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Instruction Manual
Cuemaster 77 Mk VG
Professional Transportable Recorder
Issue 3

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Instructions for performing the calibrate switch modification to the C.E.I Mk. V.

1. Set the knobs on input 1, input 2, and play level pots so that the pointers point accurately to 0 and 10 at both ends of their travel.

2. Remove the bottom section on the machine from the chassis. Remove the top cover plate and take out all the plug in PCBs and remove the mother board.

3. Unsolder and remove the 6 resistors on the 3 calibrate switches.

4. Prepare 3 x 10K log. multi-turn preset pots by soldering 30 mm lengths of insulated wire on each of their terminals and then insulating the terminals.

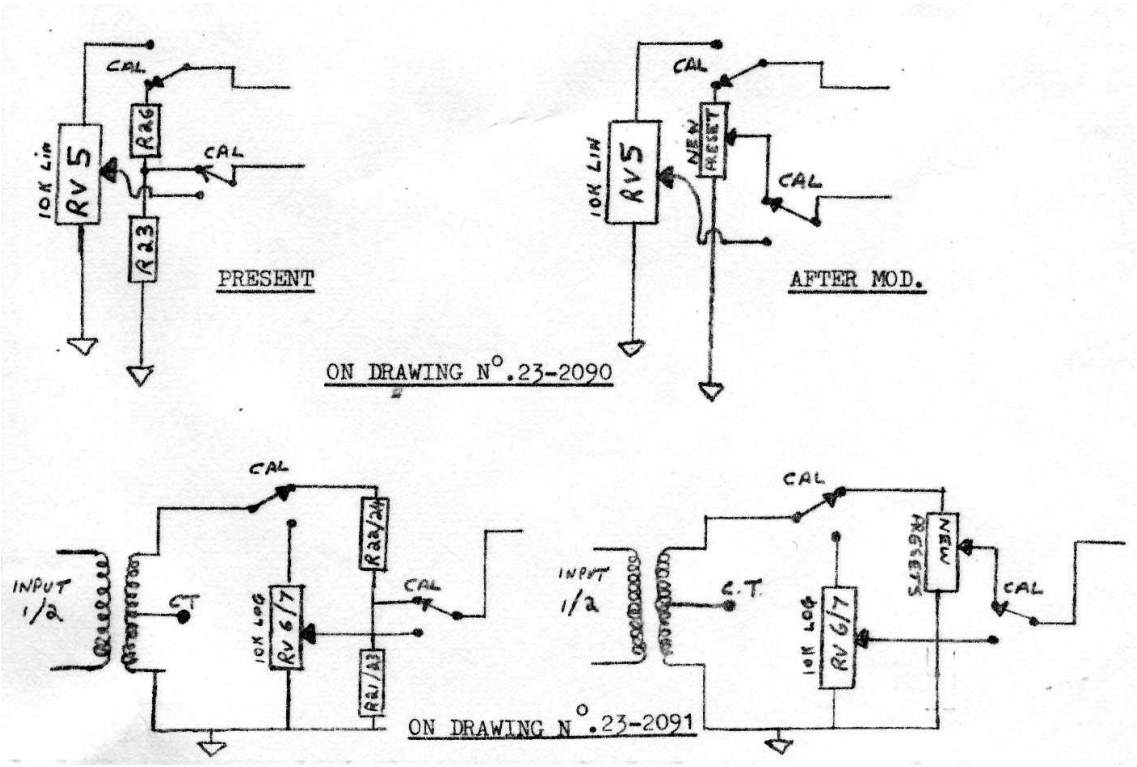
5. Glue the presets onto the rear of their associated level pots with 5-minute Araldite or equivalent. Glue them vertically in the centre so that the adjusting screw is accessible from the top.

6. Solder the wires across the points the resistors were removed from such that the calibrate switch changes over between the wipers and the top terminals of the main pot and the preset - the bottom terminals of each are joined together.

7. Reassemble all the PCBs. Put the 3 level pots to the triangle mark which indicates the centre and switch the three switches to the un-calibrated position.

8. Play a test tape and use the play level preset control to obtain the correct output level then adjust the new play-calibrate preset so that there is no change in level when the calibrate switch is operated.

9. In the record mode, adjust the new preset pots on the back of the input level pots so that there is no change in reproduced level when the calibrate switch is operated. The record level preset should then be adjusted so that a +8 dBm input signal is reproduced at +8 dBm.



Contents

1. Introduction

The Cuemaster 77 Mk VG professional recorder has been designed to provide operational flexibility and reliable performance. It represents the fifth generation of professional reel to reel transportable recorders.

Packaged as a complete recorder, it offers more facilities and features in a transportable case than many sophisticated studio console recorders.

Technical performance meets or exceeds all broadcasting specifications.

Basic features are:

- Three motor -speed Three heads -micro azimuth adjustment.
- Digital tape timer -hours, minutes, and seconds.
- Automatic tape tension control -constant tape tension.
- from beginning to end of a reel plus different size reel capability.
- Deck controls and amplifier monitoring enable accurate dub editing.
- Fully solid state electronics.

The deck is available in full track, two track or stereo configuration with one amplifier unit required for each channel.

2. Specification

2.1 Deck Specification

Size	Carry Case	527 mm wide, 445 mm high, 248 mm deep
	Deck	433 mm wide, 222 mm high, 152 mm deep
	Amplifier Unit	433 mm wide, 89 mm high, 152 mm deep
Weight	Deck	16.4 kg
	2 x Amplifier Unit	7.3 kg
	Carry Case	9.5 kg
	Total	33.2 kg

Tape size Nominal ¼ in.

Spool sizes Cine type 7 ins. (BS 1568/1960) 5 or 3 ins.

Power supply 230 to 250V, 50 Hz, 150 VA, 117V 60 Hz optional

Fuses AC 1 amp. M205 230V, 2 amp. M205 117V
DC 2 amp. M205

Heads Separate Erase, Record and Play heads. Laminated construction

Tape Timer Driven directly from the tape. Indicates in hours, minutes, and seconds. Maximum time 9 hours. 59 mins. 59 secs.

2.2 Tape Drive Capstan

Capstan is direct-drive from a hysteresis synchronous motor.
Speed change is via a toggle switch between the **Record** and **Play** push buttons. Power for the motor is derived from the 220 volt power transformer tap.

Spools
Each spool has an induction motor drive powered directly from the 240 (117) volt power line. Tape tension is automatically controlled by a tension sensing feedback system.

Brakes
The brakes are solenoid operated and dynamically assisted.
Actuation noise is eliminated by an adjustable poling pin, which stops the solenoid armature from poling.

Pressure Roller
The pressure roller is solenoid operated. Actuation force is controlled by a poling adjustment, which also eliminates noise.

Head Mount
Each head is mounted in a precision-machined one-piece brass mount. The head mount has provision for precision azimuth adjustment and a positive lock of the azimuth setting.

Controls
Stop, Play, Edit, Spool, Record, and Power On. Indication of power on is via the stop lamp. A sliding potentiometer for spooling in either direction. A reset button for the Tape Timer Counter. Tape Speed, and Local/Remote selector switches.

2.3 Performance Detailed Specification

2.3.1 Deck

Tape Speed	7.5/15 I.P.S. with 3.75/7.5 I.P.S. as an option
Tape Speed Accuracy	± 0.1% Short Term ± 0.2% Long or term
Tape Timer Accuracy	10 secs for 1,200 feet of tape
Wow and Flutter	Better than 0.08%CCIR peak weighted at 15 I.P.S.

	Better than 0.1% CCIR peak weighted at 7.5 I.P.S. Better than 0.15% CCIR peak weighted at 3.75 I.P.S.
Winding Time	Less than 70 secs. for 1,200 ft of tape
Starting Time	1 second to meet wow and flutter specifications.
Equalization	I.E.C., N.A.B. optional

2.3.2 Input Signal

	Line (balanced)		mic (balanced)
	600 ohm	10K	
Input impedance	600 ohm	10K	400 ohms
Return Loss	40 dB	-	-
30 Hz – 16 KHz			
Min. Level	- 12 dBm	-12 dBm	250 uV
Max. Level	+ 20 dBm	+20 dBm	15 mV (clipping)

2.3.3 Output Signal

Line Output (via tip, ring and sleeve jack)	+21 dBm maximum level before clipping
Output matching impedance	
Line	600 ohm balanced
Monitor	15 ohm unbalanced
Output source impedance	100 ohm max. (30 Hz to 16 K Hz) Typical 50 ohm

2.3.4 Replay Characteristics
Frequency Response:

Using test tape BASF DIN 39S at 15 I.P.S.	30 Hz to 18K Hz ±1 dB
Using test tape BASF DIN 19S at 7.5 I.P.S.	30 Hz to 16K Hz ±1 dB
Using test tape BASF DIN 9 at 3.75 I.P.S.	30 Hz to 8K Hz ±1 dB

Signal to Noise Ratio: Broad band unweighted

w.r.t.	320 nw/m	Mono 3.75 I.P.S. 58 dB 7.5 I.P.S. 62 dB 15 I.P.S. 64 dB
	510 nw/m	Stereo 3.75 I.P.S. 58 dB 7.5 I.P.S. 62 dB 15 I.P.S. 64 dB

Note:	Due to head pole effect and fringing effect frequency response is	+0.5 dB at 31 Hz and +1.5 dB at 63 Hz: 7.5 I.P.S. –1.5 dB at 63 Hz and –0.5 dB at 125 Hz: 15 I.P.S.

2.3.5 Sync. Characteristics
(Replay from Record head)

Frequency response	3.75 I.P.S. 30 Hz to 4K Hz ± 3 dB 7.5 I. P .S. 30 Hz to 8K Hz ± 3 dB 15 I.P.S. 30 Hz to 16K Hz ± 3 dB
Signal to Noise Ratio:	
w.r.t. 320 nw/m – Mono	50 dB Play only
510 nw/m – Stereo	50 dB Both channels play mode

2.3.6 Record Characteristics

Gain	20 dB
Record/Replay Frequency Response	3.75 I.P.S. 30 Hz to 8 Hz ± 2 dB 7.5 I.P.S. 30 Hz to 16K Hz ± 2 dB 15 I.P.S.30 Hz to 20K Hz ± 2 dB

Erasure 7.5 I.P.S. 70 dB @ 1K Hz recorded at 320 nwb/m mono and 510 nw/m stereo

Bias and Erase Frequency 100K Hz ±1K Hz
Maximum input level +20 dBm

Unity gain overall noise using Ampex 406 tape with bias applied WRT 320 nwb/m mono and 510 nwb/m stereo.

Line Input

	3.75 I.P.S	7.5 I.P.S.	15 I.P.S.
Broadband	54 dB	58 dB	59 dB
30 Hz – 20 KHz	58 dB	60 dB	61 dB
ANSII weighted	63 dB	65 dB	66 dB

Mic Input

	3.75 I.P.S	7.5 I.P.S.	15 I.P.S.
Broadband	54 dB	58 dB	59 dB
30 Hz – 20 KHz	58 dB	60 dB	61 dB
ANSII weighted	63 dB	65 dB	66 dB

Overall T.H.D. unweighted
Using Ampex 406 tape

320 nw/m – Mono	1.5% max.
510 nw/m – Stereo	2% (34 dB at 0.2 dB over bias @ 1K Hz)
3% distortion occurs	6 dB above quoted flux levels for mono and 2 dB above for stereo

2.3.7 Monitor Characteristics

The monitor may be switched to record, replay or bias signals.

Power	2 watt into 15 ohm
Frequency Response	30 Hz to 16K Hz ±3 dB at 2W
Signal to Noise Ratio: Record selected.	60 dB below 2 watts
Distortion at 1K Hz	1% T.H.D.

2.3.8 Line to Line

Frequency Response	30 Hz –20 KHz ±1 dB
Distortion at 1K Hz @ +16 dBm.	Less than 0.3% T.H.D.

2.3.9 Mic to Line

Frequency response	50 Hz -15K Hz ±1 dB
Distortion at 1 KHz	@2.5 mV – less than 0.5% T.H.D.

