively.

Turning on Q6 enables and sets the gain of amplifier Q7, and turning on Q1 sets the gain of the tension error amplifier. Because amplifier Q4 is not enabled, no drive is applied to the light-emitting diode in photocoupler A1 of the takeup MDA assembly. With the light-emitting diode cut off, the takeup MDA supplies full driving power to the takeup motor, causing it to develop full torque. Consequently, the tape is rapidly wound onto the takeup reel. Proper tape tension is maintained by the error signal from the tension-sensor assembly. This signal is amplified by the tension error amplifier and amplifier Q7 and used to control the supply MDA, which, in turn, controls the holdback torque of the supply motor.

Stop. When the stop mode is selected and the tape reels have actually stopped, a low level is furnished to inverters A4-6, A4-10, and A4-2. The resulting high levels from these inverters turn on transistors Q10, Q6, and Q3, respectively.

Turning on Q10 allows a constant current to pass through the light-emitting diode in photocoupler A1 of the takeup MDA. As a result, a constant drive is furnished by the takeup MDA to the takeup motor. Turning on Q6 enables and sets the gain of amplifier Q7, and turning on A3 sets the gain of the tension error amplifier. The error signal developed by the tension-error assembly is amplified by the tension-error amplifier Q7, and the supply motor drive amplifier. Consequently, sufficient drive is supplied to the supply motor to offset the torque of the takeup reel and hold the tape at rest with the proper tension.

End of Tape. When the tape-threading switch is opened or the tape supply is exhausted, the end-of-tape logic furnishes a low level to inverter A5-12. Transistor Q11 is turned on by the high output of inverter A5-12 and supplies a high current to the light-emitting diodes of photocouplers A1 and A2 of the MDA assembly. Thus, equal and low-level drive signals are supplied by the MDAs to the takeup and supply motors to keep them from turning.

Tension Select. Either one-inch or two-inch tape may be used on the tape transport. Therefore, a tape tension appropriate for either tape width is required for the play and record modes. The tape tension is automatically changed to the correct range when changing to a different size head assembly (minor readjustment of tensions may be necessary). The two-inch head assembly has a jumper connected between pins X and V on erase head connector J1. Inserting a two-inch head assembly (1) changes the quiescent operating point of the tension-error amplifier in the play and record modes by shorting the emitter of transistor Q2 to ground and (2) lowers the constant drive current supplied to the light-emitting diode in the takeup MDA. Lowering the diode drive current increases the torque of the takeup motor and, therefore, increases tape tension to the proper magnitude for two-inch tape.

Motor Drive Amplifiers

The motor drive amplifier (MDA) assembly contains two identical MDAs and a part of the capstan servo MDA. (Refer to *Capstan Servo* paragraphs for information about the circuitry of the capstan servo.) One of the MDAs drives the takeup motor, and the other drives the supply motor. Because the MDAs are identical, only the takeup MDA is discussed in detail.

The takeup drive signal from the tape-tension control circuitry of the transport control PWA is applied across the light-emitting diode in photocoupler A1 (see schematic 4840336). As discussed in the above text about the tape-tension control circuitry, current flow through the diode is determined by the mode of operation and tape-tension. High current through the diode results in low motor torque, and low current causes high torque.

Current flow through the diode causes it to emit light, which causes base current to flow in the phototransistor of the photocoupler. Current flow through the phototransistor varies directly with the current flowing through the light-emitting diode. The phototransistor drives transistor Q9, which is shunted across the base-emitter junctions of transistors Q1, Q3, and Q6.

Transistors Q3 and Q6 are connected in parallel, and this parallel combination is Darlington connected with Q1. Hence, the conduction of Q3 and Q6 varies directly with the base current of Q1. If the phototransistor is turned off, the base current of Q1 is high and limited largely by resistor R1. Conversely, the more the phototransistor conducts, the less current is available to the base of Q1, thus reducing the motor torque.

Transistor Q3 and its emitter resistor are connected in series across diode bridge CR3. Transistor Q6 and its emitter resistor R7 are similarly connected across CR3. These transistors control the current passing through the diodes of the bridge and the windings of the takeup motor. Winding current is directly proportional to torque.

Figure 4-10 shows a partial schematic of the takeup motor and diode-bridge control circuit. Notice that 117 Vac is connected across the motor and bridge circuit. When pin 1 of the motor is positive with respect to the ac neutral line, electrons flow from the ac neutral line through CR3-2, R6, R7, Q3, Q6, CR3-4, and the takeup motor to the positive potential. Conversely, when the ac neutral line is positive in respect to pin 1 of the takeup motor, electronics flow through the takeup motor, CR3-3, R6, R7, Q3, Q6, and CR3-1 to the ac neutral line. Notice that both alternations flow through Q3 and Q6 in the same direction. Consequently, the ac current through the takeup motor can be controlled by varying the base drive of the transistors.

Referring again to schematic 4840336, capacitor C3 lends stability to the MDA circuit, and resistor R1 limits the current passing through the base circuit of transistor Q1. The network composed of resistor R3 and C2 provides circuit stability and suppresses transients caused by the takeup motor. Diode CR1 prevents reverse voltages from being applied to the phototransistor and transistors Q1, Q3, and Q6. Resistors R6 and R7 ensure that the current divides equally between transistors Q3 and Q6. Capacitor C6 provides noise suppression.

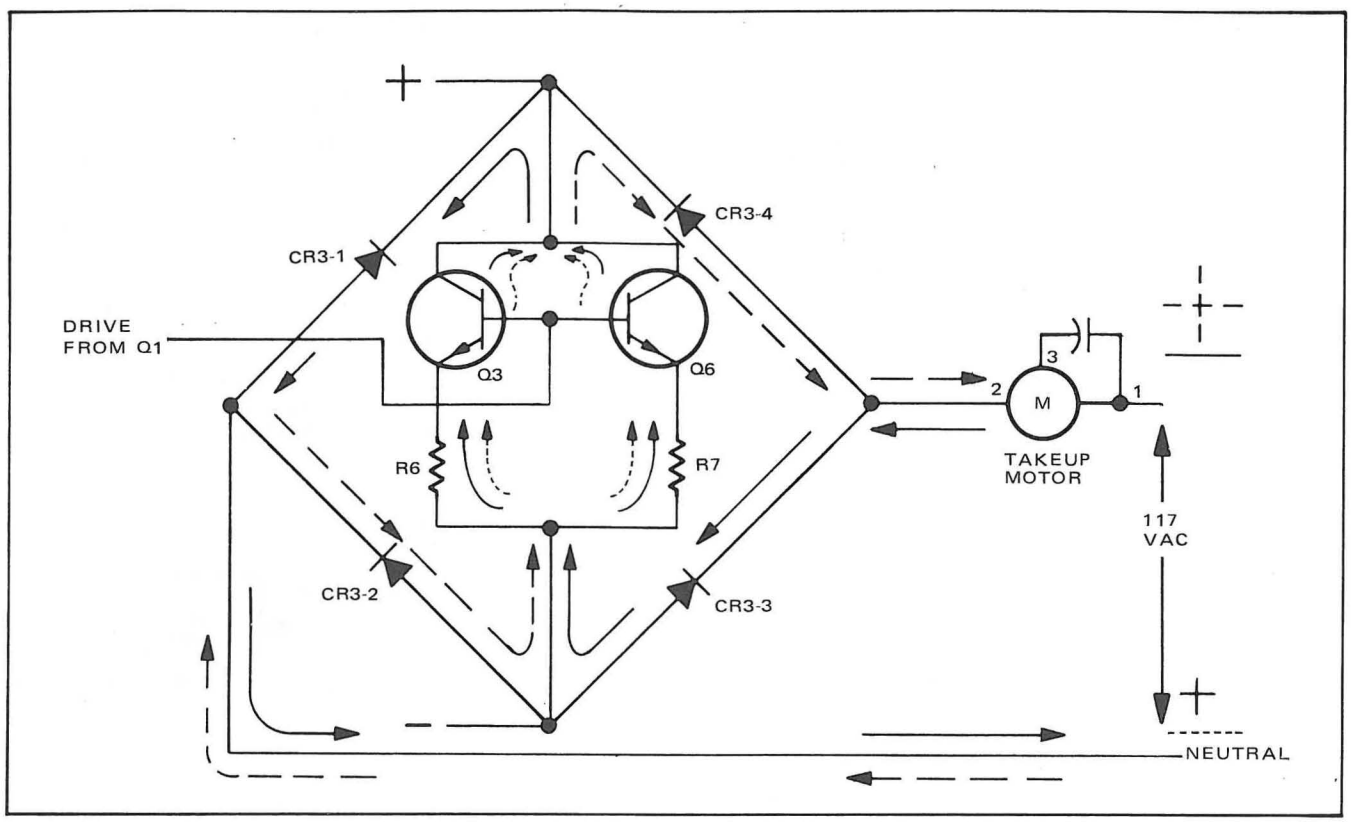


Figure 4-10. Typical MDA Bridge Circuit

CAPSTAN SERVO

The closed-loop capstan servo system consists of the capstan servo PWA; an amplifier on the MDA assembly; and a high-torque, tachometer-equipped, dc motor.The tape is driven directly by the shaft of the motor.

Block-Diagram Description

Figure 4-11 shows a block diagram of the capstan servo system. During operation, tachometer pulses are provided at a rate proportional to capstan speed. These pulses are amplified and fed to one input of a digital phase comparator. The other input to the phase comparator is a reference signal. This signal is derived from a reference oscillator and divider circuit on the capstan servo PWA or an external reference-frequency source. A pulse shaper converts the input reference signal into a train of square pulses. This pulse train is then divided by a factor of two (for 30-in/s speed), four (for 15-in/s speed), or eight (for 7.5-in/s speed). The divided signal is applied to an overspeed limiter, which, in turn, drives the reference input to the phase comparator.

The phase comparator compares the tachometer signal with the selected reference signal and produces an output that is proportional to the phase difference between the two signals. The phase-comparator output can vary from a low or high level for an extreme underspeed or overspeed condition, to a symmetrical square wave for an on-speed condition. During the record or reproduce mode, this speed-proportional output is integrated to form an error signal, which is amplified by the capstan MDA and used to drive

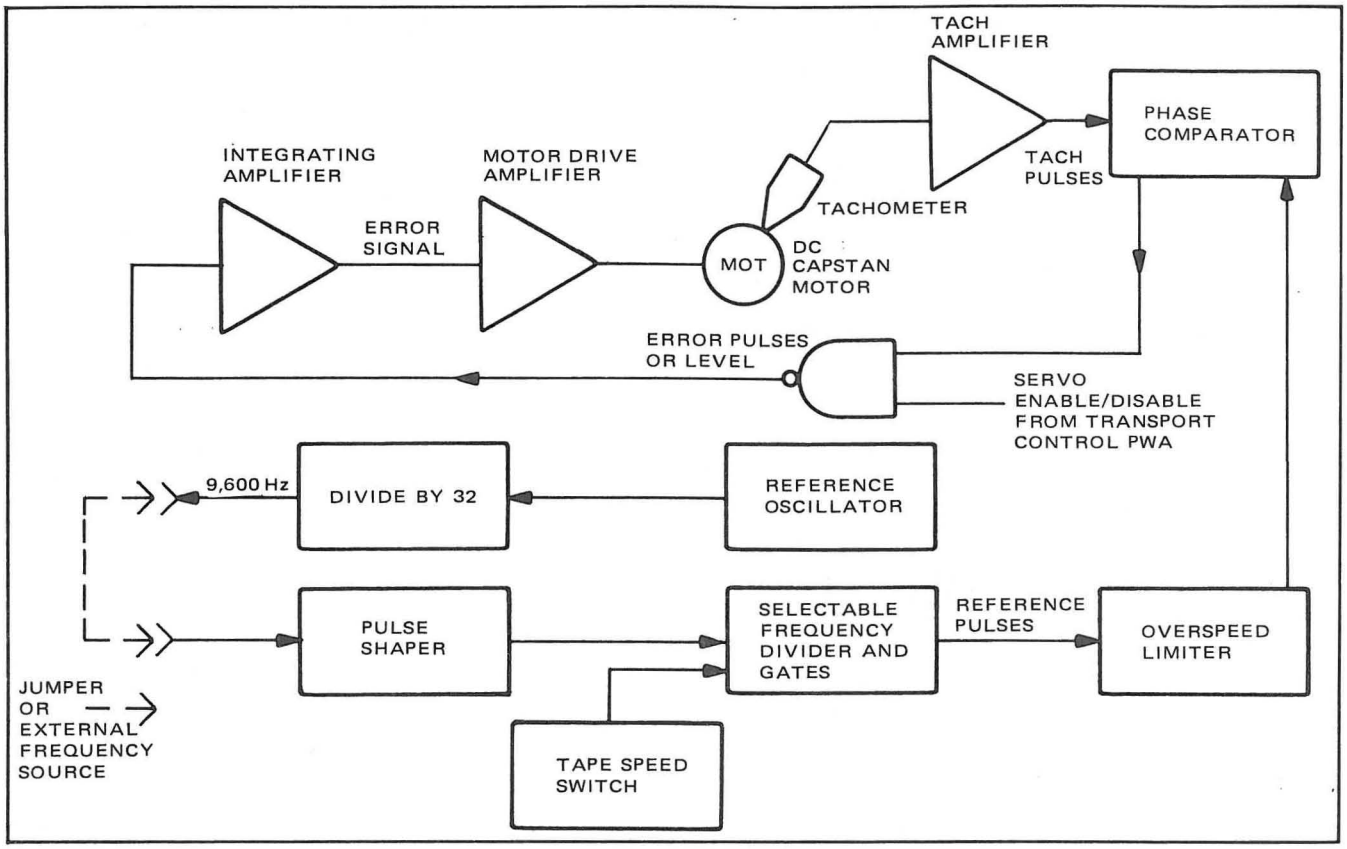


Figure 4-11. Capstan Servo Block Diagram

the capstan motor. If the capstan motor slows, the error signal causes the MDA to provide more current to the capstan motor to increase its speed. Conversely, if the capstan motor overspeeds, the MDA supplies less current to the motor causing it to slow.

The overspeed limiter prevents severe overspeeding of the capstan motor if the frequency of the external reference oscillator (when used) is set too high. If the reference frequency increases to a preset limit, the output of the limiter becomes a high level. This level causes the phase comparator to produce a low output that stops the capstan motor.

Circuit Description

Stage A5, crystal Y1, and associated components comprise the interval reference oscillator (see schematic 4840356). Crystal Y1 is situated in the feedback path of stage A5 and is series resonant at 307.2 kHz. Consequently, only a 307.2-kHz signal is fed back with minimum attenuation, causing the stage to oscillate at 307.2 kHz. This 307.2-kHz signal is fed to stage A1.

Stage A1 is an integrated circuit that is connected to divide the oscillator signal by 16. In turn, the 19.2-kHz output of stage A1 is halved in frequency by flip-flop A3-8/9. Normally, either the 9,600-Hz output of flip-flop A3-8/9 or an external 9,600-Hz signal is applied to pin 9 of the capstan servo PWA.

Diode CR1 protects the base/emitter junction of transistor Q6 from large-amplitude negative-going spikes. Transistor Q6 and associated components amplify the clipped and attenuated signal and drive Schmitt trigger A11-8. The Schmitt trigger rids the signal of noise and delivers a cleanly shaped pulse train to the input of flip-flop A3-6/5.

Flip-flops A3-6/5, A2-8/9, and A2-6/5 are interconnected to form a divider chain. This divider chain is connected to strapping points E1, E4, E3, and E6 such that division by 1, 2, 4, or 8 is possible. For 15-30 in/s operation, strapping points E5 to E3 and E2 to E4 are interconnected. For 7.5-15 in/s operation, strapping points E5 to E4 and E2 to E1 are interconnected. Thus the proper frequency division is obtained for the desired operating speed.

For 15-30 in/s operation, strapping point E2 is connected to pin 13 of NAND gate A7-11, and E5 is connected to pin 10 of NAND gate A7-8. Both NAND gates are also connected to the TAPE SPEED switch. Setting the TAPE SPEED switch to 15 enables gate A7-11 and disables gate A7-8. Conversely, setting the TAPE SPEED switch to 30 enables gate A7-8 and disables gate A7-11. Therefore, depending on the position of the TAPE SPEED switch, either a 4,800-pps or 2,400-pps pulse train is delivered to pin 1 of retriggerable one-shot A10 (overspeed limiter).

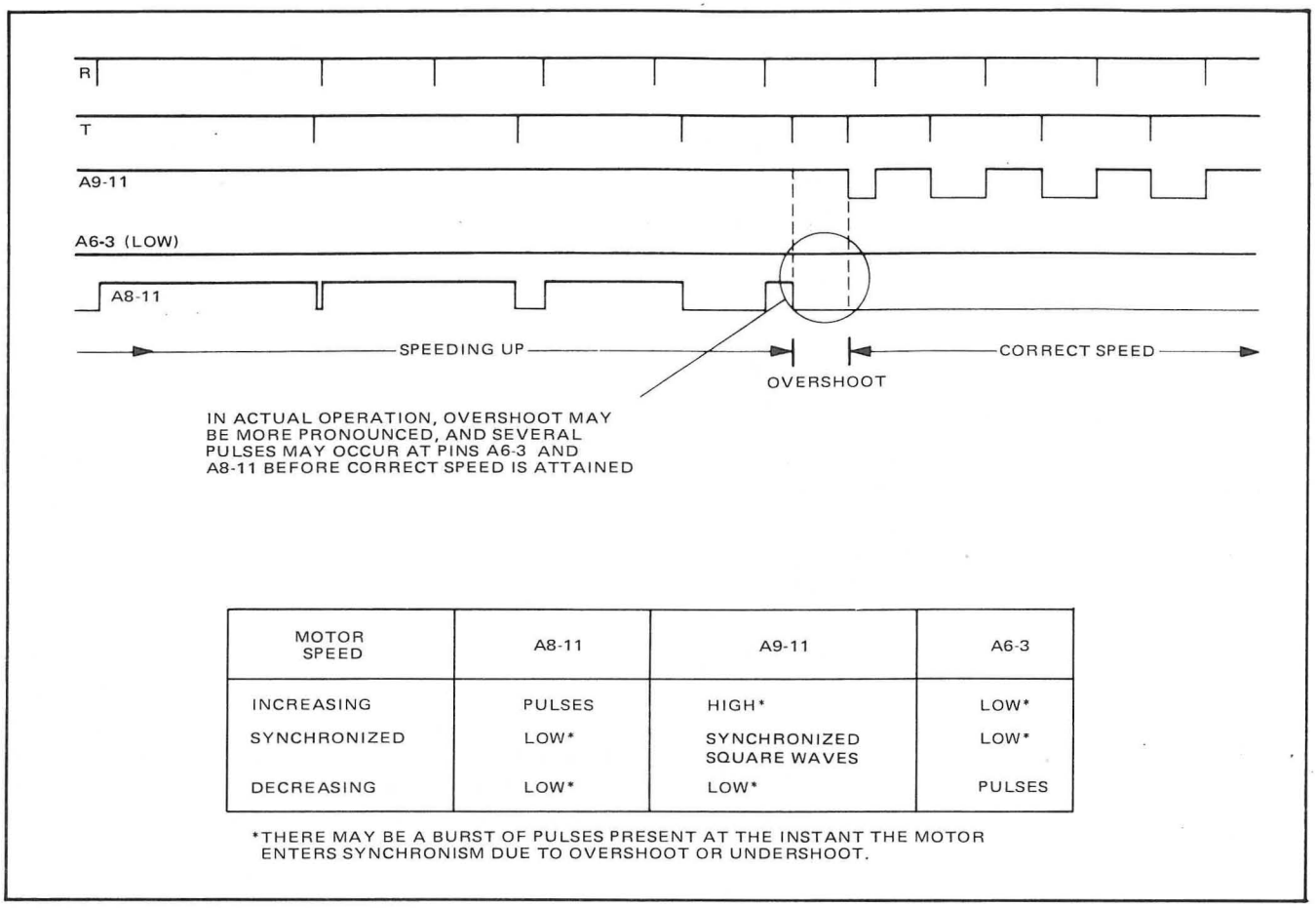
In normal operation, one-shot A10 delivers a train of negative-going pulses at a repetition rate of 4,800 or 2,400 pps to pin 6 of flip-flops A8, A9, and A6 (phase comparator). If the repetition rate of the pulse train applied to pin 1 of retriggerable one-shot A10 exceeds approximately 12,000 pps, the output of A10 becomes a high level. This high level will cause the phase comparator to stop the capstan motor, thus preventing the motor from overspeeding.

Tach pulses from the capstan-motor tachometer coil are applied to transistor Q8. Transistors Q8 and Q7 form a high-gain, non-inverting amplifier. Resistor R37 provides a dc feedback path and together with resistor R31 sets the gain of the amplifier. Capacitors C22 and C17 provide high-frequency and low-frequency roll-offs, respectively. The amplified tach signal taken from the collector of Q7 is shaped by Schmitt trigger A11-6, inverted by inverter A7-6, and applied to pin 5 of flip-flops A8, A9, and A6 (phase comparator).

Figure 4-12 shows a typical set of waveforms for the capstan phase comparator and a table listing the signal conditions at pins A8-11, A9-11, and A6-3 for each motor-speed condition. The waveforms of this figure depict a situation similar to the time when the capstan motor is accelerating to operating speed after starting. Notice that when the tach-signal (T) frequency reaches and then exceeds the reference-signal (R) frequency, two T pulses occur between adjacent R pulses. At this point flip-flop A9-3/11 begins changing state and a square wave that contains phase information appears at pin A9-11.

When the capstan motor reaches the correct speed (synchronized operation), the R and T pulses alternate and a rectangular wave is produced at pin A9-11. Notice that while the motor is increasing speed and when it is synchronized, pin 3 of flip-flop A6-3/11 is low. Further notice that during the same time interval, each T pulse causes the signal at pin A8-11 to go low, but the following R pulse returns the signal to a high level. After the instant that the tach-signal frequency exceeds the reference-signal frequency (termed overshoot), flip-flop A8-3/11 stops changing state; and the signal at pin A8-11 stays low during synchronized operation. In actual operation, although Figure 4-12 does not show it, the overshoot may be enough to cause several pulses at pins A6-3 and A8-11.

When the motor is slowing (for example, from 30 in/s to 15 in/s), pin A9-11 remains low until the capstan is turning below the correct speed (undershoot). During the undershoot interval, two T pulses occur between adjacent R pulses. Subsequently, a rectangular wave at the correct frequency is again produced at pin A9-11. (The motor-slowing sequence is not shown in Figure 4-12.) The signal at pin A6-3 is normally high and is forced low by each R pulse when the motor is slowing. At the instant of undershoot, the signal at pin A6-3 goes low and stays low. Further, the signal at pin A8-11 remains low (as the signal at pin A6-3 does when the motor is coming up to speed). However, a few pulses may appear at pin A8-11 at the instant of undershoot because the undershoot may be enough to require the motor to increase speed slightly before arriving and remaining at the correct speed.



MOTOR SPEED	A8-11	A9-11	A6-3
INCREASING	PULSES	HIGH*	LOW*
SYNCHRONIZED	LOW*	SYNCHRONIZED SQUARE WAVES	LOW*
DECREASING	LOW*	LOW*	PULSES

*THERE MAY BE A BURST OF PULSES PRESENT AT THE INSTANT THE MOTOR ENTERS SYNCHRONISM DUE TO OVERSHOOT OR UNDERSHOOT.

Figure 4-12. Capstan Phase Comparator, Typical Waveforms

The output of the phase comparator is applied to NAND gate A7-3. During the record or reproduce mode, this gate is enabled by a high level from the transport control PWA, allowing the phase-comparator output to be applied to the base of transistor Q1.

Transistor Q1 and associated components form a level-shifting stage to match the integrated circuitry with the discrete circuitry. The signal developed at the collector of Q1 is coupled to the base of transistor Q2. Transistor Q2 and associated components form a double-integrating active filter. The output signal taken from the emitter of Q2 is again integrated by another double-integrating active filter (Q3 and associated components). The signal taken from the emitter of Q3 is routed through a lead/lag network (R21, R22, R23, C14) to pin 5 of integrated circuit A4. The lead/lag network supplies the necessary phase shifts to keep the capstan servo system stable.

Integrated circuit A4 is a differential amplifier that compares the output of the lead/lag network with the feedback signal from the capstan motor drive amplifier. The difference signal developed at the output of A4 is coupled through an attenuator (R25, R26) to the base of Q4.

Transistor Q4 supplies the base-drive current for the capstan motor drive amplifier (Q5, R10, Q8, R11, R5) located on the MDA assembly. The capstan motor forms the collector load for transistors Q5 and Q8, which are connected in parallel for good power dissipation. Potentiometer R19 on the

capstan servo PWA is used to adjust the feedback signal, which, in turn, sets overall servo gain.

Transistor Q5, voltage-regulating diode VR1, and associated components on the capstan servo PWA form a 5-volt regulator. The input 15 Vdc is filtered by capacitor C5 and impressed across the series combination of resistor R6 and voltage-regulating diode VR1. The constant voltage drop across VR1 provides a fixed forward bias for transistor Q5, which causes the emitter of Q5 to be held at 5 Vdc. Capacitor C4 provides filtering for the regulated 5-Vdc bias.

POWER SUPPLIES

The MM-1100 Recorder/Reproducer contains a 39-Vdc power supply assembly and a 15/27-Vdc power supply assembly. Each assembly contains a chassis-mounted power supply circuit and a plug-in printed wiring assembly. The PWA in the 39-Vdc power supply assembly contains a 39-Vdc regulator and a 150-kHz bias/erase oscillator. A 27-Vdc regulator and a 15-Vdc regulator are contained on the PWA of the 15/27-Vdc power supply assembly. Both power supply assemblies receive input power via the ac power receptacle on the recorder/reproducer.

39-Vdc Power Supply and Regulator

Because the 39-Vdc and 27-Vdc power supplies and regulator are very similar, only the circuitry of the 39-Vdc power supply and regulator is described in this manual. As shown in Figure 4-13, input ac power is applied to transformer T1 of the 39-Vdc power supply via power receptacle J1, circuit breaker CB1, plug P3, jack J1, and fuse F1. Transformer T1 steps down the input ac voltage and drives diode-rectifier bridge CR1. Capacitor C1 filters the full-wave rectified voltage, and the filtered voltage is applied through fuse F2 to transistors Q1, Q2, and Q3 and the 39-Vdc regulator PWA. Transistors Q1 and Q2 are connected in parallel to form the series pass element of the power supply. Resistors R1 and R2 ensure that current is shared equally by Q1 and Q2. Capacitor C2 provides output filtering for the 39-Vdc regulated voltage. Transistor Q3 drives the pass transistors and, in turn, is controlled by the regulator circuitry.

Transistor Q8, resistors R10 and R24, capacitor C1, and diodes CR3 and CR4 form a constant-current source. Diodes CR3 and CR4 and capacitor C1 provide a constant forward bias for transistor Q8. Hence, the collector current of Q8 is constant. This collector current of Q8 is shared by the emitter circuit of transistor Q9 and the base circuit of transistor Q3. Consequently, the more Q9 conducts, the less Q3 conducts, and, in turn, the less Q1 and Q2 conduct.

Transistor Q9 is driven by a voltage-comparator circuit composed of transistor Q4; resistors R25, R7, R3, and R5; potentiometer R1; capacitor C2; and voltage-regulating diodes VR1 and VR3. A sample of the nominal 39-volt output voltage is sensed at the slider of potentiometer R1 and applied to the base of Q4. The emitter of Q4 is held at a constant reference voltage by the network composed of VR1, VR3, and R7. As a result, the collector current of Q4 is directly proportional to the base/emitter voltage of Q4. Therefore, if the output voltage tends to rise, Q4 conducts more, which causes Q9 to conduct more. With Q9 conducting more heavily, less base current is available to Q3, which, in turn, supplies less base current to Q1 and Q2. More voltage is then dropped across Q1 and Q2, and the output voltage is restored to 39 Vdc. Conversely, if the output voltage tends to drop, Q1 and Q2 are driven harder, again causing the output voltage to be restored to 39 Vdc.

Capacitor C1 in the constant-current source causes the power supply to be slowly turned on so that the initial current surge does not damage the circuitry of the power supply. Capacitor C2 prevents the power supply from oscillating. Diode CR1 prevents the junction of R7 and VR2 from going negative in respect to ground, thus protecting the base/emitter circuit of Q4.

Resistor R4 and adjustable resistor R6 and SCR Q3 form an overcurrent protection circuit for the power supply. Resistor R4 and adjustable resistor R6 sense the voltage drop across resistor R1, which is in series with the load. Consequently, if the load increases, the voltage drop across R1 increases. The increased voltage drop across R1 causes the voltage to rise at the junction of R4 and R6. When this voltage rise reaches the trigger point of SCR Q3, Q3 turns on and shorts the base/emitter junctions

of transistors Q1, Q2, and Q3. Shorting the base/emitter junctions turns off Q1, Q2, and Q3, which removes power from the load. To restore the 39-Vdc power supply to normal operation, the recorder/reproducer must be turned off and then turned on again. Turning the recorder/reproducer off allows Q3 to turn off. When the recorder/reproducer is turned on again, Q3 stays off, and the 39-Vdc power supply is reconnected to its load.

Voltage-regulating diode VR2; resistors R8, R11, and R12; capacitor C9; SCR Q5; and fuse F2 form an overvoltage protection circuit. If the output voltage becomes excessive, voltage regulator VR2 begins conducting. The resulting voltage drop across R11 turns on SCR Q5, which essentially shorts the power supply to ground and causes fuse F2 to blow. All voltage is thereby removed from the regulatory circuitry and the load. Capacitor C9 delays the turn on of Q5 and thus prevents the overvoltage circuitry from being activated by voltage transients.

24-Vdc Power Supply and 15/27-Vdc Regulators

Operation of the 27-Vdc power supply and regulator is very similar to the 39-Vdc power supply and regulator. The 15-Vdc regulator is included in the same package with the 27-Vdc power supply and regulator and receives its input voltage from the 27-Vdc regulator.

Transistor Q4 of the 15/27-Vdc power supply assembly is the series-pass transistor for the 15-Vdc power supply (see Figure 4-14). This pass transistor is driven by the 15-Vdc regulatory circuitry of the 15/27-Vdc regulator PWA. In normal operation, the current flowing through resistor R13 is shared by the base circuit of pass transistor Q4 and the collector circuitry of transistor Q2. Therefore, varying the collector current of Q2 varies the base current of Q4 and, thus, the emitter current of Q4. Variations in output voltage are sensed at the slider of potentiometer R2 and applied to the base of voltage comparator Q2. The emitter of Q2 is held at a constant voltage by voltage regulator diode VR4. Consequently, if the output voltage tends to rise, Q2 conducts more, which shunts current from the base circuit of Q4. As a result, Q4 conducts less, causing the output voltage to be restored to 15 Vdc. Conversely, if the output voltage tends to fail, Q2 shunts less current, Q4 conducts more, and the output voltage is again restored to 15 Vdc.

Transistor Q1 and resistor R17 form an overcurrent protection circuit. When the current flowing through R17 causes a sufficient voltage drop, transistor Q1 turns on and shorts the base/emitter circuit of pass transistor Q4. Therefore, pass transistor Q4 limits the current for the duration of the current overload.

Voltage regulator diode VR5 is connected to the over-voltage protection circuitry of the 27-Vdc regulator. If the output voltage becomes excessive, VR5 conducts and causes the overvoltage circuit of the 27-Vdc regulator to blow fuse F2 in the 27-Vdc power supply.

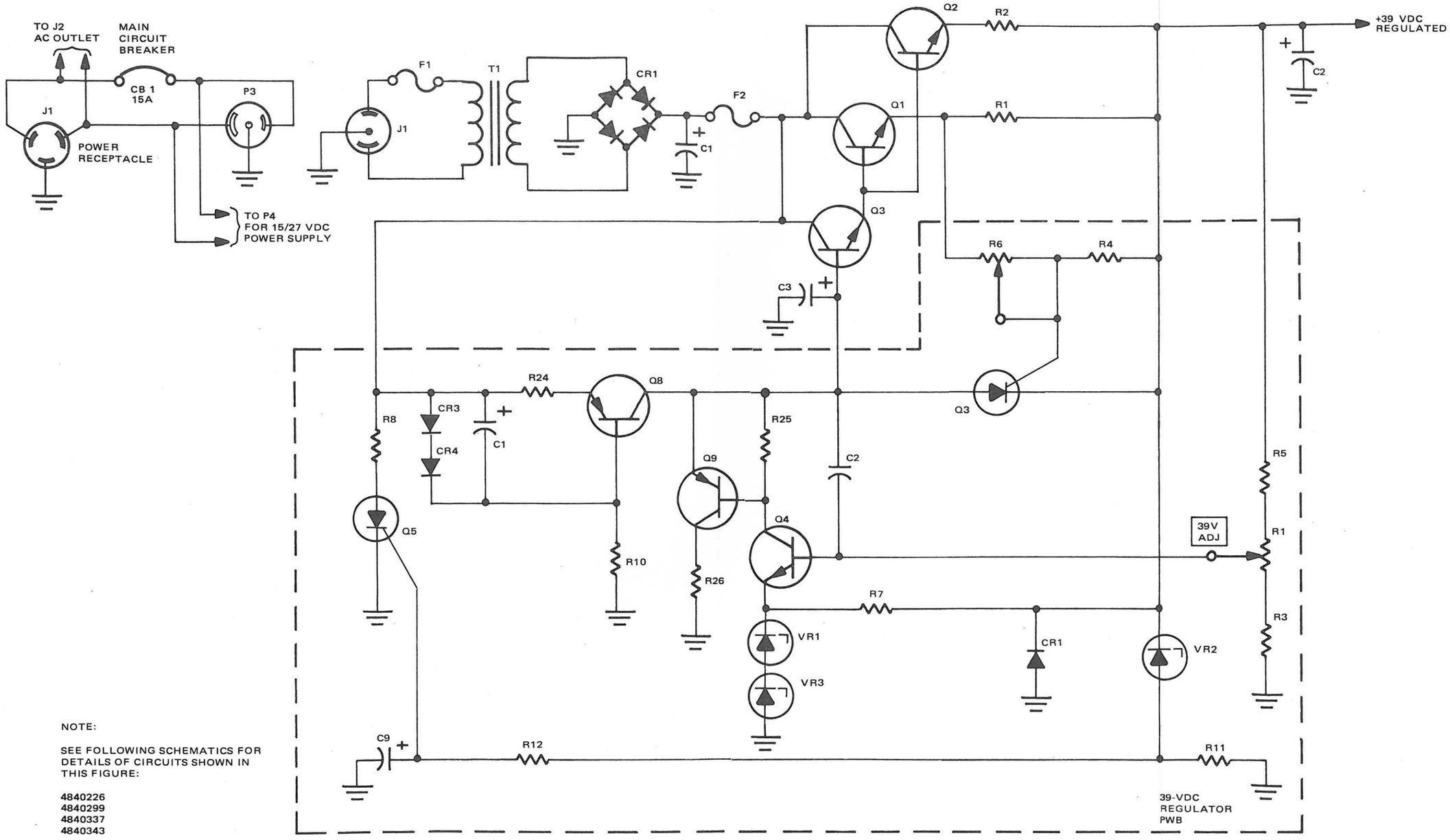
Capacitor C3 prevents the 15-Vdc regulator circuitry from oscillating. Diode CR2 protects transistor Q2 by shunting destructive negative voltages to ground.

Bias/Erase Oscillator

The bias-erase oscillator is mounted on the 39-Vdc regulator PWA and supplies a 150-kHz push-pull signal to the bias/erase amplifier of the audio electronics. Schematic 4840337 shows the details of the oscillator.

Transistors Q6 and Q7 and associated components comprise the circuitry of the oscillator, which is a variation of a standard astable multivibrator. Capacitors C5 and C6 and resistors R21 and R22 are the basic timing elements of the multivibrator. Capacitor C4 prevents the bases of Q6 and Q7 from swinging excessively negative and removes unwanted transients. The collectors of Q6 and Q7 are connected to opposite ends of the center-tapped primary of transformer T1. This primary and capacitor C7 form a tuned circuit that is shock excited by the push-pull drive from the collectors of Q6 and Q7. With the slug of T1 appropriately set, a 150-kHz push-pull sine wave signal is obtained across the center-tapped secondary of T1. This signal is sent to the bias/erase amplifier.

Operating power for the oscillator is taken from the 39-Vdc regulator. Resistor R23 and voltage regulator VR6 reduce the 39 Vdc to 13 Vdc. Capacitor C8 prevents ac signals from the oscillator from entering the 39-Vdc power line via resistor R23.



NOTE:

SEE FOLLOWING SCHEMATICS FOR DETAILS OF CIRCUITS SHOWN IN THIS FIGURE:

4840226
4840299
4840337
4840343

Figure 4-13.
Input AC, Power Supply, and 39-Vdc Regulator, Simplified Schematic

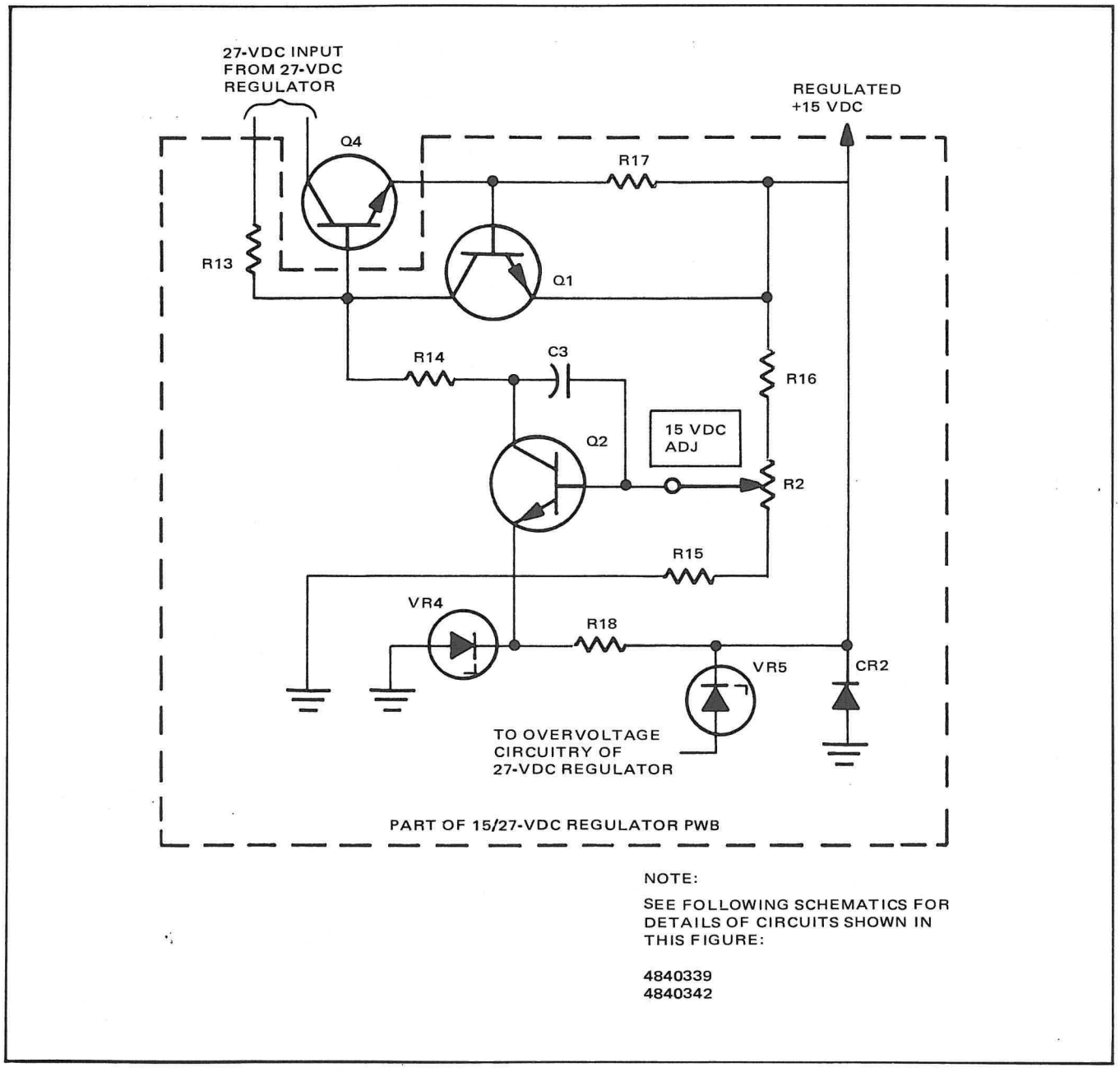


Figure 4-14. 15-Vdc Regulator, Simplified Schematic

SECTION 5

MAINTENANCE

TEST EQUIPMENT

Table 5-1 lists the test equipment required to perform the maintenance procedures listed in this section. Equivalent equipment can be substituted for the equipment suggested in the table.

CLEANING

All components in the tape path should be cleaned after every eight hours of transport operation, or more often if indicated by visual inspection, to remove accumulations of oxide deposited by the

Table 5-1. Test Equipment Required for Maintenance

DESCRIPTION	SUGGESTED MODEL	USE
Head Cleaner	Ampex Catalog No. 4010823 or 087-007	Cleaning components in tape path
Head Demagnetizer	Ampex Catalog No. 4010820	Demagnetizing components in tape path
Flutter Bridge	Model 8155-01 or 8100-W, Mincom, a Division of 3M, Camarillo, California; or Model ME102B, Gotham Audio, New York, New York	Flutter adjustment
Spring Gauge, 0-30 ounces	Model L0-2M, Hunter Spring Co., Landsdale, Penn. (Ampex Catalog No. 650-105)	Tape tension adjustment, takeup reel brakes, supply reel brakes
Spring Gauge, 0-10 pounds	Gauge-R, Chatillon, New York (Ampex Catalog No. 650-104)	Takeup reel brakes, supply reel brakes, and capstan idler adjustments
Tape Tension Gauge	Model T2-H20-2 Tentel Co., 1210 Camden Ave. Campbell, Calif. 95008	Tape tension adjustments
Volt-Ohm-Milliammeter (Multimeter)	Model 660, Weston Instruments Inc., 614 Frelinghuysen Ave., Newark, New Jersey	Voltage adjustments and overcurrent-protection adjustment
Nylon cord, 30 inches long		Takeup reel brakes, supply reel brakes and capstan idler adjustments

Table 5-1. Test Equipment Required for Maintenance (Continued)

DESCRIPTION	SUGGESTED MODEL	USE
AC Vacuum Tube Voltmeter (vtvm)	Model 400D, Hewlett Packard Co.	Audio signal measurements
Signal Generator	Model 204C or 209D, Hewlett Packard Co.	Record alignment
Wave Analyzer	Model 302A, Hewlett Packard Co.	Overall noise and distortion measurements
Extender Boards	Ampex Catalog Numbers:	Extend circuit boards for servicing and alignment
	4020151-04	Reproduce amplifier
	4020152-02	Record amplifier
	4020153-03 or	Bias amplifier (Standard)
	4020153-04	Bias amplifier (PURC)
	4020154-01	Power supply
	4050695-02	Capstan servo and transport control

recording tape. Excessive oxide deposits can cause degradation of equipment performance. Proceed as follows to perform periodic cleaning procedures:

CAUTION

USE RECOMMENDED SOLVENTS WHEN CLEANING TAPE PATH COMPONENTS, AND DO NOT USE METAL TOOLS FOR CLEANING. DO NOT ALLOW TAPE HEAD CLEANER TO COME IN CONTACT WITH THE RUBBER IDLER ROLLER OR PLASTIC FINISHES. FAILURE TO OBSERVE THIS CAUTION MAY RESULT IN DAMAGE TO TAPE PATH COMPONENTS.

1. Clean tape heads with a cotton-tipped wooden applicator moistened in Ampex head cleaner. Do not allow tape cleaning fluid to come in contact with capstan idler roller; the cleaning fluid will damage the rubber tire and cause tape slippage.

2. Clean tape guides, the capstan, and the capstan idler with isopropyl alcohol. Take care to remove fingerprints from the rubber idler roller and capstan, and immediately remove any oil deposits from the rubber idler roller.

CAUTION

DO NOT USE COMPRESSED AIR FOR CLEANING TRANSPORT MECHANISMS. THE AIR PRESSURE CAN FORCE DIRT PARTICLES INTO BEARINGS AND CAUSE DAMAGE TO TRANSPORT COMPONENTS.

DEMAGNETIZATION

Tape heads and other components in the path can acquire permanent magnetization which increases signal noise and distortion, and partially erases high frequencies on recorded tapes. Demagnetize tape path components after each eight hours of operation, using Ampex head demagnetizer as follows:

1. Turn equipment power off, and remove any recorded tape near the transport

(tape could be partially erased by the demagnetizer).

2. Cover the demagnetizer tips with pressure-sensitive tape (to prevent scratching the heads).

3. With the demagnetizer at least 3 feet from the recorder, connect it to a 110—120-volt ac power source.

4. Slowly move the demagnetizer toward the head stack.

5. Simultaneously and lightly touch the two demagnetizer tips to both faces of the head stack.

6. Hold the tips perfectly parallel to the stack face at all times. With a slow, even motion, move the tips up and down the stack several times. Slowly withdraw the demagnetizer (slow withdrawal is required for effective demagnetization).

7. Repeat steps 4 through 6 at each head stack and tape guide (including the one on the tape tension arm).

8. Move the demagnetizer at least 3 feet from the recorder, then de-energize it.

LUBRICATION

The MM-1100 requires no periodic lubrication. All moving parts are permanently lubricated at the factory prior to shipment.

CAPSTAN SERVO

Speed Pair Selection

The control panel TAPE SPEED switch permits selection of high- or low-speed operation of the transport. These speeds are determined by two shorting plugs on the capstan servo PWA, as detailed in Table 5-2.

Variable Speed Tape Mode

Using a dummy plug in J1 on the rear of the machine causes the capstan motor to run locked to a crystal-controlled reference of 9,600 Hz. To operate the system at variable speeds, it is necessary only to remove the plug and insert a variable frequency oscillator (square or sine wave) into pins 2 (HIGH) and 3 (COMM). A frequency of 9,600 Hz will correspond to the speed indicated on the control box assembly. (Speed switching and equalization switching still function in the variable speed mode.) Varying this frequency will vary the capstan speed. Input voltage to J1 should be greater than 3 Vp-p but must not exceed 30 Vp-p.

Ampex model VS-10 Variable Speed Oscillator accessory may be used to conveniently control the capstan speed. The VS-10 generates variable or preset frequencies to permit signals recorded on different machines to be matched in pitch. The accessory comes equipped with an interconnect cable and instruction manual.

Servo Gain Adjustment

The servo gain does not require periodic adjustment. If the servo motor is changed or parts are

Table 5-2. Speed Strap Positions

SPEED STRAPPING			
RANGE	60 in/s 30 in/s	30 in/s 15 in/s	15 in/s 7.5 in/s
HI	E5 to E6	E5 to E3	E5 to E4
LOW	E2 to E3	E2 to E4	E2 to E1

replaced in the servo, the servo gain should be checked. If the capstan servo PWA is not equipped with duty cycle control R45, perform step 1 only. If control R45 is present, perform step 2 only.

1. Servo gain adjustment R19 on the capstan servo PWA is normally adjusted to mid-range. However, to minimize flutter, R19 may be roughly adjusted by observing the servo error signal at TP2 on the servo PWA and advancing R19 clockwise for minimum jitter. A 9,600-Hz square wave at TP1 indicates that the crystal reference oscillator is functioning properly. Potentiometer R19 can be more accurately adjusted using a flutter tape and a flutter bridge. Adjust R19 to obtain minimum flutter indication on the flutter bridge.

2. Set R45 and R19 to midrange. Observe servo error signal at TP2 and advance R19 clockwise for minimum jitter, then adjust R45 for 50% duty cycle.

TRANSPORT CONTROL

Preliminary Procedure

1. Place transport control PWA 4050706 into the extender board provided, ensuring that the component side of the PWA is facing outward toward the meter panel, and insert board into the transport control chassis.

2. See Figure 5-1 for location of potentiometer controls and position controls as follows: R1 through R6, and R10 fully ccw; R7 and R8 fully cw; R9 mid position.

3. Without tape being threaded, secure the end-of-tape arm (Figure 5-2) out of the tape path using pressure-sensitive tape, but do not actuate tape threading latch (if installed).

NOTE

Reel servo normalizing and tension adjustment procedures are affected by power supply output voltages. Make certain that power supply output voltages are within tolerances before performing these procedures. Refer to Table 5-3.

Normalizing Reel Servos

1. Energize the recorder/reproducer. Hold the tension sensor arm (Figure 5-2) all the way in toward the center of the transport, and adjust SUP GAIN potentiometer R7 until torque on the supply reel just reduces to zero.

2. Again, while holding the tension sensor arm all the way in toward the center of the transport, place the recorder/reproducer in rewind mode and adjust T-UP GAIN potentiometer R8 until torque on the takeup reel just reduces to zero.

3. De-energize the recorder/reproducer and remove pressure-sensitive tape from the end-of-tape arm.

Tension Adjustments

It is advisable to check all tensions after making any adjustment, particularly the normalizing or gain adjustments.

NOTE

The tension sensor arm (Figure 5-3) is calibrated at the factory. If the position of the tension sensor arm or tension sensor mounting block (Figure 5-4) is changed or if the adjustment specified in step 2 of the following Stop Tension adjustment procedure cannot be achieved, perform the Tension-Sensor Arm Calibration procedure.

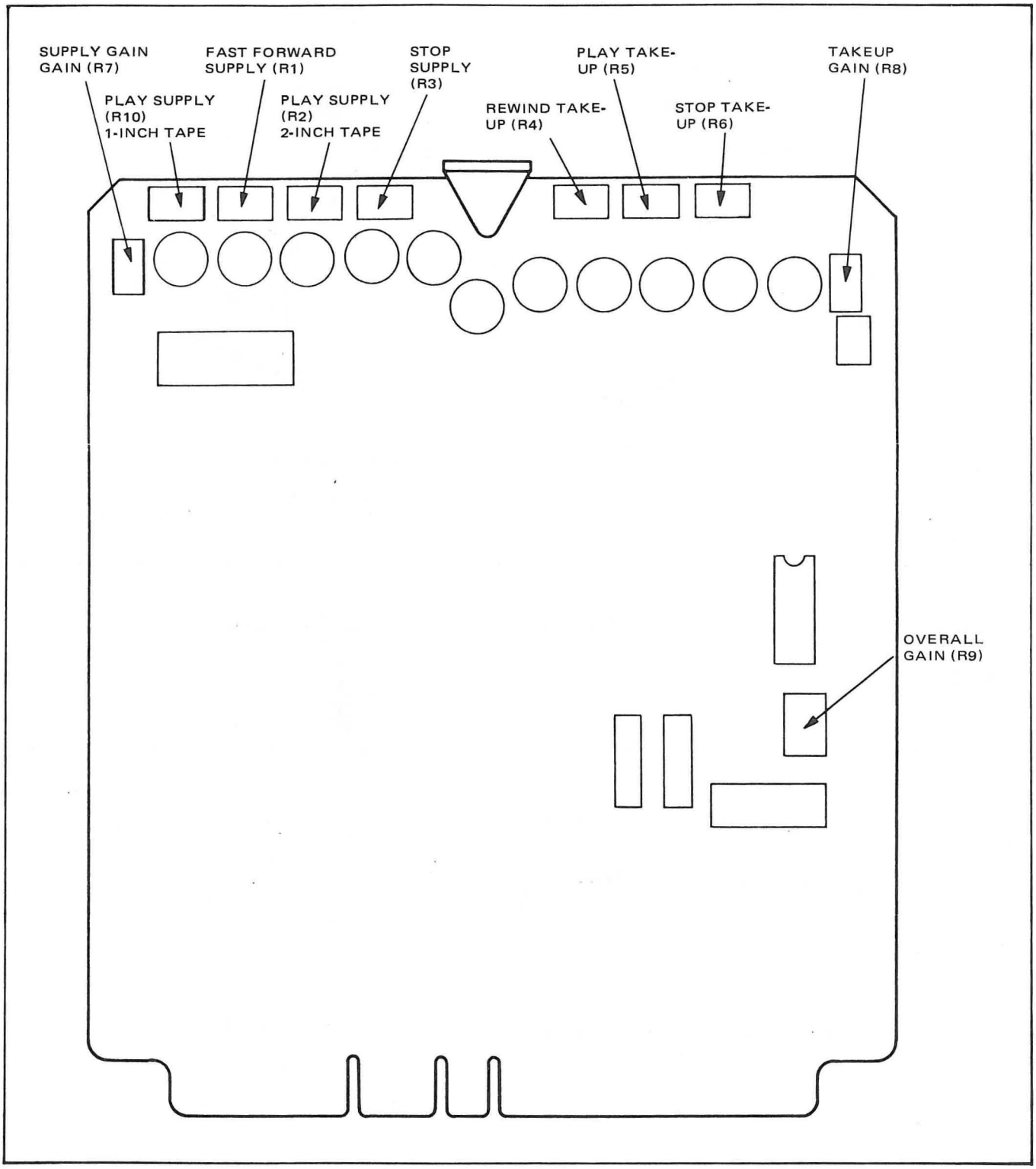


Figure 5-1. Transport Control PWA, Control Locations

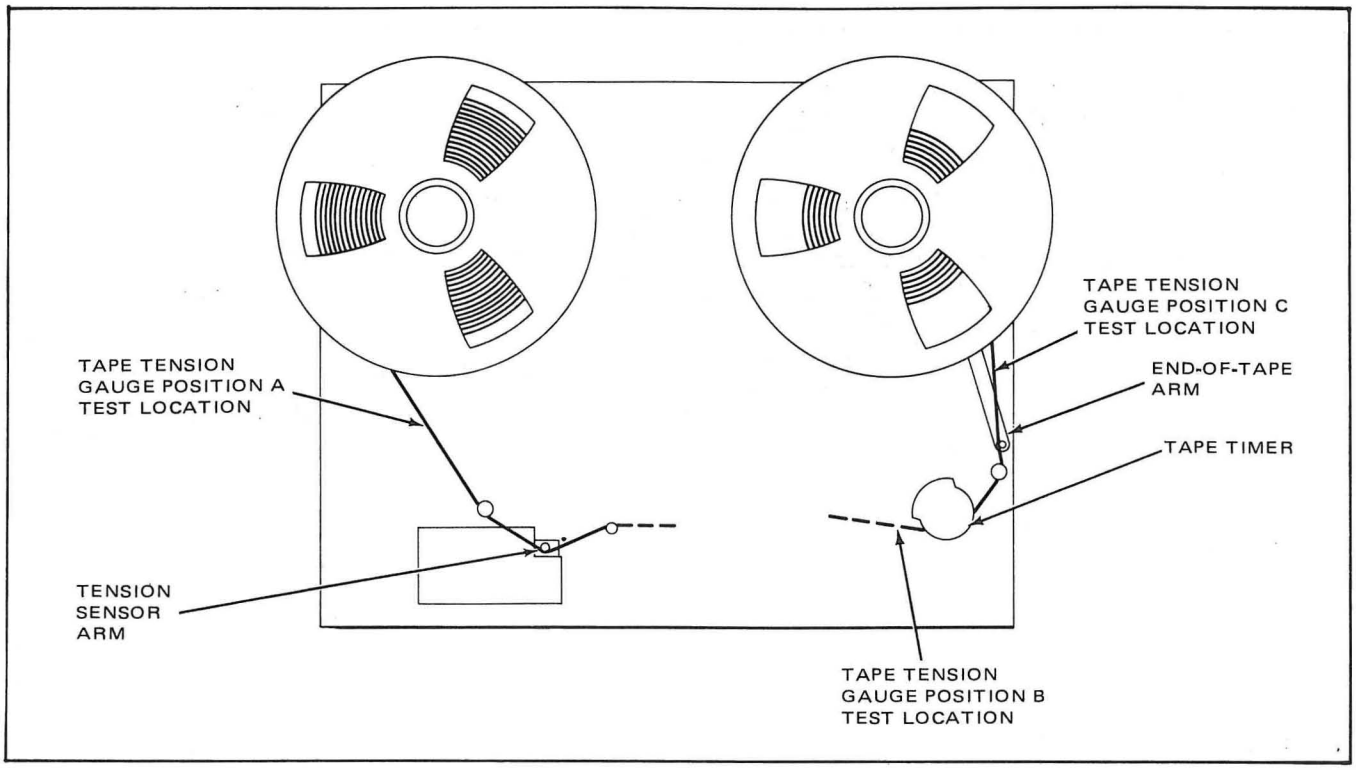


Figure 5-2. Tension Adjustments Using a Tape Tension Gauge

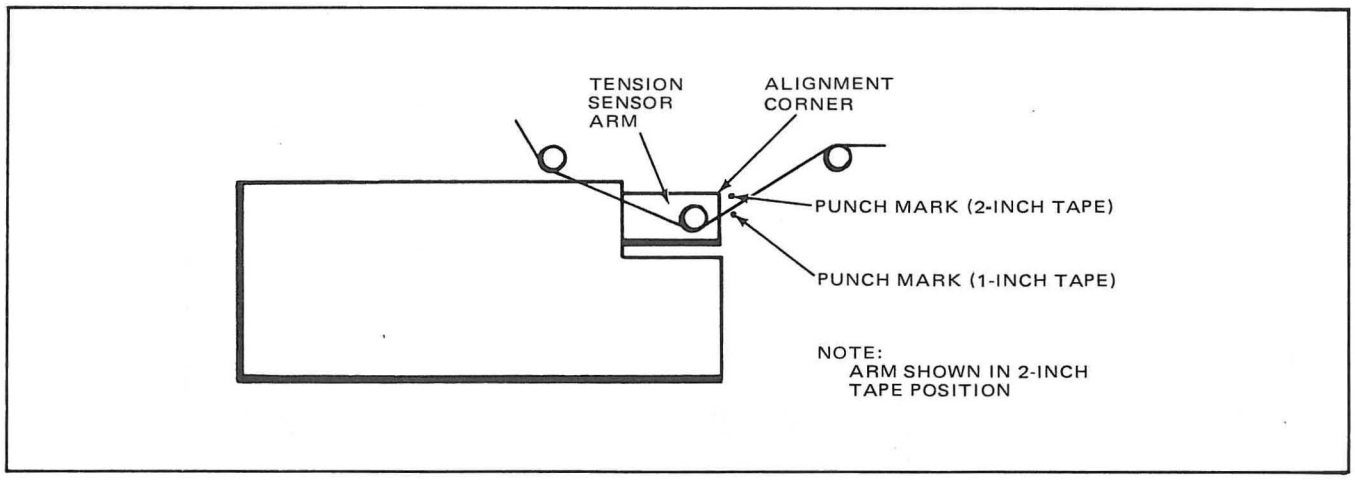


Figure 5-3. Positioning Tension Sensor Arm

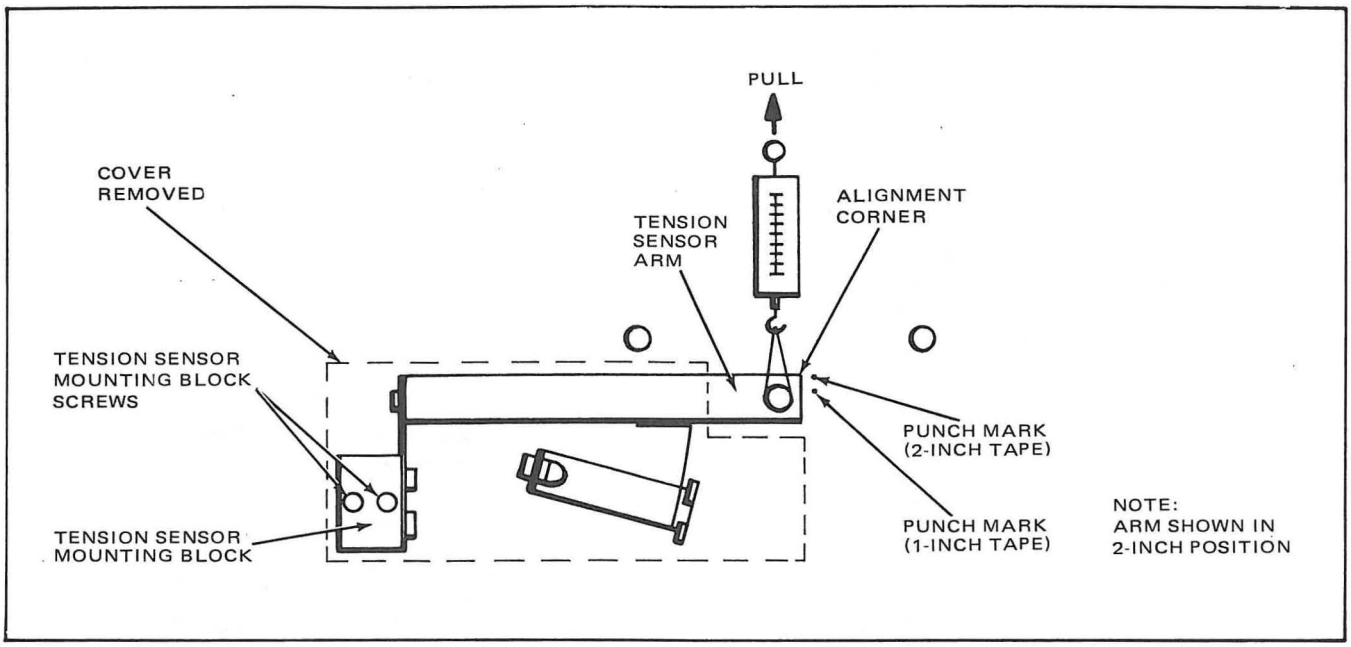


Figure 5-4. Tension Sensor Arm Calibration

Stop Tension. Check stop tension adjustment as follows:

1. Thread tape on the machine (Figure 3-2) using the largest reel size expected to be used on the machine (up to 16 inches). Wrap only two turns of tape on the takeup reel.

