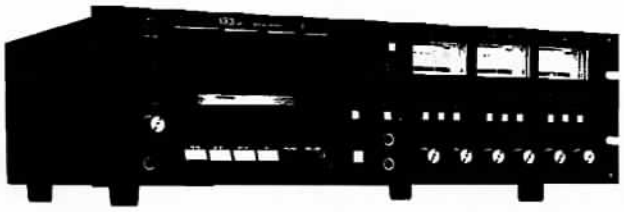
TASCAM

TEAC Production Products



SERVICE MANUAL

133

MULTI-IMAGE STEREO PLUS CUE
CASSETTE RECORDER-REPRODUCER

5704010700

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NOTES: 1. All resistors are 1/4 watt, 5 %, unless marked otherwise. Resistor values are in ohms (K = 1,000 ohms, M = 1,000,000 ohms).
2. All capacitor values are in microfarads (p = picofarads).
3. Parts marked with ⚠ are safety critical components. They must always be replaced with components specified by TEAC.
4. 0 dB is referenced to 1 V in this manual unless otherwise specified.
5. PC boards shown viewed from electro-parts side.
6. Service data are found where they are necessary. Improvements may result in service data changes without notice.

- Dolby Noise Reduction System manufactured under license from Dolby Laboratories Licensing Corporation. 'Dolby' and the double-D symbol are trademarks of Dolby Laboratories Licensing Corporation.
- dbx noise reduction system made under license from dbx, Incorporated. The name "dbx" and the dbx symbol are trademarks of dbx, Incorporated.

1. SPECIFICATIONS

MECHANICAL

Tape:		Philips Type Cassette C-60 and C-90 70 μs. Hi-Bias Tape
Track Format:		4-Track, 3-Channel
Tape Speed:		1-7/8 ips and 3-3/4 ips (4.76 cm/s and 9.5 cm/s)
Speed Accuracy:	1)	1-7/8 ips (4.76 cm/s) ±0.5 % deviation
	2)	3-3/4 ips (9.5 cm/s) ±0.5 % deviation
Wow & Flutter:	1)	1-7/8 ips (4.76 cm/s) ±0.085 % peak (DIN/IEC weighted) ±0.18 % peak (DIN/IEC unweighted) 0.06 % (NAB weighted) 0.11 % (NAB unweighted)
	2)	3-3/4 ips (9.5 cm/s) ±0.055 % peak (DIN/IEC weighted) ±0.13 % peak (DIN/IEC unweighted) 0.04 % (NAB weighted) 0.07 % (NAB unweighted)
Fast Wind Time:		Less than 90 sec. for TEAC Test Tape MTT-501 (C-60)
Motor:		1 FG Servo Controlled DC Capstan Motor 1 DC Reel Motor
Head Configuration:		2 Heads: Erase and Record/Playback
Dimensions (WxHxD):		19" x 5-13/16" x 13-1/2" (482 x 147 x 345 mm)
Weight:		19-13/16 lbs. (9 kg) net

ELECTRICAL

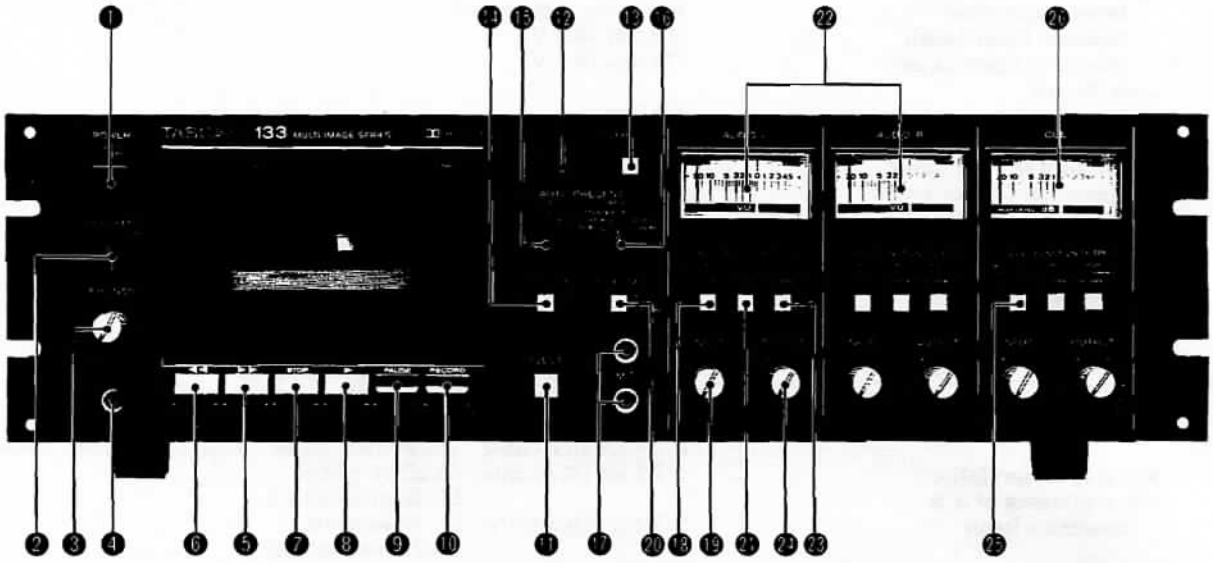
(I) Audio Tracks:		
Line Input		
Input Impedance:		70k ohms, unbalanced
Nominal Input Level:		-10 dBv (0.3 V)
Minimum Input Level:		-23 dBv (70 mV)
MIC Input		
Applicable Mic Impedance:		200 ohms to 10k ohms
Nominal Input Level:		-60 dBv (1.0 mV)
Minimum Input Level:		-72 dBv (0.25 mV)
Line Output		
Minimum Load Impedance:		10k ohms
Nominal Load Impedance:		50k ohms
Nominal Output Level:		-10 dBv (0.3 V)/0 dBv (1 V), switchable
Maximum Output Level:		-4 dBv (0.6 V)/+6 dBv (2 V), switchable
Headphone Output:		100 mW Maximum
Nominal Load Impedance:		8 ohms stereophones
Standard Recording Level:		160 nWb/m=0 VU
Bias Frequency:		60 kHz
Equalization:		1-7/8 ips (4.76 cm/s) 3180 μs + 70 μs 3-3/4 ips (9.5 cm/s) 3180 μs + 35 μs
Frequency Response 3): (Record/Reproduce)	0 VU	1-7/8 ips (4.76 cm/s) 30 – 8 kHz ±3 dB 3-3/4 ips (9.5 cm/s) 30 – 15 kHz ±3 dB
	-20 VU	1-7/8 ips (4.76 cm/s) 30 – 12.5 kHz ±3 dB 3-3/4 ips (9.5 cm/s) 30 – 15 kHz ±3 dB
Total Harmonic Distortion 3):		1.5 % at 0 VU, 1 kHz, 160 nWb/m 1-7/8 ips (4.76 cm/s) 3 % at 5 dB above 0 VU, 1 kHz, 285 nWb/m 3-3/4 ips (9.5 cm/s) 3 % at 5 dB above 0 VU, 1 kHz, 285 nWb/m
Signal to Noise Ratio 3): (At a reference of 3 % distortion level)		1-7/8 ips (4.76 cm/s) 55 dB weighted 50 dB unweighted 3-3/4 ips (9.5 cm/s) 55 dB weighted 50 dB unweighted
Adjacent Channel Separation:		Better than 45 dB at 1 kHz
Cross Talk Audio to Cue Track:		Better than 55 dB at 1 kHz
Erasure:		Better than 65 dB at 1 kHz, +10 dB above 0 VU
Headroom		
Recording Amplifier:		Better than +17 dB above 0 VU
Reproduce Amplifier:		Better than +17 dB above 0 VU

(II) Cue Track:		
Line Input		
Input Impedance:		70k ohms, unbalanced
Nominal Input Level:		-10 dBv (0.3 V)
Minimum Input Level:		-20 dBv (0.1 V)
Line Output		
Minimum Load Impedance:		10k ohms
Nominal Load Impedance:		50k ohms
Nominal Output Level:		-7 dBv (0.4 V)/+3 dBv (1.4 V), switchable
Maximum Output Level:		-1 dBv (0.9 V)/+9 dBv (2.8 V), switchable
Standard Recording Level:		200 nWb/m=0 dB*
Equalization:		1-7/8 ips (4.76 cm/s) 3180 μs + 70 μs
		3-3/4 ips (9.5 cm/s) 3180 μs + 35 μs
Frequency Response: [3]	**-3 dB***	1-7/8 ips (4.76 cm/s) 30 — 8 kHz ±3 dB
(Record/Reproduce)		3-3/4 ips (9.5 cm/s) 30 — 12.5 kHz ±3 dB
	-23 dB*	1-7/8 ips (4.76 cm/s) 30 — 10 kHz ±3 dB
		3-3/4 ips (9.5 cm/s) 30 — 12.5 kHz ±3 dB
Total Harmonic Distortion: [3]		2.0 % at -3 dB*, 1 kHz, 160 nWb/m
		1-7/8 ips (4.76 cm/s) 3 % at 5 dB above -3 dB*, 1 kHz, 285 nWb/m
		3-3/4 ips (9.5 cm/s) 3 % at 5 dB above -3 dB*, 1 kHz, 285 nWb/m
Signal to Noise Ratio: [3]		1-7/8 ips (4.76 cm/s) 55 dB weighted
(At a reference of 3 %		50 dB unweighted
distortion level)		3-3/4 ips (9.5 cm/s) 55 dB weighted
		50 dB unweighted
Cross Talk Cue to Audio Tracks:		Better than 55 dB at 1 kHz
Cue Tone Generator:		25 Hz, 1 sec.
Erasure:		Better than 65 dB at 1 kHz, +10 dB reference
Headroom		
Recording Amplifier:		Better than +17 dB above -3 dB*
Reproduce Amplifier:		Better than +17 dB above -3 dB*
(III) Power Requirement:		100/120/220/240 V AC, 50/60 Hz, 45 W
		(General Export Model)
		120 V AC, 60 Hz, 45 W
		(USA/Candda Model)
		220 V AC, 50 Hz, 45 W
		(Europe Model)
		240 V AC, 50 Hz, 45 W
		(UK/AUS Model)

* signifies peak meter values.
In these specifications, 0 dBv is referenced to 1.0 Volt. Actual voltage levels also are given in parenthesis. To calculate the 0 dB = 0.775 Volt reference level (i.e., 0 dBm in a 600-ohm circuit) add 2.2 dB to the listed dB value; i.e., -10 dB re: 1 V = -7.8 dB re:0.775 V.
1) Specifications were determined using TEAC Test Tape MTT-111.
2) Specifications were determined using TEAC Test Tape MXT-111.
3) Specifications were determined using TEAC Test Tape MTT-5061.
Dolby level is referenced to +3 VU.
Changes in specifications and features may be made without notice or obligation.

2. DESCRIPTION OF MAJOR PARTS AND CONTROLS

2-1. FRONT PANEL



❶ POWER Switch

❷ TAPE SPEED Select Switch
Two speed operation is provided on the 133. When this switch is set leftwards, to the position marked "STD", the speed is 1-7/8 IPS. Set rightwards, to the position marked "HIGH", the speed selected will be 3-3/4 IPS.

❸ PHONES (Headphone Circuit Volume Control)
Signal from track 3 (CUE) does not appear at this monitor position.

❹ PHONES Jack (Tip-Ring-Sleeve)
A stereo circuit for audio monitoring of tracks 1 and 2 (AUDIO L, R) controlled by the rotary pot immediately above it. Maximum output is 100 miliwatts into 8 ohm headphones.

❺ Fast Forward (▶▶) Key

❻ Rewind (◀◀) Key
When depressed, the tape will rewind. The stopping point can be controlled by the settings of the AUTO-PRESENT-CUE function and the counter as well as the transport control keys.

❼ STOP Key

❽ Play (▶) Key
When depressed along with the RECORD key, any or all tracks in the record mode will begin recording.

❾ PAUSE Key
This key will stop the tape and the recording process without disengaging the record logic, to continue recording, just press the play (▶) key alone. If a RECORD/PAUSE logic condition is in effect, allowing this "one key" return to record mode, the green and red L.E.D.s above the PAUSE and RECORD keys will light.

❿ RECORD Key
Depressing this key by itself has no effect. To begin recording, several conditions must first be met.

1. One or more of the FUNCTION switches that control the record/play status of each track must be engaged.
2. The play (▶) key must be depressed simultaneously with the RECORD key, or .....
3. The RECORD/PAUSE feature described previously ❾ must be activated. If so, the play key alone will start (or continue) the record process.

Note:
If any track is in the record ready condition, the red L.E.D. above the RECORD key will blink. When recording commences on any or all tracks, the red L.E.D. will glow without blinking. Because this is a "One way" cassette recording format (there is no "other side" to a 133 cassette), it is a good idea to remove BOTH protection tabs of a finished program cassette so you won't erase it by accident. To insure that you don't waste time trying to record on a cassette

that has been "protected" in this way, a special sensor has been added to the 133. If a protected cassette is in the unit the record light will not come on. Even if the record mode is engaged on the electronics and the transport controls are set to record, you will still be "SAFE".

⓫ EJECT Button

⓬ Four Digit Counter
The use of a four digit counter allows for greater precision in tape location. To make the display easier to read, the extra zeros that appear in front of the meaningful numbers are turned off. For example, if the reading is actually 23, you won't see 0023.

⓭ CLEAR Button
Depressing this button resets the counter to zero.

⓮ CUE PULSE Button
When depressed, sends a 25-cycle tone of 1 second duration to the CUE track (track 3) electronics. If the 133 is in the record mode on that track, the tone will be recorded along with the signals that appear on the CUE (track 3) line in connector on the rear panel. In playback mode, this low frequency tone will be detected by the 133 AUTO PRESENT feature, but it will not affect the operation of slide projector automation systems, most use control tones of a much higher frequency. How the 133 will respond to the 25 Hz tone will depend on the settings of the two controls in the AUTO PRESENT section.

⓯ AUTO PRESENT, CUE
This switch has three positions.

A. **STOP.** If this leftmost setting is selected, the 25 Hz tone will STOP the transport.
B. **OFF.** In the center position, the tone will not be detected, and playback will continue.
C. **REW.** When the switch is set to the right, tone detection will cause the transport to stop, and then rewind. The rewind STOP point, and what action will happen after this new STOP, is controlled by the AUTO PRESENT, RE-Wind switch position.

⓰ AUTO PRESENT, REW
There are four possible settings, in two groups. The choice of group (left or right) determines the STOP point. The option remaining is whether the tape will play or remain at STOP. If a left setting is selected, the rewind STOP will occur at counter 0000, there are two choices;

A. **COUNTER PLAY.** This leftmost setting will cause the transport to automatically re-enter the play mode, an endless repeat will then occur. The tape will cycle from counter 0000 to the 25 Hz tone until you break the cycle.
B. **COUNTER STOP.** If this position is selected, the tape will stop at counter 0000 and wait for a manual command. If a right group setting is selected, the tape will first STOP at the beginning of the cassette leader, after that, there are once again, two choices.

1. **BOT (Beginning Of Tape) STOP.** The transport will wait for a manual command.
2. **BOT PLAY.** The transport will enter play mode automatically. An endless repeat loop will be made between the beginning of the cassette leader and the 25 Hz tone until you break the cycle.

   If you examine the logic of the AUTO PRESENT feature carefully, you will note that only one "endless loop" can be in effect at a time. You may program either BOT to 25 Hz tone or counter 0000 to 25 Hz tone. Two or more separate "loops" can be programmed on the same cassette, but leaving one program and starting another will require an operator, or automation from some other source outside the 133.

ELECTRONIC CONTROLS

⓱ MIC Input 1/4 in. Connectors, L & R
Microphone inputs are available on tracks 1 and 2 only. L input reaches track 1, R input reaches track 2. To use a mic on track 3 you will need an outboard mixer. These two front panel inputs are compatible with microphone impedances from 200 ohms to 10 kohms, Minimum signal input for Zero VU is 0.25 mV (-72 dBv). Maximum safe signal input before overload is 45 mV (-27 dBv).

⓲ INPUT Select Switch
This two position push switch selects either the front panel mic in (⏢ down, or in position) or the rear panel line in RCA jack (⏢ up, or out position) as a source of signal.

⓳ INPUT Level Control
Adjust this control to set the input signal level to an acceptable reading on the VU meter. Controls signals from line in as well as mic in.

⓴ DOLBY NR Push Switch
When depressed, enables the DOLBY noise re-

duction circuitry on AUDIO L and AUDIO R (tracks 1 and 2). When left in the OUT position, bypasses the DOLBY circuits, this OUT position is correct when the rear panel patch points are used to pass signal through the RX-8 accessory DBX unit. This switch does not enable the rear panel "patch", it is used only to bypass the DOLBY when other noise reduction is used, or when noise reduction is not wanted.

❼ FUNCTION Select Switch, REC/NORMAL
On the 133, any of the three tracks can be recorded independently. This switch is provided to select which tracks will record and which will play back when the transport controls RECORD/play (▶) are depressed together. In the NORMAL (out or up) position the track is in play mode. In the REC (in, or down) position the L.E.D. above the switch will light, showing that the track is "record ready" and recording will begin when the appropriate transport controls are depressed.

❽ VU Meters, AUDIO-L, AUDIO-R (Tracks 1 and 2)
The familiar "Volume Unit" audio ballistic standard is used on the two meters that are intended for audio recording. In REC mode the meter indication will be affected by the setting of the INPUT control. In play mode (NORMAL) the meters will be affected by the setting of the OUTPUT rotary control, but there will be no change in the "0 VU" meter indication when the OUTPUT level push switch changes the output reference from -10 dBv (0.3 Volt) to 0 dBv (1 Volt). The action and logic of the OUTPUT level push switch is detailed in the next paragraph.

❾ OUTPUT Level Push Switch
On the model 133 Multi-Image recorder-reproducer, more than one output level can be selected. For normal production tasks the standard operating "0 VU" reference used by all TASCAM mixers is 0.3 VOLT. When you are preparing a tape using any of our standard production equipment, such as the model 3 mixer, this switch on the 133 should be set to the NORMAL (-10 dBv, 0.3 VOLT) position. When the model 133 is used to control a presentation "on location" and the size and weight of the equipment package becomes critical, it may be beneficial to switch to a higher reference level so that the 133 will deliver the "extra" output needed to run power amplifiers and slide projector controllers without the need for accessory "booster" amps. To set the 133 to this 1 Volt "zero" use the HIGH setting of the OUTPUT level push switch. Each channel can be adjusted for HIGH or NORMAL output gain individually.

❿ OUTPUT Gain Control
This rotary "pot" adjusts the signal level that will appear at the back panel line out RCA connector, and from AUDIO L and R (tracks 1 and 2) the signal sent to the headphone monitor circuit. On all 3 tracks this control is wired BEFORE the meter circuit playback line, so no indication of level will appear on the meter and no signal can be sent to the RCA connector or the headphone circuit unless this control is rotated rightwards. When working with tape systems it is useful to be able to check the level just used for a recording. To allow for this useful check you usually set your playback level (OUTPUT) to correspond exactly to the INPUT level. If this "comparison" between INPUT level and OUTPUT level is desired, you must "set" the OUTPUT level controls on the 133 by playing a standard alignment tape, adjusting the level, and then controlling the individual track outputs with the controls on an outboard mixer. Moving the OUTPUT controls now will upset your "reference", so you use the mixer controls to keep your comparison of levels accurate. A "rough and ready" level tape for setting levels can be made by recording a steady sound of some kind and then playing it back to set output levels, but be aware of the fact that this method will not tell you if your 133 is in need of adjustment or cleaning. The "home made" tape will cause you to incorrectly compensate for misalignment and the playback level on another recorder that is properly adjusted may not be the same.

CUE Track (Track 3) (Pulse Track)
Because the recording and reproduction of pulse information has special requirements that are somewhat different from straight "audio" work, the CUE (track 3) control panel has some features and control functions that are not quite the same as the AUDIO tracks 1 (L) and 2 (R), here is a list of the changes.

Functions omitted
1. There is no microphone preamp on the CUE (track 3), only a line level signal can be controlled here.
2. DOLBY noise reduction is not provided.
3. There is no rear panel patch point for outboard DBX.
4. The CUE (track 3) signal cannot be monitored with the headphone circuit on the 133.

Functions that are changed

1. The switch location marked INPUT-MIC/LINE is changed to CUE 1/CUE 2. Normally used on AUDIO L and R (tracks 1 and 2) for mic/line selection, this switch now selects a signal conditioning circuit, the switch has two positions.

❹ CUE Switch

CUE 1 (out, or up). Use this position for Audio recording, and Pulse and Data recording when the 133 is used with the following brands of programming equipment.

1. Arion
2. Audio Visual Laboratories
3. Electrosonic
4. Kodak
5. Spindler & Sauppé
   If the 133 does not perform properly with the Director 24, or the Director 24Z, please contact Spindler & Sauppé for service update information.
6. For brands of programmers not listed, try this position first.

CUE 2. This position provides compatibility with the following;

1. Clear Light Productions

A caution. It is wise to make sure that tapes made on the 133 are in fact, compatible with other playback equipment before you attempt to put on a show using a different recorder/reproducer, the unique head/track configuration used in the 133 to provide 3 channel capability is detailed on page 12 of the 133 owner's manual along with all other standard formats for cassette recorders. Check there first, and avoid troubles later.

CUE (Track 3) Meter ❹ Circuit. This meter uses a different standard response, or "Ballistic" that is more useful in the recording of pulse and data. The CUE (track 3) meter is a "peak" indicating type, and will read the actual peak energy of the signal instead of the average value, allowing you to avoid distorting your pulse track recording inadvertently. Average reading meters do not respond fast enough to show the momentary high levels normally found in Pulse and Data recording, and an apparently "safe" level as displayed by a standard "VU" meter may, in fact, be too high. This peak type meter will save time previously wasted in "re-makes" caused by unsuspected tape overloads. To counteract this meter misinterpretation, many programmer owner's manuals advise you to use a lower meter reading for pulse recording. This may not be necessary on the 133.

All other functions on CUE, track 3 are the same as AUDIO L & R (tracks 1 and 2). In general, if the labelling is the same, the function of the control is also the same.

2-2. Rear Panel

A.C. Power Cord

Line Input RCA Jacks

Line input sources are connected here, the input impedance of these circuits is 70k ohms.

Line Output RCA Jacks

Line output signals appear here. The true output impedance of these circuits is 1k ohms, but we recommend that the load you connect here be no lower a number than 10k ohms. Maximum output before clipping is -4 dBv (0.6 V)/+6 dBv (2 V) switchable.

Noise Reduction Interface RCA Jacks (TO DECODER, TO ENCODER)

These 8 RCA connectors are provided to "patch in" the accessory DBX unit (model RX-8). If the unit is not installed, the jumpers must be in place or no signals will pass either in or out of the 133.

CAUTION:
EVEN THOUGH NO AUDIO OR PULSE WILL PASS IN OR OUT OF THE RECORDER WITHOUT THE JUMPERS, THE UNIT WILL STILL BE CAPABLE OF ERASING A PREVIOUSLY RECORDED MASTER. DO NOT ASSUME THAT THE TAPE IS "BLANK" JUST BECAUSE YOU DON'T GET METER INDICATION. CHECK THE JUMPERS BEFORE GOING ON WITH ANY FRESH WORK.

DBX Remote Control Multipin Connector (DBX UNIT CONTROL SIGNAL)

When using the accessory DBX unit this connector provides the necessary logic commands that select Encode or Decode function on the audio tracks L (1) and R (2).

Transport Remote Control Multipin Connector (REMOTE CONTROL)

3. CIRCUIT DESCRIPTION

NOTE: In this chapter, the following are assumed.
- *The deck is initially in Stop mode unless otherwise specified.
- *Voltages, waveforms, and operating times, etc. are given simply for reference in the text.

CONTROL SECTION

3-1. SYSTEM CONTROL OUTLINED

The TASCAM 133 system is extensively controlled by an LSI controller (microprocessor). Control operations are outlined below.

The operating keys such as REC and PLAY have their output lines connected to lines D0 to D7 of an 8-bit input port of a digital multiplexer. When one depresses an operating key, an H-level signal comes into the line of the input port to which the key is connected. On the other hand, the controller has a program which controls operating modes and provides a 3-bit address code indicating the associated operating mode through its output ports (C0, C1, and C2) to the input ports (S0, S1, and S2) of the multiplexer. The multiplexer ANDs the operating code with the address code and, if the command of the operating key is the same as that indentified by the address, the multiplexer develops L-level signal through its output port (OUT). This signal, after inverted to H-level, is applied to port A3 of the controller. Now the controller knows that the control command has been given and generates signals required for executing the control command according to the program stored, in the proper sequence and timing.

The deck has another digital multiplexer. This works to resume playback at the end of rewinding to the beginning of tape or to a location whose counter reading has been preset; to maintain Stop mode; or to rewind tape which is at a halt by CUE STOP operation. In operation, this multiplexer simply controls such operations of tape as rewinding, stopping, and playing on the proper timing, and each operation is basically the same as of the multiplexer described first. Detailed description will be given later.

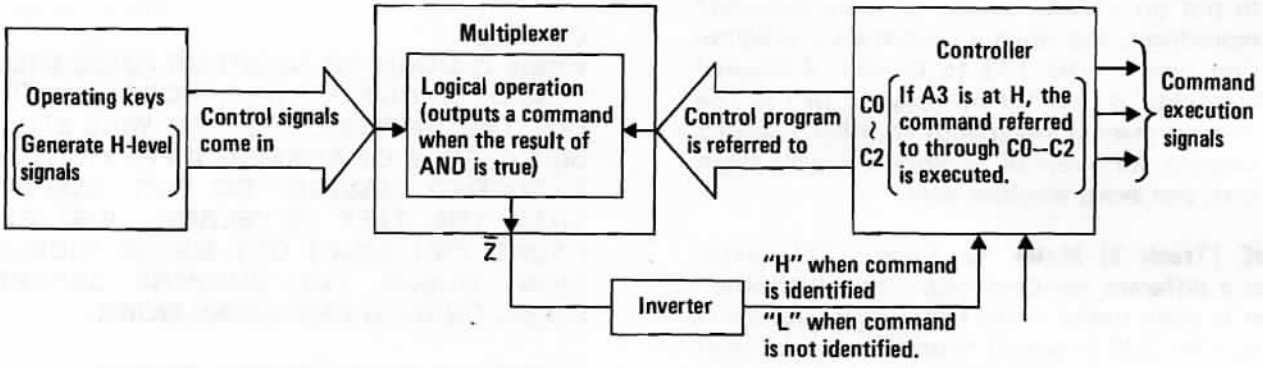


Fig. 3-1. System control outlined

3-2. MULTIPLEXER OF OPERATING KEY SIGNALS

The pin assignments, logic diagram, and truth table of multiplexer IC U912 (SN74LS151) are given below.

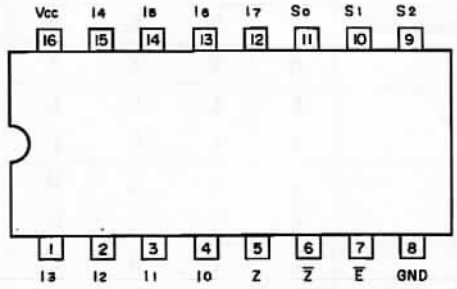


Fig. 3-2. Pin arrangement of IC U912

	Pin No.	Symbol	Function	Description
Operating command inputs	1	I_3	FF	Input of fast-forward command
	2	I_2	REC	Input of record command
	3	I_1	REW	Input of rewind command
	4	I_0	STOP	Input of stop command
Control command outputs	5	Z	Output	(Unused)
	6	$\bar{Z}$	Inverted output	Operating command input will be executed when this is L.
	7	$\bar{E}$	Enable	(Active low input) 0.6 V
	8	GND	Ground	0.6 V
Program code inputs	9	S_2	Code input	3-bit program address code coming from controller
	10	S_1	Code input	3-bit program address code coming from controller
	11	S_0	Code input	3-bit program address code coming from controller
Operation command inputs	12	I_7	REC SAFETY	H enable recording and L disables.
	13	I_6	(Unused)	(Ground via a resistor)
	14	I_5	PAUSE	Input of pause command
	15	I_4	PLAY	Input of play command
	16	Vcc	POWER	T B, MAX. 5.2 V, MIN. 4.75 V

Table 3-1. Pin assignments

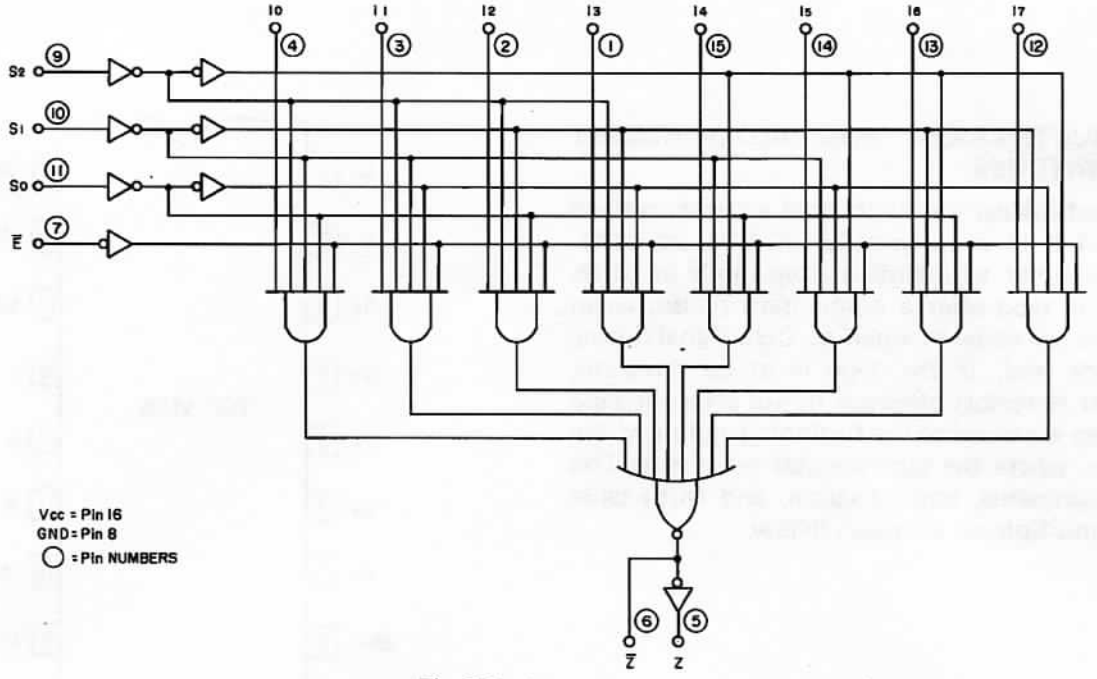


Fig. 3-3. Logic diagram

Operating mode	$\bar{E}$	S_2	S_1	S_0	I_0	I_1	I_2	I_3	I_4	I_5	I_6	I_7	$\bar{Z}$	Z
–	H	X	X	X	X	X	X	X	X	X	X	X	H	L
STOP	L	L	L	L	L	X	X	X	X	X	X	X	H	L
	L	L	L	L	H	X	X	X	X	X	X	X	L	H
REW	L	L	L	H	X	L	X	X	X	X	X	X	H	L
	L	L	L	H	X	H	X	X	X	X	X	X	L	H
REC	L	L	H	L	X	X	L	X	X	X	X	X	H	L
	L	L	H	L	X	X	H	X	X	X	X	X	L	H
FF	L	L	H	H	X	X	X	L	X	X	X	X	H	L
	L	L	H	H	X	X	X	H	X	X	X	X	L	H
PLAY	L	H	L	L	X	X	X	X	L	X	X	X	H	L
	L	H	L	L	X	X	X	X	H	X	X	X	L	H
PAUSE	L	H	L	H	X	X	X	X	X	L	X	X	H	L
	L	H	L	H	X	X	X	X	X	H	X	X	L	H
REC MUTE	L	H	H	L	X	X	X	X	X	X	L	X	H	L
	L	H	H	L	X	X	X	X	X	X	H	X	L	H
REC SAFETY	L	H	H	H	X	X	X	X	X	X	X	L	H	L
	L	H	H	H	X	X	X	X	X	X	X	H	L	H

H: HIGH Voltage Level
L: LOW Voltage Level
X: Don't Care

Table 3-2. Truth table of operating commands

3-3. MULTIPLEXER FOR AUTO-PRESENT SWITCHES

This multiplexer works to hold a command and transmit it to the controller in order to determine whether to maintain Stop mode or to rewind the tape after a momentary pause; when the tape has come to a halt by CUE signal during playback and, if the tape is to be rewound, whether to restart playback or not after the tape has been rewound to the beginning end or to the location where the tape counter reads zero. The pin assignments, logic diagram, and truth table of the multiplexer are given below.

