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.

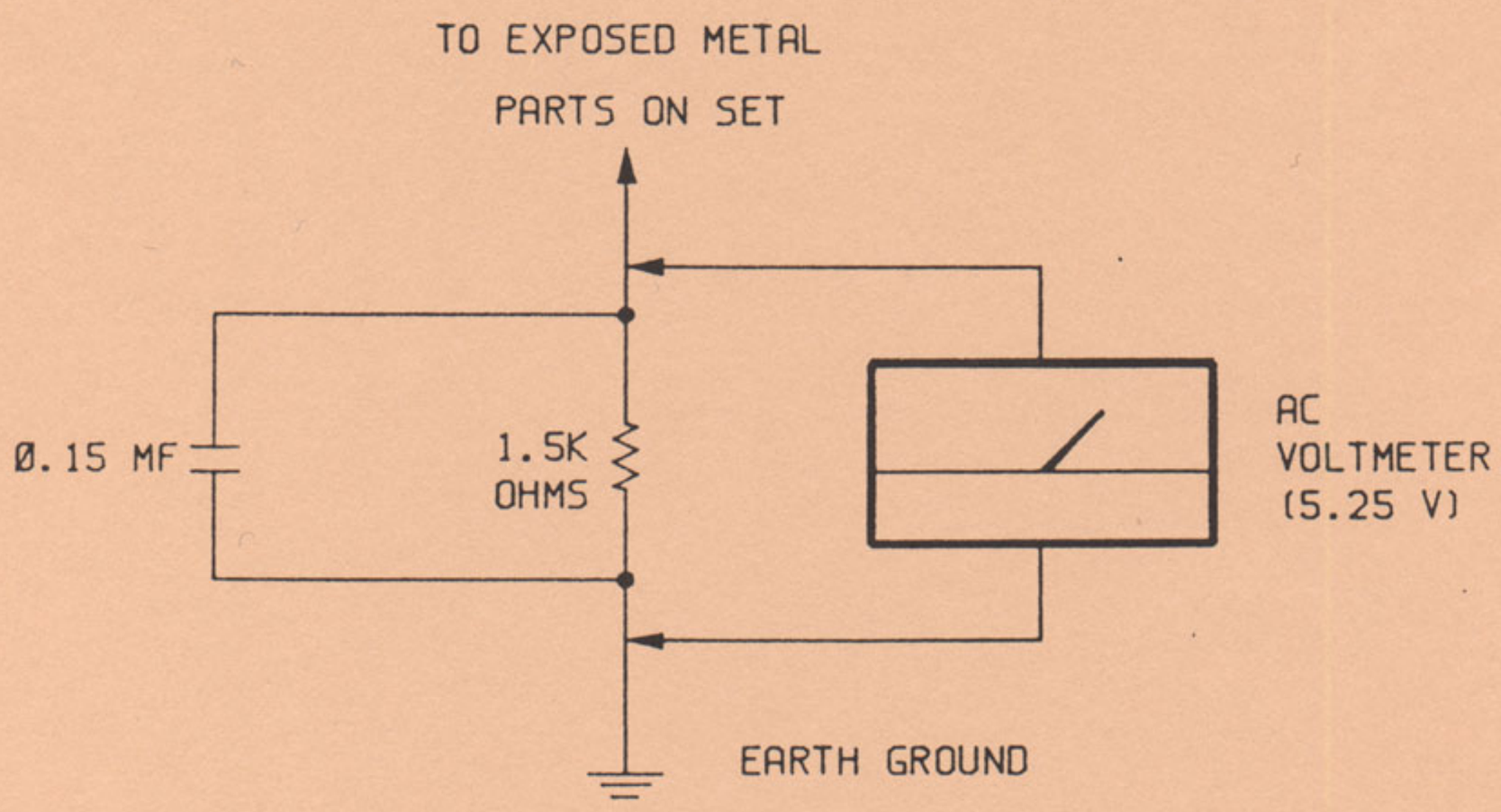

Figure A. Using an AC Voltmeter to check AC Leakage

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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

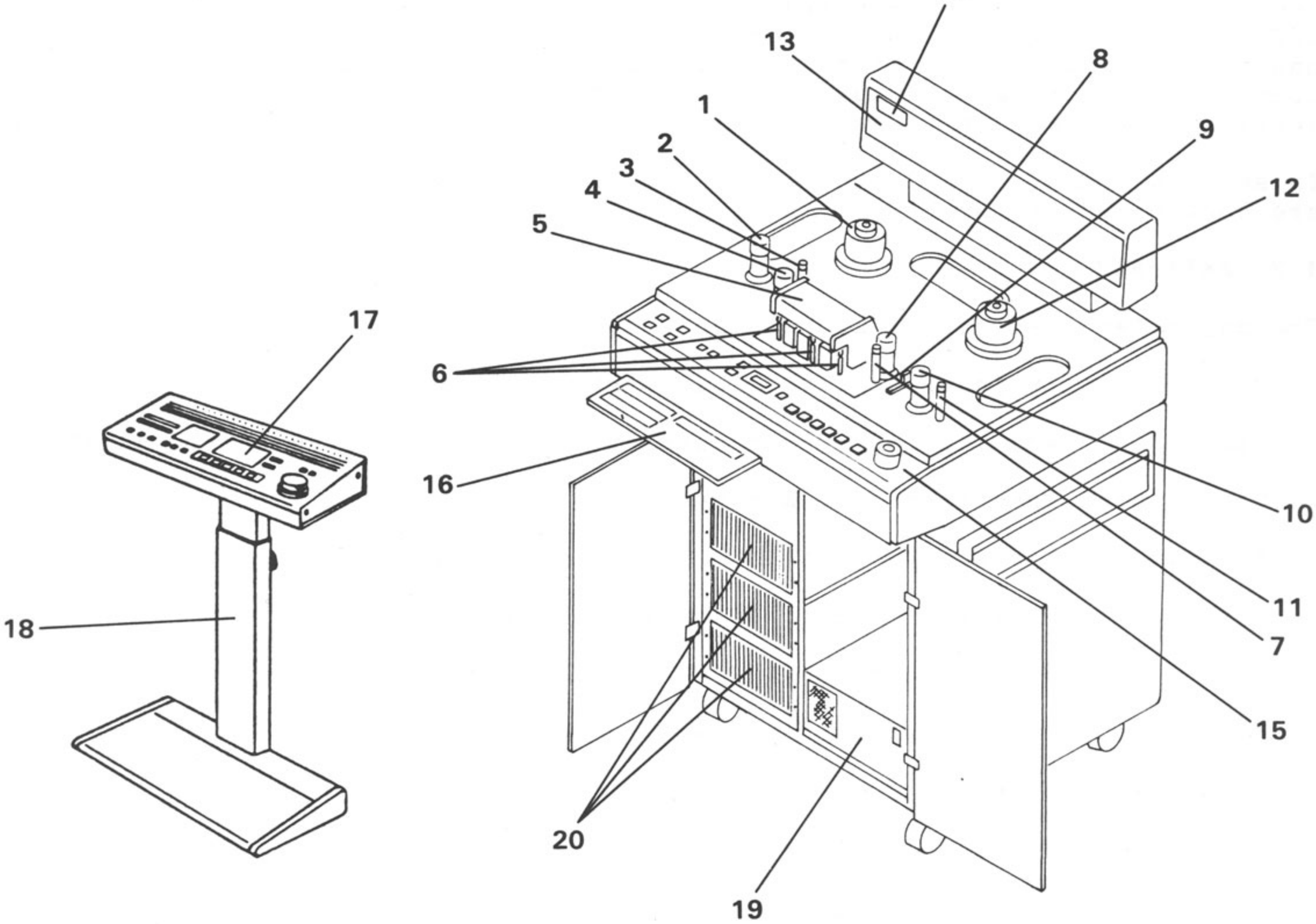


Figure 1-1. Primary Machine Components

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

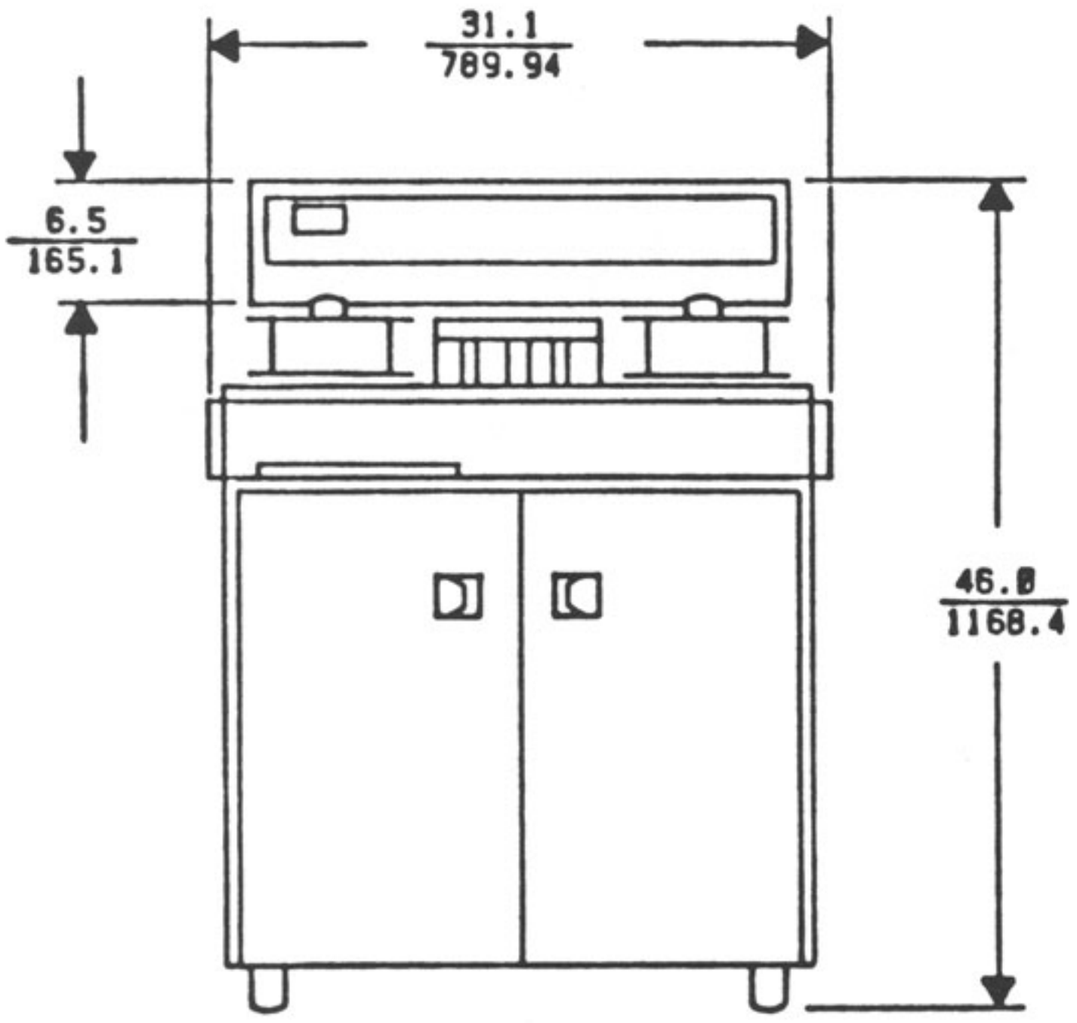
2.1 INTRODUCTION

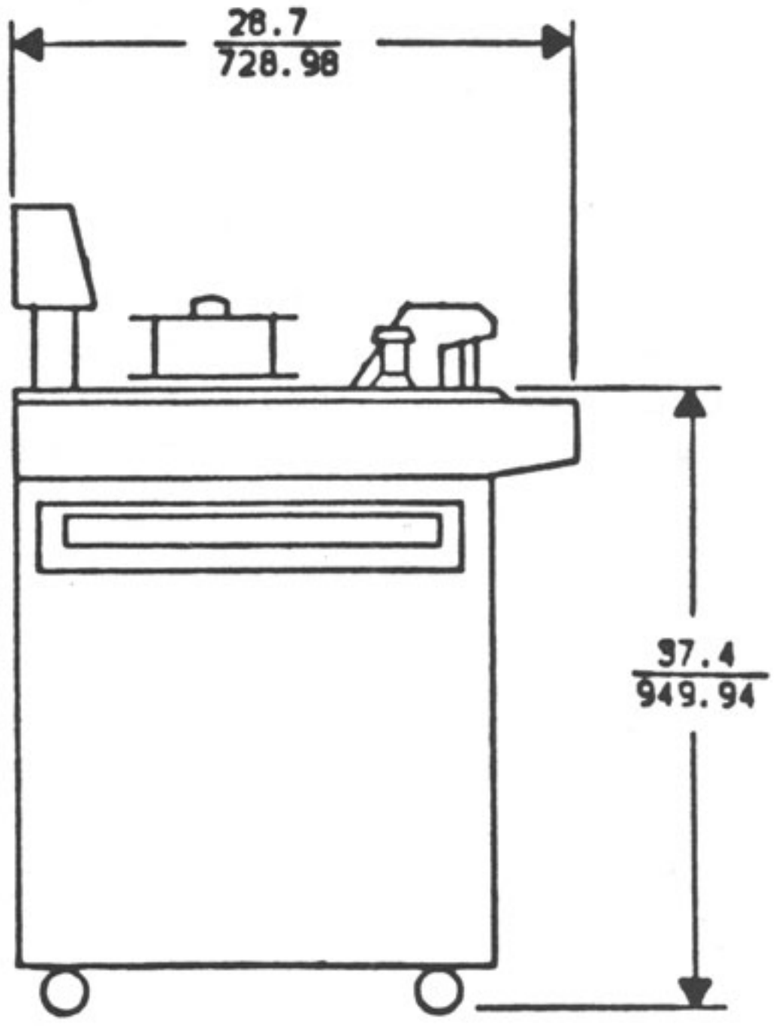
This section contains the information necessary for the installation of the **APR-24**, including space requirements, environmental considerations, repacking/unpacking, operating voltages, and external connections.