3. Operation

3.1 Deck Control

With the deck connected to a 250/230 volts and 50 Hz supply (optional 117 volt. 60 Hz), and the power switch at the lower left hand corner turned on, the **Stop** push button will illuminate.

Five push buttons and two selector switches on the lower right hand corner of the deck control the various modes of operation. There is provision for remote control of all but the **Edit** function.

3.1.1 Play may be selected at any time and is cancelled by:

(1) Tape break
(2) **Spool** push button
(3) **Stop** push button

The **Play** push button will cancel **Record** and override the tape break while actually depressed. When selecting **Play** from **Spool** the tape will automatically come to a stop before the **Play** mode is activated.

3.1.2 Edit is provided to enable manual handling of the tape for various editing purposes. When selected it will release the brakes.

Edit sets up 4 conditions of operation:

(1) Can be cancelled **only** by the **Stop** push button

(2) Cannot be selected if already in the **Spool** mode.

(3) If previously in the **Play** or **Record** mode, the **Edit** push button will release the brakes and inhibit the tape-up motor to give bin-editing.

(4) A tape break will not cancel **Edit**.

3.1.3 The **Spool** mode can be selected to enable fast spooling in either direction. The direction of spooling is controlled by a sliding potentiometer located next to the power switch.

Spool will be cancelled by any of 4 conditions:

(1) **Stop** push button

(2) Tape break

(3) **Record** push button (selects **Play**, not **Record**)

(4) **Play** push button

Spool cannot be selected if previously in the **Edit** mode.

3.1.4 **Record** can be selected **only** if previously in the **Stop** or **Play** mode **Record** will be cancelled by any of 4 conditions:

(1) Tape break

(2) **Play** push button

(3) **Spool** Push button

(4) **Stop** Push button.

For recording, the channel safe switch on the Amplifier Unit must also be switched into the record mode.

If the **Record** push button is pressed while in **Spool** mode, the tape will stop and **Play** will be activated.

3.1.5 The **Stop** push button cancels any other mode, and causes the capstan motor to run approximately 2 minutes. If a fast start is required the capstan motor will be running (from the last **Stop** action) or can be started before **Play** or **Record** is selected, by pressing the **Stop** push button.

The **Stop** lamp is only lit when the capstan motor is running.

3.1.6 The speed switch selects low or high tape speed. These speeds are 7.5 and 15 ips or 3.75 and 7.5 ips respectively. The tape timer and record and replay equalization are also changed by this switch.

3.1.7 The **Control** switch selects control of the **Tape Speed** and spooling to be on the deck or on the remote control unit. When the remote controls are used all functions are in parallel except **Speed** and spooling.

3.2 Amplifier Controls

The amplifier has controls for:

- Record/Safe/Lockout
- Record Levels
- Output Selector
- Output Level
- Monitor Selector
- Monitor Volume

One amplifier is used for one channel. Thus a stereo or two track deck requires two amplifiers.

3.2.1 Record/Safe/Lockout

This three position switch enables **Record** to be selected on the deck when in the **Record** position. When in the Lockout position the **Record** push button on the deck is inoperative and the machine cannot be placed in the **Record** mode.

When in the **Safe** position **Record** mode can be selected on the deck but bias is not applied to the **Record** and **Erase** head for that channel, but recording can still take place on the other channel of a stereo machine. The LED indicator is only lit when **Record** is selected.

3.2.2 Record levels

The amplifier has two record inputs, input 1 and 2, which are mixed before recording on tape. The level control knobs control the recorded level for each input. Both inputs have a tip ring and sleeve input socket on the front panel in parallel with the Cannon XLR connector on the side.

The **Cal** position on each knob sets unity gain from input to output when the output level knob is also set in its **Cal** position and play is selected. When in the **Cal** position the recorded signal for an input of +16 dBm will be 320 nWb/m for mono and 510nWb/m for stereo. Input 1 can be supplied as a microphone input as an option. The **Calibration** switch disables the front panel control and gets that input to the calibrate level.

3.2.3 Output Selector

The amplifier has two output connectors wired in parallel. A tip, ring and sleeve socket below the Output level control and a Cannon XLR socket on the side panel. A jack inserted into the front panel socket internally disconnects the side panel socket.

The signal that appears on these sockets is selected by the three push buttons beside the output level knob. The three signals are:

1. **Record** - the mixed signal from the record input sockets
2. **Play** - the signal from the replay head
3. **Sync** - signal from the record head used in playback instead of the normal record mode.

3.2.4 Output Level

The level control knob beside the output selector push buttons sets the output level when either **Play** or **Sync** are selected. When **Record** is selected the output level is set only by the **Input** level controls. When in the **Cal** position the recorder is set for unity gain as described in Section 7.2.2. The **Calibration** switch has the same effect as well as disabling the level control when in the calibration position.

3.2.5 Monitor Selector

This set of three push buttons selects what signal is displayed on the VU meter and amplified by the monitor speaker amplifier.

Three positions are:

1. **Input** - The signal on the two inputs are displayed to enable adjustment of the input level controls.

2. **Output** - The signal on the output socket (as selected by the **output** selector) is displayed to allow checking and adjustment of the output level.

3. **Bias** - The bias on the record head is displayed to give a check of continuing correct operation and to enable adjustment of bias level for different types of tape. 0 VU indication is correct bias level for Ampex 406 tape.

3.2.6 Monitor Volume

The selected signal on the VU meter is also fed to the input of a monitor amplifier which drives a speaker mounted in the case. The volume of this speaker is set by the Monitor Volume Control located above the monitor output socket. If a tip, ring and sleeve jack is placed in this socket, the internal speaker is disconnected and the external headphones on the jack are fed by the amplifier.

3.3 Connections

3.3.1 Remote Control 1 (Side Panel) J20

1. Spool lamp
2. Spool push button
3. Record lockout (ground to activate)
4. Timer Count Pulse
5. Record lamp
6. Ground
7. +24V
8. Record push button
9. +12V
10. Play push button
11. Play lamp
12. Stop push button
13. Stop lamp
14. Wind
15. Rewind

Return push buttons to ground - all buttons are momentary action. Return lamps to +24 V, 40MA max each .

Mates with Cannon DA 15P connector, DA20961 backshell and two D20419-16 screw latches.

The **Wind** and **Rewind** push buttons are enabled only when **Spool** is selected, and active only while actuated.

3.3.2 Remote Control 2 (Head Connector panel) J22

This socket connects to Remote Control Unit part number 23-2073 See drawing 23-2072 for details.

1. Spool lamp
2. Spool push button
3. Record lockout
4. Timer count pulse
5. Record lamp
6. Ground
7. +24 V
8. Record push button
9. N.C.
10. Monitor audio ground
11. Speed switch wiper
12. low speed contact
13. N.C.
14. +12V
15. Play push button
16. Play lamp
17. Stop push button
18. Stop lamp
19. Wind spool pot
20. Rewind spool pot
21. Timer up/down line
22. Monitor audio CH2
23. Monitor audio CH1
24. Spool pot wiper
25. High speed contact

Return all push buttons to ground
All push buttons are momentary action
Return lamps to +24V, 40 M.A. max. each.

Mates with Cannon DB 25P connector DB 24659 backshell and two D20419-16 screw latches.

3.3.3 Input

Front panel input 1	Tip, Ring balanced input 10K ohms, Sleeve ground
Side panel input 1 Mates with XLP-3-31	1 Ground 2/3 balanced 600 ohms – 10 K Ohms
Side panel Input 2 Mates with XLP-3-31	1 Ground 2/3 balanced 600 ohms – 10 K Ohms

Both inputs are 600 ohm balanced or 10K ohm bridging selected by a slide switch on the side panel.

3.3.4 Output

Front Panel	Tip/ring – Balanced 600 ohm output. Sleeve – Ground.
Side Panel	1. – Ground 2/3 Balanced 600 ohm output.

Power Inlet

L 240V 50 Hz active
N 240V 50 Hz neutral
E Ground

Mates with XLR-LNE-IIC

Note: 117V 60 Hz optional

Fuses

Mains	240V -	1 amp M205
	117V -	2 amp M205
DC		2 amp M205

4. Regular Maintenance

4.1 Tape Path and Head Cleaning

Each day of regular use all parts of the deck contacting tape should be cleaned. A clean tape path ensures optimum wow and flutter, tape drop out, frequency response and noise.

Each head face and the capstan shaft and pressure roller are the critical items. Use a solvent impregnated soft lint free swab to thoroughly clean each surface so there is no visible evidence of accumulated oxide dust or dirt. Suitable solvents are methylated spirits, toluene petroleum ether (Shell X272) or isoprophyl alcohol. Tape guides, stabilizer rollers and tension arm posts should be cleaned if they appear dirty.

Caution: do not use carbon tetrachloride for cleaning.

4.2 Head Demagnetization

Each week of regular use the heads should be demagnetized to minimise noise, program erasure and distortion.

Caution: Switch off the deck before demagnetizing the heads.

Switch on the demagnetizer at least half a metre from the deck. Slowly pass the poles of the demagnetizer over and around each head gap and capstan shaft with a circular motion. Slowly withdraw the demagnetizer from the head area and switch it off at least half a metre from the deck.

4.3 Spool Motor Check

4.3.1 To check a spooling motor, run the motor at full speed, without a tape reel in the **Spool** mode. Manually hold the brakes off and press the **Stop** and **Start** buttons simultaneously, and then release both. The motors should run on for at least ten seconds, without binding in anyone spot. If the motor fails this test, it requires new bearings.

The bearings are self-lubricated, and require no oiling.

5 Mechanical Alignment

5.1 Brakes

5.1.1 The 77 Mk VG machine employs dynamic braking to allow differential sized reels to be used on the deck. This is accomplished by allowing the machine to stop under tension control, so that any loop formed during the braking period is sensed as a loss of tension and the appropriate motor has additional voltage applied to it to remove the offending loop. Note that dynamic braking is applied only while tape is in motion, after which time the spooling motors are switched off.

The brakes are of the differential type, i.e. the braking torque in the "take-up" direction is approximately one-half the torque in the other direction. This is normally sufficient to stop equal sized reels, but when using differential sized reels, the inertia difference between the reels can exceed a 10:1 ratio, so that without dynamic assistance, tape spillage could occur. For mechanical adjustment of brakes, refer to figure 1.

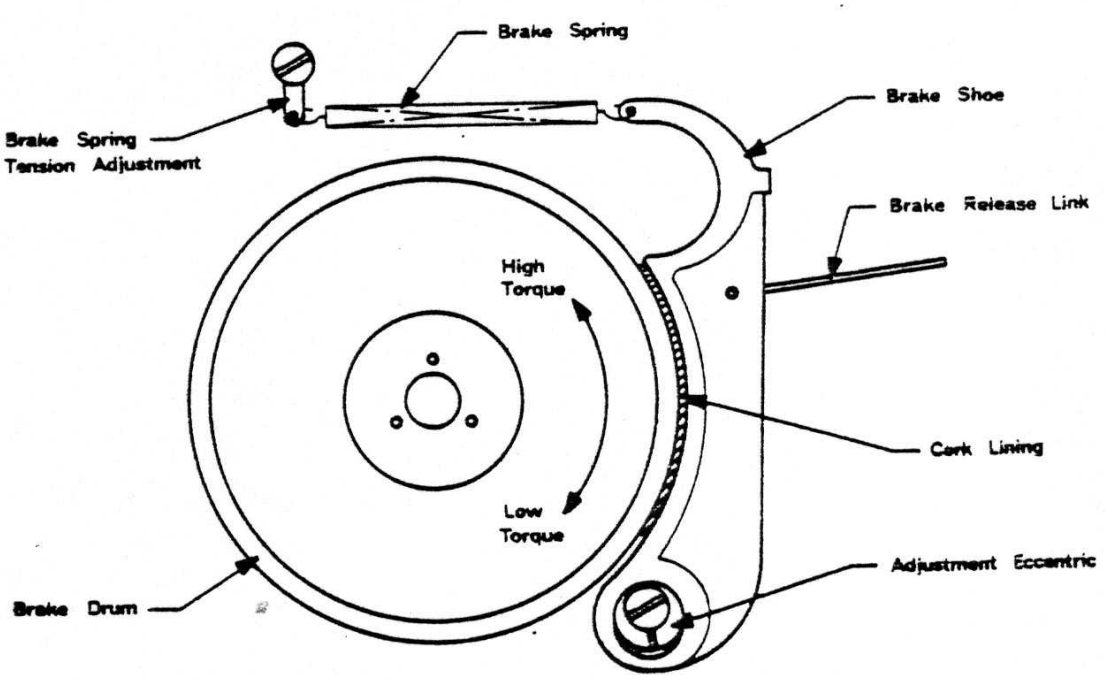


FIG. 1 BRAKE ADJUSTMENTS

5.1.2 Check differential torque on the brake drum. There should be at least a 2:1 ratio. If no significant difference is felt, adjustment of the eccentric is indicated. Slacken the lock screw and rotate the eccentric until the heel of the cork lining (nearest the eccentric) just touches the brake drum. Nip the lock screw and check the differential torque. A slight variation of the eccentric may be needed to optimise the differential torque. When satisfied, tighten the lock screw.

