

SECTION 5

ELECTRONIC ASSEMBLY

The Electronic Assembly consists of a Record Amplifier, a Playback Amplifier and a Bias and Erase Oscillator on one chassis. The Power Supply is mounted on a separate chassis.

5.1 RECORD AMPLIFIER

The Record Amplifier consists of four stages; a high-gain pentode pre-amplifier for microphone and balanced bridge inputs (V401, 12SJ7), two triode-connected-pentode amplifiers (V402, V403, two 12SJ7), and a constant-current triode output stage (V404, 6C5/6J5).

One of three available input circuits can be selected by the Input Transfer switch (S401). When S401 is in the UNBALANCED BRIDGE position, the input transformer (T401) and the input pre-amplifier (V401) are bypassed, and the signal is fed to the grid of V402 through the Record Level Control (R409).

Separate high frequency pre-emphasis for each speed is provided by the Record Equalizers (C406 or C407 and R413) between V402 and V403, and the LC combination in the cathode return of V404. Equalization is changed by the Equalization Switch (S402).

The output of the constant current amplifier (V404) is fed to the Record Head through the coupling condenser (C412). The Noise Balance Bridge (R422, R423, R424, R425) serves to counterbalance any leakage current from C412 or any asymmetry in the Bias Oscillator (V408) output, either of which would tend to magnetize the Record Head permanently and result in an increase of 5 to 10 db in noise level, and the introduction of second harmonic distortion.

When the Record button (S403) is pressed, the Record Relay (K401) is energized through contact K502-1 of the Play Relay (in its energized position), K503-1 of the Fast Forward Relay (de-energized), and K504-3 of the Rewind Relay (de-energized). The Record Relay therefore cannot be energized unless the machine is in the PLAY mode. (See Figures 1 or 2, and 3.)

5.2 PLAYBACK AMPLIFIER

The Playback Amplifier is a three-stage pentode amplifier which provides a +4 VU 600 ohm output at the Line Out Connect-

or (J404P). The feedback loop of the first stage (V405) includes the Playback Equalizer (R435 and C417) which provides a suitable RC for Playback de-emphasis. A feedback loop around the last two stages (V406, V407) serves to minimize distortion.

5.3 BIAS AND ERASE OSCILLATOR

The Bias and Erase Oscillator (V408) is a conventional push-pull triode oscillator which provides a 100 KC signal to the Erase and Record Heads.

5.4 VU METER AND MONITORING

Visual and audible monitoring checks are provided by the VU meter (M401) and the Phone Jack (J403S). With the Meter and Output Switch (S405) in the Erase position, the VU is connected across R458 and indicates erase current. With S405 in the Bias position, the VU is across R459 and indicates Bias current. The VU is across the Playback Amplifier output in both the Playback and Record positions of S405. In the Playback position, the VU monitors the complete playback circuit from the Playback Head to the Line Out (J404P). In the Record position, the last two stages of the Playback Amplifier are disconnected from the first stage and are fed by the output of the first two stages of the Record Amplifier (picked off R428, the Record Calibration Control).

5.5 POWER SUPPLY

The Power Supply (Figure 4) provides 6.3 volt AC heater power, 12.6 volt DC heater power (through a full wave selenium rectifier, SR601) and the plate supply through a 5Y3G Full Wave Rectifier.

5.6 ELECTRONIC ALIGNMENT

Alignment consists of making all adjustments necessary for proper electronic performance. A recorder "out of alignment" may be characterized by poor frequency response, high noise, low output, high distortion, or a combination of these faults. All Ampex recorders are correctly aligned at the factory just before shipment. It should not be necessary to realign the recorder on arrival. Should there be a doubt at any time

concerning the condition of the recorder, it is suggested that a rapid overall performance check be made as described in Section 2. Realignment is called for only if performance does not fall within the limits given in Specifications.

The following two sections should be thoroughly absorbed before going on to the details of alignment procedure.

5.6.1 ALIGNMENT AND TEST EQUIPMENT REQUIREMENTS

The following list covers the minimum equipment requirements for proper alignment and testing.