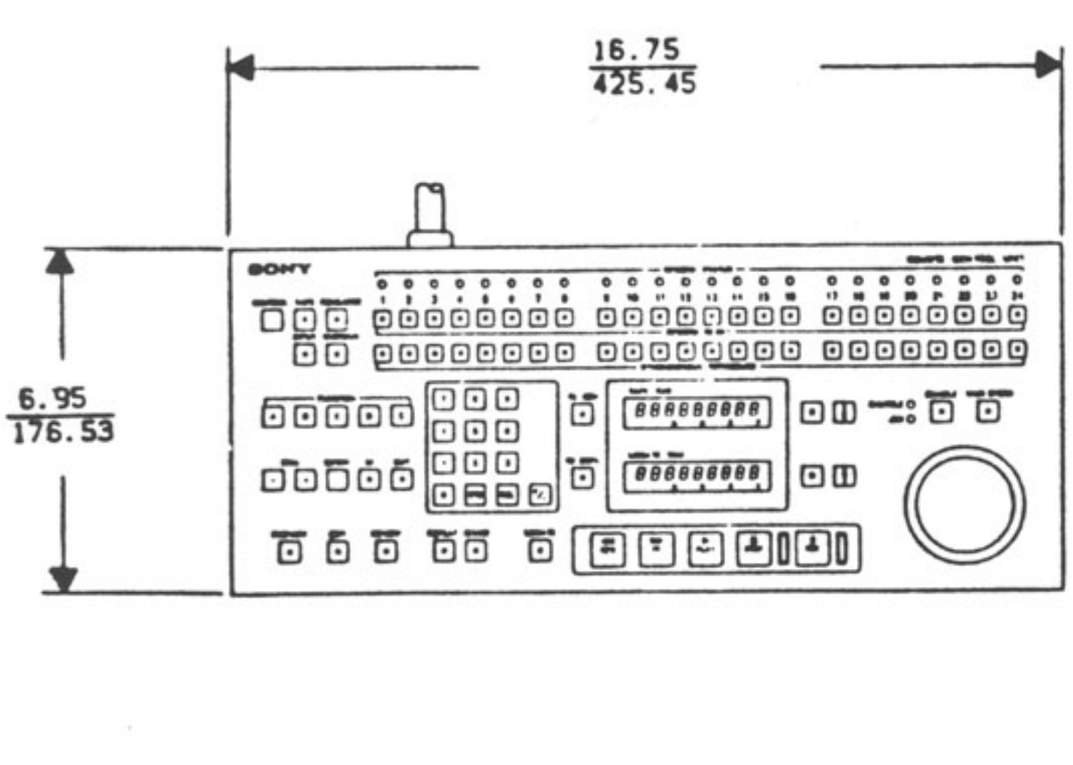
2.2 SPACE REQUIREMENTS

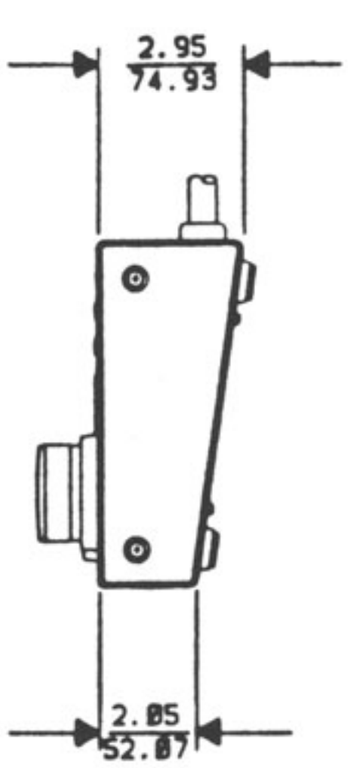
Before installing the machine in its final location, its weight and dimensions should be taken into consideration, together with those of the Remote Control Unit and its stand.

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).









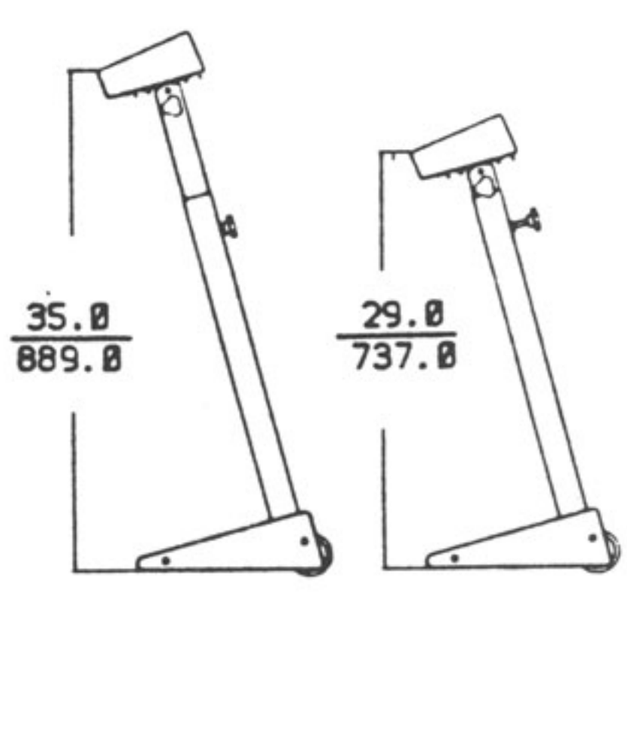


Figure 2-1. APR-24, Remote Control Unit, and SU-224 Stand Dimensions

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.

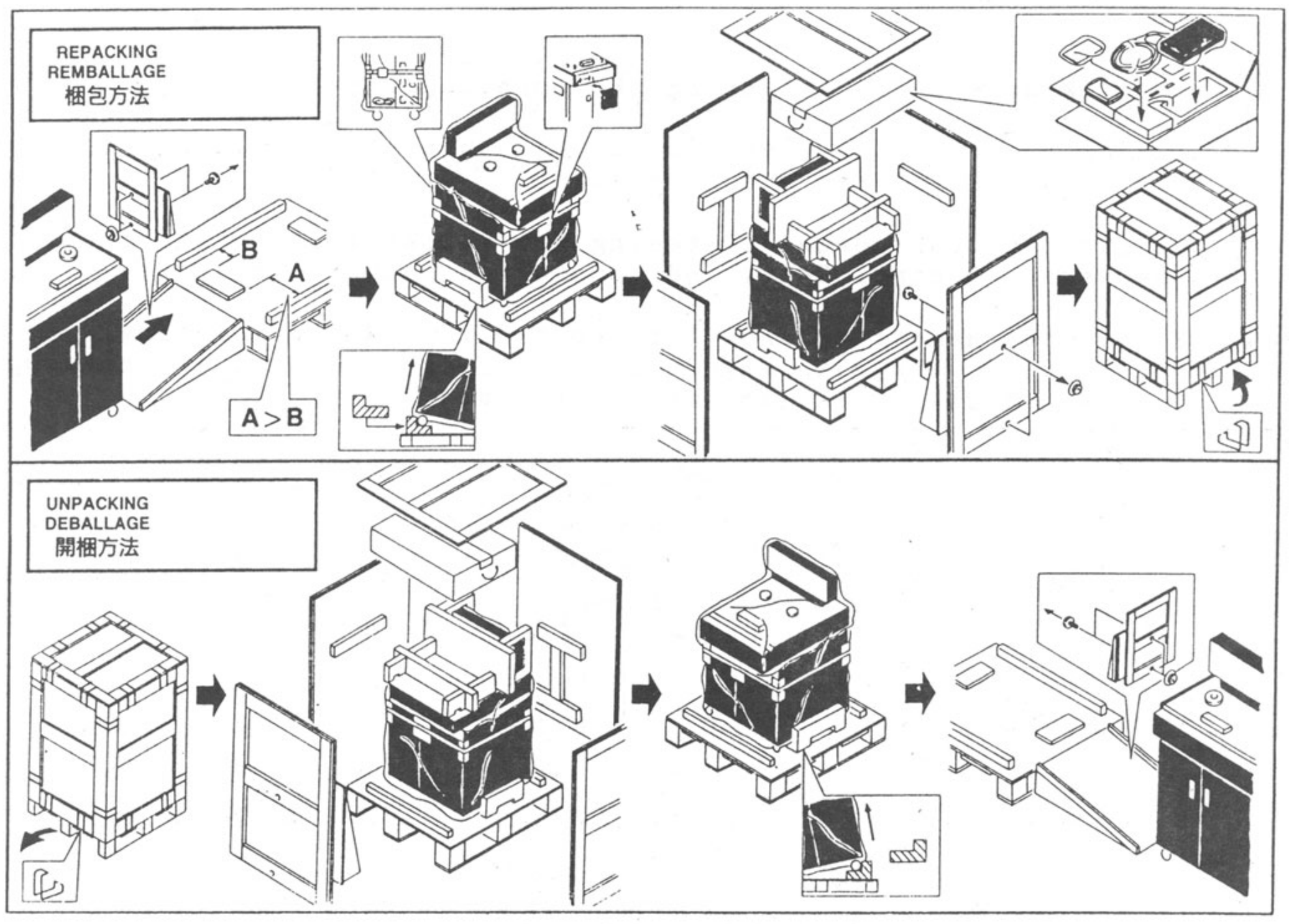


Figure 2-2. Unpacking/Packing Illustration

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.

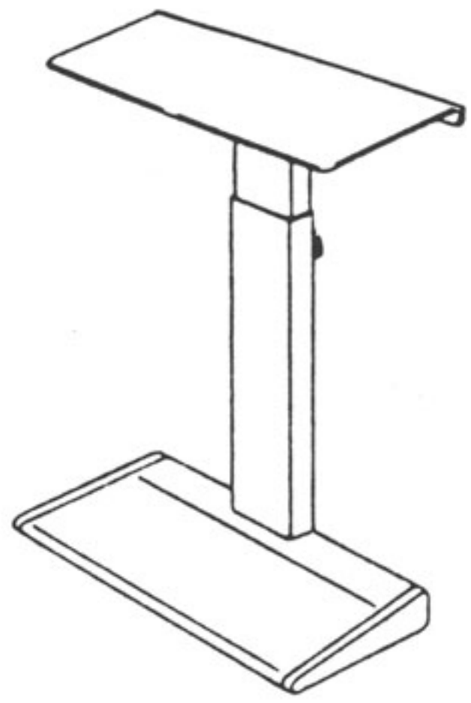


Figure 2-3. Attaching the Mounting Platform

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.

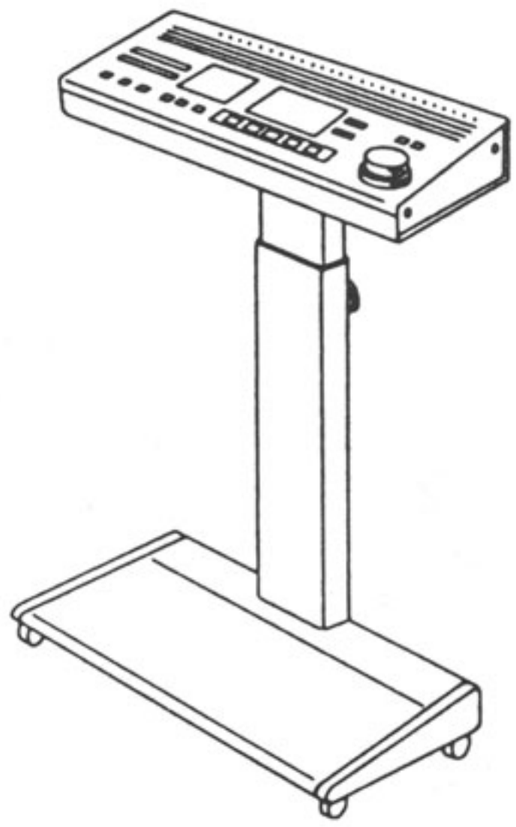


Figure 2-4. Mounting the Remote Control Unit

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.

