SONY

AUDIO RECORDER

APR-24

OPERATION AND MAINTENANCE MANUAL
2nd Edition
Serial No. 10001 and Higher

SAFETY CHECK-OUT

After repair or service, the following safety checks must be performed before releasing the equipment to the customer:

Using one of the three methods outlined below, check the metal trim, "metallized" knobs, screws, and all other exposed metal parts for AC leakage.

LEAKAGE TEST

The AC leakage current from any exposed metal part to earth ground, or to any other exposed metal part having a return to chassis, must not exceed 3.5 mA. Leakage current can be measured by any one of the following methods:

1. With a commercial leakage tester, such as the Simpson 229 or RCA WT-540A. When using such instruments, the manufacturer's instructions must be followed exactly.

2. With a battery-operated AC milliammeter, such as the Data Precision 245.

3. By using a VOM or battery-operated AC Voltmeter to measure the voltage drop across a 1.5k resistor (see Figure A). With this resistor value, the "limit" indication is 5.25V, and the meter used must have an accurate low-voltage scale. The Simpson 250 and Sanwa SH-63Trd are suitable passive VOM types. Also, most battery-operated digital multimeters having a 20 VAC range are suitable for these measurements.

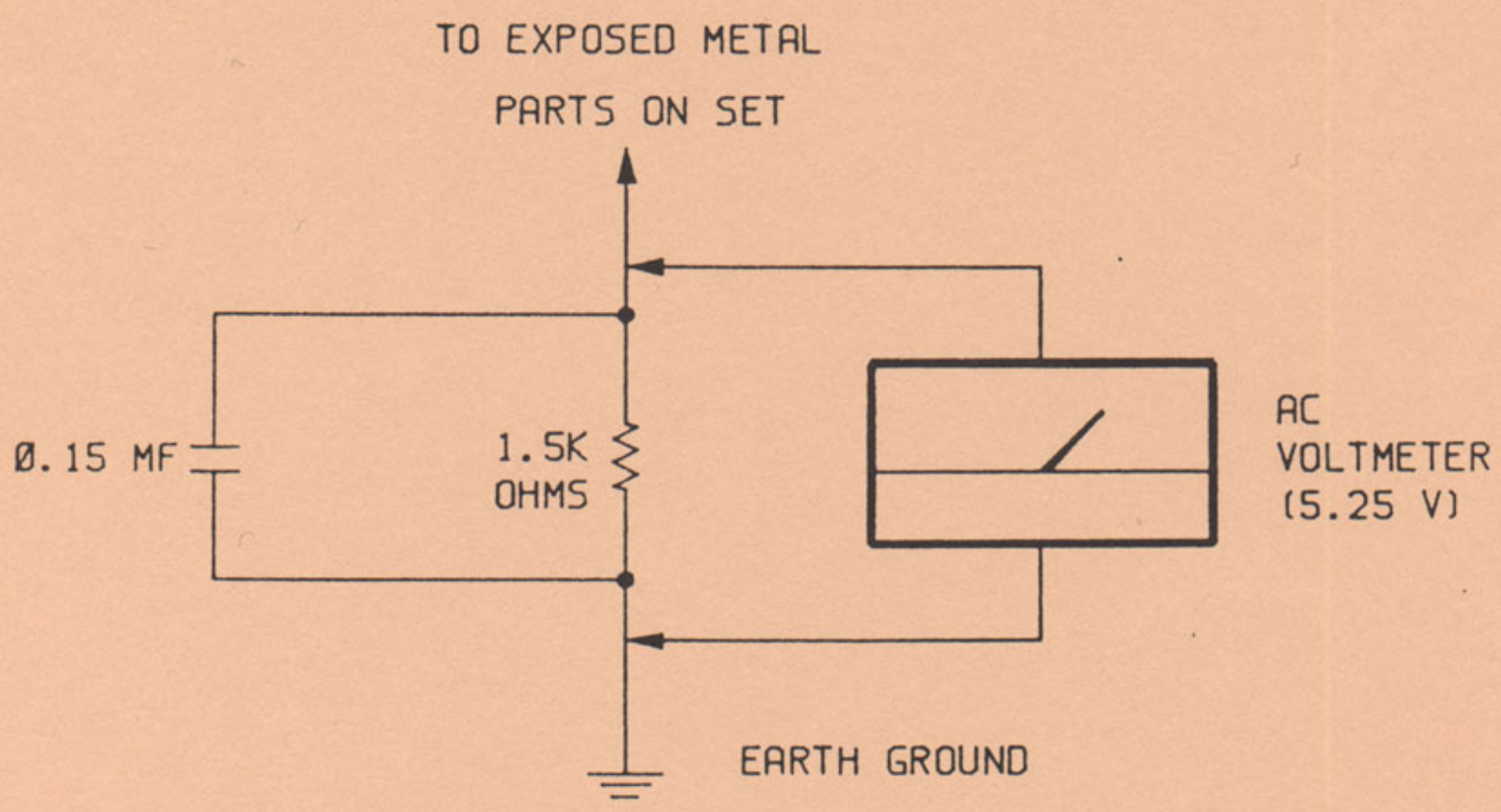

Figure A. Using an AC Voltmeter to check AC Leakage

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SECTION 1 INTRODUCTION

1.1 OVERVIEW

The **APR-24** is a 24-track analog tape recorder designed to meet the growing needs of the professional audio and video industries. The machine incorporates the latest electronic techniques and circuits to provide state-of-the-art performance, making it well suited for use in multi-track recording, film audio production, or video post-production environments.

The transport is built around a die cast, all-aluminum chassis which provides long term structural stability and performance. All transport functions are microprocessor-controlled to ensure optimum tape handling characteristics.

The audio and Time Code electronics also are microprocessor-controlled, and offer a wide range of sophisticated standard features. These include three non-volatile audio alignment memories for each speed, an assignable Time Code track, Video Sync input, and inherent Time Code synchronisation and Vertical Interval Time Code (VITC) reading capabilities.

In addition, most audio, transport, locator, and synchroniser operations are controlled at the Remote Control Unit.

1.2 FEATURES

The major features of the machine include:

- Six selectable power supply voltage settings;
- Amorphous heads for improved frequency response and longer head life;
- SMPTE-based insert/editing management;
- Resolve on Play synchronisation;
- Jog/Shuttle Dial for frame-precise tape positioning;
- Five Edit Storage Registers;
- Five User Defined Storage Registers, accessible with a single keystroke;
- Externally triggered edit operation;
- External Noise Reduction interface;
- Dual-scale bar graph metering;
- VU meter for single channel metering;
- Provision for 14" reels;
- +/- 50% Vari Speed capability;
- Spot Erasure of individual tracks.

1.3 LOCATION OF PRIMARY COMPONENTS

The primary components of the machine are located as shown in Figure 1-1.

1. Supply Reel Motor
2. Supply Guide Roller
3. Supply Tension Arm
4 Timer Roller
5. Headstack
6. Tape Guides
7. Capstan Motor
8. Pinch Roller
9. End of Tape (EOT) Sensor
10. Take-Up Guide Roller
11. Take-Up Tension Arm
12. Take-Up Reel Motor
13. Meter Housing
14. VU Meter
15. Local Control Panel
16. Alignment (ALN) Panel
17. Remote Control Unit
18. SU-224 Stand
19. Power Supply
20. CNL and MST Boards

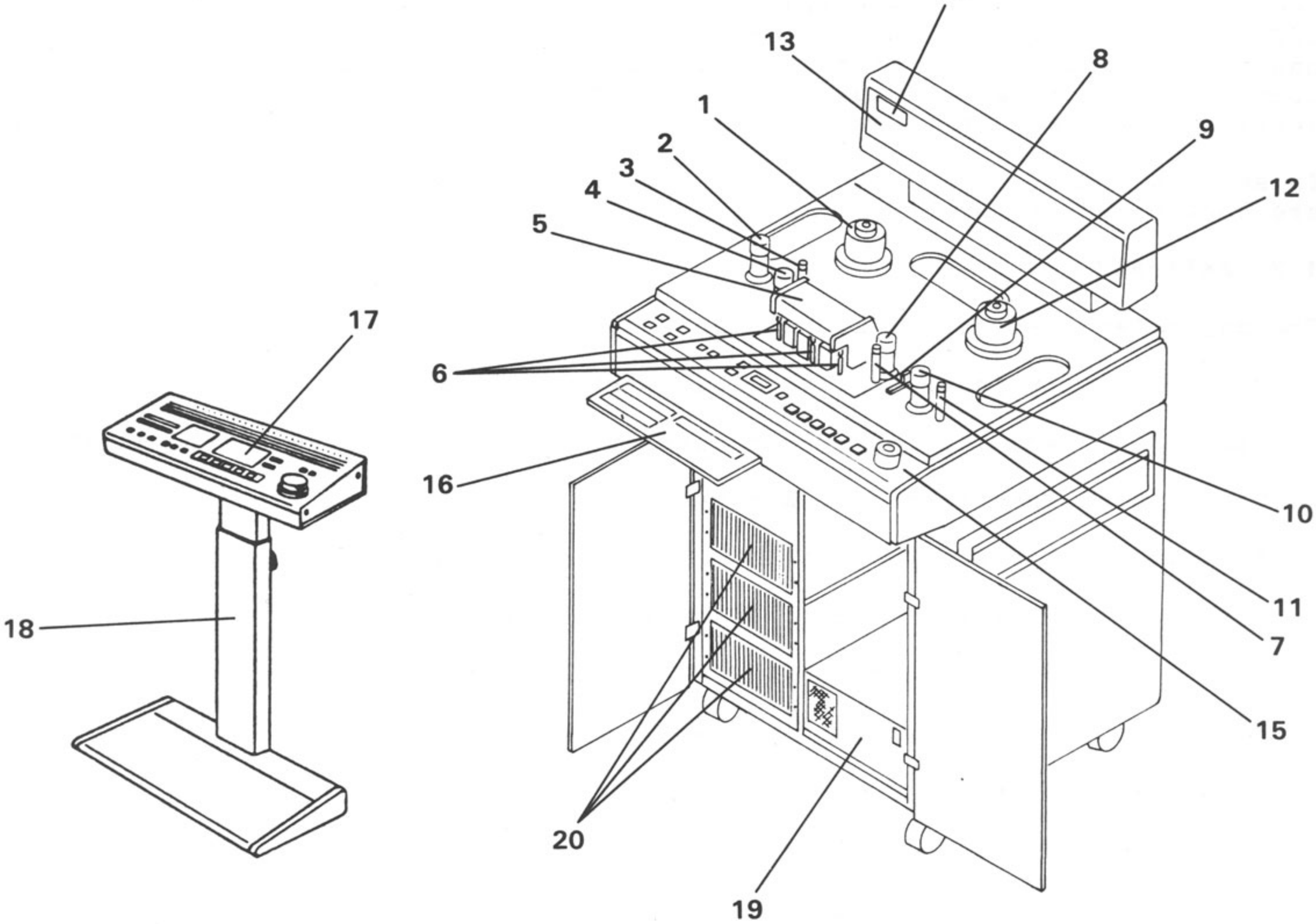


Figure 1-1. Primary Machine Components

1.4 SUPPLIED ACCESSORIES

The following accessories are supplied with the **APR-24**:

- Remote Control Unit;
- **SU-224** Stand (U.S. only);
- Extender board for CNL and MST boards;
- Six Tuchel connectors for audio Line I/O connections;
- 10 1/2" empty NAB-type metal reel;
- 10 1/2" roll, Scotch 3M 226 tape;
- 50 User labels;
- Eight power supply fuses;
- European Power Cable Accessory.

1.5 OPTIONAL ACCESSORIES

The following optional accessories may be ordered separately for use with the **APR-24**:

1.5.1 APR-OP24C Console Audio Interface Accessory

This accessory allows for external parallel control of the RECORD and RECORD READY functions for specific channels. It also enables exclusive external control of global SYNC/REPRO switching.

1.5.2 MB-24M Mounting Accessory

This accessory allows two **APR-5000** or **PCM-3102/3202** Remote Control Units to be mounted alongside the Remote Control Unit on the **SU-224** stand, thereby providing a convenient remote control station for all of the machines.

1.5.3 MB-24A Arm Rest Accessory

This accessory can be fitted only on a **SU-224** Stand which already incorporates the **MB-24M** Mounting Accessory. It is used to provide a padded arm rest in an unused **APR-5000** or **PCM-3102/3202** remote control location. Two arm rests can be installed, one in each location, if desired.

1.5.4 MB-24D Mounting Accessory

The **MB-24D** Accessory allows two **APR-24** Remote Control Units to be mounted on a single **SU-224** stand. This accessory also can be installed in conjunction with Mounting Accessory **MB-24M** to set up a central control point for two **APR-24**s and two **APR-5000**s or **PCM-3102/3202**s.

1.5.5 MB-24H Mounting Accessory

This accessory extends the capabilities of the **MB-24M** Mounting Accessory by

providing the means of mounting a **PCM-3402**-type Remote Control Unit to the **SU-224** Stand as an alternative to the **APR-5000** and **PCM-3102/3202** types. It is important to note that one **MB-24H** Mounting Accessory is required for each **RM-3400** Remote Control Unit being installed.

1.5.6 MB-24U Rack Mount Accessory

This accessory allows the **APR-24** Remote Control Unit to be mounted in a standard 19-inch rack panel or cabinet.

1.6 SPECIFICATIONS

The following are the power, transport, input, output, audio, and Time Code specifications for the **APR-24**. All specifications are typical at 25°C and are subject to change without notice.

NOTE:
0 dB = 0.775 volts
0 dBu = 0.775 volts (no load specified)
0 dBm = 0.775 volts into 600 ohms

1.6.1 Power

POWER CONSUMPTION, MAXIMUM	1200 watts
FUSE RATINGS	100V/15A; 110-120V/12A; 200V/8A; 220-240V/6A

1.6.2 Transport

REEL SIZE	2" x 10.5"
MAXIMUM REEL SIZE	2" x 14"
NOMINAL TAPE SPEEDS	30 ips (high speed) 15 ips (low speed)
VARI SPEED RANGE	+/- 50% nominal tape speed
SPEED STABILITY	Better than 0.02%
NOMINAL TAPE TENSION	9 ounces
FAST WIND SPEED, MAXIMUM IPS	475 ips
FAST WIND TIME, 2500' TAPE	73 seconds
FAST WIND TIME, SHUTTLE MODE	105 seconds
FLUTTER, DIN 45507 WEIGHTED	
30 ips AES	0.03%
15 ips NAB	0.04%

START TIME TO FLUTTER	
30 ips AES	1600 ms to 0.3%
15 ips NAB	800 ms to 0.4%

1.6.3 Inputs

AC INPUT VOLTAGE, SELECTABLE	100/110/120 200/220/240
AC LINE FREQUENCY	50 or 60 Hz
MAXIMUM AC LINE VOLTAGE DEVIATION	+/- 15%
AUDIO INPUT LINE LEVEL	+4 dBu
AUDIO INPUT IMPEDANCE	10k ohms, balanced
CALIBRATION INPUT LEVEL	+4dBu, unbalanced
TIME CODE INPUT LEVEL	-6dBu/+6dB
Minimum Level	0.6V differential p-p
Maximum Level	20 V differential p-p
Common Mode Rejection, Balanced Input	10 Vp-p, 10Hz to 100kHz
TIME CODE INPUT IMPEDANCE	10k ohms
PARALLEL PORT INPUTS	TTL and HCMOS compatible
External Source Input	9.6kHz, -50% nominal speed 19.2kHz, nominal speed 28.8kHz, +50% nominal speed

1.6.4 Outputs

AUDIO OUTPUT LINE LEVEL	+4 dBu
AUDIO OUTPUT IMPEDANCE	120 ohms, balanced
OUTPUT CLIPPING	+24dBm
CALIBRATION OUTPUT LEVEL	+4dBu, unbalanced
TIME CODE OUTPUT LEVEL	-6dBu, +/-3dB
Nominal Level	4.0V differential p-p
Maximum Level	7.5V differential p-p
RS422-TYPE TIME CODE OUTPUT	
Driver Output Level	+/- 2V minimum
Driver Load	100 ohm minimum
Receiver Input Resistance	4k ohm
Receiver Sensitivity	+/- 200mV
TIME CODE OUTPUT IMPEDANCE	120 ohms

PARALLEL PORT OUTPUTS	TTL and HCMOS compatible
Current Sink Capability	+/-6mA
Tape Tachometer Output	480Hz at 30 ips, 240Hz at 15 ips
REMOTE CONTROL UNIT POWER SUPPLY	+5 volts regulated, 0.2 amps maximum
EXTERNAL NOISE REDUCTION RELAY SUPPLY	24 volts maximum
Maximum Saturation Current	100 mA at 24 volts

1.6.5 Audio

All audio specifications are referenced to 250 nW/m unless otherwise noted.

FREQUENCY RESPONSE	
Record/Repro	
30 ips AES	48Hz to 25kHz, +.75/-3dB
15 ips NAB	25Hz to 24kHz, +.75/-3dB
Record/Sync	
30 ips AES	48Hz to 23kHz, +.75/-2dB
15 ips NAB	25Hz to 18kHz, +.75/-2dB
SIGNAL TO NOISE, RECORD/REPRO	
Unweighted 20Hz to 20kHz	
30 ips AES	58 dB
15 ips NAB	54 dB
Weighted dB(A)	
30 ips AES	63 dB
15 ips NAB	59 dB
THIRD HARMONIC DISTORTION, 1KHZ FUNDAMENTAL SIGNAL	
30 ips AES	Less than 0.15%
15 ips NAB	Less than 0.35%
BIAS FREQUENCY	400kHz
ERASE FREQUENCY	100kHz
DEPTH OF ERASURE, 510nW/m REFERENCE	Better than 75dB, 1kHz signal

1.6.6 Time Code

INTERNAL GENERATOR FREQUENCY	
SMPTE	2400 bps
EBU	2000 bps
INTERNAL GENERATOR ACCURACY	+/- 50 ppm (+/- 0.005%)

SECTION 2 INSTALLATION

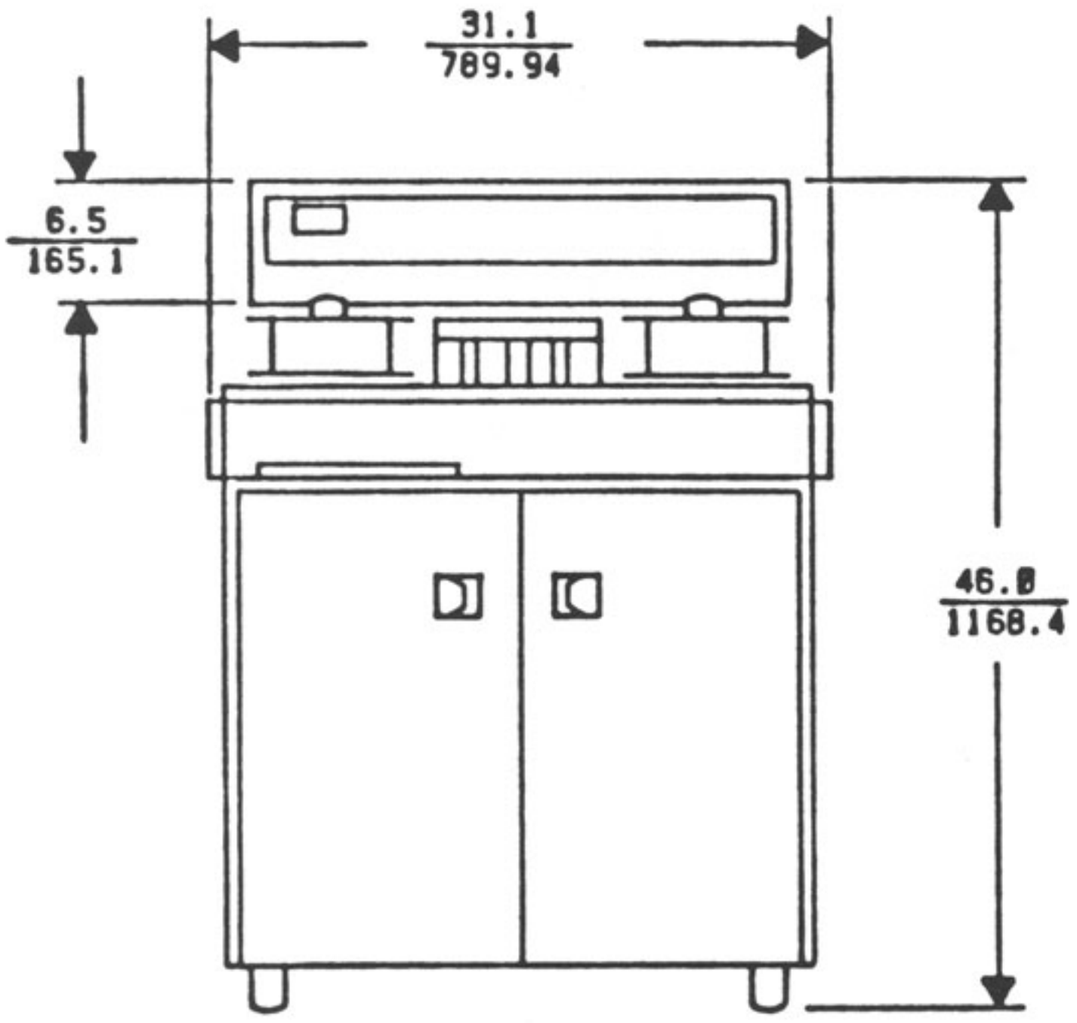
2.1 INTRODUCTION

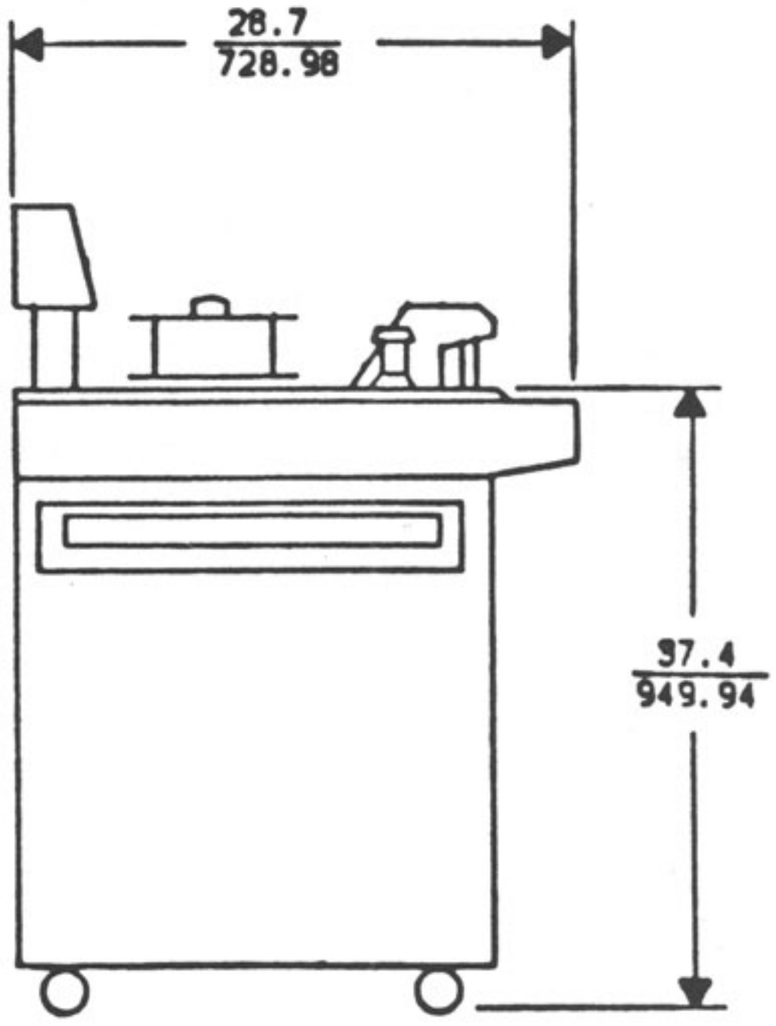
This section contains the information necessary for the installation of the **APR-24**, including space requirements, environmental considerations, repacking/unpacking, operating voltages, and external connections.

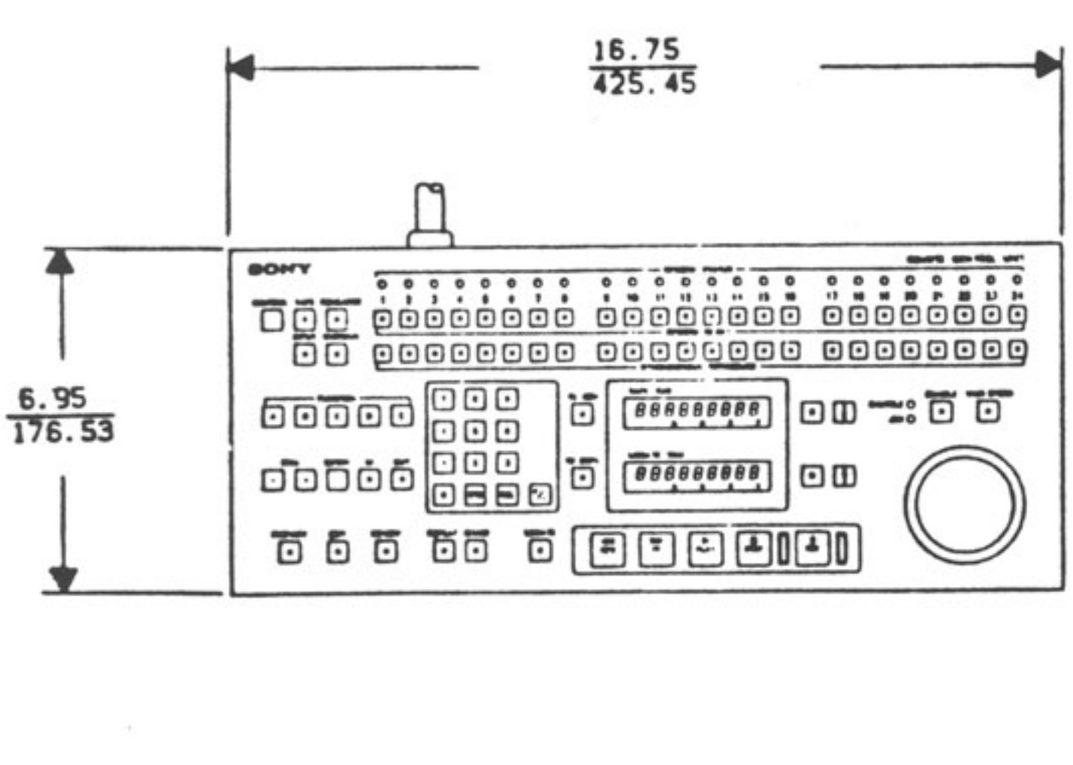
2.2 SPACE REQUIREMENTS

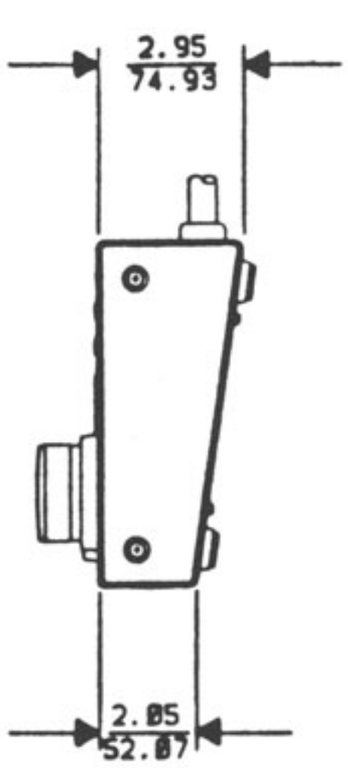
Before installing the machine in its final location, its weight and dimensions should be taken into consideration, together with those of the Remote Control Unit and its stand.

The combined weight of the **APR-24** and the Remote Control Unit is 400 lbs. (181kg). The dimensions of the **APR-24**, the Remote Control Unit, and the **SU-224** Stand are shown in Figure 2-1. The cable length of the Remote Control Unit is ten meters (32.8 feet), with a maximum recommended length of twenty meters (65.6 feet).









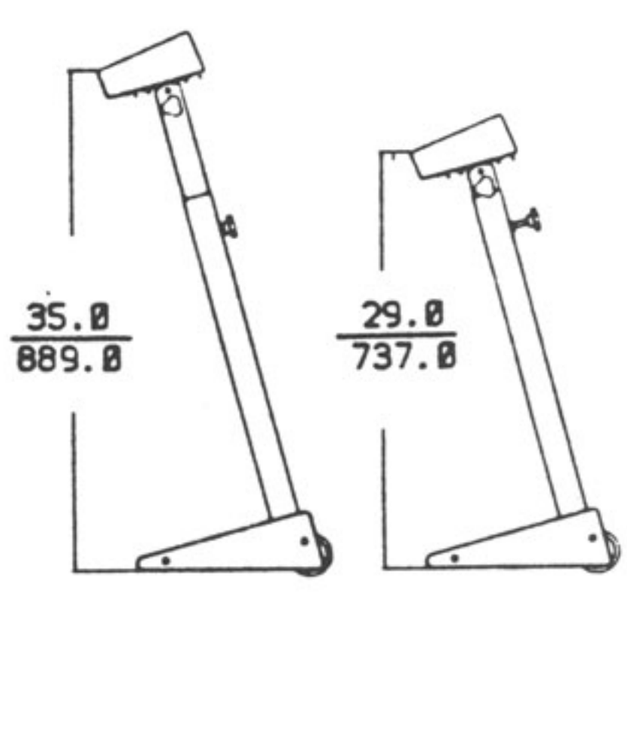


Figure 2-1. APR-24, Remote Control Unit, and SU-224 Stand Dimensions

2.3 ENVIRONMENTAL CONSIDERATIONS

The machine should be placed in an area such that it will not be exposed to direct sunlight or any other heat source. The operating temperature limits for the machine are 41 degrees to 104 degrees F. (5 degrees to 40 degrees C.), while its storage temperature range is from 4 degrees to 140 degrees F. (-20 degrees to 60 degrees C.)

To prevent internal heat build-up within the machine, free air circulation in and around the machine is absolutely essential. The ventilating fans on the rear of the machine or the space between the floor and the bottom of the machine should never be obstructed.

Finally, it is most important that the machine be located in a position that is remote from significant ambient magnetic fields. Such fields can be detrimental to the machine's signal-to-noise performance.

2.4 REPACKING/UNPACKING

Figure 2-2 illustrates how to repack and unpack the machine from the shipping crate. When initially unpacking the machine, be sure to save the crate and all of the packing material in case it should become necessary to ship the machine to another destination.

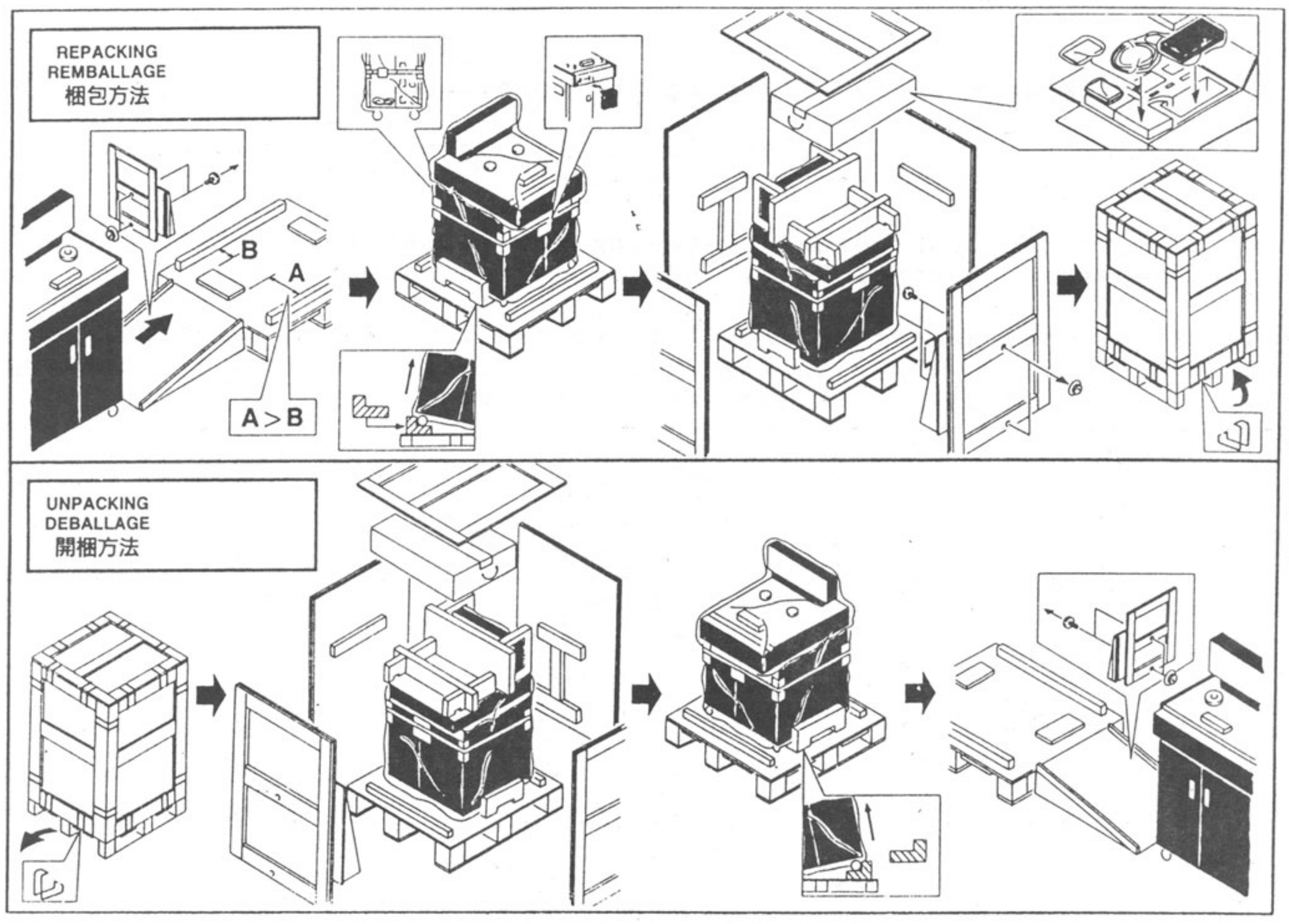


Figure 2-2. Unpacking/Packing Illustration

2.5 SU-224 ASSEMBLY

The following procedure describes how to assemble the **SU-224** Stand, and how to mount the **APR-24** Remote Control to it.

STEP 1. Remove the stand assembly and the mounting platform from the shipping carton.

STEP 2. Align the four studs on the bottom of the mounting platform with the four mounting yoke holes on the stand assembly. Lower the mounting platform into the holes, as shown in Figure 2-3.

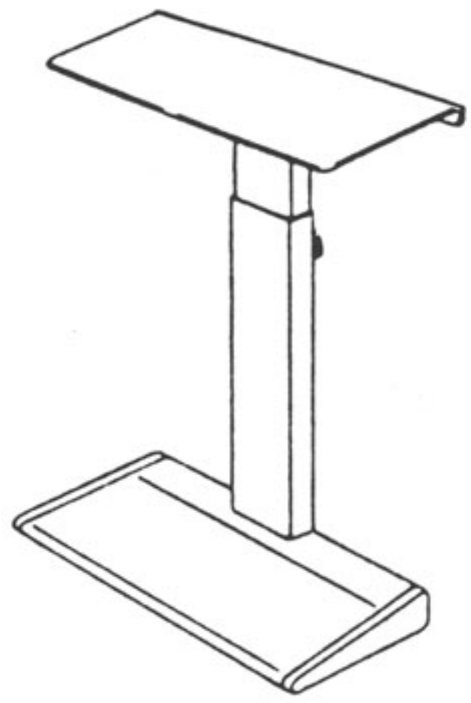


Figure 2-3. Attaching the Mounting Platform

STEP 3. Fasten the mounting platform to the mounting yoke using the four flat washers and hex nuts provided.

STEP 4. Remove the four screws fastening the rubber feet to the bottom of the Remote Control Unit, and remove the rubber feet.

STEP 5. Fasten the Remote Control Unit to the top of the mounting platform, as shown in Figure 2-4, using the four screws removed in STEP 4 and the three 3x8 screws provided.

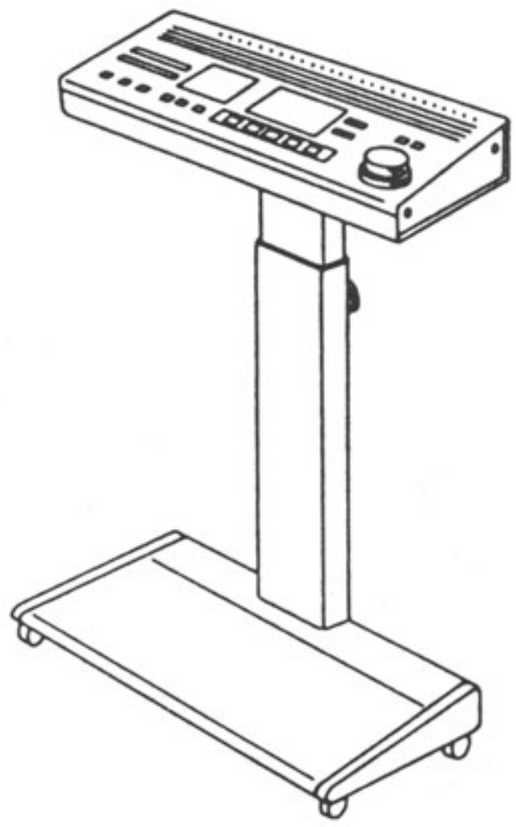


Figure 2-4. Mounting the Remote Control Unit

2.6 OPERATING VOLTAGES

WARNING:

USING THE MACHINE AT A VOLTAGE LEVEL OTHER THAN 120V MAY BRING ABOUT THE NEED TO CHANGE THE AC POWER CORD AND/OR THE AC POWER PLUG. TO REDUCE THE RISK OF FIRE OR ELECTRICAL SHOCK, ALL WIRING SHOULD BE PERFORMED BY QUALIFIED SERVICE PERSONNEL.

The operating voltage for the **APR-24** may be set to any one of six nominal levels, these being 100, 110, 120, 200, 220, and 240 volts. To change the operating voltage of the machine, the power supply system wiring must be reconfigured, and the appropriately-rated power supply fuse must be installed.

2.6.1 Changing the Operating Voltage

WARNING:

BEFORE REMOVING THE POWER SUPPLY REAR PANEL, ENSURE THAT THE POWER CORD IS DISCONNECTED FROM ANY AND ALL POWER SOURCES.

To change the operating voltage of the machine, remove the power supply rear panel, as shown in Figure 2-5, and expose the power supply connector strip. Figure 2-6 and Table 2-1 illustrate how to wire the power supply connector strip for the desired operating voltage.

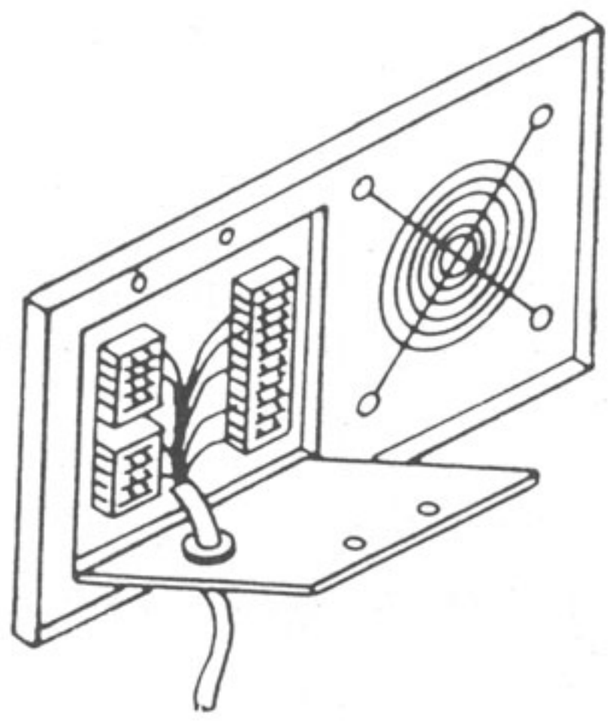


Figure 2-5. Power Supply Rear Panel Removal

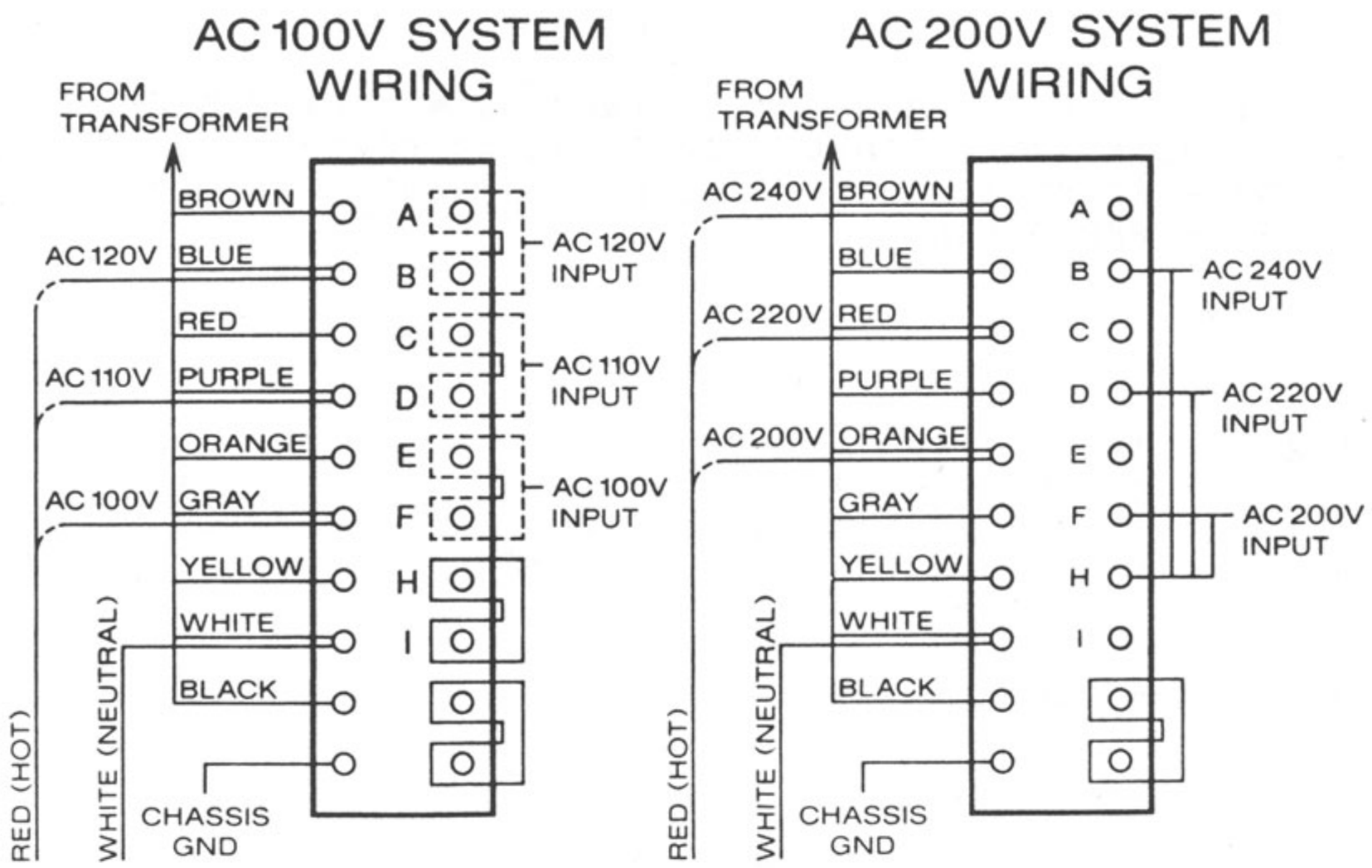


Figure 2-6. Power Supply Connector Strip

Voltage Level	Red (Hot) Connection	Input Side Connection	Ground Side Connection
100 V	Gray	E to F	H to I
110 V	Purple	C to D	H to I
120 V	Blue	A to B	H to I
200 V	Orange	F to H	J to K
220 V	Red	D to H	J to K
240 V	Brown	B to H	J to K

Table 2-1. Power Supply Voltage Wiring

2.6.2 Changing the Power Supply Fuse

WARNING:

BEFORE REMOVING THE POWER SUPPLY FUSE, ENSURE THAT THE UNIT IS DISCONNECTED FROM ANY AND ALL POWER SOURCES.

The power supply fuse is located on the front of the power supply and must be of the proper rating for the operating voltage. Table 2-2 liszt the fuse ratings for the six nominal operating voltages.

Voltage Level	Fuse Rating
100V	15A
110V	12A
120V	12A
200V	8A
220V	6.25A
240V	6.25A

Table 2-2. Voltage Level Fuse Ratings

2.6.3 European Power Cable Accessory

WARNING:

BEFORE INSTALLING THIS ASSEMBLY, ENSURE THAT THE POWER CORD IS DISCONNECTED FROM ANY AND ALL POWER SOURCES.

TO REDUCE THE RISK OF FIRE OR ELECTRICAL SHOCK, ALL WIRING SHOULD BE PERFORMED BY QUALIFIED SERVICE PERSONNEL.

The European Power Cable accessory should be installed when it becomes necessary to conform to the European power cable color code standard.

To install the accessory, remove the power supply rear panel as shown in Figure 2-5. Remove the U.S. standard power cable assembly leads from the terminals on the power supply connector strip and replace them with their equivalent European standard leads, as derived from Table 2-3. The plug (not provided) then should be appropriately connected to the input end of the cable.

Lead	U.S.	European
Hot (Line)	Black	Brown
Neutral	White	Blue
Ground	Yellow/Green	Yellow/Green

Table 2-3. Power Cable Lead Colors, U.S. v. European Standard

2.7 EXTERNAL CONNECTIONS

A brief description of all of the external connections is given in the following paragraphs, so that wiring plans and cable lengths may be determined before the machine is installed. These include Line I/Os (Inputs/Outputs), External Noise Reduction (NR), Sync Input Video, Calibration I/O, Serial Network, Parallel Port, Remote Control Port, and LTC I/O, as shown in Figure 2-7.

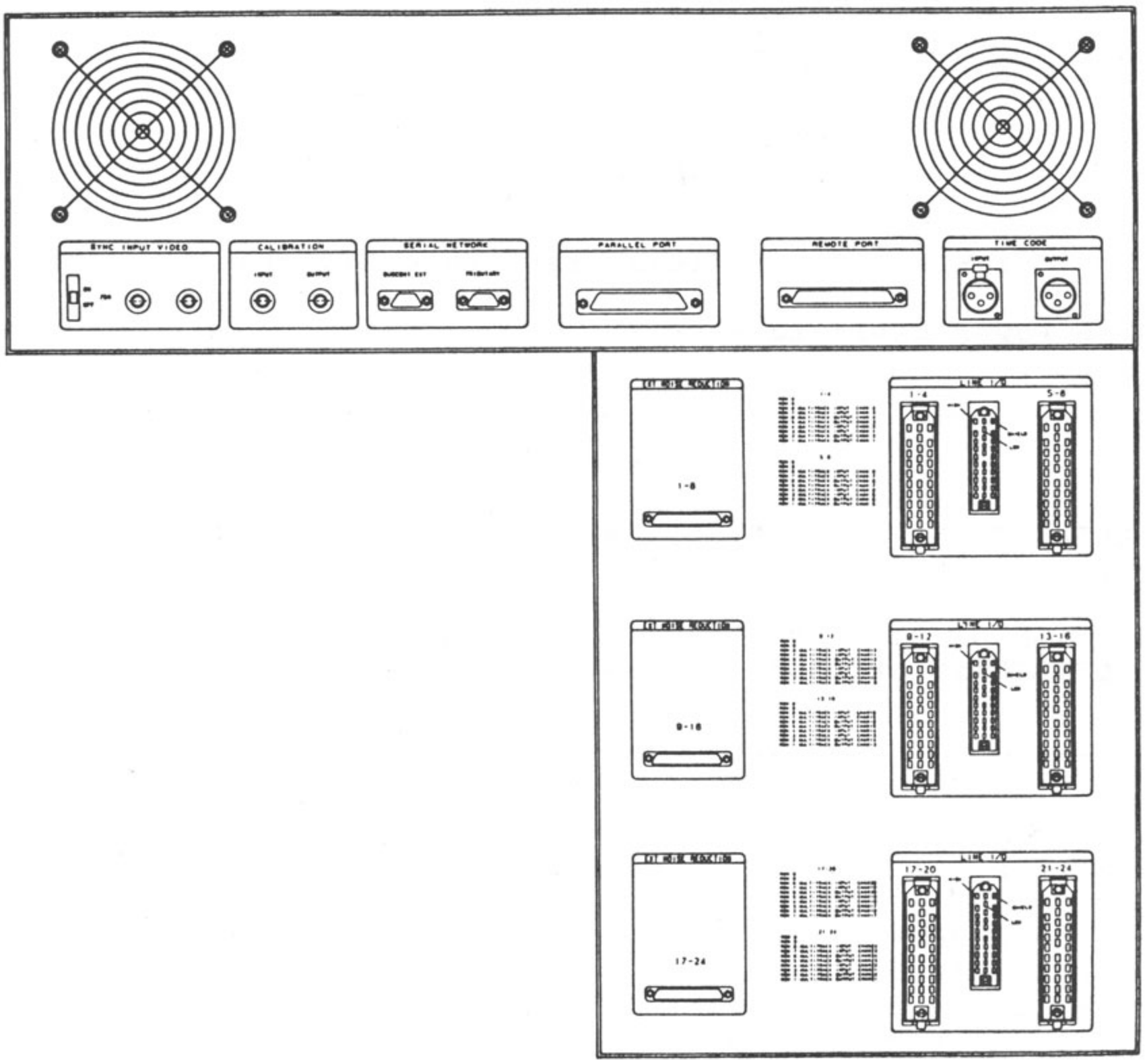


Figure 2-7. External Connections

2.7.1 Line I/Os

These six Tuchel connectors are the Line Input and Line Output connection points for the machine's 24 channels. Each Tuchel connector is laid out in a three-column by ten-row format, and the row (1 through 0) assignments for each individual channel are listed in Table 2-4. The column (a, b, c) assignments for each specific three-wire input are as follows:

Column a = HIGH

Column b = LOW

Column c = SHIELD

ROW	TRACKS					
	1–4	5–8	9–12	13–16	17–20	21–24
8	LN IN 4	LN IN 8	LN IN 12	LN IN 16	LN IN 20	LN IN 24
7	LN IN 3	LN IN 7	LN IN 11	LN IN 15	LN IN 19	LN IN 23
6	LN OUT 4	LN OUT 8	LN OUT 12	LN OUT 16	LN OUT 20	LN OUT 24
5	LN OUT 3	LN OUT 7	LN OUT 11	LN OUT 15	LN OUT 19	LN OUT 23
4	LN IN 2	LN IN 6	LN IN 10	LN IN 14	LN IN 18	LN IN 22
3	LN IN 1	LN IN 5	LN IN 9	LN IN 13	LN IN 17	LN IN 21
2	LN OUT 2	LN OUT 6	LN OUT 10	LN OUT 14	LN OUT 18	LN OUT 22
1	LN OUT 1	LN OUT 5	LN OUT 9	LN OUT 13	LN OUT 17	LN OUT 21

NOTES: 1. Tuchel Rows 9 and 0 not used 2. LN IN = Line In, LN OUT = Line Out

Table 2-4. Tuchel Connector Row Assignments

2.7.2 External Noise Reduction (NR)

Any one of the 24 channels can be connected to an external Noise Reduction (NR) unit for signal processing via the Line I/O Tuchels. The signals carried on the three 25 pin D-type External Noise Reduction connectors are used to synchronise the activation of the external NR units to the Input or Record mode activation of the channels to which they are connected.

Each of the 24 channels employs an opto-isolater circuit, as shown in Figure 2-8, for connection to the external NR unit. Setting a channel into Input or Record mode forward biases the transistor and causes current to flow between the two devices, thereby activating the external NR unit for that channel. Tables 2-5, 2-6, and 2-7 list the pin assignments for all three connectors.

