

SONY

TC 378

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MODEL

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SERVICE MANUAL

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# TC-377

*AEP Model  
AUS Model  
Canada Model  
E Model  
USA Model*



## STEREO TAPECORDER

### SPECIFICATIONS

<b>Power Requirements:</b>	AC 120V, 60Hz (Canada, USA) AC 100V, 110V, 117V, 125V, 220V, 240V, 50/60Hz (E) AC 110V, 127V, 220V, 240V, 50/60Hz (AEP, AUS)	<b>Inputs:</b>	Two MICROPHONE inputs Impedance: low impedance Maximum sensitivity: -72 dB (0.2 mV) Two LINE INPUTS Impedance: 100k $\Omega$ Maximum sensitivity: -22 dB (0.06V) REC/PB connector (AEP, E, AUS) Input impedance: 3.8k $\Omega$
<b>Power Consumption:</b>	38W (Canada, USA) 48W (AEP, E, AUS)	<b>Outputs:</b>	Two LINE OUTPUTS Load impedance: more than 10k $\Omega$ Output level: 0dB (0.78V) with 100k $\Omega$ load REC/PB connector (AEP, E, AUS) Output impedance: 3.3k $\Omega$ HEADPHONE output Load impedance: 8 $\Omega$
<b>Bias Frequency:</b>	Approx. 160kHz	<b>Semiconductors:</b>	23 transistors, 5 diodes
<b>Track System:</b>	Four track two channel stereo and mono	<b>Record Head:</b>	RF140-2902 (70 $\Omega$ /1 kHz)
<b>Reel Size:</b>	7" maximum	<b>Playback Head:</b>	PF140-4202 (1k $\Omega$ /1 kHz)
<b>Tape Speed:</b>	19 cm/s (7 1/2 ips) 9.5 cm/s (3 3/4 ips) 4.8 cm/s (1 7/8 ips)	<b>Erase Head:</b>	EF18-2902A1 (1.6k $\Omega$ /160 kHz)
<b>Frequency Response:</b>	<b>SPECIAL (SONY SLH tape)</b> NAB DIN 19 cm/s (7 1/2 ips): 20~30,000 Hz 30~24,000 Hz 19 cm/s (7 1/2 ips): 30~25,000 Hz $\pm$ 3 dB 9.5 cm/s (3 3/4 ips): 30~20,000 Hz 40~16,000 Hz <b>NORMAL (Standard tape)</b> NAB DIN 19 cm/s (7 1/2 ips): 20~25,000 Hz 30~20,000 Hz 19 cm/s (7 1/2 ips): 30~20,000 Hz $\pm$ 3 dB 9.5 cm/s (3 3/4 ips): 30~17,000 Hz 40~13,000 Hz 4.8 cm/s (1 7/8 ips): 30~9,000 Hz	<b>Motor:</b>	IC-624H1 (induction motor)
<b>Signal-to-Noise Ratio:</b>	<b>NORMAL</b> <b>SPECIAL</b> 52 dB or better 55 dB or better	<b>Dimensions:</b>	418 (w) x 210 (h) x 392 (d) mm 16 1/2 (w) x 8 5/16 (h) x 15 7/16 (d) inches
<b>Distortion:</b>	1.2%	<b>Weight:</b>	10.6 kg, 23 lb 6 oz (Canada, USA) 11.5 kg, 25 lb 6 oz (AEP, E, AUS)
<b>Wow and Flutter:</b>	19 cm/s (7 1/2 ips): 0.09% (RMS) weighted 9.5 cm/s (3 3/4 ips): 0.12% (RMS) weighted 4.8 cm/s (1 7/8 ips): 0.17% (RMS) weighted		

**SONY**  
**SERVICE MANUAL**

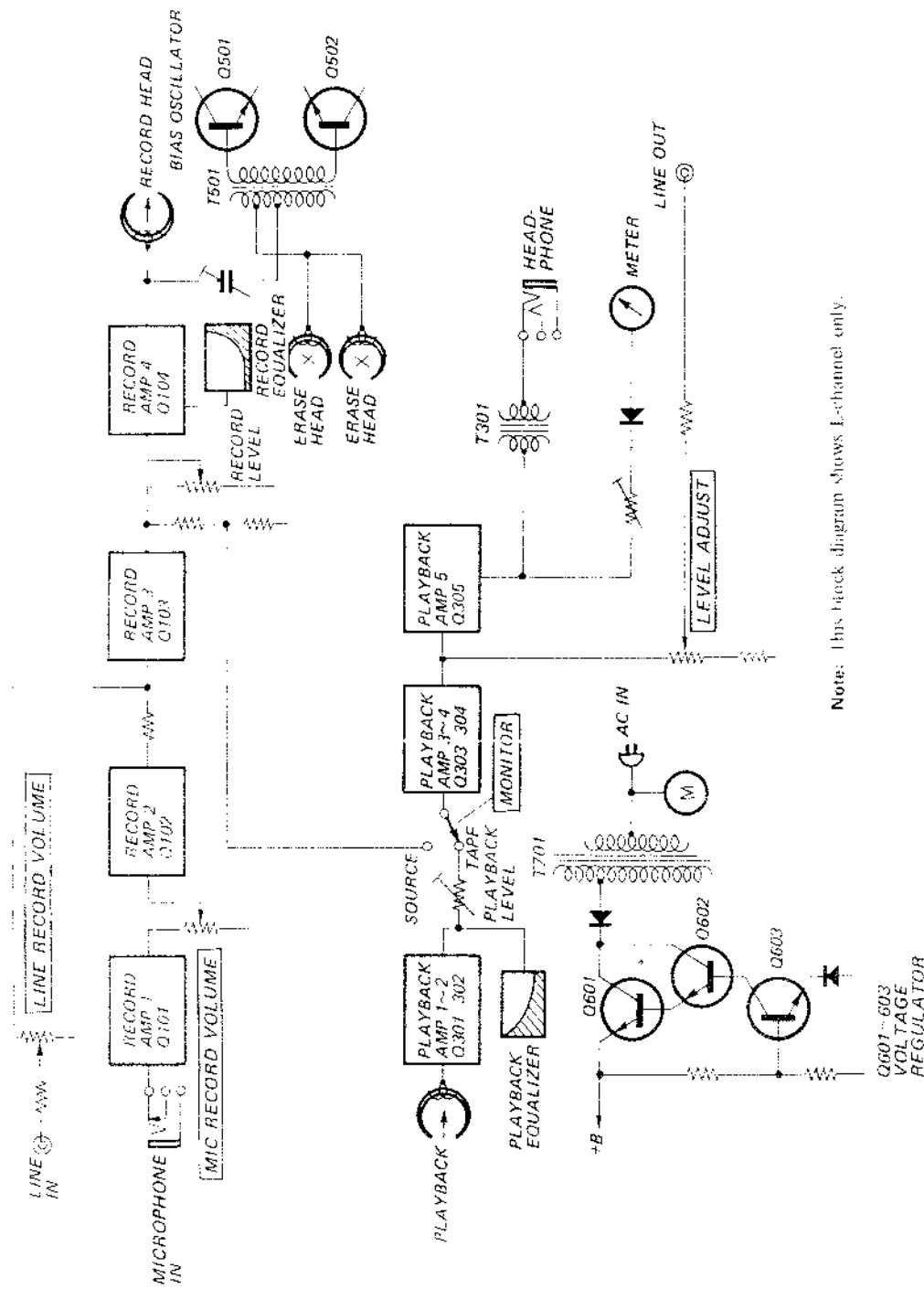
**TABLE OF CONTENTS**

<u>Section</u>	<u>Title</u>	<u>Page</u>
	Specification .....	1
<b>1</b>	<b>OUTLINE</b>	
	1-1. Block Diagram .....	3
	1-2. External Views .....	4
	1-3. Internal Views .....	5
<b>2</b>	<b>DISASSEMBLY</b> .....	6
<b>3</b>	<b>ADJUSTMENTS</b>	
	3-1. Mechanical Adjustments .....	9
	3-2. Electrical Adjustments/Measurements .....	16
	3-3. Power Frequency Adaptation .....	28
<b>4</b>	<b>DIAGRAMS</b>	
	4-1. Level Diagrams .....	29
	4-2. Schematic Diagram .....	31
	4-3. Mounting Diagrams .....	33
	4-3-1. Tape Select Switch Circuit Board .....	33
	4-3-2. Power Supply Circuit Board .....	33
	4-3-3. Bias Osc Circuit Board .....	34
	4-3-4. Record Amp Circuit Board .....	35
	4-3-5. Playback Amp Circuit Board .....	36
<b>5</b>	<b>EXPLODED VIEWS</b>	
	5-1. Cabinet - top view - .....	37
	5-2. Head Deck - top view - .....	38
	5-3. Amplifier Chassis - top view - .....	39
	5-4. Chassis - top view - .....	41
	5-5. Packing .....	43
<b>6</b>	<b>ELECTRICAL PARTS LIST</b> .....	44
<b>7</b>	<b>HARDWARE</b> .....	47
	Hardware Nomenclature .....	47

