

TC-277-4

E Model
US Model
Canadian Model
GEP Model



**4-CHANNEL
STEREO TAPECORDER**

SPECIFICATIONS

Power Requirements:	AC 100, 110, 120, 127, 220, 240 V 50/60 Hz 30 W (General Export and GEP) AC 120 V 60 Hz, 30 W (USA and Canada)	Signal-to-Noise Ratio:	55 dB or better (with SONY SLH tape) 52 dB or better (with standard tape)									
Track System:	4 track 4 channel stereo	Flutter and Wow:	0.12 % at 7 1/2 ips (19 cm/s) WRMS									
Reel Size:	7" (18 cm) maximum	Recording Bias Frequency:	Approx. 120 kHz									
Tape Speed:	7 1/2 ips (19 cm/s), 3 3/4 ips (9.5 cm/s), 1 7/8 ips (4.8 cm/s)	Inputs:	Four MICROPHONE inputs Impedance : low impedance Maximum sensitivity : 0.2 mV (-72 dB) Four LINE INputs Impedance : 100 kΩ Maximum sensitivity : 0.06 V (-22 dB)									
Recording Time: (with 1,800 ft tape)	<table><thead><tr><th>Tape Speed</th><th>4 track 4 channel</th><th>4 track 2 channel</th></tr></thead><tbody><tr><td>7 1/2 ips (19 cm/s)</td><td>45 minutes</td><td>1.5 hours</td></tr><tr><td>3 3/4 ips (9.5 cm/s)</td><td>1.5 hours</td><td>3 hours</td></tr></tbody></table>	Tape Speed	4 track 4 channel	4 track 2 channel	7 1/2 ips (19 cm/s)	45 minutes	1.5 hours	3 3/4 ips (9.5 cm/s)	1.5 hours	3 hours	Outputs:	Four LINE OUTputs Impedance : 10 kΩ Output level : 0.775 V (0 dB) with 100 kΩ load HEADPHONE outputs Load impedance : 8 Ω Output level : 30.8 mV (-28 dB)
Tape Speed	4 track 4 channel	4 track 2 channel										
7 1/2 ips (19 cm/s)	45 minutes	1.5 hours										
3 3/4 ips (9.5 cm/s)	1.5 hours	3 hours										
Frequency Response:	With SONY SLH tape 30~23,000 Hz - 15 dB (19 cm/s 7 1/2 ips) 50~18,000 Hz ± 3 dB (19 cm/s 7 1/2 ips) 30~16,000 Hz - 15 dB (9.5 cm/s 3 3/4 ips) With standard tape 30~20,000 Hz - 15 dB (19 cm/s 7 1/2 ips) 50~13,000 Hz ± 3 dB (19 cm/s 7 1/2 ips) 30~13,000 Hz - 15 dB (9.5 cm/s 3 3/4 ips)	Semiconductors:	29 transistors and 11 diodes									
		Dimensions:	15 1/2 (W) x 15 1/16 (H) x 7 3/32 (D) (398 x 392 x 196 mm)									
		Weight:	23 1b 2 oz (10.5 kg)									

SONY
SERVICE MANUAL

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When ordering replacement parts, you should use PART NUMBER listed on the Parts List or shown in the EXPLODED VIEWS. The reference number should not be used for ordering purposes.

SECTION 1
OUTLINE

1-1. ADAPTATION TO THE LOCAL POWER LINE FREQUENCY
(General Export and GEP)

	50 Hz LINE	60 Hz LINE
frequency change switch (See Fig. 1-1)	50 Hz position	60 Hz position
capstan sleeve (See Fig. 1-2)	Put it on capstan.	Put it on capstan sleeve support.

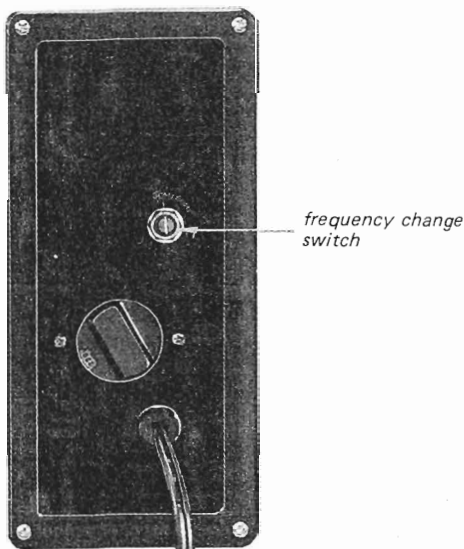


Fig. 1-1. Frequency change switch

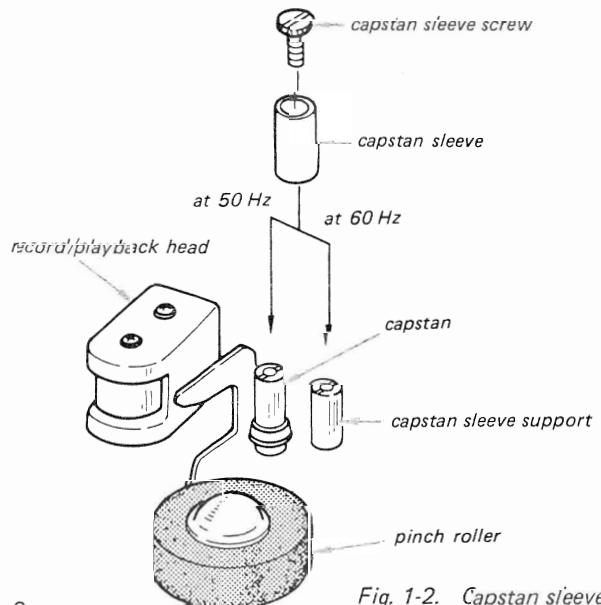
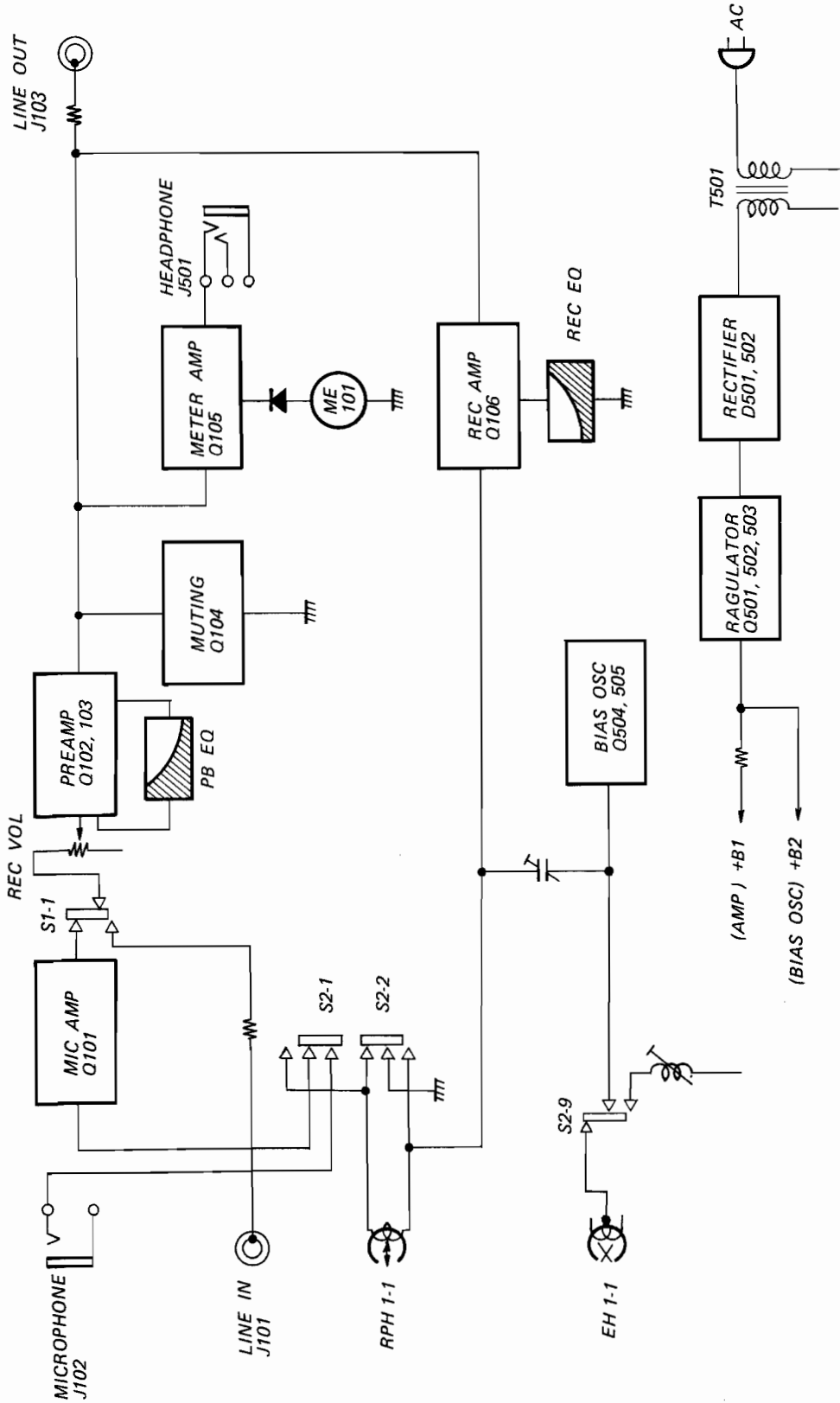


Fig. 1-2. Capstan sleeve

1-2. BLOCK DIAGRAM



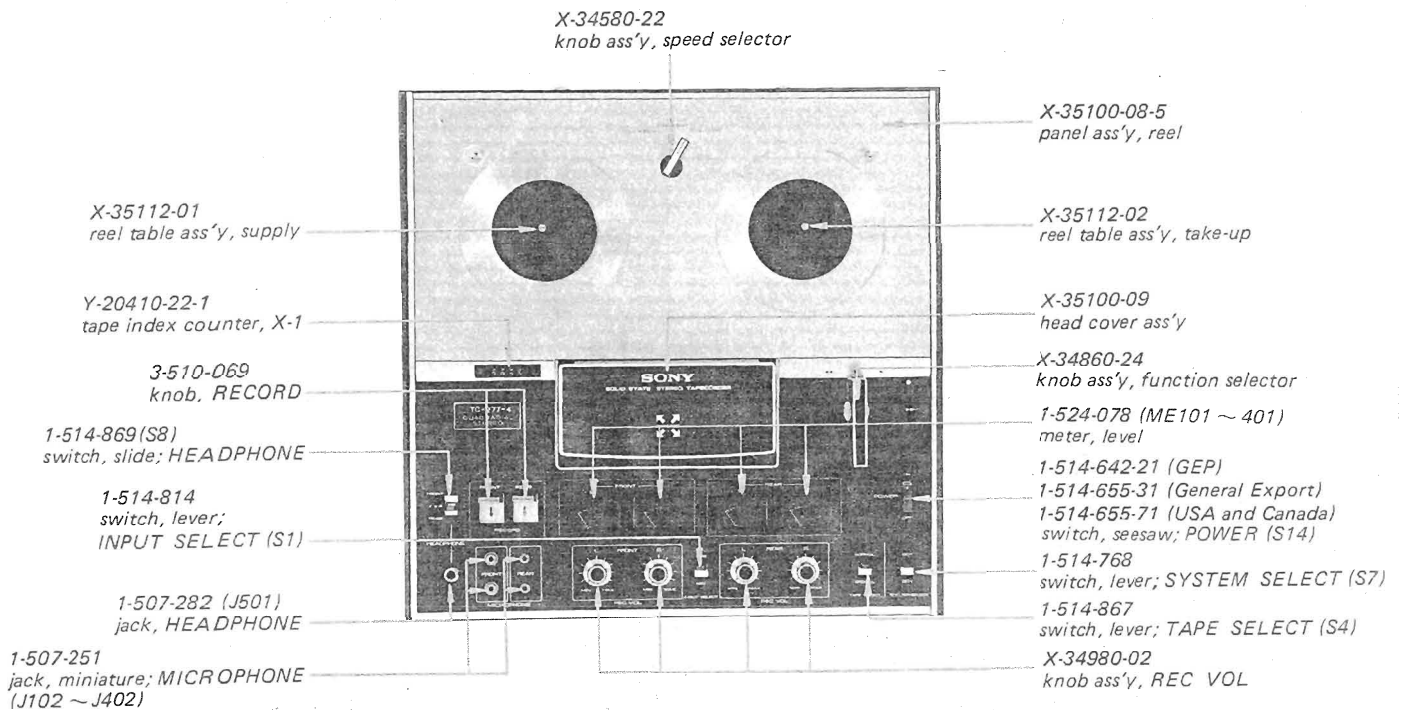
*S1 : INPUT SELECTOR SW (MIC POSI.)

*S2 : REC/PB SW (REC POSI.)

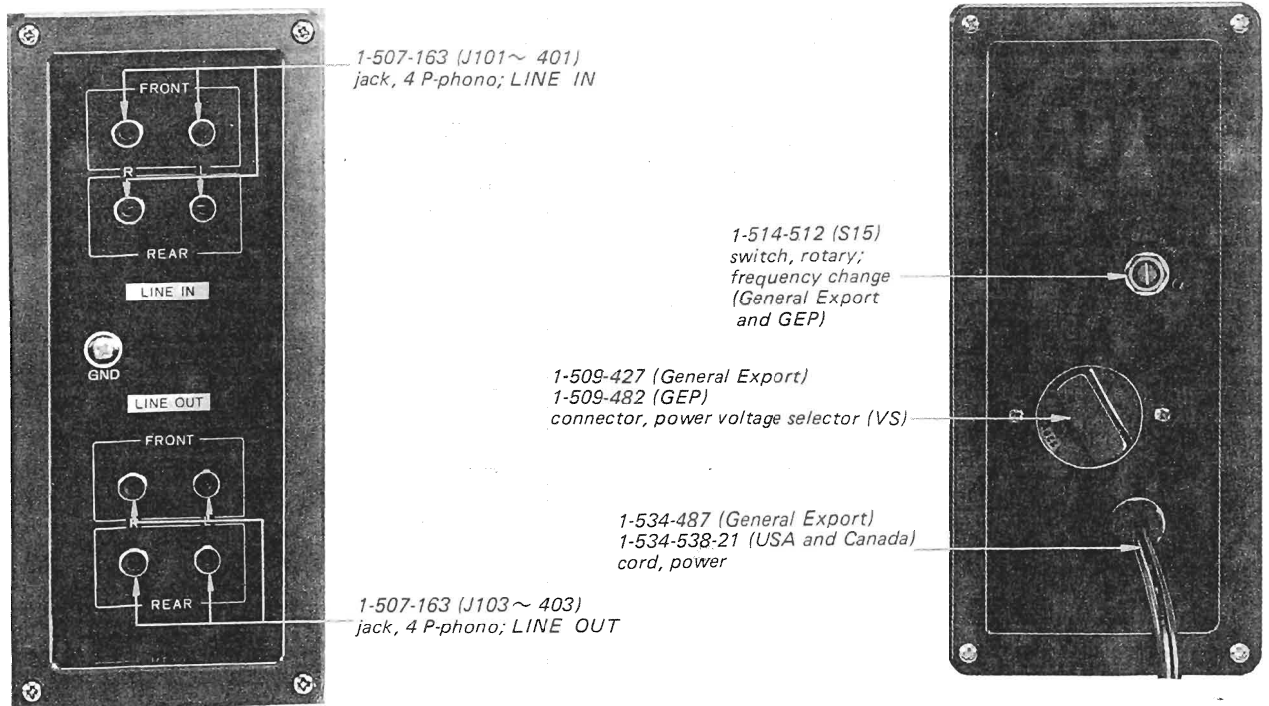
Note: This block diagram shows FRONT-L channel.
Other channels are identical.