2. Turn on recorder/reproducer, hold takeup reel, and adjust STOP SUPPLY tension potentiometer R3 until the alignment corner of the tension sensor arm shown in Figure 5-3 is just aligned with the punch mark for two-inch tape or one-inch tape, as required.

   NOTE

   If the transport exhibits a tendency to oscillate during these adjustments, overall GAIN adjustment R9 should be rotated ccw until the oscillations just stop. This adjustment should be made with a minimum tape pack on the supply reel, using the smallest available reel.

3. With maximum pack on the supply reel, adjust the STOP TAKEUP potentiometer R6 until tension on the takeup reel increases enough to cause the tape to move toward the takeup reel. Then, decrease tension until the tape just stops and exhibits no tendency to move forward. Tensions in the stop mode should now be balanced and the tape should not move regardless of the size of the tape packs.

4. If a tape tension gauge is available, perform this step.

   a. Shuttle tape so there is approximately the same amount of tape on both reels. Place system in stop mode.

   b. Insert tape tension gauge at position A (Figure 5-2). Gauge should read 6.5 ±0.5 ounce (two-inch tape) or 3.5 ±0.5 ounce (one-inch tape). Readjust R3 if necessary.

c. Insert tape tension gauge at position C. Gauge should read 6.5 ±0.5 ounce (two-inch tape) or 3.5 ±0.5 ounce (one-inch tape). Readjust R6 if necessary.

NOTE

The above adjustments result in relatively high tension in stop mode. For easier tape handling and editing purposes, R3 and R6 may be adjusted so that tension is approximately one-half of normal or less. Check that balance is maintained to prevent tape movement as specified in step 3.

Play Tension. Adjust play tension as follows:

1. Push the end-of-tape arm toward the center of the transport. This will release reel tensions and apply the brakes. Loop the tape around the outside of the capstan and take up the slack in the tape until the brakes release.

2. Push the PLAY button while holding the takeup reel securely. Adjust PLAY SUPPLY potentiometer R2 (two-inch tape) or R10 (one-inch tape) until the tension sensor arm lines up with the punch mark for two-inch or one-inch tape as required (Figure 5-3). Now release the takeup reel and adjust PLAY TAKEUP potentiometer R5 until tensions are approximately equal on both reels (i.e., tape stopped).

3. Thread tape normally and press PLAY button. The alignment surface of the tension sensor arm shown in Figure 5-3 must be aligned with center of the appropriate punch mark. If not, readjust R2 (two-inch tape) or R10 (one-inch tape) until correct alignment is obtained.

4. If a tape tension gauge is available, perform this step only. If the gauge is not available, perform steps 5, 6, and 7.

   a. Shuttle tape so there is approximately the same amount of tape on both reels. Insert tape tension gauge at position A. Press PLAY button. Gauge should read 6.5 ±0.5 ounce (two-inch tape) or 3.5 ±0.5 ounce (one-inch tape). Readjust R2 (two-inch tape) or R10 (one-inch tape) if necessary.

   b. Insert tape tension gauge at position B. Gauge should read 12 ±1 ounce (two-inch tape) or 6 ±1 ounce (one-inch tape). Readjust R5 if necessary.

5. At 15 in/s, record a 3-kHz test signal at normal operating level at the beginning of a reel. Recording time of 90 seconds is sufficient. Rewind the tape.

6. Monitor the 3-kHz output of the channel just recorded. Press the PLAY and STOP pushbuttons alternately. When the PLAY pushbutton is pressed, the reproduced signal normally rises to the correct tone. If, however, play tension is too high, the tape may overspeed for a moment before settling to the correct tone.

7. Adjust R5 to a setting just below the point where overspeed occurs.

Shuttle Tension. Adjust shuttle tension as follows:

1. Shuttle tape so two thirds of the tape is on the supply reel. Push the REWIND button. After the tape has accelerated to maximum speed, adjust REW TAKEUP potentiometer R4 so that the tension sensor arm aligns with the punch mark (Figure 5-3) for two-inch or one-inch tape as required.

2. Shuttle tape to place almost all the tape on the takeup reel. Push FAST FORWARD button and adjust F FWD SUPPLY potentiometer R1 so that the tape accelerates to full speed at the desired rate.

These settings result in optimum tape pack on a reel and maximum accuracy of the tape timer. However, for more rapid fast-forward and rewind

shuttling, R4 and R5 may be adjusted for less holdback tension.

Tension Sensor Arm Calibration. Proceed as follows:

1. Turn off recorder/reproducer and remove tape from area of tension sensor arm.

2. Using a 30-ounce spring gauge, pull tension sensor arm as shown in Figure 5-4. The alignment surface of the tension sensor arm (Figure 5-4) must align with the punch mark for one-inch tape when the gauge indicates 4 ounces and with the punch mark for two-inch tape when the gauge indicates 8 ounces.

3. If the tensions specified in step 2 are not present, recalibrate the tension sensor arm as follows:

   a. Remove one screw and remove tension sensor cover.

   b. Loosen two screws that retain tension sensor mounting block.

   c. Reposition mounting block slightly and repeat step 2 until the specified tensions are obtained. Then tighten screws that retain tension sensor mounting block.

   NOTE

   The 4- and 8-ounce settings of the tension sensor arm correspond to 3-1/4 and 6-1/2 ounces of tape tension respectively, at the supply reel.

   d. Install tension sensor cover and secure with one screw.

15/27-VOLT AND 39-VOLT POWER SUPPLIES

The MM-1100 power supplies feature both over-voltage and over-current protection. In addition, the 39-volt supply contains the 150-kHz bias and erase oscillator. The 15/27-volt supply is normally mounted on the top of the frame. As indicators of supply operation, the meter panel lamps are powered by the 39-volt supply; the control box is powered by the 27-volt supply.

Voltage Adjustment

Voltage adjustments are made by means of access holes in the rear of the machine. Pin jacks are provided to accommodate meter probes, in accordance with Table 5-3. Use multimeter for all voltage measurements.

Measurements in Table 5-3 are from the appropriate test point to TPG (ground). The bias/erase oscillator PWA is tuned through an access hole in the side of the frame. This hole is reached by removing the right side panel.

Line voltage fuse F1 (5A, slow-blow) and over-voltage protection fuse F2 (10A, fast-blow) are on the back of the machine. The over-current protection circuit can be reset by turning the machine off for approximately 20 seconds, then re-energizing it.

Overcurrent-Protection Adjustment

Adjustable resistor R6 on the 15/27-volt regulator PWA or the 39-volt regulator PWA is used to set the point at which the overcurrent-protection circuit is triggered into operation. When the over-current trigger point for either regulator needs to be readjusted due to aging or replacement of parts, proceed as follows:

1. Turn off recorder/reproducer.

2. Install and thread reel of blank tape.

3. Set all READY/SAFE switches to READY.

4. Remove regulator PWA.

5. Connect an ohmmeter across adjustable resistor R6.

6. Adjust R6 to obtain a 46-ohm indication on ohmmeter.

Table 5-3. Voltage Test Points

VOLTAGE	TEST POINT	CONTROL	SUPPLY
15 ±0.5 volts	TP2	R2	4050699
27 ±0.5 volts	TP1	R1	4050699
39 ±0.5 volts	TP1	R1	4050658

7. Install regulator PWA.

8. Connect a voltmeter between TPG (common) and TP1 (+) of regulator PWA.

9. Turn on recorder/reproducer. Voltmeter should indicate 27 Vdc for 27-Vdc power supply or 39 Vdc for 39-Vdc power supply.

10. Simultaneously press PLAY and RECORD buttons. If output voltage does not drop to zero, the overcurrent-protection adjustment is complete. If output voltage does drop to zero, proceed to step 11.

11. Readjust R6 1/8 turn cw.

12. De-energize and then energize applicable power supply by removing and installing 10A fuse (F2).

13. Repeat step 10.

CONTROL BOX

The control box can be removed from the transport for servicing by pulling the meter panel fully forward and forcing the control box up to disengage the "snap" fasteners on its base. There is no active circuitry in the control box, and servicing consists primarily of changing lamps.

Bulb Removal

Pushbutton bulbs (No. 327) are removed by pulling the button directly up and out, as shown in Figure 5-5, and removing the bulbs from the barrel of the button.

The rocker switch bulbs (Ampex Part No. 060-471) are removed by first putting the particular switch in READY and the adjacent switches in SAFE. Then remove the switch cover with pliers, thus exposing the bulb, as shown in Figure 5-6.

Remote Control and Transport-Only Control

An optional remote control cable is required for remote operation. For remote control, the control box assembly is removed, as described earlier in this section, and connected to the remote control connector on the rear of the frame via the remote control cable. In addition, a "transport only" control box is available as an option to fit in the original control box position, if desired.

MDA ASSEMBLY

The MDA assembly consists of three separate motor-drive amplifiers, one for each reel motor and one for the capstan. The reel MDAs are unique in that they use optical couplers to isolate the low-level (27-volt) signal from the transport control to the high-level (117-Vac) drivers to the reel motors. No adjustments are necessary on the MDA. However, under failure conditions where full or no torque is applied to a reel regardless of transport mode, the isolators (A1, A2) should immediately be checked.

METER PANEL ASSEMBLY

Meter panel servicing should be limited to bulb replacement. Bulbs are wired in series/parallel and may be replaced by pulling the panel out to its extreme forward position (ensuring that doors are closed). Be careful to prevent lamp sockets from shorting to the panel itself.

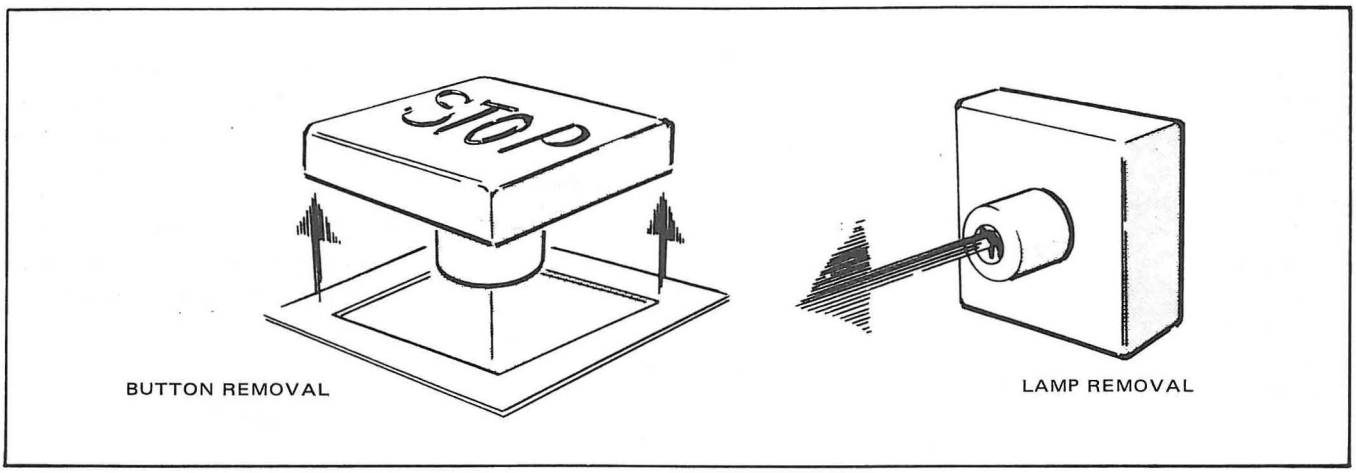


Figure 5-5. Button and Lamp Removal

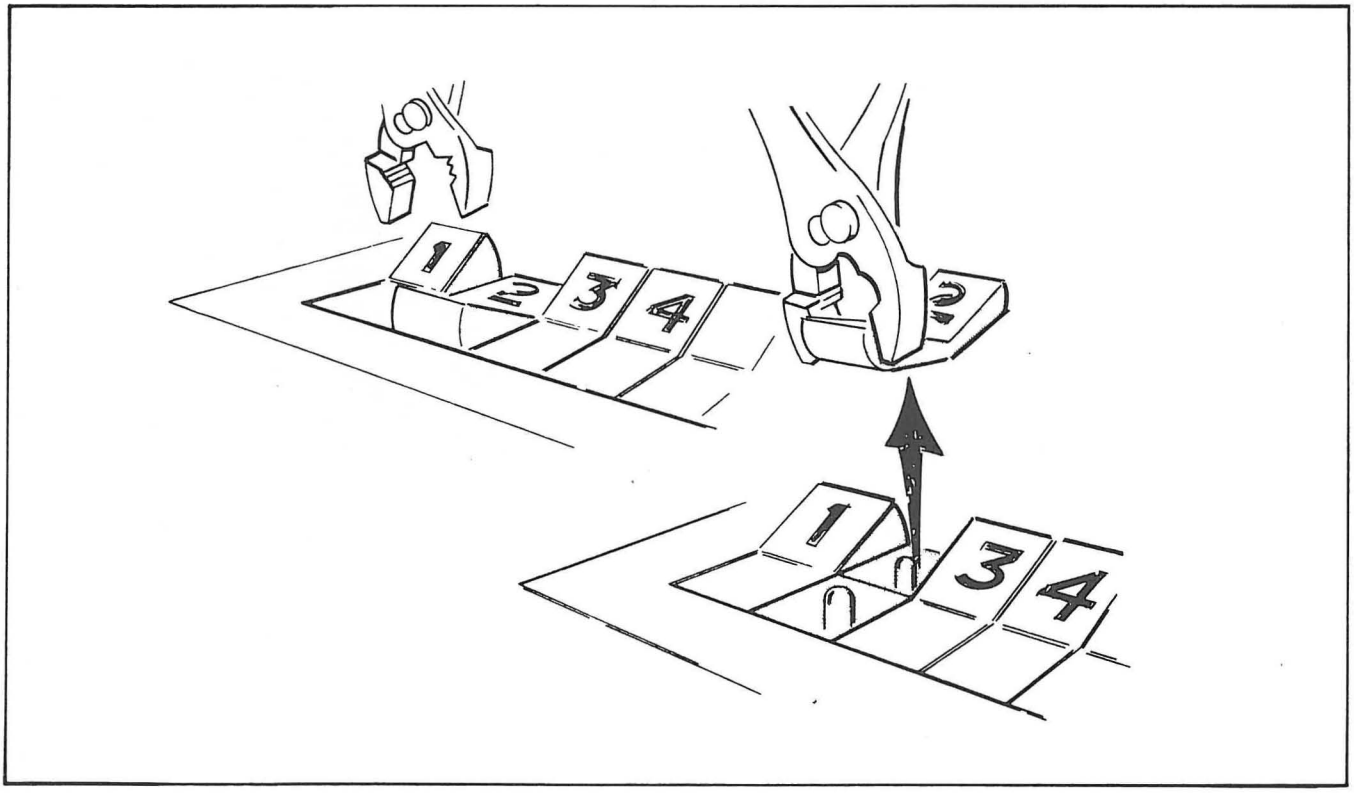


Figure 5-6. Rocker Switch Bulb Removal

HEAD ASSEMBLY

The head assembly can be quickly changed to convert from two-inch to one-inch format. To remove the head assembly, lift off the moulded head cover and back out the large jackscrew. Reverse this procedure when replacing the head assembly. When changing formats, ensure that the two quick-change guides on the transport are also switched. A shorting bar is included on all two-inch head assemblies to program tensions on the transport. Thus, tension changes are automatically effected when the head is changed.

TAPE LIFTER ADJUSTMENT

Tape lifter positions can be adjusted by removing the tension sensor cover, exposing two hex socket cap screws. These screws may be loosened and repositioned to adjust lifter positions.

BRAKE ADJUSTMENT

The brake system stops reel rotation and maintains tape tension when the equipment power is removed while in any operating mode (see Figure 5-7). A brake differential is necessary to maintain tension while stopping. The brake force is therefore higher for the tape-feeding reel in every case. Braking functions are checked with power off and no tape installed.

Takeup Reel Brakes

Adjust the takeup reel brakes as follows:

1. Wrap all 30 inches of the nylon cord ccw on takeup reel and insert hook of the 30-ounce scale in a cord loop.

2. Hold scale parallel to floor and as close as possible to reel, then pull scale. (Takeup turntable rotates ccw.)

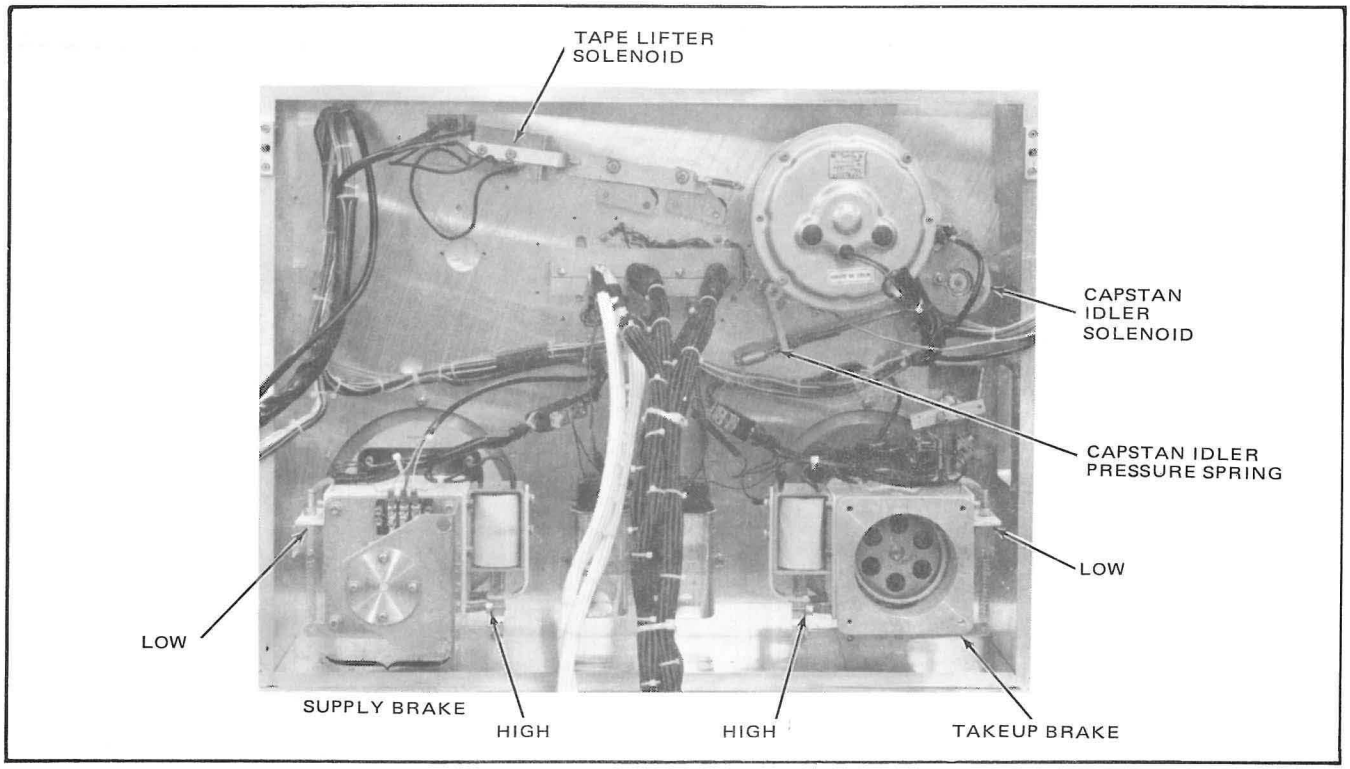


Figure 5-7. Transport Adjust Points

3. Tap reel to ensure a correct reading; then pull cord steadily and read scale indication. Repeat this procedure until scale reading has been the same several times. The scale should indicate the value given in Table 5-4.

4. If the reading is not within limits, slightly turn takeup reel brake adjustment nut. (Rotating nut cw increases braking.) Then repeat procedures beginning with step 2.

5. Wrap all of the cord cw on the reel and insert hook of the 10-lb scale in cord loop.

6. Hold scale parallel to floor and as close as possible to reel, then pull the scale. (Takeup turntable rotates cw.)

7. Tap reel to ensure a correct reading, then pull cord steadily and read scale indication. Repeat this procedure until scale reading has been the same several times. The scale should indicate the value given in Table 5-4.

8. If the reading is not within limits, slightly adjust nuts on each side of brake solenoid an equal number of turns. (Rotating nuts cw increases braking.) Then repeat procedures beginning with step 6.

NOTE

If the tension varies while the cord is being pulled at a steady rate, the tensions of the springs may be unequal.

Supply Reel Brakes

Adjust the supply reel brakes (Figure 5-7) as follows:

1. Wrap all of nylon cord cw on reel and insert hook of the 30-ounce scale in cord loop.

2. Hold scale parallel to floor and as close as possible to reel; then pull scale. (Supply turntable rotates cw.)

3. Tap reel to ensure a correct reading, then pull cord steadily and read scale indication. Repeat this procedure until scale reading has been the same several times. The scale should indicate the value given in Table 5-4.

4. If the reading is not within limits, slightly turn supply reel brake adjustment nut (rotating nut cw increases reading). Then repeat procedures beginning with step 2.

5. Wrap all of the cord ccw on reel and insert hook of the 10-lb scale in cord loop.

6. Hold scale parallel to floor and as close as possible to reel, then pull the scale. (Supply turntable rotates ccw.)

7. Tap reel to ensure a correct reading, then pull cord steadily and read scale indication. Repeat this procedure until scale reading has been the same several times. The scale should indicate the value given in Table 5-4.

8. If the reading is not within limits, slightly adjust nuts on each side of brake solenoid an

Table 5-4. Transport Brake Torques

SUPPLY REEL		TAKEUP REEL	
REWIND (CW)	FORWARD (CCW)	REWIND (CW)	FORWARD (CCW)
14 – 18 oz	4-1/2 (±1/4) lb	4-1/2 (±1/4) lb	14 – 18 oz

equal number of turns. (Rotating nuts cw increases braking.) Then repeat procedures beginning with step 6.

NOTE

If the tension varies while the cord is being pulled at a steady rate, the tensions of the springs may be unequal.

9. Remove scale and cord from transport.

CAPSTAN IDLER

The capstan idler force against the moving capstan is determined by the capstan idler pressure spring. The force is adjusted by a locknut, which compresses the capstan idler spring shown in Figure 5-7. Check pressure whenever capstan motor has been removed and replaced or when any parts associated with the capstan idler have been changed or moved.

1. Wrap a 12-inch knotted piece of lacing, nylon cord, or thin twine around pinch roller yoke as shown in Figure 5-8. Insert hook of 10-lb scale in cord loop.

2. Tape or block end-of-tape arm in on position.

3. Press PLAY button and pull on scale to pull pinch roller off capstan. The cord must not be in contact with the pinch roller.

4. Observe amount of force indicated on scale. The force required to eliminate pinch roller/capstan contact should be 8-3/4 to 9-1/4 pounds. (The pinch roller will stop rotating when it breaks contact with the capstan.)

5. Press STOP button.

6. If pinch-roller force is incorrect, adjust locknut under transport (Figure 5-7). (Turning locknut cw increases pressure.)

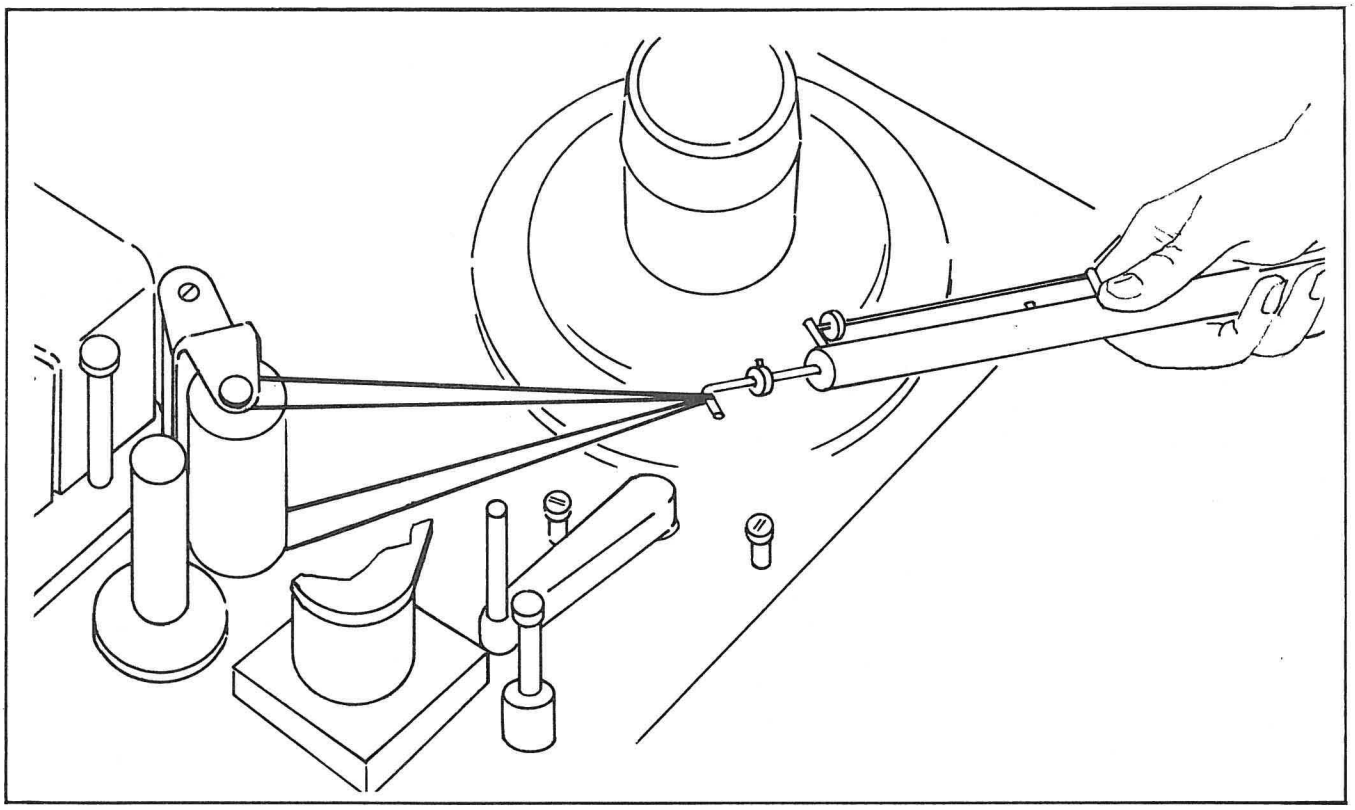


Figure 5-8. Pinch Roller Adjustment

7. Repeat steps 3 through 6 until pinch-roller force is correct.

DASH POT ADJUSTMENT

The dash pot adjustments (Figure 5-9) are set at the factory and do not require readjustment unless dash pot or tension arm parts are replaced or a malfunction develops. Proceed as follows to check-out and adjust dash pot:

1. With tension arm in released position (safety switch actuated), measure clearance between bottom of plunger and bottom of cylinder. Clearance should be 1/16 inch.

2. If clearance is not as specified, loosen adjust bolt and move plunger up or down as required.

3. Tighten adjust bolt.

4. If end-of-tape switch is not actuated as soon as desired when end-of-tape condition is reached, rotate adjust valve ccw. Switch should actuate in 1/2 to 1-1/2 seconds after end-of-tape.

AUDIO ALIGNMENT PROCEDURES

Separate audio alignment procedures for machines with operating speed pairs of 7.5 – 15 in/s and 15 – 30 in/s are presented in this section of the manual.

NOTE

The reproduce alignment procedure must be performed prior to the record alignment procedure. Also, the BIAS ADJ control adjusted in the record alignment procedure need only be adjusted for one speed of an operating speed pair.

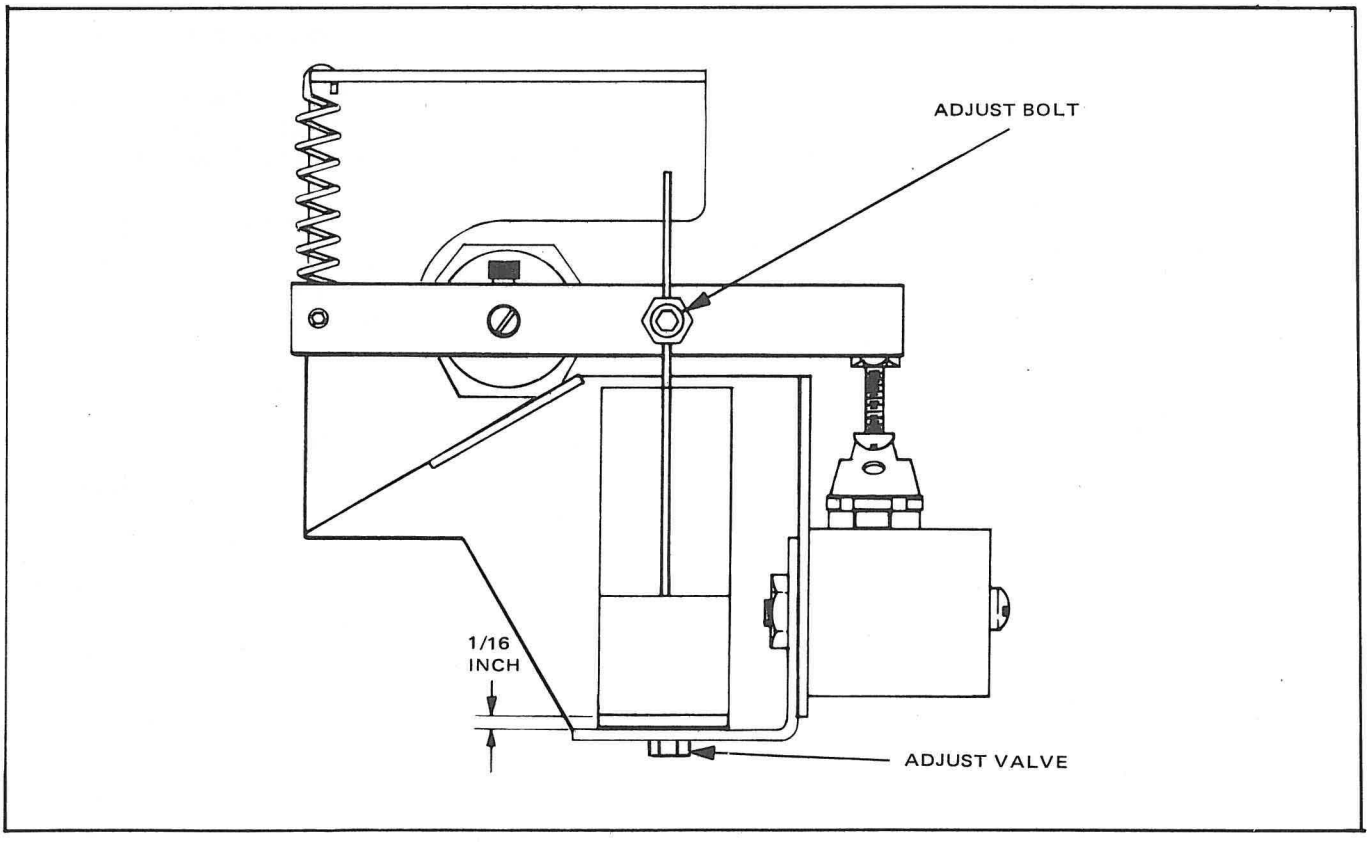


Figure 5-9. Tension Arm Dash Pot Adjustment

These alignment procedures are based on the use of low-noise, high-output tapes (Ampex 406 or equivalent) and reflect the higher saturation levels of these tapes. A new operating level referred to as "Ampex Mastering Level" is used. This level corresponds to a recorded flux 3 dB higher than the original Ampex Operating Level. (Ampex Operating Level is 185 nWb/m; hence, Ampex Mastering Level is 260 nWb/m at 500 Hz.) For optimum performance, it is suggested that the machine be aligned last in the speed most commonly used for recording.

7.5-15 In/s Reproduce Alignment

Perform the following reproduce alignment procedure.

1. Prepare the machine for reproduce alignment as follows:

   a. Degauss and clean the heads and other components in the tape path. Use Ampex head cleaner on all components except the pinch roller, which must only be cleaned with isopropyl or denatured alcohol.

   b. Thread the appropriate alignment tape on the machine (Table 5-5).

   c. Set all RECORD/SAFE switches to SAFE.

   d. Set the INPUT MON/NORM MON switch to NORM MON.

   e. Set the SEL SYNC/REPRO switch to REPRO.

   f. Set all NORMAL/SET UP/BIAS switches on electronics panel to SET UP.

2. Place MM-1100 in play mode and proceed as follows:

   a. For 7.5-in/s alignment, use the 700-Hz, −10 dB below-operating-level section of the test tape and adjust all REPRO level controls for a vu meter indication of −3 vu. (This corresponds to a line-output level of +1 dBm.)

   b. For 15-in/s alignment, use the 700-Hz operating level section of the test tape and adjust all REPRO level controls for a vu meter indication of −3 vu. (This corresponds to a line-output level of +1 dBm.)

   c. For 15-in/s alignment (only), set all SEL SYNC/REPRO switches to SEL SYNC. Use the 700-Hz operating level section of the test tape, and adjust all SEL SYNC level controls for vu meter indication of −3 vu. Set the SEL SYNC/REPRO switches back to REPRO.

3. Adjust the REPRODUCE HI FREQ equalization control for the speed in use on the 10-kHz section of the alignment tape for a vu meter indication of −3 vu.

4. Monitor the alignment tape test tones from 15 kHz through 2.5 kHz, and readjust REPRODUCE HI FREQ equalization control (if necessary) for a minimum deviation from the −3 vu reference established in step 3.

5. The following reproduce-mode low-frequency equalization adjustments, using an alignment tape, are preliminary only. These adjustments must be later finalized in an overall record/reproduce alignment procedure as described in step 4g of the *7.5 In/s Record Alignment* procedure or step 5g of the *15 In/s Record Alignment* procedure.

   NOTE

   Low-frequency reproduce equalization cannot be adjusted correctly when using a full-track alignment tape because of the fringing effect. For correct adjustment, use an alignment tape corresponding to the same track format of the machine being aligned.

   a. For 7.5-in/s alignment, adjust REPRODUCE LOW SPEED LOW FREQ equalizer control for a vu meter indication of −3 vu at 50 Hz.

Table 5-5. Ampex Alignment Test Tapes

TYPE		AMPEX PART NUMBER
NAB, 1 inch	7.5 in/s, 8-track	4690007
	7.5 in/s, full-track	4690049-65
IEC (CCIR), 1-inch	7.5 in/s, 8-track	4690021
	7.5 in/s, full-track	4690032
NAB, 2-inch	7.5 in/s, 16-track	4690022
	7.5 in/s, full-track	4690025
IEC (CCIR), 2-inch	7.5 in/s, 16-track	4690034
	7.5 in/s, full-track	4690036
NAB, 1-inch	15 in/s, 8-track	4690006
	15 in/s, full-track	4690005
IEC (CCIR), 1-inch	15 in/s, 8-track	4690020
	15 in/s, full-track	4690031
NAB, 2-inch	15 in/s, 16-track	4690018
	15 in/s, full-track	4690024
IEC (CCIR), 2-inch	15 in/s, 16-track	4690033
	15 in/s, full-track	4690035
17.5 μs, 1-inch	30 in/s, 8-track	4690042
	30 in/s, full-track	4690048
17.5 μs, 2-inch	30 in/s, 16-track	4690039
	30 in/s, full-track	4690047

b. For 15-in/s alignment, adjust REPRODUCE HI SPEED LOW FREQ equalizer control for a vu meter indication of −3 vu at 30 Hz.

6. For 7.5-in/s alignment, use the 700-Hz operating level section of the test tape and adjust all REPRO level controls for a vu meter indication of −3 vu.

7. For 7.5-in/s alignment, set all SEL SYNC/REPRO switches to SEL SYNC. Use the 700-Hz operating level section of the test tape and adjust all SEL SYNC level controls for a vu meter indication of −3 vu. Set the SEL SYNC/REPRO switches back to REPRO.

8. Measure reproduce standby noise as follows:

a. Connect a band-limiting filter (Figure 5-10) between line output and an ac vtvm.

b. Check that INPUT MON/NORM MON switch is at NORM MON and NORMAL/SET UP/BIAS switches are at SET UP.

c. Close head gate.

d. Read reproduce standby noise on ac vtvm. The reading for either speed should

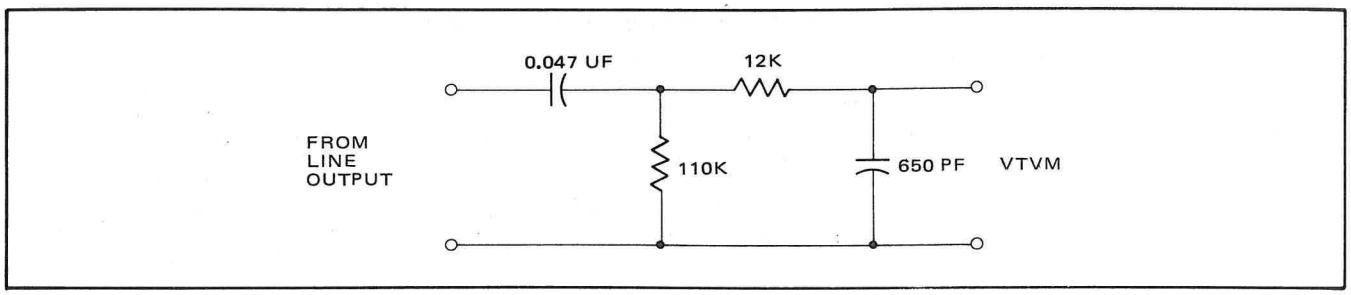


Figure 5-10. 30-Hz to 18-kHz Band-Limiting Filter

be less than –58 dBm for 8- or 16-channel systems, or less than –54 dBm for 24-channel systems.

7.5-15 In/s Record Alignment

Do not perform the 7.5-15 in/s record alignment procedure unless the reproduce alignment procedure has been performed first. Proceed as follows:

1. Prepare the machine for record alignment as follows:

   a. Thread a reel of bulk degaussed tape of the type to be used (Ampex 406, 456, or equivalent) onto the transport.

   b. Connect a signal generator and an ac vtvm to the line inputs and adjust signal generator as follows:

      For 7.5-in/s alignment, set generator to 5 kHz and signal level to +4 dBm.

      For 15-in/s alignment, set generator to 10 kHz and signal level to +4 dBm.

   c. Set the READY/SAFE switches of the channels to be aligned to READY.

   d. Set the INPUT MON/NORM MON switch to NORM MON.

   e. Set the NORMAL/SET UP/BIAS switches on the electronics panel to BIAS.

2. Place the machine in the record mode. Observe that all channels in ready mode go into record mode, and that on-scale readings appear on the vu meters. Then do one of the following steps according to the system configuration:

   a. For 8- or 16-channel systems, adjust the ERASE PEAK control on each bias/erase amplifier PWA to give a maximum reading on the respective vu channel meter. If necessary, adjust the BIAS CAL controls to obtain on-scale readings.

   b. For 24-channel systems, turn the ERASE PEAK control fully ccw and then turn the control slowly cw. The bias level indication will change very slowly at first. Then the vu meter will indicate a sudden 0.5 to 3 dB drop. If the initial drop is greater than 1.5 dB, turn ERASE PEAK control slowly ccw so that indication is between 1.0 to 1.5 dB down from level where the sudden drop occurred.

      Conversely, if initial drop is less than 0.5 dB, continue turning ERASE PEAK control cw until the indication is 1.0 to 1.5 dB down from level where the sudden drop occurred.

3. Reset all NORMAL/SET UP/BIAS switches to the SET UP position. Adjust RECORD level controls to give a mid-scale indication on the vu meters.

4. For 7.5-in/s record alignment proceed as follows:

   a. Adjust the BIAS ADJ control on each

bias amplifier PWA for maximum output amplitude of the 5.0 kHz signal.

Continue rotation of the control clockwise until the output decreases exactly 1.5 dB (406 tape) or 2.5 dB (456 tape). (Note that the BIAS ADJ control need only be adjusted for one speed of an operating speed pair.)

b. Set generator to 500 Hz and signal level to −6 dBm.

c. Adjust RECORD control for a vu-meter indication of 0 vu.

d. Set generator to 12 kHz and signal level to −6 dBm.

e. Adjust the RECORD LOW SPEED equalizer control for a vu-meter indication of 0 vu.

f. Set generator to 50 Hz and signal level to −6 dBm.

g. Adjust the REPRODUCE LOW SPEED LOW FREQ equalizer control to achieve a minimum deviation from a 0-vu-meter indication for frequencies between 40 Hz and 100 Hz.

h. Sweep the signal generator from 40 Hz to 15 kHz while maintaining a constant −6 dBm output level. The vu-meter indication should remain within ±2 vu of 0 vu.

i. Set generator to 1 kHz and signal level to +4 dBm.

j. Reset RECORD level control for vu-meter indication of 0 vu.

k. Place INPUT MON/NORM MON switch to INPUT MON position.

l. Adjust REC CAL control on each record amplifier PWA for a vu-meter indication of 0 vu.

m. Set the NORMAL/SET UP/BIAS switch to BIAS.

n. Adjust BIAS CAL control on each bias amplifier PWA to give 0-vu indication on the vu meter.

o. Return the NORMAL/SET UP/BIAS switch to the SET UP position.

5. For 15-in/s record alignment, proceed as follows:

a. Adjust the BIAS ADJ control on each bias amplifier PWA for maximum output amplitude of the 10-kHz signal. Continue rotation of the control clockwise until the output decreases exactly 1.5 dB (406 tape) or 2.5 dB (456 tape). (Note: the BIAS ADJ control need only be adjusted for one speed of an operating speed pair.)

b. Set generator to 1 kHz and signal level to +4 dBm.

c. Adjust RECORD level control for a vu meter indication of 0 vu.

d. Set generator to 15 kHz and signal level to +4 dBm.

e. Adjust RECORD HI SPEED equalizer control for a vu-meter indication of 0 vu.

f. Set generator to 50 Hz and signal level to +4 dBm.

g. Adjust REPRODUCE HI SPEED LOW FREQ equalizer control to achieve a minimum deviation from the 0-vu-meter indication for frequencies between 30 Hz and 100 Hz.

h. Sweep the signal generator from 30 Hz to 15 kHz while maintaining a constant +4-dBm output level. The vu-meter indication should remain within ±2 vu of 0 vu.

i. Set generator to 1 kHz and signal level to +4 dBm.

j. Set INPUT MON/NORM MON switch to INPUT MON position.

k. Adjust REC CAL control on each record amplifier PWA for a vu meter indication of 0 vu.

l. Set the NORMAL/SET UP/BIAS switch to the BIAS position.

m. Adjust the BIAS CAL control on each bias amplifier PWA for a vu meter indication of 0 vu.

n. Return the NORMAL/SET UP/BIAS switch to the SET UP position.

6. Perform the bias trap adjustment as follows:

a. Set the SEL SYNC/REPRO switch to SEL SYNC.

b. Set the INPUT MON/NORM MON switch to NORM MON.

c. Set READY/SAFE switches of channels adjacent to channel to be adjusted to READY.

d. Set READY/SAFE switch of channel to be adjusted to SAFE.

e. Remove tape from machine and hold the end-of-tape arm in an on position with pressure-sensitive tape.

f. Turn system power off. Mount the record amplifier PWA of the channel to be adjusted on an extender board (Table 5-1).

g. Connect an ac vtvm to the channel line output.

h. Switch system power on and place machine in record mode.

i. Adjust the bias-trap inductor, which is located between the record and reproduce connectors on the audio switching PWA, for minimum reading on the vtvm. (With the record amplifier on the extender board, the bias-trap inductor can be reached easily with a long insulated turning tool through the opening left by extending the record amplifier.)

15-30 In/s Reproduce Alignment

Perform the following reproduce alignment procedure:

1. Prepare the machine for reproduce alignment as follows:

a. Degauss and clean the heads and other components in the tape path. Use Ampex head cleaner on all components except the pinch roller, which must only be cleaned with isopropyl or denatured alcohol.

b. Thread the appropriate alignment tape on the machine (Table 5-5).

c. Set all RECORD/SAFE switches to SAFE.

d. Set the INPUT MON/NORM MON switch to NORM MON.

e. Set the SEL SYNC/REPRO switch to REPRO.

f. Set all NORMAL/SET UP/BIAS switches on electronics panel to SET UP.

g. Select desired tape speed.

2. Place MM-1100 in play mode and proceed as follows:

a. Use the 700-Hz section of the test tape, and adjust all REPRO level controls for a vu-meter indication of −3 vu. (This corresponds to a line-output level of +1 dBm.)

b. Set all SEL SYNC/REPRO switches to SEL SYNC. Use the 700-Hz section of the test tape, and adjust all SEL SYNC level controls for vu meter indication of −3 vu. Set the SEL SYNC/REPRO switches back to REPRO.

3. Adjust the REPRODUCE HI FREQ equalization control for the speed in use on the 10-kHz section of the alignment tape for a vu meter indication of –3 vu.

4. Monitor the alignment tape test tones from 15 kHz through 2.5 kHz, and readjust REPRODUCE HI FREQ equalization control (if necessary) for a minimum deviation from the –3-vu reference set in step 3.

5. The following reproduce-mode low-frequency equalization adjustments, using an alignment tape, are preliminary only. These adjustments must later be finalized in an overall record/reproduce alignment procedure as described in steps 4g of the *15 In/s Record Alignment* procedure or step 5g of the *30 In/s Record Alignment* procedure.

NOTE

Low-frequency reproduce equalization cannot be adjusted correctly when using a full-track alignment tape because of the fringing effect. For correct adjustment, use an alignment tape corresponding to the same track format of the machine being aligned.

   a. For 15-in/s alignment, adjust REPRODUCE LOW SPEED LOW FREQ equalizer control for a vu meter indication of –3 vu at 50 Hz.

   b. For 30-in/s alignment, adjust REPRODUCE HI SPEED LOW FREQ equalizer control for a vu meter indication of –4 vu at 30 Hz.

6. Measure reproduce standby noise as follows:

   a. Connect a band-limiting filter (Figure 5-10) between line output and an ac vtvm.

   b. Check that INPUT MON/NORM MON switch is at NORM MON and NORMAL/SET UP/BIAS switches are at SET UP.

   c. Close head gate.

   d. Read reproduce standby noise on ac vtvm. The reading for either speed should be less than –58 dBm for 8- or 16-channel systems, or less than–54 dBm for 24-channel systems.

15-30 In/s Record Alignment

Do not perform the 15-30 in/s record alignment procedure unless the reproduce alignment procedure has been performed first. Proceed as follows:

1. Prepare the machine for record alignment as follows:

   a. Thread a reel of bulk degaussed tape of the type to be used (Ampex 406, 456, or equivalent) onto the transport.

   b. Connect a signal generator and an ac vtvm to the line inputs and adjust signal generator as follows:

      1. For 15-in/s alignment, set generator to 10 kHz and signal level to +4 dBm.

      2. For 30-in/s alignment, set generator to 20 kHz and signal level to +4 dBm.

   c. Set the READY/SAFE switches of the channels to be aligned to READY.

   d. Set the INPUT MON/NORM MON switch to NORM MON.

   e. Set the NORMAL/SET UP/BIAS switches on the electronics panel to BIAS.

2. Place the machine in the record mode. Observe that all channels in ready mode go into record mode, and that on-scale readings appear on the vu meters. Then do one of the following steps according to the system configuration:

   a. For 8- or 16-channel sytems, adjust the ERASE PEAK control on each bias/erase amplifier PWA to give a maximum reading on the respective vu channel meter.

If necessary, adjust the BIAS CAL controls to obtain on-scale readings.

b. For 24-channel systems, turn the ERASE PEAK control fully ccw and then turn the control slowly cw. The bias level indication will change very slowly at first. Then the vu meter will indicate a sudden 0.5 to 3-dB drop. If the initial drop is greater than 1.5 dB, turn ERASE PEAK control slowly ccw so that indication is between 1.0 to 1.5 dB down from level where the sudden drop occurred.

Conversely, if initial drop is less than 0.5 dB, continue turning ERASE PEAK control cw until the indication is 1.0 to 1.5 dB down from level where the sudden drop occurred.

3. Reset all NORMAL/SET UP/BIAS switches to the SET UP position. Adjust RECORD level controls to give a mid-scale indication on the vu meters.

4. For 15-in/s record alignment, proceed as follows:

a. Adjust the BIAS ADJ control on each bias amplifier PWA for maximum output amplitude of the 10-kHz signal. Continue rotation of the control clockwise until the output decreases exactly 1.5 dB (406 tape) or 2.5 dB (456 tape). (Note that the BIAS ADJ control need only be adjusted for one speed of an operating speed pair.)

b. Set generator to 1 kHz and signal level to +4 dBm.

c. Adjust RECORD level control for a vu meter indication of 0 vu.

d. Set generator to 15 kHz and signal level to +4 dBm.

e. Adjust RECORD LOW SPEED equalizer control for a vu meter indication of 0 vu.

f. Set generator to 50 Hz and signal level to +4 dBm.

g. Adjust REPRODUCE LOW SPEED LOW FREQ equalizer control to achieve a minimum deviation for the 0-vu-meter indication for frequencies between 30 Hz and 100 Hz.

h. Sweep the signal generator from 30 Hz to 15 kHz while maintaining a constant +4 dBm output level. The vu meter indication should remain within ±2 vu of 0 vu.

i. Set generator to 1 kHz and signal level to +4 dBm.

j. Set INPUT MON/NORM MON switch to INPUT MON position.

k. Adjust REC CAL control on each record amplifier PWA for a vu meter indication of 0 vu.

l. Set the NORMAL/SET UP/BIAS switch to the BIAS position.

m. Adjust the BIAS CAL control on each bias amplifier PWA for a vu meter indication of 0 vu.

n. Return the NORMAL/SET UP/BIAS switch to the SET UP position.

5. For 30-in/s record alignment, proceed as follows:

a. Adjust the BIAS ADJ control on each bias amplifier PWA for maximum output amplitude of the 20-kHz signal. Continue rotation of the control clockwise until the output decreases exactly 1.5 dB (406 tape) or 2.5 dB (456 tape). (Note that the BIAS ADJ control need only be adjusted for one speed of an operating speed pair.)

b. Set generator to 1 kHz and signal level to +4 dBm.

c. Adjust RECORD level control for a vu meter indication of 0 vu.

d. Set generator to 15 kHz and signal level to +4 dBm.

e. Adjust RECORD HI SPEED equalizer control for a vu meter indication of 0 vu.

f. Set generator to 50 Hz and signal level to +4 dBm.

g. Adjust REPRODUCE HI SPEED LOW FREQ equalizer control to achieve a minimum deviation for the 0-vu-meter indication for frequencies between 550 Hz and 100 Hz.

h. Sweep the signal generator from 50 Hz to 18 kHz while maintaining a constant +4 dBm output level. The vu meter indication should remain within ±2 vu of 0 vu.

i. Set generator to 1 kHz and signal level to +4 dBm.

j. Set INPUT MON/NORM MON switch to INPUT MON position.

k. Adjust REC CAL control on each record amplifier PWA for a vu-meter indication of 0 vu.

l. Set the NORMAL/SET UP/BIAS switch to the BIAS position.

m. Adjust the BIAS CAL control on each bias amplifier PWA for a vu-meter indication of 0 vu.

n. Return the NORMAL/SET UP/BIAS switch to the SET UP position.

6. Perform the bias-trap adjustment as follows:

a. Set the SEL SYNC/REPRO switch to SEL SYNC.

b. Set the INPUT MON/NORM MON switch to NORM MON.

c. Set READY/SAFE switches of channels adjacent to channel to be adjusted to READY.

d. Set READY/SAFE switch of channel to be adjusted to SAFE.

e. Remove tape from machine and hold the end-of-tape arm in an on position with pressure-sensitive tape.

f. Turn system power off. Mount the record amplifier PWA of the channel to be adjusted on an extender board (Table 5-1).

g. Connect an ac vtvm to the channel line output.

h. Switch system power on and place machine in record mode.

i. Adjust the bias-trap inductor, which is located between the record and reproduce connectors on the audio switching PWA, for minimum reading on the vtvm. (With the record amplifier on the extender board, the bias-trap inductor can be reached easily with a long insulated tuning tool through the opening left by extending the record amplifier.)

Overall Noise and Distortion Measurements

A wave analyzer is recommended for making distortion measurements and is necessary for making erasure depth measurements. An oscillator with less than 0.1% distortion is also required for making distortion measurements. Demagnetized heads and tape guides and correct record and reproduce alignment are assumed prior to performing the measurements.

Distortion Measurement. Perform the following procedure to measure distortion.

1. Set up the system as follows:

   a. Thread a reel of degaussed tape of the type to be used (Ampex 406 or equivalent) onto the transport.

   b. Set all READY/SAFE switches to READY.

   c. Select NORM MON and REPRO settings.

   d. Connect a signal-generator to the line inputs. Adjust signal-generator frequency to 1 kHz and level to +4 dBm.

2. Place the machine in the record mode. Ensure that all vu meters read 0 vu. Adjust RECORD level controls as required to achieve the indication.

3. Connect the wave analyzer to the line outputs and normalize its full-scale reading at 1 kHz. Measure the second-harmonic component; this should not exceed 0.3% or −50 dB with respect to the fundamental. Similarly, measure the third-harmonic component; this should not exceed 1% or −40 dB with respect to the fundamental. Repeat this procedure for each channel.

4. If the second-harmonic component is high, degauss heads and tape guides thoroughly and repeat the measurement. A continuing high reading may indicate either a faulty record-amplifier output capacitor or a misadjusted bias amplifier PWA. Check the ERASE PEAK adjustment (previously described) initially. The record PWA may be checked by substitution with another channel. If the record PWA is not at fault, refer to the bias amplifier alignment.

5. If the third-harmonic component is high, the two most likely causes are that the record level is set too high (reproduce level incorrect), or the bias level is incorrectly set. These levels can be reset as previously described.

Noise and Erasure Depth. Perform the following procedure to measure noise and erasure depth.

1. Prepare the machine as follows:

   a. Thread a reel of tape of the type to be used (Ampex 406, 456, or equivalent) on the transport.

   b. Connect a signal-generator to the line inputs. Set signal-generator to 1 kHz and +4-dBm output level.

   c. Set all NORMAL/SET UP/BIAS switches to SET UP. Place SEL SYNC/REPRO switch in REPRO. Place INPUT MON/NORM MON in NORM MON.

   d. Set all READY/SAFE switches to READY.

2. Place machine in record mode and adjust RECORD level controls to give 0-vu indication on vu meters. (Reproduce electronics should be aligned correctly.) Increase signal-generator output level to +10 dBm. Record at this level for 2 or 3 minutes.

3. Rewind the tape to the beginning of the recorded section and remove the signal-generator input signal. The inputs should be terminated with a low impedance (600 ohms) or shorted. Connect a vtvm to the line output via a band-limiting filter (see Figure 5-10).

4. Place the machine in the record mode once again and read the residual noise of the vtvm for each channel. For 8- and 16-track systems, the meter should read less than −53 dBm, and for 24-track systems less than −48 dBm. If the ASA "A" weighted filter (Figure 5-11) is used, after correction for the insertion loss of the filter, the meter should ready −55 dBm or greater for 8- and 16-track systems, or −51 dBm or greater for 24-track systems.

NOTE

The residual noise figures in step 4 are absolute noise levels. When referred to the peak signal level of +10 dBm, the signal-to-noise ratio is obtained (i.e., meter reads −55 dBm noise using band-limiting filter). Therefore, signal-to-noise ratio is 65 dB unweighted.

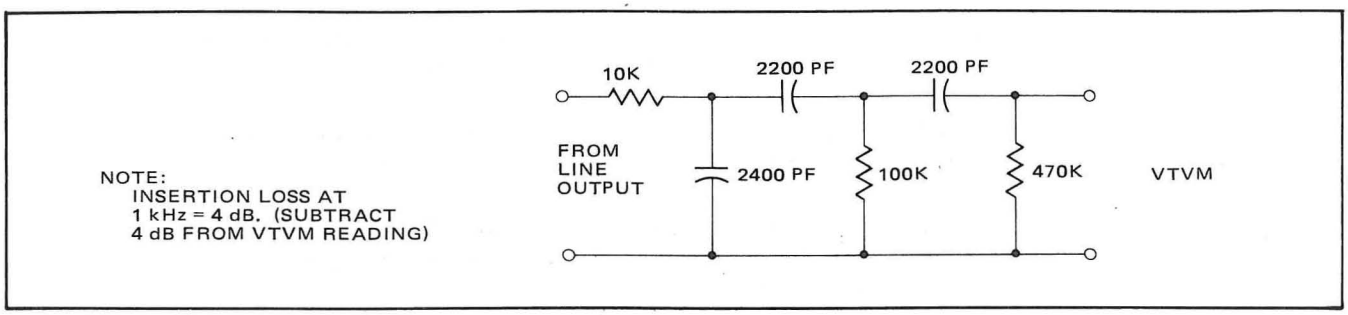


Figure 5-11. ASA "A" Weighted Filter

5. If a wave analyzer is connected to the line output, the erasure depth may also be determined. Measure the residual level of the 1,000-Hz signal; the level should not exceed –65 dBm.

Bias/Erase Amplifier PWA Alignment for 8- or 16-Channel Systems

NOTE

This adjustment should normally be required only if a bias/erase amplifier PWA is used in a channel in which it was not previously used, or if failure of the PWA requires component replacement. Operational indications that adjustment may be required are excessive second-harmonic noise, or noise occurring when all other possible sources of the noise or distortion (for example, magnetized heads or guides or faulty record amplifiers) have been eliminated.

1. Prepare the machine as follows:

   a. Place the bias/erase amplifier PWA of the channel to be aligned on an extender board (Table 5-1).

   b. If bias/erase amplifier is equipped with bias balance potentiometer R92, set this control midrange.

   c. Set the NORMAL/SET UP/BIAS switch to BIAS position.

   d. Set the channel READY/SAFE switch to READY position.

   e. Set SEL SYNC/REPRO switch to REPRO position.

   f. Thread a reel of blank tape of the type to be used (Ampex 406, 456, or equivalent) onto the transport.

2. Place the transport in record mode and proceed as follows:

   a. Adjust the BIAS CAL control on the bias/erase amplifier PWA to obtain a 2/3-scale reading on the vu meter.

   b. Adjust the core of T3 (nearest connector) to achieve maximum reading on the vu meter. (There are two peaks; select either of these.)

   c. Repeat step 2a (if necessary) and adjust the core of T4 (furthest from connector) to achieve maximum reading on the vu meter. (There are two peaks; select either of these.)

3. Adjust the ERASE PEAK control for maximum output and proceed as follows:

   a. Adjust core of T3 so that the meter is reading at the center of the dip between the two peaks.

   b. Check that ERASE PEAK control is still adjusted to give maximum output.

4. Perform *Record Alignment* procedure.

NOTE

If a large readjustment of the bias level is necessary, step 3 should be repeated.

5. If the bias amplifier is equipped with bias balance potentiometer R92, adjust R92 for minimum noise. An alternate method of adjusting R92 is as follows:

   a. Connect an ASA "A" weighted filter (Figure 5-11) to the output of the recorder.

   b. Connect a vtvm to the filter output.

   c. Adjust R92 for minimum reading on the vtvm.

NOTE

For both methods of adjusting R92, if a noise null cannot be found within range of the control, demagnetize the heads and tape-guiding components. Readjust C40, coils T3 and T4, and R92.

6. Remove the extender board and replace the bias/erase amplifier PWA in the electronics chassis.

7. If desired, recheck second-harmonic distortion of the reproduced audio as described under *Distortion Measurement*.

Bias/Erase Amplifier PWA Adjustment for 24-Channel Systems

NOTE

Step 3 differs from corresponding adjustments on 16-channel systems.

1. Prepare the machine as follows:

   a. Place the bias/erase amplifier PWA of the channel to be aligned on an extender board (Table 5-1).

   b. If bias/erase amplifier is equipped with bias balance potentiometer R92, set this control midrange.

   c. Place the NORMAL/SET UP/BIAS switch in BIAS.

   d. Place the channel READY/SAFE switch in READY.

   e. Set SEL SYNC/REPRO switch to REPRO position.

   f. Thread a reel of blank tape of the type to be used (Ampex 406, 456, or equivalent) onto the transport.

2. Place the transport in record mode and proceed as follows:

   a. Adjust the BIAS CAL control on the bias/erase amplifier PWA to obtain a 2/3-scale reading on the vu meter.

   b. Adjust the core of T3 (nearest connector) to achieve maximum reading on the vu meter. (There are two peaks; select either of these.)

   c. Repeat step 2a (if necessary) and adjust the core of T4 (furthest from connector) to achieve maximum reading on the vu meter. (There are two peaks; select either of these.)

3. Turn the ERASE PEAK control fully ccw and proceed as follows:

   a. Turn the ERASE PEAK control slowly cw. The bias level indication will change very slowly at first. Then the vu meter will indicate a sudden 0.5 to 3 dB drop. If the initial drop is greater than 1.5 dB, turn ERASE PEAK control slowly ccw so that indication is between 1.0 to 1.5 dB down from level where the sudden drop occurred.

      Conversely, if initial drop is less than 0.5 dB, continue turning ERASE PEAK control cw until the indication is 1.0 to 1.5 dB down from level where the sudden drop occurred.

   b. Leave T3 and T4 cores in their peaked positions as per step 2.

4. Perform *Record Alignment* procedure.

NOTE

If a large readjustment of the bias level is necessary, step 3 should be repeated.