*When ordering replacement parts, use PART NUMBERS listed in Parts List or shown in EXPLODED VIEW. Parts List reference numbers should not be used.*

SECTION 1  
OUTLINE

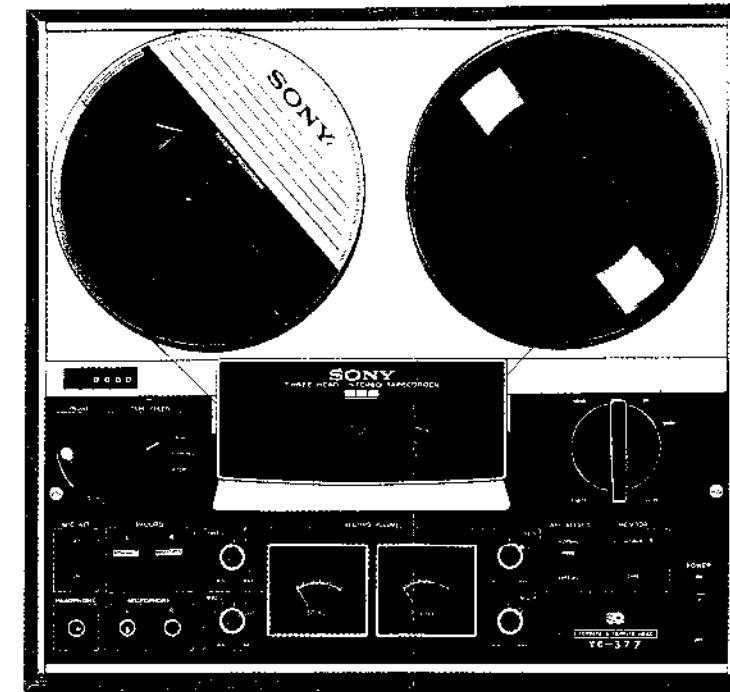
1-1. BLOCK DIAGRAM



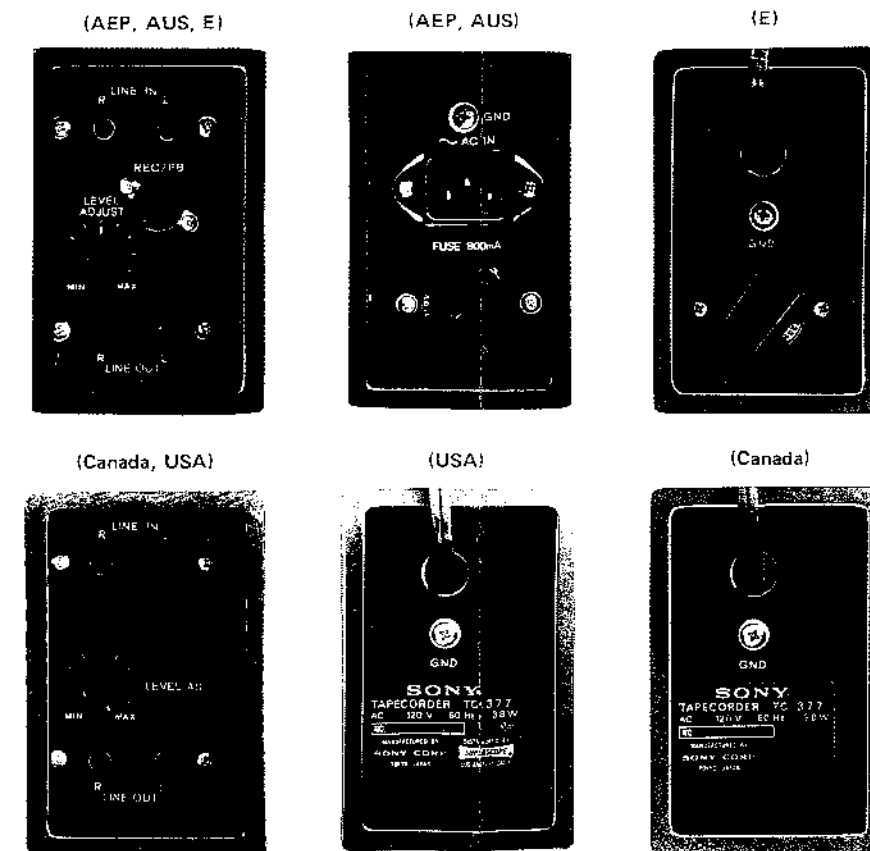
Note: This block diagram shows L-channel only.