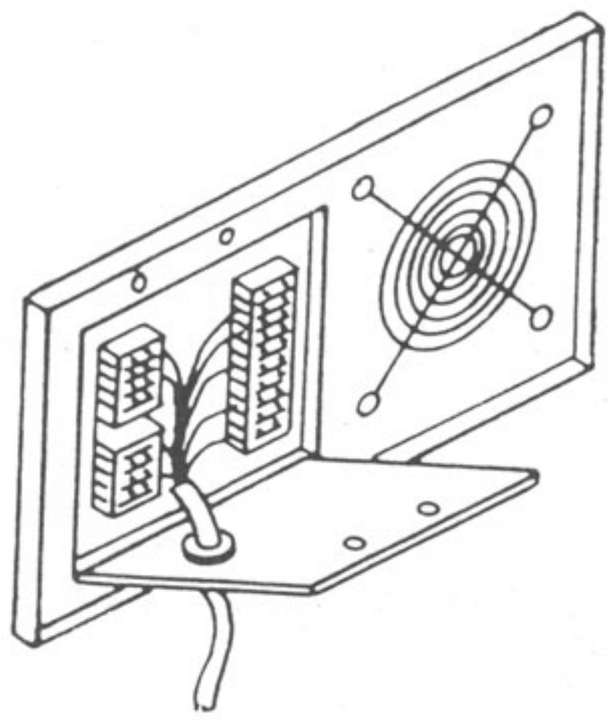


Figure 2-5. Power Supply Rear Panel Removal

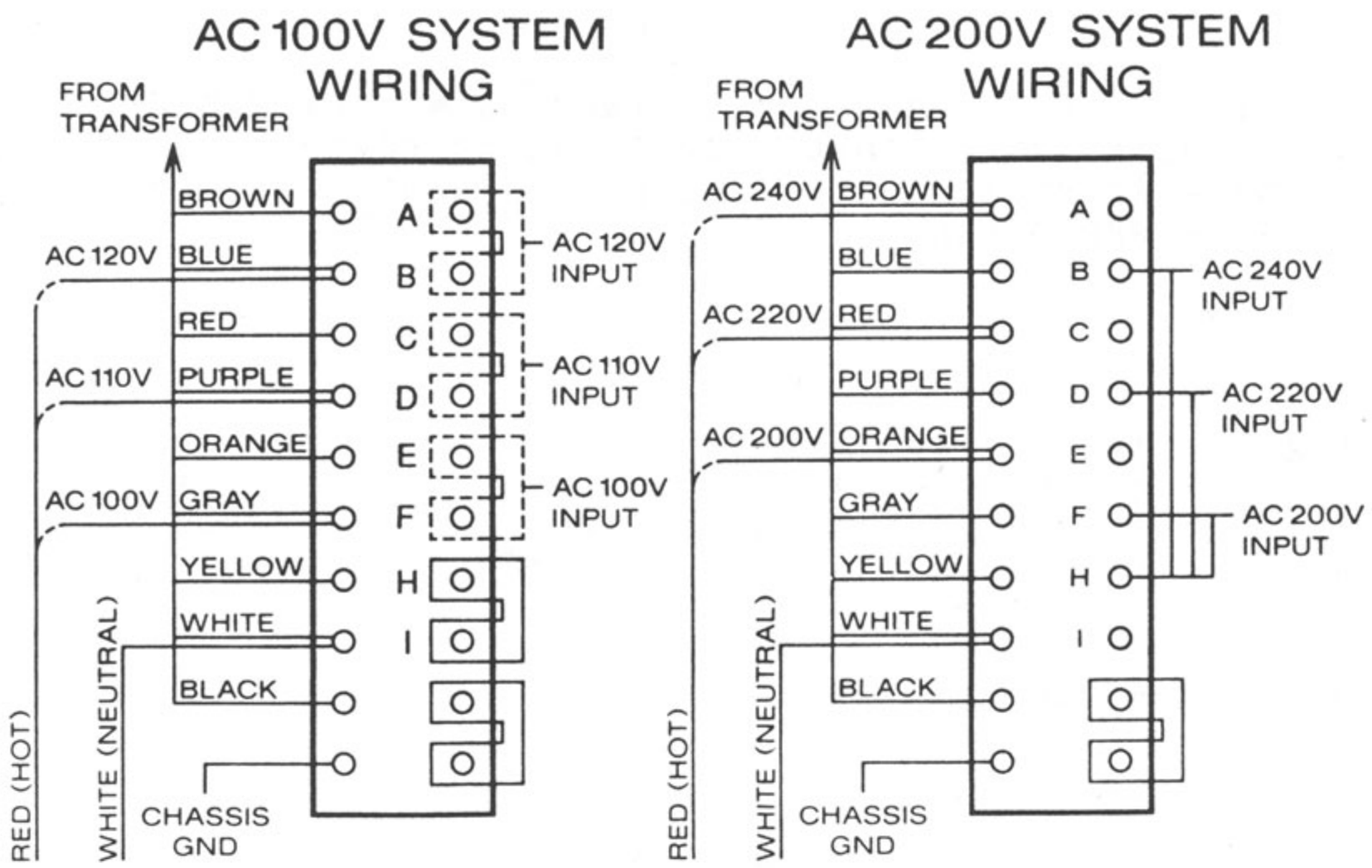


Figure 2-6. Power Supply Connector Strip

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.

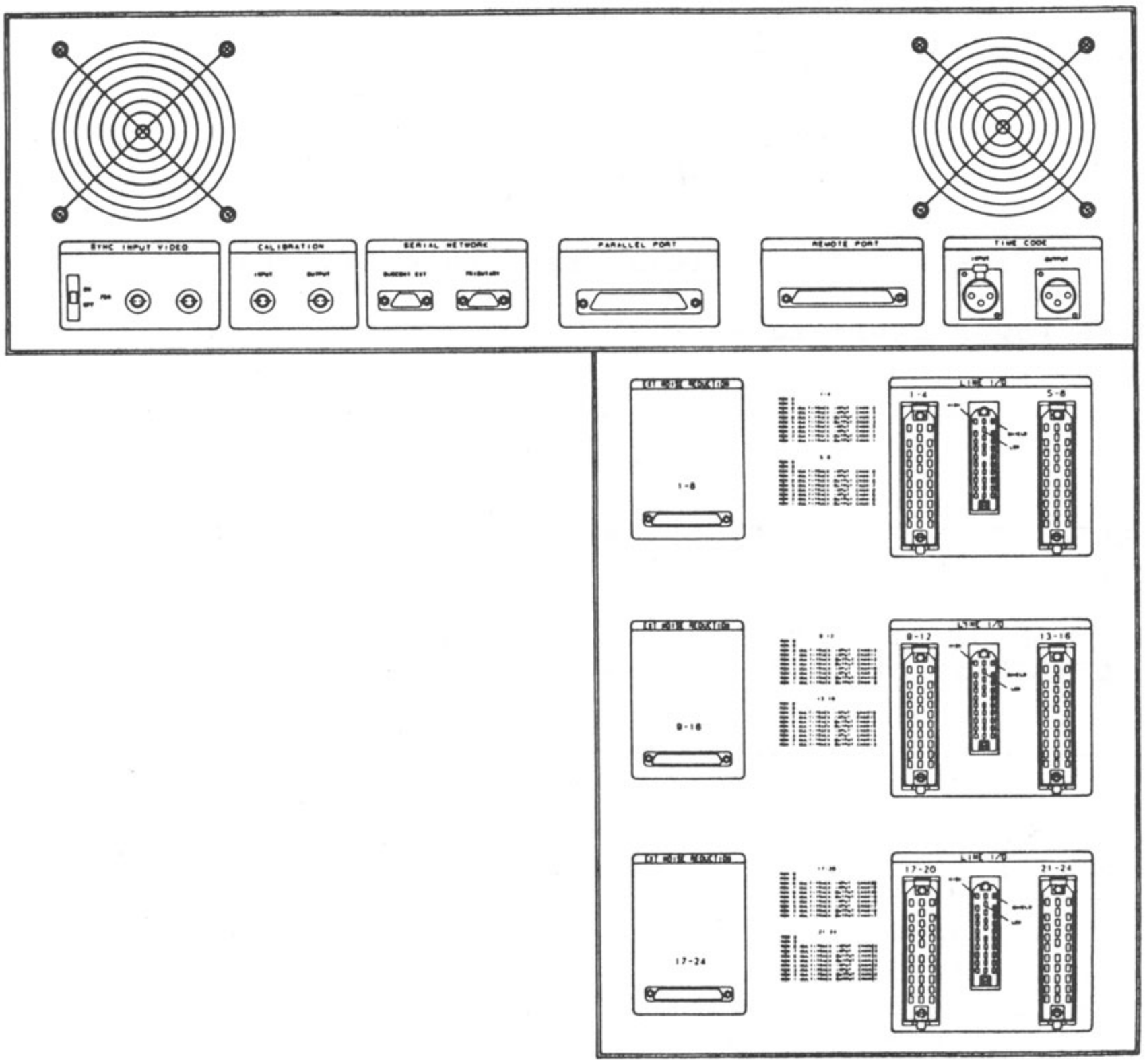


Figure 2-7. External Connections

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.

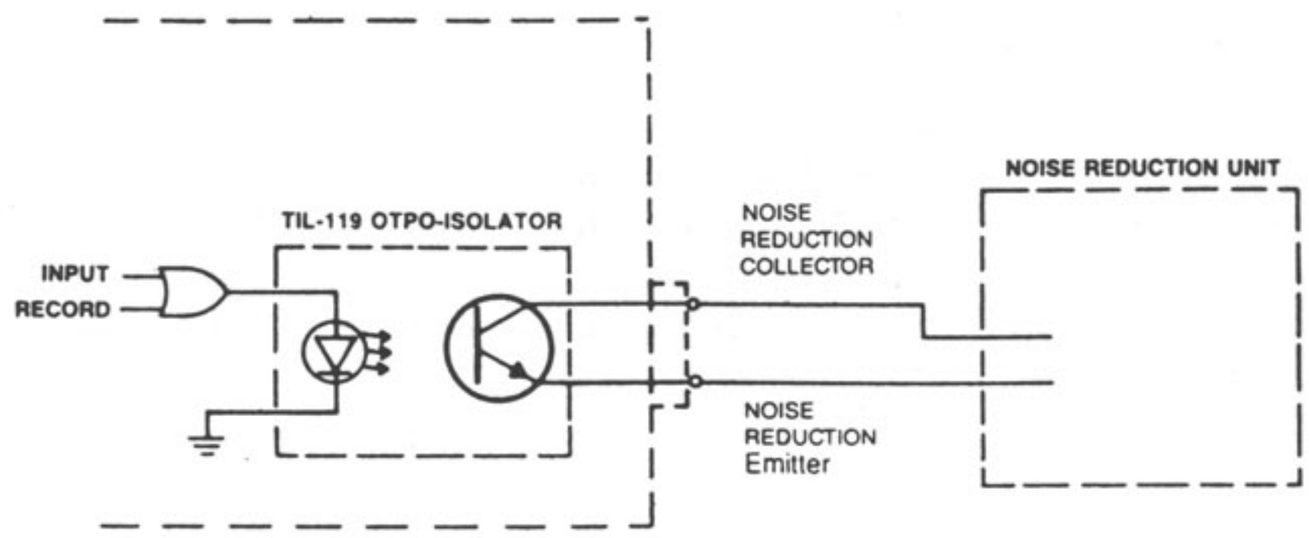


Figure 2-8. Noise Reduction Circuit

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

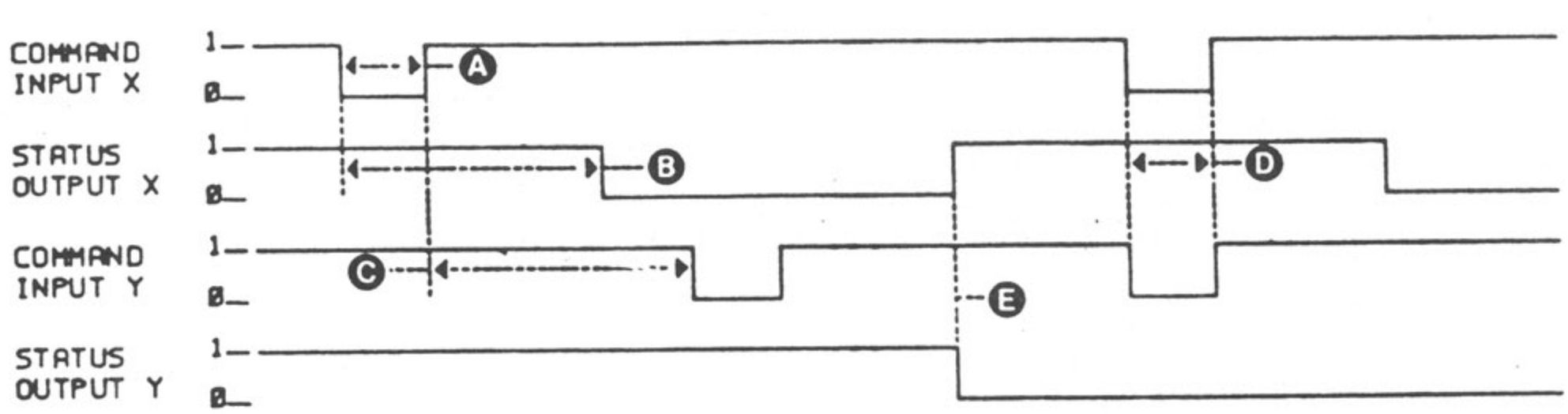


Figure 2-9. Parallel Port Timing

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%.