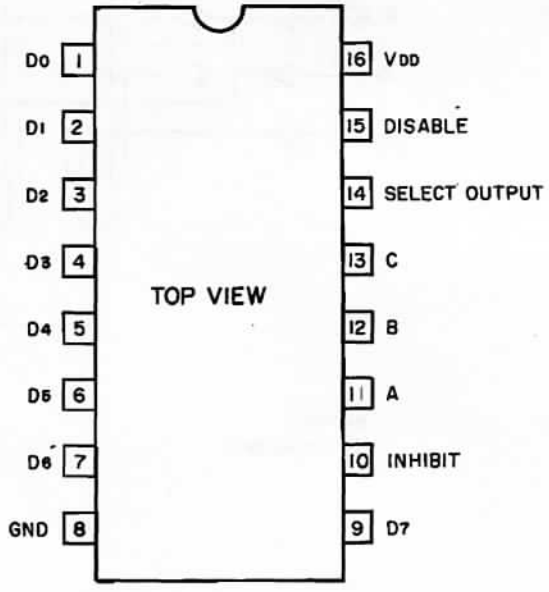


Fig. 3-4. Pin arrangement

	Pin No.	Symbol	Function	Description
Operating command inputs	1	D_0	CUE STOP	Input of the stop signal caused by CUE signal
	2	D_1	CUE REW	Input of the rewind signal that rewinds tape after pause caused by CUE signal
	3	D_2	(Unused)	
	4	D_3	COUNTER STOP	Input of the stop signal caused by counter signal
	5	D_4	COUNTER PLAY	Input of the play signal that plays back tape after pause caused by CUE signal
	6	D_5	BOT PLAY	Input of the play signal that plays back tape after rewinding to the beginning of tape.
	7	D_6	(Unused)	
	8	GND	(Ground)	
	9	D_7	CUE SIG IN	Input for identification of presence or absence of CUE signal
	10	INHIBIT	(Ground)	
Program code inputs	11	A	Code inputs	Code input 3-bit program address code coming from controller
	12	B	Code inputs	Code input 3-bit program address code coming from controller
	13	C	Code inputs	Code input 3-bit program address code coming from controller
Control outputs	14	SELECT OUT	Output	Executes operating command when output is H.
	15	DISABLE	(Ground)	
	16	V_{DD}	(Power)	+10 V (3 ~ 16 V)

Table 3-3. Pin assignments

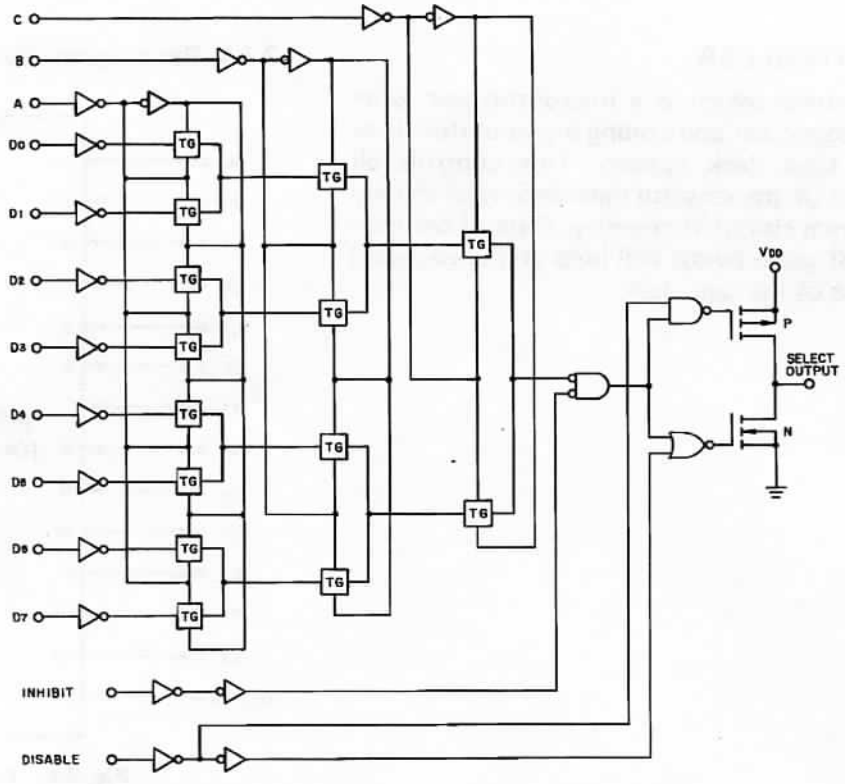


Fig. 3-5 Logic diagram

Operating mode	A	B	C	INHIBIT	DISABLE	SELECT OUTPUT
CUE STOP	L	L	L	L	L	$D_0 = H$
CUE REW	H	L	L	L	L	$D_1 = H$
(Unused)	L	H	L	L	L	$D_2 = \star$
COUNTER STOP	H	H	L	L	L	$D_3 = H$
COUNTER PLAY	L	L	H	L	L	$D_4 = H$
BOT PLAY	H	L	H	L	L	$D_5 = H$
(Unused)	L	H	H	L	L	$D_6 = \star$
CUE SIG IN	H	H	H	L	L	$D_7 = H$
(Unused)	*	*	*	H	L	L
(Unused)	*	*	*	*	H	Z

*: Don't Care
Z: High Impedance

Table 3-4. Truth table of operating commands

3-4. CONTROLLER

The controller which is a microprocessor is an LSI developed for controlling a two motor three solenoid tape deck system. This controls all operations of the cassette tape deck with the aid of a program stored in memory. Data of the controller LSI given below will help you understand operations of the tape deck.

3-4-1. Pin assignments

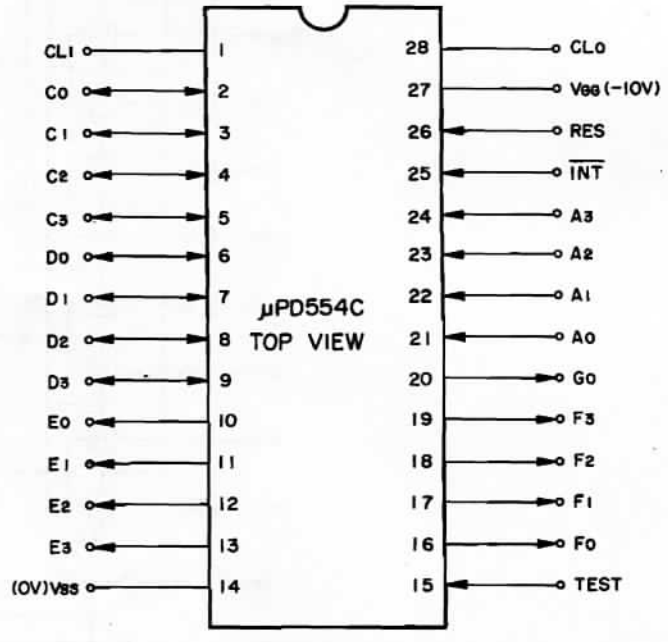


Fig. 3-6. Pin arrangements

Pin No.	Symbol	Function	Level	Remarks
1	CL_1	For clock	–	An oscillator connects across CL_1 and CL_0 (pin 28).
2	C_0	Input selecting address outputs 0	H	Outputs input selecting address together with C_1 and C_2.
		Timer REC input	H	Enters timer REC if output of G_0 comes in.
3	C_1	Input selecting address output 1	H	Outputs input selecting address together with C_0 and C_2.
		Timer PLAY input	H	Enters timer PLAY if output of G_0 comes in.
4	C_2	Input selecting address output 2	H	Outputs input selecting address together with C_0 and C_1.
5	C_3	REW output	H	Outputs REW signal.
6	D_0	RED LED output	H	Outputs H during REC PLAY and REC PAUSE. Outputs pulse in intervals of approx. 2 seconds when REC SAFETY input is H and not during REC PLAY and REC PAUSE.
		Head type identifying input	–	When G_0 is H, identifities 3-head type if D_0 is H and 2-head type if D_0 is L.
7	D_1	REC MUTE LED output	H	Outputs H during REC MUTE.
8	D_2	PAUSE LED output	H	Outputs H during PAUSE and REC PAUSE.
9	D_3			Unused
10	E_0	Flashing output	H	Flashing circuit control output
11	E_1	Pinch roller solenoid output	H	Outputs H during pinch roller operation.
12	E_2	Head base solenoid output	H	Outputs H during head base solenoid operation.
13	E_3	FF output	H	Outputs FF signal.
14	V_{SS}	Power	–	0 V
15	TEST	Test terminal	–	Must be level with V_{SS}.
16	F_0	POWER/PLAY MUTE output (2-head type)	L	Outputs L during power-on, PLAY, REC PLAY, and REC PAUSE (triggered by RESET or sensing circuit during power-off).
		POWER MUTE output (3-head type)	L	Outputs L during power-on for approx. 6 seconds (triggered by RESET or sensing circuit during power-off).
17	F_1	RELAY output (2-head type)	H	Outputs relay control signal.
		PLAY MUTE output (3-head type)	H	Outputs PLAY MUTE signal.
18	F_2	REC MUTE output	H	Outputs REC MUTE signal.
19	F_3	BIAS OSC output	H	Outputs bias oscillator control signal.
20	G_0	Timer/head type identification output	H	Outputs H during identification of timer and head type.
21	A_0	Feature mode input	H	Input of Auto-Present by address (C_0, C_1, and C_2)
22	A_1	Counter signal input	H	If this turns to H during REW, Stop or Play mode will be entered depending on mode preset.
23	A_2	POWER DOWN signal output	L	Power-off is identified by L lasting for more than approx. 6 seconds.
24	A_3	Operating button input	H	Input of operating button ANDed with address code from C_0 through C_2.
25	INT	Tape travel sensing pulse input	L	Stop mode will be entered if L lasts for more than approx. 2.5 seconds during PLAY or approx. 0.65 seconds during FF and REW.
26	RESET	Reset input	H	Reset if H lasts for more than approx. 10 μsec.
27	V_{GG}	Power	–	–10 V
28	CL_0	Clock input	–	Clock osc connection, used with CL_1, or external clock input.

Table 3-5. Pin assignments

3-4-2. Block diagram

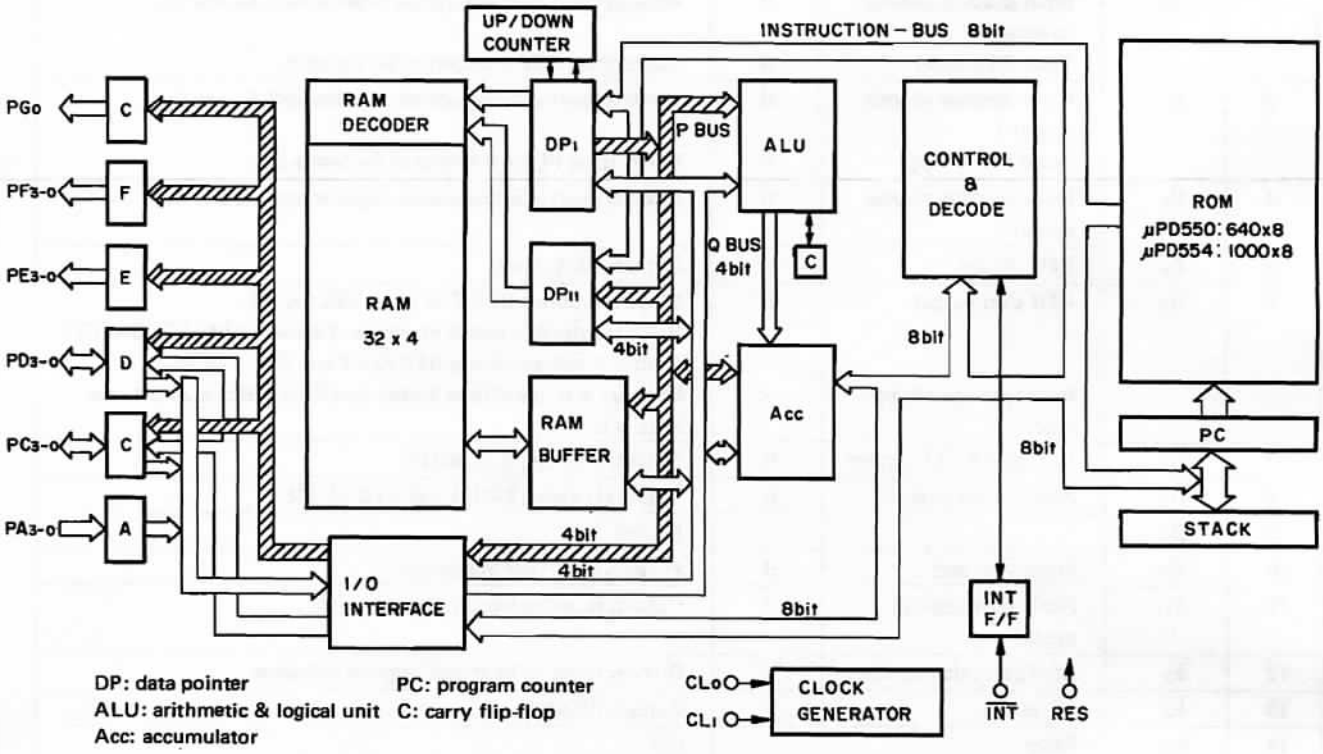


Fig. 3-7. Block diagram

3-4-3. Control program and function addresses

	Address			Auto-present	Operating button
Port	C_2	C_1	C_0	A_0	A_3
0	L	L	L	STOP by CUE signal	Operating button input STOP
1	L	L	H	REW by CUE signal	Operating button input REW
2	L	H	L	Unused	Operating button input REC
3	L	H	H	STOP by counter signal	Operating button input FF
4	H	L	L	PLAY by counter signal	Operating button input PLAY
5	H	L	H	PLAY at the beginning of tape winding	Operating button input PAUSE
6	H	H	L	Unused	Operating button input REC MUTE
7	H	H	H	CUE signal input terminal	REC SAFETY input (H enables recording)

Table 3-6. Operating functions and addresses

3-4-4. Timing diagram

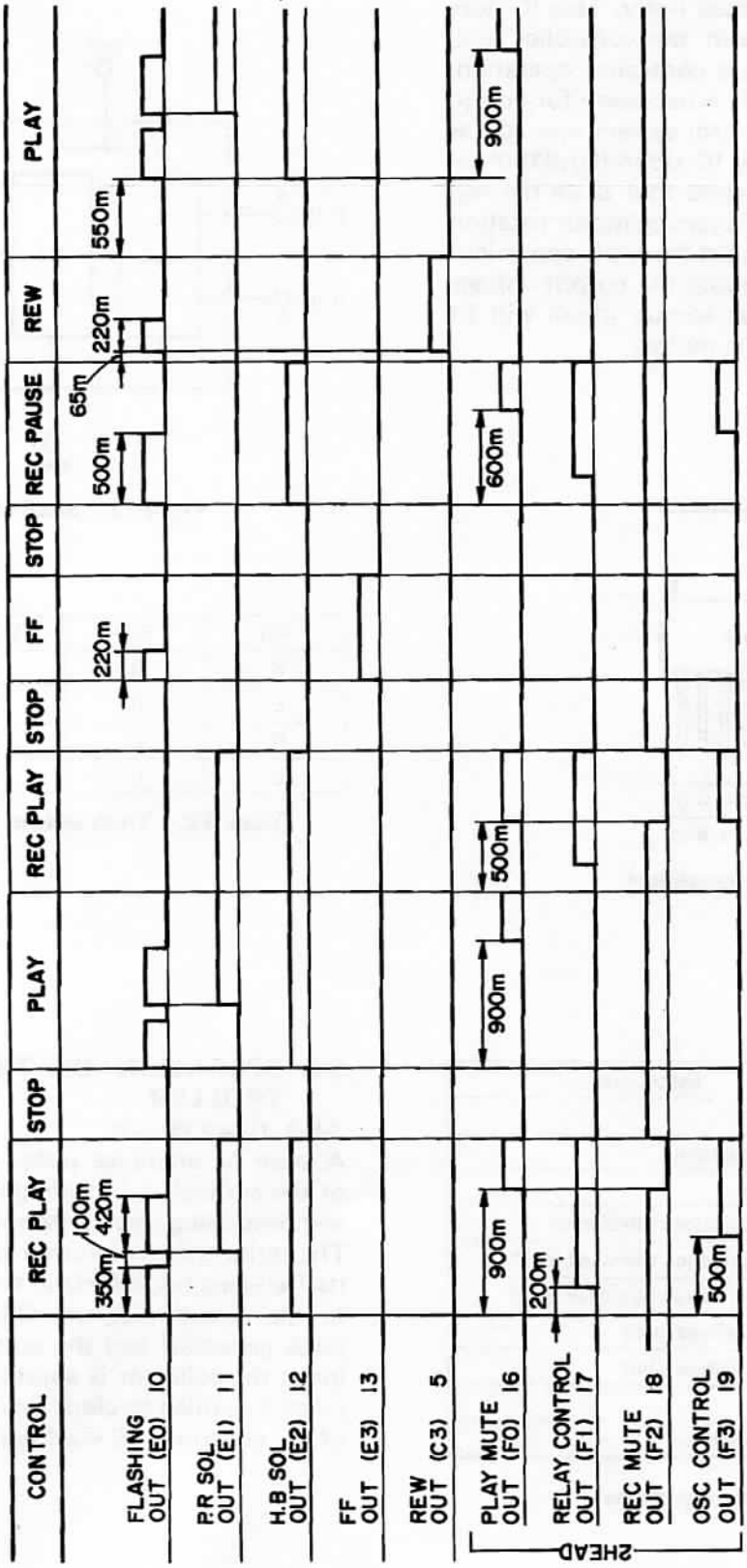


Fig. 3-8. Timing diagram of control signals

3-5. MOTOR REVERSING IC

The IC that works to reverse the direction of motor rotation is described lastly. This IC does not exchange signals with the controller and, naturally, does not affect controller operation. But knowledge of the IC is necessary for you to understand how the control system operates as a whole. Motor reversing IC U914 (BA6109) incorporates power transistors that drive the reel motor and is capable of reversing motor rotation directly by a signal supplied from the controller. It is also capable of varying the output voltage so as to generate a drive torque which will fit the operating mode of the motor.

3-5-1. Pin assignments

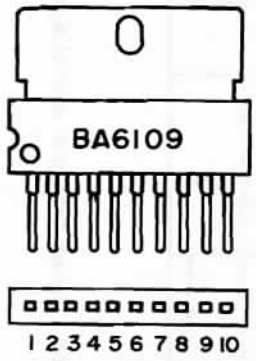


Fig. 3-9. Pin arrangement

Pin No.	Symbol	Description
1	GND	Ground
2	V_{OUT1}	Voltage output
3	V_{Z1}	
4	V_R	Output voltage control input
5	F_{IN}	Normal rotation command input
6	R_{IN}	Reverse rotation command input
7	V_{CC1}	Supply voltage input
8	V_{CC2}	Supply voltage input
9	V_{Z1}	
10	V_{OUT2}	Voltage output

Table 3-7. Pin assignments

3-5-2. Block diagram and truth table

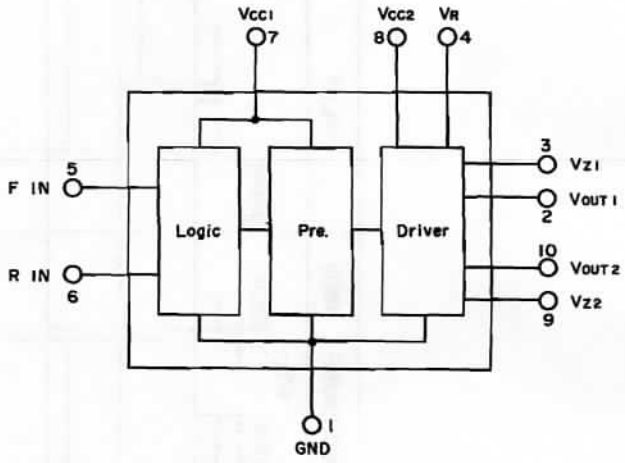


Fig. 3-10. Block diagram

FIN	RIN	V_{OUT1}	V_{OUT2}
H	H	L	L
L	H	L	H
H	L	H	L
L	L	OPEN	OPEN

Table 3-8. Truth table of inputs and outputs

3-6. OPERATION OF THE SYSTEM CONTROLLER

3-6-1. Clock circuit

A train of reference pulses times all operations of the controller, including latching input signals and processing them arithmetically and logically. The pulse train is referred to as clock pulse and its frequency is 400 Hz in the M133's controller. In the circuit diagram, Q913 forms the clock pulse generator and the output voltage developing at the collector is approx. 10 Vp-p. The clock pulse is applied to clock input port CL0 (pin 28) of the controller IC via coupling capacitor C906.

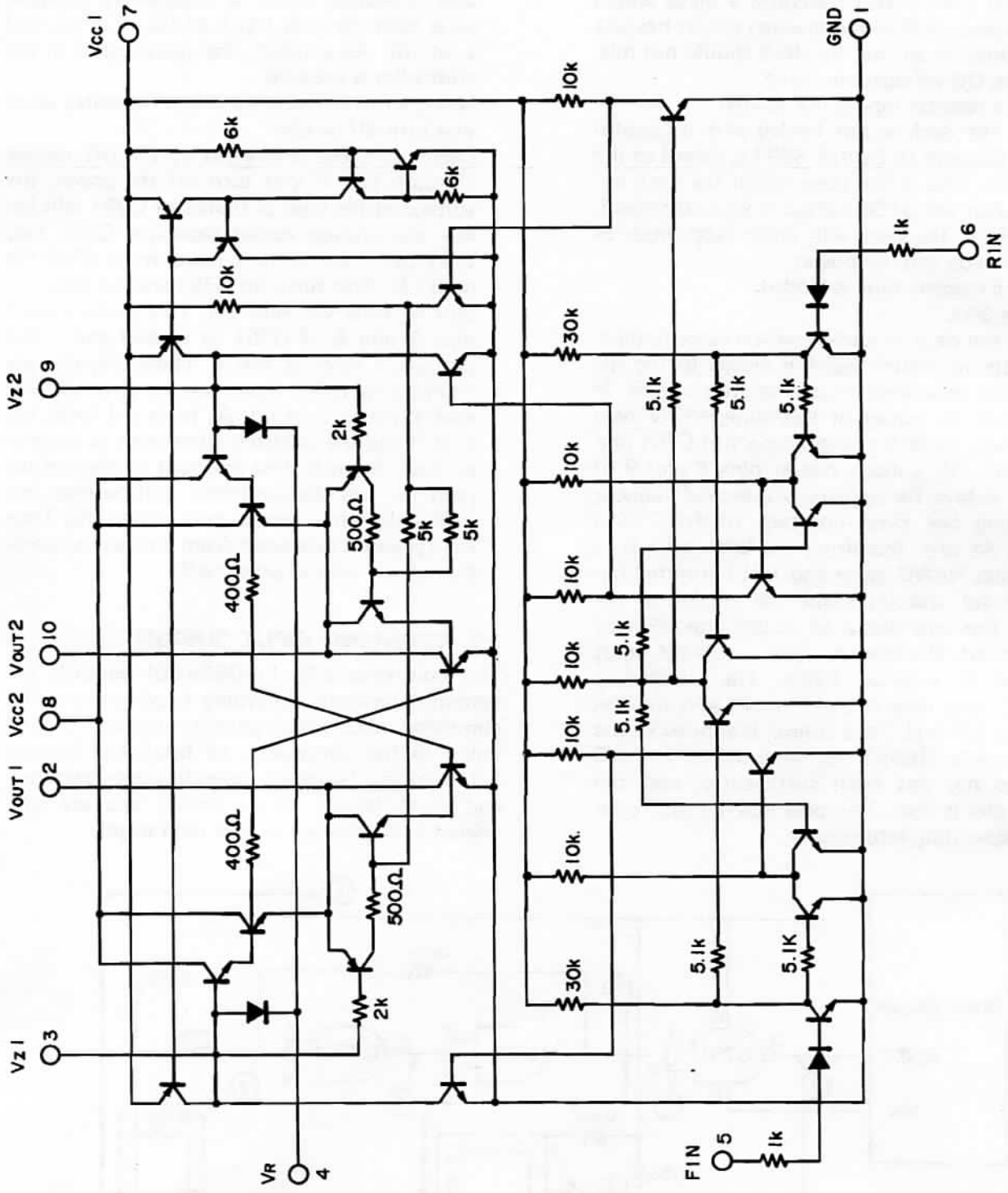


Fig. 3-11. Equivalent circuit

3-6-2. Initial reset circuit

See Fig. 3-12.

The initial reset circuit generates a signal which puts the deck in Stop mode when power has just been turned on so that the deck should not misoperate as DC voltages are rising.

1) When a cassette tape is not loaded
   When the deck is not loaded with a cassette tape, Cassette In Switch S994 is closed to the NO side. This is the state which the deck enters when the STOP button is kept depressed. Therefore, the deck will enter Stop mode as soon as you turn on power.
2) When a cassette tape is loaded
   See Fig. 3-13.
   When the deck is loaded with a cassette tape, Cassette In Switch S994 is closed to the NC side and separated from the stop circuit. If you turn on power at this time, +10 V rises gradually. Since it charges capacitor C751 first via path (1), voltage rise at pins 8 and 9 of U751 delays for approx. 2.6 seconds almost equalling the time constant of R753 and C751. At first, therefore, the level at (a) is L. The two NAND gates and R751 inserted between (a) and (c) shape the waveform for sharp rise and decay to secure operation of the circuit. The level at (c) is L since the input voltage is inverted twice. The succeeding NAND gate inverts the L-level again and the level at (d) is H. Thus H-level is applied to the controller's RESET terminal when the DC voltage has not risen sufficiently, and the controller is reset. This prevents the controller from operating erroneously.

When the DC voltage has risen sufficiently and capacitor C751 is completely charged, level turns to H at (a), L at (b), H at (c), and L at (d). As a result, the reset signal of the controller is released.

Next, let us see how the circuit operates when you turn off power.

Capacitor C752 is charged by the DC voltage via path (2). If you turn off the power, the voltage at the base of transistor Q751 falls below the voltage across capacitor C752 and, therefore, base current flows from C752 via path (3). This turns on Q751 and permits current to flow via path (4). This current turns pins 5 and 6 of U751 to H-level and U751 outputs L-level at pin 4. Therefore, charges storaged in C751 flows out via path (5) and level turns to L at (a). As (a) is at L-level, (d) is at H and the controller gets reset as explained first. A small time constant is selected for path (5) and the controller will be reset immediately when power gets turned off. Thus the system is protected from erroneous operation at the time of power-off.

3-7. COMMAND INPUT CIRCUIT

The controller LSI (μPD554-80) controls the system extensively according to commands. The command input circuit permits proper command input to the controller. As briefed in Section 3-1, two multiplexers, operating key switches, and Auto-Present rotary switch, etc, are connected to the controller (see next page).