1-2. MAJOR PARTS LOCATION

Front Panel



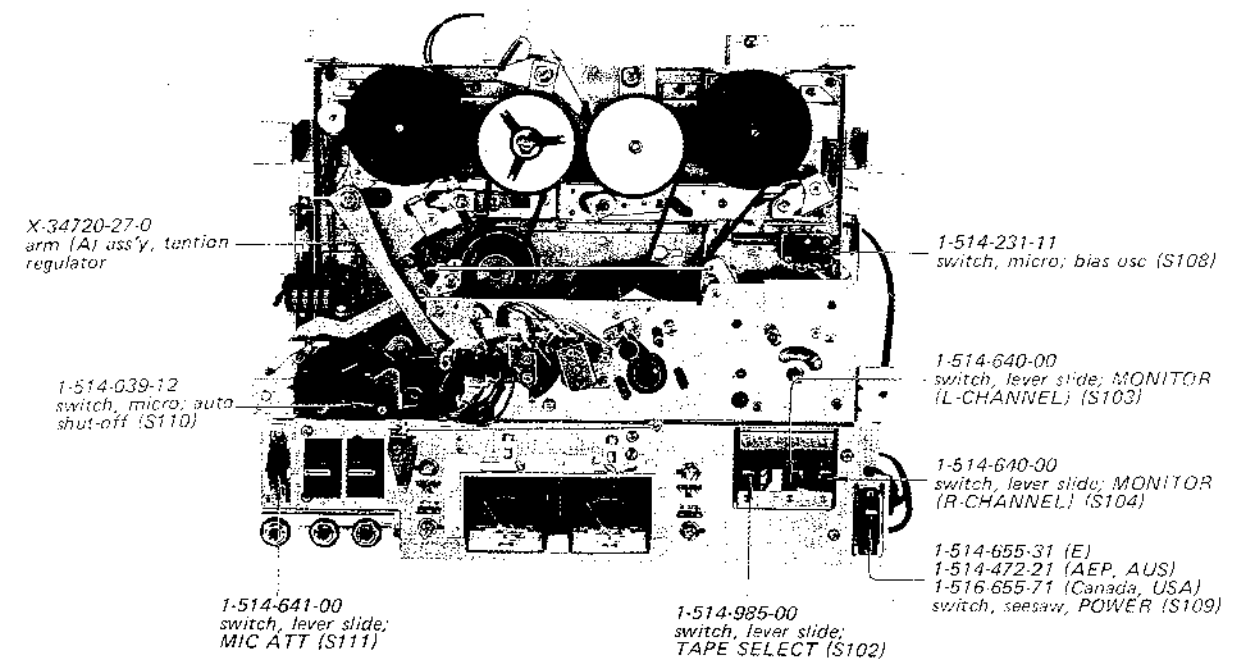
Side Panel



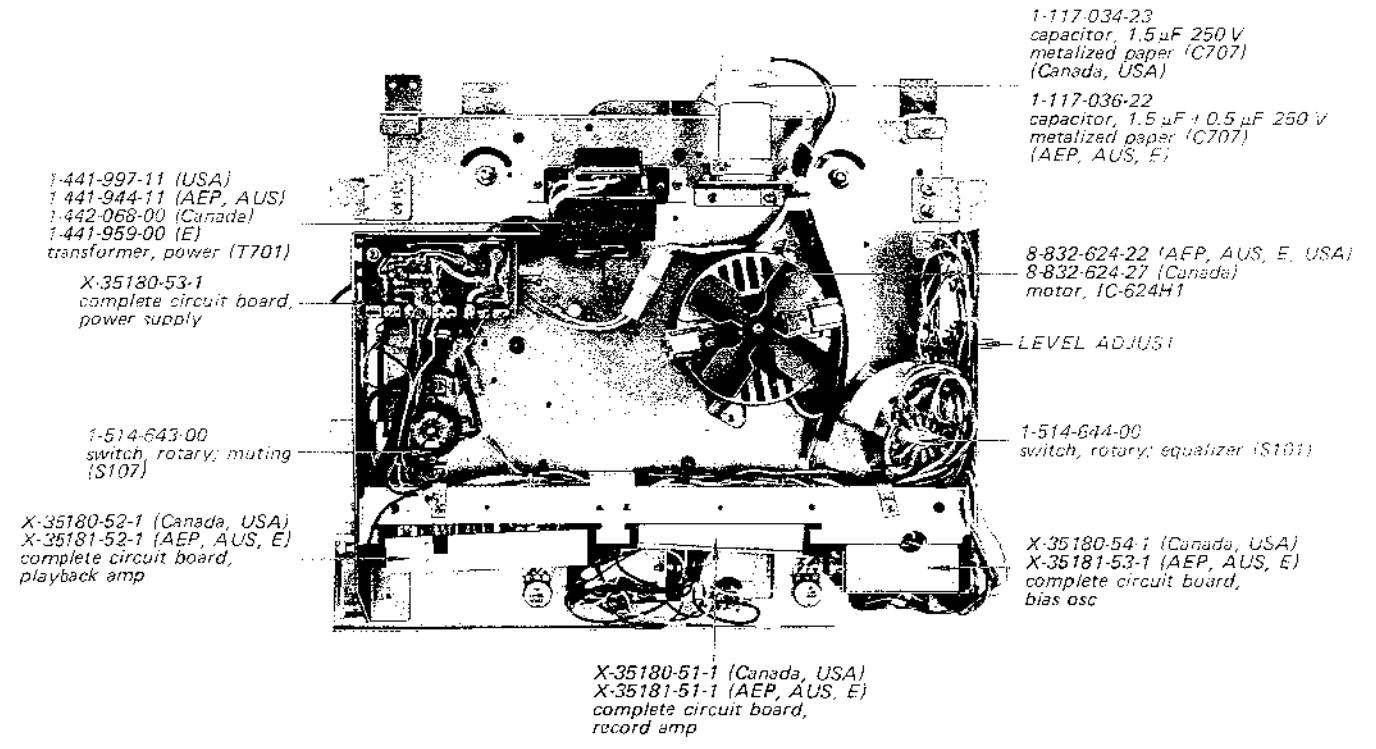
### SECTION 2 DISASSEMBLY

#### 1-3. INTERNAL VIEWS

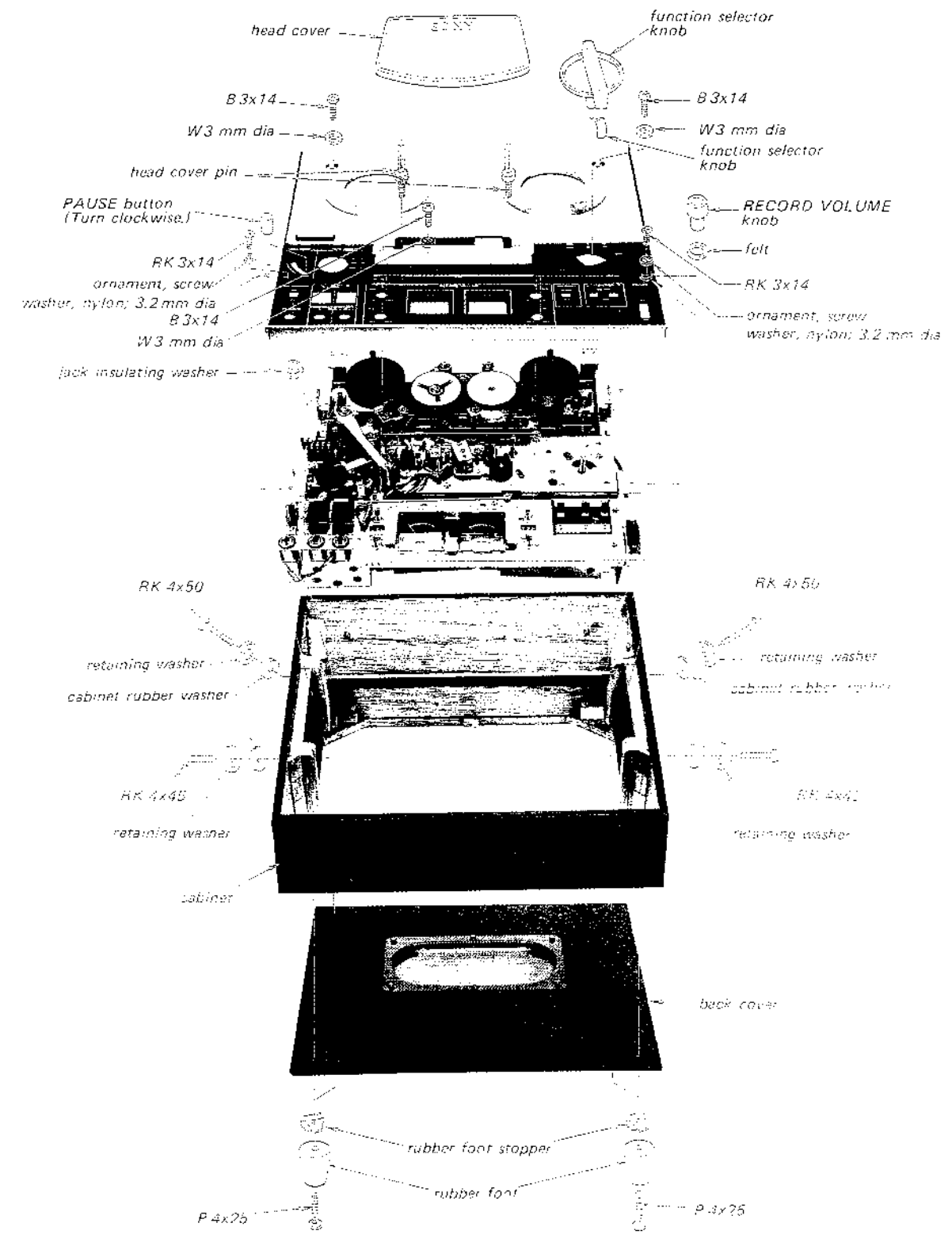
##### Chassis Front



##### Chassis Rear



#### 2-1. CABINET REMOVAL





SECTION 3  
ADJUSTMENTS

3-1. MECHANICAL ADJUSTMENTS

Precaution:

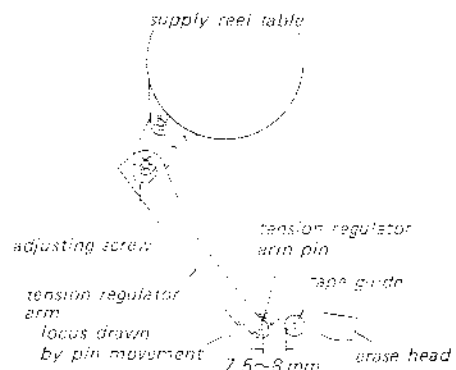
Do not use magnetized screwdriver for adjustments.

After adjustments, apply locking paint to the adjusted parts.

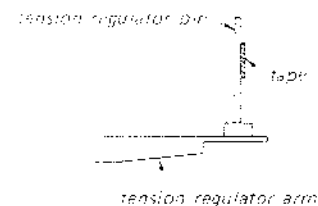
Tension Regulator Adjustment

STOP mode

- Loosen the adjusting screw and adjust so that the clearance shown is 8 mm ( $5/16"$ ) after having been turned reel table counterclockwise by hand.



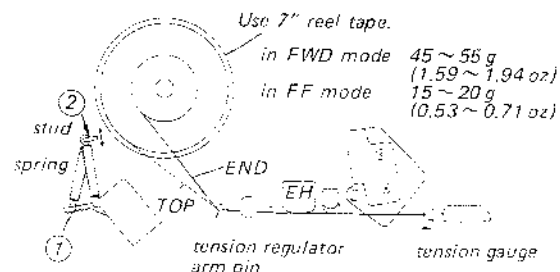
- Tape should be in contact with tension regulator pin uniformly at beginning and end portion of it.