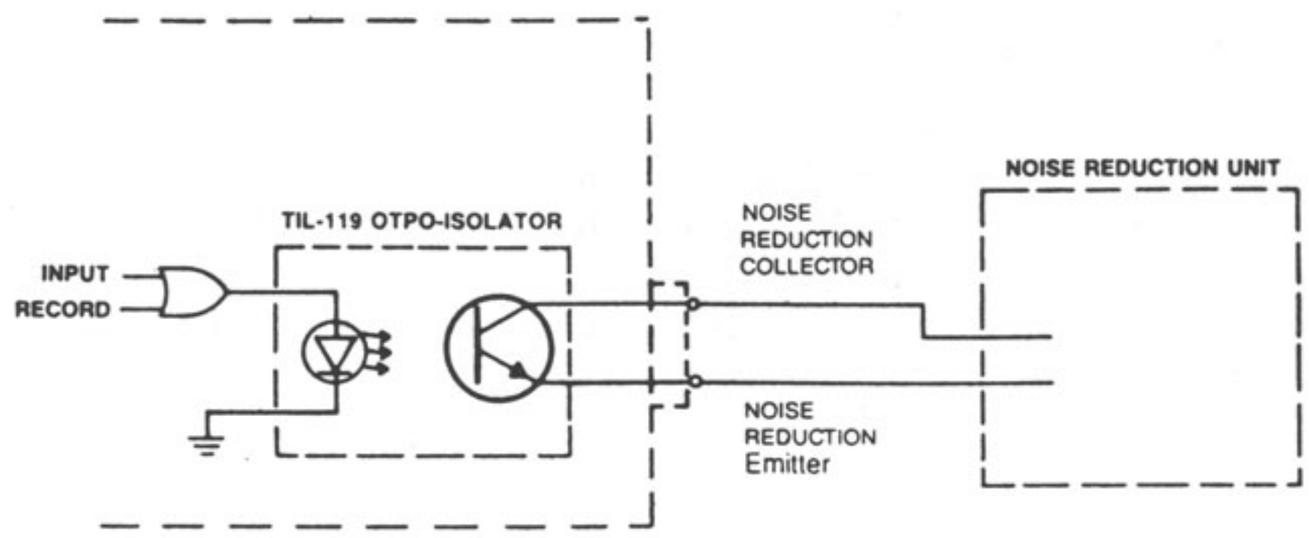


Figure 2-8. Noise Reduction Circuit

PIN	PIN ASSIGNMENT	PIN	PIN ASSIGNMENT
1	Shield	13	N/C
2	Emitter CH 1	14	Collector CH 1
3	Emitter CH 2	15	Collector CH 2
4	Emitter CH 3	16	Collector CH 3
5	Emitter CH 4	17	Collector CH 4
6	Emitter CH 5	18	Collector CH 5
7	Emitter CH 6	19	Collector CH 6
8	Emitter CH 7	20	Collector CH 7
9	Emitter CH 8	21	Collector CH 8
10	Reserved	22	Reserved
11	N/C	23	Reserved
12	N/C	24	N/C
		25	N/C

Table 2-5. External Noise Reduction Port Pin Assignments, Channels 1-8

PIN	PIN ASSIGNMENT	PIN	PIN ASSIGNMENT
1	Shield	13	N/C
2	Emitter CH 09	14	Collector CH 09
3	Emitter CH 10	15	Collector CH 10
4	Emitter CH 11	16	Collector CH 11
5	Emitter CH 12	17	Collector CH 12
6	Emitter CH 13	18	Collector CH 13
7	Emitter CH 14	19	Collector CH 14
8	Emitter CH 15	20	Collector CH 15
9	Emitter CH 16	21	Collector CH 16
10	Reserved	22	Reserved
11	N/C	23	Reserved
12	N/C	24	N/C
		25	N/C

Table 2-6. External Noise Reduction Port Pin Assignments, Channels 9-16.

PIN	PIN ASSIGNMENT	PIN	PIN ASSIGNMENT
1	Shield	13	N/C
2	Emitter CH 17	14	Collector CH 17
3	Emitter CH 18	15	Collector CH 18
4	Emitter CH 19	16	Collector CH 19
5	Emitter CH 20	17	Collector CH 20
6	Emitter CH 21	18	Collector CH 21
7	Emitter CH 22	19	Collector CH 22
8	Emitter CH 23	20	Collector CH 23
9	Emitter CH 24	21	Collector CH 24
10	Reserved	22	Reserved
11	N/C	23	Reserved
12	N/C	24	N/C
		25	N/C

Table 2-7. External Noise Reduction Port Pin Assignments, Channels 17-24.

2.7.3 Sync Input Video

These two BNC connectors are used to connect a composite sync or composite video signal source to the machine for synchronisation, editing, and other functions. Either one of the two connectors can be used as the external input, but two inputs cannot be connected simultaneously.

One of the connectors can be used to loop through the input to another destination by setting the 75 ohm termination switch to "OFF". If the input is not to be employed in this manner, the 75 ohm termination switch must be set to "ON".

2.7.4 Calibration I/O

The Calibration Input BNC connector is used to connect the machine to oscillators, function generators, and other calibrating equipment, while the Calibration Output BNC connector is used to connect the machine to oscilloscopes, digital multi-testers and other measuring equipment. These dedicated Calibration I/O lines eliminate the need to connect and disconnect the Line I/Os in order to calibrate and align each individual channel.

2.7.5 Serial Network

Full duplex, RS422 format serial communication is available at this pair of 9-pin D-type sub-miniature connectors. The circuit architecture of these two ports is designed for upward compatibility with serial control protocols currently in development. The pin-outs for the Tributary and Bus Control Extension serial ports are shown in Table 2-8.

TRIBUTARY	BUS CONT EXT
1. Frame Ground	1. Frame Ground
2. Transmit A (-)	2. Receive A (-)
3. Receive B (+)	3. Transmit B (+)
4. Receive Common	4. Transmit Common
5. Spare	5. Spare
6. Transmit Common	6. Receive Common
7. Transmit B (+)	7. Receive B (+)
8. Receive A (-)	8. Transmit A (-)
9. Frame Ground	9. Frame Ground

Table 2-8. Serial Network Port Pin Assignments

2.7.6 Parallel Port

The 50 pins on the D-type Parallel Port connector can be grouped into five general categories, these being Input Command Lines, Inputs, Output Status Lines, Outputs, and Grounds/+5 Volts. The assignment of each pin is listed in Table 2-9. Figure 2-9 illustrates the timing relationship of the parallel port signals discussed in the following paragraphs.

01	Shield Ground	26	Ground
02	N/C	27	N/C
03	N/C	28	CHASE Command
04	N/C	29	N/C
05	N/C	30	N/C
06	N/C	31	N/C
07	N/C	32	N/C
08	Lifter Defeat Status	33	Lifter Defeat Command
09	MVC Status	34	MVC Input
10	Capstan Reference Output	35	External Source Input
11	External Source Select Status	36	External Source Select Input
12	Tape Direction Output	37	External Direction Sense Input *
13	Tape Tachometer Output	38	External CTL Input *
14	N/C	39	N/C
15	Cue Gate Output **	40	Fader Start Enable Input
16	CHASE Status	41	Return To Top Command
17	N/C	42	Fader Start Input
18	Locate Status	43	Locate Command
19	Rewind Status	44	Rewind Command
20	Fast Forward Status	45	Fast Forward Command
21	Play Status	46	Play Command
22	Record Status	47	Record Command
23	Stop Status	48	Stop Command
24	Ground	49	Remote + 5 Volts
25	Ground	50	Remote + 5 Volts

* Software Version P5.01.02.0 and higher
** Software Version P5.01.03.0 and higher

Table 2-9. Parallel Port Pin Assignment

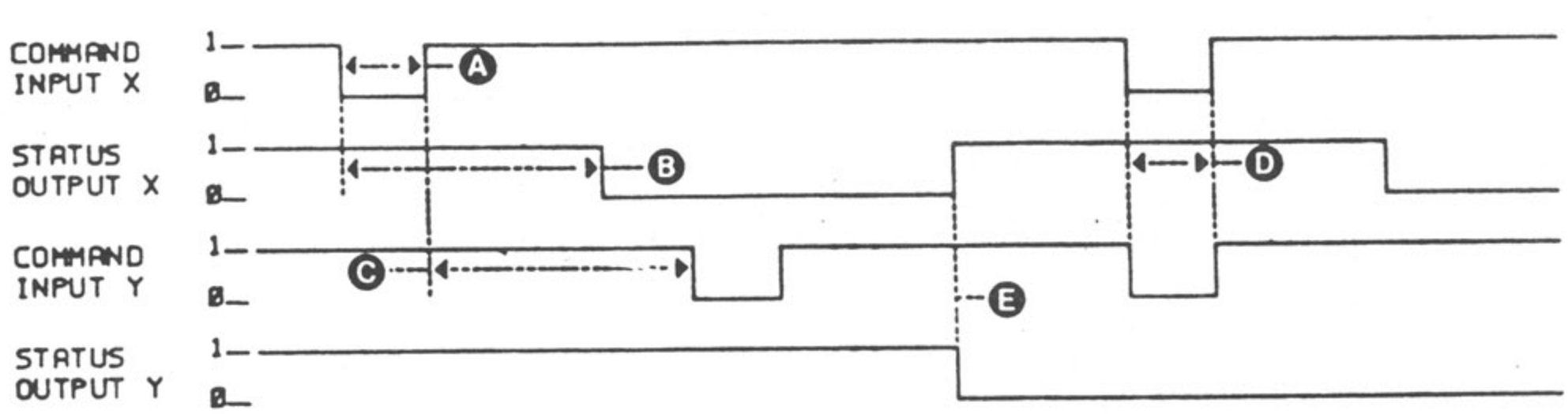


Figure 2-9. Parallel Port Timing

A. Command Input Pulse Width

The minimum command input duration which will guarantee recognition of the command is 30ms.

B. Status Output Response Time

The maximum delay time from any command input until the status outputs are guaranteed valid is 80ms, with two exceptions.

Record transition command input to bias status output response exhibits a tape speed dependent delay of up to 100ms maximum at 15 ips. Also, exit of Play mode exhibits 350ms maximum delay until the status output of the new mode is guaranteed valid. An example of this is when the machine is recording at 15 ips and is commanded to Stop. It requires 100ms to exit Record to Play, and 350ms to exit Play to Stop.

C. Command Input Separation Time

The minimum delay between command inputs to guarantee recognition of separate commands is 20ms.

D. Simultaneous Input Command Overlap Time

The minimum time duration of simultaneous input command pulses to guarantee recognition of the defined command is 30ms. Simultaneous Play and Record commands are defined and required by the PCM series to enter Record mode. This is optional for the APR series, as they will also respond to the Record command alone. Other combinations of simultaneous commands are not defined, and are not guaranteed to result in the desired response.

E. Status Output Overlap Time

The maximum time that any mutually exclusive status outputs may be simultaneously true is 10ms.

2.7.6.1 Input Command Lines

The Input Command Lines allow for external control of the machine functions listed below, and are compatible with HCMOS outputs. They are activated by LOW true logic levels when the machine is in LOCAL or BOTH mode, and are inactive when the line is open-circuited or held to a HIGH logic level.

Pin 28 CHASE Command
Pin 33 Lifter Defeat Command
Pin 41 Return to Top Command
Pin 43 Locate Command
Pin 44 Rewind Command
Pin 45 Fast Forward Command
Pin 46 Play Command
Pin 47 Record Command
Pin 48 Stop Command

2.7.6.2 Inputs

The five inputs listed below function differently from the Input Command Lines, and are described separately in the following paragraphs.

Pin 34 MVC (Manual Velocity Control) Input
Pin 35 External Source Input
Pin 36 External Source Select Input
Pin 40 Fader Start Enable
Pin 42 Fader Start

Pin 34 MVC (Manual Velocity Control) Input

MVC speed and direction can be controlled externally via this input. When this pin is held at a LOW logic level or the HIGH pulse width is less than 100 microseconds, MVC mode will be activated and the machine will achieve full rewind MVC movement. When this input is open-circuited or held to a HIGH logic level, MVC mode remains inactive.

A 1kHz square wave, with its duty cycle adjustable from 10% to 90%, can be used to vary the speed and direction of MVC movement. Figure 2-10 shows the MVC movement resulting from any given duty cycle of the 1kHz input. As can be seen, increasing rewind MVC movement is achieved by varying the duty cycle from 50% to 10%, while increasing forward MVC movement is achieved by varying the duty cycle from 50% to 90%.

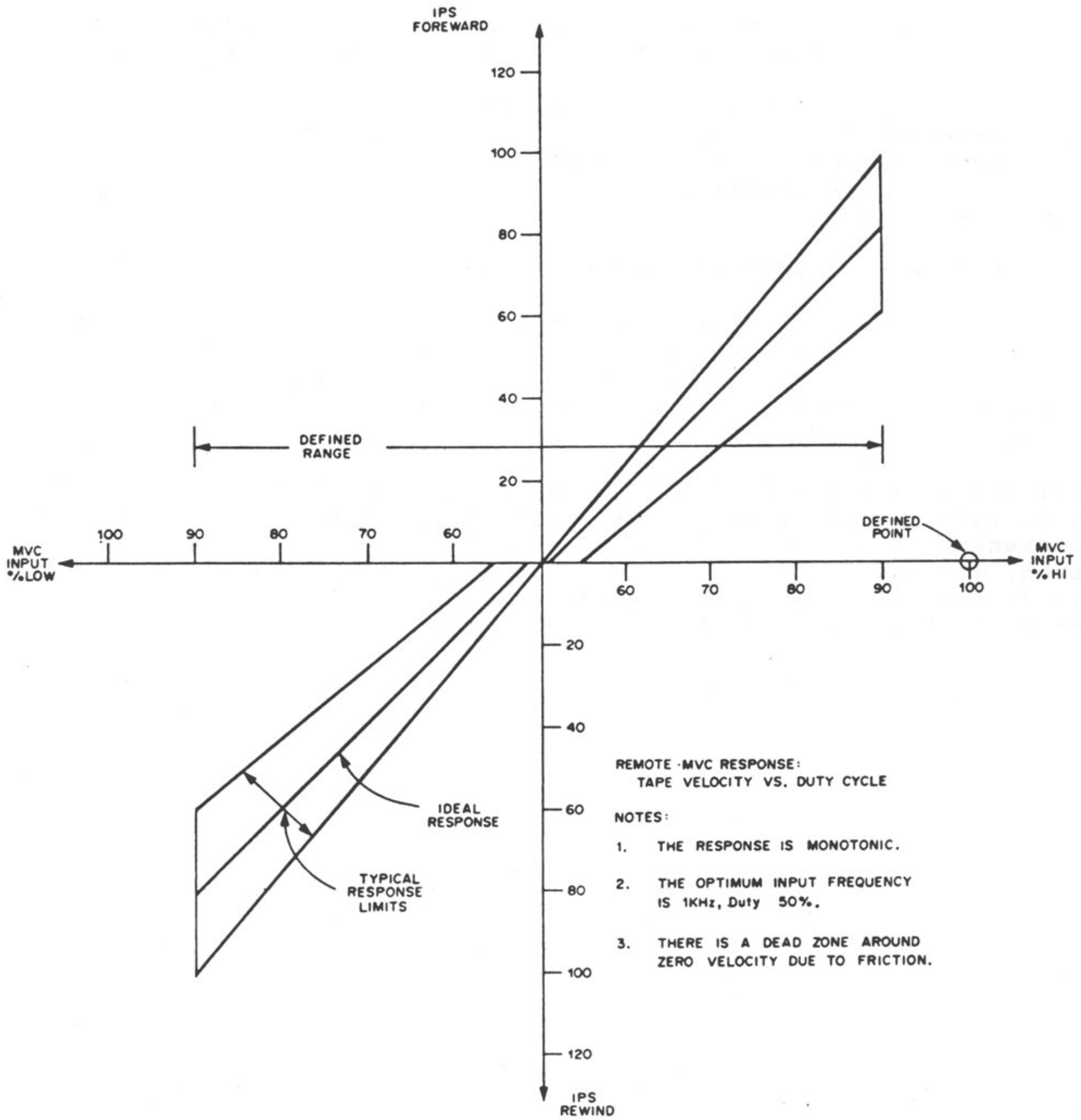


Figure 2-10. MVC Input

Pin 35 External Source Input
Pin 36 External Source Select Input

The External Source Input is used to vary the nominal play speed of the machine by injecting an external capstan motor reference frequency.

The External Source Select Input must be held to a LOW logic level in order for the External Source to be selected by the machine as the capstan reference source. When pin 36 is open-circuited or held to a HIGH logic level, the capstan reference will be internally derived.

As is shown in Figure 2-11, a 19.2 kHz input signal causes the capstan to run at the selected nominal speed (30 ips high speed, 15 ips low speed). Reducing the external reference frequency decreases the play speed, while increasing the frequency increases the play speed. The reference frequency may be reduced to 9.6kHz for -50% Vari Speed, or increased to 28.8kHz for +50% Vari Speed.

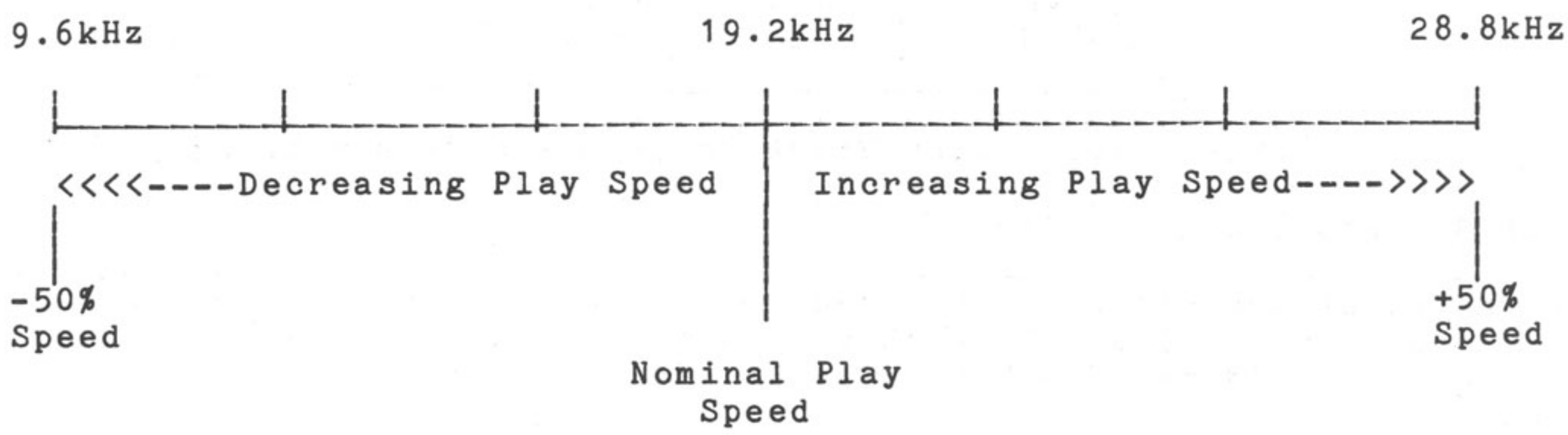


Figure 2-11. Capstan Reference Input Frequency v. Play Speed

Pin 37 External Direction Sense Input
Pin 38 External CTL (Control Track) Input

If a VTR is unable to provide valid Time Code at high speed wind modes for synchronisation to the machine, the CTL (Control Track) output from the VTR may be input at pin 38. This allows the machine to CHASE to the VTR's CTL signal when the VTR is in a high speed wind mode.

The VTR also outputs a Direction Sense flag which signals its high speed wind direction to the machine, and this should be connected to pin 37. Depending upon the VTR type, this signal may be LOW true for reverse and HIGH true for forward, or vice-versa. Provision is made in the **APR-24** (Memory Location 46) for selection between these different parameters. Refer to Section 4.5.3.7 for further information on this feature.

It should be noted that this feature is available only on software versions P5.01.02.0 and higher.

Pin 40 Fader Start Enable
Pin 42 Fader Start

The Fader Start Enable and Fader Start inputs form a two bit logic array which provides global control over Play, Stop, and Global Dim modes. The input at these pins will override other parallel input or transport commands unless both pins are either held at a HIGH logic level or are open circuited. Table 2-10 shows the resultant machine mode for the four possible inputs.

Pin 40	Pin 42	Mode
High	High	Inactive
High	Low	Global Dim
Low	High	Stop
Low	Low	Play

Table 2-10. Fader Start/Fader Start Enable Logic

2.7.6.3 Output Status Lines

The Output Status Lines can be used to externally monitor the machine functions listed below. These outputs are buffered TTL levels, capable of driving up to twenty CMOS-TTL loads or five TTL loads.

These lines are LOW when the status mode is active (LOW true logic), and remain LOW as long as the mode is active.

Pin 08 Lifter Defeat Status
Pin 09 MVC Status
Pin 11 External Source Select Status
Pin 16 CHASE Status
Pin 18 Locate Status
Pin 19 Rewind Status
Pin 20 Fast Forward Status
Pin 21 Play Status
Pin 22 Record Status
Pin 23 Stop Status

2.7.6.4 Outputs

The Capstan Reference, Tape Direction, Tape Tachometer, and Cue Gate outputs are described in the following paragraphs.

Pin 10 Capstan Reference Output

This pin outputs the capstan reference frequency, which is used to control the nominal play speed of the machine. It will output the internally derived capstan reference frequency, which has a nominal value of 19.2kHz with a +/-50% Vari Speed range of 9.6kHz to 28.8kHz.

When an external capstan reference is input to the machine and the Capstan Reference Input Select at pin 36 is held to a LOW logic level, the Capstan Reference Output will follow the external capstan reference frequency.

Pin 12 Tape Direction Output

When the machine is in Rewind mode, this output will be at a HIGH logic level, and when the machine is in Fast Forward or Play mode it will be at a LOW logic level. When the machine is stopped, the output will remain at the logic level of the most recently used winding direction.

Pin 13 Tape Tachometer Output

This pin outputs the interpolated Timer Roller counter pulse, whose frequency is 480Hz at 30 ips and 240Hz at 15 ips.

Pin 15 Cue Gate Output

This pin outputs a signal appropriate for gating a tone generator. The signal goes high for 100ms at three, two, and one seconds in advance of the Edit In Point during Preview, Edit, and Review modes.

2.7.6.5 Grounds/+5 Volts

The ground reference and +5V point connections on the Parallel Port are listed below.

Pin 01 Shield Ground
Pin 24 Ground
Pin 25 Ground
Pin 26 Ground
Pin 49 Remote +5 Volts
Pin 50 Remote +5 Volts

2.7.7 Remote Port

This 37 pin D-type connector is used to interface the Remote Control Unit to the machine. The ten meter (32.8 ft.) interconnecting cable originates at the Remote Control Unit. The maximum recommended length of this cable is twenty meters (65.6 feet).

2.7.8 LTC I/O

The XLR LTC (Longitudinal Time Code) Input connector is used to input an external LTC reference to the machine, while the XLR LTC Output connector is used to output internally or externally derived LTC from the machine.

SECTION 3 CONTROLS AND INDICATORS

3.1 INTRODUCTION

This section briefly describes the various **APR-24** controls and indicators as found on the Remote Control Unit, the Local Control Panel, the Meter Housing, and the ALN (Alignment) Panel. References to other sections in the manual, where detailed information on the operational use of these controls and indicators can be found, are also provided.

Most of the keys discussed in this section are fitted with indicator LEDs which, unless otherwise noted, will illuminate solidly when that particular key function is selected.

It should be noted that some of the controls and indicators may function slightly different than described, depending upon the software version that the machine is fitted with. Please refer to the software information bulletins at the front of the manual for further information.

3.2 REMOTE CONTROL UNIT

The controls and indicators on the Remote Control Unit can be grouped into four general categories, these being related to the Transport, Numeric Keypad, Channel Status, and Editing sections.

3.2.1 Transport Section

The Transport section of the Remote Control Unit, as shown in Figure 3-1, incorporates most of the transport controls also found on the Local Control Panel, as well as several other important features.

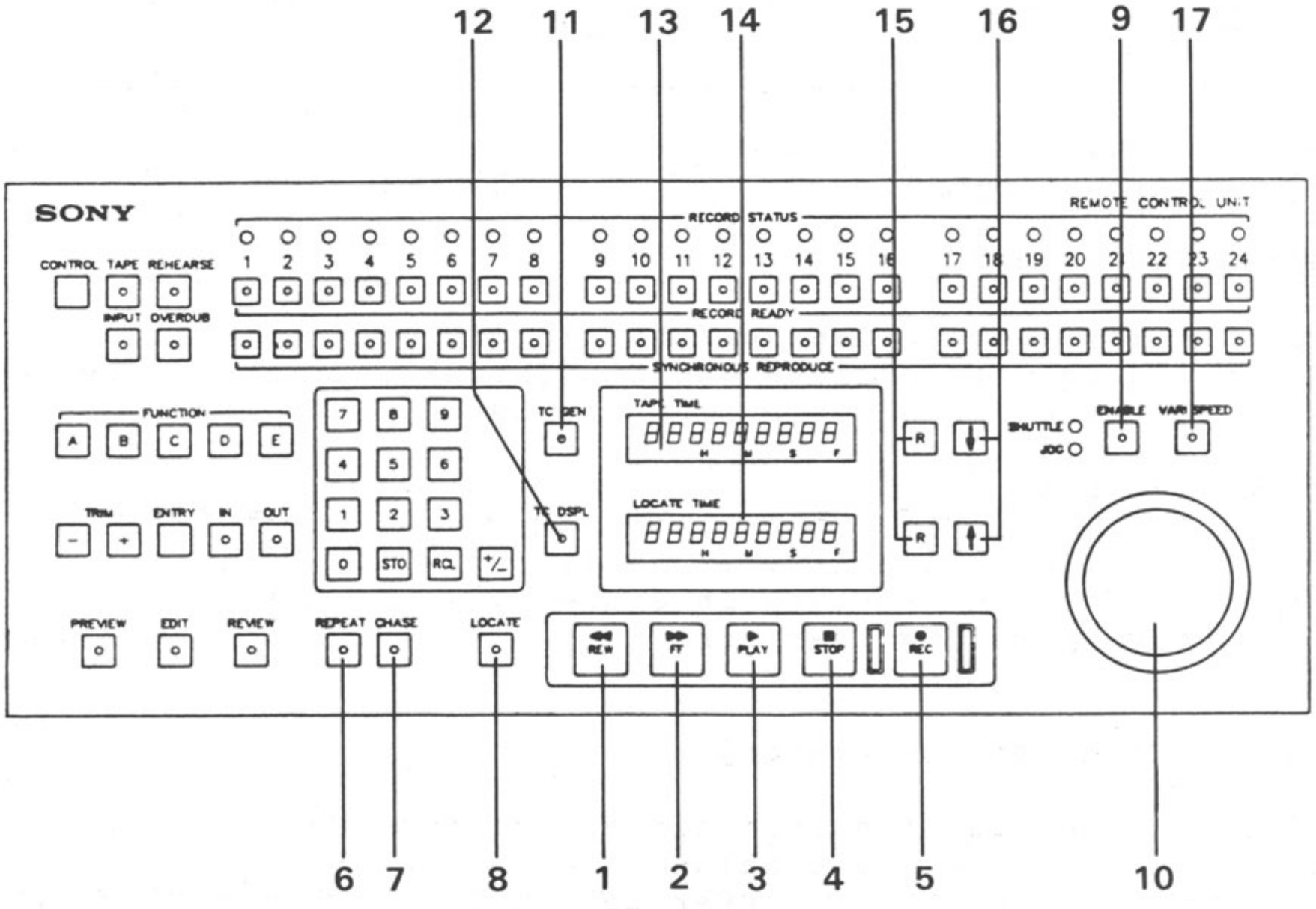


Figure 3-1. Transport Section

1. REW (Rewind)

Pressing this key activates high speed Rewind mode.

2. FF (Fast Forward)

Pressing this key activates high speed Fast Forward mode.

3. PLAY

When this key is pressed, the machine goes into Play mode.

4. STOP

Pressing this key cancels any previous Rewind, Fast Forward, or Play command, and Stops the transport.

5. REC (Record)

The REC key is used to activate Record and Spot Erase modes. Please refer to Section 4.4.2 for further information on the use of this key.

6. REPEAT

This key is used to initiate Repeat mode. Please refer to Section 4.4.1.4 for further information on this feature.

7. CHASE

This key is used to initiate Chase/Lock mode. Please refer to Section 4.5.3.1 for further information on the use of the CHASE key.

8. LOCATE

Pressing this key causes the machine to locate to the time shown in the LOCATE TIME display relative to the time shown in the TAPE TIME display.

9. JOG/SHUTTLE ENABLE

Pressing this key enables the Jog/Shuttle Dial on the Remote Control Unit, and illuminates the appropriate JOG/SHUTTLE LED. It should be noted that it does not enable the Jog/Shuttle Dial on the Local Control Panel.

10. Jog/Shuttle Dial

When the JOG/SHUTTLE ENABLE key is activated, this dial can be used to Rewind or Fast Forward the tape in either Jog or Shuttle mode. Please refer to Section 4.4.1.2 for further information on the use of the Jog/Shuttle Dial.

11. TC GEN (Time Code Generator)

The TC GEN key is used to select either the internal or external Time Code generator reference for the machine. The key indicator has three states, off, flashing, and on. Please refer to Section 4.5.2 for more information on the use of this key.

12. TC DSPL (Time Code Display)

Pressing this key causes the TAPE TIME display to toggle between real tape time (as derived from the Timer Roller pulses), and Time Code indications (either external or tape derived). Please refer to Section 4.5.2 for further information on the use of this key.

13. TAPE TIME Display

The TAPE TIME Display is used to display tape time information, with resolution to the tenth of a second. Resolution to the Time Code frame is available when TC DISPLAY mode is activated.

The significance of the decimal point indications between the Hours (H), Minutes (M), Seconds (S), and Frames (F) digits in the display is discussed in Section 4.2.3.1 and Section 4.5.2.

14. LOCATE TIME Display

The LOCATE TIME Display is used to show locate time values with resolution to the tenth of a second. Resolution to the Time Code frame is available when TC DISPLAY mode is activated.

15. R (Reset, TAPE TIME/LOCATE TIME)

Pressing the TAPE TIME RESET or the LOCATE TIME RESET keys causes the time value in the respective display to reset to zero.

It is important to note that, when the machine is in TC DISPLAY mode, the TAPE TIME Display cannot be Reset unless one channel has been assigned as the Time Code track, and that channel is in Record Ready mode.

16. ↑ and ↓ (Transfer Up/Transfer Down Arrows)

Pressing the TRANSFER UP arrow key transfers the contents of the LOCATE TIME Display into the TAPE TIME Display, while pressing the TRANSFER DOWN key transfers the contents of the TAPE TIME Display into the LOCATE TIME Display.

It is important to note that when the machine is in TC DISPLAY mode, the contents of the LOCATE TIME Display cannot be transferred to the TAPE TIME Display unless one channel has been assigned as the Time Code track, and that channel is in Record Ready mode.

17. VARI SPEED

The VARI SPEED key allows the nominal play speed of the machine to be varied by +/- 50%. The key indicator has three states, off, flashing and on, each of these indicating a different Vari Speed status. Please refer to Section 4.4.1.3 for complete Vari Speed operational information.

3.2.2 Numeric Keypad Section

The Numeric Keypad on the Remote Control Unit, as shown in Figure 3-2, is used to make numeric entries into the LOCATE TIME display, and to Store and Recall information contained within the Memory Locations. FUNCTION Keys A

through E are used in conjunction with Memory Locations 70 through 74.

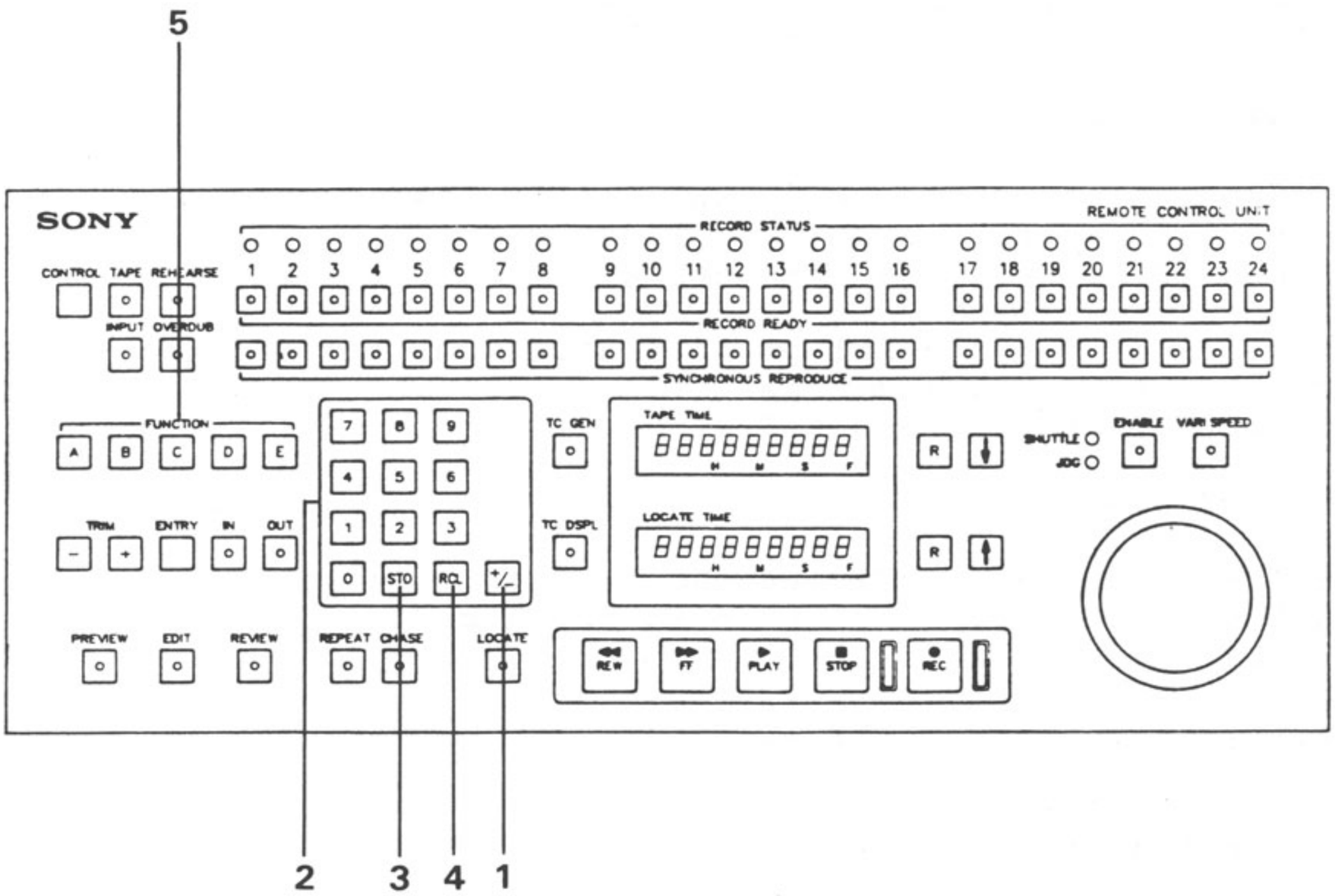


Figure 3-2. Numeric Keypad Section

1. +/- (Plus/Minus)

Pressing the +/- key toggles the sign of the time value in the LOCATE TIME display.

2. 0 through 9

The numeric keys 0 through 9 provide a means of entering specific time values into the LOCATE TIME display for locating and Memory Location addressing purposes. Please refer to Section 4.3. for further information regarding the Memory Locations.

3. STO (Store)

The STO key is used to Store data into the various Memory Locations. Refer to Section 4.3.2 for information of the use of this key.

4. RCL (Recall)

The RCL key is used to Recall data from the various Memory Locations. Refer to Section 4.3.2 for information on the use of this key.

5. FUNCTION Keys A through E

FUNCTION keys A through E provide a means of recalling the user-defined Memory Locations 70 through 74. Refer to Section 4.3.4 for further information on the use of the FUNCTION keys and these Memory Locations.

3.2.3 Channel Status Section

The Channel Status section of the Remote Control Unit, as shown in Figure 3-3, is used to indicate the individual channel Monitor and Record status of the machine. Table 3-1 lists the corresponding channel status for each monitor mode.

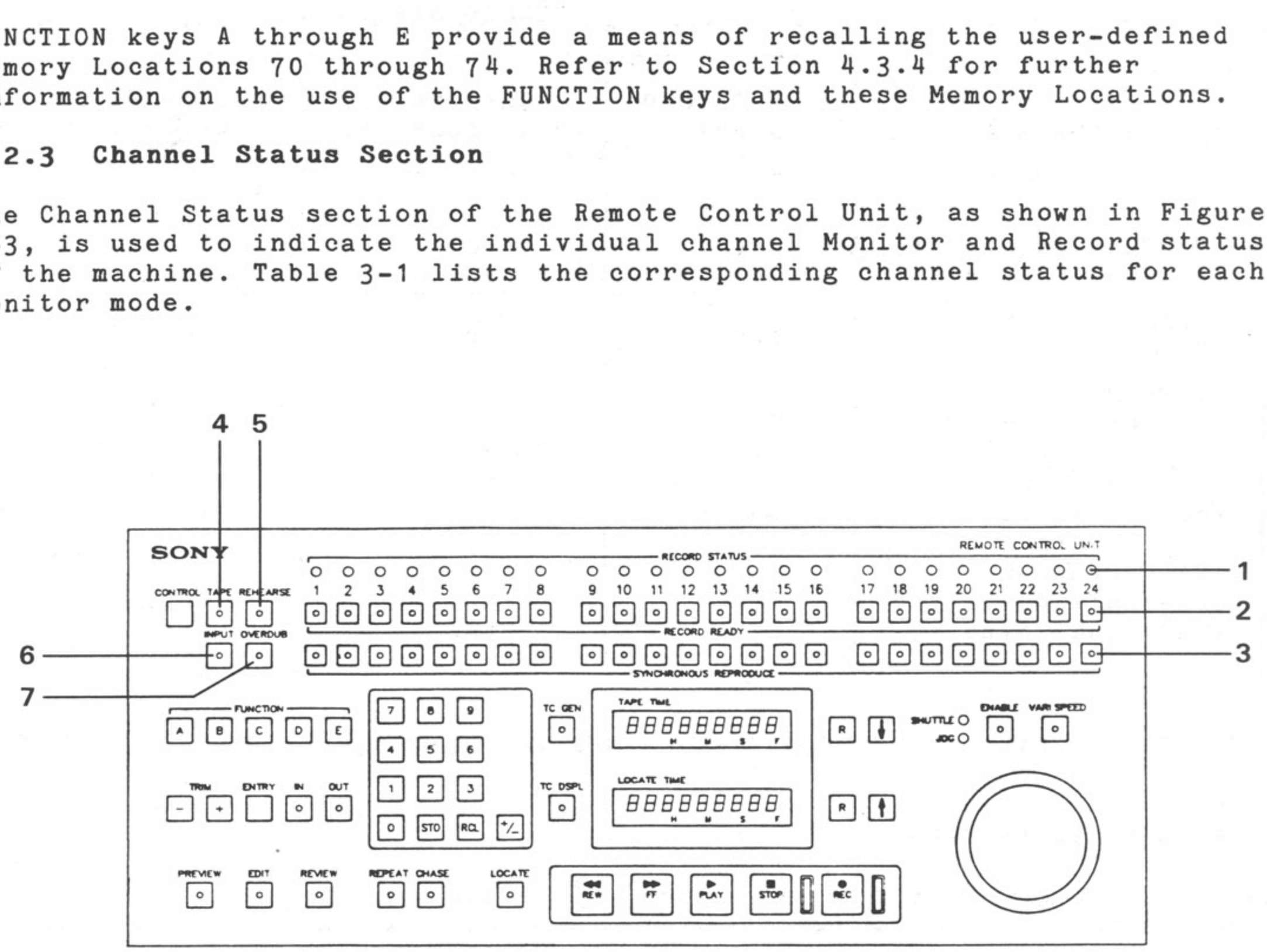


Figure 3-3. Channel Status Section

MONITOR MODE	RECORD STATUS: NON-RECORD READY	RECORD READY, NON-RECORDING	RECORD READY, RECORDING
TAPE			
Non-Individual Sync	Repro	Repro	Repro
Individual Sync	Sync	Sync	Input
INPUT	Input	Input	Input
OVERDUB			
Non-Individual Sync			
Play Modes	Sync	Sync	Input
Non-Play Modes	Sync	Input	N/A
Individual Sync	Sync	Sync	Input
INPUT/OVERDUB			
Non-Individual Sync	Sync	Input	Input
Individual Sync	Sync	Sync	Input

Table 3-1. Record Status/Monitor Mode Relationship

1. RECORD STATUS LEDs

The red LED above each channel number will illuminate when that channel is in Record mode.

2. RECORD READY Keys

These keys are used to individually place each channel into Record Ready mode. When a channel is in Record Ready, that channel will go into Record when the RECORD key is pressed simultaneously with the PLAY key, and will go into Erase when SPOT ERASE mode is activated. Refer to Section 4.4.2 for information on the use of these keys in Record and Spot Erase operations.

3. SYNCHRONOUS REPRODUCE Keys

The SYNCHRONOUS REPRODUCE keys are used to set individual channels into Sync mode. These channels will then monitor the Sync head during Playback, and monitor Input during Record.

4. TAPE

Pressing this key selects Repro mode for all 24 channels. During Playback and Record, the output of all 24 channels will monitor the Repro head, except for those channels which have been individually selected to be in Sync mode through the use of the SYNCHRONOUS REPRODUCE keys.

5. REHEARSE

When this key is pressed, all Record operations for all channels will be prohibited, and the key indicator will flash. The key indicator will also flash automatically whenever Preview or Review modes are selected.

6. INPUT

Pressing this key selects Input mode for all 24 channels. During Playback and Record, the output will always monitor the Input, regardless of whether or not any channels have been individually selected to be in Sync mode through the use of the SYNCHRONOUS REPRODUCE keys.

7. OVERDUB

Pressing this key selects Sync mode for all 24 channels. During Playback, the output will monitor the Sync head for all 24 channels. During Record, those channels in Record will monitor the Input, while those channels which are not in Record will monitor the Sync head.

In Stop, Rewind, or Fast Forward modes, the output will monitor the Input, except for those channels individually selected by the SYNCHRONOUS REPRODUCE keys, which will monitor the Sync head.

8. INPUT/OVERDUB

When the INPUT and OVERDUB keys are pressed simultaneously, Input/Overdub mode is selected, illuminating both key indicators. The output will always monitor the Input of those channels in Record Ready, and all non-Record Ready channels will monitor the Sync head.

Channels which are individually selected for Synchronous Reproduce override this global monitor mode, since these channels will always monitor the Sync head except during Record.

3.2.4 Editing Section

Figure 3-4 shows the Editing section of the Remote Control Unit, which is used to program and execute the SMPTE-based insert/editing management operations of the machine. Refer to Section 4.6 for detailed information on all of the editing operations of the machine.

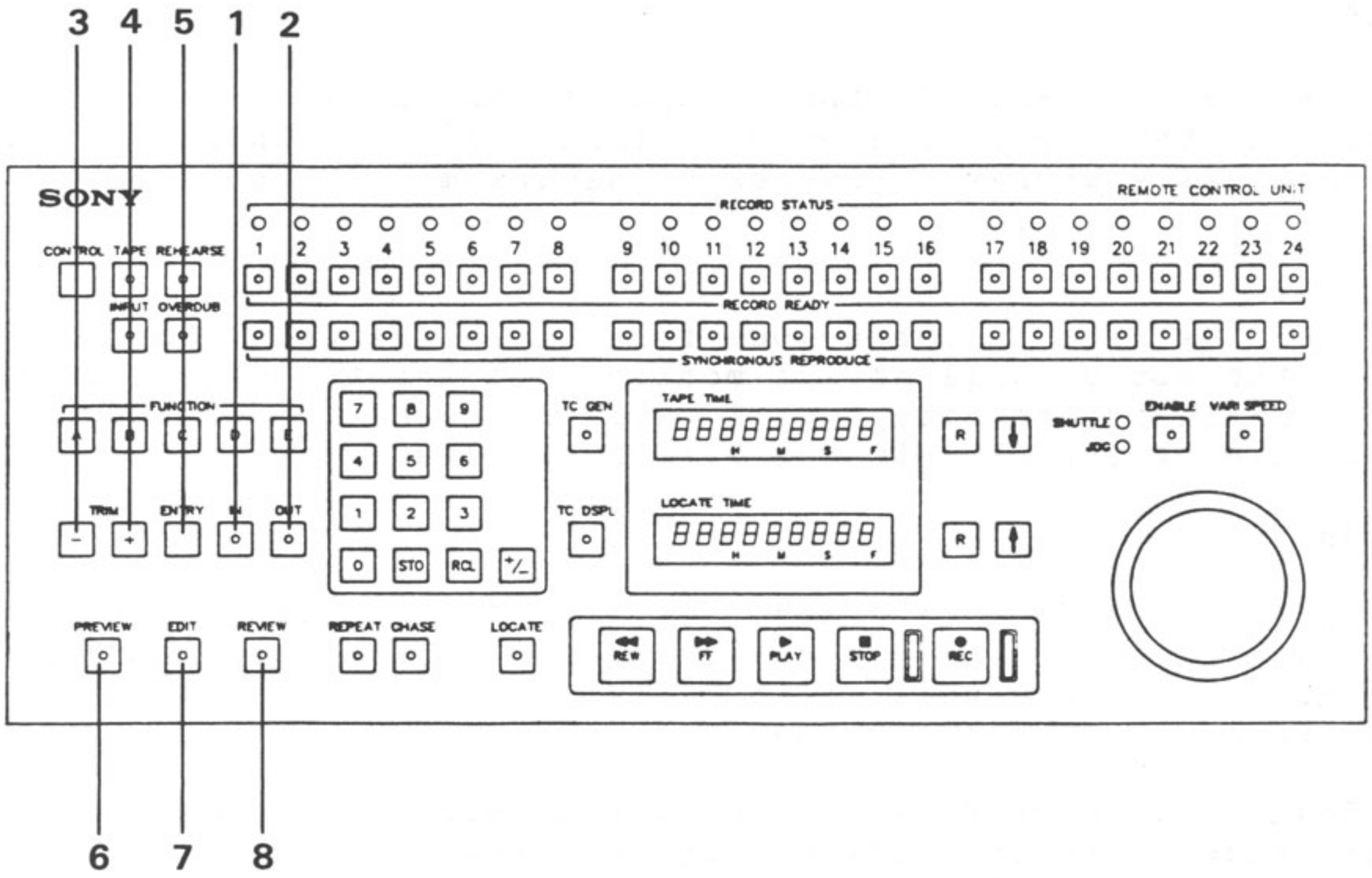


Figure 3-4. Editing Section

1. IN

This key is used to set the Edit In Point of a Programmed Edit, and when pressed will display the current Edit In Point, as stored in Memory Location 01, in the LOCATE TIME Display.

2. OUT

This key is used to set the Edit Out Point of a Programmed Edit, and when pressed will display the current Edit Out Point, as stored in Memory Location 02, in the LOCATE TIME Display.

3. TRIM -

This key decrements the frame units of the Edit In and Out Points of a Programmed Edit. The appropriate IN or OUT key must be held down while using this key.

4. TRIM +

This key increments the frame units of the Edit In and Out Points of a Programmed Edit. The appropriate IN or OUT key must be held down while using this key.

5. ENTRY

Holding down the ENTRY key and pressing the IN key will cause the current time in the TAPE TIME Display to be stored into Memory Location 01, Edit In

Point. Holding down the ENTRY key and pressing the OUT key causes the current time in the TAPE TIME Display to be stored into Memory Location 02, Edit Out Point.

This key is useful for storing Edit In and Out Points while the tape is rolling.

6. PREVIEW

This key is used to activate Preview mode, whereby a Programmed Edit may be rehearsed without the machine entering Record mode.

7. EDIT

This key is used to activate Edit mode. When this mode is selected, the machine is ready to execute a Programmed Edit.

8. REVIEW

Review mode is activated when this key is pressed, and the previously executed Programmed Edit may be played back to monitor the results.

3.3 LOCAL CONTROL PANEL

The Local Control Panel, as shown in Figure 3-5, incorporates all of the rudimentary transport function keys. Most of the keys on the Local Control Panel can also be found on the Remote Control Unit.

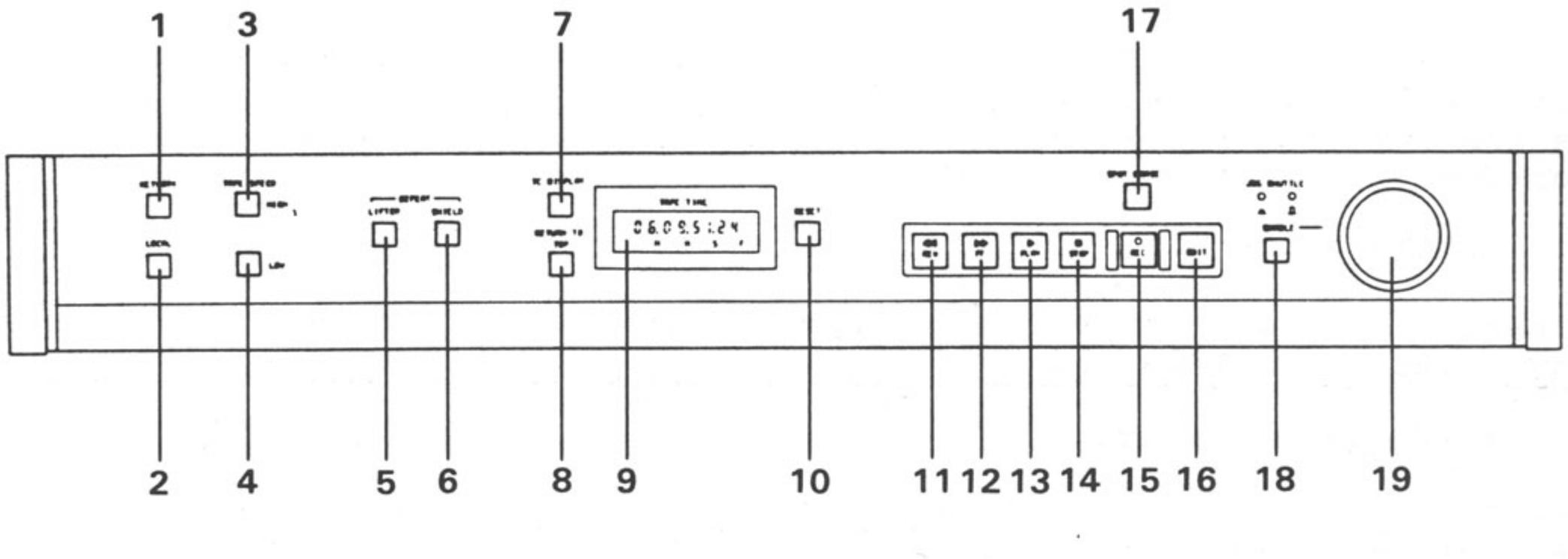


Figure 3-5. Local Control Panel

1. NETWORK

When the NETWORK key is selected, all transport and audio control is derived from the Serial Network, and LOCAL control is effectively disabled. Please refer to Section 4.2.3.2 for further information on the use of this key.

2. LOCAL

When the LOCAL key is selected, all transport and audio control is derived

internally from the machine and the parallel Remote Control Unit, and NETWORK control is effectively disabled. Please refer to Section 4.2.3.2 for further information on the use of this key.

3. TAPE SPEED HIGH

Pressing the HIGH TAPE SPEED key selects the nominal play speed of 30 ips.

4. TAPE SPEED LOW

Pressing the LOW TAPE SPEED key selects the nominal play speed of 15 ips.

5. LIFTER DEFEAT

During Rewind and Fast Forward high speed wind modes, the lifters normally move forward automatically to lift the tape off the heads, thereby preventing excessive wear of the heads.

Pressing the LIFTER DEFEAT key causes the lifters to retract during high speed wind modes, thereby permitting the tape to ride across the heads.

6. SHIELD DEFEAT

Pressing the SHIELD DEFEAT key causes the shields to descend. The shields are normally raised automatically to protect the heads from radio frequency (RF) interference and physical damage.

7. TC DISPLAY

Pressing this key causes the TAPE TIME Display to toggle between real tape time (as derived from the Timer Roller pulses), and Time Code indications (either external or tape derived). Please refer to Section 4.5.2 for further information on the use of this key.

8. RETURN TO TOP

Pressing this key causes the machine to locate to the most recent point at which the machine was put into Play.