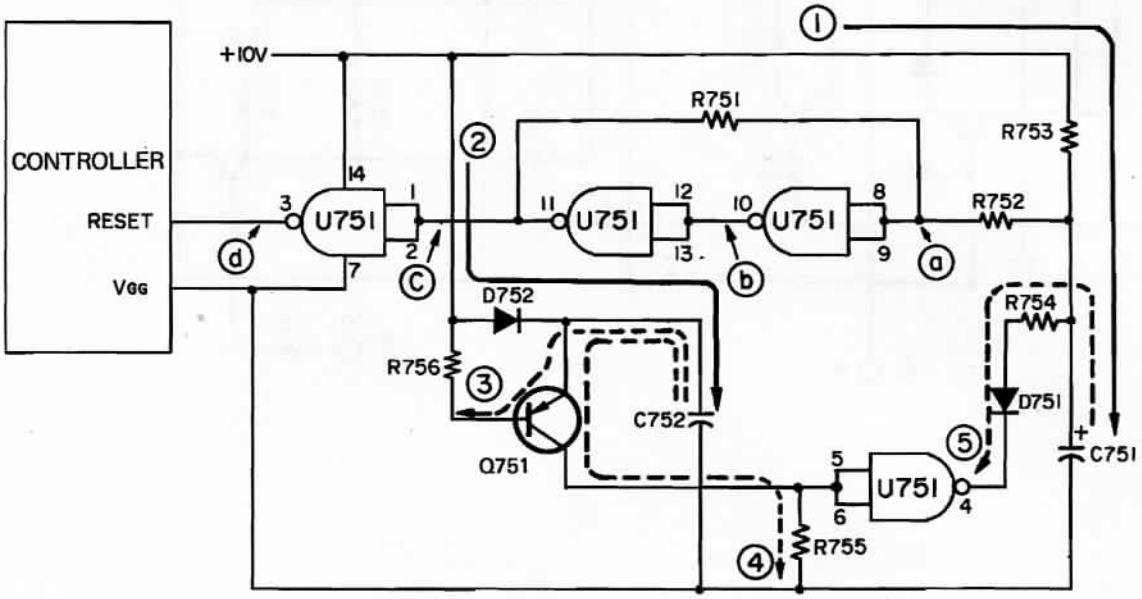


Fig. 3-12. Initial reset circuit

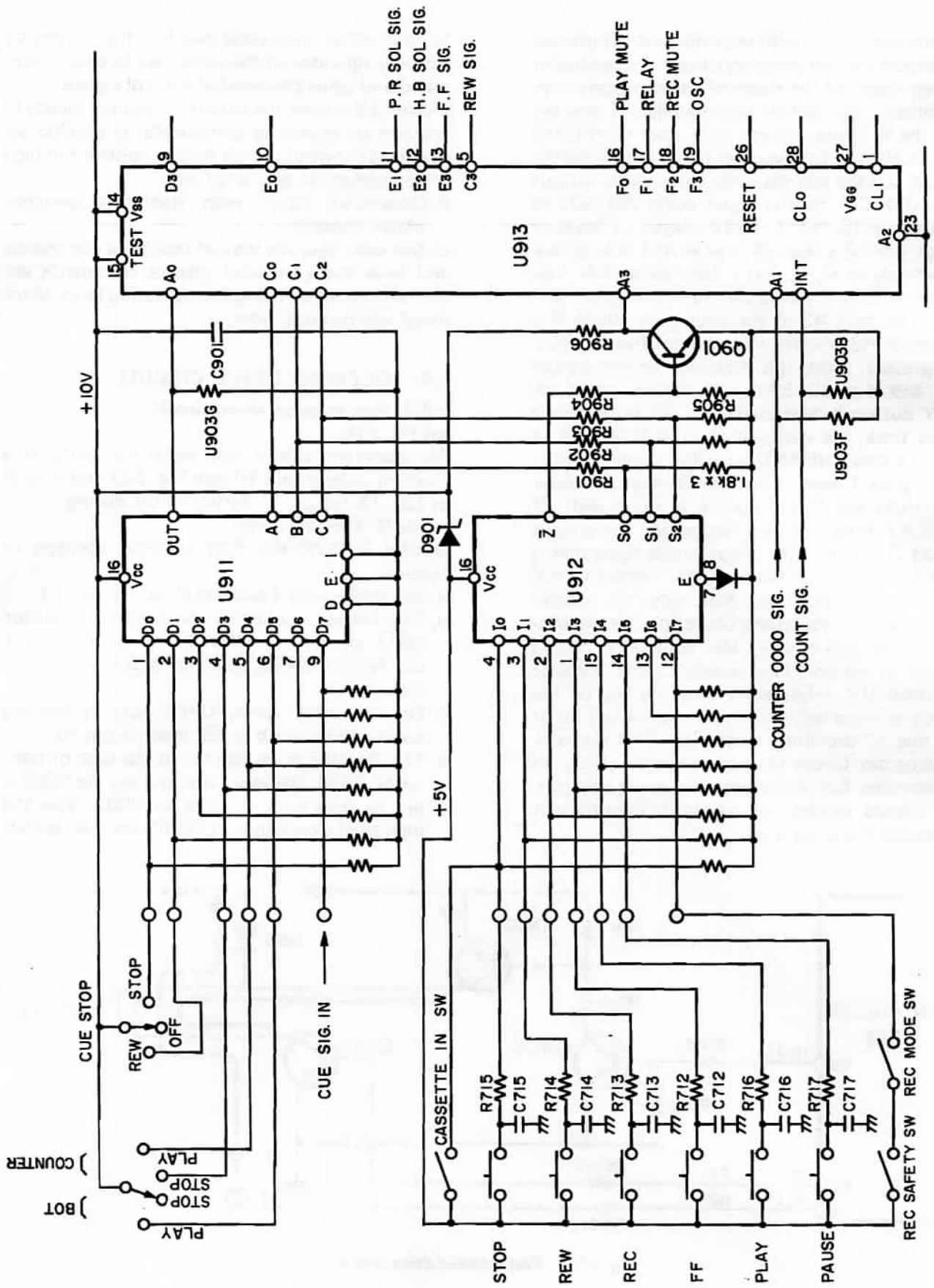


Fig. 3-13. Controller input circuit

A. Command input with operating keys (buttons)
The stored control program causes the controller to keep watch of the states of the operating keys and other input signals (commands). If you depress the REC key, for example, port I2 of U912 turns to H-level. On the other hand, the controller outputs a 3-bit address code through its output ports (C0–C2) to the input ports (S0–S2) of multiplexer IC U912. U912 outputs L-level at output port Z when I2 is at H and S0–S2 are respectively at H, L, and L (see Table 3-4). The L-level at $\overline{Z}$ is inverted by transistor Q901 and applied to port A3 of the controller. When H is applied to A3, the controller identifies the REC as depressed. Next, the controller applies signals L, L, and H to S0–S2 to see whether or not the PLAY button is depressed. If PLAY is depressed at this time, the multiplexer is at H-level at I4 and, as a result of AND with the signals of S0–S2, outputs L-level. This permits the controller to identify the PLAY button as depressed. (If the PLAY button is not depressed, the output level at $\overline{Z}$ is H and the input to the controller is L. As a result, the controller identifies the PLAY button as not depressed. Naturally, no control signals used for recording operation are generated.) In the same way, the controller checks whether or not port 17 of multiplexer IC U912 is at H-level (i.e. whether or not the tab of the cassette is removed; and REC mode is set for at least one of the three channels.) Thus the control program forces the controller to check all requirements for performing recording and generate signals needed for recording operation if the requirements are met.

In the other operating modes, the controller actually operates in the same way to check command and generates needed control signals.
Figure 3-8 shows the timing of control signals in relation to operating commands. A specific sequence of control signals totally control the tape drive mechanism and amplifier.

B. Command input with operating switches (Auto-Present)
In this case, too, the way of inputting commands and how the controller checks commands are the same as when using the operating keys. More detail will be given later.

3-8. SOLENOID DRIVE CIRCUIT

3-8-1. Fast solenoid drive circuit

See Fig. 3-14.

As described before, the controller outputs a flashing pulse at pin 10 (see Fig. 3-8) and H-level at pin 13 (at pin 5 during REW) during a Fast mode (F.FWD or REW).
During F. FWD the Fast solenoid operates as follows.

a. Controller U913 outputs H-level at pin 13.
b. The H-level applies to the base of transistor Q911 via resistor U901C, thereby turning it on. Now the Fast solenoid is grounded at an end.
c. On the other hand, U913 outputs flashing pulse whose width is 220 msec at pin 10.
d. The flashing pulse applies to the base of transistor Q906, thereby turning it on. As Q906 is on, its base current turns on Q907. Now the high level developing at Q907's emitter applies

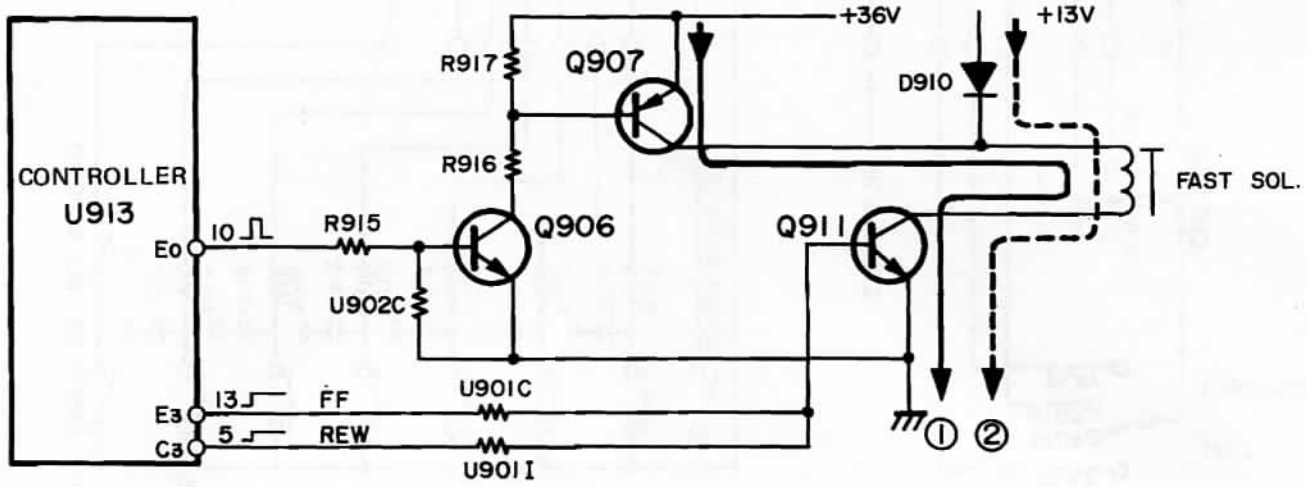


Fig. 3-14 Fast solenoid drive circuit

to the other end of the Fast solenoid via Q907 and flashing current flows through the solenoid via path (1) for 220 msec. This current causes the solenoid to operate.

e. In 220 msec, the output of the controller at P10 falls to L-level, thereby turning off transistor Q906. As Q906 is off, Q907 turns off and stops delivering the high voltage developing at its emitter to the solenoid.

f. The terminal of the solenoid which connects to Q907 is also connected to the power line of approx. 13 V via diode D910 and current continues to flow to the solenoid via the diode and path (2). This current maintains the current state of the solenoid.

Thus varying voltages (currents) are supplied to the solenoid for driving and holding it. The large drive current produces a large mechanical power in the solenoid to secure operation. The small holding current protects the solenoid from heating up. We call the circuit that controls supply voltage of the solenoid in this way the "flashing circuit" and the large drive current "flashing current".

When REW mode is selected, controller IC U913 outputs an H-level signal which turns on transistor Q911 in the same manner as in F.FWD mode. Operation of the flashing circuit is the same as in F.FWD mode but that the flashing current begins to flow with a delay of approx. 65 msec.

When the Fast mode has been released (for example, the STOP button has been depressed during F.FWD or REW mode), operation proceeds as follows.

g. The controller outputs L-level at pin 13 (F.FWD) or at pin 5 (REW).

h. With the base current cut off, transistor Q911 turns off. Now the solenoid is cut off from the circuit and, because holding current flows no longer, it gets released.

3-8-2. Head base solenoid drive circuit

See Fig. 3-15.

This solenoid operates during PLAY, PAUSE, REC/PLAY, and REC/PAUSE. The controller generates signals which control the head base solenoid during these modes (see Fig. 3-8). The timing diagram (Fig. 3-8) shows that, even in a certain operating mode (REC/PLAY, for example), the controller provides head base control pulse at varying timing depending on whether REC/PLAY mode is entered initially or transferred from PLAY mode. The same thing occurs with flashing control pulse. The reason for this is as follows. To change REW mode to PLAY mode, it is required to raise the head base after the tape has stopped and, therefore, to delay the head base control pulse for the time interval which the tape takes to stop traveling. For this reason, head base solenoid operation should be explained separately for each mode for exactness. However, it is described here only for when PLAY mode is entered from STOP mode. You may refer to the timing diagram for information of delay.

a. When the PLAY button has been depressed, controller IC U913 outputs a flashing circuit control signal (H-level) at pin 10 and a head

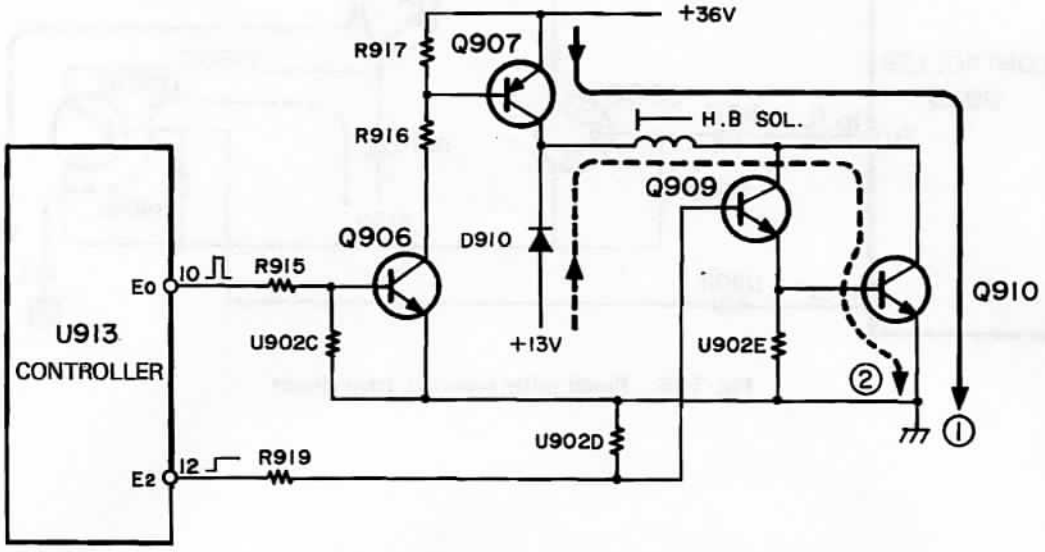


Fig. 3-15. Head base solenoid drive circuit

base solenoid control signal (H-level) at pin 12 at the timing shown in the timing diagram.

b. The H-level of pin 12 applies to the base of transistor Q909 via resistor R919, thereby turning it on. As Q909 is on, base current flows through Q910 and it turns on. Now the one end of the head base solenoid is grounded via Q111.

c. On the other hand, the flashing control signal of pin 10 turns on Q906 and Q907 which permits a high voltage to be applied to the other end of the solenoid (this process is the same as operation of the Fast solenoid drive circuit). As a result, a large current flows through the solenoid via path (1) and causes it to operate.

d. When the flashing control signal disappears, Q906 and Q907 turn off and the flashing current stops flowing. However, the current state of the solenoid is maintained since holding current continues to flow through the solenoid via diode D910 and path (2) just as with the Fast solenoid drive circuit.

3-8-3. Pinch roller solenoid drive circuit

See Fig. 3-16.

The pinch roller solenoid drive circuit operates basically in the same manner as the Fast solenoid drive circuit. The difference is that the controller supplies a control signal from pin 11 to the base of transistor Q908 to turn it on. When it is on, one end of the pinch roller solenoid gets grounded.

As the timing diagram shows, the pinch roller solenoid control signal is output with a delay of 450–550 msec to the head base solenoid control signal. This permits the tape to start traveling after the head base had moved completely to its position and the head has come into close contact with the tape.

3-9. REEL MOTOR DRIVE CIRCUIT

3-9-1. Direction of motor rotation

The reel motor drives the left or right reel disk to take up the tape. Torque is transmitted from the reel motor to one of the reel disks during the reproduce, fast-forward, and rewind modes by the processes shown in Fig. 3-17 – 3-19 (as seen from the front of the deck). As seen from Fig. 3-17 and 3-19, the reel motor rotates in the same direction during the reproduce and rewind modes and the fast-forward pulley mechanically selects either the left or right reel disk and drives it in accordance with the direction of reel motor rotation. In the pause mode, the reel motor does not rotate.

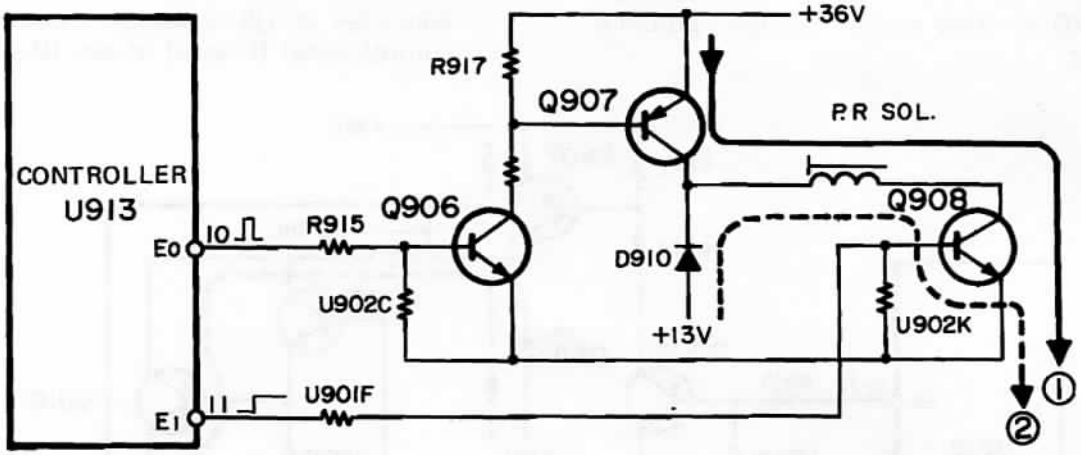


Fig. 3-16. Pinch roller solenoid drive circuit

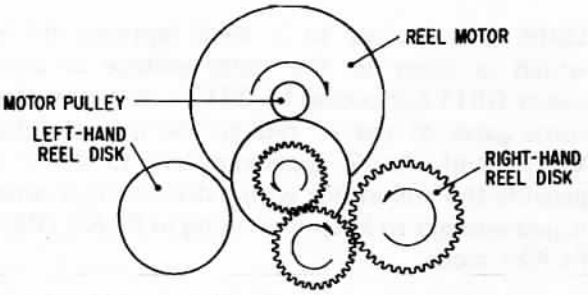


Fig. 3-17. Reel disk drive (reproduce mode)

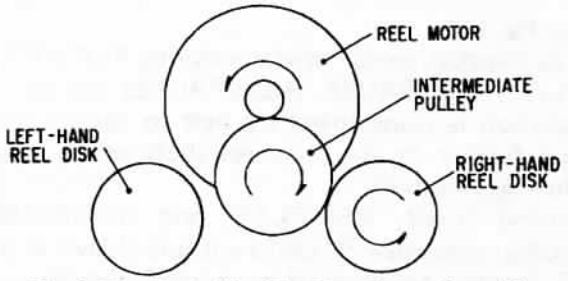


Fig. 3-18. Reel disk drive (fast-forward mode)

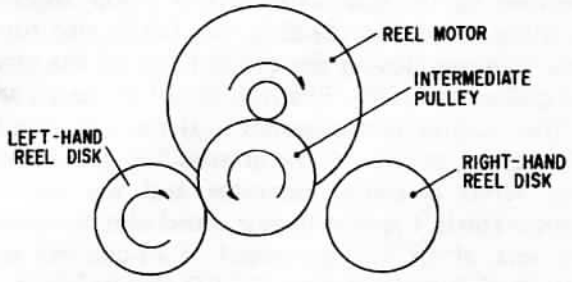


Fig. 3-19. Reel disk drive (rewind mode)

3-9-2. Motor drive circuit

See Fig. 3-20.

The motor drive circuit uses the motor reversing IC described in Section 3-4. With control signals supplied from the controller, the logic gates of the IC automatically control the direction and speed of the motor rotation.

First, let us examine the input signals of ICU914.

a. In PLAY mode
The H-level output at pin 11 of the controller is transmitted to input terminal RIN of U914 via U901G and U901L. On the other hand, the L-level output at pin 13 of the controller is transmitted to input FIN of U914 via pin 13 of U913 and resistor U901B.

b. In REW mode
The H-level developing at pin 5 of U913 is transmitted to RIN of U914 and the L-level of U913's pin 13 to FIN.

c. In F.FWD mode
The H-level developing at pin 13 of U913 is transmitted to FIN of U914 and the L-level of U913's pin 5 to RIN.

Table 3-9 summarizes the states of the input signals described above.

Mode	Input signals		Output signals		Motor state
	R_{IN}	F_{IN}	V_{OUT1}	V_{OUT2}	
PLAY	H	L	L	H	Forward rotation
REW	H	L	L	H	Forward rotation
F.FWD	L	H	H	L	Reverse rotation
STOP	L	L	OPEN	OPEN	Motor power off

Table 3-9. Motor reversing operation

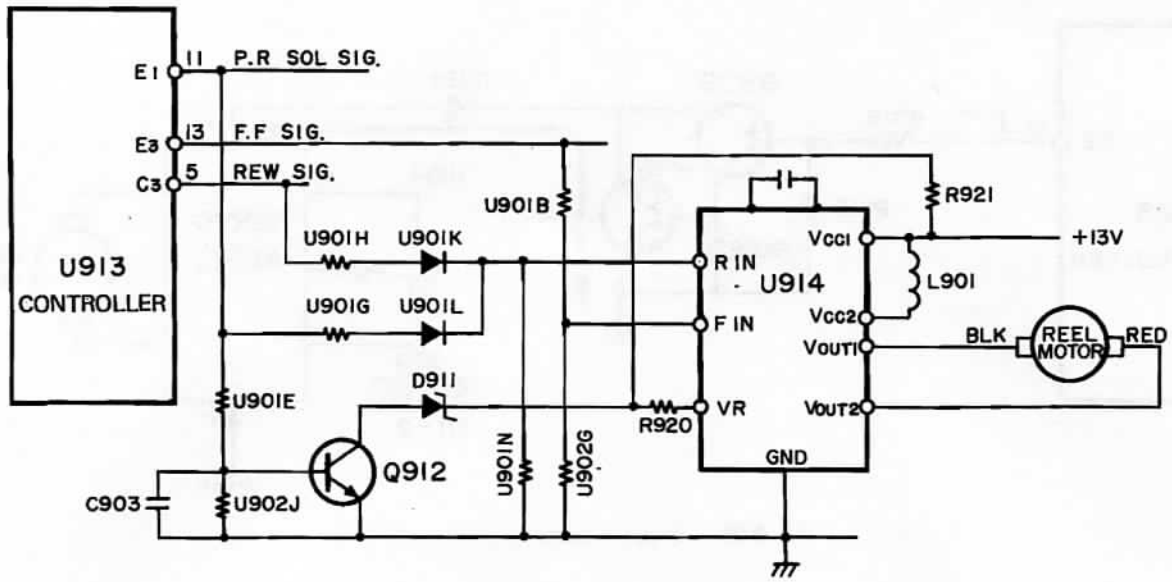


Fig. 3-20. Reel motor drive circuit

From the truth table of U914, we also find the states of the output terminals as given in Table 3-7. As the reel motor is connected across Vout1 and Vout2, drive current flows from RED to BLK (see Fig. 3-19) and drives the motor to run forward during PLAY and REW modes. During F.FWD mode, drive current flows from BLK to RED and the motor reverses the direction of rotation. Except in PLAY mode, a voltage (13 V) which is close to the supply voltage is applied to terminal VR of U914 for the reason described below so that a voltage as high as approximately 11.5 V developing across Vout1 and Vout2 drives the motor at high speed.

In PLAY mode, the voltage is reduced to about 4.5 V. The reason that the drive voltage is varied is described below.

The H-level output at pin 11 of controller IC U913 during PLAY mode is applied to the base of transistor Q912 via resistor U901E with a delay (of 1.2 sec) which capacitor C903 determines together with U901E. Q912 remains cut off for the delay time and, during this time, the supply voltage is applied to the terminal VR of IC U914 that controls reel motor drive voltage via resistors R921 and R920. Therefore, the voltage across Vout1 and Vout2 is high to provide the reel motor with enough starting torque.

After the delay time (1.2 sec) which C903 and U901E determine has elapsed, the base of Q912 rises to H-level and base current flows through it. This turns on Q912, and terminal VR of U914 gets locked to a level (approx. 5.1 V) which is close to the zener voltage of zener diode D911 connected to Q912's collector. Now some gates of the IC reduce the voltage across Vout1 and Vout2 approximately to 4.4 V to provide the reel motor with a drive torque which is just enough to keep it running in PLAY (REC/PLAY) mode.

3-10. CAPSTAN MOTOR DRIVE CIRCUIT

See Fig. 3-21.

The capstan motor operates during PLAY(REC/PLAY) and PAUSE (REC/PAUSE) modes. Its rotation is transmitted by belt to the flywheel and further to the flywheel shaft which is just the capstan shaft.

During PLAY, REC/PLAY, and REC/PAUSE modes, controller IC U913 outputs H-level at pin 12 (output terminal of head base solenoid control signal). The H-level developed at pin 13 is applied to the base of transistor Q909, thereby turning it on. As Q909 is on, Q910 also turns on, thereby closing the ground line of the servo amplifier via D991. The hot line of the servo amplifier is directly connected to the supply power. Therefore, as soon as the ground line gets closed, the servo amplifier operates and the capstan motor starts. Capstan motor speed may be selected out of STD (tape speed: 4.76 cm/sec) and HIGH (9.5 cm/sec) with SPEED switch S11-2.

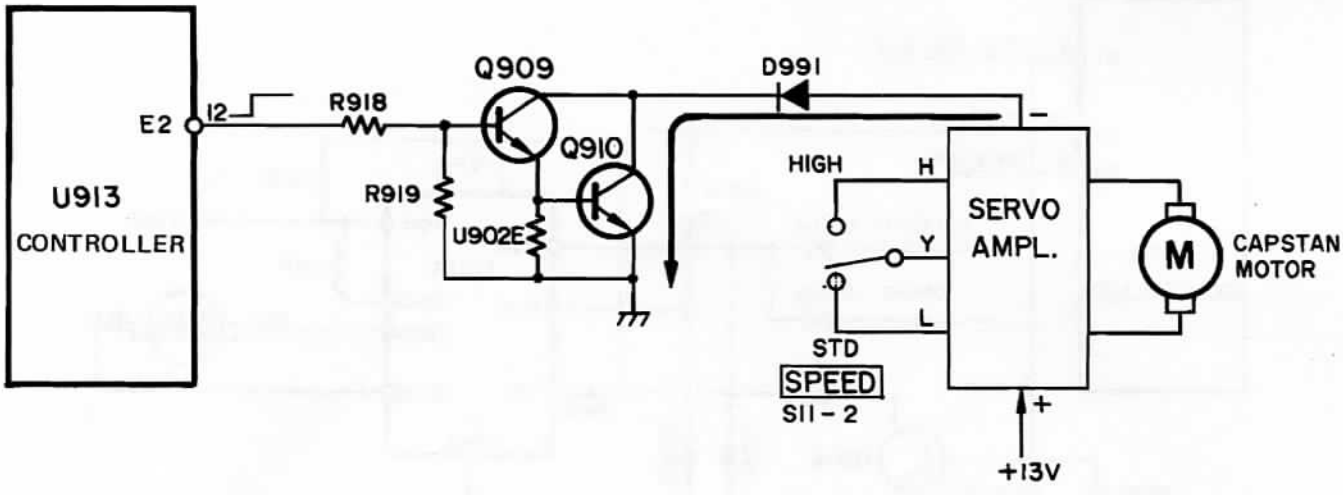


Fig. 3-21. Capstan motor drive circuit

3-11. TAPE COUNTER CIRCUIT

See Fig. 3-23.

This tape deck employs an electronic counter with digital display of LEDs. Because of this, it is required to electronically detect the state, running or stationary, of the tape and its direction of rotation. This is performed by two pairs of photocouplers fitted to the drum which is beneath the right-side reel disk and has eight slits. When the drum rotates, the slits pass between each pair of LED and phototransistor and, at this time, the phototransistors generate current. As the reel disk rotates once, each phototransistor generates eight pulses. The two pairs of photocouplers are laid in such a manner that their output pulses are 90° out of phase mutually (see Fig. 3-22). This permits detection of tape travel direction as described later.

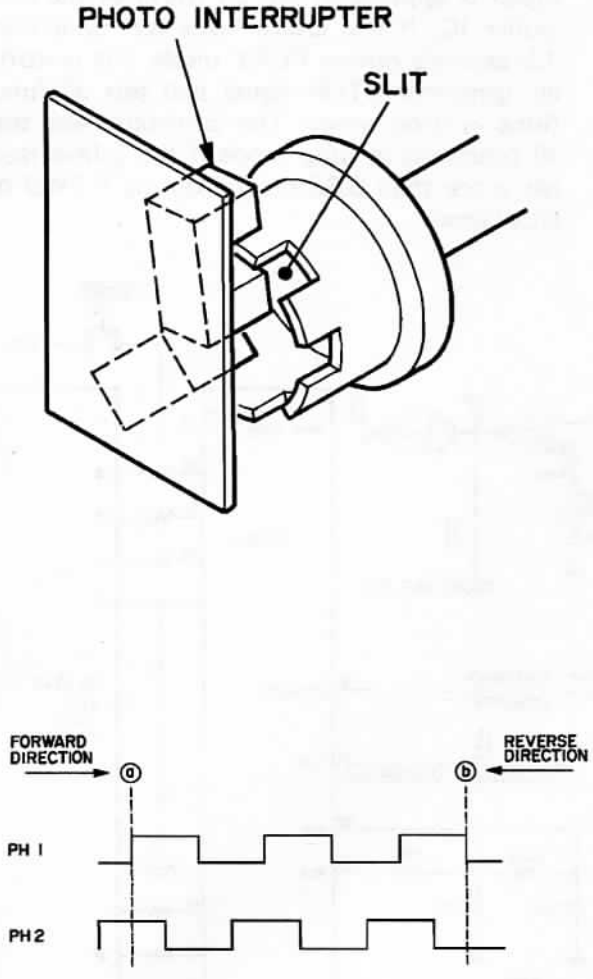


Fig. 3-22. Photocoupler and its output pulse

3-11-1. Tape counter

As already described, photocouplers PH1 and PH2 generate pulses as the reel disk rotates. The waveform of the pulse signal is not square but sinusoidal because of the waveform of the light emitted to the phototransistor through the slits. The waveform shaping circuit inserted in each photocoupler circuit shapes the pulse signal into square pulse. The shaped pulse passes through inverter U404 (pins 11 and 12) and, after resistor R488 and capacitor C433 have delayed it approximately by 100 μsec, comes to an inverter again.

One component of the delayed pulse enters U407 (pin 1), and the other comes to pins 5 and 6 of NAND gate U407. The pulse inverted by the NAND gate is delayed for approximately 100 μsec by R456 and C427, then comes to pin 2 the NAND gate. Because the input to pin 2 of the NAND gate is delayed for 100 μsec, the input voltages of both gates 1 and 2 remain at H-level for 100 μsec. Therefore, the NAND gate outputs pulse whose L-level lasts for 100 μsec. This pulse is applied to two input gates of the succeeding NAND gate unit. As a result, the pulse signal applied to the input port (pin 14) of the tape counter drive IC U406 has H-level lasting for 100 μsec. This counter input circuit has a 1/5 frequency divider and the counter increments or decrements by one as five pulses come in (whether to increment or decrement is determined by the state of UP/DOWN input described below). Since eight pulses are generated as the reel disk rotates once, the counter reading changes by one for every five-eighth rotation of the reel disk.

a. Detection of tape travel direction

The outputs of photocouplers PH1 and PH2 whose waveforms have been shaped come to input terminals C and D of U405 (1/2) which detects the direction of tape travel. The output pulses of PH1 and PH2 are 90° out of phase as shown in Figure 3-22. When the tape is traveling forward, U405 (1/2) outputs H-level (identifying forward travel) by ANDing inputs (C and D both at H) at the moment of (a). When the tape is reversing, U405 (1/2) outputs L-level since it ANDs inputs (C at H and D at L) at the moment of (b). Thus the direction of tape travel is detected. The output signal identifying tape travel direction is applied to pin 12 (UP/DOWN) of counter drive IC U406 to tell the counter whether to increment or decrement.

b. LED blanking

If the counter LEDs are active immediately after power-on, the counter might operate erroneously as when a logic error has happened due to transient voltage. A delay voltage applied to pin 7 (blanking signal in) of the counter driver IC prevents such an event. The delay voltage circuit is composed of resistor R459, capacitor C430, and zener diode D410. As the supply voltage of +10 V is applied to R459, current flows through it, thereby charging C430. Until the voltage across C430 exceeds the zener voltage of D410, no voltage is applied to pin 7 of U406 and the counter LEDs remain unlit during this time. The delay time which is the time constant of R459 and C430 is approximately 220 msec.