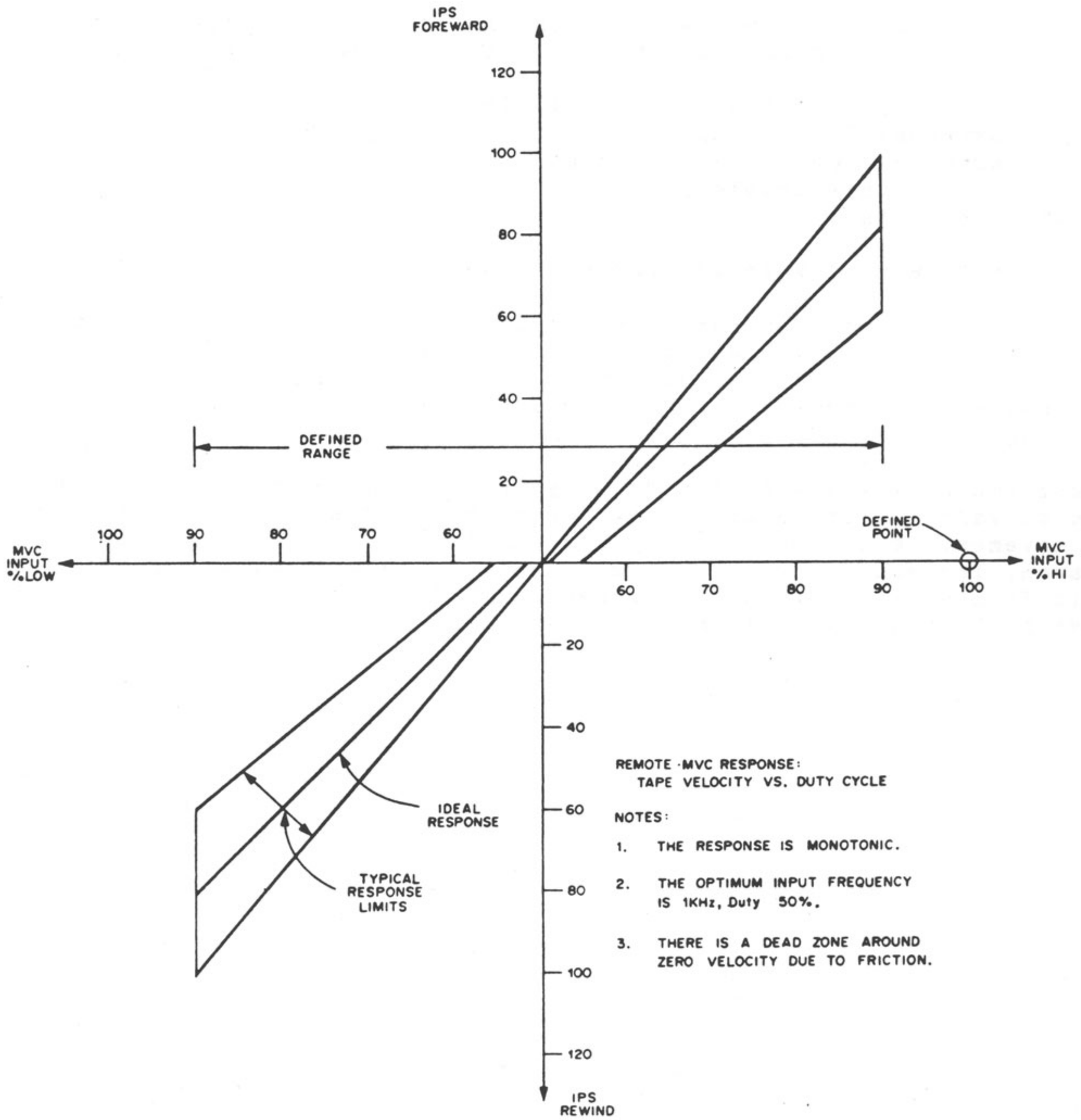


Figure 2-10. MVC Input

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.

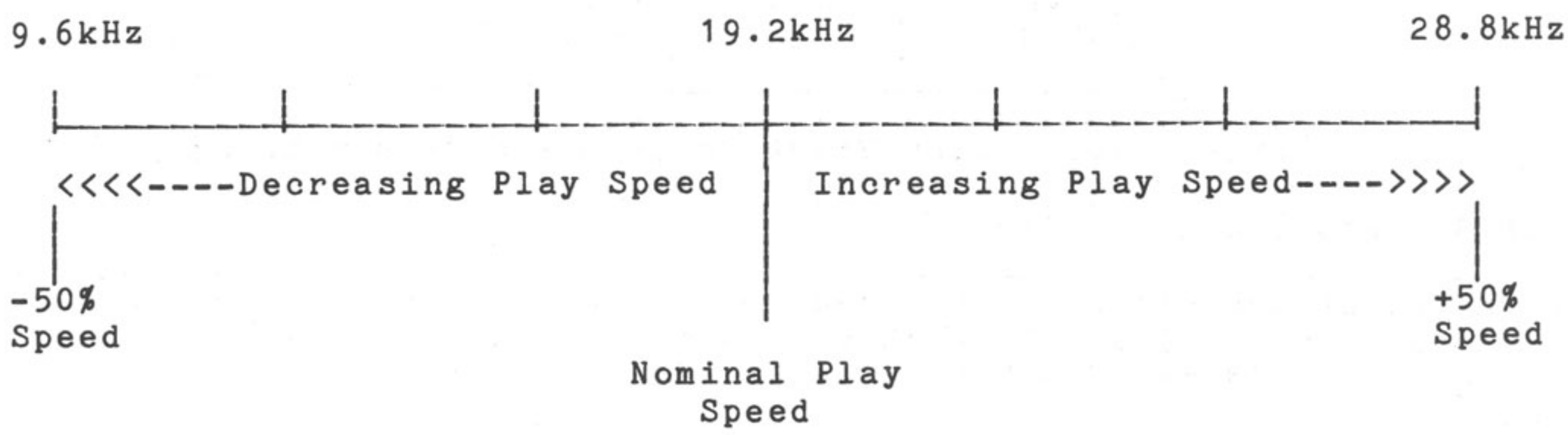


Figure 2-11. Capstan Reference Input Frequency v. Play Speed

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.

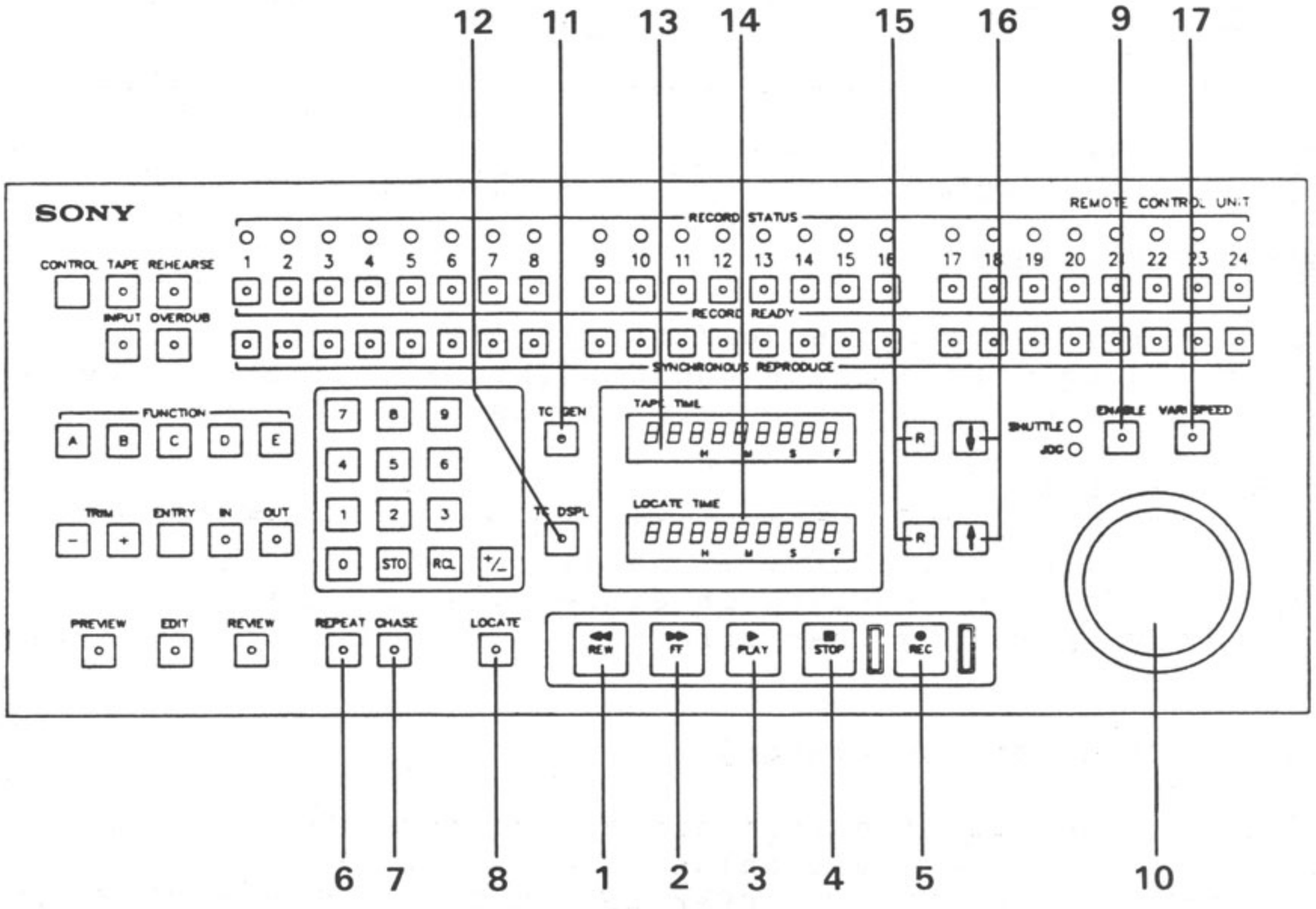


Figure 3-1. Transport Section

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.

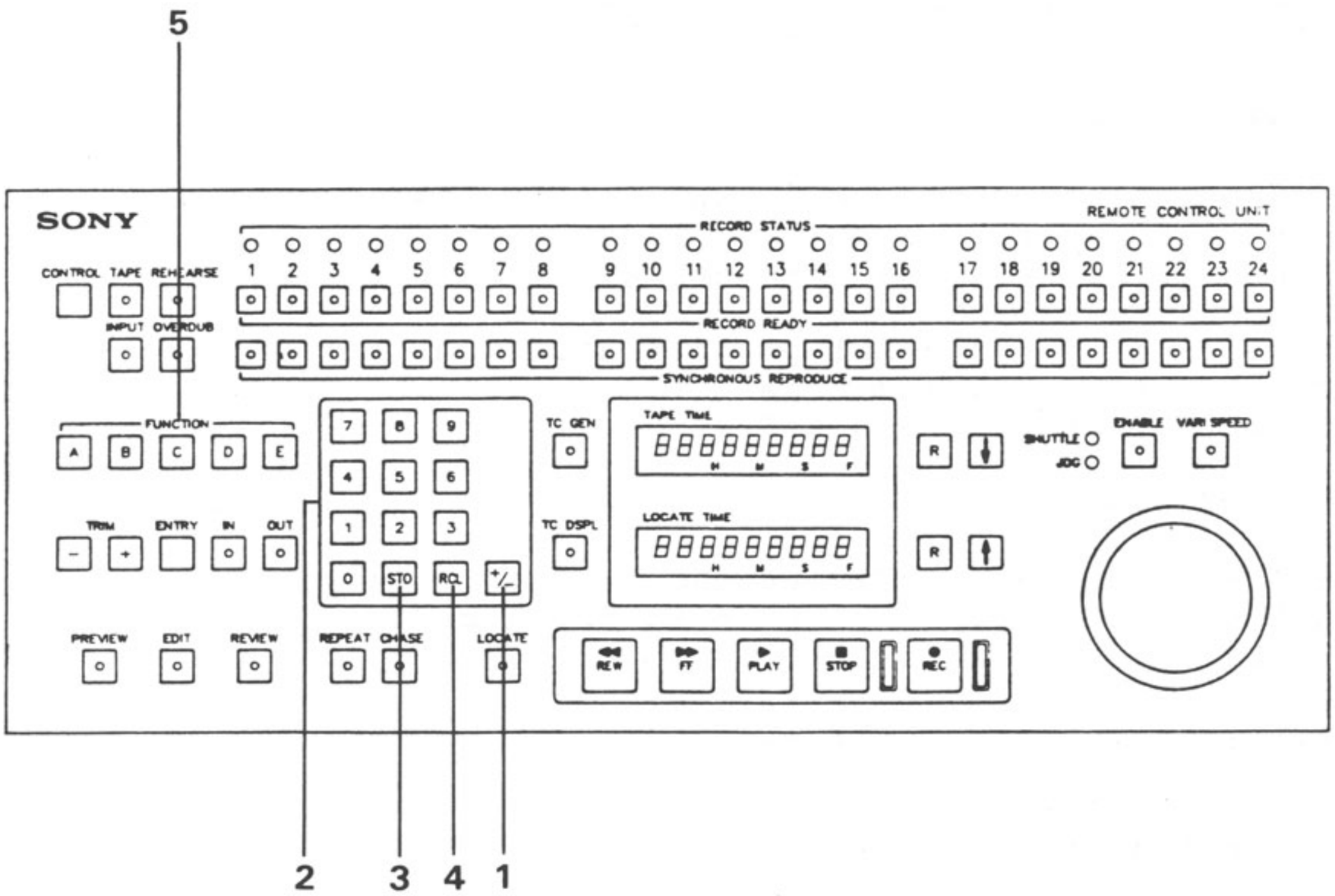


Figure 3-2. Numeric Keypad Section

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.