5. If the bias amplifier is equipped with bias balance potentiometer R92, adjust R92 for minimum noise. An alternate method of adjusting R92 is as follows:

   a. Connect an ASA "A" weighted filter (Figure 5-9) to the output of the recorder.

   b. Connect a vtvm to the filter output.

   c. Adjust R92 for minimum reading on the vtvm.

NOTE

For both methods of adjusting R92, if a noise null cannot be found within range of the control, demagnetize the heads and tape-guiding components. Readjust capacitor C40, coils T3 and T4, and R92.

6. Remove the extender board and replace the bias/erase amplifier PWA in the electronics chassis.

7. If desired, recheck second-harmonic distortion of the reproduced audio as described under *Distortion Measurement*.

SECTION 6

PARTS LISTS AND SCHEMATIC DIAGRAMS

This section of the manual provides parts lists, assembly drawings, and schematic diagrams for the Ampex MM-1100 Multichannel Recorder/Reproducer, Part No. 4010210.

Three indexes list the assemblies as follows:

- **Indentured List of Assemblies** – List of assemblies in sequence of appearance in the manual.
- **Numerical List of Assemblies** – List of assemblies in numeric sequence.
- **Numerical List of Schematics** – List of schematics in numeric sequence.

INDENTURED LIST OF ASSEMBLIES

INDENTURED LIST OF ASSEMBLIES (Continued)

NUMERICAL LIST OF ASSEMBLIES

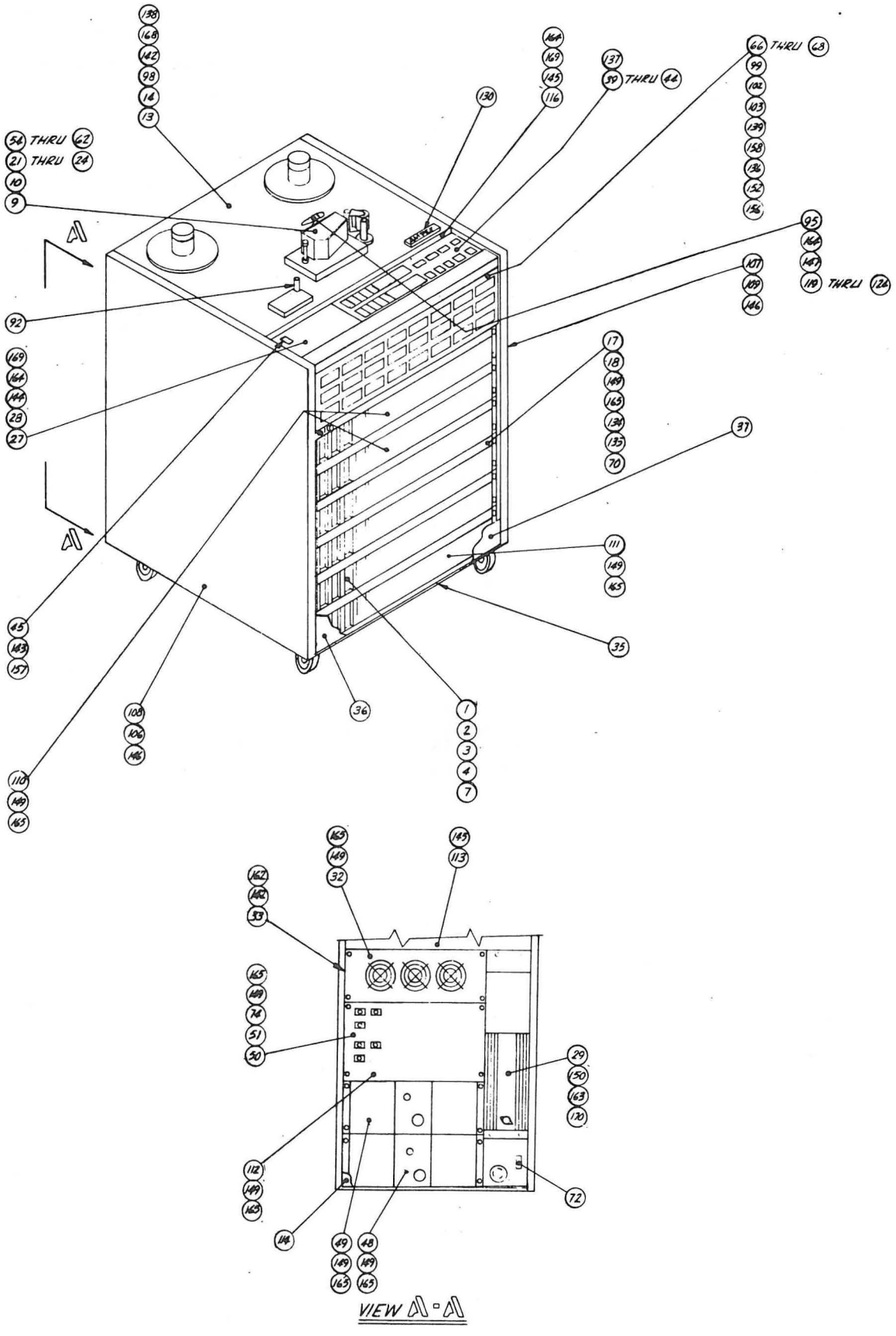
NUMERICAL LIST OF ASSEMBLIES (Continued)

NUMERICAL LIST OF SCHEMATICS

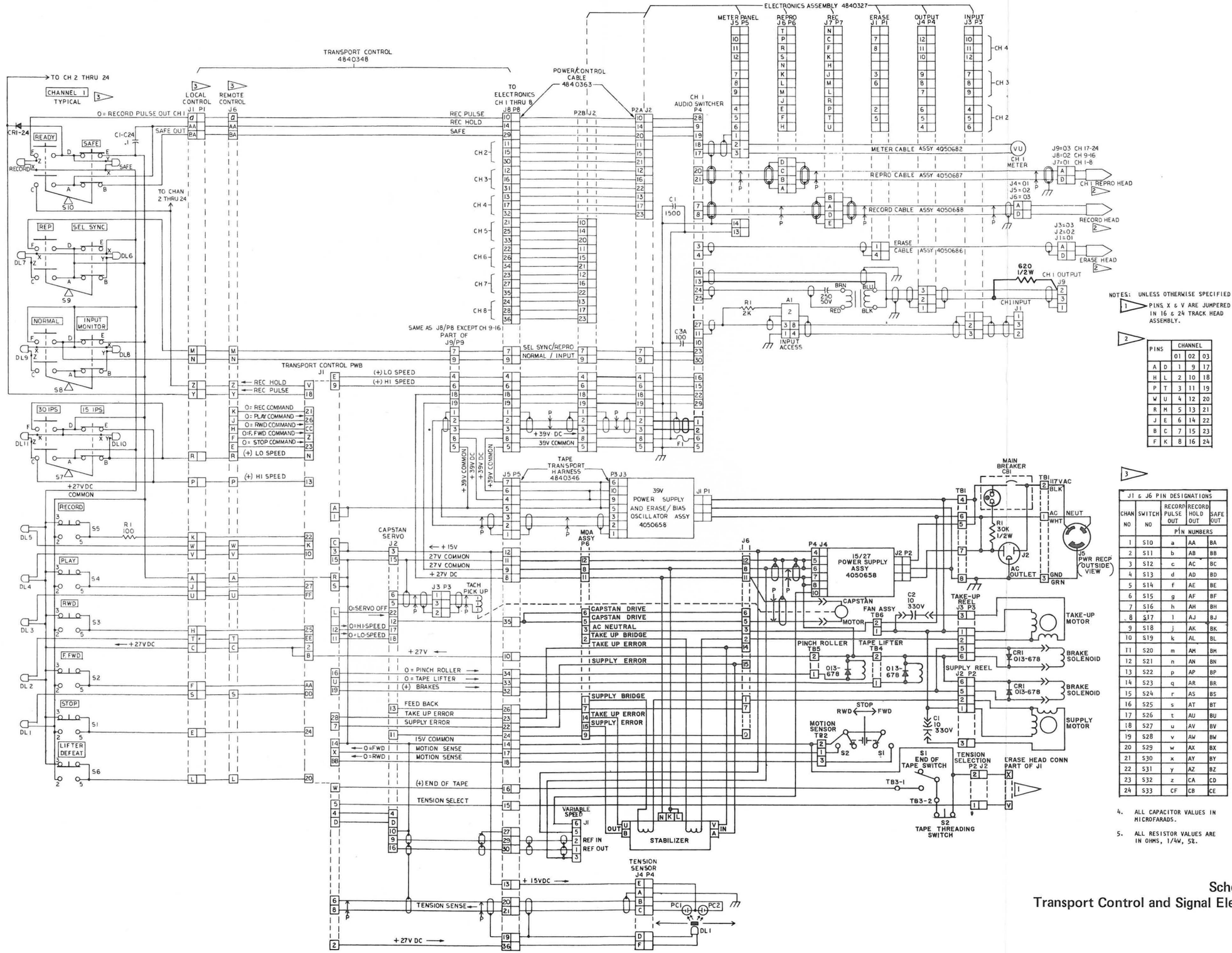
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4010210-13		MM-1100 MULTICHANNEL TAPE RECORDER/REPRODUCER ASSEMBLY, 8 CHANNEL, NAB 15–30 IPS (NHA CATALOG)	
	4010210-14		MM-1100 MULTICHANNEL TAPE RECORDER/REPRODUCER ASSEMBLY, 16 CHANNEL, NAB 15–30 IPS (NHA CATALOG)	
	4010210-15		MM-1100 MULTICHANNEL TAPE RECORDER/REPRODUCER ASSEMBLY, 24 CHANNEL, NAB 15–30 IPS (NHA CATALOG)	
	4010210-16		MM-1100 MULTICHANNEL TAPE RECORDER/REPRODUCER ASSEMBLY, 8 CHANNEL, CCIR/IEC 15–30 IPS (NHA CATALOG)	
	4010210-17		MM-1100 MULTICHANNEL TAPE RECORDER/REPRODUCER ASSEMBLY, 16 CHANNEL, CCIR/IEC 15–30 IPS (NHA CATALOG)	
	4010210-18		MM-1100 MULTICHANNEL TAPE RECORDER/REPRODUCER ASSEMBLY, 24 CHANNEL, CCIR/IEC 15–30 IPS (NHA CATALOG)	
	4010210-19		MM-1100 MULTICHANNEL TAPE RECORDER/REPRODUCER ASSEMBLY, 8 CHANNEL, NAB 7.5–15 IPS (NHA CATALOG)	
	4010210-20		MM-1100 MULTICHANNEL TAPE RECORDER/REPRODUCER ASSEMBLY, 16 CHANNEL, NAB 7.5–15 IPS (NHA CATALOG)	
	4010210-21		MM-1100 MULTICHANNEL TAPE RECORDER/REPRODUCER ASSEMBLY, 24 CHANNEL, NAB 7.5–15 IPS (NHA CATALOG)	
	4010210-22		MM-1100 MULTICHANNEL TAPE RECORDER/REPRODUCER ASSEMBLY, 8 CHANNEL, CCIR/IEC 7.5–15 IPS (NHA CATALOG)	
	4010210-23		MM-1100 MULTICHANNEL TAPE RECORDER/REPRODUCER ASSEMBLY, 16 CHANNEL, CCIR/IEC 7.5–15 IPS (NHA CATALOG)	
	4010210-24		MM-1100 MULTICHANNEL TAPE RECORDER/REPRODUCER ASSEMBLY, 24 CHANNEL, CCIR/IEC 7.5–15 IPS (NHA CATALOG)	
1	4020269-01		RECORD EQUALIZER PWA, NAB, 7-1/2–15 IPS	
2	4020269-03		RECORD EQUALIZER PWA, CCIR 7-1/2–15 IPS	
3	4020269-06		RECORD EQUALIZER PWA, CCIR/IEC 15–30 IPS	
4	4020269-08		RECORD EQUALIZER PWA, NAB 15–30 IPS	
7	4020270-02		REPRODUCE EQUALIZER PWA	
9	4020334-01		ONE INCH HEAD ASSY, 8 CHAN, 15–30 IPS	
10	4020334-02		ONE INCH HEAD ASSY, 8 CHAN, 7.5–15 IPS	
13	4020360-01		TRANSPORT ASSY, 8 CHAN	
14	4020360-02		TRANSPORT ASSY, 16 AND 24 CHAN	
17	4020371-09		ELECTRONICS ASSEMBLY, 15–30 IPS	
18	4020371-11		ELECTRONICS ASSEMBLY, 7.5–15 IPS	
21	4020372-01		HEAD ASSY, 16 CHAN, 15–30 IPS	
22	4020372-02		HEAD ASSY, 24 CHAN, 15–30 IPS	
23	4020372-03		HEAD ASSY, 16 CHAN, 7.5–15 IPS	
24	4020372-04		HEAD ASSY, 24 CHAN, 7.5–15 IPS	
27	4020373-07		TRANSPORT CONTROL ASSY, 8 AND 16 CHAN	
28	4020373-08		TRANSPORT CONTROL ASSY, 24 CHAN	
29	4020374-03		MOTOR DRIVE AMPLIFIER ASSY	
32	4020379-02		FAN ASSY	
33	4020389-01		STABILIZER UNIT	
35	4030383-02		FRAME ASSEMBLY	
36	4030387-01		DOOR ASSY	
37	4030387-02		DOOR ASSY	
39	4050646-20		CONTROL BOX ASSY, 8 CHAN, 15–30 IPS	
40	4050646-21		CONTROL BOX ASSY, 16 CHAN, 15–30 IPS	
				AE

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
41	4050646-22		CONTROL BOX ASSY, 24 CHAN, 15–30 IPS	
42	4050646-24		CONTROL BOX ASSY, 8 CHAN, 7.5–15 IPS	
43	4050646-25		CONTROL BOX ASSY, 16 CHAN, 7.5–15 IPS	
44	4050646-26		CONTROL BOX ASSY, 24 CHAN, 7.5–15 IPS	
45	4050647-03		CIRCUIT BREAKER ASSY	
48	4050658-07		POWER SUPPLY ASSY, 39V	
49	4050658-08		POWER SUPPLY ASSY, 15/27V	
50	4050685-01		INPUT/OUTPUT CONNECTOR PANEL ASSY, 8 CHAN	
51	4050685-02		INPUT/OUTPUT CONNECTOR PANEL ASSY, 16 CHAN	
54	4050686-01		ERASE HEAD CABLE ASSY	
55	4050686-02		ERASE HEAD CABLE ASSY, 16 AND 24 CHAN	
56	4050686-03		ERASE HEAD CABLE ASSY, 24 CHAN	
57	4050687-04		REPRODUCE HEAD CABLE ASSY	
58	4050687-05		REPRODUCE HEAD CABLE ASSY, 1, 16 AND 24 CHAN	
59	4050687-06		REPRODUCE HEAD CABLE ASSY, 24 CHAN	
60	4050688-01		RECORD HEAD CABLE ASSY	
61	4050688-02		RECORD HEAD CABLE ASSY, 16 AND 24 CHAN	
62	4050688-03		RECORD HEAD CABLE ASSY, 24 CHAN	
66	4050707-01		METER PANEL ASSY, 8 CHAN	
67	4050707-02		METER PANEL ASSY, 16 CHAN	
68	4050707-03		METER PANEL ASSY, 24 CHAN	
70	4050709-01		ELECTRONICS POWER AND CONTROL CABLE ASSY	
72	4050710-01		REMOTE CONTROL DUMMY PLUG ASSY	
74	4050715-01		INPUT/OUTPUT CONNECTOR PANEL ASSY, 24 CHAN	
78	4090024-01		MISCELLANEOUS PARTS KIT, 8 CHAN	
79	4090024-02		MISCELLANEOUS PARTS KIT, 16 CHAN	
80	4090024-03		MISCELLANEOUS PARTS KIT, 24 CHAN	
92	4200069-01		SLEEVE, TAPE GUIDE	
95	4220294-01		SPACER, HEAD CABLE	
96	4220297-01		SPACER, TRANSPORT, 8 AND 16 CHAN	
98	4220305-01		SPACER, 24 CHAN	
99	4220307-01		BLOCK METER PANEL, 24 CHAN	
102	4260512-01		BRACKET METER PANEL	
103	4260512-02		BRACKET METER PANEL	
106	4290825-09		PANEL, SIDE, 8 AND 16 CHAN	
107	4290825-10		PANEL, SIDE, 8 AND 16 CHAN	
108	4290825-11		PANEL, SIDE, 24 CHAN	
109	4290825-12		PANEL, SIDE, 24 CHAN	
110	4290836-01		PANEL, BLANK 4", 24", 8 AND 16 CHAN	
111	4290836-02		PANEL, BLANK 8-1/4", 24", 8 CHAN	
112	4290902-01		PANEL, FILLER, REAR, 8 AND 16 CHAN	
113	4290917-01		PANEL, FILLER, 24 CHAN	
114	4290925-02		COVER, POWER SUPPLY	
116	4330319-03		PLATE, SPACER	
119	4600153-09		CLAMP, HEAD CABLE, 8 CHAN	
				AE

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
120	4600153-10		CLAMP, HEAD CABLE, 8 CHAN	
121	4600153-05		CLAMP, HEAD CABLE, 16 CHAN	
122	4600153-06		CLAMP, HEAD CABLE, 16 CHAN	
123	4600153-07		CLAMP, HEAD CABLE, 24 CHAN	
124	4600153-08		CLAMP, HEAD CABLE, 24 CHAN	
127	4890321		INSTRUCTION MANUAL	
128	4890357		MANUAL SUPPLEMENT, 7.5–15 IPS	
130	6000039-12		TRADEMARK, CASTING	
133	4010216-01		ACCESSORIES	
134	230-099		KNOB, ROUND MARKED	
135	265-069		BUSHING, SNAP, NYLON, BLK	
136	421-342		BEARING, 0.255 ID X 0.62 OD X 0.06 THK	
137	310-532		CATCH ASSY	
138	470-048		SCREW, CAP, SOC HD, NO. 1/4 – 20 X 0.875 LG	
139	470-088		SCREW, CAP SOC, NO. 10–32 X 0.438 LG	
140	470-020		SCREW, CAP SOC HD, NO. 6–32 X 0.500 LG	
142	471-071		SCREW, XREC, PAN HD, NO. 6–32 X 1/2 LG	
143	471-073		SCREW, XREC, PAN HD, NO. 6–32 X 3/4 LG	
144	471-079		SCREW, XREC, PAN HD, NO. 8–32 X 0.438 LG	
145	471-080		SCREW, XREC, PAN HD, NO. 8–32 X 0.50 LG	
146	471-462		SCREW, XREC, PAN HD, NO. 12–24 X 0.75 LG	
147	471-514		SCREW, ROUND HD, NO. 8–32 X 2-1/2 LG	
149	472-578		SCREW, XREC, OVAL HD, NKL PLD, NO. 10–32 X 0.75 LG	
150	473-098		SCREW, XREC, PAN HD, NO. 10–32 X 0.438 LG	
151	473-624		SCREW, XREC, FLAT HD, NO. 10–32 X 1.25	
152	474-052		SCREW, SHOULDER, NO. 10–32	
155	492-011		NUT, PLAIN, NO. 10–32	
156	493-008		NUT, SELF LOCKING, NO. 10–32	
157	496-005		NUT, KEP, NO. 6–32	
158	496-007		NUT, KEP, NO. 10–32	
162	501-009		WASHER, PLAIN, NO. 6	
163	501-070		WASHER, FLAT, NO. 10	
164	501-205		WASHER, PLAIN, NO. 8	
165	501-702		WASHER, FINISHING, NYLON, BLK, NO. 10	
168	502-003		WASHER, LOCK, NO. 6	
169	502-004		WASHER, LOCK, SPLIT, NO. 8	
170	502-005		WASHER, LOCK, SPRING, NO. 10	
171	502-011		WASHER, LOCK, NO. 10	
	4840418		TRANSPORT CONTROL AND SIGNAL ELECTRONICS SCHEMATIC W/STABILIZER	AE



Assembly No. 4010210. MM-1100 Multichannel Tape Recorder/Reproducer Assembly



NOTES: UNLESS OTHERWISE SPECIFIED

1. PINS X & V ARE JUMPERED IN 16 & 24 TRACK HEAD ASSEMBLY.

2.

PINS	CHANNEL		
	01	02	03
A D	1	9	17
H L	2	10	18
P T	3	11	19
W U	4	12	20
R M	5	13	21
J E	6	14	22
B C	7	15	23
F K	8	16	24

3.

J1 & J6 PIN DESIGNATIONS				
CHAN NO	SWITCH NO	RECORD PULSE OUT	RECORD HOLD OUT	SAFE OUT
		PIN NUMBERS		
1	S10	a	AA	BA
2	S11	b	AB	BB
3	S12	c	AC	BC
4	S13	d	AD	BD
5	S14	f	AE	BE
6	S15	g	AF	BF
7	S16	h	AH	BH
8	S17	j	AJ	BJ
9	S18	j	AK	BK
10	S19	k	AL	BL
11	S20	m	AM	BM
12	S21	n	AN	BN
13	S22	p	AP	BP
14	S23	q	AR	BR
15	S24	r	AS	BS
16	S25	s	AT	BT
17	S26	t	AU	BU
18	S27	u	AV	BV
19	S28	v	AW	BW
20	S29	w	AX	BX
21	S30	x	AY	BY
22	S31	y	AZ	BZ
23	S32	z	CA	CD
24	S33	CF	CB	CE

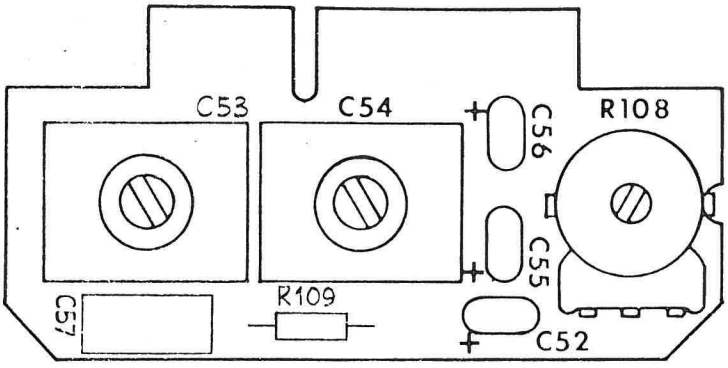
4. ALL CAPACITOR VALUES IN MICROFARADS.

5. ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%.

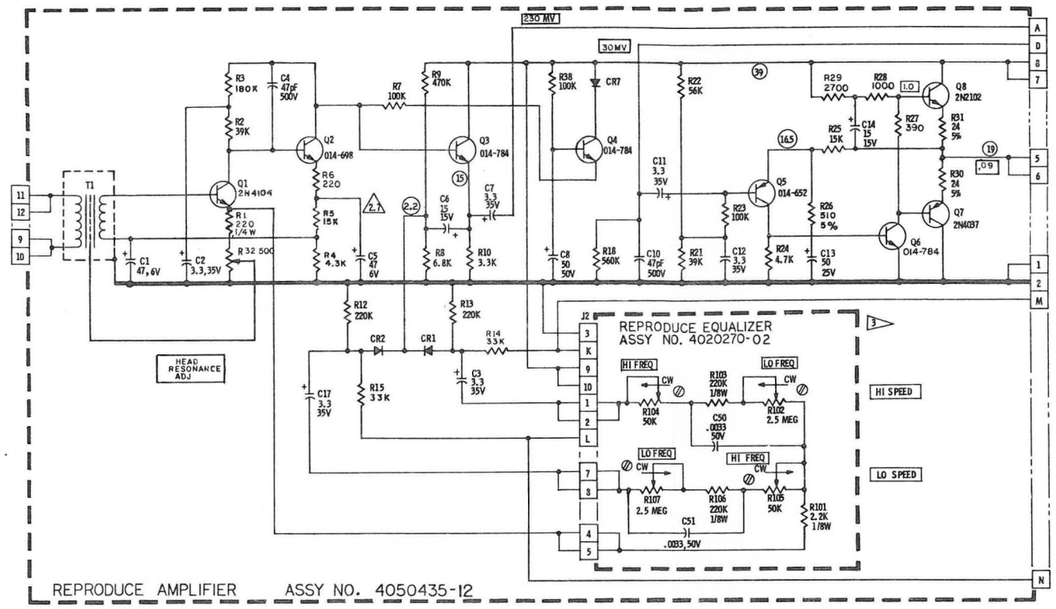
Schematic No. 4840418.
Transport Control and Signal Electronics w/Stabilizer

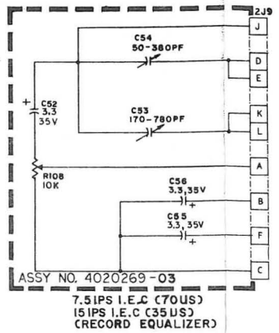
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4020269-01		RECORD EQUALIZER PWA, NAB 7.5–15 IPS (NHA 4010210)	
	4020269-03		RECORD EQUALIZER PWA, CCIR/IEC 7.5–15 IPS (NHA 4010210)	
	4020269-06		RECORD EQUALIZER PWA, CCIR/IEC 15–30 IPS (NHA 4010210)	
	4020269-08		RECORD EQUALIZER PWA, NAB 15–30 IPS (NHA 4010210)	
3	4540314-02	C54	CAPACITOR, TRIMMER, 50–380 PF, 7.5–15 IPS	
4	4540314-03	C53	CAPACITOR, TRIMMER, 170–780 PF, 7.5–15 IPS	
7	037-654	C52	CAPACITOR, TANT, 3.3 UF, 35V, 20%	
8	037-654	C55,56	CAPACITOR, TANT, 3.3 UF, 35V, 20%, CCIR/IEC	
10	055-164	C57	CAPACITOR, MYLAR, 0.0022 UF, 50V, 10%, NAB	
11	041-436	R109	RESISTOR, FXD, 18K, 1/4W, 5%, NAB	
12	037-654	C56	CAPACITOR, TANT, 3.3 UF, 35V, 20%, NAB 15–30 IPS	
13	4540314-01	C54	CAPACITOR, TRIMMER, 25–280 PF, 15–30 IPS	
14	4540314-02	C53	CAPACITOR, TRIMMER, 50–380 PF, 15–30 IPS	
18	4520153-07	R108	POTENTIOMETER, RECORD CALIBRATION, 10K	
20	4840330		SCHEMATIC, 7.5–15 IPS	
23	4840372		SCHEMATIC, 15–30 IPS	
				J

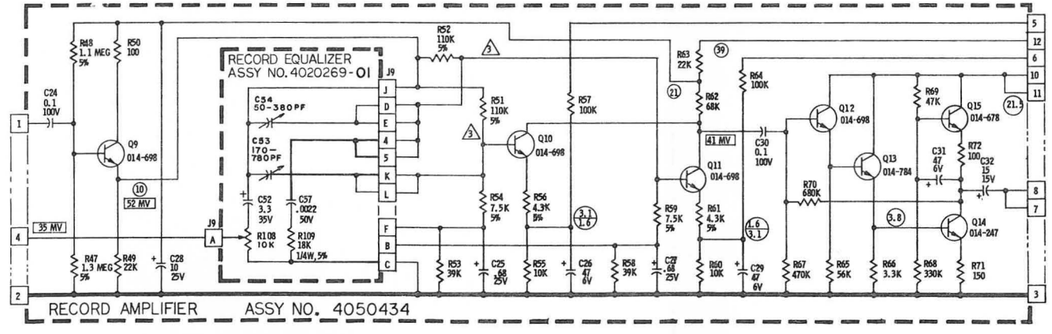
SHEET 1 OF 1

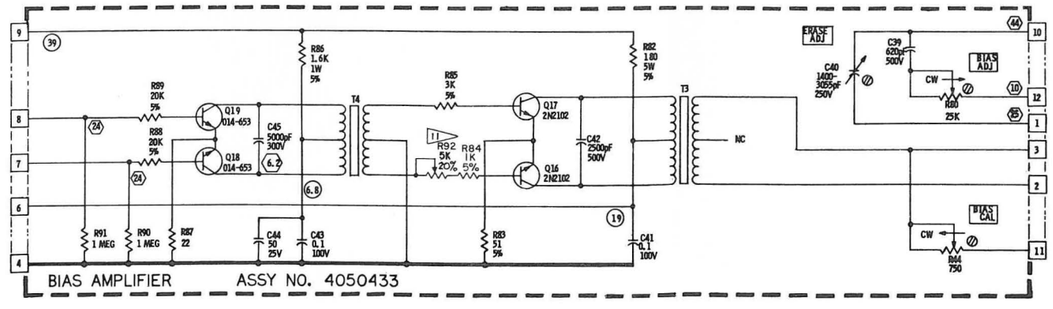


Assembly No. 4020269. Record Equalizer PWA









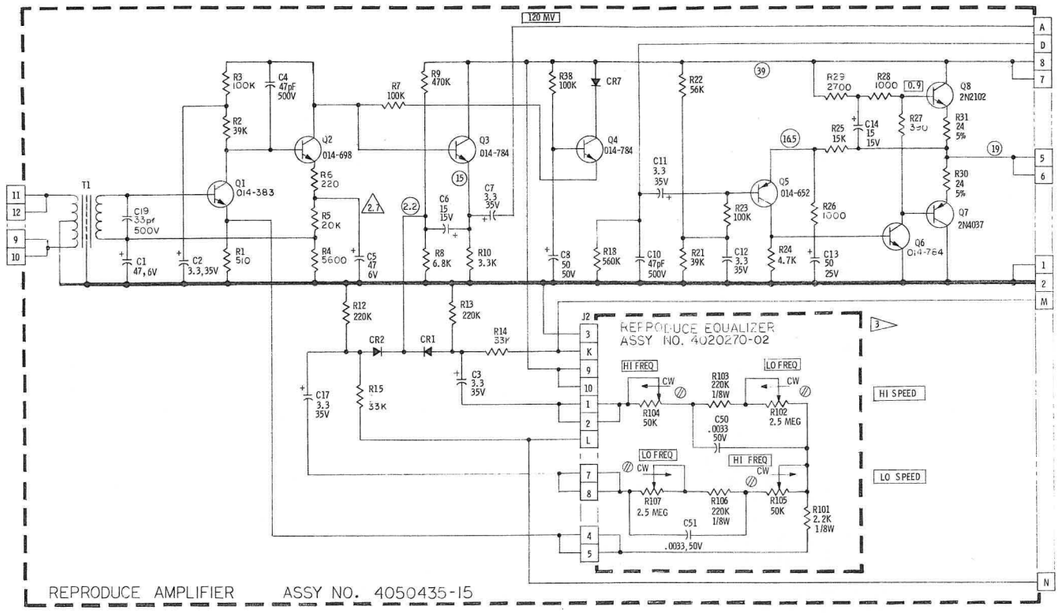
NOTES: UNLESS OTHERWISE SPECIFIED

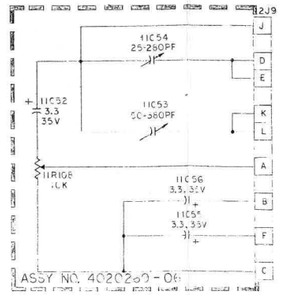
1. CAPACITANCE VALUES ARE IN MICROFARADS
2. DIODES ARE TYPE 013-599.
3. REPRODUCE EQUALIZER 4020270-02 CAN BE ADJUSTED TO NAB AND/OR CCIR.
4. RESISTANCE VALUES ARE IN OHMS 1/2W, 10%.
5. (XX) INDICATES VOLTS D.C. MEASURED WITH A 20,000 OHM/VOLT METER.
6. (XX) INDICATES VOLTS D.C. MEASURED WITH A HIGH IMPEDANCE VTVM.
7. [XX] INDICATES VOLTS R.M.S. MEASURED WITH A HIGH IMPEDANCE VTVM AT OPERATING LEVEL OF 1000 Hz.
8. ⟨XX⟩ INDICATES VOLTS R.M.S. MEASURED WITH A HIGH IMPEDANCE VTVM AT BIAS FREQUENCY.
9. REFERENCE DRAWING 4840344, SCHEMATIC, AUDIO SWITCHING.
10. FIELD SERVICE COMPONENT SUBSTITUTION :

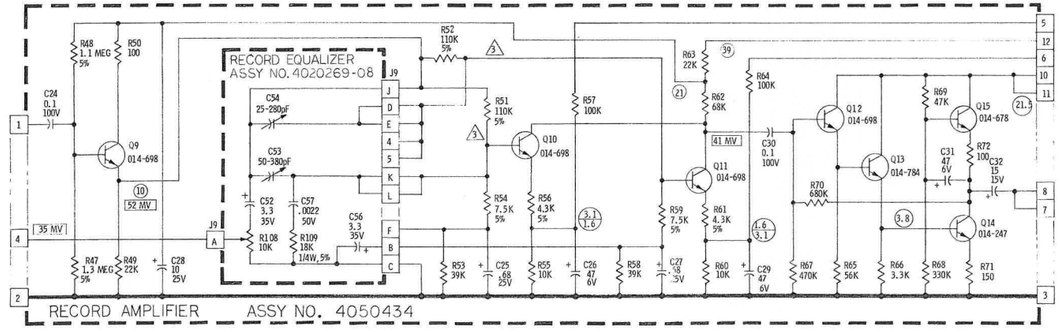
REF. DES.	AMPEX P/N	NEAREST COML. EQUIVALENT
CR1, CR2, CR7	013-599	1N914
Q14	014-247	2N2219
Q5	014-652	2N3906
Q18, Q19	014-653	2N3904
Q15	014-678	NONE
Q2, Q9-12	014-698	NONE
Q3, 4, 13, 6	014-784	NONE
Q1	014-383	2N4104

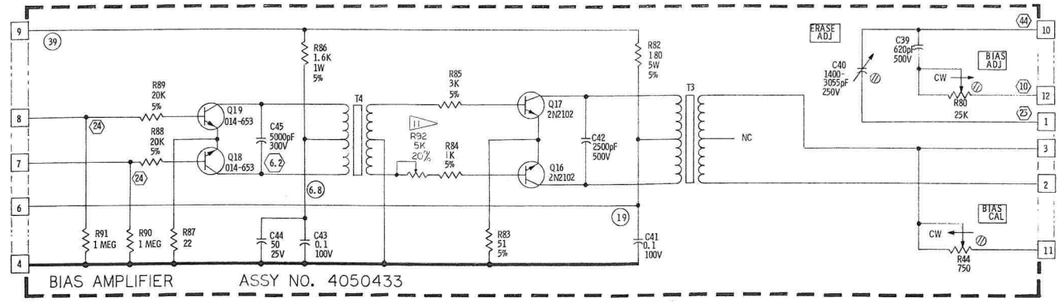
11. ADJUST R92 FOR MINIMUM NOISE FROM TAPE. IF NOISE NULL CANNOT BE FOUND, CHECK COMPONENTS FOR IMBALANCE OR HEADS FOR MAGNETIZATION

Schematic No. 4840330.
Record Reproduce Equalizers and 7.5—15 IPS Electronics









NOTES: UNLESS OTHERWISE SPECIFIED

1. CAPACITANCE VALUES ARE IN MICROFARADS
2. DIODES ARE TYPE 013-599.
3. REPRODUCE EQUALIZER 4020270-02 CAN BE ADJUSTED TO NAB AND/OR CCIR.
4. RESISTANCE VALUES ARE IN OHMS 1/2W, 10%.
5. (XX) INDICATES VOLTS D.C. MEASURED WITH A 20,000 OHM/VOLT METER.
6. △ INDICATES VOLTS D.C. MEASURED WITH A HIGH IMPEDANCE VTVM.
7. [X.X] INDICATES VOLTS R.M.S. MEASURED WITH A HIGH IMPEDANCE VTVM AT OPERATING LEVEL OF 1000 Hz.
8. (XX) INDICATES VOLTS R.M.S. MEASURED WITH A HIGH IMPEDANCE VTVM AT BIAS FREQUENCY.
9. REFERENCE DRAWING 4840344, SCHEMATIC, AUDIO SWITCHING.
10. FIELD SERVICE COMPONENT SUBSTITUTION :

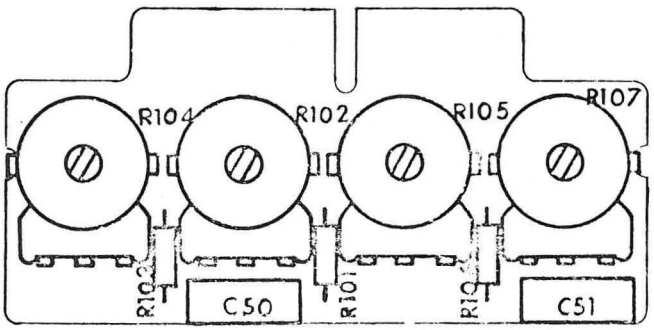
REF. DES.	AMPEX P/N	NEAREST COML. EQUIVALENT
CR1, CR2, CR7	013-599	1N914
Q14	014-247	2N2219
Q5	014-652	2N3906
Q18, Q19	014-653	2N3904
Q15	014-678	NONE
Q2, Q9-12	014-698	NONE
Q3, 4, 13, 6	014-784	NONE
Q1	014-383	2N4104

11. ADJUST R92 FOR MINIMUM NOISE FROM TAPE. IF NOISE NULL CANNOT BE FOUND, CHECK COMPONENTS FOR IMBALANCE OR HEADS FOR MAGNETIZATION.

Schematic No. 4840372.
Record, Reproduce Equalizers, Bias Amplifier and 15–30 IPS Electronics

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4020270-02		REPRODUCE EQUALIZER PWA (NHA 4010210)	
2	4520152-01	R104,105	POTENTIOMETER, 50K	
3	4520152-02	R102.107	POTENTIOMETER, 2.5M	
4	049-528	R103,106	RESISTOR, 220K, 1/8W, 10%	
5	049-527	R101	RESISTOR, 2.2K, 1/8W, 10%	
8	055-889	C50,51	CAPACITOR, MYLAR, 0.0033 MFD	
12	4840330		SCHEMATIC, 7.5–15 IPS	
13	4840372		SCHEMATIC, 15–30 IPS	D

SHEET 1 OF 1



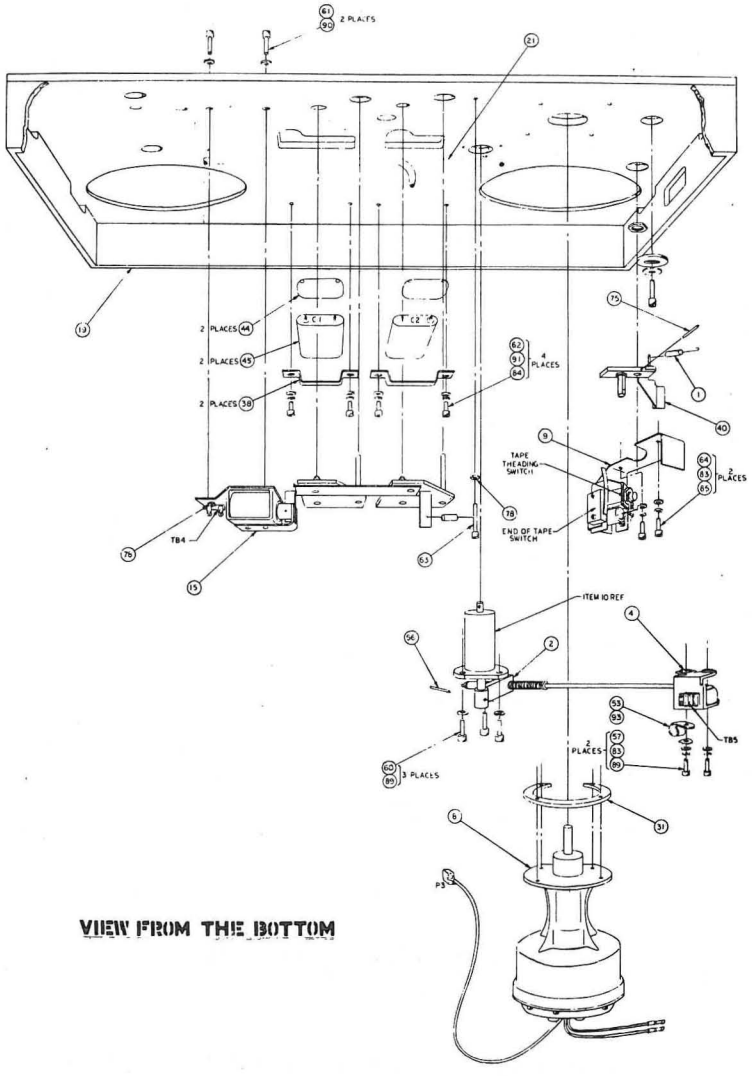
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4020360-01		TRANSPORT ASSEMBLY, 8 CHANNEL (NHA: 4010210)	
	4020360-02		TRANSPORT ASSEMBLY, 16–24 CHANNEL (NHA: 4010210)	
1	1024-01		SPRING, TAKEUP TENSION	
2	13871-02		ARM, SOLENOID	
3	50115-04		SLEEVE, BUMPER, TAPE TENSION ARM	
4	55670-05		CAPSTAN SOLENOID ASSY	
5	59102-05		TAPE TIMER ASSY	
8	4030328-11		CAPSTAN DRIVE ASSY	
9	4030341-02		SWITCH, LATCH, BRACKET ASSY	
10	4030369-01		CAPSTAN IDLER HOUSING ASSY	
12	4030375-01		REEL MOTOR ASSY, TAKEUP	
13	4030375-02		REEL MOTOR ASSY, SUPPLY	
14	4030377-01		END-OF-TAPE ARM AND HOUSING ASSY	
15	4030379-01		TAPE LIFTER ASSY	
16	4030384-02		TENSION SENSOR ASSY	
19	4041160-02		TOP PLATE ASSY	
20	4041194-02		TENSION ARM ASSY	
21	4050708-02		TAPE TRANSPORT HARNESS ASSY	
23	4110283-01		OVERLAY, TRANSPORT	
26	4210353-01		GUIDE, 1 IN FIXED, U/O 8 CHAN	
27	4210353-02		GUIDE, 2 IN FIXED, U/O 16–24 CHAN	
31	4250229-01		RING, SPACER, SERVO MOTOR	
33	4290797-02		COVER, TENSION SENSOR	
34	4290819-01		SHIELD, TRANSPORT	
38	4605002-10		BRACKET, CAP	
40	4952589-04		ARM ASSY, DASH POT	
41	4952610-03		MOTION SENSE ASSY	
44	032-084		BOOT, CAPACITOR	
45	036-142		CAPACITOR, FIXED, 10 UF, 330V	
53	302-365		CLAMP, CABLE	
56	406-030		PIN, SPRING, ROLL, 0.125 DIA X 0.625 LG	
57	470-021		SCREW, CAP, HEX SOC, NO. 6–32 X 0.625 LG	
58	470-015		SCREW, CAP, HEX SOC, NO. 6–32 X 0.188 LG	
59	470-017		SCREW, CAP, HEX SOC, NO. 6–32 X 0.312 LG	
60	470-019		SCREW, CAP, HEX SOC, NO. 6–32 X 0.44 LG	
61	470-023		SCREW, CAP, NO. 8–32 X 0.875 LG	
62	470-089		SCREW, CAP, HEX SOC, NO. 10–32 X 0.50 LG	
63	470-124		SCREW, CAP, HEX SOC, NO. 8–32 X 1.50 LG	
64	470-162		SCREW, CAP, HEX SOC, NO. 6–32 X 0.375 LG	
65	470-181		SCREW, CAP, HEX SOC, NO. 10–24 X 1.50 LG	
68	471-119		SCREW, PAN HD, XREC, NO. 6–32 X 0.37 LG	
72	474-052		SCREW, SHOULDER, NO. 10–32 X 0.250 LG	
				P

SHEET 1 OF 2

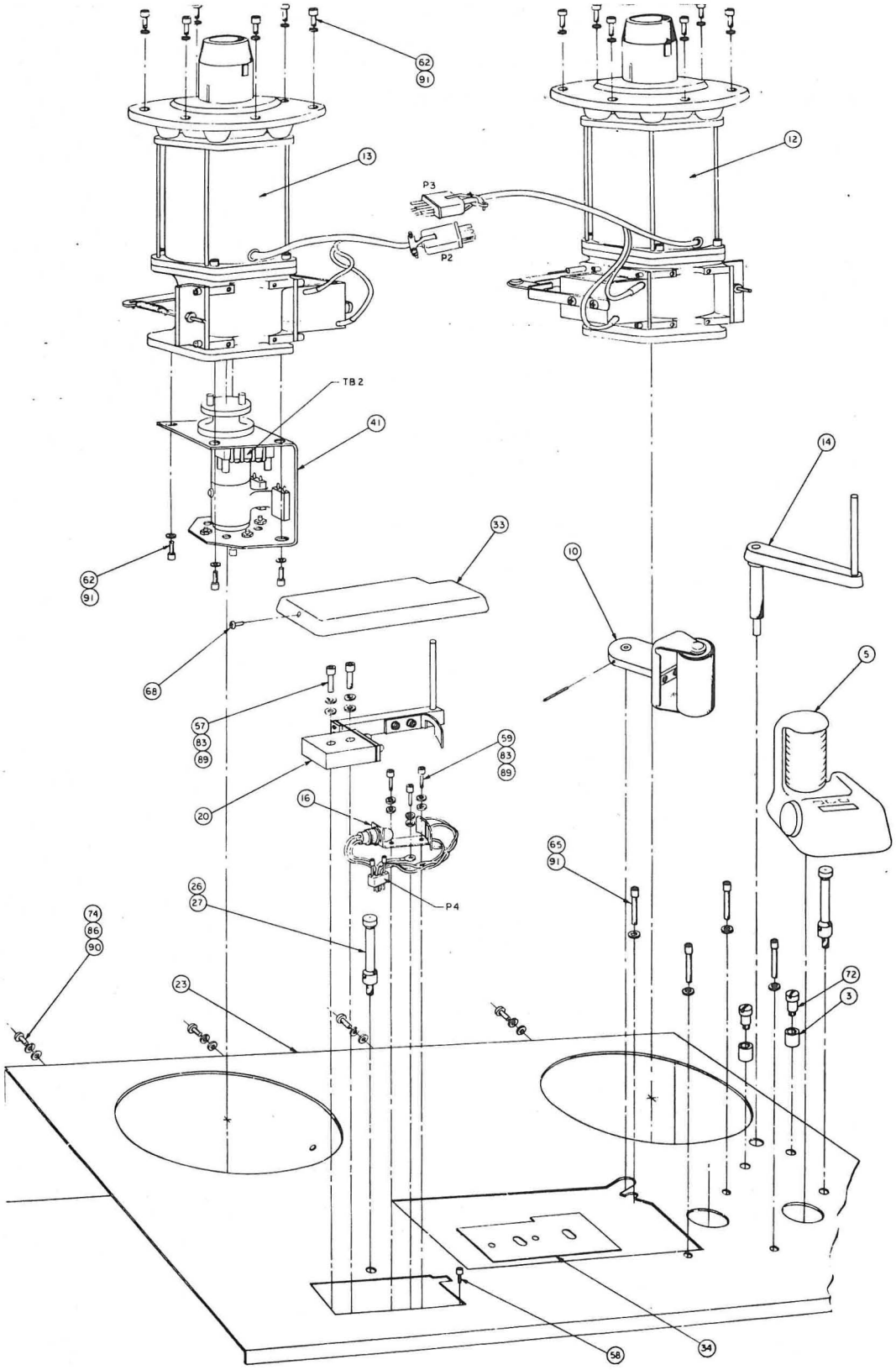
ASSEMBLY NO. 4020360 TITLE TRANSPORT ASSEMBLY

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
74	475-044		SCREW, PAN HD, XREC, NO. 8-32 X 0.375 LG	
75	477-490		SCREW, SET, NO. 4-40 X 0.188 LG	
78	496-006		NUT, KEP, NO. 8-32	
83	501-009		WASHER, PLAIN, NO. 6	
84	501-070		WASHER, PLAIN, NO. 10	
85	501-188		WASHER, PLAIN, NO. 6	
86	501-205		WASHER, PLAIN, NO. 8	
89	502-003		LOCKWASHER, SPRING, NO. 6	
90	502-004		LOCKWASHER, SPRING, NO. 8	
91	502-005		LOCKWASHER, SPRING, NO. 10	
93	506-013		WASHER, 'D', NO. 6	
126	4840346		SCHEMATIC, TRANSPORT	P

SHEET 2 OF 2

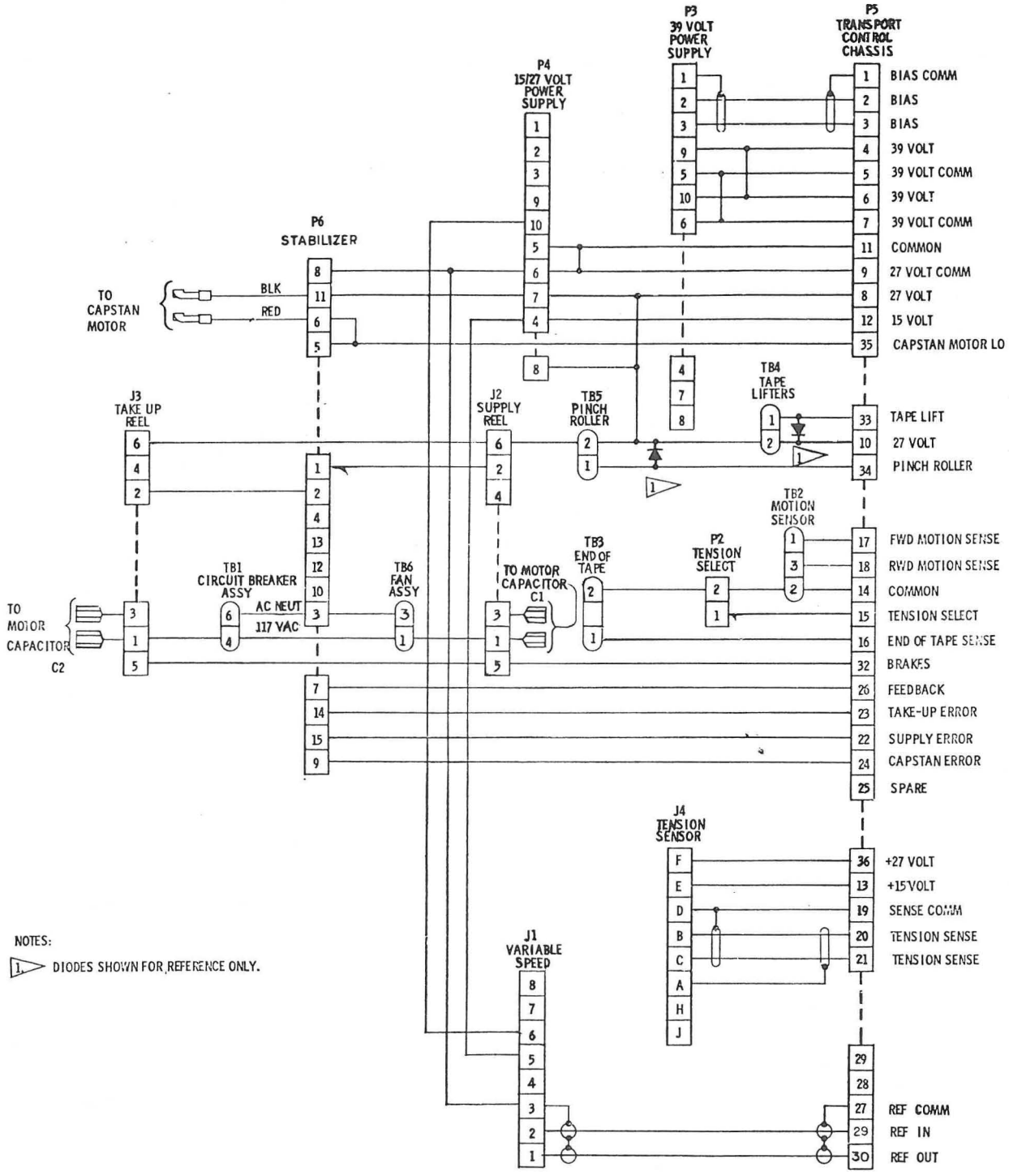


VIEW FROM THE BOTTOM



VIEW FROM THE TOP

Assembly No. 4020360. Transport Assembly

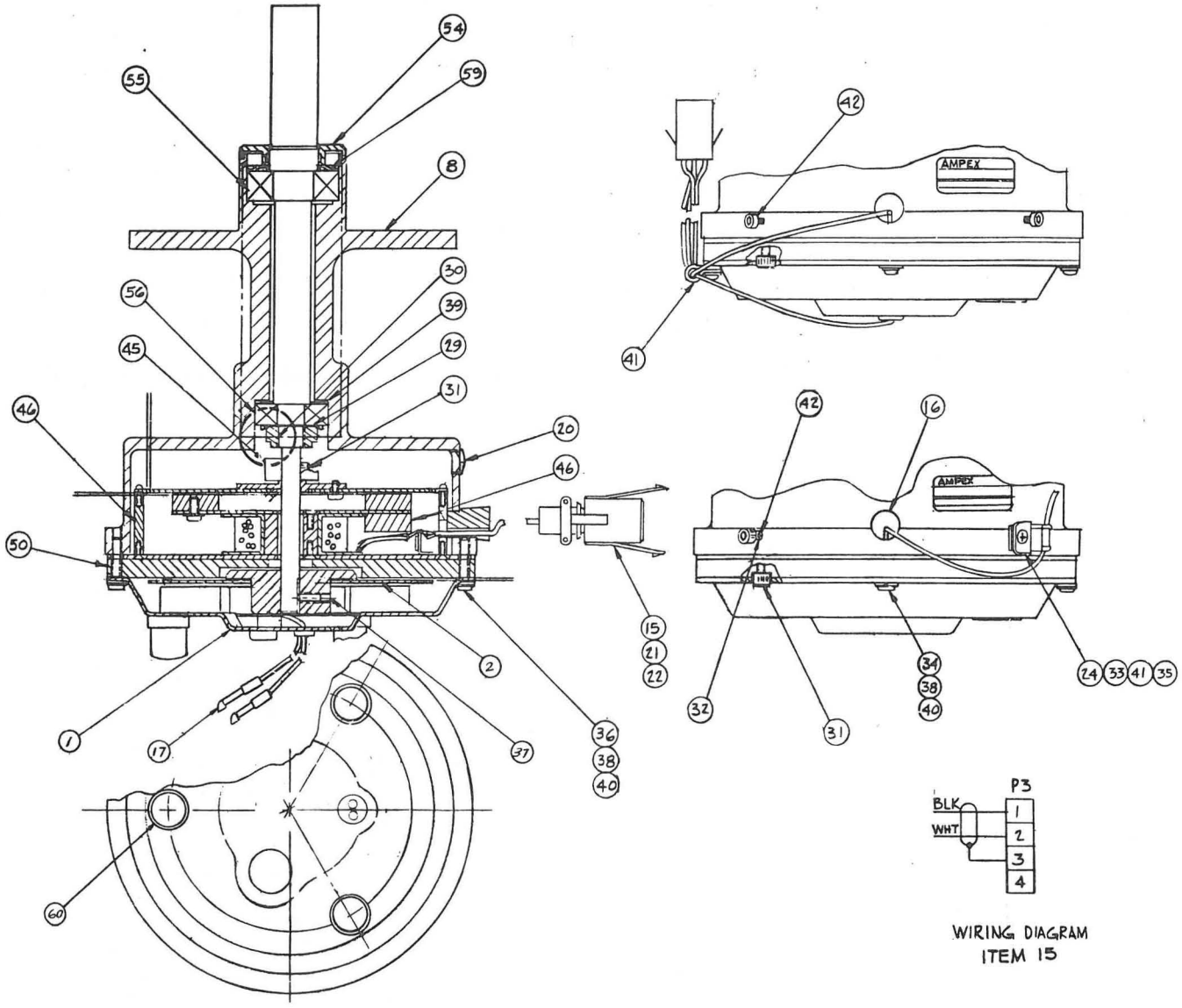


E

Schematic No. 4840346. Tape Transport Harness Assembly

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4030328-11		CAPSTAN DRIVE ASSEMBLY (NHA 4020360)	
1	4030350-01		MAGNET AND BRUSH ASSY	
2	4041199-03		ROTOR ASSY	
8	4980324-01		HOUSING, CAPSTAN DRIVE	
15	144-032		CONNECTOR, RECT, PLUG, 4 SOC	
16	160-256		RUBBER STOPPER	
17	171-009		TERMINAL, QIK DISC, SPLICE	
20	251-010		PLUG, BUTTON, 0.375 HOLE	
21	262-002		BUSHING, SLEEVE, 0.302 OD	
22	262-003		BUSHING, SLEEVE, 0.427 OD	
24	302-175		CLAMP, LOOP, OFFSET, 0.125 ID	
29	425-005		RING, SEAL, 0.4724 ID, 0.07 THK	
30	425-006		LOCKNUT	
31	470-018		SCREW, HEX DR, SOC HD, NO. 6-32 UNC X 0.38 LG	
32	470-024		SCREW, HEX DR, SOC HD, NO. 6-32 UNC X 1.0 LG	
33	471-066		SCREW, PAN HD, XREC, NO. 6-32 UNC X 0.19 LG	
34	471-073		SCREW, PAN HD, XREC, NO. 6-32 UNC X 0.75 LG	
35	477-496		SCREW, SET, HEX DR, CUP PT, NO. 6-32 UNC X 0.19 LG	
36	471-074		SCREW, PAN HD, XREC, NO. 6-32 UNC X 0.88 LG	
37	477-509		SCREW, SET, HEX DR, CUP PT, NO. 10-32 UNC X 0.38 LG	
38	501-015		WASHER, PLAIN, NO. 6, 0.375 OD	
39	501-763		WASHER, BELLEVILLE, 1.248 OD, 0.043 FREE HT	
40	502-003		WASHER, LOCK, NO. 6	
41	506-013		WASHER, 'D'	
42	477-525		SCREW, SET, HEX SOC, CUP PT, CRES, NO. 6-32 X 3/8 LG	
45	4030330-03		TACHOMETER WHEEL ASSY	
46	4030332-02		COIL SUPPORT AND PICKUP ASSY	
50	4220254-02		PLATE, MAGNET RETURN	
54	4100188-05		CAP, CAPSTAN DRIVE	
55	4200071-03		BEARING, BALL, ANGULAR CONTACT, 0.6693 ID, 1.5748 OD	
56	4200070-03		BEARING, BALL, ANGULAR CONTACT, 0.4724 ID, 1.2598 OD	
58	4210329-10		SHAFT, CAPSTAN DRIVE	
59	4600084-01		SHIELD, BEARING	
60	250-195		BUMPER	
				S

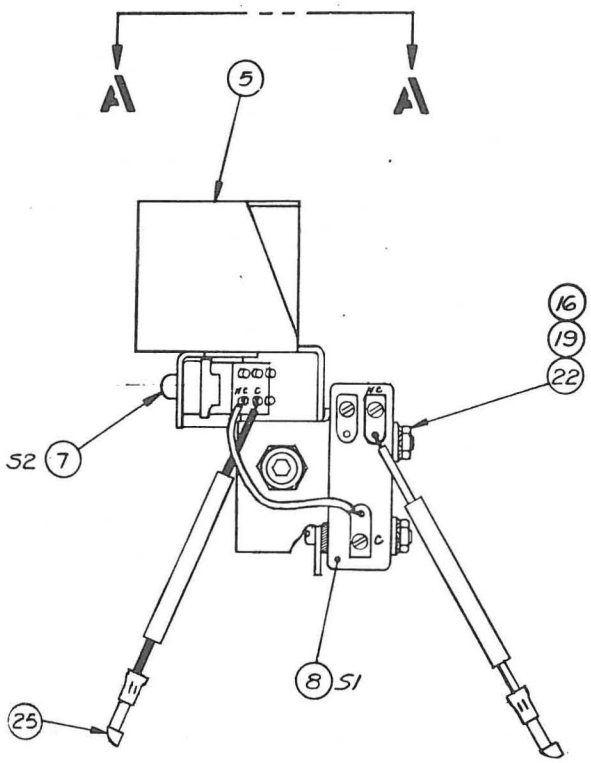
SHEET 1 OF 1

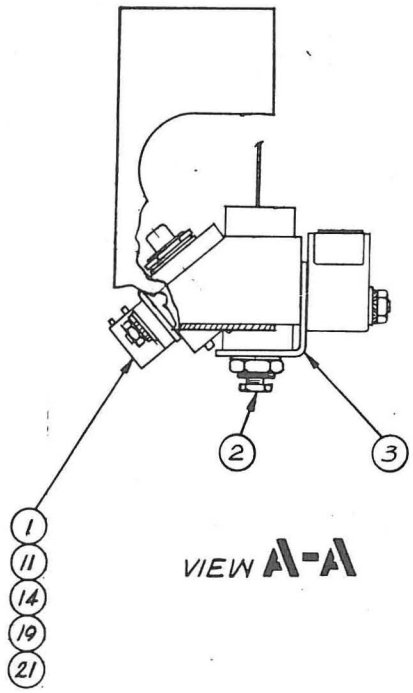


Assembly No. 4030328. Capstan Drive Assembly

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4030341-02		SWITCH, LATCH AND BRACKET ASSEMBLY (NHA 4020360)	
1	4260448-01		BRACKET, MAGNETIC LATCH	
2	4590032-01		DASHPOT	
3	4952557-02		BRACKET, DASHPOT MTG	
5	51271-01		BRACKET	
7	120-074	S2	SWITCH, PB	
8	120-062	S1	SWITCH, LEVER	
11	311-069		CATCH ASSY, MAGNET	
14	471-071		SCREW, PAN HD, XREC, NO. 6-32 X 0.50 LG	
16	471-075		SCREW, PAN HD, XREC, NO. 6-32 X 1.00 LG	
19	496-005		NUT, KEP, NO. 6-32	
21	501-009		WASHER, FLAT, NO. 6	
22	501-021		WASHER, FLAT, 0.016 THK, NO. 6	
25	171-008		TERMINAL, QIK DISC, KNIFE	B