From the tape status signals described above, U406 finally generates LED segment drive signals which are supplied to 28 segments (= 7 segments x 4 LEDs) via resistors.

c. Counter reset

The tape counter will be reset when RESET switch S13 is depressed and H-level is applied to pin 10 (reset) of U406. Besides, if the counter is decrementing, U406 generates a signal (H-level lasting for approx. 100 μsec) a little bit before the counter reads zero (i.e. when the reading is around 3 – 5). This signal causes the tape to stop traveling just when the counter reads zero. The advance of timing takes into consideration inertia of the tape transport mechanism so that the tape should stop exactly when the counter reaches zero. The line of this signal is connected to A1 of the controller IC so that the signal is used to stop tape travel or resume playback when the counter has read zero in REW mode.

d. Tape end detection

The tape end is detected by making use of the fact that COUNT SIG OUT (see Fig. 3-23) turns to L when the tape stops traveling. This signal is applied to pin 25 (INT) of the controller IC. If the L-level lasts for more than 2.5 seconds during PLAY mode, the controller generates STOP signal and sets all functions in Stop mode. The controller also sets all functions in Stop mode if the L-level lasts for more than 0.65 second during F.FWD or REW mode.

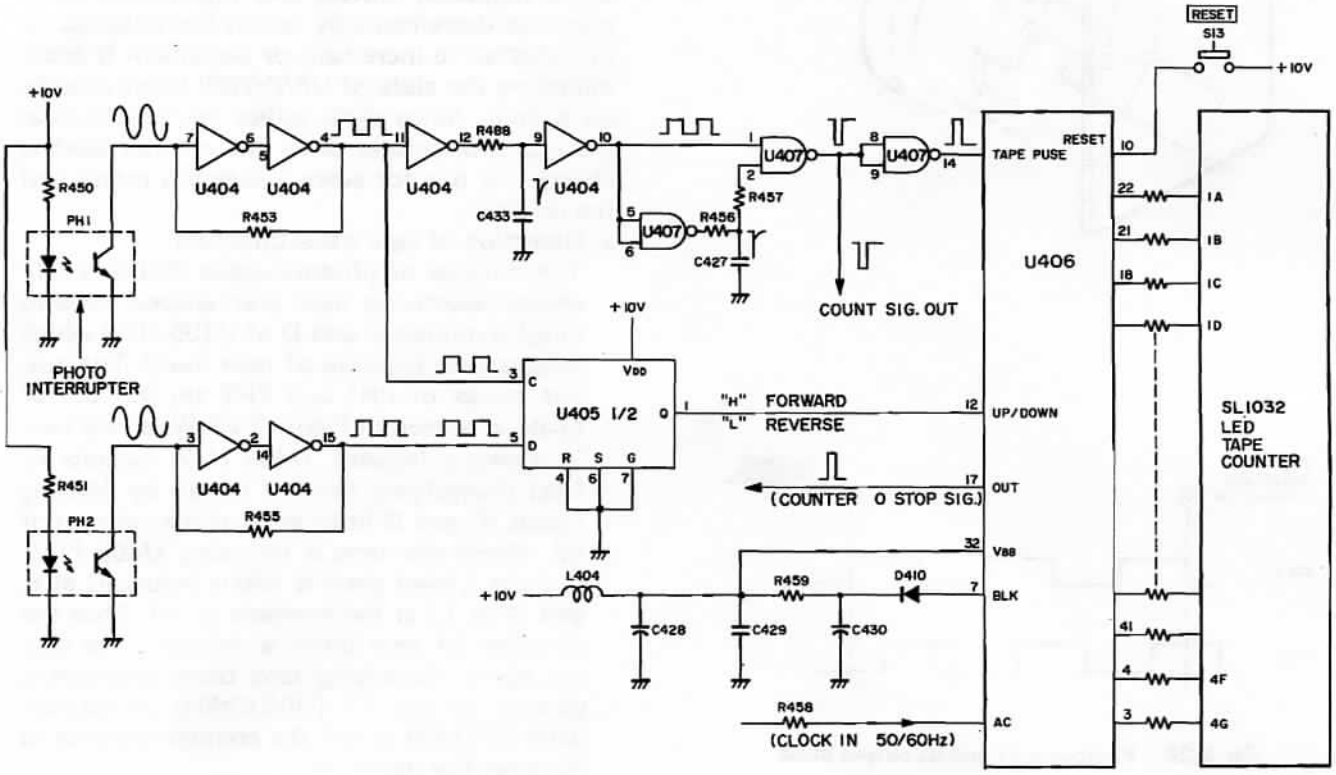


Fig. 3-23. Tape counter circuit

CUE SIGNAL SECTION

3-12. CUE SIGNAL REPRODUCING CIRCUIT

See Fig. 3-24.

The CUE signal reproducing circuit is basically the same as the audio signal reproducing circuit. The only difference is that there is no Dolby NR decoder in it. So, it is simply explained below.

a. Relay switch K301-1 switches the head to PLAY.

b. Play head amplifier U301 is provided with a negative feedback network in between its output terminal and inverted input terminal in order to compensate playback characteristics according to the tape speed. At this time, Speed switch S11-1 turns on or off FET switch Q301 to make frequency response and gain fit the tape speed. When High speed is selected, Q301 is on, which shorts resistor R308. When normal speed is selected, Q301 is off and R308 works. Thus the amplifier characteristics are varied.

c. The semi-fixed variable resistor permits adjustment of the playback level.

d. R312 and C309 compensate frequency response at high frequencies. C310 and L301 form a bias trap.

e. FET switch Q303 is turned on during PLAY mode by relay switch K301-2. Transistor switch Q304 is off during PLAY mode because the base is at L-level. Therefore, CUE signal comes in to preamplifier U301.

f. The L-C parallel resonance circuit connected to the inverted input of preamplifier U301 is the recording bias signal trap. Capacitor C334 connecting across the input and output compensates phase to stabilize operation of the operational amplifier.

g. The signal thus amplified then enters the meter amplifier and the output amplifier.

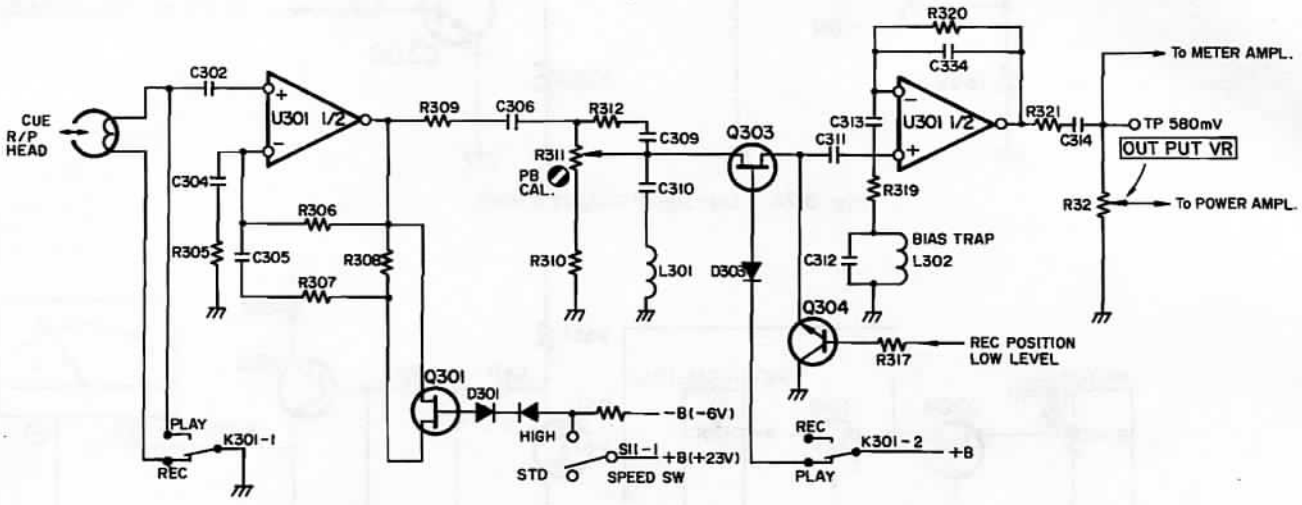


Fig. 3-24. CUE signal reproducing circuit

3-13. CUE SIGNAL OUTPUT CIRCUIT

See Fig. 3-25.

The circuitry is the same as that of the audio signal output amplifier. They have the same gain. Namely, it is 4.4 dB at the normal speed and 14.6 dB at the high speed. Thus the difference of 10 dB is provided. Muting circuit Q308 also operates the same as the audio output circuit does.

3-14. CUE SIGNAL PEAK LEVEL METER CIRCUIT

See Fig. 3-26.

The level meter reads the peak level of signal since CUE signal normally has a pulse-like waveform.

1) Play peak level meter circuit
   a. One component of the signal reproduced and amplified by preamplifier U301 comes to the hot side of OUTPUT VR R32.

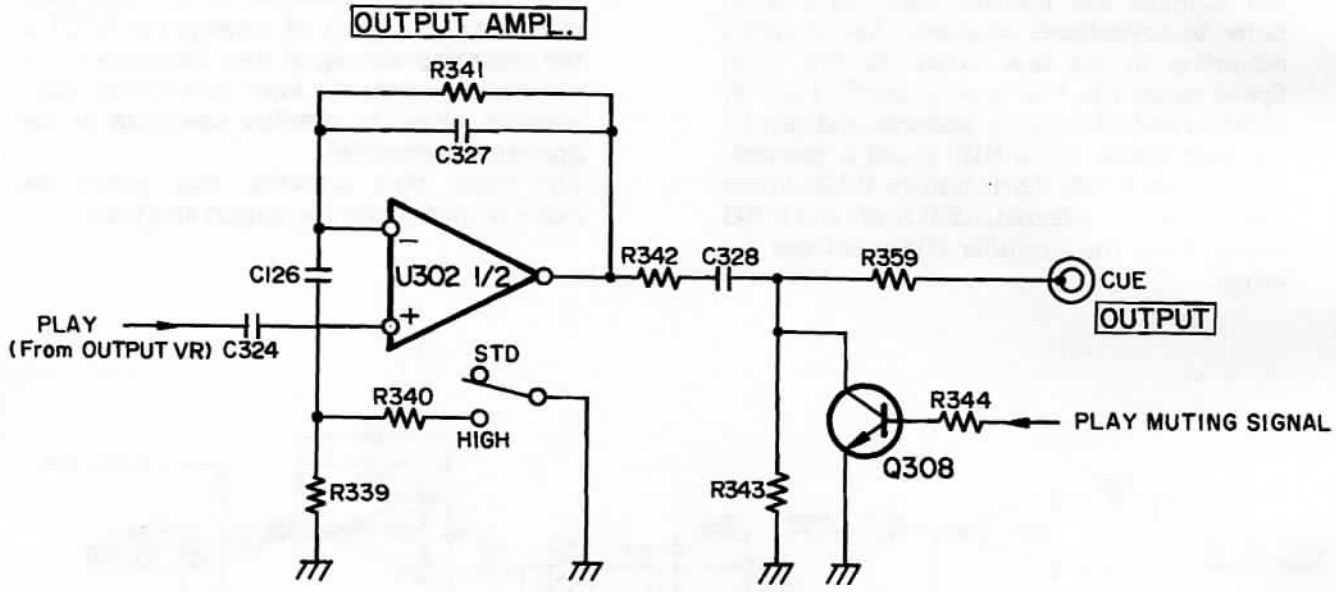


Fig. 3-25. Cue signal output circuit

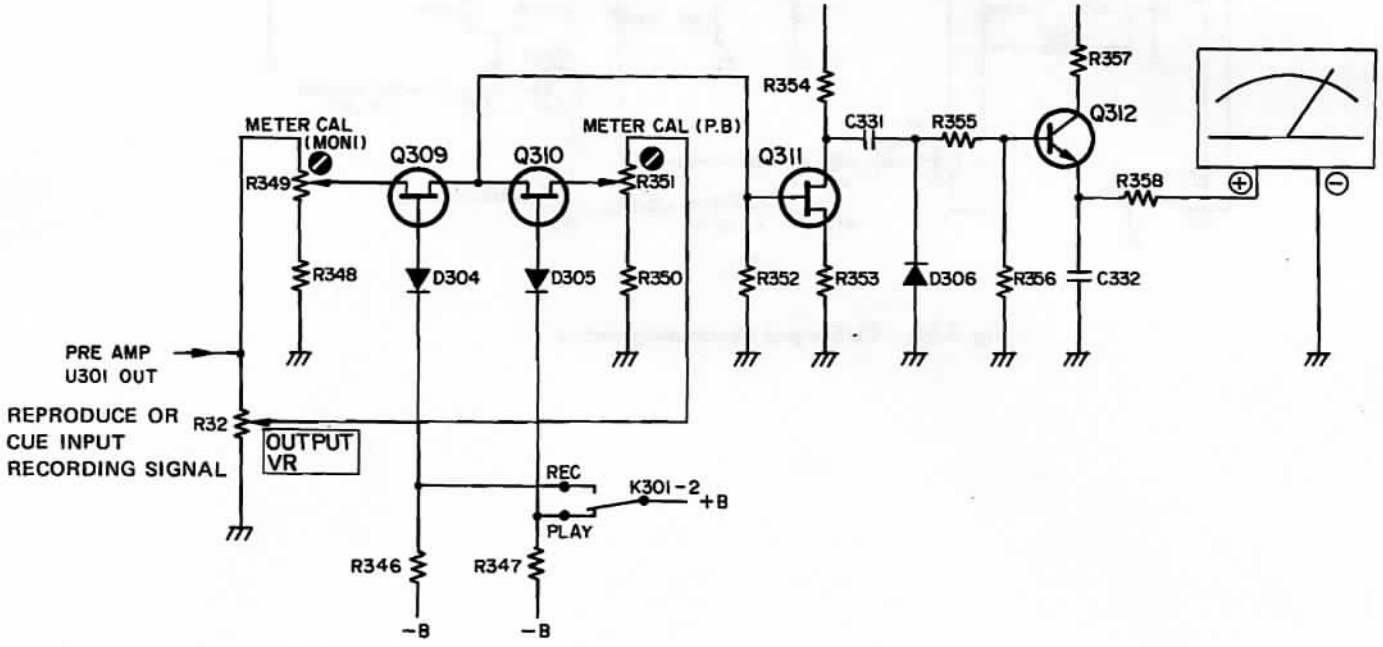


Fig. 3-26. Peak level meter circuit

b. During playback, relay switch K301-2 keeps FET switch Q310 turned on and Q309 off. Therefore, the signal passes through OUTPUT VR R32, semi-fixed variable resistor R351 (for meter calibration), and FET Q310 and comes to the gate of meter amplifier Q311.
c. Q311 amplifies the signal, then diode D306 rectifies (clamps) it.
d. The rectified signal drives transistor Q312 which drives the meter. The duration of peak level indication may be adjusted by varing the time constant of capacitor C332 and resistor R358.

2) Record peak level meter circuit
a. One component of the recording CUE signal which has been amplified by preamplifier U301 comes to the hot side of OUTPUT VR R32.
b. During recording, relay switch K301-2 keeps FET switch Q309 turned on and Q310 off.
c. Therefore, the recording signal passes through semi-fixed variable resistor R349 (for recording meter calibration) and Q309 and comes to the gate of meter amplifier Q311.
d. From now on, operation is exactly the same as in playback.

3-15. CUE SIGNAL RECORDING CIRCUIT

See Fig. 3-27.

a. During recording, relay K301-2 keeps FET switch Q302 on and Q303 off. Therefore, CUE input signal passes through R31 (CUE INPUT VR), Q302, and C311 and comes to the non-inverted input of the preamplifier. (This preamplifier is used commonly in recording and playback and, therefore, its operation is not described here.)
b. The preamplifier output comes to the semi-fixed resistor which calibrates recording level, then to recording equalizer amplifier via R322 and C316.
c. Frequency response of the recording equalizer amplifier is determined by the variable impedance of the circuit which is connected to the inverting input of the operational amplifier.
d. Namely, when High tape speed is selected, Speed switch S11-1 turns on transistor switch Q306 so that R332 and C322 connect in parallel with R328.
e. When Standard tape speed (STD) is selected, transistor switch Q307 turns on and the equalizer network which is composed of L303, R330, C320, R331, and C321 connects to the equalizer amplifier in the place of R332 and C322.

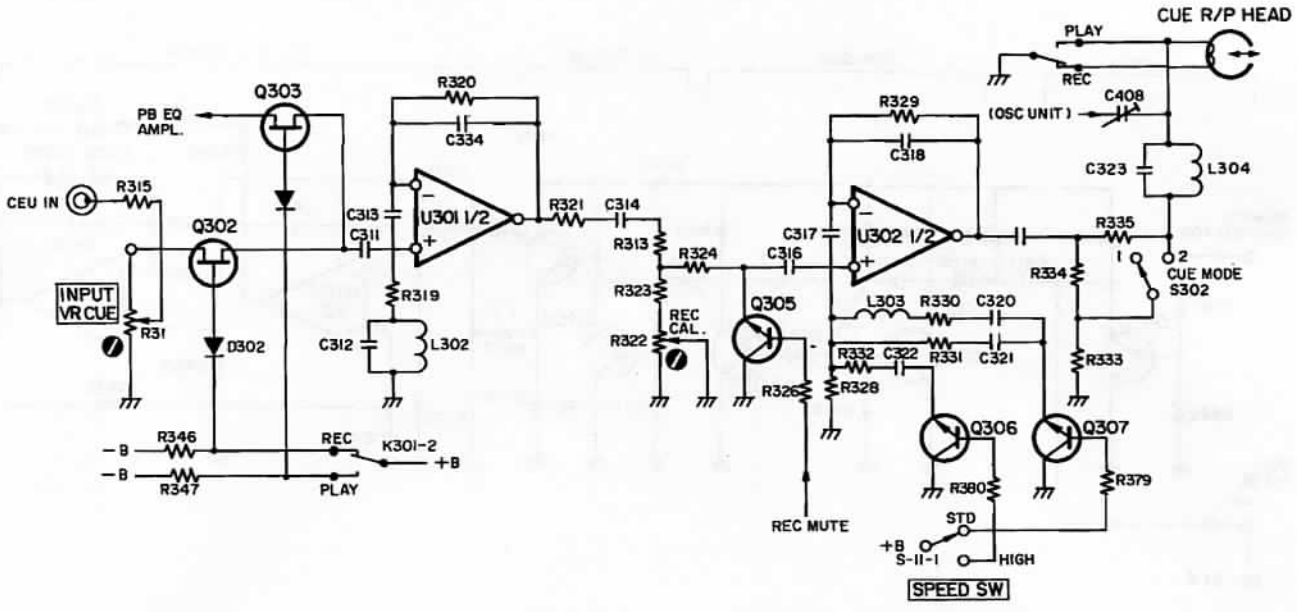


Fig. 3-27. CUE signal recording circuit

f. Thus equalized and amplified, the recording signal comes to the record head via switch S302 (CUE MODE) and 58-kHz bias trap, and recorded on the tape.
g. Transistor Q305 provides a bypass for muting the recording signal. Namely, it remains on only for 900 msec at the beginning of recording so that switching noises should not be recorded on the tape.

3-16. CUE SIGNAL (25 Hz) GENERATING CIRCUIT

See Fig. 3-28.

In this tape deck, a special signal is used to permit the deck to playback a desired piece of recording repeatedly or to stop the tape at the end of the piece of recording. This signal of approximately 25 Hz will be recorded for about a second in the Cue track of the tape. The circuit which generates this Cue signal is described below.

1) CUE signal generating circuit

See Fig. 3-28.

The 25-Hz CUE signal generating circuit is composed of a switch which gives the command to generate CUE signal, a one-shot multivibrator, transistor switches, and a 25-Hz oscillator.

a. Q410 is the transistor switch which is used to generate CUE signal by remote operation. When H-level comes from the Remote CUE switch, this turns Q410 on and the Q410 performs what switch S12 (CUE PULSE) otherwise does.
b. When one depresses switch S12 (CUE PULSE), the one-shot multivibrator that consists of transistors Q404 and Q403 generates a single pulse, as its name indicates, to keep Q404 on and Q403 off only for the time interval which is determined by parameters R414 and C410 (in this case, approx. 1.05 sec = 0.7 x 150 kohms (R414) x 10 μF (C410)).
c. As a result, Q405 and Q406 turn on for a second, thereby supplying power to the 25-Hz oscillator.
d. The 25-Hz oscillator is a C-R oscillator which combines two operational amplifiers. Its oscillating frequency is given as follows.

$$f = \frac{1}{2\pi\sqrt{R427 \times C418 \times R426 \times C416}} \fallingdotseq 25.4 \text{ Hz}$$

Zener diodes D406 and D407 connecting across the input and output of the operational amplifier limit the amplitude of CUE signal.

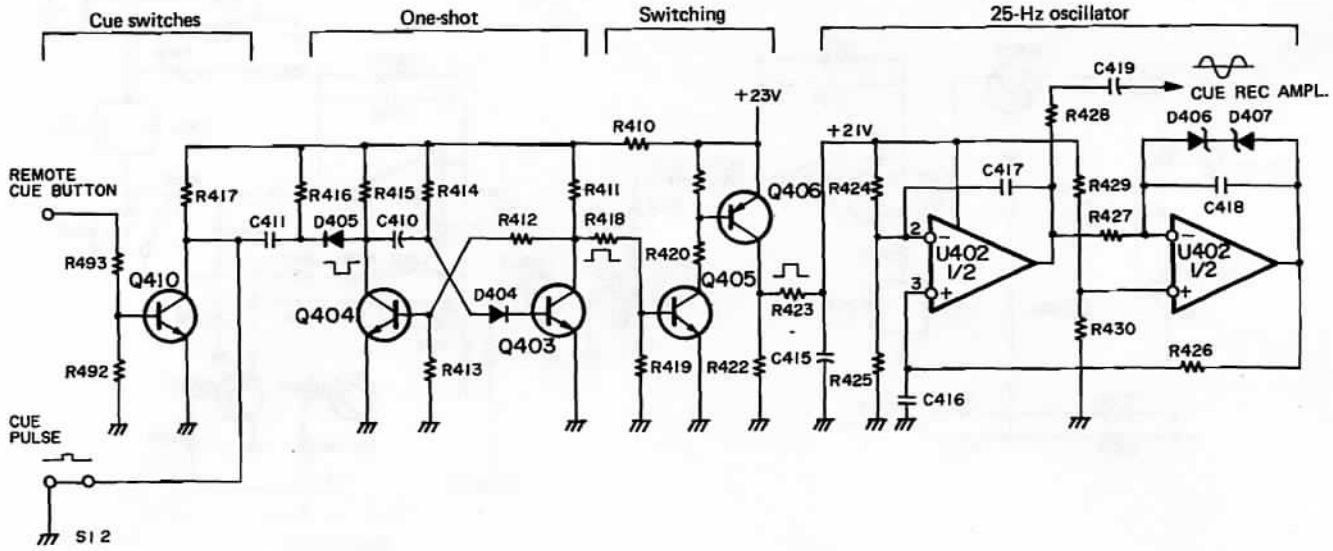


Fig. 3-28. CUE signal generating circuit

e. The 25-Hz signal that lasts only for a second enters the CUE signal recording amplifier via R428, C419, FET switch Q302, and C311 and recorded on the CUE signal track of tape.

2) 25-Hz CUE signal reproducing circuit
See Fig. 3-29.

a. The 25-Hz CUE signal picked up by the CUE play head passes through an equalizer amplifier and a preamplifier and comes into a 25-Hz bandpass filter via coupling capacitor C420.

b. The bandpass filter eliminates noise components. Then diodes D408 and D409 full-wave rectify the 25-Hz signal.

c. The rectified output is applied to the base of Q407, thereby turning it on.

d. As Q407 is on, base current flows through Q408, thereby turning it on. As a result, the H-level CUE signal develops at the collector of Q408. The H-level output falls to L-level in one second because the input CUE signal lasts only for a second.

e. The CUE output signal of Q408 is also applied to the base if switching transistor Q409 for remote CUE signal, thereby turning it on.

3-17. AUTO-PRESENT OPERATION

The Auto-Present system performs such operations as stopping the tape when the piece of music currently played back comes to the end or repeating playback all automatically. This system permits selection of one out of six modes with two switches.

1) CUE switch

* If this is set at STOP, the tape will automatically stop when a 25-Hz CUE mark recorded on the CUE signal track of tape during record mode has been encountered.
* If it is set at OFF, the tape does not stop even when a CUE mark has been detected.
* If the REW position is selected, the tape will stop for a moment when a CUE mark has been found, then it will be rewound from the marked position all automatically. It is the REW switch described next that determines the mode in which the deck will operate after the tape has been rewound in the step described above.

2) REW switch

* COUNTER STOP: Stops the tape just when the counter reads zero.
* COUNTER PLAY: Causes tape travel to halt when the counter reads zero, then resumes playback.

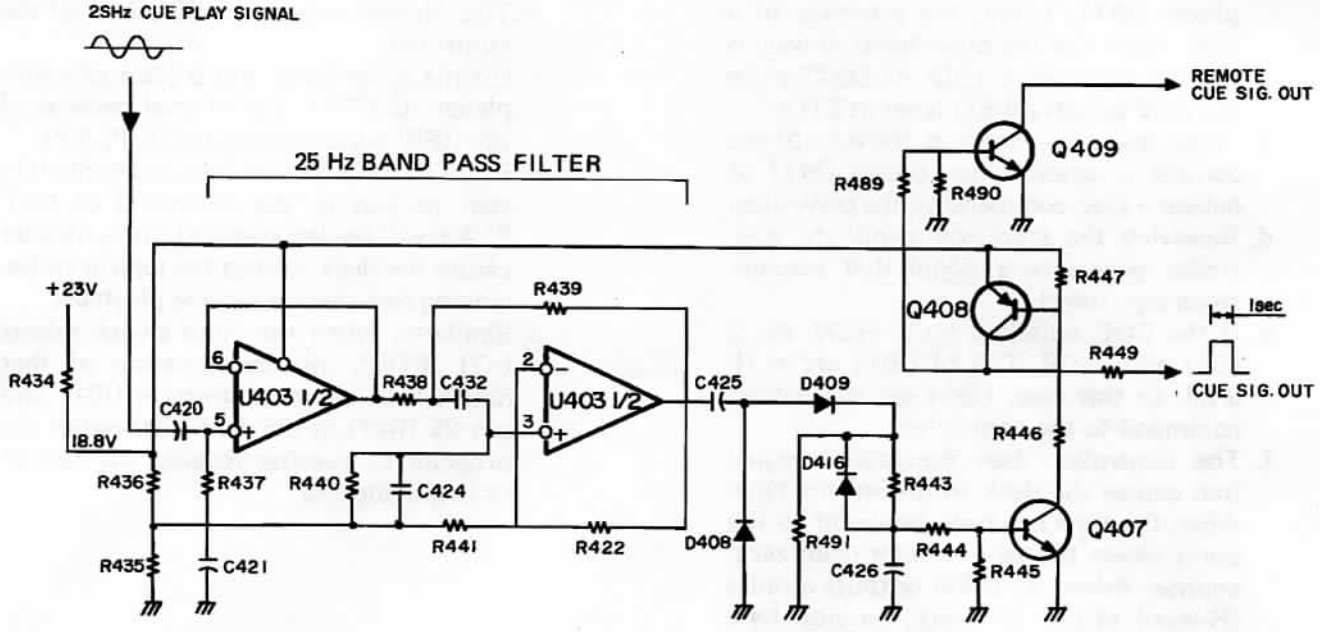


Fig. 3-29. 25-Hz CUE signal reproducing circuit

* BOT STOP: Stops the tape when it has been rewound to the beginning of tape (BOT).
* BOT PLAY: Causes tape travel to halt when the tape has been rewound to BOT, then resumes playback.

By using these functions, you may, for example, playback that portion of a tape which is bounded by a CUE mark and the point where the tape counter reads zero as many times as desired automatically. For this purpose, set the CUE switch at REW and the REW switch at COUNTER PLAY. If you set the REW switch at BOT PLAY, that portion of the tape which begins at the beginning end and ends at the point marked with a CUE signal may be automatically played back repeatedly.

These functions are described below.

A. We assume that we are going to playback a tape which contains pieces of recording, named A, B, and C respectively; a CUE mark is recorded at the end of piece B; and counter is set in such a manner that it reads zero at the beginning of piece B.

B. When the CUE switch is set at STOP:
   a. When the CUE play head picks up a 25-Hz CUE mark at the end of piece B, the CUE signal reproducing circuit amplifies and rectifies the signal into a positive pulse (CUE SIG OUT) of 1 second wide.
   b. The pulse enters pin 9 (D7) of multiplexer U911, telling the presence of a CUE mark. On the other hand, H-level is coming into pin 1 (D0) of U911 since the CUE switch (S991) is set at STOP.
   c. These two signal serve as the data of the control program which causes U911 to deliver a stop command to the controller.
   d. Receiving the stop command, the controller generates a signal that actually stops tape travel.
   e. If the CUE switch is set at REW, pin 2 (D1) and pin 9 (D7) of U911 are at H-level. In this case, U911 sends a rewind command to the controller.
   f. The controller then generates a signal that causes the deck to rewind the tape. When the tape has been rewound to the point where the tape counter reads zero, counter driver IC U406 outputs a pulse (H-level) at pin 17 (OUT) to stop tape travel (refer to the description of the tape counter circuit).
   g. The pulse enters pin 22 (AI) of the controller.
   h. On the other hand, if the AUTO PRESENT (REW) switch is set at COUNTER PLAY, H-level comes to pin 5 (D4) of multiplexer IC U911.
   i. The two signals — one entering pin 22 and the other pin 5 — causes the controller to generate a signal that commands the deck to stop rewinding tape at the counter's zero point, then a signal that commands resumption of playback. Thus playing back will be repeated.
   j. If the REW switch is set at COUNTER STOP, pin 4 (D3) of U911 is at H-level. In this case, the controller will receive a stop command and the tape stop at the counter's zero point.
   k. If the REW switch is set at BOT PLAY, the Counter Zero signal which the counter generates at its zero point during rewinding and enter pin 22 (AI) of the controller will be disregarded and rewinding continued because the REW switch is set at neither COUNTER PLAY nor COUNTER STOP.
   l. When the tape has been rewound to its beginning end, the outputs of the photocouplers (refer to the description of the tape counter circuit) disappear and a NAND gate of the counter circuit outputs an H-level signal.
   m. This H-level enters pin 25 (INT) of the controller.
   n. On the other hand, pin 6 (D5) of multiplexer IC U911 is at H-level because of the REW switch setting (BOT PLAY).
   o. From the two H-level signals described in step m and n, the command of BOT PLAY will be decoded and the controller causes the deck to stop the tape at its beginning end then to resume playback.
   p. Similarly, when the REW switch selects BOT STOP, the combination of that data which enter multiplexer U911 and pin 25 (INT) of the controller causes the program to execute to stop the tape at its beginning end.

