SECTION 5

MAINTENANCE

5-1. GENERAL

This section of the manual provides maintenance information for the ATR-100 Series Recorder/Reproducer and input/output assembly (accessory). Maintenance information is grouped under six main headings: *Overall Test Equipment Requirements, Preventive Maintenance, Conversion, Alignment* and *Adjustments, Performance Tests,* and *Corrective Maintenance.*

Under the heading *Overall Test Equipment Requirements,* Table 5-1 lists test equipment (electronic and mechanical) for testing, adjusting, and maintenance of the ATR-100. *Preventive Maintenance* covers procedures for cleaning, demagnetizing, and lubrication. *Conversion* includes procedures for changing channel configuration, tape width, operating speed pair, master bias operation, and input/output assembly operating configuration. Information grouped under the heading *Alignment* and *Adjustments* includes procedures for the audio signal system and the tape transport. Information under the heading *Performance Tests* includes tests for checking tape tension, absolute tape-speed accuracy, speed variation, operating level, signal-to-noise ratio, harmonic distortion, intermodulation distortion, and flutter. *Corrective Maintenance* covers procedures for head maintenance, troubleshooting, and component replacement procedures.

CAUTION

DO NOT USE ANY FORM OF ABRASIVE LAPPING TAPE ON THE ATR-100 FERRITE HEADS AS SERIOUS DAMAGE CAN OCCUR AND HEAD WARRANTY WILL BE VOIDED.

TO PREVENT POSSIBLE DAMAGE TO ELECTRICAL COMPONENTS, ALWAYS TURN RECORDER/REPRODUCER POWER OFF BEFORE REMOVING OR INSTALLING A HEAD ASSEMBLY, OR BEFORE REMOVING OR INSTALLING A PRINTED WIRING ASSEMBLY (PWA) IN THE RECORDER/REPRODUCER OR INPUT/OUTPUT ASSEMBLY.

5-2. OVERALL TEST EQUIPMENT REQUIREMENTS

Electronic and mechanical test equipment suggested for use during testing, alignment, adjustment, and maintenance of the recorder/reproducer is listed in Table 5-1. Test equipment with equivalent or better specifications can be substituted for the equipment suggested in the table.

Table 5-1. Overall Test and Maintenance Equipment Requirements

EQUIPMENT TYPE	SUGGESTED MODEL	USED FOR
AC Voltmeter	Hewlett-Packard Model 400 FL	Performance check and electronic alignment
DC Voltmeter – 20,000 ohms/volt	Any	Electronic checks and adjustments
Audio Oscillator	Hewlett-Packard Model 204C or 209D	Performance check and electronic alignment
Wave Analyzer or Spectrum Analyzer	Wave Analyzer Hewlett-Packard Model 3581A or Spectrum Analyzer Hewlett-Packard Model 3580A	Erasure and distortion measurements

Table 5-1. Overall Test and Maintenance Equipment Requirements (Continued)

EQUIPMENT TYPE	SUGGESTED MODEL	USED FOR
Intermodulation Analyzer	Crown Model IMA	SMPTE intermodulation distortion measurement
Oscilloscope (dual trace)	Tektronix Model 465	Head azimuth adjustment and signal system, tachometer, and servo alignment
Band Limiting Filter – 30 Hz to 18 kHz	See Figure 5-34	Signal-to-noise measurement
ANSI 'A' Weighted Filter	See Figure 5-35	Signal-to-noise measurement
Universal Noise Filter (optional)	See Figure 5-36	Signal-to-noise measurement
Flux Loop	Ampex P/N 4020423-01	Performance check and electronic alignment
Flux Loop Equalizing Amplifier	Ampex P/N 4020424-01	Performance check and electronic alignment
Tape Tension Gauge	AMPEX 360-476	Measuring tape tension
Head Demagnetizer	Ampex P/N 4040575	Demagnetizing head stacks
Hand Held Bulk Demagnetizer	Any	Demagnetizing tape guides and other components in the tape path
Head Cleaner	Ampex P/N 4010823 or 087-007	Cleaning heads
Lubricants	See text (paragraph 5-9)	Lubrication of components
Isopropyl Alcohol (approximately 92%)	Any	Cleaning tape guiding components
Technicians Tools		
I/O Level Set Accessory (optional – see text paragraph 5-52)	Ampex P/N 4020425	Alignment of input/output assembly (accessory)
Automatic Record/Play Cycler (optional)	See text (paragraph 5-62)	PURC timing alignment
Flutter Meter	Micom Model 8100W with Analyzer	Flutter measurement and trouble-shooting
Frequency Counter	Hewlett-Packard Model 5300A/5302A	Tape speed and speed variation check
Extender Board	Ampex P/N 4050800-01 (supplied with recorder/reproducer)	Extends electronics assembly PWAs for test
Extender Board	Ampex P/N 4020430-01	Extends input/output module for test

ALIGNMENT/TEST TAPES

SPEED	EQUALIZATION	STANDARD	TRACKS	PART NUMBER
1/4" ALIGNMENT TAPE				
3.75 in/s	90 μs and 3180 μs	NAB/IEC	Full	4690037-01

Table 5-1. Overall Test and Maintenance Equipment Requirements (Continued)

ALIGNMENT/TEST TAPES (Continued)				
SPEED	**EQUALIZATION**	**STANDARD**	**TRACKS**	**PART NUMBER**
1/4" ALIGNMENT TAPE (Continued)				
7.5 in/s	50 μs and 3180 μs	NAB	Full	01-31321-01
7.5 in/s	50 μs and 3180 μs	NAB	2	4690010-01
7.5 in/s	70 μs and ∞	IEC**	Full	4690014-01
15 in/s	50 μs and 3180 μs	NAB	Full	01-31311-01
15 in/s	50 μs and 3180 μs	NAB	2	4690009-01
15 in/s	35 μs and ∞	IEC**	Full	01-31313-01
30 in/s	17.5 μs and ∞	AES	Full	4690093-01
1/2" ALIGNMENT TAPE* **				
7.5 in/s	50 μs and 3180 μs	NAB	Full	01-31321-05
7.5 in/s	70 μs and ∞	IEC**	Full	4690015-01
15 in/s	50 μs and 3180 μs	NAB	Full	01-31311-05
15 in/s	35 μs and ∞	IEC**	Full	01-31313-05
30 in/s	17.5 μs and ∞	AES	Full	4690085-01
SPEED	**FREQUENCY**	**LEVEL**	**TRACKS**	**PART NUMBER**
1/4" LEVEL TAPES				
7.5 in/s	700 Hz	Operating*	Full	01-31325-01
15 in/s	700 Hz	Operating*	Full	01-31315-01

*OPERATING LEVEL, at 500 and 700 Hz, corresponds to a tape flux per unit width of 185 nWb/m. (Refer to: McKnight, John G., "Flux and Flux-Frequency Measurements and Standardization in Magnetic Recording," Journal of the SMPTE, Vol. 78, June 1969, pp 457-472.)

**Also CCIR.

***All listed 1/2-inch alignment tapes have flux/frequency characteristics which include compensation for fringing.

5-3. PREVENTIVE MAINTENANCE

It is important that preventive maintenance, consisting of cleaning, demagnetizing, and lubrication procedures, be performed at the intervals recommended.

5-4. Cleaning

The following paragraphs discuss frequency of and methods to be used when cleaning the tape path and optical devices of the recorder/reproducer.

5-5. Tape Path Cleaning. Oxide particles from the magnetic tape tend to collect on components in the tape path. These oxide accumulations degrade the performance of the recorder/reproducer. The heads and all other components in the tape path should be cleaned after each eight hours of operation, or more frequently if visual inspection indicates cleaning is needed. Frequency of cleaning required depends greatly on the quality of tape in use.

CAUTION

WHEN CLEANING THE HEADS, USE HEAD CLEANER ONLY AND DO NOT USE METAL OR ANY TOOLS THAT COULD SCRATCH HEADS. DO NOT USE HEAD CLEANER ON THE TAKEUP TENSION ARM ROLLER.

Proceed as follows:

1. Clean each head thoroughly with cotton-tipped applicator dampened with Ampex

Head Cleaner (part number 4010823 or 087-007).

2. Clean all tape-guiding components, supply tension arm, tape timer wheel, capstan, and tension arm rollers with 92% (approximately) isopropyl alcohol. Do not allow alcohol to enter bearings.

3. Clean scrape-flutter idler (on head assembly) with a dry cotton-tipped applicator.

5-6. Optical Devices. Optical devices on the ATR-100 seldom need cleaning and *should not be cleaned on a routine basis*. However, if required, clean the capstan tach disc and photo sense devices as follows:

1. Clean capstan tach disc with a soft lint-free cloth or Kimwipe moistened with Windex or isopropyl alcohol. Instructions for removal of the capstan/tach assembly are given in paragraph 5-97.

CAUTION

DO NOT USE ANY SOLVENTS, ALCOHOL, WINDEX, OR CLEANER OTHER THAN WATER, ON ANY PHOTOPOTENTIOMETER, LED, OR ANY PHOTO SENSE DEVICE. TO DO SO WILL CAUSE DAMAGE TO THE PLASTIC COVER.

2. Clean the LED's photopotentiometers, or any photo sense device with dry cotton-tipped applicator or, if necessary, an applicator moistened only with water.

5-7. Demagnetizing

The head should be demagnetized after each eight hours of operation.

CAUTION

DO NOT REMOVE THE HEAD ASSEMBLY OR A PRINTED WIRING ASSEMBLY (PWA) WITH POWER ON. TO DO SO WILL CAUSE THE HEAD TO BECOME MAGNETIZED.

Heads and other components in the tape path can acquire permanent magnetization that degrades signal-to-noise, increases distortion, and partially erases high frequencies on recorded tapes. Use an Ampex Head Demagnetizer (part number 4040575) or equivalent to demagnetize components in the tape path.

CAUTION

REMOVE RECORDED TAPE FROM THE VICINITY OF THE DEMAGNETIZER TO PREVENT ACCIDENTAL TAPE ERASURE.

Proceed as follows:

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

2. Remove transport head cover assembly.

3. Cover the head demagnetizer tips with an adhesive tape.

4. With demagnetizer at least three feet away from head assembly, connect demagnetizer to an appropriate ac power source.

5. Slowly move demagnetizer toward one head stack and lightly place demagnetizer tip to the base of the stack straddling head gap.

6. Using a slow, even motion, move the demagnetizer tips up and down the entire face of the stack several times. Then, slowly withdraw the demagnetizer.

7. Repeat steps 5 and 6 for each head stack.

8. Slowly move the demagnetizer at least three feet from the head assembly and then unplug the demagnetizer.

5-8. Scrape Flutter Idler

The only item on the recorder/reproducer that requires periodic lubrication is the scrape flutter idler. Ultrasonically clean and then lubricate the scrape flutter idler once a year or after each 2,000 hours of operation. The idler should be removed from the head assembly and delivered to a local jeweler or watchmaker who has an ultrasonic cleaner and special jewel oil.

Proceed as follows:

1. Remove head assembly from the transport (refer to *Changing Head Assembly* text, paragraph 5-87).

2. Remove head shield (four Allen-head screws shown in Figure 1-3).

3. Loosen scrape flutter idler retaining screw shown in Figure 5-1 and remove idler from head assembly base.

NOTE

Step 4 should be performed by a jeweler or watchmaker.

4. Loosen the two Allen-head bearing clamp screws (Figure 5-2) in the yoke assembly. Slide the two jewel bearing holder assemblies out of the yoke and remove the idler.

   a. Ultrasonically clean the two jewel bearing holder assemblies and the idler.

   b. Lubricate each jewel bearing holder assembly with one drop of jewel oil (or Ampex precision instrument oil, part number 087-239). Use a No. 21 gauge hypodermic needle to apply oil to bearing.

   c. Reassemble idler and jewel bearing holder assemblies into the yoke and lightly tighten the two bearing clamp screws.

5. With the upper and lower bearing clamp screws loose, set idler height (Figure 5-2) to 0.035 ±0.005 inch above the yoke base. Lightly tighten lower bearing clamp screw.

6. With upper bearing clamp screw still loose, remount idler onto the head base plate with front and side of yoke even with the two scribed lines on the base plate (Figure 5-1).

7. While pressing upper jewel bearing holder assembly toward idler with very light finger pressure, lightly tighten upper bearing clamp screw. Spin idler with finger. Idler should spin freely with no evidence of binding.

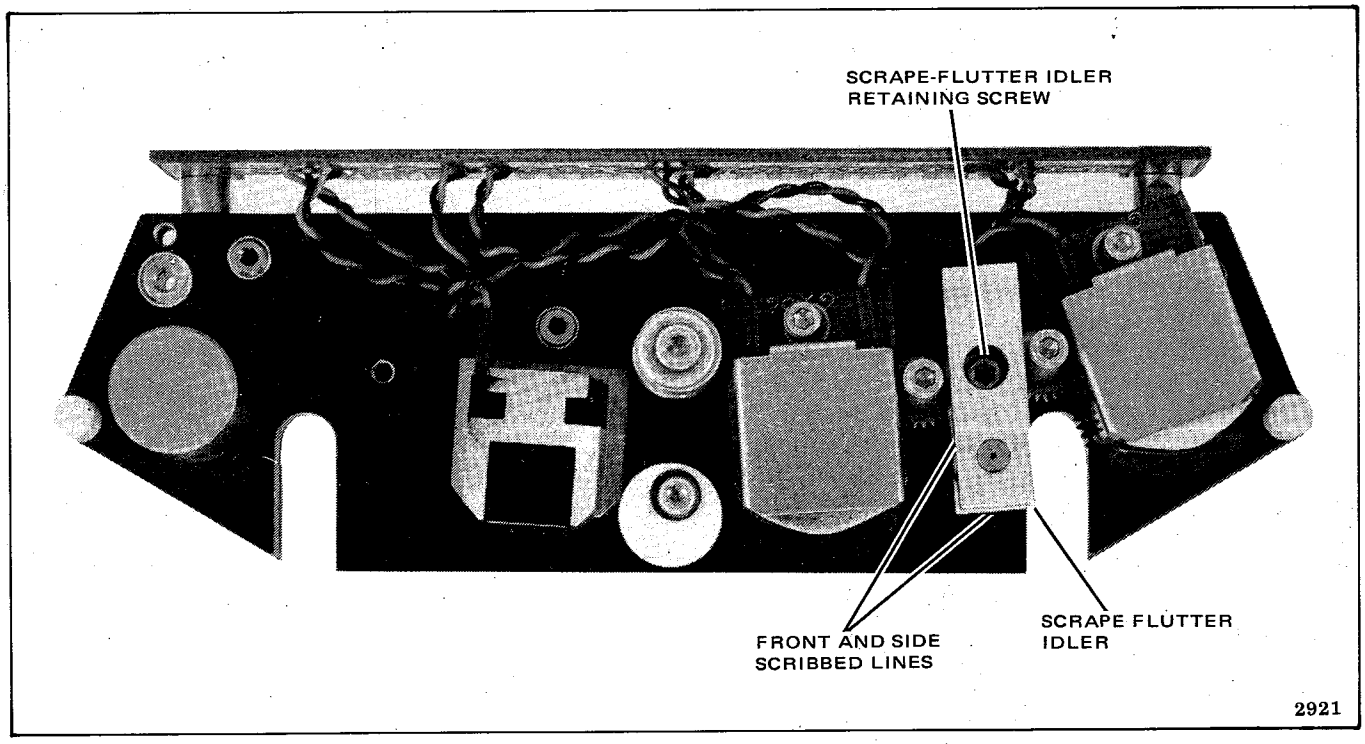


Figure 5-1. Top View of Head Assembly, Head Shield Removed

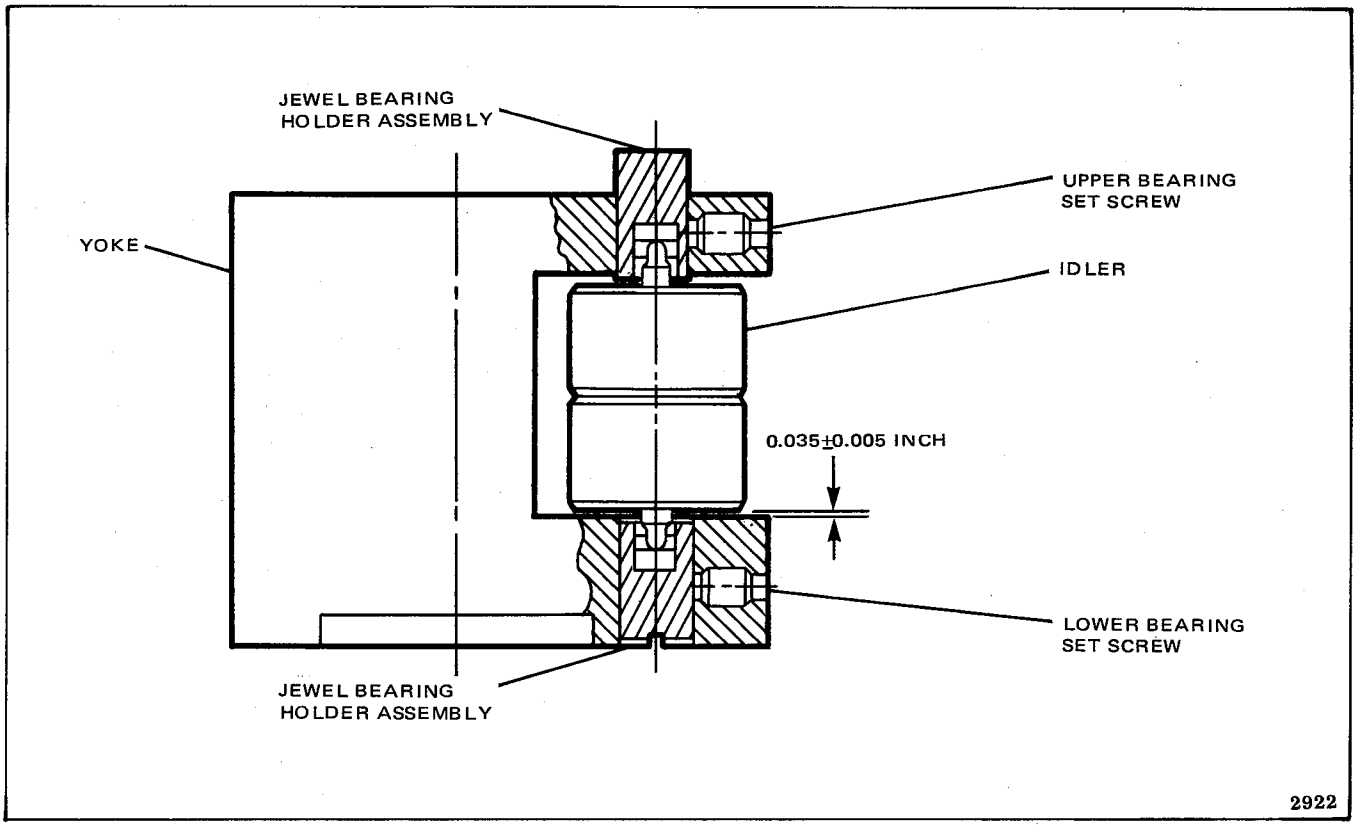


Figure 5-2. Scrape Flutter Idler, Side Cross-Section View

8. Reinstall head shield (four Allen-head screws) and install head assembly onto transport.

5-9. Lubrication

Table 5-2 provides a list of lubricants used on the recorder/reproducer, where the lubricants are used, and application instructions. Note that the capstan motor and tape timer bearings do not require relubrication. If these bearings are replaced with non-pre-lubricated bearings, use the grease suggested in the table. Except for the scrape flutter idler, which should be cleaned and lubricated after each 2,000 hours of operation, the other items shown in the table should be lubricated as required for proper operation.

5-10. Head Gate Support Bushing. There is only one support for the head gate assembly. The support consists of a shaft (Figure 5-30) that slides inside a bushing that is threaded into the tape transport casting. This bushing has been permanently lubricated; however, if additional lubrication is required, proceed as follows:

1. With the head gate in the latched (down) position, lightly apply MoS_2 high pressure grease (Table 5-2) to the entire surface of the shaft (Figure 5-31).

2. Operate the head gate up and down to distribute the grease inside the bushing bore. Remove any excess grease from shaft or bushing.

5-11. Tape Lifter Arm Bushings. The two tape lifter arm bushings have been permanently lubricated; however, if additional lubrication is required, proceed as follows:

1. Remove the head assembly (paragraph 5-87).

2. Loosen the 6-32 cap screw in the tape-lifter roller (Figure 5-28) nearest the tape lifter

Table 5-2. Lubricants Used on Recorder/Reproducer

WHERE USED	LUBRICANT DESCRIPTION	APPLICATION INSTRUCTIONS
Tape lifter and head gate support bushings	Grease, MoS_2, high pressure, mfd. by Dow Corning Corp., Midland, Michigan	Rub grease into entire surface of bushing bore.
Tape lifter solenoid	Grease, O-ring, mfd. by Parker Seal Co., Culver City, California	Use a small amount around solenoid O-ring.
Scrape flutter idler	Instrument oil Ampex Part No. 087-239	Ultrasonic clean parts. Use one drop from a No. 21 Stubbs gauge on each bearing.
Capstan bearings and shaft and tape timer bearing	Grease, general purpose channeling, ANDOK-C. Source: Barden Corp., Danbury, Connecticut	Fill each bearing 30 to 40% if bearings are not prelubricated upon replacement.

solenoid and remove the tape lifter shaft from the roller and the bushing.

3. Loosen the 6-32 cap screw in the tape-lifter roller (Figure 5-28) furthest away from the tape-lifter solenoid and remove the tape lifter shaft from the roller and the bushing.
4. Rub MoS_2 high pressure grease (Table 5-2) into the entire surface of the bushing bore. Remove any excess from bushing.
5. Reinstall the two tape lifter shafts in the reverse order of removal, but do not firmly tighten screws.
6. Reinstall head assembly (paragraph 5-87).
7. Perform steps 4 through 15 of the *Tape Lifter Arms* adjustment procedure, paragraph 5-69.

5-12. CONVERSION

Procedures for changing channel configuration, tape width, and operating-speed pair are presented in the text that follows. (For Ampex part numbers of components required for conversion, refer to Tables 1-2 and 1-3.)

5-13. Changing Channel Configuration

The ATR-100 Series Recorder/Reproducer is prewired to operate with up to four audio channels. The four-channel control unit is used to operate a one-, two-, or four-channel system. To change channel configuration, proceed as follows:

1. For each audio channel, install a Main Audio PWA and associated PADNET PWA into the electronics assembly as follows:
   a. For a full-track, 1/4-inch tape system, install a Main Audio PWA and PADNET PWA into position 1 in the electronics assembly.
   b. For a two-channel, 1/4-inch tape system, install a Main Audio PWA and PADNET PWA into positions 1 and 2 in the electronics assembly.
   c. For a four-channel, 1/2-inch tape system, install a Main Audio PWA and PADNET PWA into positions 1, 2, 3, and 4 in the electronics assembly.
2. Install the appropriate head assembly (refer to *Changing Head Assembly* text, paragraph 5-87).
3. If conversion involves changing tape width, refer to *Changing Tape Width* procedure, paragraph 5-14.
4. Perform the appropriate signal system alignment procedures given under *Alignment and Adjustments*, paragraph 5-29.