1-3. MAJOR PARTS LOCATIONS

Cabinet — front view —

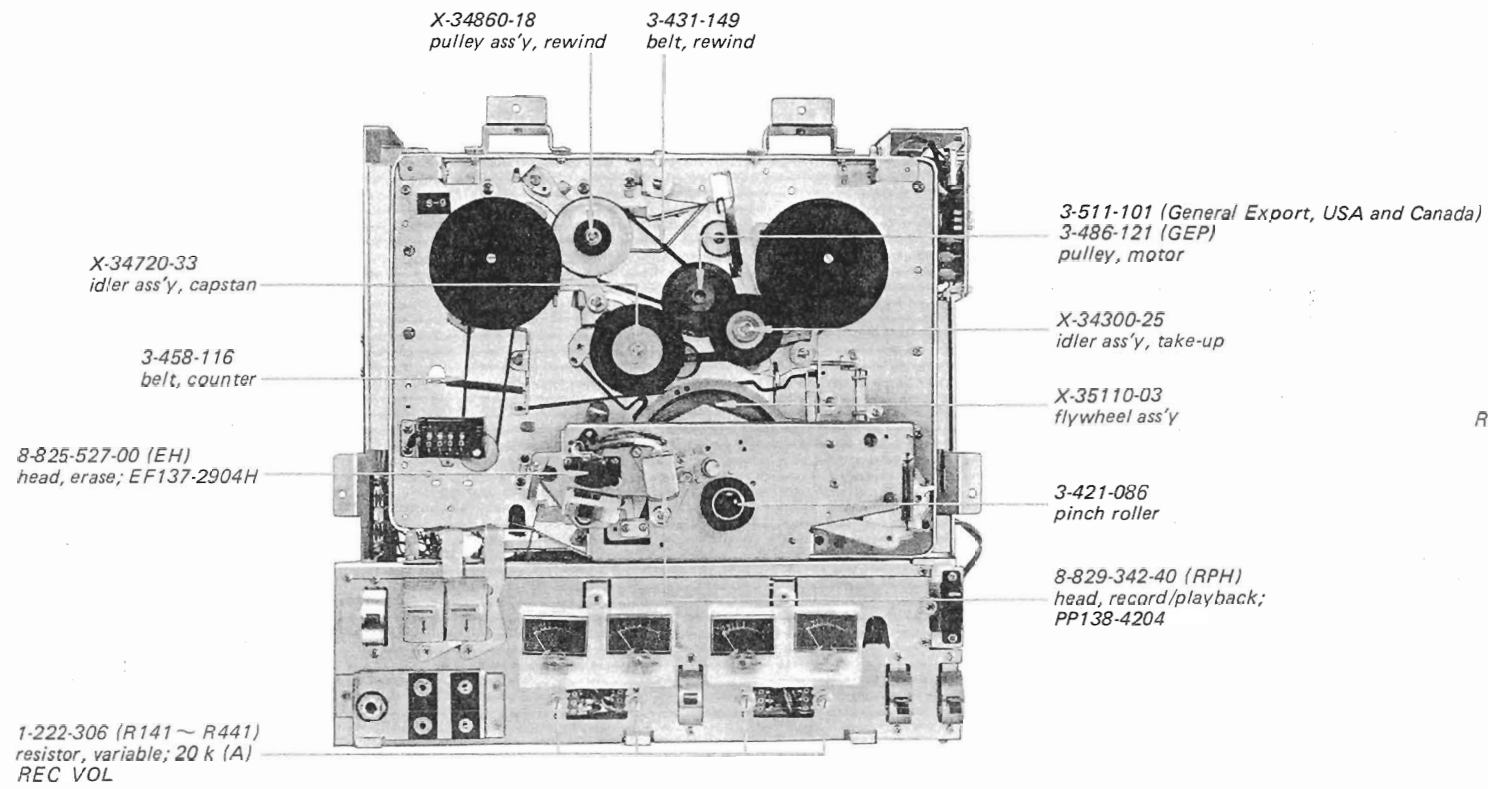


Jack Panel

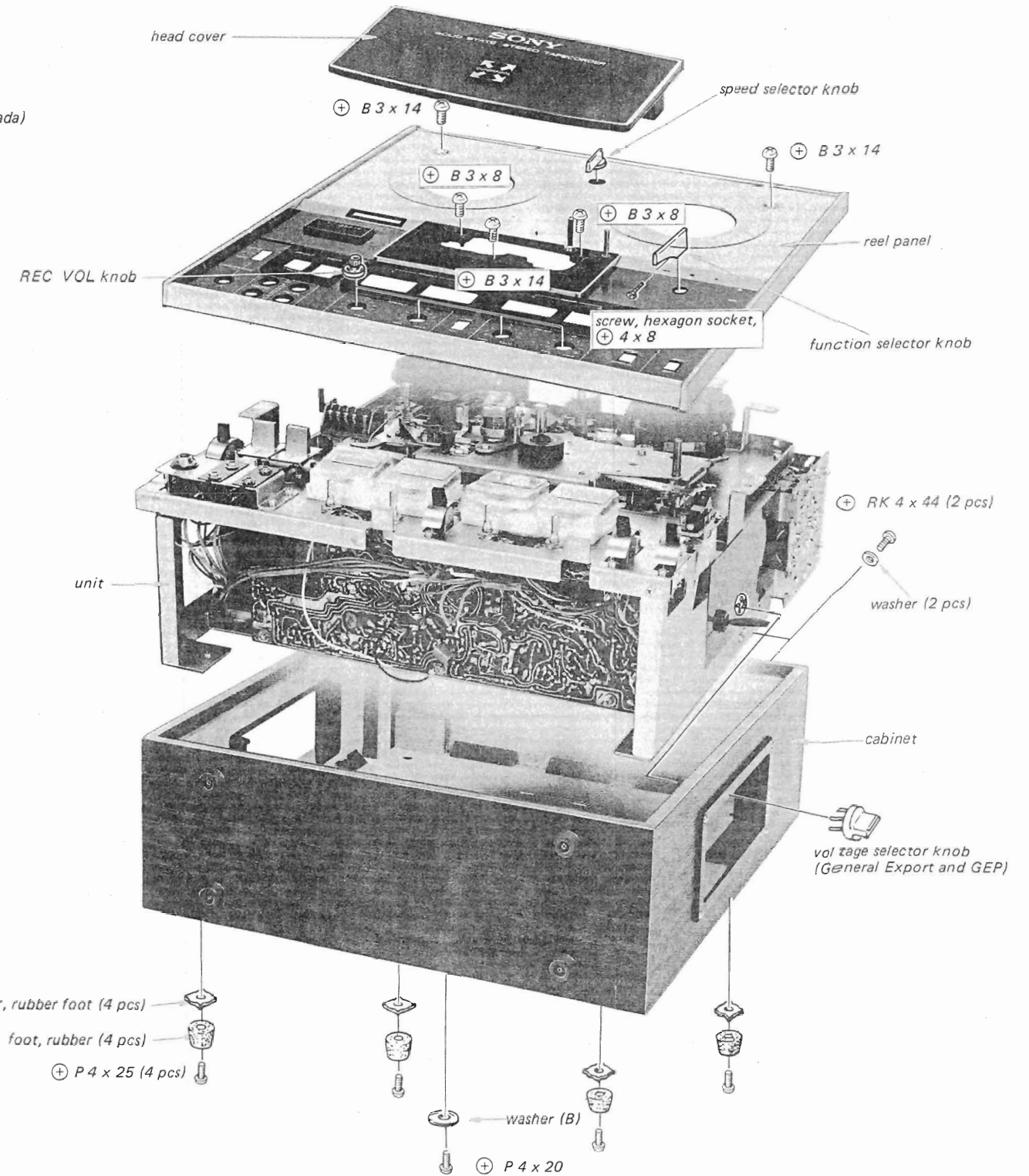
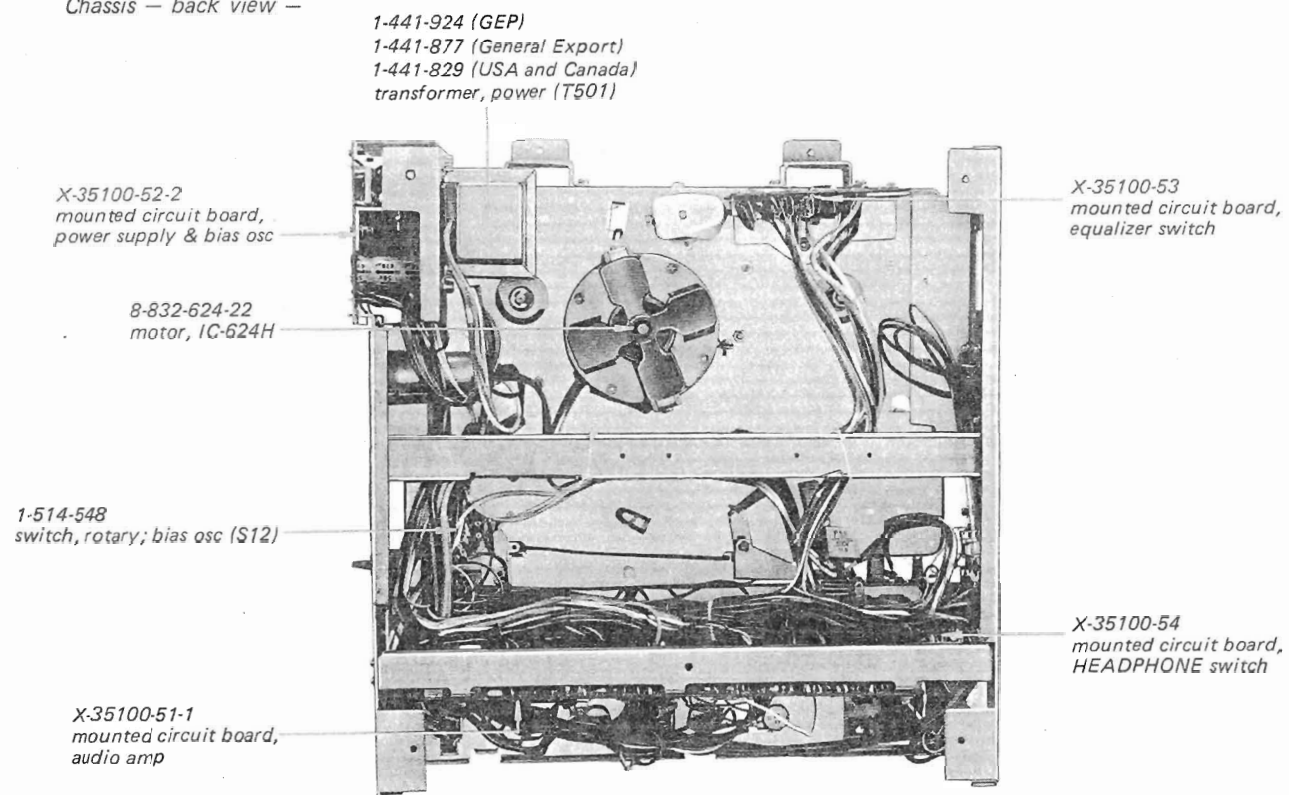


SECTION 2
DISASSEMBLY

Chassis — front view —



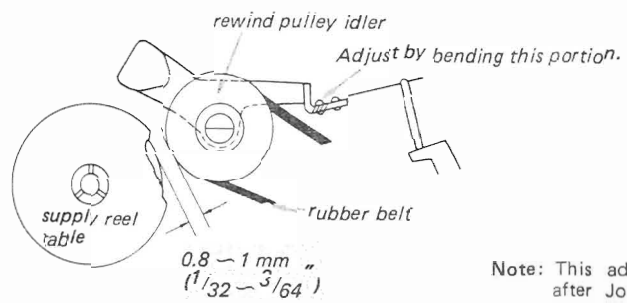
Chassis — back view —



SECTION 3
ADJUSTMENT PROCEDURES

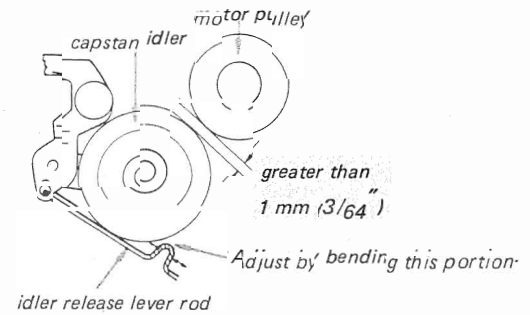
3-1. MECHANICAL ADJUSTMENTS

Rewind Pulley Adjustment
— in Stop Mode —

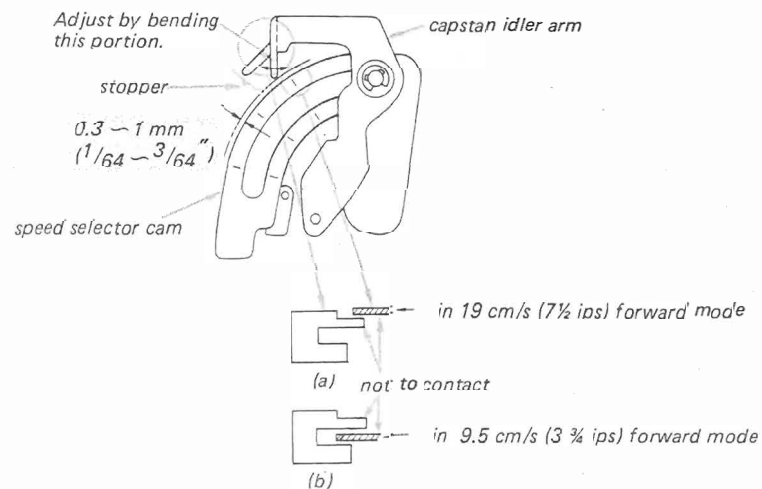


Note: This adjustment should be performed after Joint Lever Ass'y Adjustment on Page 9.

Capstan Idler and Motor Pulley Clearance Adjustment
— in 19 cm/s (7 1/2 ips) Stop Mode —

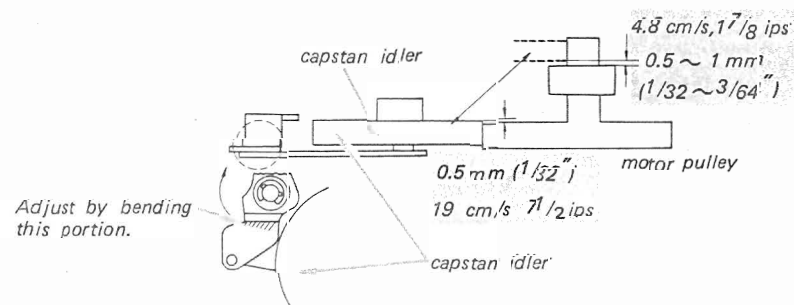


Capstan Idler Arm Stopper Adjustment

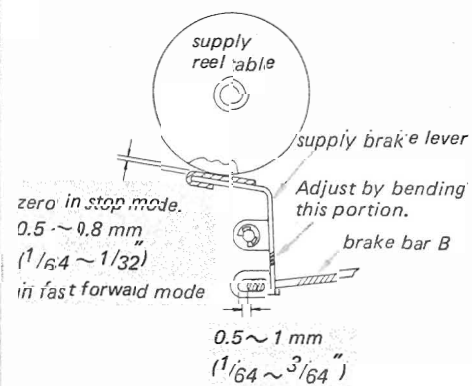


In 4.8 cm/s (1 7/8 ips) forward mode, idlers at the both sides of motor pulley should not contact.

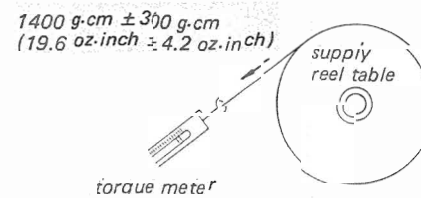
Capstan Idler Height Adjustment
— in Forward Mode —



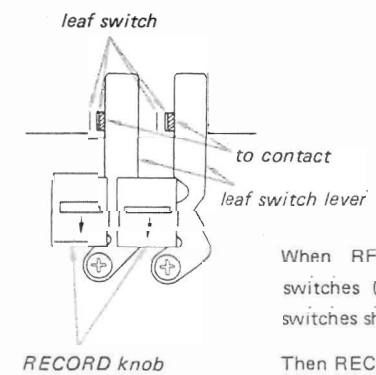
Brake (Supply) Adjustment
— in Stop Mode —



Brake Torque (Supply) Measurement
— in Stop Mode —



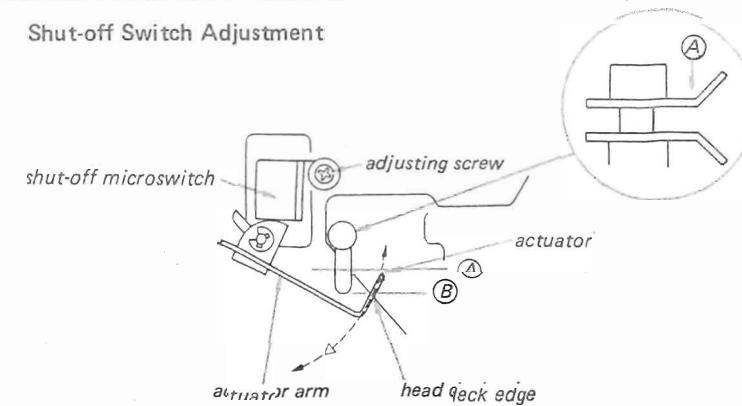
Leaf Switch Check



When RECORD knobs are depressed slide switches (S2, 3) should be changed and leaf switches should be turned on.

Then RECORD buttons are locked.

Shut-off Switch Adjustment

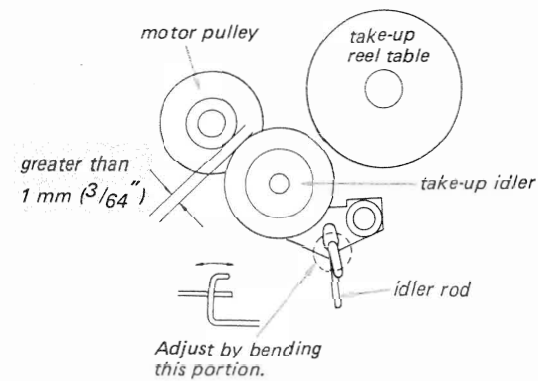


When actuator comes to the portion (A), shut-off microswitch should be turned ON.

When actuator comes to the portion (B), shut-off microswitch should be turned OFF.

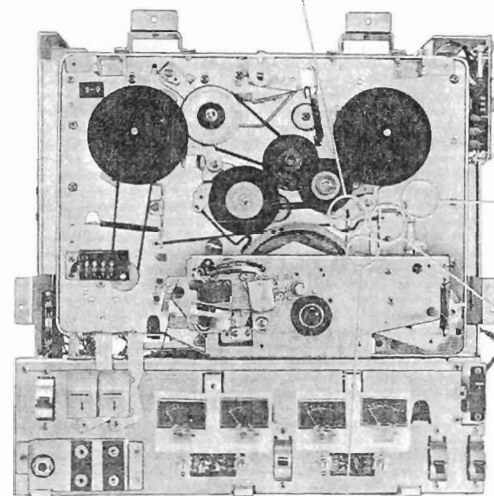
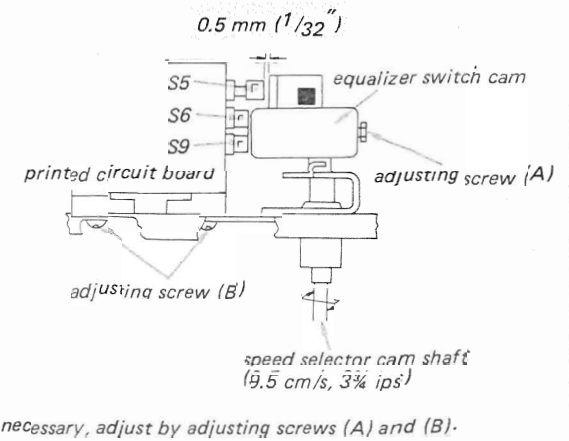
If necessary, adjust the position of shut-off microswitch by adjusting screw.

Take-up Idler Ass'y Adjustment
— in Stop Mode —

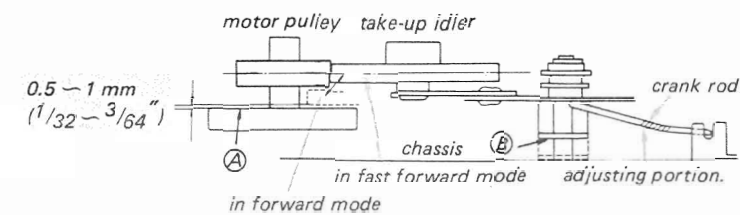


Equalizer Switch Adjustment

- | | | |
|---|---|--|
| 1.
— in 4.8 cm/s, 1 7/8 ips tape speed — | 2.
— in 9.5 cm/s, 3 3/4 ips tape speed — | 3.
— in 19 cm/s, 7 1/2 ips tape speed — |
| S5 : pushed | S5 : released | S5 : released |
| S6 : pushed | S6 : pushed | S6 : released |
| S9 : pushed | S9 : pushed | S9 : released |

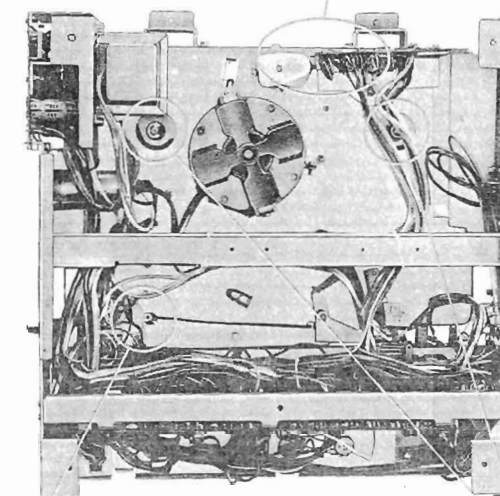


Take-up Idler and Motor Pulley Height Adjustment

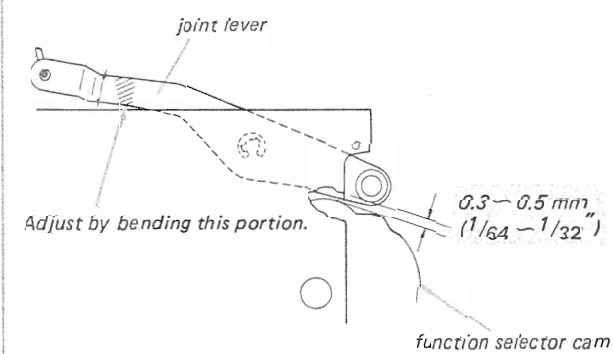


In fast forward mode, take-up idler should contact the center of motor pulley as shown. If necessary, adjust take-up idler height by bending adjusting portion.