4. ESSENTIAL MAINTENANCE EQUIPMENT/MATERIAL

Spring scale:	For pinch roller pressure check, 0 to 1 kg (2.2 lbs)
Cassette torque meter:	For torque check, 0 to 100 g-cm (0 to 1.4 oz-inch), 0 to 160 g-cm (0 to 2.2 oz-inch)
Wow & flutter meter:	Meguro Dempa Sokki Model MK-668B or equivalent
Audio oscillator:	Hewlett Packard Model 204C or equivalent
Frequency counter:	Range: 0 to 1 MHz, Sensitivity: 0.1 V RMS, Impedance: More than 1 MΩ, less than 25 pF
Level meter:	Range: –80 to +40 dB Impedance: More than 1 MΩ, less than 25 pF
Band pass filter:	1 kHz narrow band pass type
Distortion meter:	Basic frequency 400 Hz, 1 kHz
Oscilloscope:	Ordinary type
Attenuator:	Ordinary type
Test load resistor:	Noninductive type 8 ohm/1 W
Head demagnetizer:	TEAC E-3
Bulk tape eraser:	TEAC E-2A or equivalent
Cleaner:	TEAC recorder cleaner kit or pure alcohol
Oil:	TEAC oil kit or equivalent
Test tapes:	
TEAC MTT-111, MXT-111:	Wow & flutter or tape speed test tape, 3000 Hz/–10 dB
TEAC MTT-150A:	Dolby level calibration test tape, Dolby B-type tone (400 Hz), 200 nWb/m
TEAC MTT-357L:	Head azimuth/frequency characteristic test tape for EQ Co (CrO_2), 3180 μs + 70 μs
TEAC MTT-5061 or equivalent:	Blank test tape for BIAS/EQ Co (CrO_2) (high-bias tape)

5. CHECK AND ADJUSTMENT OF THE MECHANISM

5-1. HEAD BASE PLATE POSITIONING

1) Set the deck in the PLAY mode.
2) Push the head base plate by hand in the direction of the arrow and check that the head base plate and the stopper portion of the mechanism chassis make contact.
3) If there is any clearance, loosen the two screws on the head base plate solenoid and reposition the solenoid until the clearance is eliminated.

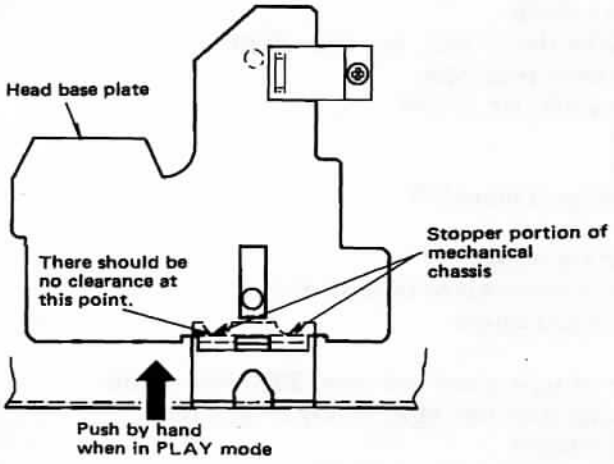


Fig. 5-1.

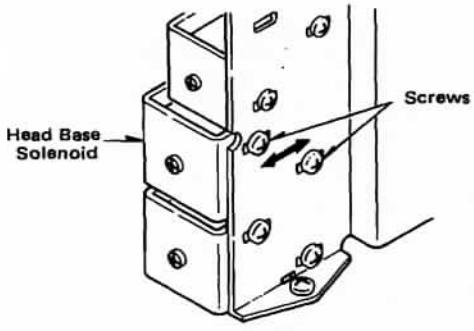


Fig. 5-2. Head base solenoid location

5-2. MICROSWITCH (A) ASSEMBLY CLEARANCE

1) Insert a blank cassette and close the cassette holder.
2) Loosen the two screws on the microswitch (A).
3) Move the switch so that actuator of the switch contacts the safety lever.
4) Adjust the switch position to obtain a clearance of between 0.1 mm to 0.3 mm.
5) Retighten the screws.

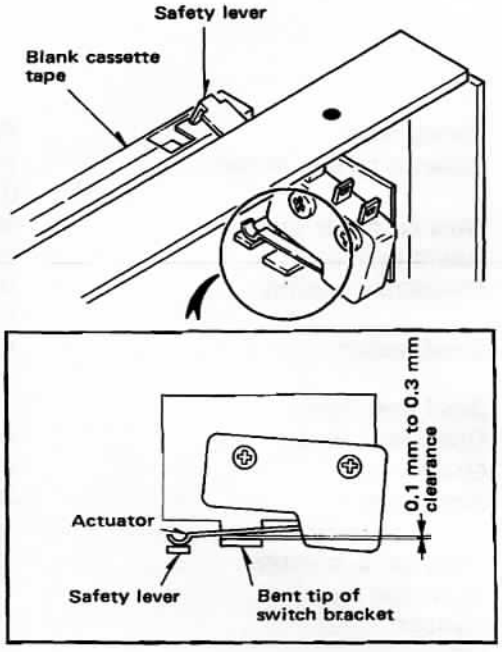


Fig. 5-3

5-3. MICROSWITCH (B) ASSEMBLY CLEARANCE

1) Push the EJECT button to open the cassette holder.
2) Loosen the two screws on the microswitch (B).
3) Move the switch so that switch actuator contacts the bent projecting portion of the eject lever.
4) Adjust the switch position to obtain a clearance of approximately 1 mm.
5) Retighten the screws.

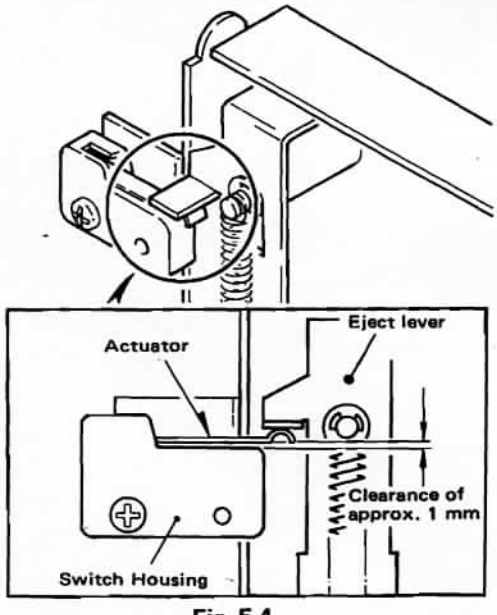


Fig. 5-4

5-4. CAPSTAN ASSEMBLY THRUST

1) Turn the thrust adjusting screw so that thrust of the capstan shaft is within 0.05 mm to 0.15 mm.

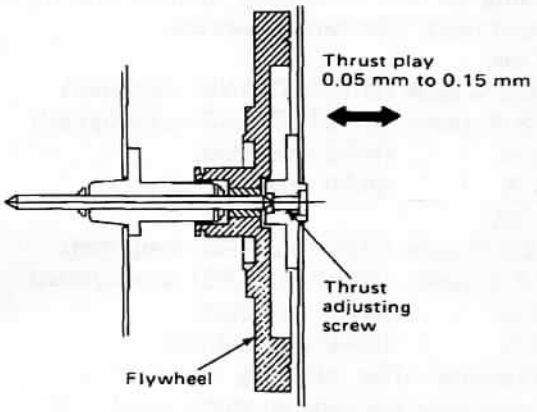


Fig. 5-5

5-5. TAKEUP TORQUE

Takeup torque adjustment is critical to stabilize tape travel and reduce variations in tape speed.

1) Load a cassette torque meter (0 to 100 g-cm, 1.4 oz-inch) in the cassette holder.
2) Measure the torque by running the tape of the meter in the reproduce mode. The meter reading should be 45 –65 g-cm (0.6–0.9 oz-inch).
3) If the reading is outside this range, clean the surface of the idler pulley in the reel table assembly which comes into contact with the tape using cleaning liquid. Also check the operation of the moving parts of the reel table assembly.
4) If the reading is still unsatisfactory, replace the reel table ass'y.

5-6. FAST FORWARD AND REWIND TORQUE

1) Load a cassette torque meter (0 to 160 g-cm, 22 oz-inch).
2) With the deck in the fast forward and rewind modes, read the meter. If the meter is provided with tape, note the readings with the tape fully wound on the reel taking up the tape in each mode so that the measurement is not influenced by the tape's inertia. The fast forward torque must be in the range 90 – 160 g-cm (1.3 – 2.2 oz-inch) and the rewind torque must be in the range 90 – 160 g-cm (1.3 – 2.2 oz-inch).
3) If the readings are outside these ranges, clean the surface of the idler pulley with cleaning liquid and check the operation of the moving parts of the reel table ass'y.

5-7. PINCH ROLLER PRESSURE

Pinch roller pressure must also be adjusted to the correct value to stabilize tape travel and reduce variation in tape speed.

1) Remove the cassette door cover to install the spring scale.
2) With the deck in the reproduce mode, attach the scale near the shaft of the pinch roller, being careful not to touch the pinch roller. See Fig. 5-6.
3) Move the scale gradually in the direction of the arrow until the capstan shaft and pinch roller are completely separated.
4) Gradually return the pinch roller and note the reading on the scale when the pinch roller touches the capstan and starts rotating. The reading should be between 390 and 490 g (13.8 and 17.3 oz).
5) If the reading is outside this range, replace the pinch roller pressure spring or adjust the pressure by bending the spring as shown in Fig. 5-6.

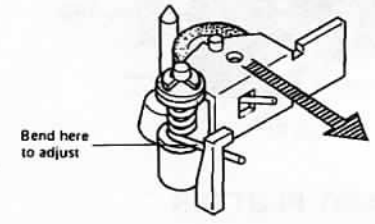


Fig. 5-6

5-8. TAPE SPEED

To check tape speed, use test tapes MTT-111 (1-7/8 ips) and MXT-111 (3-3/4 ips) on which a 3-kHz signal is recorded with high accuracy or their equivalents.

1) Connect a frequency counter to the OUTPUT terminals as shown in Fig. 5-8.
2) Play the test tape from the start of the tape and check that the frequency counter reading is within 3 kHz ±0.5 %
3) If the reading is outside this range, clean the tape path and check the pinch roller pressure and takeup tension.
4) If these values are correct, adjust the resistor of the motor so that the reading is within the range 3000 Hz ±5 Hz.

NOTE: Adjust tape speed after the tape has run for about 30 sec in the reproduce mode.

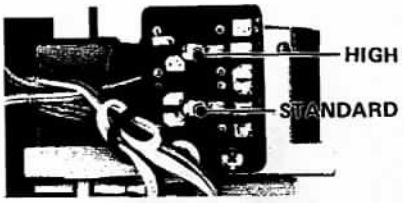


Fig. 5-7

5-9. WOW AND FLUTTER

Before measuring wow and flutter, the following points should be read carefully. It is necessary to decide which of the two measurement methods should be used.

1) **Reproduce method:** Measure while playing wow & flutter test tape MTT-111, MXT-111 or its equivalent.
   Record/reproduce method: Record a 3-kHz signal on blank tape, rewind the tape and reproduce the recorded signal.

NOTE: When measuring using the record/reproduce method, the recorded section should be reproduced repeatedly to obtain the mean value. Be careful not to read the meter for those parts of the tape in which wow & flutter components in recording and reproducing cancel each other.

2) Set the flutter meter controls to the required standard. Select the DIN/IEC/ANSI peak value or the NAB RMS value, then set the weighting control as required.
3) Measure at the beginning and the end of the tape. The measured value will differ slightly according to the measuring method and instrument used. Standard values are:

1-7/8 ips:
- ±0.085 % peak (DIN/IEC/ANSI weighted)
- ±0.18 % peak (DIN/IEC/ANSI unweighted)
- 0.06 % (NAB weighted)
- 0.11 % (NAB unweighted)

3-3/4 ips:
- ±0.055 % peak (DIN/IEC/ANSI weighted)
- ±0.13 % peak (DIN/IEC/ANSI unweighted)
- 0.04 % (NAB weighted)
- 0.07 % (NAB unweighted)

NOTE: Measure after cleaning the tape path, especially the capstan shaft, pinch roller and head surfaces.

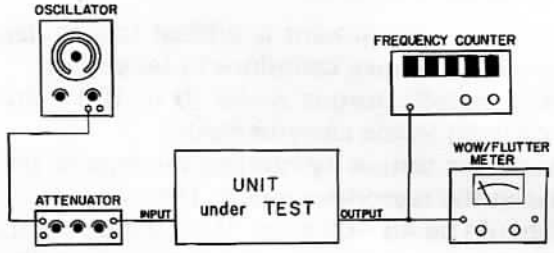
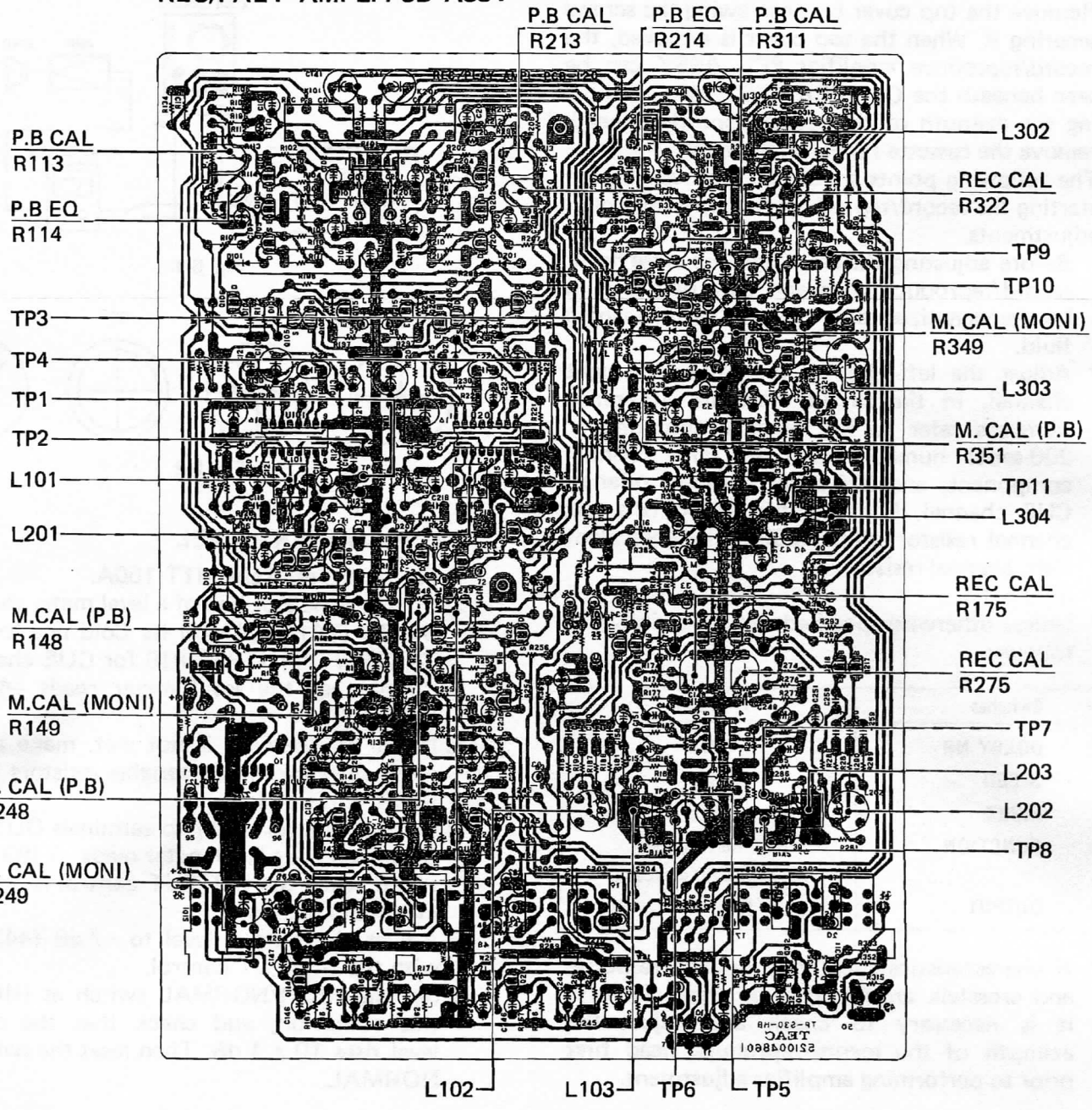


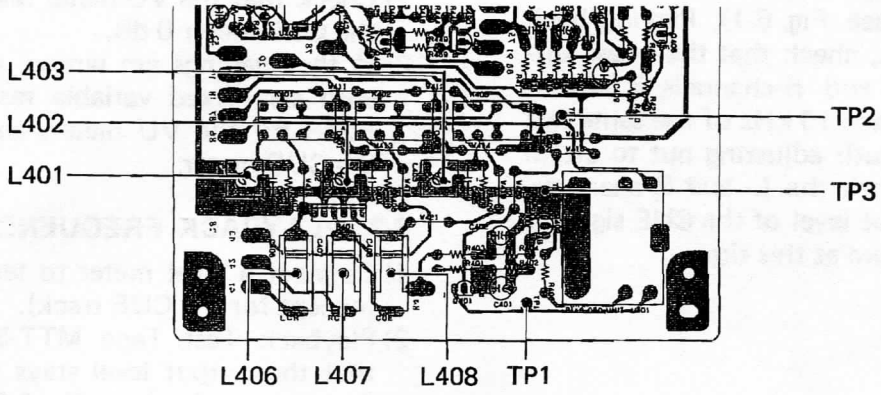
Fig. 5-8

6. CHECK AND ADJUSTMENT OF THE RECORD/PLAY AMPLIFIER

REC/PALY AMPL. PCB ASSY



OSC PCB 107 ASSY



Remove the top cover by unscrewing the screws securing it. When the top cover is removed, the record/reproduce amplifier PCB ASSY can be seen beneath the OSC PCB ASSY. When adjusting the azimuth of the record/reproduce head, remove the cassette holder door cover.
The following points should be observed before starting the record/reproduce amplifier checks or adjustments.

* Before adjusting the amplifier, the erase head, record/reproduce head and tape path should be demagnetized and cleaned with cleaning fluid.
* Adjust the left channel first, then the right channel. In the circuit diagrams, 100-series numbers refer to left channel components, 200-series numbers refer to right channel components and 300-series numbers refer to CUE channel. For example, R180 is a left channel resistor while R280 is the equivalent right channel resistor.
* 0 dB = 1 V
* Unless otherwise specified, set the switches as follows:

Switches	Positions
DOLBY NR	OUT
SPEED	STD
INPUT	LINE
FUNCTION	REC for recording, NORMAL for playback
OUTPUT	NORMAL

* If characteristics such as frequency response and crosstalk are found to be unsatisfactory, it is necessary to check and adjust the azimuth of the record/reproduce head first prior to performing amplifier adjustment.

Check and adjustment of the record/reproduce head

Connect an oscilloscope and an AC voltmeter to terminal OUTPUT (see Fig. 6-1). Playing back Test Tape MTT-357L, check that the phase difference between L- and R-channels is within 90°. Next, playing back 10 kHz of the same test tape, move the azimuth adjusting nut to attain maximum level in both the L- and R-channels. Check that the output level of the CUE signal is also nearly at maximum at this time.

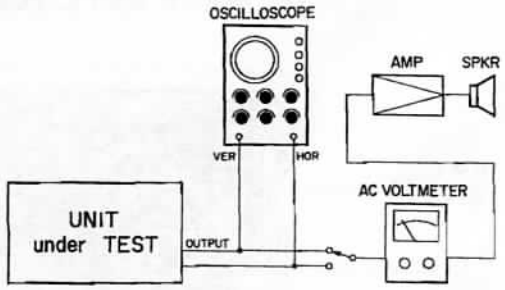


Fig. 6-1

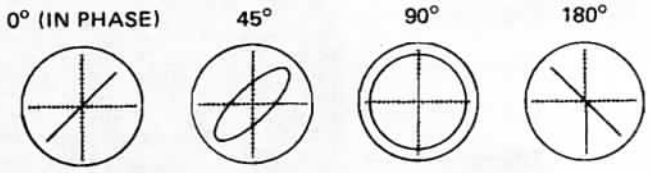


Fig. 6-2

6-1. PLAYBACK LEVEL

1) Playback Test Tape MTT-150A.
2) Connect the Hot line of a level meter to DOLBY TP (TP1/TP3) and its Cold line to GND TP (TP2/TP4) (TP9/TP10 for CUE channel). Check that the level meter reads –4.7 dB (580 mV).
3) If the requirement is not met, make adjustment with semi-fixed variable resistors R113, R213, and R311.
4) Connect a level meter to terminals OUTPUT. Check that the level meter reads -1 (891 mV) ±1 dB when the OUTPUT control is set at its maximum position.
5) Adjust the output level to -7 dB (447 mV) with the OUTPUT control.
6) Set the HIGH/NORMAL switch at HIGH in this condition, and check that the output level rises 10 ± 1 dB. Then reset the switch at NORMAL.

6-2. VU METER READING

1) Playback Test Tape MTT-150A.
2) Check that the VU meter reads +3 ±1 VU and the CUE meter 0 dB.
3) If the readings are wrong, make adjustment with semi-fixed variable resistors R148 and R248 for the VU meters and with R349 for the CUE meter.

6-3. PLAYBACK FREQUENCY RESPONSE

1) Connect a level meter to terminals OUTPUT (except for the CUE track).
2) Playback Test Tape MTT-357L and check that the output level stays within the specified boundaries (see Fig. 6-3) over the entire

frequency range.

3) If the requirement is not met, move semi-fixed variable resistors R114 and R214 to attain the same level at 315 Hz and 6.3 kHz. If the frequency response is still wrong, check the head, tape travel, etc. and adjust head azimuth again.

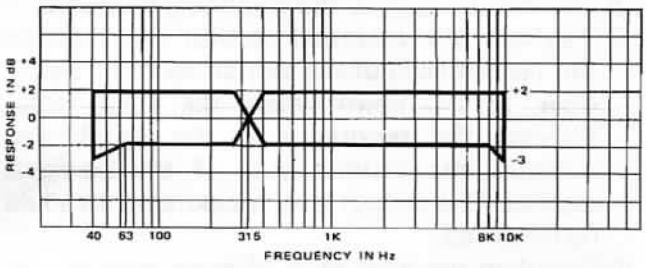


Fig. 6-3. Playback frequency response

6-4. BIAS DUMMY COIL ADJUSTMENT

1) Connect a frequency counter to test point TP2 at bias oscillator U401.
2) Load the deck with a blank test tape. Set all FUNCTION REC/MORMAL switches at REC and select REC/PAUSE mode with operating buttons.
3) Check bias frequency (fo).

NOTE: The fo is a bias frequency value determined when all the FUNCTION switches of every channels (L, R, and CUE) are set at REC, with the dummy coil in a non-operating state.

4) Resetting L-channel (S103) alone to NORMAL, adjust L401 until the bias frequency becomes fo.
5) Resetting R-channel (S203) alone to NORMAL, adjust L402 until the bias frequency becomes fo.
6) Resetting CUE channel (S303) alone to NORMAL, adjust L403 until the bias frequency becomes fo.
7) Check that the bias frequency stays within ±500 Hz of fo at any combination of settings of the REC/NORMAL switches (S103, S203, and S303).

6-5. BIAS FILTER ADJUSTMENT

1) Connect a level meter to terminals OUTPUT (L/R/CUE).
2) Load the deck with a blank test tape. Set all REC/NORMAL switches at REC and select REC/PAUSE mode with operating buttons.
3) Adjust L101, L201, L302, L501, and L502 to minimize the level of the bias signal leaking out to the output terminals.

NOTE: INPUT control should be set at MIN.

6-6. MONITOR METER ADJUSTMENT

1) Connect a level meter to terminals OUTPUT (L/R/CUE).
2) Load the deck with a blank test tape. Set all channels in REC/PAUSE mode. Apply 400 Hz, -10 dB (0.3 V) to terminals LINE.
3) Connect a level meter to terminal DOLBY TP1, 3 (TP9 for the CUE channel) and adjust the INPUT control (R11/R21/R31) of each channel so that the level becomes -4.7 dB (580 mV).
4) Adjust the OUTPUT control of each channel so that the output level becomes -7 dB (447 mV).
5) Adjust semi-fixed variable resistor R149/R249 so that the meter of the L/R-channel read +3 VU, and semi-fixed variable resistor R351 so that the CUE meter reads 0 dB.

6-7. BIAS TRAP ADJUSTMENT

1) Load the deck with a blank test tape. Set all REC/NORMAL switches at REC. Select REC/PAUSE mode with operating buttons.
2) Connect a level meter to test point TP5/TP7/TP11 of each bias trap, adjust L103/L203/L304 so that the meter reading becomes minimum.

6-8. BIAS ADJUSTMENT

Make the following preparation for adjusting bias.

a. Connect measuring instruments as shown in Figure 6-4.
b. Load the deck with Test Tape MTT5061 and put it in REC/PAUSE mode.
c. Set the REC/NORMAL switch of every channel at REC.
d. Apply 400 Hz, - 10 dB (0.3 V) to input terminals L, R, and CUE.
e. Set the OUTPUT control of every channel at its maximum position.
f. Turn the INPUT control of each channel so that its output level becomes - 1 dB (891 mV). At this-point, the Dolby level setting has been reached.
g. Turn the OUTPUT control of each channel so that its output level becomes - 7 dB (447 mV). Now preparation is complete. Make adjustment by the following procedures.
   1) Reduce the input level by 33 dB (into -43 dB, 7 mV), and record and reproduce 400 Hz and 10 kHz alternately.
   2) Check that the signal level at terminals OUTPUT remains almost unchanged at

both frequencies.

3) If the output level varies, adjust C406, C407, and C408. Then repeat the above steps until an optimum condition is met.

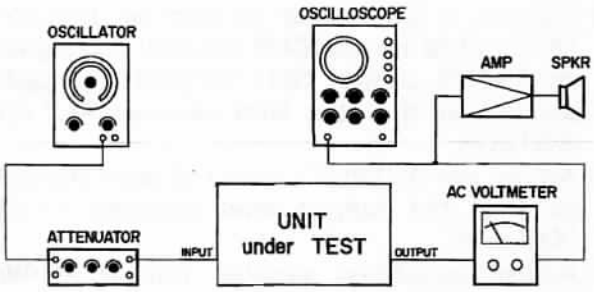


Fig. 6-4

6-9. RECORDING LEVEL

Perform steps a–g described in Section 6-8. (This condition is Dolby level).

1) Set the attenuator at -13 dB (224 mV) which is 3 dB below the input level of - 10 dB (0.3 V).
2) Record 400 Hz on a blank test tape (MTT-5061). Playing it back, adjust semi-fixed variable resistors R175/R275, and R322 so that the output level becomes - 10 dB (0.3 V).

6-10. OVERALL FREQUENCY RESPONSE

Set up the tape deck through the steps of a through g described in Section 6-8, Bias adjustment.

1) Reduce the input level to -43 dB (7 mV). Record input signals of varying frequencies on the blank test tape MTT-5061. Reproducing the signals, check if the requirements given in the table of Figure 6-5 are met. Carry out the same check at High tape speed.
   If the overall frequency response is poor, check the record/reproduce head if it is clean and not defective. Check the bias level, too.

NOTE: Keep the NR SYSTEM switch at OUT.

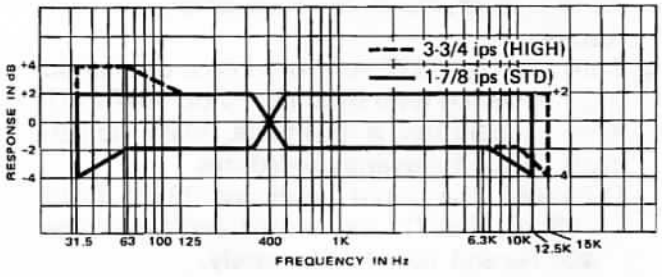


Fig. 6-5. Record/playback frequency response

6-11. OVERALL S/N

Set up the tape deck through the steps of a through g described in Section 6-8, Bias adjustment.

1) Record 400 Hz, -10 dB (DOLBY level setting) on a blank tape. Then cut off input signal and record null signal.
2) Rewind the tape to the beginning of record.
3) Playback the recorded section and measure the output level of the section with the signal, then, at the point where the signal stops, increase the sensitivity of the VTVM and measure the output level of the no-signal section. The output level measurement should be weighted.
4) Calculate the level ratio of noise with respect to the recorded signal and confirm that they are identical to the values shown in the table below.

If the values are unsatisfactory, proceed as follows:

* Demagnetize and clean the erase and record/reproduce heads.
* Check that erasing is being done effectively.
* Check and adjust reproduce and record/reproduce frequency response.
* Check and adjust the bias trap.
* Replace the tape.

SPEED / TRACK	STANDARD	HIGH
L & R	More than 49 dB	More than 49 dB
CUE	More than 43 dB	More than 43 dB

6-12. OVERALL DISTORTION

1) Connect measuring instruments as shown in Figure 6-6.
2) Set up the tape deck through the steps of a through g described in Section 6-8, Bias adjustment.

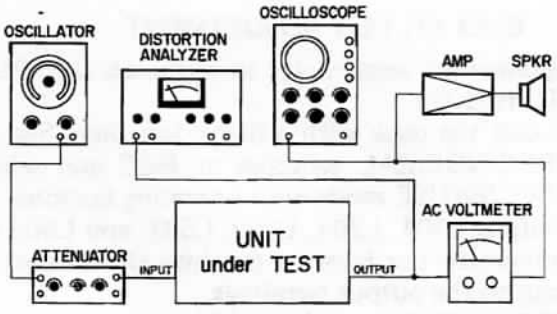


Fig. 6-6

3) Reduce the input level by 3 dB and record 400 Hz, -13 dB (224 mV). Then reproduce it and check distortion of the output signal at terminals OUTPUT.
4) Distortion should not exceed 1.5 % at the audio channels (L and R) and 2.0 % at the CUE channel. Use the MTT-5061 tape for this measurement.
If the requirements are not met, check the bias level, then S/N and overall frequency, too.

6-13. ERASING EFFECT

1) Connect measuring instruments as shown in Figure 6-7. Use a 1 kHz bandpass filter to check erasing effect.
2) Set up the tape deck through the steps of a through g described in Section 6-8, Bias adjustment.
3) Raising the input level by 10 dB, record 1 kHz (saturation level)/0 dB (1 V) on Test Tape MTT-5061
Reducing the level meter's sensitivity by about 10 dB, playback the tape and measure the level at terminals OUTPUT.
4) Rewind the tape to the start of the recording. Erase the recorded section with no input signal.
5) Playback the erased section and measure the output level, increasing the sensitivity of the VTVM.
6) Calculate the ratio of the signal output level to the output level obtained by playing the erased tape.
7) The value should be more than 65 dB for any of the tapes to be used.
If the erase effect is unsatisfactory, check whether the erase head is clean and the tape is running correctly.

NOTE: When checking erasure, make sure the blank tape used has been erased by a bulk eraser before using it. Correctly tune the frequency of the signal to be recorded to match the bandpass filter and compensate for measuring instrument loss.