5-14. Changing Tape Width

Converting the tape transport to accommodate 1/4-inch tape or 1/2-inch tape is accomplished by changing the tape guides on the supply and takeup constant-tension arms and changing the head assembly. After conversion, no electrical tension adjustments are required as a jumper on the head connector causes the tape tensions to be automatically changed. Proceed as follows:

1. Remove tape guide by unscrewing the captive knurled-head screw (Figure 5-3) that secures tape guide to the constant tension arm.
2. Clean top surface of tension arm and bottom surface of tape guide with 92% isopropyl alcohol.
3. Install tape guide on tension arm. Secure (finger tight) to arm with captive knurled-head screw supplied with tape guide. (Do not use a screwdriver to tighten screw.)
4. Install the appropriate head assembly (refer to *Changing Head Assembly* text, paragraph 5-87).

5-15. Changing Operating-Speed Pair and Master Bias Operation

The recorder/reproducer can operate at any tape-speed pair selected from the following speeds: 3.75, 7.5, 15, and 30 in/s. (Machines originally shipped from the factory are set to operate at 7.5 and 15 in/s with four-speed master bias operation.) Note that if a speed is selected on the transport control panel (Table 3-1) for which the signal system or master bias has not been set up, the LOCKOUT indicator will light, and play and record modes for that speed will be inhibited. In addition, the audio output(s) of the basic recorder/reproducer will be muted. If an input/output assembly is being used, the assembly will switch to input signal monitoring.

NOTE

On ATR-100's utilizing a 4-speed PADNET, repositioning of PADNET jumpers is not required. However, tape speed switches S2 and S3 must be set to the desired speed.

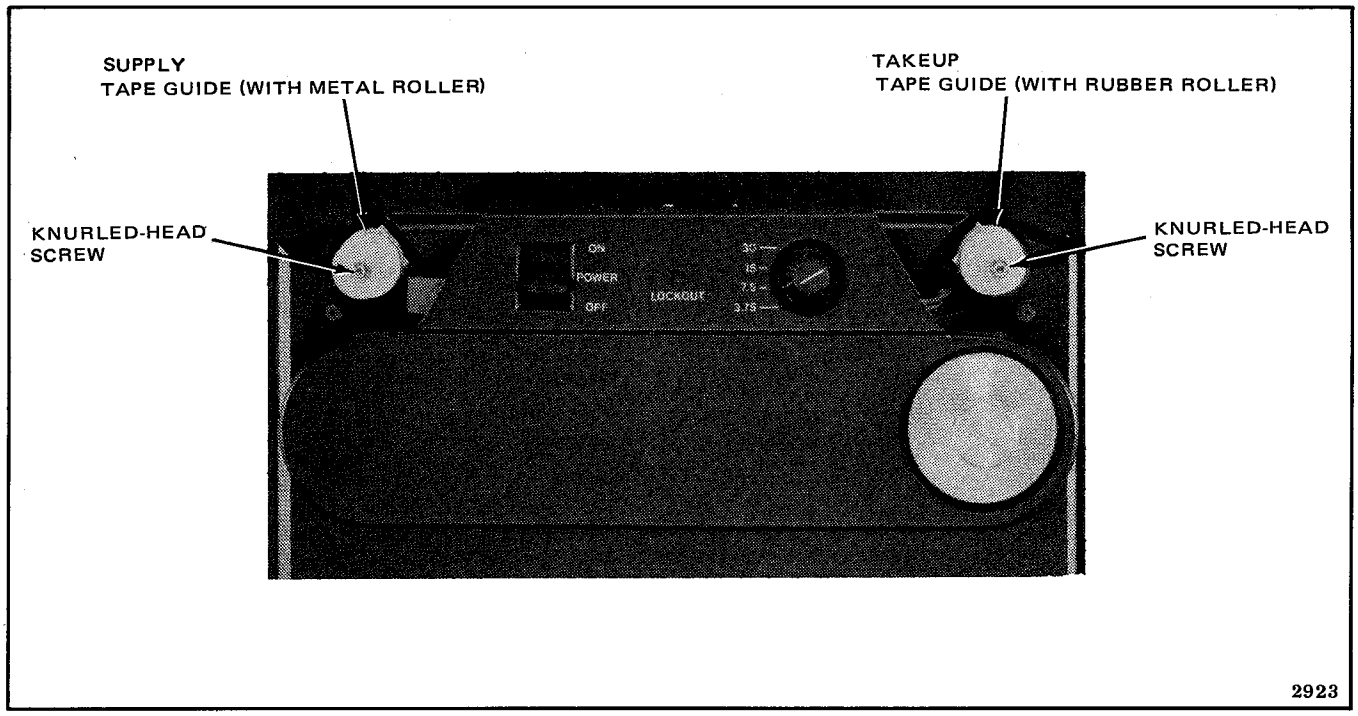


Figure 5-3. Tape Guide Securing Screws

To change operating-speed pair and master bias operation, jumper plugs are repositioned on Audio Control PWA No. 5 and on the PADNET PWA(s). The jumper plugs on the Audio Control PWA No. 5 permit the user to program the recorder/reproducer for two-speed (dual master bias) operation or four-speed master bias operation. When the recorder/reproducer is programmed for two-speed master bias operation, a bias switch on the front panel of Audio Control PWA No. 5 (Figure 5-4) enables the operator to select one of two different master bias levels for each of the two operating speeds.

When the recorder/reproducer is programmed for four-speed operation, the bias switch is permanently placed in the left-hand position and a single master bias level is provided for each speed. This master bias level is automatically switched when a speed is selected on the transport control panel.

NOTE

If the Audio Control PWA No. 5 jumpers are set for four-speed master bias operation, it is only necessary to reset jumpers on each PADNET when changing operating-speed pair. If the Audio Control PWA No. 5 jumpers are set for two-speed (dual master bias) master bias operation, then the two speeds selected on the Audio Control PWA No. 5 must match those selected on the PADNET PWA(s) or the lockout circuitry will operate.

1. To change the operating speed pair with a two-speed PADNET installed, proceed as follows:

   a. With power off, and for each channel, remove the PADNET PWA from the electronics assembly.

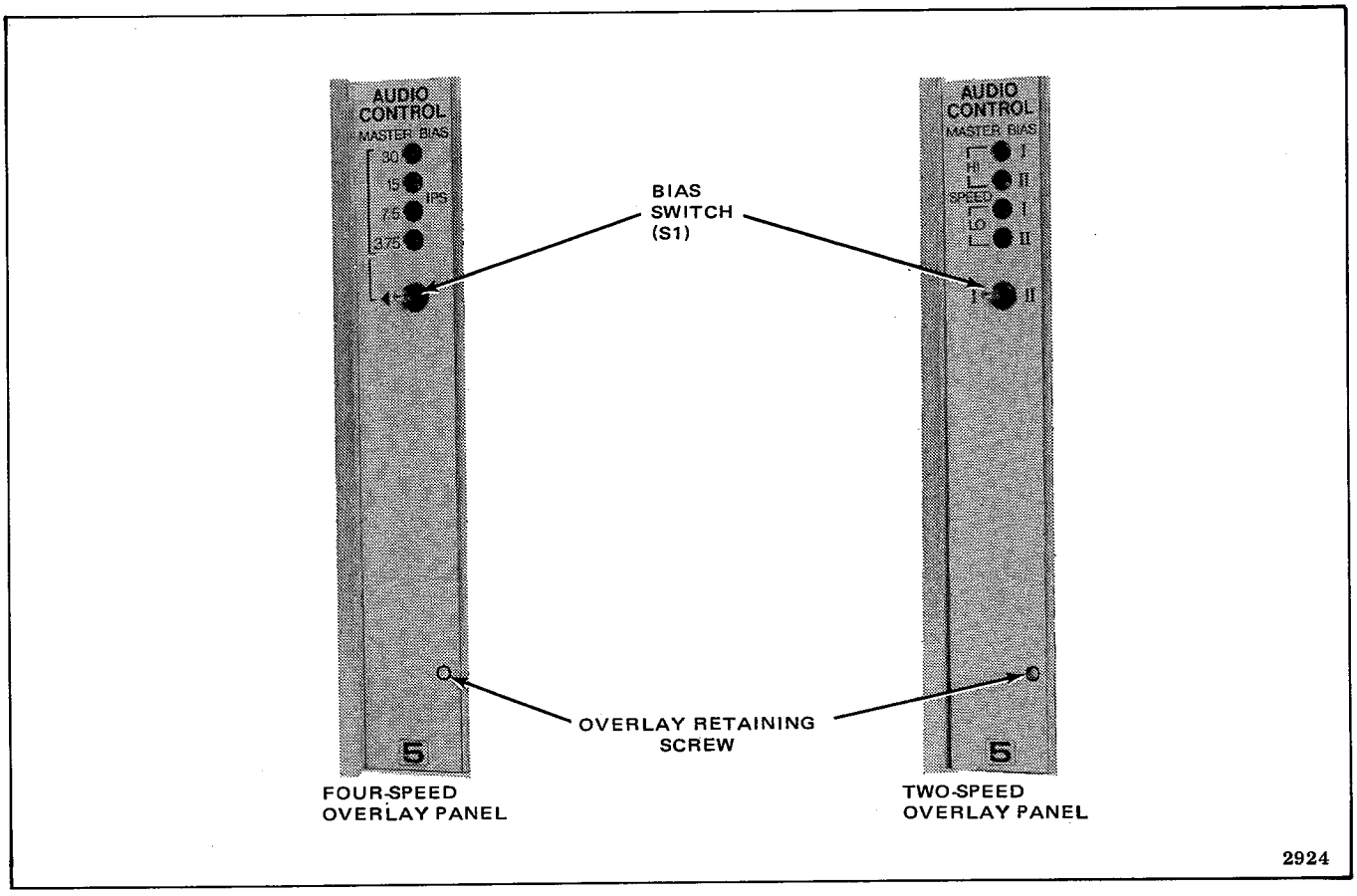


Figure 5-4. Overlay Panel, Audio Control PWA No. 5

b. Position HI speed jumper J1 to the desired high speed: 30, 15, or 7.5 in/s position (Figure 5-5).

c. Position LO speed jumper J2 to the desired low speed: 15, 7.5, or 3.75 in/s position. Reinstall PADNET PWA.

d. For each new speed selected, perform the appropriate signal systen alignment procedure given under *Alignment and Adjustments,* paragraph 5-29.

2. To change the operation speed pair with a four-speed PADNET installed, proceed as follows:

a. With power off, and for each channel, remove the PADNET PWA from the electronics assembly.

b. Position the HI speed switch (S2) to the higher speed of the two speeds selected (see Figure 5-5).

c. Position the LOW speed switch (S3) to the lower speed of the two speeds selected. Reinstall PADNET PWA.

d. Insure proper overlay panel is installed on main audio board (see Figure 5-13).

For each new speed selected, perform the appropriate signal system alignment procedure given under *Alignment and Adjustments,* paragraph 5-29.

5-16. 2-Speed Dual Master Bias. For two-speed dual master bias operation, proceed as follows:

1. With power off, remove Audio Control PWA No. 5 from the electronics assembly.

2. Two overlay panels are furnished with the PWA. If the two-speed overlay panel (Figure 5-4) is not in the front position on the PWA, remove front-panel screw, interchange overlay panels, and reinstall screw.

3. Position HI speed jumper J1 to the desired high speed: 30, 15, or 7.5 in/s position (Figure 5-6).

4. Position LO speed jumper J2 to the desired low speed: 15, 7.5, or 3.75 in/s position.

5. Position jumpers J3 and J4 to the S (stored) position. Reinstall Audio Control PWA No. 5.

6. For each new speed selected, perform the appropriate signal system alignment procedure given under *Alignment and Adjustments,* paragraph 5-29.

5-17. 4-Speed Master Bias. For 4-speed master bias operation, proceed as follows:

1. With power off, remove Audio Control PWA No. 5 from the electronics assembly.

2. Two overlay panels are furnished with the PWA. If the four-speed overlay panel (Figure 5-4) is not in the front position on the PWA, remove front-panel screw, interchange overlay panels, and reinstall screw.

3. Position jumper J1 to the 30-in/s position (Figure 5-6).

4. Position jumper J2 to the 7.5-in/s position.

5. Position jumper J3 to the 15-in/s position.

6. Position jumper J4 to the 3.75-in/s position. Reinstall Audio Control PWA No. 5.

7. For each new speed selected, perform the appropriate signal system alignment procedure given under *Alignment and Adjustments*, paragraph 5-29.

5-18. Changing Input/Output Assembly Operating Configuration

The input/output assembly is shipped from the factory with the following input and output operating characteristics:

- Input impedance — 50K ohms balanced
- Output impedance — 30 ohms balanced

The input/output assembly operating characteristics can be changed by adding a capacitor and by

AUDIO CARD PADNETS

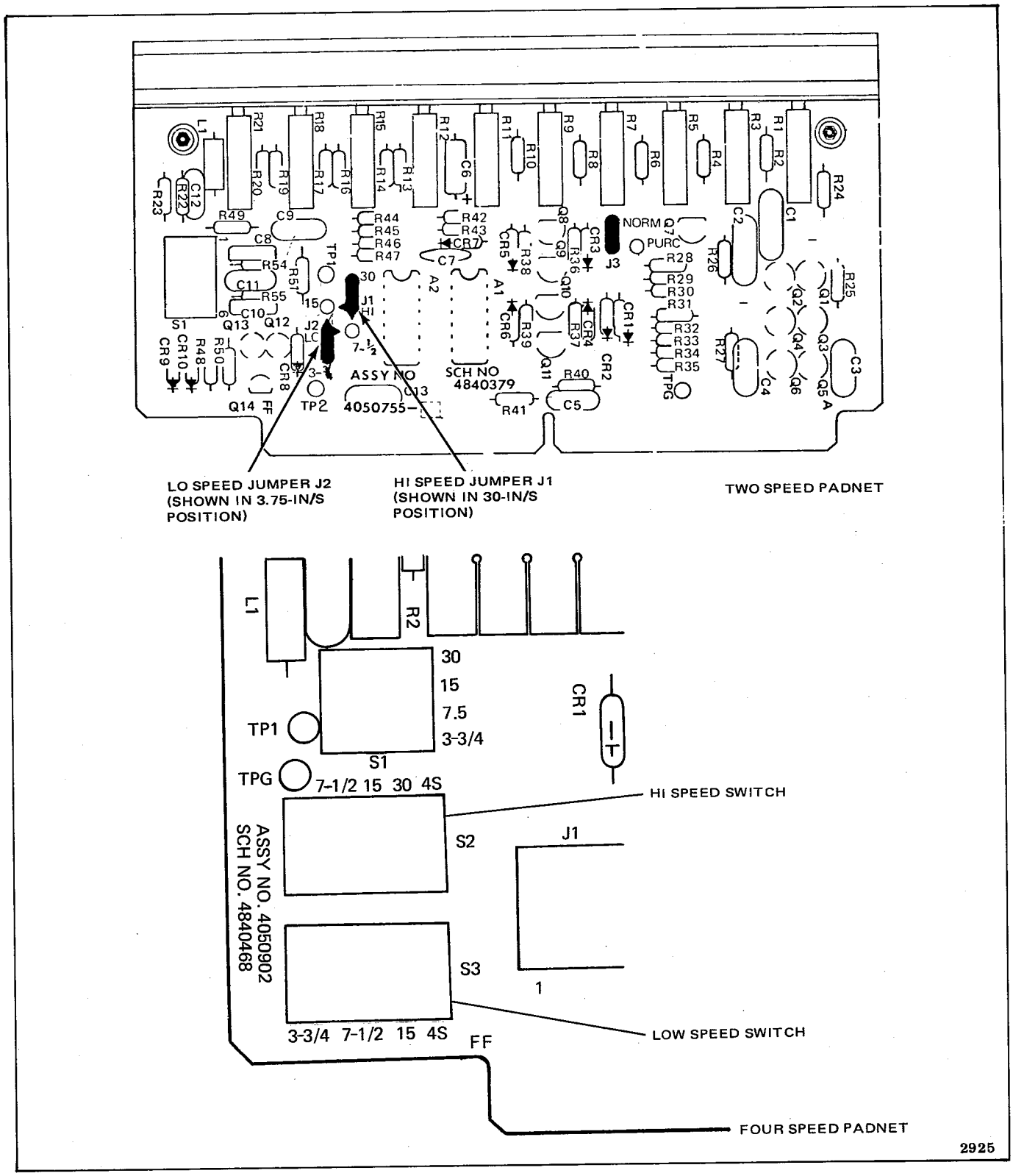


Figure 5-5. Speed Selection Controls PADNET PWA

AUDIO CONTROL CARD
PWA 5

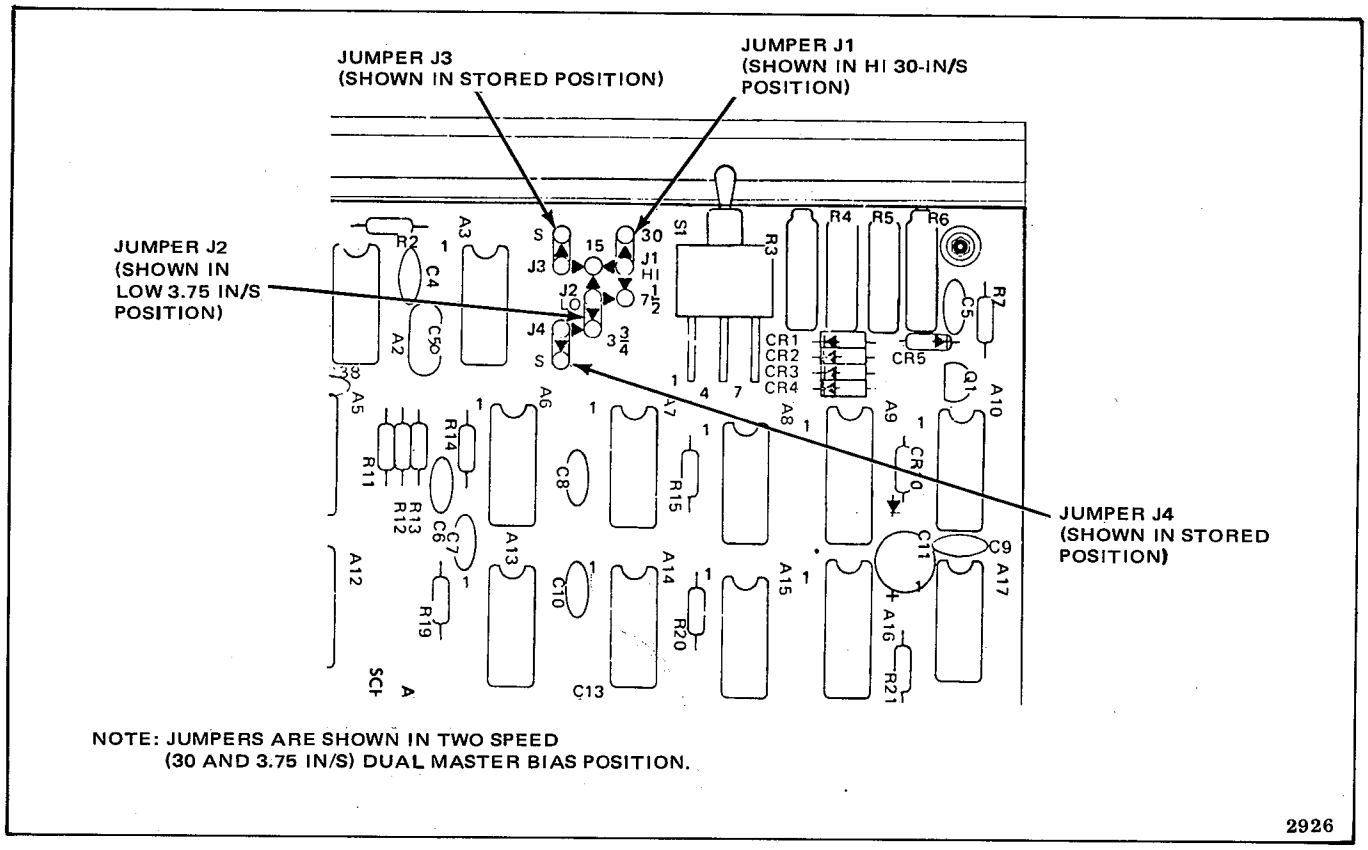


Figure 5-6. Speed/Bias Selection Jumpers, Audio Control PWA 5

adding or removing jumpers from terminals located on the input/output assembly module (Figure 5-7). Separate modification instructions are given for the input and output amplifier sections of the module.

5-19. Input Amplifier. To change the input amplifier operating configuration, proceed as follows:

5-20. *Increasing Input Sensitivity.* For a balanced input, input impedance of 25K ohms, and input sensitivity increased by 6 dB, perform the following modification.

1. Install a jumper between E16 and E17, and solder in place.
2. Install a jumper between E21 and E22, and solder in place.
3. Install capacitor C20 (47 pF, 5%, mica — customer-furnished) on the Input/Output Module PWA, and solder in place. Install the capacitor in circuit pad location designated on the Module PWA. (See note 6 on Input/Output Module PWA Schematic No. 4840421, and Figure 5-7.)

5-21. *Balanced or Unbalanced Input.* The input can be either balanced or unbalanced by the absence or presence of a jumper. For an unbalanced input, place a jumper between E24 and E25, and solder in place. For a balanced input, remove the jumper between E24 and E25.

5-22. *Bypassing Input Transformer.* If the input transformer is bypassed, the input will be unbalanced. Proceed as follows:

NOTE

If either the input or output transformer is bypassed, the signal phase will shift 180°. However, if both transformers are bypassed, the overall phase will remain the same.