9. TAPE TIME Display

The TAPE TIME Display is used to display tape time information, with resolution to the tenth of a second. Resolution to the Time Code frame is available when TC DISPLAY mode is activated.

The significance of the the Frames (F) decimal point indication in this display is described in Section 4.2.3.1.

10. RESET

Pressing the RESET key causes the time value in the TAPE TIME display to reset to zero.

It is important to note that when the machine is in TC DISPLAY mode, the TAPE TIME Display cannot be Reset unless one channel has been assigned as the Time Code track, and that channel is in Record Ready mode.

11. REW (Rewind)

Pressing this key activates high speed Rewind mode.

12. FF (Fast Forward)

Pressing this key activates high speed Fast Forward mode.

13. PLAY

When this key is pressed, the machine goes into Play mode.

14. STOP

Pressing this key cancels any previous Rewind, Fast Forward, or Play command, and Stops the transport.

15. REC (Record)

The REC key is used to activate Record and Spot Erase modes. Please refer to Section 4.4.2 for further information on the use of this key.

16. EDIT

When the EDIT key is pressed, the reel tensions become relaxed, thereby allowing the tape to be removed from the tape path for editing, cutting, etc. Pressing the STOP key restores the reel tensions.

When Edit mode is selected, pressing the PLAY key causes the machine to enter Dump Edit mode, whereby the tape is played across the heads and dumped off the right side of the machine. Pressing the STOP key cancels Dump Edit mode.

17. SPOT ERASE

When the SPOT ERASE key is selected, Spot Erase mode becomes armed, providing that there is at least one channel in Record Ready mode. Please refer to Section 4.4.2.2 for further information on SPOT ERASE mode.

18. JOG/SHUTTLE ENABLE

Pressing this key enables the Jog/Shuttle Dial on the Local Control Panel. It should be noted that it does not enable the Jog/Shuttle Dial on the Remote Control Unit.

19. Jog/Shuttle Dial

When the JOG/SHUTTLE ENABLE key is activated, this dial can be used to Rewind or Fast Forward the tape in either Jog or Shuttle mode. Please refer to Section 4.4.1.2 for further information on the use of the Jog/Shuttle Dial.

3.4 METER HOUSING

The Meter Housing, as shown in Figure 3-6, incorporates all of the status indicators necessary to monitor the Playback and Record operations of the machine.

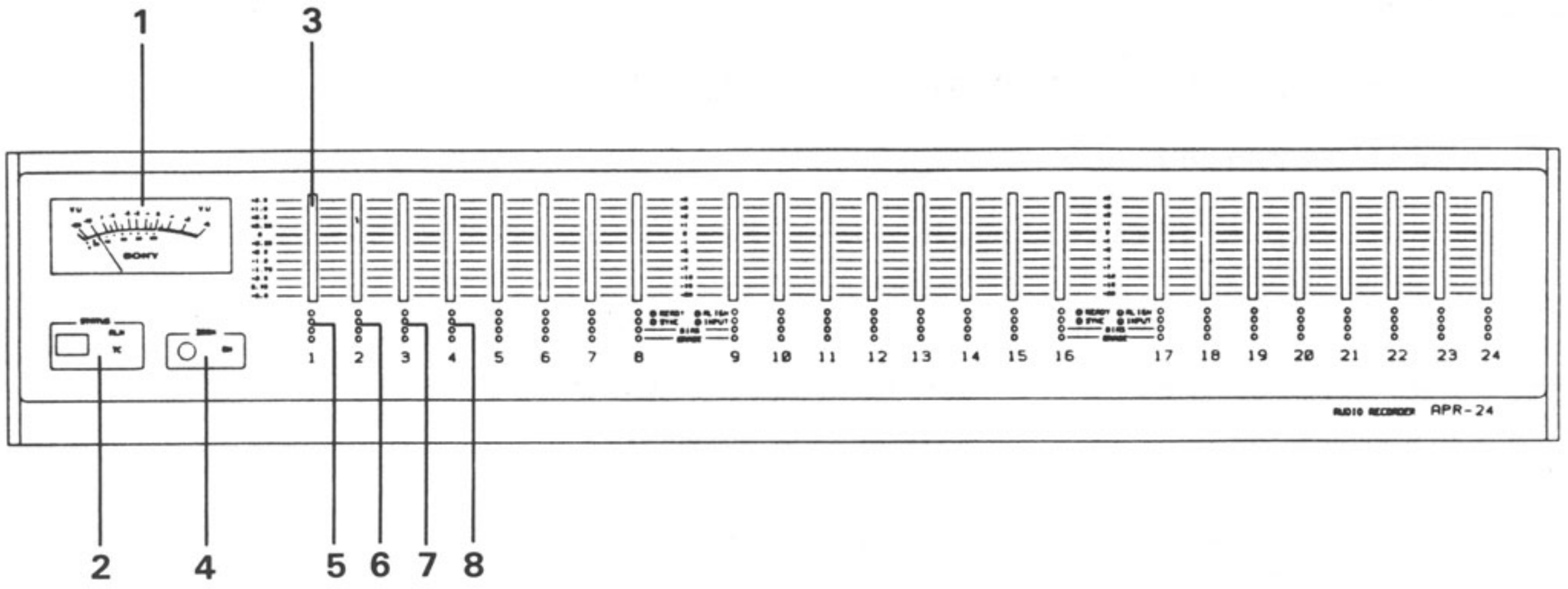


Figure 3-6. Meter Housing

1. VU Meter

The VU Meter displays the signal level of a channel, as chosen from the ALN Panel. The meter has a range of -20dB to +3dB, and is factory aligned so that 0 VU is equal to +4dB.

2. ALN STATUS Display

The STATUS Display includes two seven-segment displays, and two backlighted labels for ALN and TC status.

During alignment operations, the number of the selected channel is shown in the display, and the ALN label becomes illuminated. When a channel has been assigned as the Time Code track, the TC label becomes illuminated when the channel is selected, and the channel number is shown in the display.

3. Bar Graph Displays

Each of the 24 channels has a twelve-segment bar graph display for individual channel monitoring. The bottom green LEDs are for scale readings up to and below 0dB, while the upper red LEDs are for scale readings above 0dB.

4. ZOOM

Pressing the ZOOM pushbutton illuminates the ZOOM ON lettering, enhances the sensitivity of the bar graphs from -20dB/+6dB to -5dB/+2.5dB, and illuminates the -5dB/+2.5dB bar graph scale lettering.

5. ERASE LEDs

The red ERASE LED above each channel number will illuminate when that channel is in Record or Spot Erase mode.

6. BIAS LEDs

The red BIAS LED above each channel number will illuminate when that channel is in Record mode.

7. SYNC/INPUT LEDs

The green SYNC/INPUT LED for each channel will illuminate solidly when that channel is in Sync mode, and will flash when the channel is in Input mode.

8. READY/ALIGN LEDs

The amber READY/ALIGN LED for each channel will illuminate solidly when that channel is in Record Ready mode, will flash with a short "off" cycle when the channel is in Alignment mode, and will flash with a longer "off" cycle when the channel is in both Record Ready and Alignment mode.

3.5 ALN (ALIGNMENT) PANEL

This section defines the controls and indicators on the ALN (Alignment) Panel. The panel is divided into eight sections, these being STATUS Display, TRACK Selection, Parameter Selection, CALIBRATION Selection, EQ STD (Equalisation Standard) Selection, PRESET Storage Locations, Tape SPEED Selection, and Secondary Parameter Selection.

3.5.1 STATUS Display

As shown in Figure 3-7, the STATUS Display contains two seven-segment displays which are used to indicate track selection, hexadecimal values of chosen parameters, and Preset Error code "EP". Please refer to Section 4.2.3.4 for further information on Preset Error code "EP".

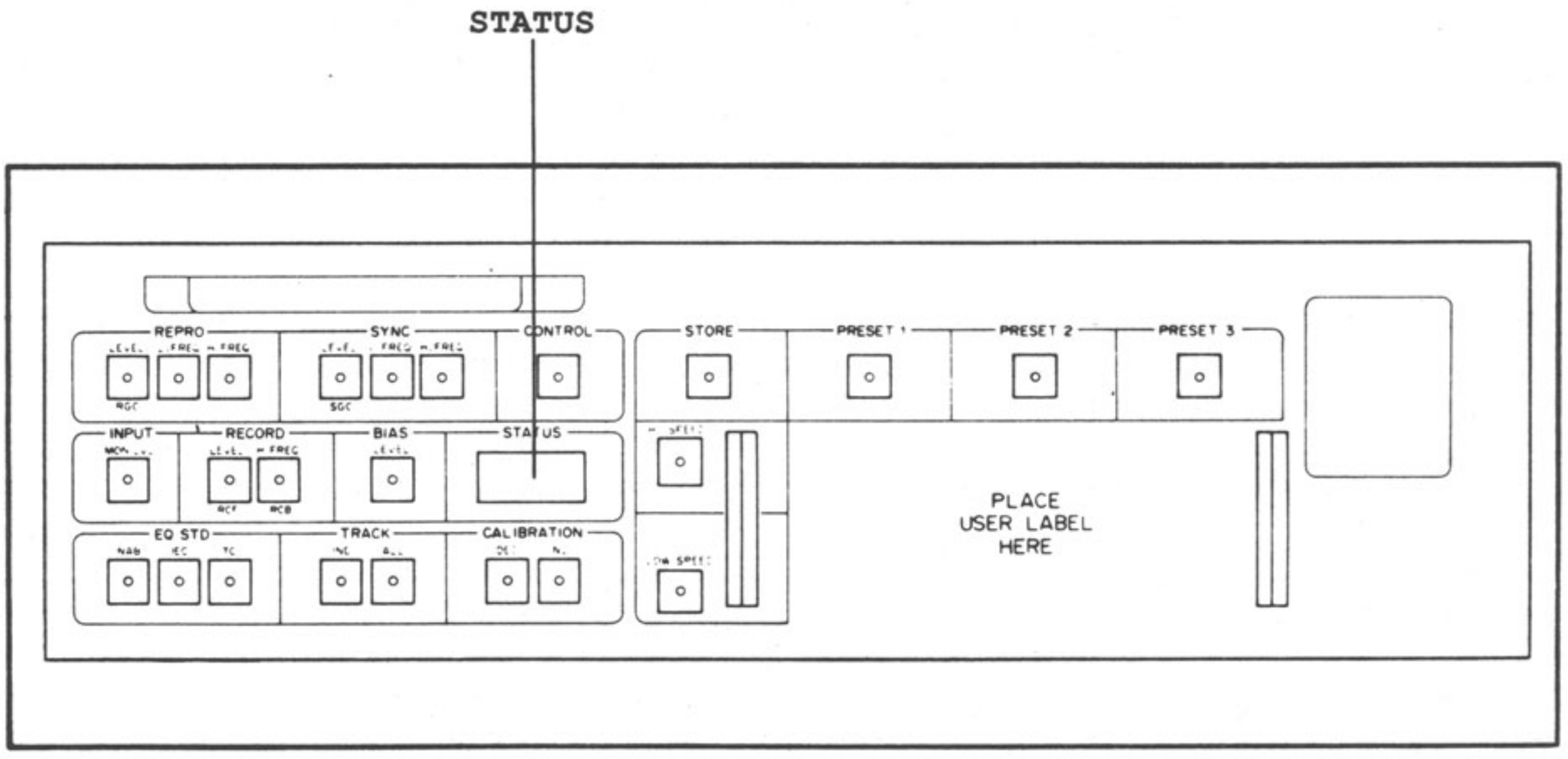


Figure 3-7. Status Display

3.5.2 TRACK Selection

The IND (Individual) and ALL keys shown in Figure 3-8 are used to address individual and global channels for calibration of their chosen parameters.

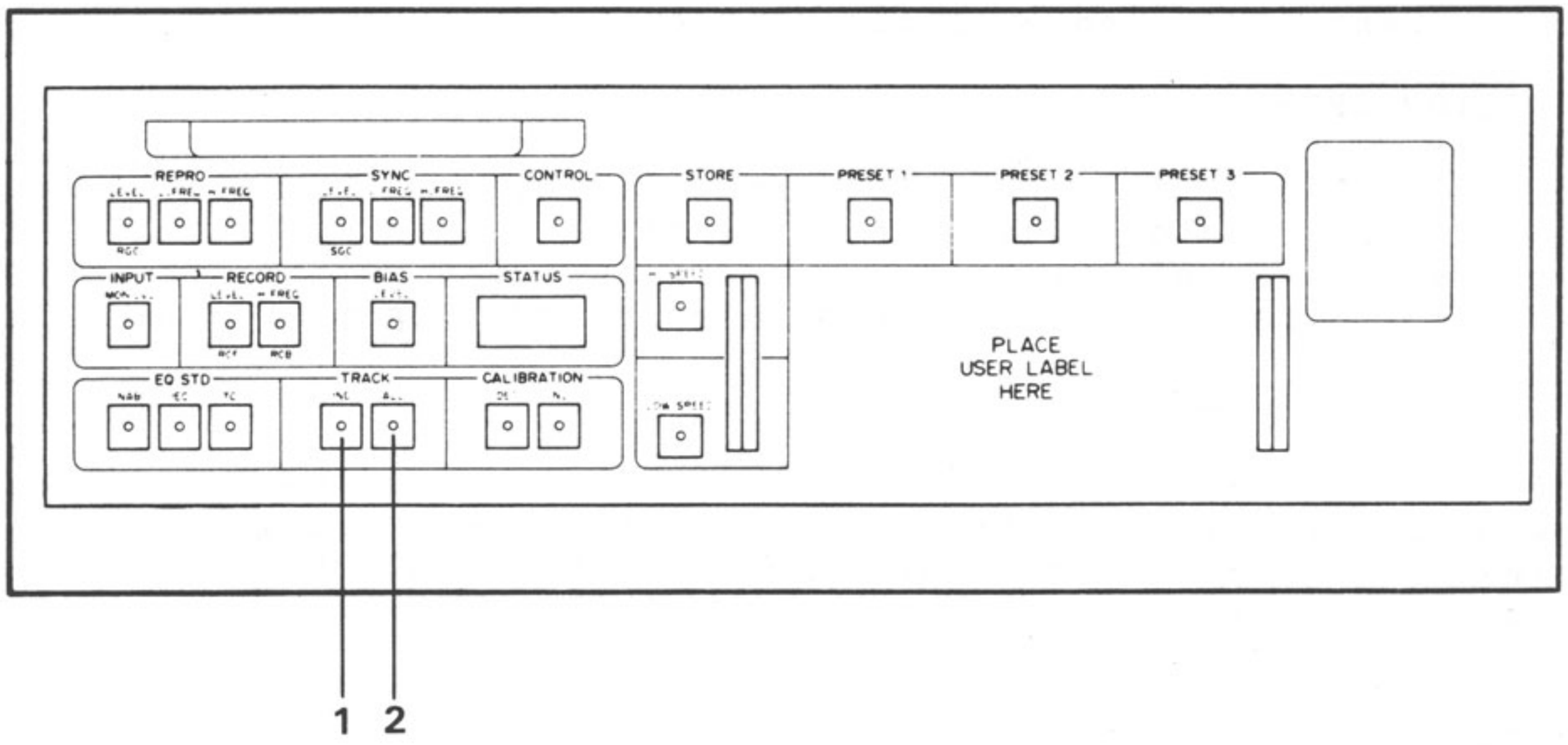


Figure 3-8. TRACK Selection

1. IND (Individual)

Pressing the IND key selects the individual tracks for monitoring or calibration. Each time the key is pressed, track selection is advanced to the next track, beginning with track one, and the number of the selected track is indicated in the STATUS Display on the ALN Panel and in the Meter Housing STATUS Display. Holding down the CONTROL key while pressing the IND key selects the tracks in reverse order.

2. ALL

Pressing the ALL key selects Global mode (the sum of all 24 tracks) for monitoring or calibration. When selected, the word ALL will appear in the STATUS Display on the ALN panel and in the Meter Housing STATUS Display.

3.5.3 Parameter Selection

Once an individual track or Global (ALL) mode has been selected, ten keys are provided for calibration of the Repro, Sync, Input, Record and Bias parameters, as shown in Figure 3-9. The levels of these parameters are represented in hexadecimal form when they appear in the ALN Status Display. The level is then adjusted electronically by incrementing or decrementing the hexadecimal value. Complete audio system alignment procedures for all of the parameters can be found in Section 7.5.

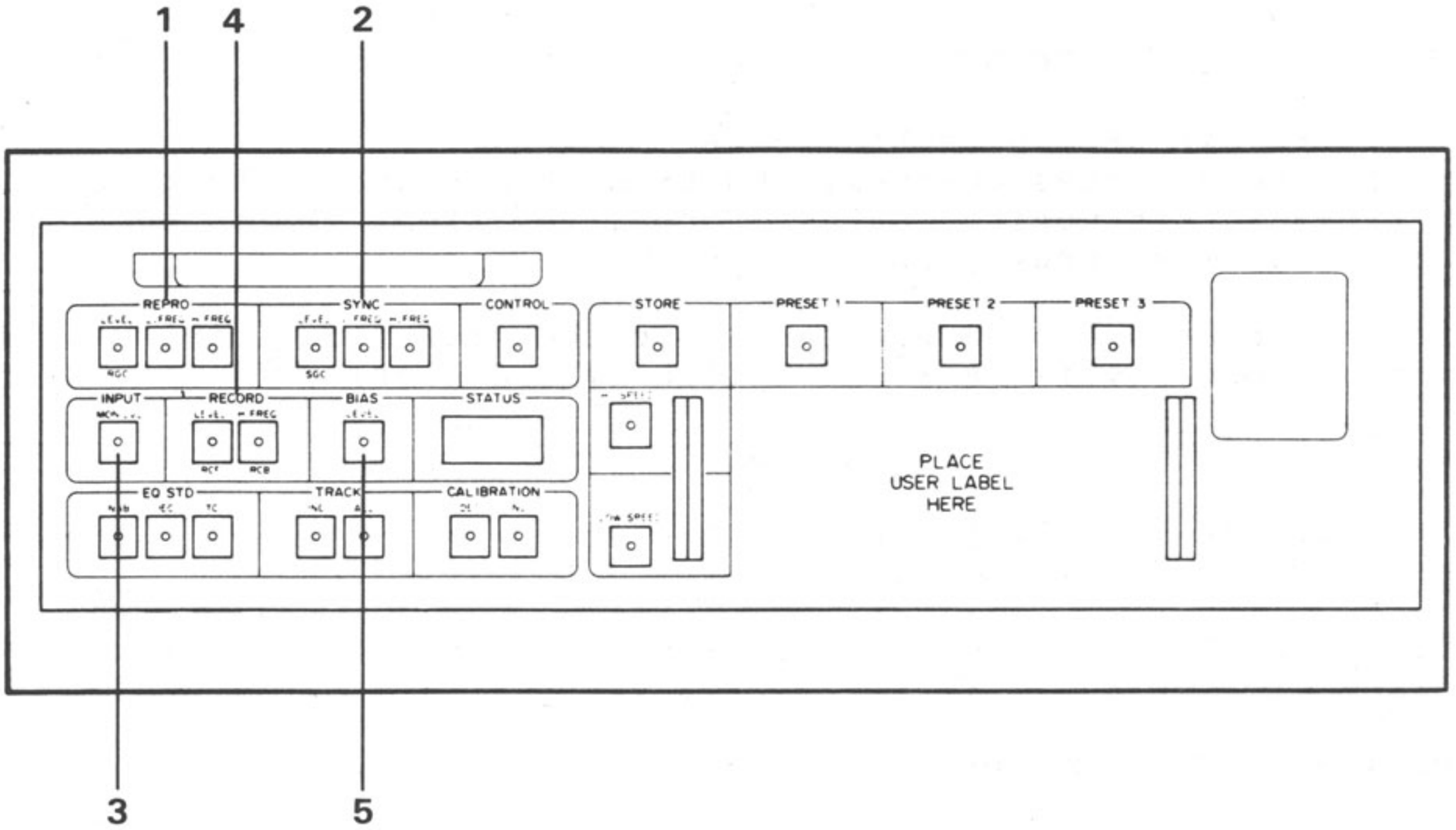


Figure 3-9. Parameter Selection

1. REPRO (LEVEL, L. FREQ, and H. FREQ)

The three keys in the REPRO section select the reproduce circuitry of the selected channel for calibration. The LEVEL key selects the overall gain control of the Repro monitor output for calibration, the L. FREQ key selects the low frequency equalisation, and the H. FREQ key selects the high frequency equalisation.

Once a track and Repro parameter are selected, the hexadecimal value of the chosen parameter will appear in the STATUS Display.

2. SYNC (LEVEL, L. FREQ, and H. FREQ)

The three keys in the SYNC section select the sync (cue) circuitry of the selected channel for calibration. The LEVEL key selects the overall gain control of the Sync monitor output for calibration, the L. FREQ key selects the low frequency equalisation, and the H. FREQ key selects the high frequency equalisation.

Once a track and Sync parameter are selected, the hexadecimal value of the chosen parameter will appear in the STATUS Display.

3. INPUT (MON LVL)

The INPUT MON LVL key selects the overall gain control of the Input monitor output of the selected channel for calibration.

Once a track and Input are selected, the hexadecimal Input value of the chosen track will be shown in the STATUS Display.

4. RECORD (LEVEL, H. FREQ)

The two keys in the RECORD section select the calibration to the Record circuitry of the selected channel. The LEVEL key selects the overall gain control of the Record monitor output for calibration, while the H. FREQ key selects the high frequency gain.

Once a track and Record parameter are selected, the hexadecimal value of the chosen parameter will be shown in the STATUS Display.

5. BIAS (LEVEL)

The BIAS LEVEL key selects the amplitude control of the bias signal of the selected channel for calibration.

Once a track and Bias are selected, the hexadecimal Bias value of the chosen track will be shown in the STATUS Display.

3.5.4 CALIBRATION Selection

Figure 3-10 shows the two keys in the CALIBRATION section which are used to either increment or decrement the hexadecimal value of the parameter currently displayed in the ALN STATUS Display. Incrementing the value will increase the signal level of the parameter and decrementing will decrease the level, except in the case of the REPRO L. FREQ, SYNC L. FREQ, and RECORD H. FREQ parameters where the DEC key actually increments these hexadecimal values and the INC key decrements them.

For information on how to use the Jog/Shuttle Dial for hexadecimal value adjustment, please refer to Section 7.5.

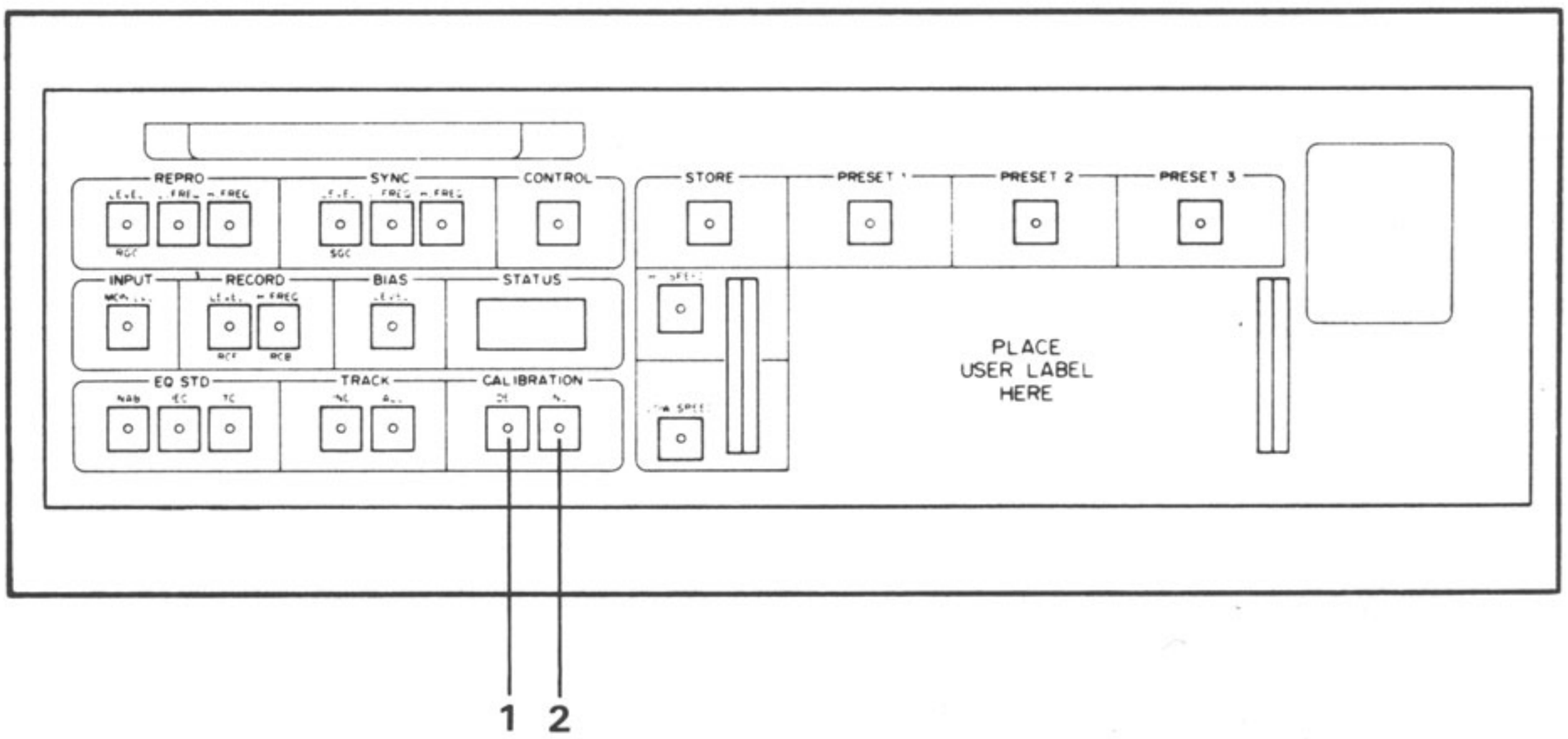


Figure 3-10. CALIBRATION Selection

1. DEC (Decrement)

Pressing the DEC key causes the hexadecimal value of a chosen parameter to slowly decrement towards 00. Pressing the key again halts decrementation. Rapid decrementation can be accomplished by holding down the CONTROL key while decrementing.

2. INC (Increment)

Pressing the INC key causes the hexadecimal value of a chosen parameter to slowly increment towards FF. Pressing the key again halts incrementation. Rapid incrementation can be accomplished by holding down the CONTROL key while incrementing.

3.5.5 EQ STD (Equalisation Standard) Selection

The EQ STD (Equalisation Standard) section is shown in Figure 3-11. Selection of NAB and IEC equalisation standards is provided, along with TC track assignment.

The IEC and NAB key indicators will illuminate to show which standard is currently selected for the chosen speed. The machine is factory aligned with IEC selected for 30 ips, and NAB for 15 ips. Please refer to Section 7.5.5 for information on how to change the selected standard.

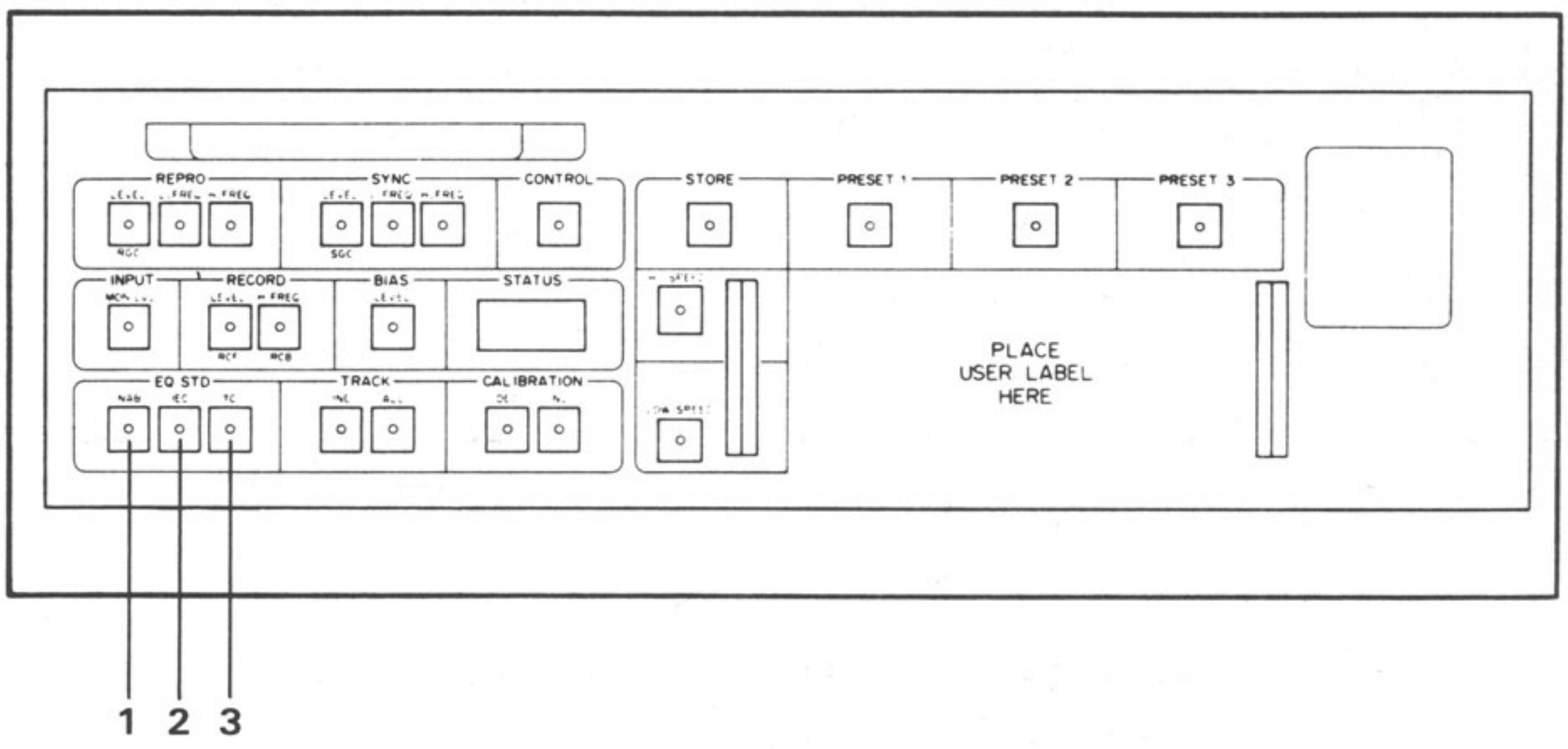


Figure 3-11. EQ STD Selection

1. NAB

When this key is illuminated, the NAB equalisation standard is selected. It should be noted that this standard cannot be selected for 30 ips operation, since NAB does not have a standard for 30 ips.

2. IEC

When this key is illuminated, the IEC equalisation standard is selected.

3. TC

The TC key can be used to assign a channel as the Time Code track. It should be noted that the indicator on the TC key is non-functional. Refer to Section 4.5.2.1 for further information on how to use this key.

3.5.6 PRESET Storage Locations

The PRESET Storage controls are shown in Figure 3-12. One set of parameters can be stored into each PRESET Storage Location for each of the two speeds. Please refer to Section 4.4.2.6 or Section 7.5.1 for further information on this feature.

It is important to note that the hexadecimal parameter values must be stored into one of the PRESET Storage Locations before switching speeds or powering the machine down, otherwise those values will not be retained.

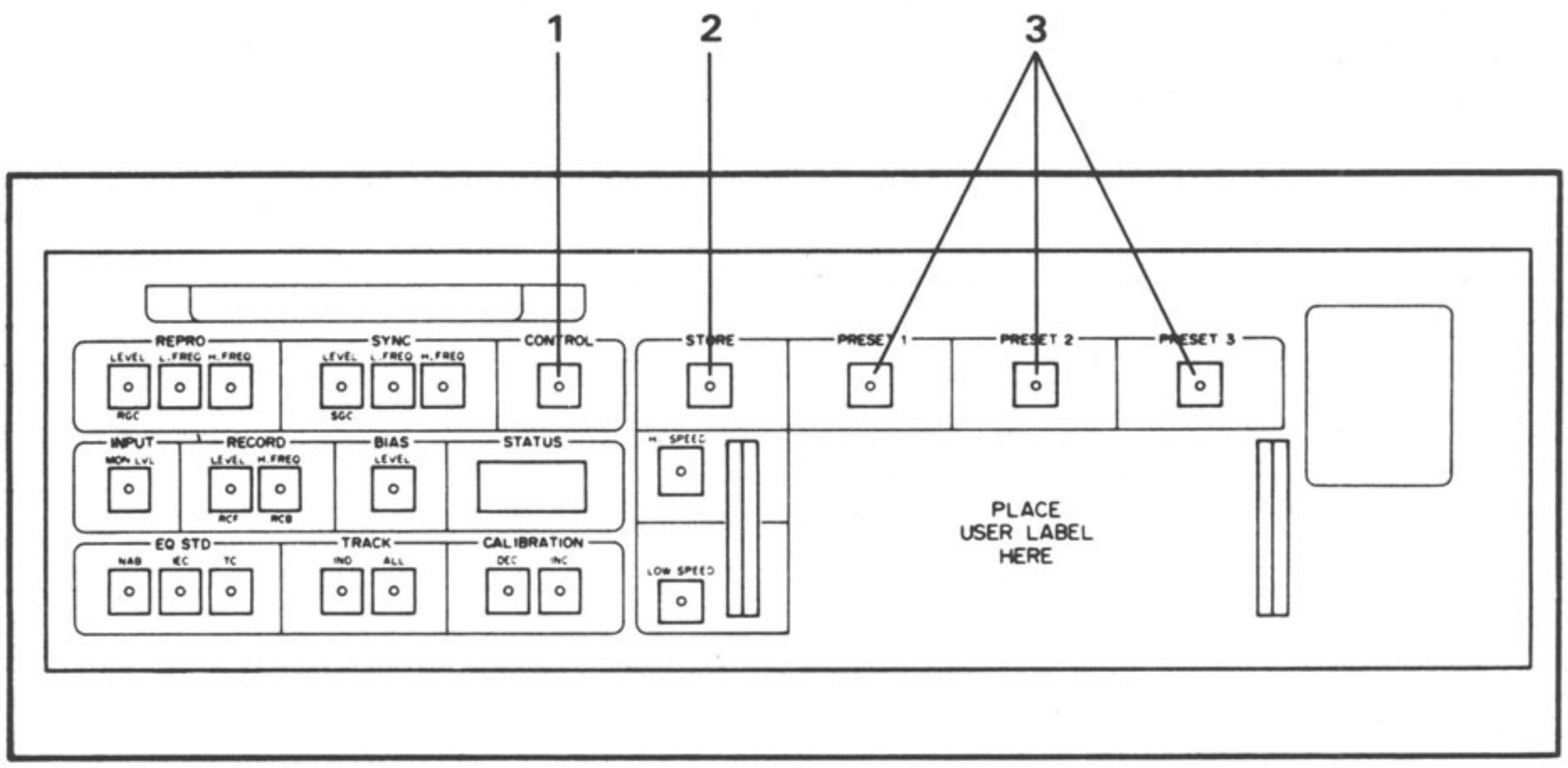


Figure 3-12. PRESET Storage Controls

1. CONTROL

This key is used in conjunction with the STORE and PRESET keys to store parameters into one of the three PRESET Storage Locations. Pressing this key arms the STORE key for storage.

The CONTROL key is also used to speed up the increment and decrement process of the audio alignment procedure (as described in Section 3.5.4), and in gaining access to the Secondary Parameters (as described in Section 3.5.8 and Section 7.5.6).

2. STORE

Once armed by the CONTROL key, the STORE key is used to store the parameters into a chosen PRESET Storage Location.

3. PRESET (1, 2, and 3)

Pressing any of these three PRESET keys recalls the hexadecimal parameter values previously stored in that location. The PRESET key indicator will remain illuminated until the value of any of the parameters is changed or another PRESET Storage Location is selected.

When the machine is initially powered up, the last chosen PRESET Storage Location will be recalled, and its key indicator will be illuminated.

3.5.7 Tape SPEED Selection

The two keys shown in Figure 3-13 are used to select the nominal play speed of the machine.

1. HI SPEED

Pressing the HI SPEED key selects the nominal play speed of 30 ips.

2. LOW SPEED

Pressing the LOW SPEED key selects the nominal play speed of 15 ips.

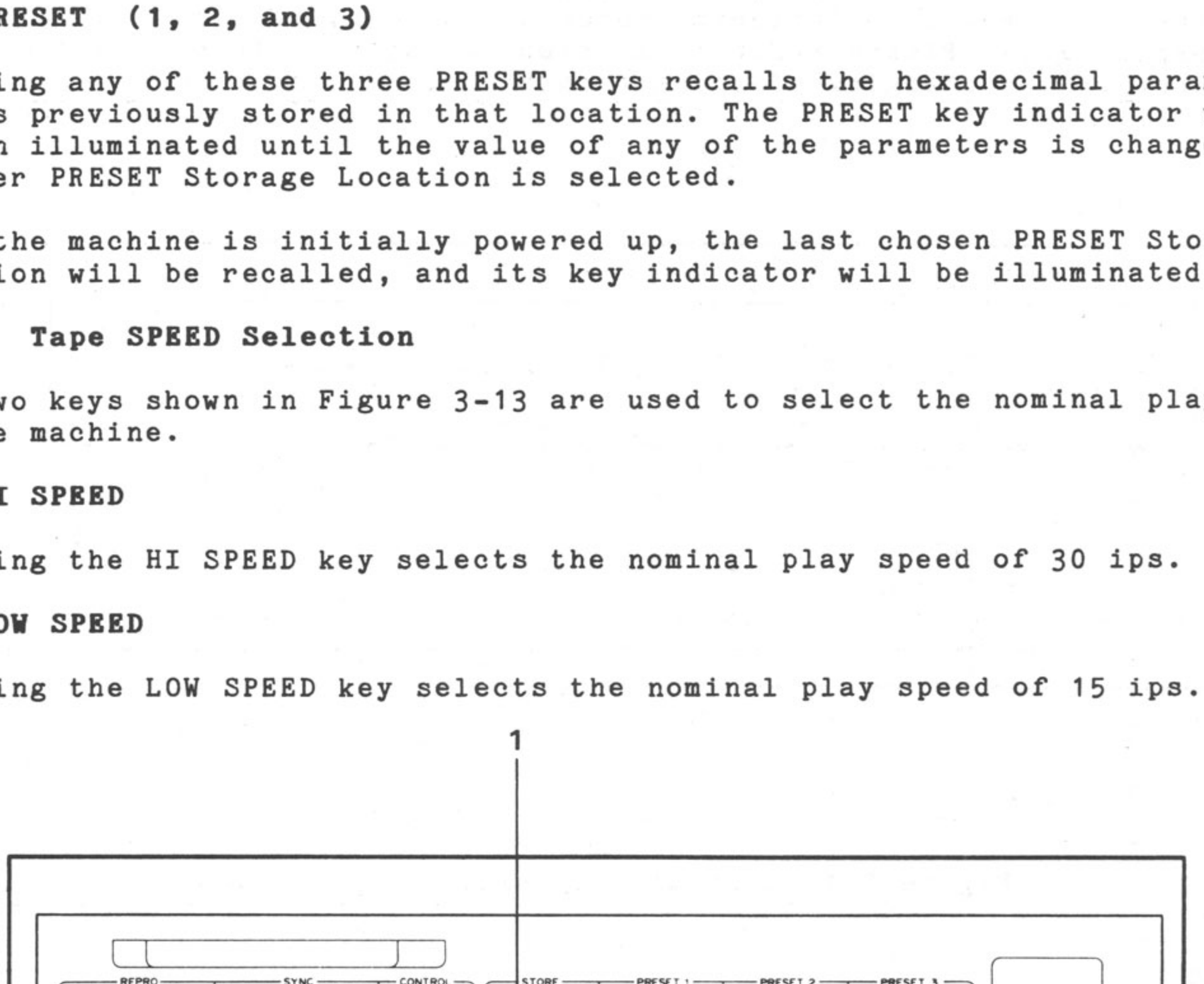


Figure 3-13. SPEED Selection

3.5.8 Secondary Parameter Selection

As shown in Figure 3-14, the REPRO LEVEL, SYNC LEVEL, RECORD LEVEL, and RECORD H. FREQ keys are also used in conjunction with the ALL and CONTROL keys to select and store secondary compensation parameters. These parameters are marked in lettering beneath the keys, RGC, SGC, RCF, and RCB, respectively. Please refer to Section 7.5.6 for information regarding the operation and changing of these parameters.

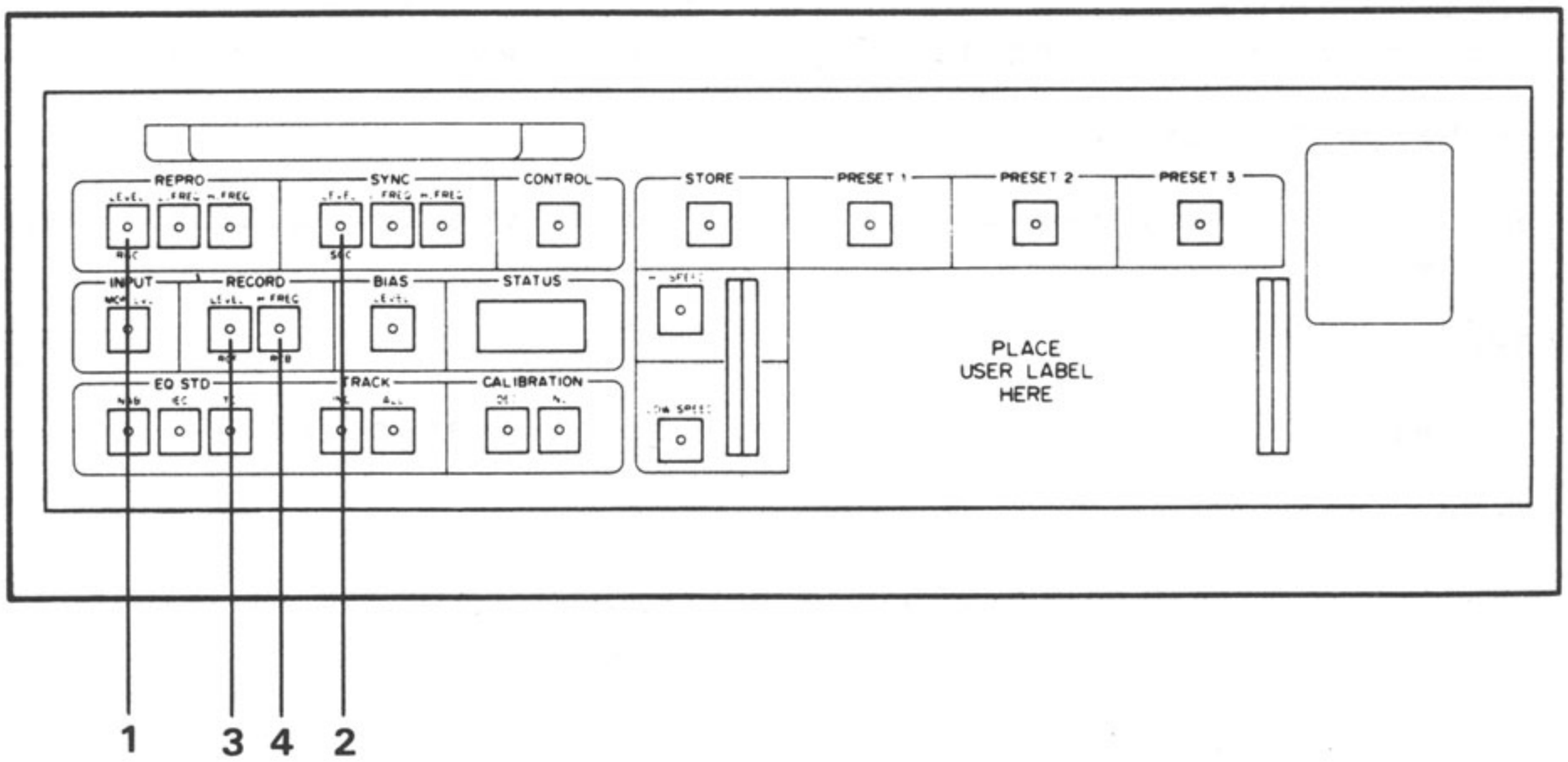


Figure 3-14. Secondary Parameter Selection

1. RGC

Repro Gap Compensation, secondary function of the REPRO LEVEL key.

2. SGC

Sync Gap Compensation, secondary function of the SYNC LEVEL key.

3. RCF

Record Feed Forward, secondary function of the RECORD LEVEL key.

4. RCB

Record Feed Back, secondary function of the RECORD H. FREQ key.

SECTION 4 OPERATION

4.1 INTRODUCTION

This section describes the transport, audio, Time Code, and editing operations of the **APR-24**, so that the user may become familiar with all of the sophisticated operations that the machine is capable of performing. The status of the various machine controls and indicators upon initial power up is also described.

It should be noted that some of the functions described in this section may not be available on earlier software versions. Please refer to the software information bulletins in the front of the manual for further information.

4.2 INITIAL POWER UP

Once the machine has been properly installed as described in Section 2, power may then be applied. This section describes the various items related to the initial powering up of the machine.

4.2.1 Headstack ID DIP Switch

In order for the **APR-24** to operate properly, the DIP switch on the AHB board must be set as shown in Figure 4-1.

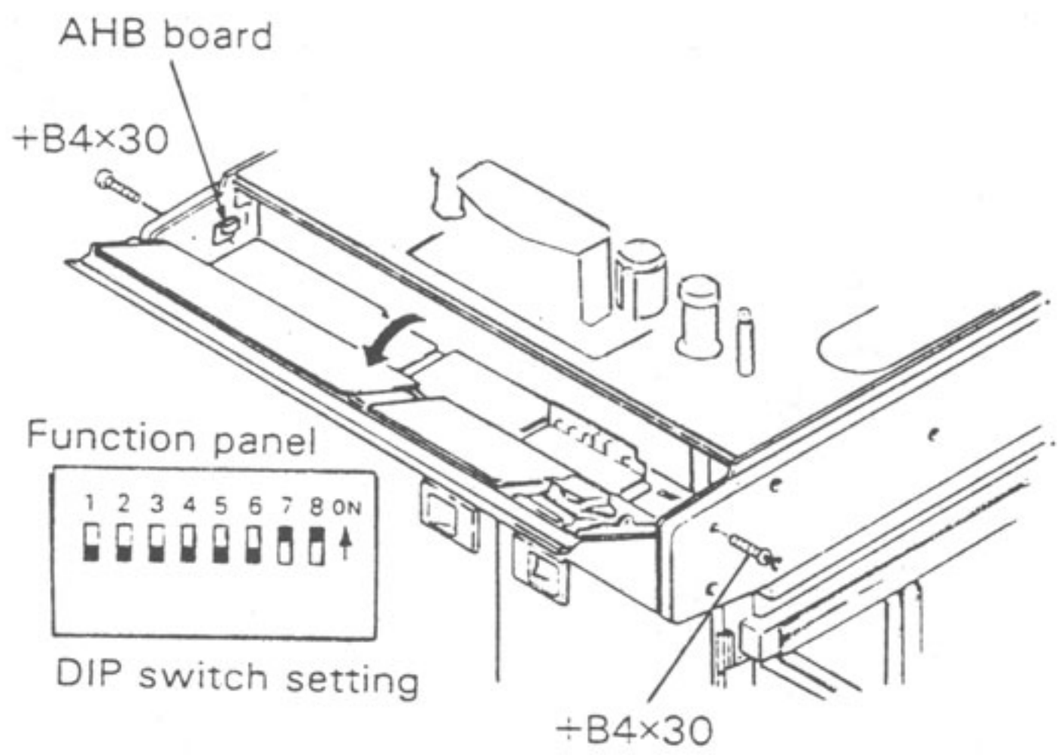


Figure 4-1. Location of AHB DIP Switch

4.2.2 Error Codes

When powered up, the machine goes through an internal CPU diagnostic sequence, normally displaying "PASS 1, PASS 2, and PASS 3" in the TAPE TIME Display on the Local Control Panel, and in the LOCATE TIME Display on the Remote Control Unit.

If, however, an error is detected during the diagnostic sequence, a "FAIL" error code message will appear in these two displays, and both STOP keys will flash to indicate that there is a failure. The error codes are defined as follows:

FAIL 1

The CPU ROM has failed checksum. Replace the ROM or repair the CPU board.

FAIL 2

The RAM scratch area of the CPU has failed its read/write test. Replace the RAM or repair the CPU board.

FAIL 3

This error code is normal when the machine is first powered up after the PROMs on the CPU have been replaced. Pressing the flashing STOP key clears the error. If the error still exists after pressing the STOP key, replace the RAM or repair the CPU board.

4.2.3 Controls and Indicators Status

Once the **APR-24** passes the internal diagnostic tests, the status of the various controls and indicators should be as described in the following paragraphs.

As previously stated, it should be noted that some of the controls and indicators may function slightly different than described, depending upon the software version that the machine is fitted with.

4.2.3.1 Remote Control Unit

TAPE key indicator - illuminated;
STOP key indicator - illuminated;
TAPE TIME Display - 00:00:00:0.

NOTES:

- The TAPE TIME Display includes four decimal points which monitor the following conditions:

  Hours Decimal Point = Valid Video Reference Signal
  Minutes Decimal Point = Valid Master Time Code
  Seconds Decimal Point = Valid Slave Time Code
  Frames Decimal Point = Valid Radius Not Established

  The Frames (F) decimal point in the TAPE TIME Display is used to monitor the establishment of a valid radius condition. When illuminated, the decimal point indicates that the machine does not have a valid radius reference. Loading a reel of tape usually establishes a valid reference, but sometime it is necessary to manually move the tape through seven and one half inches to extinguish the decimal point. If a tape is loaded and a valid radius is not established, the reels may "creep" through the required distance until a valid radius is established.

- If a channel has been assigned as the Time Code track (as stored in Memory Location 42), the TAPE TIME and LOCATE TIME Displays will be in TC DISPLAY mode, thereby illuminating the TC DSPL indicator.

- The JOG/SHUTTLE LED will indicate the previous power down state of the Jog/Shuttle Dial. If the machine was powered down in Jog mode, the JOG LED will illuminate upon power up. If the machine was powered down in Shuttle mode, however, the SHUTTLE LED will only illuminate if the dial is in the center detent position upon power up. The SHUTTLE LED will illuminate once the dial is moved to this position.

4.2.3.2 Local Control Panel

NETWORK key indicator - illuminated;
LOCAL key indicator - illuminated;
TAPE SPEED - previous power down state;
STOP key indicator - illuminated;
TAPE TIME Display - 00:00:00:0.

NOTES:

- The machine powers up in BOTH mode, that is, in both NETWORK and LOCAL modes. In NETWORK mode, all transport and audio control is derived from the Serial Network Control, and in LOCAL mode transport and audio control is derived internally from the machine and the parallel Remote Control Unit. In BOTH mode, however, transport and audio control is available from either mode on a first come/first served basis.

- The Frames (F) decimal point in the TAPE TIME Display is used to monitor the establishment of a valid radius condition. When illuminated, the decimal point indicates that the machine does not have a valid radius reference. Loading a reel of tape usually establishes a valid reference, but sometime it is necessary to manually move the tape seven and one half inches to extinguish the decimal point.

- If a channel has been assigned as the Time Code track (as stored in Memory Location 42), the TAPE TIME Display will be in TC DISPLAY mode, thereby illuminating the TC DISPLAY indicator.

- The JOG/SHUTTLE LED will indicate the previous power down state of the Jog/Shuttle Dial. If the machine was powered down in Jog mode, the JOG LED will illuminate upon power up. If the machine was powered down in Shuttle mode, however, the SHUTTLE LED will illuminate only if the dial is in the center detent position upon power up. The SHUTTLE LED will illuminate once the dial is moved to the center detent position.

4.2.3.3 Meter Housing

VU Meter - illuminated.

NOTE:

- If a channel has been assigned as the Time Code track (as stored in Memory Location 42), the number of the assigned channel will appear in the ALN STATUS Display, and the TC label will be illuminated.

4.2.3.4 ALN (Alignment) Panel

TAPE SPEED - previous power down state;
PRESET - previous power down state;
EQ STD - previous power down state.

NOTE:

- The ALN Panel will display an "EP" Preset Error code upon initial power up to indicate that the last chosen PRESET Storage Location is invalid or has been erased. To correct the Error, another PRESET Storage Location can be chosen, or a valid alignment can be stored in the PRESET Storage Location that has the Preset Error. Section 4.4.2.6 describes how to store an alignment into a PRESET Storage Location.