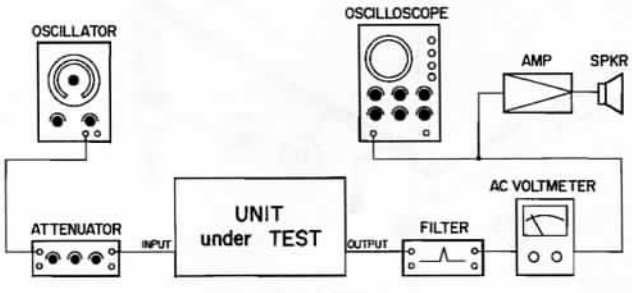


Fig. 6-7

6-14. CHANNEL SEPARATION

1) Connect measuring instruments as shown in Figure 6-7 (connect a level meter alone to the R-channel and, only for the L-channel, a 1-kHz bandpass filter between terminals OUTPUT and the level meter).
2) Set up the tape deck through the steps of a through g described in Section 6-8.
3) Make a stereo recording applying the input signal only to the left channel and no signal to the right channel.
4) Rewind the tape to the start of the recording and play it.
Measure the output levels of both channels. (The right channel will contain the recorded signal and the left channel will contain components which have leaked from the right channel.).
5) Calculate the difference in level between the two channels. This value should be more than 45 dB.

6-15. DOLBY NOISE REDUCTION EFFECT

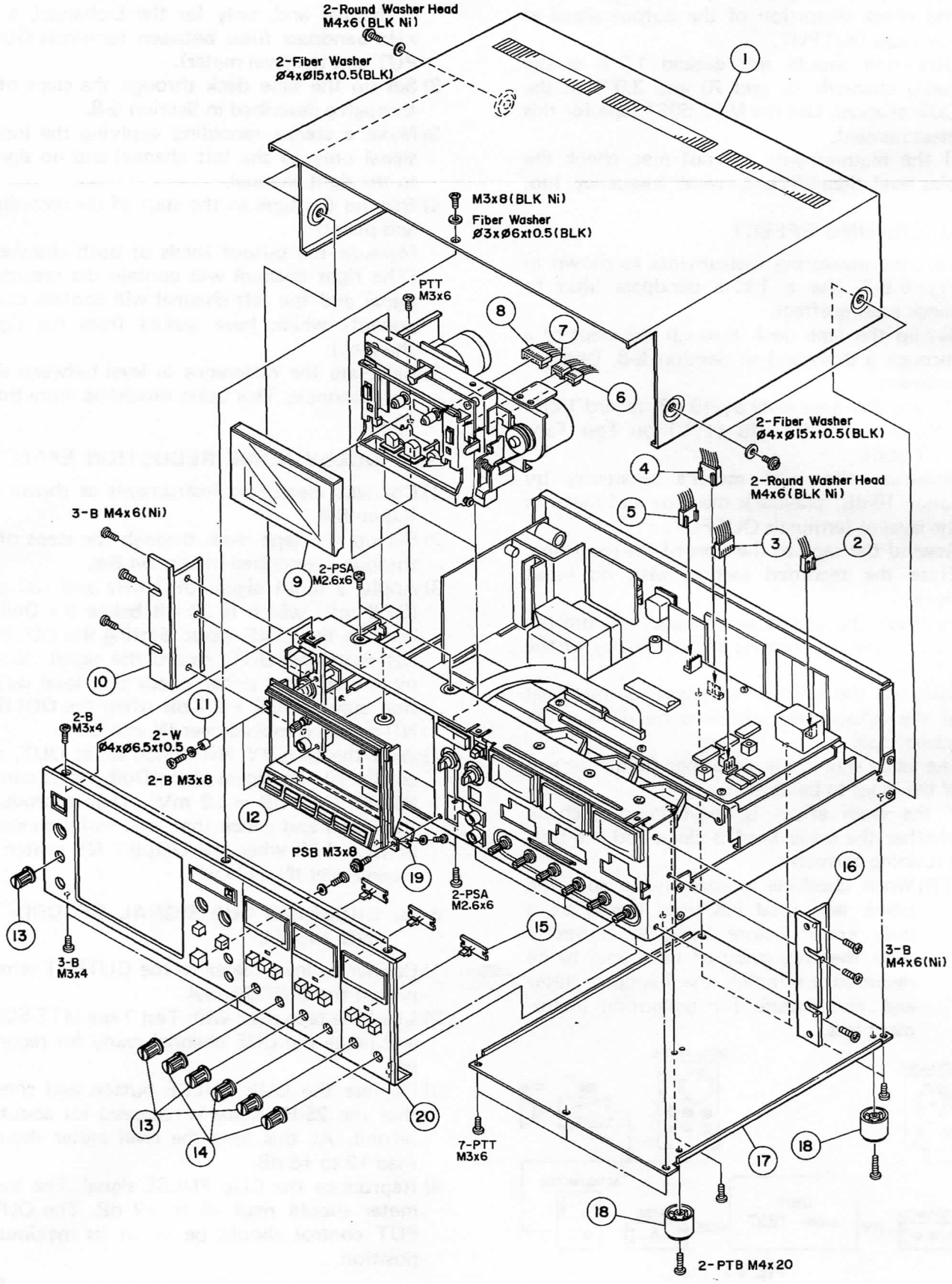
1) Connect measuring instruments as shown in Figure 6-4.
2) Set up the tape deck through the steps of a through g described in Section 6-8.
3) Apply a input signal of 1 kHz and -30 dB (31.6 mV) which is 20 dB below the Dolby level to the LINE input. Setting the DOLBY NR switch at OUT, record the signal. Next, reproducing the signal, check that level variation stays in 5.5 ± 2.2 dB when the DOLBY NR switch is moved over IN and OUT.
4) With the DOLBY NR switch set at OUT, record a 10 kHz signal of the Dolby level minus 30 dB (-40 dB = 10 mV). Then reproduce the signal and check that level variation stays in 10 ± 2 dB when the DOLBY NR switch is moved over IN and OUT.

6-16. CHECKING CUE SIGNAL RECORDING LEVEL

1) Connect a level meter to the OUTPUT terminals of the CUE channel.
2) Load the tape deck with Test Tape MTT-5061 and make the CUE channel ready for recording.
3) Depress the CUE PULSE button and check that the 25 Hz signal is recorded for about a second. At this time the level meter should read +2 to +6 dB.
4) Reproduce the CUE PULSE signal. The level meter should read -6 to +2 dB. The OUTPUT control should be set at its maximum position.

7. EXPLODED VIEWS AND PARTS LISTS

EXPLODED VIEW-1



Parts marked with * require longer delivery time.

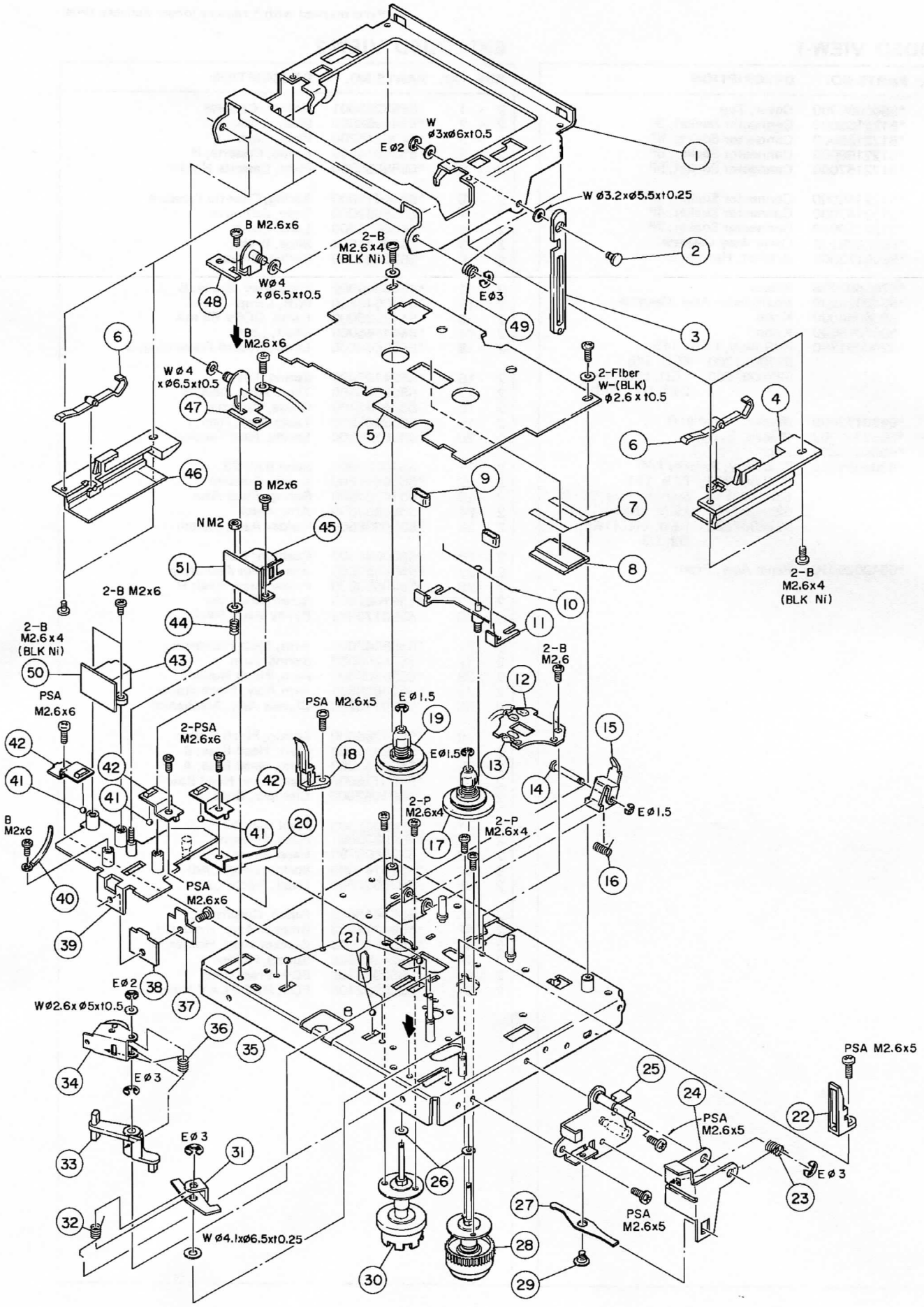
EXPLODED VIEW-1

REF. NO.	PARTS NO.	DESCRIPTION
1 - 1	*5800060300	Cover, Top
1 - 2	*5122165000	Connector Socket, 3P
1 - 3	*5122168000	Connector Socket, 6P
1 - 4	*5122168000	Connector Socket, 6P
1 - 5	*5122167000	Connector Socket, 5P
1 - 6	*5122148000	Connector Socket, 5P
1 - 7	*5122147000	Connector Socket, 4P
1 - 8	*5122150000	Connector Socket, 7P
1 - 9	*5640025100	Cover Assy Cassette
1 - 10	*5800173300	Bracket, Handle; L
1 - 11	*5785603025	Spacer
1 - 12	*5640024900	Escutcheon Assy, Cassette
1 - 13	6006054000	Knob
1 - 14	6006055000	Knob
1 - 15	*5200051700	PCB Assy, LED; 145
	5210051700	PCB, 145
	5225007800	LED, LN217RP, D11, D21, D31
1 - 16	*5800173400	Bracket, Handle; R
1 - 17	*5552340202	Chassis, Button
1 - 18	*5504676000	Foot
1 - 19	*5200051300	PCB Assy, Switch; 174
	5210051300	PCB, 174
	5302100700	Switch, Tact, S1~S6
	5225007700	LED, LN311GP, D1
	5225007600	LED, LN211RP, D2, D3
1 - 20	*5640025010	Panel Assy, Front

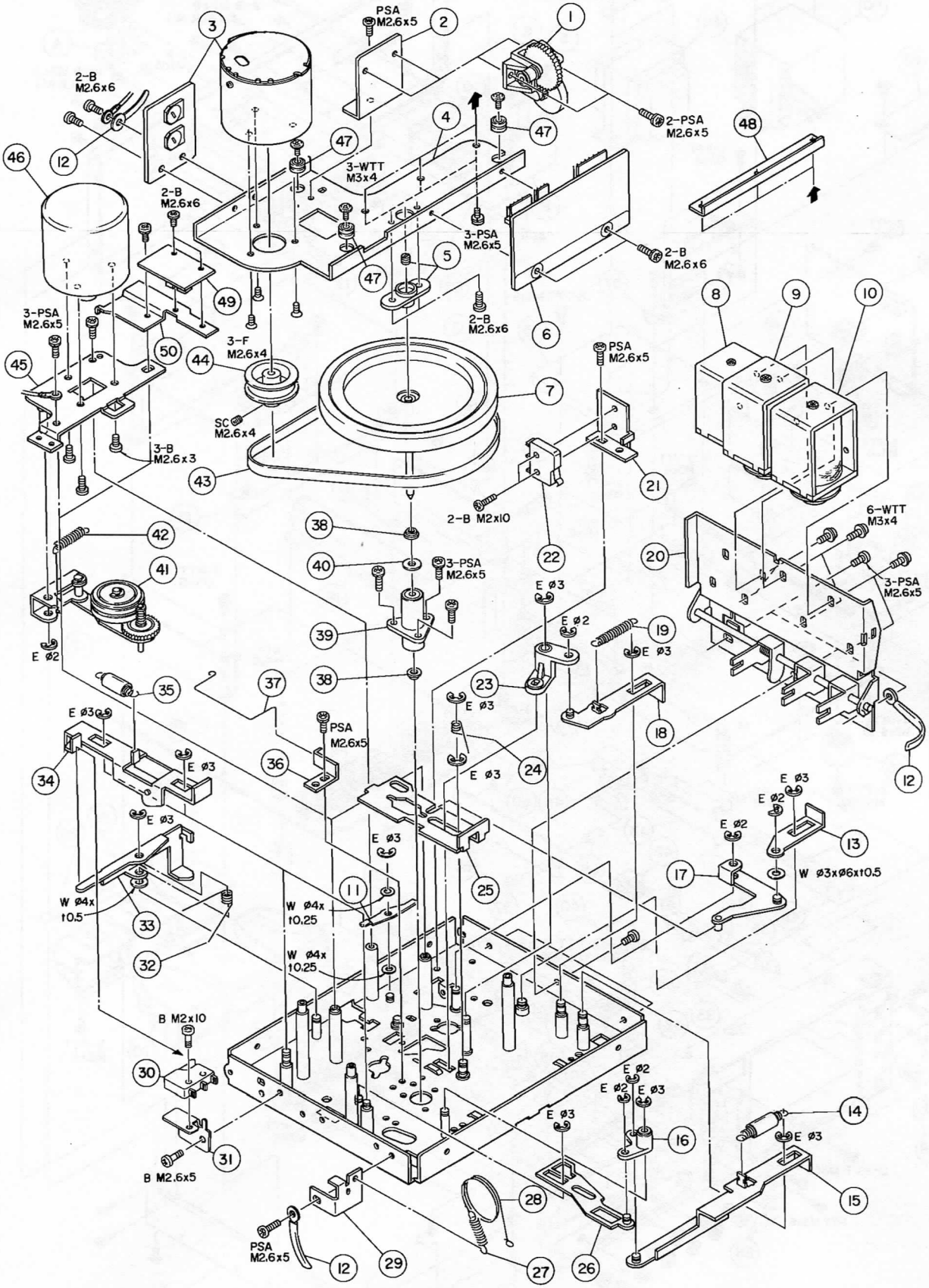
EXPLODED VIEW-2

REF. NO.	PARTS NO.	DESCRIPTION
2 - 1	*5553285001	Holder, Cassette
2 - 2	*5544958000	Shalt, Lock
2 - 3	*5800245200	Plate, Lock
2 - 4	5534614000	Guide, Cassette; R
2 - 5	*5555655000	Plate, Cassette Holder
2 - 6	*5534615000	Spring, Cassette Pressure
2 - 7	*5555582000	Tape, Adhesive
2 - 8	*5534638000	Lens, Lamp
2 - 9	*5534844000	Shoe, Brake
2 - 10	*5520333000	Spring, Brake
2 - 11	*5504669002	Plate Assy, Brake; B
2 - 12	*5210043800	PCB, Lamp
2 - 13	5142026000	Lamp, DC6V 65 mA
2 - 14	*5544656000	Shaft, Lever
2 - 15	*5555544000	Lever, Record Preventing; D
2 - 16	*5524197000	Spring, Lever
2 - 17	5800063300	Table Assy, Reel; R
2 - 18	5534683100	Guide, Cassette; L
2 - 19	5800063200	Table Assy, Reel; L
2 - 20	*5800216600	Spring, Reel Tension
2 - 21	5540056000	Steel Ball, ϕ3
2 - 22	*5534444200	Guide, Cassette
2 - 23	*5524201000	Spring, Eject Arm
2 - 24	*5555551000	Arm, Eject
2 - 25	*5800090600	Holder Assy, Switch
2 - 26	*5800098500	Cushion; Reel
2 - 27	*5555552000	Arm, Eject Actuating
2 - 28	5800063800	Pulley Assy, Reel; R
2 - 29	*5581055000	Screw, Shoulder
2 - 30	5800175801	Pulley Assy, Reel; L
2 - 31	*5555549000	Arm, Eject Preventing
2 - 32	*5524200000	Spring, Arm
2 - 33	*5534606000	Arm, Pinch Roller
2 - 34	*5504828001	Arm Assy, Pinch Roller
2 - 35	*5800170200	Chassis Assy, Mechanism
2 - 36	*5524285000	Spring, Pinch Roller
2 - 37	*5555531000	Plate, Head Base; B
2 - 38	*5555530000	Plate, Head Base; A
2 - 39	*5800176000	Plate Assy, Head Base
2 - 40	*5581062000	Clamper, Cord; E
2 - 41	5540055000	Steel Ball, ϕ2
2 - 42	*5555533001	Plate, Pressure
2 - 43	5378600700	Head, Erase
2 - 44	*5524141000	Spring, Height Adj.
2 - 45	5378600600	Head, REC-PLAY
2 - 46	5534613000	Guide, Cassette; L
2 - 47	*5504714000	Bracket Assy, Holder; L
2 - 48	*5504715000	Bracket Assy, Holder; R
2 - 49	*5524202000	Spring, Holder
2 - 50	*6050591100	PCB, Erase Head
2 - 51	*6050592100	PCB, REC-PLAY Head

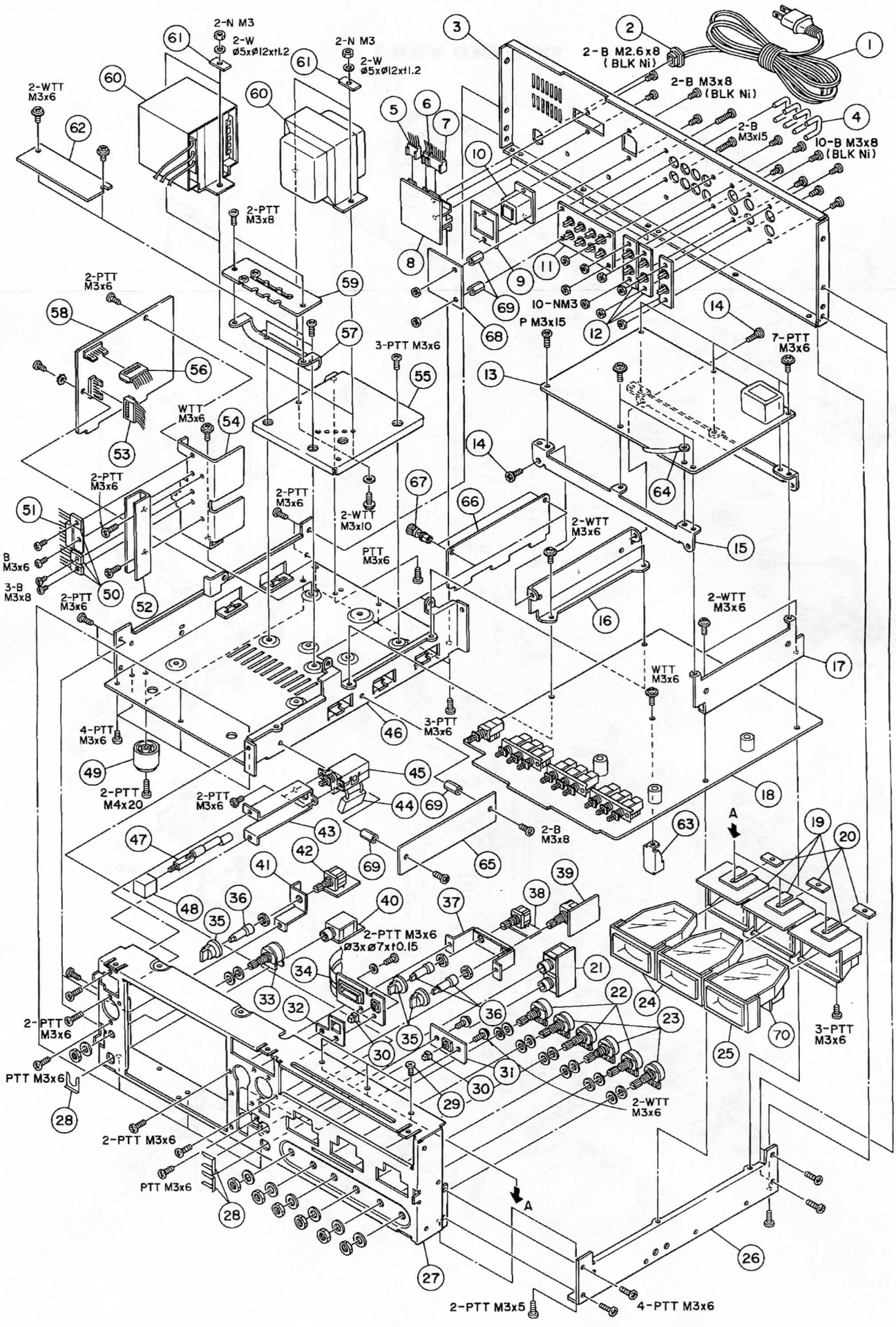
EXPLODED VIEW-2



EXPLODED VIEW-3



EXPLODED VIEW-4



EXPLODED VIEW-3

REF. NO.	PARTS NO.	DESCRIPTION
3 - 1	*5504673000	Holder Assy, Damper; C
- 2	*5555555000	Bracket, Damper
- 3	5370000600	Meter Assy, Capstan; DC
3 - 4	*5800064601	Plate, Flywheel Base
3 - 5	*5534277000	Bearing, Flywheel
3 - 6	*5200050200	PCB Assy, Joint, 123
3 - 7	5504757000	Flywheel Assy, Capstan
3 - 8	5163040000	Solenoid, B
3 - 9	5163039100	Solenoid, A
3 - 10	5313000500	Solenoid
3 - 11	*5555546000	Arm, Pressure; B
3 - 12	*5581038000	Clamper, Cord; A
3 - 13	*5800062600	Lever, Actuating
3 - 14	*5524195000	Spring, Lever
3 - 15	*5504666000	Lever Assy, Pause Actuating
3 - 16	*5534611000	Arm, Pause Actuating
3 - 17	*5800061900	Arm Assy, Actuating
3 - 18	*5504665000	Lever Assy, Actuating
3 - 19	*5524213000	Spring, Actuating; A
3 - 20	*5800065500	Bracket Assy, Solenoid; B
3 - 21	*5555543000	Bracket, Switch; A
3 - 22	5301455500	Switch, Micro
- 23	*5534610000	Arm, Base Actuating
3 - 24	*5800062700	Spring, Pulley Guide
3 - 25	*5800062900	Plate, Pulley Guide
3 - 26	*5504667000	Lever Assy, Pause
3 - 27	*5524203000	Spring, Damper
3 - 28	*5788202100	String, Damper
3 - 29	*5555556000	Angle, Spring
3 - 30	5301455500	Switch, Micro
3 - 31	*5800062300	Bracket, Switch
3 - 32	*5800062800	Spring, Cassette Pressuer
3 - 33	*5800061600	Arm, Cassette Pressuer
3 - 34	*5504670000	Lever Assy, Eject
3 - 35	*5524199000	Spring, Eject
3 - 36	*5800063000	Guide, Actuating Bar
3 - 37	*5800062500	Bar, Brake Actuating
3 - 38	*5534130000	Washer, Oil Retaining
3 - 39	*5504091000	Housing Assy, Capstan
3 - 40	*5550031000	Washer, Thrust
3 - 41	5504808000	Pulley Assy, Fast Wind
3 - 42	*5524274000	Spring, Arm
3 - 43	5800063100	Belt, Capstan Drive
3 - 44	5800062400	Pulley, Motor
3 - 45	*5504807001	Plate Assy, Motor
3 - 46	7105135000	Motor Assy, Reel; DC
3 - 47	*5534537000	Collar, Rubber
3 - 48	*5800102100	Angle, Base
3 - 49	*5200052000	PCB Assy, Sensor; 110
	5210052000	PCB, Sensor
	5228005500	Photo Interrupter GP-3501, PH1, PH2
3 - 50	*5800176600	Angle, PCB

EXPLODED VIEW-4

REF. NO.	PARTS NO.	DESCRIPTION
4 - 1	⚠ 5128034000	Cord, AC Power [GE] DM
	⚠ 5128075000	Cord, AC Power [U] UL
	⚠ 5128017000	Cord, AC Power [E] CEE
	⚠ 5128036000	Cord, AC Power [UK] BS
	⚠ 5350008300	Cord, AC Power [A] SAA
	⚠ 5128061000	Cord, AC Power [C]
4 - 2	*5534660000	Strain Relief, AC Power Cord [All except UK, C]
	*5534661000	Strain Relief, AC Power Cord [UK]
	5534663000	Strain Relief, AC Power Cord [C]
	5786700400	Rug, earth M3
4 - 3	*5800172700	Panel, Rear
4 - 4	*5330505000	Plug, 2P, Shorting
4 - 5	*5122147000	Connector Socket, 4P
4 - 6	*5122145000	Connector Socket, 2P
4 - 7	*5122150000	Connector Socket, 7P
4 - 8	*5200051200	PCB Assy, REMOTE; 111
	5210051200	PCB, 111
4 - 9	*5555700000	Nut, Plate
4 - 10	*5122339000	Connector Socket, 6P
4 - 11	*5124053000	Jack, Pin; 8P
4 - 12	*5124056000	Jack, Pin; 2P
4 - 13	*5200051805	PCB Assy, OSC; 107
4 - 14	*5581056000	Screw, Shoulder
4 - 15	*5555881000	Bracket, PCB
4 - 16	*5800172800	Bracket, OSC PCB; L
4 - 17	*5800172900	Bracket, OSC PCB; R
4 - 18	*5200048605	PCB Assy, REC-PLAY AMPL
4 - 19	*5800176901	Holder, Meter
4 - 20	*5800176800	Nut, Meter
4 - 21	*5200049100	PCB Assy, MIC JACK
	5210049100	PCB, Mic Jack
	5330007700	Jack, Mic, J11, J21
4 - 22	5282010502	Variable Resistor, 100 kΩ (A)
4 - 23	5282010402	Variable Resistor, 50 kΩ (A)
4 - 24	5296003100	Meter, VU
4 - 25	5296003200	Meter, Peak
4 - 26	*5553269101	Chassis, L
4 - 27	*5800171801	Chassis, Front
4 - 28	*5800178500	Stopper, Jack
4 - 29	*5581055000	Screw, Shoulder; D
4 - 30	*5800177300	Button
4 - 31	*5200149000	PCB Assy, Switch; 177
	5210049000	PCB' 177
	6051083000	Switch, Tact, S12
4 - 32	*5800180300	Spacer, Push; C
4 - 33	5282407602	Variable Resistor, 50 kΩ (A) x 2
4 - 34	*5200051500	PCB Assy, Counter; 103
	5210051500	PCB, 103
	5225007500	LED, SL1032
	6051083000	Switch, Tact
4 - 35	5800176700	Knob, Rotary
4 - 36	*5800178100	Rod, Joint
4 - 37	*5800177900	Bracket, Switch; A
4 - 38	*5200048800	PCB Assy, Switch; 175
	5210048800	PCB, 175
	5301203300	Switch, Rotary 2-3, S991
4 - 39	*5200048900	PCB Assy, Switch; 176
	5210048900	PCB, 176
	5301203400	Switch, Rotary 2-4, S992
4 - 40	*5200049200	PCB Assy, PHONES; 102
	5330007800	Jack, Phone, FJ-318 NBH-Z, J12

[U]: U.S.A. [C]: CANADA [GE]: GENERAL EXPORT
[A]: AUSTRALIA [E]: EUROPE [UK]: U.K.

Parts marked with * require longer delivery time.