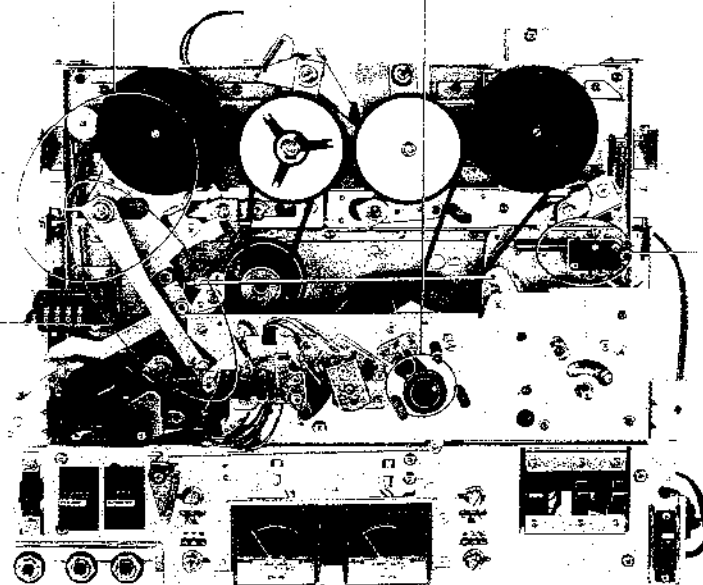
Tension Regulator Back-tension Adjustment

FWD and FF modes

This adjustment should be done after Tension Regulator Adjustment.



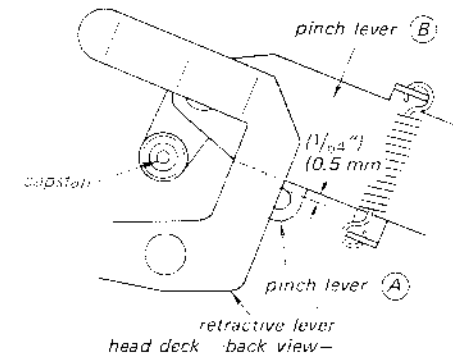
- Adjust by changing the spring hook position.
- If necessary, adjust by bending the stud or perform the tension regulator adjustment again.



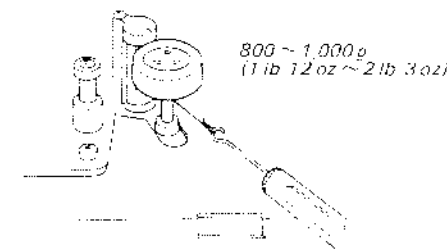
Pinch Roller Pressure Check

STOP mode

- Remove head deck ass'y. (See "HEAD DECK REMOVAL" on page 7)
- Put dummy capstan into capstan bearing and be sure that the clearance between pinch levers A and B is approx. 0.5 mm ( $1/64"$ ).



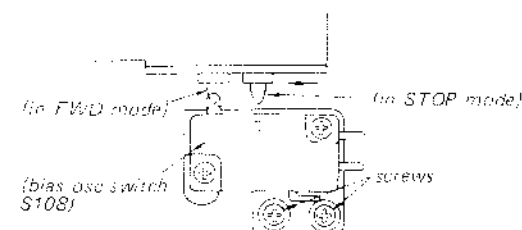
- Be sure that the tension gauge indicates 800~1,000 g (1 lb 12 oz~2 lb 3 oz) when the pinch roller is detached from capstan in FWD mode.



Bias Switch Position Adjustment

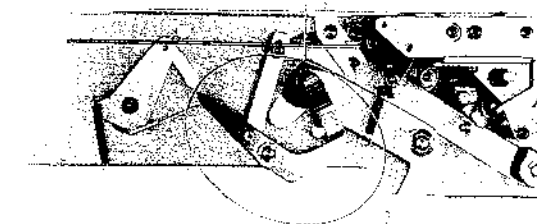
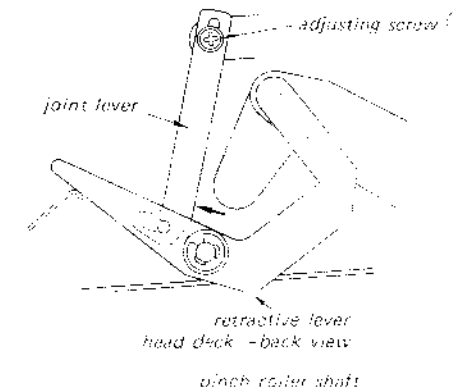
Loosen two screws and adjust by positioning the switch.

Switch should be turned ON in FWD mode and with function selector knob changed slowly from FWD to STOP, record levers are released after the switch turns OFF.



Pinch Roller Stroke Adjustment

- Remove head deck (See page 7).
- Loosen adjusting screw ① so that pinch roller shaft comes in contact with retractive lever at position A in STOP mode.
- Fix adjusting screw ① while pushing the joint lever in the direction shown by arrow.
- Put the dummy capstan into the capstan bearing and be sure that pinch roller shaft moves by approx. 3~4 mm ( $1/8$ ~ $5/16"$ ) on the surface of retractive lever when function selector knob is changed from STOP to FWD.
- Be sure that the washer on pinch roller shaft does not come in contact with C position when function selector knob is changed slowly from FWD to FF.

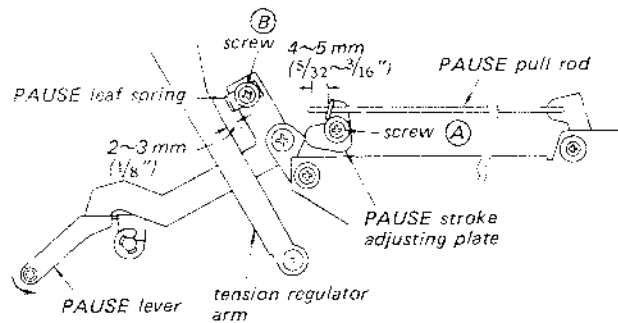


Head deck bottom view.

**PAUSE Adjustment  
STOP mode**

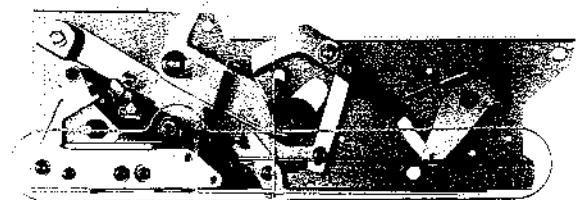
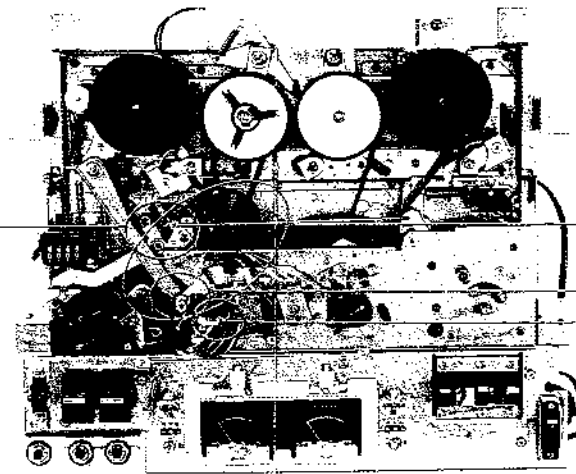
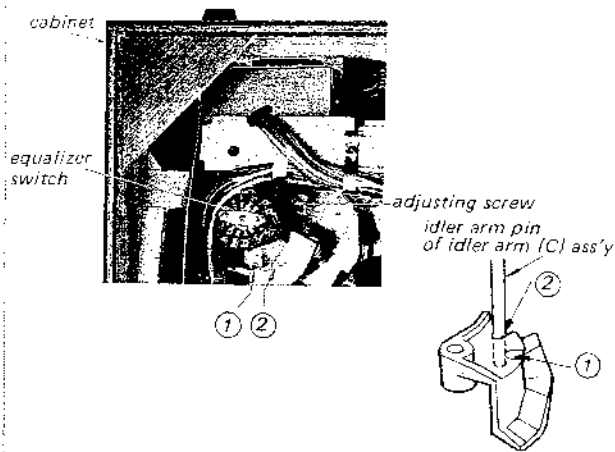
This adjustment should be done after tension regulator adjustment.