4.3 MEMORY LOCATIONS

The Memory Locations described throughout this section are used to store and enable a wide variety of machine parameters and functions. Information regarding Default Settings, Recalling and Storing, Storage Registers 03-27, and FUNCTION Keys A through E is provided, as well as a reference index which lists where in the manual operational information regarding the Memory Locations can be found.

4.3.1 Default Settings

The machine is factory-shipped with all of the Memory Locations set to zero, except for Memory Locations 51, Preroll Duration, and 52, Postroll Duration, which have default settings of ten and two seconds, respectively. Memory Location 38, Maintain Lock Reference, has a default setting of 1 with software version P5.01.03.0 and higher.

4.3.2 Recalling and Storing

To recall a Memory Location, press the RCL key and enter the number of the Memory Location. The contents of that Memory Location will then be shown in the LOCATE TIME Display.

If it is desired to store a new value into a Memory Location after recalling its contents, enter the new value on the keypad and then press the STO key.

4.3.3 Storage Registers 01-29

Memory Locations 01-29 may be used to store any time values that might be beneficial to recall for locating, editing, and other purposes. Memory Locations 01 and 02 also are used to store the Edit In and Out Points, respectively, and Memory Locations 28 and 29 are used to store the Repeat Start and Stop Times, respectively.

The ENTRY key on the Remote Control Unit can also be used to store the current TAPE TIME position into Memory Locations 01-09. Please refer to Section 4.6.1.2 for further information.

4.3.4 FUNCTION Keys A-E

FUNCTION keys A-E correlate to the following Memory Locations:

A = Memory Location 70
B = Memory Location 71
C = Memory Location 72
D = Memory Location 73
E = Memory Location 74

Any one of these Memory Locations can be used to store any other Memory Location. Then, pressing any of the FUNCTION keys A through E recalls that Memory Location and its contents in the LOCATE TIME Display.

For example, when a 28 is stored in Memory Location 70, pressing the A FUNCTION key recalls Memory Location 28 and displays its contents in the LOCATE TIME Display.

These user defined FUNCTION keys are particularly useful to store Memory Locations 60-64, the Edit Storage Registers.

4.3.5 Memory Location Reference

Table 4-1 lists where in the manual operational and functional descriptions can be found for all of the Memory Locations.

	MEMORY LOCATIONS		REFERENCE
00	SYNCHRONISATION OFFSET, FRAME RESOLUTION		SECTION 4.5.3.2
01	EDIT IN POINT, FRAME RESOLUTION		SECTION 4.6.1.1
02	EDIT OUT POINT, FRAME RESOLUTION		SECTION 4.6.1.1
03-27	STORAGE REGISTERS		SECTION 4.3.3
28	REPEAT START TIME		SECTION 4.4.1.4
29	REPEAT STOP TIME		SECTION 4.4.1.4
30	AUTO TIME CODE MODE		SECTION 4.5.2.4
31	TIME CODE FORMAT		SECTION 4.5.2.2
32	SMPTE DROP FRAME FORMAT		SECTION 4.5.2.2
35	BURST TIME CODE	*	SECTION 4.5.3.6
37	ESTABLISH LOCK REFERENCE		SECTION 4.6.3.1
38	MAINTAIN LOCK REFERENCE		SECTION 4.6.3.2
39	RESOLVE ON PLAY		SECTION 4.5.3.4
41	VARI SPEED IPS/SEMITONE DISPLAY		SECTION 4.4.1.3
42	TIME CODE TRACK ASSIGNMENT		SECTION 4.5.2.1
43	TRIGGERED EDIT OPERATION		SECTION 4.6.3
44	EXTERNAL RECORD/RECORD READY CONTROL	*	SECTION 4.4.2.3
45	EXTERNAL SYNC/REPRO SWITCHING CONTROL	*	SECTION 4.4.2.4
46	CONTROL TRACK FOLLOW/DIRECTION SENSE	*	SECTION 4.5.3.7
49	RECORD IN/OUT MONITOR MUTING DEFEAT	**	SOFTWARE INFORMATION-2
50	ACCELERATION ALLOWANCE		SECTION 4.5.3.5
51	PREROLL DURATION		SECTION 4.6.1.3
52	POSTROLL DURATION		SECTION 4.6.1.3
53	ERASE RAMP DURATION	*	SECTION 4.6.6
54	BIAS RAMP DURATION	*	SECTION 4.6.6
60-64	EDIT STORAGE REGISTERS		SECTION 4.6.5
70-74	USER DEFINED FUNCTIONS		SECTION 4.3.4
91	EDIT IN POINT, BIT RESOLUTION	*	SECTION 4.6.1.1
92	EDIT OUT POINT, BIT RESOLUTION	*	SECTION 4.6.1.1
98	SYNCHRONISATION OFFSET, BIT RESOLUTION		SECTION 4.5.3.2
99	OFFSET CALCULATION		SECTION 4.5.3.3

* Software Version P5.01.02.0 and later
** Software Version P5.01.03.0 and later

Table 4-1. Memory Location Reference Index

4.4 TRANSPORT AND AUDIO OPERATIONS

The rudimentary transport and audio operations of the **APR-24** are discussed in the following paragraphs.

4.4.1 Transport Operations

The following procedure will familiarise the user with the basic transport operations of the machine through the use of the controls on the Local Control Panel and the Remote Control Unit. Several other important transport-related features, such as the Jog/Shuttle Dial, Vari Speed mode, and Repeat mode, are also discussed.

4.4.1.1 Basic Operation

STEP 1. Ensure that the power switch is set to ON.

STEP 2. Cover the EOT (End Of Tape) sensor with an opaque card. Ensure that the supply and take-up motors slowly idle.

STEP 3. Spin the Timer Roller counter-clockwise and ensure that the time in the TAPE TIME Display increments. Spin the Timer Roller clockwise and ensure that the time in the TAPE TIME Display decrements.

STEP 4. Remove the opaque card and thread a reel of tape onto the machine as shown in Figure 4-2. Ensure that the frames decimal point in the TAPE TIME Display extinguishes to indicate that a valid radius has been established.

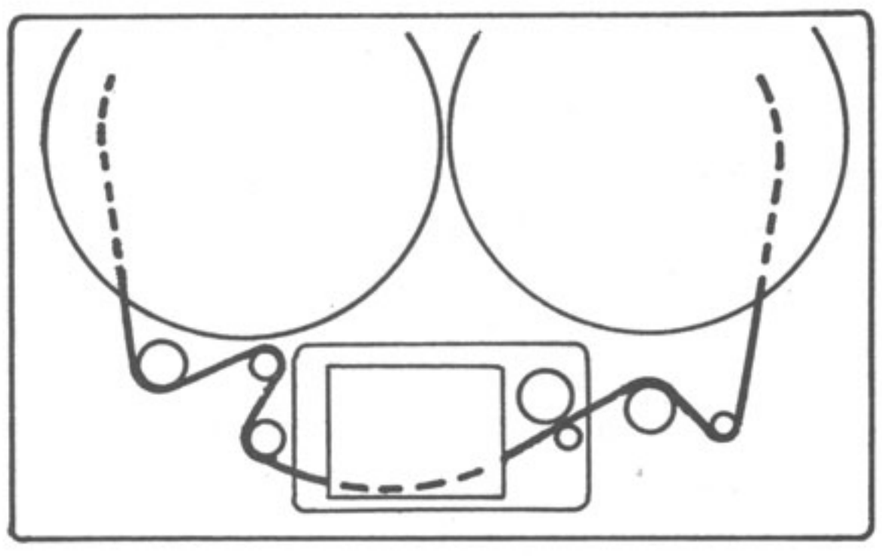


Figure 4-2. Tape Path

STEP 5. Press PLAY. Ensure that the PLAY key indicator illuminates, the shields ascend, the pinch roller engages with the spinning capstan motor, and that the machine plays the tape across the heads.

STEP 6. Press FWD. Ensure that the FWD key indicator illuminates, the lifters come forward, and that the tape accelerates to fast speed in the forward direction.

STEP 7. Press LIFTER DEFEAT. Ensure that the LIFTER DEFEAT key indicator illuminates, and that the lifters retract. Press the key again and ensure that the key indicator extinguishes and the lifters come forward to their original position.

STEP 8. Press SHIELD DEFEAT. Ensure that the SHIELD DEFEAT key indicator illuminates, and that the shields descend. Press the key again and ensure that the key indicator extinguishes and the shields ascend to their original position.

STEP 9. Press REW. Ensure that the REW key indicator illuminates, and that the tape accelerates to fast speed in the rewind direction.

STEP 10. Press STOP. Ensure that the STOP key indicator illuminates, the tape decelerates, stops, and the lifters retract.

STEP 11. Press EDIT. Ensure that the EDIT key indicator illuminates, and that the reel tensions become relaxed.

STEP 12. Press PLAY. Ensure that the take-up reel is motionless as the tape is played across the heads and dumped off the right side of the machine.

STEP 13. Press STOP. Ensure that the play motion of the tape ceases.

STEP 14. Press STOP again. Ensure that the EDIT key indicator extinguishes and that the reel tensions are restored.

4.4.1.2 Use of the Jog/Shuttle Dial

When the JOG/SHUTTLE ENABLE key is activated, the Jog/Shuttle Dial can be used to Rewind or Fast Forward the tape.

When the dial is locked in the up position (Shuttle mode), turning the dial more to the left increases the Rewind velocity of the tape, while turning it more to the right increases the Fast Forward velocity of the tape.

When the dial is locked in the down position (Jog mode), turning the dial to the left increases the Rewind velocity of the tape in direct proportion to the relative velocity of the dial, while turning it to the right increases the Fast Forward velocity of the tape in the same manner.

The Jog/Shuttle Dial can also be used to change the audio alignment parameters with software version P5.01.02.0 and higher, as described in Section 7.5, and to adjust the Vari Speed function, as described in the following paragraphs.

4.4.1.3 Vari Speed Mode

The VARI SPEED key enables the nominal play speed of the machine to be varied by +/- 50%. The VARI SPEED key indicator has three states, off, flashing, and on, as shown in Figure 4-3.

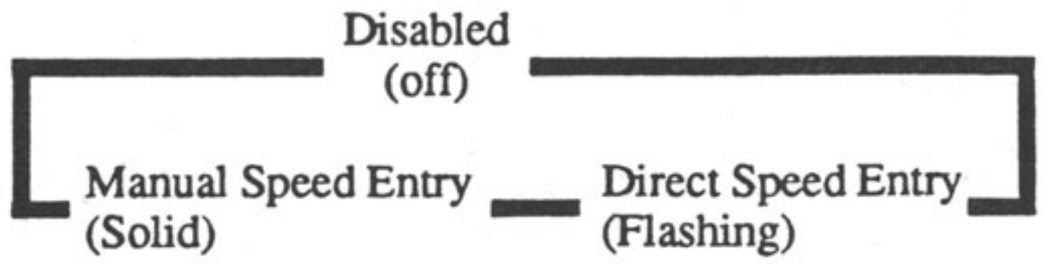


Figure 4-3. Vari Speed Key Indicator States

The machine runs at the nominal play speed, regardless of any Vari Speed entries, when the key indicator is off.

Pressing the VARI SPEED key once enters Direct Entry mode and causes the key indicator to flash. In this mode, the desired play speed variation percentage is entered via the numeric keypad, and this percentage is shown in the LOCATE TIME Display. Any entered value greater than +50% automatically defaults to +50%, and any value less than -50% defaults to -50%.

Pressing the VARI SPEED key a second time enters Execute/Manual Entry mode and causes the key indicator to illuminate solidly. In this mode, the nominal play speed is deviated by the percentage entered in Direct Entry mode. It is important to note that the nominal play speed will not vary until the machine is in Execute/Manual Entry mode.

In addition, Execute/Manual Entry mode allows the Jog/Shuttle Dial to be used to deviate the nominal play speed percentage within the +/- 50% deviation limits, providing that Jog/Shuttle mode is not enabled. Turning the dial to the left reduces the play speed, while turning it to the right increases the play speed. This is convenient for fine tuning the desired amount of speed variation.

Pressing the VARI SPEED key a third time extinguishes the key indicator.

The Vari Speed percentage shown in the LOCATE TIME Display can be changed to show semitone variations/ips by storing a 1 in Memory Location 41. The semitone values are then displayed in increments of 0.25 semitones.

4.4.1.4 Repeat Mode

When the REPEAT key is pressed on the Remote Control Unit, the machine locates to the time value stored in Memory Location 28 and automatically goes into Play. The machine remains in Play until the time value stored in Memory Location 29 is reached, at which time the machine stops and locates back to the time value in Memory Location 28 and goes into Play again, continuing this loop ad infinitum until the STOP key is pressed.

It is important to note that the time value stored in Memory Location 29 must be positive with respect to the time value stored in Memory Location 28 in order for Repeat mode to function.

4.4.2 Audio Operations

The following procedure will familiarise the user with the basic audio operations of the machine through the use of the controls on the Remote Control Unit and the Local Control Panel. Several other important audio-related features, such as Spot Erase, External RECORD READY and SYNC/REPRO Switching Control, and PRESET Storage, are also discussed.

4.4.2.1 Basic Operation

STEP 1. Ensure that the power switch is set to ON, and load a reel of tape onto the machine.

STEP 2. Press the orange RECORD READY key for each channel on the Remote Control Unit, ensuring that each key indicator illuminates and that the amber LEDs on the Meter Housing illuminate solidly.

STEP 3. Press the SYNCHRONOUS/REPRODUCE key for each channel on the Remote Control Unit, ensuring that each key indicator illuminates and that the green LEDs on the Meter Housing illuminate solidly.

STEP 4. Press PLAY and REC simultaneously. Ensure that the PLAY and REC key indicators are illuminated on the Remote Control Unit and on the Local Control Panel;

Ensure that the red RECORD STATUS LEDs on the Remote Control Unit for each channel are illuminated, along with all of the ERASE and BIAS LEDs on the Meter Housing. Ensure that the green LEDs on the Meter Housing are flashing.

STEP 5. Press STOP. Ensure that the PLAY and REC key indicators and the red RECORD STATUS, ERASE, and BIAS LEDs all extinguish.

STEP 6. Press the orange RECORD READY key for each channel on the Remote Control Unit, ensuring that each key indicator extinguishes along with the amber LEDs on the Meter Housing.

Press the SYNCHRONOUS/REPRODUCE key for each channel on the Remote Control Unit, ensuring that each key indicator extinguishes along with the green LEDs on the Meter Housing.

STEP 7. Press ALL on the ALN Panel. Ensure that ALL appears in the ALN and Meter Housing Status Displays, and that the amber LEDs on the Meter Housing flash with a short "off" cycle.

STEP 8. Press the orange RECORD READY key for each channel on the Remote Control Unit, ensuring that each key indicator illuminates and that the amber LEDs on the Meter Housing flash with a longer "off" cycle than that observed in STEP 7.

STEP 9. Press the orange RECORD READY key for each channel on the Remote Control Unit, ensuring that each key indicator extinguishes.

STEP 10. Press the global INPUT key on the Remote Control Unit. Ensure that the key indicator illuminates, and that the green LEDs on the meter housing flash in sync with the amber LEDs.

STEP 11. Press the global OVERDUB (sync) key on the Remote Control Unit. Ensure that the key indicator illuminates along with each SYNCHRONOUS/REPRODUCE key indicator, as well as the green LEDs on the Meter Housing.

STEP 12. Press the global TAPE key on the Remote Control Unit. Ensure that the key indicator illuminates, and that the SYNCHRONOUS/REPRODUCE keys on the Remote Control Unit extinguish, as well as the green LEDs on the Meter Housing.

STEP 13. Press ALL on the ALN Panel. Ensure that ALL is cleared from both Status Displays, and that the flashing amber LEDs on the Meter Housing extinguish.

4.4.2.2 Spot Erase

When the SPOT ERASE key is pressed, Spot Erase mode becomes armed, providing that there is at least one channel in Record Ready mode.

Pressing the RECORD key then causes the channels in Record Ready mode to enter Spot Erase mode. The program material on those channels will be erased as the tape is manually moved across the erase head. It is recommended to have the tape already moving when the RECORD key is pressed in order to minimise the artifact that a spot erase punch-in produces.

Pressing the STOP key halts the erase current to the erase head but leaves Spot Erase mode armed, thereby allowing for additional spot erasures to be performed on another section of the tape, if desired. It is recommended to keep the tape moving when the STOP key is pressed in order to minimise the artifact that a spot erase punch-out produces. Pressing the SPOT ERASE key again will then disarm Spot Erase mode.

4.4.2.3 External RECORD/RECORD READY Control

When the **APR-OP24C** accessory is installed, storing a 1 in Memory Location 44 allows for track-specific external RECORD/RECORD READY control. Refer to the **APR-OP24C** Manual for further information on this feature.

4.4.2.4 External SYNC/REPRO Switching Control

When the **APR-OP24C** accessory is installed, storing a 1 in Memory Location 45 allows for external SYNC/REPRO global switching. Refer to the **APR-OP24C** Manual for further information on this feature.

4.4.2.5 Audio Alignment

The machine is factory aligned using a reference fluxivity of 250nW/m and Scotch 226 tape. Complete Input, Playback, and Record alignment procedures can be found in Section 7.5.

4.4.2.6 PRESET Storage

The PRESET keys on the ALN Panel can be used to store and recall three separate audio alignments per speed.

To arm the Preset store function so that a new set of parameters may be stored, hold down the CONTROL key and press the STORE key. The key indicator on the STORE key will illuminate solidly. Then, pressing any one of the three PRESET keys erases the previously stored parameters in that PRESET Storage Location, and replaces it with the current parameter values of all 24 channels.

It is important to note that the hexadecimal parameter values must be stored into one of the PRESET Storage Locations before switching speeds or powering the machine down, or else those values will not be stored.

Pressing any of the three PRESET keys recalls the parameter values that have been stored in that Storage Location, and illuminates the key indicator solidly. The PRESET key indicator will remain illuminated until the value of any of the parameters is changed or another PRESET Storage Location is selected.

4.5 TIME CODE OPERATIONS

The **APR-24** is capable of performing a wide variety of Time Code generation and synchronisation operations. These operations, as well as background information regarding Time Code standards, are discussed in the following paragraphs.

It is important to note that the machine must be in TIME CODE DISPLAY mode for these features to operate properly.

4.5.1 Time Code Background

Originally standardised by the Society of Motion Picture and Television Engineers (SMPTE) for use in videotape editing, Time Code is a digitally-encoded signal of succedent Hours, Minutes, Seconds, and Frames. It provides time-based reference points on audio and video tape similar to sprocket holes on film. When recorded on one tape source, it can be used for locating, synchronising, and editing purposes with other Time Code sources.

4.5.1.1 Time Code Types and Formats

There are two types of Time Code, Longitudal Time Code (LTC) and Vertical Interval Time Code (VITC).

LTC is recorded on audio or video tape on a separate audio track, and contains 80 bits of information per Time Code word. When LTC is recorded onto video tape, each frame of the video signal is labeled with its own unique Time Code word which identifies that particular frame in terms of Hours, Minutes, Seconds, and Frames.

VITC is recorded on video tape in the vertical blanking interval portion of the video signal, and contains 90 bits of information per word.

The two Time Code types can be in one of four formats, European Broadcasting Union (EBU), SMPTE Non-Drop Frame (NDF), SMPTE Drop Frame (DF), or FILM. Each format is designed for use in a specific application, to wit:

- **EBU** is used for videotapes made at a rate of 25 frames per second (Fr/s), in accordance with European broadcasting standards;

- **SMPTE NDF** is used for monochrome videotapes made at a rate of 30 Fr/s, in accordance with National Television Standards Committee (NTSC) standards;

- **SMPTE DF** is used for color videotapes made at a rate of 29.97 Fr/s, in accordance with NTSC color television standards;

- **FILM** is used for motion pictures made at a rate of 24 Fr/s.

4.5.1.2 SMPTE DF

The **APR-24** records SMPTE NDF and SMPTE DF Time Code at a frequency of 2400 bits per second (80 bits LTC x 30 Fr/s). However, in order to accommodate the color videotape frame rate of 29.97, the first two frames of each minute are dropped from the SMPTE DF data stream (with the exception of every tenth minute) to correct the offset error that occurs because of the frame rate differential.

4.5.1.3 The Time Code Word

The Time Code word is a digitally-encoded signal of succedent Hours, Minutes, Seconds, and Frames. Before encoding, the 80-bit LTC word is a square wave pulse train of 40 positive and 40 negative excursions, with each bit having a digital value of 0. When the voltage level is switched in the center of the bit, as shown in Figure 4-4, it generates a 1/2 bit and assigns that bit with a digital value of 1.

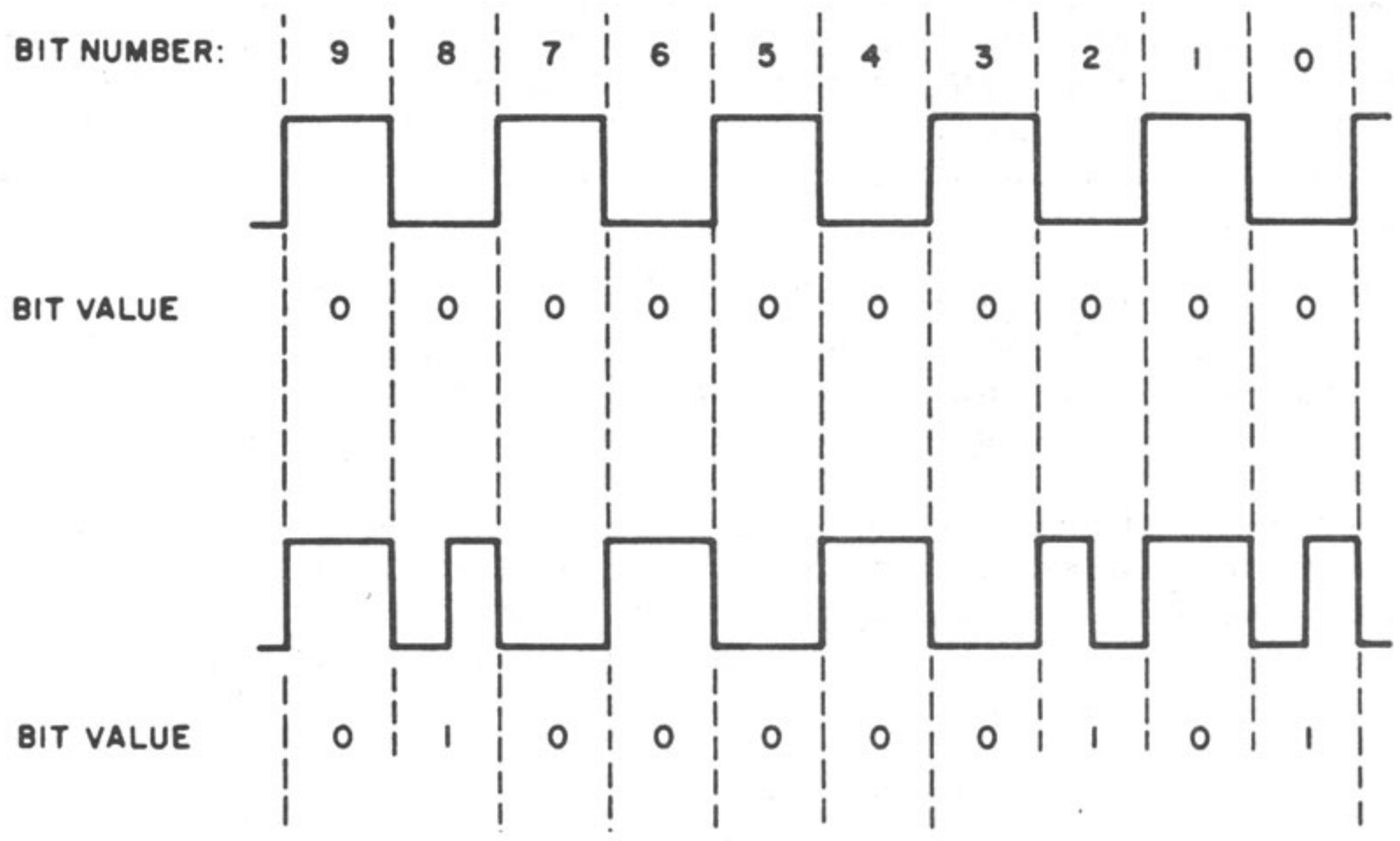


Figure 4-4. Time Code Bit Values

The 80 bits of the LTC word are divided as shown in Figure 4-5. In this example, bits 2 and 8 of the Frames count switched their voltage level in the center of the bit, and therefore have a digital value of 1. As these bits represent the numbers 4 and 10, respectively, of the Frames count, adding them together produces a Frames count of 14. Continuing on in this manner to the Seconds, Minutes, and Hours bits, the Time Code word in this example can be derived to have a value of 15 Hours, 31 Minutes, 47 Seconds, and 14 Frames.

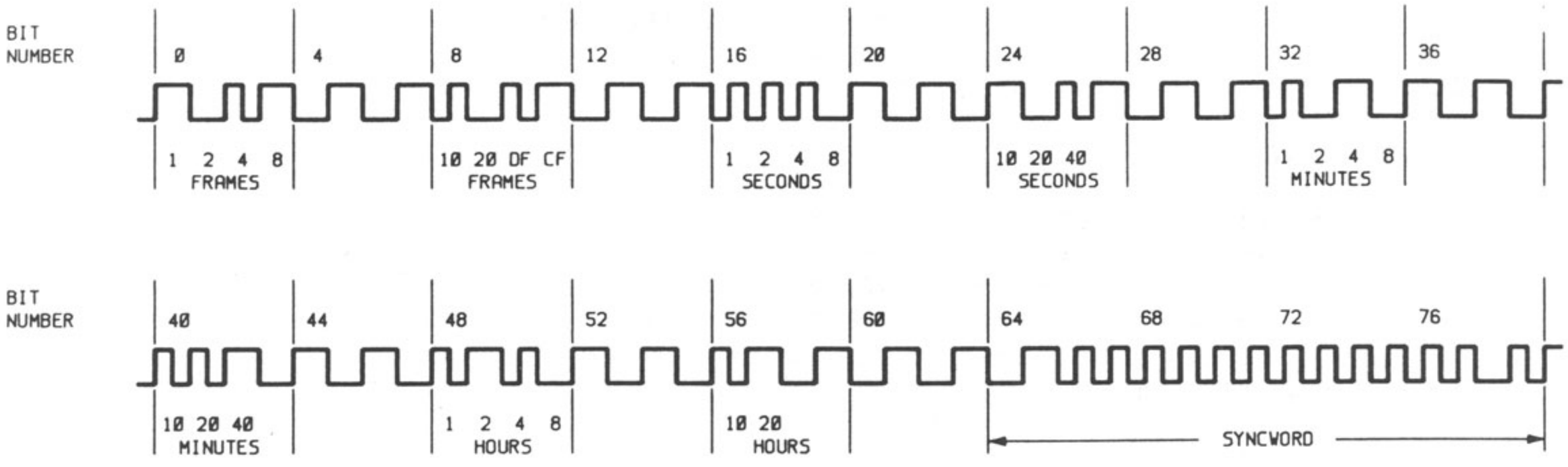


Figure 4-5. LTC Word Bit Assignments

The Time Code word also has several other bits and groups of bits within the data stream for other encoding purposes.

Eight groups of four **User Bits** are interspersed between the various Time Code counter bits. The User Bits are all set to 0, and are available for whatever auxiliary encoding that the user might want to assign to them. It should be noted that the **APR-24** does not generate or display User Bits, as this must be done by an external Time Code generator. The machine does, however, record and output the bits in the same manner as any other bits in the Time Code word.

Bit 10 is called the **Drop Frame Bit**. Time Code generated in Drop Frame format is identified by having this bit set to a digital 1. Bit 11 is the **Color Frame Bit**, and when set to a digital 1 it indicates that color frame identification has been applied to the Time Code signal.

Bits 64 through 79 comprise the **Sync Word**. The Sync Word is detected by an external Time Code reader as the end of the Time Code word. It is also used by an external reader to determine whether the tape is running in the forward or reverse direction. These sixteen bits will always have the same value in every LTC word.

The VITC word has ten bits more than the LTC word. Two **Sync Bits** are placed before each of the numbers count bits, bit 35 is the **Field Mark Bit** which allows VITC readers to index each video field, and, in place of the sixteen bit Sync Word found at the end of the LTC word, VITC has an eight bit **Cyclic Redundancy Check (CRC)** error detection code at the end of each word.

4.5.2 Time Code Generation

The **APR-24** can record Time Code onto an assigned Time Code track through the use of the TC GEN key on the Remote Control Unit. The Time Code can originate from either the internally derived clock signal or from an externally input source. The TC GEN key has three indication states, each of which corresponds to a specific type of internal or external Time Code generation, as shown in Table 4-2.

KEY INDICATOR	MODE OF OPERATION
OFF	External reference, external start point
FLASHING	External reference, internal start point
ON	Internal reference, internal start point

Table 4-2. TC GEN Key Indications

It is important to note that, before recording any external or internal Time Code onto the assigned Time Code track, the machine must be in TC DISP mode.

Also, ensure that the Time Code reference signal is recognised by the machine as valid by observing the decimal points in the TAPE TIME Display on the Remote Control Unit, to wit:

Hours decimal point = Valid Video Reference Signal
Minutes decimal point = Valid Master Time Code
Seconds decimal point = Valid Slave Time Code

4.5.2.1 Time Code Track Assignment

Any one of the 24 channels may be assigned as the Time Code track by storing the channel number into Memory Location 42. If it is not desired to have a Time Code track, this Memory Location must be set to 0.

When a channel is assigned as the Time Code track, the presets for that channel default to values chosen to maintain both optimum signal integrity and fluxivity during record, and minimal adjacent channel crosstalk during playback. De-assigning an assigned channel returns its presets to their previous settings.

The TC key on the ALN Panel can be used to assign the Time Code track by selecting the desired channel with the IND key, and then pressing the TC key (the indicator on this key is non-functional). This automatically stores the channel into Memory Location 42 as the Time Code track.

4.5.2.2 Internal Time Code

When the TC GEN key indicator is on, the Time Code recorded on the assigned Time Code track will be that generated by the internal Time Code clock signal. The starting point time value can be programmed by the user by entering the desired starting point time value into the LOCATE TIME Display, and then transferring it to the TAPE TIME Display using the TRANSFER UP Arrow key.

The Time Code type recorded on the tape will be always be LTC, since the **APR-24** does not generate VITC. The format of the Time Code will be determined by the contents of Memory Locations 31 and 32, as follows:

Memory Location 31
0 = SMPTE
1 = EBU
2 = FILM

Memory Location 32
0 = SMPTE NDF, EBU, FILM
1 = SMPTE DF

Storing a 1 in Memory Location 32 automatically sets Memory Location 31 to 0, and storing a 1 or 2 in Memory Location 31 automatically sets Memory Location 32 to 0, thereby ensuring that a valid Time Code format is always selected.

NOTE:

The SMPTE Time Code produced by the internal Time Code clock is generated at 30 Fr/s, with the internal crystal reference of all Time Code formats accurate to +/- 50 ppm. If SMPTE DF is required at the NTSC rate of 29.97 Fr/s, it is advisable to use an external reference that produces said frame rate.

4.5.2.3 External Time Code

Before recording external Time Code onto the assigned Time Code track, Memory Location 37 must be set to indicate what type of Time Code is being input to the machine, as follows:

0 = LTC
1 = VITC

LTC must be input to the LTC IN XLR connector on the rear of the machine, and VITC must be input to the VIDEO IN BNC connector.

It is recommended when using external Time Code to store a 1 in Memory Location 30 to enable Auto Time Code mode, whereby the machine identifies the format of the external reference and automatically programs Memory Locations 31 and 32 to reflect the format. If Auto Time Code mode is not enabled, Memory Locations 31 and 32 must be set manually as follows:

Memory Location 31
0 = SMPTE
1 = EBU
2 = FILM

Memory Location 32
0 = SMPTE NDF, EBU, FILM
1 = SMPTE DF

Storing a 1 in Memory Location 32 automatically sets Memory Location 31 to 0, and storing a 1 or 2 in Memory Location 31 automatically sets Memory Location 32 to 0, thereby ensuring that a valid Time Code format is always selected.

When the TC GEN key indicator is off, the Time Code recorded on the assigned Time Code track will be the externally input Time Code source, with the external starting point.

When the TC GEN key indicator is flashing, the Time Code recorded on the assigned Time Code track will be the external Time Code source, but the starting point time value can be programmed by the user. The desired starting point is entered into the LOCATE TIME Display and transferred to the TAPE TIME Display using the TRANSFER UP Arrow key. The Time Code recorded on the assigned Time Code track then will start its count at the programmed time value, independent of the time value of the external input.

It is important to note that the channel assigned as the Time Code track must be in Record Ready mode in order to program the desired starting point into the LOCATE TIME Display.

4.5.2.4 Auto Time Code Mode

Storing a 1 in Memory Location 30 enables Auto Time Code mode. This allows the machine to identify the Time Code format of either the Time Code on a tape being played or an externally input Time Code signal.

If a tape with Time Code on it is played when this Memory Location is enabled, the machine will identify the Time Code format and automatically set Memory Locations 31 and 32 to reflect that format. When external Time Code is being input to the machine, the format of that external source will also automatically be stored into Memory Locations 31 and 32, providing that the TC GEN key is in one of the two external indicator modes, Flashing or On.

It is also important to note that, when using and external source, Memory Location 37 must also be programmed manually by the user to reflect the type of the external Time Code, with 0 = LTC and 1 = VITC.

4.5.2.5 RS422-Type Output

Normally, the internally or externally generated Time Code is made available in differential analog form for external use at the LTC OUTPUT XLR connector on the rear of the machine. If RS422-type Time Code output is desired, remove jumpers JU4 and JU6 on the MRA board and install them onto jumpers JU3 and JU5. (Refer to Figure 4-6.)

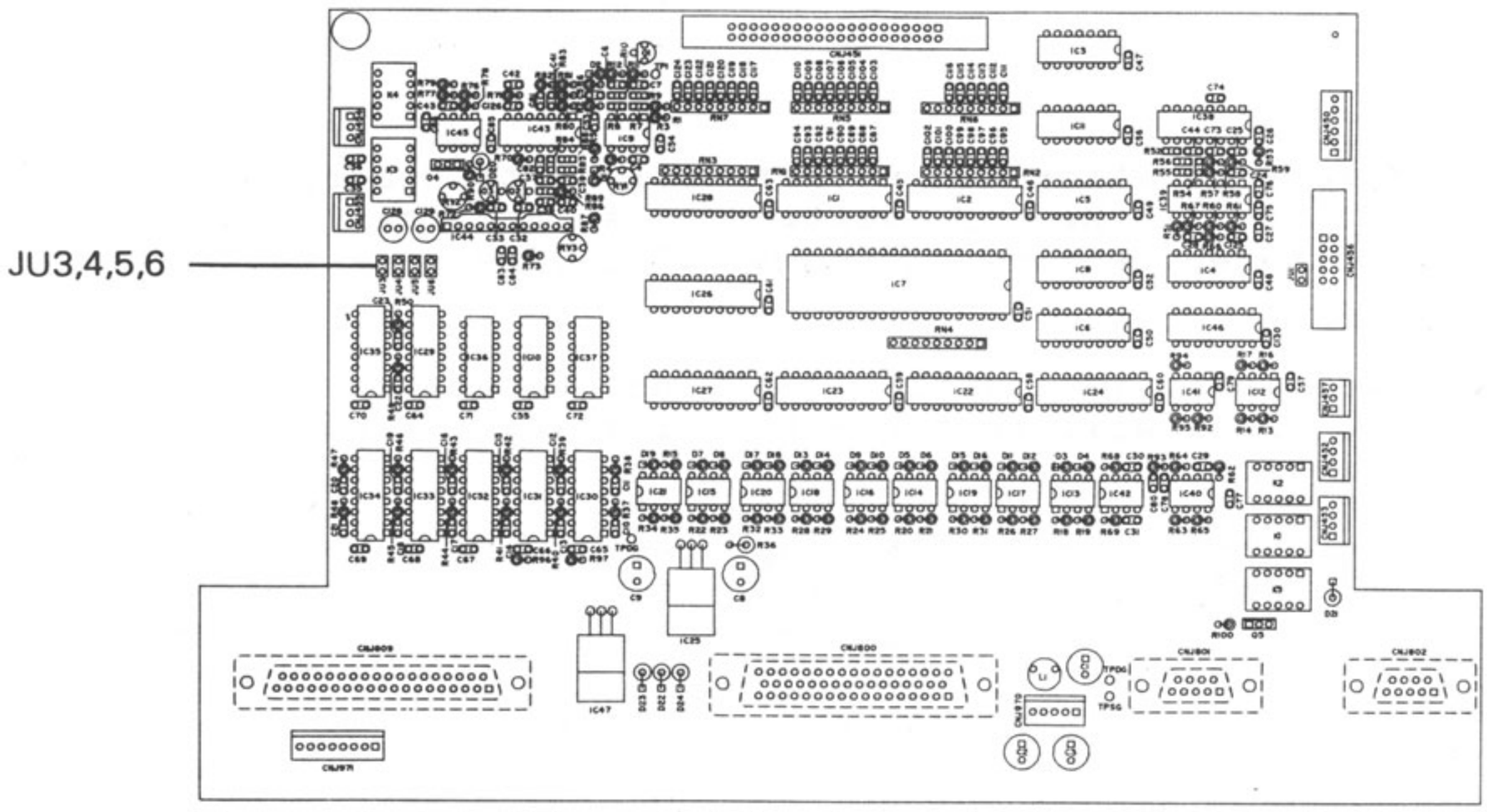


Figure 4-6. Location of Jumper Blocks on MRA Board

4.5.3 Time Code Synchronisation

Time Code recorded onto an assigned track can be used to synchronise the machine to an external Time Code source, where either the machine follows the external source (Slave mode) or the external source follows the machine (Master mode).

The decimal points in the TAPE TIME display of the Remote Control Unit are used to indicate the validity of the following signals:

Hours decimal point = Valid Video Reference Signal
Minutes decimal point = Valid Master Time Code
Seconds decimal point = Valid Slave Time Code

4.5.3.1 Chase/Lock

Chase/Lock mode allows the machine to synchronise to an external source in Slave mode, provided that the Time Code recorded on tape is of the same format as that of the external source.

The format of the external source must be programmed into Memory Locations 31 and 32 automatically by storing a 1 in Memory Location 31 to enable Auto Time Code mode. Please refer to Section 4.5.2.4 for further information on Auto Time Code mode.

Memory Location 37, Establish Lock Reference, must be programmed to reflect the external master Time Code type that the machine will establish its initial reference to, as follows:

0 = LTC
1 = VITC, video signal, or tone

(It is important to note that LTC must be input to the LTC IN XLR connector on the rear of the machine, and VITC, video signal or tone must be input to the VIDEO IN BNC connector.)

Once the Memory Locations have been properly set, pressing the CHASE key on the Remote Control Unit initiates Chase mode. The CHASE key indicator will flash while the machine is establishing Lock, and will illuminate solidly when the machine is locked to the external source, plus or minus any offset stored in Memory Locations 00 and 98. The machine will stay locked to the external source for a maximum drop out period of two seconds before it unlocks.

Beginning with software version P5.01.03.0, the machine can be programmed to maintain Lock to the data dependent condition stored in Memory Location 38. Memory Location 38, Maintain Lock Reference, has a default setting of 1, and can be used to program the desired data dependency condition of the external source that the machine maintains Lock to, as follows:

0 = LTC, data independent
1 = LTC, data dependent
2 = Video signal or tone, data independent
3 = VITC, data dependent

The designation of a Maintain Lock Reference separate from an Establish Lock Reference allows greater flexibility when working with discontinuous Master data and mixed Drop and Non-Drop Time Code formats. It is important to note that the machine will not follow the Master when it changes speed or direction with a Video signal or tone reference.

4.5.3.2 Synchronisation Offset

The machine may be programmed to Chase/Lock ahead or behind an external source in Slave mode by storing the desired amount of offset time into Memory Location 00.

Synchronisation Offset can be adjusted to the bit level through the use of Memory Location 98. When this Memory Location is recalled, turning the Jog/Shuttle Dial clockwise or counter-clockwise changes the modulo 80 bit count of the Time Code frame offset up or down accordingly. It should be noted that adjustment past the modulo 80 bit count of the Time Code word will result in an appropriate underflow or overflow of the frames offset resolution as stored in Memory Location 00.

4.5.3.3 Offset Calculation

Recalling Memory Location 99 captures the current frames offset between the machine and an external source, and displays it in the LOCATE TIME Display. Pressing STORE 99 then stores the calculated offset into Memory Location 00, as Memory Location 99 does not have a storage feature of its own.

It should be noted that the bit offset between the machine and the external source is not captured by this feature, and must be manually adjusted as described in Section 4.5.3.2.

4.5.3.4 Resolve on Play

The Resolve on Play feature allows the PLAY key to be used to initiate data independent synchronisation of the machine to an external LTC, video signal, or tone reference. To enable this feature, Memory Location 39, Resolve on Play, must be set to a 1, Memory Location 30, Auto Time Code mode, must be set to a 1, and Memory Location 37, Establish Lock Reference, must be selected as follows:

0 = LTC INPUT
1 = VIDEO SIGNAL or TONE INPUT

Once the Memory Locations have been properly set, pressing the PLAY key initiates Resolve on Play mode. The CHASE key indicator will flash while the machine is establishing Lock and will then illuminate solidly when the machine is locked to the external source.

Tables 4-3 and 4-4 list the interresolution capabilities and limits between the machine and the external source. One of the most interesting applications of this feature is the machine's ability to resolve a 60 Hz input tone reference to 24 Fr/s Film Time Code, as shown in Table 4-4.

The +0.1% and -0.1% resolve percentages listed in Tables 4-3 and 4-4 indicate the deviation from the nominal recorded tape speed which the transport runs at during Resolve on Play mode. It should be noted that operation of the machine to other more substantially mis-matched clock rates during Resolve on Play mode will not provide reliable operation.

LTC INPUT	TIME CODE ON TAPE			
	SMPTE NDF	SMPTE DF	EBU	FILM
SMPTE NDF 30 Fr/s	YES	+0.1%	-	-
SMPTE DF 29.97 Fr/s	-0.1%	YES	-	-
EBU 25 Fr/s	-	-	YES	-
Film 24 Fr/s	-	-	-	YES

Table 4-3. Resolve Capabilities with LTC Input

VIDEO SIGNAL/TONE INPUT	TIME CODE ON TAPE			
	SMPTE NDF	SMPTE DF	EBU	FILM
NTSC B/W-60Hz	YES	+0.1%	-	YES
NTSC Color-59.94 Hz	-0.1%	YES	-	-0.1%
PAL/SECAM-50 Hz	-	-	YES	-

Table 4-4. Resolve Capabilities with Video Signal/Tone Input

4.5.3.5 Acceleration Allowance

The Acceleration Allowance feature allows the difference between the starting ballistics of the machine and those of a parked Master to be adjusted and compensated for, thereby optimising Chase/Lock synchronisation.

Memory Location 50 is used to adjust the distance at which the machine parks ahead of the Master's last known position, with a maximum allowable time value of five seconds minus one frame. Storing a zero recalls the machine's internal default time value. It should be noted that this Memory Location is volatile, and its contents will not be retained when the machine is powered down.

4.5.3.6 Burst Time Code

Some external synchronisers and readers are unable to interpret the Time Code that the machine outputs during high speed wind modes. Enabling the Burst Time Code feature provides accurate time position information over an unlimited wind speed range for the external device, thereby simplifying the external device's task of determining tape and stopping positions at high wind speeds.

Storing a 1 in Memory Location enables the Burst Time Code feature, in which high speed wind Time Code is updated once every fifteen frames by the CPU before it is output to the external device. This presents a Time Code signal to the external device that appears to be in Play mode, thereby allowing it to read the Time Code.

When the machine reaches its stopping position, a 30 frame "burst" of the actual stopping position is output, thereby assuring frame-accurate lock between the machine and the external device.

It should be noted that this feature is functional only on software version P5.01.02.0 and higher.

4.5.3.7 Control Track Follow

The **APR-24** can Chase to the externally output Control Track of a VTR if that VTR is unable to provide valid Time Code at high speed wind modes.

In order for this function to operate, the Control Track pulse output from the VTR must be input to pin 38 of the 50-pin Parallel Port connector on the rear of the machine, and the External Direction Sense output from the VTR must be input to pin 37 of the Parallel Port connector. Also, Memory Location 46 must be set to reflect the appropriate External Direction Sense of the incoming Control Track, to wit:

0 = Normal high speed Time Code CHASE
1 = Direction sense low (true) for reverse
2 = Direction sense low (true) for forward

When the machine is synchronised in Slave mode to the VTR and the VTR goes into high speed wind mode, the machine will Chase to the one pulse per frame Control Track pulse output from the VTR. The machine will re-lock to the VTR once valid Time Code is again provided.

It should be noted that this feature is functional only on software version P5.01.02.0 and higher.

4.6 EDITING OPERATIONS

The **APR-24** is designed to meet a wide variety of sophisticated audio and video tape editing needs, and can be programmed for either normal or externally-synchronised triggered execution. Five Edit Storage Registers are provided, and the erase and bias ramp durations can also be adjusted.

4.6.1 Programming an Edit

A Programmed Edit may be executed manually or triggered from an external source. It is important to note that the assigned Time Code track is prohibited from going into Record during a Programmed Edit.

The following Memory Locations are used in the execution of a Programmed Edit:

01 EDIT IN POINT
02 EDIT OUT POINT
91 EDIT IN POINT, BIT RESOLUTION
92 EDIT OUT POINT, BIT RESOLUTION
51 PREROLL DURATION
52 POSTROLL DURATION

4.6.1.1 Edit In/Out Points

When TC DISP mode is activated, the Edit In/Out Points can be programmed into their respective Memory Locations with resolution down to the Time Code frame, and, if necessary, to the individual bit of the Time Code frame.

The current Edit In Point can be displayed by pressing the IN key on the Remote Control Unit, and the current Edit Out Point can be displayed by pressing the OUT key.

To set the Edit In Point, store the desired punch-in time into Memory Location 01. To set the Edit Out Point, store the desired punch-out time into Memory Location 02. It is important to note that the time value stored in Memory Location 02 must be positive with respect to the time value stored in Memory Location 01, and must not exceed an absolute value of twelve hours.

In applications where the Edit In Point must be accurate to an individual bit of the Time Code frame, recall Memory Location 91 and store the desired bit number. In applications where the Edit Out Point must be accurate to an individual bit of the Time Code frame, recall Memory Location 92 and store the desired bit number. It should be noted that this feature is available only on software version P5.01.02.0 and higher.

4.6.1.2 Use of the Trim and Entry Keys

The Edit In and Out Points can be adjusted through the use of the TRIM keys on the Remote Control Unit. When the IN key is held down, pressing the TRIM + key increments the Edit In Point by one frame, while pressing the TRIM - key decrements the Edit In Point by one frame. Holding down the OUT key allows the frame resolution of the Edit Out Point to be incremented or decremented with the TRIM keys in the same manner.

Bit Resolution of the Edit In and Out Points can be adjusted through the use of the TRIM keys. When both of the TRIM keys are held down simultaneously, pressing the IN key allows the Jog/Shuttle Dial to be turned clockwise to increment or counter-clockwise to decrement the bit number of the Edit In Point as stored in Memory Location 91. Pressing the OUT key while holding down both of the TRIM keys allows the Bit Resolution of the Edit Out Point as stored in Memory Location 92 to be incremented or decremented with the Jog/Shuttle Dial in the same manner.

It is important to note that over or undershooting the modulo 80 bit count of the Edit In and Out Point Bit Resolution Memory Locations with the Jog/Shuttle Dial will result in an appropriate underflow or overflow of the Edit In and Out Point Memory Locations frames count.

Another method to store Edit In and Out Points is through the use of the ENTRY key on the Remote Control Unit. Holding down the ENTRY key and pressing the IN key will cause the current time in the TAPE TIME display to be stored into Memory Location 01, Edit In Point. Similarily, holding down the ENTRY key while pressing the OUT key causes the current TAPE TIME to be stored into Memory Location 02, Edit Out Point. This feature is particularly convenient for storing Edit In and Out Points while the tape is rolling.

Beginning with software version P5.01.03.0, the ENTRY key can also be used to store the current TAPE TIME position into Memory Locations 01-09. Pressing the ENTRY key followed by the number of the Memory Location stores the current TAPE TIME position into the chosen Memory Location.

4.6.1.3 Preroll and Postroll Duration

Preroll Duration is the amount of time that the machine is in Play before the Edit In Point of a Programmed Edit is executed, and Postroll Duration is the amount of time that the machine remains in Play after the Edit Out Point of a Programmed Edit has been executed, as shown in Figure 4-7.

The Preroll Duration has a default setting of ten seconds, while the Postroll Duration has a default setting of two seconds. To program the Preroll Duration, recall Memory Location 51 and store the desired Preroll time. To program the Postroll Duration, recall Memory Location 52 and store the desired Postroll time.

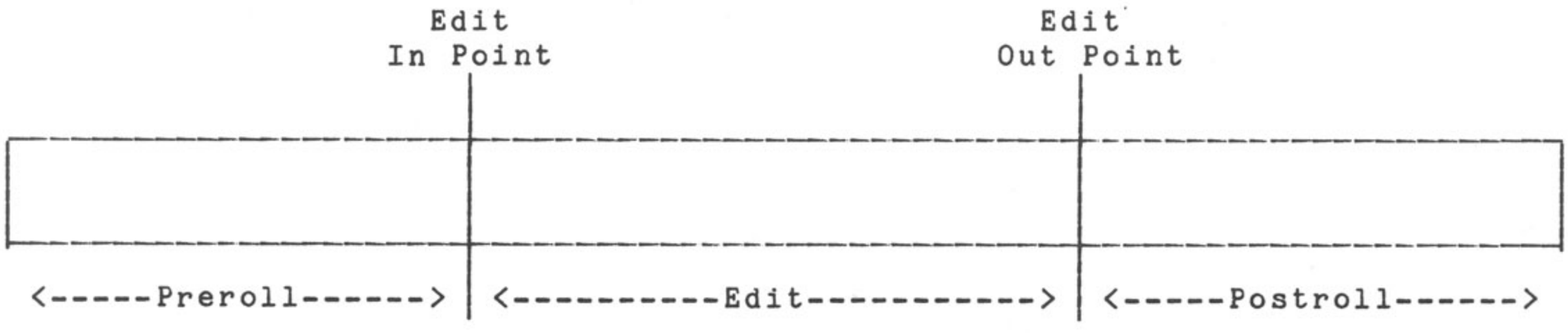


Figure 4-7. Preroll and Postroll Durations

4.6.2 Executing an Edit

Once the Edit In and Out Points and the Preroll and Postroll Durations have been programmed, Preview, Edit or Review mode may then be executed. It is important to note that the assigned Time Code track is not allowed to go into Record during a Programmed Edit.

4.6.2.1 Preview

Preview mode allows the Programmed Edit to be rehearsed without the machine actually going into Record.

When the PREVIEW key on the Remote Control Unit is pressed, the REHEARSE key flashes and the machine locates to the Edit In Point minus the Preroll Duration, parking there with the PLAY key flashing.

Pressing the PLAY key then causes the machine to imitate the Programmed Edit, with all channels monitored from the Sync head. Then, at the Edit In Point, those channels which are in Record Ready switch to Input so that the new program material may be rehearsed over those channels. At the Edit Out Point, all the channels switch back to Sync mode and the machine continues to Play for the amount of time programmed in the Postroll Duration.

4.6.2.2 Edit

Edit mode actually executes the Programmed Edit, with those channels in Record Ready going into Record.

When the EDIT key on the Remote Control Unit is pressed, the machine locates to the Edit In Point minus the Preroll Duration, parking there with the PLAY and RECORD keys flashing.

Pressing the PLAY key then causes the machine to initiate the Programmed Edit, with all channels monitored from the Sync head. Then, at the Edit In Point, those channels which are in Record Ready go into Record so that the new program material is then recorded onto those channels. At the Edit Out Point, all the channels in Record drop out of Record and the machine continues to Play for the amount of time programmed in the Postroll Duration.

4.6.2.3 Review

Review mode will play back the previously executed Edit, so that the results can be monitored.