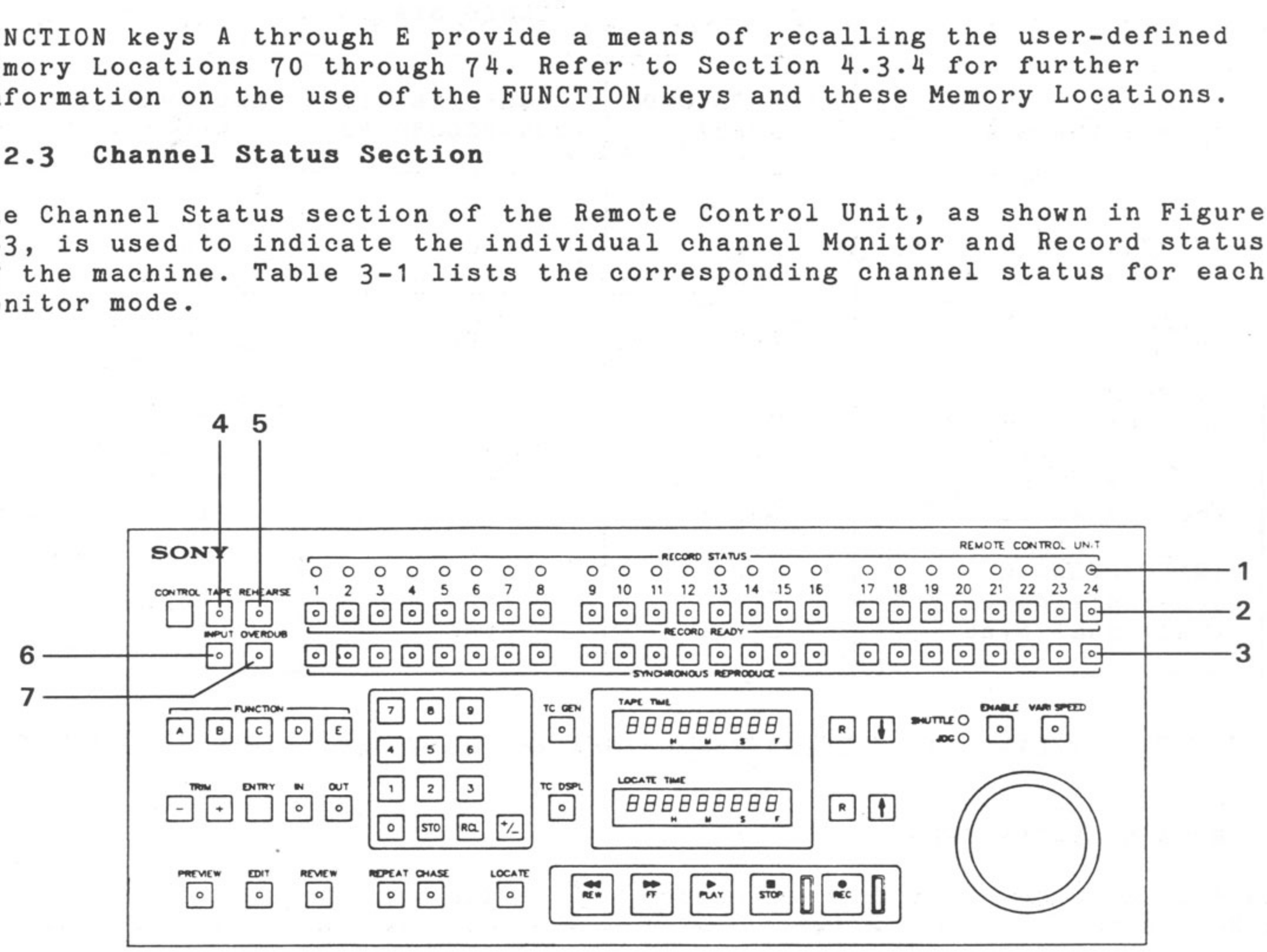


Figure 3-3. Channel Status Section

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.

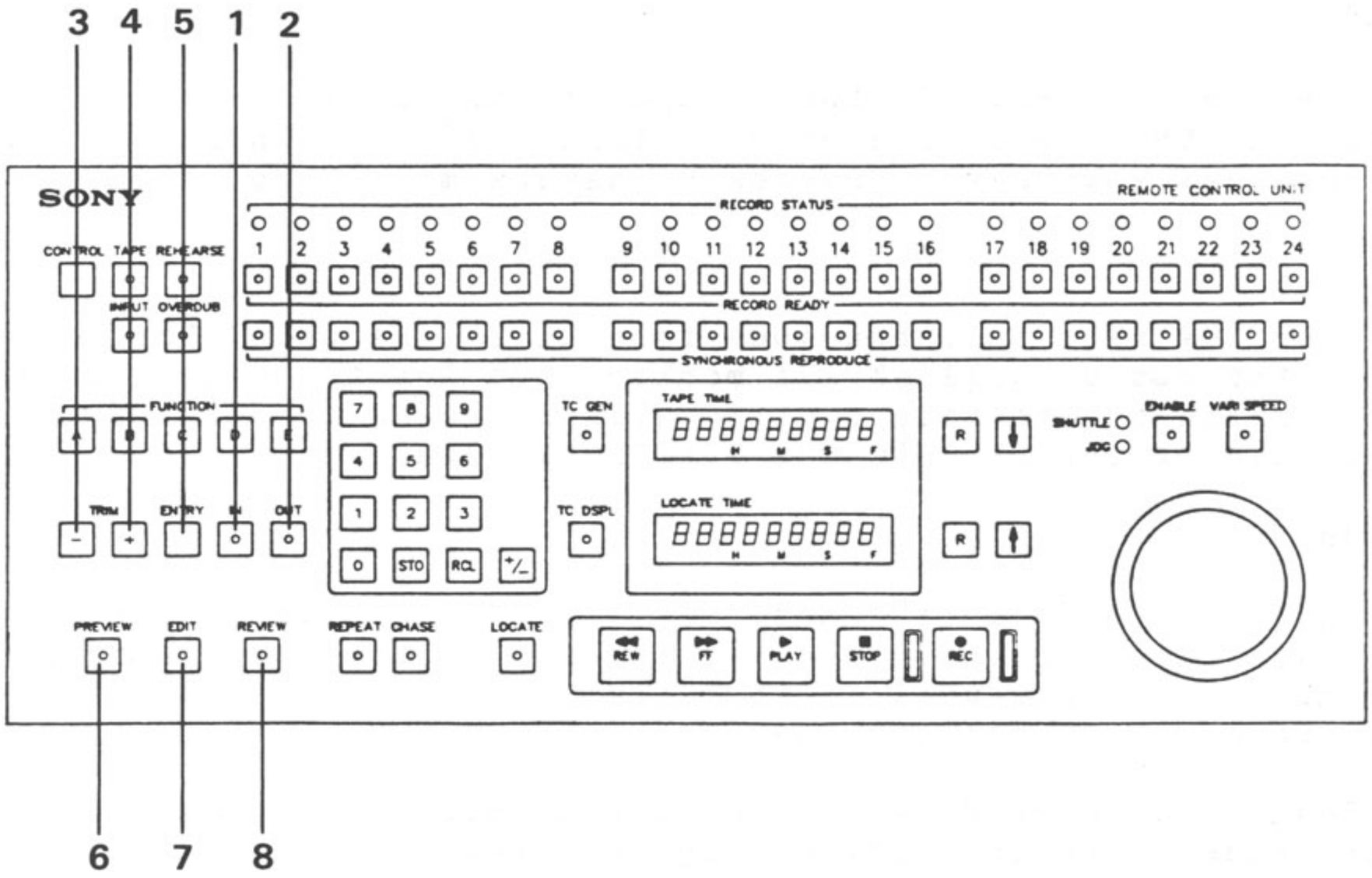


Figure 3-4. Editing Section

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.

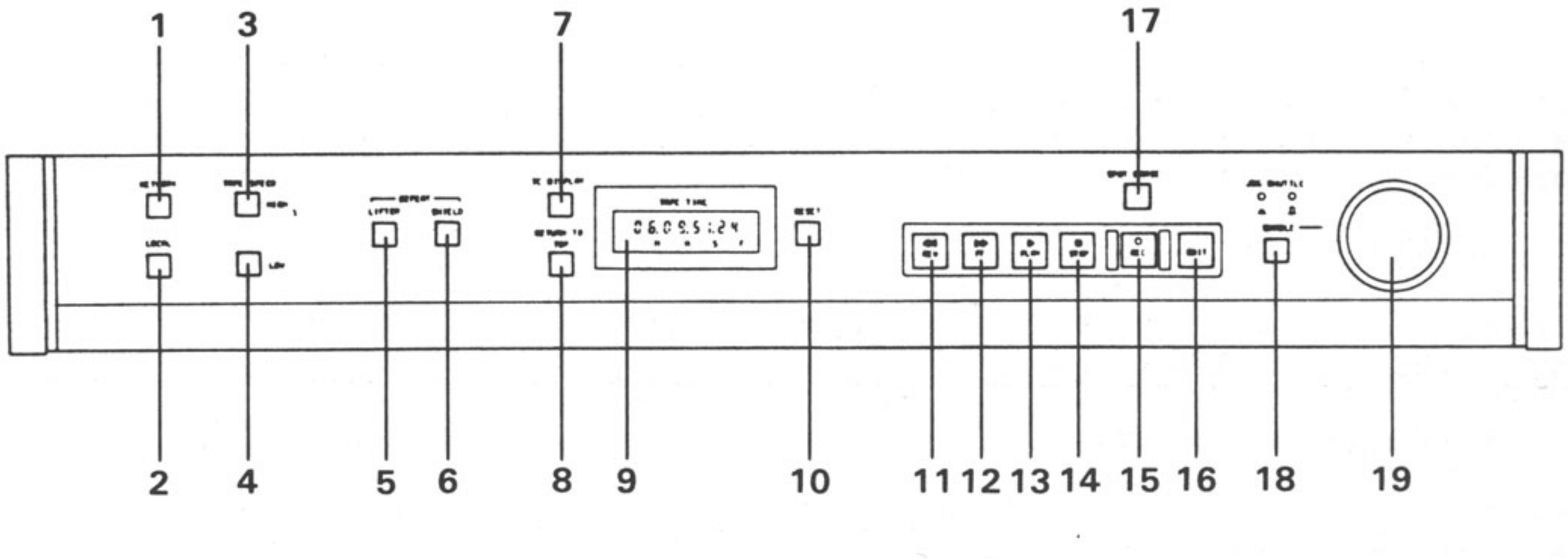


Figure 3-5. Local Control Panel

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.

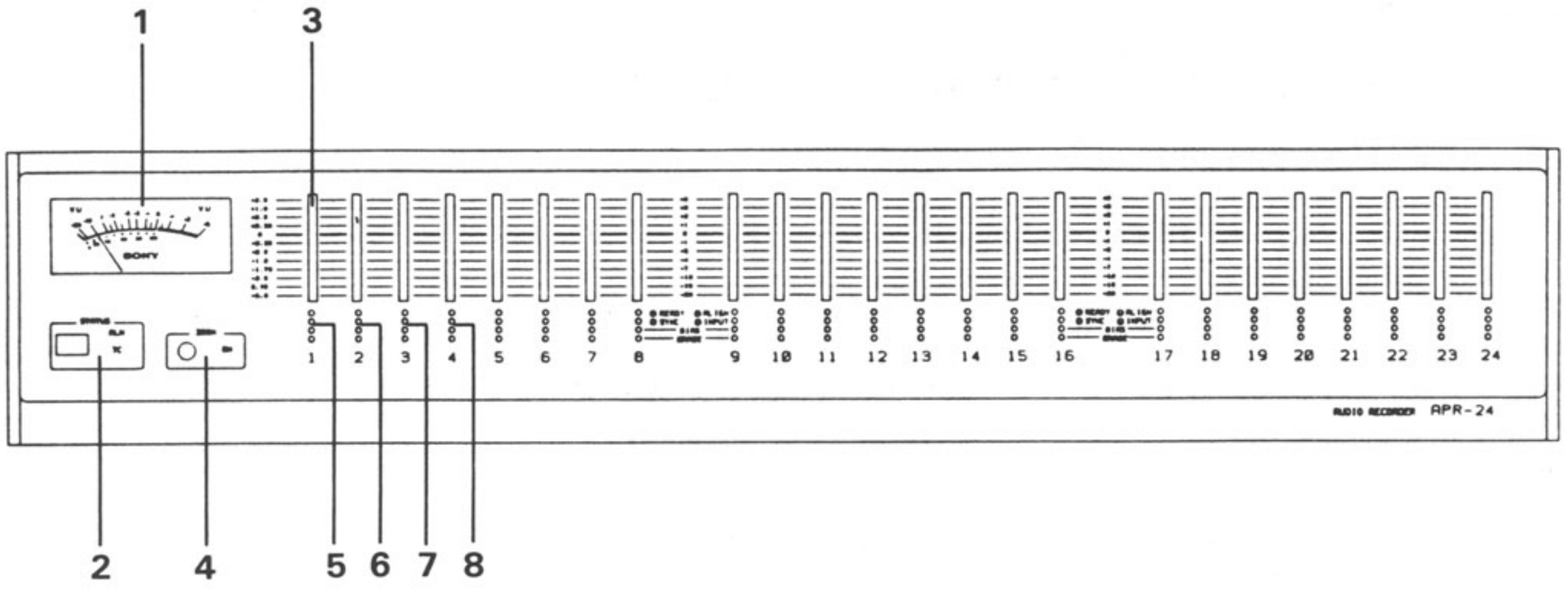


Figure 3-6. Meter Housing

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".