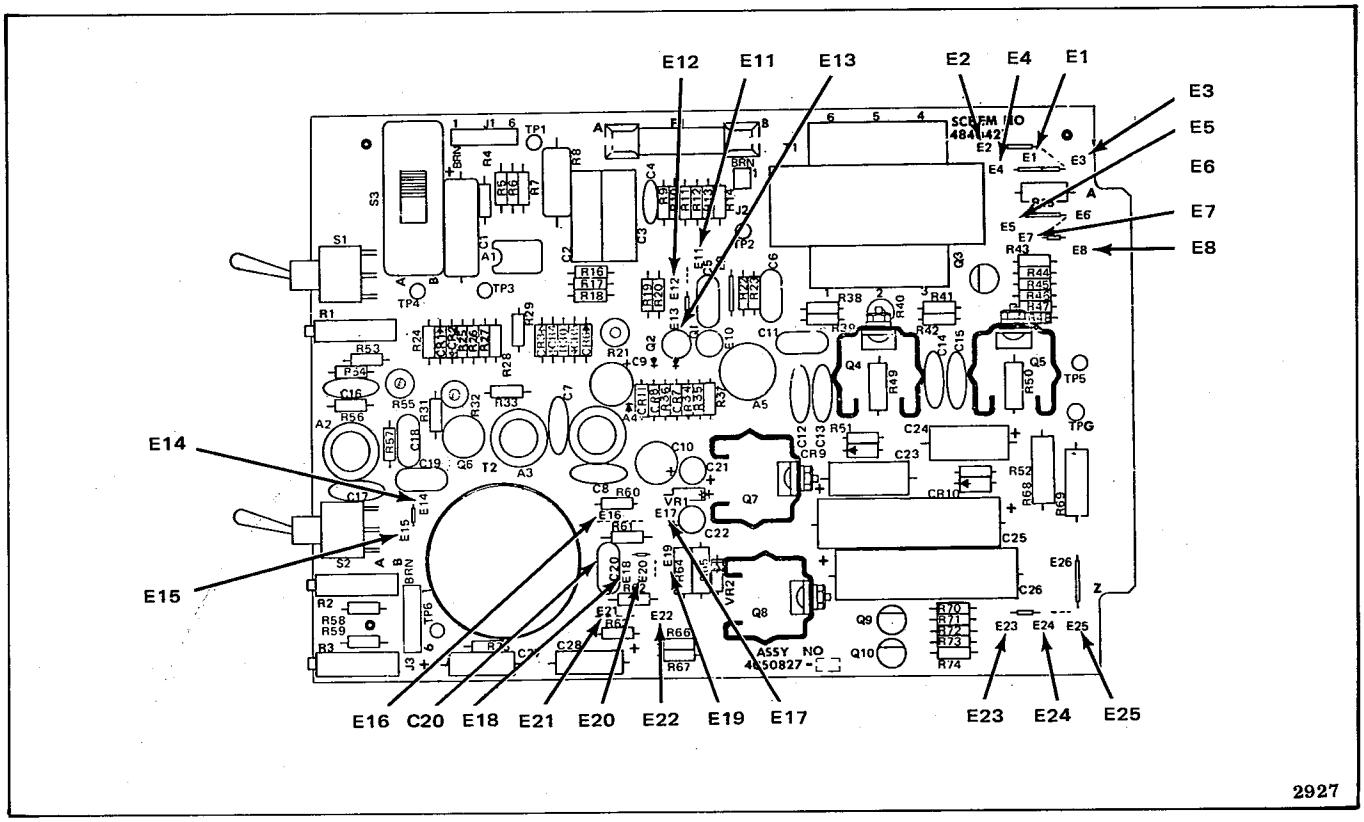


Figure 5-7. Input/Output Assembly Module — Jumper Terminals and Capacitor C20

1. Remove the following jumpers:

   E14 to E15
   E18 to E19
   E23 to E24

2. Add the following jumpers and solder in place:

   E24 to E25
   E19 to E20

3. After performing steps 1 and 2, the input impedance will be 25K ohms. To increase the gain by 6 dB and provide an input impedance of 12.7K ohms, install a jumper between E16 and E17 and solder in place.

5-23. *Shield Grounding.* The input connector (XLR type) is shipped from the factory with the shield grounded. If desired to have a "floating" shield, remove jumper between E25 and E26.

5-24. Output Amplifier. To change the putput amplifier operating configuration, proceed as follows:

5-25. *Balanced or Unbalanced Output.* The output can be either balanced or unbalanced by the absence or presence of a jumper. For an unbalanced output, place a jumper between E6 and E7 and solder in place. For a balanced output, remove the jumper between E6 and E7.

5-26. *Bypassing Output Transformer.* If the output transformer is bypassed, the output will be unbalanced. Proceed as follows:

NOTE

If either the input or output transformer is bypassed, the signal phase will shift 180°. However, if both transformers are bypassed, the overall phase will remain the same.

1. Remove the following jumpers:

   E12 to E13
   E1 to E2
   E3 to E4
   E5 to E6

2. Add the following jumpers and solder in place:

   E11 to E12
   E1 to E3
   E6 to E7

3. Change resistor R20 from 10K to 1.5K ohms, 1/4 watt.

4. Recalibrate the level meter as follows:

   a. Connect an audio oscillator to the line input connector (Figure 2-14).

   b. Set oscillator frequency to 1.0 kHz and adjust oscillator output level to +4 dBm (or other operating level selected by the user).

   c. Set RECORD MANUAL/PRESET switch to PRESET position.

   d. Place input/output module on an extender board and insert board into mainframe.

   e. Apply power and place ATR-100 into input mode.

   f. Adjust meter calibration potentiometer R21 (Figure 5-18) for –6 (meter switch S3 in peak position) or 0 (meter switch S3 in vu position).

   g. With power off, remove input/output module and extender board from mainframe and reinstall input/output module into mainframe.

   h. Disconnect audio oscillator.

5-27. *Increasing Output Resistance with Balanced Output.* To increase the output resistance of the amplifier, install appropriate equal value resistors between E3 and E4 and between E5 and E6. For example, if a nominal output resistance of 600 ohms is desired, install 300-ohm resistors between E3 and E4 and between E5 and E6. Solder resistors in place.

5-28. *Shield Grounding.* The output connector (XLR type) is shipped from the factory with the shield grounded. If desired to have a "floating" shield, remove jumper from between E7 and E8.

5-29. ALIGNMENT AND ADJUSTMENTS

The following paragraphs contain information on the use of alignment tapes and flux loop, and head azimuth phase, and reproduce equalization adjustments.

5-30. Audio Signal System Alignment

The reproduce alignment procedure must be performed prior to the record alignment procedure. Reproduce alignment consists of setting low and high frequency equalization of each channel, adjusting reproduce head azimuth and phasing (multichannel systems), and setting operating level of each channel. Record alignment consists of setting bias level, setting record high frequency equalization, and setting system output level.

The alignment procedures are presented step-by-step in serial form for reproduce and record alignment of each channel. For the alignment of 2- or 4-channel systems, and after the reader has become familiar with the procedures, it may be more convenient to perform the steps in parallel for each channel.

The basic recorder/reproducer input and output level is set to –5 dBm, regardless of the actual operating level flux level selected for use. For maximum performance, the use of Ampex 456 tape with an operating level of 370 nWb/m is recommended. (This level is 6 dB higher than the 185-nWb/m reference level on Ampex Standard Alignment Tapes.) Procedures are included in this manual for setting the operating level to 185 nWb/m, 260 nWb/m, and 370 nWb/m.

When the basic recorder/reproducer is correctly adjusted, the Ampex input/output accessory or

any input/output assembly (either one correctly adjusted) can be connected to the recorder/reproducer without any adjustment.

NOTE

All voltage levels are expressed in dB referenced to 0.775 volt rms across 600 ohms. Therefore a level of zero dBm corresponds to 0.775 volt rms.

5-31. Use of Alignment Tapes — General Discussion. The alignment tapes have been precisely recorded and must be correctly handled and stored to retain their accuracy. The following requirements should be especially followed.

1. Clean and demagnetize the heads and other tape-handling components before using the test tape.

2. Never store test tapes in areas where there are temperature or humidity extremes or where magnetic fields may be present.

3. Remove test tapes from equipment only after a normal play or spool mode run (never after a fast-winding mode).

The test tape is threaded on the recorder/reproducer in the normal tape path (from the supply to the takeup reel). During alignment procedures, the rewind and fast forward modes may be used as necessary. After alignment, wind the tape completely on the takeup reel and then place the recorder/reproducer in the rewind spool mode to wind the tape back on its original reel. Note that after extensive use, high frequency tones on the alignment tape may drop as much as 2 dB, particularly at the slower tape speeds.

Operating level and reproduce frequency response can be checked with a standard alignment tape (Table 5-1). When using a standard alignment tape that is recorded the full width of the tape to check a system with heads less than full width, the response readings below approximately 10.0 kHz become progressively invalid as the frequency decreases. This is caused by the low-frequency fringing effect of the reproduce head. The reproduce head picks up additional flux beyond the track width of the head as the frequency decreases. This error, being wavelength dependent, becomes worse as the wavelength increases.

Therefore, if the equalization is correctly adjusted, the reproduce response when using a full-track alignment tape on either a 2-track, 1/4-inch tape system or a 4-track, 1/2-inch tape system should conform to the relative curves shown in Figure 5-8 within the tolerances given in Table 5-3. The curves given in Figure 5-8 display the *relative* fringing frequency response and *do not* include the fixed error due to the wider reproduce core width (as compared to the record head width).

Table 5-4 provides the amplitude correction factors to be used when setting operating level using a full-track alignment tape on a 2-track, 1/4-inch tape system or a 4-track, 1/2-inch tape system.

The correction factors in Table 5-4 are the amounts by which the actual measured reproduce output from a full width alignment tape will exceed the reproduce output of the correct track width recorded to the same fluxivity. The table includes the fixed error due to the wider reproduce core width and the relative fringing error (shown in Figure 5-8) for frequencies of 500 Hz, 700 Hz, and 1.0 kHz. For example, when reproducing the 700-Hz, 185 nWb/m tone on an Ampex 15 in/s full-width alignment tape on a 2-track, 1/4-inch tape system, the output (as read on an ac voltmeter) will be +1.14 dB higher (Table 5-4) as compared to reproducing and alignment tape that has the same track format as the recorder/reproducer.

The amplitude correction factor of 1.14 dB was obtained by adding the following figures:

0.56 dB – compensation for wide reproduce core width (see asterisk, Table 5-4).

0.58 dB – relative fringing frequency response due to fringing error effect at 700 Hz and 15 in/s (Figure 5-8).

1.14 dB – amplitude correction factor.

Table 5-3. Reproduce Frequency Response Tolerances

SPEED	TOLERANCE ±0.5 dB	TOLERANCE ±1.5 dB	SEL SYNC ±2.0 dB
30 in/s	250 Hz – 20 kHz	35 Hz – 250 Hz 20 kHz – 28 kHz	50 Hz – 15 kHz
15 in/s	125 Hz – 15 kHz	20 Hz – 125 Hz 15 kHz – 20 kHz	40 Hz – 12 kHz
7.5 in/s	125 Hz – 10 kHz	30 Hz – 125 Hz 10 kHz – 15 kHz	–
3.75 in/s	125 Hz – 5 kHz	30 Hz – 125 Hz 5 kHz – 10 kHz	–

NOTE: To the above tolerances, add manufacturing tolerances of the alignment tape and relative fringing frequency response due to fringing effect (Figure 5-8).

Table 5-4. Amplitude Correction Factors for Setting Operating Level when using Full-Track Alignment Tapes on 2-Track or 4-Track Systems

SPEED	REFERENCE FREQUENCY	CORRECTION FACTOR*	
		2 TRACK	4 TRACK
30 in/s	500 Hz	+1.61 dB	+2.10 dB
	700 Hz	+1.46 dB	+1.85 dB
	1.0 kHz	+1.29 dB	+1.58 dB
15 in/s	500 Hz	+1.29 dB	+1.58 dB
	700 Hz	+1.14 dB	+1.34 dB
	1.0 kHz	+1.01 dB	+1.13 dB
7.5 in/s	500 Hz	+1.01 dB	+1.13 dB
	700 Hz	+0.90 dB	+0.99 dB
	1.0 kHz	+0.81 dB	+0.87 dB
3.75 in/s	500 Hz	+0.81 dB	+0.87 dB
	700 Hz	+0.74 dB	+0.79 dB
	1.0 kHz	+0.69 dB	+0.74 dB

*The amplitude correction factors shown in the table are the sum of the values shown in Figure 5-8 for the frequencies shown in the table, and the fixed errors due to wider reproduce core width as follows:

2 track – 0.56 dB due to 80-mil reproduce core on 75-mil track
4 track – 0.6 dB due to 75-mil reproduce core on 70-mil track

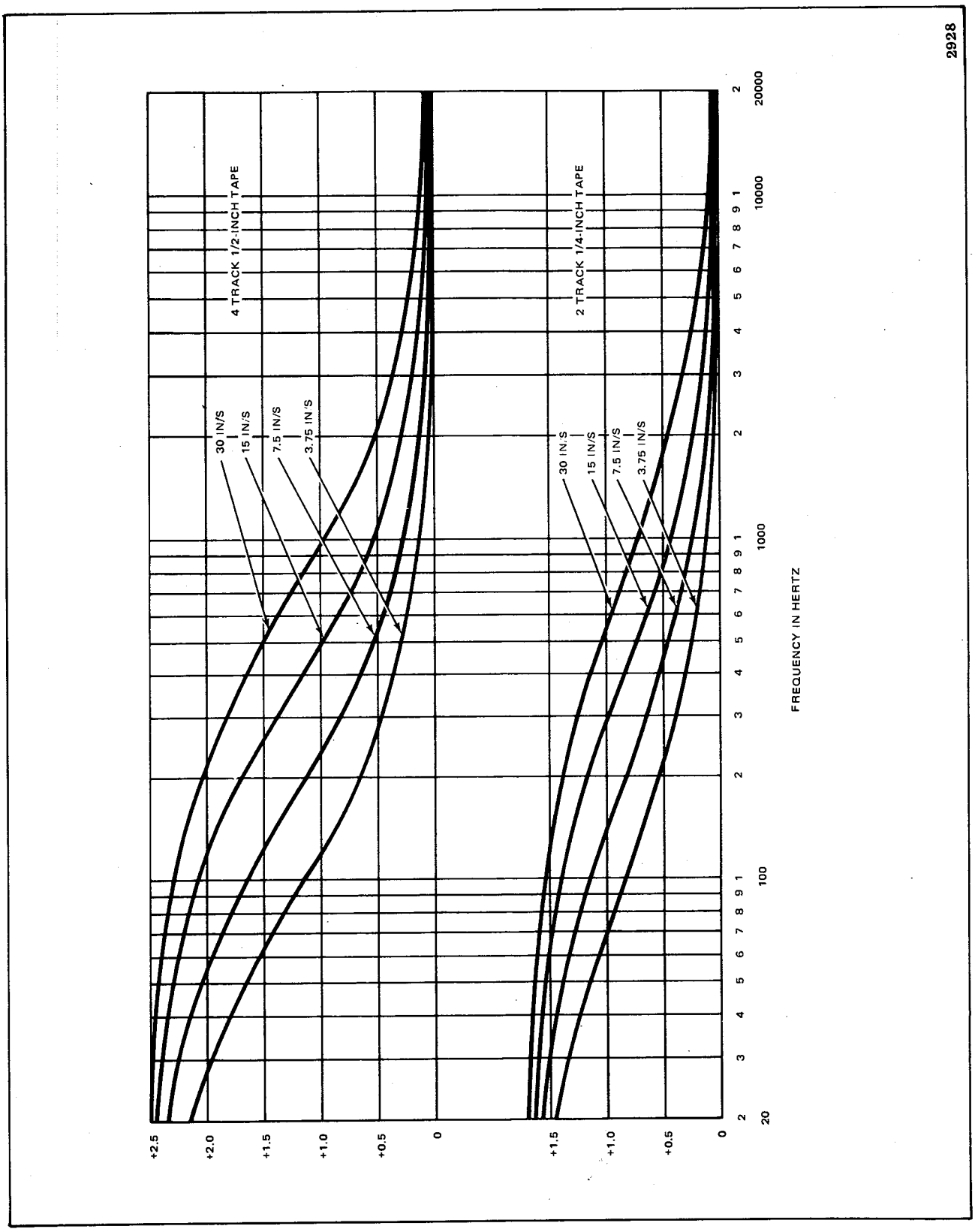


Figure 5-8. Relative Fringing Frequency Response Due to Fringing Effect

Note that if the alignment tape used matches the head track format, the correction factors given in Table 5-4 are not used. Also no corrections are required when using a full-width alignment tape to align a full-track head assembly system.

Another source of error is the reproduce head pole contour effect. This effect is prevalent when using the low-frequency sections of the alignment tape. If the alignment tape track format matches the reproduce head format, the error is not severe. This type of error can be minimized by adjustment of the low frequency reproduce equalizers while performing the overall record/reproduce alignment procedure.

5-32. Using a Flux Loop – General Discussion. An accurate method of setting equalization involves the use of a flux loop driven by an audio oscillator in order to induce an electromagnetic field into the reproduce head. The field produced by the flux loop may be equalized to simulate the short circuit flux/frequency response from an ideally recorded alignment tape. The response of a correctly equalized reproduce system to a correctly equalized flux loop will be an almost constant output with frequency over the audio range of interest. However, the use of the flux loop will not disclose the following errors:

- Reproduce head low frequency pole contour and secondary gap effect.
- Reproduce head high frequency gap loss.
- Effects due to head-to-tape contact or azimuth errors.

The ATR-100 incorporates automatically selected preset equalization to correct for secondary gap rise at 15 and 30 in/s. Therefore, at 15 and 30 in/s, with the reproduce low frequency and high frequency equalizer controls correctly set, the actual flux-looped low-frequency response will depart from a flat response by a specific amount depending on frequency. Figure 5-9 shows the correct response that should be obtained at 15 and 30 in/s with the reproduce equalizers adjusted to match the equalization standard set on the equalized flux loop. The output frequency response using a correctly equalized flux loop should be flat for 3.75 and 7.5 in/s.

A recommended flux loop for use with the ATR-100 is the Ampex flux loop (Ampex Part No. 4020423) used with an Ampex flux loop equalizing amplifier (Ampex Part No. 4040424). This equalizing amplifier contains inverse compensation for the secondary gap rise for the setting of equalization at 15 and 30 in/s. Therefore, Figure 5-9 does not apply when using the Ampex equalizing amplifier.

When an equalizing amplifier is not used, the flux loop may be passively equalized by use of a capacitor connected across the oscillator terminals, to provide the high-frequency transition. Table 5-5 provides capacitor values for specified equalization standards when using an audio oscillator with 600 ohms output and an Ampex flux loop that has a dc resistance of 100 ohms. If a flux loop or audio oscillator with other characteristics is used, a nominal capacitor value may be calculated by the following formula:

$$C = \frac{T(R_o + R_1)}{R_o \cdot R_1}$$

Where:

T = equalization transition time constant (seconds) (Table 5-5)

R_0 = oscillator output resistance (ohms)

R_1 = flux loop dc resistance (ohms)

C = capacity in μF

Figure 5-10 shows the desired system response from an unequalized flux loop, with constant current drive, for the most common equalization standards.

5-33. Head Azimuth and Phase – General Discussion. The only head adjustment required is for record and reproduce head stack azimuth. Precision mounting of the record and reproduce head stack has eliminated the need for adjusting tape wrap, height, and zenith. The azimuth adjustment is made by turning a hex socket screw accessible through the top of the head shield (Figure 5-11) which causes a tapered gear to rotate underneath the head-stack precision plate. The azimuth adjustment is adjustable over a range of ± 15 minutes of arc.

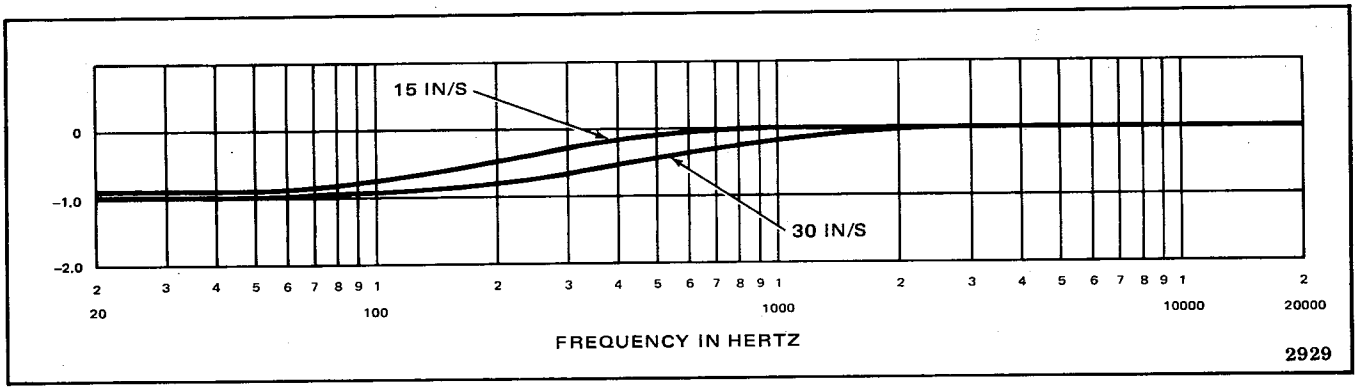


Figure 5-9. Equalized Flux Loop Response for 15 in/s and 30 in/s

Table 5-5. Capacitor Values for Passive Equalization of High Frequency Turnover

TAPE SPEED AND EQUALIZATION STANDARD	HIGH FREQUENCY TRANSITION TIME CONSTANT	−3 dB FREQUENCY	CAPACITOR VALUE*
30 in/s AES	17.5 μs	9,095 Hz	0.204 μF
15 in/s IEC/CCIR	35 μs	4,547 Hz	0.408 μF
7.5/15 in/s NAB	50 μs	3,183 Hz	0.583 μF
7.5 in/s IEC/CCIR	70 μs	2,274 Hz	0.817 μF
3.75 in/s	90 μs	1,768 Hz	1.05 μF

*Capacitor value when using audio oscillator with 600-ohm output impedance and Ampex flux loop, part number 4020423-01 (R_{loop} = 100 ohms).

The adjustment of head phase can be considered a fine adjustment of head azimuth and is adjusted to eliminate phase error between tracks of a 2-track or 4-track head assembly. Prior to the adjustment of head phase, the following criteria should be met:

1. Reproduce head — Reproduce equalization is correct.

2. Record head — Reproduce equalization and reproduce head azimuth have been adjusted. Record equalization and bias have been set for overall system high-frequency response and azimuth adjusted for maximum short wave output.

Failure to observe the above criteria can result in incorrect mechanical azimuth being set in order to compensate for inter-track phasing errors. These errors are electrical in origin (differences between tracks in reproduce equalization, record equalization and/or record bias).

5-34. Operating Level — General Discussion. The operating level used is a matter of individual preference by the user of the recorder/reproducer. However, the use of Ampex 456 tape (or direct equivalent) with an operating level of 370 nWb/m is recommended. This level will provide the lowest distortion and adequate headroom prior to tape saturation. Use of Ampex 456 tape with a lower operating level will degrade signal-to-noise ratio but will lower distortion and increase headroom.