SHEET 1 OF 1

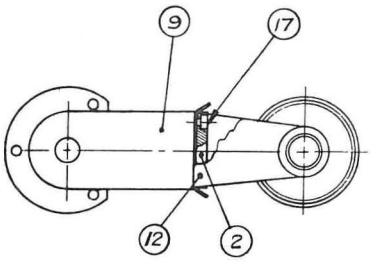


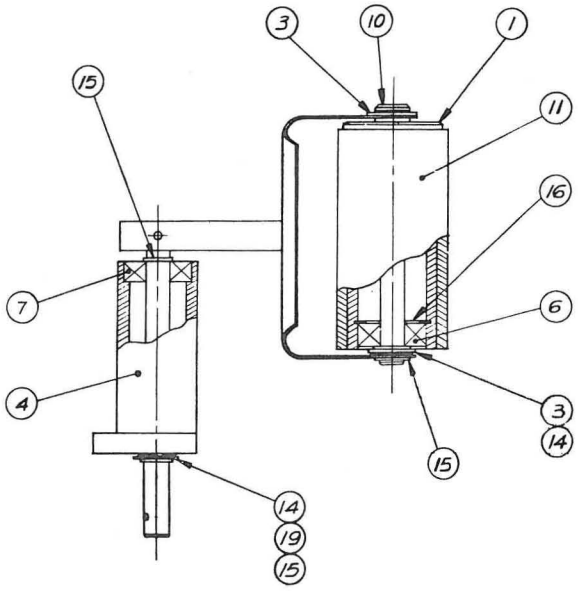


ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4030369-01		CAPSTAN IDLER HOUSING ASSEMBLY (NHA 4020360)	
1	13867-02		CAP, PINCH ROLLER	
2	13868-03		PLATE, HOUSING ARM MTG	
3	13869-01		SPACER, CAPSTAN IDLER SHAFT	
4	14563-01		HOUSING, CAPSTAN IDLER SHAFT	
6	164834-03		BEARING, BALL	
7	164834-02		BEARING, BALL	
9	4030372-01		CAPSTAN IDLER ARM ASSY	
10	4210369-01		SHAFT, CAPSTAN IDLER PINCH ROLLER	
11	4250230-01		PINCH ROLLER, CAPSTAN IDLER ARM	
12	4260504-01		BRACKET, CAPSTAN IDLER	
14	501-932		WASHER, WAVY, 0.346 ID X 0.005 THK X 0.080, FREE HEIGHT	
15	430-006		RING, RET	
16	430-027		RING, RET	
17	470-008		SCREW, CAP, HEX SOC HD, NO. 4–40 X 1/4 LG	
19	501-022		WASHER, 0.328 ID, 0.562 OD, 0.032 THK	

B

SHEET 1 OF 1

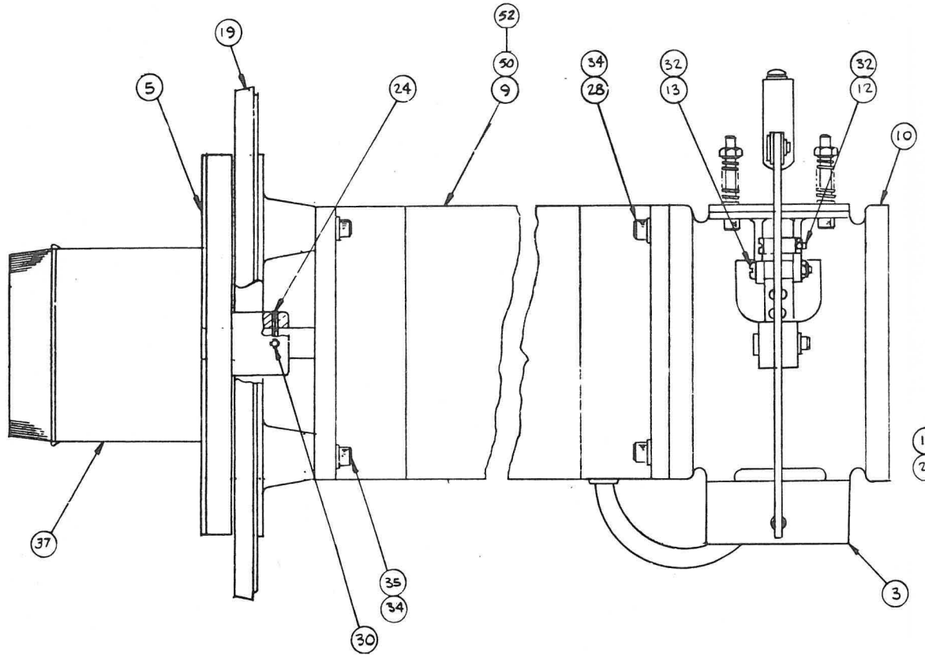


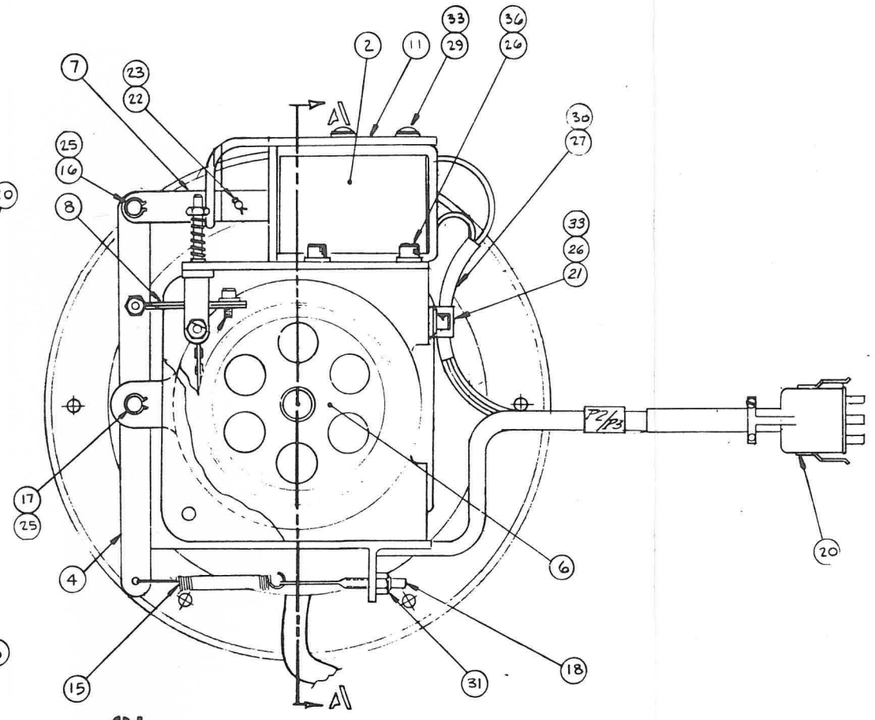


ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4030375-01		REEL MOTOR ASSEMBLY, TAKEUP (NHA 4020360)	
	4030375-02		REEL MOTOR ASSEMBLY, SUPPLY (NHA 4020360)	
2	13954-01		SOLENOID ASSY	
3	13958-01		PLATE, BRAKE SPRING	
4	13959-02		LEVER, BRAKE SPRING	
5	13964-01		PAD, TURNTABLE	
6	13966-02		DRUM, BRAKE	
7	13968-01		LINK, SOLENOID	
8	14331-01		BRAKE BAND ASSY	
9	14349-01		MOTOR, TORQUE	
10	14418-08		HOUSING, BRAKE	
11	14585-04		STOP, SOLENOID	
12	50630-01		PIN, BRAKE LOOP	
13	50630-02		PIN, BRAKE LOOP	
15	52172-01		SPRING, BRAKE ADJ	
16	52173-01		PIN, LINK	
17	52173-02		PIN, LINK	
18	52174-01		BOLT, EYE	
19	4220283-01		FLANGE, REEL MTG	
20	145-012		CONNECTOR, 6 PIN, LOCKING, MALE	
21	302-007		CLAMP, CABLE, 1/4 ID, PLASTIC	
22	400-009		PIN, CLEVIS, 1/8 DIA X 17/32 LG	
23	401-007		PIN, COTTER, 1/16 DIA X 1/2 LG	
24	406-012		PIN, ROLLPIN, 0.094 DIA X 1.0 LG	
25	430-004		RING, RET	
26	470-029		SCREW, CAP, NO. 8-32 X 1/2 LG	
27	171-009		CONNECTOR, SOLDERLESS, KNIFE	
28	470-039		SCREW, CAP, NO. 10-32 X 5/8 LG	
29	475-038		SCREW, SEM, NO. 8-32 X 5/16 LG	
30	477-067		SCREW, SET, NO. 8-32 X 1/4 LG	
31	493-008		NUT, SELF LOCK, NO. 10-32	
32	493-009		NUT, SELF LOCK, NO. 6-32	
33	501-010		WASHER, FLAT, NO. 8	
34	502-005		WASHER, LOCK, SPRING, NO. 10	
35	470-040		SCREW, CAP, NO. 10-32 X 3/4 LG	
36	502-004		WASHER, LOCK, SPRING, NO. 8	
37	1360126-04		KNOB, TURNTABLE ASSY	
43	013-678	CR1	DIODE	1N4385
50	506-016		WASHER, 'D', NO. 8	
52	502-026		WASHER, LOCK, NO. 8	

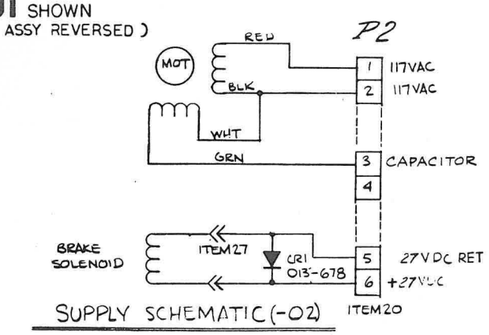
C

SHEET 1 OF 1

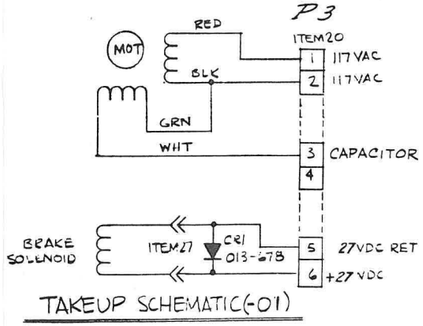




-01 SHOWN
(-02 BRAKE ASSY REVERSED)



SUPPLY SCHEMATIC (-02)

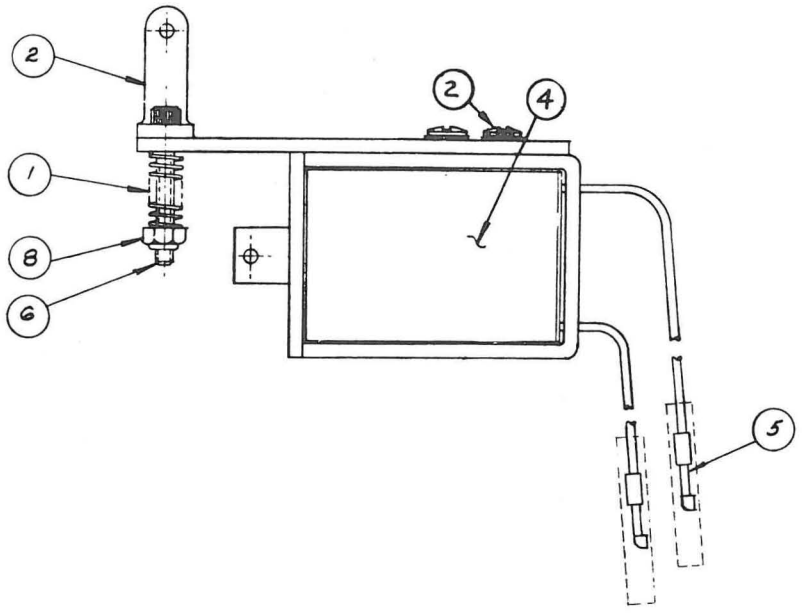


TAKEUP SCHEMATIC (-01)

Assembly No. 4030375.
Reel Motor Assembly

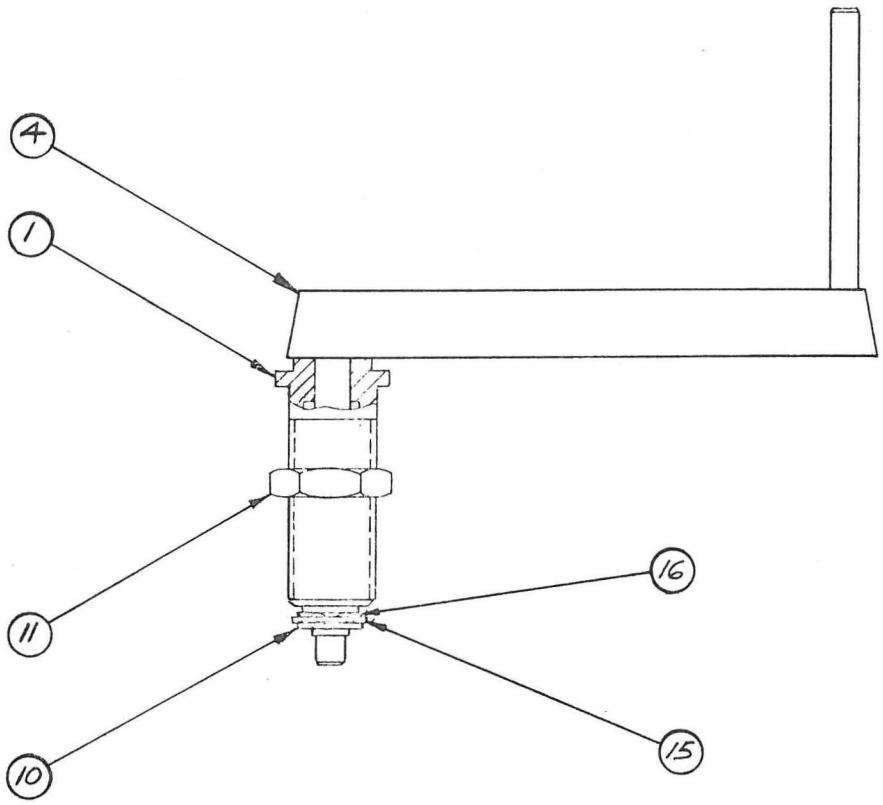
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	13954-01		SOLENOID ASSEMBLY (NHA 4030375)	
1	13817-01		SPRING	
2	13955-01		BRACKET, BRAKE LIMIT	
3	13957-02		PLATE, SOLENOID BASE	
4	14415-01		SOLENOID	
5	171-009		CONNECTOR, SOLDERLESS	
6	470-124		SCREW, CAP, NO. 8-32 X 1-1/2 LG	
7	475-038		SCREW, SEM, NO. 8-32 X 1-5/16 LG	
8	493-007		NUT, SELF LOCKING, NO. 8-32	E

SHEET 1 OF 1



ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4030377-01		END OF TAPE ARM AND HOUSING ASSEMBLY (NHA 4020360)	
1	51101-01		HOUSING ASSY, TAPE TENSION ARM	
4	4041163-02		TENSION ARM ASSY	
10	430-006		RING, RET	
11	498-018		NUT, HEX, 3/4–16	
15	501-888		WASHER, PLAIN, 0.316 ID X 0.047 THK	
16	501-932		WASHER, WAVY, 0.346 ID X 0.005 THK X 0.080 FREE HEIGHT	A

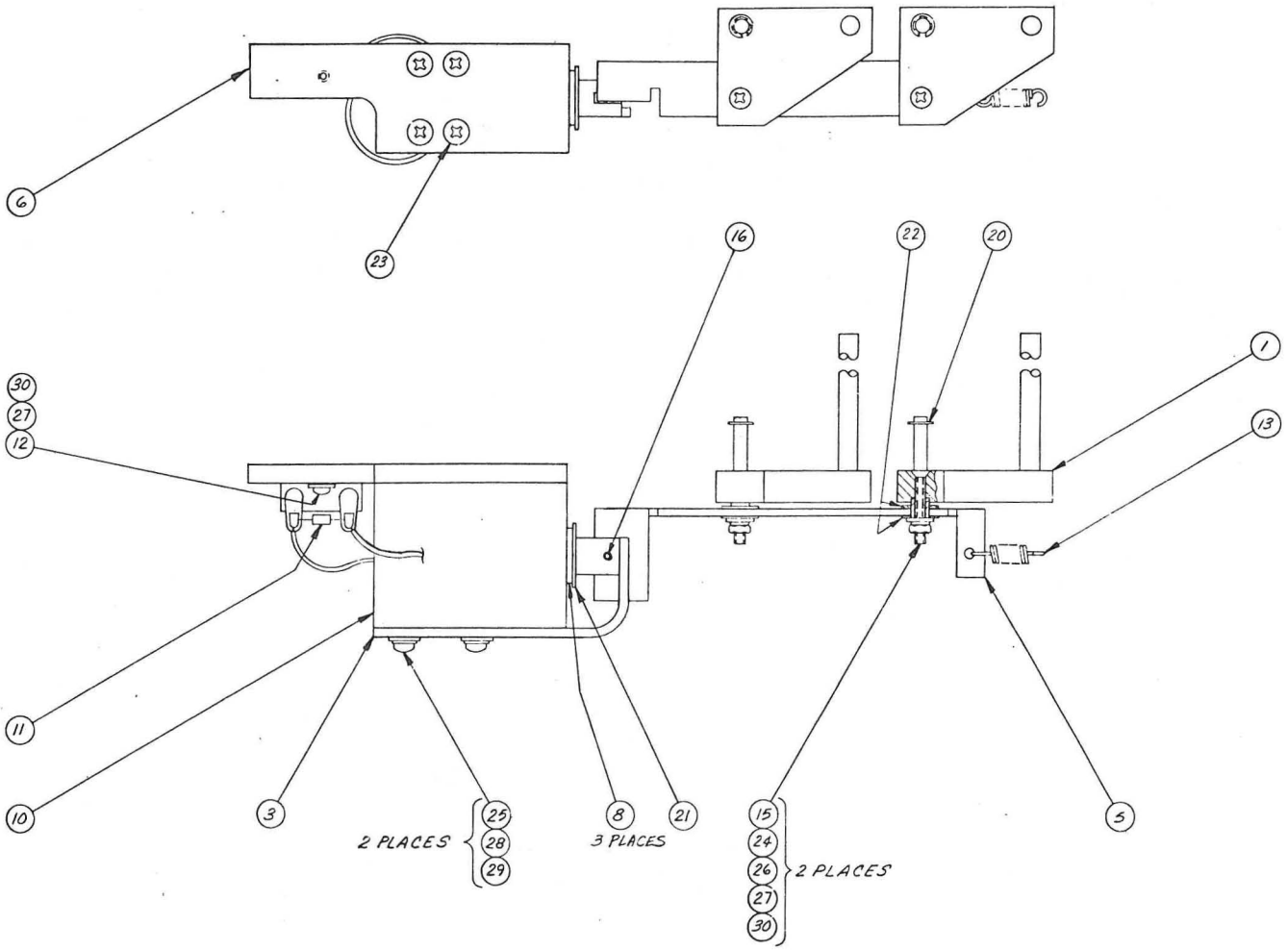
SHEET 1 OF 1



ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4030379-01		TAPE LIFTER ASSEMBLY (NHA 4020360)	
1	4041162-01		ARM, BLOCK ASSY	
3	4220291-02		STOP, SOLENOID	
5	4230254-01		LINK, TAPE LIFTER	
6	4330302-01		PLATE, MTG, SOLENOID	
8	4440312-04		WASHER, FELT	
10	022-179		SOLENOID, 24V	
11	013-678		DIODE, SILICON	1N4385
12	180-023	TB4	STRIP, TERMINAL	
13	352-362		SPRING, 0.250 OD X 1.00 LG	
15	421-343		BEARING, SLEEVE, 0.159 ID X 0.253 OD X 0.250 LG	
16	406-284		PIN, SPRING ROLL, 0.094 DIA X 0.50 LG	
20	430-090		RING, RET	
21	501-032		WASHER, 0.515 ID X 0.87 OD X 0.032 THK	
22	501-736		WASHER, NYLON, 0.253 ID X 0.031 THK	
23	471-345		SCREW, FLAT HD, NO. 8-32 X 0.37 LG	
24	471-342		SCREW, FLAT HD, NO. 6-32 X 1.00 LG	
25	471-078		SCREW, PAN HD, NO. 8-32 X 0.37 LG	
26	501-009		WASHER, PLAIN, NO. 6	
27	502-003		WASHER, LOCK, NO. 6	
28	501-205		WASHER, PLAIN, NO. 8	
29	502-026		WASHER, LOCK, NO. 8	
30	492-008		NUT, PLAIN, NO. 6-32	
31	471-067		SCREW, PAN HD, NO. 6-32 X 0.25 LG	

D

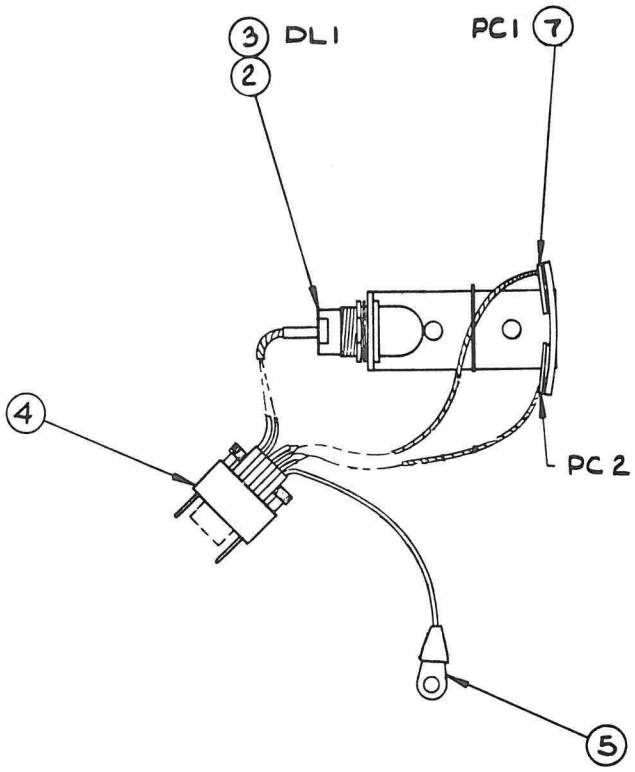
SHEET 1 OF 1



Assembly No. 4030379. Tape Lifter Assembly

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4030384-02		TENSION SENSOR ASSEMBLY (NHA 4020360)	
1	4260143-01		BRACKET, MTG, LAMP AND PHOTOCELL	
2	060-373		LAMP, INCAND, 28V, 0.06 AMP	
3	132-313		INDICATOR, LAMP, FIXTURE, INCAN	
4	139-514		CONNECTOR, RECT PLUG, 8 PIN	
5	172-010		LUG, TERMINAL, SOLDER, NO. 6	
7	581-204		DIODE, PHOTOVOLTAIC, SELENIUM	C

SHEET 1 OF 1

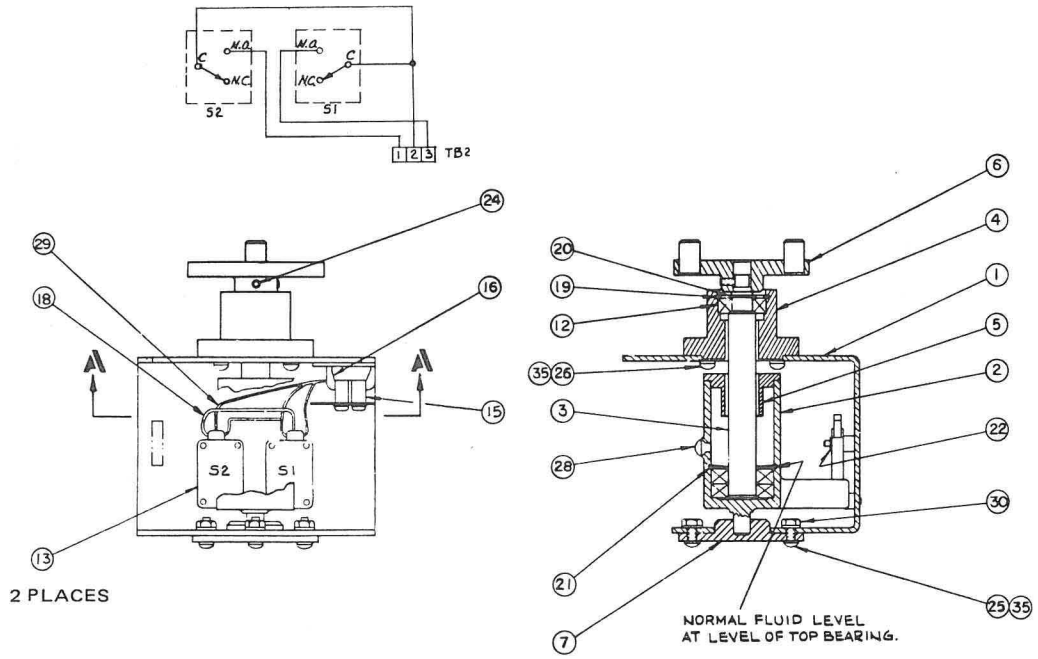


ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050708-02		TAPE TRANSPORT HARNESS ASSEMBLY (NHA 4020360)	
1	4840346		HARNESS, SCHEMATIC DIAGRAM (SEE PAGE 6-17)	
3	4260481-01		BRACKET, CONNECTOR MTG	
4	139-515	J4	CONNECTOR, 8 SOC, FEMALE	
5	144-013	J2,3	CONNECTOR, 6 SOC, FEMALE	
6	144-030	P6	CONNECTOR, 15 SOC, FEMALE	
7	144-037	P2	CONNECTOR, 2 SOC, FEMALE	
8	145-020	P3,4	CONNECTOR, 10 PIN, MALE	
9	146-003	J1	CONNECTOR, 8 SOC, FEMALE	
11	166-863	P5	CONNECTOR, 36 SOC, FEMALE	
12	171-009		TERMINAL, QIK DISC, KNIFE	
13	171-117		TERMINAL, CRIMP, SPADE TONGUE	
14	171-238		TERMINAL, QIK DISC, FEMALE	
15	171-001		TERMINAL, CRIMP, SPADE LUG	
16	187-037		CONTACT, CONNECTOR, SOC	
17	171-043		TERMINAL, QIK DISC, FEMALE	
38	187-183		CONTACT, CONNECTOR, SOC	

G

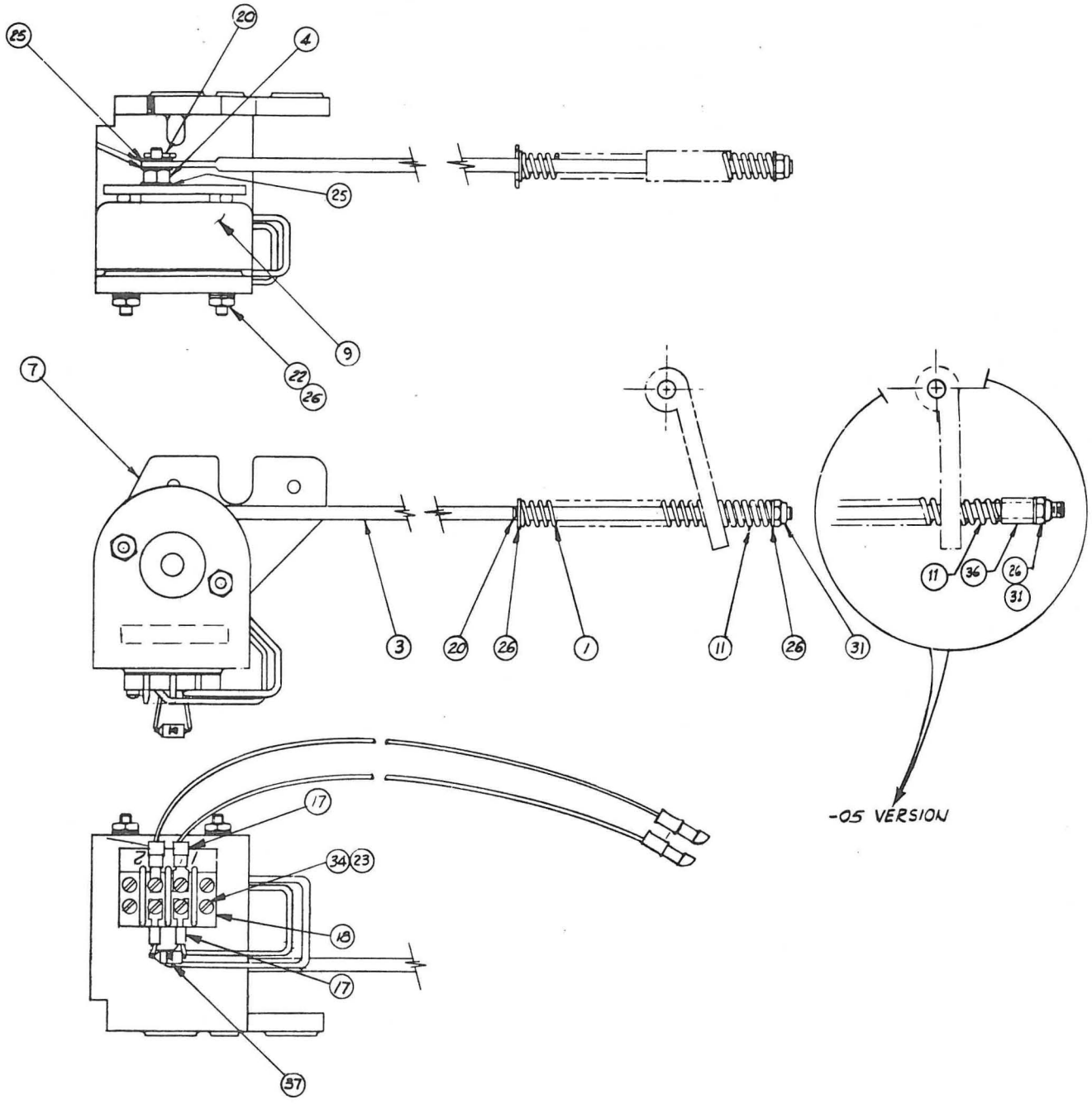
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4952610-03		MOTION SENSE ASSEMBLY (NHA 4020360)	
1	1210942-10		BRACKET, MOTION SWITCH	
2	1210943-10		HOUSING, ACTUATOR	
3	1210945-10		SHAFT, BEARING S/A	
4	1210946-10		HOUSING, BEARING	
5	1210947-10		CAP, HOUSING	
6	1210950-10		COUPLING, PIN, S/A	
7	1210951-10		COLLAR	
9	1211065-10		COVER, TERM BLOCK	
12	164866-03		BEARING, BALL	
13	120-607	S1,2	SWITCH	
15	280-016		SPACER, 1/4 DIA X 3/8 X NO. 6-32 THD	
16	180-422		BLOCK, TERM, 3 TERM, W/MARKER STRIP	
19	430-085		RING, RET	
20	430-086		RING, RET	
21	430-063		RING, RET	
22	430-902		RING, RET	
23	471-338		SCREW, FLAT HD, NO. 6-32 X 1/2 LG	
24	477-184		SCREW, SET, NO. 6-32 X 3/16, NYLOK	
25	471-071		SCREW, PAN HD, NO. 6-32 X 1/2 LG	
26	475-059		SCREW, SEM, NO. 6-32 X 1/2 LG	
27	475-013		SCREW, SEM, NO. 6-32 X 3/16 LG	
28	470-185		SCREW, CAP, NO. 8-32	
30	496-002		NUT, KEP, NO. 6-32	
35	501-009		WASHER, FLAT, NO. 6	F

SHEET 1 OF 1



ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	55670-05		TWO-SPEED CAPSTAN SOLENOID ASSEMBLY (NHA 4020360)	
1	55337-01		SPRING, RETURN SOLENOID	
3	55572-01		BAR, DRAW	
4	55573-01		PIN, DRAW	
7	55673-02		BRACKET, SOLENOID MTG	
9	1380008-01		SOLENOID, SPEC DWG	
11	4270118-01		SPRING, SOLENOID ADJ	
17	171-001		CONNECTOR, SOLDERLESS, SLOTTED TONGUE	
18	180-075		TERMINAL STRIP, BARRIER, 2 TERM	
20	401-004		PIN, COTTER, 1/16 DIA X 3/8 LG	
22	492-011		NUT, HEX, NO. 10-32	
23	475-018		SCREW, SLTD, PAN HD, ASSEM WASH, NO. 6-32 X 5/8 LG	
25	501-004		WASHER, FLAT, NO. 8 X 0.032 THK	
26	501-011		WASHER, FLAT, NO. 10	
31	493-008		NUT, ELASTIC, STOP, NO. 10	
34	501-188		WASHER, FLAT, NO. 6, 0.016 THK	
36	280-404		SPACER, PLAIN, 0.194 ID X 0.500 OD X 0.5 LG	
37	013-678		DIODE	1N4005
				S

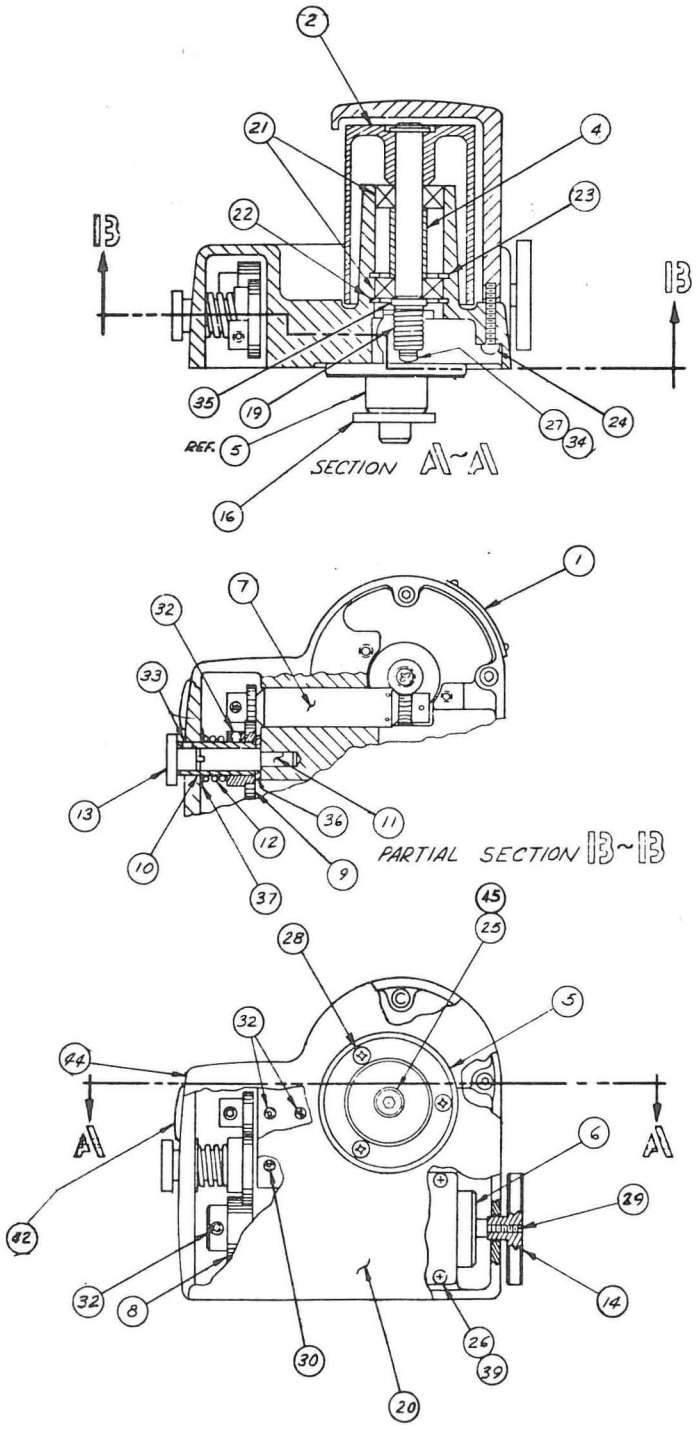
SHEET 1 OF 1



Assembly No. 55670. Two-Speed Capstan Solenoid Assembly

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	59102-05		TAPE TIMER ASSEMBLY (NHA 4020360)	
1	6000035-01		LABEL, IDENTIFICATION	
2	51305-01		IDLER SUBASSEMBLY (60 CY VERSION)	
4	51307-02		SLEEVE, SPACING	
5	51309-01		BOSS, MTG	
6	51310-01		COUNTER REQUIREMENTS	
7	51315-02		GEAR SHAFT ASSEMBLY	
8	51316-01		GEAR, COUNTER	
9	51317-01		GEAR, FINE SETTING	
10	51318-01		SLEEVE, FINE SETTING GEAR	
11	51319-01		SHAFT, FINE SETTING GEAR	
12	51320-01		SPRING, FINE SETTING GEAR	
13	51321-01		KNOB, FINE SETTING	
14	51322-01		KNOB, RESET	
16	51324-01		WASHER, HOLDDOWN	
19	52297-01		WORM, PRECISION	
20	52335-01		COVER, DUST	
21	164834-02		BEARING, BALL	
22	430-027		RING, RET, INT, FLAT	
23	430-060		RING, RET, INT, BOWED	
24	470-014		SCREW, CAP, NO. 4-40, NC-2A X 3/4 LG	
25	470-047		SCREW, CAP, NO. 1/4-20 UNC-2A X 0.750 LG	
26	471-054		SCREW, MACH, NO. 2-56 NC-2A X 1/4	
27	471-061		SCREW, MACH, NO. 4-40 NC-2A X 5/16	
28	471-327		SCREW, MACH, NO. 4-40 NC-2A X0.312 LG	
29	477-032		SCREW, SET, NO. 4-40 NC-2A X 5/16 LG	
30	477-038		SCREW, SET, NO. 6-32 NC-2A X 7/16 LG	
32	477-760		SCREW, SET, NO. 6-32 NC-2A X 1/8 LG	
33	477-122		SCREW, SET, NO. 4-40 X 1/8 LG	
34	501-008		WASHER, FLAT, NO. 4	
35	501-011		WASHER, FLAT, NO. 10	
36	501-012		WASHER, FLAT, 1/4	
37	501-071		WASHER, FLAT, 3/8	
39	502-023		WASHER, LOCK, NO. 2	
42	51323-02		PLUGBUTTON	
43	51325-03		SHIELD, IDLER	
44	51302-04		BASE	
45	502-006		WASHER, 0.250, SPRING LOCK	
				N

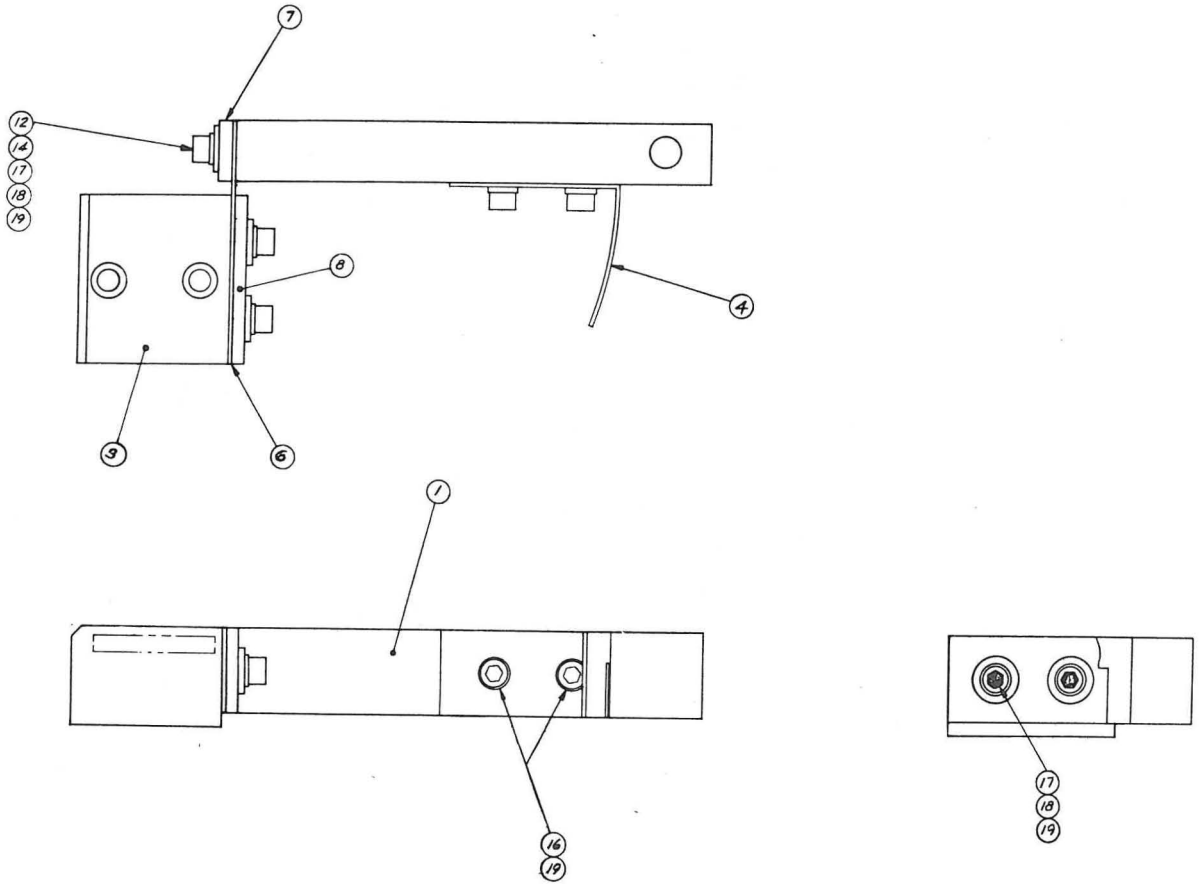
SHEET 1 OF 1



Assembly No. 59102. Tape Timer Assembly

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4041194-02		TENSION ARM **ASSEMBLY (NHA 4020360)**	
1	4041181-01		ARM ASSY, TENSION SENSOR	
3	4220128-01		BLOCK, MTG, TENSION SENSOR	
4	4230148-01		ARM, PHOTOCELL COVER	
5	4270131-01		SPRING, SENSOR	
6	4270131-02		SPRING, SENSOR	
7	4330294-01		PLATE, SENSING ARM BACKING	
8	4330312-01		PLATE, BACKING	
16	470-162		SCREW, CAP, NO. 6-32 X 0.375 LG	
17	470-020		SCREW, CAP, NO. 6-32 X 0.50 LG	
18	501-009		WASHER, FLAT, NO. 6	
19	502-003		WASHER, SPRING, NO. 6	B

SHEET 1 OF 1

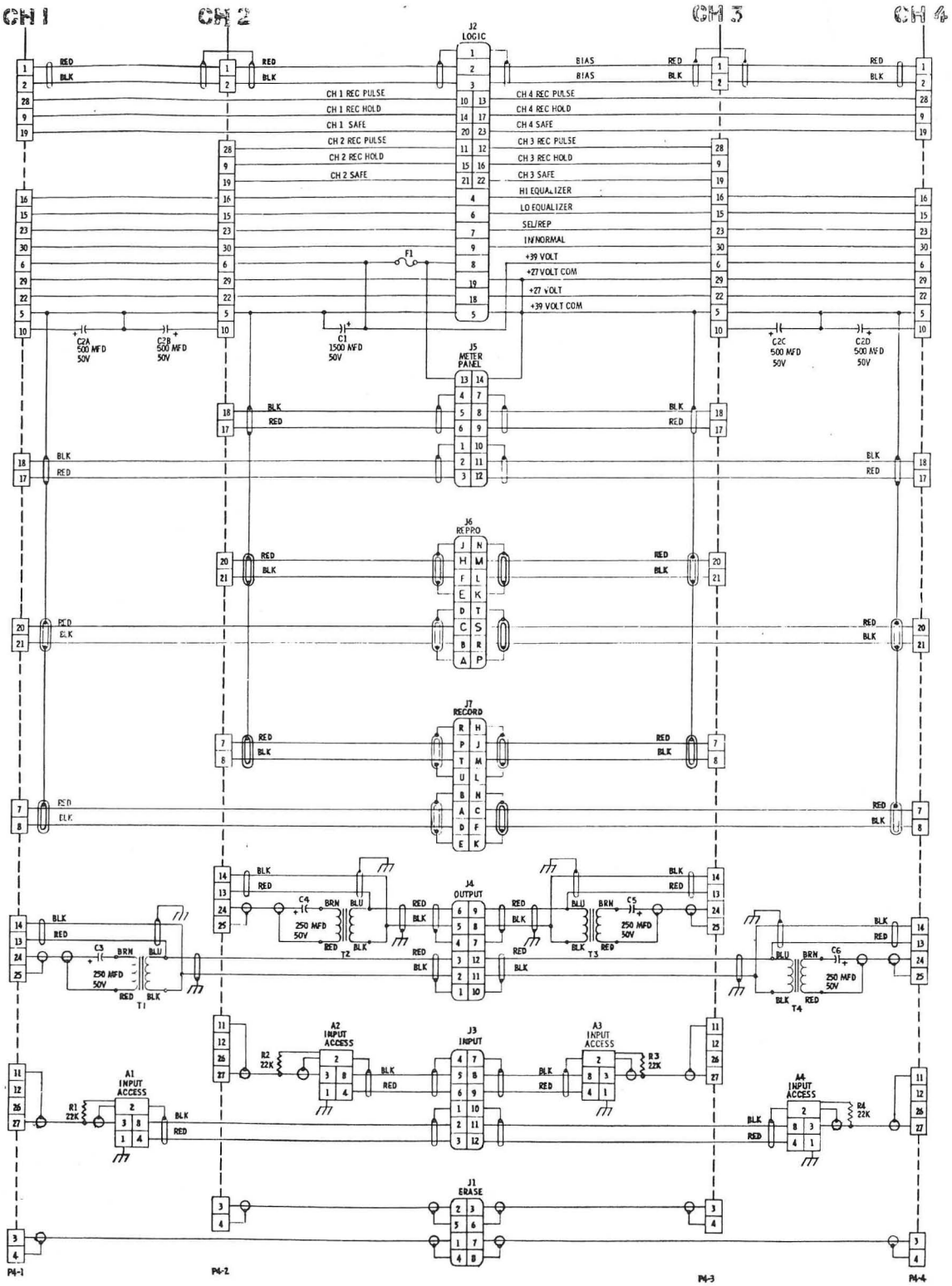


ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4020371-09		ELECTRONICS ASSEMBLY, 15–30 IPS (NHA 4010210)	
	4020371-11		ELECTRONICS ASSEMBLY, 7.5–15 IPS (NHA 4010210)	
1	4050433-05		BIAS AMPLIFIER PWA	
2	4050434-01		RECORD AMPLIFIER PWA	
4	4050435-15		REPRODUCE AMPLIFIER PWA, U/O 15–30 IPS	
5	4050435-12		REPRODUCE AMPLIFIER PWA, U/O 7.5–15 IPS	
6	4050690-06		AUDIO SWITCHING PWA	
7	4050691-02		ELECTRONICS HARNESS ASSY	
8	4050704-02		HEAD AND INPUT HARNESS	
12	4210350-04		SHAFT, EXTENDER	
13	4220312-02		COUPLING	
15	4230263-01		GUIDE, PCB, VERTICAL	
17	4290807-02		PANEL REAR, ELECT	
18	4290808-02		PANEL TOP, ELECT	
19	4290812-03		CHASSIS, ELECT	
22	4550147-04	C1	CAPACITOR, ALUM ELECT, 1500 UFD, 50 VDC	
23	4580193-01	T1-4	TRANSFORMER, OUTPUT	
24	4580200-01		TRANSFORMER, INPUT	
29	031-126	C3-6	CAPACITOR, ALUM, 250 UF, 50 VDC	
30	041-406	R1-4	RESISTOR, COMP, 22K, 1/4W, 5%	
32	063-091		CLAMP, CAPACITOR	
33	063-191	C2	CAPACITOR, QUAD, ALUM, 500 UFD, 50 VDC	
35	070-019		FUSE, 125V, 2 AMP, SLO-BLO	
36	085-001		FUSEHOLDER	
37	502-091		WASHER, LOCK, INT TOOTH	
39	150-023		ELECTRON TUBE SOCKET, OCTAL	
40	166-867		CONNECTOR, BODY, RECT 18 SOCKET	
41	169-083		CONNECTOR, BODY, RECT, 20 SOCKET	
44	180-039		STRIP, TERMINAL	
46	251-019		BUTTON, PLUG	
50	471-062		SCREW, PAN HD, XREC, NO. 4–40 X 0.375 LG	
51	471-060		SCREW, PAN HD, XREC, NO. 4–40 X 1/4 LG	
52	471-064		SCREW, PAN HD, XREC, NO. 4–40 X 1/2 LG	
53	471-068		SCREW, PAN HD, XREC, NO. 6–32 X 5/16 LG	
54	471-069		SCREW, PAN HD, XREC, NO. 6–32 X 3/8 LG	
55	496-004		NUT, KEPS, NO. 4	
56	496-005		NUT, KEPS, NO. 6–32	
58	501-008		WASHER, PLAIN, NO. 4	
59	501-009		WASHER, PLAIN, NO. 6	
60	502-002		WASHER, LOCK, SPRING, NO. 4	
61	502-003		WASHER, LOCK, SPRING, NO. 6	
62	502-025		WASHER, LOCK, INT TOOTH, NO. 6	
				U

ASSEMBLY NO. 4020371 TITLE ELECTRONICS ASSEMBLY

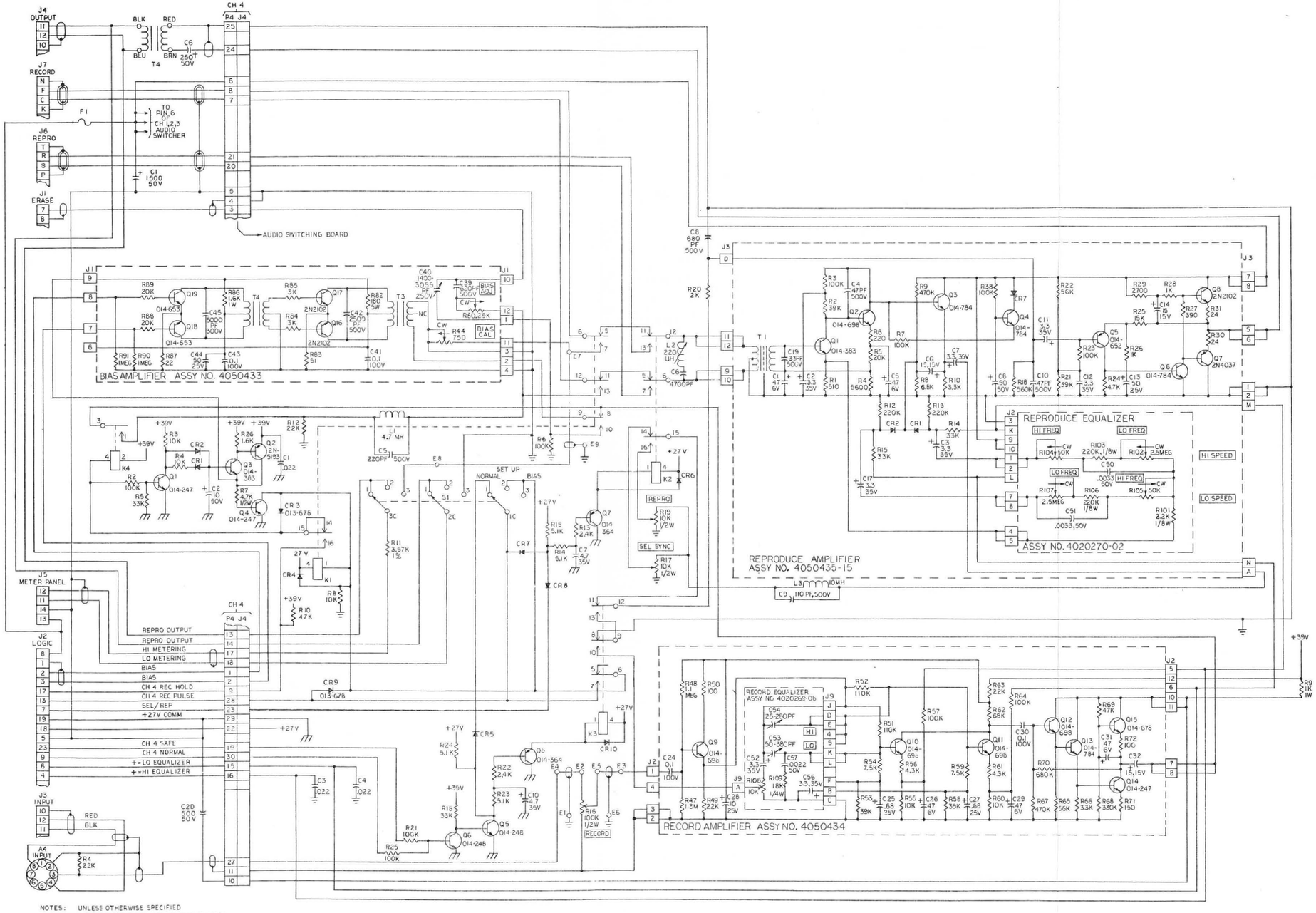
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
64	530-159		GUIDE, PCB EDGE	
65	530-164		GUIDE, PCB EDGE	
71	4840327		INTERCONNECT DIAGRAM, ELECTRONICS ASSY	
72	4840330		SCHEMATIC, ELEC, U/O 7.5–15 IPS	
73	4840372		SCHEMATIC, ELEC, U/O 15–30 IPS	
74	4840224		SCHEMATIC, ELEC, CHANNEL 4 TYPICAL	
				U

SHEET 2 OF 2



Schematic No. 4840327. Electronic Assembly Interconnect Diagram, 7.5—15 IPS

(C)



NOTES: UNLESS OTHERWISE SPECIFIED

1 ALL CAPACITOR VALUES ARE IN MICROFARADS

2 ALL DIODES ARE 013-599

3 ALL RESISTANCE VALUES:

3A FOR REPRO AMP 4050435, RECORD AMP 4050434, AND BIAS AMP 4050433 ARE; 1/2 W, 10%

3B ALL OTHERS ARE; 1/4W, 5%

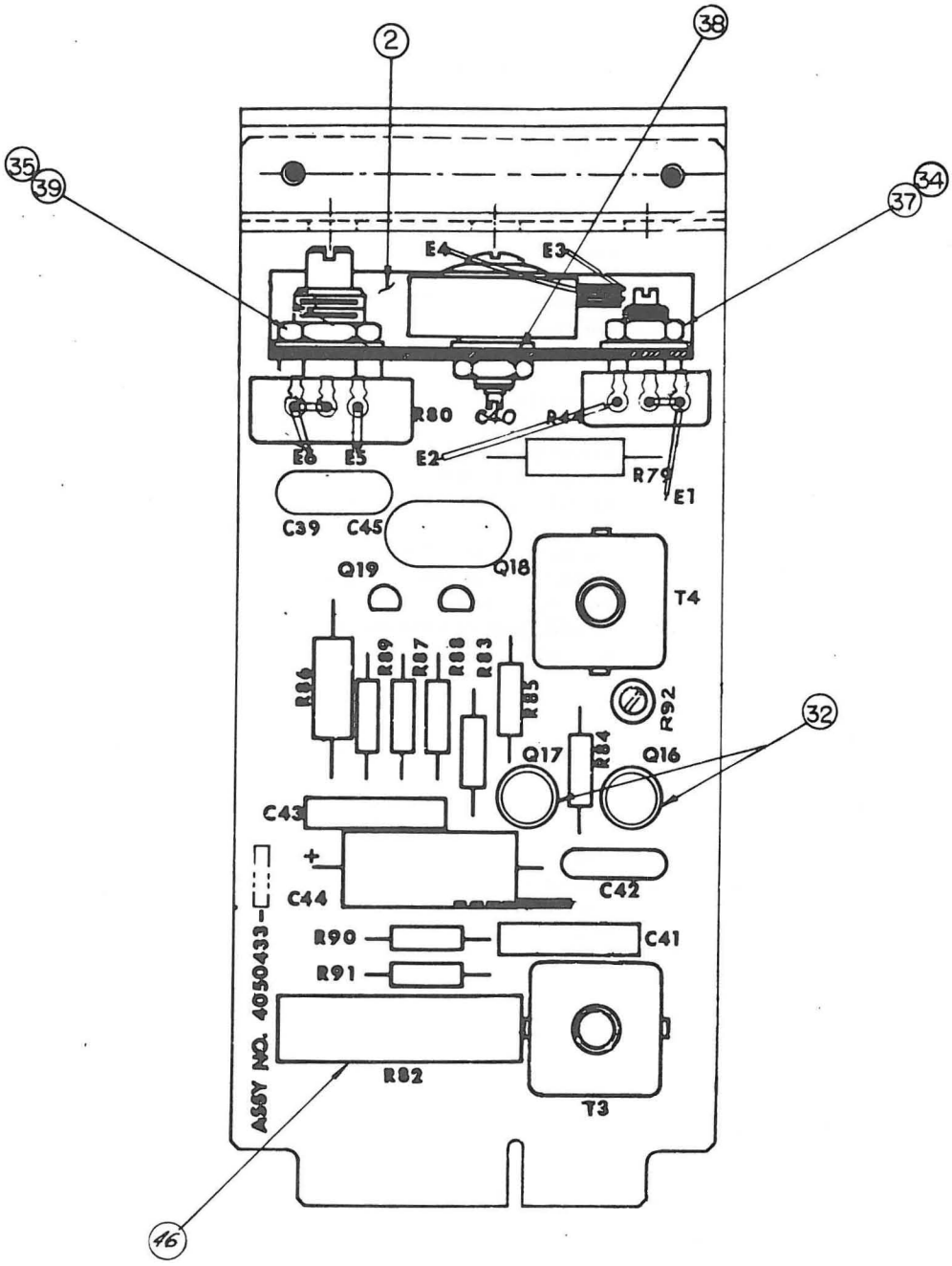
Schematic No. 4840224.
Electronic Assembly, Channel 4
Typical and Reproduce Amplifier, 15–30 IPS

B

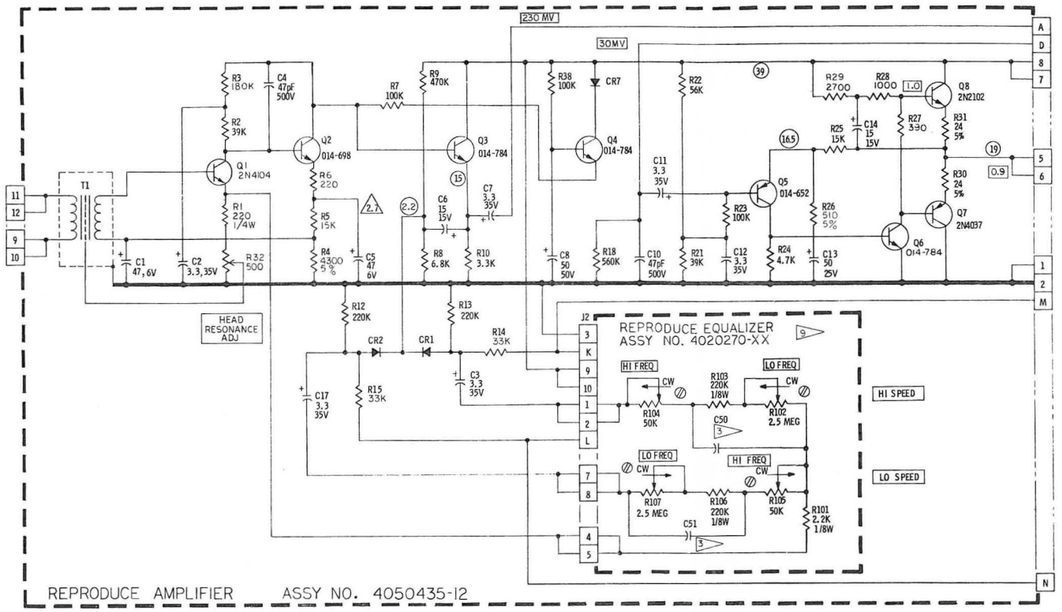
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050433-08		BIAS AMPLIFIER PWA (NHA 4020371)	
2	4040972-01		BRACKET, BIAS EQUALIZATION	
4	4330261-01		FRONT PLATE, BIAS MODULE	
5	4520154-01	R44	POTENTIOMETER, BIAS CALIBRATE, 750 OHM	
6	4520145-20	R80	POTENTIOMETER, BIAS ADJUST, 25K	
7	4580123-01	T3,4	COIL, OSCILLATOR	
18	014-329	Q16,17	TRANSISTOR	2N2107
19	014-653	Q18,19	TRANSISTOR	2N3904
20	031-190	C44	CAPACITOR, ELECT, 50 MFD, 25V	
21	034-994	C42	CAPACITOR, MICA, 2500 PFD, 500V, 5%	
22	034-960	C45	CAPACITOR, MICA, 5000 PFD, 300V, 5%	
24	041-031	R90,91	RESISTOR, FIXED, 1M, 1/2W, 10%	
25	041-033	R84	RESISTOR, COMP, 22 OHM, 1/2W, 10%	
26	041-345	R83	RESISTOR, COMP, 51 OHM, 1/2W, 5%	
27	041-353	R86	RESISTOR, FIXED, 1.6K, 1W, 5%	
29	041-529	R88,89	RESISTOR, FIXED, 20K, 1/2W, 5%	
30	055-106	C41,43	CAPACITOR, MYLAR, 0.1 MFD, 100V, 10%	
31	059-017	R82	RESISTOR, WW, 180 OHM, 5W, 5%	
32	280-131		PAD, XSTR, 0.200 DIA	
33	475-006		SCREW, SEM, PAN HD, NO. 4-40 X 1/4 LG	
34	492-046		NUT, HEX, 1/4-32	
35	492-095		NUT, HEX, 3/8-32	
36	501-008		WASHER, FLAT, NO. 4	
37	502-028		WASHER, FLAT, INT TOOTH, 1/4 IN	
38	502-059		WASHER, FLAT, INT TOOTH, NO. 12	
39	502-083		WASHER, FLAT, INT TOOTH, 3/8	
42	034-928	C39	CAPACITOR, MICA, 620 PF, 500V, 5%	
43	475-007		SCREW, PAN HD, SEM, NO. 4-40 X 5/16 LG	
44	038-011	C40	CAPACITOR, VAR, 1,400-3,055 PF, 250V	
46	103307-01		STANDOFF	
47	041-245	R84	RESISTOR, COMP, 1K, 1/2W, 5%	
48	044-944	R92	RESISTOR, VAR CERMET, 5K, 20%	
49	041-475	R85	RESISTOR, COMP, 3K, 1/2W, 5%	
79	4840372		SCHEMATIC, 15-30 IPS	
80	4840249		SCHEMATIC, 7.5-15 IPS	

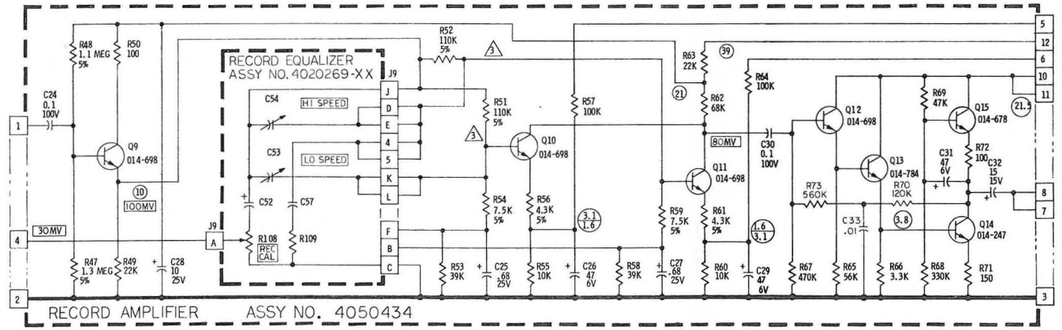
L

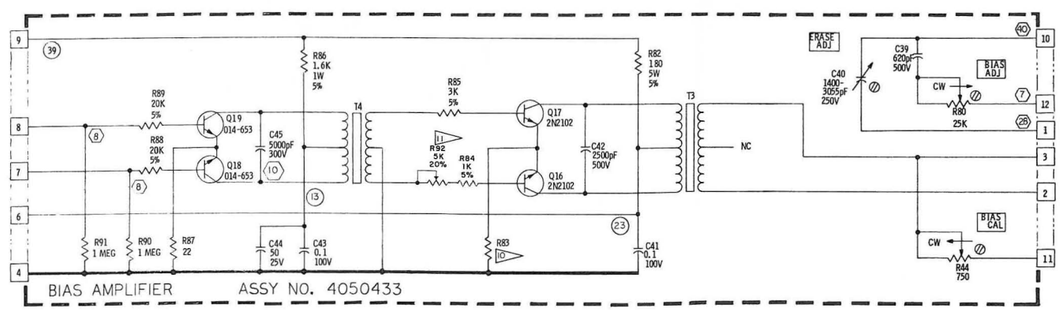
SHEET 1 OF 1

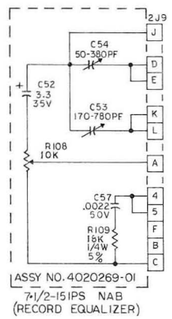


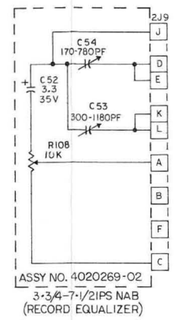
Assembly No. 4050433. Bias Amplifier PWA

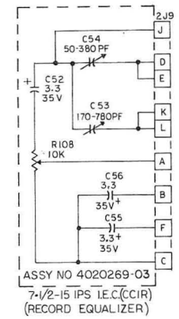










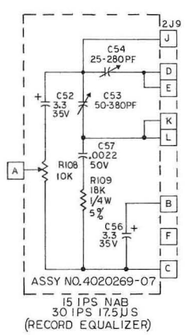


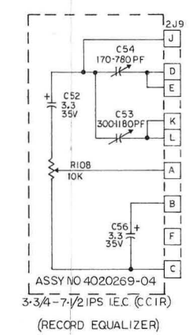
NOTES: UNLESS OTHERWISE SPECIFIED

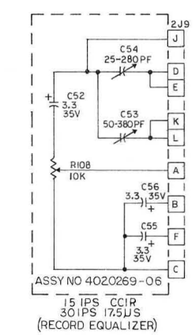
1. CAPACITANCE VALUES ARE IN MICROFARADS
2. DIODES ARE TYPE 013-599.
3. .0047 FOR 4020270-01 EQUALIZER, .0033 FOR 4020270-02
4. RESISTANCE VALUES ARE IN OHMS 1/2W, 10%.
5. (XX) INDICATES VOLTS D.C. MEASURED WITH A 20,000 OHM/VOLT METER.
6. (XX) INDICATES VOLTS D.C. MEASURED WITH A HIGH IMPEDANCE VTVM.
7. XX INDICATES VOLTS R.M.S. MEASURED WITH A HIGH IMPEDANCE VTVM AT OPERATING LEVEL OF 700 Hz., +8VU OUT, 75 MIL TRACK HEADS.
8. (XX) INDICATES VOLTS R.M.S. MEASURED WITH A HIGH IMPEDANCE VTVM AT BIAS FREQUENCY.
9. EQUALIZER 4020270-01 CAN BE ADJUSTED FOR 3-3/4 THRU 15 IPS, NAB OR CCIR.
   EQUALIZER 4020270-02 CAN BE ADJUSTED FOR 7-1/2 THRU 30 IPS, NAB OR CCIR.