When the REVIEW key on the Remote Control Unit is pressed, the REHEARSE key flashes and the machine locates to the Edit In Point minus the Preroll Duration, parking there with the PLAY key flashing.

Pressing the PLAY key then causes the machine to play back the programmed edit, with all channels monitored from the Repro head. The machine continues to play and then stops at the end of the Postroll Duration.

4.6.3 Programming Triggered Edits

As previously stated, a Programmed Edit may also be executed by using an external reference to trigger the desired Edit mode.

The Edit In and Out Points and the Preroll and Postroll Durations must first be programmed as described in Section 4.6.1. In addition, a 1 must be stored in Memory Location 43 to enable the Triggered Edit Operation, and the following Memory Locations must be programmed:

37 ESTABLISH LOCK REFERENCE
38 MAINTAIN LOCK REFERENCE

4.6.3.1 Establish Lock Reference

Memory Location 37 must be set to the type of external Time Code reference that the machine will be establishing synchronisation to during the Preroll Duration portion of the Triggered Edit. It should be set as follows:

0 = LTC
1 = VITC, video signal, or tone

4.6.3.2 Maintain Lock Reference

Memory Location 38 must be set to select the external reference that the machine will maintain synchronisation to once the Edit In Point of a Triggered Edit has been reached.

Data dependent synchronisation refers to the machine maintaining lock to the exact time value of the ascending external reference during the Triggered Edit. Data independent synchronisation refers to the machine maintaining lock to the sync pulses rather than the exact ascending time value of the external reference during the Triggered Edit. Memory Location 38 should be set as follows:

0 = LTC, data independent
1 = LTC, data dependent
2 = Video signal or tone, data independent
3 = VITC, data dependent

4.6.4 Executing Triggered Edits

Prior to initiating a Triggered Edit, ensure that the Synchronisation Offset between the machine and the external source is as precise as necessary.

Once all of the Memory Locations required to perform a Triggered Edit have been programmed, the desired Edit mode may then be selected for the Triggered Edit.

Figure 4-8 shows the relationship between the ascending controlled device internal LTC and the ascending external Time Code in the synchronisation of a Triggered Edit.

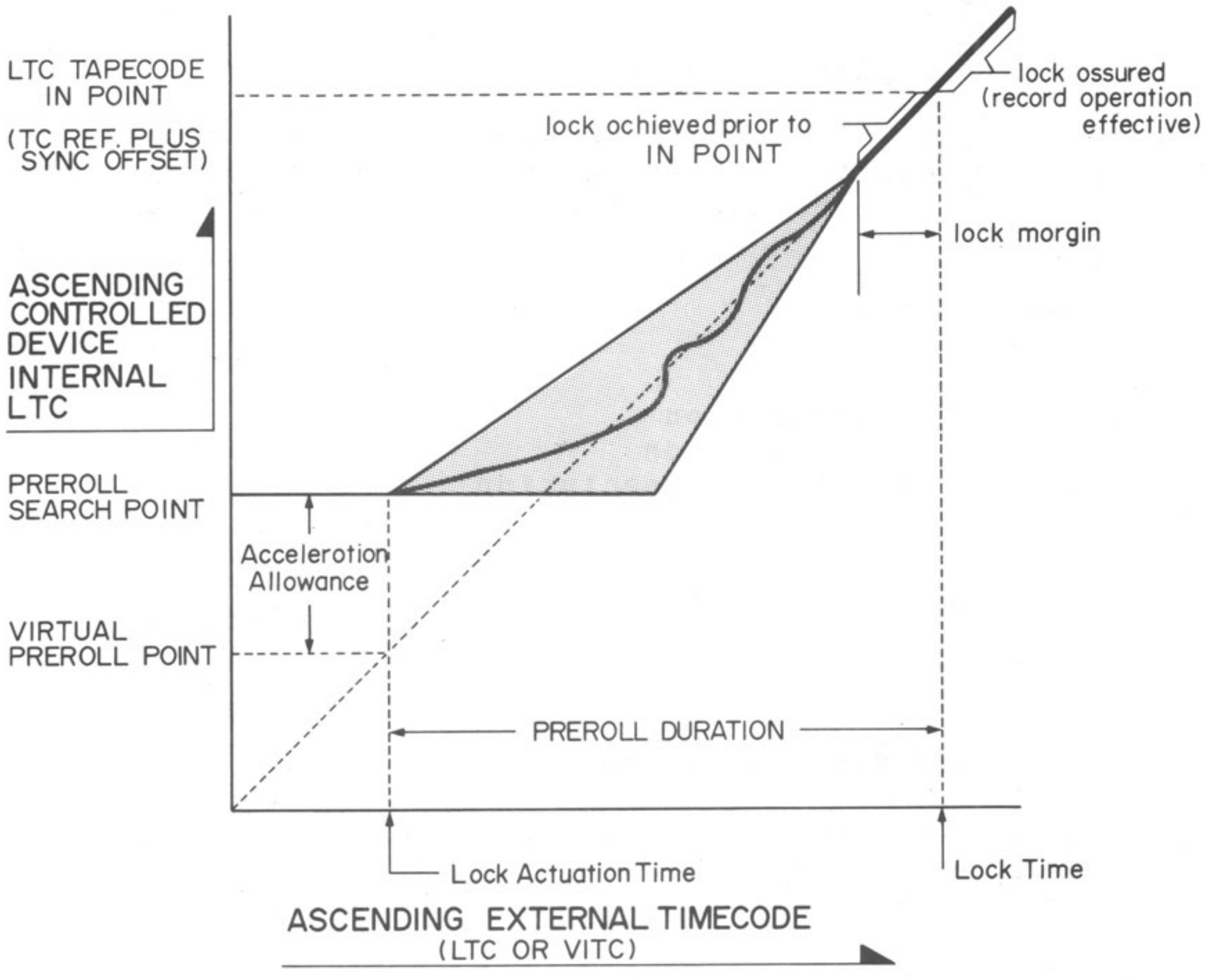


Figure 4-8. Triggered Edit Synchronisation

4.6.4.1 Preview, Edit, and Review

The Preview, Edit, and Review modes perform exactly the same functions for a Triggered Edit as they do for a Manually executed edit. Selecting the Preview, Edit, or Review modes for a Triggered Edit causes the machine to locate to the Edit In Point minus the Preroll Duration and park there with the PLAY key flashing.

However, instead of pressing the PLAY key to initiate the mode, the machine waits for the time value of the external reference to reach the time value of where the machine is parked, at the start of the Preroll Duration. Once this time value is reached, the Programmed Edit is then executed automatically. It is important to note that any Synchronisation Offset stored in Memory Locations 00 and 98 will effect the execution start time of the Triggered Edit by the amount of the offset.

Synchronisation is established during the Preroll Duration in accordance with the external Time Code type, as stored in Memory Location 37, so that synchronisation ahead of the Edit In Point is ensured. The external reference should be presented to the machine for a reasonable amount of time during the Preroll Duration. If for any reason synchronisation is not established ahead of the Edit In Point, the Triggered Edit operation will be aborted before any Record editing functions are executed.

After the Edit In Point is reached, synchronisation is maintained as specified by the reference stored in Memory Location 38.

4.6.5 Edit Storage Registers 60-64

Memory Locations 60-64 can be used to store five different Programmed Edits. Each Memory Location stores the Record Ready and Sync status of all 24 channels, as well as the data stored in the following six Memory Locations:

00 Synchronisation Offset
01 Edit In Point
02 Edit Out Point
91 Edit In Point, Bit Resolution
92 Edit Out Point, Bit Resolution
98 Synchronisation Offset, Bit Resolution

Pressing the STORE key followed by the desired Storage Register stores the channel status and Memory Location data into that Storage Register. Recalling the Storage Register places the channels into their programmed status as stored, as well as setting the six Memory Locations to their pre-programmed data.

4.6.6 Erase and Bias Ramp Durations

Beginning with software version P5.01.02.0, Memory Locations 53 and 54 allow for the adjustment of the Erase and Bias Ramp Durations, respectively, at the Record punch-in and punch-out points.

The duration of the ramp is shortened with increasing preset parameters 0-16, as shown in Figure 4-9. Storing a 0 sets the machine to its default settings. It should be noted that with software version P5.01.02.0, Memory Locations 53 and 54 are volatile and their contents will not be retained when the machine is powered down, but with software version P5.01.03.0 and higher, these Memory Locations are non-volatile.

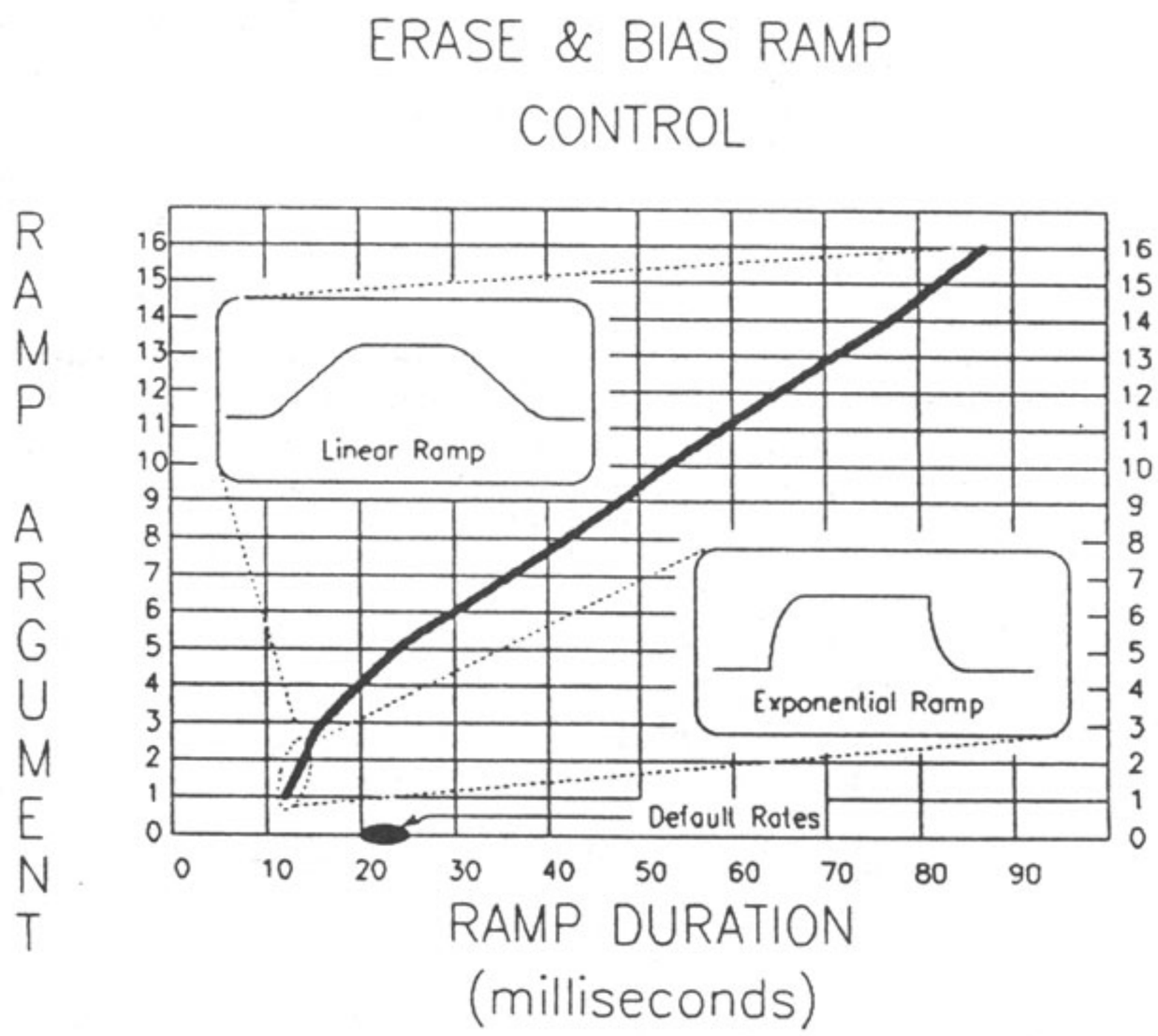


Figure 4-9. Erase and Bias Ramp Durations Parameters

4.6.6.1 Erase Ramp Durations

At the punch-in and punch-out points, a low-level "whump", or Low Frequency Artifact (LFA) is recorded onto the tape. This is an unavoidable by-product of the erase signal ramping on at the punch-in point and off at the punch-out point. The slower the Erase Ramp Duration, the less pronounced the LFA will be.

4.6.6.2 Bias Ramp Durations

The high frequency bias signal that is added to the program material when recorded onto tape is used to improve the distortion and frequency response characteristics of the tape.

Slowing down the Bias Ramp Duration makes the tape have a less-than optimum amount of bias being applied to it at the ramp on and ramp off points. The tape is in an underbiased condition at these points, and the amount of distortion present increases.

4.6.6.3 Effects of Adjustment

Faster Erase and Bias Ramp Durations are useful when musically tight or time critical punch-in and punch-outs are required. Although speeding up the Erase Ramp produces a more pronounced LFA, the faster Bias Ramp Duration lowers the amount of distortion that can be heard on tapes recorded with slower Bias Ramp Durations.

Slower Erase and Bias Ramp Durations are useful for simultaneous multiple channel punch-in and punch-outs, and where editing amid low level signals and/or periods of silence occurs. The slower Erase Ramp lowers the LFA, but the slower Bias Ramp produces higher distortion at the punch-in and punch-out points. However, the distortion should not be of any significant concern, as slower ramps are chosen to accommodate a punch-in or punch-out that does not have to be musically tight or time critical.

4.6.6.4 Adverse Effects

Changing both the Erase and Bias Ramp Durations so that they are significantly spaced apart from each other can cause holes and overlapping of program material at the punch-in and punch-out points. Unless there is a specific need to alter the machine's default settings, it is recommended that the user refrain from making indiscriminate adjustments.

It is also important to note that, at the bit level, the Edit In and Out Points of a Programmed Edit are specific to the center of the default Bias Ramp Duration. When the Bias Ramp Duration is set to a time greater than 36ms, it may be necessary to adjust the Edit In and Out Point Bit Synchronisations to maintain the same relationship to the center of the Bias Ramp. The following equation can be used to calculate how to adjust the Bit Synchronisation if this is the case:

Bit Adjustment = (Bias ramp duration in milliseconds /.75) - 32

SECTION 5 ROUTINE MAINTENANCE

5.1 INTRODUCTION

This section contains all of the routine maintenance procedures that must be performed on the **APR-24** at the designated intervals. These include hours meter replacement, cleaning, demagnetising, lubrication, and inspection/replacement procedures. Drawings illustrating the removal and opening of the cosmetic panels are also provided.

CAUTION:

DO NOT INSTALL OR REMOVE ANY OF THE CIRCUIT BOARDS WITH POWER APPLIED TO THE MACHINE.

5.2 HOURS METER

The **APR-24** has an hours meter which displays the total accumulated play time of the machine. The meter is used to determine when the maintenance items listed in Table 5-1 need to be performed, and must be replaced every 5000 hours.

The meter is located inside the local control panel, as shown in Figure 5-11. Removing the two 4x30 screws on the side of the panel allows it to open forward on its hinges and expose the meter. Figure 5-1 illustrates how to remove the meter from the control board bracket assembly for replacement.

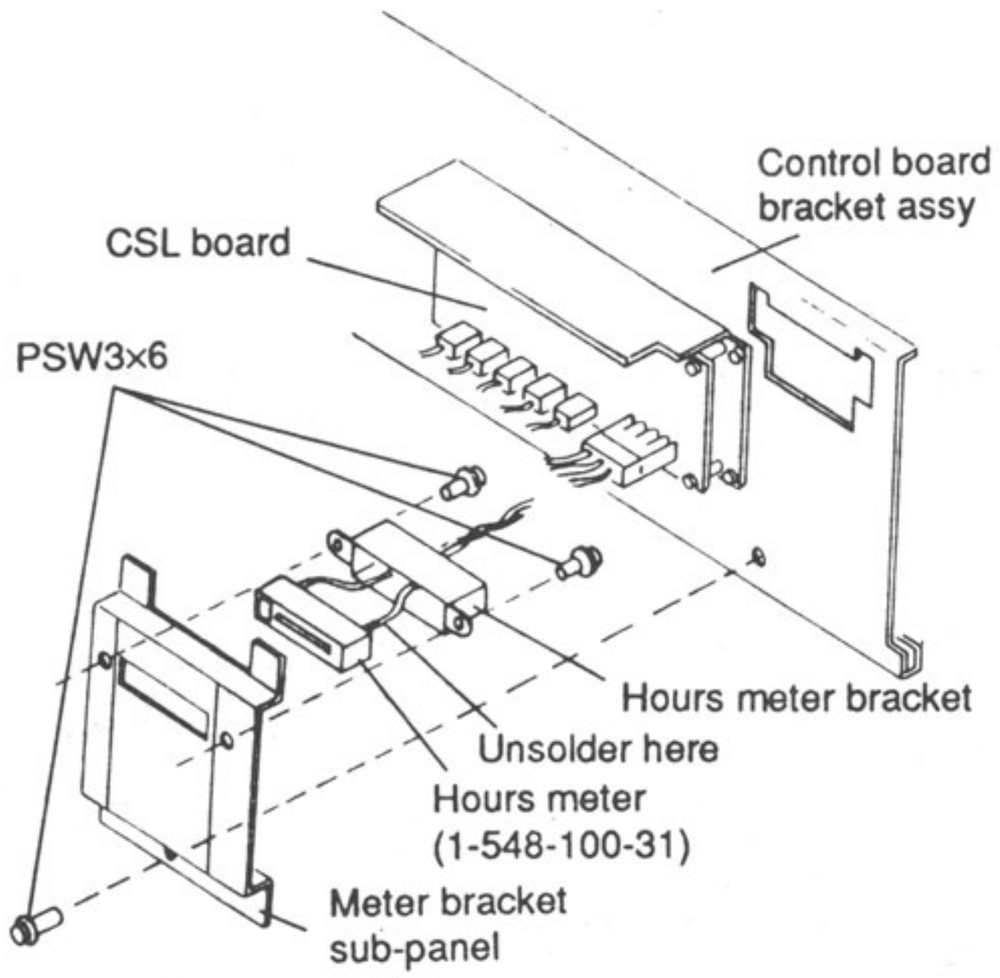


Figure 5-1. Hours Meter Replacement

5.3 ROUTINE MAINTENANCE SCHEDULE

Table 5-1 is the routine maintenance schedule for the **APR-24**. Specific cleaning, demagnetising, lubrication, and inspection/replacement procedures can be found in the ensuing paragraphs.

	PLAY TIME IN HOURS							
	10	20	100	500	1000	2500	5000	10K
Heads	C	D						
Tape Path, Stationary Guides	C	D			I			
Tape Path, Moving Guides		D	C					
Tape Guides	C				I		R	
Head Azimuth			I					
Head Height					I			
Timer Roller				C				
Timer Roller Assembly								R
Timer Roller Bearings					I		R	
Timer Roller Rotation Noise					I			
Guide Rollers								R
Guide Roller Bearings					I		R	
Guide Roller Rotation Noise					I			
Tension Arm Rollers								R
Tension Arm Pivot Bushings					L			
Tension Arm Bearings					I		R	
Tension Arm Rotation Noise					I			
Lifters					I/L			
Shields					I/L			
Pinch Roller		C						
Pinch Roller Assembly				I	L	R		
Pinch Roller Pressure					I			
Reel Motor Brakes					I			
Reel Motor Brake Torque					I			
Reel Motor Rotation Noise					I			
Tape Tension					I			
FF/REW Speeds					I			
Capstan Motor Shaft	C							
Capstan Motor Rotation Noise					I			
Wow and Flutter						I		
Power Supply Voltages							I	
Hours Meter							R	

C = Clean; D = Demagnetise; I = Inspect; L = Lubricate; R = Replace.

Table 5-1. Routine Maintenance Schedule

5.3.1 Cleaning

Figure 5-2 shows the location of the parts which need to cleaned at the intervals listed in Table 5-1.

The heads, tape guides, and tape path guides must be cleaned every ten hours using photographic grade chamois or foam swabs (Sony part number 2-034-697-00) moistened with cleaning fluid or methanol (Sony part number Y-2031-001-0). Do not spill any cleaning fluid into the guide roller bearings when cleaning the moving tape path guides.

The pinch roller, timer roller, and capstan motor shaft must be cleaned using a non-detergent household cleaner. Do not use cleaning fluid on the pinch roller or the timer roller, since this will cause the rubber on these parts to deteriorate.

To clean the capstan motor shaft, remove the tape and pinch roller, and cover the EOT sensor with opaque material. Press EDIT and PLAY. Apply the non-detergent cleaner to a lint-free cleaning cloth or cotton swab, and, as shown in Figure 5-3, move the swab vertically along the capstan shaft. Keep a dry swab underneath the damp swab to avoid getting any cleaning fluid into the upper bearing of the capstan motor. The lifespan of the capstan motor will be drastically reduced if any fluid enters either of the capstan motor bearings.

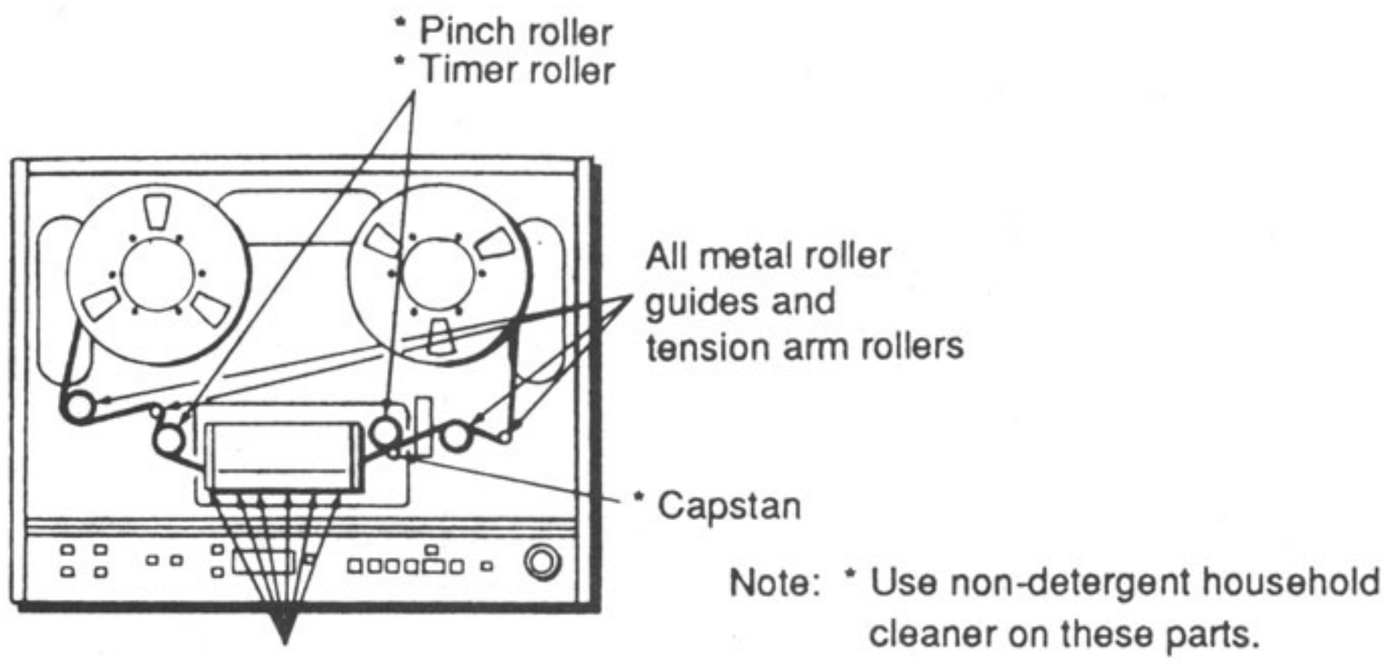


Figure 5-2. Parts Requiring Cleaning

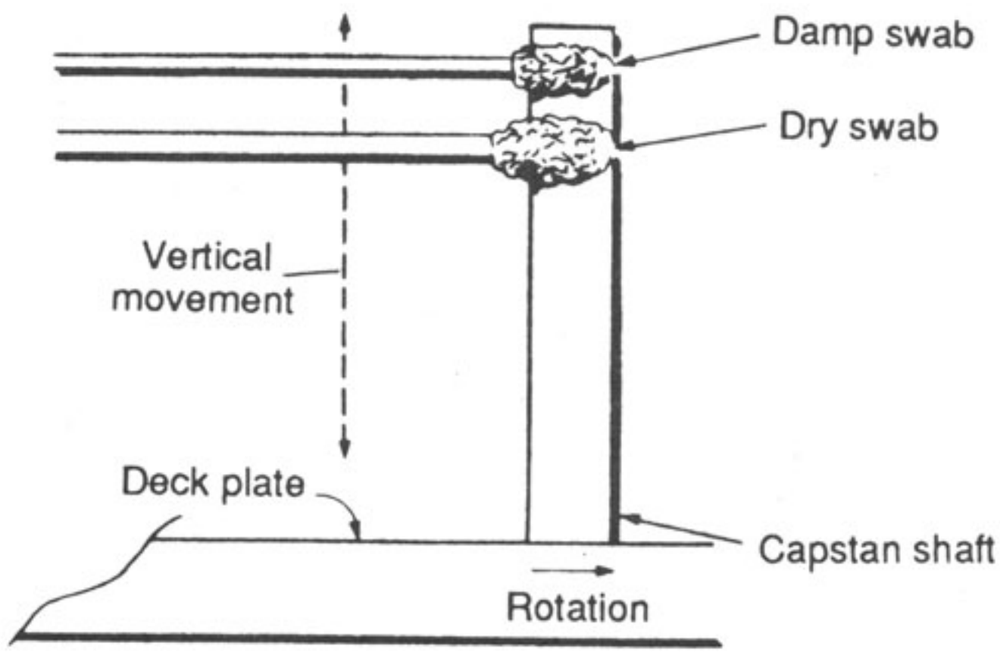


Figure 5-3. Cleaning the Capstan Motor Shaft

5.3.2 Demagnetising

The headstack and tape path components should be demagnetised every twenty hours. After only a few hours of use these surfaces become slightly magnetised, and, in extreme cases, tape passing over a magnetised head or tape guide can become partially erased.

Before beginning any demagnetisation, make sure that the machine is powered off. Then start a circular motion with the degausser approximately eighteen inches away from the front of the component, as shown in Figure 5-4. Slowly move the degausser closer to the component until the degausser is within 1/16 of an inch of the component, ensuring that the component and the degausser do not make contact. Continue the circular motion and slowly move the degausser away from the component until the distance between them is approximately three feet.

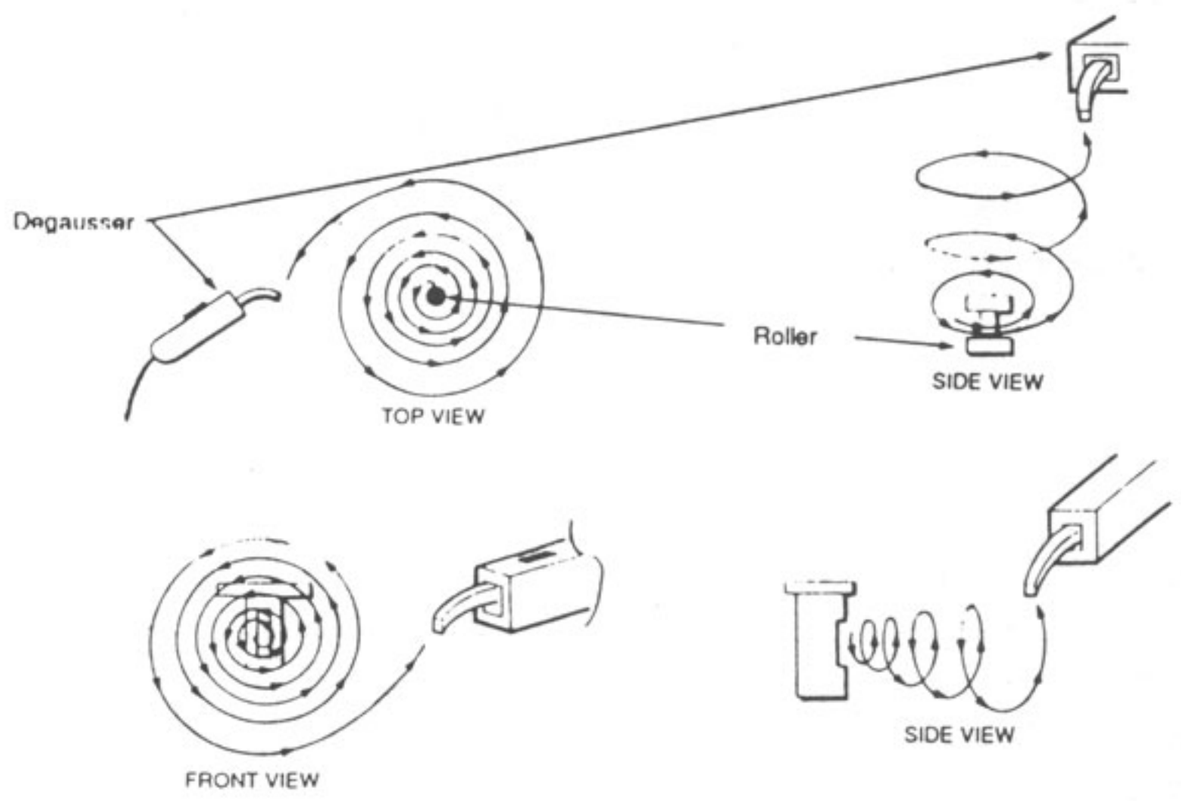


Figure 5-4. Demagnetising Technique

5.3.3 Lubrication

Lubrication of the pinch roller, tension arm, lifter, and shield assemblies is described in the following paragraphs. These components must be lubricated every 1000 hours with Sony Oil (Sony part number 7-661-018-01). The cosmetic top panel must be removed, as shown in Figure 5-10, in order to expose these assemblies for lubrication.

5.3.3.1 Pinch Roller Assembly

Remove the top "C" ring from the pinch roller pivot, as shown in Figure 5-5. Apply two drops of oil to the pivot bushing and reinstall the "C" ring.

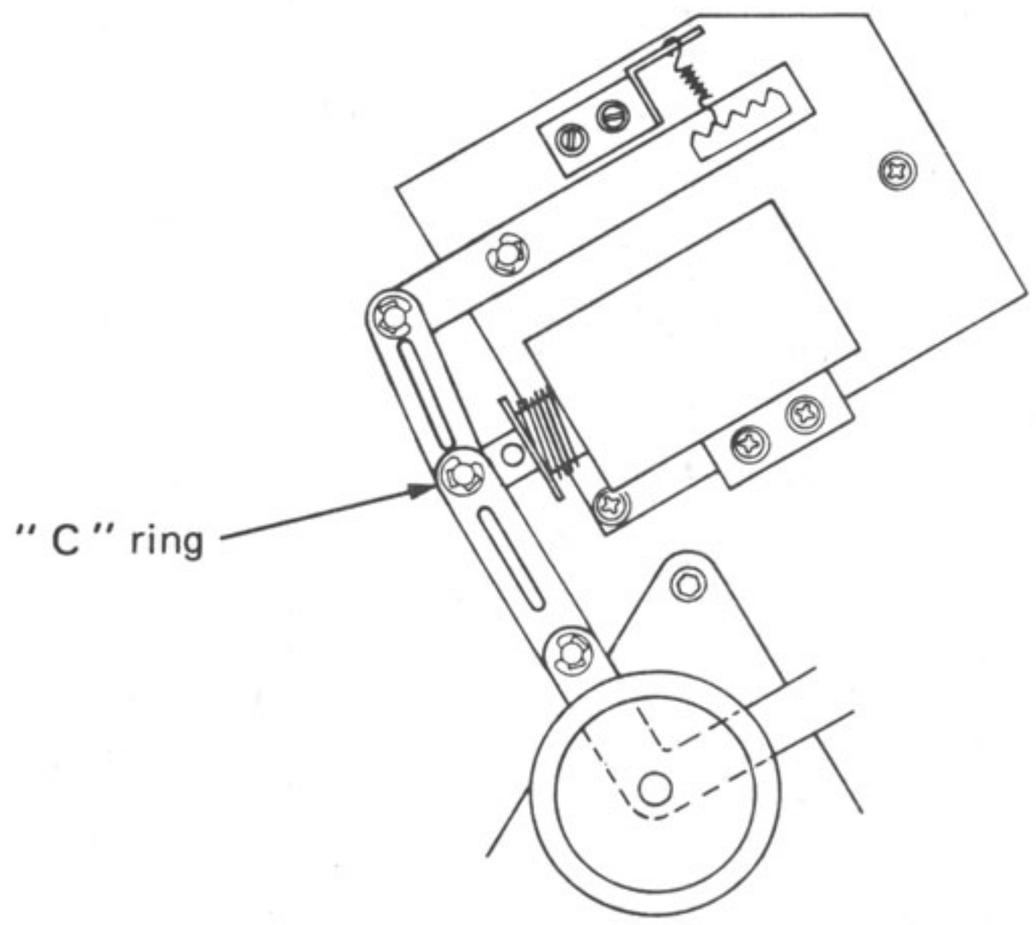


Figure 5-5. Pinch Roller Assembly

5.3.3.2 Tension Arm Assemblies

Apply two drops of oil to the supply side tension arm pivot bushing, as shown in Figure 5-6, and two drops to the take-up tension arm pivot bushing, as shown in Figure 5-7.

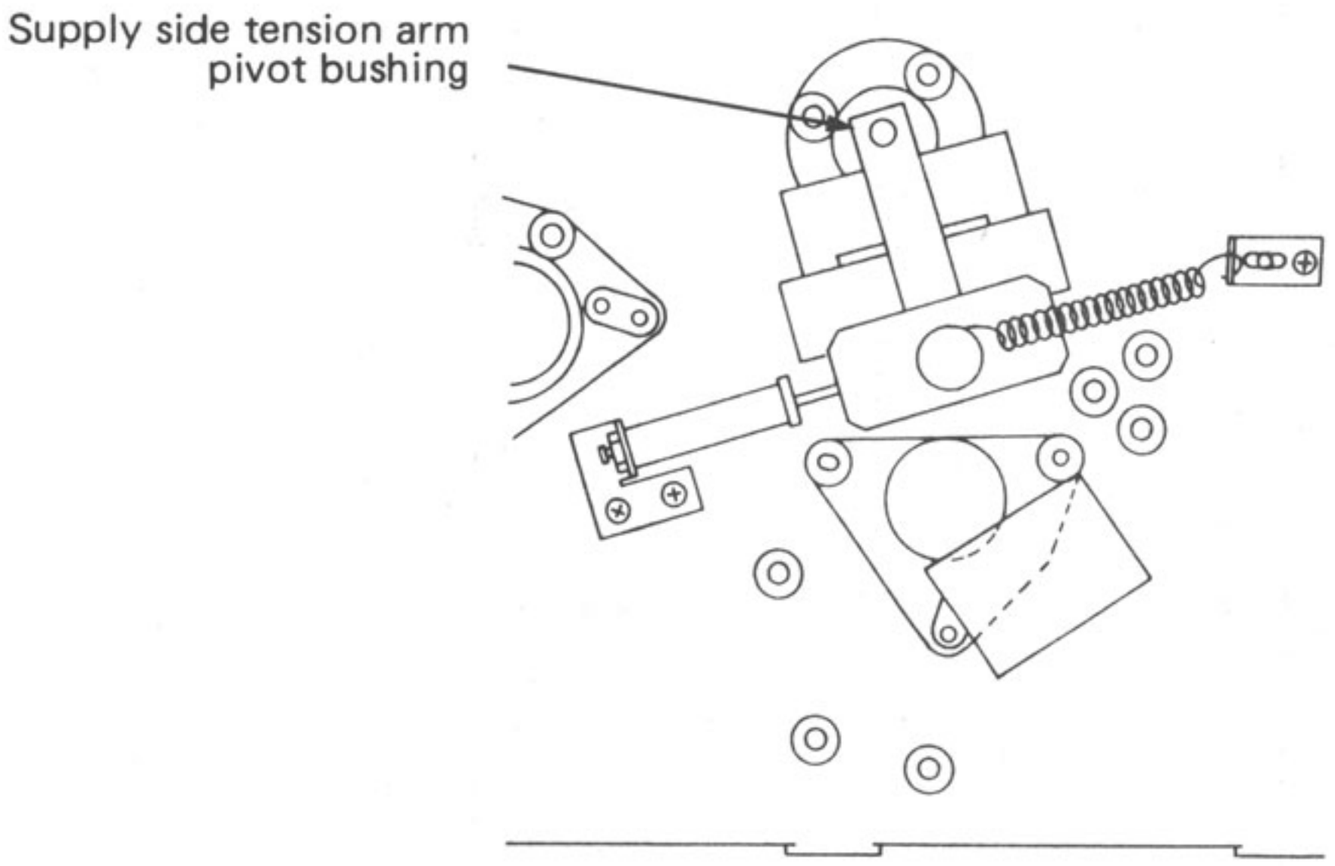


Figure 5-6. Supply Tension Arm

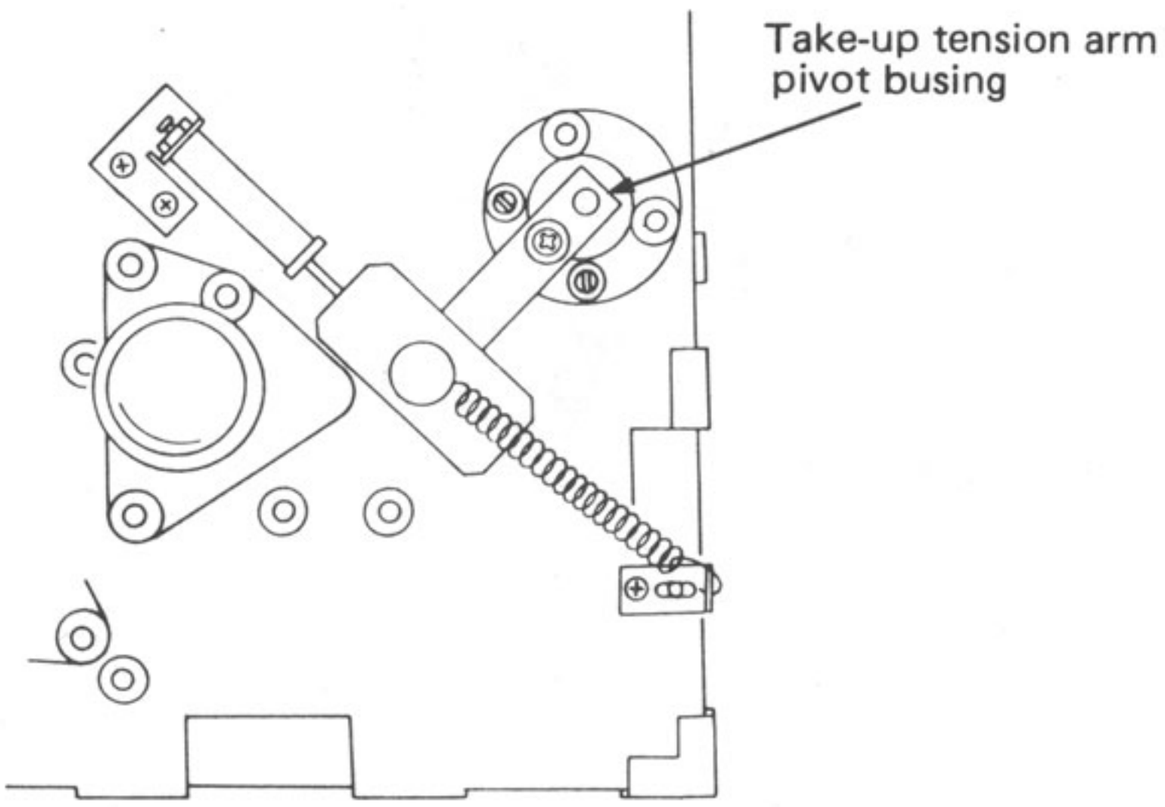


Figure 5-7. Take-Up Tension Arm

5.3.3.3 Lifter Assembly

Push the shields down to expose the lifter assembly. Apply one drop of oil to each of the three pivot points shown in Figure 5-8.

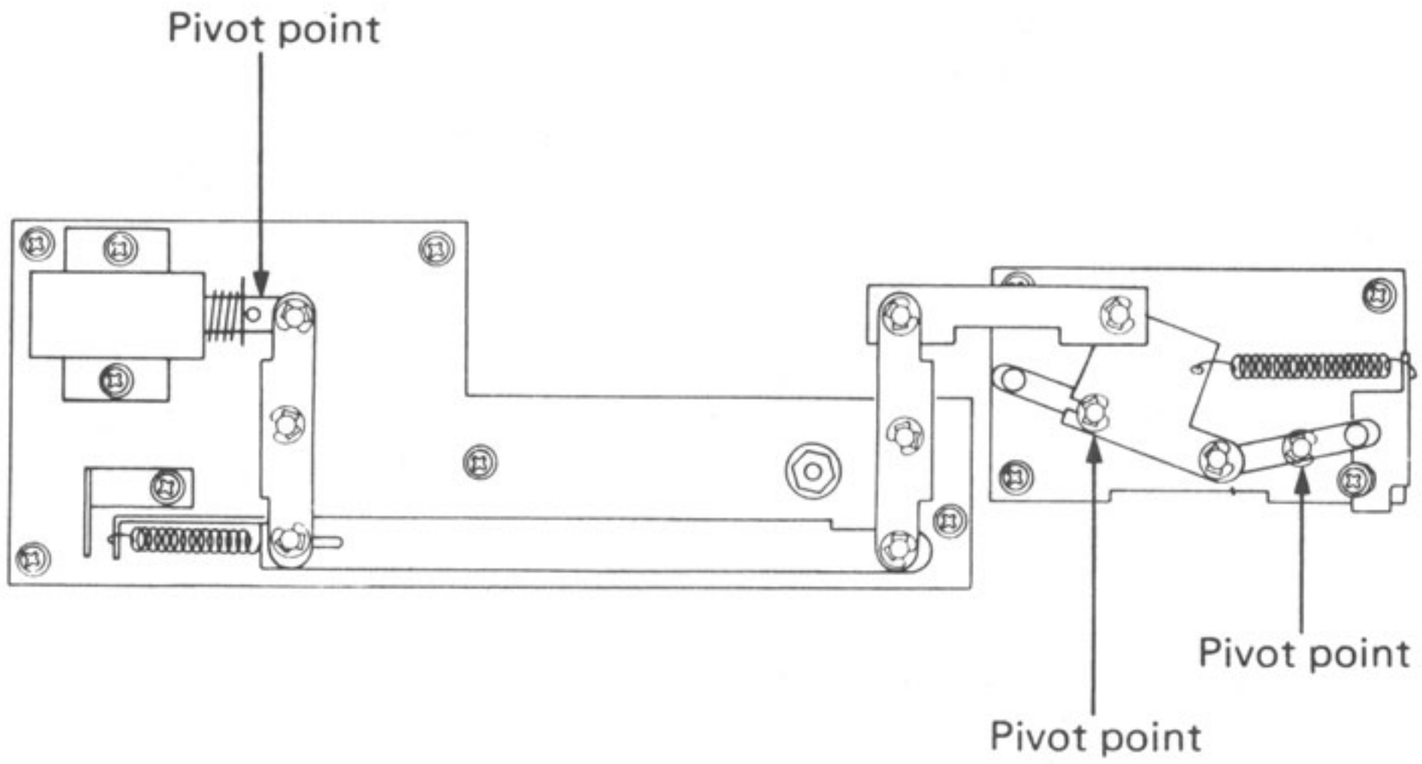


Figure 5-8. Lifter Assembly

5.3.3.4 Shield Assembly

Push the shields down about one inch. Apply two drops of oil to each of the shield shaft bushings shown in Figure 5-9.

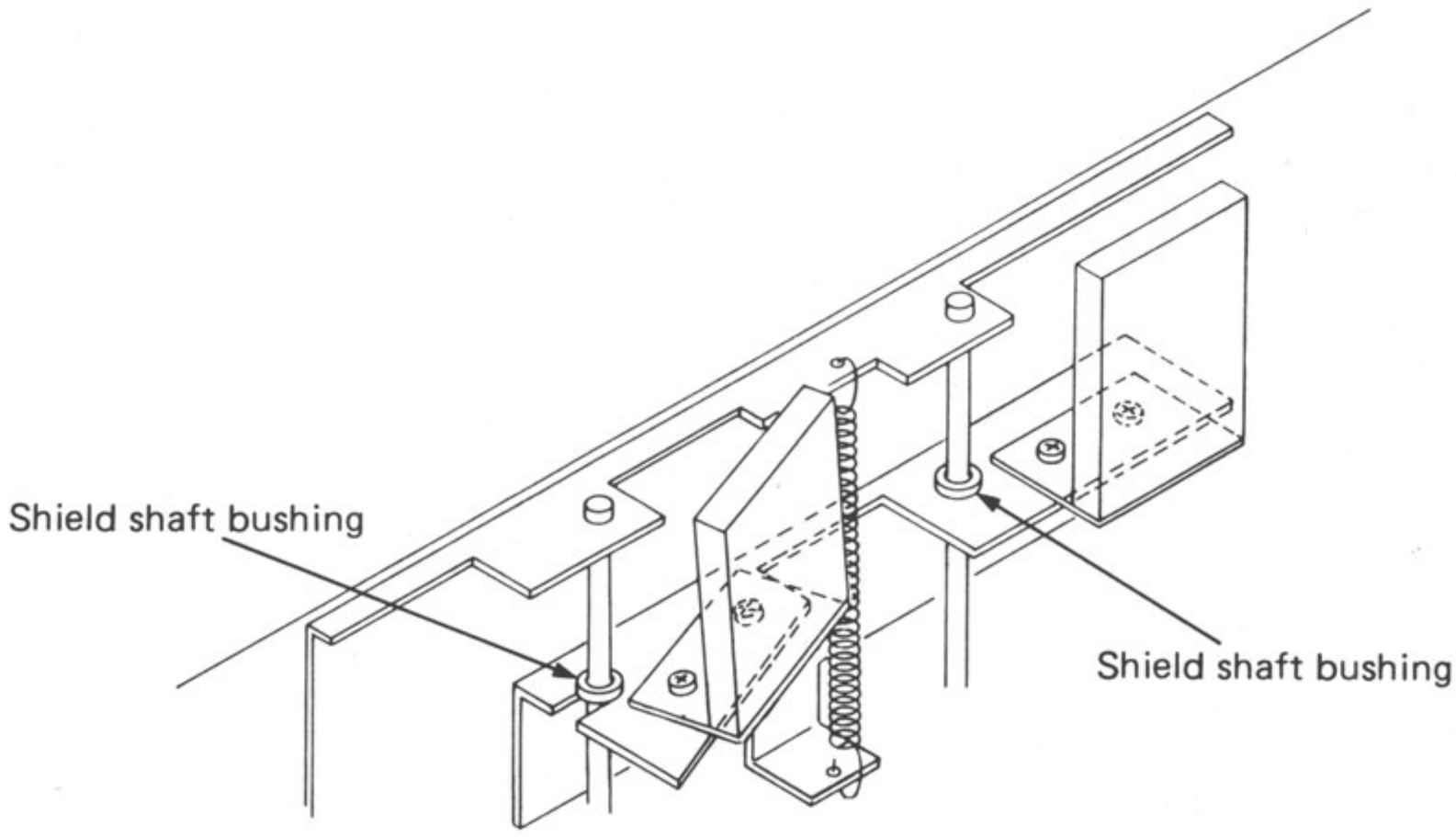


Figure 5-9. Shield Assembly

5.3.4 Inspection/Replacement

Table 5-2 lists where the inspection/replacement procedures for the given items can be found in the manual.

Tape Path (Heads, Rollers, Tension Arms)	- Section 6.3
Lifters	- Section 6.4
Shields	- Section 6.7
Pinch Roller Pressure	- Section 6.5
Reel Motor Brakes	- Section 6.6
Tape Tension	- Section 7.3
Power Supply Voltage Check	- Section 5.5

Table 5-2. Inspection/Replacement Index

5.4 PANEL REMOVAL AND OPENING

The following figures illustrate the removal and opening of the various cosmetic panels on the **APR-24**. A standard US and Metric tool kit is required.

5.4.1 Top Panel

Figure 5-10 illustrates how to remove the cosmetic top panel. Removing the top panel exposes the HES board, RTS/TTS boards, reel motor brakes, pinch roller assembly, capstan motor, lifters, shields, and all of the other tape path components.

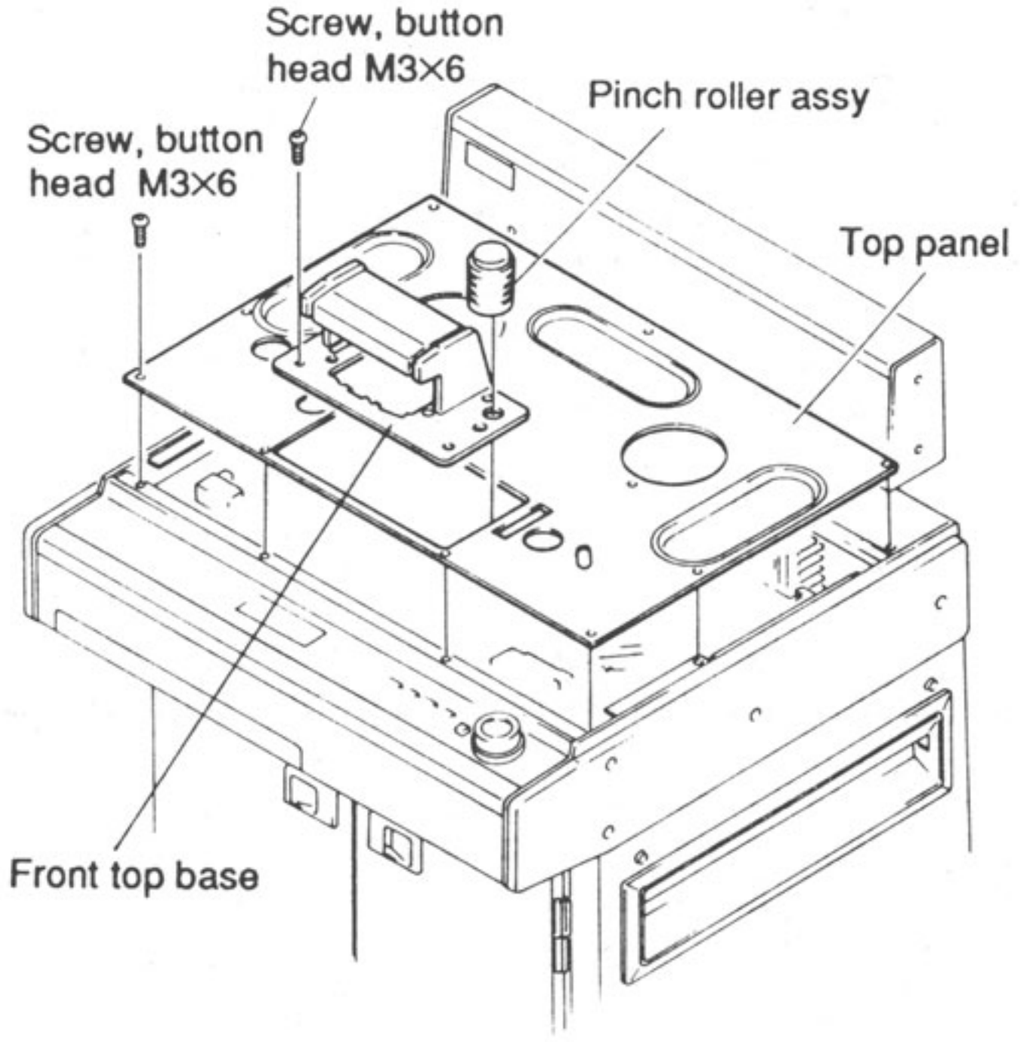


Figure 5-10. Top Panel Removal

5.4.2 Local Control Panel

Removing the two 4x30 screws on the side of the machine, as shown in Figure 5-11, allows the local control panel to open on its hinges, thereby exposing the headstack ID DIP switch, hours meter, and MFP, CPU, TIB, CSL, and MFC boards.