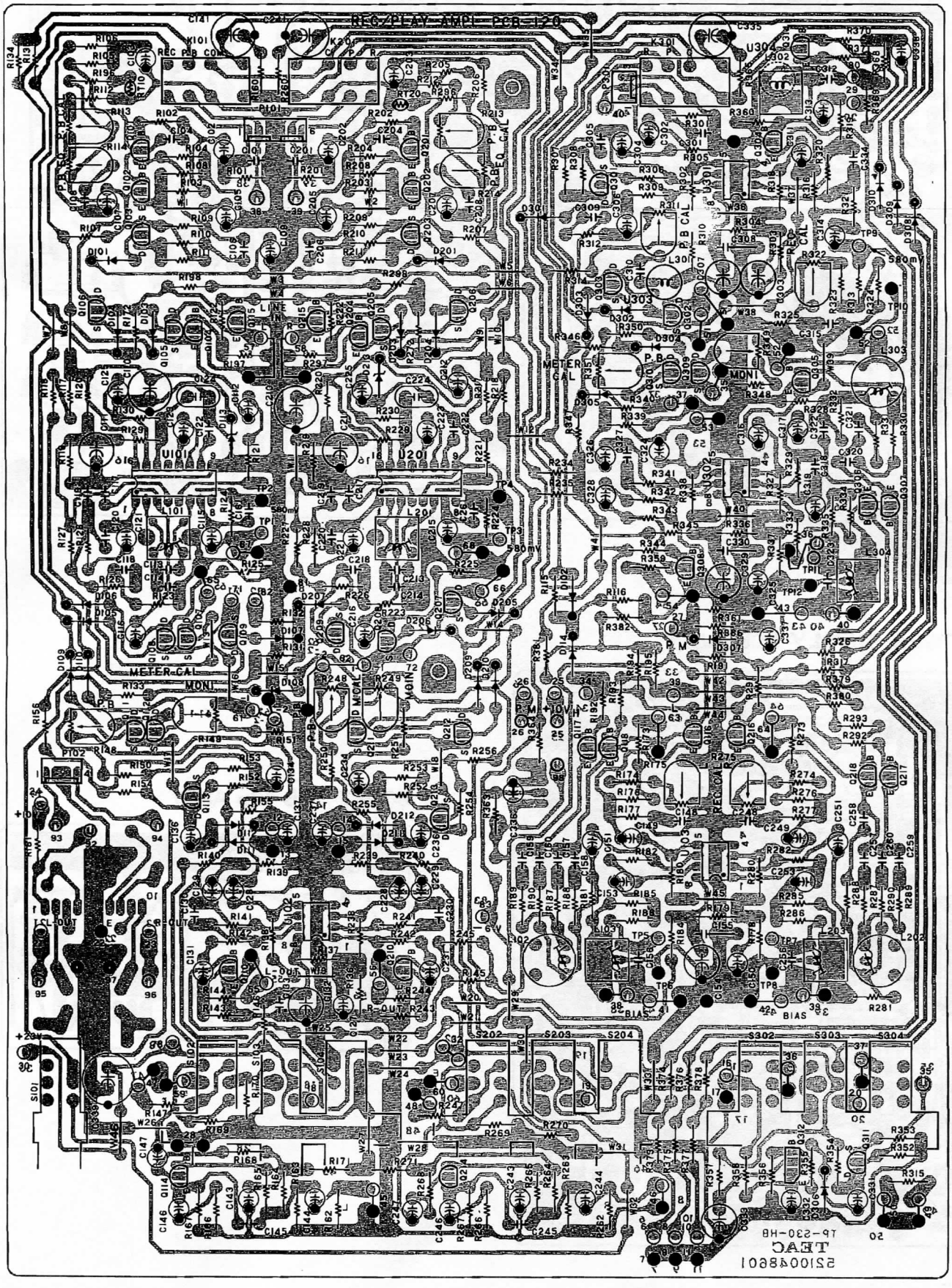
REF. NO.		PARTS NO.	DESCRIPTION
4 - 41		*5800178000	Bracket, Switch; B
4 - 42		*5200048700	PCB Assy, Switch; 173
		5210048700	PCB, 173
		5301203200	Switch, Rotary, SRU2-2, S11
4 - 43		*5555561000	Bracket, Power Switch
4 - 44	⚠	5052906000	Spark Killer, 0.033 μF + 120 Ω/ 250 V [U]
	⚠	5052907000	Spark Killer, 0.01 μF + 300 Ω/400 V [GE]
	⚠	5052911000	Spark Killer, 0.033 μF + 120 Ω/ 250 V [C]
	⚠	5267702500	Spark Killer, 0.0047 μF/250 V [E, UK, A]
4 - 45	⚠	5134018000	Switch, Power [U, C]
	⚠	5134011000	Switch, Power [E, UK, A]
	⚠	5134009000	Switch, Power [GE]
4 - 46		*5551031200	Chassis, R
4 - 47		*5800116200	Rod, A
4 - 48		5800173100	Button, Power
4 - 49		*5504676000	Foot
4 - 50		5231755500	Transistor, 2SD985
4 - 51		5220411500	IC, BA6109
4 - 52		*5800180200	Heat Sink, B
4 - 53		*5122228000	Connector Socket, 9P
4 - 54		*5800178200	Heat Sink
4 - 55		*5553353101	Bracket, Transformer; B
4 - 56		*5122228000	Connector, Socket, 9P
4 - 57		*5555060000	Bracket, B [GE]
4 - 58		*5200050806	PCB Assy, POWER SUPPLY
4 - 59		*5168548100	PCB Assy, VOLTAGE SELECTOR [GE]
4 - 60	⚠	5320014500	Transformer, Power [U, C]
	⚠	5320007400	Transformer, Power [GE]
	⚠	5320007500	Transformer, Power [E, UK, A]
4 - 61		*5555626000	Washer, Transformer
4 - 62		*5200036600	PCB Assy, FUSE [E, UK, A]
	⚠	5210036600	PCB, Fuse
		5142188000	Fuse, 1.6A 250 V F1~F4
	⚠	5041138000	Fuse, 500 mA 250 V F5
	⚠	5142087000	Holder, Fuse
4 - 63		*5555565200	Angle, PCB
4 - 64		*5581038000	Clamper, Cord; A
4 - 65		*5200072900	PCB Assy muting
4 - 66		*5200061501	PCB Assy, Phone Ampl.
4 - 67		*5534473000	T-Type, Rivet
4 - 68		*5200064500	PCB Assy, Control
4 - 69		*5785603050	Spacer, ϕ 3 x 5
4 - 70		*5200051100	PCB Assy, Lamp
		5210051100	PCB, 109
		5310005500	Lamp. 6.3 V 0.07A

[U]: U.S.A. [C]: CANADA [GE]: GENERAL EXPORT
[A]: AUSTRALIA [E]: EUROPE [UK]: U.K.

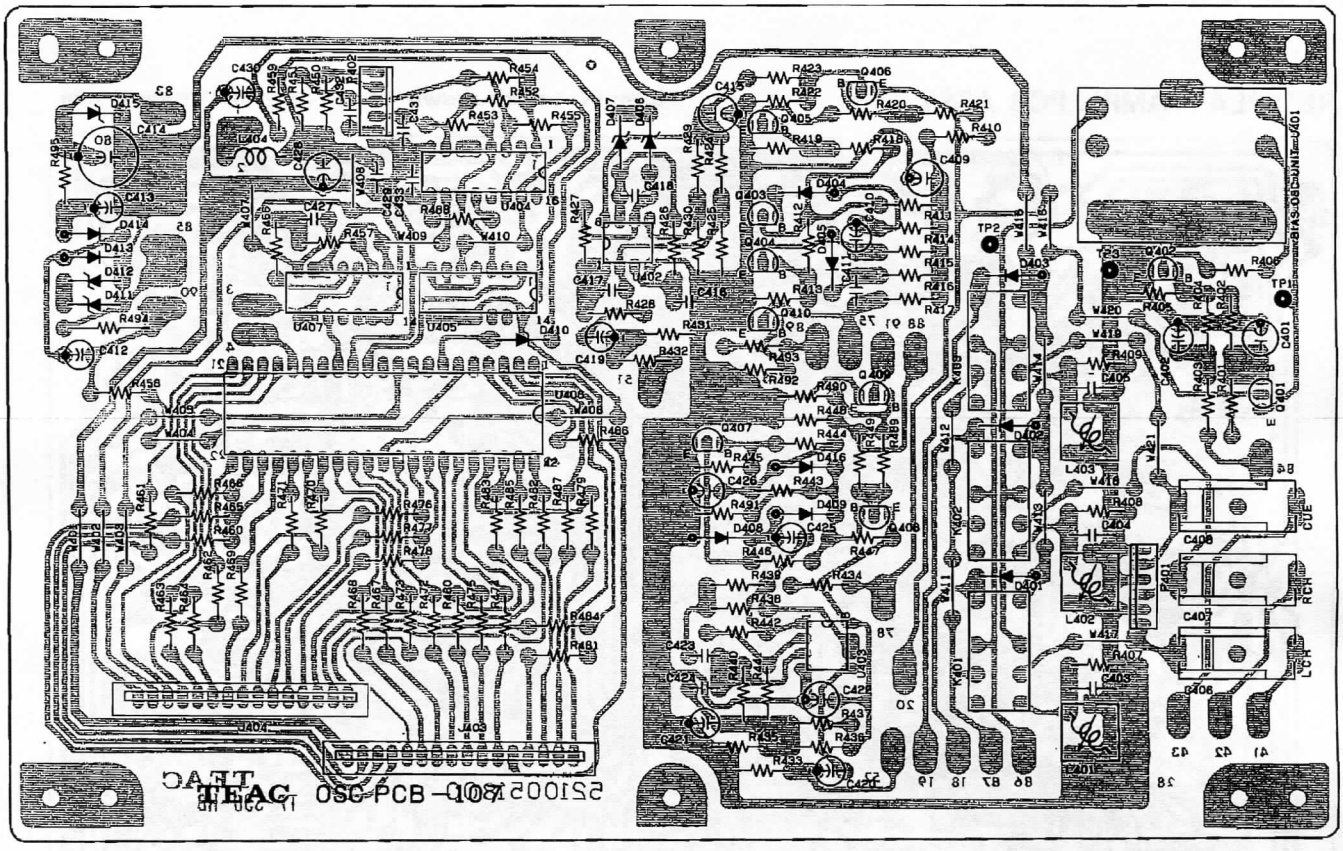
8. PC BOARDS AND PARTS LIST

REC/PLAY AMPL. PCB ASSY

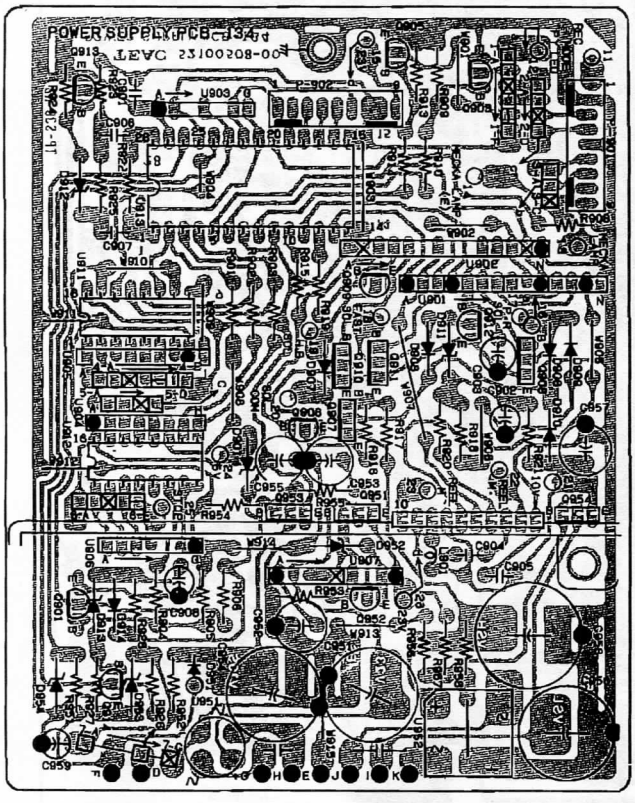
Note: PC boards shown viewed from electro-parts side.



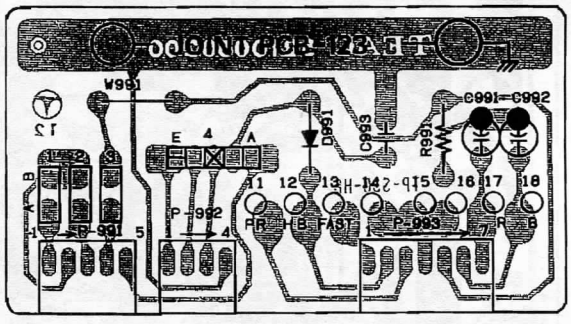
OSC PCB 107 ASSY



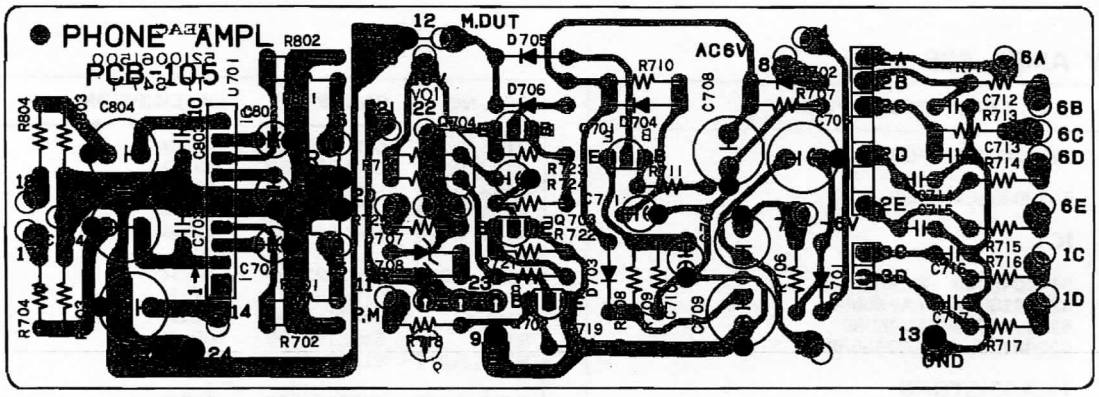
POWER SUPPLY PCB ASSY



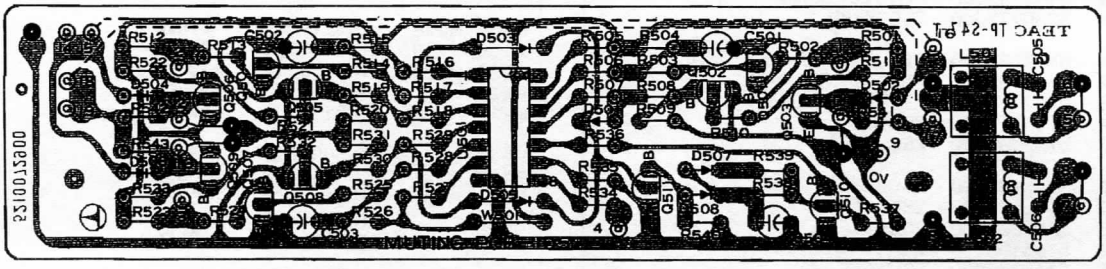
JOINT PCB 123 ASSY



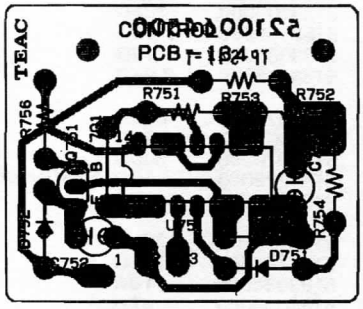
PHONE AMPL. PCB ASSY



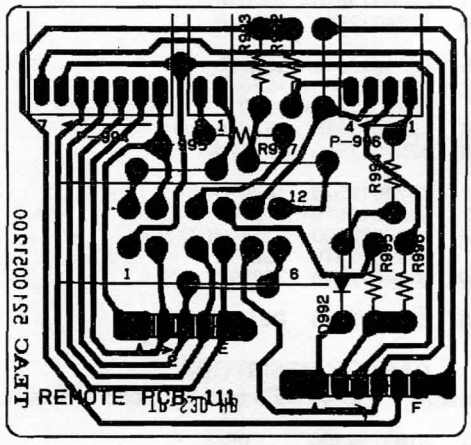
MUTING PCB ASSY



CONTROL PCB ASSY



REMOTE PCB 111 ASSY



REC/PLAY AMPL. PCB ASSY

REF. NO.	PARTS NO.	DESCRIPTION
	5200048605	PCB Assy
	5210048601	PCB
	IC's	
U101, U201	5147046000	NE-646B
U102, U103	5220410900	TA75589P
U301	5220411600	TL4558P
U302	5220410900	TA75558P
	TRANSISTORS	
Q101, Q201	5145119000	2SC1844F
Q102, Q202	5145035000	2SC900EA
Q103, Q203	5145103000	FET, 2SK68AM
Q104, Q204	5145185000	2SD655E
Q105, Q205	5145103000	FET, 2SK68AM
Q106, Q206	5145103000	FET, 2SK68AM
Q107, Q207	5145103000	FET, 2SK68AM
Q108, Q208	5145103000	FET, 2SK68AM
Q109, Q209	5145103000	FET, 2SK68AM
Q110, Q210	5230775000	2SC2878B
Q111, Q211	5145103000	FET, 2SK68AM
Q112, Q212	5145103000	FET, 2SK68AM
Q113, Q213	5232005800	FET, 2SK117GR
Q114, Q214	5145119000	2SC1844F
Q115, Q215	5145091000	2SC945AK
Q116, Q216	5145185000	2SD655E
Q117, Q217	5145091000	2SC945AK
Q118, Q218	5145091000	2SC945AK
Q301~Q303	5145103000	FET, 2SK68AM
Q304, Q305	5145185000	2SD655E
Q306, Q307	5145091000	2SC945AK
Q308	5230775000	2SC2878B
Q309~Q311	5232005800	FET, 2SK117GR
Q312	5145110000	2SC1637-1
Q314	5145082000	2SC2060Q
	DIODES	
D101, D201	5224012510	1S2076
D102	5224012510	1S2076
D103, D203	5224012510	1S2076
D104, D204	5224012510	1S2076
D105, D205	5224012510	1S2076
D106, D206	5224012510	1S2076
D107, D207	5224012510	1S2076
D108	5224012510	1S2076
D109, D209	5224012510	1S2076
D110, D210	5224012510	1S2076
D111, D211	5224012510	1S2076
D112, D212	5224012510	1S2076
D113, D213	5143059000	Zener, RD13EB
D114	5224012510	1S2076
D301~D307	5224012510	1S2076
D308, D313	5224013210	DS135D
	CARBON RESISTORS	
	All resistors are rated ±5% tolerance and 1/4 watt.	
R101, R201	5183154000	1MΩ
R102, R202	5183070000	330Ω
R103, R203	5183122000	47kΩ
R104, R204	5183058000	100Ω
R105, R205	5183118000	33kΩ

REF. NO.	PARTS NO.	DESCRIPTION	
R106, R206	5183098000	4.7kΩ	
R107, R207	5183098000	4.7kΩ	
R108, R208	5183072000	390Ω	
R109, R209	5183142000	330kΩ	
R110, R210	5183094000	3.3kΩ	
R111, R211	5183092000	2.7kΩ	
R112, R212	5183104000	8.2kΩ	
R115	5183142000	330kΩ	
R116	5183130000	100kΩ	
R117, R217	5183064000	180Ω	
R118, R218	5183064000	180Ω	
R119, R219	5183082000	1kΩ	
R120, R220	5183082000	1kΩ	
R121, R221	5183082000	1kΩ	
R122, R222	5183130000	100kΩ	
R123, R223	5183118000	33kΩ	
R124, R224	5183118000	33kΩ	
R125, R225	5183118000	33kΩ	
R126, R226	5183058000	100Ω	
R127, R227	5183094000	3.3kΩ	
R128, R228	5183122000	47kΩ	
R129, R229	5183136000	180kΩ	
R130, R230	5183138000	220kΩ	
R131	5183140000	270kΩ	
R132	5183122000	47kΩ	
R133	5183098000	4.7kΩ	
R134, R234	5183130000	100kΩ	
R135, R235	5183130000	100kΩ	
R136	5183106000	10kΩ	
R137	5183106000	10kΩ	
R138, R238	5183130000	100kΩ	
R139, R239	5183110000	15kΩ	
R140, R240	5183092000	2.7kΩ	
R141, R241	5183106000	10kΩ	
R142, R242	5183074000	470Ω	
R143, R243	5183146000	470kΩ	
R144, R244	5183074000	470Ω	
R145, R245	5183106000	10kΩ	
R146	5183074000	470Ω	
R147, R247	5183120000	39kΩ	
R150, R250	5183130000	100kΩ	
R151, R251	5183106000	10kΩ	
R152, R252	5183146000	470kΩ	
R153, R253	5183038000	15Ω	
R154, R254	5183096000	3.9kΩ	
R155, R255	5183078000	680Ω	
R156, R256	5183090000	2.2kΩ	
R160, R260	5183070000	330Ω	
R161	5184225000	10Ω	Nonflammable
R162, R262	5183130000	100kΩ	
R163, R263	5183114000	22kΩ	
R164, R264	5183146000	470kΩ	
R165, R265	5183034000	10Ω	
R166, R266	5183050000	47Ω	
R167, R267	5183070000	330Ω	
R168, R268	5183108000	12kΩ	
R169, R269	5183130000	100kΩ	
R170, R270	5183082000	1kΩ	
R171, R271	5183090000	2.2kΩ	
R172, R272	5183130000	100kΩ	
R173, R273	5183114000	22kΩ	
R174, R274	5183082000	1kΩ	
R176, R276	5183126000	68kΩ	
R177, R277	5183118000	33kΩ	
R178	5183106000	10kΩ	
R179	5183106000	10kΩ	

REF. NO.	PARTS NO.	DESCRIPTION
R180, R280	5183138000	220kΩ
R181, R281	5183094000	3.3kΩ
R184	5183074000	470Ω
R185, R285	5183130000	100kΩ
R186, R286	5183106000	10kΩ
R187, R287	5183058000	100Ω
R188, R288	(deleted)	
R189, R289	5183058000	100Ω
R190, R290	(deleted)	
R191, R291	5183106000	10kΩ
R102, R292	5183098000	4.7kΩ
R193, R293	5183098000	4.7kΩ
R194, R294	5183130000	100kΩ
R195, R295	5183130000	100kΩ
R196, R296	5183114000	22kΩ
R197, R297	5183130000	100kΩ
R198, R298	5183130000	100kΩ
R301	5183154000	1MΩ
R302	5183130000	100kΩ
R303, R304	5183106000	10kΩ
R305	5183058000	100Ω
R306	5183142000	330kΩ
R307	5183094000	3.3kΩ
R308	5183092000	2.7kΩ
R309	5183074000	470Ω
R310	5183104000	8.2kΩ
R312	5183106000	10kΩ
R313	5183114000	22kΩ
R314	5183074000	470Ω
R315	5183128000	82kΩ
R316	5183154000	1MΩ
R317, R318	5183130000	100kΩ
R319	5183082000	1kΩ
R320	5183114000	22kΩ
R321	5183074000	470Ω
R323	5183082000	1kΩ
R324	5183126000	68kΩ
R325	5183118000	33kΩ
R326	5183106000	10kΩ
R327	5183130000	100kΩ
R328	5183094000	3.3kΩ
R329	5183118000	33kΩ
R330	5183068000	270Ω
R331	(deleted)	
R332	5183082000	1kΩ
R333	5183092000	2.7kΩ
R334	5183124000	56kΩ
R335~R337	5183106000	10kΩ
R338	5183130000	100kΩ
R339	5183110000	15kΩ
R340	5183092000	2.7kΩ
R341	5183106000	10kΩ
R342	5183074000	470Ω
R343, R344	5183106000	10kΩ
R345	5183074000	470Ω
R346, R347	5183130000	100kΩ
R348	5183098000	4.7kΩ
R350	5183130000	100kΩ
R352	5183146000	470kΩ
R353	5183038000	15Ω
R354	5183096000	3.9kΩ
R355	5183114000	22kΩ
R356	5183146000	470kΩ
R357	5184249000	100Ω Nonflammable
R358	5183112000	18kΩ

REF. NO.	PARTS NO.	DESCRIPTION
R359	5183074000	470Ω
R360	5183130000	100kΩ
R361	5183090000	2.2kΩ
R363	5183130000	100kΩ
R364	5183058000	100Ω P = 10
R365	5183070000	330Ω
R366	5183082000	1kΩ
R368	5183130000	100kΩ
R369	5183058000	100Ω
R370	5183104000	8.2kΩ
R371	5183114000	22kΩ
R372	5181763000	Jumper
R373~R378	5183082000	1kΩ
R379, R380	5183098000	4.7kΩ
R381, R382	5183106000	10kΩ

CAPACITORS

C101, C201	5173731000	Polypro.	820pF	100V	5%
C102, C202	5173571800	Elec.	10μF	16V	
C103, C203	5173027800	Elec.	33μF	16V	
C104, C204	5172304000	Ceramic	22pF	50V	10%
C105, C205	5173035800	Elec.	47μF	10V	
C106, C206	5170425000	Mylar	0.01μF	100V	5%
C107, C207	5260225812	Elec. MD	0.33MF	50V	
C108, C208	5170409000	Mylar	0.0022μF	100V	5%
C109	5172992800	Elec.	1μF	50V	
C110, C210	5173054800	Elec.	220μF	16V	
C111, C211	5173053800	Elec.	220μF	10V	
C112, C212	5260225812	Elec. MD	0.33MF	50V	
C113, C213	5173729000	Polypro.	560pF	100V	5%
C114, C214	5170407000	Mylar	0.0018μF	100V	5%
C115, C215	5173010800	Elec.	10μF	16V	
C116, C216	5173010800	Elec.	10μF	16V	
C117, C217	5172324000	Ceramic	0.001μF	50V	10%
C118, C218	5170419000	Mylar	0.0056μF	100V	5%
C119, C219	5170435000	Mylar	0.027μF	100V	5%
C120, C220	5170417000	Mylar	0.0047μF	100V	5%
C121, C221	5173010800	Elec.	10μF	16V	
C122, C222	5170441000	Mylar	0.047μF	100V	5%
C123, C223	5173010800	Elec.	10μF	10V	
C124, C224	5170449000	Mylar	0.1μF	100V	5%
C125, C225	5260225812	Elec. MD	0.33MF	50V	
C127	5173010800	Elec.	10μF	16V	
C128, C228	5172992800	Elec.	1μF	50V	
C129, C229	5173010800	Elec.	10μF	16V	
C130, C230	5172308000	Ceramic	47pF	50V	10%
C131, C231	5173010800	Elec.	10μF	16V	
C132	5173046800	Elec.	100μF	25V	
C133	5054230000	Ceramic	0.047μF	50V	10%
C134, C234	5173011800	Elec.	10μF	25V	
C136, C236	5172992800	Elec.	1μF	50V	
C137, C237	5173017800	Elec.	22μF	10V	
C144, C244	5173572800	Elec.	10μF	25V	
C145, C245	5172316000	Ceramic	220pF	50V	10%
C146, C246	5173035800	Elec.	47μF	10V	
C147, C247	5173564800	Elec.	4.7μF	25V	
C148, C248	5170445000	Mylar	0.068μF	100V	5%
C149, C249	5172990800	Elec.	0.47μF	50V	
C150	5173010800	Elec.	10μF	16V	
C151, C251	5173010800	Elec.	10μF	16V	
C153, C253	5173010800	Elec.	10μF	16V	
C154	5173019800	Elec.	22μF	25V	
C155	5172344000	Ceramic	0.047μF	50V	+80% -20%
C156, C256	5170409000	Mylar	0.0027μF	100V	5%
C157, C257	5170425000	Mylar	0.01μF	100V	5%
C158, C258	(deleted)				
C159, C259	5170415000	Mylar	0.0039μF	100V	5%

REF. NO.	PARTS NO.	DESCRIPTION			
C160, C260	(deleted)				
C301	5173731000	Polypro.	820pF	100V	5%
C302	5173571800	Elec. MD	10μF	16V	
C303	5173045800	Elec.	100μF	16V	
C304	5173035800	Elec.	47μF	10V	
C305	5170425000	Mylar	0.01μF	100V	5%
C306	5173553800	Elec. MD	0.33MF	50V	
C307	5173046800	Elec.	100μF	25V	
C308	5172344000	Ceramic	0.047μF	50V	+80% -20%
C309	5173729000	Polypro.	560pF	100V	5%
C310	5170401000	Mylar	0.001μF	100V	5%
C311	5173553800	Elec. MD	0.33μF	50V	
C312	5170409000	Mylar	0.0022μF	100V	5%
C313	5173018800	Elec.	22μF	16V	
C314	5173010800	Elec.	10μF	16V	
C315	5170445000	Mylar	0.068μF	100V	5%
C316	5172992800	Elec.	1μF	50V	
C317	5173010800	Elec.	10μF	16V	
C319	5173010800	Elec.	10μF	16V	
C320	5170427000	Mylar	0.012μF	100V	5%
C321	5170425000	Mylar	0.01μF	100V	5%
C322	5170421000	Mylar	0.0068μF	100V	5%
C323	5170409000	Mylar	0.0022μF	100V	5%
C324	5172992800	Elec.	1μF	50V	
C325	5173010800	Elec.	10μF	16V	
C326	5173010800	Elec.	10μF	16V	
C327	5172308000	Ceramic	47pF	50V	10%
C328	5173010800	Elec.	10μF	16V	
C329	5173046800	Elec.	100μF	25V	
C330	5172344000	Ceramic	0.047μF	50V	+80% -20%
C331	5173550800	Elec. MD	0.1μF	50V	
C332	5173019800	Elec.	22μF	25V	
C333	5173037800	Elec.	47μF	25V	
C334	5172304000	Ceramic	22pF	50V	10%
C335	5173048800	Elec.	100μ	25V	
C336	5172992800	Elec.	1μ	50V	
C337	5173010800	Elec.	10μF	16V	
C338	5173018800	Elec.	22μF	16V	
C339	5173073800	Elec.	470μF	25V	
	THERMISTORS				
RT10, RT20	5143127000	S5C14			
	VARIABLE RESISTORS				
R113, R213	5280004002	Semi-fixed	50kΩ(B)		
R114, R214	5280004002	Semi-fixed	50kΩ(B)		
R148, R248	5280004302	Semi-fixed	200kΩ(B)		
R149, R249	5280004002	Semi-fixed	50kΩ(B)		
R175, R275	5280004002	Semi-fixed	50kΩ(B)		
R311, R322	5280004002	Semi-fixed	50kΩ(B)		
R349	5280004002	Semi-fixed	50kΩ(B)		
R351	5280004302	Semi-fixed	200kΩ(B)		
	COILS				
L101, L201	5056655000	Trap, 12mH			
L102, L202	5160042000	Record EQ, 3.6mH			
L103, L202	5056656000	Trap, 3mH			
L301	5160080000	Choke, 6.8μH			
L302	5056659000	Trap, 3mH			
L303	5160042000	Record EQ, 3.6mH			
L304	5056659000	Trap, 3mH			

REF. NO.	PARTS NO.	DESCRIPTION
	MISCELLANEOUS	
K101, K201	5290008900	Relay, G2V-2 24V
K301	5290008900	Relay, G2V-2 24V
P101	5122130000	Connector Plug, 6P(WHT)
P102	5122128000	Connector Plug, 4P(WHT)
P301	5122127000	Connector Plug, 3P(WHT)
	5300022900	Switch Push
	5300023000	Switch Push, 3-gang
	DIODES	
D308, D310	5224013210	DS135

OSC PCB 107 ASSY

REF. NO.	PARTS NO.	DESCRIPTION
	5200051804	PCB 107 Assy
	5210051800	PCB
	IC's	
U402, R403	5220410900	TA75558P
U404	5220014000	MSM4049RS
U405	5220014900	MSM4013RS
U406	5220018800	LM8523
U407	5220013700	MSM4011RS
	TRANSISTORS	
Q401, Q402	5145082000	2SC2060Q
R403~Q405	5145091000	2SC945AK
Q406	5042553000	2SA733P
Q407	5145091000	2SC945AK
Q408	5042553000	2SA733P
Q409, Q410	5145091000	2SC945AK
	DIODES	
D401~D403	5224013210	DS135D
D404, D405	5224012510	1S2076
D406, D407	5143184000	Zener, EQA01-06S
D408, D409	5224012510	1S2076
D410	5143143000	Zener, RD4.3E
D411, D412	5224531702	Zener, BZ056
D416	5224012500	1S2076
	CARBON RESISTORS	
	All resistors are rated ±5% tolerance and 1/4 watt.	
R401	5183084000	1.2kΩ
R402	5183092000	2.7kΩ
R403	5183074000	470Ω
R404	5183104000	8.2kΩ
R405	5183114000	22kΩ
R406	5183010000	1Ω
R407~R409	5183100000	5.6kΩ
R410	5183082000	1kΩ
R411	5183098000	4.7kΩ
R412	5183134000	150kΩ
R413	5183122000	47kΩ
R414	5183134000	150kΩ
R415	5183098000	4.7kΩ
R416~R418	5183122000	47kΩ
R419	5183098000	4.7kΩ

REF. NO.	PARTS NO.	DESCRIPTION
R420	5183122000	47kΩ
R421	5183098000	4.7kΩ
R422	5183130000	100kΩ
R423	5183074000	470Ω
R424, R425	5183144000	390kΩ
R426	5183138000	220kΩ
R427	5183136000	180kΩ
R428	5183112000	18kΩ
R429, R430	5183144000	390kΩ
R431	5183082000	1kΩ
R432	5183130000	100kΩ
R433	5183154000	1MΩ
R434	5183082000	1kΩ
R435, R436	5183106000	10kΩ
R437	5183154000	1MΩ
R438~R440	5183129000	91kΩ
R441	5183106000	10kΩ
R442	5183120000	39kΩ
R443	5183122000	47kΩ
R444	5183130000	100kΩ
R445	5183118000	33kΩ
R446	5183130000	100kΩ
R447	5183106000	10kΩ
R448	5183112000	18kΩ
R449	5183098000	4.7kΩ
R450, R451	5183072000	390Ω
R452	5183130000	100kΩ
R453	5183146000	470kΩ
R454	5183130000	100kΩ
R455	5183146000	470kΩ
R456	5183130000	100kΩ
R457	5183106000	10kΩ
R458	5183130000	100kΩ
R459	5183114000	22kΩ
R460~R487	5183090000	2.2kΩ
R488	5183130000	100kΩ
R489	5183114000	22kΩ
R490	5183098000	4.7kΩ
R491~R493	5183106000	10kΩ
R494	5184676000	4.7Ω 1W Metal Film Nonflammable
CAPACITORS		
C401	5173037800	Elec. 47μF 25V
C402	5173010800	Elec. 10μF 16V
C403~C405	5054330000	Dip. Mica 150pF 50V 10%
C409	5173037800	Elec. 47μF 25V
C410	5173011800	Elec. 10μF 25V
C411	5170401000	Mylar 0.001μF 100V 5%
C415	5173037800	Elec. 47μF 25V
C416~C418	5170437000	Mylar 0.033μF 100V 5%
C419	5173010800	Elec. 10μF 16V
C420	5172990800	Elec. 0.47μF 50V
C421	5173010800	Elec. 10μF 16V
C422	5173037800	Elec. 47μF 25V
C423, C424	5170449000	Mylar 0.1μF 100V 5%
C425	5173011800	Elec. 10μF 25V
C426	5173018800	Elec. 22μF 16V
C427	5170401000	Mylar 0.001μF 100V 5%
C428	5173036800	Elec. 47μF 16V
C429	5172336000	Ceramic 0.01μF 50V 20%
C430	5173010800	Elec. 10μF 16V
C431, C432	5170417000	Mylar 0.0047μF 100V 5%
C433	5170401000	Mylar 0.001μF 100V 5%
TRIMMER CAPACITORS		
C406~C408	5267205300	30pF-210pF, MAX.