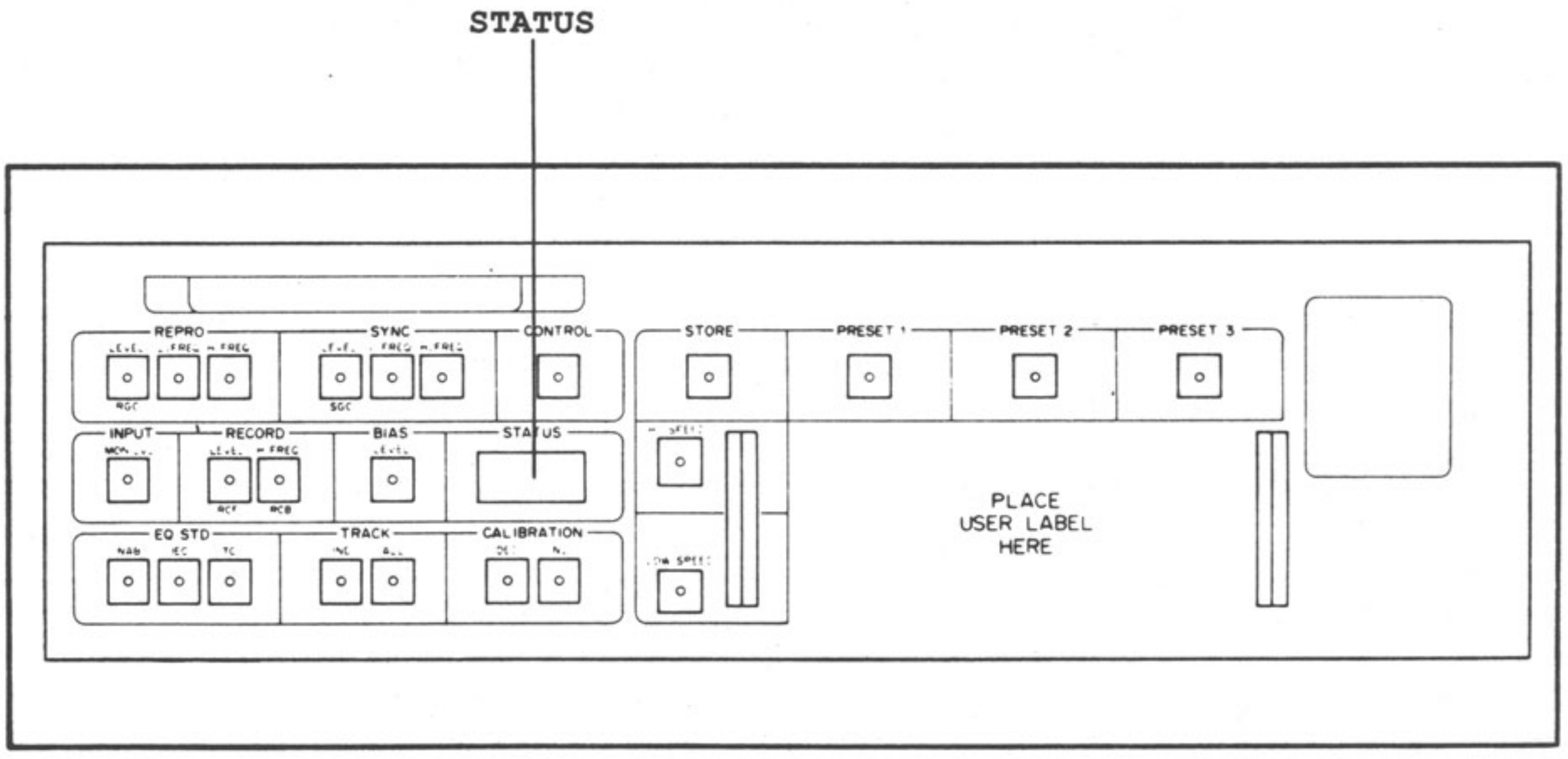


Figure 3-7. Status Display

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.

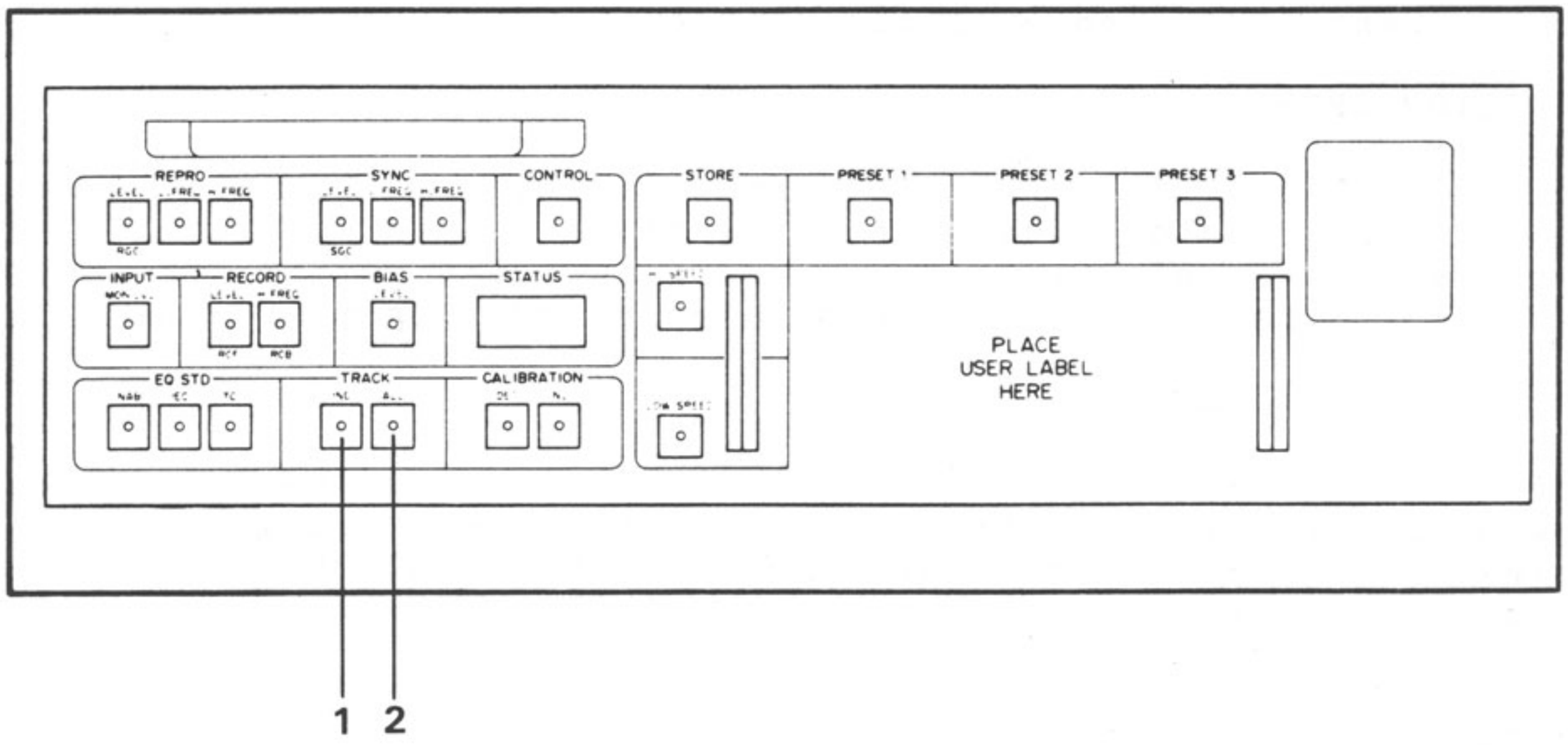


Figure 3-8. TRACK Selection

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.

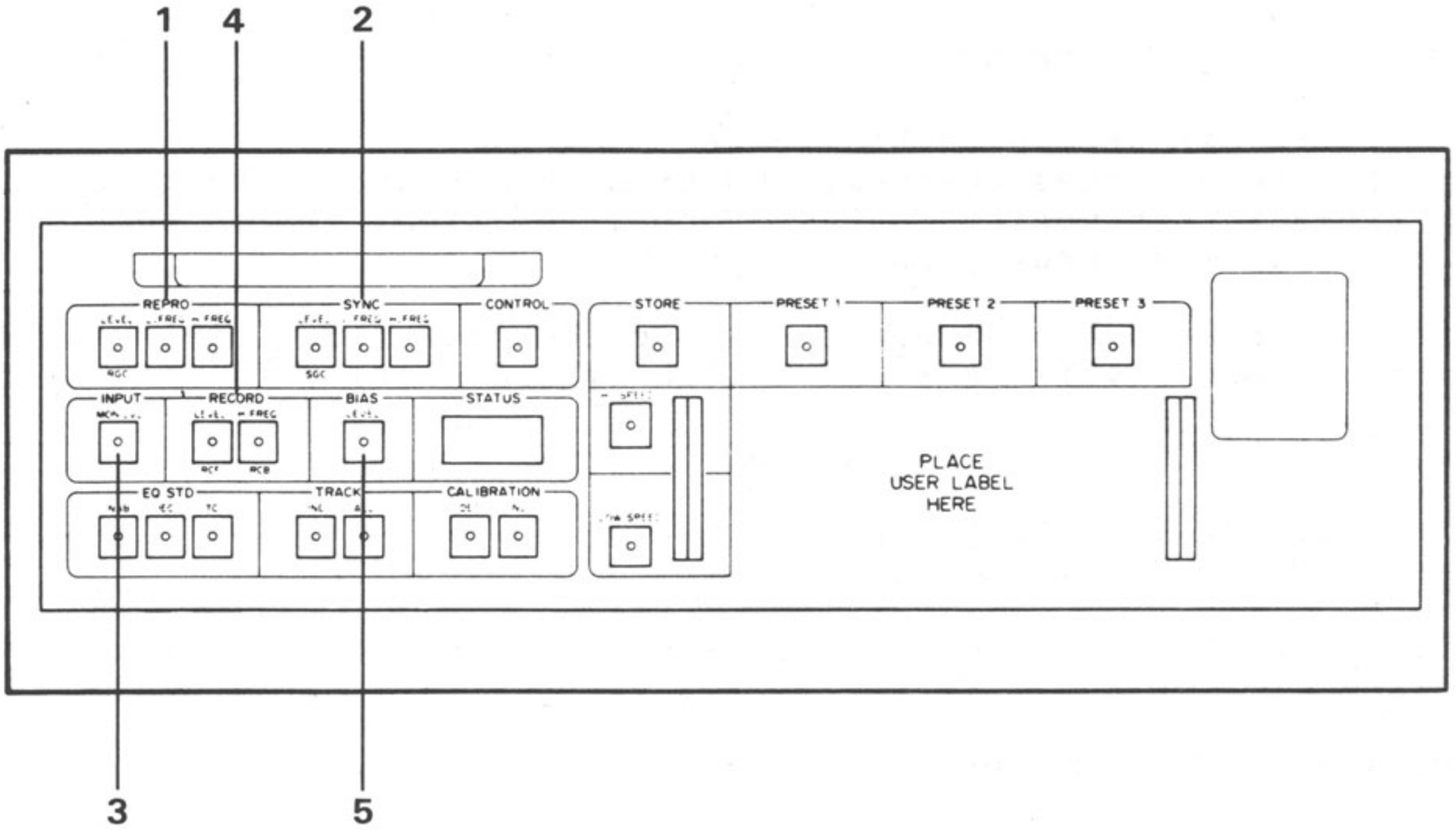


Figure 3-9. Parameter Selection

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.

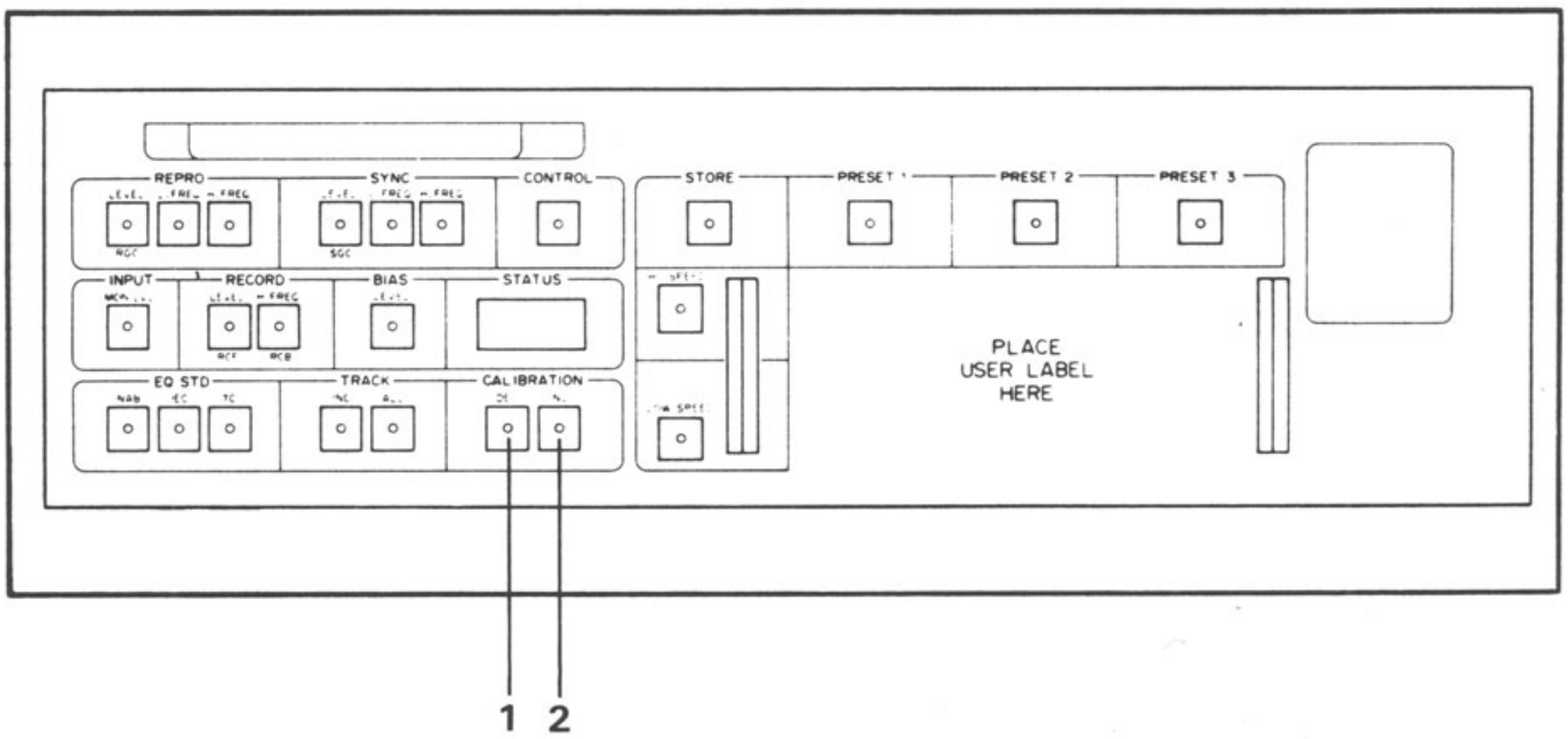


Figure 3-10. CALIBRATION Selection

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.