A. **Audio Oscillator** - Hewlett-Packard Model 200C or equivalent.

B. **Vacuum Tube Voltmeter** - Hewlett-Packard Model 400C or equivalent.

C. **Ampex Alignment Tape**

For 3-3/4 - 7-1/2 inch machines - Ampex Catalog #5563

For 7-1/2 - 15 inch machines - Ampex Catalog #4494

Both of these tapes are recorded at 10 db below Operating Level. The Catalog #5563 tape is recorded at 7-1/2 inches per second, the #4494 at 15 inches per second. Each tape contains voice announcements for the following tone sequence: playback head azimuth check tone, reference tone for playback level adjustment, tone series for playback response check.

D. **Ampex Head Demagnetizer** - Ampex Catalog #704.

E. **High Impedance Headphones**

F. **1/4" Hexagonal Socket Wrench**

5.6.2 GENERAL PRECAUTIONS

It is always advisable to demagnetize the record and playback heads **BEFORE** putting an alignment tape on the machine. Magnetization of the heads will cause partial erasure of the high frequencies on the tape and make it useless as a standard. Demagnetization procedure is given in Section 4.4.3.

The amplifier output must always be terminated in 600 ohms when testing or aligning. Either put the **LINE TERMINATION**

switch (S404) in the ON position or terminate the **LINE OUT** externally with a 600 ohm resistor.

It is not necessary to dismount the Electronic Assembly from the console or case for most alignment procedures. The procedures that require bench adjustments are specially noted as they appear. **CAUTION: There are a few distinct differences between adjusting a 3-3/4 - 7-1/2 inch machine and a 7-1/2 - 15 inch machine. Read the procedures carefully where these differences are indicated.**

A vacuum tube voltmeter is not strictly necessary in most of the procedures outlined, as the internal VU meter serves adequately. Only in cases where levels fall in the less sensitive ranges of the VU meter is a VTVM called for. Corresponding readings of VU meter and VTVM are given wherever applicable.

5.6.3 PLAYBACK CIRCUIT ALIGNMENT

Playback circuit alignment consists of the following:

A. **Playback Head Alignment** (Steps 1, 2, 3, 4, 5)

B. **Playback Level Setting** (Step 6)

C. **Playback Response Check** (Step 7)

D. **Playback Equalization** (Step 8)

A. **Playback Head Alignment**

1. Throw the Line Termination Switch (S404) ON. Throw the Tape Speed Switch (S503) and the Equalization Switch (S402) to HIGH. Turn the Meter and Output Switch (S405) to **PLAYBACK-LEVEL**. Set the Playback Level Control (R438) at mid-scale.

2. Connect a VTVM to **LINE OUT** (J404P), strapping Pins 1 and 2 together. Connect high impedance phones to Phone Jack (J403S).

3. Remove the two screws from the top of the **Head Housing Cover**, and pull the cover gently up and back to remove it. (The heads, from left to right, when facing the machine, are: Erase, Record, and Playback.) The left-hand elastic stop nut on top of the Record and Playback heads is the azimuth adjust. **CAUTION: NEVER ATTEMPT TO ADJUST ANY OTHER NUT OR SCREW ON THESE HEADS.**

4. Thread the appropriate alignment tape on the machine (see Section 5.6.1 C), and press the Play button. The first tone on the tape is for Playback Head alignment.
5. Using a 1/4 inch hexagonal socket wrench, adjust the left-hand elastic stop nut on top of the Playback Head for maximum output as seen on the VU or the VTVM.

B. Playback Level Adjustment

6. The second tone on the tape is for Playback Level adjustment. Adjust the Playback Level Control (R438) for a reading of -10 on the VU (-6 DBM on the VTVM). CAUTION: THIS SETTING MUST BE RETAINED UNTIL THE RECORD LEVEL METER CALIBRATION HAS BEEN ADJUSTED AS DESCRIBED LATER. IT IS SUGGESTED THAT THE SETTING BE MARKED BY A PENCIL LINE ON THE FACE PLATE.

C. Playback Response Check

7. The next series of tones is for checking the frequency response of the Playback Head and Amplifier. If the playback circuit is properly aligned, the response will meet specifications at both speeds available on the machine. If the response does not meet specifications, one of the following is indicated:

- (a) Worn or otherwise faulty Playback Head.
- (b) Faulty alignment tape. (High frequencies partially erased by passing over magnetized heads.)
- (c) Playback Amplifier improperly equalized. (See Step 8, which follows.)