1. Adjust screw (A) so that the distance between the end of PAUSE pull rod and PAUSE stroke adjusting plate is 4~5 mm ( $\frac{5}{32}$ "~ $\frac{3}{16}$ " in STOP mode.
2. Be sure that the clearance between pinch roller and capstan is more than 1 mm ( $\frac{1}{32}$ " in) when pulling the PAUSE lever in FWD mode, and PAUSE button is not locked when pulling it in STOP mode.
3. Adjust screw (B) so that the clearance between tension regulator arm and PAUSE leaf spring is 2~3 mm ( $\frac{1}{8}$ " in) in STOP mode. Brake should work, when pulling the PAUSE lever in FWD mode.



**Speed Selector Cam Position Adjustment  
FWD mode**

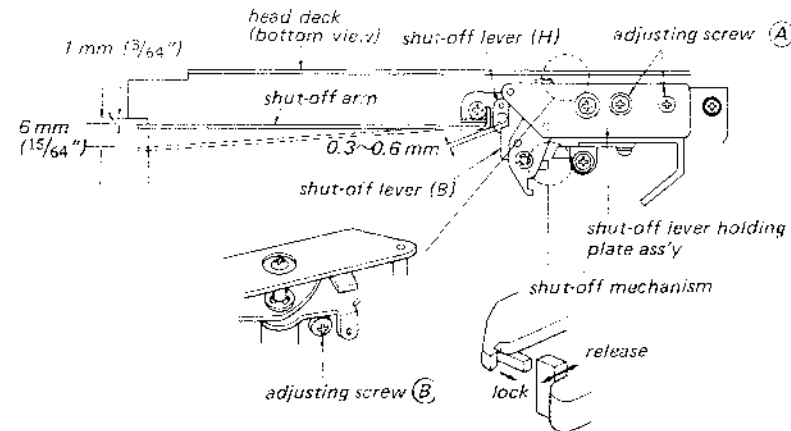
Loosen the screw and adjust to locate the idler arm pin in the stopper slot (2) shown, at 19 cm/s tape speed.



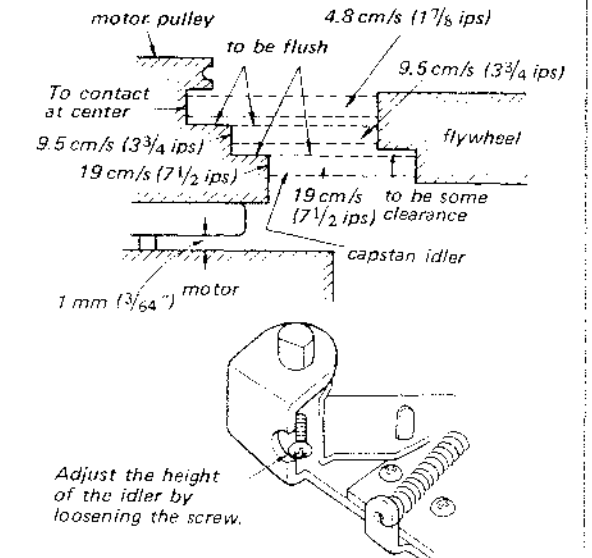
Head deck bottom view.

**Shut-off Mechanism Adjustment  
STOP mode**

1. Loosen two screws (A) and adjust by positioning the shut-off lever holding plate ass'y so that the shut-off mechanism is locked when the clearance between the shut-off arm end and head deck is 6 mm ( $\frac{15}{64}$ " in), and shut-off mechanism is released completely when it is ( $\frac{3}{64}$ " in).
2. Adjust screw (B) so that the clearance between shut-off levers (B) and (H) is 0.3~0.6 mm ( $\frac{1}{64}$ " in) in STOP mode.



**Capstan Idler Position Adjustment  
FWD mode**

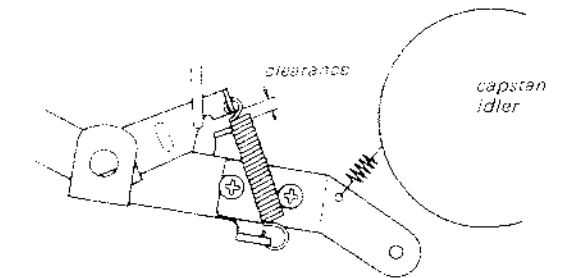


After adjustment, capstan idler should not come in contact with flywheel and 60 Hz motor pulley in STOP mode and the clearance between capstan idler and 50 Hz motor pulley is more than 3 mm ( $\frac{1}{8}$ " in) in STOP mode.

**Idler Arm (C) Stroke Check  
FWD mode**

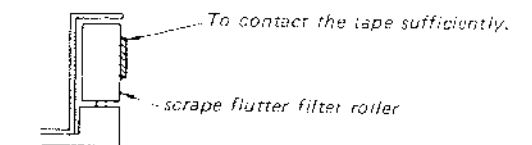
At 4.8 cm/s ( $\frac{1}{8}$  ips) tape speed:

50 Hz	clearance is more than 0.6 mm ( $\frac{1}{64}$ " in)
60 Hz	some clearance



**Scrape Flutter Filter Roller Check  
FWD mode**

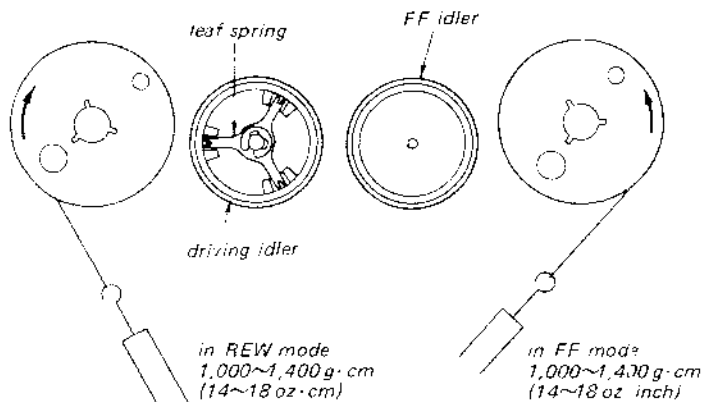
At 4.8 cm/s ( $\frac{1}{8}$  ips) tape speed



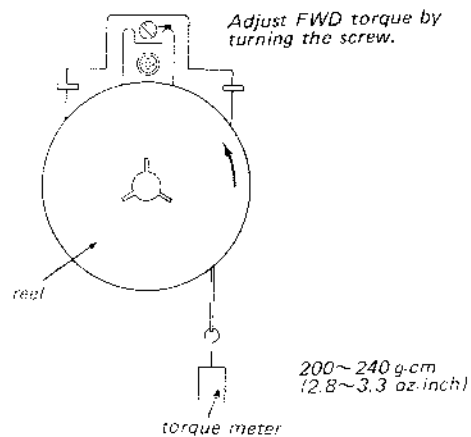


**FF and REW Torque Adjustment**  
FF and REW modes

Adjust by changing the position of leaf spring to obtain the specified values on torque meter. (Read the values when driving idler is forced to stop the motion.)

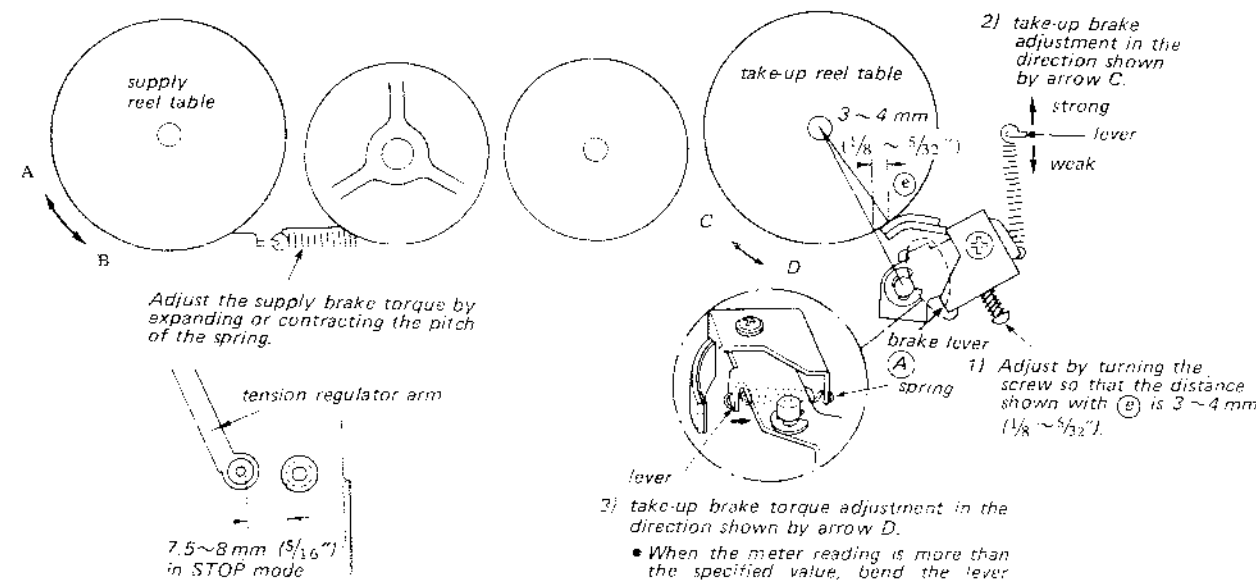


**FWD Torque Adjustment**  
FWD mode



**Brake Adjustment**  
STOP mode

supply brake torque	direction A	500~750 g·cm (6.96~10.4 oz·inch)	take-up brake torque	direction C	400~550 g·cm (5.56~7.65 oz·inch)
	direction B	1,000~1,800 g·cm (13.9~25 oz·inch)		direction D	1,600~2,200 g·cm (22.2~30.6 oz·inch)