Note that the eccentric mating hole in the brake shoe is slightly oval in the vertical direction to allow the brake shoe to move in this plane, so that when supplying tape, the shoe is driven away from the eccentric,

causing the heel (lower) of the shoe to contact the drum (high braking torque) and when accepting the tape the shoe is driven towards the eccentric causing the toe (upper) of the shoe to contact the drum (low braking torque)

5.1.3 With the deck in **Stop** mode adjust the brake spring to give a spring force of 200 to 300 grams.

A simple check on braking force is to press both **Play** and **Stop** together with no tape loaded. This turns on the spooling motors with the brakes still applied. The motor should just turn slowly. If they do not turn the brake force is excessive and the spring should be loosened. If they spin quickly the spring should be tightened.

5.1.4 After realigning the brakes, check that the release mechanism works satisfactorily. Select **Edit** mode (releases brakes) and check that the brakes release completely, and hubs rotate freely. Select **Stop** mode and check that the brake release links are free in the mating hole in the shoes.

If the brakes fail to release either bend the release link to absorb excess slack, or check that the solenoid "poling" adjustment (eccentric "**Delrin**" cam on the rear of the deck near the brake solenoid) is correctly set.

This adjustment prevents the solenoid from poling, and hence reduces the audible noise resulting from poling. It is adjusted by releasing the cam lock screw and manually pushing the solenoid "home", then rotating the cam until the cam and brake solenoid lever touch. Rotate the cam slightly further so that the solenoid is just off poling (about 0.25 mm or 0.010 inch). Lock the cam locking screw and readjust the brake linkages.

Total solenoid travel should be less than 2 mm (0.08 inch) to minimise acoustic noise.

5.2 Pressure Roller Solenoid

5.2.1 The pressure roller solenoid is also designed to be acoustically quiet and hence must be adjusted so that it does not pole. Refer to figure 2 for adjustment points.

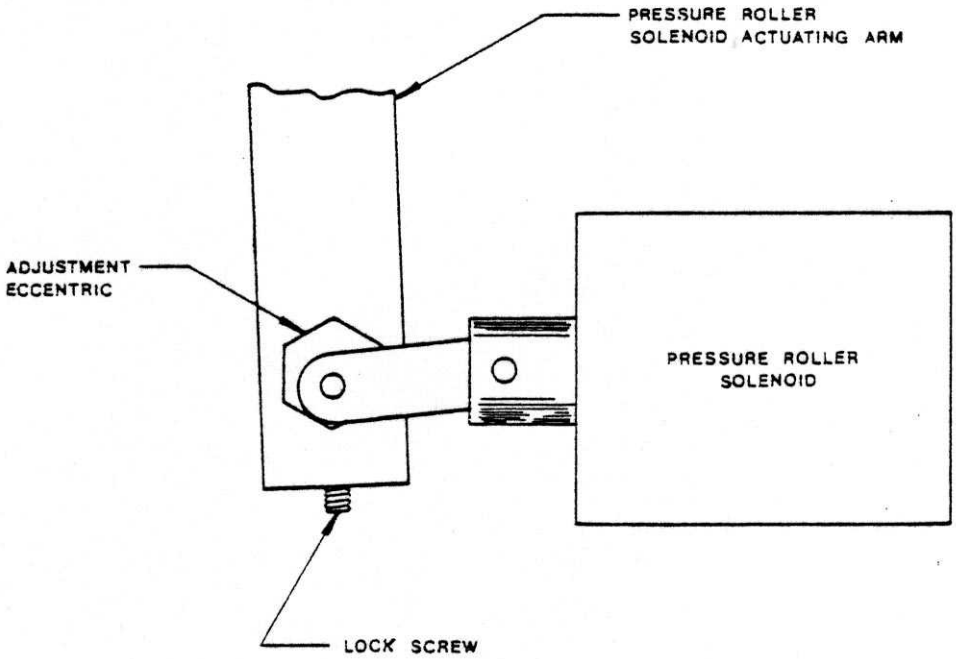


FIG. 2 - PRESSURE ROLLER SOLENOID ADJUSTMENT

5.2.2 Check that when starting the transport the solenoid noise is quiet and the pressure roller force is 2 Kg ±2 Kg. Force is checked by pulling the pressure roller off the capstan with a spring balance. When tape movement stops the balance indicates the pressure roller force. Note that this check is made with the supply spool empty and the take up spool full.

Pressure roller force is altered by releasing the locking screw on the solenoid actuating arm and rotating the solenoid adjustment eccentric until the required force is obtained.

Note that if the solenoid "poles", the adjustment has been taken too far.

5.2.3 The tape lift arm is set so that when spooling with the **Edit** control disengaged the tape clears the play and record heads by approximately 2 mm.

5.3. Tape Path Alignment

5.3.1 Remove the two tape guides between the Erase and Record heads and between the Replay head and Capstan motor. Thread a tape and operate manual **Edit** knob so tape is against all three heads.

Set **Spool** control in the centre and select **Spool** mode. Spool the tape slowly back and forth across the heads. The tape should track centrally across each head. If this is not the case adjust the stabilizer roller heights by changing the shims below the roller bearing.

Note that if a shim is removed it should be added to the top of the roller bearing.

Select **Play** mode and check tape height again. If it rides up or down, adjust capstan parallelism adjusting nut (nut "B" in fig 4) using an 8 mm AF "Spintite". This adjustment is locked by nut D.

5.3.2. Adjust the height of the brake drums to place the tape central on the spool.

5.3.3 Replace the two tape guides and check that the tape rides centrally without touching the edges of the guides.

5.4 Tape Tension Setting

5.4.1 With the sensor arms in normal play position (about 3 mm deflection), measure the spring return force at the sensor. It should be 8 gm ±2 gm and have a hysteresis of less than 2 gm. (Hysteresis is the change in force required to reverse the direction of motion of the sensor arm).

5.4.2 With the sensor covers in place and a full reel of tape on the machine measure tape tension between reel and sensor arm with equal tape on each reel. Adjust RV1 + RV2 on the spooling board to give 40 gm of tension. If a tentelometer is not available adjust for 3 mm deflection of the tape path over the sensor arm.

In the operating position check that manually moving the tension arm gives a tension range of at least 20 gms to 100 gms.

5.4.3 Check tension at beginning and end of both reels. It must be between 30 and 60 gms, and is typically 30 to 45 gms.

5.4.4 Tension setting should be as close as possible to the minimum figure to ensure correct hold back tension in **Spool** mode. Check hold back tension and adjust the tension setting to give a maximum of 60 grams. On the take up side the check should be made with the pressure roller in the "non-edit position". Check the tension on each reel both full and empty and allow time for the start pulse to settle before making a measurement.

Excessive hold back will slow spooling towards the end of a reel.

5.4.5 Place the deck in a vertical plane and re-check tension. A 15% variation is normal but should not result in the tape tension exceeding the limits of min 30 grams to a max. 60 grams.

5.5 Capstan Motor Replacement

5.5.1 Removal - Refer to figure 3.

To remove the capstan motor disconnect the electrical cable at the capstan supply circuit board and place the deck vertically on the bench. Unclip the +24V power supply circuit board and place to one side. Unscrew nuts A, B, and C and slide the motor out to the rear.

5.5.2 Assembly - Refer to figure 3 and 4.

Assembly is the reverse of removal. With the motor in place tighten nuts A and C just finger tight and bring up B until the capstan is approximately parallel to the pressure roller.

Tighten nuts A and C firmly. Play tape and adjust nut B so the tape between the capstan and tape timer roller is flat and free of buckles and twists. Lock this adjustment by tightening nut D.

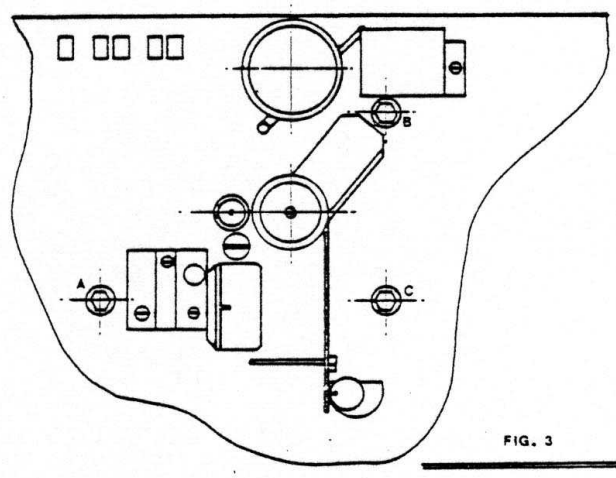


FIG. 3

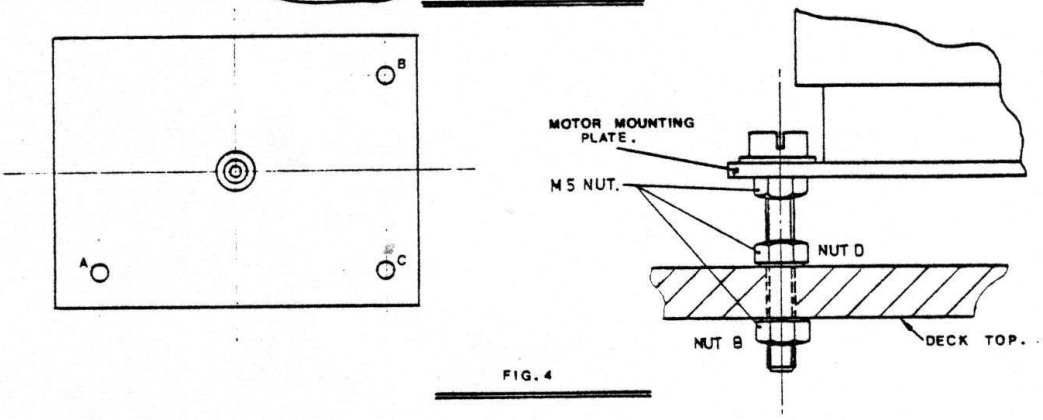


FIG. 4

5.6 Head Replacement

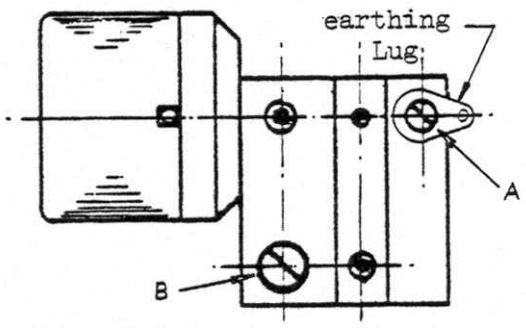
5.6.1 To remove any of the three head-mount assemblies, the pop-up hum shield should first be removed, by pulling it up off its post. The post is then removed by rotating it 90 degrees and lifting up.

The head leads are then unsoldered from the deck-connector bracket and earthing-lug and the two head-block locating screws (A) and (B) are removed. Remove the tape-guide pins, and lift the assembly off the deck.