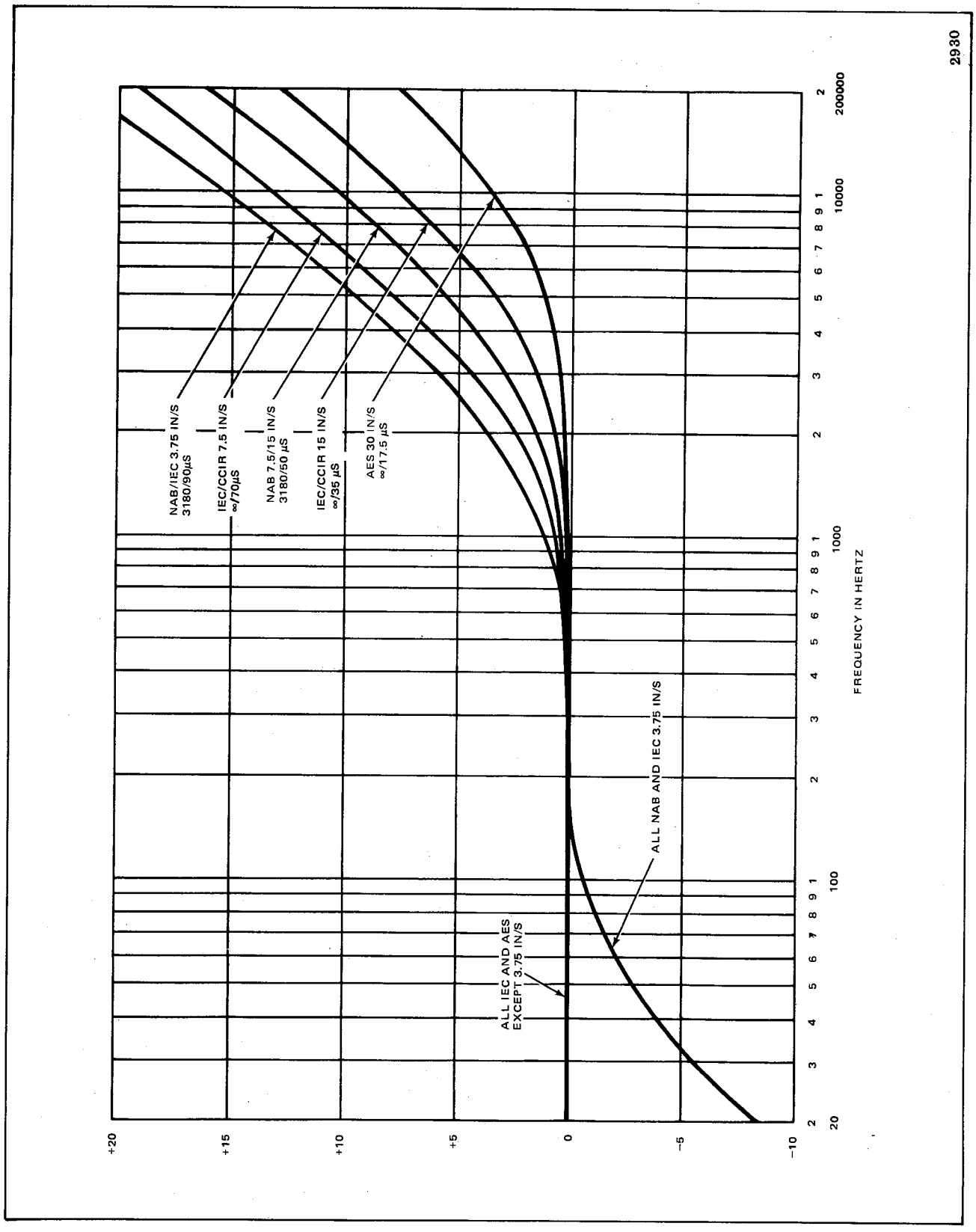


Figure 5-10. Reproduce Response from Unequalized Flux Loop

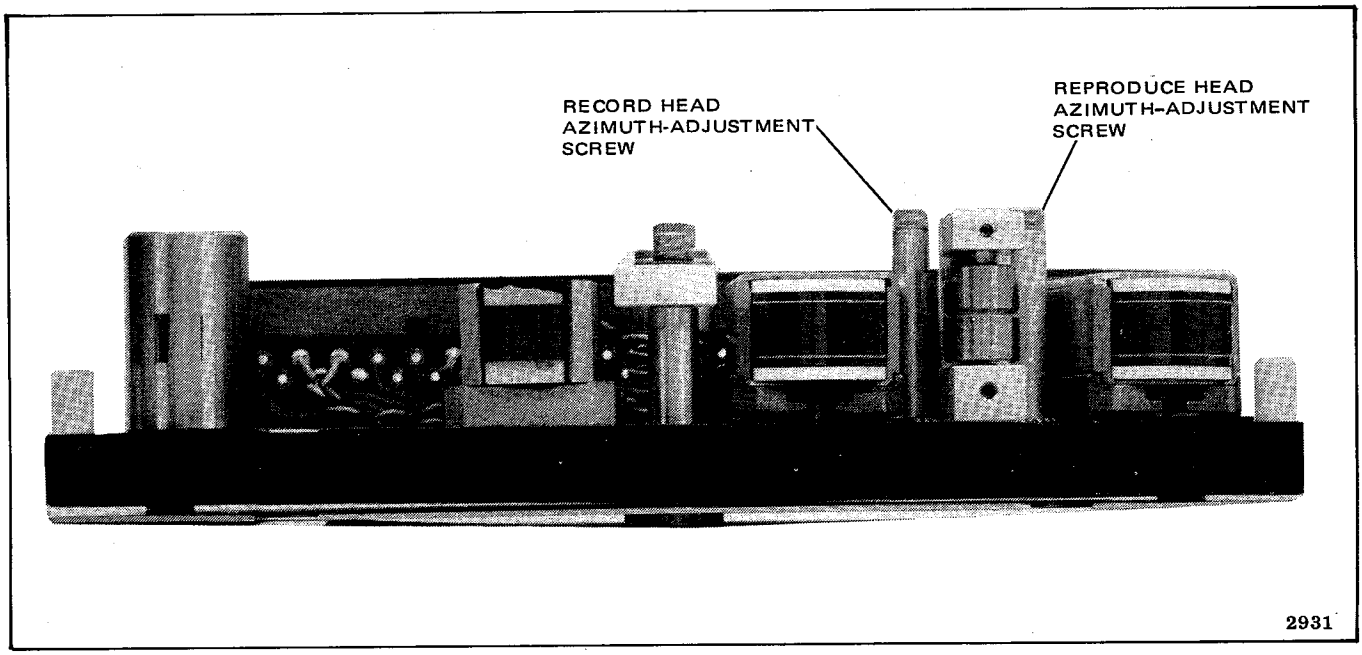


Figure 5-11. Azimuth Adjustment Screw Location

With other types of tape, other operating levels may be preferable. For example, when using Ampex 406/407 tape, an operating level of not more than 260 nWb/m is recommended.

Operating level is set while reproducing a standard alignment tape of known short circuit fluxivity, and adjusting the recorder/reproducer reproduce gain appropriately. In the case of the Ampex alignment tapes, reference levels of 700 Hz (500 Hz at 3.75 in/s) at 185 nWb/m are used. (Other manufacturers of alignment tapes have standard reference levels at 200 nWb/m or 250 nWb/m at 1.0 kHz, or 320 nWb/m at 1.0 kHz.) Table 5-6 shows the relative differences in level between Ampex reference level (185 nWb/m) and other reference levels in domestic and international use.

If a full width alignment tape is used to set reproduce gain on a 2- or 4-track system, errors in absolute reproduce sensitivity to recorded fluxivity will result due to the fringing effect. This error becomes more pronounced at the higher tape speeds. Table 5-4 lists the correction factors to be applied when using a full-width alignment tape for setting reference level when using a 2-track or 4-track reproduce head assembly.

The correction factors in Table 5-4 are the amounts by which the actual measured reproduce output from a full-width alignment tape will exceed the reproduce output of the correct track width recorded to the same fluxivity. For example, when reproducing the 700-Hz, 185-nWb/m tone of an Ampex 15 in/s full-width alignment tape on a 2-track, 1/4-inch head assembly, the reproduce gain is set to provide 1.14 dB higher output than actually required. This correction factor provided in Table 5-4 also compensates for the wider-than-normal core head used on the ATR-100. The wider reproduce core minimizes level errors when reproducing tape recorded on other machines with head heights set incorrectly.

Note that if the alignment tape used matches the head track format, the correction factors given in Table 5-4 are not used. Also no corrections are required when using a full-width alignment tape to align a full-track head system.

5-35. Reproduce Equalization Adjustment. Reproduce equalization adjustment consists of setting the low and high frequency equalization of each audio channel, utilizing a standard alignment tape or a flux loop. The more accurate method of

Table 5-6. Relative Operating Levels

DESCRIPTION	RELATIVE LEVEL	SHORT CIRCUIT FLUXIVITY	FREQUENCY
Ampex reference level (standard operating level)	0 dB	185 nWb/m	700 Hz or 500 Hz
Other U.S. reference levels	+0.7 dB	200 nWb/m	1.0 kHz
Elevated operating level	+3 dB	250/260 nWb/m	1.0 kHz
IEC reference level	+4.8 dB	320 nWb/m	1.0 kHz
Recommended operating level for ATR-100 and 456 tape	+6 dB	370 nWb/m	700 Hz

setting equalization involves the use of a flux loop driven by an audio oscillator to induce a flux into the reproduce head. Both methods of setting equalization are given in the procedures. Prior to performing the alignment procedure, refer to the general discussion regarding the use of flux loops, paragraph 5-32.

NOTE

Where input and output line levels pertaining to the input/output assembly are stated, it is assumed that the input/output assembly has been set to the factory-adjusted input and output line level of +4-dBm operating level (0 vu). If another value line input and output operating level is being used, the levels stated in the adjustment procedures should be amended by the amount of deviation from the +4-dBm operating level.

CAUTION

TO PREVENT POSSIBLE DAMAGE TO ELECTRICAL COMPONENTS ON A PRINTED WIRING ASSEMBLY (PWA), ALWAYS TURN RECORDER/REPRODUCER POWER OFF BEFORE REMOVING OR INSTALLING A PWA IN THE RECORDER/REPRODUCER OR INPUT/OUTPUT ASSEMBLY.

5-36. *Equalization Adjustment on the 2-Speed PADNET Using an Alignment Tape.* The procedure assumes use of an Ampex alignment tape. Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* portion of the manual, paragraphs 5-4 and 5-7.

2. Remove Main Audio PWA from electronics assembly corresponding to channel being adjusted.

3. Set control R34 (Figure 5-12) to midrange. Reinstall PWA.

4. Set REPR GAIN control R1 on PADNET PWA (Table 5-7) to full clockwise position.

5. Connect ac voltmeter to one of the following output connectors.

   a. If an input/output assembly is not being used, connect ac voltmeter to appropriate recorder/reproducer output connector J13 or J14 (Figure 2-13 and Tables 2-2 and 2-3).

   b. If an input/output assembly is being used, connect ac voltmeter to appropriate output connector (Figures 2-14 and 2-15).

6. Select appropriate system tape speed at the transport control panel.

7. Thread appropriate alignment tape (Table 5-1) on the transport and place system in thread mode.

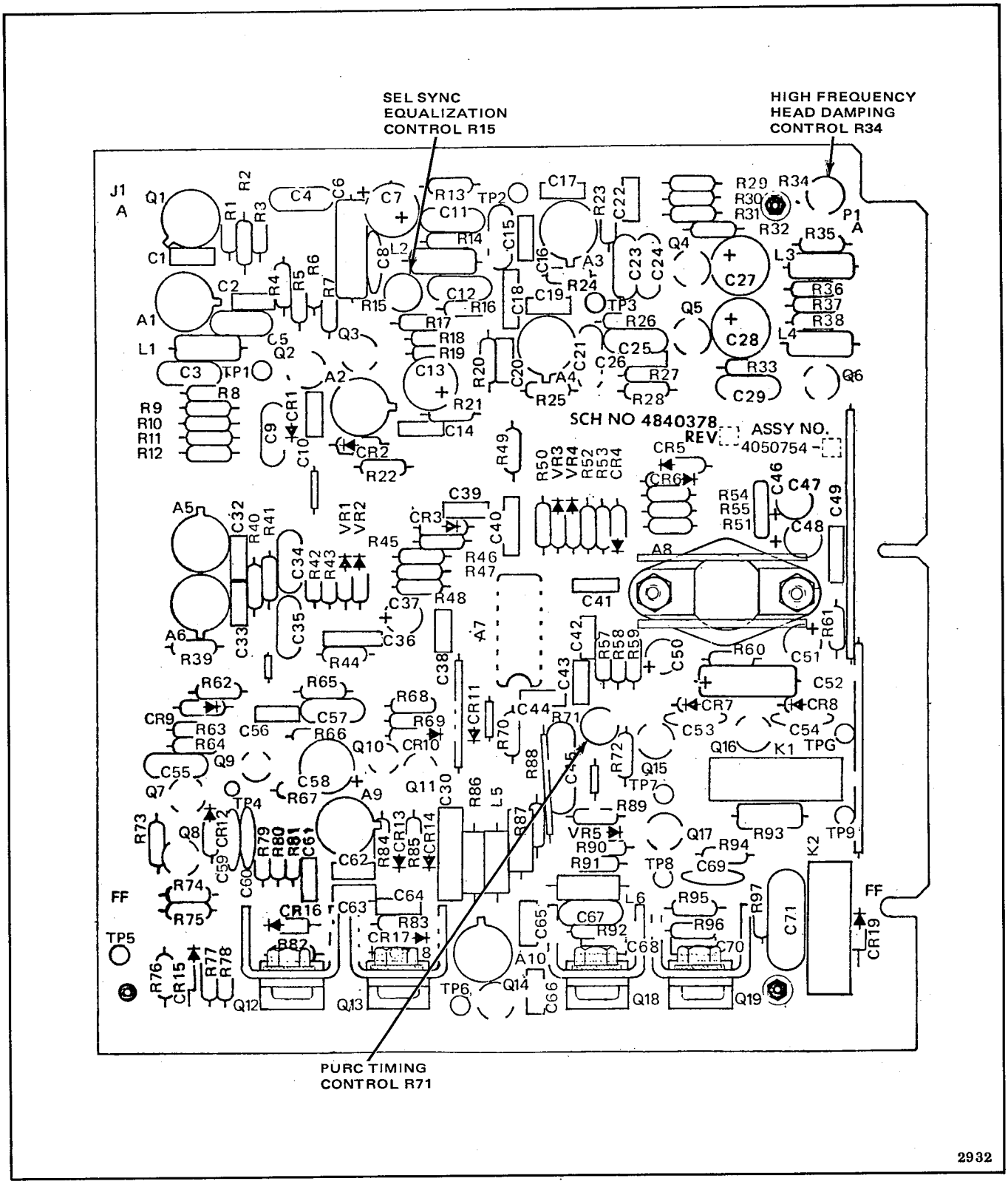


Figure 5-12. Main Audio PWA 1, 2, 3, or 4 — Alignment Controls

NOTE

If a full-track alignment tape is used to adjust a multitrack system, it will be necessary to correct for the fringing effect. Refer to fringing effect discussion given under *Use of Alignment Tapes,* paragraph 5-31.

8. If an input/output assembly is being used, place REPRODUCE MANUAL/PRESET switch on input/output module to PRESET position.

9. Place system in play mode and establish reference frequency level as follows:

   a. 3.75 in/s — Set REPR GAIN control so that ac voltmeter reads −15 dBm at the 500-Hz reference tone (−10 dB below 185 nWb/m, first tone on tape) at the output of the recorder/reproducer, or −6 dBm at the output of the input/output assembly.

   b. 7.5 in/s — Set REPR GAIN control so that ac voltmeter reads −15 dBm at the 700-Hz reference tone (−10 dB below 185 nWb/m, first tone on tape) at the output of the recorder/reproducer, or −6 dBm at the output of the input/output assembly.

   c. 15 or 30 in/s — Set REPR GAIN control so that ac voltmeter reads −5 dBm at the 700-Hz reference tone (185 nWb/m, first tone on tape) at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.

10. While reproducing the highest frequency tone on the alignment tape (7.5 kHz at 3.75 in/s or 15 kHz at 7.5, 15, and 30 in/s), adjust the reproduce head azimuth screw (Figure 5-11) for maximum output.

11. While reproducing the 10.0-kHz tone (7.50 kHz at 3.75 in/s), adjust appropriate reproduce equalizer control (HI SPEED HF or LO SPEED HF) on PADNET (Table 5-7) for the same level obtained in step 9 (or to required relative level as indicated in Figure 5-8, if applicable).

12. While reproducing the 50-Hz tone, adjust appropriate reproduce equalizer control (HI SPEED LF or LO SPEED LF) on PADNET for the same level obtained in step 9. (Note: This is an approximate setting, final adjustment will be made during an overall record/reproduce alignment procedure.)

13. Reproduce the frequency response test tones on the alignment tape. Reproduce response should conform to tolerances shown in Table 5-3. If applicable, refer to relative fringing error curves shown in Figure 5-8.

14. Repeat steps 2 through 13 for other audio channels to be adjusted.

15. Adjust operating level by following instructions given starting with paragraph 5-43.

NOTE

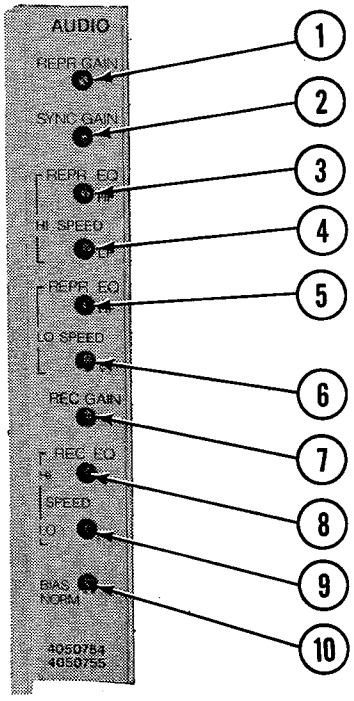
Final adjustment of the reproduce low frequency equalizers for optimum low-frequency response will be accomplished during an overall record/reproduce alignment procedure given later in this section of the manual.

5-37. *Equalization Adjustment on the 4-Speed PADNET Using an Alignment Tape.* The procedure assumes use of an Ampex alignment tape. Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* portion of the manual, paragraphs 5-4 and 5-7.

2. Remove Main Audio PWA from electronics assembly corresponding to channel being adjusted.

Table 5-7. 2-Speed PADNET PWA – Alignment Controls



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INDEX NO.	CONTROL	FUNCTION
1	REPR GAIN (R1)	Adjusts basic recorder/reproducer interface reproduce level.
2	SYNC GAIN (R3)	Adjusts basic recorder/reproducer sel sync reproduce interface level.
3	HI SPEED HF (R5)	Adjusts high-speed, high-frequency reproduce equalization.
4	HI SPEED LF (R7)	Adjusts high-speed, low-frequency reproduce equalization.
5	LO SPEED HF (R9)	Adjusts low-speed, high-frequency reproduce equalization.
6	LO SPEED LF (R11)	Adjusts low-speed, low-frequency reproduce equalization.
7	REC GAIN (R12)	Adjusts basic recorder/reproducer interface record level.
8	HI SPEED (R15)	Adjusts high-speed, high-frequency record equalization.
9	LO SPEED (R18)	Adjusts low-speed, high-frequency record equalization.
10	BIAS NORM (R21)	Normalizes bias level for individual channel to common master bias bus level.

3. Set control R34 (Figure 5-12) to midrange. Reinstall PWA.

4. Set all REPRO GAIN controls (R23, R24, R25, and R26) on PADNET PWA (Table 5-8) to full clockwise position.

5. Connect ac voltmeter to one of the following output connectors.

   a. If an input/output assembly is not being used, connect ac voltmeter to appropriate recorder/reproducer output connector J13

Table 5-8. Reproduce Tape Speed Adjustments

TAPE SPEED	REPRO GAIN	REPRO EQ	
		HF	LF
30	R26	R22	R18
15	R25	R21	R17
7.5	R24	R20	R16
3.75	R23	R19	R15

or J14 (Figure 2-13 and Tables 2-2 and 2-3).

b. If an input/output is being used, connect ac voltmeter to appropriate output connector (Figures 2-14 and 2-15).

6. Select appropriate system tape speed at the transport control panel.

7. Thread appropriate alignment tape (Table 5-1) on the transport and place system in thread mode.

NOTE

If a full-track alignment tape is used to adjust a multitrack system, it will be necessary to correct for the fringing effect. Refer to fringing effect discussion given under *Use of Alignment Tapes,* paragraph 5-31.

8. If an input/output assembly is being used, place REPRODUCE MANUAL/PRESET switch on input/output module to PRESET position.

9. Place system in play mode and establish reference frequency as follows: (see Figure 5-13).

a. 3.75 in/s – Set REPRO GAIN 3.75 control so that ac voltmeter reads –15 dBm at the

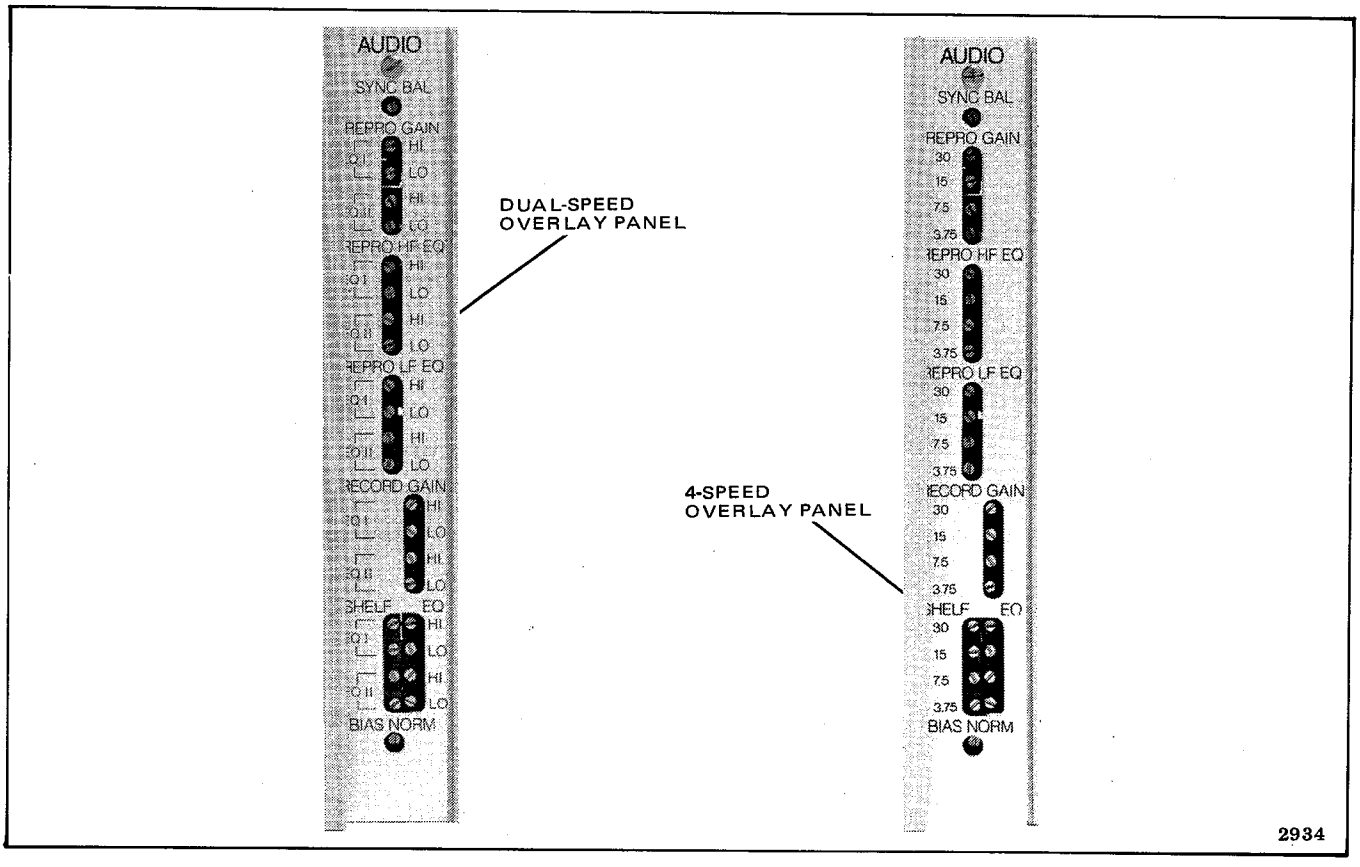


Figure 5-13. Overlay Panels, Main Audio PWA Nos. 1, 2, 3, and 4 for Use with 4-Speed PADNET

500-Hz reference tone (–10 dB below 185 nWb/m, first tone on tape) at the output of the recorder/reproducer, or –6 dBm at the output of the input/output assembly.

b. 7.5 in/s – Set REPRO GAIN 7.5 control so that ac voltmeter reads –15 dBm at the 700-Hz reference tone (–10 dB below 185 nWb/m, first tone on tape) at the output of the recorder/reproducer, or –6 dBm at the output of the input/output assembly.

c. 15 in/s – Set REPRO GAIN 15 control so that ac voltmeter reads –5 dBm at the 700-Hz reference tone (185 nWb/m, first tone on tape) at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.

d. 30 in/s – Set REPRO GAIN 30 control so that ac voltmeter reads –5 dBm at the 700-Hz reference tone (185 nWb/m first tone on tape) at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.