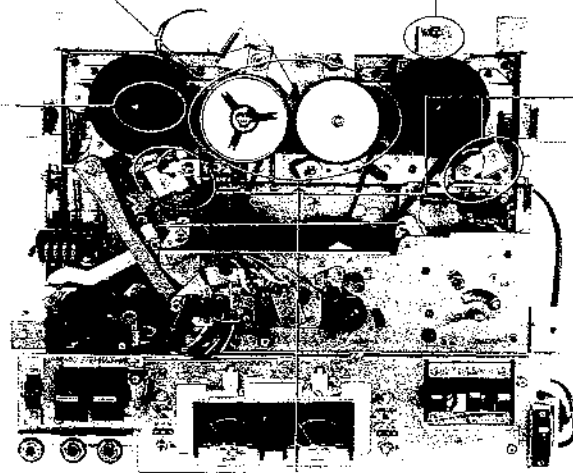
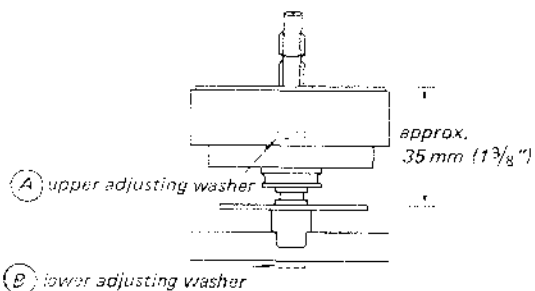


After having performed the tension regulator adjustment on page 9, make the supply brake torque adjustment.

- When the meter reading is more than the specified value, bend the lever in the direction shown by arrow.
- When the meter reading is less than the specified value, cut off one turn of the spring end and hook the spring.

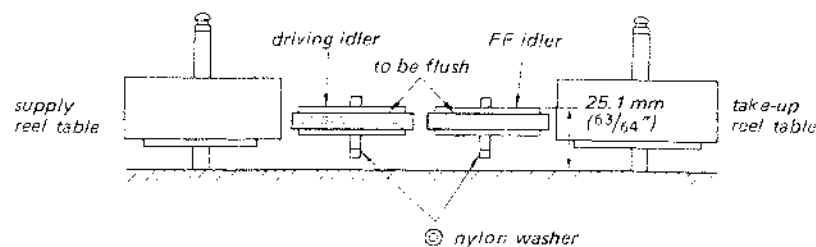
**Reel Table Height Adjustment**  
FWD, REW & FF modes

1. Adjust the height of reel table by adding or removing the adjusting washers (A, B) so that tape does not come in contact with reel flange in FWD, REW & FF modes.
2. Perform tension regulator back tension adjustment on page 9 and FWD torque adjustment.



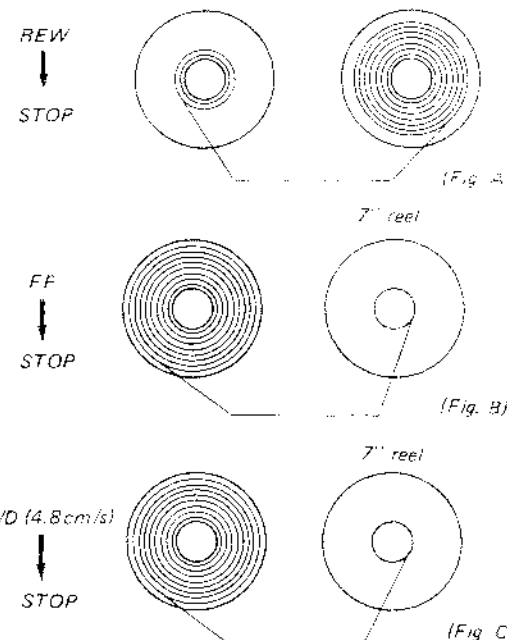
**FF and Driving Idler Height Adjustment**  
STOP mode

Adjust the height of idler by adding or removing the nylon washer.



**Tape Slack Check**

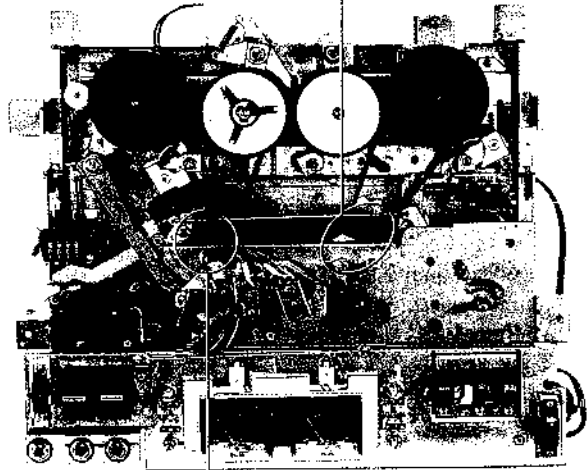
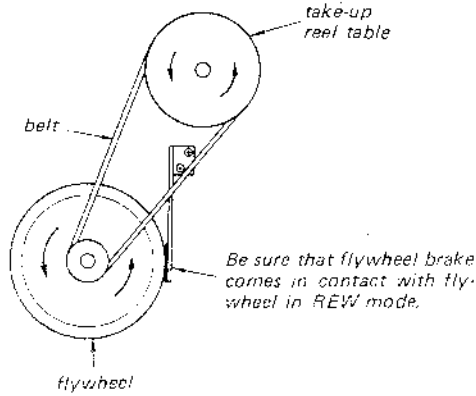
Place the machine in vertical position and thread tape with 7" reel.



Be sure not to slack the tape in the following conditions.

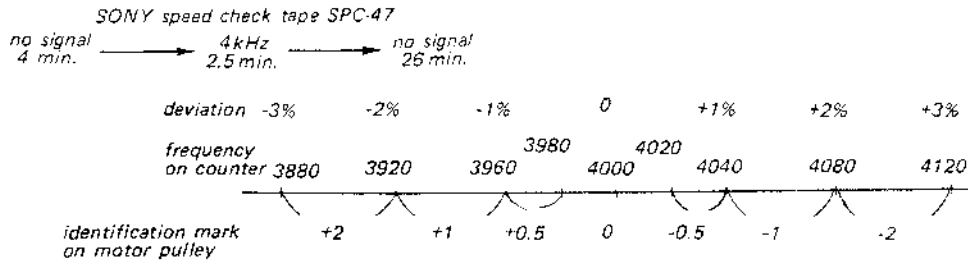
Portion of Tape	Function Selector Knob
end portion of tape	REW → STOP (Fig. A)
beginning of tape	FF → STOP (Fig. B)
beginning of tape	Pull PAUSE lever in FWD mode at 19 cm/s (7 1/2 ips).
beginning of tape	FWD → STOP at 4.8 cm/s (1 7/8 ips) (Fig. C)

**Flywheel Brake Check**  
REW mode



**Tape Speed Adjustment**

1. Playback SONY speed check tape (SPC-47) at 19 cm/s (7 1/2 ips) tape speed in horizontal position. Read digital frequency counter connected to LINE OUT jack.
2. If the counter reading is out of 3,960 ~ 4,040 Hz, replace with the motor pulley with identification mark shown below.  
(As for part No. of motor pulley, refer to page 28.)