5.6.2 Replacement is the reversal of removal. Place the head-mount assembly on the deck, with one 0,13 mm shim (part no. 01101001) and two 0,25 mm shims (part no. 01101002) under it. Replace the screw, Shake-proof washer and earthing lug at A, and the screw at B. Adjust the head-mounts until the screws are in the centre of the holes in the head-block, then tighten the screws.

5.6.3 Thread a tape behind the tape-lift arm (on the head-side of the arm), and spool forward to settle the tape. Stop the tape by centralizing the spooling-pot lever. Look at the tape-position across the laminations.

For a full-track mono machine, the edges of the laminations should show above and below the tape: for a two-track stereo machine the tape should completely cover the laminations.



5.6.4 Adjust the head-mount by adding or removing head-mount shims, so that all three heads are in line with each other and the centre of the tape, to within 0.05 mm. (After adding or removing shims, spool the tape as in 5.6.3 to re-settle it on the heads).

5.6.5 After the head-height is set, resolder the head-leads to the appropriate connections. Then set the horizontal position of the head-mount assembly. The Replay head position is set to give equal angle tape wrap on each side of the gap. A visual check gives satisfactory accuracy. The actual total wrap angle can best be optimised while playing the azimuth section of a BA5F DIN 195 test tape. Adjust the azimuth for peak output. If the output level can be increased by increasing the tape tension by holding back the supply reel, then either the tape tension is too low, or the Replay wrap angle is insufficient. Check tape tension as per section 5.4. If holding back the supply reel to increase tape tension now produces an increase in output level by more than 0.5 dB the wrap angle is insufficient. Move the Replay head mount forward. A point will be reached at which forward movement produces no further increase in output. At this position the level will also display an increased steadiness.

5.6.6 The Record head is set the same as the Replay head, except that **Sync** should be selected to check wrap.

5.6.7 The Erase head is not critical, however it should be set to maximise erasure of 50 Hz pre-recorded tone.

5.6.6 Replace the tape guide-pins as follows:
Assemble a lock-nut (03200102) to each guide-pin, and then screw the cheese-head supply guide-pin (01600734) into the hole between the Erase and Record heads. Spool a tape back and forth across the heads and adjust the guide-pin up or down until the tape rides centrally without touching either edge of the guide.

Repeat with the tapered take-up guide-pin, (01600876) which is screwed into the hole adjustment to the spooling motor. Tighten the lock-nuts on the guide-pins.

5.7 Tension Arm Replacement
If the tension arm is replaced special care must be taken in setting its operating point. The spring force is adjusted to 8 gm ±2 gm with less

than 2 gm hysteresis. Hysteresis is the change in force required to reverse the direction of motion of the sensor arm.

Having set the tensions as per section 5.4 the check on control range must be made and the 20 gm to loo gm range must be achieved to ensure full proportional range from beginning to end of the reel. The arm must be close to the sensor coil and parallel to it. Arm to coil clearance should be between 0.1 mm to 0.2 mm. If the lower end of the control range (20 gm) cannot be achieved by manually moving the sensor arm over the coil while tape is running, the arm angle must be adjusted so the arm covers less sensor coil area in the normal running position.

Note: Bending the arm will change the set tension and a pot adjustment will need to be made before rechecking the control range. Check hold-back tension as per section 5.4.4

5.8 Stabilizer Roller Replacement

The stabilizer roller height must be carefully set to ensure correct tape handling. The .005" shims enable the height to be adjusted. To set the roller height remove both tape guides and pressure roller. Position the shims to give central tape positioning over the heads with the deck in **Play** mode. Between two and five shims will be needed to take up the clearance between roller height and available post height. When the roller height has been set fill the excess space between roller and top cap with shims to give minimum clearance. Do not compress the shims between the roller and top cover as this will tighten the bearing and produce tape timer errors and wow and flutter problems. When the height is set replace the tape guides and pressure roller. Ensure that the roller rotates freely. Check wow and flutter and tape timer accuracy.

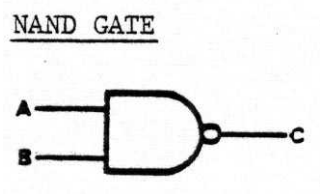
6. Circuit Description

6.1 Deck Control Logic -Refer Drg. 23-2098

The deck control logic circuits control the correct operating sequences of the deck, and ensure that undesirable operating states cannot occur. It consists of five bistable memories to store commands from push buttons, solenoid drivers, capstan motor timer, and interlocking logic.

The two basic logic elements used in the circuit are CMOS NAND and NOR gates operating on a +12V supply.

NAND Gate



$$C = \overline{A \cdot B}$$

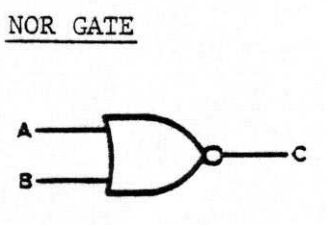
Truth Table

A Input	B Input	C Output
0	0	1
0	1	1

1	1	1
1	0	0

By De Morgan's Law:
If all inputs are 1, the output will be 0
of if any input is 0, the output will be 1.

NOR Gate



$$C = \overline{A + B}$$

Truth Table

A Input	B Input	C Output
0	0	1
0	1	0
1	0	0
1	1	0

By De Morgan's Law

If all inputs are 0, the output will be 1
or if any input is 1, the output will be 0.

Note: Either type of gate, with all inputs connected together acts as an Inverter.

Each of the bistables consists of a two input **NOR** gate and a transistor. The **Edit** bistable is described in detail. U1/8 is normally high via R19 and R21. U1/9 is normally low. Thus U1/10 is low and transistor Q1 is off, and its collector is high, maintaining the high drive to U1/8.

Pushing the **Edit** push button takes U1/8 low and since both inputs to the **NOR** gate are now low, its output U1/10 goes high which immediately turns on Q1 into saturation. Q1 collector going low takes U1/8 low through R19. This positive feedback through R19 holds U1/8 low even after the push button is released. Thus the bistable is in a stable condition as long as neither input to the NOR gate is forced high. Q1 being low is used to control deck functions in line with **Edit** requirements.

To reset the bistable the condition of both inputs low on the **NOR** gate must be changed. Either input going high will force the output U1/1O low, Q1 will turn off and allow U1/8 to go high and so maintain the reset condition. This resetting action comes from U3/1O which is normally low and goes high when deck conditions necessitate the resetting of the **Edit** bistable.

Note that the **NOR** gate is powered from a +12V supply and R19 will place +24V through R21 on input pin 8. This does not exceed the absolute maximum rating of the device since all gate input pins have

internal diode clamps to ground and +12V. Thus the actual voltage appearing on the input will be +12.6V and the diode will conduct approximately $\frac{11.4\ \mathrm{V}}{100\mathrm{K}} = 114$ micro amps to the +12V supply.

6.1.1 Play Mode

Play mode is selected by setting two consecutive bistable memories. The output of each bistable controls different elements on the deck to implement tape playing.

The first bistable called the Play Request bistable, is formed by U1/a and Q2. Pressing the **Play** push button sets the bistable if the reset-input (U1/2) is low.

Resetting action occurs when U3/3 is forced high by either the **Stop** push button or the **Tape Break** switch making, or when the **Spool** push button is pressed when not in the **Edit** mode, and causing U3/2 or U3/1 to go low.

Once this bistable is set, U1/3 turns on the capstan motor through Q2.

The brake and pressure roller solenoids, the play lamp, and the pulse start to the spooling motor control board will not be energised until the second bistable, formed by U1/b and Q3 is set.

This bistable is set by the motion input, from the tape timer board going low, and reset by the output of the first **Play** bistable going high. Once the first bistable is set, the second will be set when tape motion ceases and the *Motion* line goes low.

When this occurs, 3 events take place simultaneously:

(i) U1/4 provides a pulse start to the spooling board through Q5.
(ii) U1/4 energises the brake solenoid through R33, Q9 and Q10.
(iii) Q3 collector energises the pressure roller solenoid through Q8 and also turns on the **Play** push button lamp.

The **Play** push button resets the Spool bistable through U6/3 and the **Record** bistable through US/4.

The spooling motors will run when Q13 is turned on by U4c and Q11. U4/10 goes high to turn on Q13 only if **Stop** is not active and the **Motion** line is active. The spooling motor will run whenever there is tape motion. The **Motion** line is generated by the Tape Timer circuit and will be inactive if there is a **Tape Break**. This logic ensures that when the tape break switch is made the spooling motor will not run on due to the over-spin of the stabilizer roller that generates the **Motion** signal.

6.1.2 Stop Mode

The **Stop** push button resets the **Play**, **Record** and **Spool** bistables through U3/1, US/5 and U6/2 respectively (wired **OR** through D11 with US/13 which is the $\overline{\text{Stop Bus}}$).

The $\overline{\text{Stop Bus}}$ is active when the **Stop** push button is pressed or when a **Tape Break** occurs, only if the **Play**, **Record** or **Spool** push buttons are not pressed. This condition is sensed by U5b.

It also resets **Edit** directly through U3/9 and sets the capstan motor timer formed by U3/b and U2/d. This timer keeps the capstan motor running for approximately two minutes through Q12. If, during the two minute period, the **Stop** button is pushed again, D12 discharges the timing capacitor C9 so the timing period commences from zero again.

The **Stop** lamp is illuminated through Q1 via U3/4 whenever Capstan motor turns.

6.1.3 Record Mode

The record bistable is formed by U2/b and Q4.

The **Record** push button takes U2/5 low to set the **Record** bistable and U1/1 low through D4 to set the **Play** REQUEST bistable. When the **Motion** line goes low indicating no tape motion, the **Play** bistable is set. U1/4 which is normally low holds the **Record** bistable reset through US/2 and enables the bistable to be set only when it goes high.

The **Spool** bistable is reset through U6/4 when the **Record** push button is pushed. Q4 going low illuminates the **Record** lamp and starts the bias oscillator in the amplifier chassis.

The **Record Lock-Out** switch in the amplifier chassis holds the **Record** bistable reset through U5/13.

The **Play** push button also resets the **Record** bistable through U5/4.

6.1.4 Spool Mode

The **Spool** bistable is formed by U2/a and Q6.

The **Spool** push button sets the bistable through U2/2. The bistable is reset by the following:

(i) **Play** push button through U6/3.
(ii) **Record** push button through U6/4
(iii) **Stop** BUS through U6/2.
(iv) It is held reset by the **Edit** bistable output Q5 through U6/5. This resetting action ensures that **Spool** cannot be selected once **Edit** is active.

The collector of Q6 is low when **Spool** is selected and earths the wiper of the **Spool** control potentiometer enabling control of tape motion left and right. It also provides a pulse start to the spooling motors through Q5 to take up any tape slackness when **Spool** is selected.

Q6 collector also holds the **Edit** bistable reset through U3/8 so that once in **Spool**, **Edit** cannot be selected. U2/2 energises the brake solenoid through U4/8 when **Spool** is active.

6.1.5 Edit Mode

The **Edit** pushbutton sets the **Edit** bistable through U1/8 which in turn energises the brake solenoid through U4/1 and 2.

U1/10 inhibits the take-up motor only when **Play** is active through U3d and D13 so that when **Play** is also selected a "**Bin Edit**" control is achieved. When **Edit** only is selected the take up motor is not inhibited and manually moving the spools will give tensioned tape because MOTION will go true and provide constant-tension drive to the spooling motors.

The bistable is held reset by **Spool** through U3/8 and the **Stop** push button through U3/9.

The tape break switch does not reset **Edit** unless D8 is in the circuit. If the machine is in the "**Bin Edit**" mode the tape break switch will reset the **Play** bistable and set the machine back to

6.2 Monitor- Ref. drg. 23-2092

The signal selected by SS to be displayed on the VU meter is amplified by Q1 and Q2, which form a wideband (flat to 300 K Hz) class A amplifier with a closed loop gain of 10. The collector of Q2 drives the VU meter through R11 and drives the monitor volume potentiometer direct. The wiper of the monitor volume pot drives the monitor speaker amplifier formed by Q3 to Q9.