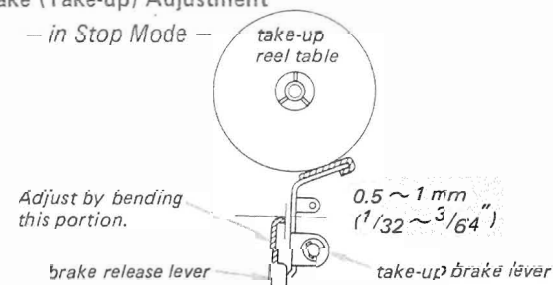
In forward mode, clearance between bottom of take-up idler and plain (A) should be 0.5~1 mm (1/32 ~ 3/64"), and (B) should contact chassis. If necessary, adjust motor pulley height.



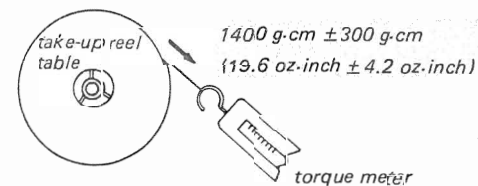
Joint Lever Ass'y Adjustment
— in Forward Mode —



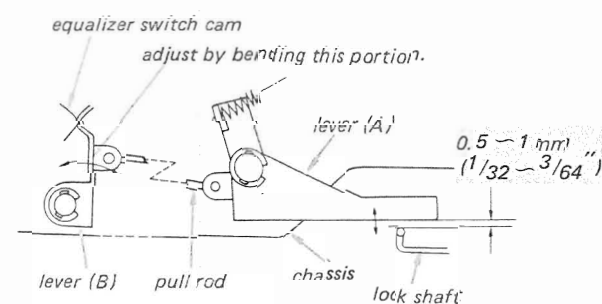
Brake (Take-up) Adjustment
— in Stop Mode —



Brake Torque (Take-up) Measurement
— in Stop Mode —

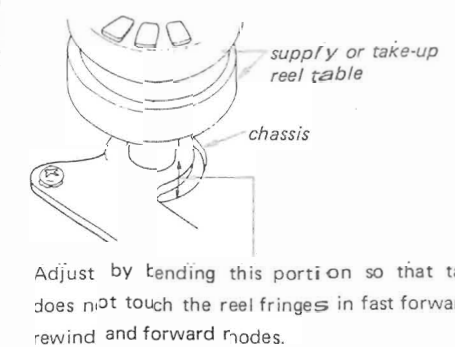


Record Mechanism Adjustment
— in Stop Mode —



Check to see that except in the stop mode, RECORD knobs cannot be depressed and that if RECORD knobs are depressed one by one, the other depressed RECORD knob is released.

Reel Table Angle Adjustment



3-2. ELECTRICAL ADJUSTMENTS/MEASUREMENTS

Precautions:

- Clean the following parts with alcohol moistened swab:
 - record/playback head
 - erase head
 - capstan
 - pinch roller
 - rubber belts
 - idlers
- Demagnetize record/playback and erase heads with a head demagnetizer.
- Do not use magnetized screwdrivers for the following adjustments.
- Apply locking compound to the parts after the following adjustments.
- Go through the adjustments in numerical order.
- Adjustments and measurements should be performed for each channel.
- 2-channel Stereo Recording.
 - Set SYSTEM SELECT switch to 2 CH.
 - Depress FRONT RECORD lever only.

Note: Do not depress REAR RECORD lever at this time, otherwise track 2 and 4 will be erased.

Equipment Required:

- audio oscillator (af osc)
- attenuator (att)
- VTVM
- 1-kHz band-pass filter (BPF)
- resistor 100 kΩ
- SONY alignment tapes

TAPE TONE	J-19-F2	J-9-F1
1	400 Hz (0 dB)	5 kHz (-10 dB)
2	400 Hz (-10 dB)	400 Hz (0 dB)
3	10 Hz (-10 dB)	400 Hz (-10 dB)
4	12.5 kHz (-10 dB)	5 kHz (-10 Hz)
5	7 kHz (-10 dB)	3 kHz (-10 dB)
6	80 Hz (-10 dB)	160 Hz (-10 dB)
7	40 Hz (-10 dB)	80 Hz (-10 dB)

Normal Input Level

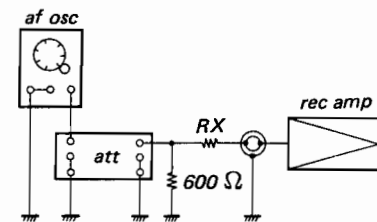
	MICROPHONE	LINE IN
signal source impedance	600 Ω	10 kΩ
input signal level	-60 dB (0.77 mV)	-10 dB (0.24 V)

Normal Output Level

	LINE OUT
load resistor	100 kΩ
output level	0 dB (0.775 V)

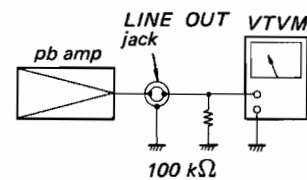
Equipment Connections:

Input Connection:



RX
MICROPHONE... 600 Ω
LINE IN..... 10 kΩ

Output Connection:



Standard Control/Switch-Setting:

REC VOLUME Control:

After the playback output level adjustment and level meter calibration, set REC VOL control for 0 VU on level meter with normal input.

TAPE SELECT Switch:
NORMAL

TAPE SPEED Switch:
7 1/2 19 cm

SYSTEM SELECT Switch:
4 CH

unless otherwise indicated.

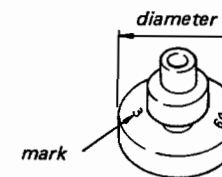
1. Tape Speed Adjustment (9.5 cm/s)

Procedure:

- Connect a frequency counter to the LINE OUT jack.
- Play back the SONY speed check tape SPC-47 (4 kHz) at 7 1/2 ips (19 cm/s) tape speed in horizontal position.

Note: If the counter reading is out of the range between 3920 and 4080 Hz, replace the motor pulley.

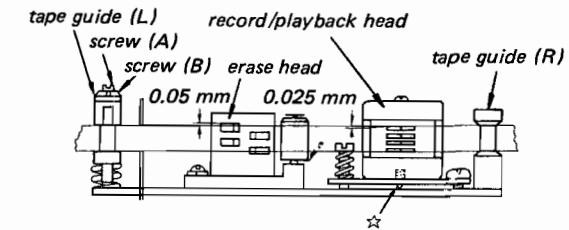
Motor Pulley		
Mark	Diameter	Part No.
2	bigger	3-511-101-01
3	↑	3-511-101-11
4		3-511-101-21
5	↓	3-511-101-31
6		3-511-101-41



2. Tape Path Adjustment

2-1. Tape Guide Adjustment

Setup:



Procedure:

- Loosen the inner screw (A) of the tape guide L.
- Adjust the outer screw (B) so that the top edge of the erase head core is just visible above the top edge of the tape.
- Turn the outer screw (B) 35 degrees clockwise.
- Fix the tape guide by turning the inner screw (A) clockwise. Then the core top edge comes 0.05 mm higher than the tape top edge.

2-2. Record/Playback Head Temporary Adjustment

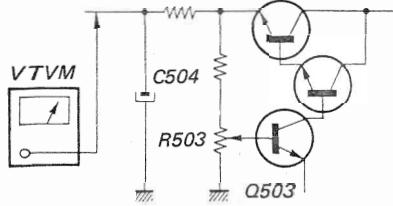
- Note:**
- Repeat azimuth, zenith and height adjustments because these adjustments are related each other.
 - After this temporary adjustment, perform the electrical adjustments 4, 5 on Page 13.

Procedure:

- Adjust by turning the two screws marked ☆ evenly so that the cores fit to the middle of tape width. After that, perform the azimuth adjustment.
- Turn the two screws marked ☆ the same turns in the same direction so that the top edge of the record/playback head core is just visible above the top edge of the tape.
- Turn the screw marked ☆ 15 degrees clockwise. Then the core top edge of the record/playback head comes 0.025 mm lower than the tape top edge.

3. Power Voltage Adjustment

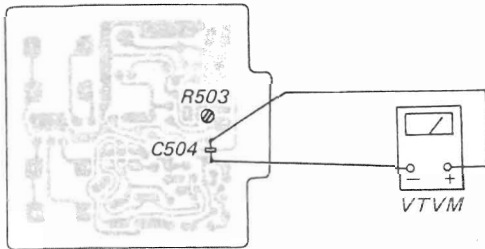
Setup:



Procedure:

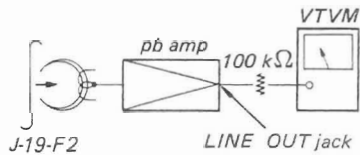
1. Use 120 V ac regulated power source.
2. Adjust semi-fixed resistor R503 so that voltage across capacitor C504 is $26\text{ V} \pm 0.5\text{ V}$ on VTVM.

Adjusting Parts Location - Conductor Side -



4. Record/Playback Head Zenith Adjustment

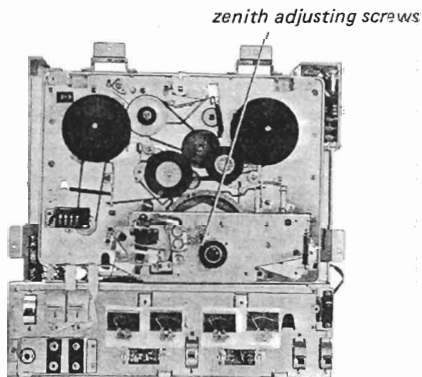
Setup:



Procedure:

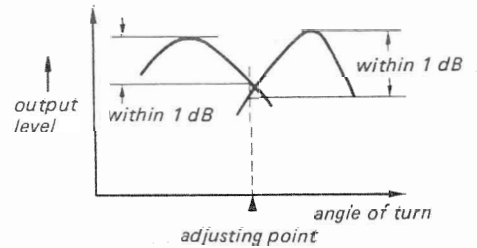
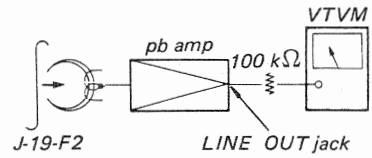
1. Play 4th tone (12.5 kHz) on SONY alignment tape J-19-F2.
2. Adjust the zenith adjusting screws for maximum VTVM reading.

Adjusting Parts Location



5. Record/Playback Head Azimuth Adjustment

Setup:

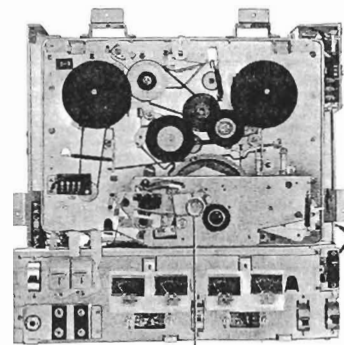


Procedure:

1. Play 4th tone (12.5 kHz) on SONY alignment tape J-19-F2.
2. Adjust the azimuth adjusting screw for the biggest peak VTVM reading.

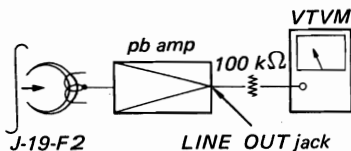
- Note:
1. If you turn the azimuth adjusting screw more than one turn, perform tape path adjustment (page 12) again.
 2. If you cannot obtain the biggest peak reading for each channel at one screw position, take the mid between the both extreme positions of the screw, and the difference between each extreme peak level and the adjusted output level should be within 1 dB difference. If the difference is more than 1 dB, perform record/playback head zenith adjustment. If you still cannot obtain desired result, change the record/playback head.

Adjusting Parts Location



6. Playback Output Level Adjustment and Level Meter Calibration

Setup:



Procedure:

1. Play 1st tone (400 Hz) on SONY alignment tape J-19-F2.
2. Adjust semi-fixed resistors R113, 213, 313, 413 for 0 dB (0.775 V) VTVM reading and then adjust semi-fixed resistors R131, 231, 331, 431 for 0 VU on the level meter.

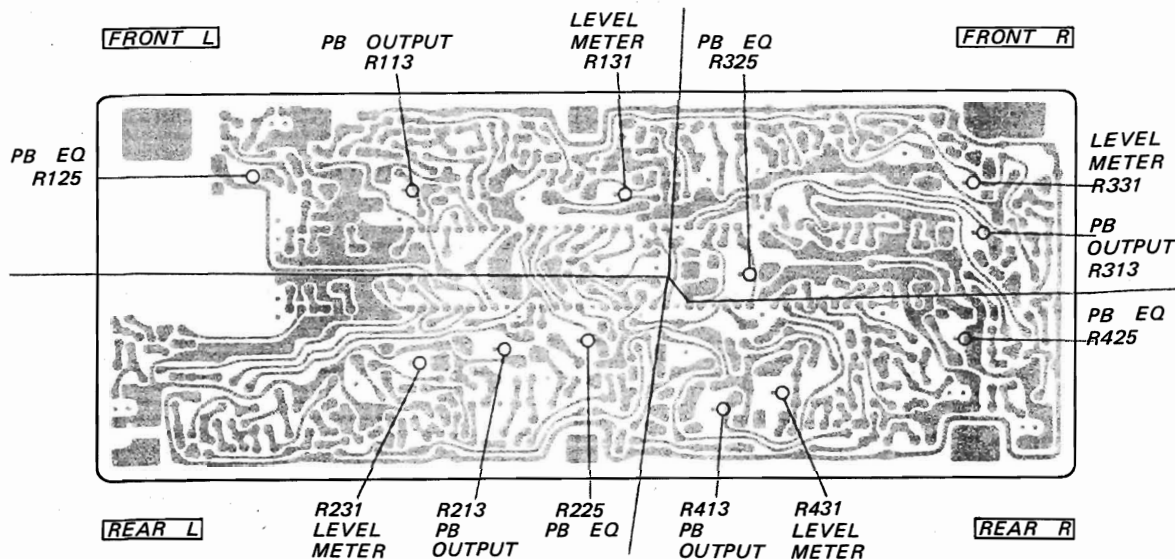
Note: 1. When changing the TAPE SELECT switch to SPECIAL, the LINE OUTPUT level will decrease as follows.

FRONT:	-1.3 dB ± 0.5 dB
	(0.6 ~ 0.7 V)
REAR:	-2.7 dB ± 0.5 dB
	(0.5 ~ 0.6 V)

2. When changing the SYSTEM SELECT switch to 2 CH, REAR level meters will not work.

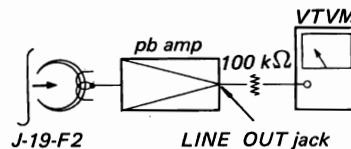
Adjusting Parts Location

- Conductor Side -



7. Playback Equalizer Adjustment (19 cm/s 7½ ips)

Setup:



Procedure:

1. Play 2nd tone (400 Hz) on SONY alignment tape J-19-F2.
2. Read the output level.
3. Play 3rd tone (10 kHz) on the alignment tape.
4. Adjust the semi-fixed resistors R125, 225, 325, 425 for the same output level as the step 2.

Note: Playback frequency response should be as follows:

19 cm/s (7½ ips) J-19-F2

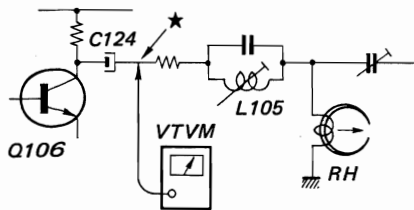
	2nd (400 Hz)	3rd (10 kHz)	4th (12.5 kHz)	5th (7 kHz)	6th (80 Hz)	7th (40 Hz)
output level	standard	0 dB	0 ± 2 dB		+2 ± 2 dB	+3 ± 2 dB

9.5 cm/s (3¾ ips) J-9-F1

	3rd (400 Hz)	4th (5 kHz)	5th (3 kHz)	6th (160 Hz)	7th (80 Hz)
output level	standard	0 ± 2 dB		+1 ± 2 dB	+1.5 ± 2 dB

8. Bias Trap Coil Adjustment (1)

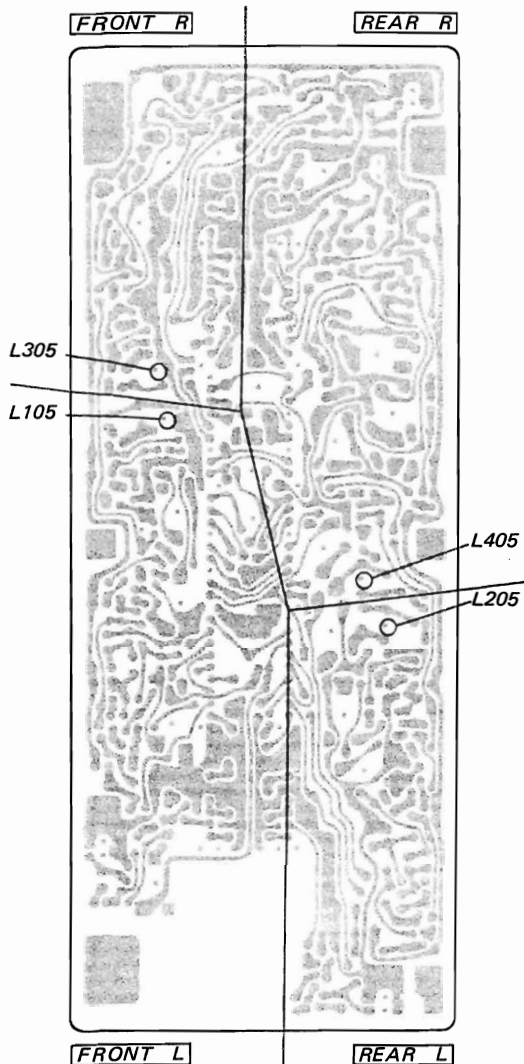
Setup:



Procedure:

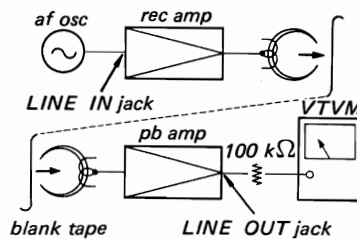
1. Place the unit in 4-channel record mode.
2. Turn REC VOL control fully counterclockwise (MIN).
3. Adjust bias trap coil so that the voltage of ★ position is minimum on VTVM.
4. Perform above adjustments for all channels.

Adjusting Parts Location — Conductor Side —



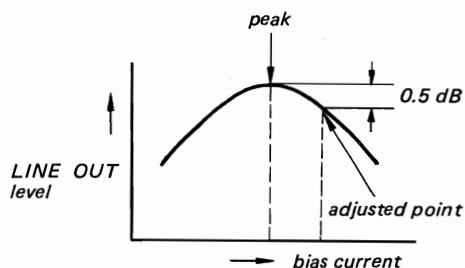
9. Recording Bias Adjustment

Setup:



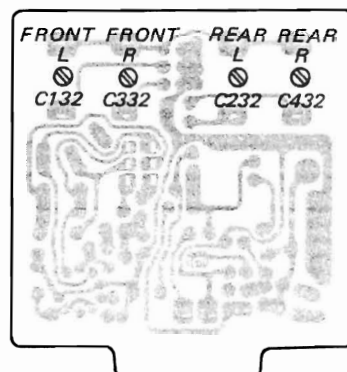
Procedure:

1. Set REC VOL control to standard setting (Page 11) and loosen the trimmer capacitor.
2. Record a 1 kHz signal of -10 dB (0.24 V) through LINE IN jack.
3. Play back the recorded signal.
4. Repeating Step 2 and Step 3, adjust by turning the trimmer capacitor clockwise for 0.5 dB below and beyond the maximum reading as shown below.