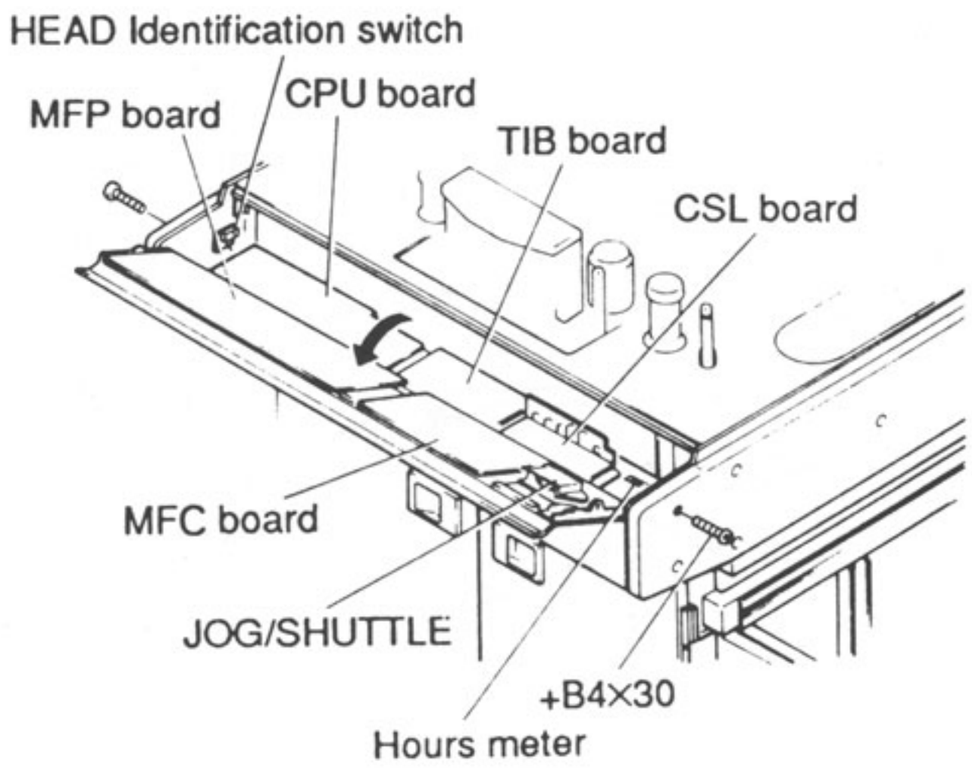


Figure 5-11. Local Control Panel Opening

5.4.3 Front Doors

Opening the front doors exposes the CNL and the MST cards, as well as the front of the power supply. Figure 5-12 illustrates how to remove the doors from their hinges.

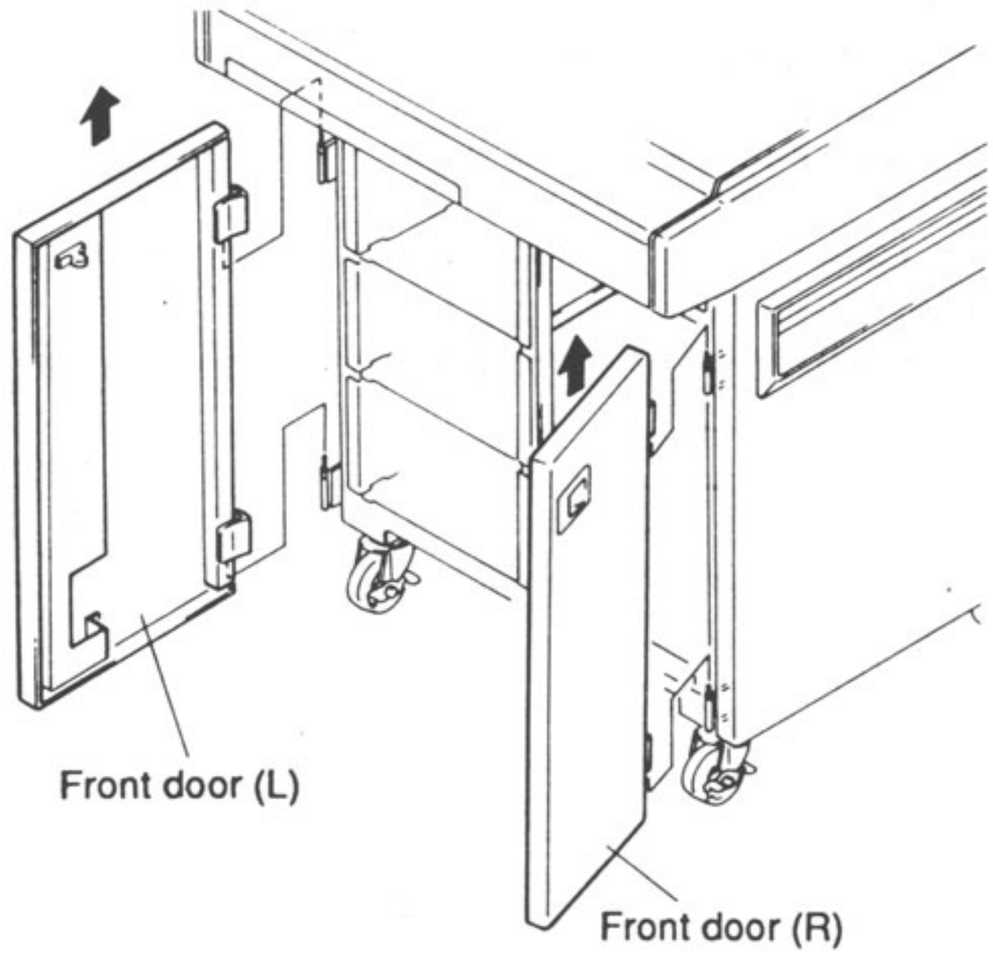


Figure 5-12. Front Door Removal

5.4.4 Meter Housing Rear Panel

Unfastening the six 3x5 screws on the meter housing rear panel allows for the removal of the panel, thereby exposing the VU meter, ASB board, and BDS boards, as shown in Figure 5-13.

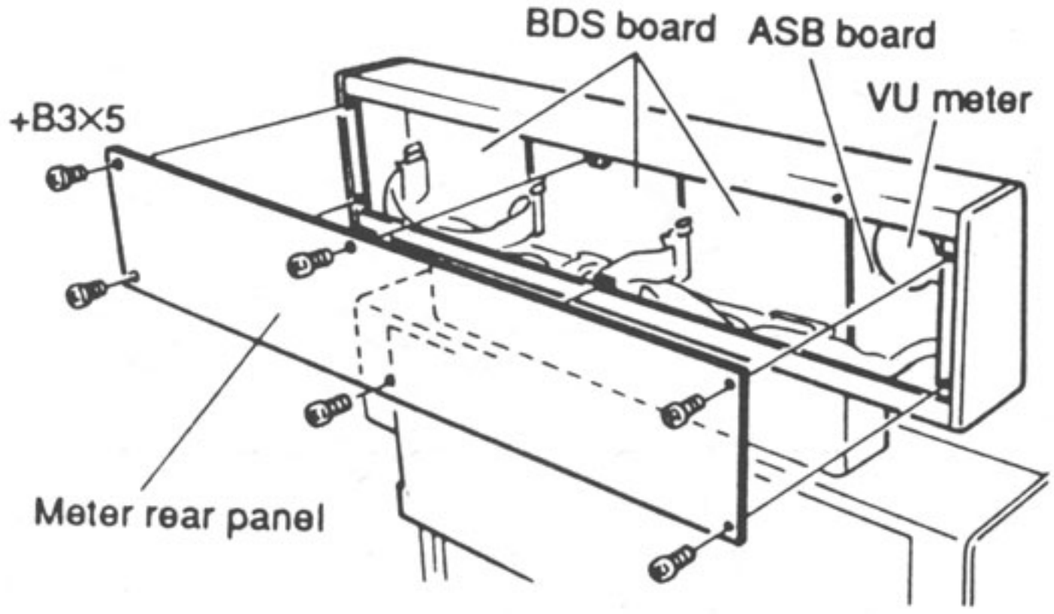


Figure 5-13. Meter Housing Rear Panel Removal

5.4.5 Audio and Transport Rear Panels

Figure 5-14 shows the location of the transport, audio, and power supply rear panels.

Removing the three 4x6 screws on the transport rear panel allows the panel to swing down and expose the MFX boards and audio wiring of the machine. Removing the three 4x6 screws on the audio rear panel allows the panel to swing out and expose the RMD-II, CSC, MRA, VVT, and LNT boards.

Removing the two 4x6 screws on the top power supply rear panel allows the panel to swing out to expose the PCP board. Removing the two 3x6 screws on the power supply bottom rear panel unfastens the panel and exposes the power supply connector strip.

Figure 5-15 shows the locations of the various audio and transport boards that become accessible once these panels are opened.

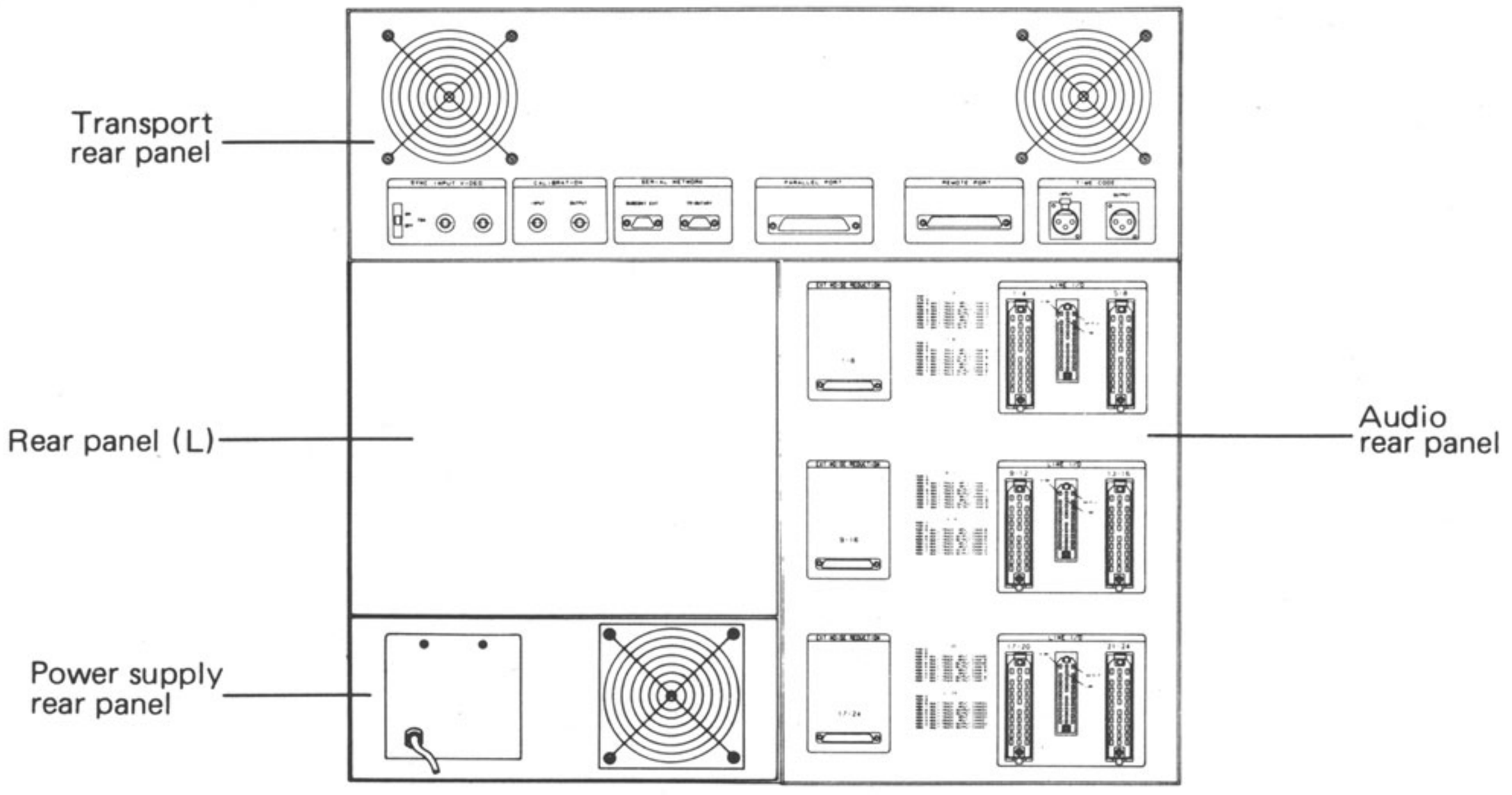


Figure 5-14. Audio and Transport Rear Panels

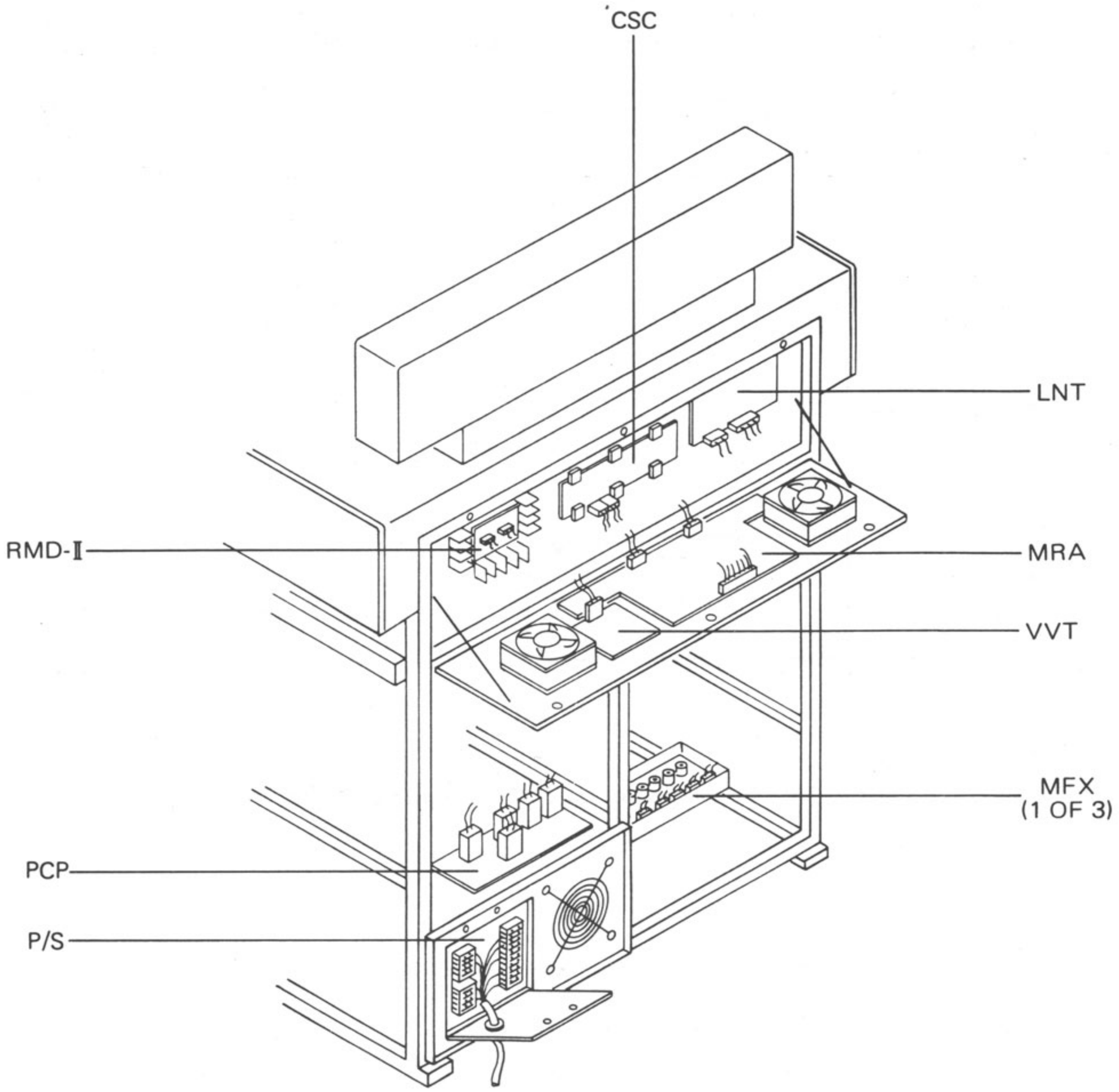


Figure 5-15. Rear Panel Audio and Transport Boards

5.4.6 Power Supply Removal

Figure 5-16 illustrates how to remove the power supply from the machine for troubleshooting and/or replacement.

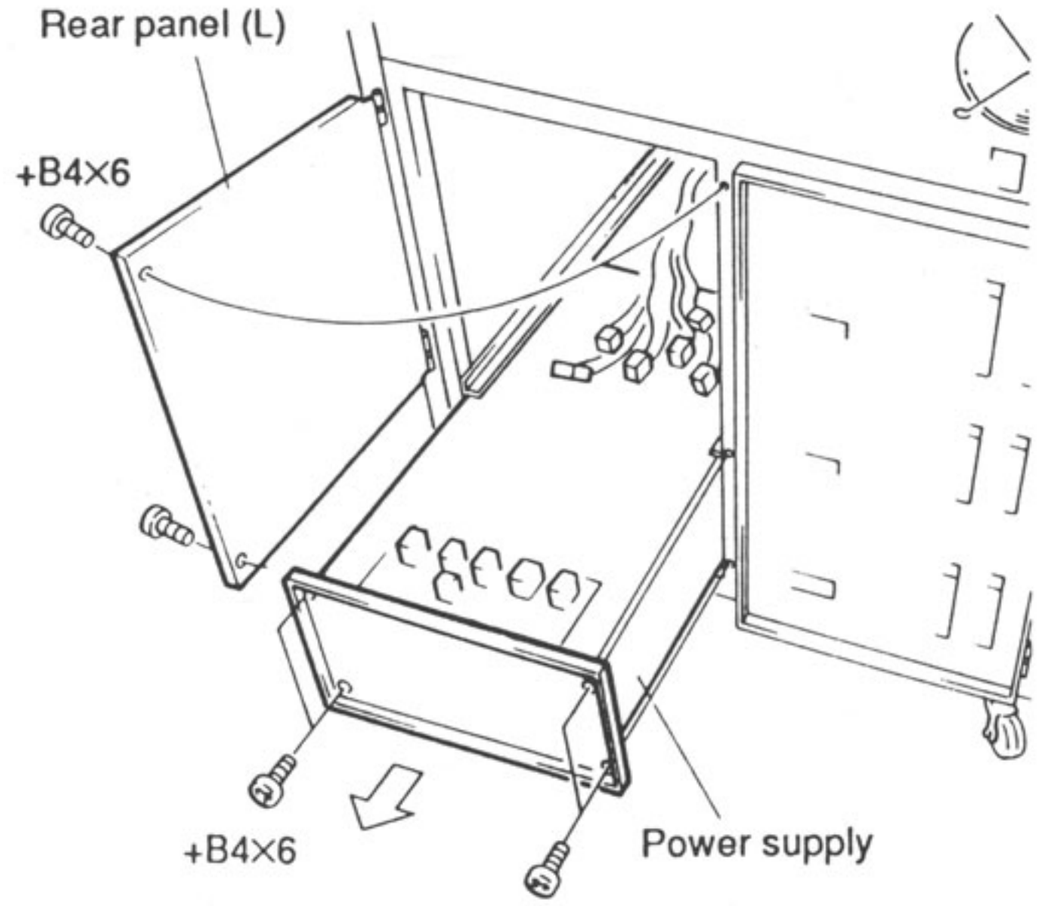


Figure 5-16. Power Supply Removal

5.5 POWER SUPPLY VOLTAGE CHECK

The PCP board, as shown in Figure 5-17, provides power connection points for the various circuit boards on the **APR-24**. It is located on top of the power supply.

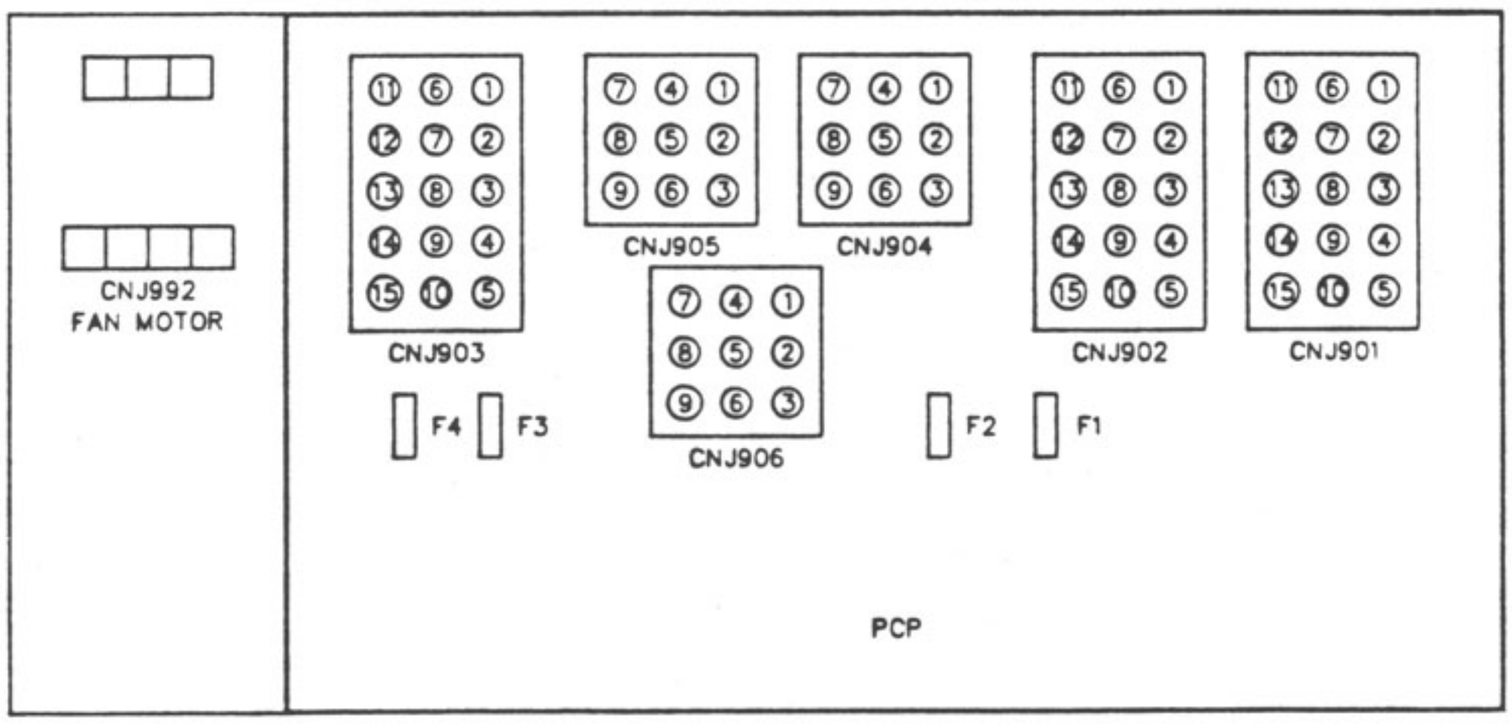


Figure 5-17. PCP Board

The power supply voltages should be checked every 5000 hours to ensure that they are within the specified tolerances. Tables 5-3 and 5-4 list the voltages as found on the six PCP board connectors together with their tolerances.

Ensure that all the connectors are connected for a full load when measuring the voltages. When checking CNJ903 pin 4, use pin 10 as the ground, and for pins 7 and 8 use either pins 1, 2, or 3 as the ground reference. For all other voltages use the chassis as ground reference.

CNJ901		CNJ902		CNJ903	
PIN		PIN		PIN	
1	+5V, +/-5%	1	Chassis	1	Return Gnd, Pins 7 and 8
2	+5V, +/-5%	2	+5V, +/-5%	2	Return Gnd, Pins 7 and 8
3	Analog Gnd	3	N/C	3	Return Gnd, Pins 7 and 8
4	Analog Gnd	4	N/C	4	+24V unregulated, +/-20%
5	Analog Gnd	5	N/C	5	Chassis
6	+18V, +/-5%	6	+24V, +/-5%	6	Chassis
7	-18V, +/-5%	7	+15V, +/-5%	7	+11V unregulated, +/-20%
8	-18V, +/-5%	8	-15V, +/-5%	8	+11V unregulated, +/-20%
9	-18V, +/-5%	9	Digital Gnd	9	N/C
10	+5V, +/-5%	10	Power Down Imminent	10	Return Gnd, Pin 4
11	Chassis	11	Chassis	11	Chassis
12	Chassis	12	Chassis	12	+5V, +/-5%
13	Chassis	13	+5V, +/-5%	13	+15V, +/-5%
14	+18V, +/-5%	14	+5V, +/-5%	14	-15V, +/-5%
15	+18V, +/-5%	15	Analog Gnd	15	Analog Gnd

Table 5-3. PCP Connectors CNJ 901, 902, 903

CNJ904		CNJ905		CNJ906	
PIN		PIN		PIN	
1	Analog Gnd	1	-15V, +/-5%	1	-15V, +/-5%
2	+24V, +/-5%	2	Analog Gnd	2	N/C
3	-24V, +/-5%	3	N/C	3	N/C
4	N/C	4	Chassis	4	Chassis
5	Chassis	5	+24V, +/-5%	5	+15V, +/-5%
6	+5V, +/-5%	6	+15V, +/-5%	6	Analog Gnd
7	+36V, unregulated	7	Chassis	7	+5V, +/-5%
8	Analog Gnd	8	+5V, +/-5%	8	Lamp Gnd
9	-36V, unregulated	9	N/C	9	+5V Lamp

Table 5-4. PCP Connectors CNJ 904, 905, 906

SECTION 6 MECHANICAL ADJUSTMENTS

6.1 INTRODUCTION

This section describes the adjustments for the mechanical aspects of the **APR-24**. These adjustments include tape path, lifters, pinch roller, reel motor brakes, and shields. In order to gain access to these parts, the cosmetic top panel must first be removed, as described and illustrated in Section 5.4.1.

These adjustments should only be made if a part is replaced or if a problem is discovered during a routine maintenance inspection. The Routine Maintenance Schedule can be found in Section 5.3.

6.2 TOOLS

The following is a list of the tools necessary to perform the mechanical adjustments.

Tools	**Sony Part No.**
Technician's Tool Kit	US and Metric standard tools
Torque Driver	J-6103-860-A
Zenith Block, 2"	J-6221-460-A
Reel Height Gauge	J-6221-440-A
Reel Shim .005"	T-9455-110-1
Reel Shim .010"	T-9455-111-1
Reel Shim .020"	T-9455-112-1
Roller Height Fixture	J-6220-910-A
Roller Guide Shim 20um	3-651-334-01
Roller Guide Shim 50um	3-651-334-11
Roller Guide Shim 100um	3-651-334-21
5kg Tension Scale	J-6041-640-A
200g Tension Scale	J-6041-630-A
Sony Oil	7-661-018-01
Tape, 2"	Scotch 226

6.3 TAPE PATH

The components that determine the tape path are the headstack, guide rollers, reel motors, tension arms, timer roller, capstan motor, and lifters. It is strongly advised not to adjust the tape path unless a tape path component has been replaced.

6.3.1 Headstack

It is essential that the headstack be properly aligned before beginning any tape path adjustments, as the three tape guides in the headstack serve as the foremost datum plane for the overall tape path. Even the smallest misalignment may cause errors in level and response that could be mistakenly attributed to the electronics. When a tape guide is replaced, it is necessary to check, and adjust if necessary, all of the tape path components.

Once the head zenith and height have been adjusted, the head azimuth and wrap must be checked, and adjusted if necessary, as described in Section

7.5.3. Figure 6-1 shows the location of the head adjustment screws. The zenith, height, and azimuth adjustment screws on the headstack all require a 2mm hex driver for adjustment, while a flatblade screwdriver is used to adjust the wrap.

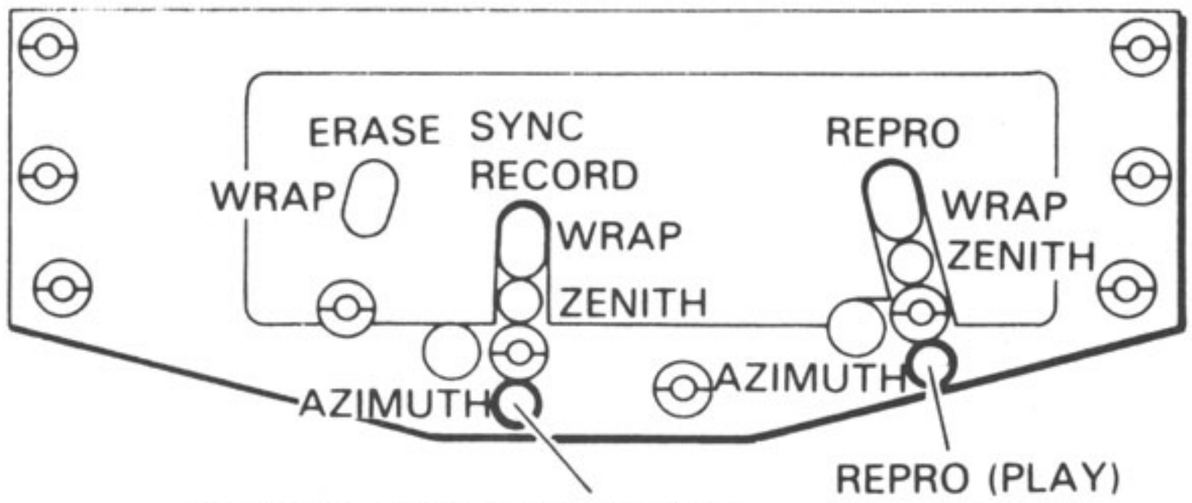


Figure 6-1. Head Adjustment Screws

6.3.1.1 Head Zenith

STEP 1. Ensure that the power is OFF. Remove the headstack cover and lift the nine U-shaped head connector handles on the rear of the headstack from their connectors.

STEP 2. Unfasten the four head stack mounting screws using a 2.5 mm hex driver, and remove the headstack from the machine.

STEP 3. Position one end of the 2" zenith block against the left tape guide and the other end against the erase head surface, applying light pressure to the zenith block at the tape guide end.

STEP 4. Observe the clearance between the zenith block and the erase head surface, and ensure that no light is visible.

STEP 5. Position one end of the zenith block against the erase head surface and the other end against the sync head surface, applying light pressure to the zenith block at the erase head end.

STEP 6. Observe the clearance between the zenith block and the sync head surface, and adjust the zenith screw of the sync head until no light is visible.

STEP 7. Position one end of the zenith block against the sync head surface and the other end against the center guide surface, applying light pressure to the zenith block at the sync head end.

STEP 8. Observe the clearance between the zenith block and the center guide surface, and ensure that no light is visible.

STEP 9. Position one end of the zenith block against the center guide surface and the other end against the repro head surface, applying light pressure at the center guide end.

STEP 10. Observe the clearance between the zenith block and the repro head surface, and adjust the zenith screw of the repro head until no light is visible.

STEP 11. Position one end of the zenith block against the repro head and the other end against the right tape guide surface, applying light pressure to the zenith block at the repro head end.

STEP 12. Observe the clearance between the zenith block and the right tape guide surface, and ensure that no light is visible.

STEP 13. Proceed to the Head Height procedure and adjust if necessary.

6.3.1.2 Head Height

STEP 1. Install the headstack onto the machine, and tighten the four headstack mounting screws using a 2.5mm hex driver.

STEP 2. Ensure that the power is ON, and load a reel of tape onto the machine.

STEP 3. Press PLAY and observe the tape movement across the repro and sync heads. The tape should be centered between the two grooves in the top and bottom surface of each head.

STEP 4. If necessary, turn the head height adjustment screw to raise or lower the head so that it is centered between the two grooves.

STEP 5. Turn the zenith adjustment screw the same number of turns and in the same direction as the height screw was turned in STEP 4.

STEP 6. Turn the azimuth screw the same number of turns in the opposite direction as that in STEPS 4 and 5 to compensate for the tilt caused by adjusting the head height.

STEP 7. Return to the Head Zenith procedure and adjust if necessary.

6.3.1.3 Head Azimuth and Wrap

Once the head zenith and height have been adjusted, the head azimuth and wrap must be adjusted as described in Section 7.5.3.1.

6.3.2 Individual Components

Once the headstack has been mechanically aligned, then the other tape path components can be checked, and adjusted if necessary. Figure 6-2 shows the location of the individual tape path components.

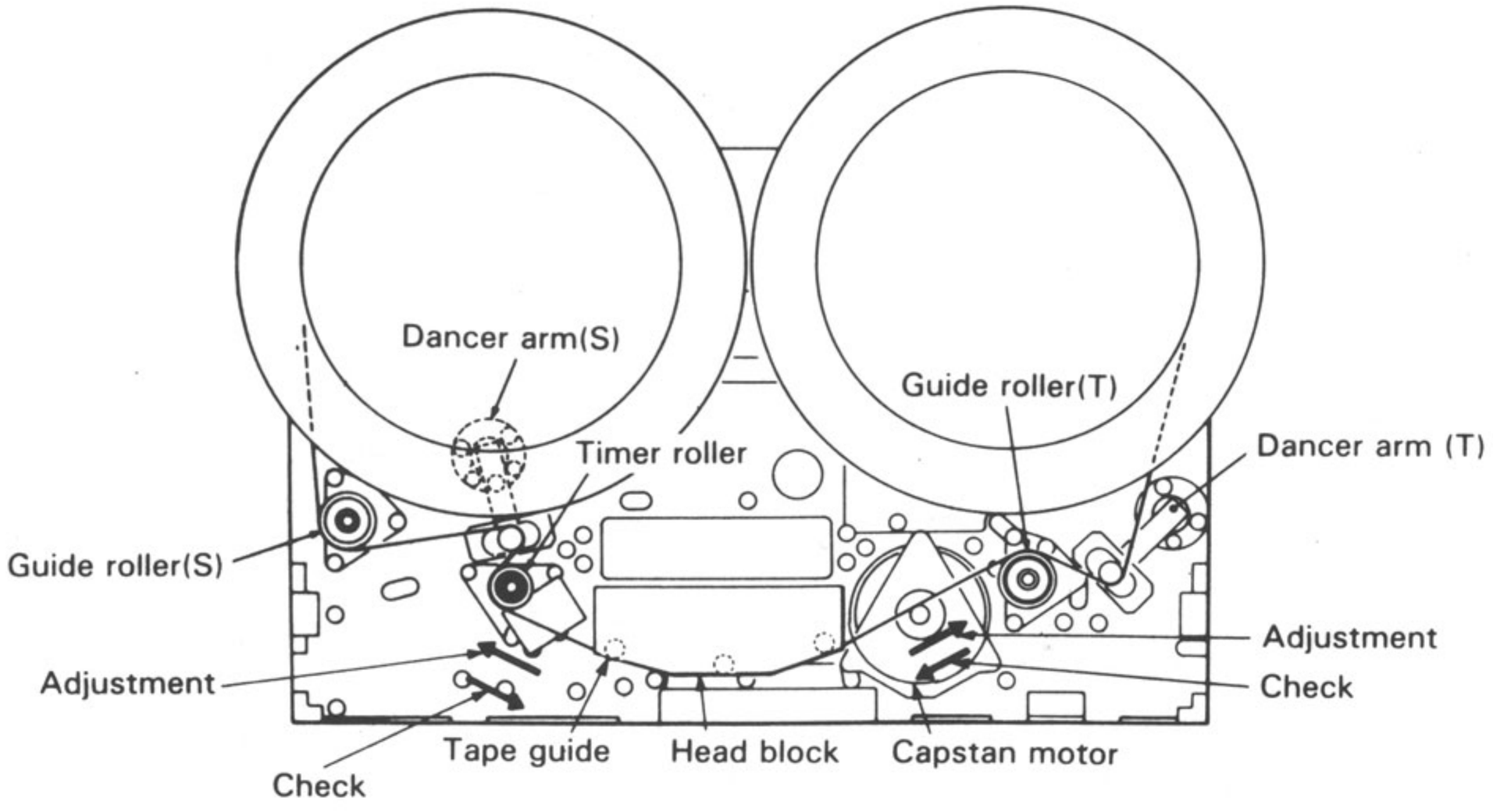


Figure 6-2. Tape Path Components

6.3.2.1 Guide Rollers (S and T)

The two guide rollers (S and T) serve as the foremost datum plane for the reel motor height and tension arm adjustments. These rollers should not be shimmed or adjusted during the normal tape path alignment.

If an unsuitable amount of tape curl is observed on either roller after all of the other individual tape path adjustments have been made, then adjustment of the guide rollers may be undertaken using the same method as outlined in the Timer Roller Perpendicularity procedure described later in this section.

6.3.2.2 Reel Table Height

Before installing a reel motor or to check the motors already installed in a machine, use the reel height gauge as shown in Figure 6-3. If it is necessary to adjust the height of a reel table, use the following procedure.

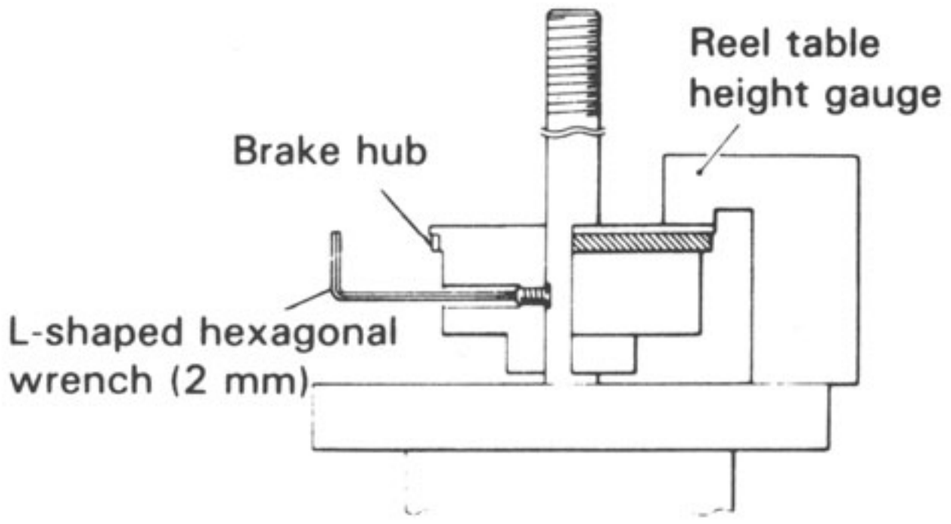


Figure 6-3. Reel Table Height

STEP 1. Loosen the set screw in the brake hub as shown in Figure 6-3 using a 2mm hex wrench.

STEP 2. Adjust the table height so that it is perpendicular to the gauge.

STEP 3. Tighten the set screw back into place.

6.3.2.3 Supply Motor Height

The height of the supply motor is adjusted so that the tape travels in the middle of the guide roller (S). Figure 6-4 shows the various parts of the reel motor assembly.

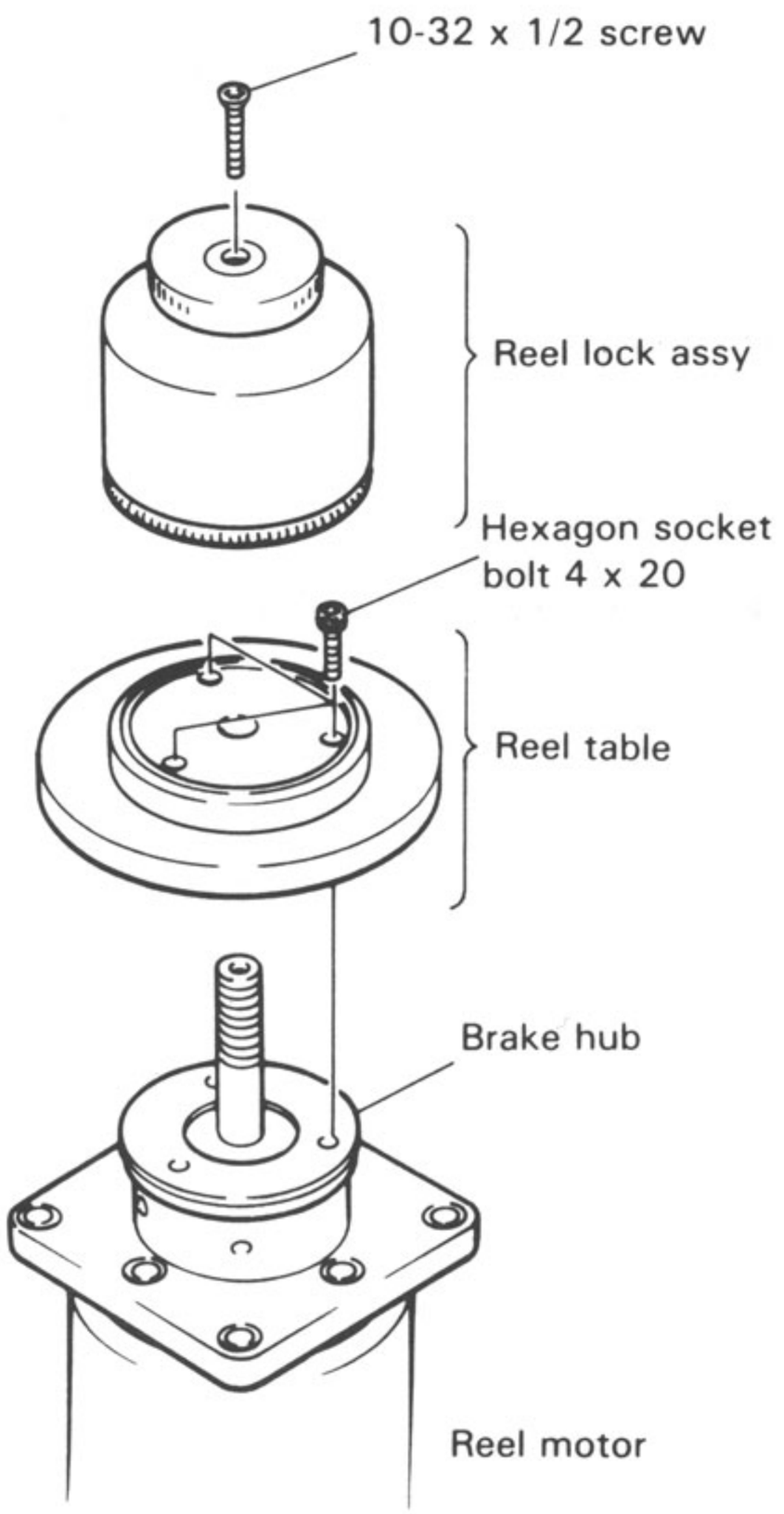


Figure 6-4. Reel Motor Assembly

STEP 1. Load a roll of tape onto the machine and Fast Forward the tape until the supply eel is nearly empty.

STEP 2. Put the machine in Rewind/Shuttle mode, and observe the tape as it exits the guide roller (S) into the supply reel.

STEP 3. Ensure that the tape is not curling at either the top or bottom of the roller.

STEP 4. If the tape is riding at the top of the roller the reel height is too high; if it is riding at the bottom of the roller the reel height is too low. If either case exists proceed to STEP 5.

STEP 5. Remove the tape from the machine.

STEP 6. Refer to Figure 6-4. Loosen the 10-32 x 1/2 screw on the reel lock assembly using a 1/8" hex driver.

STEP 7. Loosen the reel lock assembly top and remove both pieces of the reel lock assembly.

STEP 8. Remove the three 4x20 hexagon socket bolts on the reel table using a 3mm hex wrench, and remove the reel table.

STEP 9. Add or delete the appropriate amount of reel shims to the top of the brake hub as determined in STEP 4.

STEP 10. Assemble the reel table and reel lock assembly back onto the brake hub, and return to STEP 1.

6.3.2.4 Take-Up Tension Arm Perpendicularity

Before adjusting the take-up motor height, it is necessary to check that the take-up tension arm does not move the tape too far up or down in either Shuttle mode, thus causing the guide roller (T) to curl the tape at the reel.

The take-up tension arm rarely, if ever, requires shimming. However, if it is unquestionably apparent that adjustment is necessary, refer to the Supply Tension Arm Perpendicularity procedure later in this section for the effect of shim placement on tape travel.

6.3.2.5 Take-Up Motor Height

The height of the take-up motor is adjusted so that the tape travels in the center of the guide roller (T).

STEP 1. Load a roll of tape onto the machine.

STEP 2. Put the machine in Fast Forward/Shuttle mode, and observe the tape as it exits the guide roller (T) into the take-up reel.

STEP 3. Ensure that the tape is not curling at either the top or bottom of the roller.

STEP 4. If the tape is riding at the top of the roller the reel height is too high; if it is riding at the bottom of the roller the height is too low. If either symptom is observed proceed to STEP 5.

STEP 5. Remove the tape from the machine.

STEP 6. Refer to Figure 6-4. Loosen the 10-32 x 1/2 screw on the reel lock assembly using a 1/8" hex driver.

STEP 7. Loosen the reel lock assembly top and remove both pieces of the reel lock assembly.

STEP 8. Remove the three 4x20 hexagon socket bolts on the reel table using a 3mm hex wrench, and remove the reel table.

STEP 9. Add or delete the appropriate amount of reel shims to the top of the brake hub as determined in STEP 4.

STEP 10. Assemble the reel table and reel lock assembly back onto the brake hub, and return to STEP 1.

6.3.2.6 Timer Roller Height

The timer roller height adjustment must be made with the tape threaded as shown in Figure 6-5. If the tape does not travel in the center of the roller while shuttling the tape in Rewind and Fast Forward, use the following procedure.

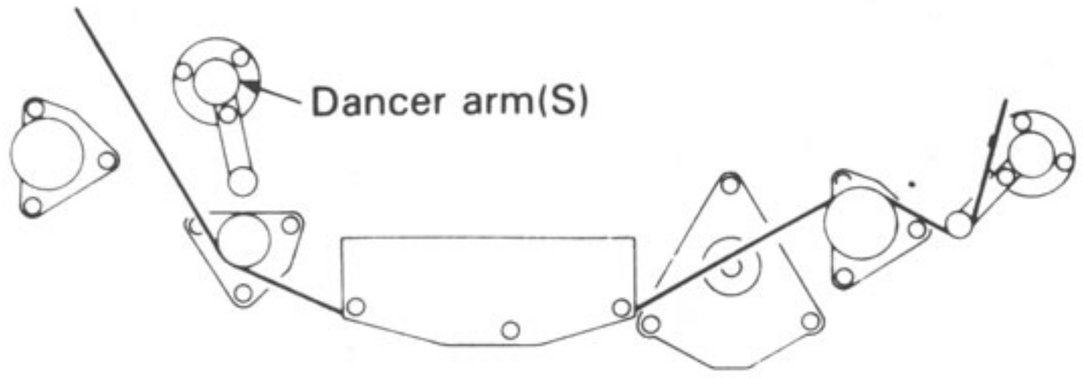


Figure 6-5. Timer Roller Tape Path

STEP 1. Remove the timer roller cap.

STEP 2. Install the roller height fixture onto the timer roller as shown in Figure 6-6, so that the end of the fixture is flush with the top of the timer roller.

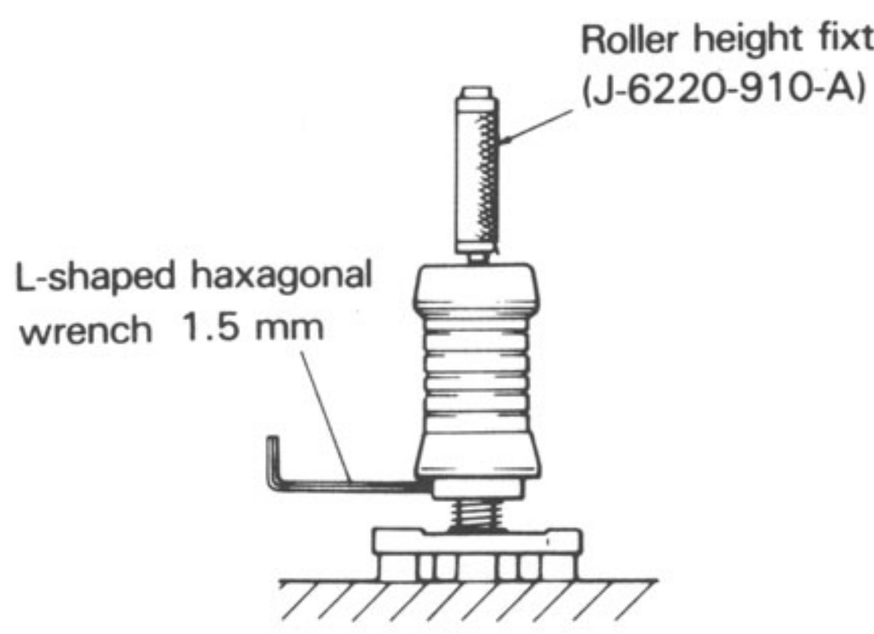


Figure 6-6. Timer Roller Height Adjustment

STEP 3. Loosen the 1.5mm set screw.

STEP 4. While shuttling the tape in Rewind and Fast Forward modes, rotate the roller height fixture until the tape travels in the center of the timer roller.

STEP 5. Tighten the 1.5mm set screw into place, and replace the timer roller cap.

6.3.2.7 Timer Roller Perpendicularity

The timer roller perpendicularity adjustment must be made with the tape threaded as shown in Figure 6-5. If the tape moves up or down on the timer roller when the direction of the Shuttle mode is changed, use the following procedure.

STEP 1. Lightly press the timer roller cap and find the direction in which the tape does not move up or down in Rewind or Fast Forward Shuttle modes. Figure 6-7 shows the direction the tape will take, be it up or down, if a roller shim is installed at that particular installation boss.

NOTE:
→: Tilt direction of the shaft
●: Insert position of the shim

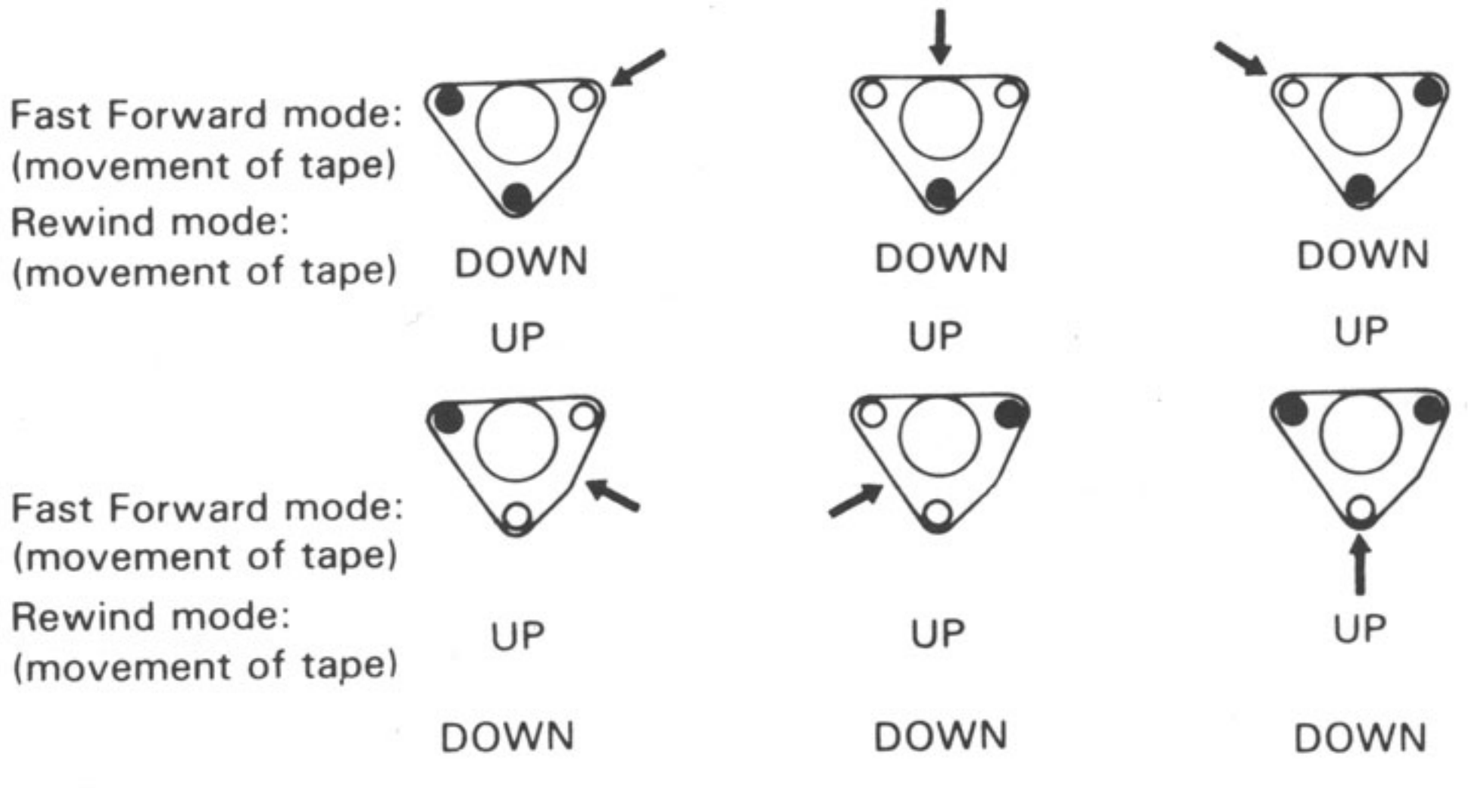


Figure 6-7. Effect of Timer Roller on Tape Movement

STEP 2. Loosen the three 4x8 screws at the base of the timer roller and insert the roller guide shim(s) of appropriate thickness at the installation boss as determined in STEP 1.