Q3 and Q4 are a high gain darlington input buffer driving the power drivers Q6, Q8 and Q7, Q9. QS provides D.C. bias to eliminate cross-over distortion in the output stage. Gain is set at approximately 20 by R12 and R14.

6.3 Spooling Motor Control - Ref. drg 23-2094

Control of the two spooling motors to provide correct operating and braking tension, and wind and rewind speed, is achieved by two tension control systems sensing tape tension, and controlling the spooling motors through a transistor in a bridge rectifier in series with the motor.

The take up and supply motor circuits are almost identical so only the take up circuit is described.

Transistor Q1 and transformer T5 form a tuned collector oscillator with a fixed frequency of approximately 170 K Hz.

The transformer T5 is mounted on the deck below the tape arm.

As tape tension changes, the tape arm swings across T to change its “Q". The changing "Q" adjusts the output level on the secondary S2. Thus tape tension is directly proportional to S2 output voltage. The

oscillator oscillates only when Q1 emitter is earthed through diodes CR1, CR2 and CR4.

Secondary S2 is rectified and filtered by CR9 and C3, and this level drives the base of Q3 which is in series with the motor via a bridge rectifier formed by CR11 - CR14. Thus Q3 controls the motor current and therefore, the tape tension to hold the tape arm at the preset position over the sensing transformer T5.

R13, C5, and R8 provide feedback on Q3 to provide a clean sinusoidal current waveform to the motor. C7, 8 and 9 are the phase lead capacitors for the motor start winding. C17 protects Q3 from mains transients.

When **Play** is selected, pin 12 on the spooling motor control board is grounded and forward biases CR4 and CR7. Thus the oscillators begin oscillating and turn on the motors. For about 100 milli-secs after **Play** or **Spool** has been selected, pin 8 is held to ground, forward biasing CR1 and CR5. This causes the oscillators to provide the maximum base drive to Q3 for the 100 milliseconds regardless of the position of the tape arms, and thus give a full 240V drive to the take up motor. R17 in series with CR5 reduces the level of this pulse drive to the supply motor. This high torque pulse gets the tape up to speed quickly and reduces initial tape bounce and flutter. RV1 and RV2 control the preset tension on the spooling motors.

After the **Stop** button is pressed, pin 12 is held at ground until tape motion ceases, and forward biases CR4 and CR7. This provides dynamic braking drive to the motors while the brakes are applied, but removes the drive after the tape is stopped.

When **Spool** is selected the wiper of the spooling potentiometer is grounded. Shifting the pot left (right) places less (more) resistance in series with CR6 (CR2) through pin 13 (17) and the supply (take up) oscillator increases (decreases) in output to move the tape left (right) onto the supply (take up) reel. To provide a large neutral area in its mid position, the pot is large in resistance so neither oscillator has extra drive in the pot's centre area. To provide a controlled minimum tension when passing through this mid position pin 8 is also grounded to maintain both oscillators running in the normal constant tension mode, through CR1 and CR5. R19 and 20 reverse bias diodes CR2 and CR6 to maintain preset tension in **Spool** mode when the **Spool** pot wiper is at each extreme of the pot.

Selecting **Edit** disables the take up motor by grounding pin 4 and hence the base of Q1. The motor is disabled so that when **Edit** and **Play** are selected together a **Bin Edit** mode results.

6.4 Capstan Motor Control - Ref. drg. 23-1326

The capstan motor runs when Q12 on the deck logic PCB earths the LED in PC 1 and causes approximately 22 mA to flow through it, illuminating the LDR (light dependent resistor) in the optical isolator, which drops from many meg-ohms to below 50K ohms.

C3 and diac DC 1 then go into a relaxation oscillation mode and turn on triac TC 1. The triac is turned on during the zero crossing of the

load current due to the leading voltage on the diac caused by C2. This action causes a clean spike-free switching for the motor current. R3 and C4 remove the possibility of false firing of the triac by suppressing transient voltages caused by the back E.M.F. of the motor. C5 - C8 are the phase lead capacitors for the start winding of the motor.

When current is not flowing in the LED the LDR in the optical isolator is many meg-ohms in resistance and does not allow any voltage to appear on the diac. Thus the triac does not conduct, and the motor does not run.

Two speeds can be selected via the tape speed select switch.

(1) High speed -earthing the switch (i.e. energising both relay A and B)
(2) Low speed -opening the switch

The relay contacts switch the motor windings to give a 6 or 12 pole configuration. The high speed requires more torque and therefore, more phase lead capacitance (by switching in another 0.47 uF capacitor C1) for the start winding of the motor.

6.5 Power Supply -Ref. drg. 23-2096

The 35 volt secondary of the power supply transformer is rectified by BR1 and filtered by C1 to produce 40 volts .

This is fused by Fl and then used to drive the two solenoids and the 24 volt regulator.

The 24 volt regulator uses three transistors to accomplish regulation.

Zener diode CR1 forms astable 12 volt reference connected to the emitter of Q3. The output voltage is sampled by a resistive divider R5 and 6, and compared with the reference. The difference is amplified by Q3 and used to drive – Q1 and Q2 which turn on or off to reduce the difference to zero. If the output were to fall, the divider R5 and R6 would sense the fall and remove base drive from Q3. This reduces the collector current of Q3 and, hence more of the current being supplied by R1 and R3 goes into the base of Q which, in turn, increases the drive to Q1. Q1 turns on further to restore the original output voltage and reduce the difference between reference voltage and sampled voltage.

R2 in series with Q2 collector limits the base drive to Q3 so if the output is shorted, the short circuit current is limited to a safe level before the fuse blows.

- Unregulated voltages 40 to 50 V
- Regulated voltage 22 to 25 V.
- Maximum output current 2 amps
- Short circuit current 4 to 8 amps
- Regulation at 1 amp 200 millivolts
- Ripple at 0.2 amp 15 millivolts peak to peak

- DC fuse — 2 amp M205
- AC fuse — 1 amp M205 -240 V
  2 amp M205 -117 V

6.6 Replay Amplifier -Ref: drg. 23-2090

Transistors Q1, Q2 and Q3 form a low noise DC coupled equalized preamplifier with a mid band gain of approximately 40 dB. Speed equalization networks are selected by earthing the gates of field effect transistors Q4 and Q5. RV2 (RV4) provide independent level adjustments for the low (high) speed and RV1 (RV3) provide independent high frequency compensation adjustment for the low (high) speed. Resistor R15 (R16) sets the low frequency for the low (high) speed.

The output of the preamplifier is wired to the front panel **Output** potentiometer. The input to the program amplifier is switch selectable to be the output of the preamp (in **Play** and **Sync** modes) or the **Record** input. This input has a OVU nominal level of -15 dBm for **Play** and **Record** switch settings and -35 dBm for **Sync** switch selection. The input is driven through a filter L1 to remove bias.

The program amplifier has a nominal gain of 18 dB. The output of the program amplifier is connected to the output balancing transformer which has a 6 dB voltage gain. The balanced output impedance is typically 50 ohms. The capacitor across the balanced output of the transformer rolls off the frequency response beyond 20 K Hz and at 100 K Hz the output is in excess of 40 dB down.

In **Sync** mode Relay RL1/1 is energised. This disconnects the play head from the input to the preamplifier and substitutes the record head. Since the record head has been optimised for "record" performance its output level is approximately 20 dB lower than the play head, hence an additional 20 dB gain is required in the program amplifier to bring the **Sync** level up to the **Play** level. This network is "switched in" by earthing the gate of FET Q7 (automatic in **Sync Replay** mode). RV7 controls the **Sync** gain. Note that there is additional logic behind selecting **Sync** mode.

If **Sync** mode is selected when the deck is recording, **Sync** operation is inhibited, thus returning the replay channel to replaying from the replay head. Additionally in two track machines, if the front panel **Safe** switch is in **Safe** mode, **Sync** operation is permitted in this channel, while recording takes place in the other channel.

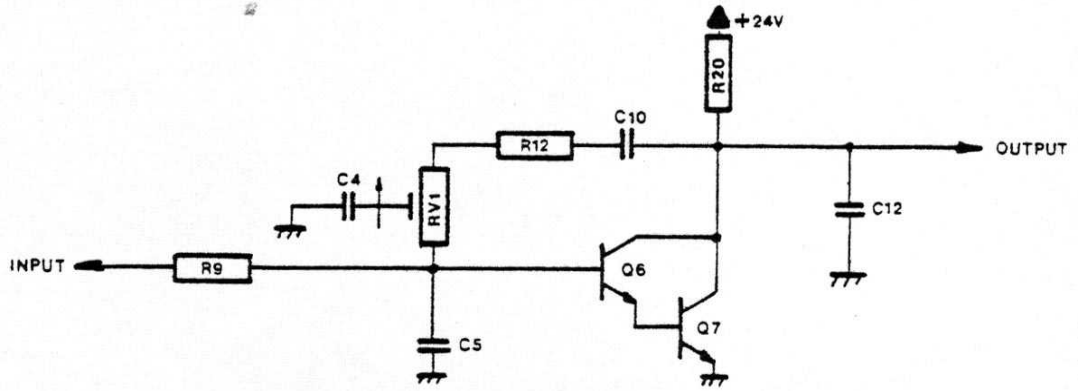
Warning: In the **Safe** mode, this channel can be replaying from the record head while the other channel is recording **onto** the other channel of the same record head. The channel to channel crosstalk of the record head is about -60 dB. However the record track can have up to 2 volts RMS of high frequency audio on it, which means that there will be a high crosstalk between channels in this mode especially above 10K Hz.

This mode should only be used for **Foldback** and not used to remix into the recording channel, otherwise a danger exists of the recording channel oscillating at 15 K Hz to 20K Hz.

6.7 Record Amplifier - Ref. drg. 23-2091

Transistors Q1 and Q2 form a low noise low distortion mixing preamplifier with again of 20 dB. The preamplifier mixes two line inputs which are attenuated by the respective front panel **Record Level** controls .

The preamplifier output is passed on to the low (high) speed level preset potentiometer RV2 (RV4). The equalizing amplifier, Q6 and Q7 is self-biased via resistors R17, 18 and 19 and capacitor C13. The speed equalizing networks are selected by earthing the gates of Q3 (low speed) or Q4 (high speed).



The above circuit is the equivalent equalizing circuit when low speed is energised (biasing components removed).

It forms a 3 "pole" adjustable active filter. Phase delay network R9/C5, R20/C12 and RV1/C4 delay the phase of the feedback signal with respect to the input to such an extent that the network can self oscillate (180 degrees phase shift) under maximum phase delay. R12 is used to reduce the phase delay to less than 180 degrees to prevent oscillation but still permit the required high frequency boost to be given to the record head driver.

The phase delay is controlled by RV1 and C4. Figure 5 shows the maximum, minimum and typical frequency responses of this.

Capacitor C10 is used to provide the 3180 microsecond NAB break point if reduced to 0.047 UF, i.e. 3 dB boost at 50 Hz.

Since the recording process is basically a constant flux characteristic, a constant head current is required when frequencies are below 3 KHz. Above 3 KHz the head current requires to be boosted a certain amount to compensate for head losses and tape losses. To implement this current drive to the heads the collector load of Q8 is a 10 mA current source formed by Q9 and associated components.

Transistor Q8 works as an emitter follower so that the collector current in Q8 is directly proportional to the emitter voltage which in turn is equal to output of the equalizer stage.