10. While reproducing the highest frequency tone on the alignment tape (7.5 kHz at 3.75 in/s or 15 kHz at 7.5, 15, and 30 in/s), adjust the reproduce head azimuth screw (Figure 5-11) for maximum output.

11. While reproducing the 10.0-kHz tone (7.50 kHz at 3.75 in/s), adjust appropriate REPRO EQ control R19, R20, R21, or R22 (HF) or R15, R16, R17 or R18 (LF) (see Table 5-8) on PADNET (Table 5-9) for the same level obtained in step 9 (or to required relative level as indicated in Figure 5-8, if applicable).

12. While reproducing the 50-Hz tone, adjust appropriate reproduce equalizer control R19, R20, R21 or R22 (HF) or R15, R16, R17 or R18 (LF) on PADNET for the same level obtained in step 9. (Note: This is an approximate setting, final adjustment will be made during an overall record/reproduce alignment procedure.)

13. Reproduce the frequency response test tones on the alignment tape. Reproduce response should conform to tolerances shown in Table 5-3. If applicable, refer to relative fringing error curves shown in Figure 5-8.

14. Repeat steps 2 through 13 for other audio channels to be adjusted.

15. Adjust operating level by following instructions given starting with paragraph 5-43.

NOTE

Final adjustment of the reproduce low frequency equalizers for optimum low-frequency response will be accomplished during an overall record/reproduce alignment procedure given later in this section of the manual.

5-38. *Reproduce Equalization Adjustment on the 2-Speed PADNET Using a Flux Loop.* A flux loop is used to induce an electromagnetic field into the reproduce head for the purpose of adjusting reproduce equalization. Prior to performing the alignment procedure, refer to the general discussion concerning the use of flux loops, paragraph 5-32. Proceed as follows:

1. With system power off, remove Main Audio PWA from electronics assembly corresponding to channel being adjusted.

2. Set control R34 (Figure 5-12) to midrange. Reinstall PWA.

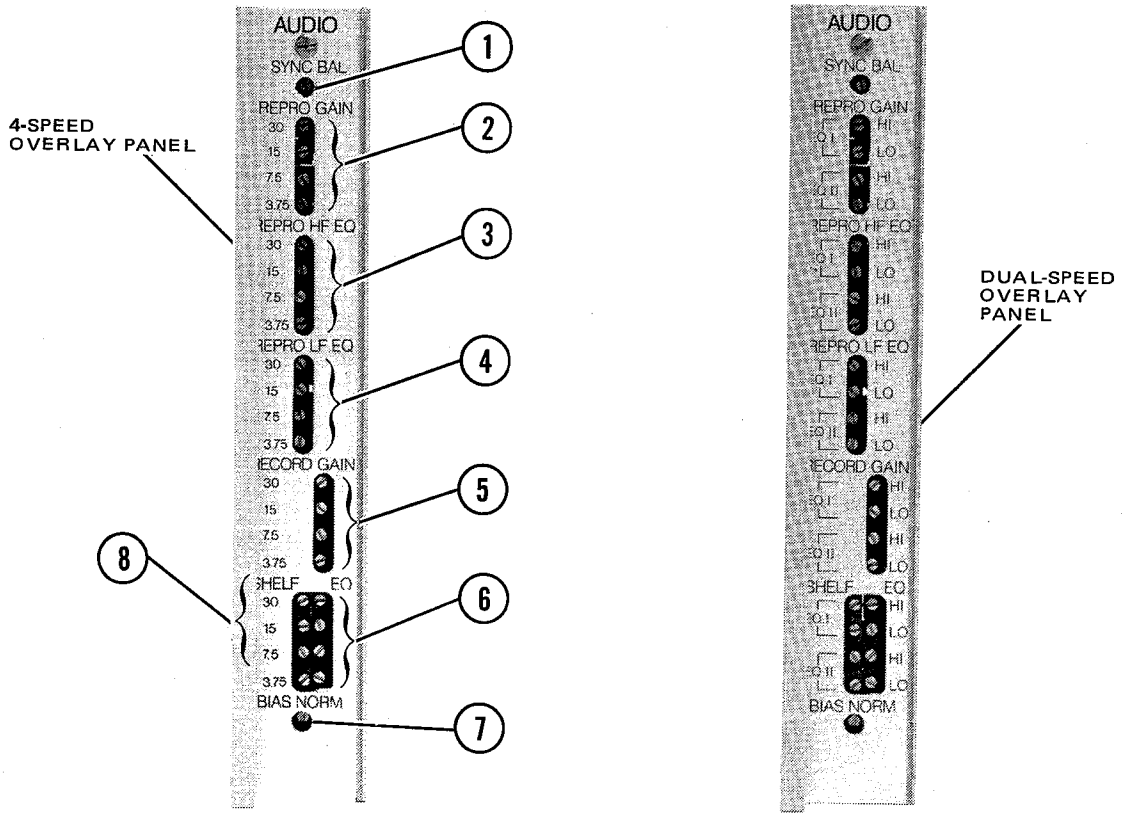
3. Select appropriate system tape speed at the transport control panel.

4. Clip flux loop to reproduce head.

5. If a flux loop equalizing amplifier is being used (Table 5-1), select the appropriate equalization time constant on the amplifier and connect amplifier to audio oscillator. Observe that amplifier is not overdriven so as to cause clipping, particularly of low-frequency signals.

6. If a flux loop equalizing amplifier is not being used, connect an appropriate equalizing capacitor (Table 5-5) across audio oscillator terminals and connect flux loop (Ampex Part No. 4020423) to the oscillator.

Table 5-9. 4-Speed PADNET PWA — Alignment Controls



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INDEX NO.	CONTROL	FUNCTION
1	SYNC BALANCE (R27)	Adjusts basic recorder/reproducer sel sync reproduce interface level.
2	30 REPRO GAIN (R26) 15 REPRO GAIN (R25) 7.5 REPRO GAIN (R24) 3.75 REPRO GAIN (R23)	Adjusts recorder/reproducer interface reproduce level for selected tape speed.
3	30 REPRO HF EQ (R22) 15 REPRO HF EQ (R21) 7.5 REPRO HF EQ (R20) 3.75 REPRO HF EQ (R19)	Adjusts high-frequency reproduce equalization for selected tape speed.
4	30 REPRO LF EQ (R18) 15 REPRO LF EQ (R17) 7.5 REPRO LF EQ (R16) 3.75 REPRO LF EQ (R15)	Adjusts low-frequency reproduce equalization for selected tape speed.
5	30 REC GAIN (R48) 15 REC GAIN (R49) 7.5 REC GAIN (R50) 3.75 REC GAIN (R51)	Adjusts recorder/reproducer interface record level for selected tape speed.

Table 5-9. 4-Speed PADNET PWA – Alignment Controls (Continued)

INDEX NO.	CONTROL	FUNCTION
6	30 EQ (R52) 15 EQ (R53) 7.5 EQ (R54) 3.75 EQ (R55)	Adjusts record equalization for selected tape speed.
7	BIAS NORM (R1)	Normalizes bias level for individual channel to common master bias bus level.
8	30 SHELF (R6) 15 SHELF (R5) 7.5 SHELF (R4) 3.75 SHELF (R3)	Adjusts record shelfing on all selected tape speeds.
NOTE:	(1) When dual speed overlay is installed reference designations of controls will remain the same. (2) EQ I HI/LO refers to speed selected in configuration 2 with bias switch in the I position. (3) EQ II HI/LO is similar to EQ I except the bias switch will be in the EQ II position.	

7. Set oscillator to +4 dBm output at 1.0 kHz.
8. Connect ac voltmeter to one of the following output connectors:
   a. If an input/output assembly is not being used, connect ac voltmeter to appropriate recorder/reproducer output connector J13 and J14 (Figure 2-13 and Tables 2-2 and 2-3).
   b. If an input/output assembly is being used, connect ac voltmeter to appropriate recorder/reproducer output connector (Figures 2-14 and 2-15).
9. If an input/output assembly is being used, place REPRODUCE MANUAL/PRESET switch on input/output module to PRESET position.
10. Apply system power and set REPR GAIN control so that ac voltmeter reads –20 dBm at the output of the recorder/reproducer, or –10 dBm at the output of the input/output assembly.
11. Change oscillator frequency to 15.0 kHz.
12. Adjust appropriate reproduce equalizer control (HI SPEED HF or LOW SPEED HF) on PADNET for the same level obtained in step 10.
13. Sweep oscillator through frequency range of 10 kHz to 20 kHz. The response should be within ±0.25 dB of the level at 10 kHz. If not, remove power and make slight adjustment of R34 on Main Audio PWA. Reinstall PWA and apply power.
14. Repeat step 13 as necessary to achieve the desired results.
15. Change oscillator frequency to 30 Hz.
16. Adjust appropriate reproduce equalizer control (HI SPEED LF or LOW SPEED LF) on PADNET for same level obtained in step 10 for 3.75 in/s or 7.5 in/s, or for level to conform to response curves in Figure 5-9 for 15 in/s or 30 in/s.

NOTE

The Ampex flux loop equalizing amolifier contains compensation for secondary gap rise. Therefore the equalizer control should be set for flat response and reference to Figure 5-9 is not required.

17. Sweep oscillator through frequency range of 20 Hz to 20 kHz. For speeds 3.75 in/s and 7.5 in/s, response should be flat ±0.25 dB. For

speeds 15 in/s and 30 in/s, response should match curves in Figure 5-9 within ±0.25 dB.

18. Repeat steps 1 through 17 for the other audio channels to be adjusted.

NOTE

Final adjustment of the reproduce low-frequency equalizers for optimum low-frequency response will be accomplished during an overall record/reproduce alignment procedure given later in this section of the manual.

5-39. *Reproduce Equalization Adjustment on the 4-Speed PADNET Using a Flux Loop.* A flux loop is used to induce an electromagnetic field into the reproduce head for the purpose of adjusting reproduce equalization. Prior to performing the alignment procedure, refer to the general discussion concerning the use of flux loops, paragraph 5-32. Proceed as follows:

1. With system power off, remove Main Audio PWA from electronics assembly corresponding to channel being adjusted.
2. Set control R34 (Figure 5-12) to midrange. Reinstall PWA.
3. Select appropriate system tape speed at the transport control panel.
4. Clip flux loop to reproduce head.
5. If a flux loop equalizing amplifier is being used (Table 5-1), select the appropriate equalization time constant on the amplifier and connect amplifier to audio oscillator. Observe that amplifier is not overdriven so as to cause clipping, particularly of low-frequency signals.
6. If a flux loop equalizing amplifier is not being used, connect an appropriate equalizing capacitor (Table 5-5) across audio oscillator terminals and connect flux loop (Ampex Part No. 4020423) to the oscillator.
7. Set oscillator to +4 dBm output at 1.0 kHz.
8. Connect ac voltmeter to one of the following output connectors:
   a. If an input/output assembly is not being used, connect ac voltmeter to appropriate recorder/reproducer output connector J13 and J14 (Figure 2-13 and Tables 2-2 and 2-3).
   b. If an input/output assembly is being used, connect ac voltmeter to appropriate recorder/reproducer output connector (Figures 2-14 and 2-15).
9. If an input/output assembly is being used, place REPRODUCE MANUAL/PRESET switch on input/output module to PRESET position.

NOTE

Refer to Table 5-8 for proper PADNET controls to be adjusted at selected tape speed.

10. Apply system power and set appropriate REPRO GAIN control R23, R24, R25, or R26 so that ac voltmeter reads −20 dBm at the output of the recorder/reproducer, or −10 dBm at the output of the input/output assembly.
11. Change oscillator frequency to 15.0 kHz.
12. Adjust appropriate reproduce equalizer control R19, R20, R21, or R22 (REPRO HF EQ) or R15, R16, R17 or R18 (REPRO LF EQ) on PADNET for the same level obtained in step 10.
13. Sweep oscillator through frequency range of 10 kHz to 20 kHz. The response should be within ±0.25 dB of the level at 10 kHz. If not, remove power and make slight adjustment of R34 on Main Audio PWA. Reinstall PWA and apply power.
14. Repeat step 13 as necessary to achieve the desired results.
15. Change oscillator frequency to 30 Hz.
16. Adjust appropriate reproduce equalizer control R19, R20, R21, or R22 (REPRO HF EQ) or R15, R16, R17, or R18 (REPRO LF EQ)

on PADNET for same level obtained in step 10 for 3.75 in/s or 7.5 in/s, or for level to conform to response curves in Figure 5-9 for 15 in/s or 30 in/s.

NOTE

The Ampex flux loop equalizing amplifier contains compensation for secondary gap rise. Therefore the equalizer control should be set for flat response and reference to Figure 5-9 is not required.

17. Sweep oscillator through frequency range of 20 Hz to 20 kHz. For speeds 3.75 in/s and 7.5 in/s, response should be flat ±0.25 dB. For speeds 15 in/s and 30 in/s, response should match curves in Figure 5-9 within ±0.25 dB.

18. Repeat steps 10 through 17 for each tape speed.

19. Repeat steps 1 through 17 for the other audio channels to be adjusted.

5-40. Reproduce Head Azimuth and Phase Adjustment. The adjustment of head phase can be considered a fine adjustment of head azimuth and is adjusted to eliminate phase error between tracks of a 2-track or 4-track head assembly. Prior to performing the alignment procedure, refer to the general discussion concerning head azimuth and phase adjustment, paragraph 5-33.

5-41. *2-Track or 4-Track Reproduce Head Azimuth and Phase Adjustment.* Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described under *Preventive Maintenance,* paragraphs 5-4 and 5-7.

2. As a preliminary adjustment, turn reproduce head azimuth adjusting screw (Figure 5-11) so that reference hole in tapered gear is in front of the head-gap region.

3. Connect a dual trace scope as follows:

NOTE

If a dual trace scope is not available, proceed to step 4.

a. For a 2-track head assembly system, connect scope to channel 1 and channel 2 outputs of the recorder system.

b. For a 4-track head assembly system, connect scope to channel 1 and channel 4 outputs of the recorder system.

c. Trigger scope from recorder channel 1 output.

d. Proceed to step 5.

4. If a dual trace scope is not available, connect a single channel scope to display a Lissajou pattern as follows:

a. For a 2-track head assembly system, connect channel 1 output to the vertical input of scope, and connect channel 2 output to the horizontal input of the scope.

b. For a 4-track head assembly system, connect channel 1 output to the vertical input of scope, and connect channel 4 output to the horizontal input of the scope.

5. Thread appropriate alignment tape (Table 5-1) on the transport and place system in thread mode.

6. While reproducing the 700-Hz (500-Hz at 3.75 in/s), 185-nWb/m tone, adjust reproduce head azimuth adjusting screw to obtain minimum phase error as viewed on scope (or Lissajou pattern straight line at 45°).

7. Minimize average phase error by carefully adjusting the head azimuth adjusting screw while playing back one of the following higher frequency test tones on the alignment tape.

a. 30 in/s — 15 kHz

b. 15 in/s — 10 kHz

c. 7.5 in/s — 5.0 kHz

d. 3.75 in/s — 2.5 kHz

NOTE

The frequencies given in step 7 were chosen to provide a wavelength on tape of 1.5 mils or longer. For use of alignment tapes with other than the above frequencies, wavelength may be calculated by the formula:

$$\lambda = \frac{v}{f}$$

Where:

λ = wavelength on tape (inches)

v = tape speed (in/s)

f = frequency (Hz)

8. Minimize means phase error by repeating step 7 but playing back the highest frequency test tone on the alignment tape.

9. For a 4-track head assembly system, play back full sequence of test tones and observe that no phase reversal occurs. If phase reversal occurs, repeat steps 6 through 8. (Note that for a 2-track head assembly system, it is not possible to incorrectly set phase if wavelength is 1.5 mil or longer.)

10. For a 4-track head assembly system only while observing a 1.5-mil wavelength, replace the channel 4 output to the oscilloscope with channel 3 and then with channel 2. The mean phase error at this wavelength should be less than ± 10° . (Note: This figure depends on the accuracy that reproduce high-frequency equalization has been set, and upon the quality and mechanical condition of the alignment tape.)

5-42. *Full-Track Reproduce Head Azimuth Adjustment.* Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* portion of this section of the manual.

2. As a preliminary adjustment, turn reproduce head azimuth adjusting screw (Figure 5-11) so that reference hole in tapered gear is in front of the head-gap region.

3. If an input/output assembly is not being used, connect scope or ac voltmeter to output of recorder system.

4. Select the lower of the two operating speeds selected for recorder operation.

5. Thread the appropriate full-track alignment tape (Table 5-1) on transport, and place system in thread mode.

6. While reproducing the highest tone on the alignment tape (shortest wavelength), adjust the reproduce head azimuth adjusting screw for maximum signal amplitude as read on input/output assembly meter, or on scope or ac voltmeter. (Note: At the slower tape speeds, it may be possible to set azimuth to an incorrect secondary peak. Rotate azimuth adjusting screw through 360° to ensure that the maximum amplitude peak is obtained. Continuous rotation of azimuth adjusting screw provides only ± 15 minute of arc change.)

5-43. Operating Level Adjustment. Operating level is set by reproducing a standard alignment tape of known short circuit fluxivity, and adjusting the recorder/reproducer reproduce gain for the desired operating level. Prior to performing the alignment procedure, refer to the general discussion concerning operating level, paragraph 5-34. Note that on Ampex alignment tapes for 15 and 30 in/s, the 185 nWb/m, 700 Hz reference tone is the first tone on the tape. For 3.75 and 7.5 in/s, the 185 nWb/m, 700 Hz (500 Hz at 3.75 in/s) tone is the last tone on the tape.

NOTE

Where input and output line levels pertaining to the input/output assembly are stated, it is assumed that the input/output assembly has been set to the factory adjusted input and output line level of +4 dBm operating level (0 vu). If another value line input and output operating level is being used, the levels stated in the adjustment procedures should be amended by the amount of deviation from the +4 dBm operating level.

CAUTION

IF THE TAPE IN USE OR LOCAL STANDARDS REQUIRE THE USE OF OPERATING FLUXIVITIES LESS THAN 185 nWb/m, OR IF A HIGHER INTERFACE OUTPUT LEVEL IS DESIRED (GREATER THAN –5 dBm OUTPUT LEVEL), NOTE THAT THE REPRO GAIN ON THE PADNET MUST NOT BE INCREASED ABOVE A SENSITIVITY EQUIVALENT TO –5-dBm OUTPUT FROM THE BASIC RECORDER/REPRODUCER WHEN REPRODUCING A 185-nWb/m, 700-Hz (500-Hz AT 3.75 in/s) TONE. IF THIS PRECAUTION IS NOT OBSERVED AND A HIGH OUTPUT TAPE, SUCH AS AMPEX 456 TAPE, IS REPRODUCED ON THE ATR-100, ELECTRONIC CLIPPING MAY OCCUR BEFORE TAPE SATURATION. (THE MID-BAND SATURATED OUTPUT OF AMPEX 456 TAPE IS APPROXIMATELY +20.5 dB ABOVE 185 nWb/m.)

NOTE

Paragraphs 5-44 through 5-46 describe adjusting the operating level with a 2-speed PADNET installed.

Paragraphs 5-47 through 5-49 describe adjusting the operating level with a 4-speed PADNET installed.

5-44. *370 nWb/m Operating Level Adjustment.* Use Ampex 456 tape (or direct equivalent) and proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described under *Preventive Maintenance,* paragraphs 5-4 and 5-7.

2. Select system tape speed at the transport control panel.

3. Connect voltmeter to one of the following output connectors:

   a. If an input/output assembly is not being used, connect ac voltmeter to appropriate recorder/reproducer output connector J13 or J14 (Figure 2-13 and Tables 2-2 and 2-3).

   b. If an input/output assembly is being used, connect ac voltmeter to appropriate output connector (Figures 2-14 and 2-15).

4. If an input/output assembly is being used, place REPRODUCE MANUAL/PRESET switch on input/output module to PRESET position.

5. Thread appropriate alignment tape (Table 5-1) on transport and place system into thread mode.

6. While reproducing the 700-Hz (500-Hz at 3.75 in/s), 185-nWb/m tone, adjust REPRO GAIN control as follows:

   a. If alignment tape track format matches the head track format, adjust REPRO GAIN control R-1 on PADNET for –11 dBm at the output of the recorder/reproducer, or –2 dBm at the output of the input/output assembly.

   b. If using a full-width alignment tape on a 2- or 4-track system, follow directions in step 6a but algebraically add the appropriate correction factor given in Table 5-4 to the –11 dBm or –2 dBm level for the tape speed, track format, and reference frequency in use. (For example: at 15 in/s, 2-track system, at 700 Hz: –11 dBm + (+1.14 dBm) = –9.86 dBm.)

7. Repeat steps 2 through 6 for audio channels to be adjusted.

5-45. *260 nWb/m Operating Level Adjustment.* Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* portion of this section of the manual.

2. Select system tape speed at the transport control panel.

3. Connect ac voltmeter to one of the following output connectors:

   a. If an input/output assembly is not being used, connect ac voltmeter to appropriate

recorder/reproducer output connector J13 or J14 (Figure 2-13).

b. If an input/output assembly is being used, connect ac voltmeter to appropriate output connector (Figure 2-14).

4. If an input/output assembly is being used, place REPRODUCE MANUAL/PRESET switch on input/output module to PRESET position.