D. Playback Equalization

8. Equalization setting will usually be found most convenient as a bench procedure. The curves to which the machines are set at the factory are shown in Figure 6. Note that the 7-1/2" and 15" Playback curves are identical. The 3-3/4" curve differs, but is not adjustable. Therefore, Playback equalization need be set only at the 7-1/2" speed on any machine. With the Equalization Switch set for the 7-1/2" speed, connect an audio oscillator and VTVM as shown in Figure 6, and adjust the Playback Equalizer (R435) to give the frequency re-

sponse of the 7-1/2" - 15" curve. Deviation from this curve is not recommended. CAUTION: IF IT HAS BEEN NECESSARY TO ADJUST THE PLAYBACK EQUALIZATION, AS DESCRIBED ABOVE, GO BACK AND REPEAT STEP 6 BEFORE PROCEEDING ANY FURTHER.

5.6.4 ERASE AND RECORD CIRCUIT ALIGNMENT

Erase and Record Circuit Alignment consists of the following:

- A. Erase Adjustment (Steps 1, 2)
- B. Bias Adjustment (Steps 3, 4, 5, 6)
- C. Bias Meter Calibration (Step 7)
- D. Record Level Meter Calibration (Steps 8, 9)
- E. Record Head Alignment (Steps 10, 11)
- F. Record Equalization and Response Check (Steps 12, 13, 14, 15)
 - 15" Equalization (Steps 12, 13)
 - 7-1/2" Equalization (Steps 12, 14)
 - 3-3/4" Equalization (Steps 12, 15)
- G. Noise Balance Adjustment (Step 16)

A. Erase Adjustment

1. Thread a new blank tape on the machine.
2. Turn the Meter and Output Switch (S405) to the ERASE position. Put the machine in the Record mode and read the erase current indication of the VU meter. The reading should be approximately zero. (Since line voltage has some effect on erase current, variations of ± 1 db in the meter reading may be expected. Do not readjust the Erase Trimmer if the reading falls within this range.) To adjust erase current, back off the Erase Trimmer (C438) to minimum capacity (clockwise), and then increase the capacity until the VU meter reads approximately zero. CAUTION: THE ERASE CURRENT ADJUSTMENT HAS A DIRECT EFFECT ON BIAS CURRENT AND SHOULD NOT BE CHANGED AFTER THE BIAS ADJUSTMENT HAS BEEN MADE AS DESCRIBED BELOW. THE BIAS ADJUSTMENT WILL NOT AFFECT THE ERASE CURRENT.

B. Bias Adjustment

3. Turn the Meter and Output Switch (S405) to the PLAYBACK-LEVEL position. Turn the Input Transfer Switch (S401) to the UNBALANCED BRIDGE position. Throw the Tape Speed Switch (S503) and Equalization Switch (S402) to HIGH.
4. Connect an audio oscillator to the LINE IN (J401S) strapping Pins 1 and 2 together.
5. For a 3-3/4" - 7-1/2" machine, set the audio oscillator frequency at 500 cycles. For a 7-1/2" - 15" machine set the oscillator at 1000 cycles. (These are the optimum frequencies for adjusting Record Bias on the two machines. The adjustment is made at the higher of the two speeds available on any machine, and serves for both speeds.) Put the machine in the Record mode, and adjust the Record Level Control (R409) for a reading of approximately zero on the VU, (approximately +4 DBM on the VTVM).
6. Adjust the Bias Control (R460) for maximum output as seen on the VU or VTVM. (It is desirable to be within at least 1/2 db of the maximum efficiency point in order to achieve wide frequency range recording at the lower of the two available speeds.)

C. Bias Meter Calibration

7. With the machine still operating as described under Bias Adjustment, above, turn the Meter and Output Switch to the RECORD-BIAS position. Adjust the slide on the Bias Meter Calibration resistor (R459) for a zero reading on the VU meter, (+4 DBM on the VTVM).

D. Record Level Meter Calibration

8. With the machine operating as described in the last step, turn the Meter and Output Switch to the PLAYBACK-LEVEL position, and re-set the audio oscillator to 250 cycles. Set the Record Level Control (R409) for a reading of zero on the VU (+4 DBM on the VTVM). BE SURE THE PLAYBACK LEVEL CONTROL IS STILL SET AS DESCRIBED IN SECTION 5.6.3 STEP 6.
9. Turn the Meter and Output Switch to the RECORD-LEVEL position, and ad-

just the Record Level Meter Calibration resistor (R428) for a reading of zero on the VU (+4 DBM on the VTVM).