STEP 3. Tighten the three 4x8 screws loosened in STEP 2 and check to ensure that the shimming has corrected the problem. If it has not, return to STEP 1.

6.3.2.8 Supply Tension Arm Perpendicularity

Before adjusting the supply reel height, it is necessary to check that the supply tension arm does not move the tape excessively up or down in Rewind or Fast Forward Shuttle modes, thus causing the guide roller (S) to curl the tape at the reel.

If it is unquestionably apparent that the supply tension arm perpendicularity is causing an unsuitable amount of up or down tape travel, then use the following procedure.

STEP 1. Using Figure 6-8, determine where the roller shim should be placed to correct the up or down movement of the tape travel.

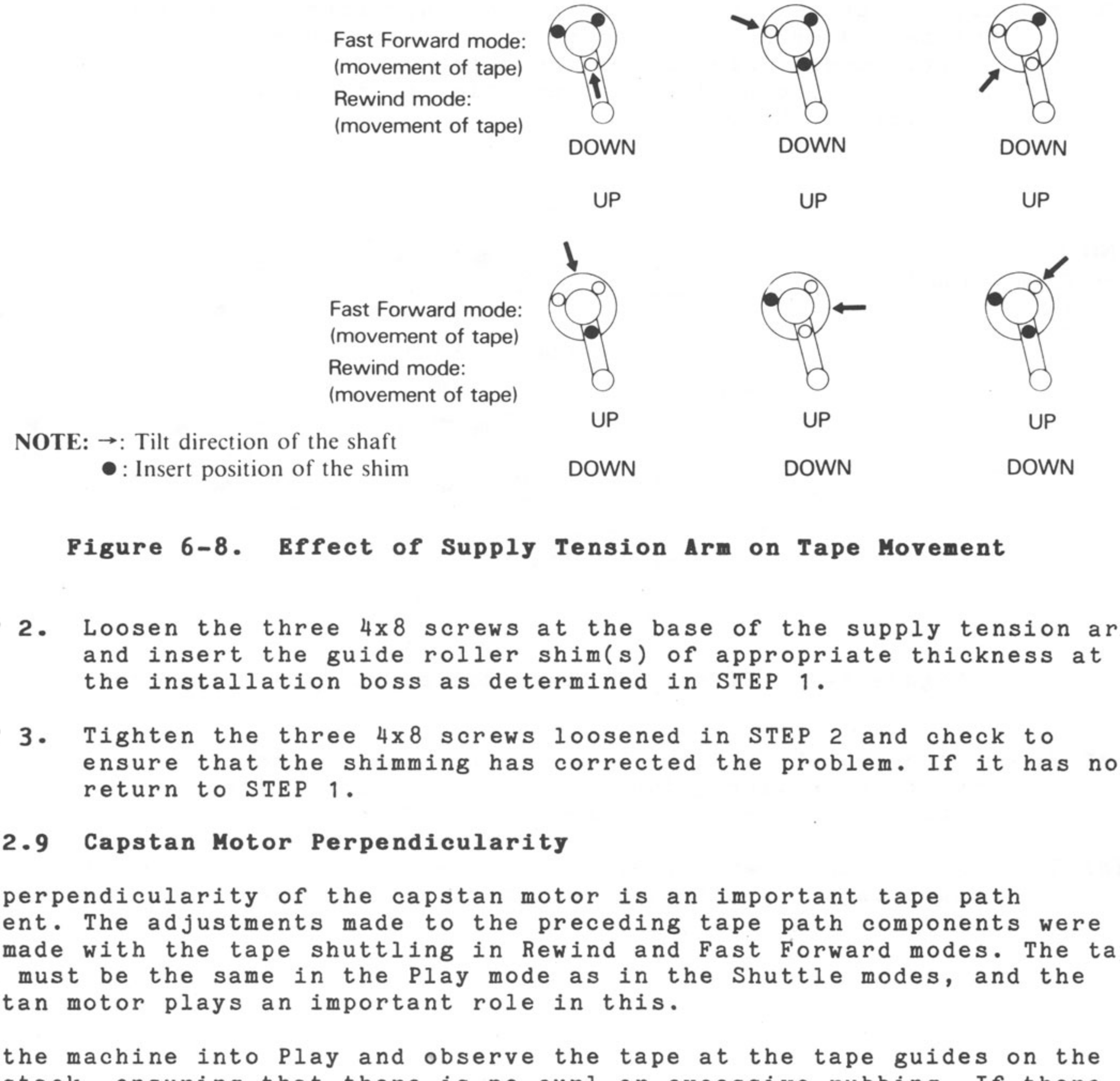


Figure 6-8. Effect of Supply Tension Arm on Tape Movement

STEP 2. Loosen the three 4x8 screws at the base of the supply tension arm and insert the guide roller shim(s) of appropriate thickness at the installation boss as determined in STEP 1.

STEP 3. Tighten the three 4x8 screws loosened in STEP 2 and check to ensure that the shimming has corrected the problem. If it has not, return to STEP 1.

6.3.2.9 Capstan Motor Perpendicularity

The perpendicularity of the capstan motor is an important tape path element. The adjustments made to the preceding tape path components were all made with the tape shuttling in Rewind and Fast Forward modes. The tape path must be the same in the Play mode as in the Shuttle modes, and the capstan motor plays an important role in this.

Put the machine into Play and observe the tape at the tape guides on the headstack, ensuring that there is no curl or excessive rubbing. If there is, use the following procedure.

STEP 1. Using Figure 6-9, determine where the roller shim should be inserted to correct the movement of the tape.

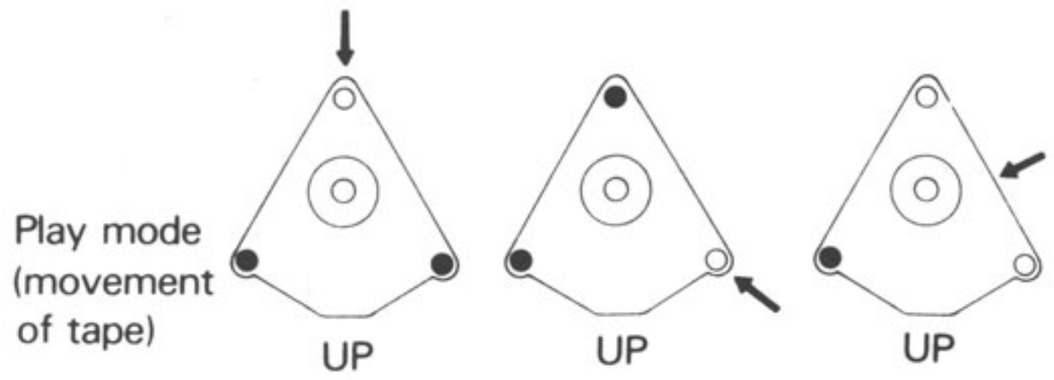


Figure 6-9. Effect of Capstan Motor on Tape Movement

STEP 2. Using a 3mm hex driver, loosen the three screws at the base of the capstan motor and insert the guide roller shim(s) of appropriate thickness at the installation boss as determined in STEP 1.

STEP 3. Tighten the three screws loosened in STEP 2 and check to ensure that the shim has corrected the problem. If not, return to STEP 1.

It should be noted that the distance between the capstan motor shaft and the tape is designed to be about 0.5mm. After making the capstan motor adjustment, ensure that this space still exists.

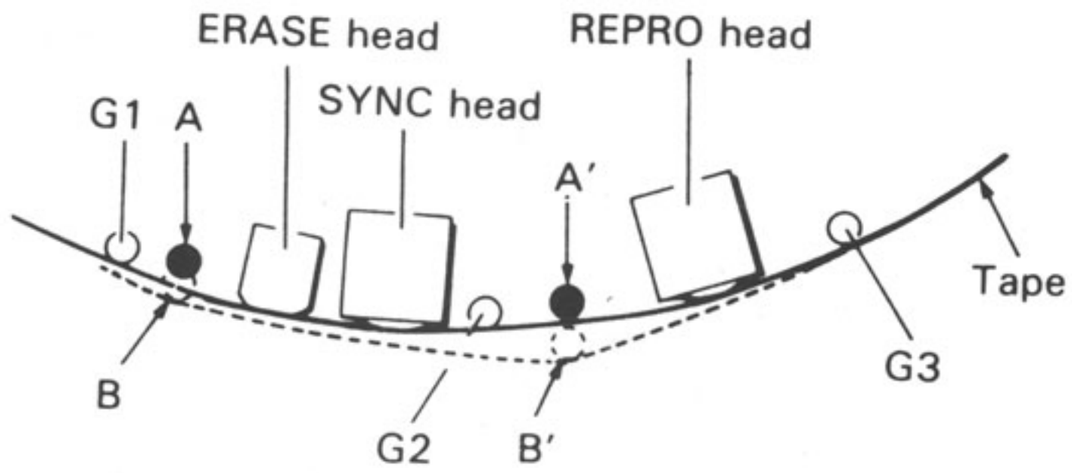
6.3.2.10 Lifter Shaft Perpendicularity

If the lifter perpendicularity causes extreme disturbance of the tape path, it is recommended that the entire lifter assembly be replaced and that all of the tape path adjustments be checked, and adjusted if necessary.

6.4 LIFTERS

The fundamental purpose of the lifters is to prevent wear of the heads during Rewind and Fast Forward modes. The ideal relationship between the tape and the lifters is illustrated in Figure 6-10. The solid line represents the tape during the in position of the lifters, and the dotted line is the tape during the out position.

To adjust the in (lifters disengaged) and out (lifters engaged) position of the lifters, refer to the following procedures.



——: Tape at "IN position"
-----: Tape at "OUT position"

Figure 6-10. Lifters Position

6.4.1 In Position

STEP 1. Load a reel of tape onto the machine.

STEP 2. Loosen the 3x6 screw on the stopper plate as shown in Figure 6-11.

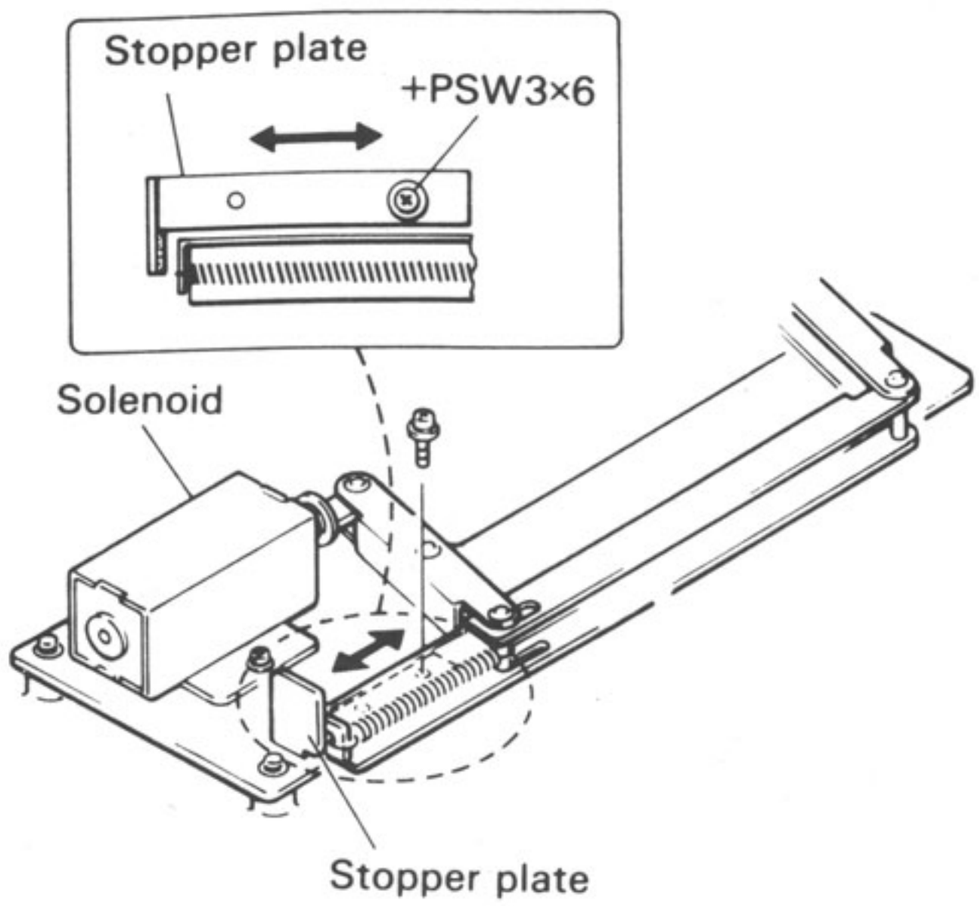


Figure 6-11. Lifters In Position Adjustment

STEP 3. Move the stopper plate in the appropriate direction of the arrow so that the clearance between the tape and the right lifter shaft (A' in Figure 6-10) is between 1.0mm and 1.5mm.

STEP 4. Tighten the 3x6 screw on the stopper plate.

6.4.2 Out Position

STEP 1. Ensure that a reel of tape is loaded onto the machine and put the machine in Fast Forward/Shuttle mode.

STEP 2. Loosen the two 3x6 screws on the solenoid mounting as shown in Figure 6-12.

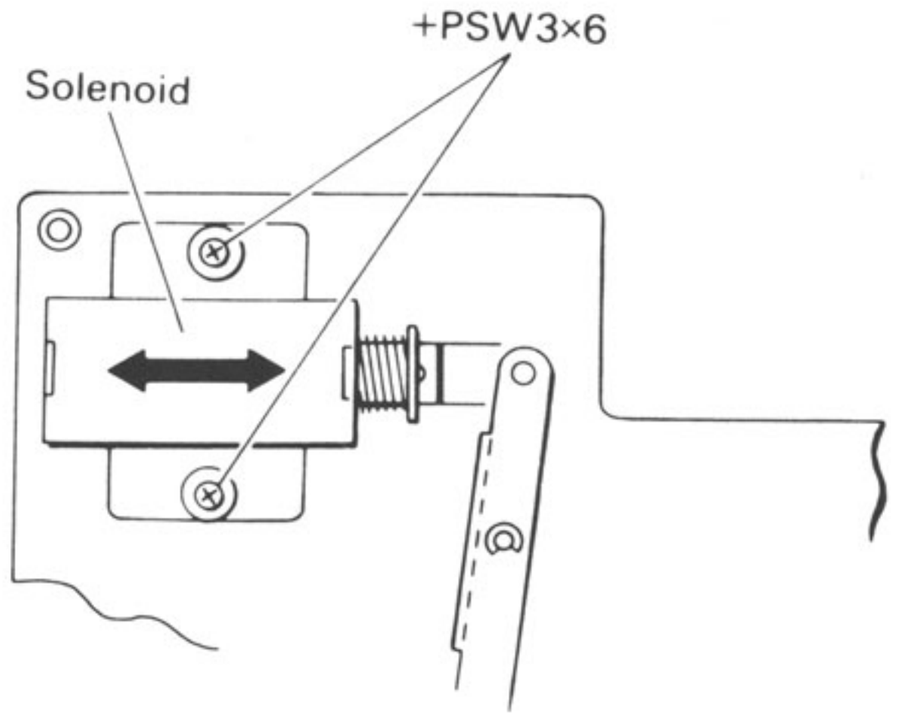


Figure 6-12. Lifters Out Position Adjustment

STEP 3. Move the solenoid position in the appropriate direction of the arrow so that the clearance between the tape and the record head is not less than 2.0mm and not greater than 3.0mm. Ensure that the tape is making full surface contact with the take-up side tape guide and very light contact with the erase head.

STEP 4. Tighten the two 3x6 screws on the solenoid mounting.

6.5 PINCH ROLLER

The pinch roller pressure must be checked, and adjusted if necessary, whenever the capstan motor, pinch roller, or pinch roller assembly are replaced.

Pinch roller pressure should be checked if problems relating to flutter, start-up, tape slippage, or tape path deviation upon start-up are experienced.

STEP 1. Ensure that there is no tape on the machine and that the power is ON.

STEP 2. Cover the EOT sensor with opaque material.

STEP 3. Attach a piece of nylon string to the 5kg tension scale and place the string around the pinch roller shaft as shown in Figure 6-13.

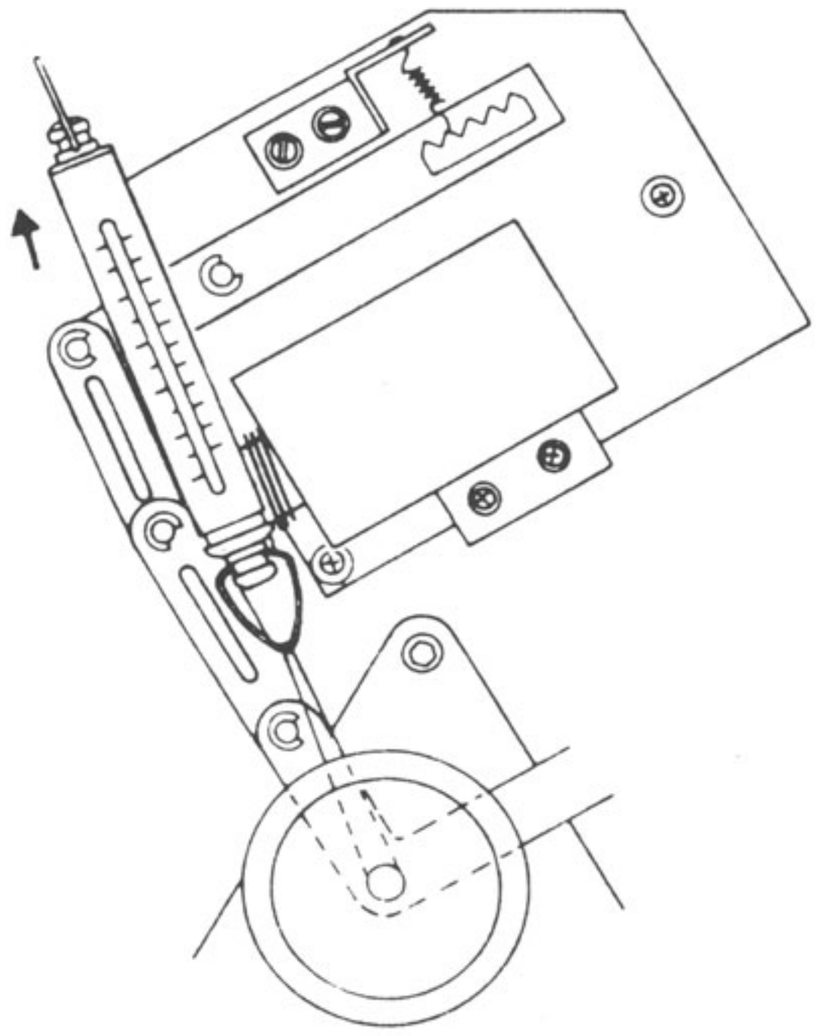


Figure 6-13. Tension Scale Placement

STEP 4. Put the machine in Play mode and apply light pressure to the side of the pinch roller with the forefinger.

STEP 5. Pull the spring scale in the direction of the arrow and observe the reading on the scale when the pinch roller stops rotating. Press STOP.

STEP 6. If the pinch roller pressure is not between 2.7 kg and 3.0 kg, then adjust the tension spring in the appropriate direction as shown in Figure 6-14, and return to STEP 4.

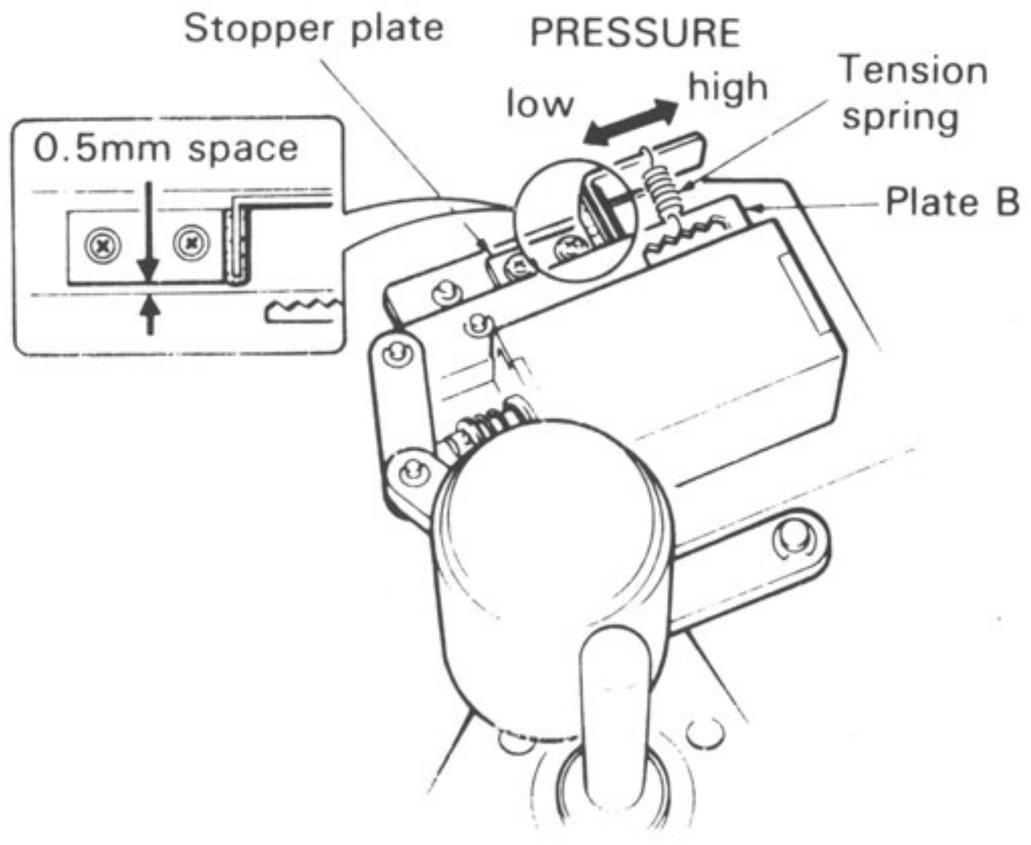


Figure 6-14. Tension Spring Adjustment

STEP 7. In Play mode, ensure that a space of approximately .5mm still exists between the stopper plate and plate B, as shown in Figure 6-14. If not, loosen the two 3x6 screws on the stopper plate and move the plate accordingly, and return to STEP 4.

6.6 REEL MOTOR BRAKES

The reel motor brakes need to be checked, and adjusted if necessary, whenever a reel motor or a reel motor brake spring is replaced.

STEP 1. Ensure that the machine is OFF, and place a 10.5" empty reel onto the supply reel motor table.

STEP 2. Wind a string around the reel as shown in Figure 6-15 and attach a 5kg tension scale to the end of the string.

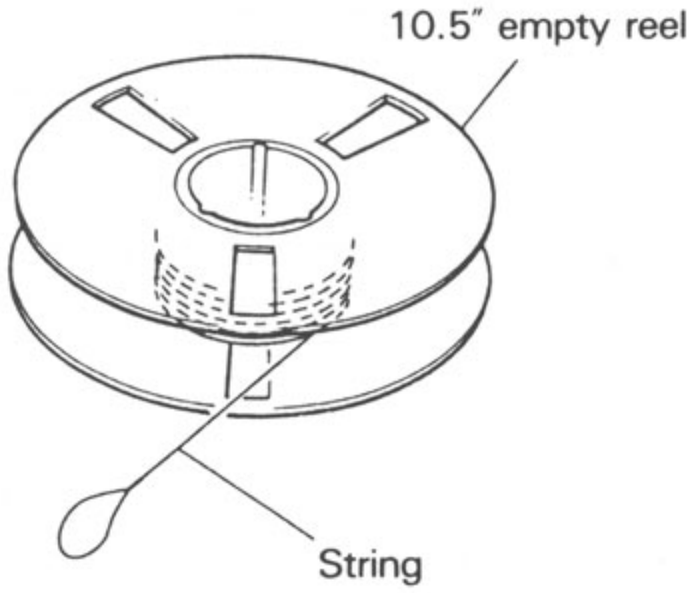


Figure 6-15. Reel and String

STEP 3. Pull the scale so that the reel turns in a counter-clockwise direction, observing the average reading on the scale when the hub starts to turn. Specification is 1.25kg, +/- 250g.

STEP 4. To increase the brake torque, move spring A as shown in Figure 6-16 away from the motor; to reduce the torque, move the spring in the opposite direction.

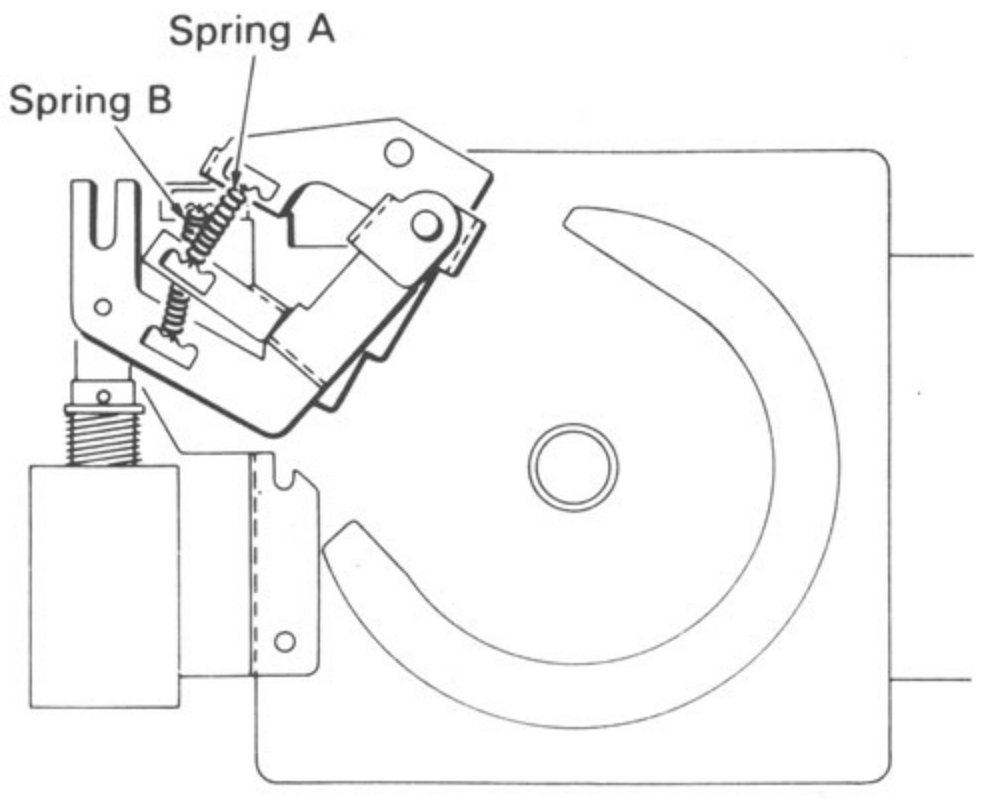


Figure 6-16. Torque Adjustment

STEP 5. Attach a 200g tension scale to the end of the string.

STEP 6. Pull the scale so that the reel turns in a clockwise direction, observing the average reading on the scale when the hub starts to turn. Specification is 100g, +/- 50g.

STEP 7. To increase the brake torque, move spring B as shown in Figure 6-16 away from the motor; to reduce the torque, move the spring in the opposite direction.

STEP 8. Remove the 10.5" reel with a string from the supply reel motor and place it onto the take-up reel motor.

STEP 9. Attach a 5kg tension scale to the end of the string.

STEP 10. Pull the scale so that the reel turns in a clockwise direction, observing the average reading on the scale when the hub starts to turn. Specification is 1.25kg, +/- 250g. To adjust, refer to STEP 4.

STEP 11. Attach a 200g tension scale to the string and pull the string in a counter-clockwise direction, observing the average reading on the scale when the hub starts to turn. Specification is 100g, +/- 50g. To adjust, refer to STEP 7.

6.7 SHIELDS

The shield dampening is the only adjustment on the shield assembly, and should only require adjustment if the dampening dashpot, shield tension spring, or shield assembly is replaced.

STEP 1. Load a reel of tape onto the machine, and put the machine in Play mode.

STEP 2. Press the SHIELD DEFEAT key several times and observe the shield action to ascertain the smoothness of the dampening performance.

STEP 3. If it is apparent that the shield operation is not sufficiently smooth, adjust the shield dashpot adjustment screw as shown in Figure 6-17 while repeating STEP 2.

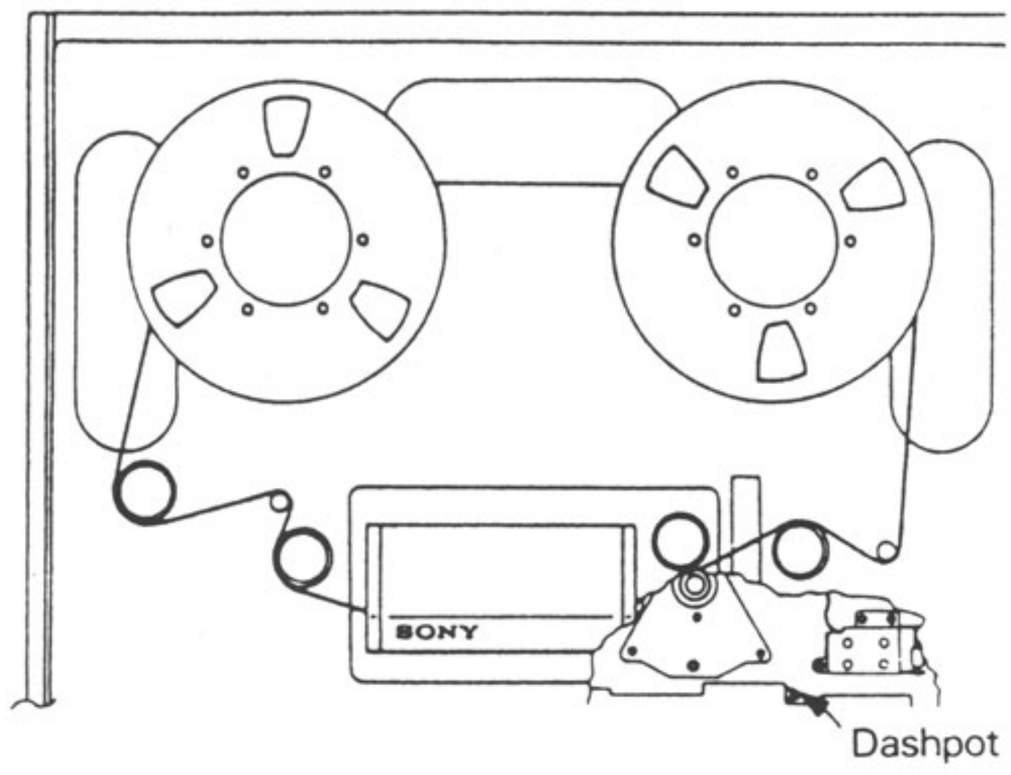


Figure 6-17. Shield Dashpot

SECTION 7 ELECTRICAL ADJUSTMENTS

7.1 INTRODUCTION

This section describes the electrical adjustments for the **APR-24**. These include adjustments to the transport, audio, and audio system alignment circuits.

Adjustments to the transport and audio circuits should only be made if a part is replaced or if a problem is discovered during a routine maintenance check. The Routine Maintenance Schedule can be found in Section 5.3.

The drawings in Section 5.4 illustrate how to remove and open the various panels to access the boards and assemblies described in this section. Appendix D provides an exploded view of the machine illustrating the location of all of the **APR-24** circuit boards.

CAUTION:

DO NOT INSTALL OR REMOVE ANY OF THE CIRCUIT BOARDS WITH THE POWER APPLIED.

7.2 TOOLS AND TEST EQUIPMENT

The following is a list of the tools and test equipment necessary to perform the adjustments described in this section. Test equipment model recommendations may be substituted as long as the substitute has equivalent or better specifications.

Tools	**Sony Part No.**
Technician's Tool Kit	US and Metric standard tools
Torque Driver	J-6103-860-A
Tension Adjustment Tool	J-6221-420-A
Extender Board	A-7850-380-A
Tape, 2"	Scotch 226
DIP Clip, 14 pin	

Test Equipment	**Recommended Model**
Oscilloscope	Tektronix 455
Digital Voltmeter (DVM)	Fluke 77
AC Voltmeter (ACVM)	HP 400FL
Frequency Counter	HP 5381A
Signal Generator	HP 209
Flutter Meter	EMT 424
Test Tapes	MRL #51J213 15 ips NAB
	MRL #51J223 15 ips IEC
	MRL #51L214 30 ips AES

7.3 TRANSPORT

The electrical adjustments that are made to the transport include the HES, TTS/RTS, tension arm tension, RMD offset, RMD tape tension, tension arm dampening, variable speed, and EOT sensor adjustments. Each procedure details what prerequisites there are, if any, before beginning the procedure, and when the adjustment should be made.

7.3.1 HES

The position of the supply tension arm is monitored by the HES board to provide tape tension information to the CPU. Adjustment should not be necessary unless the board has been replaced or a part on the board has been changed. The HES board should be checked, and adjusted if necessary, before carrying out any of the other tension-related adjustments.

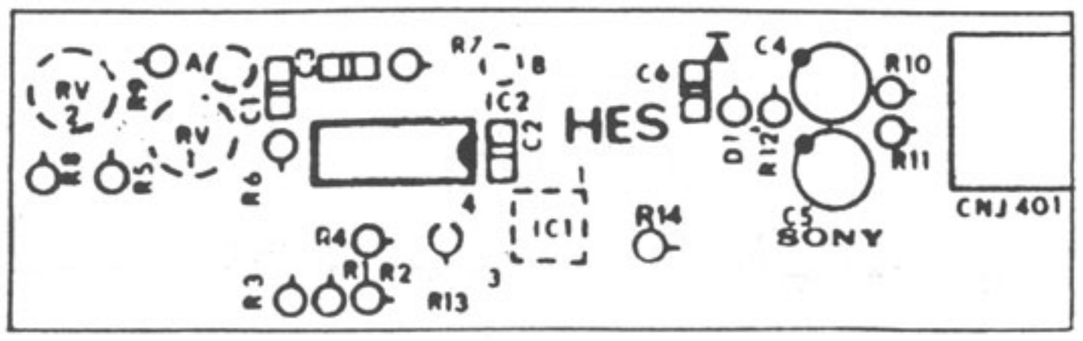


Figure 7-1. HES Board

STEP 1. Ensure that there is no tape on the machine and that the power switch is set to ON.

STEP 2. Connect the negative lead of the DVM to TP1 on the TIB and the positive lead to TPA on the HES board, as shown in Figure 7-1.

STEP 3. Move the supply tension arm so that it touches the left stop shaft, and ensure that the DVM indication is -6.0V, +1.0/-2.0 VDC.

STEP 4. Move the supply tension arm so that it touches the right stop shaft, and ensure that the DVM indication is +6.0V, +2.0/-1.0 VDC.

STEP 5. If the specifications of STEPS 3 and 4 are not met, loosen the HES board mounting screws and reposition the board. Tighten the screws once the specifications have been achieved.

STEP 6. Connect the positive lead of the DVM to TPB on the HES board.

STEP 7. Move the supply tension arm from the right stop shaft to the left stop shaft, and ensure that there is a total voltage change of 10.25 VDC, +/-.5 VDC. Adjust RV1 if specification is not met.

STEP 8. Position the supply tension arm to the right stop shaft and ensure that the DVM indication is 0 VDC, +/-.25 VDC. Adjust RV2 if specification is not met.

STEP 9. Position the supply tension arm to the left stop shaft and ensure that the DVM indication is +10.25 VDC, +/-.25 VDC.

STEP 10. Repeat STEPS 7 through 9 until all specifications are met.

7.3.2 TTS/RTS

The Tape Tach Sensor/Reel Tach Sensor (TTS/RTS) signals must be checked, and adjusted if necessary, before carrying out any of the tension arm or RMD adjustments. Adjustment should not be necessary unless a tach sensor board, TIB board, or reel motor has been replaced.

STEP 1. Ensure that the machine is OFF and connect the 14-pin DIP clip to IC13 on the TIB board (Figure 7-2).

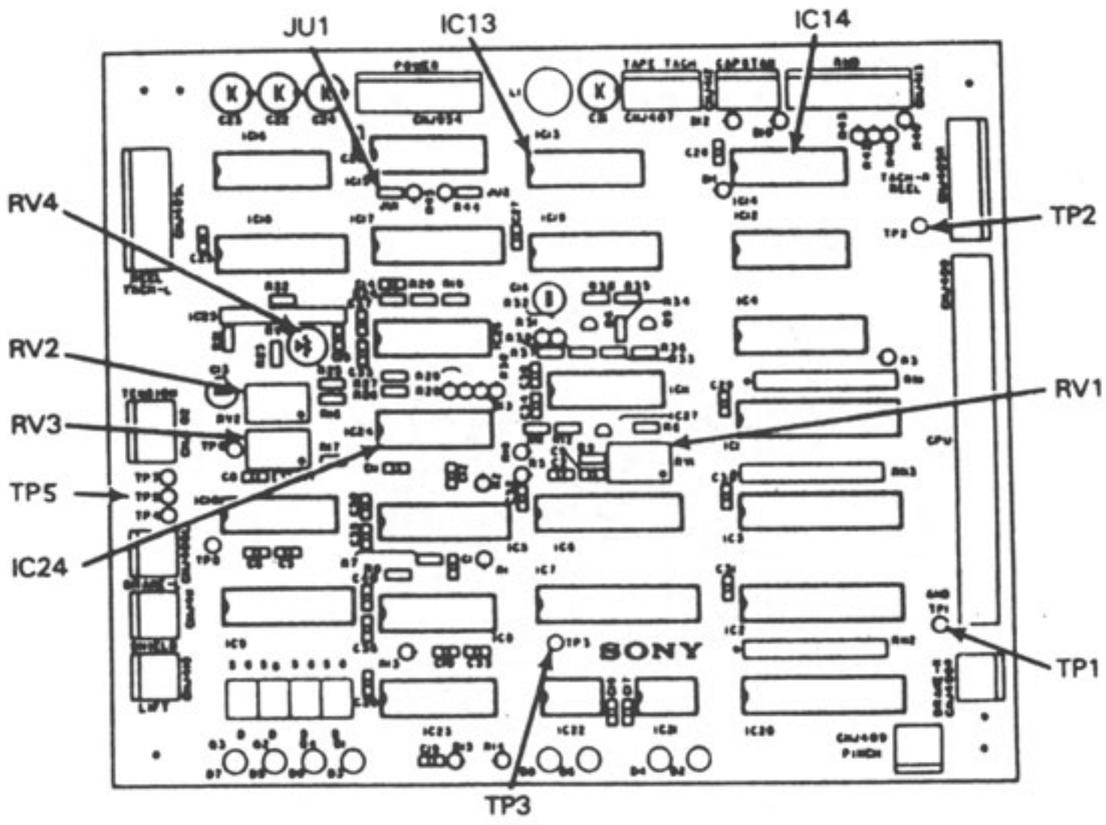


Figure 7-2. TIB Board

STEP 2. Load a reel of tape onto the machine and turn the power ON.

STEP 3. Connect the oscilloscope ground lead to TP1 on the TIB board and press PLAY.

STEP 4. Connect the oscilloscope probe to pin 8 on the DIP clip, and adjust the sec/div calibration of the oscilloscope so that one cycle of the displayed tach waveform is equal to exactly 10 divisions on the CRT graticule.

STEP 5. Adjust RV1 on the TTS board (Figure 7-3) so that the duty cycle of the displayed waveform becomes 50%.

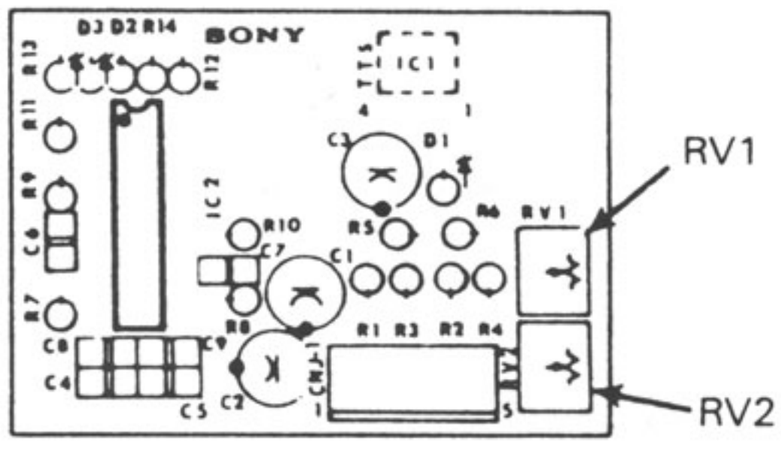


Figure 7-3. TTS Board

STEP 6. Connect the oscilloscope probe to pin 10 on the DIP clip, and ensure that one cycle of the displayed tach waveform is equal to exactly 10 divisions on the CRT graticule.

STEP 7. Adjust RV2 on the TTS board so that the duty cycle of the displayed waveform becomes 50%.

STEP 8. Connect the oscilloscope probe to pin 2 on the DIP clip, and ensure that one cycle of the displayed tach waveform is equal to exactly 10 divisions on the CRT graticule.

STEP 9. Adjust RV1 on the supply motor RTS board (Figure 7-4) so that the duty cycle of the displayed waveform becomes 50%.

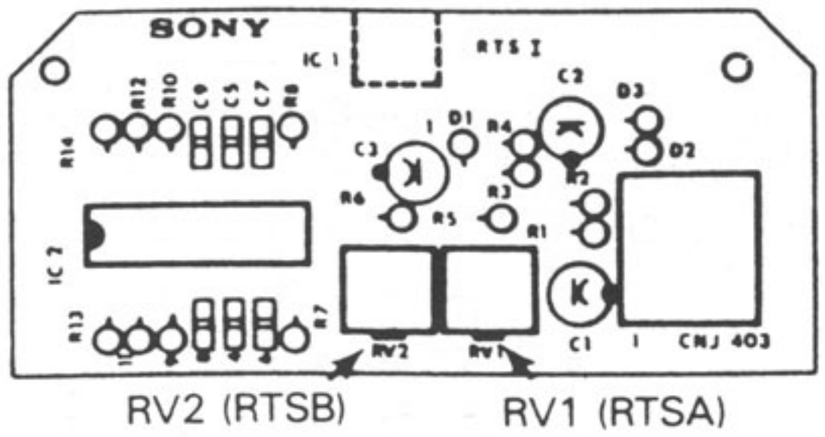


Figure 7-4. RTS Board

STEP 10. Connect the oscilloscope probe to pin 4 on the DIP clip, and ensure that one cycle of the displayed tach waveform is equal to exactly 10 divisions on the CRT graticule.

STEP 11. Adjust RV2 on the supply motor RTS board so that the duty cycle of the displayed waveform becomes 50%.

STEP 12. Connect the oscilloscope probe to pin 6 on the DIP clip, and ensure that one cycle of the displayed tach waveform is equal to exactly 10 divisions on the CRT graticule.

STEP 13. Adjust RV1 on the take-up motor RTS board so that the duty cycle of the displayed waveform becomes 50%.

STEP 14. Connect the oscilloscope probe to pin 12 on the DIP clip, and ensure that one cycle of the displayed tach waveform is equal to exactly 10 divisions on the CRT graticule.

STEP 15. Adjust RV2 on the take-up motor RTS board so that the duty cycle of the displayed waveform becomes 50%.

7.3.3 Tension Arm Tension

The tension arms absorb any slack in the tape that might exist due to fluctuations in the tape tension, while simultaneously managing the tape tension. The tension arm tensions must be checked, and adjusted if necessary, before setting the RMD adjustments and the tension arm dampening.

7.3.3.1 Supply Tension Arm

STEP 1. Ensure that there is no tape on the machine and that the power is OFF.

STEP 2. Place the tension adjustment tool against the center of the supply tension arm as shown in Figure 7-5 and push the tool in the direction of the arrow. Read the scale when the arm is at the center of the two stop shafts.

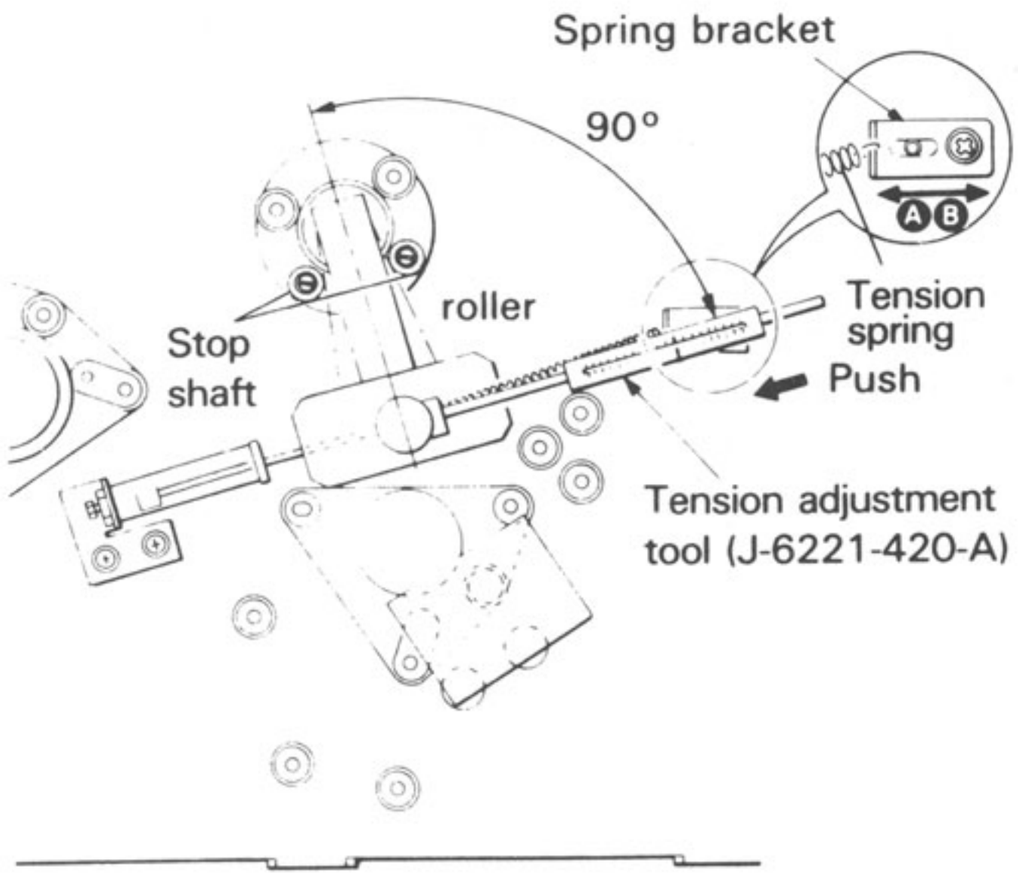


Figure 7-5. Supply Tension Arm Adjustment

STEP 3. If the tension is not 400g +/-10g, loosen the 3x6 screw on the tension spring bracket and move the bracket in the A direction to reduce the tension, or in the B direction to increase the tension.

STEP 4. Tighten the 3x6 screw loosened in STEP 3 and return to STEP 2.

7.3.3.2 Take-Up Tension Arm

STEP 1. Ensure that there is no tape on the machine and that the power is OFF.

STEP 2. Place the tension adjustment tool against the center of the take-up tension arm as shown in Figure 7-6 and push the tool in the direction of the arrow. Read the scale when the arm is at the center of the two stop shafts.

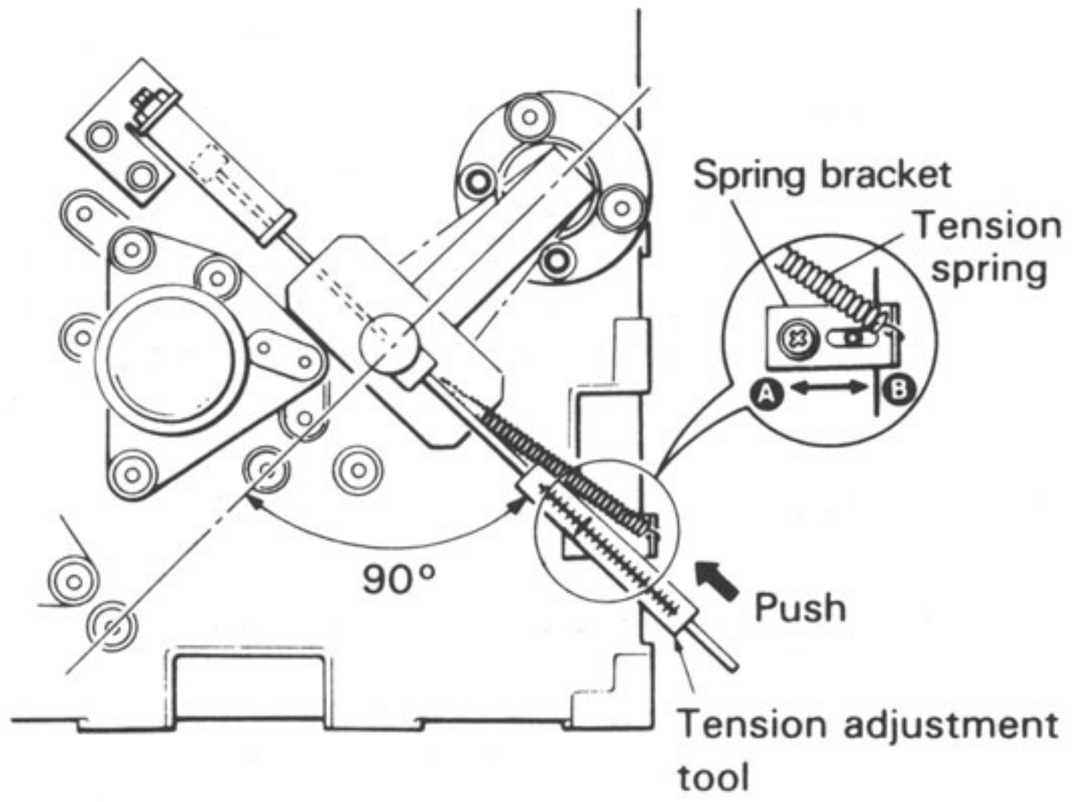


Figure 7-6. Take-Up Tension Arm Adjustment

STEP 3. If the tension is not 450g +/-10g, loosen the 3x6 screw on the tension spring bracket and move the bracket in the A direction to reduce the tension, or in the B direction to increase the tension.

STEP 4. Tighten the 3x6 screw loosened in STEP 3 and return to STEP 2.

7.3.4 RMD Offset

The RMD DC offset is measured when the reel motors have no tension, and then set to the lowest possible level. This adjustment must be made before setting the RMD tape tension.

STEP 1. Unfasten the three 4x6 retaining screws on the transport rear panel, and open the panel.

STEP 2. Ensure that the power is ON and that there is no tape on the machine.

STEP 3. Cover the EOT sensor with opaque material and press the EDIT key.

STEP 4. On the RMD-II board, connect the negative lead of the DVM to TP1 and the positive lead to TP2, as shown in Figure 7-7.