REF. NO.	PARTS NO.	DESCRIPTION
COILS		
L401~L403	6046640000	Choke 1.2mH
L404	5286001500	Choke 2mH
MISCELLANEOUS		
K401~K403	5290008900	Relay, G2V-2 24V
P401	5122130000	Connector Plug, 6P(WHT)
P402	5122129000	Connector Plug, 5P(WHT)
P403	5334017500	Connector Socket, 15P
P404	5334017600	Connector Socket, 16P
U401	6046641100	OSC Unit 100kHz

POWER SUPPLY PCB ASSY

REF. NO.	PARTS NO.	DESCRIPTION
	5200050806	PCB Assy
	5210050800	PCB
IC's		
U901	5293001100	08-0069
U902	5293001200	01-0321
U903	5293001300	01-0322
U904	5293001400	01-0323
U905	5293001500	01-0324
U906	5293001600	07-0054
U907	5293001700	02-0066
U911	5220018600	MSN4512RS
U912	5220018700	SN74LS151
U913	5220803100	NPD554C
U914	5220411500	BA6109
U951 ⚠	5228005000	W02
U952 ⚠	5228005100	KBPC102
TRANSISTORS		
Q901, Q903	5042521000	2SC945P
Q905	5042521000	2SC945P
Q906	5230770700	2SC1841E
Q907	5230506100	2SB794L
Q908	5231755500	2SD985
Q909	5230770700	2SC1841E
Q910	5231756200	2SD882Q or P
Q911	5231755500	2SD985
Q912~Q914	5042521000	2SC945P
Q951	5231755500	2SD985
Q952	5042521000	2SC945P
Q953, Q954	5231755500	2SD985
DIODES		
D901	5143143000	Zener, RD4.3E
D906~D910	5224013210	DS135D
D911	5224531501	Zener, RD4.7EB1
D912	5224518000	Zener, RD8.2EB3
D913	5143122000	Zener, RD7.5E
D914	5224012500	1S2076
D951	5143089000	W03C
D952	5143108000	Zener, RD13EB3
D953, D954	5224518100	Zener, RD11EB2

REF. NO.	PARTS NO.	DESCRIPTION
	CARBON RESISTORS	
	All resistors are rated ±5% tolerance and 1/4 watt.	
R901~R903	5183086000	1.5kΩ
R904	5183108000	12kΩ
R905	5183090000	2.2kΩ
R906, R908	5183108000	12kΩ
R909	5183090000	2.2kΩ
R910	5183108000	12kΩ
R913	5183090000	2.2kΩ
R914	5183108000	12kΩ
R915	5183100000	5.6kΩ
R916	5183090000	2.2kΩ
R917	5183086000	1.5kΩ
R918	5183096000	3.9kΩ
R919~R921	5183086000	1.5kΩ
R922	5183118000	33kΩ
R923	5183108000	12kΩ
R924, R925	5183130000	100kΩ
R926	5183108000	12kΩ
R927	5183124000	56kΩ
R928	5183116000	27kΩ
R951	5183090000	2.2kΩ
R952	⚠ 5184263000	390Ω Nonflammable
R953	5183102000	6.8kΩ
R954, R955	5183086000	1.5kΩ
R956	5183090000	2.2kΩ
R957	5183086000	1.5kΩ
R958	5183110000	15kΩ
	CAPACITORS	
C901	5173395000	Ceramic 0.047μF 50V 10%
C902	5173018800	Elec. 22μF 16V
C903	5173052800	Elec. 220μF 6.3V
C904, C905	5173395000	Ceramic 0.047μF 50V 10%
C906, C907	5172792000	Styl. 33pF 50V 5%
C908	5173010800	Elec. 10μF 16V
C909	5172992800	Elec. 1μF 50V
C951	⚠ 5173084800	Elec. 1000μF 50V
C952	5173038800	Elec. 47μF 35V
C953	5173046800	Elec. 100μF 25V
C954	⚠ 5173073800	Elec. 470μF 25V
C955	5173045800	Elec. 100μF 16V
C956	⚠ 5173082800	Elec. 1000μF 25V
C957	5173045800	Elec. 100μF 16V
C958	⚠ 5262000200	Elec. 2200μF 50V
C959	5173018800	Elec. 22μF 16V
	COIL	
L901	5286001500	Choke, 2mH
	MISCELLANEOUS	
P901	5122190000	Connector Plug, 9P(BLK)
P902	5122133000	Connector Plug, 9P(WHT)

JOINT PCB 123 ASSY

REF. NO.	PARTS NO.	DESCRIPTION
	5200050200	PCB Assy
	5210050200	PCB
D991	5224013200	Diode, DS135D
R991	5183038000	Resistor, Carbon; 15Ω 5% 1/4W
C991, C992	5172900800	Capacitor, Elec. 10μF 16V
C993	5173393000	Capacitor, Ceramic 0.01μF 50V 10%
P991	5122148000	Connector Plug, 5P(WHT)
P992	5122147000	Connector Plug, 4P(WHT)
P993	5122150000	Connector Plug, 7P(WHT)

PHONE AMPL. PCB ASSY

REF. NO.	PARTS NO.	DESCRIPTION
	5200061501	PCB Assy
	5210061500	PCB
	IC	
U701	5220406800	TA7230P
	TRANSISTORS	
Q701	5042553000	2SA733P
Q702, Q703	5230775300	LC945K
Q704	5042553000	2SA733P
	DIODES	
D701~D703	5224013200	DS135D
D704~D706	5143118000	1S2473HJ
	CARBON RESISTORS	
	All resistors are rated ±5% tolerance and 1/4 watt.	
R701, R801	5183132000	120kΩ
R702, R802	5183100000	5.6kΩ
R703, R803	5183082000	1kΩ
R704, R804	5183036000	12Ω
R706	5183082000	1kΩ
R707	5180058000	100Ω 1/2W
R708	5183106000	10kΩ
R709	5183104000	8.2kΩ
R710, R711	5183130000	100kΩ
R712~R717	5183058000	100Ω
R718, R719	5183106000	10kΩ
R720, R721	5183122000	47kΩ
R722	5183114000	22kΩ
R723	5183110000	15kΩ
R724	5183130000	100kΩ
	CAPACITORS	
C701	5173017800	Elec. 22μF 10V
C702, C802	5173035800	Elec. 47μF 10V
C703, C803	5170449000	Mylar 0.1μF 100V 5%
C704, C804	5173072800	Elec. 470μF 16V
C705	5173072800	Elec. 470μF 16V

REF. NO.	PARTS NO.	DESCRIPTION			
C706	5173045800	Elec.	100μF	16V	
C707	5173044800	Elec.	100μF	10V	
C708	5172961800	Elec.	470μF	16V	
C709	5173053800	Elec.	220μF	10V	
C710	5172992800	Elec.	1μF	50V	
C711	5173035800	Elec.	47μF	10V	
C712~C717	5173395000	Ceramic	0.047μF	50V	10%
C718	5172992800	Elec.	1μF	50V	

MUTING PCB ASSY

REF. NO.	PARTS NO.	DESCRIPTION
	52600072900	PCB Assy
	5210072900	PCB
	IC's	
U501	5220017300	HD14070BP
	TRANSISTORS	
Q507	5145082000	2SC2060(Q)
Q508	5145091000	2SC945A(K)
Q509	5042553000	2SA733(P)
Q510, Q511	5145091000	2SC945A(K)
	DIODES	
D505	5143118000	1S2473HJ
D507	5042517000	1S2473VE
D508	5042554000	RD6.2EB
	COILS	
L501, L502	5286010800	65 mH
	CAPACITORS	
C503, C504	5172916800	33μF 16V
C505, C506	5054744000	100pF 50V
	CARBON RESISTORS	
	All resistors and rated ±5% tolerance and 1/4 watt.	
R504~R506	5240172200	47kΩ
R515~R517	5240172200	47kΩ
R523	5240170600	10kΩ
R524	5240165800	100Ω
R525	5240163400	10Ω
R526~R530	5240172200	47kΩ
R531	5240171400	22kΩ
R532	5240172200	47kΩ
R533	5240171400	22kΩ
R534, R535	5240170600	10kΩ
R536	5240171400	22kΩ
R537	5240169800	4.7kΩ
R538	5240172200	47kΩ
R539	5240165800	100Ω
R540	5240171400	22kΩ

CONTROL PCB ASSY

REF. NO.	PARTS NO.	DESCRIPTION
	5200064500	PCB ASSY
	5210064500	PCB
	IC's	
U715	5220013700	MSM4011RS
	TRANSISTOR	
Q751	5042553000	2SA733(P)
	DIODES	
D751, D752	5143118000	Silicon, 1S2473
	CARBON RESISTORS	
R751	5183146000	470kΩ
R752	5183082000	1kΩ
R753	5183132000	120kΩ
R754	5183082000	1kΩ
R755, R756	5183106000	10kΩ
	CAPACITORS	
C751	5172996800	2.2μF 16V
C751	5173018800	22μF 16V

REMOTE PCB 111 ASSY

REF. NO.	PARTS NO.	DESCRIPTION		
	5200051200	PCB 111 Assy		
	5210051200	PCB 111		
	DIODE			
D992	5224013210	DS135D		
	CARBON RESISTORS			
R992	5183084000	1.2kΩ	5%	1/4W
R993	5183078000	680Ω	5%	1/4W
R994	5183084000	1.2kΩ	5%	1/4W
R995	5183078000	680Ω	5%	1/4W
R996	5183084000	1.2kΩ	5%	1/4W
R997	5183078000	680Ω	5%	1/4W
	MISCELLANEOUS			
	5334010100	Connector Socket, 12P		
P994	5122150000	Connector Plug, 7P(WHT)		
P995	5122145000	Connector Plug, 2P(WHT)		
P996	5122147000	Connector Plug, 4P(WHT)		

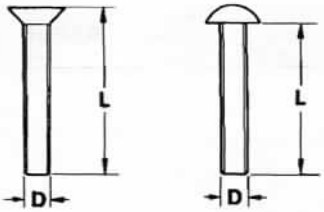
9. ASSEMBLING HARDWARE CODING LISTS

All screws conform to ISO standards, and have crossrecessed heads, unless otherwise noted.
ISO screws have the head inscribed with a point as in the figure to the right.



FOR EXAMPLE:

B M 3 x 6
- Length in mm (L)
- Diameter in mm (D) *
- Metric System
- Nomenclature



* Inner dia. for washers and nuts

	Code	Name	Type
MACHINE SCREW	R	Round Head Screw	
	P	Pan Head Screw	
	T	Stove Head Screw (Truss)	
	B	Binding Head Screw	
	F	Flat Countersunk Head Screw	
	O	Oval Countersunk Head Screw	
WOOD SCREW	RW	Round Head Wood Screw	
TAPTITE SCREW	PTT	Pan Head Taptite Screw	
	WTT	Washer Head Taptite Screw	
SEMS SCREW	BSA	Binding Head SEMS Screw(A Type)	
	BSB	Binding Head SEMS Screw(B Type)	
	BSF	Binding Head SEMS Screw(F Type)	
	PSA	Pan Head SEMS Screw(A Type)	
	PSB	Pan Head SEMS Screw(B Type)	

	Code	Name	Type
TAPPING SCREW	BTA	Binding Head Tapping Screw(A Type)	
	BTB	Binding Head Tapping Screw(B Type)	
	RTA	Round Head Tapping Screw(A Type)	
	RTB	Round Head Tapping Screw(B Type)	
SETSCREW	SF	Hex Socket Setscrew(Flat Point)	
	SC	Hex Socket Setscrew(Cup Point)	
	SS	Slotted Socket Setscrew(Flat Point)	
WASHER	E	E-Ring (Retaining Washer)	
	W	Flat Washer (Plain)	
	SW	Lock Washer (Spring)	
	LWI	Lock Washer (Internal Teeth)	
	LWE	Lock Washer (External Teeth)	
	TW	Trim Washer (Countersunk)	
NUT	N	Hex Nut	

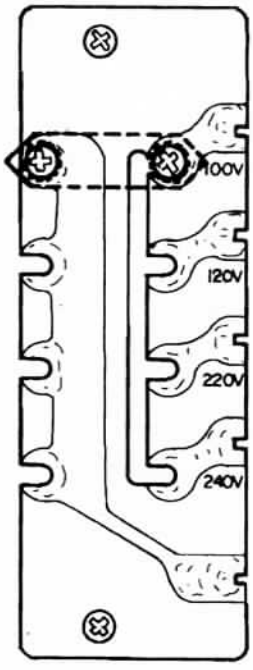
Voltage Conversion and Note for U.K. Customers

General Export Model Only:

If it is necessary to alter the AC power setting to suit the line voltage in your area, use the following procedures.

ALWAYS DISCONNECT THE POWER LINE CORD BEFORE MAKING THESE ADJUSTMENTS!

1. Remove the top cover of the deck by removing the screws from the sides.
2. Locate the voltage selector, shown in the illustration, to the front of the power transformer.
3. Loosen the two screws in the shorting bar and move the bar so that it shorts across the terminals marked with the required voltage (100, 120, 220 or 240).
4. Retighten the screws.
5. Replace the top cover.



U.K. Customers Only:

Due to the variety of plugs being used in the U.K., this unit is sold without an AC plug. Please request your dealer to install the correct plug to match the mains power outlet where your unit will be used as per these instructions.

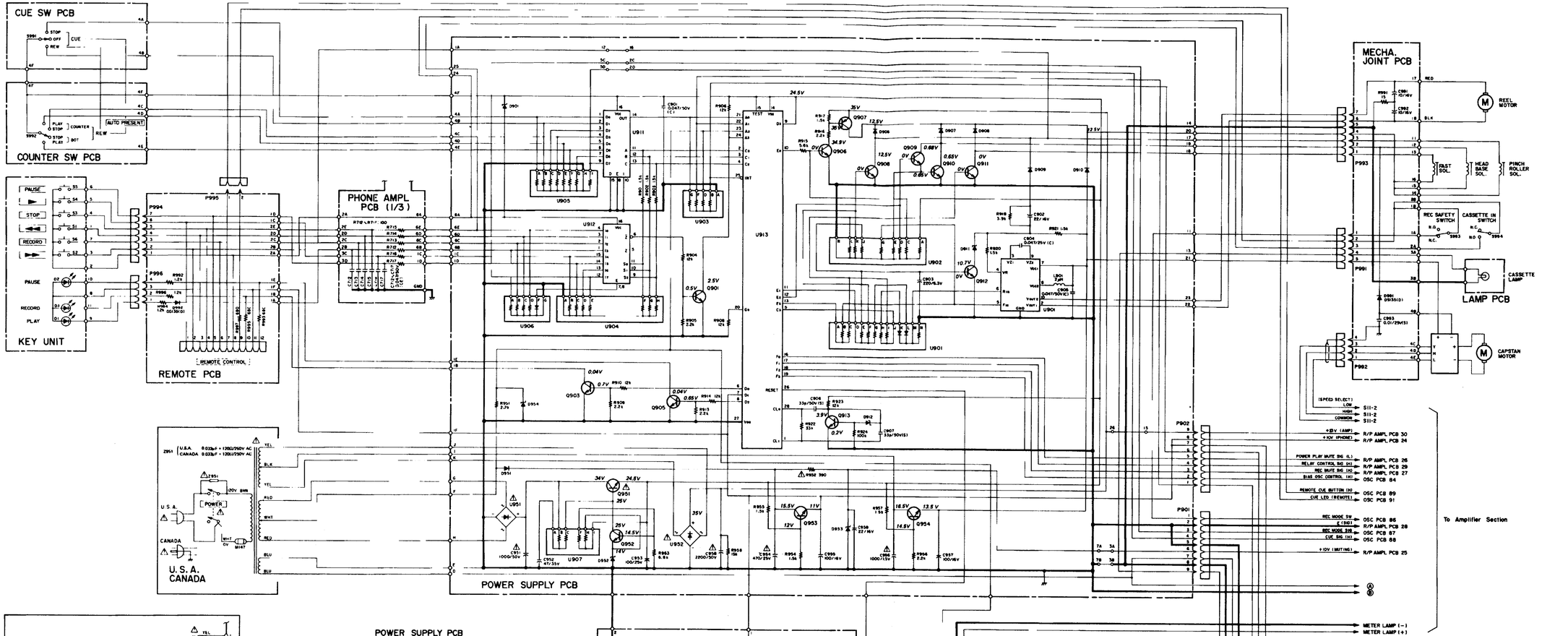
IMPORTANT

The wires in this mains lead are coloured in accordance with the following code:

BLUE:	**NEUTRAL**
BROWN:	**LIVE**

As the colours of the wires in the mains lead of this apparatus may not correspond with the coloured markings identifying the terminals in your plug, proceed as follows.

The wire which is coloured BLUE must be connected to the terminal which is marked with the letter N or coloured BLACK. The wire which is coloured BROWN must be connected to the terminal which is marked with the letter L or coloured RED.



POWER SUPPLY PCB

U911	MSM5412RS	Q901	2SC945(P)	D901	RD4.3EB
U912	SN74LS151	Q902	(Not used)		
U913	μPD554-80	Q903	2SC945(P)	D906	DS135(D)
U914	BA6109	Q904	(Not used)	D907	DS135(D)
		Q905	2SC945(P)	D908	DS135(D)
U951	W02			D909	DS135(D)
U952	KBPC102	Q906	2SC1841(E)	D910	DS135
		Q907	2SB794		
		Q908	2SD985	D911	RD4.7EB
		Q909	2SC1841(E)	D912	RD8.2EB3
		Q910	2SD882(P,Q)	D913	RD7.5EB3
				D914	1S2076
		Q911	2SD985		
		Q912	2SC945(P)	D951	DS135(D)
		Q913	2SC945(P)	D952	RD13EB3
		Q914	(Not used)	D953	RD11EB2
				D954	RD11EB2
		Q951	2SD985		
		Q952	2SC945(P)		
		Q953	2SD985		
		Q954	2SD985		

U751	MSM4011RS	Q751	2SA733P
Q751	1S2473	Q752	1S2473

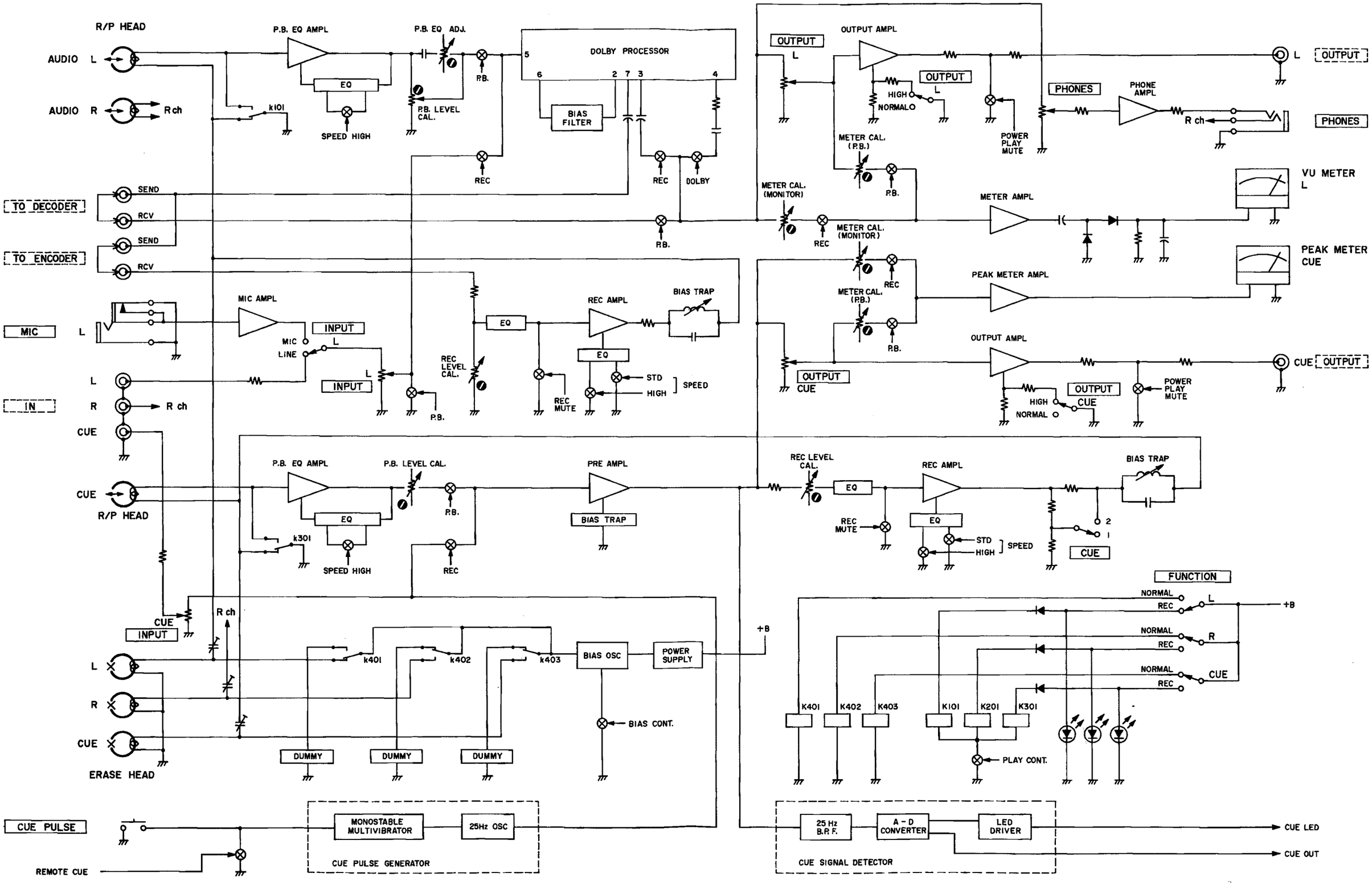
U404	MSM4049RS	D410	RD4.3EB
U405	MSM4013RS	D411	BZ056
U406	LM8523	D412	BZ056
U407	MSM4011RS		

NOTES

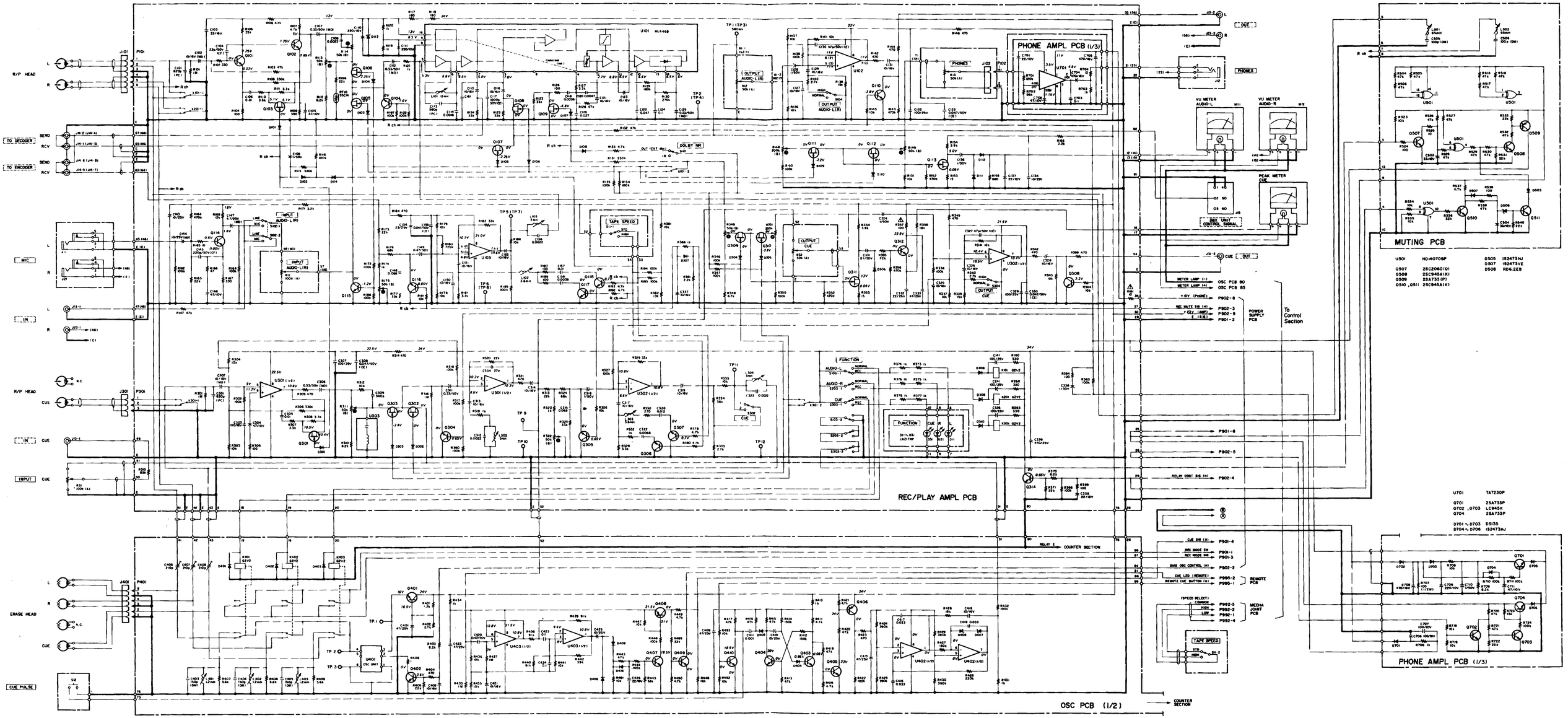
1. All resistors are 1/4 watt, ±5 %, unless marked otherwise. Resistor values are in ohms (k = 1,000 ohms).
2. All capacitor values are in microfarads (p = picofarads).
3. ⚠ Parts marked with this sign are safety critical components. They must always be replaced with identical components – refer to the TEAC parts list and ensure exact replacement.
4. ▭: front panel indication
5. ▭: rear panel indication
6. DC voltages are reference values.
   DC voltage measurement conditions
   - Measure with DC volt meter
   - Mode REC/PAUSE

MULTI-IMAGE STEREO PLUS CUE
CASSETTE RECORDER-REPRODUCER

10. BLOCK-DIAGRAM



Note: The ⊗ mark designates electronic switch.



REC/PLAY AMPL PCB

U101 (U201)	NE6468	Q101 (Q201)	2SC1844(F)	Q111 (Q211)	2SK117(GR)	Q301 ~ Q303	2SK117(GR)	D101 ~ D112
U102	TA7555BP	Q102 (Q202)	2SC900(UB)	Q112 (Q212)	2SK117(GR)	Q304, Q305	2SD655(E)	(D201 ~ D212)
U103	TA7555BP	Q103 (Q203)	2SK117(GR)	Q113 (Q213)	2SK117(GR)	Q306, Q307	LC945(K)	
		Q104 (Q204)	2SD655(E)	Q114 (Q214)	2SC1844(F)	Q308	2SC2878(B)	DI13 (D213)
U301	TL4558P	Q105 (Q205)	2SK117(GR)	Q115 (Q215)	LC945(K)	Q309 ~ Q311	2SK117(GR)	D114 (
U302	TA7555BP							
		Q106 (Q206)	2SK117(GR)	Q116 (Q216)	2SD655(E)	Q312	2SK637(II)	D301 ~ D307
		Q107 (Q207)	2SK117(GR)	Q117 (Q217)	LC945(K)	Q313	(Not used)	D308 ~ D313
		Q108 (Q208)	2SK117(GR)	Q118 (Q218)	LC945(K)	Q314	2SC2060(Q)	
		Q109 (Q209)	2SK117(GR)					
		Q110 (Q210)	2SC2878(B)					

OSC PCB (1/2)

U401	OSC UNIT	D401 ~ D403	05135
U402, U403	TA7555BP	D404, D405	152473
		D406, D407	FQA01-06S
D401, D402	2SC2060(Q)	D408, D409	152473
D403 ~ D405	LC945(K)	D410	152473
D406	2SA733(P)		
D407	LC945(K)		
D408	2SA733(P)		
D409, D410	LC945(K)		

MUTING PCB

U501	HD14070BP	D505	1S2473HJ
Q507	2SC2060(Q)	D507	1S2473VE
Q508	2SC945A(K)	D508	RD6.2ES
Q509	2SA733(P)		
Q510 ,Q511	2SC945A(K)		

U701 TA7230P

Q701	2SA733P
Q702 ,Q703	LC945K
Q704	2SA733P
D701 ~ D703	DSI35
D704 ~ D706	1S2473HJ

NOTES

1. All resistors are 1/4 watt, ±5 %, unless marked otherwise. Resistor values are in ohms (k = 1,000 ohms).
2. All capacitor values are in microfarads (p = picofarads).
3. ⚠ Parts marked with this sign are safety critical components. They must always be replaced with identical components – refer to the TEAC parts list and ensure exact replacement.
4. [ ]: front panel indication
5. [ ]: rear panel indication
6. DC voltages are reference values. DC voltage measurement conditions
   - Measure with DC volt meter
   - Mode REC/PAUSE