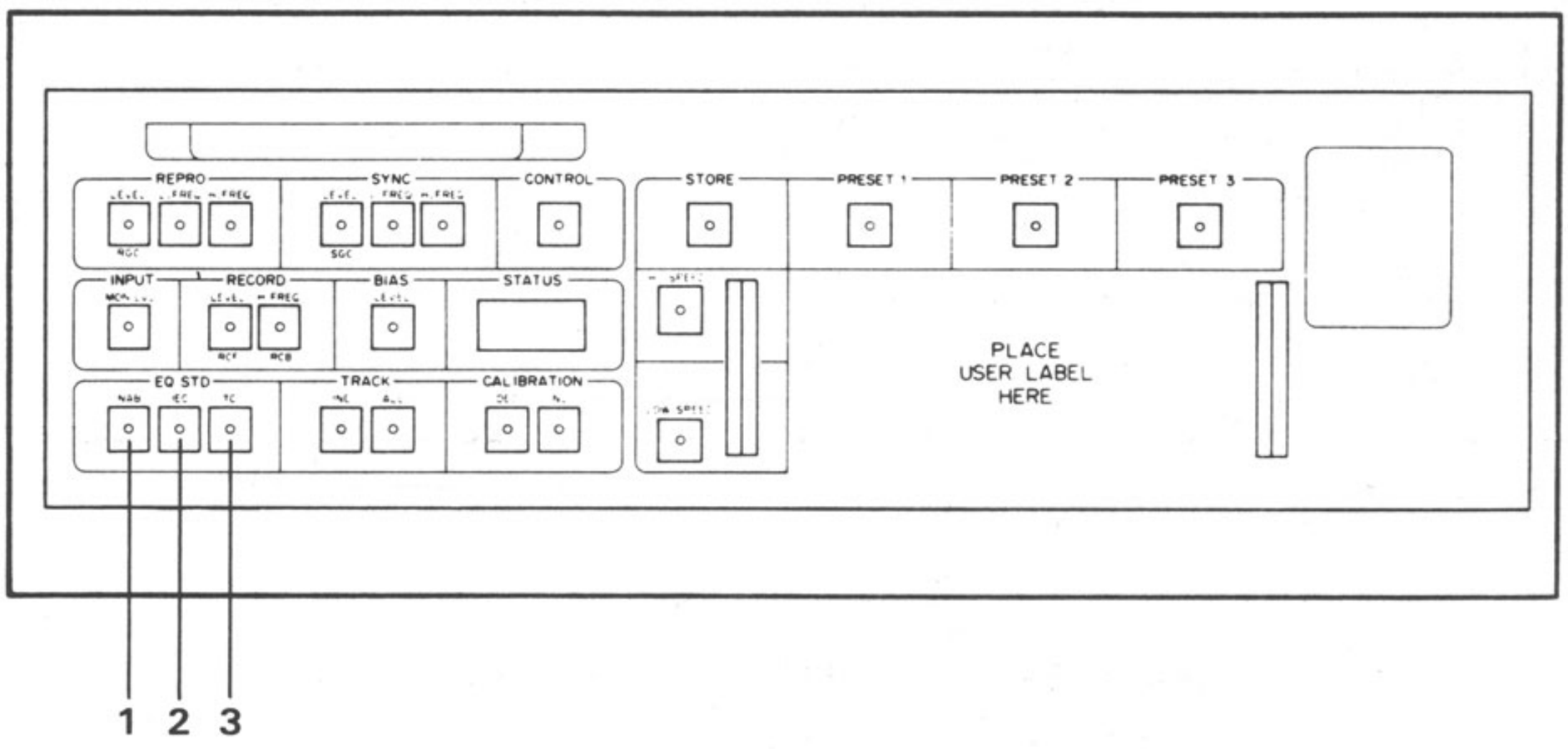


Figure 3-11. EQ STD Selection

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.

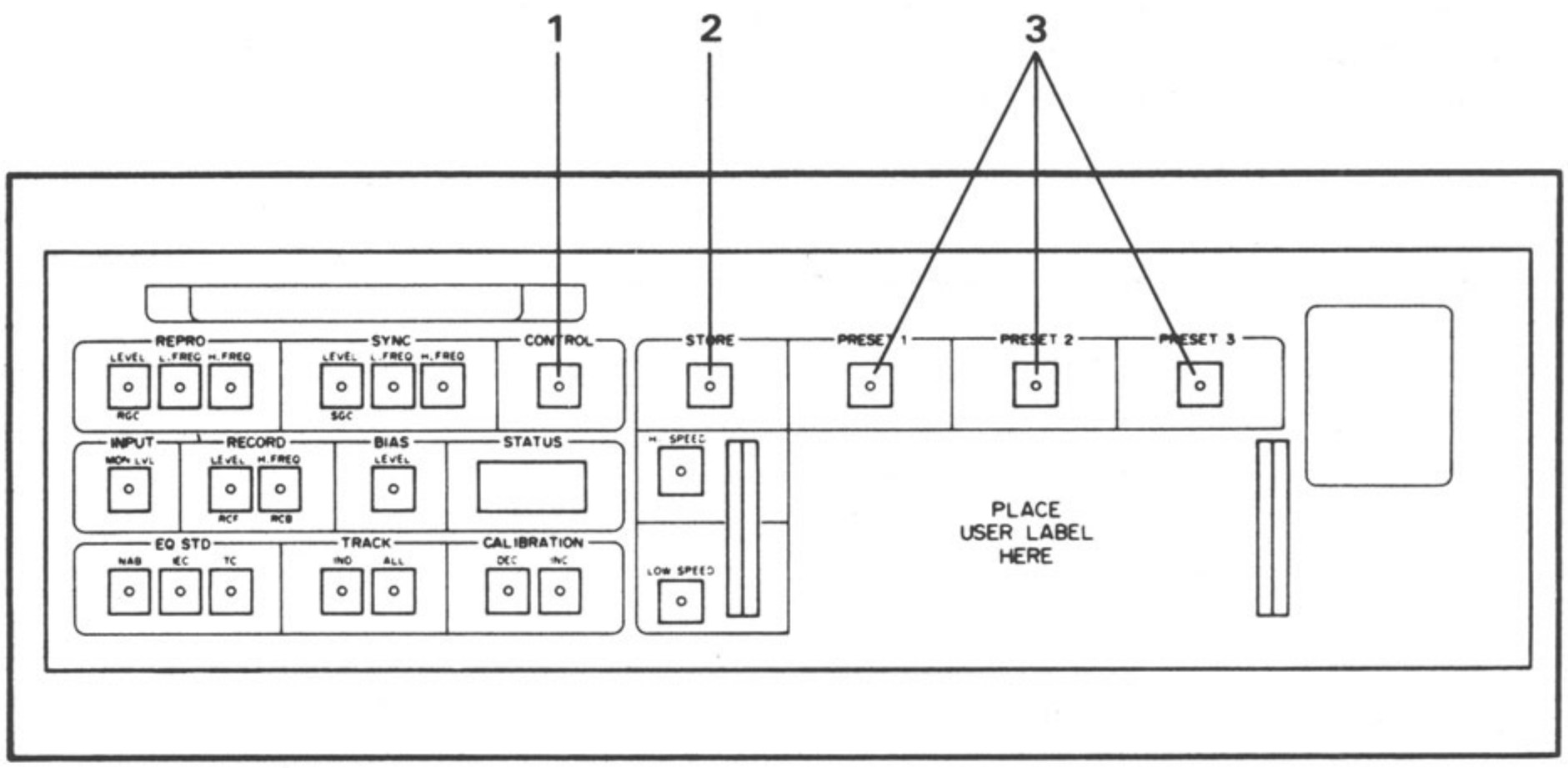


Figure 3-12. PRESET Storage Controls

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.

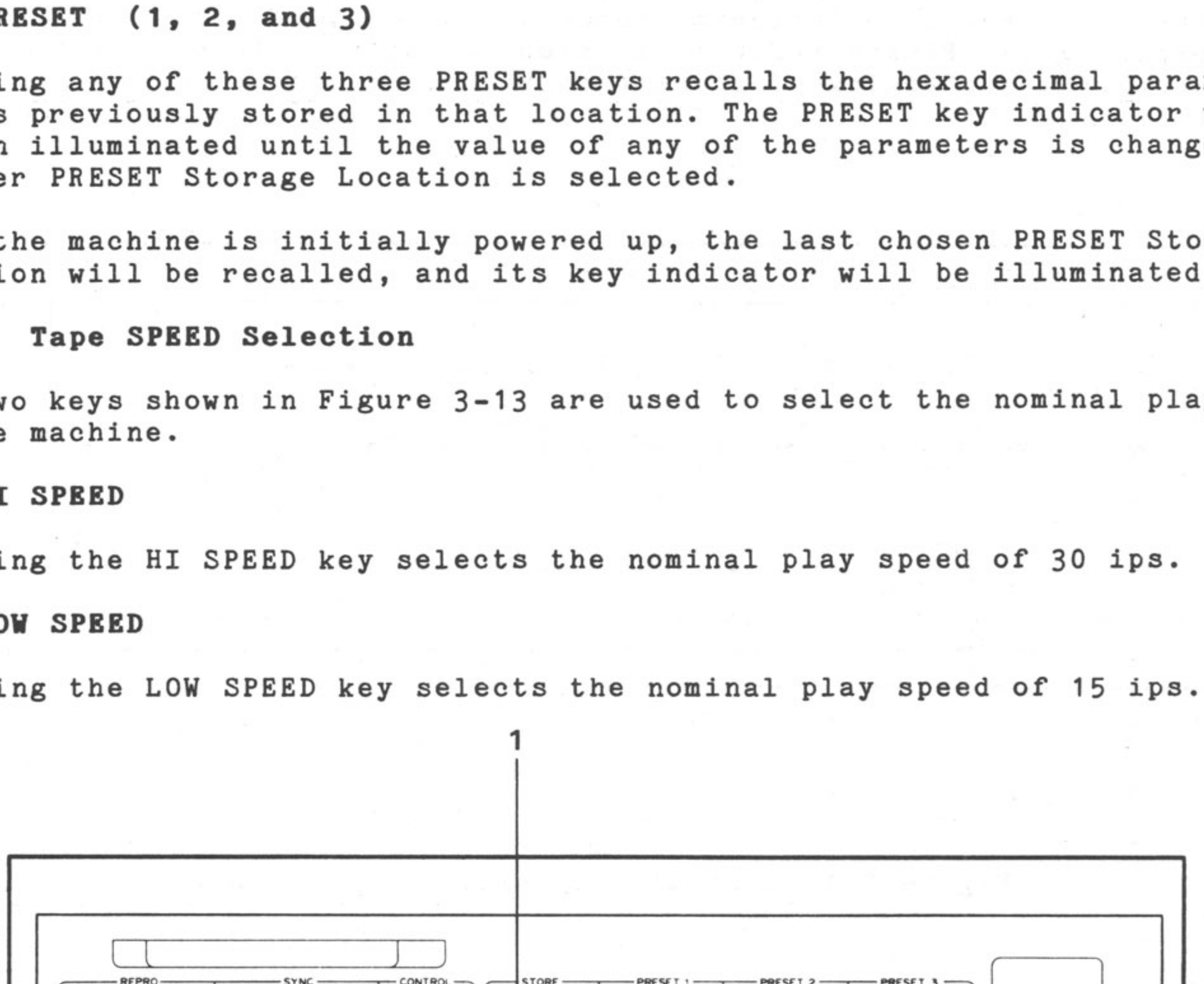


Figure 3-13. SPEED Selection

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.