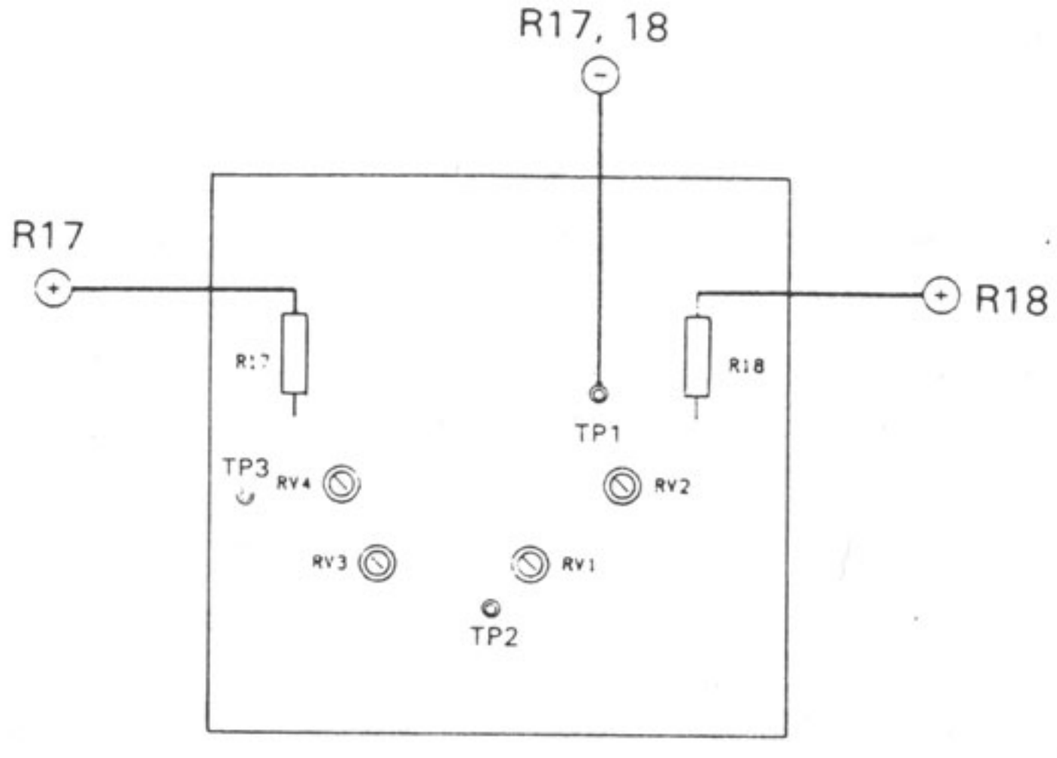


Figure 7-7. RMD Board

STEP 5. Set the DVM to the millivolts range, and adjust RV2 on the RMD II board until the DVM reads zero volts, +/- 10mV.

STEP 6. Connect the positive lead of the DVM to TP3 as shown in Figure 7-7, and adjust RV4 until the DVM reads zero volts, +/- 10mV.

7.3.5 RMD Tape Tension

The tape tension settings on the RMD board ensure that the tape tension remains constant regardless of the amount of tape on the supply and take-up reels. Tape tension should not be set until the TTS/RTS, tension arm tension, and RMD offset adjustments all have been made.

STEP 1. Ensure that the power is ON and load a reel of tape onto the machine so that there is an equal amount of tape on both reels.

STEP 2. Press PLAY, and adjust RV1 on the RMD II board until the supply tension arm is centered between the two stop shafts on the tension arm assembly, as shown in Figure 7-8.

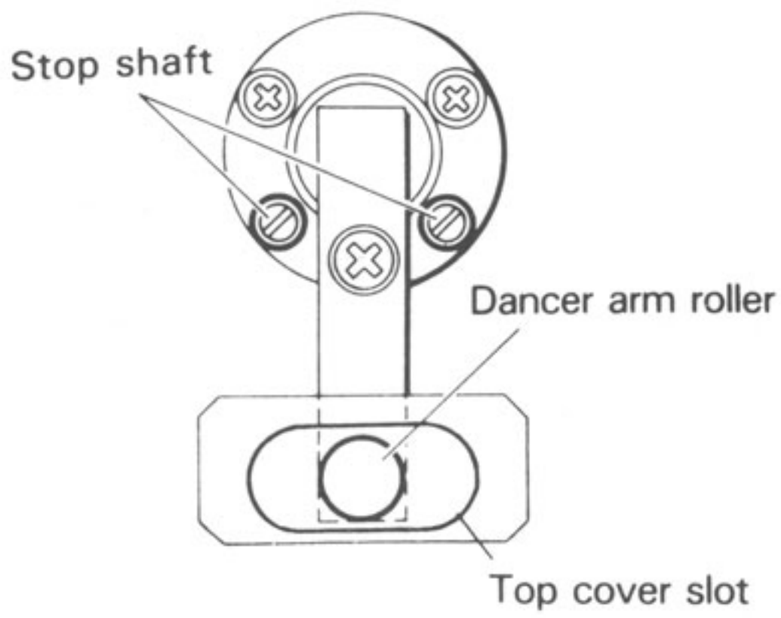


Figure 7-8. Tension Arm Centering

STEP 3. Adjust RV3 on the RMD II board until the take-up tension arm is centered between the two stop shafts on the tension arm assembly, as shown in Figure 7-8.

STEP 4. Press STOP. Unthread the tape completely from the tape path so that the tape runs directly from reel to reel, taking up any slack that might exist between the two reels.

STEP 5. Cover the EOT sensor with opaque material.

STEP 6. Manually rotate the take-up reel through several counter-clockwise revolutions, and observe the motion of both reels after discontinuing the manual rotation.

STEP 7. Manually rotate the supply reel through several clockwise revolutions, and observe the motion of both reels after discontinuing the manual rotation.

STEP 8. If a tendency to "creep" is detected in either reel after discontinuing the manual rotations, adjust RV3 on the RMD II board to minimise the creeping movement, and return to STEP 6.

7.3.6 Tension Arm Dampening

The tension arm dampeners ensure that the tape does not become overstressed during stop to play and play to stop transitions. Misadjustment will adversely effect the start-up time and steady-state flutter of the machine.

It is critically important that the tension arms contact their respective stops only gently during a valid radius start. The TTS/RTS, tension arm tension, and RMD adjustments must all be performed before adjusting the tension arm dampening.

STEP 1. Ensure that the power is ON and load a reel of tape onto the machine so that the supply reel is nearly full. Select HI speed.

STEP 2. Press PLAY and STOP alternately, observing the action of the supply tension arm during the initiation of each mode. If the tension arm tends to jitter during the mode transition, this indicates that the dampening is excessive; if the tension arm has little or no effect on the tape handling during the transition, this indicates that the dampening is inadequate.

STEP 3. If the dampening is unsatisfactory, turn the adjustment screw on the supply tension arm dampening dashpot, as shown in Figure 7-8, clockwise to increase the dampening or counter-clockwise to decrease the dampening. Return to STEP 2.

STEP 4. Fast Forward the tape so that the take-up reel is nearly full.

STEP 5. Press PLAY and STOP alternately, observing the action of the take-up tension arm during the initiation of each mode. If the tension arm tends to jitter during the mode transition, this indicates that the dampening is excessive; if the tension arm has little or no effect on the tape handling during the transition, this indicates that the dampening is inadequate.

STEP 6. If the dampening is unsatisfactory, turn the adjustment screw on the take-up tension arm dampening dashpot, as shown in Figure 7-9, clockwise to increase the dampening or counter-clockwise to decrease the dampening. Return to STEP 5.

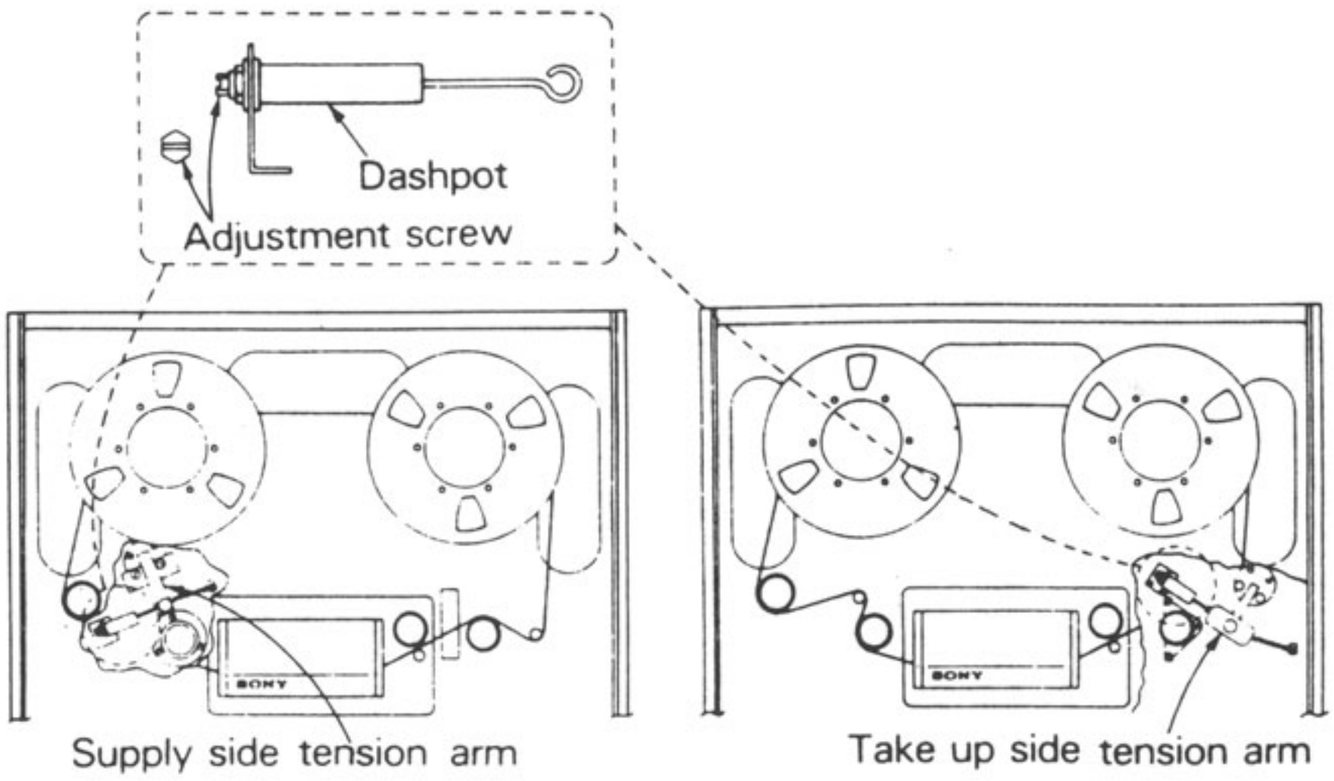


Figure 7-9. Tension Arm Dashpot Dampening

7.3.7 Variable Speed

The following procedure explains how to check, and adjust if necessary, the variable speed function of the machine. Adjustment is usually not necessary unless the TIB board or parts on the board have been replaced.

STEP 1. Ensure that the power is OFF and remove jumper block JU-1 from the TIB board.

STEP 2. Turn the power ON and press the STOP key twice.

STEP 3. Connect the negative lead of the DVM to TP1, and the positive lead to TP5 on the TIB board (Figure 7-10).

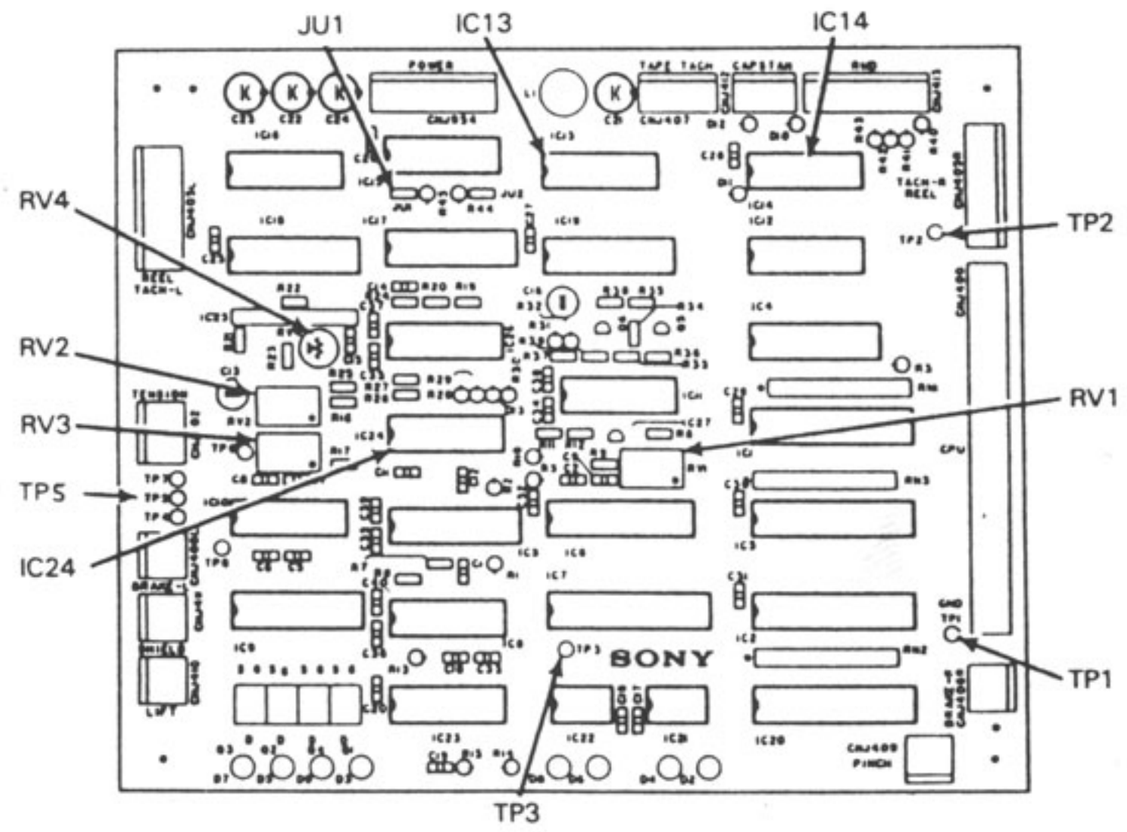


Figure 7-10. TIB Board

STEP 4. Adjust RV1 on the TIB board until the DVM indicates +10 VDC, +/-.01 VDC.

STEP 5. Press the STOP key and ensure that the DVM indicates -10 VDC, +/- .1 VDC.

STEP 6. Press the STOP key and ensure that the DVM indicates zero VDC, +/- .02 VDC.

STEP 7. Remove the DVM leads from the test points and connect the ground lead of the frequency counter to TP1, and the frequency counter probe to TP2 on the TIB board.

STEP 8. Adjust RV2 on the TIB board until the frequency counter reads 14.4 kHz, +/- 2Hz.

STEP 9. Press the STOP key and adjust RV3 on the TIB board until the frequency counter reads 28.8kHz.

STEP 10. Turn the power OFF, and replace jumper block JU-1 on the TIB board.

7.3.8 EOT Sensor

Because of variations in lighting environments, End Of Tape (EOT) sensor sensitivity cannot be standardised. The following procedure should be used in the event of EOT sensor replacement or where it is desired to compensate for different or adverse lighting conditions (such as film studio lighting, camera flash bulbs, etc.)

STEP 1. Ensure that the power is ON, and load a reel of tape onto the machine.

STEP 2. Ensure that there is a physical gap between the tape and the EOT sensor, and that the tape does not touch the sensor.

STEP 3. Move the tape in and out of the EOT sensor beam path, verifying that the machine enters Stop mode when the tape breaks the beam. If it does not respond correctly, or it is desired to change the sensitivity, proceed to STEP 4.

STEP 4. Unfasten the two retaining screws on the side of the local control panel and swing the panel door forward.

STEP 5. Adjust RV2 on the MFP board, as shown in Figure 7-11, to set the desired EOT sensor sensitivity.

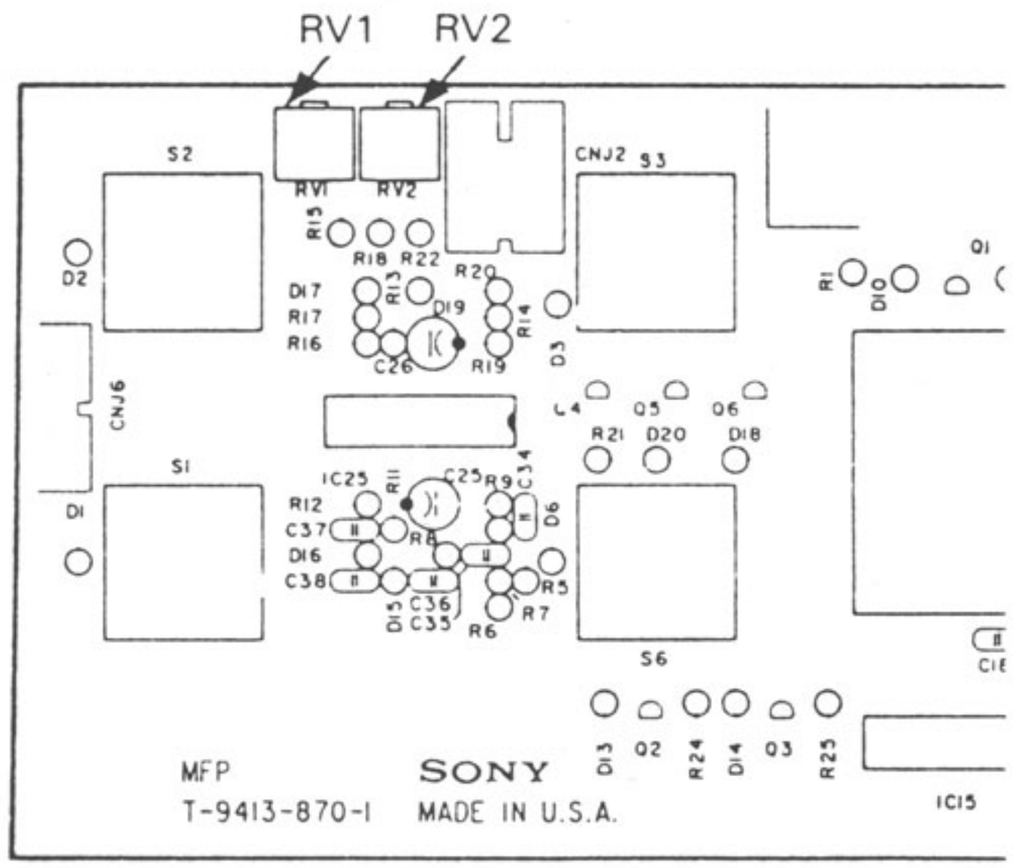


Figure 7-11. MFP Board

7.4 AUDIO

The electrical adjustments that are made to the audio include MST bias and erase level, CNL bias and erase symmetry, ASB voltage reference and offset, and Time Code clock recovery circuit.

7.4.1 MST Bias and Erase Level

The bias and erase settings on the MST boards need be adjusted only when a MST board is replaced or when parts on the board have been changed.

STEP 1. Ensure that the power is OFF.

STEP 2. Remove the MST from its slot, install it onto the extender board, and reinsert it into its slot. Turn the power ON.

STEP 3. Connect the oscilloscope ground lead to pin 1 on the extender board and connect the oscilloscope probe to pin 23A.

STEP 4. Adjust RV2 (Bias) on the front of the MST so that the amplitude of the displayed waveform becomes 12 Vpp, +/- 0.1 V.

STEP 5. Connect the oscilloscope probe to pin 23B on the extender board.

STEP 6. Adjust RV1 (Erase) on the front of the MST so that the amplitude of the displayed waveform becomes 12.5 Vpp, +/- 0.1 V.

STEP 7. Turn the power OFF and remove the oscilloscope probe from the extender board. Take the MST off the extender board, remove the extender board from the slot, and insert the MST back into its slot.

7.4.2 CNL Bias and Erase Symmetry

Adjustment is provided on the CNL boards for bias and erase ramp symmetry. Adjustment should only be necessary if a CNL board has been replaced or when parts on the board have been changed.

STEP 1. Ensure that the power is OFF.

STEP 2. Remove the CNL board from its slot, install it onto the extender board, and reinsert it into its slot. Turn the power ON.

STEP 3. Load a reel of tape onto the machine and set all channels into Record Ready mode.

STEP 4. Set the oscilloscope to read 1V/div at 20ms/div. Connect the oscilloscope ground lead to pin 1 of the extender board and the oscilloscope probe to pin 6A.

STEP 5. While observing the waveform on the oscilloscope, punch in and out of Record several times, verifying that the amplitude of the displayed erase ramp is symmetrical. If this condition is not met, adjust RV4 on the CNL board until the ramp is symmetrical.

STEP 6. Connect the oscilloscope probe to pin 5A on the extender board.

STEP 7. While observing the waveform on the oscilloscope, punch in and out of Record several times, verifying that the amplitude of the displayed bias ramp is symmetrical. If this condition is not met, adjust RV5 on the CNL board until the ramp is symmetrical.

STEP 8. Turn the power OFF and remove the oscilloscope probe from the extender board. Take the CNL off the extender board, remove the extender board from the slot, and insert the CNL back into its slot.

7.4.3 ASB V REF and V OFFSET

The validity of the bar graph display indication depends greatly upon the accuracy of the ASB voltage adjustments, and should only be adjusted when the ASB board has been replaced or when parts on the board have been changed.

STEP 1. Unfasten the six 3x5 retaining screws on the meter housing rear panel, and remove the panel. Ensure that the power is ON.

STEP 2. On the ASB board, connect the negative lead of the DVM to pin 5 of IC6 (analog ground) and the positive lead to TP3.

STEP 3. Adjust RV2 so that the DVM indication is exactly +1.335 VDC.

STEP 4. Connect the positive lead of the DVM to TP2 and verify that the DVM indication is +0.565 VDC.

NOTE: Since there is no adjustment for this voltage on the ASB board, failure to meet specification can only be corrected by replacing either or both of the voltage divider components R18 and R19. It is possible that both resistors will measure within tolerance but provide incorrect voltages, as one resistor might be at the high end of the tolerance window while the other is at the low end. When troubleshooting, be sure that both resistors are at the same end of the tolerance window.

STEP 5. Connect the positive lead of the DVM to TP1 and adjust RV3 so that the DVM indication becomes exactly -0.622 VDC

7.4.4 Time Code Clock Recovery Circuit

The Time Code clock recovery circuit adjustments on the CPU board optimize the machine's ability to interpret both playback Time Code and external source Time Code of any type, ensuring correct operation without regard to the time and user bit data within the Time Code data stream. Adjustment should not be necessary unless the CPU board has been replaced, or parts on the board have been changed.

STEP 1. Ensure that the power is OFF. Unfasten the two retaining screws on the side of the local control panel and swing the panel door forward.

STEP 2. Disconnect the three ribbon cables from the CPU board, leaving only the power cable CNJ950 connected.

STEP 3. Connect the TTL output of the signal generator to the frequency counter and adjust the generator until the counter reads exactly 1.818kHz (550 us).

STEP 4. Connect the TTL output of the signal generator to CH-1 Input of the oscilloscope, adjusting the sec/div calibration of the oscilloscope so that the input 1.818kHz signal is equal to exactly 10 divisions on the CRT graticule. Connect the oscilloscope probe to CH-2 Input of the oscilloscope.

STEP 5. Turn the power ON. Apply the TTL output of the signal generator to pin 37 of CNJ 421 on the CPU board.

STEP 6. Set the oscilloscope to falling edge triggering and connect the oscilloscope probe to TP9 on the CPU. Adjust RV1 on the CPU to achieve the duty cycle as shown in Figure 7-12.

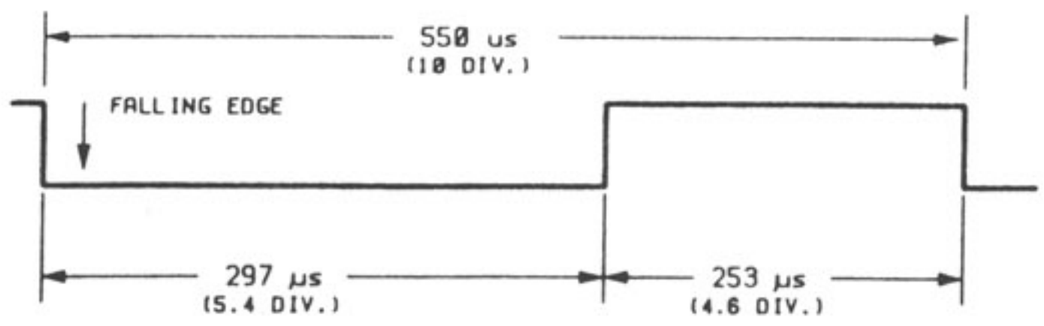


Figure 7-12. RV1, RV2 Duty Cycle Adjustment

STEP 7. Set the oscilloscope to rising edge triggering and connect the oscilloscope probe to TP8 on the CPU. Adjust RV3 on the CPU to achieve the duty cycle as shown in Figure 7-13.

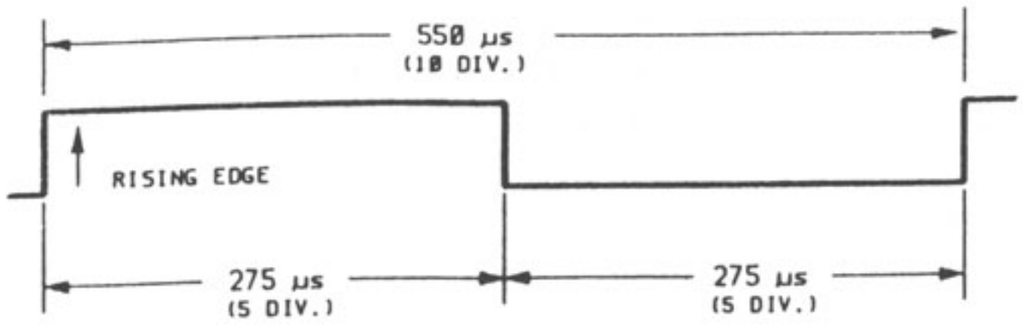


Figure 7-13. RV3, RV4 Duty Cycle Adjustment

STEP 8. Remove the TTL output of the signal generator from pin 37 of CNJ 421 on the CPU board and apply it to pin 35.

STEP 9. Set the oscilloscope to falling edge triggering and connect the oscilloscope probe to TP10 on the CPU. Adjust RV2 on the CPU to achieve the duty cycle as shown in Figure 7-12.

STEP 10. Set the oscilloscope to rising edge triggering and connect the oscilloscope probe to TP7 on the CPU. Adjust RV4 to achieve the duty cycle as shown in Figure 7-13. Remove the TTL output of the signal generator from pin 35 of CNJ 421 on the CPU board.

STEP 11. Turn the power OFF and reconnect the three ribbon cables that were disconnected from the CPU in STEP 1.

7.5 AUDIO SYSTEM ALIGNMENT

The three sections covered in the audio system alignment are input, playback, and record. Before beginning the alignment procedures, the machine's transport and audio circuits must be correctly adjusted as previously described in this section.

The accuracy of the audio system alignment is maintained until a change such as a different tape formulation, reference fluxivity, or headstack type is implemented. When a part is replaced in the audio circuitry, appropriate test and adjustment procedures should be carried out to verify the performance of the new component.

Unless otherwise noted, the test equipment should be connected as shown in Figure 7-14 to perform the alignments. The calibration input (CAL IN) and calibration output (CAL OUT) connectors can be connected to permanent test equipment lines.

It should also be noted that, beginning with software version P5.01.02.0, when Jog mode is enabled, the Jog/Shuttle Dial can be used to increment or decrement the hexadecimal values of the audio parameters by turning the dial clockwise to emulate the increment key, and counter-clockwise to emulate the decrement key. This function significantly reduces the time required to align the audio system.

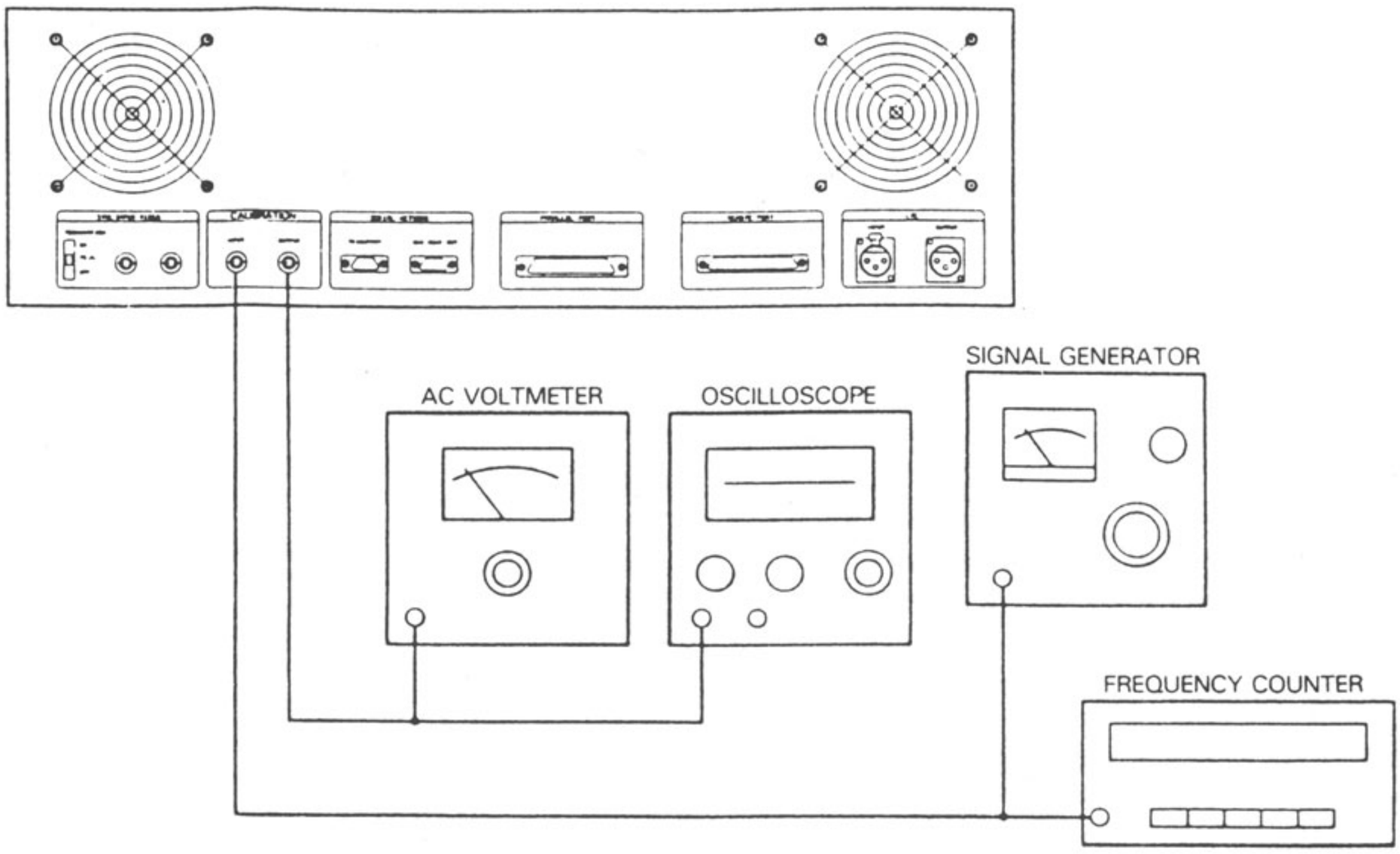


Figure 7-14. Test Equipment Connections

7.5.1 PRESET Storage Location Procedure

The **APR-24** is capable of storing three separate alignments per speed. When one of the three PRESET Storage Location keys on the ALN panel is pressed, the key indicator becomes illuminated, and the alignment parameters stored in that location are recalled and used by the audio electronics of the machine.

It is important to remember that a new alignment must be stored into a PRESET Storage Location before switching speeds or turning the power off, or those parameters will not be retained. If it is desired to store a new alignment into one of the locations, use the following two-step procedure.

STEP 1. While holding down the CONTROL key on the ALN panel, press the STORE key. The STORE key indicator will illuminate, and the key indicator of the previously selected PRESET Storage Location will extinguish.

STEP 2. Press the key of the PRESET Storage Location (PRESET 1, PRESET 2, or PRESET 3) that it is desired to store the new alignment into. The previous hexadecimal parameters stored in that location are now erased, and the new alignment is stored in its place.

7.5.2 Input

The input adjustments include input level, VU meter calibration, and bar graph calibration. Before adjusting any of the other audio system alignments, input should be checked, and adjusted if necessary.

7.5.2.1 Input Level

STEP 1. Ensure that the power is ON. Set the signal generator to supply a 1kHz sine wave at 4.0dBm.

STEP 2. On the ALN panel, press IND once so that a "1" is shown in the ALN STATUS Display window. Channel one is now selected.

STEP 3. Select INPUT MON LVL on the ALN panel. This causes the CNL board for channel one to be set into INPUT mode. The STATUS display window on the ALN panel should show a hexadecimal value, and the VU meter and bar graph indicators should show signal level.

STEP 4. Verify that the ACVM indication is 4.0dBm, +/- 0.1dBm. If adjustment is necessary, press the INC or DEC key in the CALIBRATION section of the ALN panel until the specification is met, or use the Jog/Shuttle Dial as described in Section 7.5.

STEP 5. Press the IND key on the ALN panel and repeat STEP 4. Continue in this manner until the input level of all 24 channels have been checked, and adjusted if necessary.

NOTE: If it is desired to store the input alignment into a PRESET Storage Location, it must be stored before switching speeds or turning the power off. Refer to Section 7.5.1 for information on how to use the preset storage feature.

7.5.2.2 VU Meter Calibration

The input level must be adjusted before calibrating the VU meter, as described in the preceding paragraph. Adjustment should not be necessary unless the meter or the ASB board have been replaced.

STEP 1. Ensure that the power is ON. Set the signal generator to supply a 1kHz sine wave at 4.0dBm.

STEP 2. On the ALN panel, press IND once so that a "1" is shown in the ALN STATUS display window, and then press the INPUT MON LVL key.

STEP 3. Adjust the signal generator so that the input level of Channel 1 as indicated on the ACVM is exactly 4.0dBm.

STEP 4. Observe the VU meter. If the reading is not 0 VU, then unfasten the six 3x5 retaining screws on the meter housing rear panel, and remove the rear panel.

STEP 5. Adjust RV1 on the ASB board until the VU meter indication becomes 0 VU.

7.5.2.3 Bar Graph Calibration

The input level must be adjusted before calibrating the bar graphs. Adjustment should not be necessary unless a CNL or a BDS board have been replaced. The following procedure is for an individual channel.

STEP 1. Ensure that the power is ON. Set the signal generator to supply a 1kHz sine wave at 4.0dBm.

STEP 2. Press the IND key on the ALN panel until the desired channel number is shown in the ALN STATUS display window, and then press the INPUT MON LVL key.

STEP 3. Ensure that the input level of the channel as indicated on the ACVM is 4.0dBm, +/- .1dB. Select ZOOM mode on the Monitor Housing and verify that the top green segment on the bar graph indicator of the channel under test is illuminated but that the bottom red segment is extinguished. If adjustment is necessary, proceed to STEP 4.

STEP 4. Turn the power OFF. Remove the appropriate CNL from its slot, install it onto the extender board, and reinsert it into its slot. Turn the power ON.

STEP 5. Press the IND key on the ALN panel until the desired channel number is shown in the ALN STATUS display window, and then press the INPUT MON LVL key. Select ZOOM mode on the Monitor Housing.

STEP 6. Adjust RV3 on the CNL until the bottom red segment is illuminated and then rotate RV3 counter-clockwise until the segment extinguishes.

STEP 7. Turn the power OFF. Take the CNL off the extender board, remove the extender board from the slot, and insert the CNL back into its slot.

7.5.3 Playback

Playback adjustments include head azimuth and wrap, repro/sync level, and repro/sync high frequency level. It is essential that the tape path adjustments, as described in Section 6.3, be performed before beginning any of the following alignments. Input level, VU meter calibration, and bar graph calibration must also be properly set.

Before using the test tapes, ensure that the tape path and the heads have been cleaned and demagnetised, as described in Section 5. It is strongly recommended that the test tapes be handled and stored with great care so as to lengthen the life of the tapes and maintain accurate audio system alignments.

7.5.3.1 Head Azimuth and Wrap

The head azimuth and wrap adjustments for the sync and repro heads fix the final mechanical position of the heads, and must be set before adjusting the electronic reproduce and record levels.

Before adjusting the head azimuth and wrap, the head zenith and height must be checked, and adjusted if necessary, as described in Section 6.3.1. Once the head azimuth and wrap have been adjusted, the head zenith and height must then be rechecked, and adjusted if necessary.

The azimuth adjustment is especially important because it fine tunes the phase relationship between all of the multitrack head channels, minimising the phase differences between them. The wrap adjustment places the gap of the head in the exact center of the head-to-tape contact area, thereby ensuring maximum audio playback level.

STEP 1. Connect Channel 1 LINE OUT to CH-1 Input of the oscilloscope and Channel 24 LINE OUT to CH-2 Input of the oscilloscope. Connect calibration output (CAL OUT) to the ACVM.

STEP 2. Ensure that the power is ON and select Rehearse mode on the Remote Control Unit.

STEP 3. Select LOW speed and load the 15 ips test tape onto the machine.

STEP 4. Select Overdub mode on the Remote Control unit to adjust the sync head.

STEP 5. Select ALL on the ALN.

STEP 6. Locate to the 10 kHz tone on the test tape and press PLAY.

STEP 7. Turn the head wrap adjusting screw for peak reading on the ACVM.

STEP 8. Adjust the head azimuth adjusting screw until maximum level is observed on the ACVM, and the two signals displayed on the oscilloscope are in phase.

STEP 9. Repeat STEPS 7 and 8 until no change is noticed in either adjustment.

STEP 10. Select Repro mode on the Remote Control Unit to adjust the repro head, and repeat STEPS 6 through 9.

STEP 11. Return to the Head Zenith and Height procedures, Section 6.3.1, and adjust if necessary.

7.5.3.2 Repro/Sync Level

The repro/sync level adjustments are made using the test tape of the desired speed and reference fluxivity. Before adjusting the repro/sync levels, it is imperative that the head azimuth and wrap adjustments be made to both heads as described in the preceding paragraphs.

STEP 1. Ensure that the power is ON and press the REHEARSE key on the Remote Control Unit.

STEP 2. Load the desired test tape onto the machine and select the appropriate speed.

STEP 3. Press TAPE on the Remote Control to enter Repro mode, and select ZOOM mode on the Monitor Housing.

STEP 4. Locate to the 1 kHz tone on the test tape and press PLAY. Verify that all the bar graph indications are 0 VU, +/- .1dB. If adjustment is necessary proceed to STEP 5. Otherwise, go directly to STEP 8.

STEP 5. On the ALN panel, use the IND key to select the channel that is in need of adjustment, and then press the REPRO LEVEL key.

STEP 6. Press the INC or DEC key in the CALIBRATION section of the ALN panel until the bar graph indication for that channel is 0 VU, +/- .1dB. The Jog/Shuttle Dial can also be used to increment or decrement, as described in Section 7.5.

STEP 7. Repeat STEPS 5 and 6 for all channels in need of adjustment.

STEP 8. Press the OVERDUB key on the Remote Control Unit to enter Sync mode.

STEP 9. Locate to the 1 kHz tone on the test tape and press PLAY. Verify that all the bar graph indications are 0 VU, +/- .1dB. If adjustment is necessary proceed to STEP 10.

STEP 10. On the ALN panel, use the IND key to select the channel that is in need of adjustment, and then press the SYNC LEVEL key.

STEP 11. Press the INC or DEC key in the CALIBRATION section of the ALN panel until the bar graph indication for that channel is 0 VU, +/- .1dB.

STEP 12. Repeat STEPS 10 and 11 for all channels in need of adjustment, and then proceed to the Repro/Sync High Frequency Level procedure.

NOTE: If it is desired to store the repro/sync alignment into a PRESET Storage Location, it must be stored before switching speeds or turning the power off. Refer to Section 7.5.1 for information on how to use the preset storage feature.

7.5.3.3 Repro/Sync High Frequency Level

The repro/sync levels must be adjusted before adjusting the repro/sync high frequency levels. This procedure is a continuation of the Repro/Sync Level procedure.

STEP 1. Press TAPE on the Remote Control Unit to enter Repro mode.

STEP 2. Locate to the 10kHz tone on the test tape and press PLAY. Verify that all the bar graph indications are 0 VU, +/- .1dB. If adjustment is necessary proceed to STEP 3. Otherwise, go directly to STEP 6.

STEP 3. On the ALN panel, use the IND key to select the channel that is in need of adjustment, and then press the REPRO H. FREQ key.

STEP 4. Press the INC or DEC key in the CALIBRATION section of the ALN panel until the bar graph indication for that channel is 0 VU, +/- .1dB. The Jog/Shuttle Dial can also be used to increment or decrement, as described in Section 7.5.

STEP 5. Repeat STEPS 3 and 4 until all channels are within specification.

STEP 6. Press OVERDUB on the Remote Control Unit to enter Sync mode.

STEP 7. Locate to the 10kHz tone on the test tape and press PLAY. Verify that all the bar graph indications are 0 VU, +/- .1dB. If adjustment is necessary proceed to STEP 8.

STEP 8. On the ALN panel, use the IND key to select the channel that is in need of adjustment, and then press the SYNC H. FREQ key.

STEP 9. Press the INC or DEC key in the CALIBRATION section of the ALN panel until the bar graph indication for that channel is 0 VU, +/- .1dB.

STEP 10. Repeat STEPS 8 and 9 for all channels in need of adjustment.

NOTE: If it is desired to store the repro/sync high frequency alignment into a PRESET Storage Location, it must be stored before switching speeds or turning the power off. Refer to Section 7.5.1 for information on how to use the preset storage feature.

7.5.4 Record

The record alignments need to be adjusted when calibrating for a different tape formulation, a changed headstack, or when it is desired to change the presets stored in a storage location.

It is essential that the tape path adjustments as detailed in Section 6, and the input and playback adjustments previously detailed in this section be performed before beginning the record alignments.

Ideally, the tape that is used during the record alignments will be the same one that is going to be used for the recording. Since this is not always possible, using the same type of tape formulation for the record alignments as that used for the recording will produce excellent results. Old tapes should never be used when adjusting the record circuitry, since they can lead to a less than optimum alignment.

7.5.4.1 Record Levels

The record alignment includes adjustment of the bias, record, input, record high frequency, and low frequency bump levels. The following procedure is for an individual channel and should be carefully followed.

The record and bias level adjustments are interactive and are critical to obtaining optimum audio performance in the recordings produced by the **APR-24**. The record level determines the fluxivity level of the signal recorded on tape, and directly affects harmonic distortion. The bias level sets the amplitude of the bias signal, with the level of overbias used directly affecting the amount of high frequency loss.

It may be advantageous in some cases to record the program material at a fluxivity that results in lower distortion but greater high frequency loss. The level at which the overbias should be set varies with different tapes, tape formulations, heads and tape speeds. The audio signal applied to the tape should have the desired compromise between distortion and high frequency loss.

STEP 1. Ensure that the power is ON and load a reel of tape onto the machine.

STEP 2. Put all channels into Record Ready mode at the Remote Control Unit and set the signal generator to supply a 10kHz sine wave at 4.0dBm.

STEP 3. Select the desired speed and press the PLAY and RECORD keys simuletaneously to enter Record mode.

STEP 4. Use the IND key on the ALN panel to select the channel to be adjusted, and then press the BIAS LEVEL key.

STEP 5. Press the INC or DEC key until the VU meter attains a peak indication, where the level does not increase or decrease. The Jog/Shuttle Dial can also be used to increment and decrement, as described in Section 7.5.

STEP 6. Press the INC key until the VU meter indication falls to the level of desired overbias. Typical overbias values using Scotch 226 are 2.0dB at 30 ips and 3.0dB at 15 ips.

STEP 7. Set the signal generator to supply a 1kHz sine wave at 4.0dBm and press the RECORD LEVEL key on the ALN.

STEP 8. Press the INC or DEC key until the VU meter indication is 0 VU. key until the VU meter indication is 0 VU.

STEP 9. Press the INPUT MON LVL key on the ALN and press the INC or DEC.

STEP 10. Set the signal generator to supply a 10kHz sine wave at 4.0dBm and press the RECORD H. FREQ key on the ALN.

STEP 11. Press the INC or DEC key until the VU meter indication is 0 VU.

STEP 12. Repeat STEPS 7 through 11 until all specifications are met, and proceed to STEP 13.

STEP 13. Ensure ZOOM mode is selected on the meter housing, and set the signal generator frequency to 70Hz for 30 ips or 30Hz for 15 ips.

STEP 14. Slowly increase the signal generator frequency until a peak indication on the bar graph displays is reached.

STEP 15. Press the REPRO L. FREQ key on the ALN.

STEP 16. Press the INC or DEC key until the bar graph indication of the channel under adjustment is +0.5dB.

STEP 17. Reset the TAPE TIME and LOCATE TIME Displays, and record approximately 10 seconds of the low frequency bump.

STEP 18. Press the LOCATE key to locate to the beginning of the recorded tone.

STEP 19. Press OVERDUB on the Remote Control Unit and press the SYNC L. FREQ key on the ALN.

STEP 20. Once the locate time is reached, press PLAY and observe the bar graph display of the channel under adjustment.

STEP 21. Press the INC or DEC key until the bar graph indication is +0.5dB.

NOTE: If it is desired to store the record alignment into a PRESET Storage Location, it must be stored before switching speeds or turning the power off. Refer to Section 7.5.1 for information on how to use the preset storage feature.

7.5.5 Equalisation Standards

Selection of NAB and AES equalisation standards (EQ STD) for the audio alignment is provided on the ALN panel, as previously described in Section 3.5.5. It should be noted that at 30 ips, the machine will always have the IEC equalisation standard, as NAB does not have a standard for 30 ips.

7.5.5.1 Changing the Equalisation Standard

If it is desired to change 15 ips from its factory-set NAB EQ STD, use the following two-step procedure.

STEP 1. Press the ALL key on the ALN panel and ensure that the word ALL appears in the STATUS Display.

STEP 2. Press the IEC key on the ALN panel and ensure that the key indicator illuminates.

NOTE: If it is desired to store the new EQ STD into a PRESET Storage Location, it must be stored before switching speeds or turning the power off. Refer to 7.5.1 for information on how to use the preset storage feature.

7.5.6 Secondary Compensations

The audio alignment is effected by the secondary parameters described in the following paragraphs. A procedure for changing the parameters is also given.

7.5.6.1 Repro/Sync Gap Compensation

The Repro Gap Compensation (RGC) and Sync Gap Compensation (SGC) parameters are used to counteract the losses that occur in playback due to different head gap widths. Should extensive relapping of the heads cause a change in high frequency performance, the gap compensators may be adjusted to offset the loss.

Both gap compensators provide a shelving high frequency boost of 10kHz to 25kHz with increasing parameter values of c0 through c7. Parameter values c8 through cF provide the same shelving high frequency boost range as c0 through c7, but have an additional low frequency boost.

RGC is the secondary function of the REPRO LEVEL key on the ALN panel, and SGC is the secondary function of the SYNC LEVEL key.

7.5.6.2 Record Feed Forward/Back

The Record Feed Forward (RCF) and Record Feed Back (RCB) parameters are used to adjust the record circuitry so that the frequency response during playback will be flat over a wide range of diverse tape formulations. Adjustment of these parameters should only be considered if the tape formulation shows significantly undesirable response characteristics that cannot be remedied by normal record equalisation and overbias adjustments.

As shown in Figure 7-15, RCF provides a shelving high frequency boost from 8kHz to 25kHz with increasing parameter values c0 through c7. c8 through cF are functionally identical to c0 through c7. RCB provides a shelving high frequency boost from 2kHz to 8kHz with decreasing control parameters c0 through c7.

RCF is the secondary function of the RECORD LEVEL key on the ALN panel, and RCB is the secondary function of the RECORD H. FREQ key.

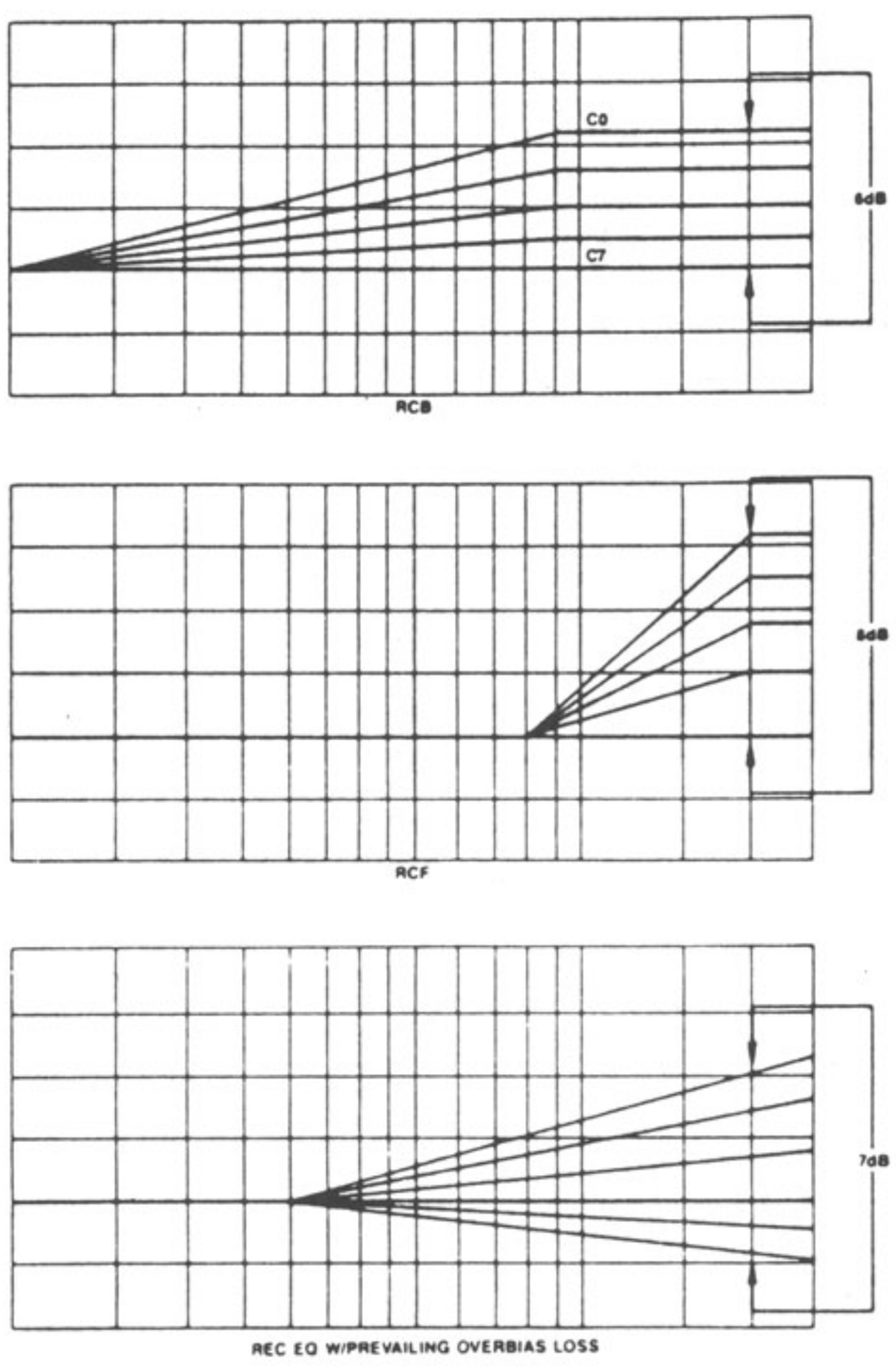


Figure 7-15. RCF and RCB Characteristics

7.5.6.3 Changing the Secondary Parameters

The **APR-24** is factory-aligned at a reference fluxivity of 250 nW/m using 3M Scotch 226. The secondary parameters are set as listed in Table 7-1.

	RGC	SGC	RCF	RFB
30 ips	c1	c1	c0	c0
15 ips	c8	cB	c3	c4

Table 7-1. Secondary Parameters

If it is desired to change the secondary parameters, use the following procedure:

STEP 1. Press the ALL key on the ALN panel and ensure that the word ALL appears in the STATUS Display.

STEP 2. While holding down the CONTROL key, press the key of the desired secondary parameter.

STEP 3. Use the INC or DEC key to change the parameter value until the desired effect is achieved.

NOTE: If it is desired to store the new parameters into a PRESET Storage Location, it must be stored before switching speeds or turning the power off. Refer to Section 7.5.1 for information on how to use the preset storage feature.