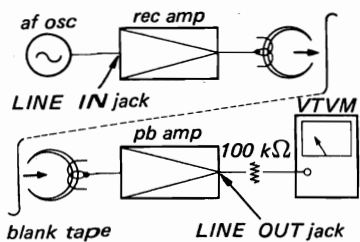
Adjusting Parts Location

— Conductor Side —



10. Dummy Coil Adjustment

Setup:

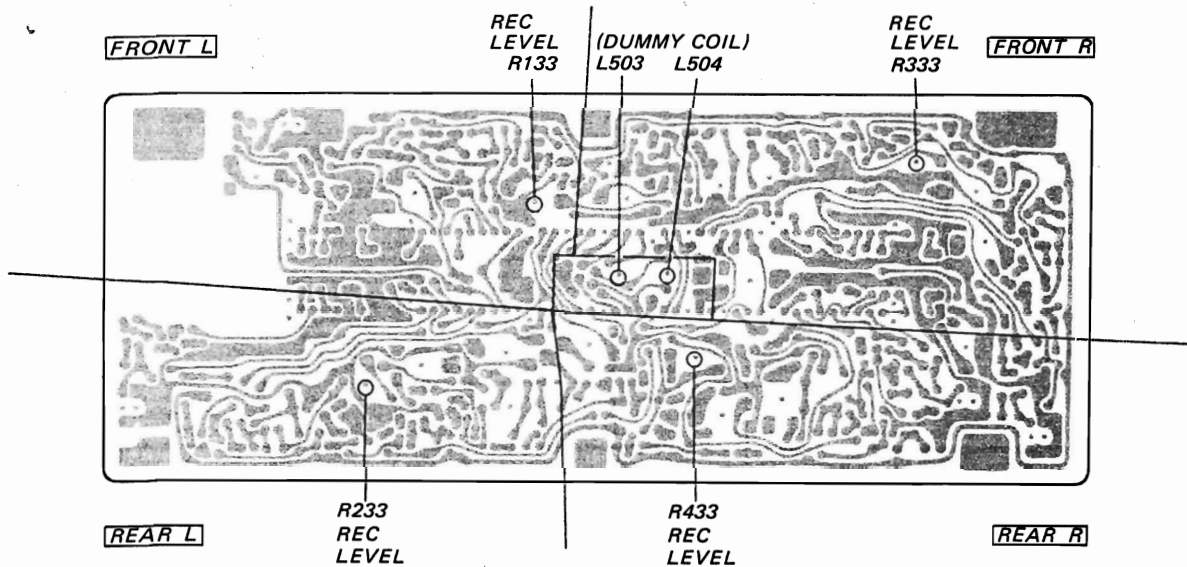


Procedure:

1. Record a 10 kHz signal of -20 dB (77 mV) through the LINE IN jack.
2. Playback the recorded signal.
3. Repeating Step 1 and Step 2, adjust REC VOL control so that each channel LINE OUT level is the same.
4. Set HEADPHONE switch to FRONT and change SYSTEM SELECT switch to 2 CH.
5. Adjust dummy coils L504 (L503) so that FRONT (REAR) LINE OUT level is the same as Step 3.

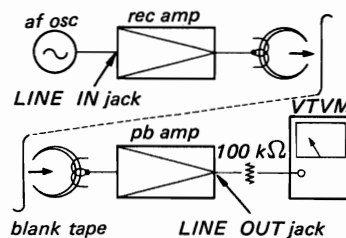
Adjusting Parts Location

- Conductor Side -



11. Record Level Adjustment

Setup:

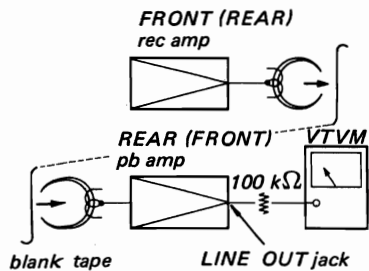


Procedure:

1. Record a 1 kHz of -10 dB (0.24 V) through the LINE IN jack.
2. Turn REC VOL control for 0 VU on the level meter.
3. Play back the recorded signal and read the output level.
4. Repeating Step 1 and Step 3, adjust the semi-fixed resistors R133, 233, 333, 433 for 0 dB (0.775 V) VTVM reading.

12. Bias Trap Coil Adjustment (2)

Setup:

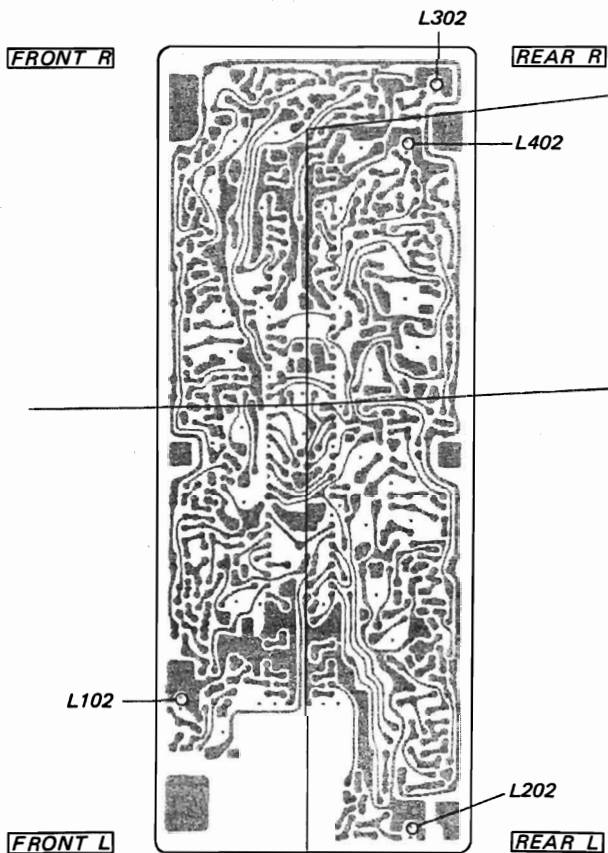


Procedure:

1. Turn all REC VOL controls fully clockwise (MAX).
2. Set REAR (FRONT) channels in record mode and FRONT (REAR) channels in playback mode.
3. Adjust bias trap coil L102, L302 (L202, L402) for minimum VTVM reading.

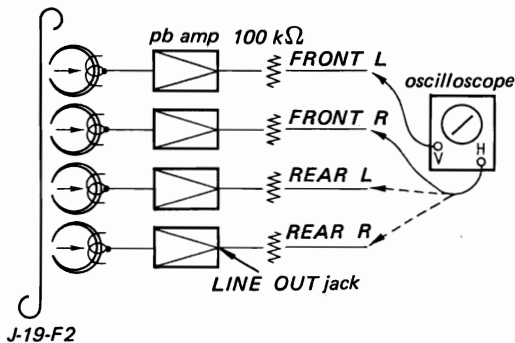
() : REAR channel.

Adjusting Parts Location – Conductor Side –



13. Phasing Measurement

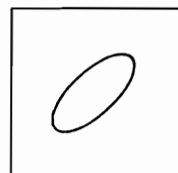
Setup:



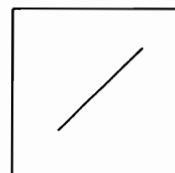
J-19-F2

Procedure:

1. Playing 1st tone 400 Hz on SONY alignment tape J-19-F2, LINE OUTPUT level should be in phase on oscilloscope as shown in figure below.
2. Connecting oscilloscope to HEADPHONE jack, repeat Step 1.



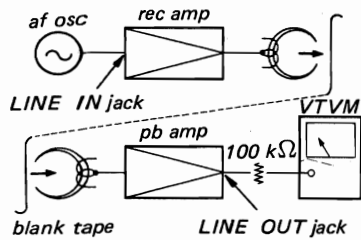
out-of-phase



in-phase

14. Minimum Input Level Measurement

Setup:



Procedure:

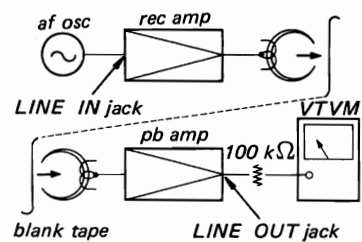
1. Turn REC VOL control fully clockwise (MAX).
2. Record a 1 kHz signal of -22 dB (62 mV) through the LINE IN jack.
3. Play back the recorded signal.
4. Measure the LINE OUTPUT level.

Specification:

greater than 0 dB (0.77 V)

15. Overall Frequency Response Measurement

Setup:



Procedure:

1. Set REC VOL control to standard setting (Page 11).
2. Record 50 Hz, 100 Hz, 1 kHz, 5 kHz, 7 kHz, 12.5 kHz and 18 kHz of -20 dB (77.5 mV) through the LINE IN jack.
3. Play back the signals and make sure that each deviation from the 1 kHz signal level is within the specified values.

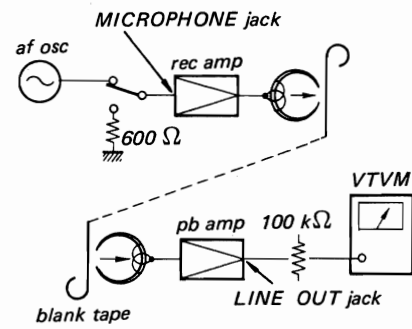
Specification (NORMAL, SPECIAL)

speed tone	7½ ips (19 cm/s)	3¾ ips (9.5 cm/s)
50 Hz	-4 ~ +2 dB	-
100 Hz	± 3 dB	± 3 dB
1 kHz	0 dB	0 dB
5 kHz	± 3 dB	± 3 dB
7 kHz	± 3 dB	± 3 dB
12.5 kHz	± 3 dB	-
18 kHz	-6 ~ +3 dB	-

Note: Use SLH tape for SPECIAL.

16. Overall S/N Ratio Measurement

Setup:



Procedure:

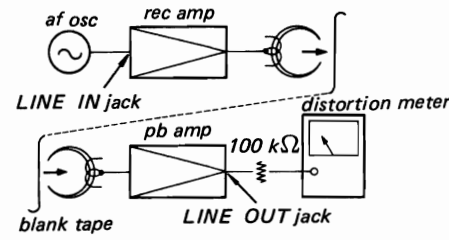
1. Record a 1 kHz signal of -60 dB (0.77 mV) through the MICROPHONE jack with REC VOL control set to 0 VU on the level meter.
2. Terminate the LINE IN jack with a 600 Ω resistor.
3. Continue recording with no input signal.
4. Play back the signal recorded portion and no signal recorded portion, and measure the output level difference between the two portions.

Specification:

greater than 46 dB

17. Overall Distortion Measurement

Setup:



Procedure:

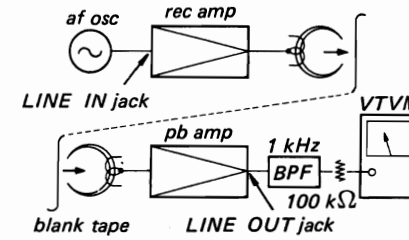
1. Record a 1 kHz signal of -10 dB (0.24 V) through the LINE IN jack with REC VOL control set to 0 VU on the level meter.
2. Play back the signal and measure distortion.

Specification:

less than 1.5 %

18. Erase Ratio Measurement

Setup:



Procedure:

1. Set REC VOL controls to standard setting (Page 11).
2. Record a 1 kHz signal of 0 dB (0.77 V) through the LINE IN jack in the 2-channel stereo record mode.
3. Rewind a half of recorded tape.
4. Disconnect the input connection and turn REC VOL controls fully counterclockwise.
5. Erase the tape by recording with no input signal.
6. Play back the signal recorded portion and the erased portion, and measure the output level difference between the two portions through a 1 kHz bandpass filter (BPF).

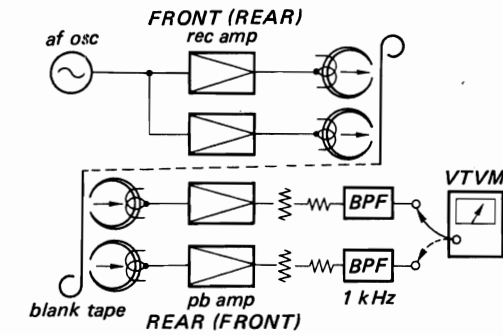
Specification:

greater than 65 dB

Note: This adjustment should be performed for FRONT channels and for REAR channels respectively.

19. Crosstalk Measurement (between channels)

Setup:



Procedure:

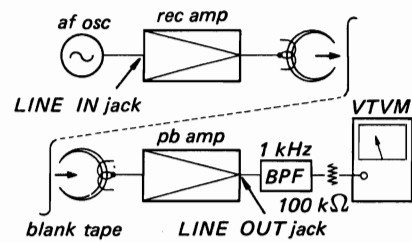
1. Set FRONT (REAR) REC VOL controls to standard setting (Page 11).
2. Place the unit in the 4-channel record mode.
3. Record a 1 kHz signal of 0 dB (0.77 V) through the FRONT (REAR) LINE IN jack.
4. Play back the tape and measure the level difference between REAR (FRONT) channel output level and FRONT (REAR) channel output level through a 1 kHz bandpass filter (BPF).

Specification:

greater than 45 dB

18. Erase Ratio Measurement

Setup:



Procedure:

1. Set REC VOL controls to standard setting (Page 11).
2. Record a 1 kHz signal of 0 dB (0.77 V) through the LINE IN jack in the 2-channel stereo record mode.
3. Rewind a half of recorded tape.
4. Disconnect the input connection and turn REC VOL controls fully counterclockwise.
5. Erase the tape by recording with no input signal.
6. Play back the signal recorded portion and the erased portion, and measure the output level difference between the two portions through a 1 kHz bandpass filter (BPF).

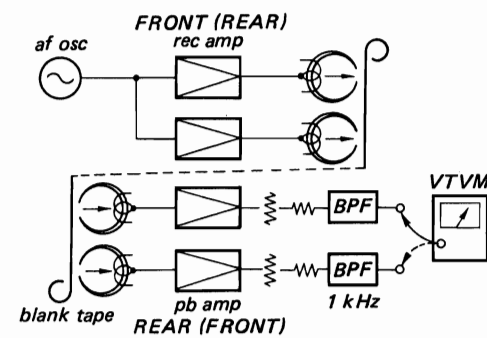
Specification:

greater than 65 dB

Note: This adjustment should be performed for FRONT channels and for REAR channels respectively.

19. Crosstalk Measurement (between channels)

Setup:



Procedure:

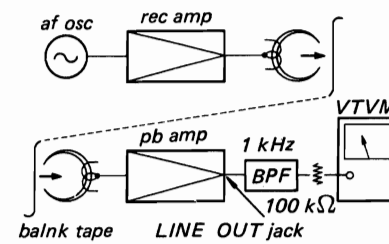
1. Set FRONT (REAR) REC VOL controls to standard setting (Page 11).
2. Place the unit in the 4-channel record mode.
3. Record a 1 kHz signal of 0 dB (0.77 V) through the FRONT (REAR) LINE IN jack.
4. Play back the tape and measure the level difference between REAR (FRONT) channel output level and FRONT (REAR) channel output level through a 1 kHz bandpass filter (BPF).

Specification:

greater than 45 dB

19. Crosstalk Measurement (between tracks)

Setup:



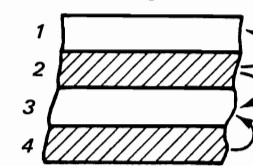
Procedure:

1. Set FRONT REC VOL controls to standard setting. (Page 11).
2. Turn REAR REC VOL controls fully counterclockwise (MIN).
3. Record a 1 kHz signal of 0 dB (0.77 V) through the FRONT LINE IN jack in the 2-channel stereo record mode.
4. Play back the signal and note the VTVM reading.
5. Reverse tape threading and play back the opposite and adjacent tracks of the recorded tape.
6. Note the VTVM reading.
7. Measure the level difference between Step 4 and Step 6.

Specification:

greater than 50 dB

crosstalk on tape after being reversed



21. Wow (Flutter) Measurement

Switch Settings

TAPE SELECT Switch : NORMAL
MONITOR Switch : TAPE

at 7½ ips (19 cm/s) and 3¾ ips (9.5 cm/s)

Measure the wow (flutter) at the tape end in both vertical and horizontal set positions.

7½ ips (19 cm/s) : Play back the tape WS-19-7.

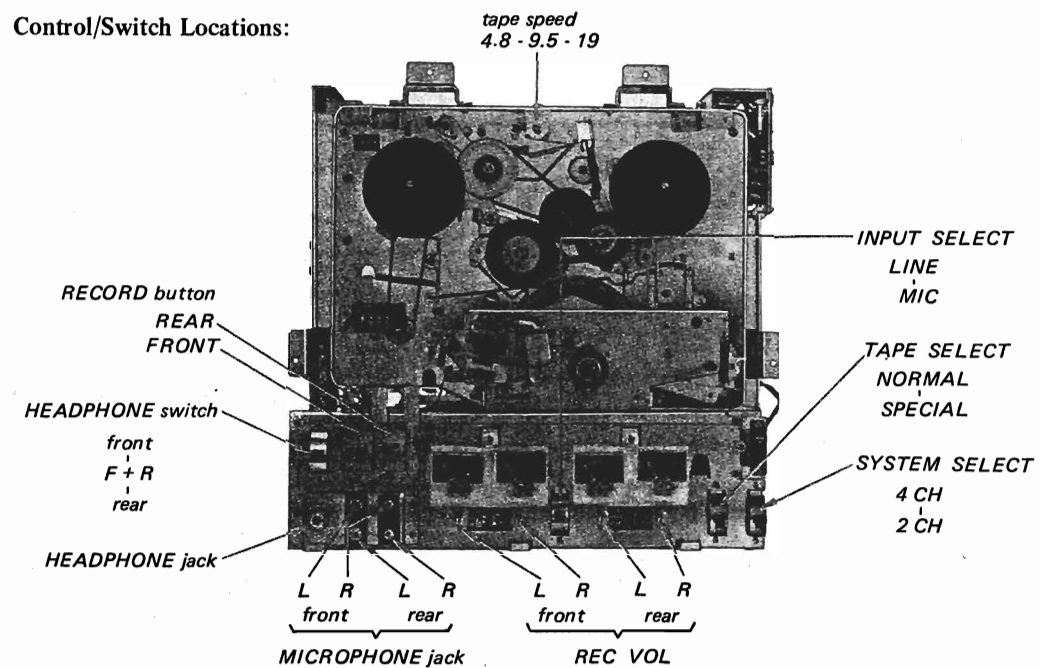
3¾ ips (9.5 cm/s) : Play back the tape WS-9-7.

at 1⅞ ips (4.8 cm/s)

Deliver a 3 kHz signal of -60 dB (0.775 mV) to the MICROPHONE jack, record the signal on a SONY blank tape "super 150" at the end approx. five minutes and read the wow meter.