5. Thread appropriate alignment tape (Table 5-1) on transport and place system in thread mode.

6. While reproducing the 700-Hz (500-Hz at 3.75 in/s), 185-nWb/m tone, adjust REPRO GAIN control as follows.

a. If alignment tape track format matches the head track format, adjust REPRO GAIN control on PADNET for –8 dBm at the output of the recorder/reproducer, or +1 dBm at the output of the input/output assembly.

b. If using a full-width alignment tape on a 2- or 4-track system, follow directions in step 6a but algebraically add the appropriate correction factor given in Table 5-4 to the –8 dBm or +1-dBm level for the tape speed, track format, and reference frequency in use. (For example: at 15 in/s, 2-track system, at 700 Hz: –8 dBm + (+1.14 dBm) = –6.86 dBm.)

7. Repeat steps 2 through 6 for other audio channels to be adjusted.

5-46. *185 nWb/m Operating Level Adjustment.* Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described under *Preventive Maintenance,* paragraphs 5-4 and 5-7.

2. Select system tape speed at the transport control panel.

3. Connect ac voltmeter to one of the following output connectors.

a. If an input/output assembly is not being used, connect ac voltmeter to appropriate recorder/reproducer output connector J13 or J14 (Figure 2-13 and Tables 2-2 and 2-3).

b. If an input/output assembly is being used, connect ac voltmeter to appropriate output connector (Figures 2-14 and 2-15).

4. If an input/output assembly is being used, place REPRODUCE MANUAL/PRESET switch on input/output module to PRESET position.

5. Thread appropriate alignment tape (Table 5-1) on transport and place system in thread mode.

6. While reproducing the 700-Hz (500-Hz at 3.75 in/s), 185-nWb/m tone, adjust REPRO GAIN control as follows:

a. If alignment tape track format matches the head track format, adjust REPRO GAIN control R-1 on PADNET for –5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.

b. If using a full-width alignment tape on a 2- or 4-track system, follow directions in step 6a but algebraically add to the appropriate correction factor given in Table 5-4 to the –5-dBm or +4-dBm level for the tape speed, track format, and reference frequency in use. (For example: at 15 in/s, 2-track system, at 700 Hz: –5 dBm + (+1.14 dBm) = –3.86 dBm.)

7. Repeat steps 2 through 6 for other audio channels to be adjusted.

NOTE

Paragraphs 5-47 through 5-49 describe adjusting the operating level with a 4-speed PADNET installed.

Paragraphs 5-44 through 5-46 describe adjusting the operating level with a 2-speed PADNET installed.

5-47. *370 nWb/m Operating Level Adjustment.* Use Ampex 456 tape (or direct equivalent) and proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described under *Preventive Maintenance,* paragraphs 5-4 and 5-7.

2. On PWA 5 set the I/II switch to the I position and on the transport select the higher speed of the two selected as pair I.

3. Connect voltmeter to one of the following output connectors:

   a. If an input/output assembly is not being used, connect ac voltmeter to appropriate recorder/reproducer output connector J13 or J14 (Figure 2-13 and Tables 2-2 and 2-3).

   b. If an input/output assembly is being used, connect ac voltmeter to appropriate output connector (Figures 2-14 and 2-15).

4. If an input/output assembly is being used, place REPRODUCE MANUAL/PRESET switch on input/output module to PRESET position.

5. Thread appropriate alignment tape (Table 5-1) on transport and place system into thread mode.

6. While reproducing the 700-Hz (500-Hz at 3.75 in/s), 185-nWb/m tone, adjust REPRO GAIN control as follows:

   a. If alignment tape track format matches the head track format, adjust REPRO GAIN control R26 on PADNET for −11 dBm at the output of the recorder/reproducer, or −2 dBm at the output of the input/output assembly.

   b. If using a full width alignment tape on a 2- or 4-track system, follow directions in step 6a but algebraically add the appropriate correction factor given in Table 5-4 to the −11 dBm or −2 dBm level for the tape speed, track format, and reference frequency in use. (For example: at 15 in/s, 2-track system, at 700 Hz: −11 dBm + (+1.14 dBm) = −9.86 dBm.)

7. Select SYNC mode and adjust SYNC BAL for same level obtained in step 6a.

8. On PWA 5 set the I/II switch to the II position and on the transport select the higher speed of the two selected as pair II.

9. Adjust REPRO GAIN as follows:

   a. Set REPRO GAIN control R24 on PADNET for −11 dBm at the output of the recorder/reproducer, or −2 dBm at the output of the input/output assembly.

   b. If using a full-width alignment tape on a 2- or 4-track system, follow directions in step 9a, but algebraically add the appropriate corrector factor given in Table 5-4 to the −11 dBm or −2 dBm level for the tape speed, track format, and reference frequency in use. (For example: at 15 in/s, 2-track system, at 700 Hz: −11 dBm + (+1.14 dBm) = −9.86 dBm.)

10. On PWA 5 set the I/II switch to the I position and on the transport select the lower speed of the two selected as pair I.

11. Thread appropriate alignment tape (Table 5-1) on transport and place system into thread mode.

12. While reproducing the 700-Hz (500-Hz at 3.75 in/s), 185-nWb/m tone, adjust REPRO GAIN control as follows:

   a. If alignment tape track format matches the head track format, adjust REPRO GAIN control R-25 on PADNET for −11 dBm at the output of the recorder/reproducer, or −2 dBm at the output of input/output assembly.

   b. If using a full width alignment tape on a 2-4-track system, follow directions in step 12a but algebraically add the appropriate correction factor given in Table 5-4 to the −11 dBm or −2 dBm level for the tape speed, track format, and reference frequency in use. (For example: at 15 in/s, 2-track system, at 700 Hz: −11 dBm + (+1.14 dBm) = −9.86 dBm.)

13. On PWA 5 set the I/II switch to the II position and on the transport select the higher speed of the two selected as pair II.

14. Adjust REPRO GAIN as follows:

    a. If alignment tape track format matches the head track format, adjust REPRO GAIN control R-23 on PADNET for –11 dBm at the output of the recorder/reproducer, or –2 dBm at the output of the input/output assembly.

    b. If using a full width alignment tape on a 2- or 4-track system, follow directions in step 14a but algebraically add the appropriate correction factor given in Table 5-4 to the –11 dBm or –2 dBm level for the tape speed, track format, and reference frequency in use. (For example: at 15 in/s, 2-track system, at 700 Hz: –11 dBm + (+1.14 dBm) = –9.86 dBm.)

15. Repeat steps 2 through 14 for other audio channels to be adjusted.

5-48. *260 nWb/m Operating Level Adjustment.* Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described under *Preventive Maintenance,* paragraphs 5-4 and 5-7.

2. On PWA 5 set the I/II switch to the I position and on the transport select the higher speed of the two selected as pair I.

3. Connect voltmeter to one of the following output connectors:

    a. If an input/output assembly is not being used, connect ac voltmeter to appropriate recorder/reproducer output connector J13 or J14 (Figure 2-13).

    b. If an input/output assembly is being used, connect ac voltmeter to appropriate output connector (Figure 2-14).

4. If an input/output assembly is being used, place REPRODUCE MANUAL/PRESET switch on input/output module to PRESET position.

5. Thread appropriate alignment tape (Table 5-1) on transport and place system into thread mode.

6. While reproducing the 700-Hz (500-Hz at 3.75 in/s), 185-nWb/m tone, adjust REPRO GAIN control as follows:

    a. If alignment tape track format matches the head track format, adjust REPRO GAIN control R26 on PADNET for –8 dBm at the output of the recorder/reproducer, or +1 dBm at the output of the input/output assembly.

    b. If using a full width alignment tape on a 2- or 4-track system, follow directions in step 6a but algebraically add the appropriate correction factor given in Table 5-4 to the –8 dBm or +1 dBm level for the tape speed, track format, and reference frequency in use. (For example: at 15 in/s, 2-track system, at 700 Hz: –8 dBm + (+1.14 dBm) = –6.86 dBm.)

7. Select SYNC mode and adjust SYNC BAL for same level obtained in step 6a.

8. On PWA 5 set the I/II switch to the II position and on the transport select the higher speed of the two selected as pair II.

9. Adjust REPRO GAIN as follows:

    a. Set REPRO GAIN control R-24 on PADNET for –8 dBm at the output of the recorder/reproducer, or +1 dBm at the output of the input/output assembly.

    b. If using a full-width alignment tape on a 2- or 4-track system, follow directions in step 9a but algebraically add the appropriate correction factor given in Table 5-4 to the –8-dBm or +1-dBm level for the tape speed, track format, and reference frequency in use. (For example: at 15 in/s, 2-track system, at 700 Hz: –8 dBm + (+1.14 dBm) = –6.86 dBm.)

10. On PWA 5 set the I/II switch to the I position and on the transport select the lower speed of the two selected as pair I.

11. Thread appropriate alignment tape (Table 5-1) on transport and place system into thread mode.

5-49. *185 nWb/m Operating Level Adjustment.* Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described under *Preventive Maintenance*, paragraphs 5-4 and 5-7.
2. On PWA 5 set the I/II switch to the I position and on the transport select the higher speed of the two selected as pair I.
3. Connect voltmeter to one of the following output connectors:
   a. If an input/output assembly is not being used, connect ac voltmeter to appropriate recorder/reproducer output connector J13 or J14 (Figure 2-13 and Tables 2-2 and 2-3).
   b. If an input/output assembly is being used, connect ac voltmeter to appropriate output connector (Figures 2-14 and 2-15).
4. If an input/output assembly is being used, place REPRODUCE MANUAL/PRESET switch on input/output module to PRESET position.
5. Thread appropriate alignment tape (Table 5-1) on transport and place system into thread mode.
6. While reproducing the 700-Hz (500-Hz at 3.75 in/s), 185-nWb/m tone, adjust REPRO GAIN control as follows:
   a. If alignment tape track format matches the head track format, adjust REPRO GAIN control R26 on PADNET for –5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.
   b. If using a full-width alignment tape on a 2- or 4-track system, follow directions in step 6a but algebraically add the appropriate correction factor given in Table 5-4 to the –5 dBm or +4-dBm level for the tape speed, track format, and reference frequency in use. (For example: at 15 in/s, 2-track system, at 700 Hz: –5 dBm + (+1.14 dBm) = –3.86 dBm.)
7. Select SYNC mode and adjust SYNC BAL for same level obtained in step 6a.
8. On PWA 5 set the I/II switch to the II position and on the transport select the higher speed of the two selected as pair II.
9. Adjust REPRO GAIN control as follows:
   a. Set REPRO GAIN control R24 on PADNET for –5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.
   b. If using a full-width alignment tape on a 2- or 4-track system, follow directions in step 9a but algebraically add the appropriate correction factor given in Table 5-4 to the –5 dBm or +4-dBm level for the tape speed, track format, and reference frequency in use. (For example: at 15 in/s, 2-track system, at 700 Hz: –5 dBm + (+1.14 dBm) = –3.86 dBm.)
10. On PWA 5 set the I/II switch to the I position and on the transport select the lower speed of the two selected as pair I.
11. Thread appropriate alignment tape (Table 5-1) on transport and place system into thread mode.
12. While reproducing the 700-Hz (500 Hz at 3.75 in/s), 185 nWb/m tone, adjust REPRO GAIN control as follows:
   a. If alignment tape track format matches the head track format, adjust REPRO GAIN control R25 on PADNET for –5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.
   b. If using a full-width alignment tape on a 2- or 4-track system, follow directions in step 12a but algebraically add the appropriate correction factor given in Table 5-4 to the

–5 dBm or +4-dBm level for the tape speed, track format, and reference frequency in use. (For example: at 15 in/s, 2-track system, at 700 Hz: –5 dBm + (+1.14 dBm) = –3.86 dBm.)

13. On PWA 5 set the I/II switch to the II position and on the transport select the higher speed of the two selected as pair II.

14. Adjust REPRO GAIN as follows:

    a. Set REPRO GAIN control R23 on PADNET for –5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.

    b. If using a full-width alignment tape on a 2- or 4-track system, follow directions in step 14a but algebraically add the appropriate correction factor given in Table 5-4 to the –5 dBm or +4-dBm level for the tape speed, track format, and reference frequency in use. (For example: at 15 in/s, 2-track system, at 700 Hz: –5 dBm + (+1.14 dBm) = –3.86 dBm.) Repeat steps 2 through 14 for other audio channels to be adjusted.

5-50. Record Alignment. The record alignment procedure should only be performed after reproduce equalization, reproduce gain, and reproduce head azimuth have been set or are known to be correct. Record alignment consists of setting bias level, setting record high frequency equalization, and setting system output level. The alignment procedures include instructions for aligning the record system for the first speed followed by the second speed record alignment procedure. The second speed record alignment procedure is abbreviated, as it does not require the readjustment of BIAS NORM or record head azimuth.

The following general information and conditions are applicable to both record alignment procedures.

1. Operating level is 370 nWb/m when using Ampex 456 tape or direct equivalent.

2. Operating level is 260 nWb/m when using Ampex 406 tape or equivalent.

3. Frequency response alignment is performed at the following operating levels: 15 and 30 in/s at operating level, 7.5 in/s at 10 dB below operating level, and 3.75 in/s at 20 dB below operating level.

4. Master bias operation has been set for either two-speed dual master bias operation or for four-speed master bias operation as desired. See *Changing Operating Speed Pair and Master Bias Operation* text, paragraph 5-15. (Recorder/reproducers shipped from the factory are set for four-speed master bias operation.) If two-speed dual master bias operation is selected, perform the entire record alignment procedure with bias switch S1 (Figure 5-4) in position I or II. The other position may be used to provide a preadjusted bias position for another type of tape.

5. If an input/output assembly is connected to the recorder/reproducer, the assembly is assumed to be correctly calibrated and set for +4-dBm line input and output operating level and at –5 dBm recorder/reproducer interface operating level (see *Input/Output Assembly Adjustment* procedure, paragraph 5-57).

5-51. *First Speed Record Alignment.* Perform the following alignment procedure for each channel (as applicable).

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* portion of this section of the manual, paragraphs 5-4 and 5-7.

NOTE

For ATR-100's that utilize a 4-speed PADNET proceed to step 3.

2. Set preset record equalization standard selector switch S1 (Figure 5-14) on PADNET to equalization standard desired for each of the two operating speeds, as shown in Table 5-10. Note that switches S1 through S1-3 are for the higher speed, and switches S1-4 through S1-6 are for the lower speed.

3. If not already set, set speed select jumpers (switches on four-speed PADNET) on PADNET

PWA for the two desired operating speeds, and set master bias operation jumpers on Audio Control PWA No. 5 for either two-speed or four-speed master bias operation. (See *Changing Operating Speed Pair and Master Bias Operation* text, paragraph 5-15.)

4. Select first tape speed to be aligned at the transport control panel.

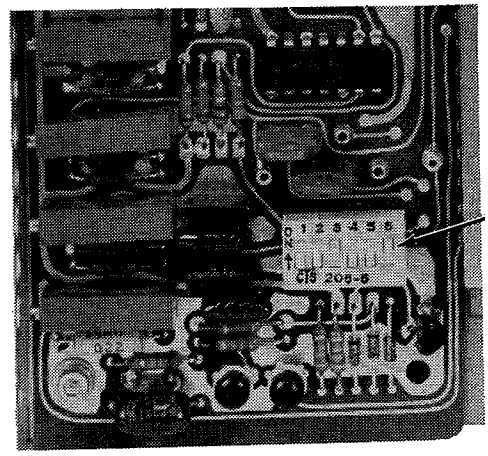


Figure 5-14. Record Equalization Standard Selector Switch S1, 2-Speed PADNET PWA

5. If an input/output assembly is being used, connect an ac voltmeter to appropriate output connector, and connect an audio oscillator to appropriate input connector (Figures 2-14 and 2-15). Set MANUAL/PRESET switch to PRESET.

6. If an input/output assembly is not being used, connect an ac voltmeter to appropriate recorder/reproducer output connector J13 or J14, and connect audio oscillator to appropriate input connector J13 or J14 (Figure 2-13 and Tables 2-2 and 2-3).

7. Set oscillator frequency to 1.0 kHz.

8. If erase alignment has not been performed or is not known to be correct, set master erase bus level control R34 (Figure 5-15), on Audio Control PWA No. 5, to midrange position.

9. Connect scope probe to one of the following locations to monitor the amplitude of the master bias signal.

   a. If test point TP1 is present on Audio Control PWA No. 5 (later versions of the PWA), place PWA on extender board and reinstall into electronics assembly. Connect probe to TP1.

   b. If TP1 (step 9a) is not present (early versions of the PWA), place a Main Audio

Table 5-10. Record Equalization Standard Selector Switch S1 Switch Positions (2-Speed PADNET PWA)

EQUALIZATION STANDARD/μs	IN/S	SWITCH S1-1 OR S1-4	SWITCH S1-2 OR S1-5	SWITCH S1-3 OR S1-6 (∞ OR 3180 μs)
AES 17.5/∞	30	OFF	OFF	ON
NAB 50/3180	15	ON	OFF	OFF
NAB 50/3180	7.5	OFF	ON	OFF
IEC 35/∞	15	OFF	OFF	ON
IEC 70/∞	7.5	OFF	OFF	ON
NAB/IEC 90/3180	3.75	OFF	ON	OFF

NOTE: Switches S1-1 through S1-3 are for the higher of the two speeds. Switches S1-4 through S1-6 are for the lower of the two speeds.

PWA and PADNET on extender board and reinstall into electronics assembly. Connect probe to pin FF on PADNET.

10. Apply power, and adjust appropriate MASTER BIAS level control (Table 5-11 or Table 5-12) for the speed in use to provide a 2.5-Vp-p, 432-kHz square wave on scope.

11. Remove power and scope probe from PWA (step 9). Reinstall PWA into electronics assembly.

12. Apply system power, thread a reel of bulk-erased tape on transport, and place system into thread mode.

13. Select input monitoring for channel being aligned.

14. Adjust audio oscillator output to provide –5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.

15. Place channel(s) being aligned in ready mode.

16. Place system in record mode.

17. Select repro monitoring for channel being aligned.

18. Adjust BIAS NORM control (Table 5-7) on PADNET for maximum 1.0-kHz output.

19. Adjust REC GAIN control (Table 5-7) on 2-speed PADNET (or appropriate RECORD GAIN on 4-speed PADNET [Table 5-8]) for –5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.

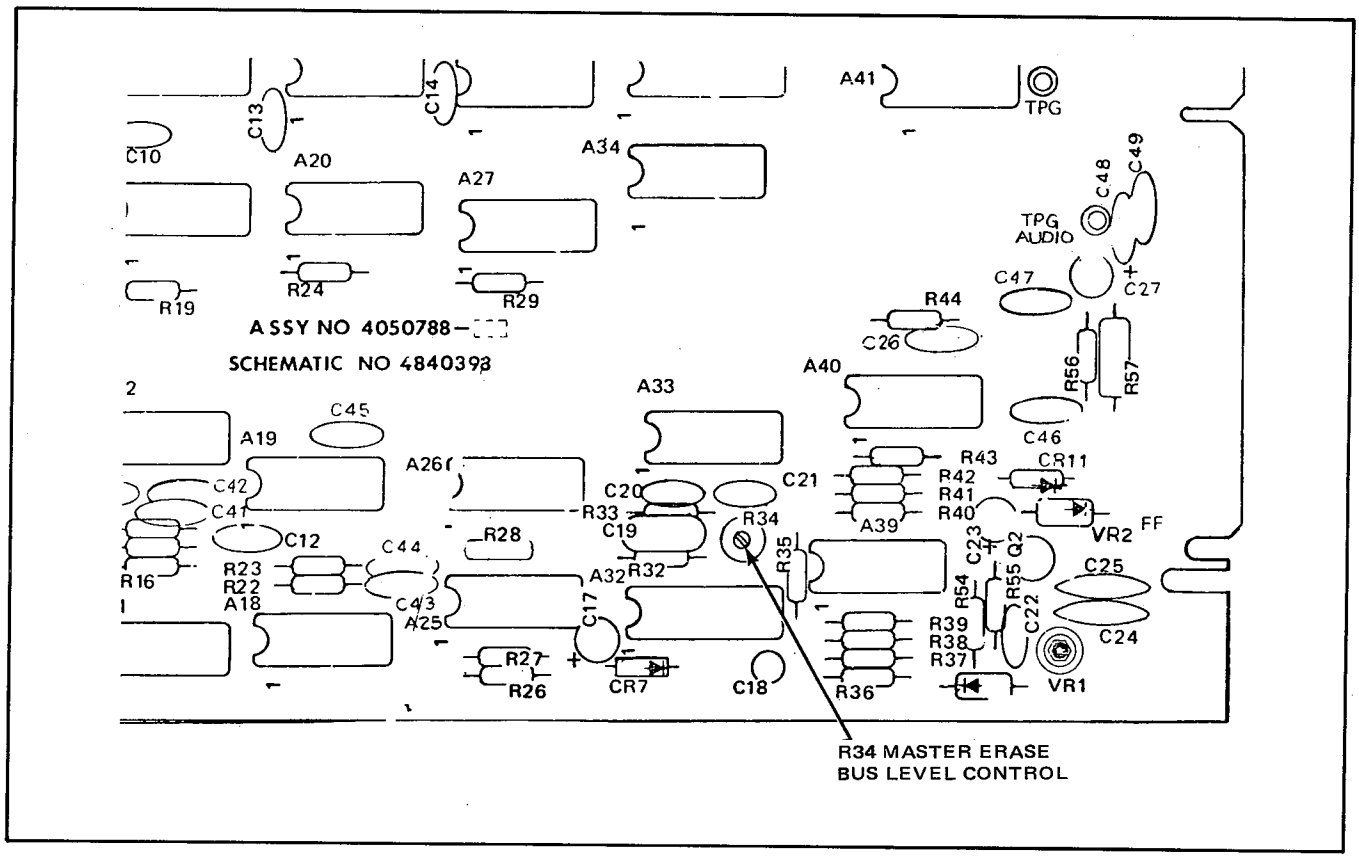
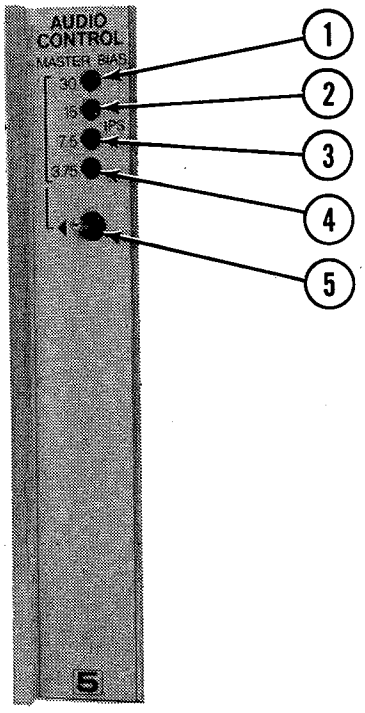


Figure 5-15. Audio Control PWA No. 5

Table 5-11. Audio Control PWA No. 5 — 4-Speed Alignment Controls



INDEX NO.	CONTROL	FUNCTION
1	30 (R6)	Adjusts 30-in/s master bias level.
2	15 (R5)	Adjusts 15-in/s master bias level.
3	7.5 (R4)	Adjusts 7.5-in/s master bias level.
4	3.75 (R3)	Adjusts 3.75-in/s master bias level.
5	Switch (S1)	(Switch to remain in left-hand position for four-speed operation.)