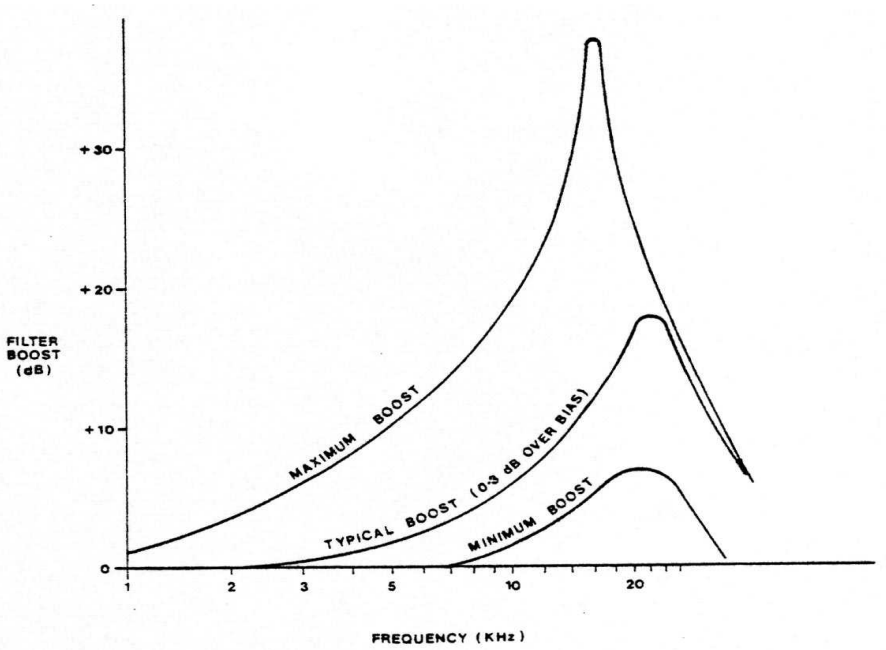


FIG. 5
RECORD EQUALIZER BOOST CHARACTERISTICS

Since the load on Q8 is a constant current any change in current through Q8 must be compensated for by an equal and opposite change in the current through capacitor C16, i.e. the head current.

Thus the record head driver is a voltage to current converter with a transconductance of 5mA/volt with a maximum current drive of 10mA P-P and a limiting voltage of 15V P-P. The source impedance of the current drive is equal to R24 (47K).

The record head current is passed through bias trap L1/C18 to isolate bias frequencies from the record head driver.

Capacitor C16 absorbs any stray bias which happens to leak through the bias trap.

Bias, derived from the bias oscillator, is adjusted by RV7 and passed through capacitor C19 to the record head. C19 has a high impedance at audio frequencies and prevents any of the audio current being bypassed by the bias level control.

Sync relays RL1/1 and RL2/1 are energised in **Play** mode to direct the record head output to the replay amplifier **Sync** relay so that in **Sync** REPLAY mode the record head is accessible to the replay amplifier.

In **Record** mode relays RL 1 and RL2 de-energise and connect the record head to the record amplifier.

Both leads of the record head are switched to prevent earth loops forming in **Sync** mode since the same head is shared between two circuits.

Control of relays RL1 and RL2 is designed for a fast de-energise and a slow energise to ensure that the record head is never switched when there is bias on it.

This timing function is performed by Q1 on the mother board to de-energise relays in less than 10 mSec and energise in about 100 mSec.

6.8 Mic Pre-Amp - ref. drg. 23-2089

The microphone input is coupled to the pre-amplifier via a 200 ohm to 50K transformer with a gain of 20 dB. The pre-amp is a 3 stage DC coupled amplifier with a fixed gain of 28 dB. The output of the pre-amp drives the front panel INPUT 1 level pot, the wiper of which is mixed with the INPUT 2 level pot output to drive the record head amplifier.

Transistor Q1 operates with a collector current of 10 uA. Its bias voltage is derived from the emitter of Q3 and maintained by the DC feedback path. Two negative feedback paths to Q1, one via R5 and the other via R11 and C6 in parallel, increase the input impedance of the amplifier. Q3 is an emitter follower which gives a low source impedance for the feedback and output.

6.9 Tape Timer - Ref. drg. 23-1354

The tape timer counts revolutions of the top stabilizer roll and converts this to an equivalent tape playing time, at the selected speed.

6.9.1 Counting, and the direction of the count (either up or down) are sensed by blocking the infra-red light (from LED1 and LED2) to the photo transistors Q1 and Q2. When the light is blocked Q1 (Q2) turns off, Q3 (Q4) turns off and U 2/5,6 (U2/8,9) goes high which in turn produces a low at U2/4 (U2/10). R4, C17 and R3 (R8, C8 and R7) provide positive feedback around the sensor to give a clean transition on the output of U2.

When both Q1 and Q2 are covered U3/1 and U3/4 are both low. This gives a low at U1/12 which indicates a "coincidence". This coincidence pulse is used to clock the counter U6 to produce the timing indication.

6.9.2 The stabilizer roll has a circumference of 3.75 inches, and one revolution produces two coincidence pulses for 3.75 inches of tape. U4 is set as a binary counter and produces four outputs; divide by 2, 4, 8 and 16 on pins 6, 11, 14 and 2 respectively. It is clocked by the coincidence pulse so each output produces one pulse per second if the tape speed is 3.75, 7.5, 15 and 30 I.P.S. respectively.

The appropriate output of U4 is gated to the input, U6/36 of the counter, by grounding the appropriate input line on U5.

6.9.3 Since tape can be wound in both directions the timer must decrease its reading when tape is being spooled back on to the supply reel. Direction of rotation is sensed by U3. U1/5,6 and U1/9, 8 and R11, R12 and C5 form a 250 K Hz oscillator that clocks the first flip-flop of U3. U3/3 will be high at the leading edge of coincidence when

counting up and so U3/5 will be clocked high by U1/12. This line is used to control the count direction (either up or down) of the counter U6. If the direction of rotation is reversed U3/5 will go low causing the counter to go down. An error condition can exist if the direction of rotation is reversed during coincidence and the particular coincidence pulse is about to clock the counter chain. In this situation the timer will count one second in the wrong direction. At 7.5 I.P.S. this can occur only on every fourth pulse.

6.9.4 The selected count pulse on U6/36 clocks U6 to provide the timing indication. U6 is a 6 digit up down counter-display driver. The clock pulses on pin 36 clock the counter either up or down depending on the state of the up-down line U6/40. U6 provides a multiplexed display drive for common cathode I7 segment displays. Each segment is driven directly from the chip through 1K resistors R16 to R22. Each digit is sequentially selected by Q5 to Q9.

6.9.5 The **Motion** signal is generated on U2/11 by rectifying and filtering the output of one sensor on U2/4. When tape is in motion U2/4 will be alternately high and low. C3 A.C. couples this signal to D2 which will hold C4 discharged. When motion ceases C4 will charge through R9 and U2/11 will change from high to low when the charge on C4 reaches half supply. This short delay in signalling no motion to the deck logic board is to ensure that tape has definitely stopped before **Play** mode begins.

Tape Break high will force U2/11 low regardless of the state of U2/13.

6.10 Bias Oscillator -Ref. drg. 23-1329

When the deck is in the **Record** mode, pin 11 on the bias oscillator PCB is grounded and will turn on Q4 if the **Safe** switch is in the **Record** position. Q4 turning on will turn on Q1 over a period of approximately 60 milliseconds. Q2, Q3 and L1 form a class C push-pull oscillator which runs when supplied with 24V D.C. from the collector of Q1. Thus when a bias is turned on, it increases to its maximum level over a period of 60 milliseconds, and when turned off decreases to zero level over the same period. This controlled rise and fall of bias eliminates recorded "clicks" on tape. In a two track configuration the oscillators in each amplifier must run at the same frequency to stop beat notes being generated. C6 couples the emitter of Q3 in each oscillator to synchronize their-frequencies.

7 Amplifier Alignment

7.1 Preliminary

Before the audio performance of the machine is checked, or a primary alignment made, the deck must be fully functional and the tape path must be clean and demagnetized.

Caution:

1. Switch off power before demagnetizing the heads.
2. Do not make D.C. resistance measurements on the heads.
3. Use an inert solvent such as methylated spirits to clean the heads and tape path.

7.2 Replay

7.2.1 Select a tape speed of 7.5 I.P.S.: LO on a 7.5/15 I.P.S. machine and MED on a 3.7517-.5 I.P.S. machine. Thread a BASF DIN 19S test tape, select **Play** on the output selector push buttons, and place the output level-switch at the **Cal** position. Place an A.C. voltmeter across the balanced output and load the output with 600 ohms.

7.2.2 Play the test tape. The first section of tone enables the correct **Cal** level to be set. Adjust **Lo Level** RV2 on the replay board to give a reading of +16 dBm on the output for a mono head and +12 dBm for a stereo head. With the first 1 kHz section still playing adjust the azimuth to peak the output level. RV2 may now need to be readjusted to the specified levels above. To set the azimuth slacken the locking screw and rotate the adjusting screw until the output level peaks. Do not overtighten the locking screw. A light lock is sufficient. Fig. 6 shows the adjustment points.

Caution: Beware of secondary peaks on either side of the true azimuth setting.

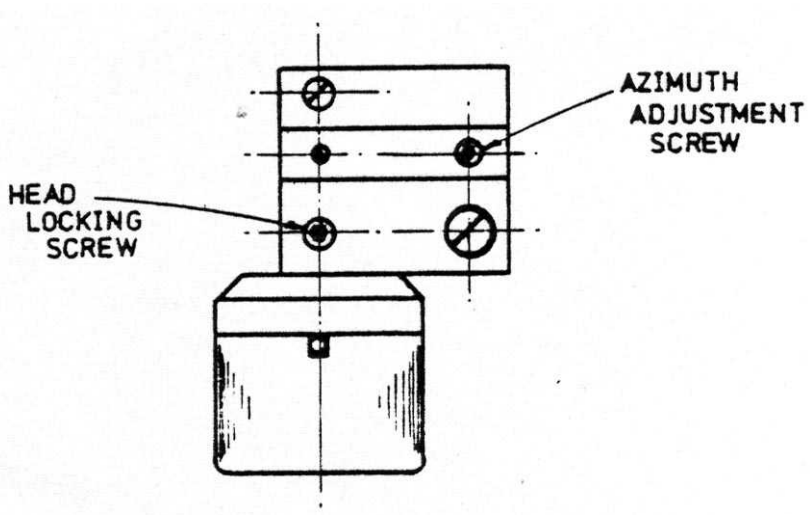


FIG. 6
AZIMUTH ADJUSTMENTS.

7.2.3 The next section of the test tape enables azimuth to be set at 10K Hz. The azimuth should be adjusted to a peak steady output level for a full track machine. On a two track deck adjust the azimuth for an in phase signal between the two tracks.

The rest of the tape enables frequency response to be checked.

The output should not vary by greater than + 1 dB over the range 30 Hz to 16K Hz. High frequency levels can be adjusted by RV1 - **H.F. Comp Lo** on the replay board. Note that the **H.F. Comp** control affects the 1K Hz level slightly, so this must be checked after adjusting the high frequency response. Low frequency response below 60 Hz can be adjusted by changing R15. Decreasing R15 decreases the level.

Remove the test tape and select **Play** mode. Check that the noise on the output is less than -46 dBm. This corresponds to a signal to noise ratio of -62 WRT + 16 dBm.

7.2.4 Select MED speed (15 I.P.S. on a 7.5/15 I.P.S. machine) and thread a BASF DIN 38S test tape. Set the **Hi Level** RV4 on the replay board for +16 dBm for mono and +12 dBm for stereo. Azimuth should not be adjusted since it is set with the 7.5 I.P.S. tape. Check frequency response - ±1 dB 30 Hz to 18K Hz. High frequency response is adjusted by RV3, **HF Comp Med**. Low frequency can be increased by increasing R16. Noise with **Play** selected, but no tape against the head, should be below -48 dBm. This corresponds to a signal to noise ratio of -64 dB WRT + 16 dBm.

7.2.5 For a 33/4/71/2 I.P.S. machine the replay levels at 33/4 I.P.S. using a DIN 9 test tape are set to +14 dBm for a full track machine and +10 dBm for a two track machine. This is because the level section on the test tape is 250 nwb/m and not 320 nwb/m as in the 71/2 and 15 I.P.S. test tapes.

7.3 Line to Line

7.3.1 Connect an audio oscillator set for +8 dBm to **Input 2** and set the **Record 2 Level** switch at **Cal**. Select **Record** on the output selector and measure the signal on the output loaded with 600 ohms. Adjust the **Transfer Gain RV4** on the mother board to give +8 dBm on the output.

7.3.2 With **Record** still selected on the **Output** switch increase the input level to +16 dBm. Measure total harmonic distortion on the output. It should be less than 0.5% at 1K Hz.