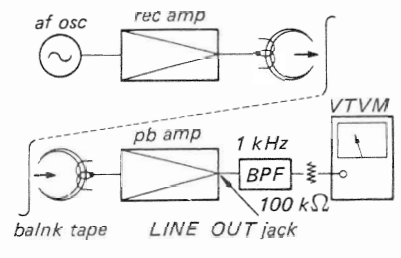
	Tape Speed	Wow (Flutter)
in both horizontal or vertical position	7½ ips (19 cm/s)	0.19 % RMS
	3¾ ips (9.5 cm/s)	0.24 % RMS
	1⅞ ips (4.8 cm/s)	0.3 % RMS

Control/Switch Locations:



19. Crosstalk Measurement (between tracks)

Setup:

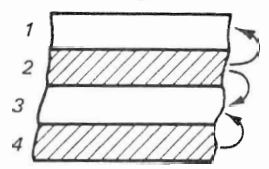


Procedure:

1. Set FRONT REC VOL controls to standard setting. (Page 11).
2. Turn REAR REC VOL controls fully counter-clockwise (MIN).
3. Record a 1 kHz signal of 0 dB (0.77 V) through the FRONT LINE IN jack in the 2-channel stereo record mode.
4. Play back the signal and note the VTVM reading.
5. Reverse tape threading and play back the opposite and adjacent tracks of the recorded tape.
6. Note the VTVM reading.
7. Measure the level difference between Step 4 and Step 6.

Specification: greater than 50 dB

crosstalk on tape after being reversed



21. Wow (Flutter) Measurement

Switch Settings

TAPE SELECT Switch : NORMAL
 MONITOR Switch : TAPE

at 7½ ips (19 cm/s) and 3¾ ips (9.5 cm/s)

Measure the wow (flutter) at the tape end in both vertical and horizontal set positions.

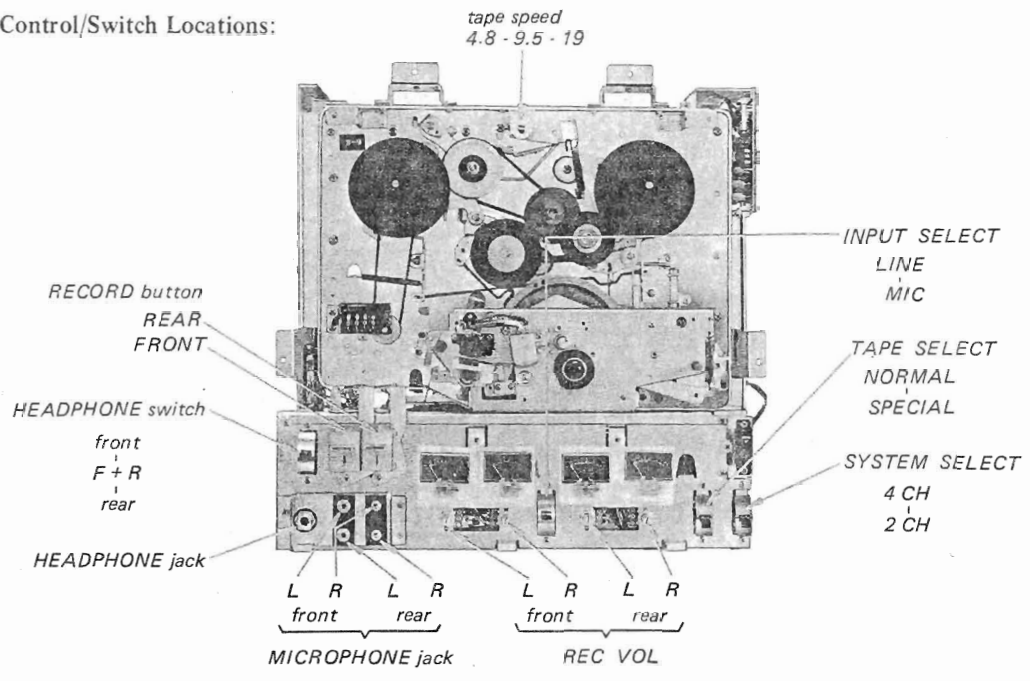
- 7½ ips (19 cm/s) : Play back the tape WS-19-7.
- 3¾ ips (9.5 cm/s) : Play back the tape WS-9-7.

at 1⅞ ips (4.8 cm/s)

Deliver a 3 kHz signal of -60 dB (0.775 mV) to the MICROPHONE jack, record the signal on a SONY blank tape "super 150" at the end approx. five minutes and read the wow meter.

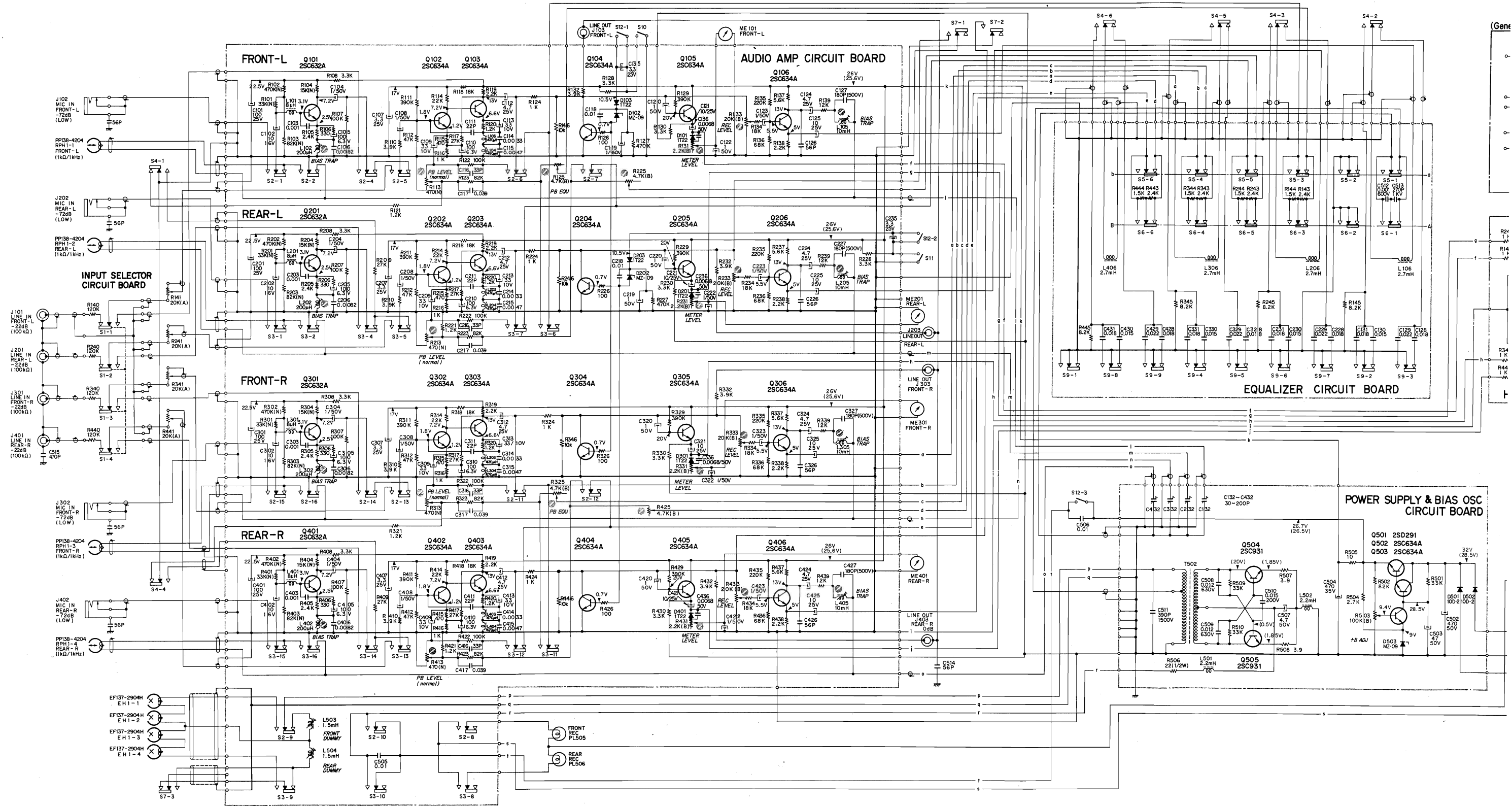
	Tape Speed	Wow (Flutter)
in both horizontal or vertical position	7½ ips (19 cm/s)	0.19 % RMS
	3¾ ips (9.5 cm/s)	0.24 % RMS
	1⅞ ips (4.8 cm/s)	0.3 % RMS

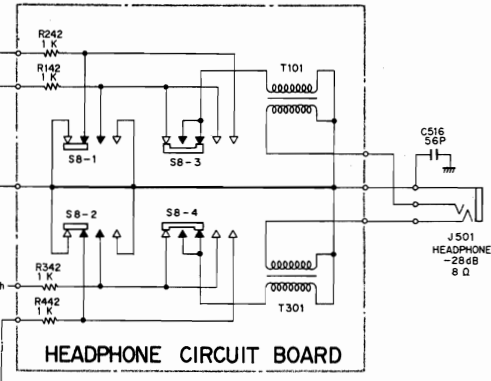
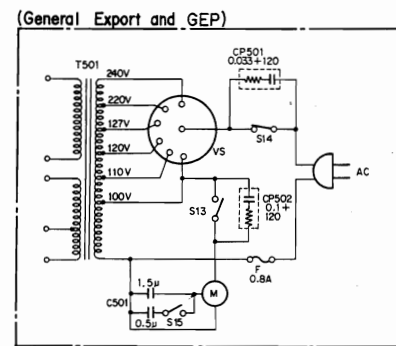
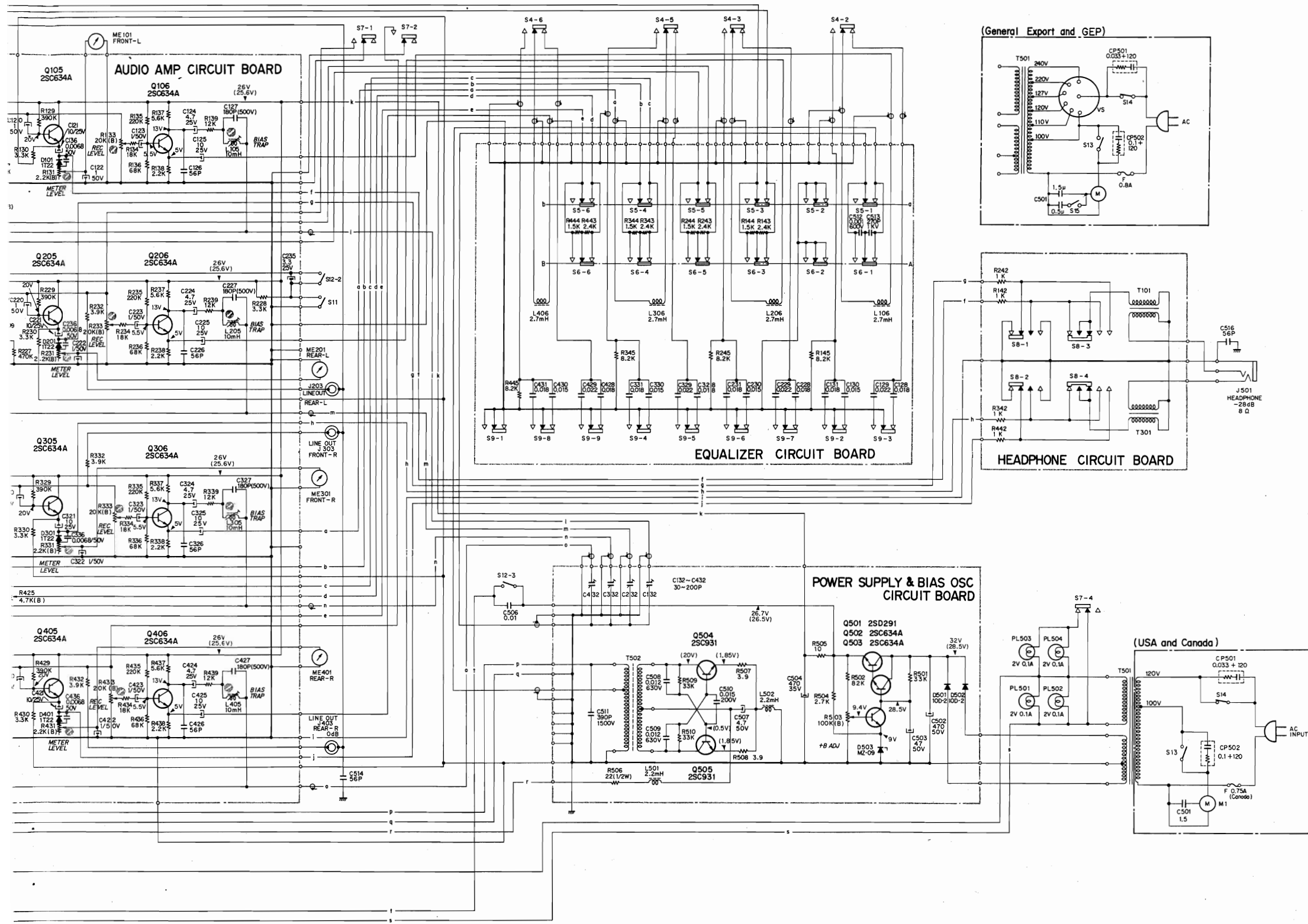
Control/Switch Locations:



SECTION 4
DIAGRAMS

4-1. SCHEMATIC DIAGRAM





Note:

- Switch Position is as follows:
 - S1 - 1 ~ 4 ... INPUT SELECT (LINE POSITION)
 - S2 - 1 ~ 16 .. FRONT REC/PB (PB POSITION)
 - S3 - 1 ~ 16 .. REAR REC/PB (PB POSITION)
 - S4 - 1 ~ 6 ... TAPE SELECT (NORMAL POSITION)
 - S5 - 1 ~ 6 ... PB EQUALIZER BIAS (19 cm/s)
 - S6 - 1 ~ 6 ... POSITION)

S5	S6	SPEED
a	A	19 cm
b	A	9.5 cm
b	B	4.8 cm

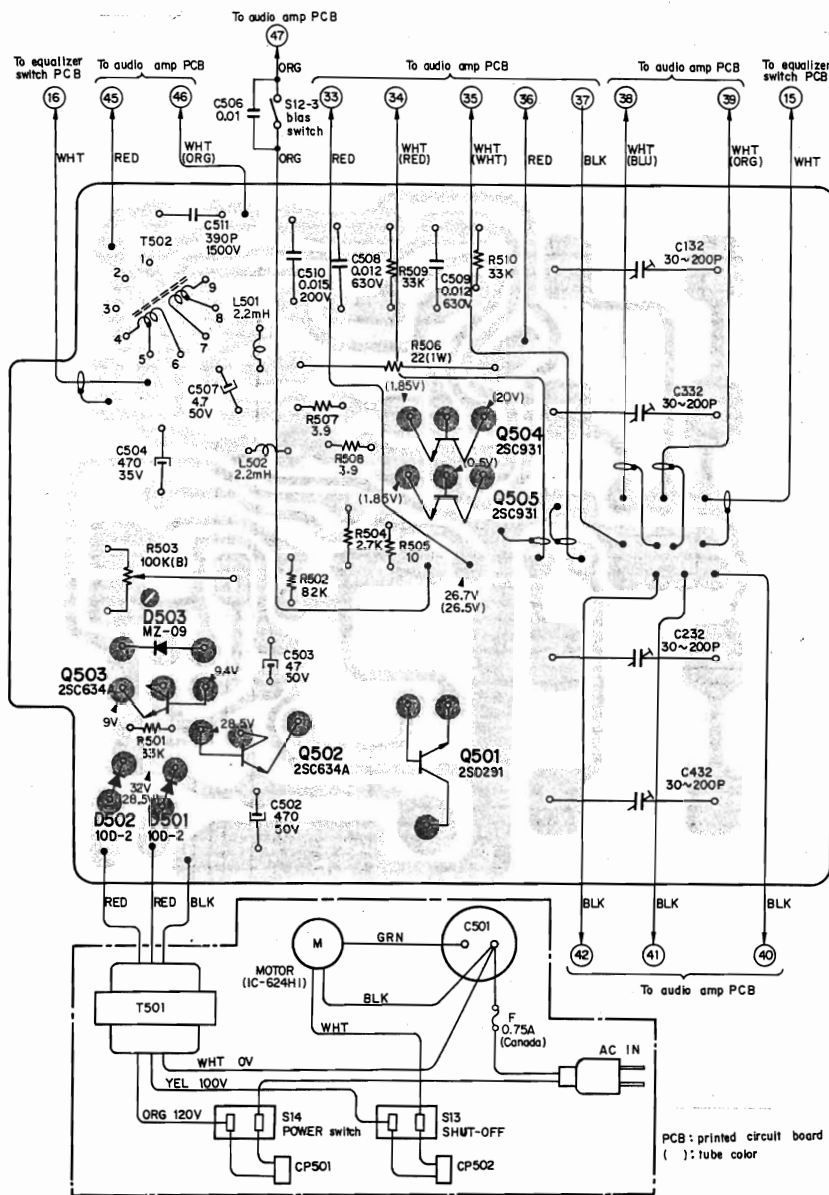
- S7 - 1 ~ 4 ... SYSTEM SELECT (4CH POSITION)
- S8 - 1 ~ 4 ... HEADPHONE (FRONT POSITION)
- S9 - 1 ~ 9 ... REC EQUALIZER (19 cm/s POSITION)
- S10 FRONT MUTING SW (ON POSITION)
- S11 REAR MUTING SW (ON POSITION)
- S12 - 1 FRONT MUTING (OFF POSITION)
- S12 - 2 REAR MUTING (OFF POSITION)
- S12 - 3 BIAS SW (OFF POSITION)
- S13 MOTOR AUTO-SHUT-OFF (OFF POSITION)
- S14 POWER (ON POSITION)
- S15 FREQUENCY CHANGE (50 Hz) (General Export and GEP)

- adjustable
- Voltage values are measured by a voltmeter (20 kΩ/V) with no signal input in playback mode. Voltage values in parentheses are measured in record mode. Variations may be noted due to normal production tolerances.
- All resistors and capacitors are shown in Ω and μF respectively, unless otherwise indicated.
- The suffix letters (A) and (B) of variable resistor indicates its characteristics.