E. Record Head Alignment

10. Set the audio oscillator at 15,000 cycles, (10,000 cycles for 3-3/4" - 7-1/2" machines) and be sure the Tape Speed and Equalization switches are on HIGH. Turn the Meter and Output Switch to the RECORD-LEVEL position. Set the Record Level Control (R409) for a reading of -10 on the VU (-6 DBM on the VTVM). (For 3-3/4" - 7-1/2" machines, set for -16 DBM on the VTVM).
11. Turn the Meter and Output Switch to the PLAYBACK-LEVEL position. With the machine in the Record mode, adjust the left-hand elastic stop nut on top of the Record Head for maximum output as seen on the VU or VTVM. Several peaks may be noted. Always choose the peak of greatest amplitude. NOTE: The Playback Level Control (R438) may be set for increased gain so that this and the following adjustments may be made in a more sensitive meter range. CAUTION: WHEN REPLACING THE HEAD HOUSING COVER, DO NOT TIGHTEN DOWN TOO HARD ON THE SCREWS, OR THE HEAD ALIGNMENT MAY BE DISTURBED BY BOWING OF THE HEAD MOUNTING PLATE.

F. Record Equalization and Response Check

12. Unlike Playback Amplifier Equalization, Record Amplifier Equalization must be adjusted at both speeds available on any machine. The curves shown in Figure 7 are those to which the machines have been set at the factory, using a typical professional quality tape. If the factory settings do not produce a flat response on the tape of your choice, do not hesitate to readjust the equalization (bias must be re-adjusted as well). The following procedure will produce a flat overall response for any professional quality tape.

15" Equalization

13. Set the Tape Speed Switch and Equalization Switch for 15" speed. Set the audio oscillator at 250 cycles. Turn the Meter and Output Switch to the RECORD-LEVEL position and set the Record Level Control (R409) for a reading of -10 on the VU (-6 DBM on

the VTVM). Switch to the PLAYBACK-LEVEL position. (The Playback Level Control, (R438) may be set for increased gain if desired.) Re-set the audio oscillator to 8,000 cycles, put the machine in the Record mode, and adjust the appropriate Record Equalizer for a reading of -10 on the VU (-6 DBM on the VTVM). Frequency response should now be within specifications, and can be checked by sweeping the oscillator through the range specified in Section 1.

7-1/2" Equalization

14. Set the Tape Speed Switch and Equalization Switch for 7-1/2" speed. Set the audio oscillator to 250 cycles. Turn the Meter and Output Switch to the RECORD-LEVEL position and set the Record Level Control for a reading of -16 DBM on the VTVM. Switch to the PLAYBACK-LEVEL position. (The Playback Level Control may be set for increased gain if desired.) Re-set the audio oscillator to 8,000 cycles, put the machine in the Record mode, and adjust the appropriate Record Equalizer for a reading of -16 DBM on the VTVM. Frequency response should now be within specifications, and can be checked by sweeping the oscillator through the range specified in Section 1.

3-3/4" Equalization

15. Set the Tape Speed Switch and Equalization Switch for 3-3/4" speed. Set the audio oscillator to 250 cycles. Turn the Meter and Output Switch to the RECORD-LEVEL position and set the Record Level Control for a reading of -16 DBM on the VTVM. Switch to the PLAYBACK-LEVEL position. (The Playback Level Control may be set for increased gain if desired.) Re-set the audio oscillator to 6,500 cycles, put the machine in the Record mode, and adjust the appropriate Record Equalizer for a reading of -16 DBM on the VTVM. Frequency response should now be within specifications, and can be checked by sweeping the oscillator through the range specified in Section 1.

G. Noise Balance Adjustment

16. The Noise Balance Control (R424) should never be touched unless the heads have first been thoroughly demagnetized as described in Section 4.4.3. If a crackling noise is still heard in the output after head demagnetization, connect a 1 MFD condenser across the LINE OUT and adjust R424 for minimum Record noise as read on a sensitive meter or heard in a loudspeaker connected to the output through a power amplifier.