20. Set audio oscillator to 25 kHz at 30 in/s, 15 kHz at 15 in/s or 7.5 in/s, or 7.5 kHz at 3.75 in/s.

21. Adjust record head azimuth adjustment screw (Figure 5-11) for maximum signal output.

22. Adjust bias by overbiasing a short wavelength signal (1.5 mils) for the speed in use as follows.

    a. Set oscillator to frequency given in Table 5-13 for speed in use.

    b. Reduce oscillator output level to obtain signal output level given in Table 5-13 for speed in use. (The output level is relative to the level set in step 19.

    c. Adjust BIAS NORM control (Table 5-7) on PADNET counterclockwise until level of signal being reproduced starts to fall. Then turn BIAS NORM slowly clockwise for maximum signal output. (If necessary, reduce oscillator level to maintain level set in step 22b.)

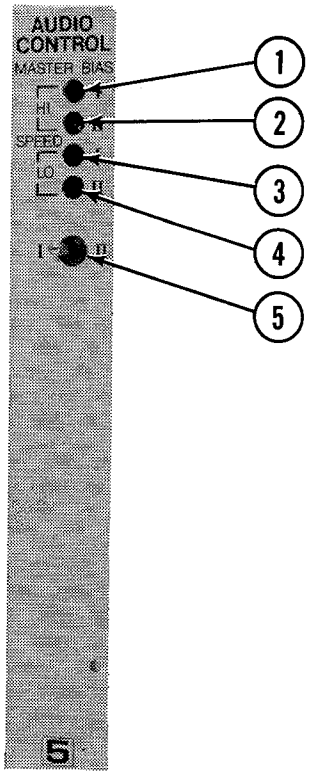
    d. Continue turning BIAS NORM control clockwise until level has dropped from the maximum level obtained in step 22c by the amount specified in Table 5-13 for the speed and tape use.

23. Set oscillator frequency to 1.0 kHz (500 Hz at 3.75 in/s).

24. Adjust audio oscillator output level to provide the following system output level:

    a. If input/output assembly is not being used, adjust oscillator output for –5 dBm at 15

Table 5-12. Audio Control PWA No. 5 — Two-Speed Alignment Controls



INDEX NO.	CONTROL	FUNCTION
1	HI I (R6)	Adjusts high-speed I master bias level.
2	HI II (R5)	Adjusts high-speed II master bias level.
3	LO I (R4)	Adjusts low-speed I master bias level.
4	LO II (R3)	Adjusts low-speed II master bias level.
5	I/II Switch (S1)	Selects master bias I or II.

Table 5-13. Recommended Frequency, Signal Level, and Overbias Values for Bias and Equalization Adjustment

SPEED	FREQUENCY	LEVEL FOR BIAS AND EQUALIZATION ADJUSTMENT (Relative to 1.0 kHz Operating Level*)	OVERBIAS VALUE	
			406/407 TAPE	456 TAPE
30 in/s	20 kHz	0	1.75 ±0.25 dB	2.75 ±0.25 dB
15 in/s	10 kHz	0	1.75 ±0.25 dB	2.75 ±0.25 dB
7.5 in/s	5 kHz	−10 dB	1.75 ±0.25 dB	2.75 ±0.25 dB
3.75 in/s	2.5 kHz	−20 dB	1.75 ±0.25 dB	2.75 ±0.25 dB

*Recommended operating level is 370 nWb/m using Ampex 456 tape or 260 nWb/m using Ampex 406/407 tape.

NOTE: Frequency at each tape speed shown in the table has been chosen to provide a short wavelength signal of 1.5 mils.

and 30 in/s, −15 dBm at 7.5 in/s, or −25 dBm at 3.75 in/s.

b. If input/output assembly is being used, adjust oscillator output for +4 dBm at 15 and 30 in/s, −6 dBm at 7.5 in/s, or −16 dBm at 3.75 in/s.

25. Set oscillator frequency to 20 kHz at 30 in/s, 15 kHz at 15 in/s, 10 kHz at 7.5 in/s, or 7.5 kHz at 3.75 in/s.

26. Adjust appropriate record equalizer control (HI SPEED or LO SPEED) on 2-speed PADNET (Table 5-7) or (EQ) on 4-speed PADNET (Table 5-8) for same level as in step 24.

27. Sweep oscillator through the following frequency range and fine-adjust the appropriate reproduce equalizer control (HI SPEED LF or LO SPEED LF) on 2-speed PADNET (Table 5-7) or REPRO HF EQ or REPRO LF EQ (Table 5-9) on 4-speed PADNET to obtain the most uniform low frequency response.

    a. 30 in/s – 35 Hz to 400 Hz

    b. 15 in/s, 7.5 in/s, or 3.75 in/s – 20 Hz to 200 Hz

28. Sweep oscillator through frequency ranges given in Table 5-14 for speed in use. Output should remain within limits shown in Table 5-14 for each frequency range. If necessary, make slight adjustments to the appropriate record high-frequency equalizer control (HI SPEED or LO SPEED) and/or reproduce low-frequency equalizer control (HI SPEED LF or LO SPEED LF) on 2-speed PADNET PWA (Table 5-7) to obtain flattest midband response consistent with meeting extreme high- and low-frequency tolerances.

    a. When adjusting the 4-speed PADNET use appropriate record equalizer control (EQ) and/or appropriate reproduce low frequency control (REPRO LF EQ) Table 5-9.

    b. Midband response may be further flattened by using the appropriate shelfing control on the 4-speed PADNET.

29. Select input monitoring for channel being aligned.

30. Set oscillator frequency to 1.0 kHz (500 Hz at 3.75 in/s).

31. Adjust oscillator output level for –5 dBm at the output of the recorder/reproducer, or for +4 dBm at the output of the input/output assembly.

32. Select repro monitoring for channel being aligned.

33. Adjust REC GAIN on 2-speed PADNET PWA (Table 5-7) or appropriate RECORD GAIN on 4-speed PADNET (Table 5-8) for –5 dBm at the output of the recorder/reproducer, or for +4 dBm at the output of the input/output assembly.

34. For a single-channel system, this completes the record alignment for the first speed selected for adjustment. To adjust for the second speed, proceed to the *Second Speed Record Alignment* procedure, paragraph 5-52.

Table 5-14. Overall Record/Reproduce Frequency Response

SPEED/EQUALIZATION STANDARD	REFERENCE FREQUENCY	TOLERANCE ±0.75 dB	TOLERANCE ±2.0 dB	LEVEL FOR FREQUENCY RESPONSE RELATIVE TO OPERATING LEVEL*
30 in/s AES	1 kHz	200 Hz – 20 kHz	35 Hz – 25 kHz	0 dB
15 in/s NAB or IEC	1 kHz	100 Hz – 15 kHz	20 Hz – 20 kHz	0 dB
7.5 in/s NAB or IEC	500 Hz	100 Hz – 10 kHz	30 Hz – 15 kHz	–10 dB
3.75 in/s NAB/IEC	500 Hz	(not specified)	30 Hz – 10 kHz**	–20 dB

*Operating level is 370 nWb/m at 700 Hz for Ampex 456 tape and 260 nWb/m at 700 Hz for Ampex 406/407 tape.
**For Ampex 456 tape.
For Ampex 406/407 tape specification is: 30 Hz – 7.5 kHz, ±2.0 dB.

35. For a 2-track or 4-track system, align the other channels for the same speed in use by following the *First Speed Record Alignment* procedure, steps 2, 5, 6, 14 through 20, and 22 through 33. Do not readjust MASTER BIAS level control on Audio Control PWA No. 5 (steps 9 and 10) and do not readjust record head azimuth (steps 20 and 21).

5-52. *Second Speed Record Alignment.* When aligning the record system for a second speed after all channels have been adjusted for the first speed, none of the BIAS NORM controls are readjusted. Bias level for the second speed is set by adjusting the appropriate MASTER BIAS level control on Audio Control PWA No. 5. When aligning a 2-track or 4-track system, the MASTER BIAS level need only be set once while monitoring the output of any one channel. The bias level for the other channel(s) is automatically set correctly to the same biasing point as the channel that was monitored.

To align the record system for a second speed after the first speed has been adjusted, proceed as follows:

1. Set system tape speed at the transport control panel.

2. Set oscillator frequency to 1.0 kHz.

3. Select input monitoring for channel being aligned.

4. Adjust audio oscillator output to provide –5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.

5. Place channel being aligned in ready mode.

6. Place system in record mode.

7. Select repro monitoring for channel being aligned.

8. Adjust bias by overbiasing a short wavelength signal (1.5 mils) for the speed in use as follows:

   a. Set oscillator to frequency given in Table 5-13 for speed in use.

   b. Reduce oscillator output level to obtain signal output level given in Table 5-13 for speed in use.

   c. Adjust appropriate MASTER BIAS control (Table 5-11 or 5-12), on audio control PWA 5, counterclockwise until level of signal being reproduced starts to fall. Then turn MASTER BIAS control slowly clockwise for maximum signal output. (If necessary, reduce oscillator level to maintain level set in step 8b.)

   d. Continue turning MASTER BIAS control clockwise until level has dropped from the maximum level obtained in step 8c by the amount specified in Table 5-13 for the speed and tape in use.

9. Set oscillator frequency to 1.0 kHz (500 Hz at 3.75 in/s).

10. Adjust audio oscillator output level to provide the following system output level:

    a. If input/output assembly is not being used, adjust oscillator output for –5 dBm at 15 and 30 in/s, –15 dBm at 7.5 in/s, or –25 dBm at 3.75 in/s.

    b. If input/output assembly is being used, adjust oscillator output for +4 dBm at 15 and 30 in/s, –6 dBm at 7.5 in/s, or –16 dBm at 3.75 in/s.

11. Set oscillator frequency to 20 kHz at 30 in/s, 15 kHz at 15 in/s, 10 kHz at 7.5 in/s, or 7.5 kHz at 3.75 in/s.

12. Adjust appropriate record equalizer control (HI SPEED or LO SPEED) on 2-speed PADNET (Table 5-7) or (EQ) on 4-speed PADNET (Table 5-8) for same level as in step 10.

13. Sweep oscillator through the following frequency range and fine-adjust the appropriate reproduce equalizer control (HI SPEED LF or LO SPEED LF) on 2-speed PADNET

(Table 5-7) or (REPRO LF EQ) on 4-speed PADNET (Table 5-9) to obtain the most uniform low-frequency response.

a. 30 in/s – 35 Hz to 400 Hz.

b. 15 in/s, 7.5 in/s, or 3.75 in/s – 20 Hz to 200 Hz.

14. Sweep oscillator through frequency ranges given in Table 5-14 for speed in use. Output should remain within limits shown in Table 5-14 for each frequency range. If necessary, make slight adjustments to the appropriate record high-frequency equalizer control (HI SPEED or LO SPEED) and/or reproduce low-frequency equalizer control (HI SPEED LF or LO SPEED LF) on PADNET PWA (Table 5-7) to obtain flattest midband response consistent with meeting extreme high- and low-frequency tolerances.

    a. When adjusting the 4-speed PADNET use appropriate record equalizer control (EQ) and/or appropriate reproduce low frequency equalizer control (REPRO LF EQ) (Table 5-9).

    b. Midband response may be further flattened by using the appropriate shelving control on the 4-speed PADNET.

15. Select input monitoring for channel being aligned.

16. Set oscillator frequency to 1.0 kHz (500 Hz at 3.75 in/s).

17. Adjust oscillator output level for –5 dBm at the output of the recorder/reproducer, or for +4 dBm at the output of the input/output assembly.

18. Select repro monitoring for channel being used.

19. Check that reproduced level is –5 dBm ±0.5 dB at the output of the recorder/reproducer, or is +4 dBm ±0.5 dB at the output of the input/output assembly.

5-53. *2-Track or 4-Track Record Head Azimuth and Phase Adjustment.* The adjustment of record head azimuth and phase (multitrack systems only) should not be attempted unless the following criteria have been met: reproduce equalization is correct, reproduce head azimuth has been set using a standard alignment tape, and record equalization and bias are known to be correct. Prior to performing the alignment procedure, refer to the general discussion concerning head azimuth and phase adjustment, paragraph 5-33. Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* section of the manual, paragraphs 5-4 and 5-7.

2. As a preliminary adjustment, turn record head azimuth adjusting screw (Figure 5-12) so that reference hole in tapered gear is in front of the head-gap region.

3. Connect a dual trace scope as follows:

    NOTE

    If a dual trace scope is not available, proceed to step 4.

    a. For a 2-track head assembly system, connect scope to channel 1 and to channel 2 outputs of the recorder system.

    b. For a 4-track head assembly system, connect scope to channel 1 output and to channel 4 output of the recorder system.

    c. Trigger scope from recorder channel 1 output.

    d. Proceed to step 5.

4. If a dual trace scope is not available, connect a single-channel scope to display a Lissajou pattern as follows:

    a. For a 2-track head assembly system, connect channel 1 output to the vertical input of scope and connect channel 2 output to the horizontal input of the scope.

b. For a 4-track head assembly system, connect channel 1 output to the vertical input of scope and connect channel 4 output to the horizontal input of the scope.

5. Connect audio oscillator to input of recorder system to drive all channels simultaneously.

6. Set oscillator frequency to 1.0 kHz.

7. Connect ac voltmeter to any one of the audio outputs.

8. Apply power and thread a reel of tape on transport and place system into thread mode.

9. Select the lower of the two operating speeds.

10. Place all channels into record mode.

11. Select repro monitoring mode.

12. Adjust oscillator output level for –5 dBm at the output of the recorder/reproducer or for +4 dBm at the output of the input/output assembly.

13. Adjust record head azimuth adjusting screw (Figure 5-12) for minimum phase error (or straight 45° line on Lissajou display).

14. Increase oscillator frequency to frequency specified in Table 5-13 for speed in use.

15. Reduce oscillator output level as required to provide system output level specified in Table 5-13 relative to level set in step 12 at 1.0 kHz.

16. Fine-adjust record head azimuth adjusting screw to further minimize mean phase error.

17. If system is a 4-track head assembly system, replace channel 4 input to oscilloscope with channel 3 and repeat step 15. Repeat this step and step 15, but with scope connected to channel 2. The maximum mean phase error difference from channel 1 to channel 4 should not exceed ± 10° at frequencies shown in frequency column of Table 5-13.

NOTE

Dynamic phase errors are mainly dependent upon tape slitting accuracy and other tape related factors. Typical dynamic phase errors are as follows:

2-track – 1/4-inch tape systems, ± 15° at 1.5 mil wavelength recorded on tape.
4-track – 1/2-inch tape systems, ±25° at 1.5 mil wavelength recorded on tape.

(A 1.5-mil wavelength recorded on tape is equivalent to 20 kHz at 30 in/s, 10 kHz at 15 in/s, 5 kHz at 7.5 in/s, or 2.5 kHz at 3.75 in/s.)

5-54. *Full-Track Record Head Azimuth Adjustment.* The adjustment of record head azimuth should not be attempted unless the reproduce head azimuth has been set using a standard alignment tape. Prior to performing the alignment procedure, refer to the general discussion concerning head azimuth adjustment, paragraph 5-33. Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* section of the manual, paragraphs 5-4 and 5-7.

2. As a preliminary adjustment, turn record head azimuth adjusting screw (Figure 5-12) so that reference hole in tapered gear is in front of the head-gap region.

3. Connect a scope or ac voltmeter to the output of the recorder system.

4. Connect an audio oscillator to input of recorder system.

5. Apply power and thread a reel of tape on transport and place system into thread mode.

6. Select the lower of the two operating speeds.

7. Place recorder/reproducer into record mode.

8. Select repro monitoring mode.

9. Set oscillator frequency to upper band edge frequency shown in Table 5-14 for speed in use.

10. Adjust oscillator output to level for –5 dBm at the output of the recorder/reproducer, or for +4 dBm at the output of the input/output assembly.

11. Readjust oscillator output level shown in Table 5-14 for the level of frequency response relative to operating level for the speed in use.

12. Adjust record head azimuth adjusting screw (Figure 5-12) for maximum system output level.

5-55. Sel Sync Equalization and Gain Adjustment. The sel sync equalization and gain adjustment is made while reproducing a recording made on the recorder/reproducer. The recorder/reproducer has an additional low-frequency reproduce equalizer for the sel-sync mode which must be adjusted prior to the adjustment of SEL SYNC gain. Since sel-sync mode is most commonly used for 15- and 30-in/s operation, adjustment instructions are given for these two speeds. The sel-sync adjustment procedure should only be performed after the reproduce and record alignment procedures have been performed. Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* portion of this section of the manual, paragraphs 5-4 and 5-7.

2. Set sel-sync equalization control R15 on Main Audio PWA (Figure 5-13) to the center of its range.

3. Place Main Audio PWA of channel to be aligned on extender board and install into electronics assembly.

4. If an input/output assembly is being used, connect an ac voltmeter to appropriate output connector, and connect an audio oscillator to appropriate input connector (Figures 2-14 and 2-15).

5. If an input/output assembly is not being used, connect an ac voltmeter to appropriate recorder/reproducer output connector J13 or J14, and connect audio oscillator to appropriate input connector J13 or J14 (Figure 2-13 and Tables 2-2 and 2-3).

6. Apply power, thread reel of tape on transport, and place system into thread mode.

7. Set oscillator frequency to 1.0 kHz.

8. Select input monitoring for channel being aligned.

9. Adjust audio oscillator output to provide –5 dBm at the output of the recorder/reproducer or +4 dBm at the output of the input/output assembly.

10. Place channel being aligned in ready mode.

11. Select 15- or 30-in/s tape speed and place system into record mode.

12. Select repro monitoring for channel being aligned.

13. Verify that system output level is –5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly. If output is not as specified, perform the applicable reproduce or record alignment procedure.

14. Set tape timer to zero and continue to record 1.0-kHz signal for five seconds.

15. Switch oscillator frequency to 100 Hz and note 100-Hz reproduced output level relative to 1.0-kHz output level. Continue alternating oscillator input frequency between 1.0 kHz and 100 Hz at five-second intervals for at least two minutes.

16. Stop recording and rewind tape to tape-timer zero.

17. Place channel being aligned in sync mode.

18. Place system in play mode.

19. Adjust SYNC GAIN control (Table 5-7) on 2-speed PADNET or SYNC BALANCE control (Table 5-9) on 4-speed PADNET PWA to obtain output of –5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.

20. Carefully adjust sel-sync equalization control R15 (Figure 5-13) during 1.0-kHz tone until 100-Hz level and 1.0-kHz level have the same value.

21. Remove system power and replace Main Audio PWA into electronics assembly without extender board.

22. Reapply system power, select sync mode for channel being aligned, and place system in play mode to reproduce recording made in step 15.

23. Note the relative difference between the 100-Hz signal and the 1.0-kHz signal as compared to relative difference noted in step 15. If relative error differs more than ± 0.5 dB, remove system power and make a small adjustment to R15 on Main Audio PWA. (Note: Turning R15 clockwise increases 1.0-kHz level relative to 100-Hz level.)

24. Repeat steps 22 and 23 as necessary to reduce error to within ± 0.5 dB.

25. Set tape timer to zero and record a 1.0-kHz signal for 15 seconds.

26. While still recording, record a slow sweep in frequency from 40 Hz to 12 kHz at 15 in/s, or 80 Hz to 15 kHz at 30 in/s.

27. Stop recording and rewind tape to tape-timer zero.

28. Select sync mode for channel being aligned.

29. Place system in play mode.

30. While reproducing the 1-kHz tone, adjust SYNC GAIN or SYNC BALANCE on 4-speed PADNET for –5 dBm at the output of the recorder/reproducer, or +4 dBm output of the input/output assembly.

31. While reproducing the sweep tone recorded in step 26, verify that the output is within ± 2 dB of the 1-kHz level recorded in step 25.

5-56. Erasure Depth Adjustment and Measurement. The erase current supplied to the erase head is adjustable by means of a master erase bus potentiometer control on Audio Control PWA 5. This is the only adjustment required for the erase system. Because of the extreme erase depth of which the recorder/reproducer is capable, it is mandatory that the tape used for adjustment and depth measurement be thoroughly bulk degaussed. This will prevent any crosstalk from an unerased portion of the tape being interpreted as the erased signal level. For accurate measurement of erasure depth, a spectrum analyzer, wave analyzer, or 1/10 octave filter should be used. If these instruments are unavailable, a reasonably accurate adjustment can be made by listening to the erased signal at an elevated monitoring level. The erase performance specifications given in this procedure apply to Ampex 406, 407, or 456 tape or the exact equivalent. Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* portion of this section of the manual, paragraphs 5-3 and 5-7.

2. Set master erase bus level control R24 on Audio Control PWA No. 5 (Figure 5-15) to the center of its range.

3. Place audio control PWA No. 5 on an extender board and install into electronics assembly.

4. If an input/output assembly is being used, connect a spectrum analyzer, wave analyzer, or 1/10 octave filter to appropriate output connector, and connect an audio oscillator to appropriate input connector (Figures 2-14 and 2-15).

5. If an input/output assembly is not being used, connect a spectrum analyzer, wave analyzer, or 1/10 octave filter to appropriate recorder/reproducer output connector J13 or J14, and connect an audio oscillator to appropriate input connector J13 or J14 (Figures 2-13 and Tables 2-2 and 2-3).

6. Apply power, thread a reel of bulk-degaussed tape of the same kind that was used to align the reproduce and record circuits. Place system into thread mode.

7. Set speed select switch to highest operating speed.

8. Place system in record mode (channels not under test should also be placed in record mode).

9. Set oscillator frequency to appropriate frequency as follows: 400 Hz at 30 in/s, 200 Hz at 15 in/s, or 100 Hz at 7.5 in/s. Adjust oscillator output level for +5 dBm at the output of the recorder/reproducer, or +14 dBM at the output of the input/output assembly.

10. Adjust analyzer to zero reference, or note analyzer range setting and meter reading.

11. Reset tape timer display to zero.

12. Record continuously for five minutes and rewind tape to tape timer display zero.

13. Remove oscillator and short signal input terminals (or short input with an impedance not greater than 300 ohms).

14. Again place system into record mode and adjust analyzer range setting to observe residual erase signal level.

15. Adjust R34 (Figure 5-15) slowly counterclockwise, and note when erased signal amplitude suddenly increases. Then adjust R34 slowly clockwise until erase signal is 85 dB below unerased level established in step 9 (−80 dBm at the output of the recorder/reproducer or −71 dBm at the output of the input/output assembly). If a wave analyzer or spectrum analyzer with a resolution bandwidth less than 5 Hz is being used, continue turning R34 clockwise until a minimum amplitude erased signal is seen.