REF. DES.	AMPEX P/N	NEAREST COML. EQUIVALENT
CR1, CR2, CR7	013-599	1N914
Q14	014-247	2N2219
Q5	014-652	2N3906
Q18, Q19	014-653	2N3904
Q15	014-678	2N2219A
Q2, Q9-12	014-698	2N3117 OR 2N5088
Q3, 4, 13, 6	014-784	2N4946

10. 51Ω, 5% EXCEPT 180Ω, 10% FOR USE WITH 1/4 TRACK ERASE HEADS.
11. ADJUST R92 FOR MINIMUM NOISE FROM TAPE. IF NOISE NULL CAN NOT BE FOUND, CHECK COMPONENTS FOR IMBALANCE OR HEADS FOR MAGNETIZATION



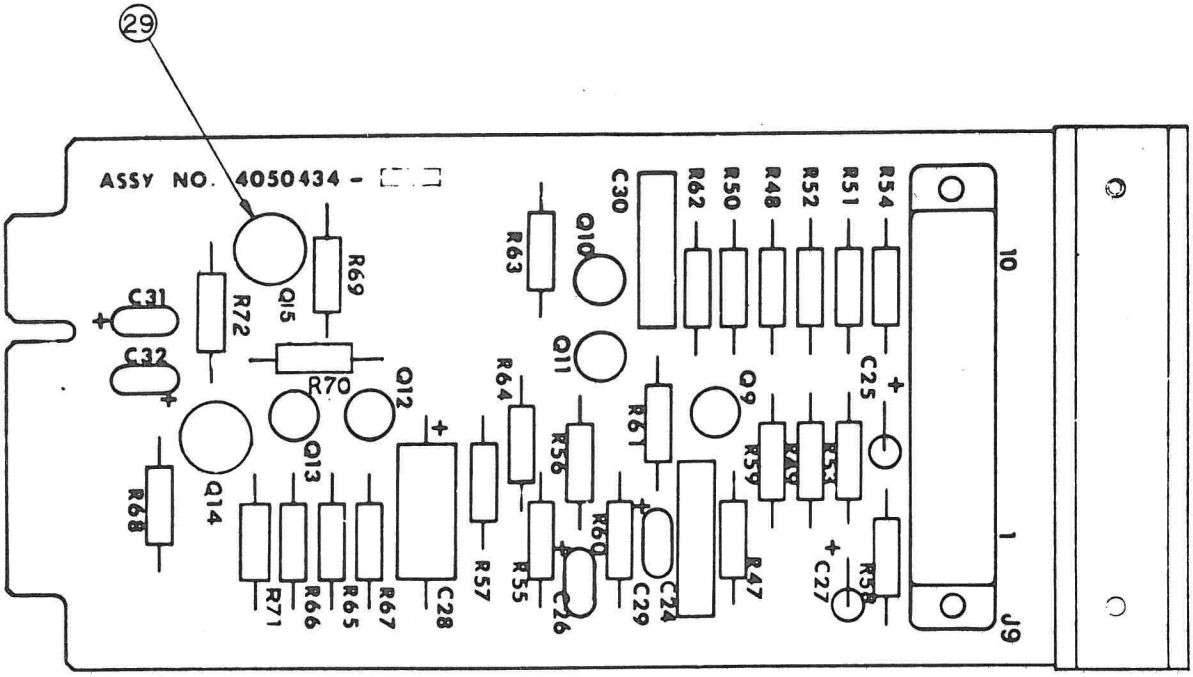




Schematic No. 4840249
Reproduce and Bias Amplifiers, 7.5—15 IPS

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050434-01		RECORD AMPLIFIER PWA (NHA 4020371)	
2	4330262-01		PLATE, FRONT, RECORD MODULE	
5	031-148	C28	CAPACITOR, ELECT, 10 UF, 25V	
6	037-446	C32	CAPACITOR, TANT, 15 UF, 15V, 20%	
7	037-494	C26,29,31	CAPACITOR, TANT, 47 UF, 6V, 20%	
9	055-106	C24,30	CAPACITOR, MYLAR, 0.1 UF, 100V, 10%	
10	041-012	R56,61	RESISTOR, FIXED, 4.3K, 1/2W, 5%	
11	041-024	R51,52	RESISTOR, FIXED, 110K, 1/2W, 5%	
12	041-038	R50,72	RESISTOR, FIXED, 100 OHM, 1/2W, 10%	
13	041-054	R66	RESISTOR, FIXED, 3.3K, 1/2W, 10%	
14	041-060	R55,60	RESISTOR, FIXED, 10K, 1/2W, 10%	
15	041-064	R49,63	RESISTOR, FIXED, 22K, 1/2W, 10%	
16	041-067	R53,58	RESISTOR, FIXED, 39K, 1/2W, 10%	
17	041-068	R69	RESISTOR, FIXED, 47K, 1/2W, 10%	
18	041-069	R65	RESISTOR, FIXED, 56K, 1/2W, 10%	
19	041-070	R62	RESISTOR, FIXED, 68K, 1/2W, 10%	
20	041-072	R57,64	RESISTOR, FIXED, 100K, 1/2W, 10%	
21	041-078	R68	RESISTOR, FIXED, 330K, 1/2W, 10%	
22	041-080	R67	RESISTOR, FIXED, 470K, 1/2W, 10%	
23	041-082	R70	RESISTOR, FIXED, 680K, 1/2W, 10%	
24	041-241	R71	RESISTOR, FIXED, 150 OHM, 1/2W, 10%	
25	041-361	R54,59	RESISTOR, FIXED, 7.5K, 1/2W, 5%	
26	041-377	R47	RESISTOR, FIXED, 1.3M, 1/2W, 5%	
27	041-898	R48	RESISTOR, FIXED, 1.1M, 1/2W, 5%	
29	280-131		PAD, XSTR	
30	475-006		SCREW, SEM, PAN HD, NO. 4-40 X 1/4	
31	501-008		WASHER, FLAT, NO. 4	
32	4030270-01	J9	CONNECTOR, ASSY, 10 PIN	
35	014-784	Q13	TRANSISTOR, SILICON	
36	014-678	Q15	TRANSISTOR, SILICON	2N3945
37	014-247	Q14	TRANSISTOR, SILICON	2N2219
38	014-698		TRANSISTOR	2N3565
39	067-026	C25,27	CAPACITOR, TANT, 0.68 UF, 25V, 5A	

J



Assembly No. 4050434. Record Amplifier PWA

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050435-12		REPRODUCE AMPLIFIER PWA, 7.5–15 IPS (NHA 4020371)	
	4050435-15		REPRODUCE AMPLIFIER PWA, 15–30 IPS (NHA 4020371)	
1	4030270-02	J2	CONNECTOR ASSY, 10 CONTACT	
4	4330263-01		PLATE, FRONT, REPRODUCE MODULE	
7	4580044-01	T1	TRANSFORMER, INPUT, U/O 15–30 IPS	
8	4580199-01	T1	TRANSFORMER, INPUT, U/O 7.5–15 IPS	
12	013-599	CR1,2,7	DIODE	1N914
13	014-329	Q8	TRANSISTOR	2N2102
15	014-652	Q5	TRANSISTOR	2N3906
16	014-698	Q2	TRANSISTOR	2N3565
17	014-706		HEATSINK, XSTR	
18	014-723	Q7	TRANSISTOR	2N4037
19	014-784	Q3,4,6	TRANSISTOR	2N4946
21	031-187	C8	CAPACITOR, ELECT, 50 MFD, 50V	
22	031-190	C13	CAPACITOR, ELECT, 50 MFD, 25V	
24	034-181	C4,10	CAPACITOR, MICA, 47 PFD, 500V, 5%	
25	034-962	C19	CAPACITOR, MICA, 500V, 33 PF, 5%, U/O 15–30 IPS	
28	037-446	C6,14	CAPACITOR, TANT, 15 MFD, 15V, 20%	
29	037-494	C1,5	CAPACITOR, TANT, 47 MFD, 6V, 20%	
30	037-654	C2,3,7,11,12,17	CAPACITOR, TANT, 3.3 MFD, 35V, 20%	
33	041-012	R4	RESISTOR, COMP, 4.3K, 1/2W, 5%, U/O 7.5–15 IPS	
34	041-040	R6	RESISTOR, 220 OHM, 1/2W, 10%	
35	041-043	R27	RESISTOR, 390 OHM, 1/2W, 10%	
36	041-048	R26,28	RESISTOR, COMP, 1K, 1/2W, 10%	
40	041-053	R29	RESISTOR, 2.7K, 1/2W, 10%	
41	041-054	R10	RESISTOR, COMP, 3.3K, 1/2W, 10%	
42	041-056	R24	RESISTOR, COMP, 4.7K, 1/2W, 10%	
43	041-057	R4	RESISTOR, 5.6K, 1/2W, 10%, U/O 15–30 IPS	
44	041-058	R8	RESISTOR, COMP, 6.8K, 1/2W, 10%	
46	041-062	R5,25	RESISTOR, COMP, 15K, 1/2W, 10%	
47	041-067	R2,21	RESISTOR, COMP, 39K, 1/2W, 10%	
48	041-069	R22	RESISTOR, COMP, 56K, 1/2W, 10%	
49	041-072	R3,7,23,38	RESISTOR, COMP, 100K, 1/2W, 10%	
50	041-075	R3	RESISTOR, COMP, 180K, 1/2W, 10%, U/O 7.5–15 IPS	
51	041-076	R12,13	RESISTOR, COMP, 220K, 1/2W, 10%	
52	041-080	R9	RESISTOR, COMP, 470K, 1/2W, 10%	
53	041-081	R18	RESISTOR, COMP, 560K, 1/2W, 10%	
56	041-404	R1,26	RESISTOR, COMP, 510 OHM, 1/2W, 5%	
57	041-529	R5	RESISTOR, COMP, 20K, 1/2W, 5%, U/O 15–30 IPS	
58	041-533	R30,31	RESISTOR, COMP, 24 OHM, 1/2W, 5%	
61	041-066	R14,15	RESISTOR, COMP, 33K, 1/2W, 10%	
62	049-517	R1	RESISTOR, COMP, 220 OHM, 1/4W, 10%, U/O 7.5–15 IPS	

AB

ASSEMBLY NO. 4050435 TITLE REPRODUCE AMPLIFIER PWA

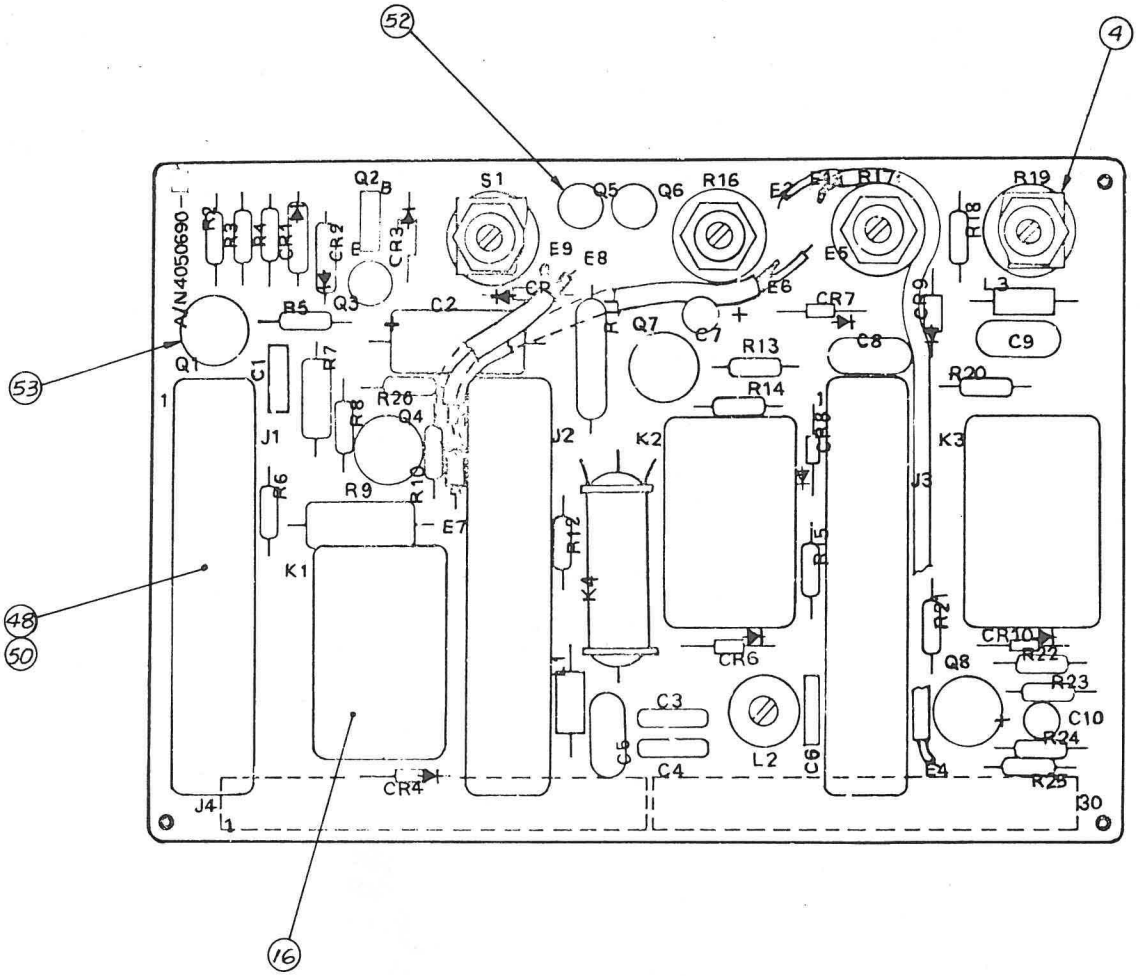
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
63	058-689	R32	RESISTOR, VAR, 500 OHM, 10%, U/O 7.5–15 IPS	
65	280-130		PAD, MTG, XSTR	
66	280-131		PAD, MTG	
69	475-007		SCREW, SEM, PAN HD, NO. 4–40 X 5/16	
71	501-008		WASHER, FLAT, NO. 4	
73	580-135	Q1	TRANSISTOR	2N4104
75	4840224		SCHEMATIC, MM1100, U/O 15–30 IPS	
76	4840249		SCHEMATIC, U/O 7.5–15 IPS	
81	4840330		SCHEMATIC, MM1100, U/O 15–30 IPS	

AB

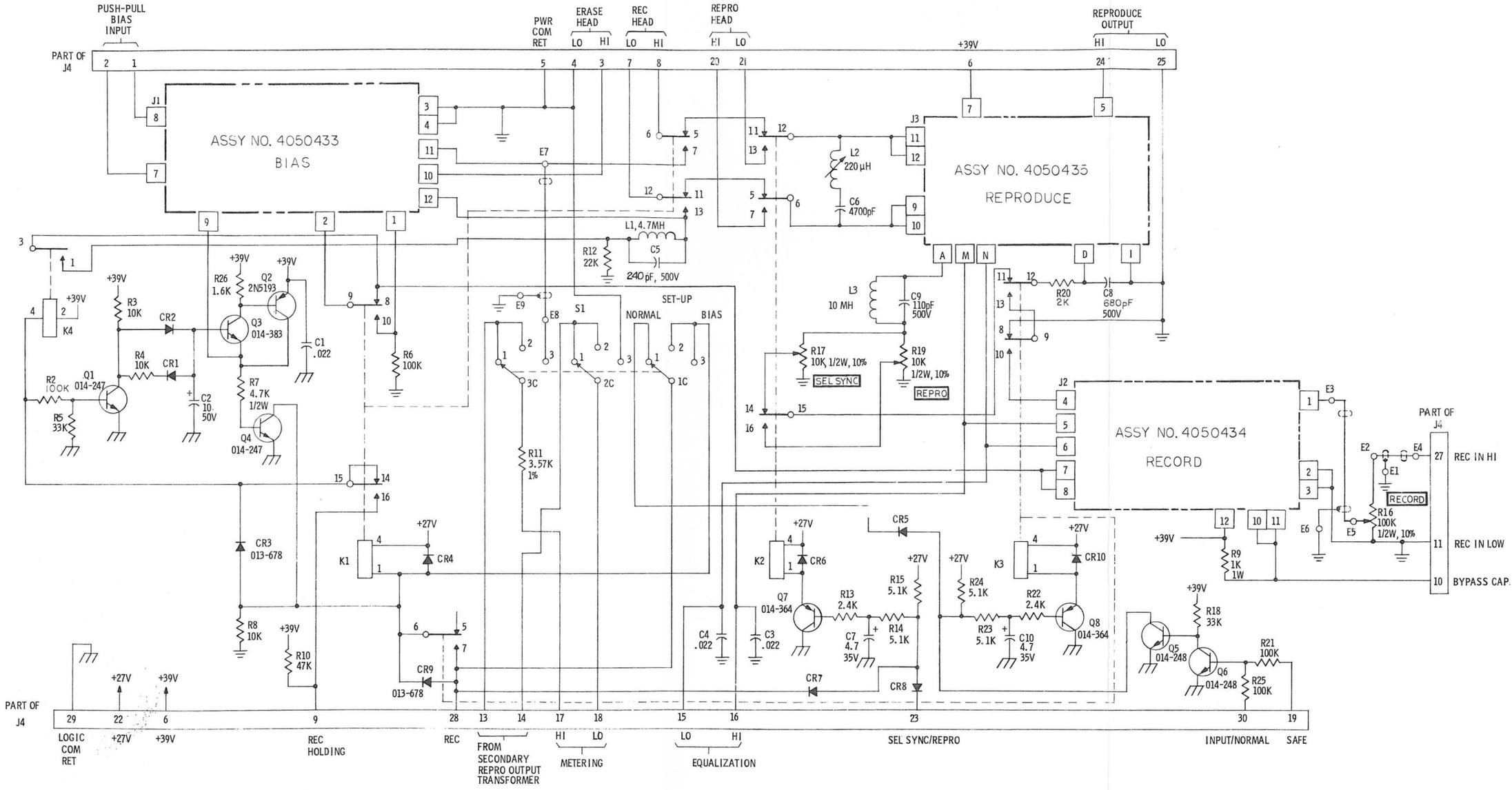
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050690-06		AUDIO SWITCHING PWA (NHA 4020371)	
2	4840344		SCHEMATIC	
4	4260511-02		STRAP, POT SUPPORT	
7	013-599	CR1,2,4-8,10	DIODE	1N914
8	013-678	CR3,9	DIODE	1N4385
10	014-247	Q1,4	TRANSISTOR	2N2219
11	014-248	Q5,6	TRANSISTOR	2N2222
12	014-364	Q7,8	TRANSISTOR	2N2905A
13	014-383	Q3	TRANSISTOR	2N2484
15	020-629	K1-3	RELAY, ARMATURE, 4 PDT, FORM D	
16	020-810		SOCKET, RELAY W/RET SPRING	
17	020-592	K4	RELAY, REED, SPST	
18	034-927	C8	CAPACITOR, MICA, 680 PF, 500V, 5%	
21	034-938	C9	CAPACITOR, MICA, 110 PF, 500V, 5%	
22	035-730	C6	CAPACITOR, MYLAR, 4700 PF, 50V, 5%	
23	035-828	C1,3,4	CAPACITOR, MYLAR, 0.022 UF, 50V, 5%	
24	034-543	C5	CAPACITOR, MICA, 240 PF, 500V, 1%	
25	037-908	C7,10	CAPACITOR, TANT, 4.7 UF, 35V, 20%	
27	041-013	R7	RESISTOR, COMP, 4.7K, 1/2W, 5%	
28	041-102	R9	RESISTOR, COMP, 1K, 1W, 5%	
29	041-406	R12	RESISTOR, COMP, 22K, 1/4W, 5%	
30	041-408	R3,4,8	RESISTOR, COMP, 10K, 1/4W, 5%	
31	041-394	R2,6,21,25	RESISTOR, COMP, 100K, 1/4W, 5%	
32	041-411	R10	RESISTOR, COMP, 47K, 1/4W, 5%	
33	041-437	R26	RESISTOR, COMP, 1.6K, 1/4W, 5%	
34	041-518	R5,18	RESISTOR, COMP, 33K, 1/4W, 5%	
35	041-561	R14,15,23,24	RESISTOR, COMP, 5.1K, 1/4W, 5%	
36	041-570	R13,22	RESISTOR, COMP, 2.4K, 1/4W, 5%	
38	041-560	R20	RESISTOR, COMP, 2K, 1/4W, 5%	
39	051-360	L1	INDUCTOR, FIXED, 4.7 MH	
40	057-759	R11	RESISTOR, MF, 3.57K, 1/4W, 1%	
41	058-838	R17,19	RESISTOR, VAR, CARBON, 10K, 1/2W, 10%	
42	058-837	R16	RESISTOR, VAR, CARBON, 100K, 1/2W, 10%	
45	037-980	C2	CAPACITOR, TANT, 10 UF, 50 VDC	
47	122-405	S1	SWITCH, ROTARY, 3P3T	
48	139-512	J1-3	CONNECTOR, PC RECP, 12 CONTACTS	
49	139-513	J4	CONNECTOR, WAFER, RT ANGLE	
50	169-818		KEY, POLORIZING	
52	280-130		PAD, MTG, XSTR, T0-18	
53	280-998		PAD, MTG, XSTR, T0-5	
55	051-952	L3	INDUCTOR, 10 MH, 5%	
57	541-133	L2	INDUCTOR, VAR, 220 UH	
59	580-394	Q2	TRANSISTOR	2N5193

F

SHEET 1 OF 1



Assembly No. 4050690. Audio Switching PWA



NOTES: UNLESS OTHERWISE SPECIFIED

1. CAPACITANCE VALUES ARE IN MICROFARADS, 50V.
2. DIODES ARE TYPE 013-599.
3. RESISTANCE VALUES ARE IN OHMS, 1/4W, 5%.
4. LAST SCHEMATIC REVISION FOR 4050690-04 BOARD ASSY WAS B.

REFERENCE DESIGNATIONS	
LAST USED	NOT USED
E9	
K4	
CR10	
Q8	
R26	R1
C10	
S1	
J4	

Schematic No. 4840344.
Audio Switching PWA

D

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050691-02		ELECTRONICS HARNESS ASSEMBLY (NHA 4020371)	
1	166-876		CONTACT, CONN, SPRING TYPE	
2	166-862	J2	CONNECTOR, RECT, 36 PIN	
3	187-036		PIN, MALE	MOLEX 1560
4	187-037		SOCKET, FEMALE	MOLEX 1561
5	166-868	P4-1,2,3,4	CONNECTOR, HOUSING	
6	166-099	J1	CONNECTOR, RECT, 9 PIN	
15	166-146	J5	CONNECTOR, RECT, 15 PIN	
18	139-511	J4	CONNECTOR, RECT, 12 PIN	
				E

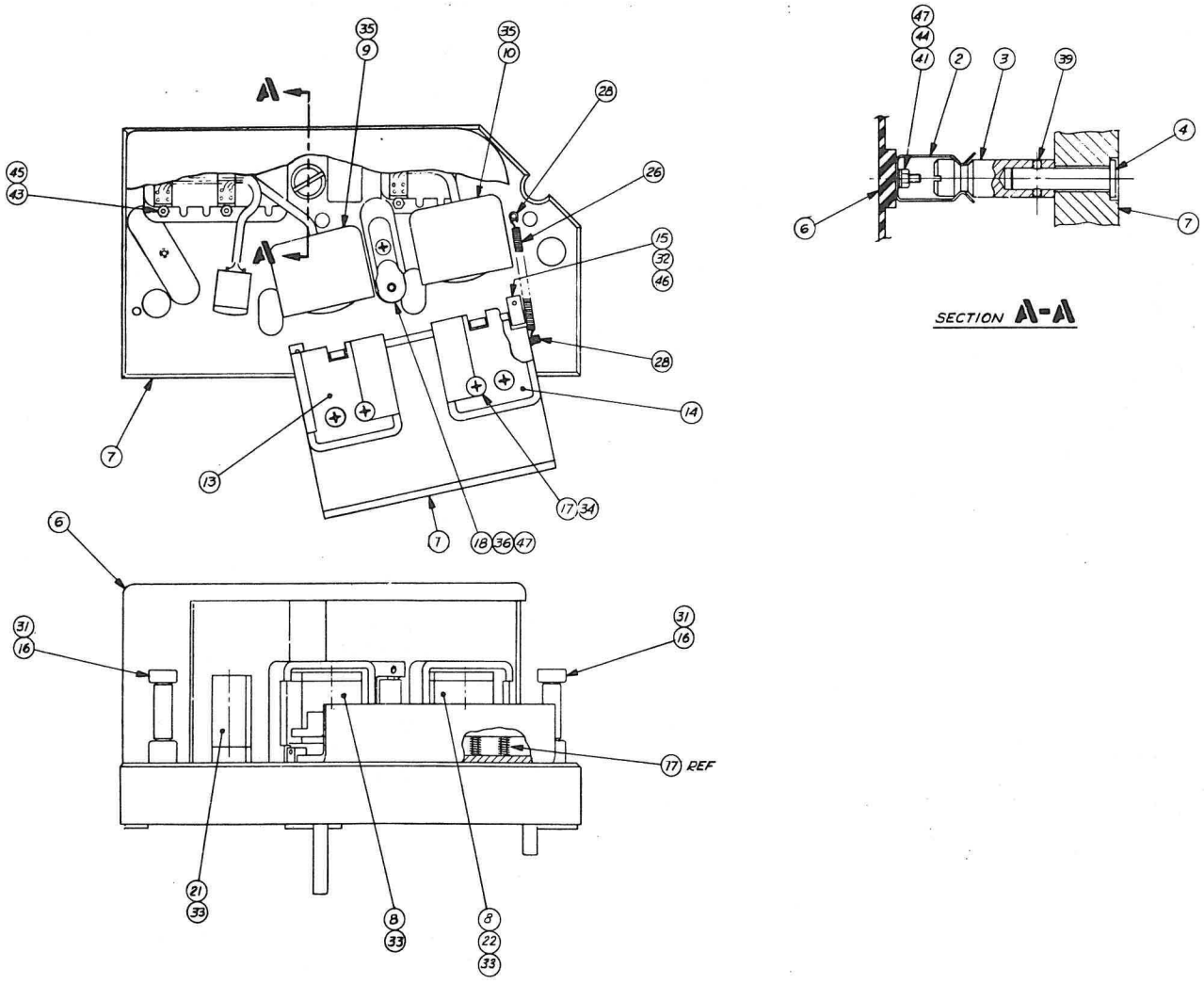
SHEET 1 OF 1

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050704-02		HEAD AND INPUT HARNESS (NHA 4020371)	
1	4700473-01		CABLE, HEAD, DOUBLE SHIELD	
3	166-876		CONTACT, CONNECTOR, SPRING TYPE	
5	169-152		CONTACT, SOC, WIN, 100	100-1014S
6	169-085		CONTACT, SOC, WIN	100-51024S
8	187-036		PIN, MALE	MOLEX 1560
				C

SHEET 1 OF 1

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4020334-01		ONE INCH HEAD ASSEMBLY, 8 CHANNEL, 15–30 IPS (NHA 4010210)	
	4020334-02		ONE INCH HEAD ASSEMBLY, 8 CHANNEL, 7.5–15 IPS (NHA 4010210)	
1	4041184-03		SHIELD COVER BRACKET ASSY	
2	4120023-01		CLIP, COVER	
3	4120070-01		HANDLE, HEAD PLATE LIFTER	
4	4200190-02		BUSHING, HEAD PLATE LIFTER	
6	4290898-02		COVER, HEAD ASSY	
7	4330307-04		PLATE, HEAD MTG	
9	4350180-01		SHIELD, CAN 1 IN	
10	4350180-02		SHIELD, CAN 1 IN	
13	4350181-01		COVER, SHIELD 1 IN	
14	4350181-02		COVER, SHIELD 1 IN	
15	4952316-01		HINGE BLOCK, HEAD SHIELD COVER	
16	4952408-01		GUIDE, TAKEUP	
17	4952762-01		SPRING, HEAD SHIELD	
18	4041048-05		SCRAPE FLUTTER IDLER, 1 IN	
26	352-247		SPRING, EXT, 0.125 OD X 1.500 LG	
28	470-002		SCREW, CAP HD, HEX SOC, NO. 2–57 X 0.25 LG	
31	470-024		SCREW, CAP HD, HEX SOC, NO. 6–32 X 1.00 LG	
32	470-171		SCREW, CAP HD, HEX SOC, NO. 4–40 X 1.00 LG	
33	471-411		SCREW, FLAT HD, XREC, NO. 10–32 X 1.00 LG	
34	471-615		SCREW, FLAT HD, XREC, NO. 6–32 X 0.69 LG	
35	471-803		SCREW, BIND HD, SLOTTED, NO. 2–56 X 1.00 LG	
36	471-074		SCREW, PAN HD, XREC, NO. 6–32 X 0.87 LG	
39	477-613		SCREW, SET, HEX SOC, NO. 6–32 X 0.188 LG	
41	492-015		NUT, PLAIN, NO. 6–32	
43	493-168		NUT, SELF LOCKING, NO. 2–56	
44	501-009		WASHER, PLAIN, NO. 6	
45	501-184		WASHER, PLAIN, NO. 2	
46	502-002		WASHER, SPRING LOCK, NO. 4	
47	502-003		WASHER, SPRING LOCK, NO. 6	
				G

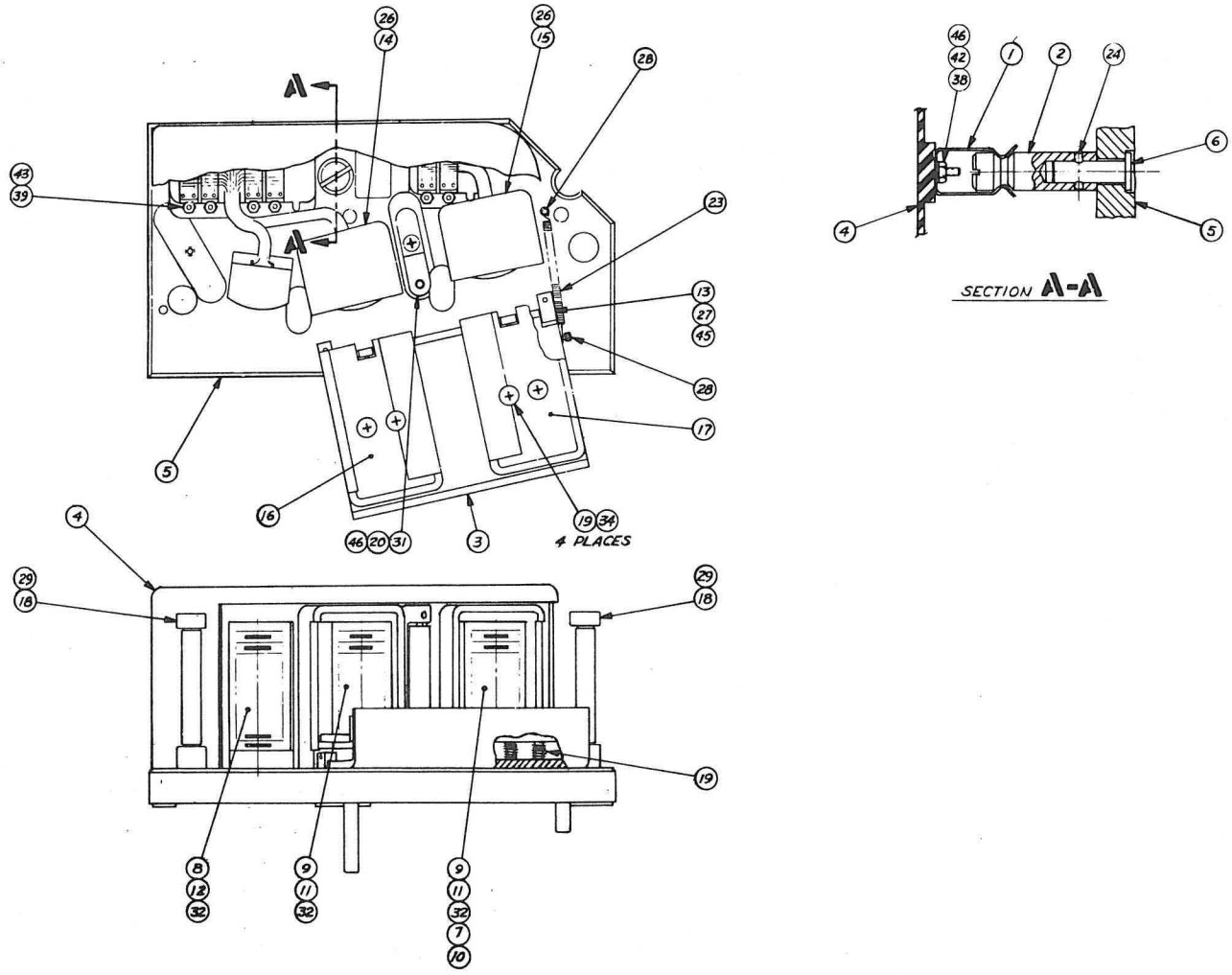
SHEET 1 OF 1



Assembly No. 4020334. One Inch Head Assembly, 8 Channel

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4020372-01		TWO INCH HEAD ASSEMBLY, 16 CHANNEL, 15–30 IPS (NHA 4010210)	
	4020372-02		TWO INCH HEAD ASSEMBLY, 24 CHANNEL, 15–30 IPS (NHA 4010210)	
	4020372-03		TWO INCH HEAD ASSEMBLY, 16 CHANNEL, 7.5–15 IPS (NHA 4010210)	
	4020372-04		TWO INCH HEAD ASSEMBLY, 24 CHANNEL, 7.5–15 IPS (NHA 4010210)	
1	4120023-01		CLIP, COVER	
2	4120070-01		HANDLE, HEAD PLATE LIFTER	
3	4041184-04		SHIELD, COVER BRACKET	
4	4290898-02		COVER, HEAD ASSY	
5	4330307-03		PLATE, HEAD MTG	
6	4200190-01		BUSHING, HEAD PLATE LIFTER	
13	4952316-01		HINGE BLOCK, HEAD SHIELD COVER	
14	4952399-03		SHIELD, CAN 2 IN	
15	4952399-04		SHIELD, CAN 2 IN	
16	4952400-07		COVER, SHIELD 2 IN	
17	4952400-06		COVER, SHIELD 2 IN	
18	4952408-02		GUIDE, TAKEUP	
19	4952762-01		SPRING, HEAD SHIELD	
20	4952442-02		SDRAPE FLUTTER IDLER, 2 IN	
23	352-247		SPRING, EXT, 0.125 OD X 1.500 LG	
24	477-613		SCREW, SET, HEX SOC, NO. 6–32 X 0.188 LG	
26	470-004		SCREW, CAP HD, HEX SOC, NO. 2–56 X 0.37 LG	
27	470-013		SCREW, CAP HD, HEX SOC, NO. 4–40 X 0.62 LG	
28	470-002		SCREW, CAP HD, HEX SOC, NO. 2–56 X 0.25 LG	
29	470-021		SCREW, CAP HD, HEX SOC, NO. 6–32 X 0.62 LG	
31	471-072		SCREW, PAN HD, XREC, NO. 6–32 X 0.62 LG	
32	471-356		SCREW, FLAT HD, XREC, NO. 10–32 X 0.50 LG	
34	471-615		SCREW, FLAT HD, XREC, NO. 6–32 X 0.69 LG	
38	492-015		NUT, PLAIN, NO. 6–32	
39	493-168		NUT, SELF LOCKING, NO. 2–56	
42	501-009		WASHER, PLAIN, NO. 6	
43	501-184		WASHER, PLAIN, NO. 2	
45	502-002		WASHER, SPRING LOCK, NO. 4	
46	502-003		WASHER, SPRING LOCK, NO. 6	
				J

SHEET 1 OF 1



Assembly No. 4020372. Two Inch Head Assembly

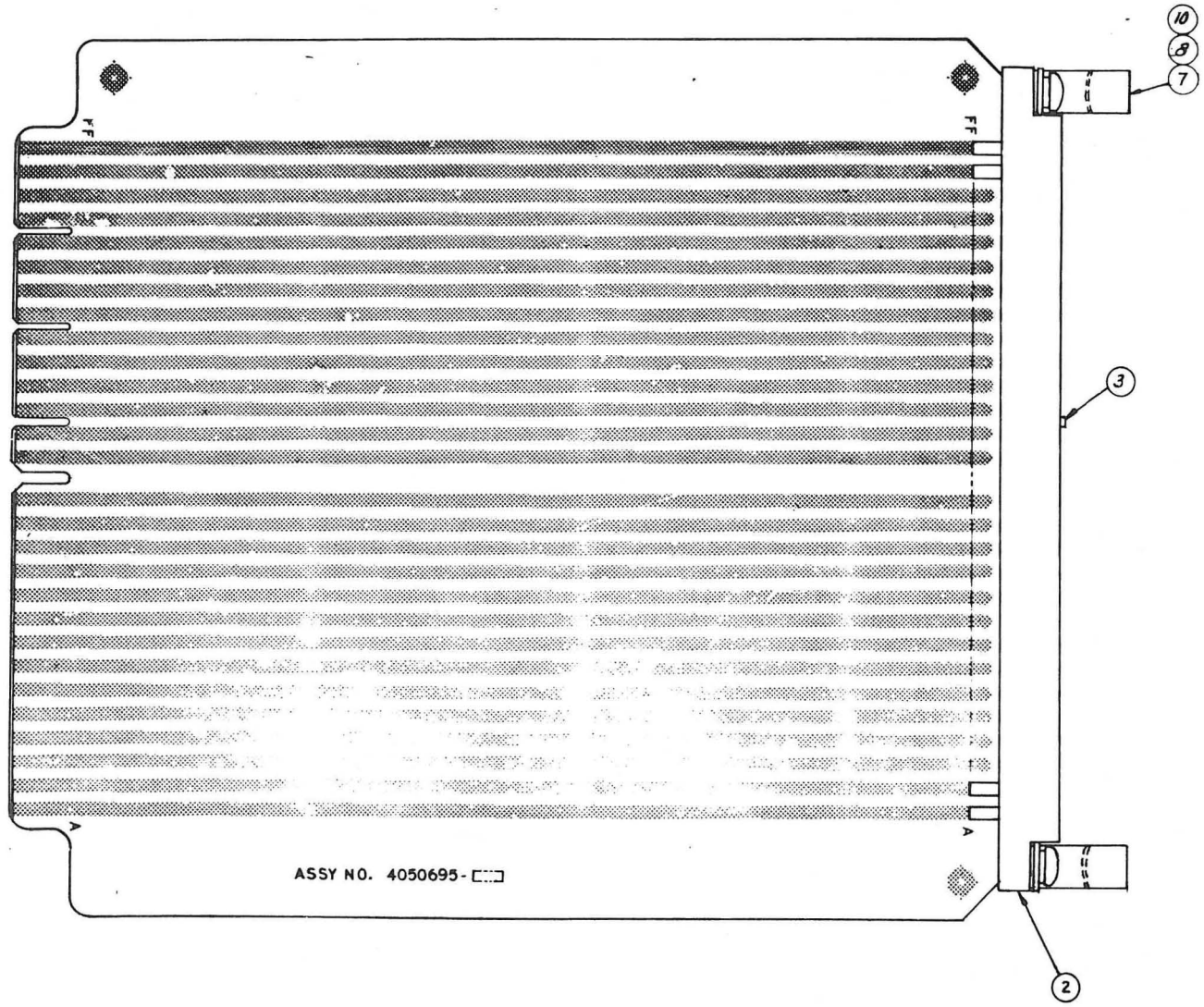
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4020373-07		TRANSPORT CONTROL CHASSIS ASSEMBLY, 8–16 CHANNEL (NHA 4010210)	
	4020373-08		TRANSPORT CONTROL CHASSIS ASSEMBLY, 24 CHANNEL (NHA 4010210)	
3	4050695-04		EXTENDER BOARD PWA	
6	4290896-02		CHASSIS, TRANSPORT CONTROL	
9	4290704-03		COVER, TRANSPORT CONTROL CHASSIS	
10	143-804	J1,2,4	CONNECTOR, PC DUAL, 56 PIN	
11	146-257	P1	CONNECTOR, 104 PLUG	MRAC 104S
12	146-258	J6	CONNECTOR, 104 SOC	MRAC 104S
13	147-036	J3	CONNECTOR, CINCH-JONES, 4 PIN MALE	
14	4050692-06		CAPSTAN SERVO PWA	
15	166-862	J5	CONNECTOR, MOLEX, PLUG, 36 PIN	
16	166-863	J8-10	CONNECTOR, MOLEX,RECEPT, 36 SOC	
17	169-076		CONTACT, CONN, SOC, 22 AWG	
18	169-318		KEY, POLARIZING, PC CONN	
20	187-036		CONTACT, CONN, PIN	
21	187-037		CONTACT, CONN, SOC	
22	260-007		BUSHING, FLANGED, 0.750 ID	
23	471-060		SCREW, MACH, PAN HD, XREC, NO. 4–40 X 1/4 LG	
24	471-067		SCREW, MACH, PAN HD, XREC, NO. 6–32 X 1/4 LG	
25	496-005		NUT, KEP, NO. 6–32	
27	501-008		WASHER, FLAT, NO. 4	
28	501-009		WASHER, FLAT, NO. 6	
29	502-024		WASHER, LOCK, INT STAR, NO. 4	
30	502-025		WASHER, LOCK, INT STAR, NO. 6	
32	530-159		GUIDE, PC	
51	4050706-07		TRANSPORT CONTROL PWA	
52	4290905-02		PANEL, CONN, TRANSPORT CONTROL	
53	471-068		SCREW, PAN HD, XREC, NO. 6–32 X 0.312 LG	
54	302-344		STRAP, MTG PLATE	

T

SHEET 1 OF 1

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050695-04		EXTENDER BOARD PWA (NHA 4020373)	
2	143-804		CONNECTOR, PC RCPT	
3	169-318		KEY, POLARIZING	
7	471-060		SCREW, PAN HD, NO. 4–40 X 0.025 LG	
8	501-008		WASHER, PLAIN, NO. 4	
10	4290886-01		HOOK, EXTENDER BOARD	
				D

SHEET 1 OF 1



ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050692-06		CAPSTAN SERVO PWA (NHA 4020373)	
2	4840356		SCHEMATIC	
4	52528-01		HANDLE	
6	013-678	CR1	DIODE	1N4385
7	013-983	VR1	DIODE	1N752A
8	013-599	CR2-5	DIODE	1N914
9	014-652	Q3,7	TRANSISTOR	2N3906
10	014-698	Q1,2,6,8	TRANSISTOR	2N3565
11	014-793		PAD, MTG, XSTR	
12	280-130		PAD, MTG, XSTR	
13	017-122	Y1	CRYSTAL, MONITOR, PRODUCTS	
14	037-459	C23	CAPACITOR, TANT' 1.0 UF, 35V, 10%	
15	030-057	C2,3,6-8,15,16,19	CAPACITOR, CER, DISC, 0.01 UF, 100V, 20%	
16	030-437	C1,9	CAPACITOR, MONO, 0.1 UF, 25V	
17	055-156	C14	CAPACITOR, MYLAR, 0.22 UF, 50V, 5%	
18	055-195	C18	CAPACITOR, MYLAR, 0.0068 UF, 50V, 5%	
19	041-411	R2,18	RESISTOR, COMP, 47K, 5%, 1/4W	
20	034-283	C22	CAPACITOR, MICA, 820 PF, 300V, 5%	
22	035-853	C13	CAPACITOR, MYLAR, 0.056 UF, 50V, 5%	
24	035-596	C11	CAPACITOR, MYLAR, 0.082 UF, 50V, 5%	
25	041-408	R4,9-11,32	RESISTOR, COMP, 10K, 1/4W, 5%	
26	037-367	C17,20	CAPACITOR, TANT, 2.2 UF, 20V, 10%	
27	037-620	C5	CAPACITOR, TANT, 100 UF, 20V, 10%	
28	037-894	C4,21	CAPACITOR, TANT, 100 UF, 10V, 5%	
29	041-482	R37	RESISTOR, COMP, 12K, 1/4W, 5%	
31	041-407	R7,8,27,34	RESISTOR, COMP, 3.3K, 1/4W, 5%	
33	041-410	R5,15,30	RESISTOR, COMP, 1K, 1/4W, 5%	
35	041-412	R14	RESISTOR, COMP, 4.7K, 1/4W, 5%	
37	041-443	R1	RESISTOR, COMP, 39K, 1/4W, 5%	
38	041-483	R35	RESISTOR, COMP, 27K, 1/4W, 5%	
39	041-495	R3	RESISTOR, COMP, 8.2K, 1/4W, 5%	
40	041-502	R26	RESISTOR, COMP, 240 OHM, 1/4W, 5%	
41	041-503	R6	RESISTOR, COMP, 270 OHM, 1/4W, 5%	
42	041-504	R25	RESISTOR, COMP, 510 OHM, 1/4W, 5%	
44	041-530	R29	RESISTOR, COMP, 15 OHM, 1/4W, 5%	
45	041-409	R36	RESISTOR, COMP, 15K, 1/4W, 5%	
46	041-394	R33,39	RESISTOR, COMP, 100K, 1/4W, 5%	
47	041-653	R31	RESISTOR, COMP, 39 OHM, 1/4W, 5%	
48	055-133	C10	CAPACITOR, MYLAR, 0.0022 UF, 50V, 5%	
49	055-168	C12	CAPACITOR, MYLAR, 0.0056 UF, 50V, 5%	
50	041-562	R28	RESISTOR, COMP, 43K, 1/4W, 5%	
				H

ASSEMBLY NO. 4050692 TITLE CAPSTAN SERVO PWA

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
52	041-427	R38	RESISTOR, 330 OHM, 1/4W, 5%	
53	058-754	R19	RESISTOR, VAR, CER, 100 OHM, 1W, 20%	
54	143-981	E1-6	CONNECTOR, JACK	
55	150-106		BRACKET, MTG, CRYSTAL	
56	166-628		PLUG, SHORTING BLOCK, BLK	
57	041-393	R44	RESISTOR, COMP, 1M, 1/4W, 5%	
58	471-062		SCREW' PAN HD, XREC, NO. 4-40 X 0.375 LG	
59	492-008		NUT, PLAIN, HEX, NO. 4-40	
60	501-008		WASHER, FLAT, NO. 4	
61	502-024		WASHER, LOCK, NO. 4	
64	580-332		HEATSINK	
65	580-395	Q4,5	TRANSISTOR	2N5190
66	058-498	R45	RESISTOR, VAR, CER, 500 OHM, 1/2W, 20%	
67	057-137	R12,13,16,17	RESISTOR, MF, 51K, 1/4W, 2%	
68	586-153	A7	INTEGRATED CIRCUIT	MC846P
69	586-268	A4	INTEGRATED CIRCUIT	UA741C
70	586-283	A1	INTEGRATED CIRCUIT	SN7493N
71	586-309	A10	INTEGRATED CIRCUIT	U6A9601
72	586-425	A2,3	INTEGRATED CIRCUIT	MC853P
73	586-698	A6,8,9	INTEGRATED CIRCUIT	U6A9950
74	587-086	A5	INTEGRATED CIRCUIT, 8 PIN	LM311N
75	586-680	A11	INTEGRATED CIRCUIT	S SN7413J
76	057-108	R41	RESISTOR, MF, 3.3K, 1/4W, 2%	
77	057-110	R42	RESISTOR, MF, 3.9K, 1/4W, 2%	
78	057-115	R22,23	RESISTOR, MF, 6.2K, 1/4W, 2%	
79	057-129	R20	RESISTOR, MF, 24K, 1/4W, 2%	
80	057-134	R21	RESISTOR, MF, 39K, 1/4W, 2%	
81	057-141	R43	RESISTOR, MF, 75K, 1/4W, 2%	

H

SHEET 2 OF 2

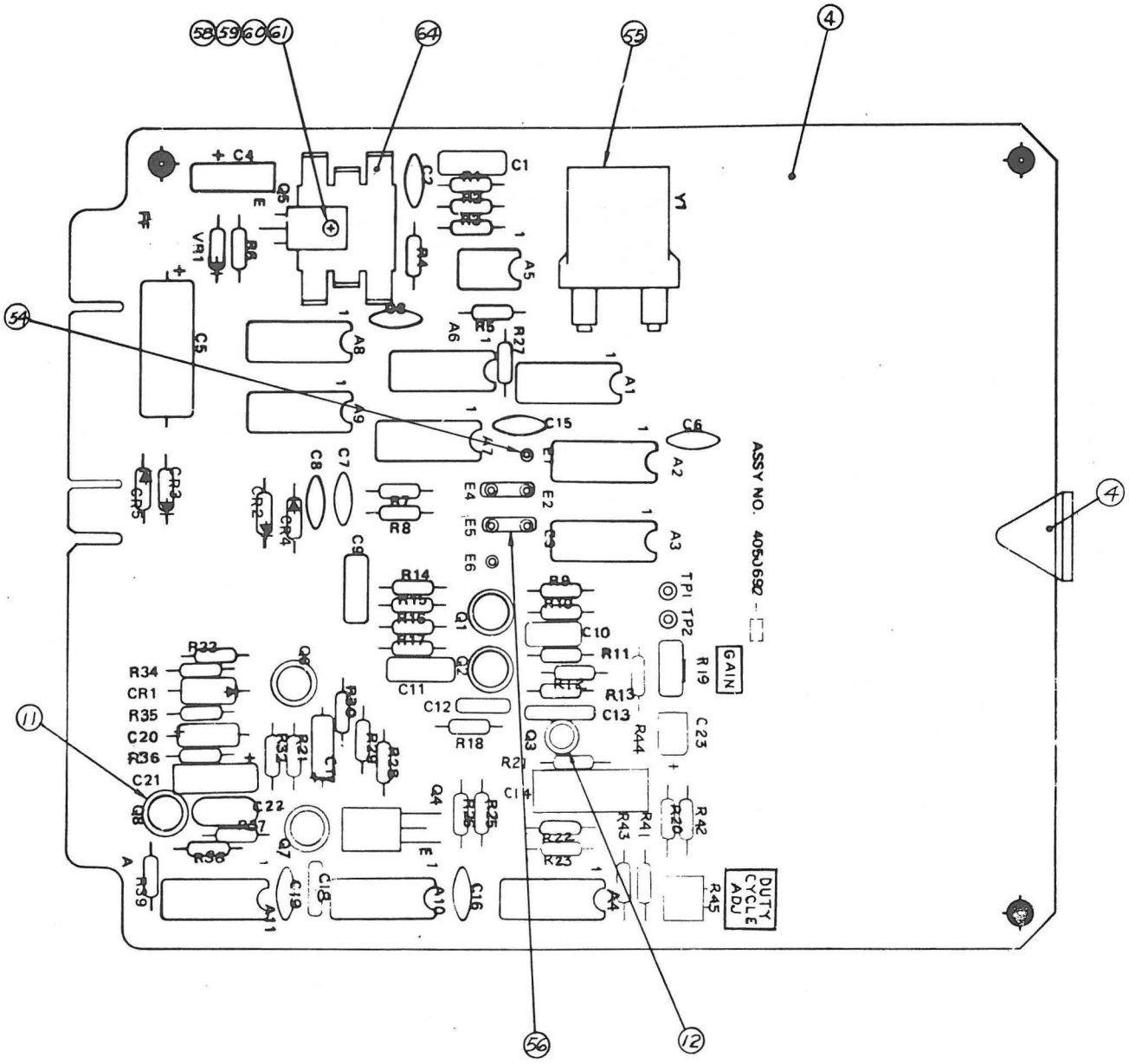


TABLE 1

SPEED STRAPPING			
RANGE	HI	MED	LO
HI	E5 TO E6	E5 TO E3	E5 TO E4
LO	E2 TO E3	E2 TO E4	E2 TO E1

Assembly No. 4050692. Capstan Servo PWA

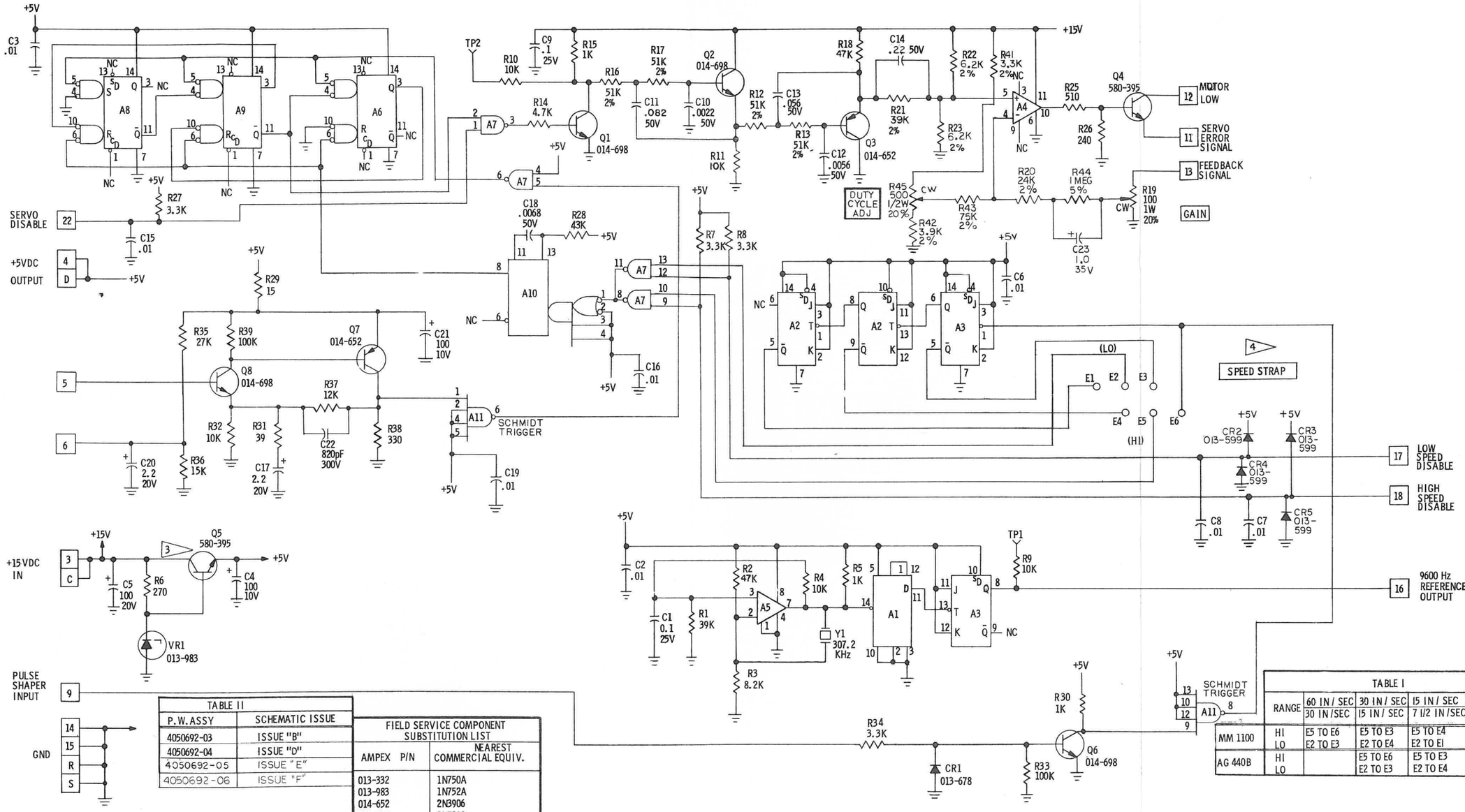


TABLE II	
P.W. ASSY	SCHEMATIC ISSUE
4050692-03	ISSUE "B"
4050692-04	ISSUE "D"
4050692-05	ISSUE "E"
4050692-06	ISSUE "F"

FIELD SERVICE COMPONENT SUBSTITUTION LIST	
AMPEX P/N	NEAREST COMMERCIAL EQUIV.
013-332	1N750A
013-983	1N752A
014-652	2N3906
580-395	2N5190
014-698	NONE
013-678	1N4385

TABLE I					
RANGE	60 IN/SEC 30 IN/SEC	30 IN/SEC 15 IN/SEC	15 IN/SEC 7 1/2 IN/SEC	7 1/2 IN/SEC 3 3/4 IN/SEC	
MM 1100	HI	E5 TO E6	E5 TO E3	E5 TO E4	
	LO	E2 TO E3	E2 TO E4	E2 TO E1	
AG 440B	HI		E5 TO E6	E5 TO E3	E5 TO E4
	LO		E2 TO E3	E2 TO E4	E2 TO E1

NOTES: UNLESS OTHERWISE SPECIFIED

1. CAPACITANCE VALUES ARE IN MICROFARADS, 100V.
2. RESISTANCE VALUES ARE IN OHMS 1/4W, 5%.
3. HEATSINK REQUIRED.
4. SEE TABLE 1 FOR SPEED STRAPPING.