4.2. MOUNTING DIAGRAMS

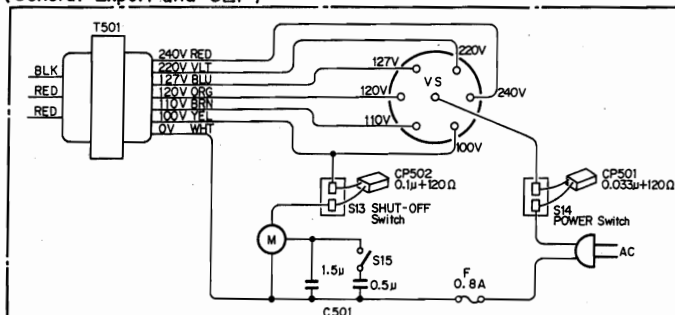
4-2-1. Power Supply and Bias OSC Circuit Board

-Conductor Side -

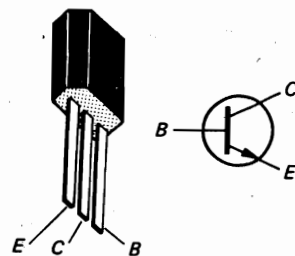


(USA and Canada)

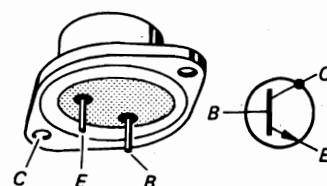
(General Export and GEP)



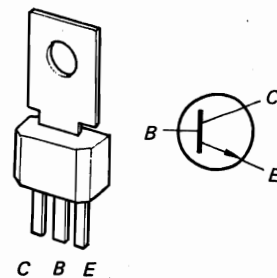
2SC634A



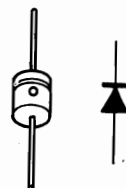
2SD291



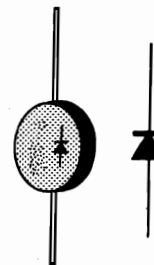
2SC931



10D2

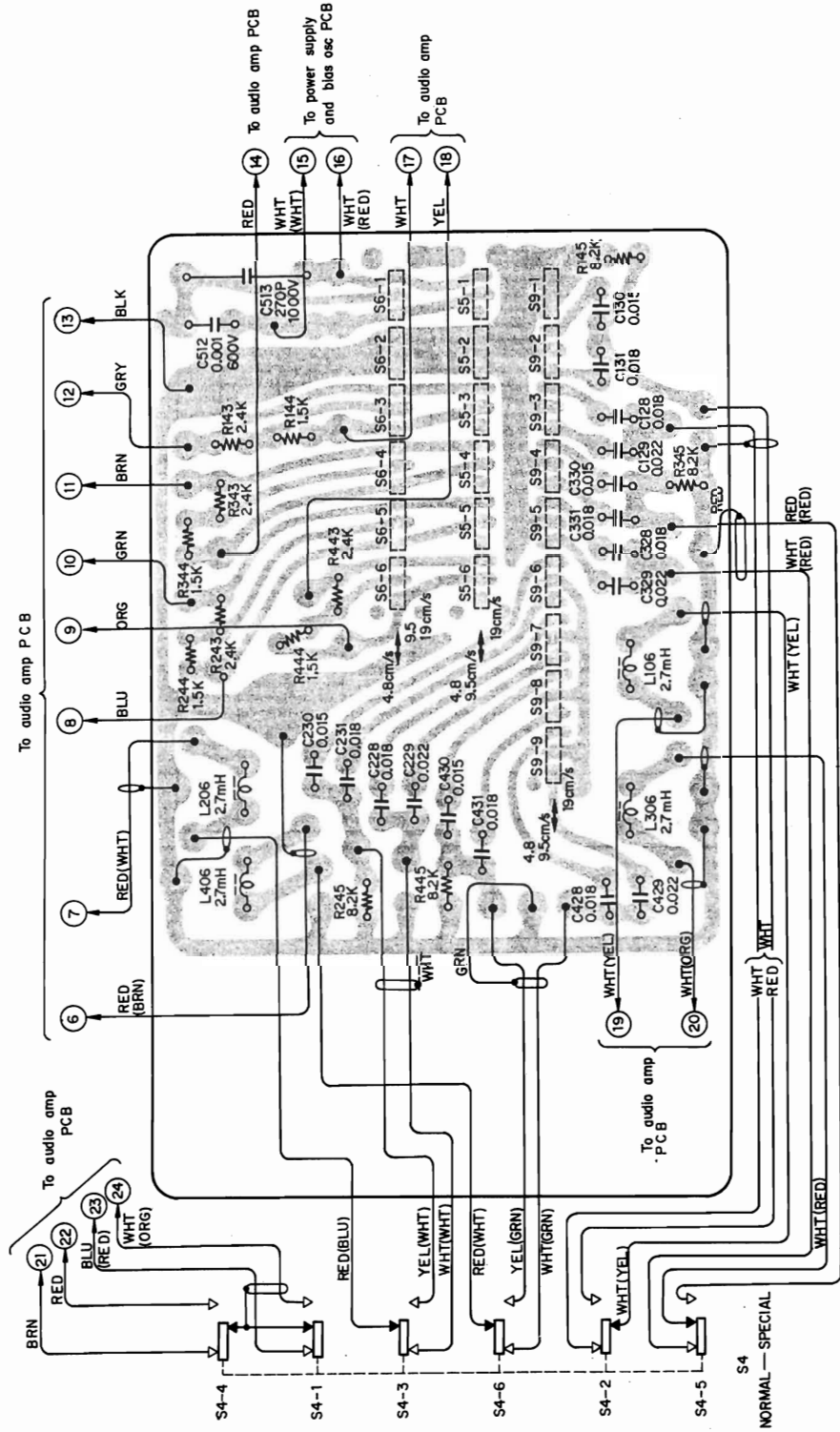


MZ-09



4-2-2. Equalizer Switch Circuit Board

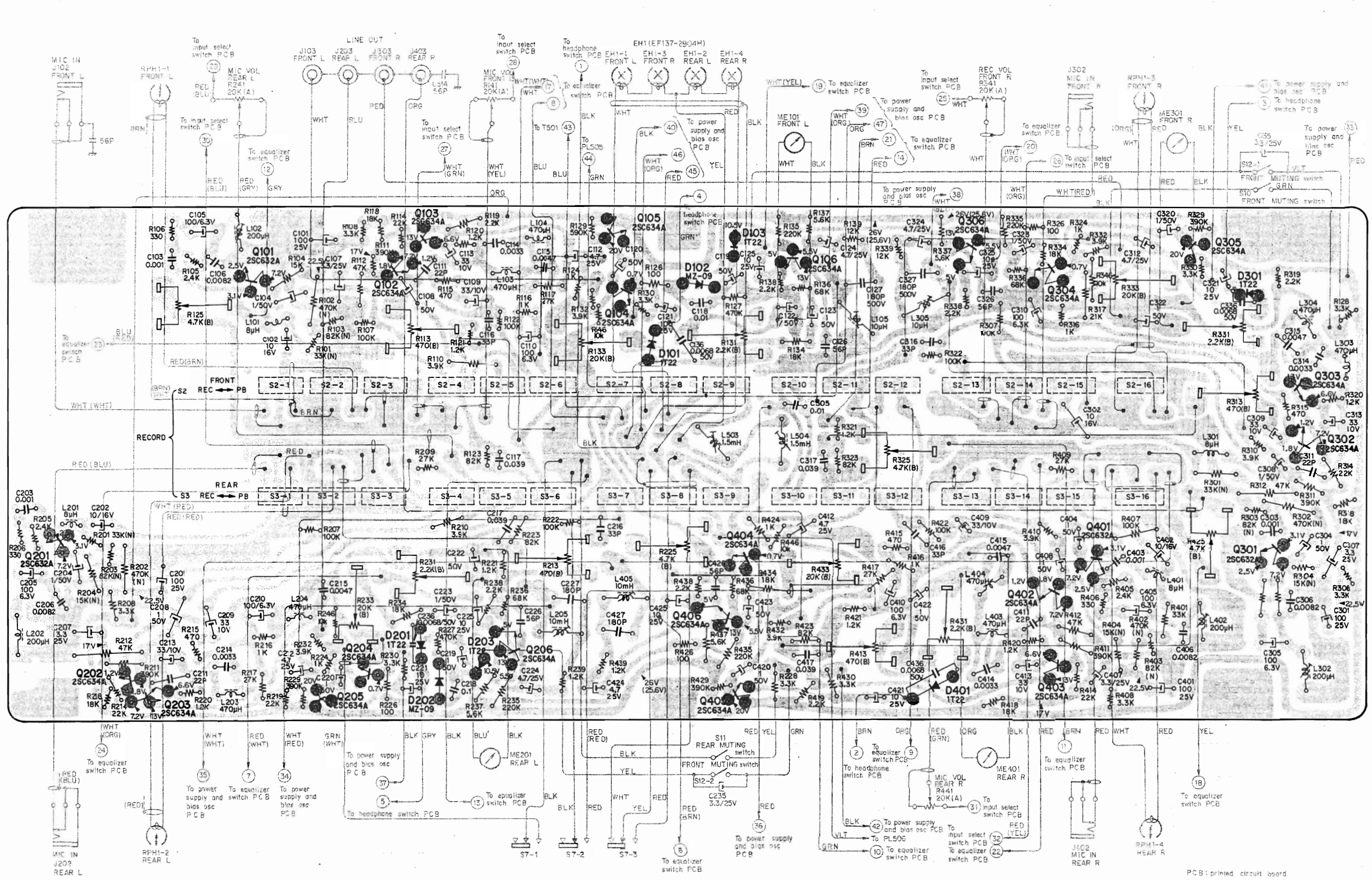
— Conductor Side —



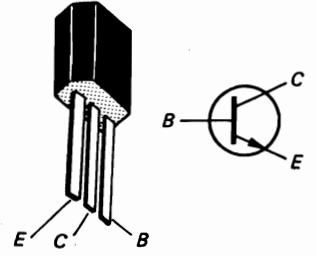
PCB : printed circuit board
() : tube color