7.3.3 Reduce the input level back to +8 dBm and check the frequency response from input to output. It should be + 1 dB 30 Hz to 20 KHz.

7.3.4 Deselect **Calibration** switch and increase the **Record 2 Level** control to maximum, select **Record** on the **Output** selector switch and decrease the oscillator output until the output is 0 dBm. Measure the oscillator output. It should be -20 dBm, or less which gives a maximum record gain of 20 dB or more.

7.3.5 Select **Record** on the **Output** selector and set the oscillator for 100K Hz at +20 dBm. Rotate the slug of the replay bias trap L4 on the mother board to give a null on the output.

7.4 Mic to Line

7.4.1 On machines equipped with a microphone input, set **Input 1** level switch to **Cal** and select **Record** on the output selector. Measure the output level loaded with 600 ohm and apply a 1K Hz signal on the **Record** input at a level of 2 mV R.M.S. The output level should be + 8 dBm for an input level in the range of 2 to 3 mV.

Note: **Transfer Gain** must have been previously set as in 7.3.1 before this check is made.

A level of 2 mV may be difficult to obtain. A satisfactory method is to use a 1000 to 1 divider formed by a 47K and 47 ohm resistor, but measuring at the output of the oscillator. With this divider 2 mV on the input to the pre-amp would be measured at the oscillator output as a level of 2V.

With the input 1 level switch set to **Cal** a + 8 dBm output should be obtained with an input between 2 and 3 mV.

7.4.2 With **Record** still selected on the **Output** switch, increase the input level to 15 mV and reduce the **Input** level 1 control until the output is +16 dBm. Measure the total harmonic distortion. It should be less than 0.5% at 1K Hz.

7.4.3 Decrease the oscillator level until the output is +8 dBm and check the frequency response. It should be ±1 dB 50 Hz to 15K Hz.

7.4.4 Set the **Input 1** level control to **Cal** and set the **Input 2** level control to zero. Disconnect the oscillator. If the divider described in 7.4.1 is not used, bridge the input with a 47 ohm resistor. Measure the output noise. It should be -40 dBm or less to give a signal to noise ratio of 56 dB.

7.5 Record

Select **Record** on the **Record/Lockout** switch and select **Record** mode on the deck.

7.5.1 On a full track deck monitor the bias oscillator at TP2 with a high impedance meter or oscilloscope. The level should be 55V RMS (170V P.P.) Connect a frequency meter at the TP1 on the monitor board (drg. 23-2092) and adjust the bias oscillator coil slug to give a 100K Hz ±500 Hz output. Check that **safe** stops the oscillator.

On a two track deck put CH1 in **Record** and CH2 in **Safe** and set CH1 bias oscillator to 100K Hz as above. Place both channels in **Record** and adjust the CH2 bias oscillator to the centre point between the audible out-of-sync points. The sync note can be heard by selecting BIAS on the monitor switch.

7.5.2 Connect an oscilloscope at TP3 on the Record PCB and rotate L1 for a null in the 100K Hz level. The level should be less than 2V P.P.

Connect a low distortion audio oscillator set for +8 dBm to **Input 2** and set the **Record 2 Level** control to **Cal**. Select **Play** on the **Output Selector**, and set the **Output Level** control to **Cal**. Connect an AC voltmeter to the output and load it with 600 ohms. Thread a reel of Ampex 406 bulk erased tape on the deck. Set the **Bias Level** RV7 on the record board to approximately 1/2 clockwise rotation and set the input audio oscillator to 1K Hz. Push the **Record** button on the deck. Adjust the **Level Lo** RV2 control on the record board for +8 dBm on the output at 7.5 I.P.S. Adjust the **Level Med** RV4 for +8 dBm on the output at 15 I.P.S.

7.5.3 At 7.5 I.P.S. set the Record head azimuth for peak output at 1K Hz.

Adjust RV7 **Bias Level** for peak output at 1K Hz. Increase the bias level until the 1K Hz-level drops by 0.2 dB. Change the oscillator frequency to 15K Hz and readjust the azimuth for a peak steady output level. On a two track deck set the azimuth for an in phase signal between the two channels at 15K Hz.

7.5.4 Re-adjust the **Level Lo** controls RV2 and RV4 for 8 dBm output at 1K Hz. Check the overall frequency response of the machine at -4 dBm both speeds. The high frequency response is adjusted by **Hf Comp Lo** RV1 at 7.5 I.P.S. and **Hf Comp Med** RV3 at 15 I.P.S. The output should be within ±2 dB from 30 Hz to 16K Hz at 7.5 I.P.S. 30 Hz to 20K Hz for 15 I.P.S. and 30 Hz to 8K Hz at 3.75 I.P.S.

7.5.5 Set the oscillator to 1K Hz and increase its level until the output is +16 dBm. Connect a distortion meter across the output and load it with 600 ohm. Measure the distortion. It should be less than 1.5% THD for a mono deck and less than 2% THD for a stereo deck.

7.5.6 Change the oscillator frequency to 50 Hz and check that distortion is within the specified limits.

7.5.7 Record a length of tape with 50 Hz at +16 dBm. Re-record over the section with no input signal present then replay again in **Play** mode only. The output while replaying is a measure of the erasing ability. The output should be less than -40 dBm to give an erasure of 56 dB at 50 Hz.

7.5.8 Record a section of tape with no input signal. Replay that section of tape in **Play** mode only. The output noise should be less than -42 dBm at 7.5 I.P.S. to give an overall signal to noise ratio of 58 dB. The output noise should be less than -43 dBm at 15 I.P.S. to give an overall signal to noise ratio of 59 dB.

7.6 Monitor

7.6.1 Connect an audio oscillator set for +8 dBm at 1K Hz to **Input 2** and set the **Record 2 Level** switch to **Cal**. Load the output with 600 ohm and connect an AC voltmeter across it.

7.6.2 Select **Record** on the output selector and **Play** on the monitor selector. Adjust the **Monitor Output Level** RV2 on the mother board for 0 VU indication on the VU meter.

7.6.3 Select **Record** on the monitor selector. Adjust the **Monitor Input Level** RV1 on the mother board for 0 VU indication.

7.6.4 Select **Record** mode on the deck and BIAS on the monitor selector. Adjust **Monitor Bias Level** RV3 on the mother-board for 0 VU indication.

Select **Record** on the monitor selector and set the oscillator for 0 VU indication. Place a 15 ohm load across the tip and ring of the monitor jack and connect a noise and distortion meter across it. Set the **Monitor Level** to 5.5 V RMS to give an output power of 2 watts. Measure the distortion. It should be less than 1% THD.

7.6.5 With the **Monitor Level** still set at 2 watts, check the frequency response. It should be within ±3 dB, 30 Hz to 16K Hz.

7.6.6 With the **Monitor Level** still set at the 2W point remove the input signal and measure the noise across the 15 ohm load. It should be less than 5.5 millivolts RMS to give a signal to noise ratio of 60 dB.

7.7 Sync

7.7.1 Select **Lockout** on the **Safe** switch and thread a BASF DIN 19S test tape on the deck. Select **Sync** on the output selector and set the output level with **Sync Level** RV7. Check frequency response at 7.5 I.P.S. It should be within ±3 dB 30 Hz to 8K Hz. With a BASF DIN 38S test tape the frequency response at 15 I.P.S. should be within ±3 dB 30 Hz to 16 K Hz. At 3.75 I.P.S. with a DIN 9 test tape it should be ±3 dB 30 Hz to 4 K Hz.

7.7.2 Remove the tape. Select **Play** mode and with **Sync** still selected on the output selector measure the noise on the output. The level should be less than -34 dBm to give a signal to noise ratio of 50 dB w.r.t. 16 dBm.

7.8 Wow and Flutter Check

7.8.1 Thread a reel of bulk erased Ampex 406 tape on the deck. Connect an oscillator to **Record Input 2** and set it to 3K Hz. Set **Record 2 Level** to **Cal** and record a tape with 3K Hz, at the required speed.

Set output level to **Cal**. Then select **Play** on the output selector and connect a Wow and Flutter meter across the output connector. Place the deck in **Play** mode and at each tape speed, measure the Peak weighted CCIR Wow and Flutter. It should be less than;

0.08% @ 15 I.P.S.
0.1% @ 7.5 I.P.S.
0.15% @ 3.75 I.P.S.

8. Spare Parts Listing

8.1 Amplifier

Description	Manufacturer	Manufacturer's Part No.	CEI Part No.
Extender P.C.B. assy.			04000871
Bias oscillator P.C.B.			04000884
Record Amplifier PCB assy. I.E.C. 3 3/4 - 71/2 I.P.S.			04000928
Record Amplifier PCB assy. I.E.C. 71/2 -15 I.P.S.			04000934
Replay Amplifier PCB assy. I.E.C 3 3/4-71/2 I.P.S.			04000927
Replay Amplifier PCB assy. I.E.C. 7 l/2-15. I.P.S.			04000933
Monitor PCB assy.			04000922
Mother PCB assy.			04000923
Input Transformer	L.M. Ericsson	4542006/1	00400322
Output Transformer			00400323
Bias Transformer			02200041
Replay bias trap			02200042
Record bias trap			02200045
V.U. Meter	Master Instruments	FB30A Illuminated 24V	00700016
Input bridging switch	Swann	1299-02-01	00803026
Monitor & output switch Assy.	Schadow	3XF22UGR15FSB	00803177
Pot, Input, Output. & Monitor	A. &. R. Soanar	VCU10KC	00200661
Record lockout switch	C & K	7103 KYZGE SPDT	00803157
Card relay	National	RS24V	02000034
Mic Pre-amplifier			02302085
Mic input transformer			90304007
Calibrate Switch	C & K	7201	00803043
Peak Indicator PCB Assembly			02302188

8.2 Below Deck

Description	Manufacturer	Manufacturer's Part No.	CEI Part No.
71/2 -15 IPS Capstan motor	Papst	HSKZ 32-80-6112-440D	04001229
3 3/4 -71/2 IPS Capstan motor	Papst	HSKZ 32-80-6112-440D	04001370
240V Spooling motor			04001074
117V Spooling motor			04001318
Pressure roller solenoid	I.R.H.	428-36V	02301054
Brake solenoid	I.R.H.	427-36V	02301053
Power transformer			00400039
Fuse holder	Belling Lee	L2006A	00802910
Power Supply PCB assy.			04000909
240V 50 Hz Capstan motor PCB assy.			04000926
240V 50 Hz spool motor PCB assy.			04000921
117V 60 Hz Capstan motor PCB assy.			04000900
117V 60 Hz Spool motor PCB assy.			04000901
Motor connector pin - male	Utilux	H9002	00802098
Motor connector pin - female	Utilux	H9001	00802087
Nylon PCB support pin	Richlok	CBS-3N	00000150
Capstan PCB relay	Relay Pty Ltd	SRE D24	02000045
Capstan PCB optical isolator			02301040

8.3 Above Deck

Description	Manufacturer	Manufacturer's Part. No.	CEI Part. No.
Record and replay head hum shield			01602012
Pop-up hum shield			02301207
Spool retaining knob			02301049
Top stabilizer roller assy.			02301316
Bottom stabilizer roller assy.			02301339
Stabilizer roller cover			01600785
Pressure roller cover			01600786
Tape lifter arm			01600719
Tension arm and boss assy. take-up.			02301363
Tension arm and boss assy. supply.			02301364
Brake drum assy.			02301063
Brake shoe assy.			02301062
Tape break micro switch	Micro Switch	311SM703-T	00803170
Tape lifter and brake spring			00900525
Tape arm spring - take-up			00900539
Tape arm spring – supply			00900540
Tension Sensor PCB assy.			04000867
Tape timer PCB assy.			04000899
Spool potentiometer	A & R Soanar	VSU45-5K LIN	01101010
Spool pot knob	A & R Soanar	BH-25MM	00900047
Transistor IR425	IRH	IR 425	01000164
Mains Switch	C & K	7201-J51-Z-Q-RED	00803171
Deck Logic PCB assy.			04000908
Stop push button	Mulon	MUM-IS3W-KB	00803180
Play push button	Mulon	MUM-IS3Y-KB	00803181
Edit push button	Mulon	MUM-IS3G-KB	00803182
Spool push button	Mulon	MUM-IS3B-KB	00803183
Record push button	Mulon	MUM-IS3R-KB	00803184
Push button lamp	Chicago Miniature	CM 388	00803112
Tape timer reset push button	C & K	8125-V3	00803168
Tape timer push button cap	C & K	BLACK 7089	00803169
Speed and local remote switch	C & K	7201-J52-Z-Q	00803167
Pressure roller 7.5 -15 I.P.S.			02301064
Pressure roller 3 3/4 –7.5 I.P.S.			02301159
Tape-guide pin (supply)			01600734
Tape-guide pin (take-up)			01600876
Head mount shim: 0.25 mm (.0101")			01101001
Head mount shim: 0.13 mm (.005")			01101002

8.4 HEADS

The Nortronics part number is the type of head used, but this is mounted in a block and the CEI part number is matched head and head mount assembly.