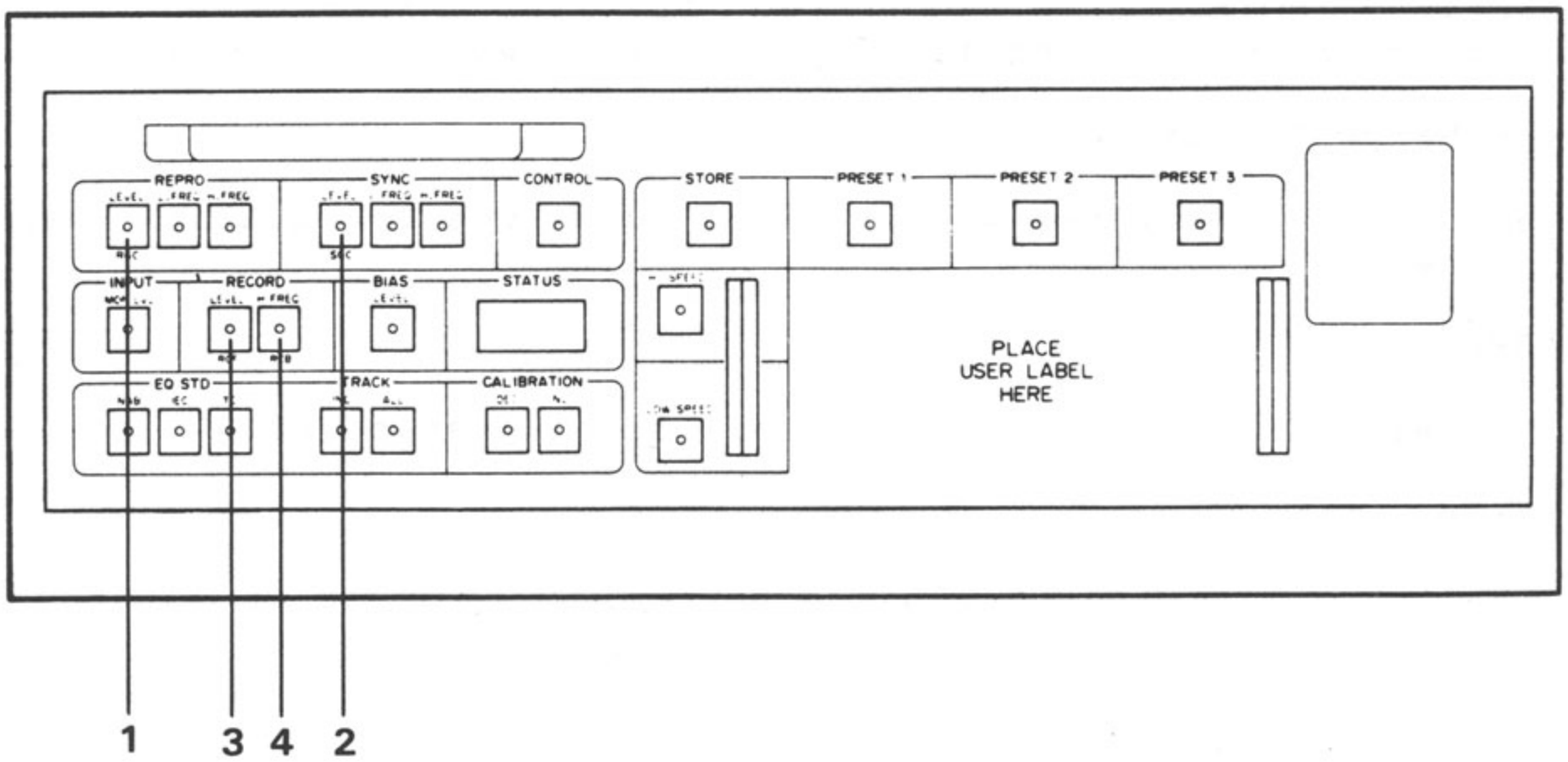


Figure 3-14. Secondary Parameter Selection

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.

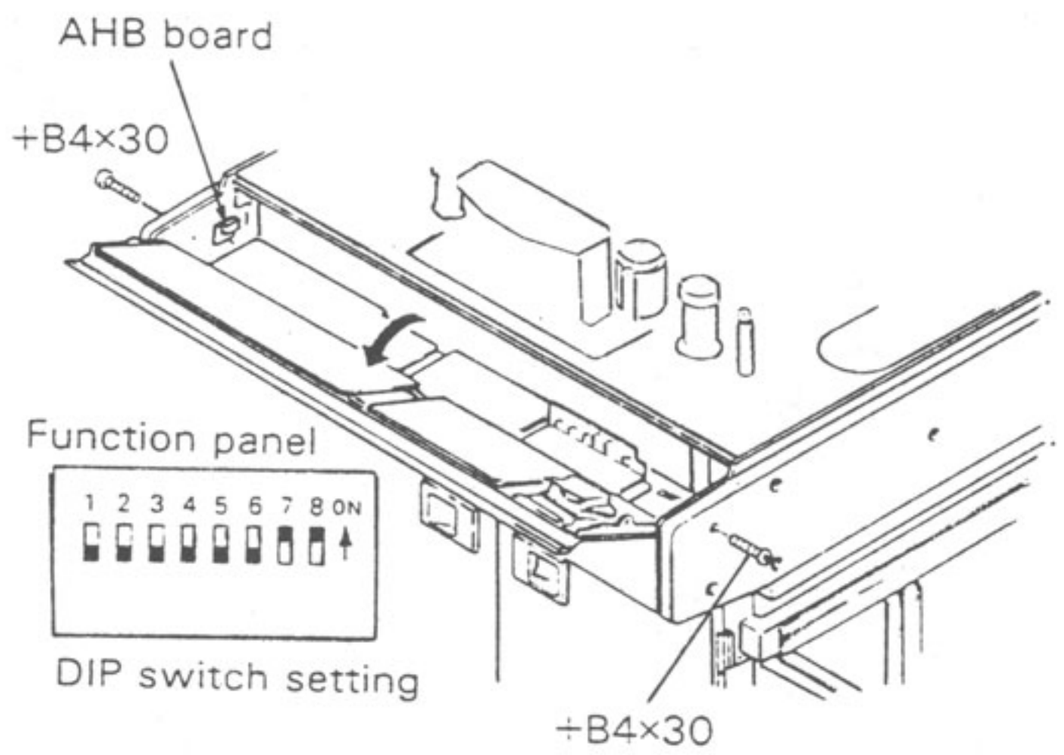


Figure 4-1. Location of AHB DIP Switch

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.

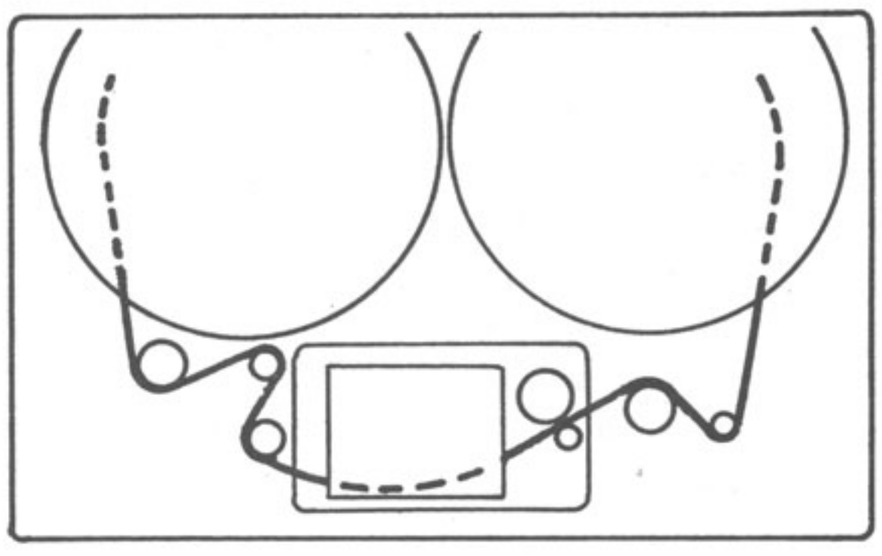


Figure 4-2. Tape Path

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.

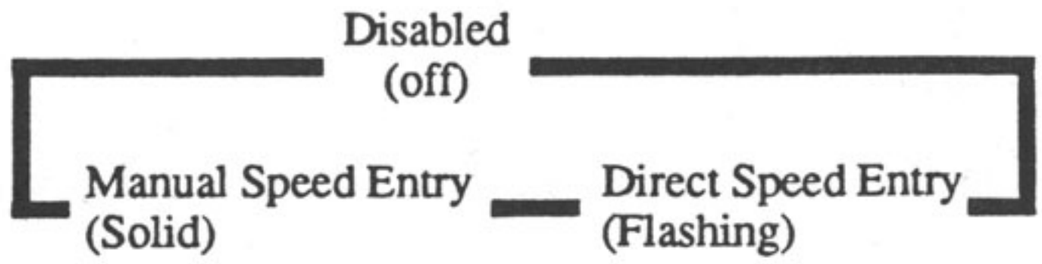


Figure 4-3. Vari Speed Key Indicator States

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.

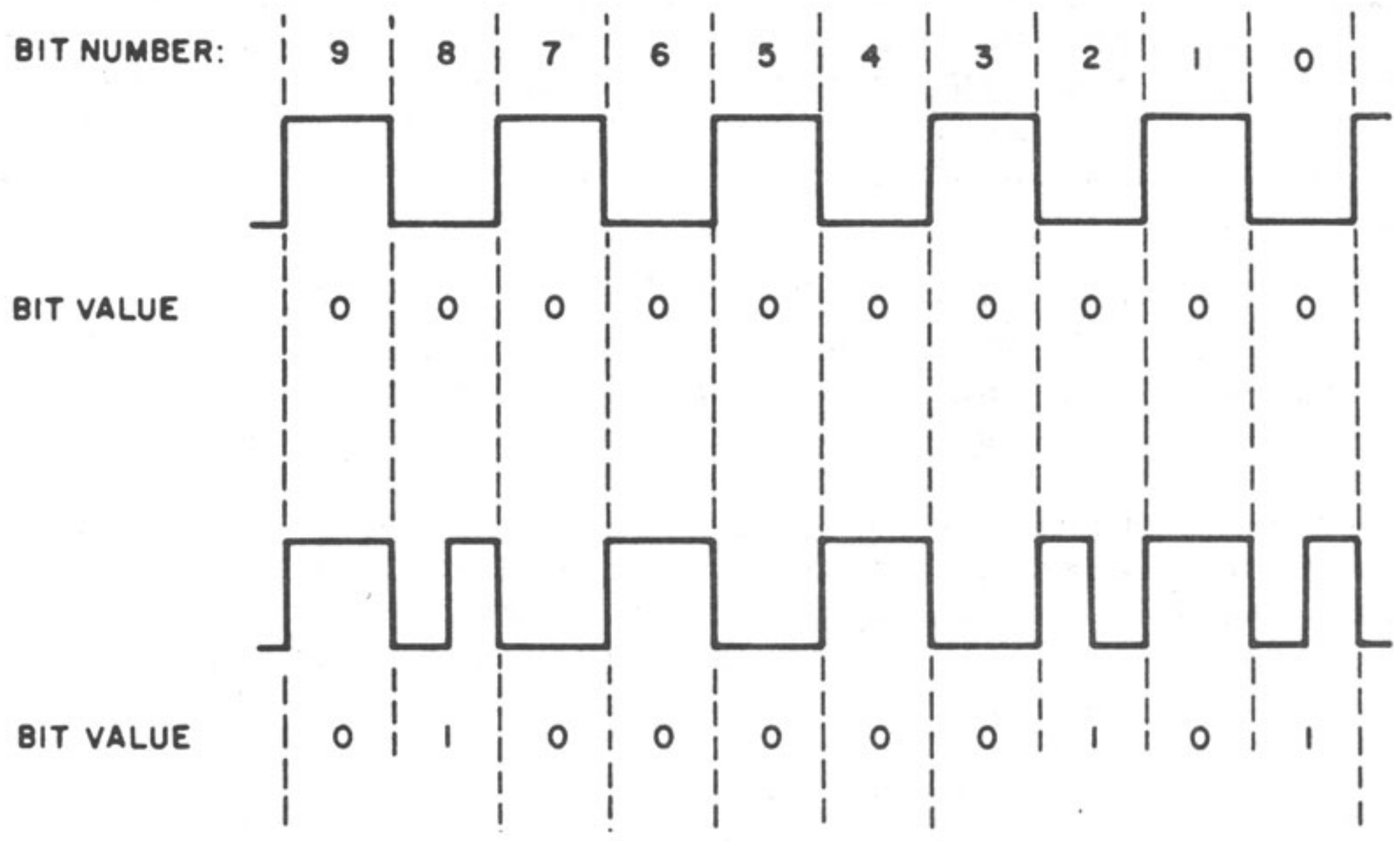


Figure 4-4. Time Code Bit Values

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.

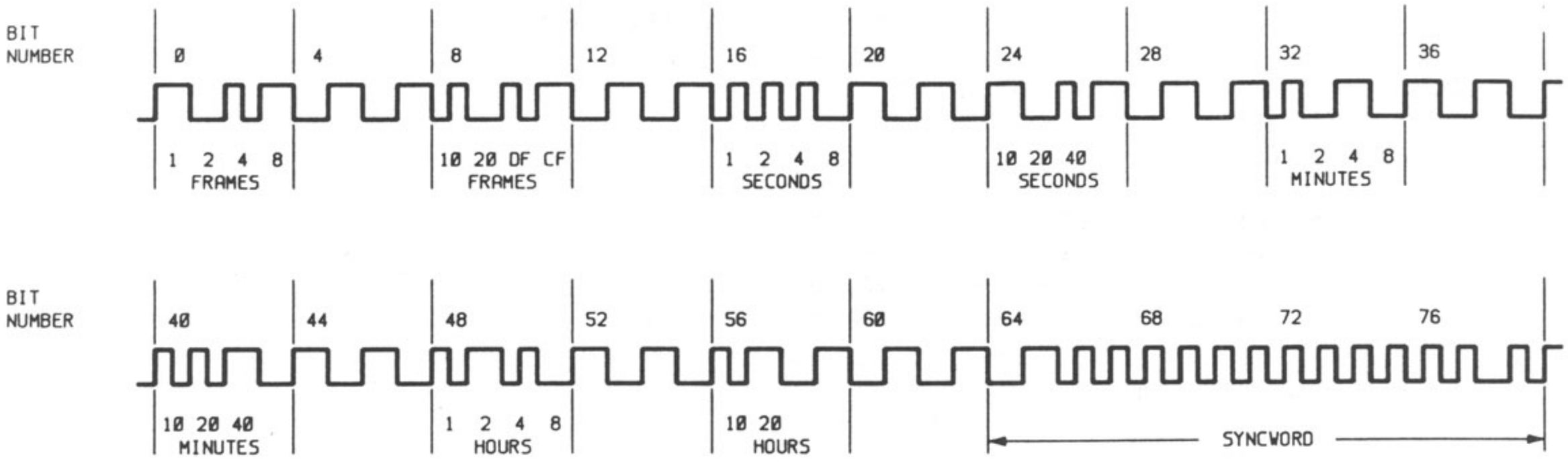


Figure 4-5. LTC Word Bit Assignments

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