REFERENCE DESIGNATION	
LAST USED	NOT USED
A11 Q8 C23 Y1 R45 CR5 TP2 E6 VR1	R24 R40

I.C. LIST								
REFERENCE DESIGNATION	A11	A6,8,9	A7	A4	A1	A2,3	A5	A10
AMPEX P/N	586-680	586-698	586-153	586-268	586-283	586-425	587-086	586-309
VENDOR P/N	SN7413J	U6A9950	MC 846P	UA 741C	SN7493N	MC 853P	LM-311N	U6A9601
VOLTAGE PIN	14	14	14	11	5	14	8	14
GROUND PIN	7	7	7	6	10	7	4,1	7

Schematic No. 4840356.
Capstan Servo PWA

F

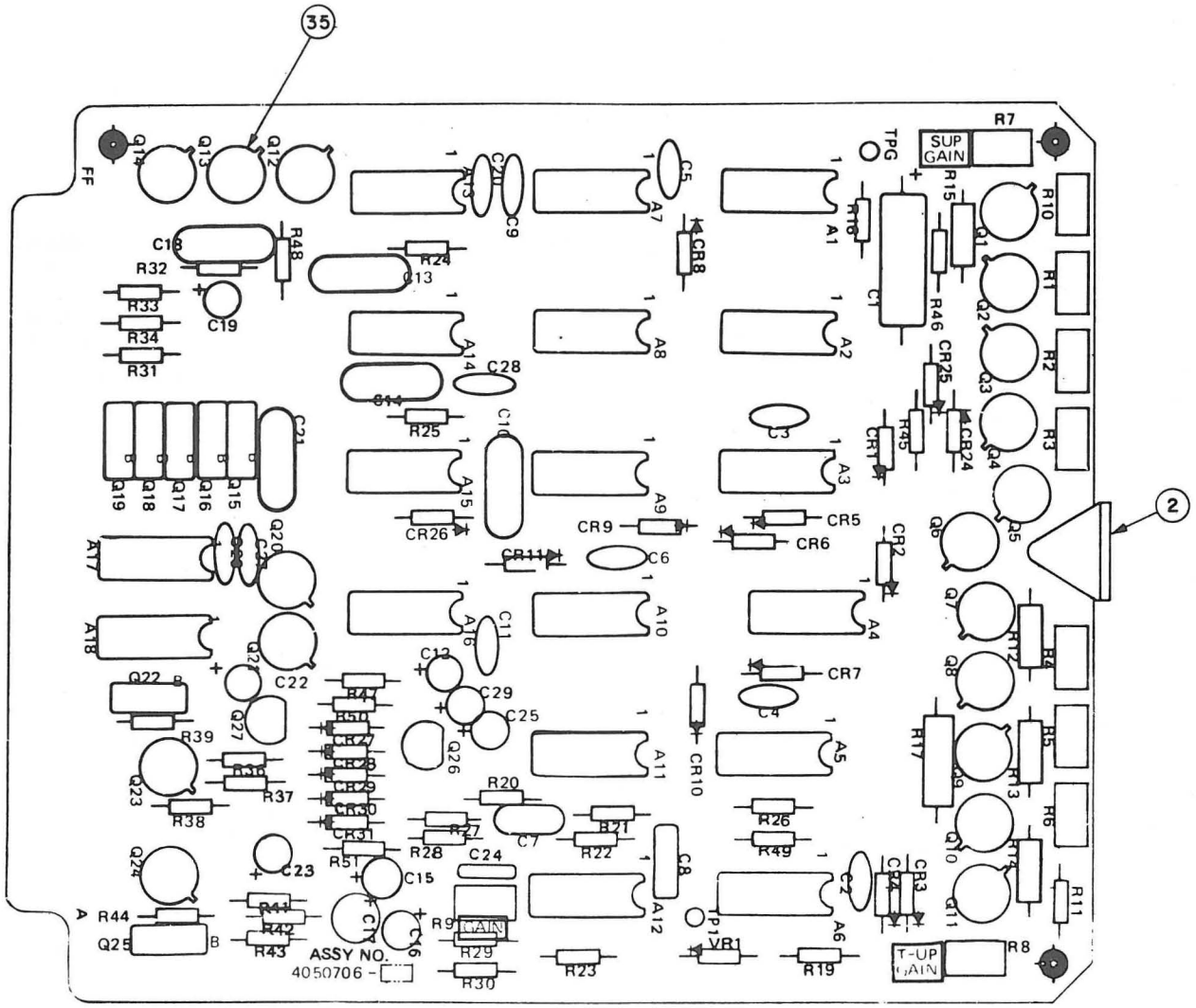
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050706-07		TRANSPORT CONTROL PWA (NHA 4020373)	
2	52528-01		HANDLE, SNAP ON	
4	4840345		SCHEMATIC	
5	013-983	VR1	DIODE	1N752A
7	014-247	Q1-14,20,21	TRANSISTOR	2N2219
16	037-750	C1	CAPACITOR, TANT, 68 UF, 20V	
17	041-336	R12,13	RESISTOR, COMP, 470 OHM, 1/2W, 5%	
20	041-469	R21	RESISTOR, COMP, 330K, 1/4W, 5%	
22	041-483	R36,41	RESISTOR, COMP, 27K, 1/4W, 5%	
23	041-501	R17	RESISTOR, COMP, 330 OHM, 1W, 5%	
24	041-561	R16	RESISTOR, COMP, 5.1K, 1/4W, 5%	
26	041-772	R23	RESISTOR, COMP, 1.2M, 1/4W, 5%	
31	058-602	R5-8	RESISTOR, VAR, 5K, 1W, 20%	
32	058-662	R1-4	RESISTOR, VAR, 10K, 1W, 10%	
33	058-855	R9	RESISTOR, VAR, 1.0M, 1/2W, 20%	
35	280-998		PAD, MTG, XSTR, T05, REF: Q1-14, 20, 21, 23, 24	
36	580-464	Q22,25	TRANSISTOR	MJE1090
37	580-467	Q15-19	TRANSISTOR	MJE1100
38	586-268	Q11,12	INTEGRATED CIRCUIT	UA741
39	587-103	A4,5,13,16	INTEGRATED CIRCUIT	MC680
40	587-101	A2,9,14	INTEGRATED CIRCUIT	MC661
41	587-102	A1,3,6-8,10,15,	INTEGRATED CIRCUIT	MC668
42	586-795	A18	INTEGRATED CIRCUIT	MC665
43	041-396	R29,30,46	RESISTOR, COMP, 220 OHM, 1/4W, 5%	
44	041-560	R11,38,43	RESISTOR, COMP, 2K, 1/4W, 5%	
45	041-528	R14,15	RESISTOR, COMP, 300 OHM, 1/2W, 5%	
46	041-408	R19,39,44	RESISTOR, COMP, 10K, 1/4W, 5%	
48	041-413	R37,42	RESISTOR, COMP, 6.8K, 1/4W, 5%	
50	041-678	Q23,24	TRANSISTOR	2N3945
51	041-432	R27,28	RESISTOR, COMP, 220K, 1/4W, 5%	
52	058-588	R10	RESISTOR, VAR, 1K, 1W, 10%	
53	041-774	R20	RESISTOR, COMP, 1.5M, 1/4W, 5%	
54	041-508	R45	RESISTOR, COMP, 20K, 1/4W, 5%	
55	035-883	C8	CAPACITOR, MYLAR, 0.068 UF, 50V	
56	056-163	C7	CAPACITOR, MICA, 470 PF, 500V, 5%	
59	055-166	C24	CAPACITOR, MYLAR, 0.001 UF, 50V	
63	013-599	CR1-11,24,31	DIODE, SILICON	1N914
64	014-698	Q27	TRANSISTOR	2N3565
65	014-781	Q26	TRANSISTOR	MPS 6518-5
66	030-057	C2-6,9,11,20, 26-28	CAPACITOR, CER, 0.01 UF, 100V	
67	034-153	C10,13,14,18,21	CAPACITOR, TANT, 2.2 UF, 20V, 20%	

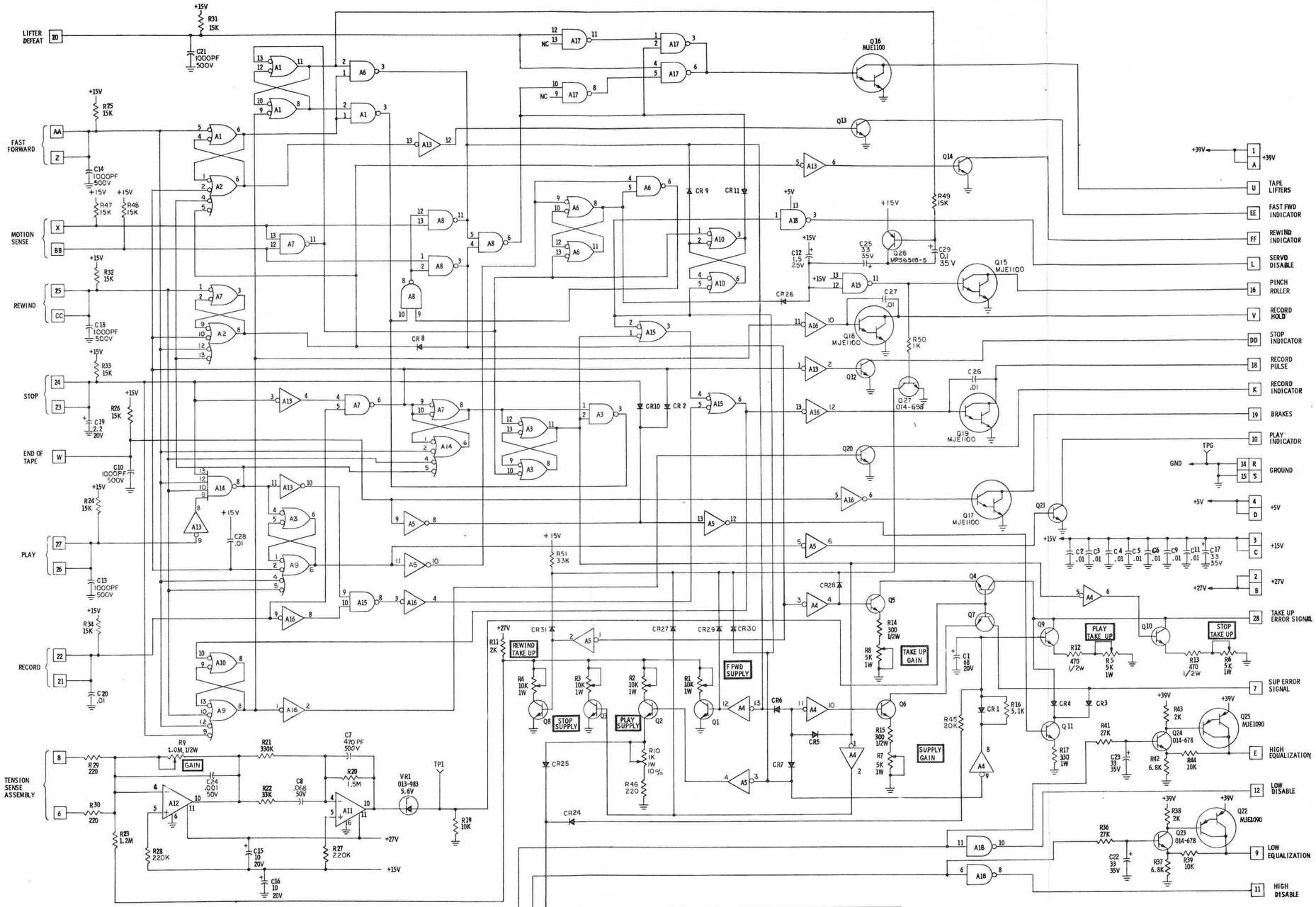
L

ASSEMBLY NO. 4050706 TITLE TRANSPORT CONTROL PWA

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
68	037-790	C19	CAPACITOR, TANT, 2.2 UF, 20V, 20%	
69	037-812	C15,16	CAPACITOR, TANT, 10 UF, 25V, 20%	
70	037-938	C17,22,23,25	CAPACITOR, TANT, 33 UF, 35V, 20%	
72	041-409	R24-26,31-34, 47-49	RESISTOR, COMP, 15K, 1/4W, 5%	
73	041-410	R50	RESISTOR, COMP, 1K, 1/4W, 5%	
74	041-518	R22,51	RESISTOR, COMP, 33K, 1/4W, 5%	
75	037-899	C29	CAPACITOR, TANT, 0.1 UF, 35V, 20%	
76	037-942	C12	CAPACITOR, TANT, 1.5 UF, 25V, 20%	L

SHEET 2 OF 2





REFERENCE DESIGNATIONS	
LAST USED	NOT USED
A18	R18, 35, 40
C29	CR12-23
CR9, VR1	
Q27	
R51	
TP1, TPG	

I.C. LIST					
REFERENCE DESIGNATIONS	A1, 3, 6, 7, 8, 10, 15, 17	A2, 9, 14	A4, 5, 13, 16	A11, 12	A18
AMPEX P/N	587-102	587-101	587-103	586-268	586-795
VENDOR P/N	MC668	MC661	MC680	UA741	MC665
VOLTAGE (PIN)	14	14	14	11	14
GROUND (PIN)	7	7	7	6	7

TABLE I	
P.W. ASSY.	SCHEMATIC ISSUE
4050706-06	ISSUE "F"
4050706-07	ISSUE "G"

NOTES: UNLESS OTHERWISE SPECIFIED
1. CAPACITANCE VALUES ARE IN MICROFARADS, 100V
2. DIODES ARE PART NO. 013-599 FOR FIELD SERVICE SUBSTITUTE 1N914.
3. TRANSISTORS ARE PART NO. 014-247, FOR FIELD SERVICE SUBSTITUTE 2N2219.
4. RESISTANCE VALUES ARE IN OHMS, 1/4W, ±5%.

Schematic No. 4840345.
Transport Control PWA

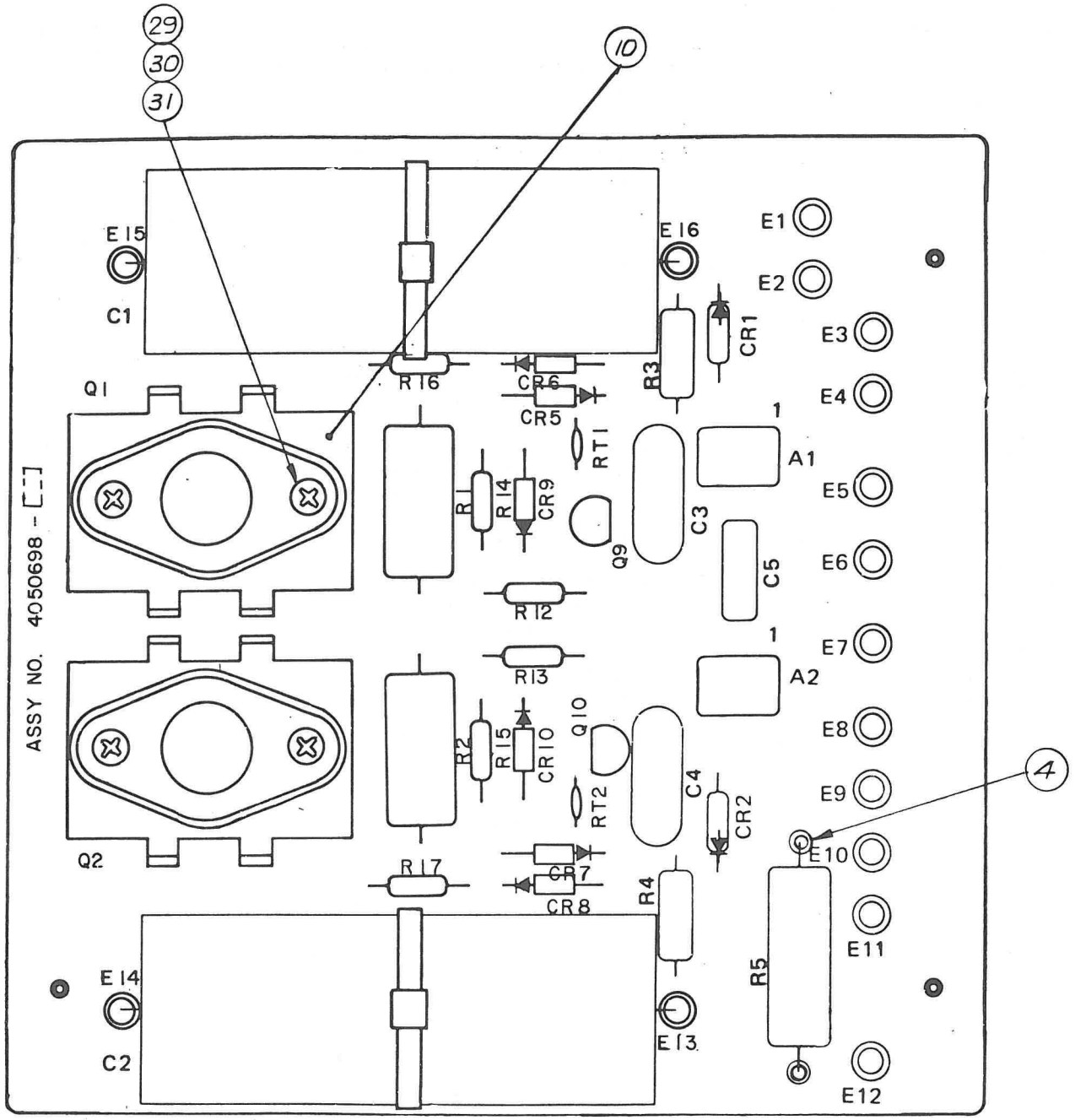
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4020374-03		MOTOR DRIVE AMPLIFIER ASSEMBLY (NHA 4010210)	
3	4290883-01		COVER, MDA CHASSIS	
4	4290894-01		HEATSINK, POWER XSTR	
5	4290882-03		CHASSIS, MOTOR DRIVE ASSY	
6	471-082		SCREW, MACH, PAN HD, XREC, NO. 8-32 X 3/4 LG	
7	4840336		MOTOR DRIVE ASSY, SCHEMATIC	
8	043-806	R10,11	RESISTOR, WW POWER, 0.5 OHM, 5W, 5%	
9	030-300	C6,7	CAPACITOR, 0.1 UF, 500V	
10	014-614	Q5,8	TRANSISTOR, POWER	2N3715
12	150-142		MOUNTING KIT, XSTR	
13	147-007		CONNECTOR, MALE, CHASSIS MTG, 15 PIN	
14	173-492		TERMINAL, QIK DISC, 16-14 AWG, FEMALE	
15	043-556	R6-9	RESISTOR, WW POWER, 1 OHM, 5W, 3%	
16	260-014		GROMMET	
17	471-062		SCREW, MACH, PAN HD, XREC, NO. 4-40 X 3/8 LG	
18	471-060		SCREW, MACH, PAN HD, XREC, NO. 4-40 X 1/4 LG	
22	496-004		NUT, KEP, NO. 4-40	
23	496-005		NUT, KEP, NO. 6-32	
24	501-008		WASHER, PLAIN, NO. 4	
25	501-009		WASHER, PLAIN, NO. 6	
26	501-010		WASHER, PLAIN, NO. 8	
27	502-002		WASHER, LOCK, SPRING, NO. 4	
29	502-004		WASHER, LOCK, SPRING, NO. 8	
30	4050698-02		MOTOR DRIVE AMPLIFIER PWA	
31	580-533	Q3,4,6,7	TRANSISTOR, POWER	
32	581-095	CR3,4	DIODE BRIDGE ASSY	SCBA2
36	180-023		STRIP, TERM, 3 TERM, A1, D, A1	
37	471-072		SCREW, MACH, PAN HD, XREC, NO. 6-32 X 5/8 LG	

E

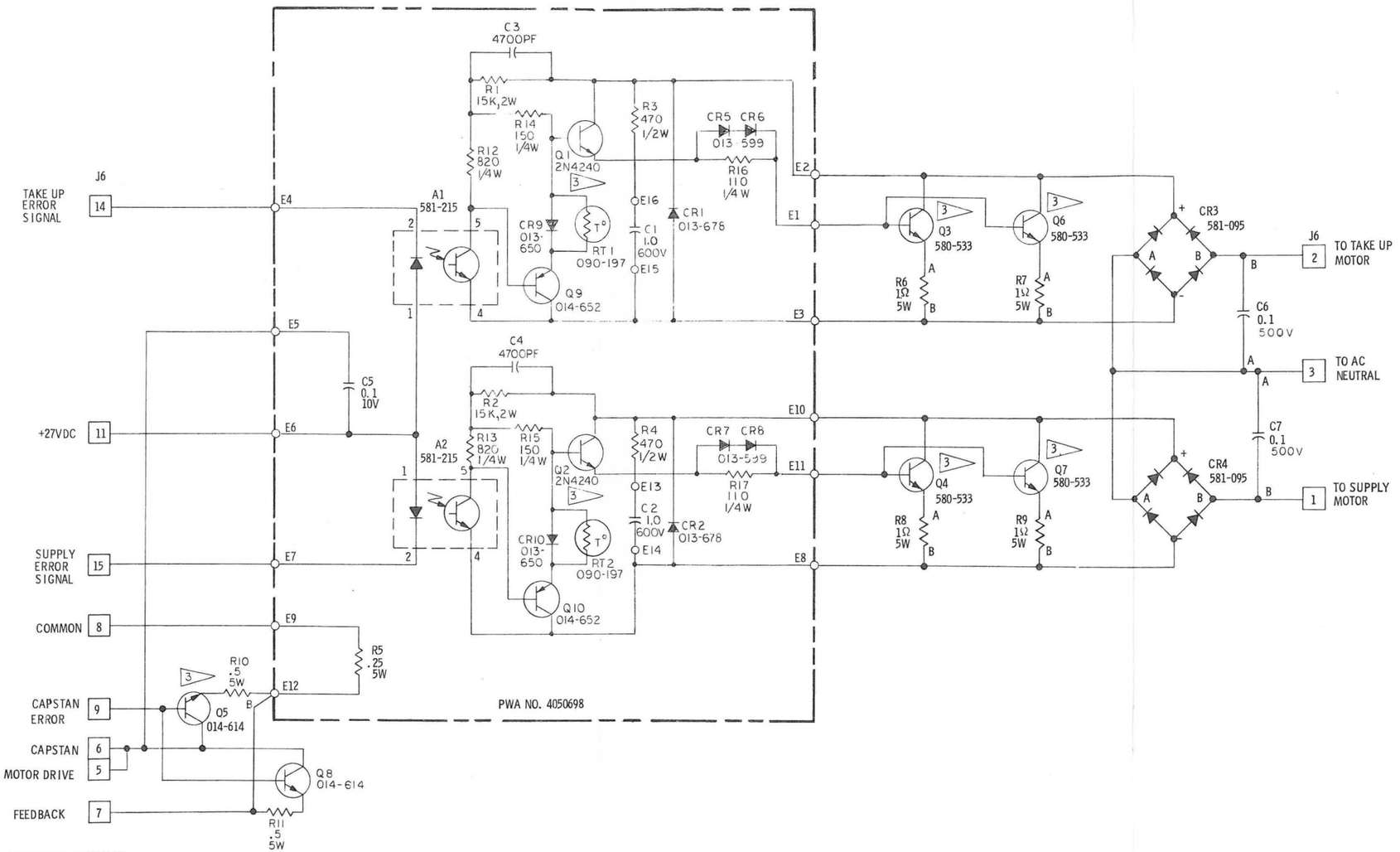
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050698-02		MOTOR DRIVE AMPLIFIER PWA (NHA 4020374)	
2	4840336		SCHEMATIC	
4	103307-01		STANDOFF	
5	013-599	CR5-8	DIODE	1N914
6	013-678	CR1-2	DIODE	1N4385
7	013-650	CR9-10	DIODE	1N270
8	580-219	Q1,2	TRANSISTOR	2N4240
9	014-652	Q9,10	TRANSISTOR	2N3906
10	014-959		HEATSINK	
11	090-197	RT1,2	THERMISTOR	
13	030-292	C3,4	CAPACITOR, FIX CERAMIC, 4700 PF, 1KV	
15	030-082	C5	CAPACITOR, FIX MYLAR, 0.1 UF, 100V	
17	055-909	C1,2	CAPACITOR, 1.0 UF, 600V	SPRAGUE 6TM-M1
18	041-736	R16,17	RESISTOR, COMP, 110 OHM, 1/4W, 5%	
19	041-984	R1,2	RESISTOR, FIX COMP, 15K, 2W, 5%	
20	041-336	R3,4	RESISTOR, FIX COMP, 470 OHM, 1/2W, 5%	
21	041-435	R14,15	RESISTOR, COMP, 150 OHM, 1/4W, 5%	
22	041-506	R12,13	RESISTOR, COMP, 820 OHM, 1/4W, 5%	
23	043-968	R5	RESISTOR, FIX WW POWER, 0.25 OHM, 5W, 3%	
25	586-683	A1,2	ISOLATOR, OPTICALLY COUPLED	T1XL113
29	471-062		SCREW, NO. 4-40 X 3/8	
30	496-004		NUT, KEP, NO. 4-40	
31	501-008		WASHER, FLAT, NO. 4	

C

SHEET 1 OF 1



Assembly No. 4050698. Motor Drive Amplifier PWA



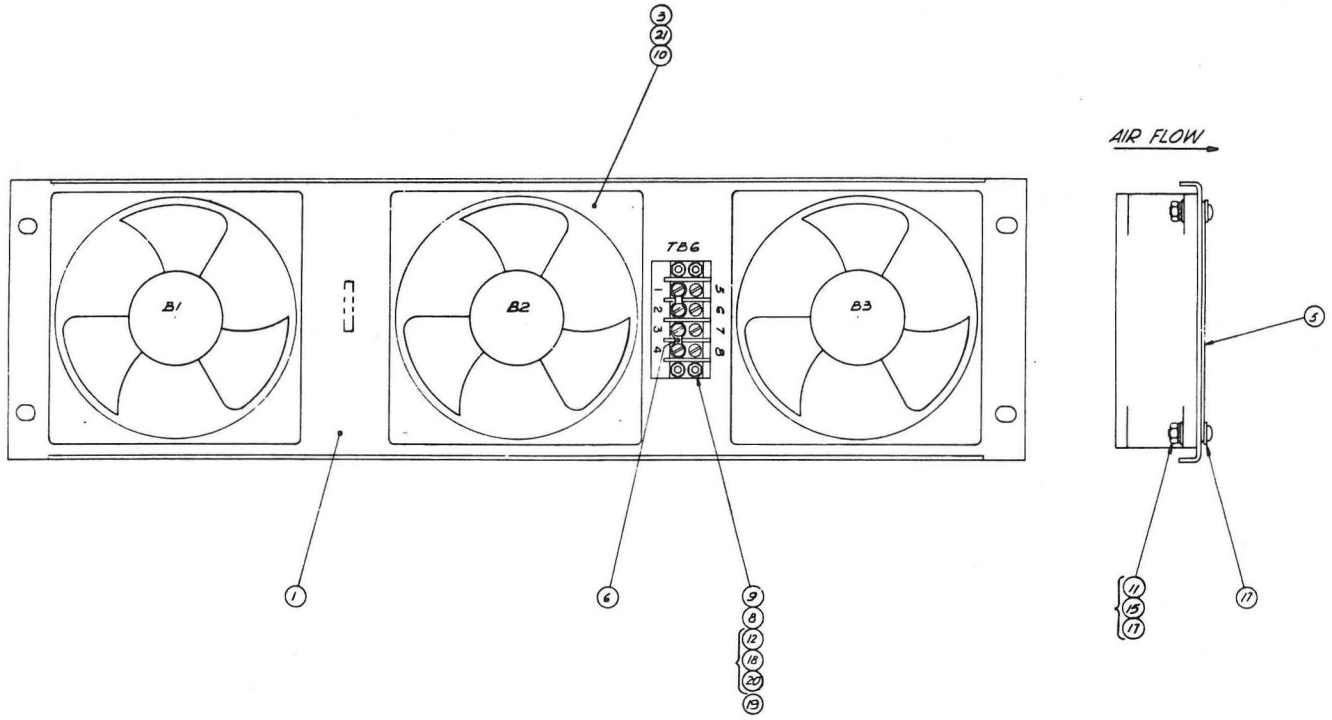
NOTES: UNLESS OTHERWISE SPECIFIED

1. CAPACITANCE VALUES ARE IN MICROFARADS.
2. RESISTANCE VALUES ARE IN OHMS.
3. HEATSINK REQUIRED.

Schematic No. 4840336.
Motor Drive Amplifier Assembly

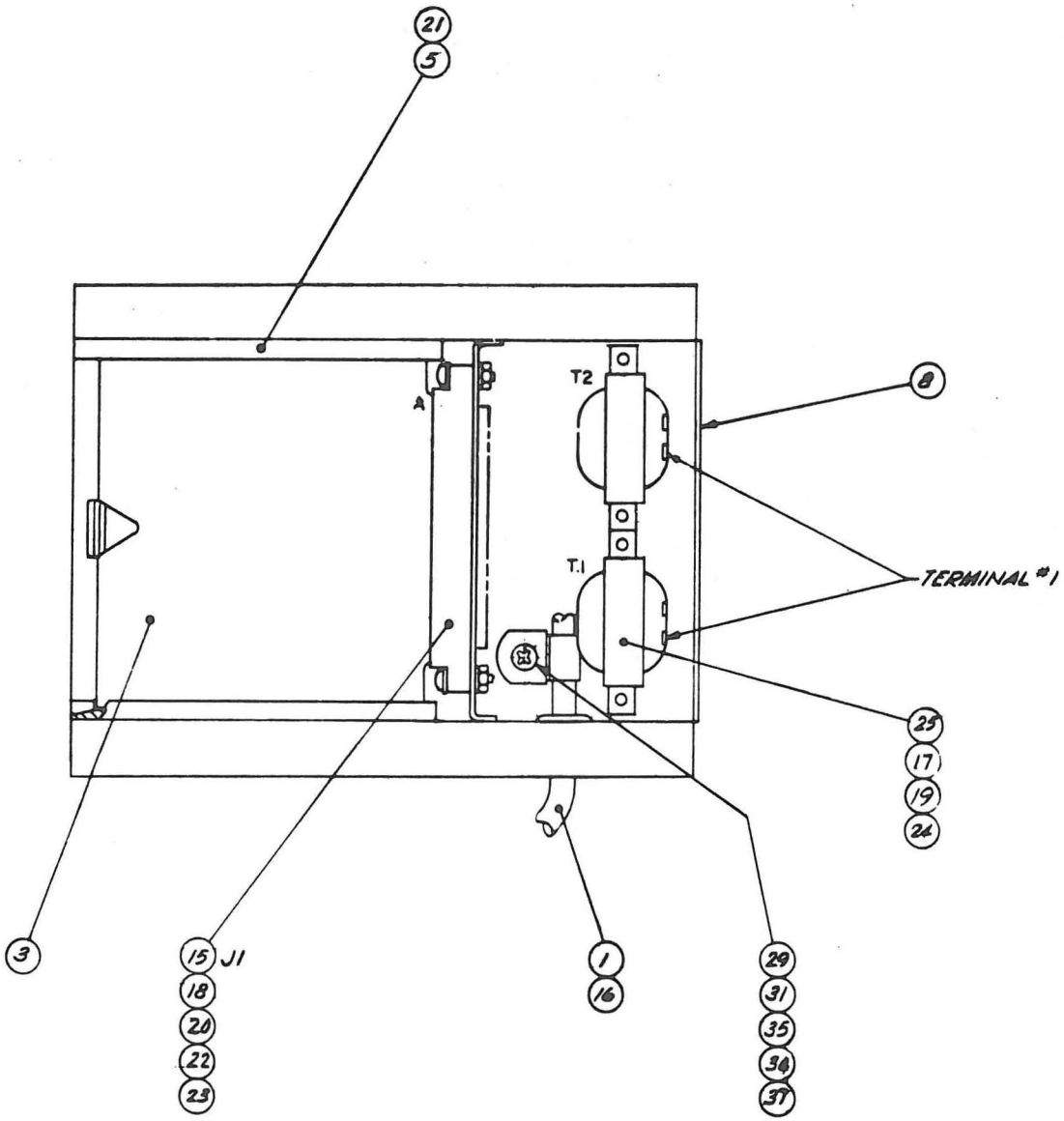
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4020379-02		FAN ASSEMBLY (NHA 4010210)	
1	4290897-01		PANEL, FAN	
3	591-053	B1-3	FAN, ROTRON WHISPER	
5	591-207		GUARD, FAN	
6	180-142		JUMPER	
8	180-816		MARKER, STRIP	
9	180-970	TB6	STRIP, TERM	
10	171-001		LUG, TERM	
11	471-073		SCREW, PAN HD, NO. 6-32 X 0.750 LG	
12	471-072		SCREW, PAN HD, NO. 6-32 X 0.625 LG	
15	496-005		NUT, KEP, NO. 6	
17	501-009		WASHER, FLAT, NO. 6	
18	492-034		NUT, HEX, NO. 6-32, SMALL PATTERN	
19	501-188		WASHER, FLAT, NO. 6 SMALL PATTERN	
20	502-003		WASHER, LOCK, SPRING, NO. 6	
21	591-140		CORD SET	
				E

SHEET 1 OF 1

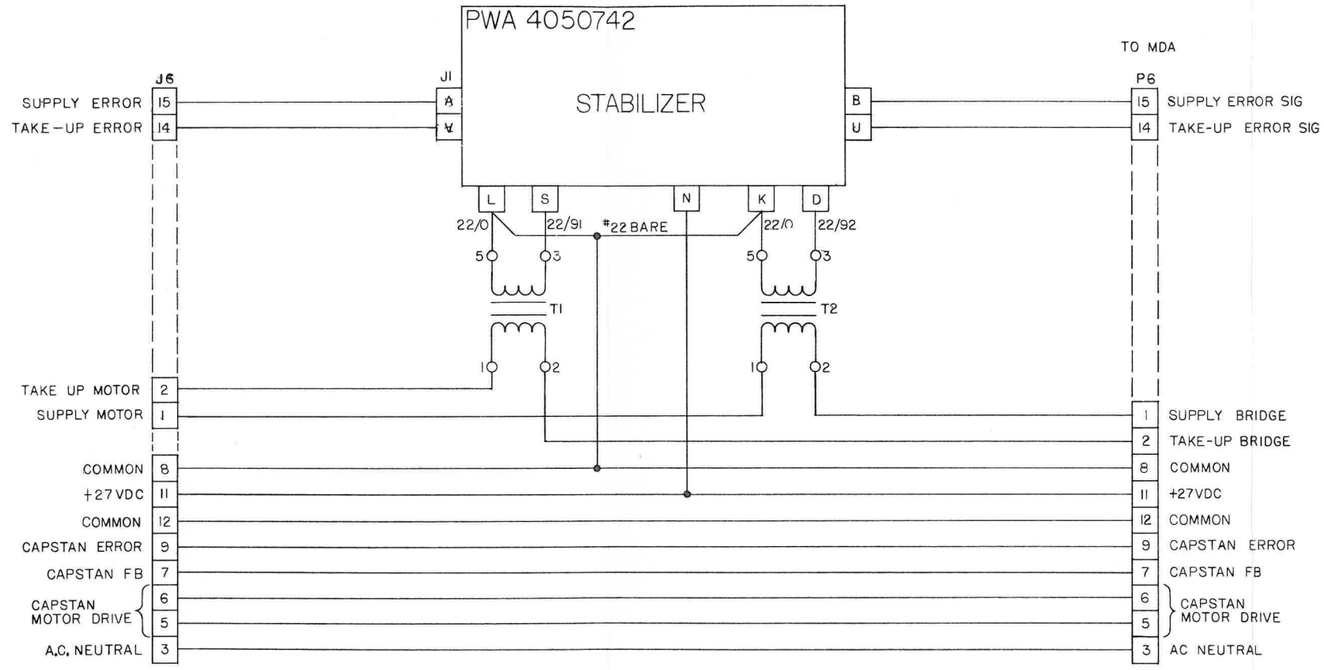


ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4020389-01		STABILIZER UNIT (NHA 4010210)	
1	4050741-01		STABILIZER UNIT CABLE ASSEMBLY	
3	4050742-01		STABILIZER PWA	
5	4230133-02		GUIDE, PWB	
8	4290719-01		CHASSIS	
11	4840331		SCHEMATIC	
15	146-986	J1	CONNECTOR, SINGLE CIRCUIT, PC, 18 CONT	
16	260-005		GROMMET, NEOPRENE, 0.312 ID	
17	471-069		SCREW, MACH, PAN HD, NO. 6-32 X 0.375 LG	
18	471-065		SCREW, MACH, PAN HD, NO. 4-40 X 0.62 LG	
19	497-032		NUT, SPRING CLIP "U", NO. 6-32	
20	492-008		NUT, PLAIN, HEX, NO. 4-40	
21	498-445		NUT, SPRING, 0.125 DIA	
22	501-008		WASHER, FLAT, NO. 4	
23	502-002		WASHER, LOCK, NO. 4	
24	502-025		WASHER, LOCK, NO. 6, IT	
25	560-409	T1,2	TRANSFORMER	
29	302-036		CLAMP, CABLE, NYLON, 0.312 ID, YEL	
31	506-013		WASHER, "D"	
35	471-070		SCREW, PAN HD, XREC, NO. 6-32 X 0.437 LG	
36	496-005		NUT, KEP, NO. 6-32	
37	501-009		WASHER, FLAT, NO. 6	

SHEET 1 OF 1



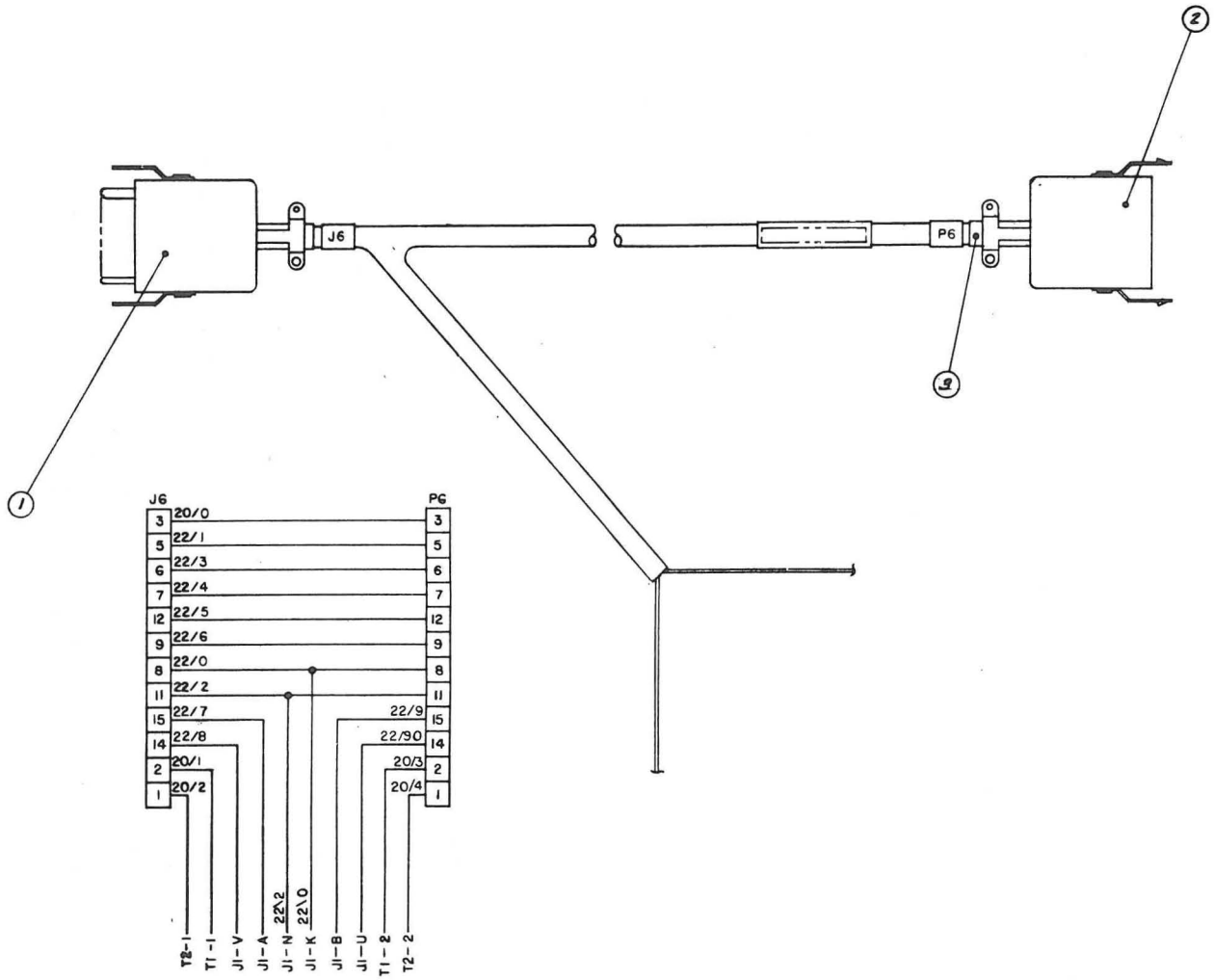
Assembly No. 4020389. Stabilizer Unit



Schematic No. 4840331.
Stabilizer Unit

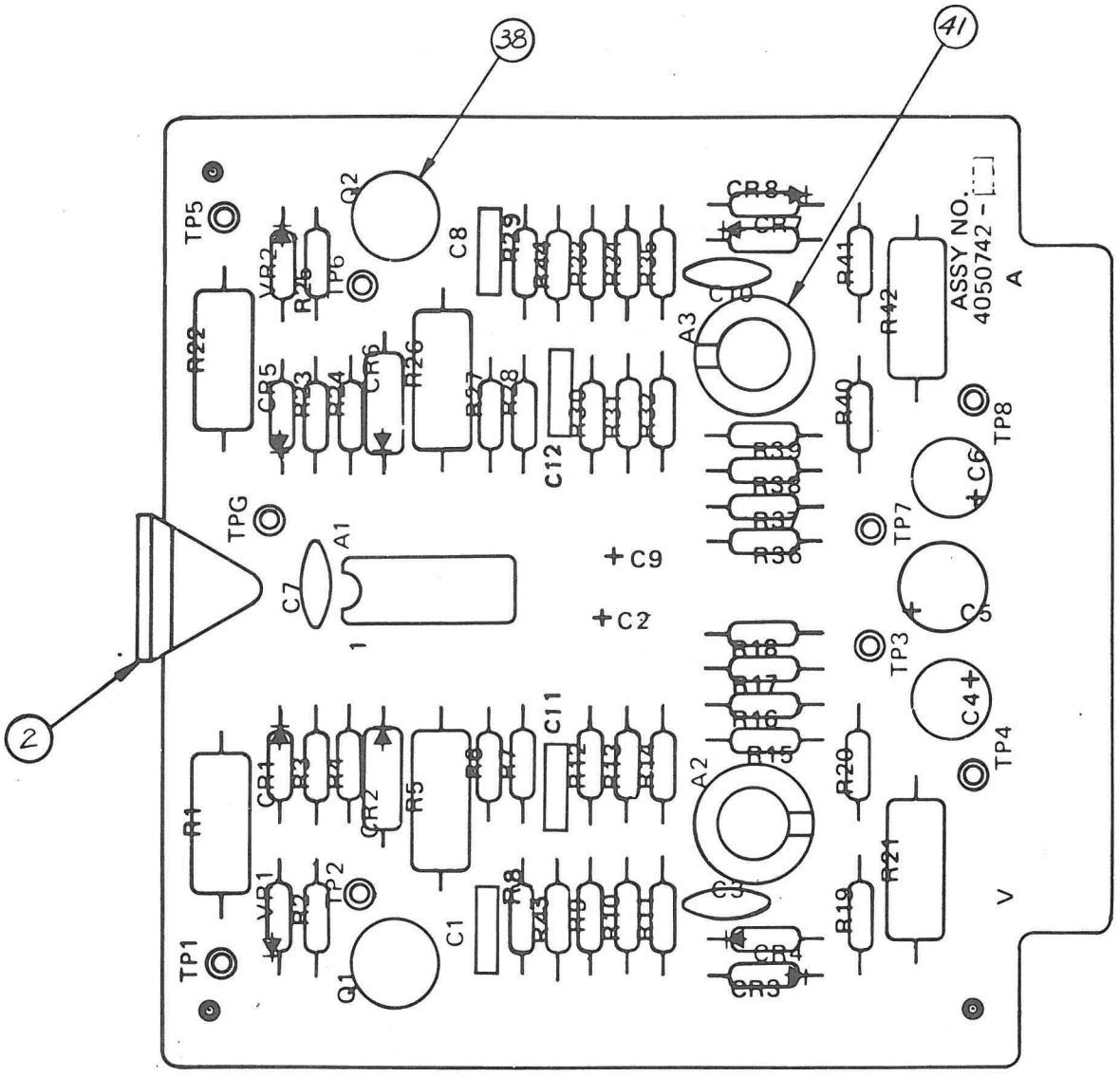
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050741-01		STABILIZER CABLE ASSEMBLY (NHA 4020389)	
1	139-736	J6	CONNECTOR, SIGNAL CIRCUIT, PLUG, 15 PIN	
2	144-030	P6	CONNECTOR, SIGNAL CIRCUIT,PLUG, 15 SOC	
3	262-005		BUSHING, SLEEVE	

SHEET 1 OF 1

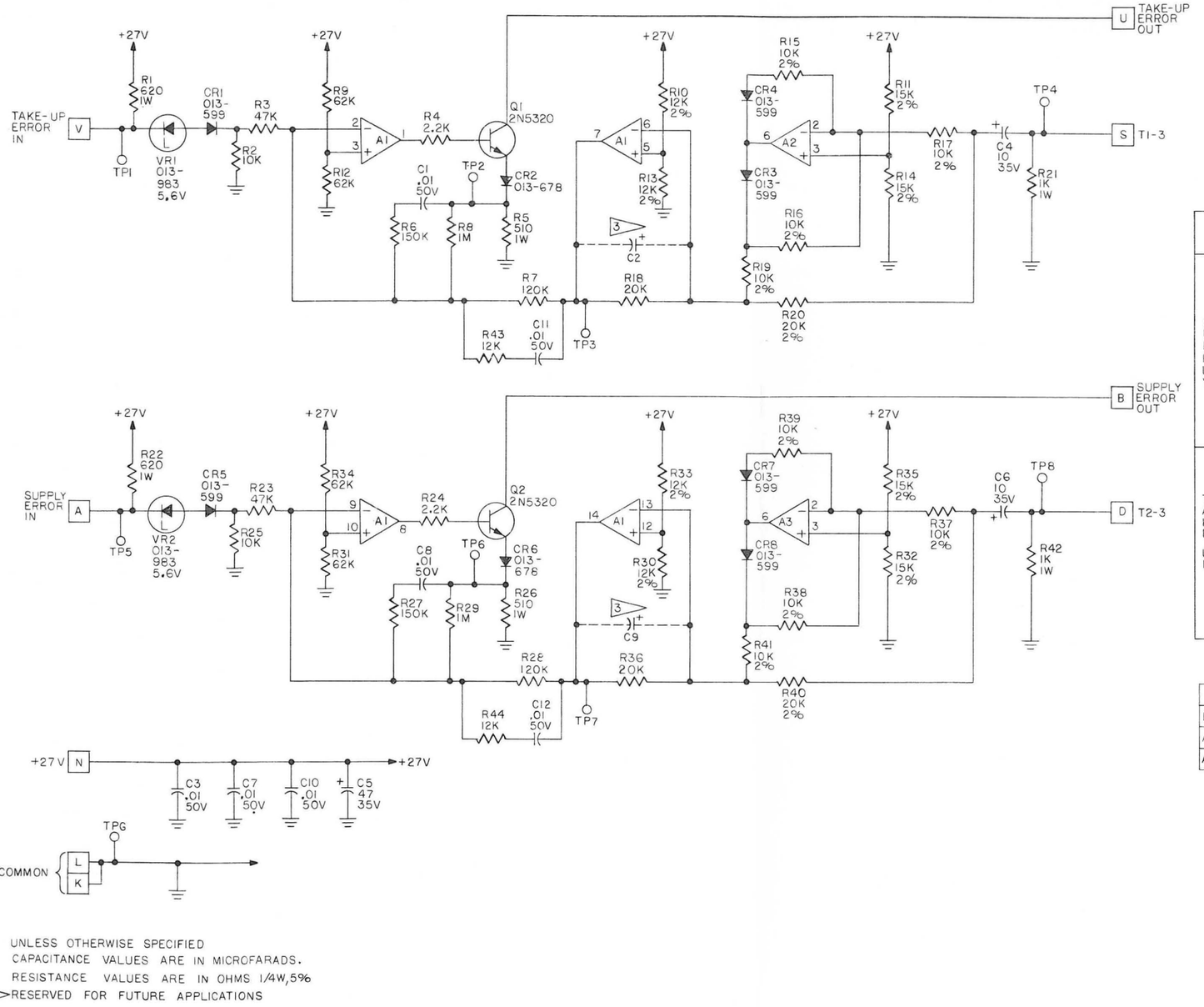


ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050742-01		STABILIZER PWA (NHA 4020389)	
2	52528-01		HANDLE, SNAP ON	
3	4840326		SCHEMATIC, PWA, STABILIZER	
4	013-599	CR1,3-5,7,8	DIODE	1N914
5	013-678	CR2,6	DIODE	1N4385
6	013-983	VR1,2	DIODE, ZENER	1N752A
9	580-167	Q1,2	TRANSISTOR	2N5320
12	030-448	C3,7,10	CAPACITOR, CER, 0.01 UF, 50V, -20 +80%	
14	035-734	C1,8,11,12	CAPACITOR, MYLAR, 0.01 UF, 50V, 5%	
16	037-933	C4,6	CAPACITOR, TANT, 10 UF, 35V, 20%	
17	037-940	C5	CAPACITOR, TANT, 47 UF, 35V, 20%	
20	041-101	R1,22	RESISTOR, COMP, 620 OHM, 1W, 5%	
21	041-102	R21,42	RESISTOR, COMP, 1K, 1W, 5%	
22	041-393	R8,29	RESISTOR, COMP, 1M, 1/4W, 5%	
23	041-408	R2,25	RESISTOR, COMP, 10K, 1/4W, 5%	
24	041-411	R3,23	RESISTOR, COMP, 47K, 1/4W, 5%	
25	041-414	R4,24	RESISTOR, COMP, 2.2K, 1/4W, 5%	
26	041-431	R6,27	RESISTOR, COMP, 150K, 1/4W, 5%	
27	041-484	R7,28	RESISTOR, COMP, 120K, 1/4W, 5%	
28	041-500	R5,26	RESISTOR, COMP, 510 OHM, 1W, 5%	
29	041-508	R18,36	RESISTOR, COMP, 20K, 1/4W, 5%	
30	041-753	R9,12,31,34	RESISTOR, COMP, 62K, 1/4W, 5%	
31	041-482	R43,44	RESISTOR, COMP, 12K, 1/4W, 5%	
33	057-120	R15-17,19,37-39, 41	RESISTOR, MF, 10K, 1/4W, 2%	
34	057-122	R10,13,30,33	RESISTOR, MF, 12K, 1/4W, 2%	
35	057-124	R11,14,32,35	RESISTOR, MF, 15K, 1/4W, 2%	
36	057-127	R20,40	RESISTOR, MF, 20K, 1/4W, 2%	
38	280-998		PAD, MTG, XSTR, T0-5	
41	280-173		SPACER, INT, CIRCUIT, 8 PIN	
44	586-269	A2,3	INTEGRATED CIRCUIT	741
45	587-458	A1	INTEGRATED CIRCUIT	LM324

SHEET 1 OF 1



Assembly No. 4050742. Stabilizer PWA



NOTES: UNLESS OTHERWISE SPECIFIED
1. CAPACITANCE VALUES ARE IN MICROFARADS.
2. RESISTANCE VALUES ARE IN OHMS 1/4W,5%
3. RESERVED FOR FUTURE APPLICATIONS

TABLE I
TYPICAL VOLTAGE READINGS AND WAVEFORMS AT TEST POINTS

	TP#	WAVEFORM	TRANSPORT MODE			
			STOP	PLAY	FAST FWD	FAST RWD
SUPPLY	5	DC	+20V	+20V	+20V	+25V
	6	P, 0, 120Hz	P=+3V	P=+3V	RANDUM IN TRANSIT UP TO+4VDC AT FULL SPEED P=+2~+3V	OV DC, OR SHORT AND NARROW PULSE MAY APPEAR
	7	P, V, 120Hz, 0	V=+14V P=5V	V=+14V P=5V	V=+14V P=5V	V=+14V P=12V
	8	0, P, 60Hz	P=10V	P=8V	P≒0 IN TRANSIT P=4~5V MAX AT FULL SPEED	P=20V (SINE WAVE)
TAKE UP	1	DC	+20V	+20V	+25V	+20V
	2	P, 0, 120Hz	P=+3V	P=+3V	OV DC, OR SHORT AND NARROW PULSE MAY APPEAR	RANDUM IN TRANSIT UP TO ABOUT +15V AT FULL SPEED P=+3V
	3	P, V, 120Hz, 0	V=+14V P=6V	V=+14V P=6V	V=+14V P=12V	V=+14V P=6V
	4	0, P, 60Hz	P=12V	P=12V	P=20V (SINE WAVE)	P≒0 IN TRANSIT P=ICV MAX AT FULL SPEED

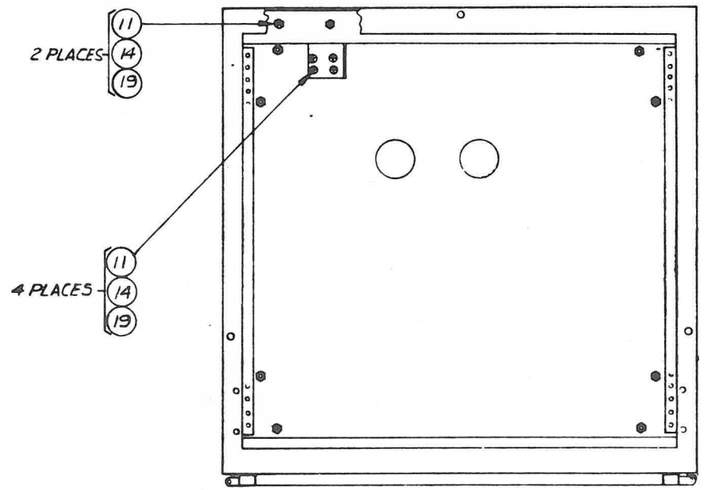
INTEGRATED CIRCUIT LIST				
REFERENCE DESIGNATION	AMPEX P/N	VENDOR P/N	VOLTAGE PIN	GROUND PIN
A1	587-458	LM324N	4	11
A2,3	586-269	741	7	4

Schematic No. 4840326.
Stabilizer PWA

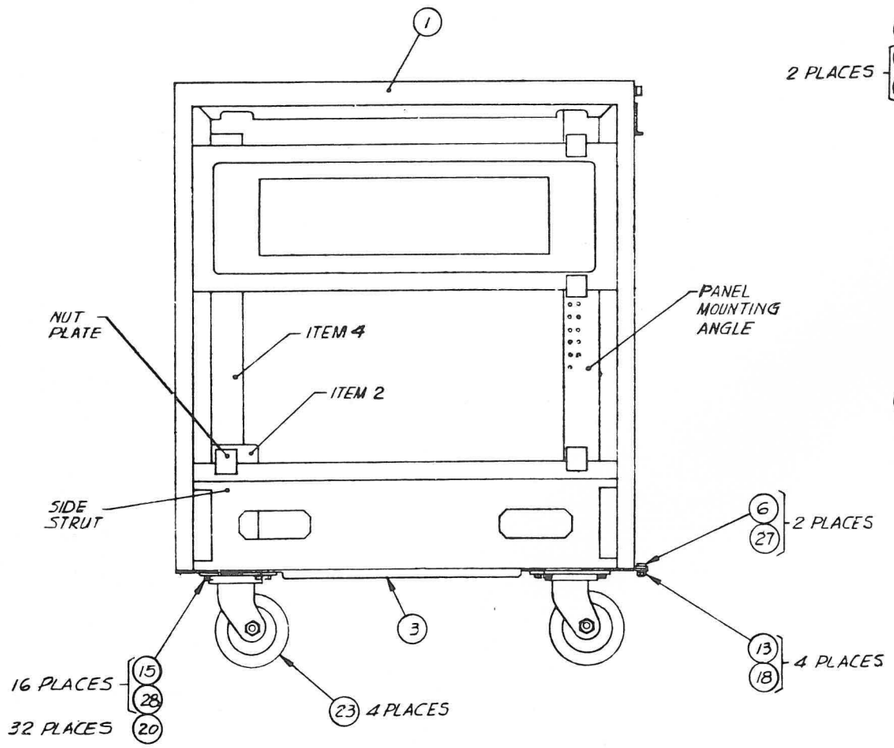
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4030383-02		FRAME ASSEMBLY (NHA 4010210)	
1	4150349-04		FRAME MODIFICATION	
2	4290881-02		PANEL, CONNECTOR	
3	4290805-01		PANEL, BOTTOM	
4	4260505-01		MOUNTING, ANGLE, REAR	
6	4330321-01		PLATE, DOOR HINGE	
7	4120072-01		CATCH	
9	4260513-01		BRACKET, DOOR HINGE	
10	4260513-02		BRACKET, DOOR HINGE	
11	470-036		SCREW CAP, HEX SOC HD, NO. 10–32 X 3/8	
13	496-005		NUT, KEP, NO. 6–32	
14	496-007		NUT, KEP, NO. 10–32	
15	496-009		NUT, KEP, NO. 1/4–20	
17	497-190		NUT, SPRING, NO. 10–32	
18	501-009		WASHER, NO. 6	
19	501-011		WASHER, NO. 10	
20	501-012		WASHER, NO. 1/4–20	
23	082-050		CASTER, SWIVEL	
27	422-016		BEARING, NYLON	
28	480-096		SCREW, BOLT, HEX HD, NO. 1/4–20 X 3/4 LG	
33	4220121-01		SPACER, MODIFIED	
35	471-093		SCREW, PAN HD, XREC, NO. 10–32 X 1 IN LG	
36	496-007		NUT, KEP	

D

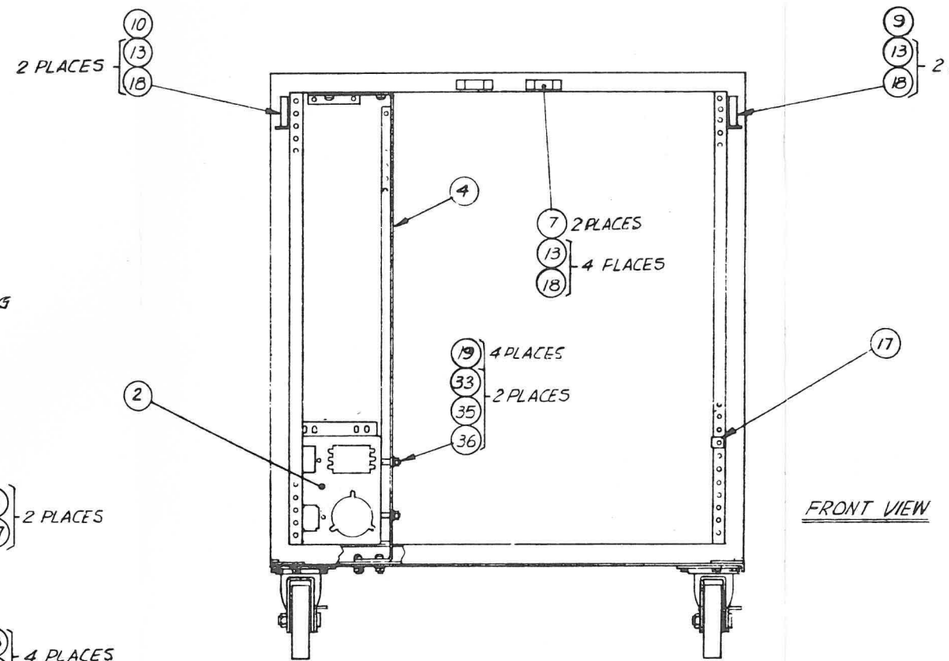
SHEET 1 OF 1



TOP VIEW
(ITEM 2 REMOVED FOR CLARITY)