	19 cm/s (7 1/2 ips)	9.5 cm/s (3 3/4 ips)	4.8 cm/s (1 7/8 ips)
Deviation (%)	±1.5	±1.5	±1.5
Variation Limit (%)	1	1	1

**3-2. ELECTRICAL ADJUSTMENTS/  
MEASUREMENTS**

**Precaution:**

1. Clean the following parts with an alcohol moistened swab:
 

record head	pinch roller
playback head	rubber belts
erase head	idlers
capstan	tape guides
2. Demagnetize record head and playback head with a head demagnetizer.
3. Do not use magnetized screwdriver for adjustments.
4. After adjustments, apply locking paint to the adjusted parts.
5. Adjustments should be performed in the order given in this service manual.
6. Adjustments and measurements should be performed for both L-CH and R-CH with rated power supply voltage unless otherwise specified.

**Test Equipment/Tools Required:**

- audio oscillator (af osc)
- VTVM
- 400 Hz bandpass filter
- attenuator (600Ω)
- non-magnetic screwdriver
- wow meter
- distortion meter
- oscilloscope
  
- resistors ..... 600Ω (1/2W), 300Ω (1/2W)
- 10 kΩ (1/2W), 100 kΩ (1/2W)

SONY test tape  
J-19-F1

	1	2	3	4	5	6	7
Frequency (Hz)	10k	400	400	10k	7k	80	40
Level (dB)	-10	0	-10	-10	10	-10	-10

blank tape (completely erased with bulk eraser)  
 { SONY super 150  
 { SONY SLH

**Note:** When connecting the measuring equipments to the input or the output jack of the machine, take the impedance matching correctly.

Input	Rated Input Level (Input Impedance)	Output	Rated Output Level (Load Impedance)
MICROPHONE	-60 dB, 0.78 mV (600Ω)	LINE OUT	0 dB, 0.78 V (100kΩ)
LINE IN	-10 dB, 0.25 V (10kΩ)		

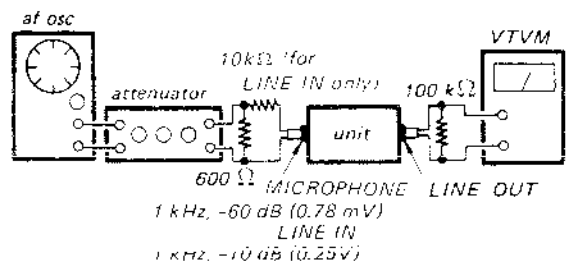
RECORD VOLUME control should be set as follows unless otherwise specified.

**LINE RECORD VOLUME**

Position to obtain 0 dB (0.78 V) LINE OUTPUT for 1 kHz, -10 dB (0.25 V) LINE INPUT with MIC RECORD VOLUME set to the minimum position and MONITOR switch set to SOURCE position.

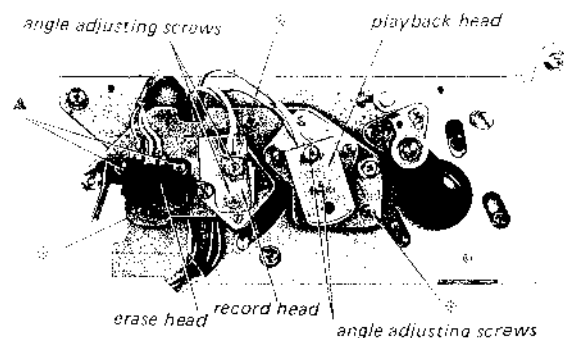
**MIC RECORD VOLUME**

Position to obtain 0 dB (0.78 V) LINE OUTPUT for 1 kHz, -60 dB (0.78 mV) MICROPHONE input with LINE RECORD VOLUME set to minimum position and MONITOR switch set to SOURCE position.



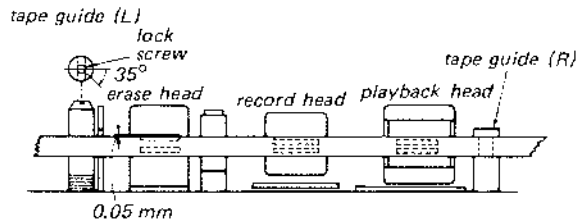
**Note on replacing the heads:**

1. Erase Head Removal  
When removing the erase head from the head deck, remove the two screws shown with A.  
(Do not remove the three screws shown below.)
2. Record or P.B. Head Removal  
When removing the record or the p.b. head, remove the respective angle adjusting screws.  
(Do not turn the screws except the angle adjusting screws.)



**1. Tape Path Adjustment**

**A. Tape Guide (left) Adjustment**



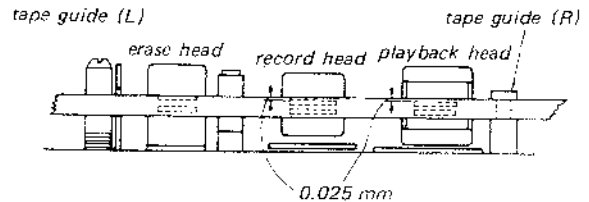
**Procedure:**

1. Thread a tape and place unit in playback mode.
2. Loosen the lock screw and align the upper edge of the erase head core and that of the tape by turning tape guide (L).
3. Turn tape guide (L) clockwise by approximately 35 degrees from the position obtained in the preceding step so that the upper edge of the tape is approximately 0.05 mm (2 mil) lower than the upper edge of the erase head core.
4. Fix the tape guide with the lock screw.

**B. Record and Playback Head Preadjustment**

(Rough adjustment for Playback Head Angle Adjustment and Playback Head Azimuth Adjustment)

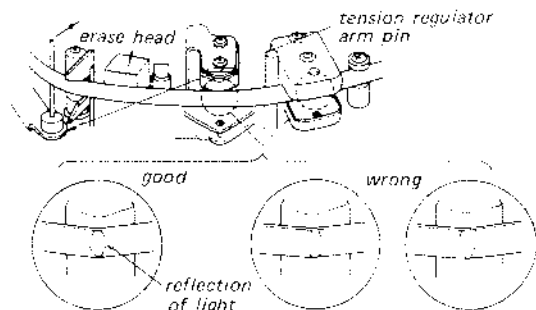
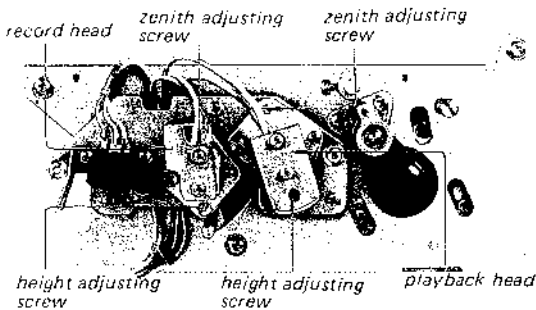
**Note:** This adjustment and the following adjustments (Playback Head Angle Adjustment and Playback Head Azimuth Adjustment) should be repeated alternately several times.



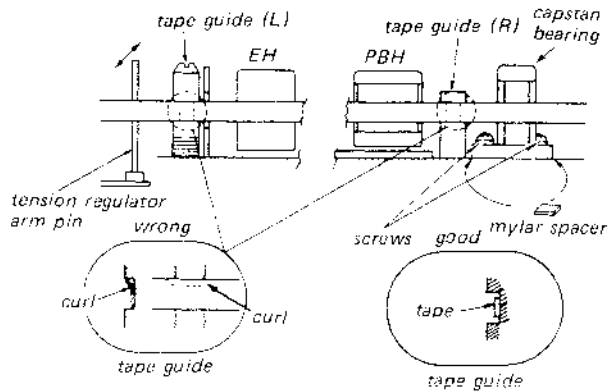
**Procedure:**

1. Align the upper edges of record and playback head cores and that of the tape by evenly turning the record and playback head height adjusting screws.
2. Turn record and playback head height adjusting screws clockwise by approximately 15 degrees so that the upper edges of record and playback head cores are 0.025 mm (1 mil) lower than that of the tape and memorize the angle of turns.
3. Turn zenith adjusting screws by the same angle of turns to the same direction of record and playback head height adjusting screws.
4. Thread SONY tape super 150 or PS-2 and place unit in playback mode at 19 cm/s (7 1/2 ips).
5. Make the tape loose a little by pushing the tension regulator arm pin in the direction shown by arrow and then adjust playback head and record head zenith adjusting screws to obtain the reflection of light as shown.

**Adjustment Location:**



**2. Tape Curl Adjustment**



**Procedure:**

1. Thread SONY tape super 200 (thin tape) and place unit in playback mode at 4.8 cm/s (1 7/8 ips) tape speed.
2. Be sure that the tape comes in contact with two tape guides exactly as shown.
  - a) If tape is curled at tape guide (L), adjust by bending tension regulator arm pin with fingers.
  - b) If tape is curled at tape guide (R), loosen two capstan bearing holding screws and adjust by adding or removing the mylar spacer.