Head		Nortronics Part No.	CEI Part No.
Replay	Full track mono	9102	02302080
-	Two track stereo	9213	02301220
Record	Full track mono	9103	02302081
-	Two track stereo	9209	02301221
Erase	Full track mono	9125	02302082
-	Two track stereo	9222	02301222

Drawing List

Part No:	Title	Issue	Size
02600319	Deck - Top View	A	4
02600320	Deck - Front View	A	4
02600321	Deck - Bottom View	A	4
02600322	Deck - Bottom View (Frame Removed)	A	4
02600323	Amplifier - Top View	A	4
02600309	Head Connection Circuit	A	3
02302090	Replay Amplifier Circuit	F	3
02300927	Replay Amp. PCB Assembly IEC 33/4 -71/2 IPS	C	3
02300933	Replay Amp PCB Assembly IEC 71/2 -15 IPS		
02302091	Record Amplifier Circuit	F	3
02300928	Record Amp PCB Assembly IEC 33/4 -71/2 IPS	E	3
02300934	Record Amp PCB Assembly IEC 71/2 -15 IPS		
02302092	Monitor Amplifier Circuit	B	3
02300922	Monitor Amp PCB Assembly	B	4
02301329	Bias Oscillator Circuit	D	4
02300884	Bias Oscillator PCB Assembly	B	4
02302093	Amplifier Interconnection	E	3
02300923	Mother PCB Assembly	F	3
02302096	Power Supply Circuit	A	4
02300909	Power Supply PCB Assembly	B	4
02302094	Spooling Motor PCB Circuit	F	3
02300921	Spooling Motor PCB Assembly	H	3
02301326	Capstan Motor PCB Circuit	B	4
02300926	Capstan Motor PCB Assembly	B	4
02301354	Tape Timer Circuit	D	3
02300889	Tape Timer PCB Assembly	D	3
02302098	Deck Logic Circuit	E	3
02300908	Deck Logic PCB Assy.	E	3
02302097	Deck Block Diagram	C	3
02302095	Amplifier Block Diagram	E	3
02302089	Mic. Pre-Amp Circuit	D	3
02300929	Mic. Pre-Amp PCB Assembly	B	3
02300930	Remote Control PCB Layout	A	3
02302072	Remote Control Unit Circuit	A	3
02300942	Logic PCB Circuit Sheet 1	B	4
02300942	Logic PCB Assembly Sheet 2	B	4
02600342	Deck Assembly Sheets 1 to 10	A	4/3/2

Drawing No: 02600342 Page 2 of 10
Deck Assembly 77 mk V
This Parts List Includes
Handles
Screws
Stand-Offs Bushes

1	01600855	Deck
2	01600792	Deck Cover Stand-Off
3	03200520	Csk Head Screw M6 X 20 Protection Frame
4	03200500	Cheese Head Screw M6 X 10
5	01600838	Handle Bar
6	01600840	Handle Support Locking
7	01600839	Handle Support
8	00608022	Pin 3116" Dia X 518" Long
9	01600772	Pivot Block
10	01600780	Locking Block
11	03200907	Cheese Head Screw M3 X 30
12	00900511	Spring
13	01300166	Plastic Washer M3
14	03200017	Shake-proof Washer M3
15	03200104	Nut M3
16	02301293	Pivot Block Assembly
17	01600609	Pin-Edit Switch Stop
18	03200501	Cheese Head Screw M6 X 12
19	03200022	Spring Washer M6
20	03200305	Cheese Head Screw M4 X 20
21	01600613	Brake Shoe Post
22	03200304	Cheese Head Screw M4 X 16
23	00600199	Solder Lug
24	03200009	Shake-proof Washer M4
25	01600595	Spring Anchor Stand-Off
26	01600876	Tape Guide Pin, Taper
27	01600734	Tape Guide Pin 28 03200102 Nut M4
29	03200324	Csk Head Screw M4 X 16
30	01600697	Tension Arm Stop
31	03200203	Cheese Head Screw M2 X 12
32	01600496	Tape Break Switch Stop
33	01600856	PCB Stand-Off
34	00900925	Nilsen Bush

Drawing No: 02600342 Page 8 Of 10
Deck Assembly 77 mk V

This Parts List Includes
Stabilizing Rollers
Tension Arms
Pop-up Shield

1	01600785	Stabilizing Roller Cover
2	01101013	Shim Washer
3	02301316	Stabilizing Roller Assembly, Take Up
4	02301339	Stabilizing Roller Assembly, Supply
5	02302150	Tension Arm Boss Assembly, Take Up
6	02302149	Tension Arm Boss Assembly, Supply
7	03200268	Grub Screw M2.5 X 8 Cup Point
8	01600894	Tension Sensor Arm, Take Up
9	01600893	Tension Sensor Arm, Supply
10	00900539	Tension Arm Spring, Take Up
11	00900540	Tension Arm Spring, Supply
12	01600821	Tension Control Mounting Post
13	00900319	Circlip
14	01101005	Post Shim -For Height Adjustment
15	01600611	Bearing Housing Nut
16	01600892	Tension Arm Boss, Take Up
17	01600891	Tension Arm Boss, Supply
18	00900945	Shorlube Bush - Dry
19	01600787	Stabilizing Roller, Take Up
20	01600788	Stabilizing Roller, Supply
21	00900940	Bearing, Supply
22	00900949	Bearing, Take Up
23	01300060	'0' Ring
24	01101040	Shim Washer
25	00900339	Circlip
26	01600817	Weight
27	00900527	Pop-Up Shield Latch Spring
28	03200301	Cheese Head Screw M4 X 8
29	03200009	Shake-proof Washer M4
30	03200008	Flat Washer M4
31	01600751	Spring Retaining Bush
32	01100903	Pop-up Mu-Metal Shield
33	01600741	Pop-up Shield Block
34	03200250	Cheese Head Screw M2.5 X 6
35	00900528	Retaining Spring
36	02301205	Pop-up Shield Shaft Assembly
37	02301204	Bearing-Housing Assembly
38	01600739	Pop-up Shield Nut
39	01600738	Pop-up Shield Bearing Housing
40	00900923	Nilsen Bush

Drawing No: 02600342 Page 10 Of 10
Deck Assembly 77 mk V
This Parts List Includes
Edit Switch
Pressure Roller
Tape Lift Arm

1	02301195	Edit Switch Assembly
2	00900051	Black Knob
3	00000011	Flat Washer
4	00000183	Wave Washer
5	00900328	Grip Ring
6	02301197	Pressure Roller Pilot Bearing Assembly
7	01600611	Bearing Housing Nut
8	02302183	Pressure Roller Shaft & Arm Assembly
9	02301064	Pressure Roller Assembly 19/38 Cm.P.S.
or	02301159	Pressure Roller Assembly 9.5/19 Cm.P.S.
10	01600696	Cover
11	03200260	Csk Head Screw M2.5 X 6
12	02302076	Tape Lift Arm Support Bar Sub-Assembly
13	03200340	Grub Screw M4 X 8 Cup Point
14	00801052	Heat Shrink 12 mm Dia
15	01600719	Tape Lift Arm
16	03200343	Socket Head Screw M4 X 8
17	03200009	Shake-proof Washer M4
18	03200008	Flat Washer M4
19	01600129	Edit Switch Cam
20	01600610	Edit Switch Shaft
21	00602024	Sellock Pin 1/8'1 Dia,. X 1/2" Long
22	01600725	Pressure Roller Pivot Bearing Housing
23	00900913	Nilsen Bush
24	01600862	Pressure Roller Swing Arm
25	01600724	Pressure Roller Pivot Shaft
26	01600577	Pressure Roller Shaft

Drawing No: 02600342 Page 6 Of 10
Deck Assembly 77 mk V
This Parts List Includes

Heads
Brakes
Transistors

1	02301226	Play Head Assembly, Stereo
	02301223	Play Head Assembly, Mono
2	02301227	Record Head Assembly, Stereo
	02301224	Record Head Assembly, Mono
3	02301228	Erase Head Assembly, Stereo
	02301225	Erase Head Assembly, Mono
4	01602012	Head Shield
5	01600857	Head Mount Body
6	01600598	Azimuth Adjusting Arm
7	00900511	Spring
8	03200947	Socket Head Cap Screw M3 X 20
9	03200930	Grub Screw M3 X 6 Cup Point
10	03200945	Socket Head Cap Screw M3 X 10
11	01101002	Head Mount Shim 0.127 Thick For Height Adjust
12	01101001	Head Mount Shim 0.254 Thick For Height Adjust
13	03200009	Shake-proof Washer M4
14	00600199	Solder Lug
15	03200348	Socket Head Screw M4 X 25
16	02301062	Brake Shoe Assembly
17	00900525	Cotton Damped Spring
18	01600727	Brake Tie Rod, Long
19	01600728	Brake Tie Rod, Short
20	02301058	Brake Lever Shaft
21	01600570	Brake Lever Arm
22	01300234	Mica Insulation See Kit 01000064
23	01000164	Transistor
24	01000064	Transistor
25	00802314	Solder Lug
26	01300234	Step Washer See Kit 01000064
27	03200005	Shake-proof Washer M2.5
28	03200252	Cheese Head Screw M2.5 X 10
29	01300099	Transistor Cover
30	02302268	Insulated Screw Assembly M2.5
31	03200004	Washer M2.5
32	03200101	Nut M2.5

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Deck Assembly 77 mk V

This Parts List Includes
Switches
Brake Drums
Tape Timer Display
Tape Tension PCB's
Tape Break Micro-switch

1	00803146	Mains Switch
2	01100945	Bracket
3	03200301	Cheese Head Screw M4 X 8
4	03200009	Shake-proof Washer M4
5	01101010	Spooling Pot
6	00900053	Black Knob – FSB Schadow
7	01100893	Bracket
8	03200900	Cheese Head Screw M3 X 6
9	03200017	Shake-proof Washer M3
10	00804044	Red Lens
11	00804043	Bulb Mu 0893 28v
12	01100980	Bracket
13	03200300	Cheese Head Screw M4 X 6
14	03200009	Shake-proof Washer M4
15	00803167	Switch
16	01000185	Led, Red
17	01000186	Led, Green
18	01101004	Bracket
19	00804045	Blue, Lens Logic PCB Switches
20	00804046	Green, Lens Logic PCB Switches
21	00804047	Yellow, Lens Logic PCB Switches
22	00804048	White, Lens Logic PCB Switches
23	01101003	Support Bar
24	04000899	Tape Timer Display PCB
25	03200250	Cheese Head Screw M2.5 X 6
26	01300191	Tape Timer Display Insulation
27	01300160	Micro-switch Insulation
28	00803170	Tape Break Micro-switch
29	03200203	Cheese Head Screw M2 X 12
30	03200000	Washer M2
31	00802307	Solder Lug
32	01101000	Tension Sensor Shield, Take Up
33	01100999	Tension Sensor Shield, Supply
34	02300867	Tape Tension PCB
35	01300136	Tape Tension Insulation
36	00900511	Spring
37	03200253	Cheese Head Screw M2.5 X 12
38	02301063	Brake Drum Assembly
39	02301049	Spool Retaining Knob Assembly