4-2-3. Audio Amp Circuit Board

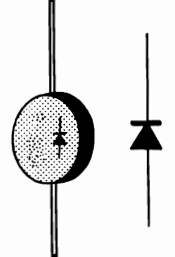
— Conductor Side —



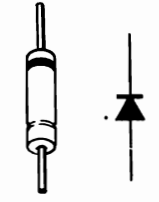
2SC632A, 2SC634A



MZ-09

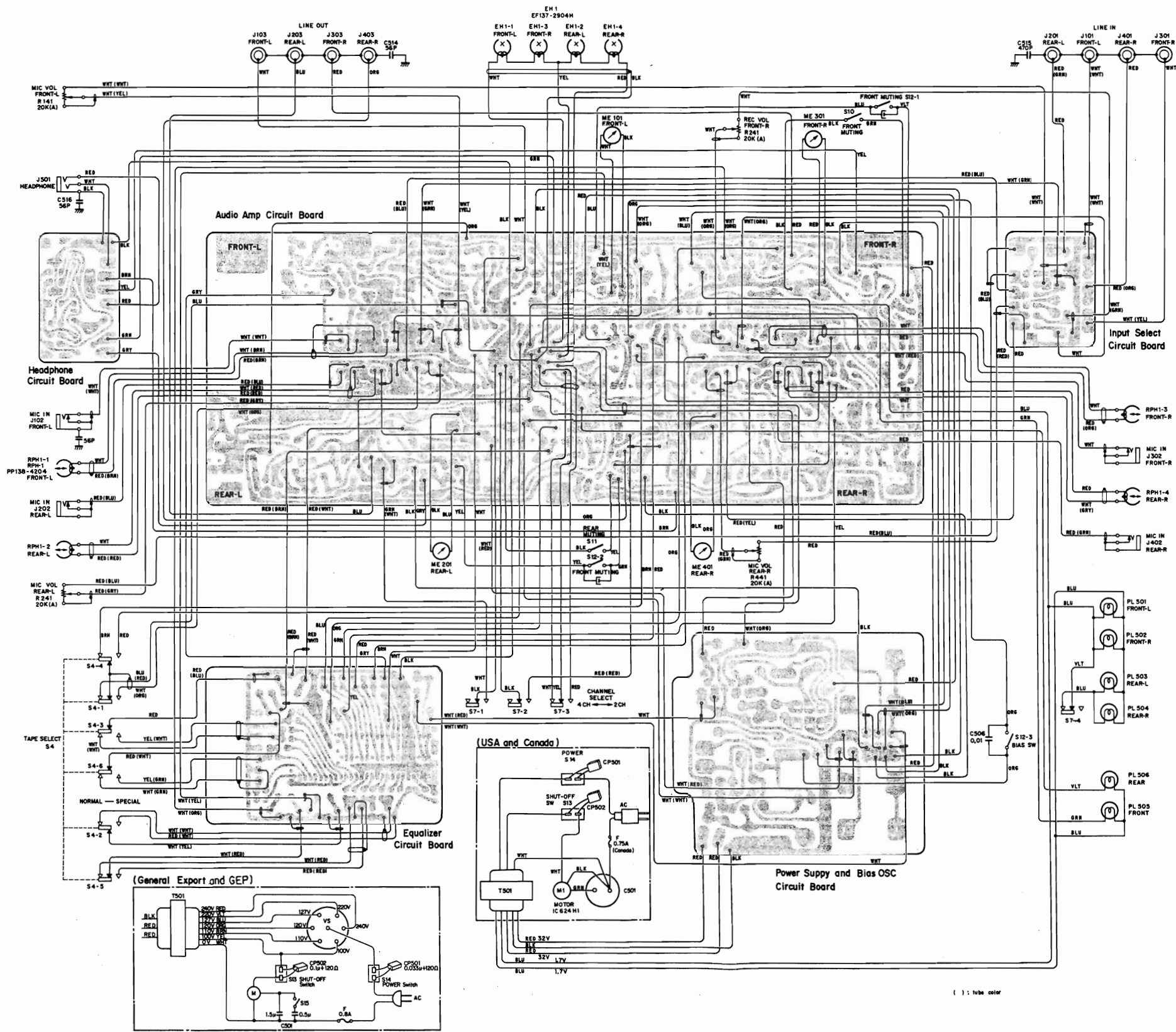


1T22

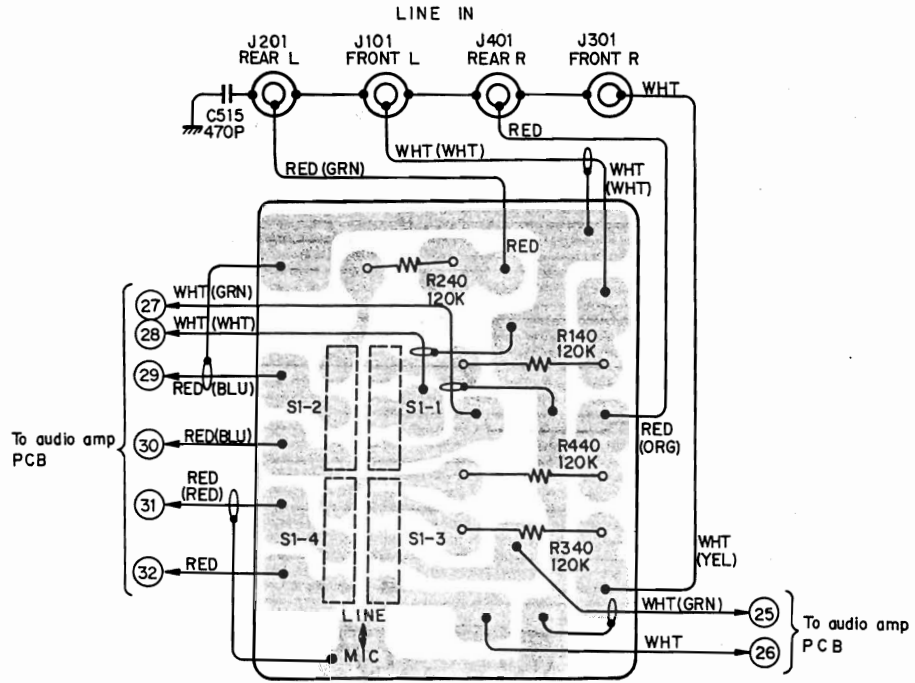


PCB: printed circuit board
 () : 1/100 color

4-2-4. Wiring

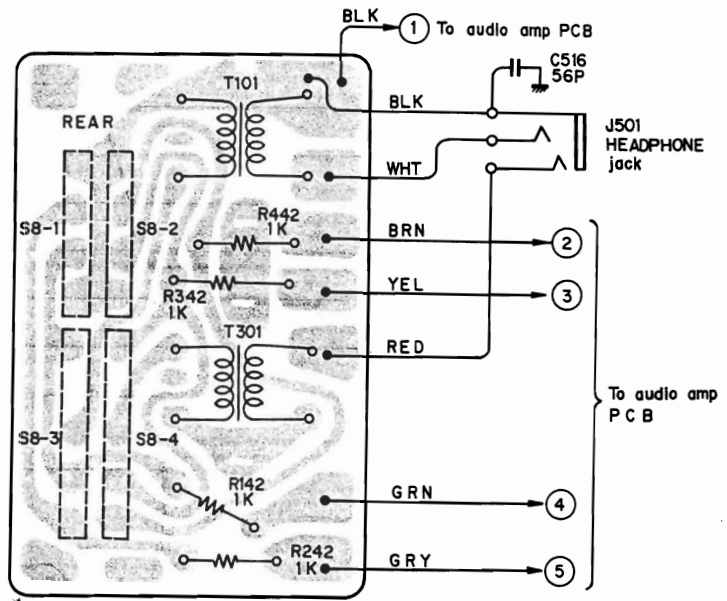


4-2-5. Input Select Switch Circuit Board



PCB: printed circuit board
 (): tube color

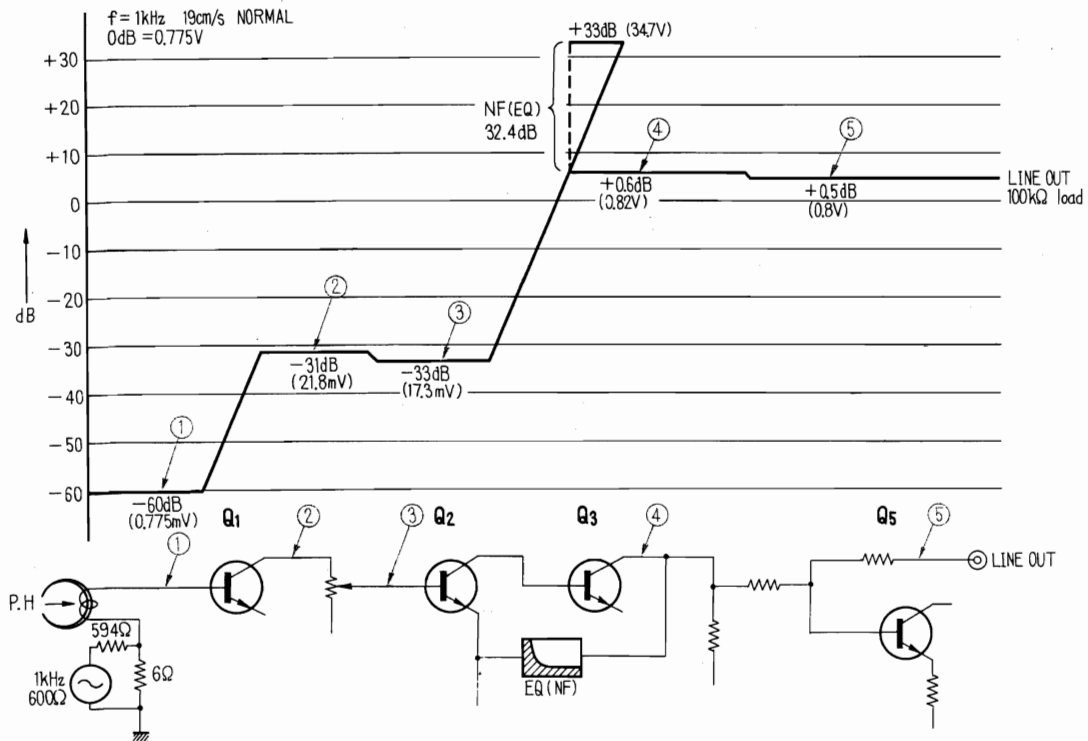
4-2-6. Headphone Switch Circuit Board



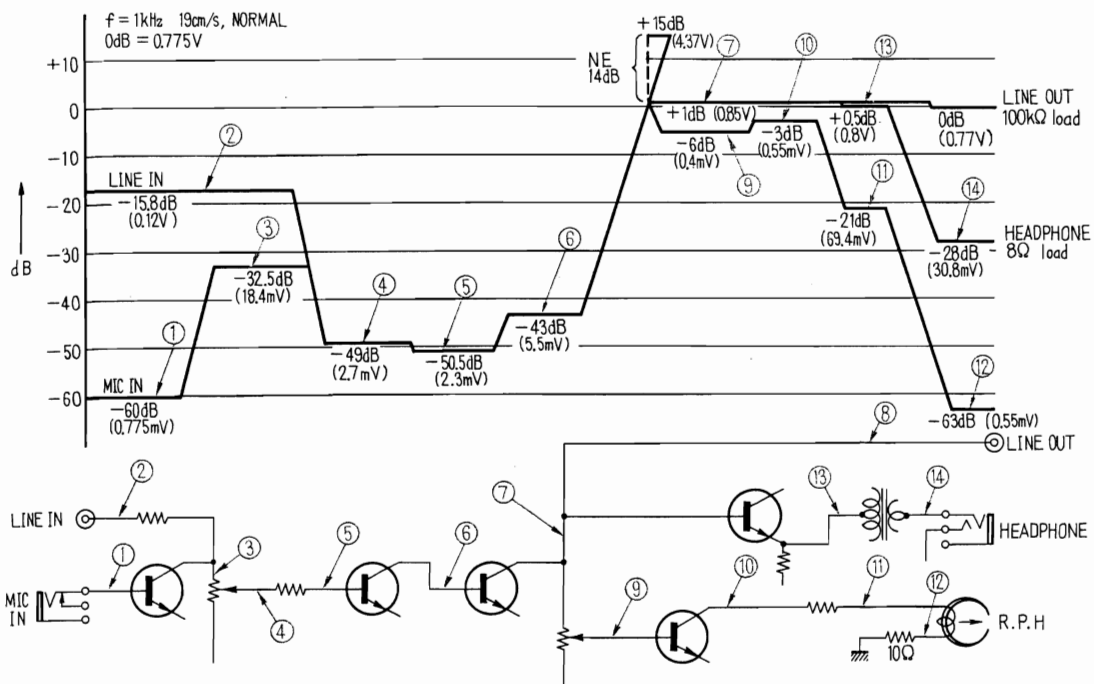
PCB: printed circuit board

4.3. LEVEL DIAGRAMS

Playback

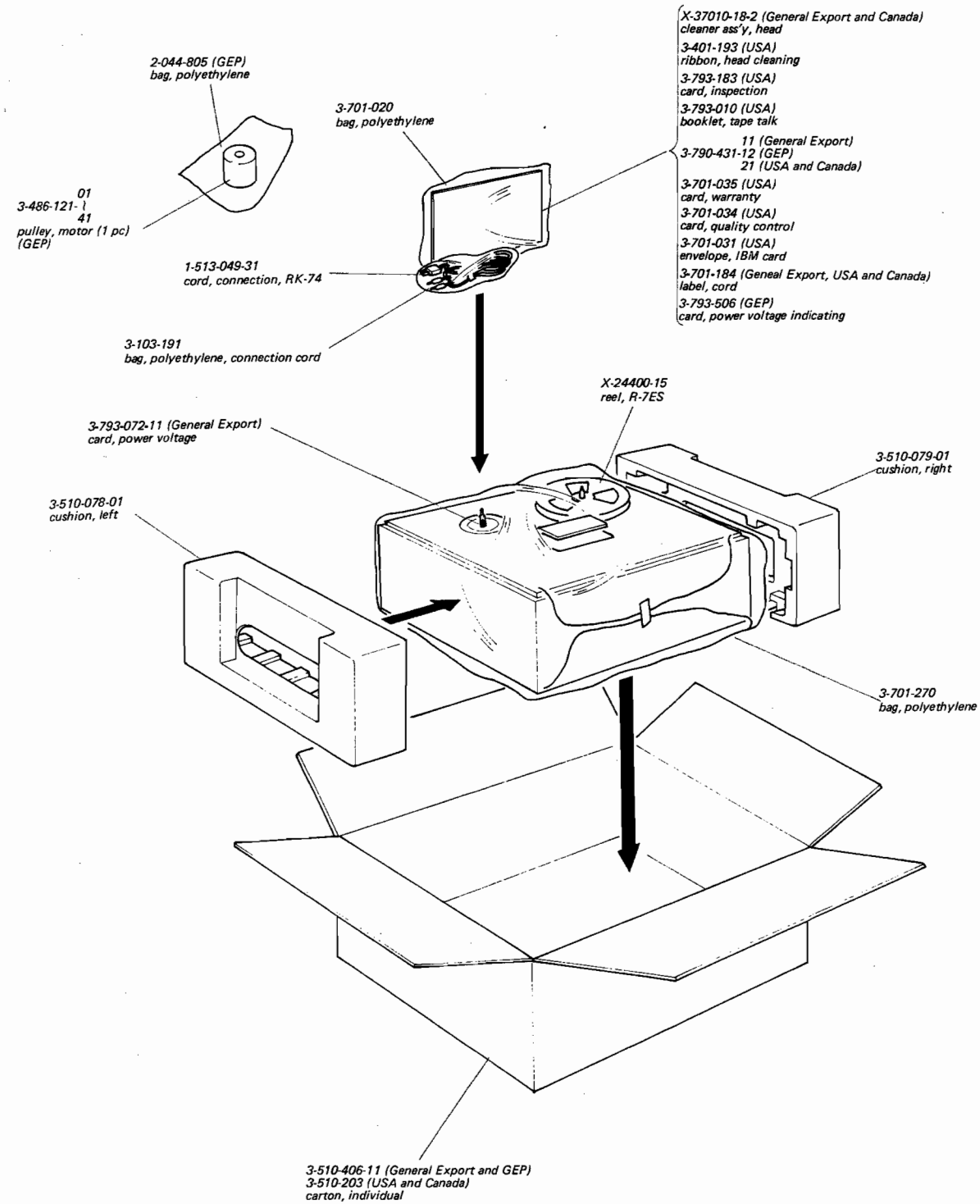


Record

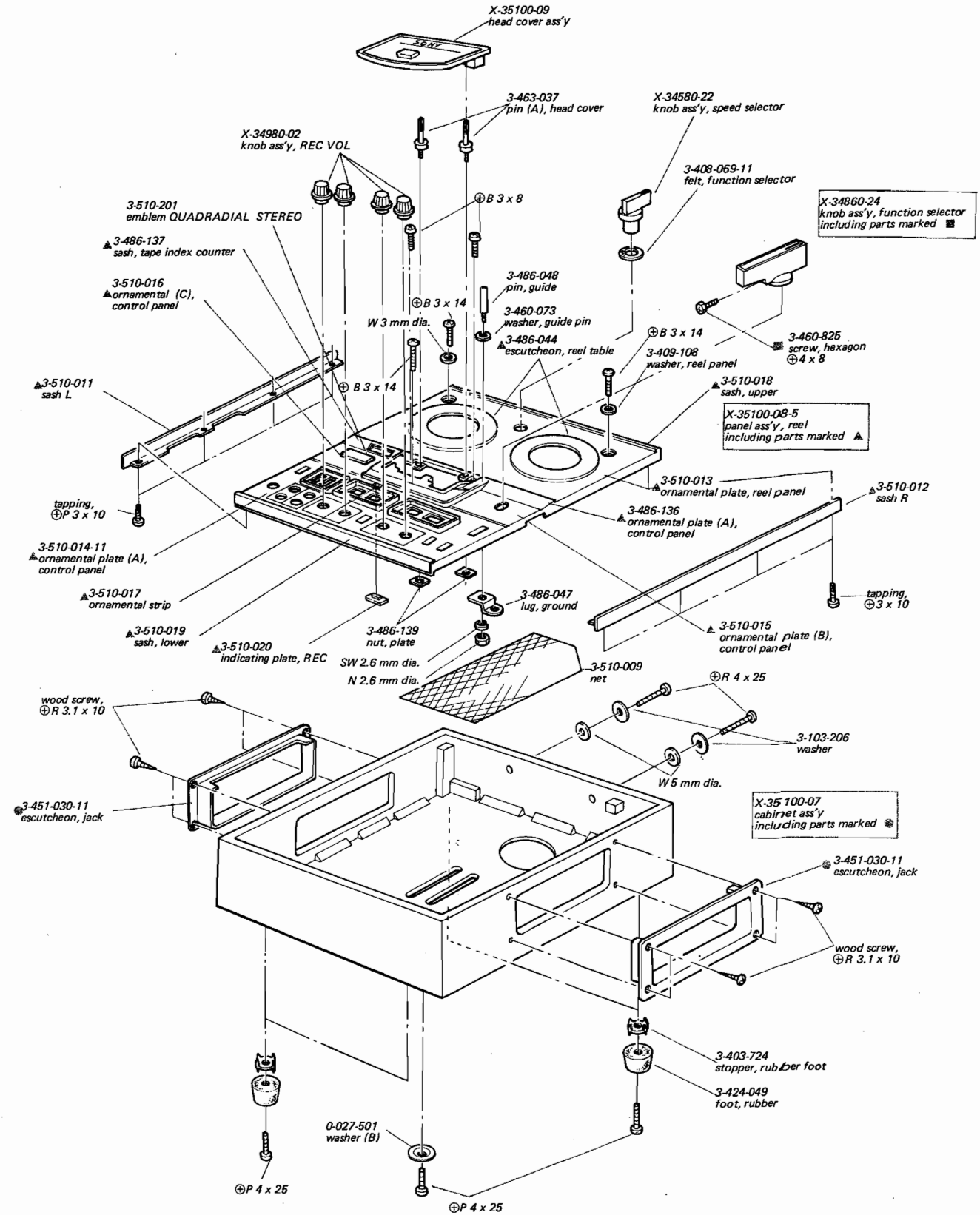


SECTION 5
EXPLODED VIEWS

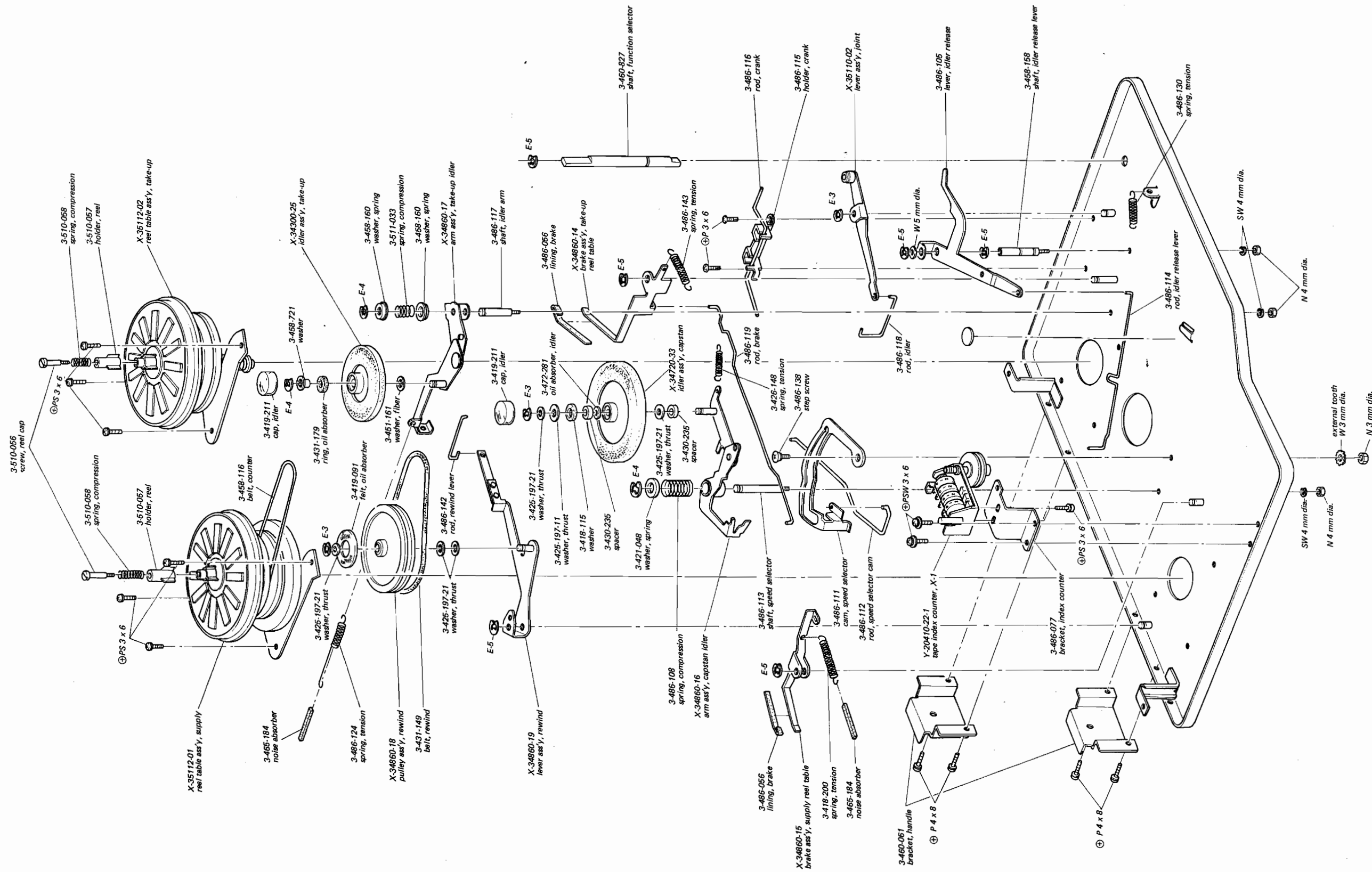
5-1. PACKING



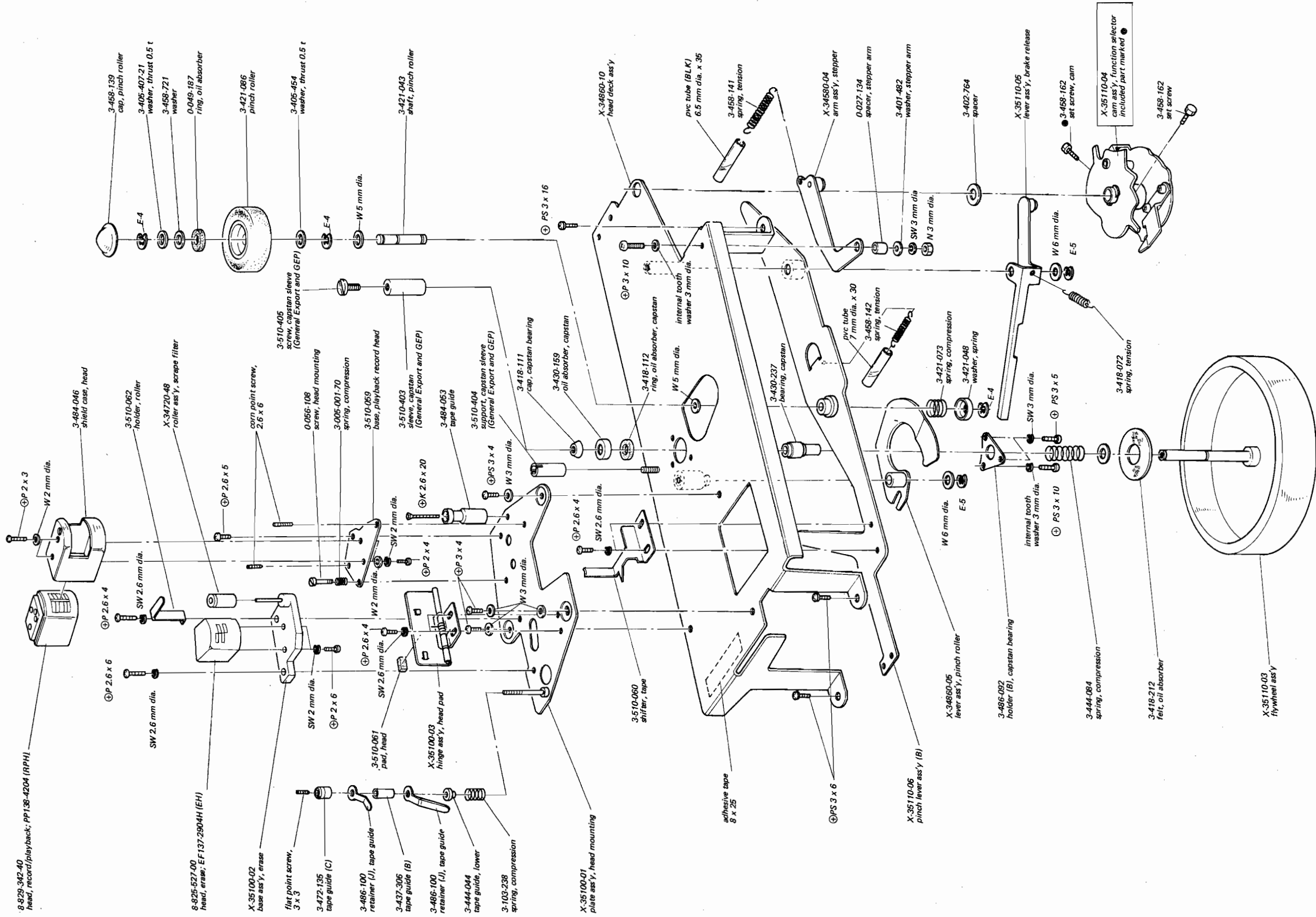
5-2. CABINET — top view —



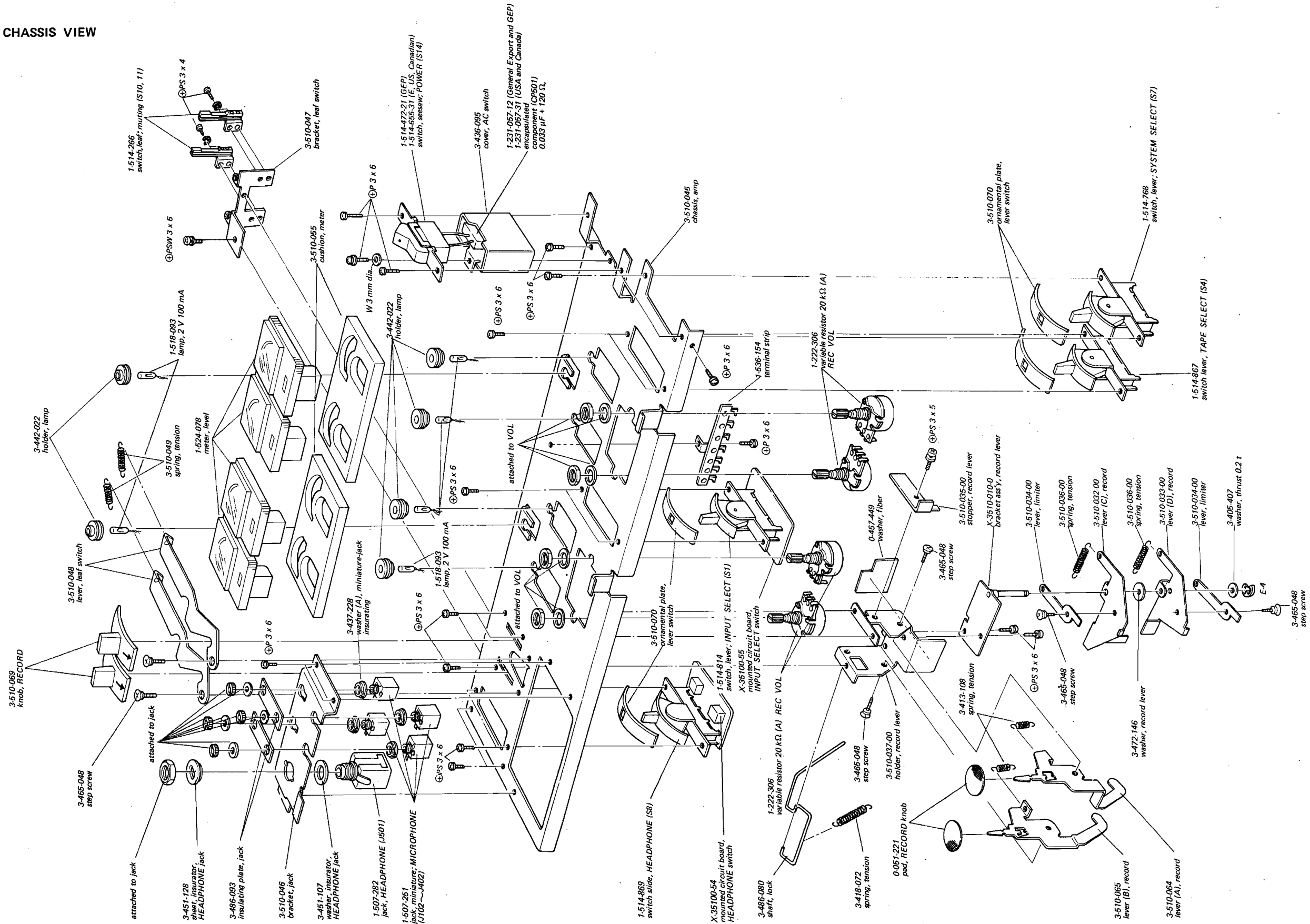
5-3. CHASSIS — top view —



5-5. HEAD DECK VIEW



5-6. AMP CHASSIS VIEW



SECTION 6
ELECTRICAL PARTS LIST

Ref. No.	Part No.	Description	Ref. No.	Part No.	Description	Ref. No.	Part No.	Description	Ref. No.	Part No.	Description
PRINTED CIRCUIT BOARD			L105, 205	1-407-290	inductor, variable; 10 mH	C118, 218	1-105-520-12	0.01 μ F 50 V mylar	R104, 204	1-242-701-09	15 k Ω low noise
X-35100-51-1	audio amp		L106, 206	1-407-199	inductor, micro; 2.7 mH	C119, 219	1-121-391	1 μ F 50 V electrolytic	304, 404		
X-35100-52-1	power & bias osc		L301, 401	1-407-519	inductor, micro; 8 μ H	C120, 220	1-121-391	1 μ F 50 V electrolytic	R105, 205	1-242-682-11	2.4 k Ω
X-35100-53	equalizer switch		L302, 402	1-409-132	trap; 200 μ H	320, 420			305, 405		
X-35100-54	headphone switch		L303, 403	1-407-488	inductor, micro; 470 μ H	C121, 221	1-121-398	10 μ F 25 V electrolytic	R106, 206	1-242-661-11	330 Ω
X-35100-55	input select switch		L304, 404	1-407-488	inductor, micro; 470 μ H	321, 421			306, 406		
SEMICONDUCTORS			L305, 405	1-407-290	inductor, variable; 10 mH	C122, 222	1-121-391	1 μ F 50 V electrolytic	R107, 207	1-242-721-11	100 k Ω
Q101	transistor	2SC632A	L306, 406	1-407-199	inductor, micro; 2.7 mH	322, 422			307, 407		
Q102	transistor	2SC634A	L501, 502	1-407-198	inductor, micro; 2.2 mH	C123, 223	1-121-391	1 μ F 50 V electrolytic	R108, 208	1-242-685-11	3.3 Ω
Q103	transistor	2SC634A	L503, 504	1-407-285	inductor, variable; 1.5 mH	323, 423			308, 408		
Q104	transistor	2SC634A	TRANSFORMERS			C124, 224	1-121-395	4.7 μ F 25 V electrolytic	R110, 210	1-242-687-11	3.9 k Ω
Q105	transistor	2SC634A	T101, 301	1-427-299	output	324, 424			310, 410		
Q106	transistor	2SC634A	T501	1-441-829	power (USA and Canada)	C125, 225	1-121-398	10 μ F 25 V electrolytic	R111, 211	1-242-735-11	390 k Ω
Q201	transistor	2SC632A		1-441-877	power (General Export)	325, 425			311, 411		
Q202	transistor	2SC634A		1-441-924	power (GEP)	C126, 226	1-107-125	56 pF 50 V silvered mica	R112, 212	1-242-713-11	47 k Ω
Q203	transistor	2SC634A	T502	1-433-152	bias osc	326, 426			312, 412		
Q204	transistor	2SC634A	CAPACITORS			C127, 227	1-107-175	180 pF 500 V silvered mica	R113, 213	1-222-770-11	470 Ω (B)
Q205	transistor	2SC634A	C101, 201	1-121-416	100 μ F 25 V electrolytic	327, 427			313, 413		
Q206	transistor	2SC634A	301, 401			C128, 228	1-106-031-12	0.018 μ F 50 V mylar	R114, 214	1-242-705-11	22 k Ω
Q301	transistor	2SC632A	C102, 202	1-121-916	10 μ F 16 V electrolytic	328, 428			314, 414		
Q302	transistor	2SC634A	302, 402			C129, 229	1-106-033-12	0.022 μ F 50 V mylar	R115, 215	1-242-665-11	470 Ω
Q303	transistor	2SC634A	C103, 203	1-105-058-12	0.001 μ F 50 V mylar	329, 429			315, 415		
Q304	transistor	2SC634A	303, 403			C130, 230	1-106-029-12	0.015 μ F 50 V mylar	R116, 216	1-242-673-11	1 k Ω
Q305	transistor	2SC634A	C104, 204	1-121-391	1 μ F 50 V electrolytic	330, 430			316, 416		
Q306	transistor	2SC634A	304, 404			C131, 231	1-106-031-12	0.018 μ F 50 V mylar	R117, 217	1-242-707-11	27 k Ω
Q401	transistor	2SC632A	C105, 205	1-121-413	100 μ F 6.3 V electrolytic	331, 431			317, 417		
Q402	transistor	2SC634A	305, 405			C132, 232	1-141-034	30 pF 200 pF trimmer	R118, 218	1-242-703-11	18 k Ω
Q403	transistor	2SC634A	C106, 206	1-105-512-12	0.0082 μ F 50 V mylar	332, 432			318, 418		
Q404	transistor	2SC634A	306, 406			C135, 235	1-121-392-11	3.3 μ F 25 V electrolytic	R119, 219	1-242-681-11	2.2 k Ω
Q405	transistor	2SC634A	C107, 207	1-121-392	3.3 μ F 25 V electrolytic	C136, 236	1-105-671-12	0.0068 μ F 50 V mylar	319, 419		
Q406	transistor	2SC634A	307, 407			336, 436			R120, 220	1-242-675-11	1.2 k Ω
Q501	transistor	2SD291	C108, 208	1-121-391	1 μ F 50 V electrolytic	C501	1-117-034	1.5 μ F 250 V MP (USA and Canada)	320, 420		
Q502	transistor	2SC634A	308, 408			1-117-036	1.5 + 0.5 μ F 350 V MP (General Export and GEP)		R121, 221	1-242-675-11	1.2 k Ω
Q503	transistor	2SC634A	C109, 209	1-121-402	33 μ F 10 V electrolytic	C502	1-121-810	470 μ F 50 V electrolytic	R122, 222	1-242-721-11	100 k Ω
Q504	transistor	2SC931	309, 409			C503	1-121-441	47 μ F 50 V electrolytic	322, 422		
Q505	transistor	2SC931	C110, 210	1-121-413	100 μ F 6.3 V electrolytic	C504	1-121-361	470 μ F 35 V electrolytic	R123, 223	1-242-719-11	82 k Ω
D101, 201	diode	1T-22	310, 410			C505, 506	1-105-520-12	0.01 μ F 50 V mylar	323, 423		
D102, 202	diode	MZ-09	C111, 211	1-107-115	22 pF 50 V silvered mica	C507	1-121-396	4.7 μ F 50 V electrolytic	R124, 224	1-242-673-11	1 k Ω
D103, 203	diode	1T-22	311, 411			C508, 509	1-129-715	0.012 μ F 630 V polypropylene film	324, 424		
D301, 401	diode	1T-22	C112, C212	1-121-395	4.7 μ F 25 V electrolytic	C510	1-129-795	0.015 μ F 200 V polypropylene film	R125, 225	1-222-773-11	4.7 k Ω (B) semi-fixed
D501, 502	diode	10D-2	312, 412			C511	1-107-256	390 pF 1500 V silvered mica	325, 425		
D503	diode	MZ-09	C113, 213	1-121-402	33 μ F 10 V electrolytic	C512	1-106-029-12	0.001 μ F 600 V mylar	R126, 226	1-242-649-11	100 Ω
COILS			313, 413			C513	1-107-254	270 pF 1000 V silvered mica	326, 426		