SIDE VIEW



FRONT VIEW

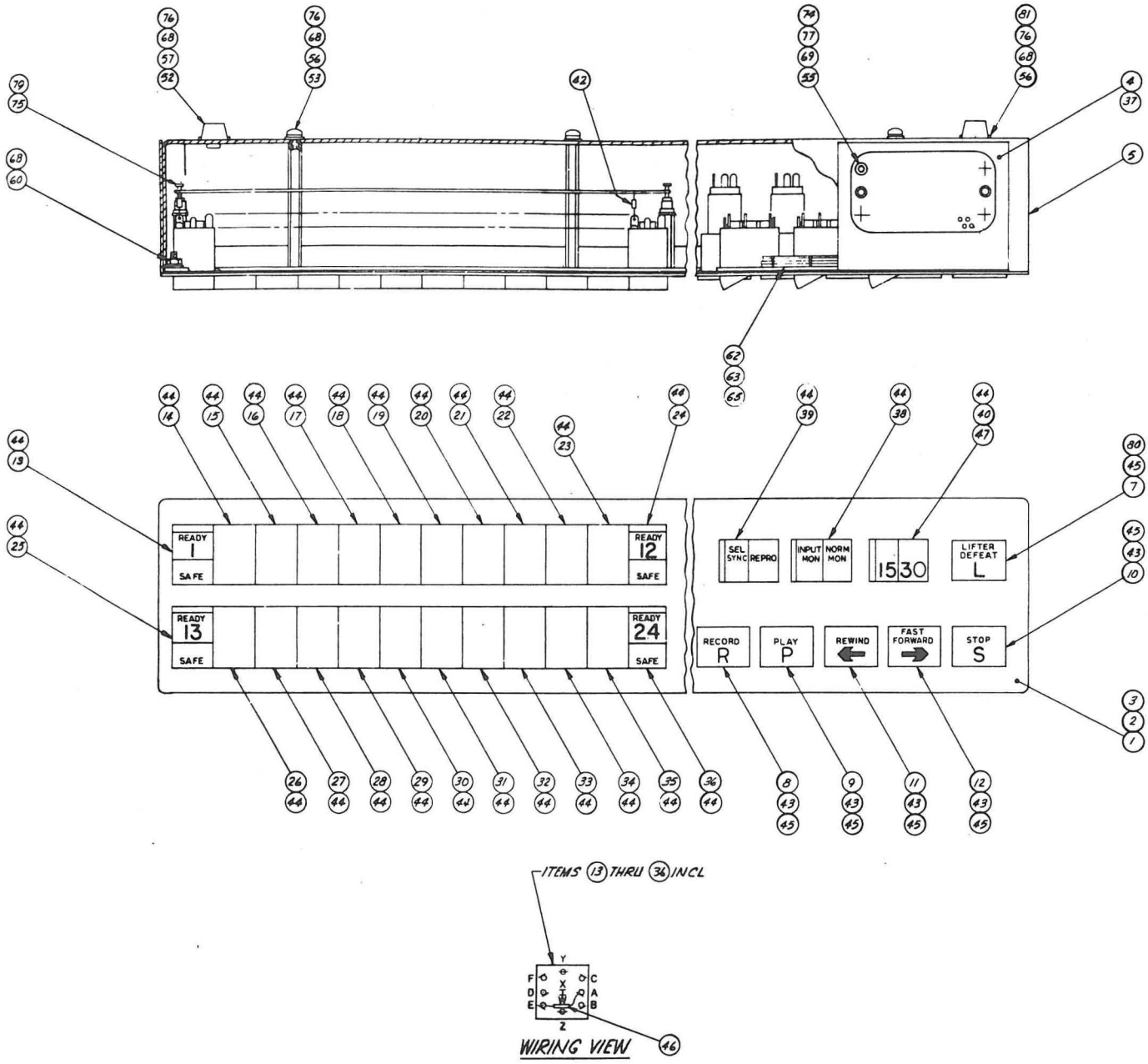
Assembly No. 4030383.
Frame Assembly

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050646-20		CONTROL BOX ASSEMBLY, 8 CHANNEL, 15–30 IPS (NHA 4010210)	
	4050646-21		CONTROL BOX ASSEMBLY, 16 CHANNEL, 15–30 IPS (NHA 4010210)	
	4050646-22		CONTROL BOX ASSEMBLY, 24 CHANNEL, 15–30 IPS (NHA 4010210)	
	4050646-24		CONTROL BOX ASSEMBLY, 8 CHANNEL, 7.5–15 IPS (NHA 4010210)	
	4050646-25		CONTROL BOX ASSEMBLY, 16 CHANNEL, 7.5–15 IPS (NHA 4010210)	
	4050646-26		CONTROL BOX ASSEMBLY, 24 CHANNEL, 7.5–15 IPS (NHA 4010210)	
1	4110284-09		OVERLAY, CONTROL PANEL, 8 CHANNEL	
2	4110284-10		OVERLAY, CONTROL PANEL, 16 CHANNEL	
3	4110284-11		OVERLAY, CONTROL PANEL, 24 CHANNEL	
4	4290821-12		SUBPANEL, CONTROL BOX, 24 CHANNEL	
5	4330308-03		BASE, CONTROL BOX	
7	4620081-01		BUTTON, "LIFTER DEFEAT"	
8	4620081-07		BUTTON, "RECORD", RED	
9	4620081-03		BUTTON, "PLAY", GREEN	
10	4620081-04		BUTTON, "STOP", YELLOW	
11	4620081-05		BUTTON, "REWIND"	
12	4620081-06		BUTTON, "FAST FORWARD"	
13	4620082-01		SWITCH, ROCKER, SAFE/READY, NO. 1	
14	4620082-02		SWITCH, ROCKER, SAFE/READY, NO. 2	
15	4620082-03		SWITCH, ROCKER, SAFE/READY, NO. 3	
16	4620082-04		SWITCH, ROCKER, SAFE/READY, NO. 4	
17	4620082-05		SWITCH, ROCKER, SAFE/READY, NO. 5	
18	4620082-06		SWITCH, ROCKER, SAFE/READY, NO. 6	
19	4620082-07		SWITCH, ROCKER, SAFE/READY, NO. 7	
20	4620082-08		SWITCH, ROCKER, SAFE/READY, NO. 8	
21	4620082-09		SWITCH, ROCKER, SAFE/READY, NO. 9, 16–24 CHAN	
22	4620082-10		SWITCH, ROCKER, SAFE/READY, NO. 10, 16–24 CHAN	
23	4620082-11		SWITCH, ROCKER, SAFE/READY, NO. 11, 16–24 CHAN	
24	4620082-12		SWITCH, ROCKER, SAFE/READY, NO. 12, 16–24 CHAN	
25	4620082-13		SWITCH, ROCKER, SAFE/READY, NO. 13, 16–24 CHAN	
26	4620082-14		SWITCH, ROCKER, SAFE/READY, NO. 14, 16–24 CHAN	
27	4620082-15		SWITCH, ROCKER, SAFE/READY, NO. 15, 16–24 CHAN	
28	4620082-16		SWITCH, ROCKER, SAFE/READY, NO. 16, 16–24 CHAN	
29	4620082-17		SWITCH, ROCKER, SAFE/READY, NO. 17, 24 CHAN	
30	4620082-18		SWITCH, ROCKER, SAFE/READY, NO. 18, 24 CHAN	
31	4620082-19		SWITCH, ROCKER, SAFE/READY, NO. 19, 24 CHAN	
32	4620082-20		SWITCH, ROCKER, SAFE/READY, NO. 20, 24 CHAN	
33	4620082-21		SWITCH, ROCKER, SAFE/READY, NO. 21, 24 CHAN	
34	4620082-22		SWITCH, ROCKER, SAFE/READY, NO. 22, 24 CHAN	
35	4620082-23		SWITCH, ROCKER, SAFE/READY, NO. 23, 24 CHAN	
36	4620082-24		SWITCH, ROCKER, SAFE/READY, NO. 24, 24 CHAN	
				P

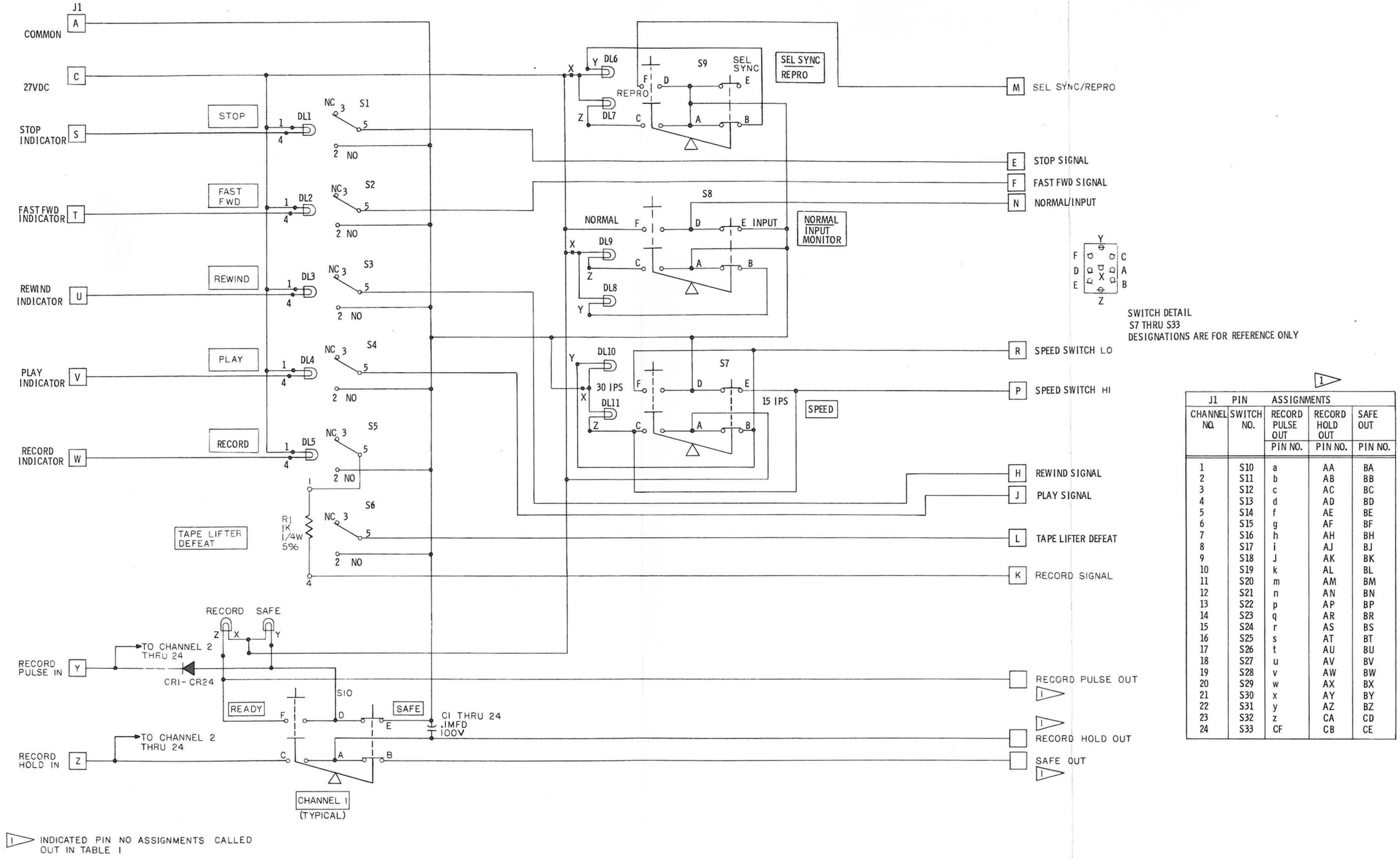
ASSEMBLY NO. 4050646 TITLE CONTROL BOX ASSEMBLY

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
37	4290821-11		SUBPANEL, CONTROL BOX, 8–16 CHAN	
38	4620083-01	S8	SWITCH, ROCKER, MONITOR NORMAL/INPUT, YEL-GRN	
39	4620083-02	S9	SWITCH, ROCKER, "REPRO-SELSYNC", YEL-GRN	
40	4620083-03	S7	SWITCH, ROCKER, "SPEED 30–15", GRN-RED, 15–30 IPS	
41	4840347		SCHEMATIC, CONTROL BOX	
42	013-678		DIODE, SILICON, SM SIG	1N4385
43	060-373		LAMP, INCAND, 28V	
44	060-471		LAMP, INCAND, 28V	
45	119-188		SWITCH, PB, MOMENTARY	
46	030-963		CAPACITOR, CER, RECT, 0.1 MFD, 100V, 10%	
47	4620083-04		SWITCH, ROCKER, "SPEED 7.5–15" GRN-RED, 7.5–15 IPS	
52	250-165		BUMPER, RUBBER	
53	280-716		SPACER, THREADED, NO. 4–40 X 2.25 LG	
55	470-018		SCREW, CAP, HEX SOC, NO. 6–32 X 0.375 LG	
56	471-061		SCREW, MACH, PAN HD, NO. 4–40 X 5/16 LG	
57	471-064		SCREW, MACH, PAN HD, NO. 4–40 X 1/2 LG	
60	496-004		NUT, KEP, NO. 4–40	
62	4050703-01		HARNESS ASSY, CONT BOX, 8 CHAN	
63	4050703-02		HARNESS ASSY, CONT BOX, 16 CHAN	
65	4050703-03		HARNESS ASSY, CONT BOX, 24 CHAN	
68	501-169		WASHER, FLAT, 0.125 ID X 0.250 OD	
69	501-188		WASHER, FLAT, 0.143 ID X 0.267 OD	
74	502-025		WASHER, LOCK, NO. 6	
75	280-829		SPACER, PLAIN, NO. 4–40 X 0.937 LG	
76	501-002		WASHER, LOCK, NO. 4	
77	492-034		NUT, NO. 6–32	
79	473-646		STUD, TERM, NO. 4–40, EXT THD	
80	041-410		RESISTOR, 1K, 1/4W, 5%	
81	310-740		CATCH ASSY	

P



Assembly No. 4050646. Control Box Assembly



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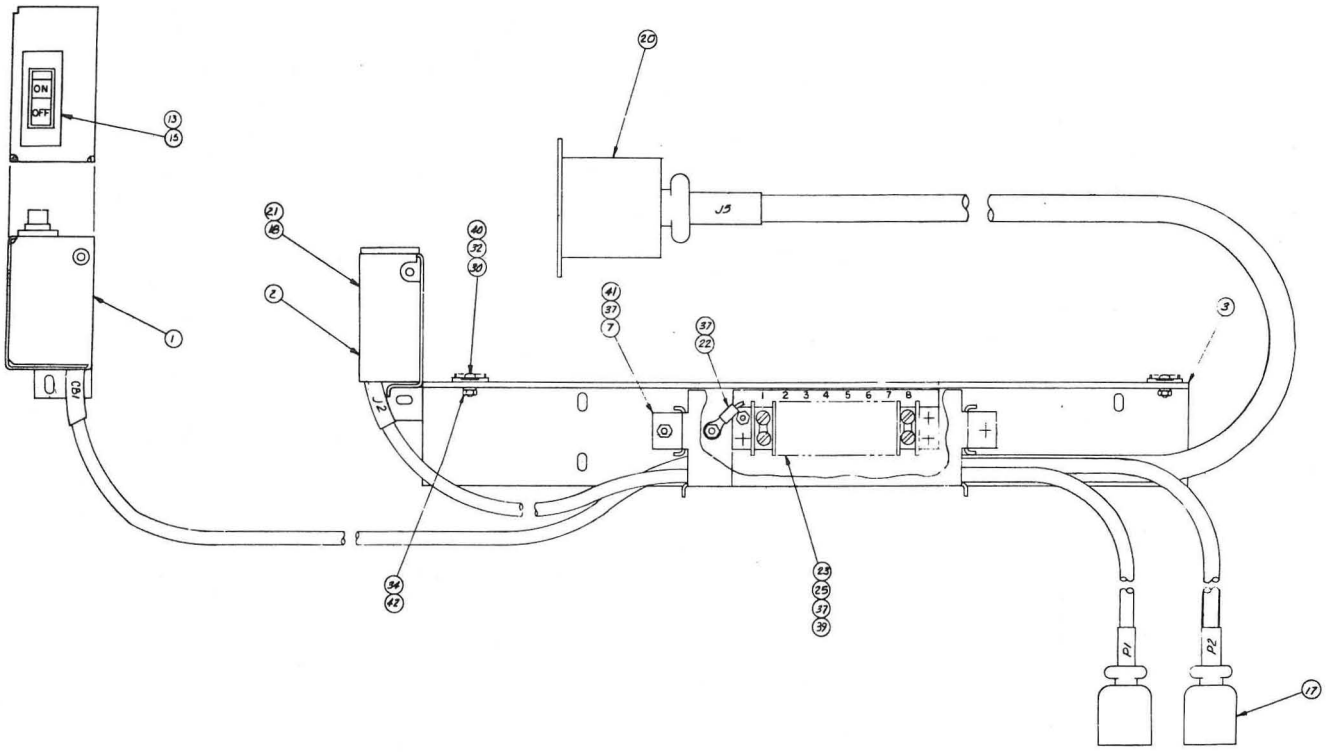
J1 PIN ASSIGNMENTS				
CHANNEL NO.	SWITCH NO.	RECORD PULSE OUT PIN NO.	RECORD HOLD OUT PIN NO.	SAFE OUT PIN NO.
1	S10	a	AA	BA
2	S11	b	AB	BB
3	S12	c	AC	BC
4	S13	d	AD	BD
5	S14	f	AE	BE
6	S15	g	AF	BF
7	S16	h	AH	BH
8	S17	i	AJ	BJ
9	S18	J	AK	BK
10	S19	k	AL	BL
11	S20	m	AM	BM
12	S21	n	AN	BN
13	S22	p	AP	BP
14	S23	q	AR	BR
15	S24	r	AS	BS
16	S25	s	AT	BT
17	S26	t	AU	BU
18	S27	u	AV	BV
19	S28	v	AW	BW
20	S29	w	AX	BX
21	S30	x	AY	BY
22	S31	y	AZ	BZ
23	S32	z	CA	CD
24	S33	CF	CB	CE

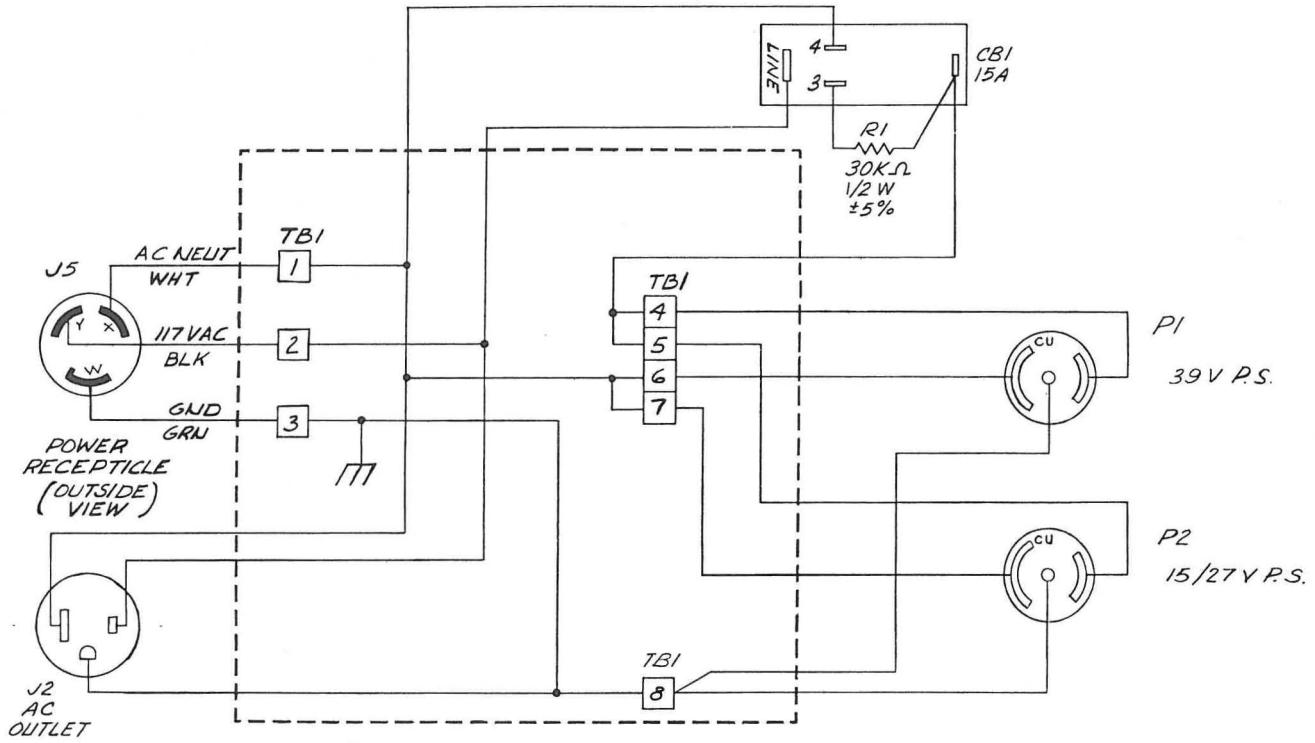
Schematic No. 4840347.
Control Box Assembly

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050647-03		CIRCUIT BREAKER ASSEMBLY (NHA 4010210)	
1	4260419-01		BRACKET, CIRCUIT BREAKER	
2	4260425-01		BRACKET, AC OUTPUT	
3	4260487-03		ANGLE, CONTROL BOX	
7	4290906-01		COVER, TERM BLOCK	
13	041-535	R1	RESISTOR, COMP, 30K, 1/2W, ±5%	
15	126-257	CB1	CIRCUIT BREAKER, 15 AMP	
17	144-093	P1,2	CONNECTOR, PLUG, AC POWER	
18	145-590	J2	CONNECTOR, RECP, AC POWER CONVENIENCE	
20	147-995		CONNECTOR, RECP, AC POWER	
21	171-009		TERMINAL, KNIFE DISC	
22	171-044		LUG, TERM, CRIMP, RING TONGUE	
23	180-005		STRIP, TERM, 8 DUAL TERM	
25	180-072		MARKER, STRIP	
30	310-740		CATCH ASSY	
32	471-062		SCREW, PAN HD, NO. 4–40 X 3/8 LG	
34	492-008		NUT, HEX, NO. 4	
37	496-005		NUT, KEP, NO. 6	
39	501-062		WASHER, NO. 6	
40	501-008		WASHER, FLAT, NO. 4	
41	501-009		WASHER, NO. 6	
42	502-002		WASHER, LOCK, SPRING, NO. 4	
45	600-007		SLEEVING, PVC, FLEXIBLE, 0.265 ID BLK	
46	600-054		SLEEVING, PVC, FLEX, 0.208 ID, BLK	
47	600-056		SLEEVING, PVC, FLEXIBLE, 0.625 ID BLK	
48	616-028		CABLE, JACKETED, 3 COND, 18 AWG	
49	616-032		CABLE, JACKETED 3 COND, 14 AWG	
51	619-986		WIRE, HOOKUP, 18 AWG, WHT	
52	619-995		WIRE, HOOKUP, 18 AWG, BLK	
53	600-092		SLEEVING, SHRINKABLE, BLK, 0.250 ID	
54	600-094		SLEEVING, SHRINKABLE, BLK, 0.375 ID	
55	600-095		SLEEVING, SHRINKABLE, BLK, 0.500 ID	
82	4840343		SCHEMATIC, CIRCUIT BREAKER	
				J

SHEET 1 OF 1



Assembly No. 4050647. Circuit Breaker Assembly



Schematic No. 4840343. Circuit Breaker Assembly

A

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050658-07		POWER SUPPLY ASSEMBLY, 39V (NHA 4010210)	
	4050658-08		POWER SUPPLY ASSEMBLY, 15/27V (NHA 4010210)	
1	4290894-01		HEATSINK, XSTR	
2	4920818-02		CHASSIS, POWER SUPPLY	
6	4580214-01	T1	TRANSFORMER, POWER	
7	4840299		SCHEMATIC, 39V POWER SUPPLY	
8	4840342		SCHEMATIC, 15/27V POWER SUPPLY	
10	4290924-01		SHIELD, POWER SUPPLY	
11	014-614	Q4	TRANSISTOR, POWER, 15/27V	2N3715
12	014-035	Q1,2	TRANSISTOR, POWER	2N3773
13	014-833		TRANSISTOR, MTG KIT, T0-66	
14	501-006		WASHER, PLAIN, NO. 10	
17	031-411	C3	CAPACITOR, AL, 500 UF, 25V, U/O 15/27V	
18	470-096		SCREW, CAP, HEX SOC, NO. 1/4-20 X 0.62 LG	
19	047-748	R1,2	RESISTOR, WW, 0.25 OHM, 25W, 3%	
21	063-182	C1	CAPACITOR, AL, 10K UF, 75V	
22	063-183	C2	CAPACITOR, AL, 1400 UF, 75V	
23	501-110		WASHER, PLAIN, NO. 4	
24	070-020	F1	FUSE, 5A, SLO BLO	
25	070-054	F2	FUSE, 10A, FAST BLO	
26	085-001		HOLDER, FUSE	
28	143-307	J5	CONNECTOR, PC RECP, 18 CONTACTS	
29	146-018	J3,4	CONNECTOR, RECT RECP, 10 SOC	
30	147-079	J1,2	CONNECTOR, TWIST-LOCK, POWER, 3 MALE CONTACTS	
31	171-016		LUG, NO. 10	
32	150-142		KIT, MTG, XSTR, T0-3	
35	171-044		LUG, TERM, CRIMP, RING TONGUE, NO. 6	
37	173-492		TERMINAL, QIK DISC	
38	260-039		GROMMET, 3/8 ID	
39	260-052		GROMMET, CATERPILLAR	
40	171-007		LUG, RING, NO. 10	
41	302-062		CLAMP, CRADLE, U-SHAPE, 1.662 ID, NYLON, U/O 15/27V	
45	471-061		SCREW, PAN HD, NO. 4-40 X 5/16 LG	
46	471-062		SCREW, PAN HD, NO. 4-40 X 3/8 LG	
47	471-064		SCREW, PAN HD, NO. 4-40 X 1/2 LG	
48	471-067		SCREW, PAN HD, NO. 6-32 X 1/4 LG	
49	471-068		SCREW, PAN HD, NO. 6-32 X 5/16 LG	
50	471-073		SCREW, PAN HD, NO. 6-32 X 5/8 LG	
51	471-334		SCREW, FLAT HD, NO. 6-32 X 1/4 LG	
52	496-004		NUT, KEP, NO. 4-40	
53	037-152	C3	CAPACITOR, TANT, 82 UF, 50V, 20%, U/O 39V	
54	501-008		WASHER, FLAT, NO. 4	

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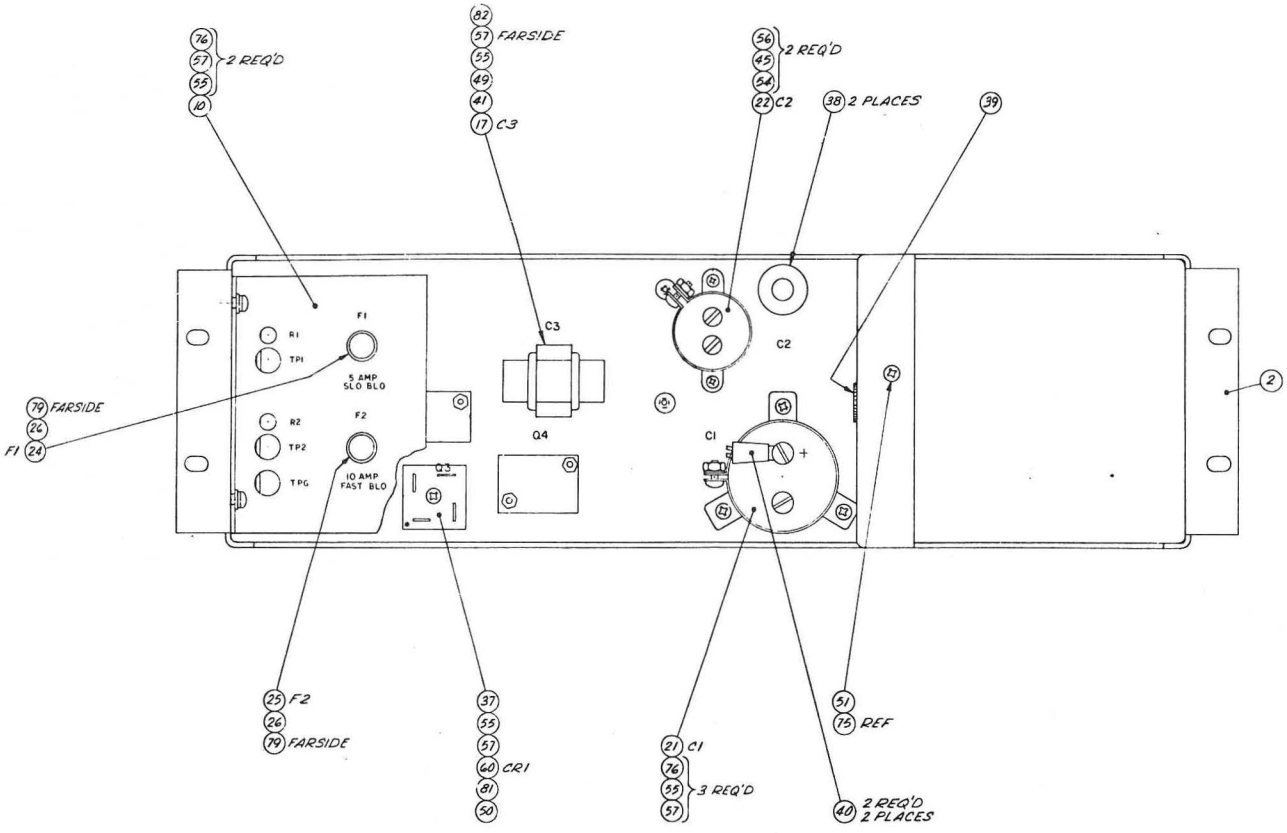
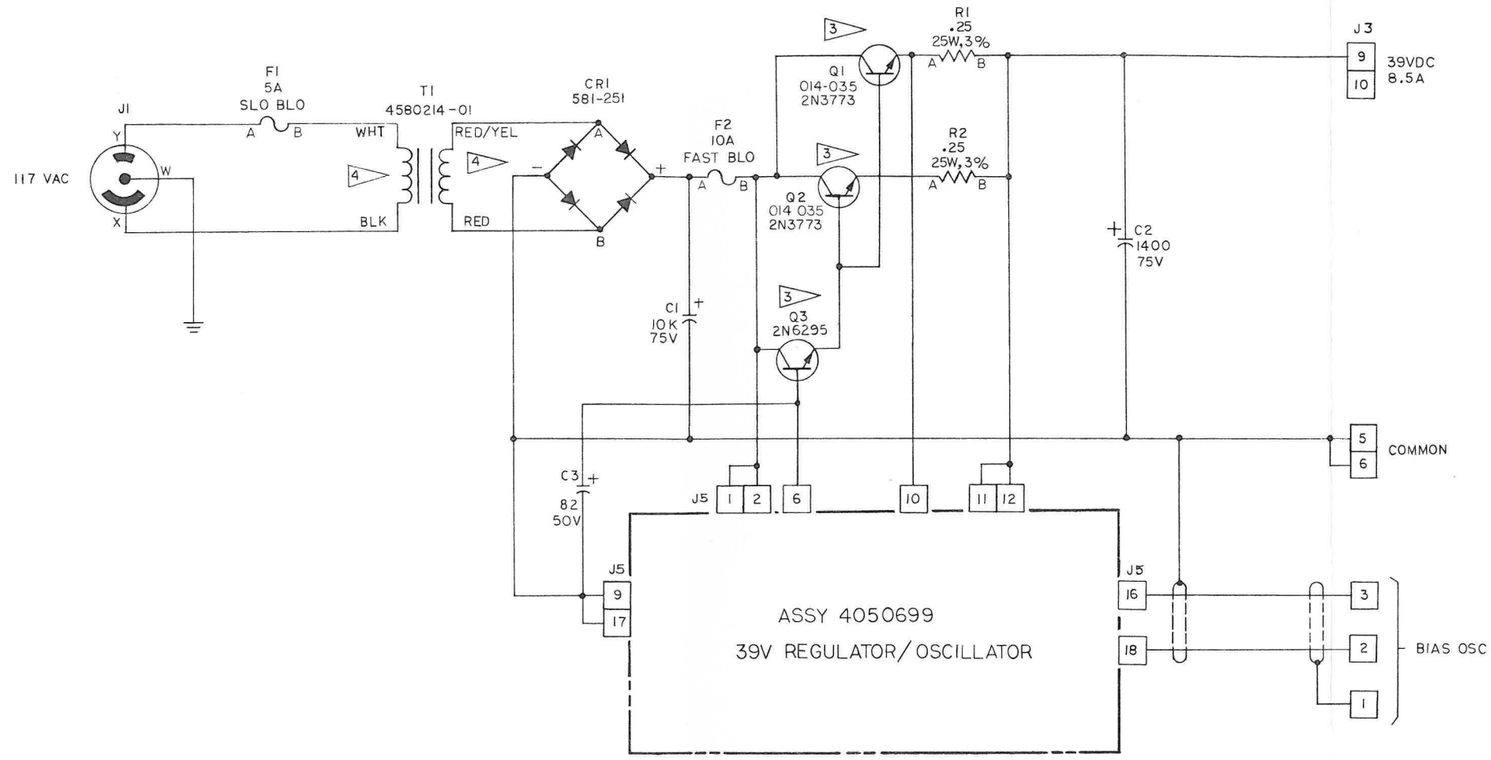
ASSEMBLY NO. 4050658 TITLE POWER SUPPLY ASSEMBLY

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
55	501-009		WASHER, FLAT, NO. 6	
56	502-002		WASHER, LOCK, SPLIT, NO. 4	
57	502-003		WASHER, LOCK, SPLIT, NO. 6	
58	580-639	Q3	TRANSISTOR, POWER	
60	581-251	CR1	DIODE ASSY, POWER	
62	471-063		SCREW, PAN HD, NO. 4-40 X 0.31 LG	
74	4290922-01		ENCLOSURE, TRANSFORMER	
75	4290923-01		COVER, TRANSFORMER	
76	471-069		SCREW, PAN HD, NO. 6-32 X 0.31 LG	
82	302-066		CLAMP, CRADLE, NYLON, U/O 15/27V	
83	4050699-09		REGULATOR PWA, 39V	
84	4050699-10		REGULATOR PWA, 15/27V	

L

SHEET 2 OF 2





NOTES: UNLESS OTHERWISE SPECIFIED

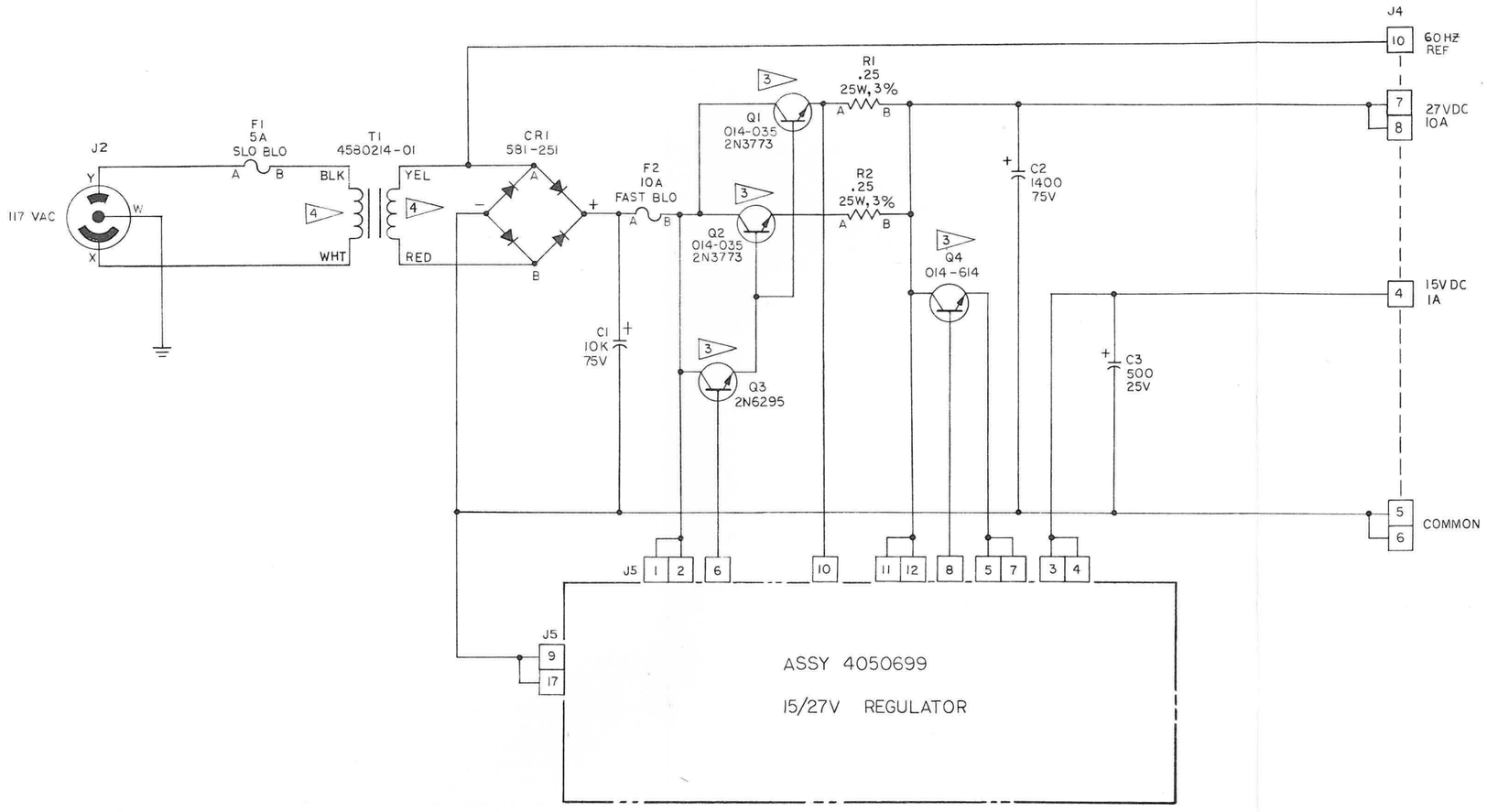
1. CAPACITANCE VALUES ARE IN MICROFARADS.
2. RESISTANCE VALUES ARE IN OHMS.
3. THIS TRANSISTOR TO HAVE HEAT SINK.
4. PRIMARY AND SECONDARY TRANSFORMER LEADS TO BE TWISTED TOGETHER TIGHTLY.

REFERENCE DESIGNATIONS	
LAST USED	NOT USED
C3 CR1 F2 J3 Q3 R2 T1	

TABLE I

PWA DASH NUMBER	SCHEMATIC ISSUE
4050658-03	"B"
4050658-05	"C"

Schematic No. 4840299.
Power Supply Assembly, 39V



NOTES UNLESS OTHERWISE SPECIFIED

1. CAPACITANCE VALUES ARE IN MICROFARADS.
2. RESISTANCE VALUES ARE IN OHMS.
3. THIS TRANSISTOR TO HAVE HEAT SINK.
4. PRIMARY AND SECONDARY TRANSFORMER LEADS TO BE TWISTED TOGETHER TIGHTLY.

REFERENCE DESIGNATIONS	
LAST USED	NOT USED
C3 CR1 F2 J3 Q4 R2 T1	

Schematic No. 4840342.
Power Supply Assembly, 15/27V

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050699-09		REGULATOR PWA, 39V (NHA 4050658)	
	4050699-10		REGULATOR PWA, 15/27V (NHA 4050658)	
2	4580123-01	T1	COIL, BIAS OSCILLATOR, U/O 39V	
4	4840337		SCHEMATIC, 39V	
5	4840339		SCHEMATIC, 15/27V	
7	52528-01		HANDLE, SNAP ON	
10	013-599	CR3,4	DIODE	1N914
11	013-678	CR1	DIODE, U/O 39V	1N4385
12	013-678	CR1,2	DIODE, U/O 15/27V	1N4385
13	013-747	VR6	DIODE, ZENER, 13V, 2W, U/O 39V	2EZ13.OD5
14	581-296	VR2	DIODE, ZENER, 43V, 1W, U/O 39V	1N4755A
15	013-911	VR2	DIODE, ZENER, 33V, 1W, U/O 15/27V	1N4752
16	013-370	VR4	DIODE, ZENER, 6.8V, 1W, U/O 15/27V	1N4736
17	581-197	VR1	DIODE, ZENER, 8.2V, 1W	1N4738
18	581-202	VR3	DIODE, ZENER, 9.1V, 1W	1N4739
19	581-203	VR5	DIODE, ZENER, 16V, 1W, U/O 15/27V	1N4745
20	580-616	Q8,9	TRANSISTOR	2N4036
22	014-247	Q1	TRANSISTOR	2N2219
23	014-555		HEATSINK, XSTR, T0-5	
24	014-590	Q4	TRANSISTOR, U/O 39V	2N3053
25	014-590	Q2,4	TRANSISTOR, U/O 15/27V	2N3053
26	014-653	Q6,7	TRANSISTOR, U/O 39V	2N3904
27	014-070		HEATSINK, XSTR, T0-5	
29	014-931	Q3	THYRISTOR, SCR	G106B2-GE
30	030-057	C2	CAPACITOR, CER, 0.01 UF, 50V, 20%, U/O 39V	
31	030-057	C2,3	CAPACITOR, CER, 0.01 UF, 50V, 20%, U/O 15/27V	
32	055-491	C8	CAPACITOR, CER, 0.1 UF, 50V, 10%, U/O 39V	
33	580-564	Q5	THYRISTOR, SCR	2N4442
34	034-507	C5,6	CAPACITOR, MICA, 5600 PF, 300V, 5%, U/O 39V	
35	034-994	C7	CAPACITOR, MICA, 2500 PF, 500V, 5%, U/O 39V	
37	037-363	C1	CAPACITOR, TANT, 330 UF, 6V, 10%,	
38	041-003	R12	RESISTOR, COMP, 100 OHM, 1/2W, 5%	
39	041-008	R3	RESISTOR, COMP, 1.5K, 1/2W, 5%, U/O 39V	
40	041-008	R3,15,16	RESISTOR, COMP, 1.5K, 1/2W, 5%, U/O 15/27V	
41	041-010	R7,11	RESISTOR, COMP, 2K, 1/2W, 5%	
42	041-016	R21,22	RESISTOR, COMP, 22K, 1/2W, 5%, U/O 39V	
43	041-135	R14	RESISTOR, COMP, 39 OHM, 1W, 10%, U/O 15/27V	
44	041-147	R23	RESISTOR, COMP, 1.2K, 1W, 10%, U/O 39V	
49	041-533	R19,20	RESISTOR, COMP, 24 OHM, 1/2W, 5%, U/O 39V	
51	041-245	R5	RESISTOR, COMP, 1K, 1/2W, 5%	
53	047-880	R8	RESISTOR, WW, 1 OHM, 25W, 3%	
54	041-485	R4	RESISTOR, COMP, 16 OHM, 1/2W, 5%	

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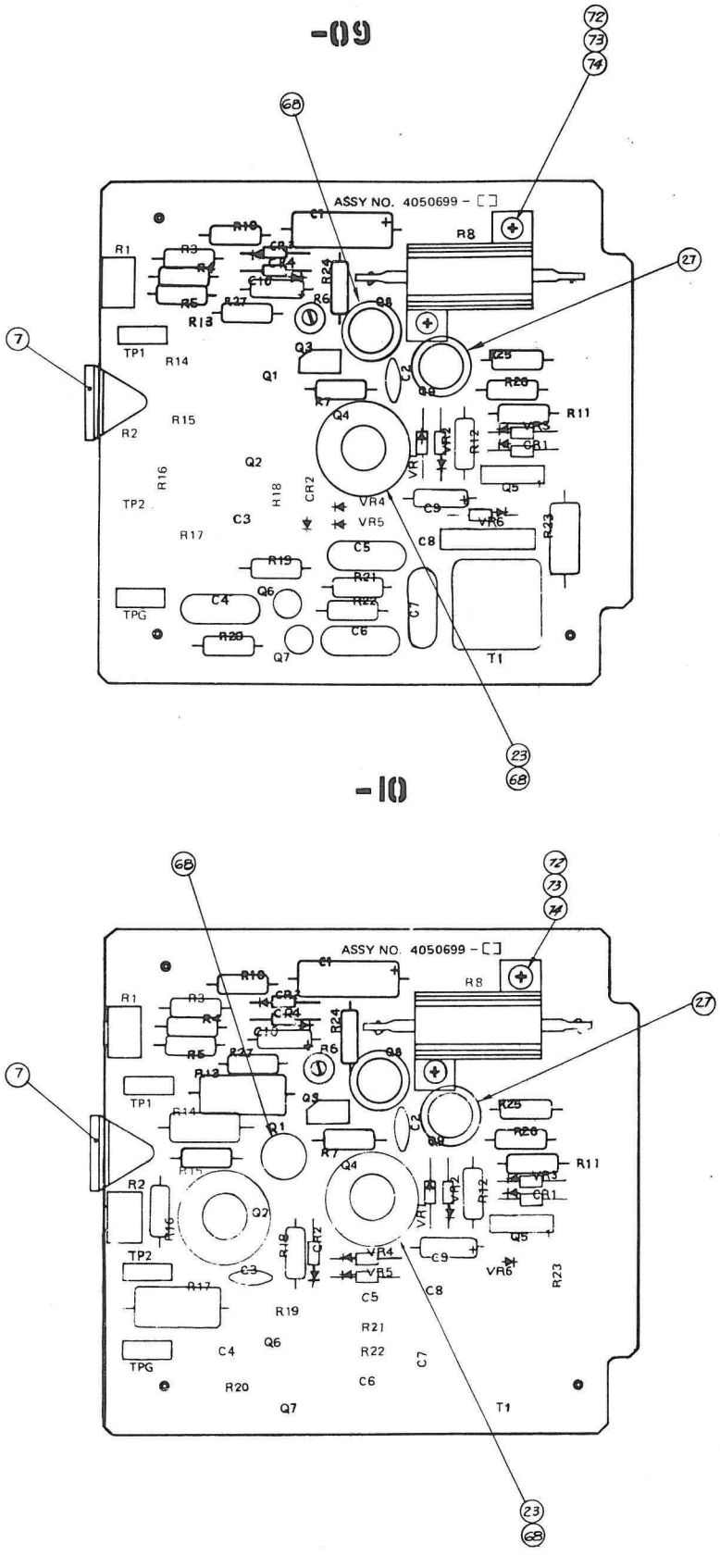
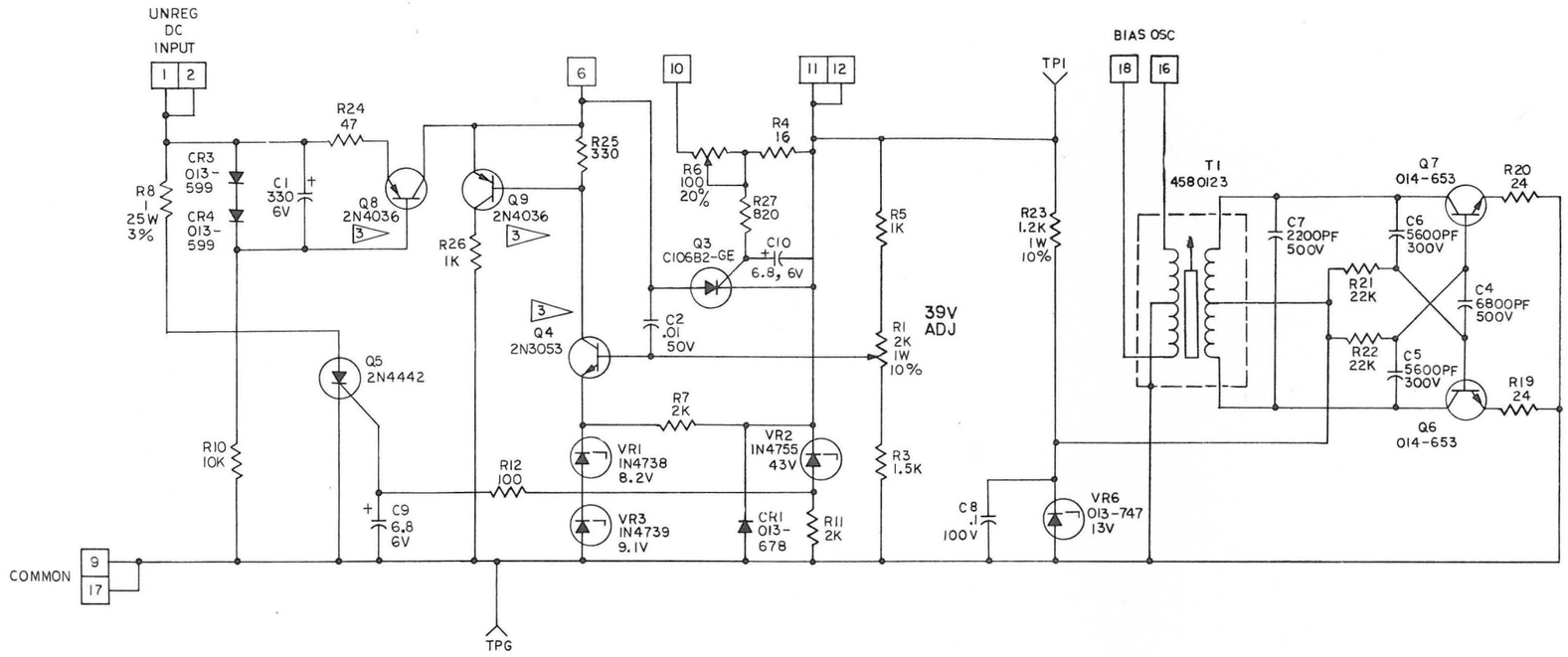
ASSEMBLY NO. 4050699 TITLE REGULATOR PWA

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
56	056-108	C4	CAPACITOR, MICA, 6800 PF, 500V, 5%, U/O 39V	
57	041-606	R13	RESISTOR, COMP, 220 OHM, 2W, 5%, U/O 15/27V	
58	058-569	R1	RESISTOR, CERMET, VAR, 2K, 1W, 10%, U/O 39V	
59	058-569	R1,2	RESISTOR, CERMET, VAR, 2K, 1W, 10%, U/O 15/27V	
60	047-364	R17	RESISTOR, WW, 0.47 OHM, 2W, 5%, U/O 15/27V	
62	044-941	R6	RESISTOR, CERMET, VAR, 100 OHM, 1/2W, 20%	
63	041-317	R18,27	RESISTOR, COMP, 820 OHM, 1/2W, 5%	
64	148-057	TP2	CONNECTOR, PC TIP JACK, GRN, U/O 15/27V	
65	148-058	TP1	CONNECTOR, PC TIP JACK, RED	
66	148-059	TPG	CONNECTOR, PC TIP JACK, BLK	
67	037-728	C9,10	CAPACITOR, TANT, 6.8 UF, 6V, 10%	
68	280-998		PAD, MTG, XSTR, T0-5	
72	471-061		SCREW, PAN HD, XREC, NO. 4-40 X 5/16 LG	
73	496-004		NUT, KEP, NO. 4-40	
74	501-008		WASHER, FLAT, NO. 4	
76	041-014	R10	RESISTOR, COMP, 10K, 1/2W, 5%	
77	041-283	R24	RESISTOR, COMP, 47 OHM, 1/2W, 5%	
78	041-329	R25	RESISTOR, COMP, 330 OHM, 1/2W, 5%	
79	041-245	R26	RESISTOR, COMP, 1K, 1/2W, 5%	
				G



Assembly No. 4050699. Regulator PWA



NOTES: UNLESS OTHERWISE SPECIFIED

1. CAPACITANCE VALUES ARE IN MICROFARADS.
2. RESISTANCE VALUES ARE IN OHMS, 1/2W, 5%.

3 THIS TRANSISTOR TO HAVE HEAT SINK.

REFERENCE DESIGNATIONS	
LAST USED	NOT USED
C10 CR4 Q9 R27 VR6 TP1 TPG	C3 CR2 Q1, 2 R2, 9, 13-18 VR4, 5

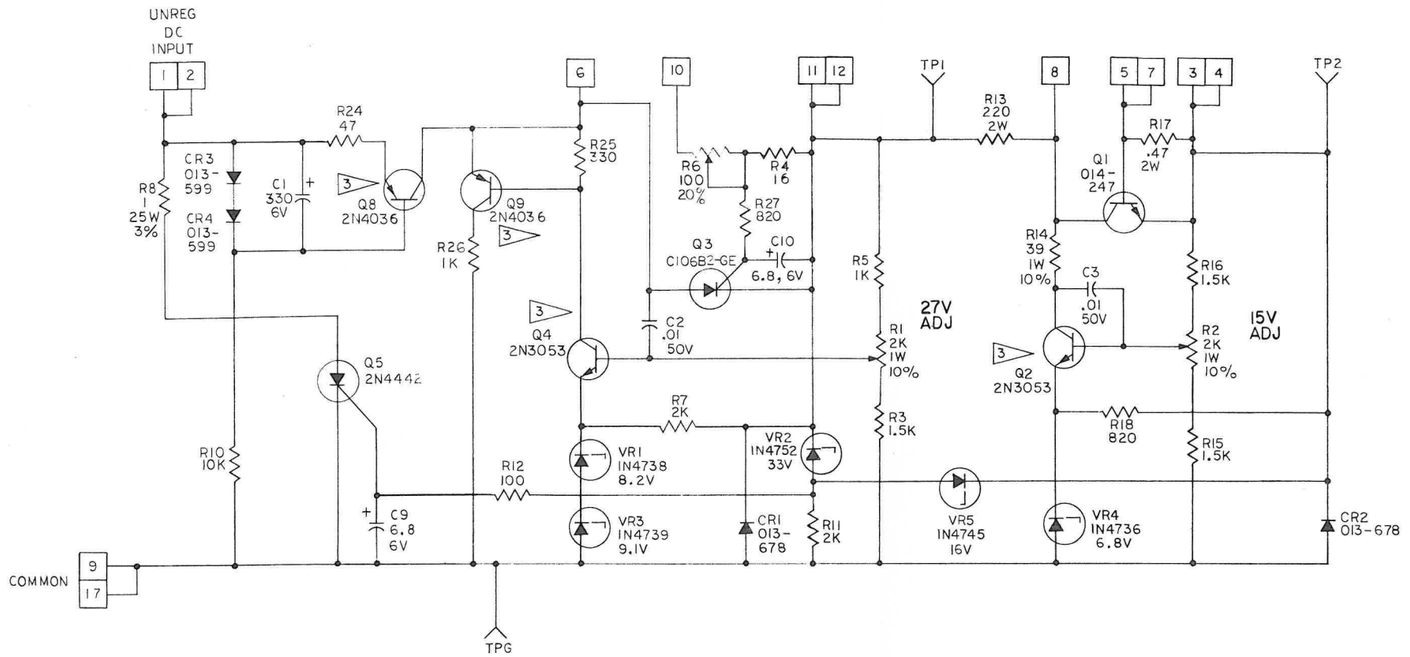
FIELD SERVICE COMPONENT SUBSTITUTION LIST	
AMPEX P/N	NEAREST COMMERCIAL EQUIVALENT
014-653	2N3904

TABLE I

PWA DASH NUMBER	SCHEMATIC ISSUE
4050699-05	"B"
4050699-07	"C"
4050699-09	"D"

Schematic No. 4840337.
Regulator/Oscillator PWA, 39V

E



NOTES: UNLESS OTHERWISE SPECIFIED

1. CAPACITANCE VALUES ARE IN MICROFARADS.
2. RESISTANCE VALUES ARE IN OHMS, 1/2W, 5%.

3 THIS TRANSISTOR TO HAVE HEAT SINK.

REFERENCE DESIGNATIONS	
LAST USED	NOT USED
C10 CR4 Q9 R27 VR5 TP2 TPG	C4 THRU C8 Q6,7 R9.13-23

FIELD SERVICE COMPONENT SUBSTITUTION LIST	
AMPEX P/N	NEAREST COMMERCIAL EQUIVALENT
014-247	2N2219

TABLE I

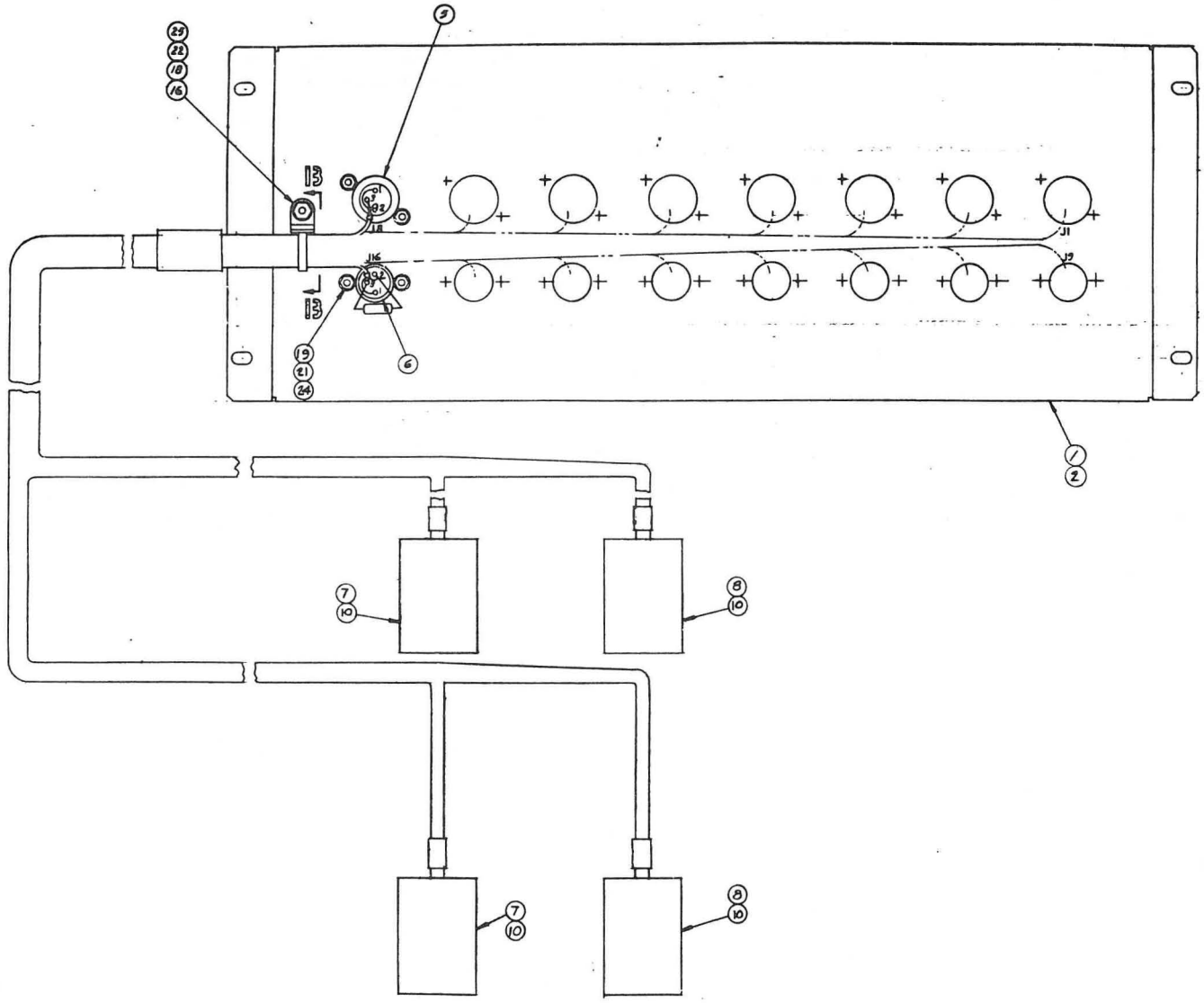
PWA DASH NUMBER	SCHEMATIC ISSUE
4050699-06	"B"
4050699-08	"C"
4050699-10	"D"

Schematic No. 4840339.
Regulator/Oscillator PWA, 15/27V

D

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050685-01		INPUT/OUTPUT CONNECTOR PANEL ASSEMBLY, 8 CHANNEL (NHA 4010210)	
	4050685-02		INPUT/OUTPUT CONNECTOR PANEL ASSEMBLY, 16 CHANNEL (NHA 4010210)	
1	4290919-03		PANEL, CONNECTOR, 8 CHAN	
2	4290919-04		PANEL, CONNECTOR, 16 CHAN	
5	146-998		CONNECTOR, AUDIO RECP, 3 SOC	XLR-3-31
6	147-999		CONNECTOR, AUDIO RECP, 3 PIN	XLR-3-32
7	166-146	P3	CONNECTOR, RECT RECP, 15 SOC	
8	166-866	P4	CONNECTOR, RECT RECP, 12 SOC	
10	187-037		TERMINAL, QIK DISC, FEMALE	
14	041-006		RESISTOR, COMP, 620 OHM, 1/2W, 5%	
16	302-365		STRAP, CABLE	
18	471-069		SCREW, MACH, PAN HD, XREC, NO. 6-32 X 0.375	
19	471-328		SCREW, MACH, FLAT HD, XREC, NO. 4-40 X 0.375	
21	496-004		NUT, KEP, NO. 4-40	
22	496-005		NUT, KEP, NO. 6-32	
24	501-008		WASHER, FLAT, NO. 4	
25	501-009		WASHER, FLAT, NO. 6	
				C