16. Without disturbing the setting of R34 established in step 15, repeat steps 8 through 14 for the other channel(s). If any channel does not measure at least 85 dB below the unerased level, repeat step 15 for that channel.

17. Connect oscilloscope to TP2 (144 kHz) on audio control PWA No. 5.

18. Note peak-to-peak amplitude of square wave signal. Voltage level at TP2 should not exceed 6 Vp-p. At that setting of R34, the residual erased signal level will normally be greater than 90 dB below unerased level set in step 9.

5-57. Input/Output Assembly Adjustment. Procedures for adjusting offset null, input and output operating level, and level meter calibration are given below. Instructions for setting the operating input and output level to +4 dBm are given, but other values may be selected by the user. Input levels can be from +30 to −5 dBm in the variable mode or +20 dBm to −1 dBm in the preset mode. Output levels can be from +12 dBm to −25 dBm in the variable mode or from +20 dBm to −1 dBm in the preset mode. (However, the interface input and output operating level to and from the ATR-100 should be set to −5 dBm regardless of the levels selected for the input/output assembly line input and line output.)

Two methods for adjusting the input and output levels are presented. Method 1 requires a jumper/clip lead and standard test equipment interconnect cables. Method 2 requires an I/O Level Set Accessory (Ampex Part No. 4020425) shown in Figure 5-16.) This accessory consists of a printed circuit board that is plugged into the ATR-100 electronics assembly (on an extender board) in place of the standard audio PWA. The accessory connects the signal input and output of the input/output assembly together and provides a coaxial cable fitted with a GR plug that connects to an ac voltmeter. Each method will enable equal results but method 2 is more convenient for the user and, therefore, is the preferred method. Refer to Figures 5-17 and 5-18 and proceed as follows:

CAUTION

DO NOT REMOVE OR INSERT AN INPUT/OUTPUT MODULE OR ATR-100 PWA WITH POWER ON. TO DO SO MAY CAUSE DAMAGE TO COMPONENTS.

5-58. *Offset Null Adjustments.* Perform these steps on each input/output module only if repairs have been made or components have been changed on the input/output assembly that may affect circuit operation.

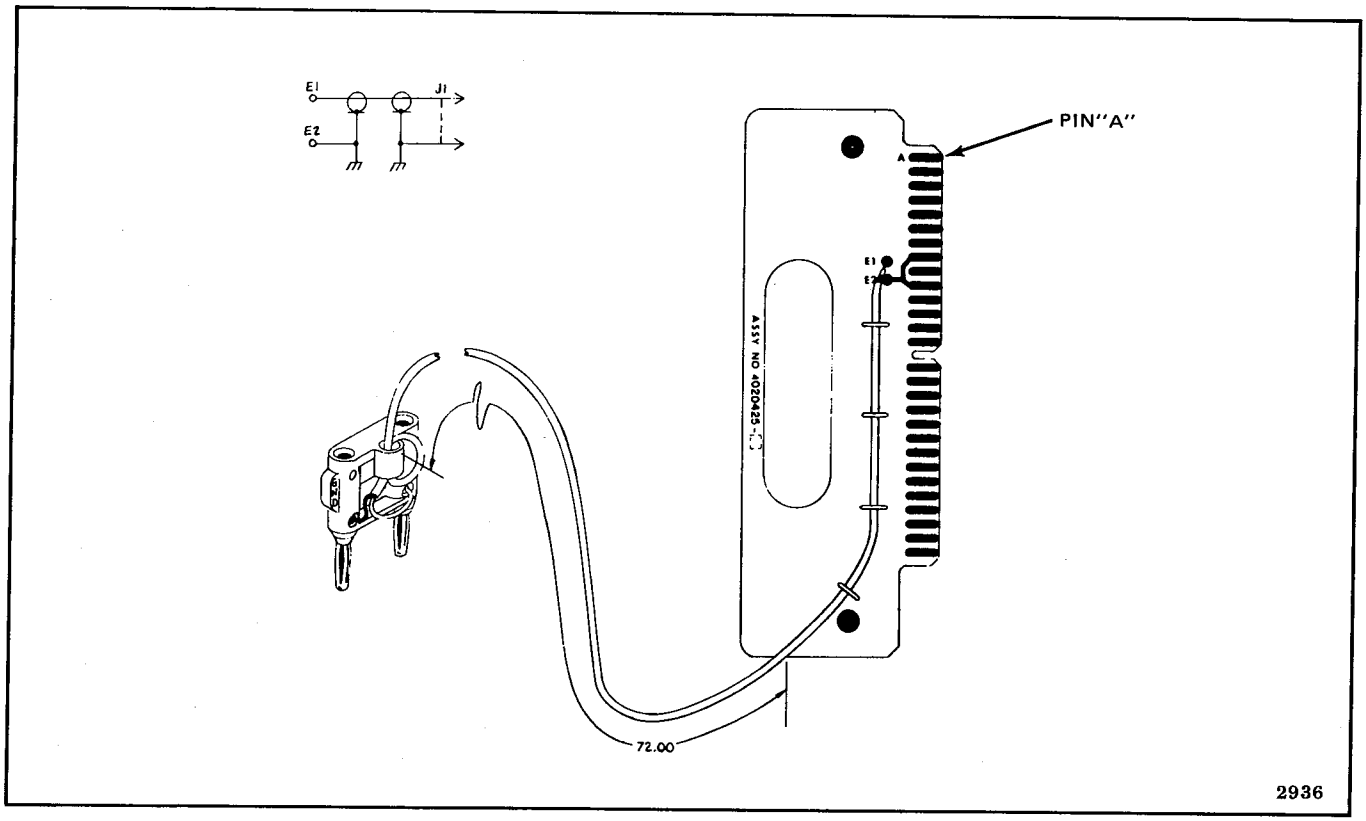


Figure 5-16. I/O Level Set Accessory

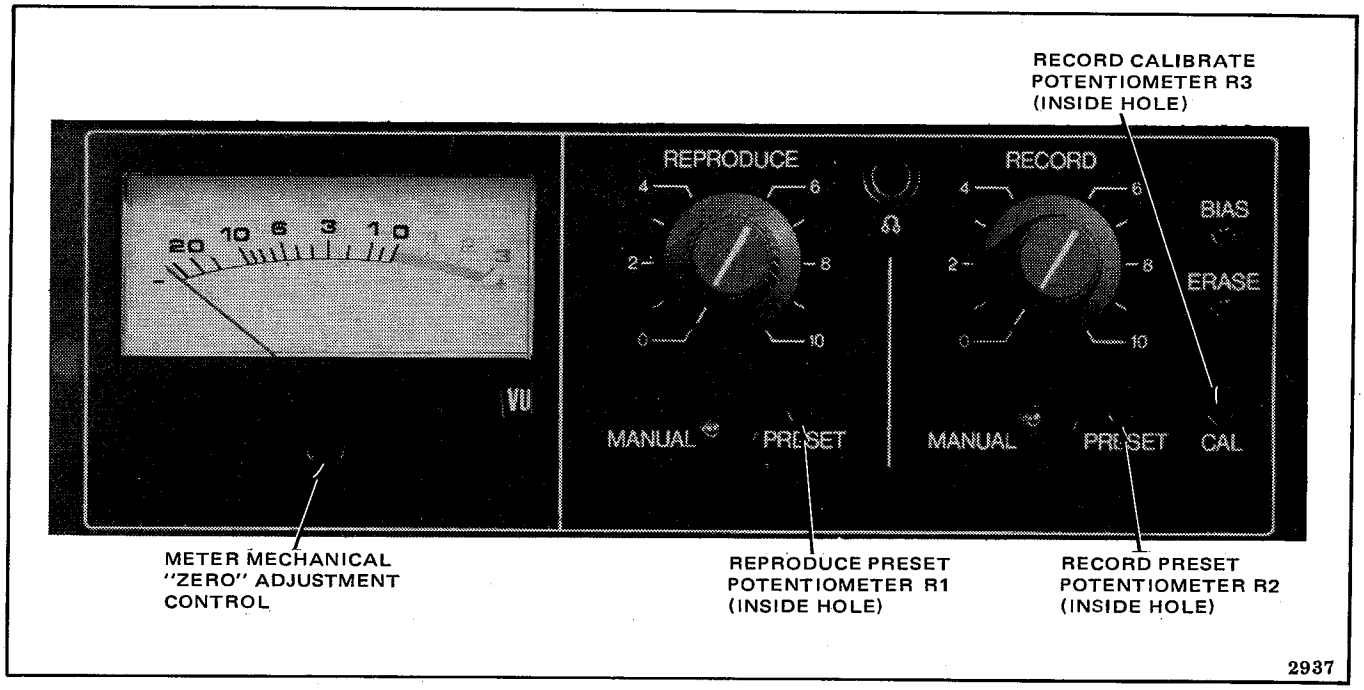


Figure 5-17. Input/Output Module Adjustment Control Locations

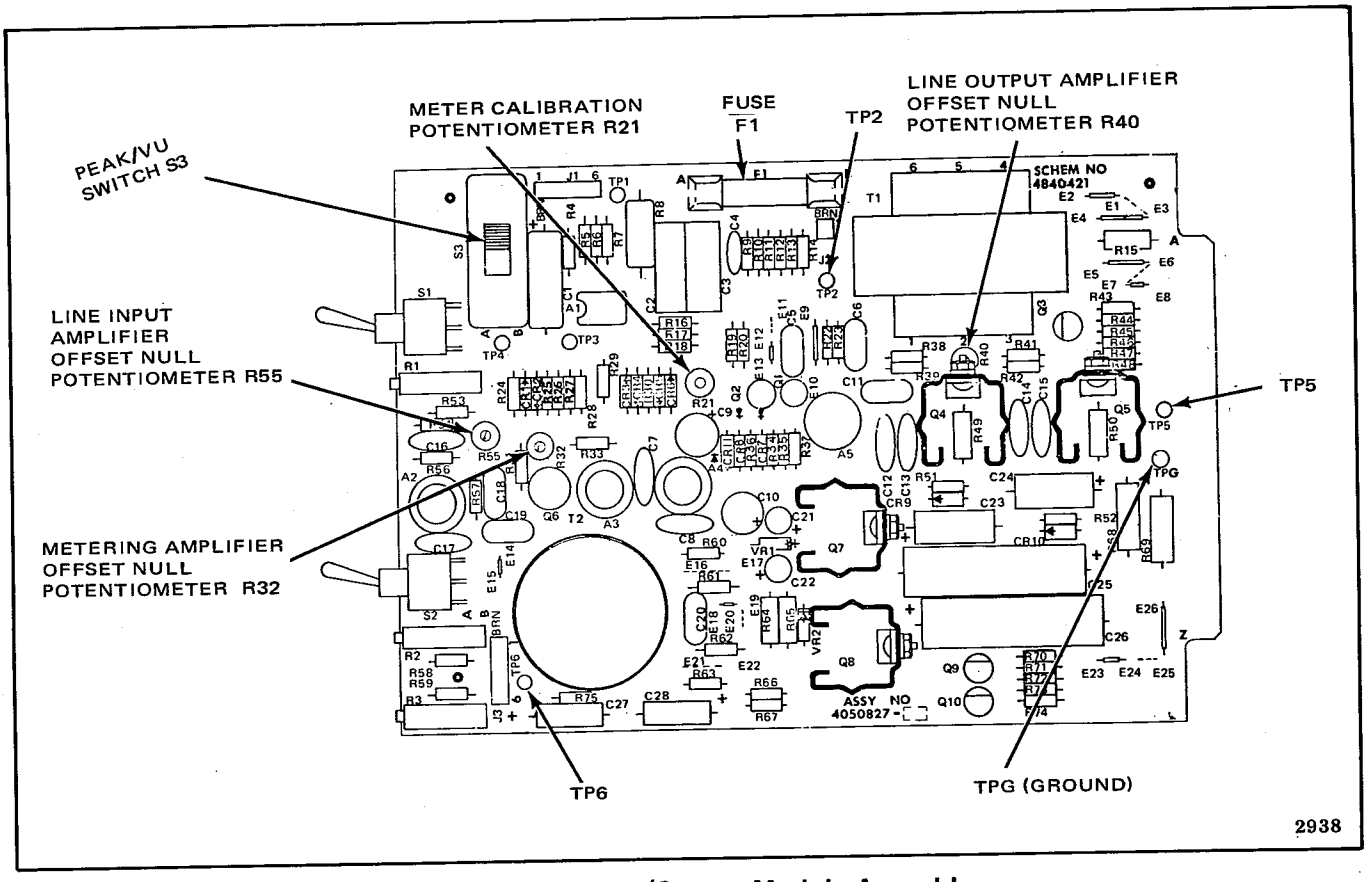


Figure 5-18. Input/Output Module Assembly

1. With power removed, adjust the meter mechanical "zero" adjustment control (Figure 5-17) for mechanical zero (meter at left-hand dial position).

2. Remove input/output module from input/output mainframe and place module on an extender board (Table 5-1). Insert extender board into mainframe.

3. Remove fuse F1 (Figure 5-18).

4. Set peak/vu switch S3 to desired operating position (peak or vu reading on vu/peak meter).

5. Disconnect signal input so that there is no signal being fed to input/output assembly.

6. Apply power and adjust metering amplifier offset null potentiometer R32 (Figure 5-18) for zero indication (same as step 1) on the level meter.

7. Connect a dc voltmeter to TP6 and ground (Figure 5-18).

8. Set RECORD MANUAL/PRESET switch to MANUAL position.

9. Adjust line input amplifier offset null potentiometer R55 for zero change in voltage at TP6 while rotating RECORD potentiometer through its range.

10. Connect dc voltmeter to TP2 and ground (Figure 5-18).

11. Adjust line output amplifier offset null potentiometer R40 (Figure 5-18) for 0 ±30 mV at TP2. Remove dc voltmeter.

12. Remove power and reinstall fuse F1.

5-59. *Record Level Adjustment (Method 1).* Proceed as follows:

1. Connect an audio oscillator to the line input connector (Figure 2-14). Set oscillator frequency to 1.0 kHz and adjust oscillator output level to +4 dBm (or other operating level selected by the user).
2. Connect ac voltmeter to TP6 and ground (Figure 5-18).
3. Set RECORD MANUAL/PRESET switch to PRESET position.
4. Adjust record preset potentiometer R2 (Figure 5-17) for –5 dBm level at TP6.
5. Connect ac voltmeter to line output connector (Figure 2-14) and terminate line output with 600 ohms, or place switch (Figure 2-14) in the terminate position.
6. Select input monitoring for channel being aligned.
7. Adjust record calibrate potentiometer R3 (Figure 5-17) for +4-dBm level on the ac voltmeter (or other line output operating level selected by the user).
8. Remove power and set peak/vu meter switch S3 (Figure 5-18) to desired operating position, peak or vu. Reapply power.
9. Select input monitoring for channel being aligned.
10. Adjust meter calibration potentiometer R21 (Figure 5-18) for indication of –6 dB (meter switch S3 in peak position) or 0 vu (meter switch S3 in vu position).

5-60. *Reproduce Level Adjustment (Method 1).* Proceed as follows:

1. Remove power and remove all audio PWA's from the recorder/reproducer electronics assembly.
2. Connect a jumper from TP5 to TP6 (Figure 5-18).
3. Connect an audio oscillator to the line input connector (Figure 2-14). Set frequency to 1.0 kHz and output level to +4 dBm (or other operating level selected by the user).
4. Set REPRODUCE MANUAL/PRESET switch to PRESET position.
5. Connect ac voltmeter to line output connector (Figure 2-14) and terminate line output with 600 ohms or place switch (Figure 2-14) in the terminate position.
6. Apply power and adjust reproduce preset potentiometer R1 (Figure 5-17) for +4-dBm level on the ac voltmeter (or other line operating level selected by the user).
7. Repeat the *Record Level Adjustment (Method 1)* and *Reproduce Level Adjustment (Method 1)* procedures for the other audio channels.
8. With power off, remove input/output module and extender board from input/output mainframe. Remove jumper connected from TP5 to TP6. Reinstall input/output module into mainframe.
9. Reinstall all audio PWA's into the recorder/reproducer electronics assembly.

5-61. *Record and Reproduce Level Adjustment (Method 2).* Proceed as follows:

1. Remove power and remove all audio PWA's from the recorder/reproducer.
2. Install recorder/reproducer extender board into electronics assembly corresponding to channel to be adjusted.
3. Install I/O level set accessory connector (Figure 5-16) into extender board with pin A in the uppermost position. Connect cable to ac voltmeter.
4. Remove input/output module from input/output mainframe and place module on an extender board (Table 5-1). Insert extender board into mainframe.

5. Connect an audio oscillator to line input connector (Figure 2-14). Set oscillator frequency to 1.0 kHz and adjust oscillator output level to +4 dBm (or other input operating level selected by the user).

6. Set RECORD MANUAL/PRESET switch to PRESET position.

7. Apply power and adjust record preset potentiometer R2 (Figure 5-17) for −5-dBm level on the ac voltmeter connected to the I/O level set accessory.

8. Connect ac voltmeter to line output connector (Figure 2-14) and terminate line output with 600 ohms or place switch (Figure 2-14) in the terminate position.

9. Select input monitoring for channel being aligned.

10. Adjust record calibrate potentiometer R3 (Figure 5-17) for +4-dBm level on the ac voltmeter (or other line output operating level selected by the user).

11. Select repro monitoring for channel being aligned.

12. Set REPRODUCE MANUAL/PRESET switch in the PRESET position.

13. Adjust reproduce preset potentiometer R1 (Figure 5-17) for +4-dBm level on the ac voltmeter (or other line output operating level selected by the user).

14. Remove power and set peak/vu meter switch S3 (Figure 5-18) to desired operation position, peak or vu. Reapply power.

15. Adjust meter calibration potentiometer R21 (Figure 5-18) for indication of −6 dB (meter switch S3 in peak position) or 0 vu (meter switch S3 in vu position).

16. Repeat procedure for the other audio channels.

17. With power off, remove input/output module and extender board from input/output mainframe. Reinstall input/output module into mainframe.

18. Remove extender board from electronics assembly and reinstall audio PWAs removed in step 1.

5-62. PURC Timing Alignment. The recorder/reproducer is capable of operating with or without PURC operation on each channel, as desired, by placement of a jumper located on each two-speed PADNET or a switch on each four-speed PADNET PWA. See *Installation* section of the manual (paragraph 2-30) for jumpering information. (Note: recorder/reproducers shipped from the factory are set for normal non-PURC, operation.)

The only adjustment required for PURC alignment is the adjustment of PURC timing to normalize the delay timing to establish correct operation for all speeds. Once the adjustment control has been set for one speed, timing is automatically set when the other speed is selected.

To aid in the alignment of the PURC timing, an optional automatic record/play cycler may be used to cycle the recorder/reproducer for insert-edit operation (paragraph 3-19) while the PURC timing adjustment is being made. (The cycler is constructed by the user. See Figure 5-19 for cycler schematic diagram and parts list.) The PURC alignment procedure should only be performed if the record, reproduce, and erase alignment is known to be correct. Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* portion of this section of the manual, paragraphs 5-4 and 5-7.

2. Connect an audio oscillator to audio input connector corresponding to first channel to be aligned.

3. Set oscillator frequency to 1.0 kHz.

4. Connect scope to audio output connector corresponding to first channel to be aligned.

5. Adjust scope time base for 1.0-second horizontal sweep.

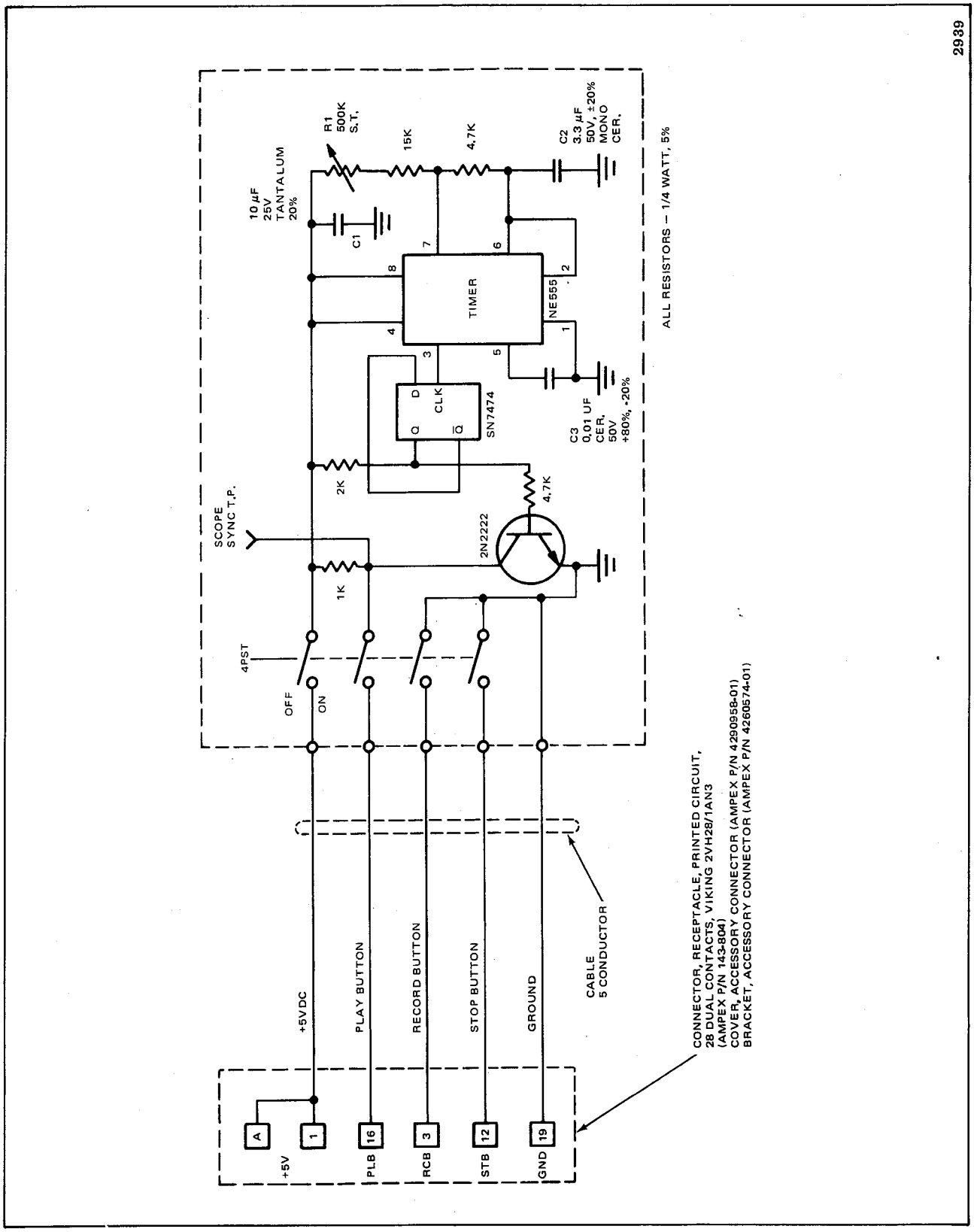


Figure 5-19. Automatic Record/Play Cycler