L101, 201	1-407-519	inductor, micro; 8 μ H	C114, 214	1-105-507-12	0.0033 μ F 50 V mylar	C514, 516	1-107-125	56 pF 50 V silvered mica	R127, 227	1-242-739-11	470 k Ω
L102, 202	1-409-132	trap; 200 μ H	314, 414			C515	1-107-244	470 pF 50 V silvered mica	R128, 228	1-242-685-11	3.3 k Ω
L103, 203	1-407-488	inductor, micro; 470 μ H	C115, 215	1-105-509-12	0.0047 μ F 50 V mylar	RESISTORS			R129, 229	1-242-735-11	390 k Ω
L104, 204	1-407-488	inductor, micro; 470 μ H	315, 415			All resistors are 1/4 W and carbon type unless otherwise noted.			R329, 429		
			C116, 216	1-107-119	33 pF 50 V silvered mica	R101, 201	1-242-709-09	33 k Ω low noise	R130, 230	1-242-685-11	3.3 k Ω
			316, 416			301, 401			330, 430		
			C117, 217	1-105-520-12	0.039 μ F 50 V mylar	R102, 202	1-242-739-09	470 k Ω low noise	R131, 231	1-222-772-11	2.2 k Ω (B) semi-fixed
			317, 417			302, 402			331, 431		

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
R132, 232 332, 432	1-242-687-11	3.9 kΩ	S12	1-514-548	rotary, bias osc
R133, 233 333, 433	1-222-715-11	20 kΩ (B); semi-fixed	S13	1-514-039	micro, shut-off
R134, 234 334, 434	1-242-703-11	18 kΩ	S14	1-514-472-21	seesaw, POWER (GEP)
R135, 235 335, 435	1-242-729-11	220 kΩ		1-514-655-31	seesaw, POWER (General Export)
R136, 236 336, 436	1-242-717-11	68 kΩ		1-514-655-71	seesaw, POWER (USA and Canada)
R137, 237 337, 437	1-242-691-11	5.6 kΩ	S15	1-514-512	rotary, frequency change (General Export and GEP)
R138, 238 338, 438	1-242-681-11	2.2 kΩ	JACKS		
R139, 239 339, 439	1-242-699-11	12 kΩ	J101 ~ J401	1-507-163	4-P-phono, LINE IN
R140, 240 340, 440	1-242-723-11	120 kΩ	J102 ~ J402	1-507-251	M-10, miniature; MICROPHONE
R141, 241 341, 441	1-222-306-11	20 kΩ (A); variable MIC VOL	J103 ~ J403	1-507-163	4-P-phono, LINE OUT
R142, 242 342, 442	1-242-673-11	1 kΩ	J501	1-507-282	JM65, M-15; HEADPHONE
R143, 243 343, 443	1-242-682-11	2.4 kΩ	HEADS		
R144, 244 344, 444	1-242-681-11	1.5 kΩ	R PH	8-829-342-40	record/playback, PP138-4204
R145, 245 345, 445	1-242-695-11	8.2 kΩ	EH	8-825-527-00	erase, EF 137-2904H
R146, 246 346, 446	1-242-697-12	10 kΩ	MISCELLANEOUS		
R209, 409	1-242-707-11	27 kΩ	CP501	1-231-057-12	encapsulated components, 0.033 μF + 120 Ω (General Export and GEP)
R501	1-242-709-11	33 kΩ		1-231-057-31	encapsulated components, 0.033 μF + 120 Ω (USA and Canada)
R502	1-242-719-11	82 kΩ	CP502	1-101-534-12	encapsulated components, 0.1 μF + 120 Ω (General Export and GEP)
R503	1-222-777-11	100 kΩ (B); semi-fixed		1-101-534-31	encapsulated component, 0.1 μF + 120 Ω (USA and Canada)
R504	1-242-683-11	2.7 kΩ	PL501 ~ 506	1-518-093	lamp, 0.1 A
R505	1-242-625-11	10 Ω	ME101 ~ 401	1-524-078	meter, level
R506	1-209-204-11	22 Ω		1-534-487	cord, power (General Export)
R507, 508	1-242-615-11	3.9 Ω		1-534-538-21	cord, power (USA and Canada)
R509, 510	1-242-709-11	33 kΩ		1-536-154	terminal strip A type 3L3
SWITCHES			M	8-832-624-22	motor, IC-624H
S1-1 ~ 4	1-514-814	slide, INPUT SELECT	VS	1-509-427	connector, power voltage selector (General Export)
S2 - 1 ~ 16	1-514-961	slide, rec/pb, front		1-509-482	connector, power voltage selector (GEP)
S3 - 1 ~ 16	1-514-961	slide, rec/pb, rear	F	1-532-163	fuse, 0.8A (General Export)
S4 - 1 ~ 6	1-514-867	slide, TAPE SELECT	F	1-532-264	fuse, 0.75A (Canada)
S5 - 1 ~ 6	1-514-453	slide, playback, equalizer and bias switch front	F	1-532-063	fuse, 1 A (GEP)
S6 - 1 ~ 6	1-514-453	slide, playback, equalizer and bias switch rear	F	1-532-204	fuse, 2 A (GEP)
S7 - 1 ~ 4	1-514-768	slide, SYSTEM SELECT	F	1-532-215	fuse, 0.8 A (GEP)
S8-1 ~ 4	1-514-869	slide, HEADPHONE		1-533-006	holder, fuse; W/cover (General Export)
S9-1 ~ 9	1-514-454	slide, record equalizer		1-533-026	holder, fuse (GEP)
S10	1-514-266	leaf, muting, front			
S11	1-514-266	leaf, muting, rear			

SECTION 7 HARDWARE

<u>Part No.</u>	<u>Description</u>	<u>Part No.</u>	<u>Description</u>
SCREWS			
7-621-169-52	⊕ R 4 x 25	7-623-105-01	W 2 mm dia.
7-621-209-82	⊕ P 2.6 x 14	7-623-108-01	W 3 mm dia.
7-621-255-19	⊕ P 2 x 3	7-623-110-12	W 4, middle t = 0.1
7-621-255-22	⊕ P 2 x 4	7-623-110-12	W 5, middle t = 0.2
7-621-255-42	⊕ P 2 x 6	7-623-113-18	W 6, middle t = 0.5
7-621-259-22	⊕ P 2.6 x 4	7-623-113-18	W 6, middle t = 0.3
7-621-259-30	⊕ P 2.6 x 5	7-623-205-11	SW 2 mm dia.
7-621-259-40	⊕ P 2.6 x 6	7-623-207-11	SW 2.6 mm dia.
7-621-560-22	⊕ K 2.6 x 20	7-623-208-27	SW 3 mm dia.
7-621-743-21	⊕ R 3.1 x 10, wood screw	7-623-210-28	SW 4 mm dia.
7-682-145-00	⊕ P 3 x 4	7-623-308-05	W 3, internal tooth
7-682-146-01	⊕ P 3 x 5		
7-682-147-01	⊕ P 3 x 6	NUTS	
7-682-148-00	⊕ P 3 x 8	7-622-107-00	2.6 mm dia.
7-682-149-01	⊕ P 3 x 10	7-684-014-01	4 mm dia.
7-682-161-01	⊕ P 4 x 8	7-684-033-01	3 mm dia.
7-682-167-00	⊕ P 4 x 25		
7-682-548-00	⊕ B 3 x 8	RETAINING RINGS	
7-682-551-00	⊕ B 3 x 14	7-624-104-01	E-2
7-682-552-00	⊕ B 3 x 16	7-624-106-05	E-3
7-682-561-01	⊕ B 4 x 8	7-624-108-05	E-4
7-682-645-00	⊕ PS 3 x 4	7-624-109-05	E-5
7-682-646-00	⊕ PS 3 x 5		
7-682-647-00	⊕ PS 3 x 6	LUG	
7-682-648-00	⊕ PS 3 x 8	7-623-508-01	3 mm dia.
7-682-652-00	⊕ PS 3 x 16		
7-682-661-00	⊕ PS 4 x 8	BOLT	
7-682-947-01	⊕ PSW 3 x 6	7-683-323-00	4 x 16, hexagon
7-682-948-01	⊕ PSW 3 x 8		
7-682-960-01	⊕ PSW 4 x 6		
7-685-145-31	⊕ PS 3 x 6, self tapping		
7-685-147-01	⊕ P 3 x 10, self tapping		
7-685-158-01	⊕ P 4 x 6, self tapping		

— Hardware Nomenclature —

<p>P - Pan Head Screw </p> <p>PS - Pan Head Screw with Spring Washer </p> <p>K - Flat Countersunk Head Screw ... </p> <p>B - Binding Head Screw </p> <p>RK - Oval Countersunk Head Screw ... </p> <p>T - Truss Head Screw </p> <p>R - Round Head Screw </p> <p>F - Flat Fillister Head Screw </p>	<p>SC - Set Screw </p> <p>E - Retaining Ring (E Washer) </p> <p style="text-align: center;">W - Washer SW - Spring Washer LW - Lock Washer N - Nut</p> <p style="text-align: center;">— Example —</p> <div style="display: flex; align-items: center;"> <div style="margin-right: 20px;"> <p>⊕ P 3x10</p> <p>└── Type of Slot</p> <p>└── Length in mm (L)</p> <p>└── Diameter in mm (D)</p> <p>└── Type of Head</p> </div> </div>
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