SHEET 1 OF 1



Assembly No. 4050685. Input/Output Connector Panel Assembly

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050686-01		ERASE HEAD CABLE ASSEMBLY (NHA 4010210)	
	4050686-02		ERASE HEAD CABLE ASSEMBLY, 16–24 CHANNEL (NHA 4010210)	
	4050686-03		ERASE HEAD CABLE ASSEMBLY, 24 CHANNEL (NHA 4010210)	
1	146-129		CONNECTOR, RECT RECP, 20 SOC	
2	166-085		CONNECTOR PART, BODY, RECT RECP, 9 CONTACTS	
3	145-023		CONNECTOR, CIRCULAR, 2 PIN, LATCHING	
4	187-037		TERMINAL, QIK DISC, FEMALE	
				B

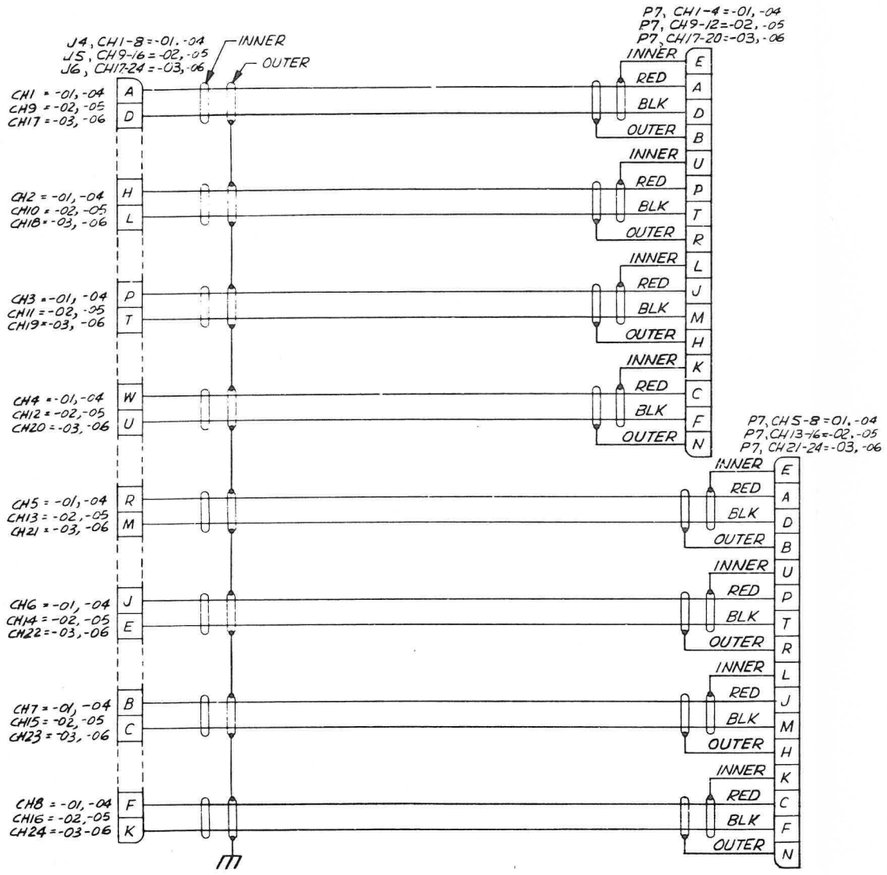
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050687-04		REPRODUCE HEAD CABLE ASSEMBLY, 8 CHANNEL (NHA 4010210)	
	4050687-05		REPRODUCE HEAD CABLE ASSEMBLY, 16 CHANNEL (NHA 4010210)	
	4050687-06		REPRODUCE HEAD CABLE ASSEMBLY, 24 CHANNEL (NHA 4010210)	
3	166-854		CONNECTOR, BODY, RECT RECP, 18 PIN	
4	146-129		CONNECTOR, SIGNAL CIRCUIT, RECT RECP, 20 SOC	
6	169-080		CONTACT, PIN, 14–16 AWG	
7	169-086		CONTACT, PIN, 24 AWG	
8	172-003		LUG, TERM, SOLDER, RING TONGUE	
				B

SHEET 1 OF 1

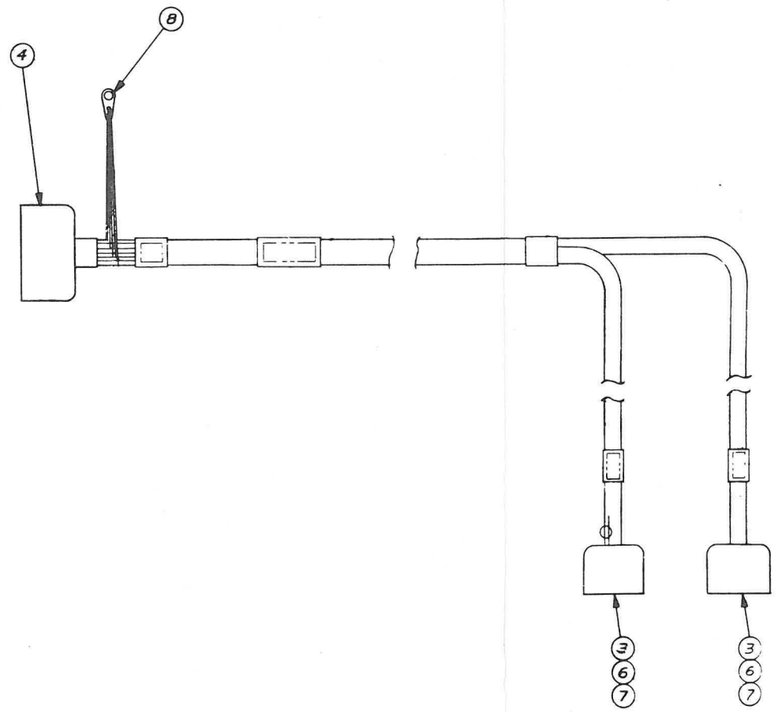
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050688-01		RECORD HEAD CABLE ASSEMBLY, 8 CHANNEL (NHA 4010210)	
	4050688-02		RECORD HEAD CABLE ASSEMBLY, 16 CHANNEL (NHA 4010210)	
	4050688-03		RECORD HEAD CABLE ASSEMBLY, 24 CHANNEL (NHA 4010210)	
3	145-170		CONNECTOR BODY, RECT PLUG, 20 POSITIONS	
4	146-129		CONNECTOR, SIGNAL CIRCUIT, RECT RECP, 20 SOCKETS	
6	169-080		CONTACT, PIN, 14-16 AWG	
7	169-086		CONTACT, PIN, 24 AWG	
8	172-003		LUG, TERMINAL, SOLDER, RING TONGUE, NO. 6	

A

SHEET 1 OF 1



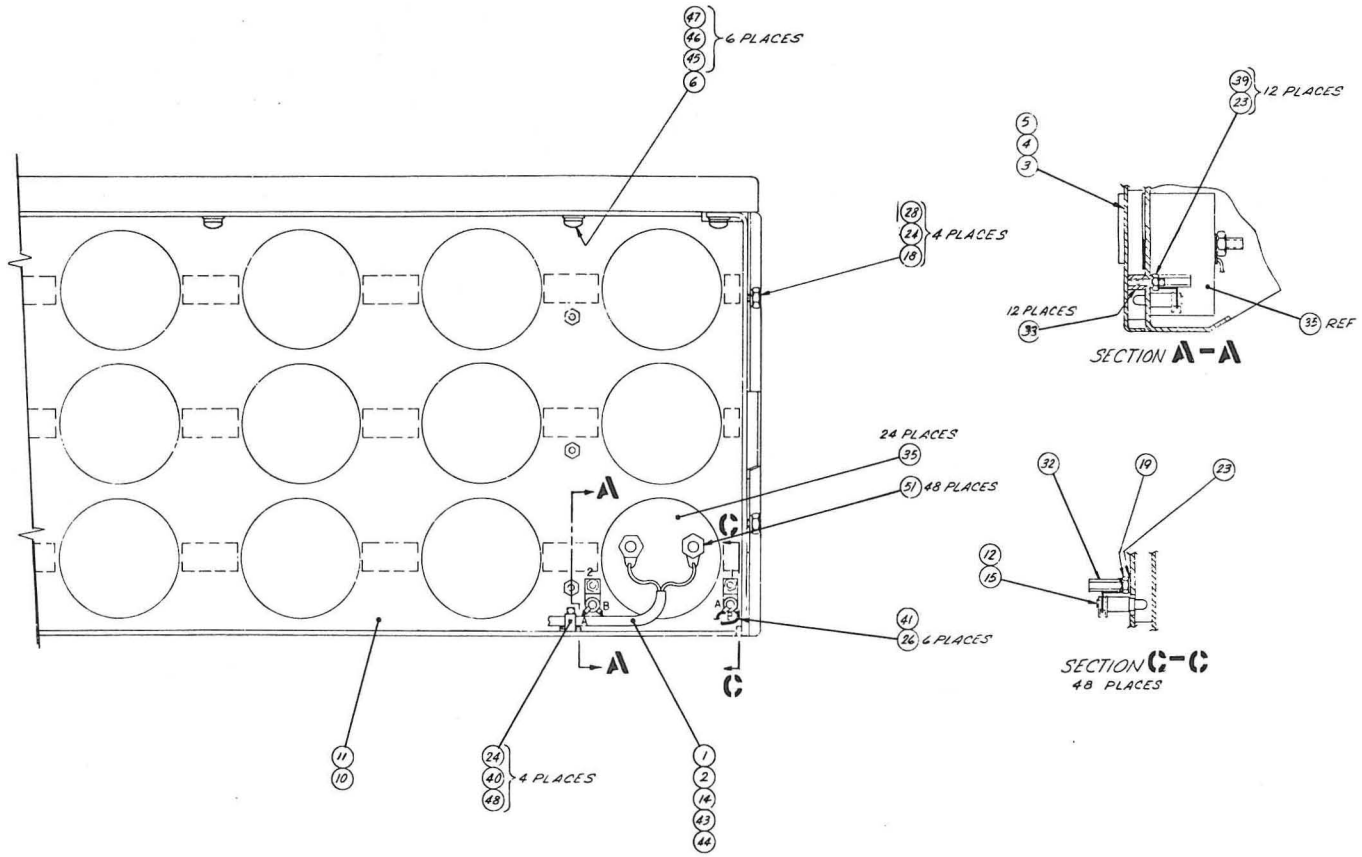
WIRING DIAGRAM



Assembly No. 4050688.
Record Head Cable Assembly

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050707-01		METER PANEL ASSEMBLY, 8 CHANNEL (NHA 4010210)	
	4050707-02		METER PANEL ASSEMBLY, 16 CHANNEL (NHA 4010210)	
	4050707-03		METER PANEL ASSEMBLY, 24 CHANNEL (NHA 4010210)	
1	4050682-01		METER PANEL CABLE ASSY, U/O 24 CHANNEL	
2	4050682-02		METER PANEL CABLE ASSY, U/O 24 CHANNEL	
3	4110287-04		OVERLAY, METER PANEL, U/O 8 CHANNEL	
4	4110287-05		OVERLAY, METER PANEL, U/O 16 CHANNEL	
5	4110289-01		OVERLAY, METAL PANEL, U/O 24 CHANNEL	
6	4150350-02		ARM REST ASSY	
10	4290834-03		METER PANEL, U/O 8-16 CHANNEL	
11	4290904-03		METER PANEL, U/O 24 CHANNEL	
12	060-283		LAMP, 28 VOLT	
14	4050682-03		METER PANEL CABLE, U/O 24 CHANNEL	
15	130-048		SOCKET, LAMP	
18	471-069		SCREW, NO. 6-32 X 0.37 LG, PAN HD, XREC, U/O 8-16 CHANNEL	
19	492-008		NUT, PLAIN, NO. 4-40	
23	501-008		WASHER, PLAIN, NO. 4	
24	501-009		WASHER, PLAIN, NO. 6	
26	171-009		TERMINAL, QUICK DISCONNECT, SPLICE	
28	502-003		WASHER, LOCK, NO. 6, U/O 8-16 CHANNEL	
32	280-719		SPACER, HEX 3/16 AF, NO. 4-40 X 0.50 LG	
33	280-718		SPACER, THREADED, NO. 4-40 X 0.31 LG	
35	090-178		METER	MODUTEC 820-539
39	496-004		NUT, KEP, NO. 4-40	
40	302-365		STRAP, CABLE	
41	302-335		STRAP, CABLE	
43	4050682-04		METER PANEL CABLE ASSY, U/O 8-16 CHANNEL	
44	4050682-05		METER PANEL CABLE ASSY, U/O 16 CHANNEL	
45	475-061		SCREW, PAN HD, XREC, NO. 8-32 X 0.50 LG	
46	501-010		WASHER, PLAIN, NO. 8	
47	502-004		WASHER, LOCK, NO. 8	
48	496-005		NUT, KEP, NO. 6-32	
51	502-027		WASHER, LOCK, INT TOOTH NO. 10	

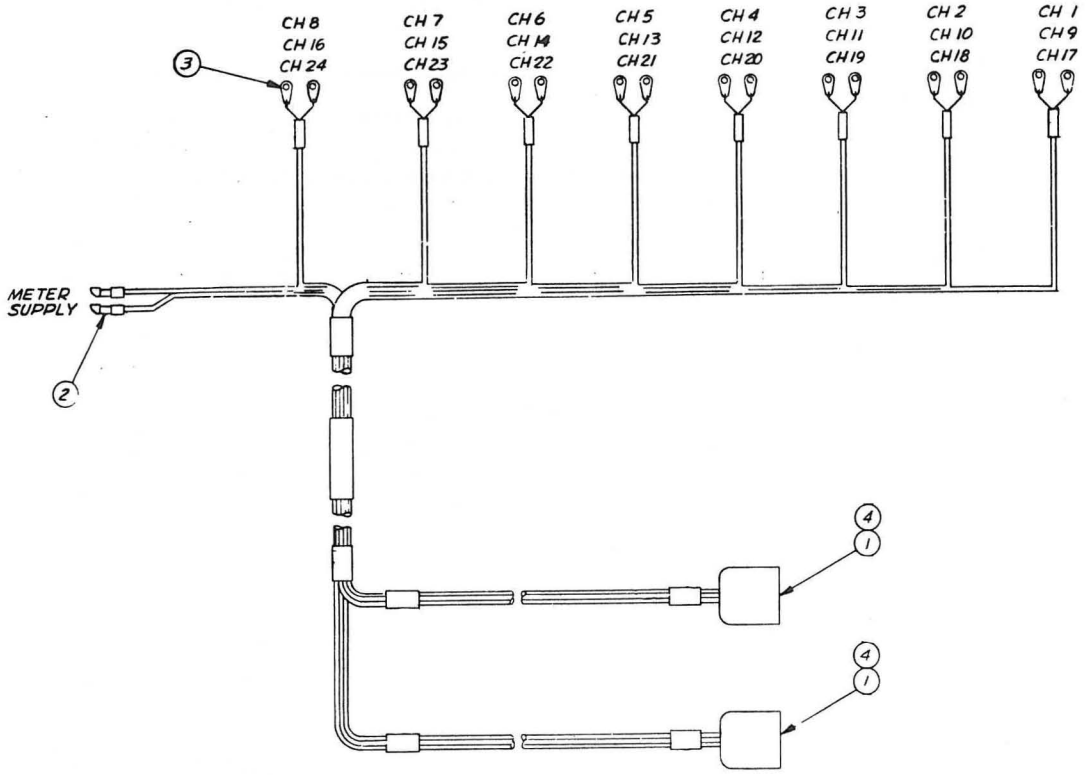
H



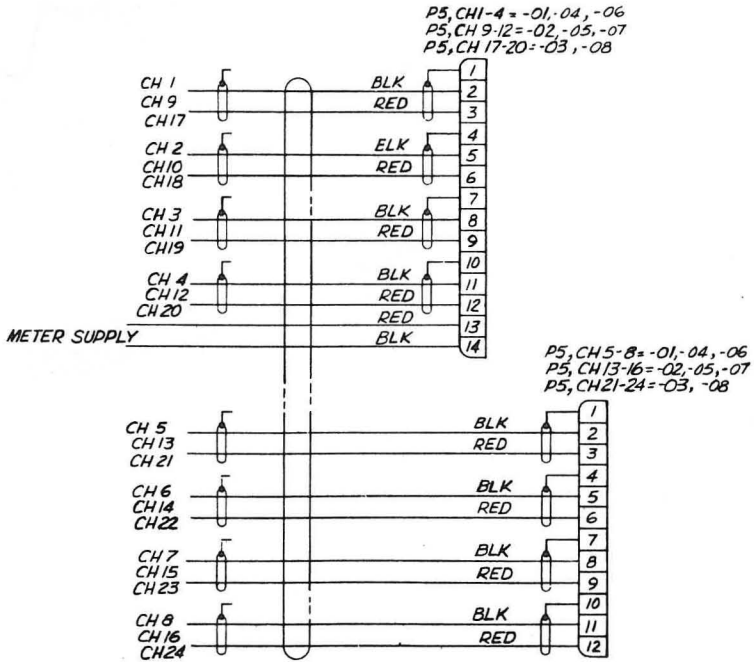
Assembly No. 4050707. Meter Panel Assembly

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050682-01		METER PANEL CABLE ASSEMBLY, 24 CHANNEL (NHA 4050707)	
	4050682-02		METER PANEL CABLE ASSEMBLY, 24 CHANNEL (NHA 4050707)	
	4050682-03		METER PANEL CABLE ASSEMBLY, 24 CHANNEL (NHA 4050707)	
	4050682-04		METER PANEL CABLE ASSEMBLY, 8–16 CHANNEL (NHA 4050707)	
	4050682-05		METER PANEL CABLE ASSEMBLY, 16 CHANNEL (NHA 4050707)	
1	166-154		CONNECTOR BODY, RECT PLUG, 15 CONT	
2	171-009		TERMINAL, QIK DISC, KNIFE-TYPE	
3	172-005		LUG, TERM, SOLDER, RING TONGUE, NO. 10	
4	187-036		TERMINAL, QIK DISC, MALE	
				D

SHEET 1 OF 1



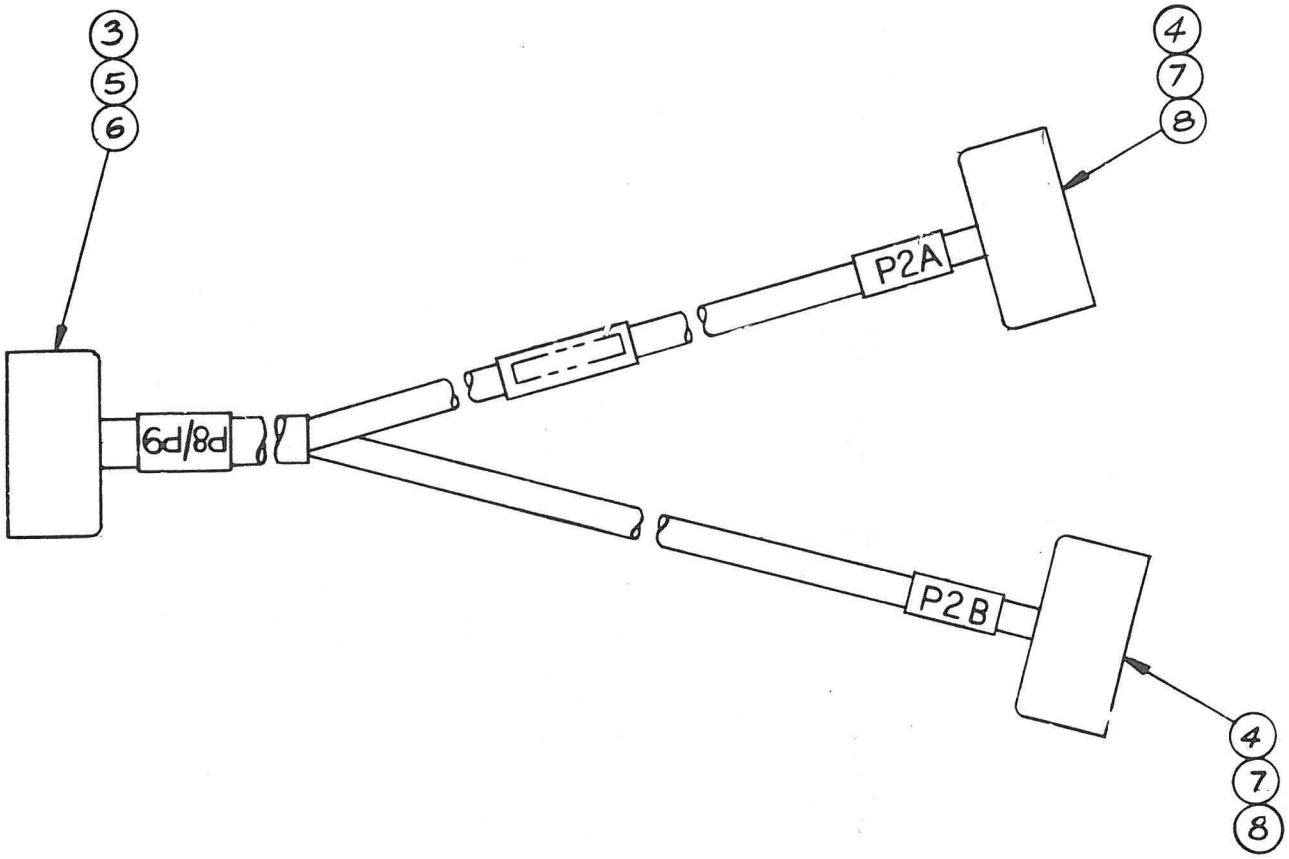
WIRING DIAGRAM

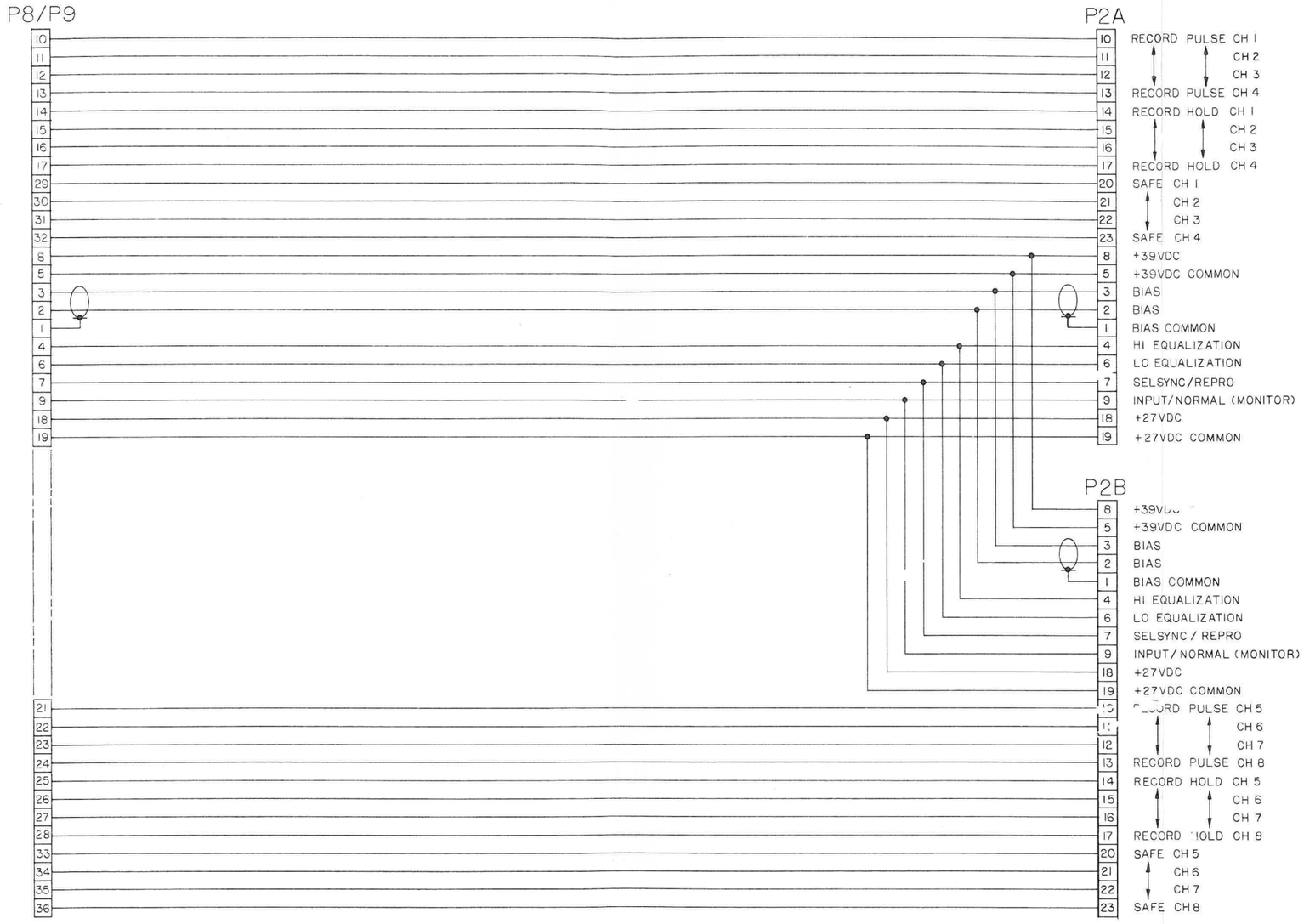


Assembly No. 4050682. Meter Panel Cable Assembly

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050709-01		ELECTRONIC POWER AND CONTROL CABLE ASSEMBLY (NHA 4010210)	
1	4840363		SCHEMATIC, POWER AND CONTROL CABLE	
3	166-862	P8/P9	CONNECTOR, RECT PLUG, 36 PIN	
4	166-863	P2A, 2B	CONNECTOR, RECT RECP, 36 SOC	
5	166-341		CONTACT, CONN, PIN, REF P8/P9	
6	187-036		CONTACT, CONN, PIN, REF P8/P9	
7	187-037		CONTACT, CONN, SOC, REF P2A, 2B	
8	187-183		CONTACT, CONN, SOC, REF R2A, 2B	B

SHEET 1 OF 1

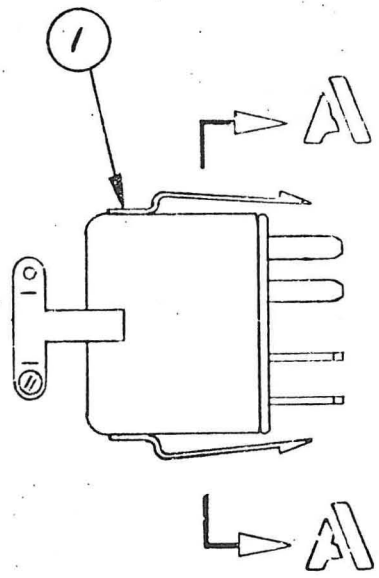




Schematic No. 4840363.
Electronic Power and Control Cable Assembly

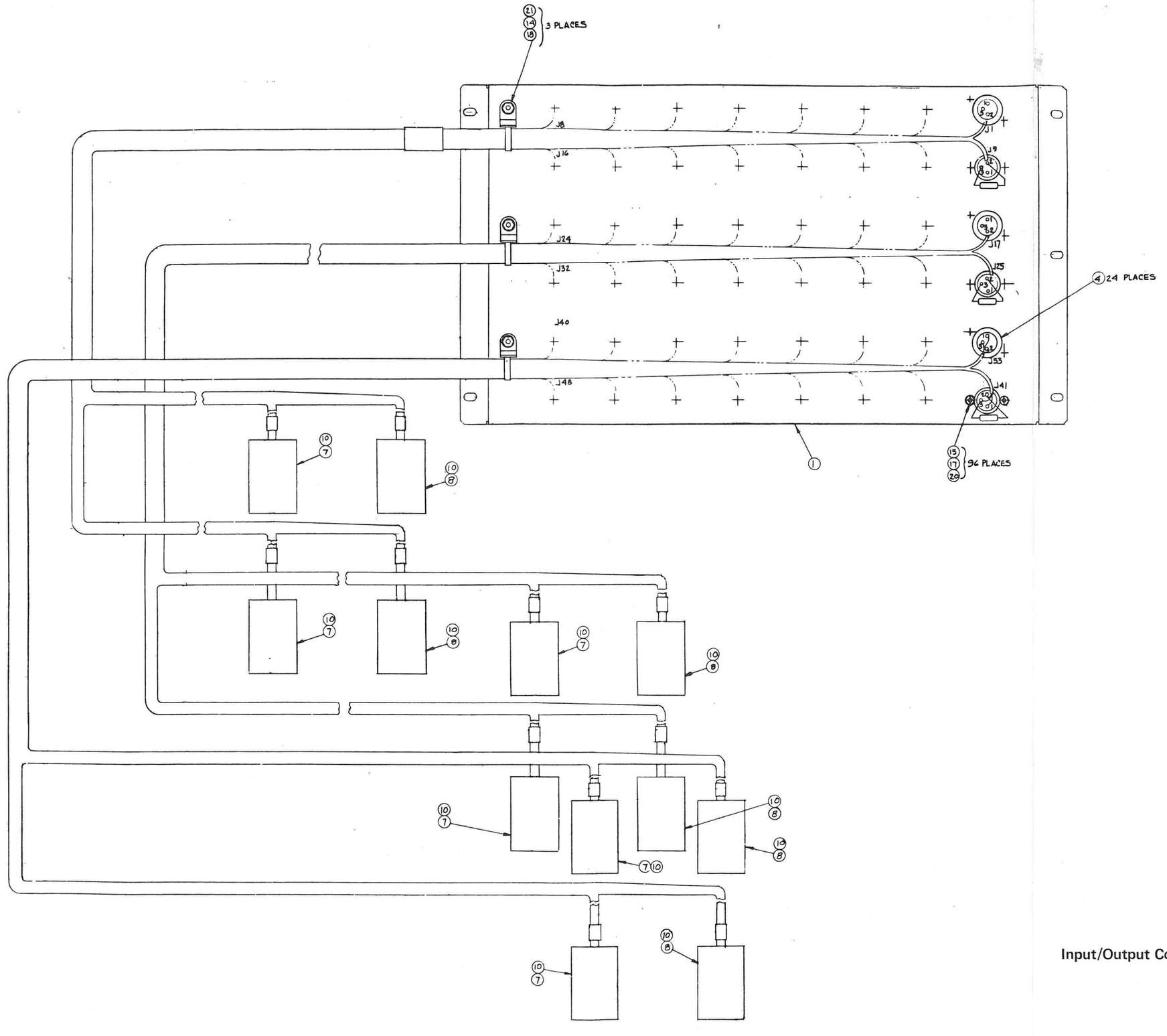
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050710-01		REMOTE CONTROL DUMMY PLUG ASSEMBLY (NHA 4010210)	
1	145-013		CONNECTOR, SIGNAL CIRCUIT, 8 PIN	B

SHEET 1 OF 1



ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050715-01		INPUT/OUTPUT CONNECTOR PANEL ASSEMBLY, 24 CHANNEL (NHA 4010210)	
1	4290916-01		PANEL, CONN, 24 CHAN	
4	146-998		CONNECTOR, AUDIO RECP, 3 SOC	
6	147-999	CO	CONNECTOR, AUDIO RECP, 3 PIN	
7	166-146	P3	CONNECTOR, RECT, RECP, 15 SOC	
8	166-866	P4	CONNECTOR, RECT, RECP, 12 SOC	
10	187-037		TERMINAL, QIK DISC, FEMALE	
11	041-006		RESISTOR, COMP, 620 OHM, 1/2W, 5%	
14	471-069		SCREW, MACH, PAN HD, XREC, NO. 6–32 X 0.375	
15	471-328		SCREW, MACH, FLAT HD, XREC, NO. 4–40 X 0.375	
17	496-004		NUT, KEP, NO. 4–40	
18	496-005		NUT, KEP, NO. 6–32	
20	501-008		WASHER, FLAT, NO. 4	
21	501-009		WASHER, FLAT, NO. 6	
22	501-188		WASHER, FLAT, NO. 6	
28	4050713-01		HARNESS, CONN, PANEL	
29	4050713-02		HARNESS, CONN, PANEL	
30	4050713-03		HARNESS, CONN, PANEL	
				B

SHEET 1 OF 1



Assembly No. 4050715.
Input/Output Connector Panel Assembly, 24 Channel

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4090024-01		MISCELLANEOUS PARTS KIT,8 CHANNEL (NHA: 4010210)	
	4090024-02		MISCELLANEOUS PARTS KIT, 16 CHANNEL (NHA: 4010210)	
	4090024-03		MISCELLANEOUS PARTS KIT, 24 CHANNEL (NHA: 4010210)	
2	4730039-01		CORD, 110V POWER	
4	4952254-01		RING, HLDN, U/O 8 CHAN	
5	4952563-01		ADAPTER RING, REEL LOWER, U/O 8 CHAN	
8	A1471		REEL, 1 INCH, U/O 8 CHAN	
9	A2571		REEL, 2 INCH, U/O 16–24 CHAN	
10	310-633		CATCH ASSY	
				B

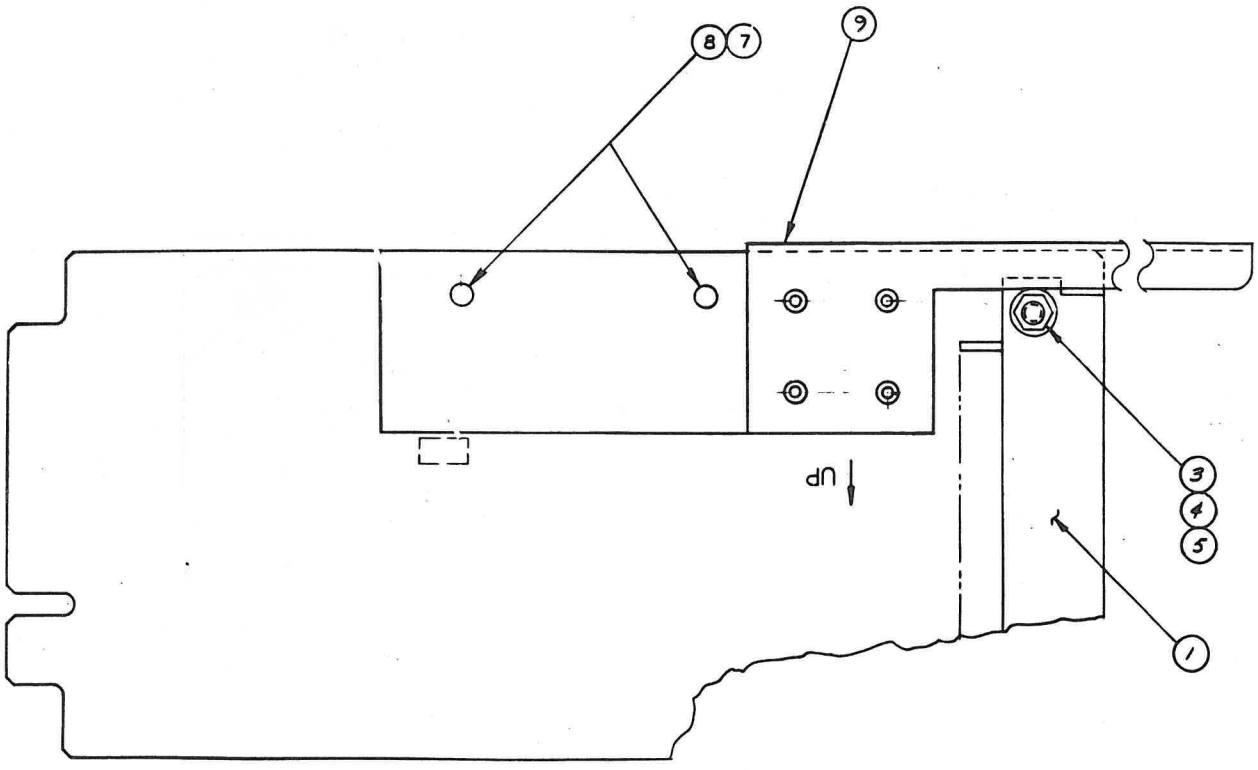
SHEET 1 OF 1

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4010216-01		**MM-1100 ACCESSORIES (NHA 4010210)**	
1	4020151-04		REPRODUCE EXTENDER BOARD ASSY	
2	4020152-02		RECORD EXTENDER BOARD ASSY	
3	4020153-03		BIAS AMP EXTENDER BOARD ASSY	
4	4020154-01		POWER SUPPLY EXTENDER BOARD ASSY	
5	4020334-01		HEAD ASSY, ONE INCH, 8 CHAN	
6	4020372-01		HEAD ASSY, 16 CHAN	
9	4050646-23		CONTROL BOX, TRANSPORT ONLY	
11	4850154		CONVERSION KIT, 2 IN TO 1 "	
12	4850155		CONVERSION KIT, 8 TO 16 CHAN	
13	4850156		CONVERSION KIT, 16 TO 24 CHAN	
18	4952348-02		REMOTE CONTROL CABLE ASSY	
				B

SHEET 1 OF 1

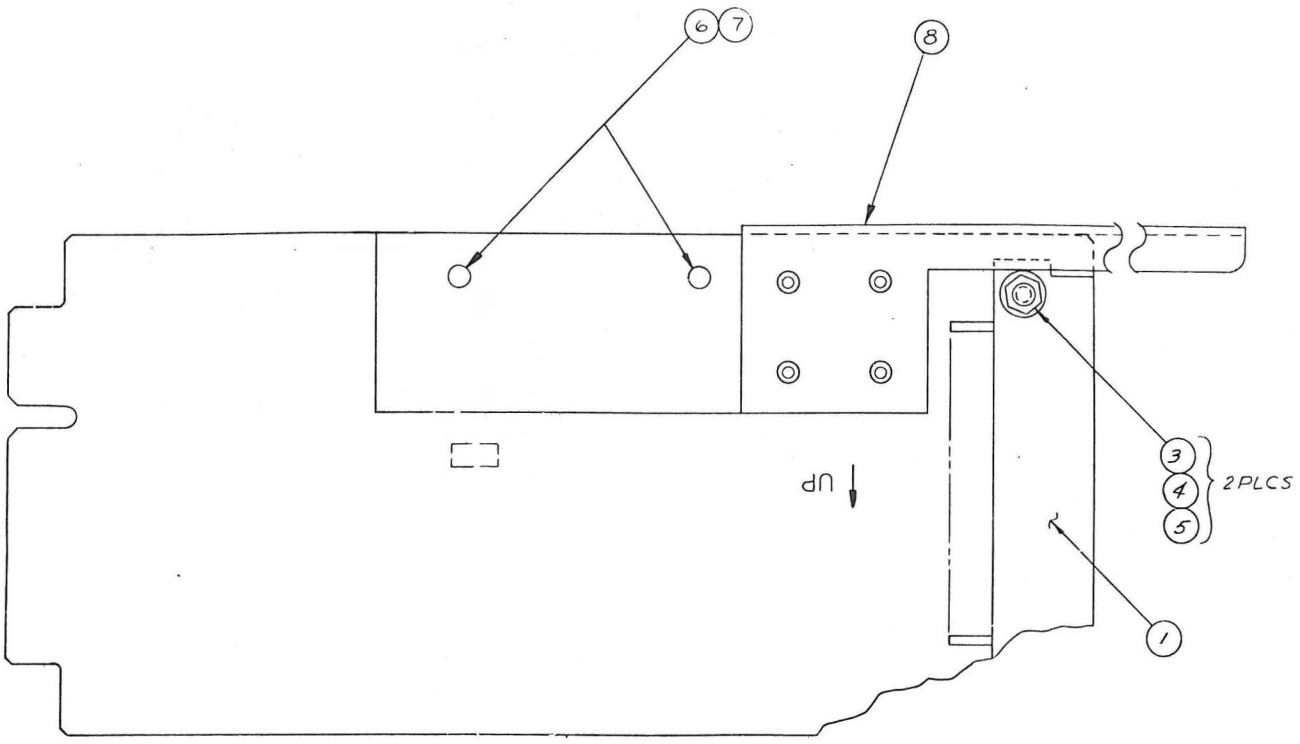
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4020151-04		REPRODUCE EXTENDER BOARD ASSEMBLY (NHA 4010216)	
1	4030274-01		CONNECTOR, 12 CONT	
3	471-065		SCREW, PAN HD, XREC, NO. 4 X 5/8 LG	
4	496-004		NUT, KEP, NO. 4	
5	501-008		WASHER, FLAT, NO. 4	
7	501-186		WASHER, PLAIN, NO. 4	
8	473-284		SCREW, PAN HD, XREC, NO. 4–40 X 0.250 LG	
9	4041198-01		HANDLE ASSY, EXT BD	
				E

SHEET 1 OF 1



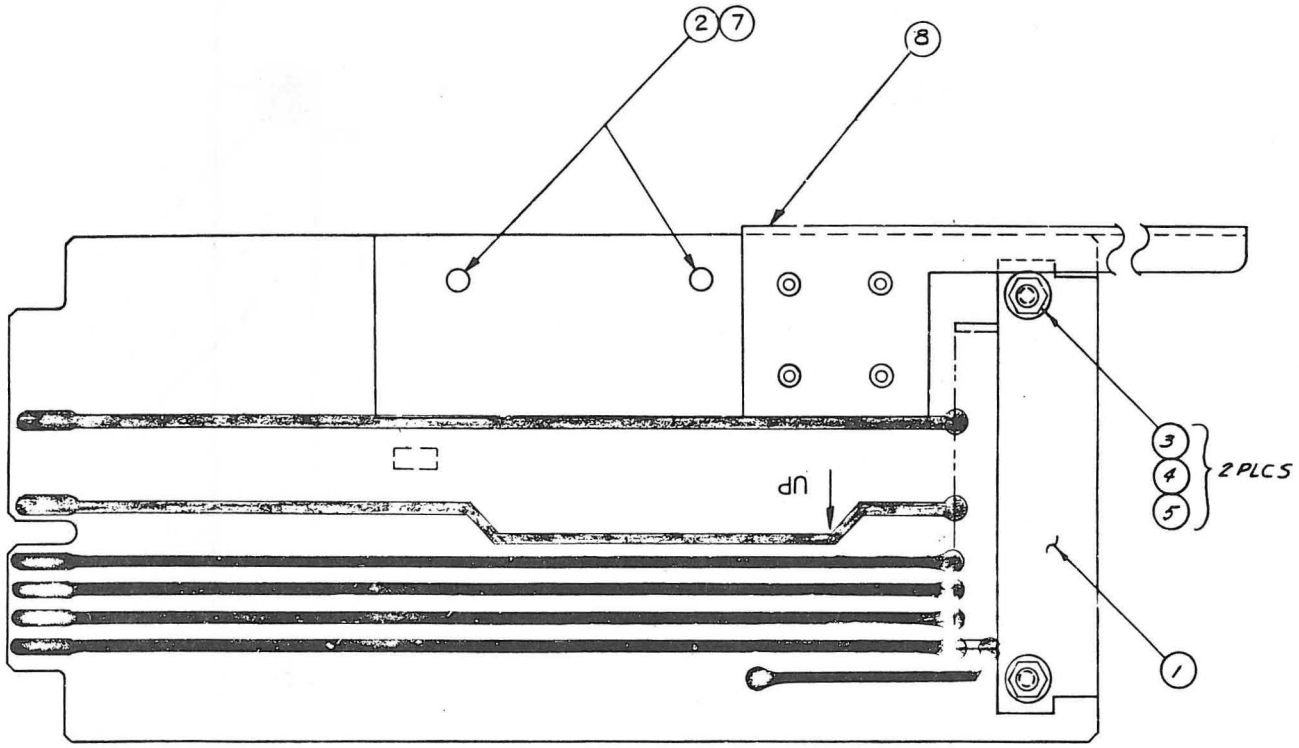
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4020152-02		RECORD EXTENDER BOARD ASSEMBLY (NHA 4010216)	
1	4030274-03		CONNECTOR, 12 CONT	
3	471-065		SCREW, PAN HD, XREC, NO. 4 X 5/8 LG	
4	496-004		NUT, KEP, NO. 4	
5	501-008		WASHER, FLAT, NO. 4	
6	501-186		WASHER, PLAIN, NO. 4	
7	473-284		SCREW, PAN HD, XREC, NO. 4-40 X 0.250 LG	
8	4041198-01		HANDLE ASSY, EXT BD	
				B

SHEET 1 OF 1



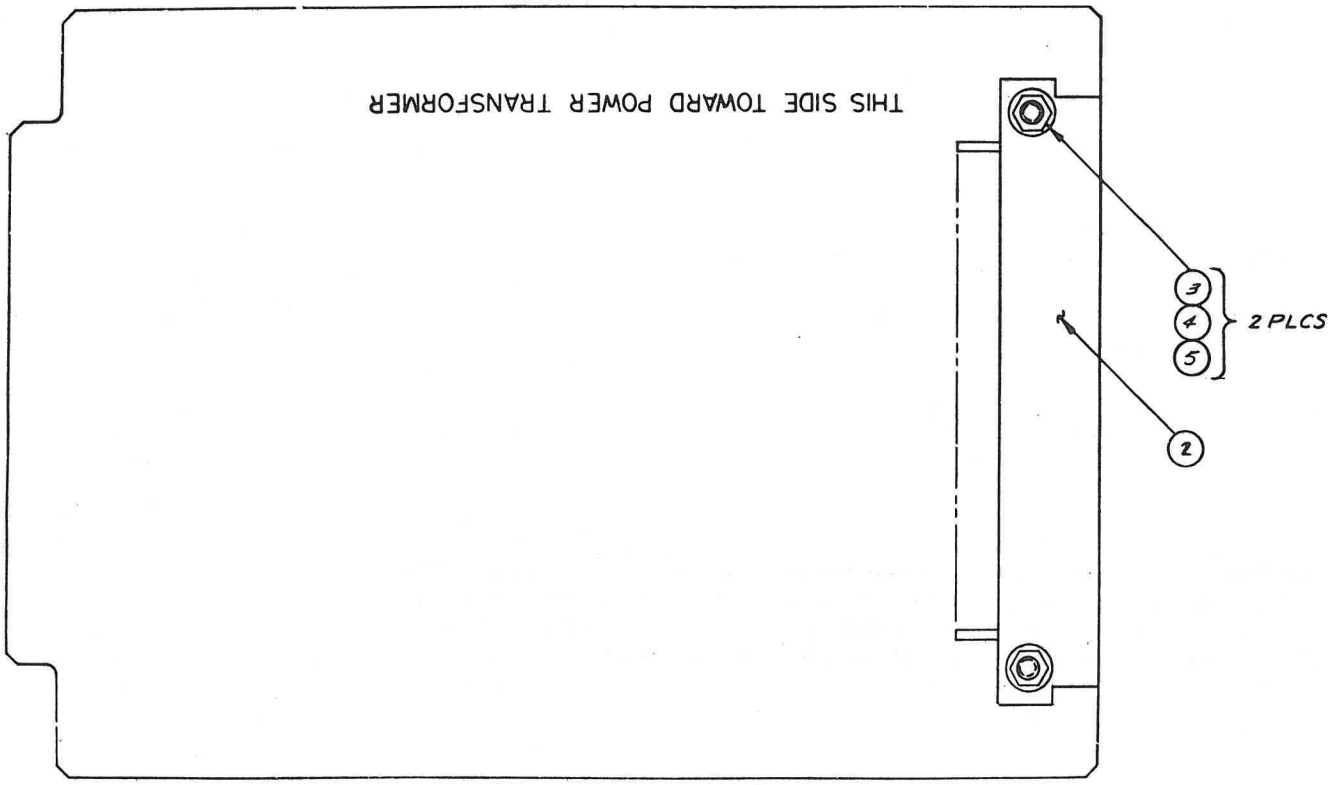
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4020153-04		BIAS AMPLIFIER EXTENDER BOARD ASSEMBLY (NHA **4010216**)	
1	4030274-02		CONNECTOR, 12 CONT	
2	501-186		WASHER, PLAIN, NO. 4	
3	471-065		SCREW, PAN HD, XREC, NO. 4 X 5/8 LG	
4	496-004		NUT, KEP, NO. 4	
5	501-008		WASHER, FLAT, NO. 4	
7	473-284		SCREW, PAN HD, XREC, NO. 4–40 X 0.250 LG	
8	4041198-01		HANDLE ASSY, EXT BD	
				D

SHEET 1 OF 1



ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4020154-01		POWER SUPPLY EXTENDER BOARD ASSEMBLY (NHA 4010216)	
2	143-450		CONNECTOR, 18 CONT	
3	471-065		SCREW, PAN HD, XREC, NO. 4 X 5/8 LG	
4	496-004		NUT, KEP, NO. 4	
5	501-008		WASHER, FLAT, NO. 4	
				A

SHEET 1 OF 1



ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050646-23		CONTROL BOX ASSEMBLY, TRANSPORT ONLY (NHA 4010210)	
5	4330308-03		BASE, CONTROL BOX	
6	4110284-12		OVERLAY, CONTROL PANEL, XPORT ONLY	
7	4620081-01		BUTTON, "LIFTER DEFEAT"	
8	4620081-07		BUTTON, "RECORD", RED	
9	4620081-03		BUTTON, "PLAY", GREEN	
10	4620081-04		BUTTON, "STOP", YEL	
11	4620081-05		BUTTON, "REWIND"	
12	4620081-06		BUTTON, "FAST FORWARD"	
37	4290821-11		SUBPANEL, CONT BOX	
41	4840347		SCHEMATIC, CONT BOX	
43	060-373		LAMP, INCAND, 28V	
45	119-188		SWITCH, PB, MOMENTARY	
52	250-165		BUMPER, RUBBER	
53	280-716		SPACER, THREADED, NO. 4-40 X 2.25 LG	
55	470-018		SCREW, CAP, HEX SOC, NO. 6-32 X 0.375 LG	
56	471-061		SCREW, MACH, PAN HD, NO. 4-40 X 5/16 LG	
57	471-064		SCREW, MACH, PAN HD, NO. 4-40 X 1/2 LG	
60	496-004		NUT, KEP, NO. 4-40	
66	4050703-04		HARNESS ASSY, CONT BOX	
68	501-169		WASHER, FLAT, 0.125 ID X 0.250 OD	
69	501-188		WASHER, FLAT, 0.143 ID X 0.267 OD	
74	502-025		WASHER, LOCK, NO. 6	
76	501-002		WASHER, LOCK, NO. 4	
77	492-034		NUT, NO. 6-32	
80	041-410	R1	RESISTOR, 1K, 1/4W, 5%	
81	310-740		CATCH ASSY	
				P

SHEET 1 OF 1

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4850154-01		CONVERSION KIT, TWO INCH TO ONE INCH (NHA 4010210)	
1	4020334-01		HEAD ASSEMBLY, 1 IN, 8 CHAN	
3	4210353-01		GUIDE, FIXED, 1 IN	
6	4952563-01		RING, ADAPTER, REEL LOWER	
7	4952254-01		RING, HLDN	
9	A1471		REEL, 1 IN	

SHEET 1 OF 1

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4850155-01		CONVERSION KIT, 8 TO 16 CHANNELS (NHA 4010216)	
1	4020371-09		ELECTRONICS ASSEMBLY	
3	4020372-01		HEAD ASSEMBLY, 16 CHAN	
5	4050646-21		CONTROL BOX ASSY, 16 CHAN	
6	4050685-02		INPUT/OUTPUT CONNECTOR PANEL ASSEMBLY	
7	4050686-02		ERASE HEAD CABLE ASSEMBLY	
8	4050687-05		REPRODUCE HEAD CABLE ASSEMBLY	
9	4050688-02		RECORD HEAD CABLE ASSEMBLY	
12	4050707-02		METER PANEL ASSY, 16 CHAN	
14	4050709-01		ELECTRONICS POWER AND CONTROL CABLE ASSEMBLY	
19	4210353-02		GUIDE, FIXED, 2 IN	
21	4600153-05		CLAMP, HEAD CABLE	
22	4600153-06		CLAMP, HEAD CABLE	
25	A2573		REEL, 2 IN	
28	472-578		SCREW, OVAL HD, XREC, NO. 10–32 X 0.75 LG	
29	501-702		WASHER, FINISHING, NYLON, BLK, NO. 10	
31	4020269-08		RECORD EQUALIZER PWA, NAB	
32	4020270-02		REPRODUCE EQUALIZER PWA	
				E

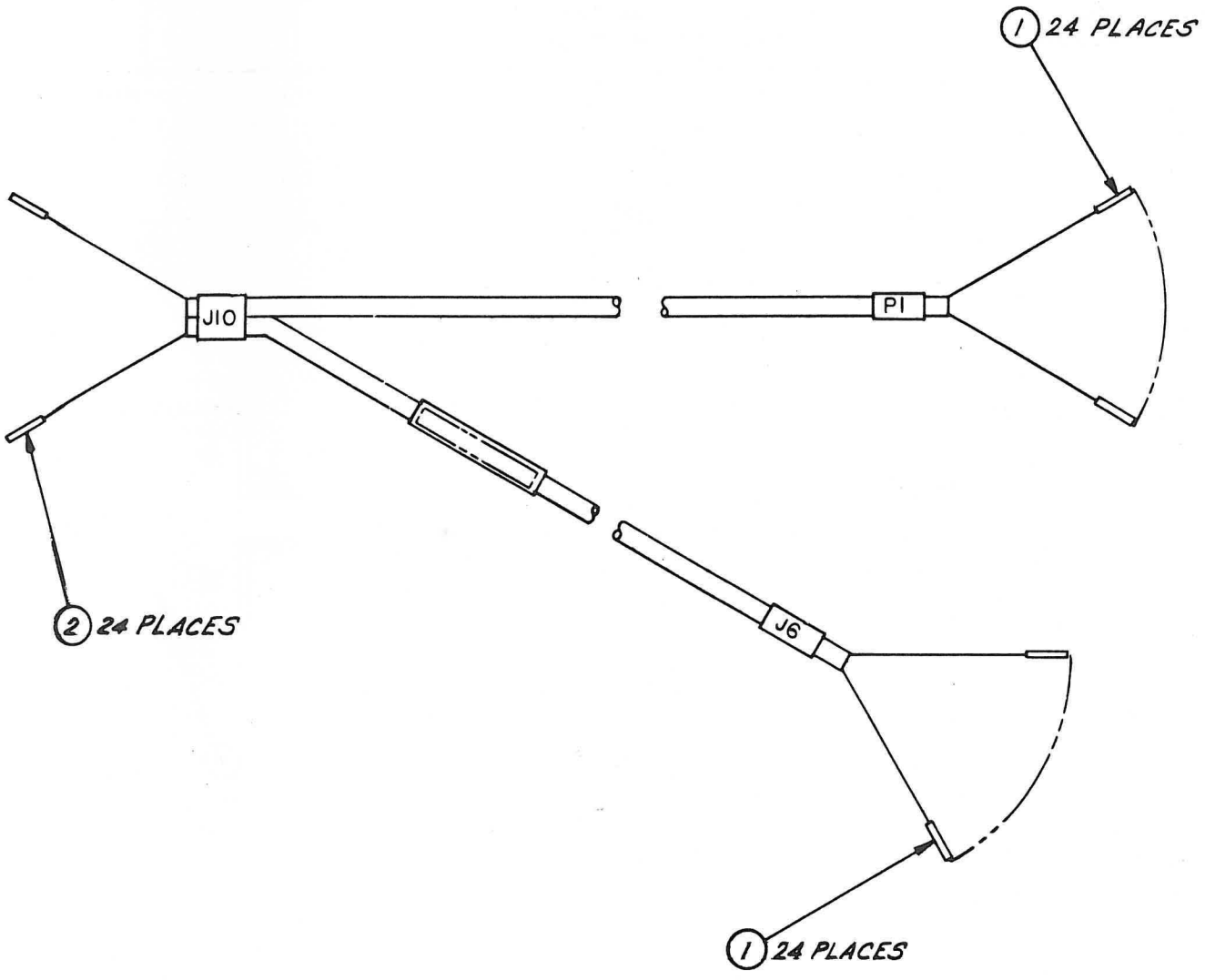
SHEET 1 OF 1

ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4850156-01		CONVERSION KIT, 16 TO 24 CHANNELS (NHA CATALOG)	
1	4020371-09		ELECTRONICS ASSEMBLY	
3	4020372-02		HEAD ASSEMBLY, 24 CHAN	
5	4050646-22		CONTROL BOX ASSY, 24 CHAN	
7	4050676-01		TRANSPORT CONTROL CHASSIS, CH 17-24 CABLE ASSY	
9	4050686-03		ERASE HEAD CABLE ASSEMBLY	
10	4050687-06		REPRODUCE HEAD CABLE ASSEMBLY	
11	4050688-03		RECORD HEAD CABLE ASSEMBLY	
13	4050707-03		METER PANEL ASSEMBLY	
15	4050709-01		ELECTRONICS POWER AND CONTROL CABLE ASSEMBLY	
17	4050715-01		INPUT/OUTPUT CONNECTOR PANEL ASSEMBLY	
23	4220305-01		SPACER, TRANSPORT, 24 CHAN	
24	4220307-01		BLOCK, METER PANEL	
26	4290825-11		PANEL, SIDE 24 CHAN	
27	4290825-12		PANEL, SIDE 24 CHAN	
28	4290917-01		PANEL, FILLER 24 CHAN	
31	4600153-07		CLAMP, HEAD CABLE	
32	4600153-08		CLAMP, HEAD CABLE	
35	4020269-08		RECORD EQUALIZER, NAB, PW ASSY	
36	4020270-02		REPRO EQUALIZER, PW ASSY	
38	471-079		SCREW' PAN HD, XREC, NO. 8-32 X 0.438 LG (23)	
39	471-470		SCREW, PAN HD, XREC, NO. 6-32 X 1-1/2 LG (31,32)	
40	472-578		SCREW, OVAL HD, XREC, NO. 10-32 X 0.75 LG	
41	470-040		SCREW, CAP, HEX SOC HD, NO. 10-32 X 0.750 LG (24)	
42	501-009		WASHER, PLAIN, NO. 6 (31,32)	
43	501-702		WASHER, FINISHING, NYLON, BLK, NO. 10	
				B

SHEET 1 OF 1

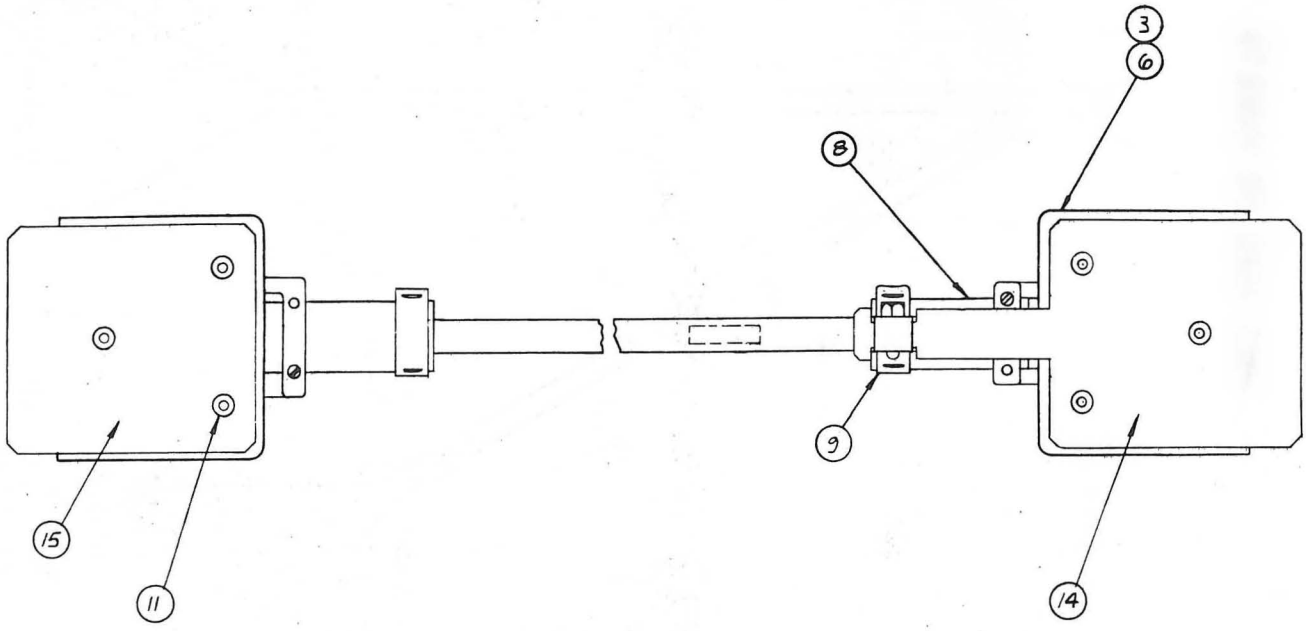
ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4050676-01		TRANSPORT CONTROL CHASSIS CABLE ASSEMBLY (NHA 4850156)	
1	169-076	P1,J6	SOCKET	
2	187-037	J10	TERMINAL, QIK DISC, FEMALE	A

SHEET 1 OF 1



ITEM NO.	AMPEX PART NO.	REFERENCE NUMBER	DESCRIPTION	JEDEC NO. OR MFR. PART NO.
	4952348-02		REMOTE CONTROL CABLE ASSEMBLY (NHA 4010216)	
1	4630054-01		SHELL, CONNECTOR, RECT PLUG, 104 PINS	
3	4630054-02		SHELL, CONNECTOR, SIGNAL CIRCUIT, PLUG, 8 PINS	
5	169-143		CONNECTOR, CONTACT, PIN	
6	169-144		CONNECTOR, CONTACT, OSC	
8	262-007		BUSHING, SLEEVE, 0.75 ID X 0.927 OD X 2.125 LD X 1.314 FLG	
9	302-522		CLAMP, BAND, GEAR	WITTEK 10H
11	460-502		RIVET, TUBULAR, OVAL HEAD, 0.123 DIA X 0.156 LG	
14	4260514-01		BRACKET, CABLE ANCHOR	
15	4290815-01		COVER, CONNECTOR PINS	
				K

SHEET 1 OF 1



AMPEX

MM-1100