**Note:** After adding or removing the mylar spacer (0.1 mm thick), perform playback head zenith adjusting screw. (See "Record and Playback Head Preadjustment" on page 17.)

**3. Playback Head Angle Adjustment**

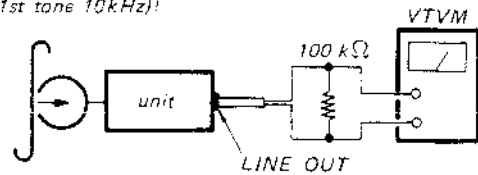
**Control/Switch Setting:**

- TAPE SELECT switch: NORMAL
- TAPE SPEED selector: 7 1/2 ips (19 cm/s)
- MONITOR switch: TAPE

**Procedure:**

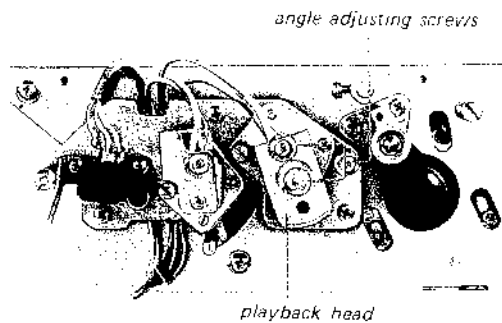
1. Mode: playback

J-19-F1  
(1st tone 10kHz!)



2. Adjust angle-adjusting screws for maximum VTVM reading.
3. Apply back-tension by holding lightly the supply reel table, reproducing the alignment tape, and then adjust the angle of the head by loosening two angle-adjusting screws so that VTVM reading on both L-CH and R-CH does not rise.

**Note:** Unless playback head is installed at correct angle, VTVM reading will rise



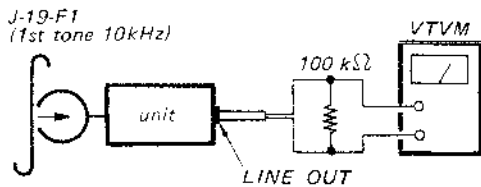
**4. Playback Head Azimuth Adjustment**

**Control/Switch Setting:**

- TAPE SELECT switch: NORMAL
- TAPE SPEED selector: 7½ ips (19 cm/s)
- MONITOR switch: TAPE

**Procedure:**

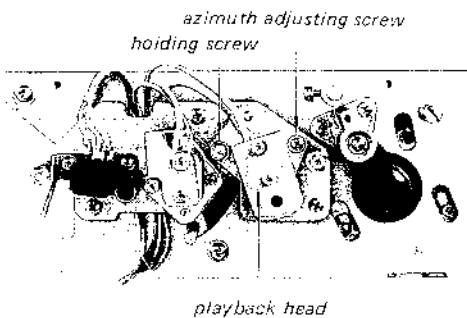
1. Be sure that playback head is fixed sufficiently to head deck with holding screw as shown below and tape path adjustment has been made.
2. Mode: playback



3. Adjust azimuth adjusting screw for maximum VTVM reading.

**Note:** If azimuth angles of L-CH and R-CH are not the same, set the screw midway between two screw positions.

**Adjustment Location:**



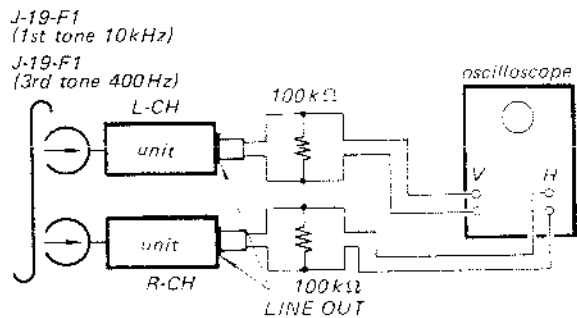
**5. Playback Head Phase Check**

**Control/Switch Setting:**

- TAPE SELECT switch: NORMAL
- TAPE SPEED selector: 7½ ips (19 cm/s)
- MONITOR switch: TAPE

**Procedure:**

1. Mode: playback



- 2.

Adjust	On the oscilloscope			
azimuth adjusting screw				
(400 Hz)	good	wrong		
(10 kHz)		good		wrong

**Note:** If necessary, finally adjust the playback head azimuth adjusting screw.

**6. Playback Output Level Adjustment and Level Meter Calibration**

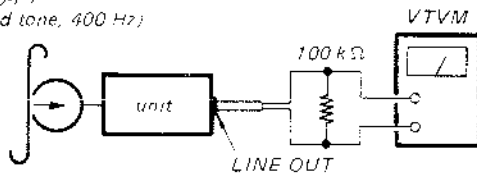
**Control/Switch Setting:**

TAPE SELECT switch: NORMAL  
 TAPE SPEED selector: 7½ ips (19 cm/s)  
 MONITOR switch: TAPE

**Procedure:**

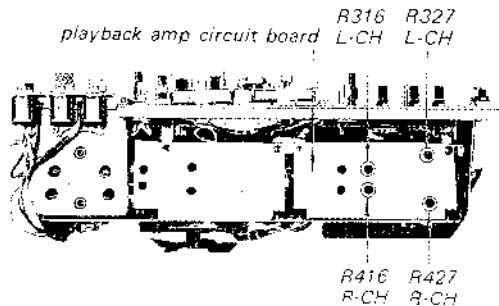
1. Mode: playback

J-19-F1  
 (2nd tone, 400 Hz)



2. Adjust R316, R416 for 0 dB (0.78V) VTVM reading.
3. Adjust R327, R427 for 0 reading on RECORD LEVEL meters.
4. Change TAPE SELECT switch to SPECIAL and be sure that VTVM reading is -2 dB ~ -3 dB (0.62~0.55V).

**Adjustment Location:**



**7. Playback Equalizer Adjustment**

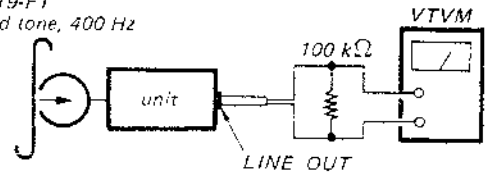
**Control/Switch Setting:**

TAPE SELECT switch: NORMAL  
 TAPE SPEED selector: 7½ ips (19 cm/s)  
 MONITOR switch: TAPE

**Procedure:**

1. Mode: playback

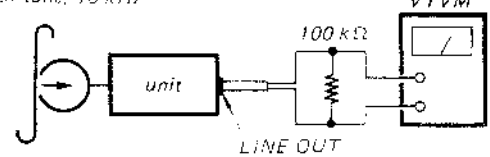
J-19-F1  
 3rd tone, 400 Hz



Memorize VTVM reading.

2. Mode: playback

J-19-F1  
 4th tone, 10 kHz

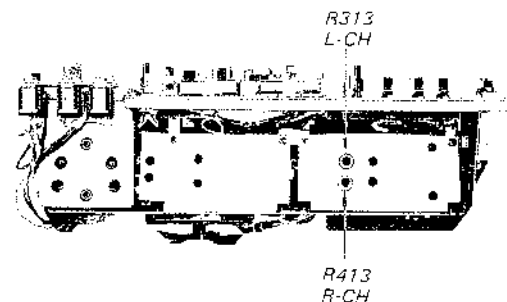


Adjust R313, 413 to obtain the same VTVM reading as in step 1.

3. Playback the following tones and make sure that each tone output level deviation against 3rd tone is as follows.

Tone		4th	5th	6th	7th
J-19-F1	Frequency (Hz)	10k	7k	80	40
Level Deviation from 3rd tone (400Hz)	L-CH	0±2dB	0±2dB	2±2dB	4±2dB
	R-CH			2.5±3dB	4.5±2dB

**Adjustment Location:**



**8. Playback S/N Ratio Check**

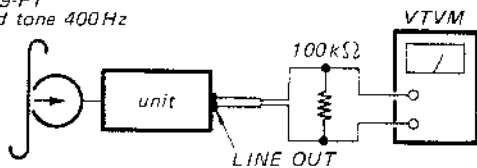
**Control/Switch Setting:**

- TAPE SELECT switch: NORMAL
- TAPE SPEED selector: 7½ ips (19 cm/s)
- MONITOR switch: TAPE

**Procedure:**

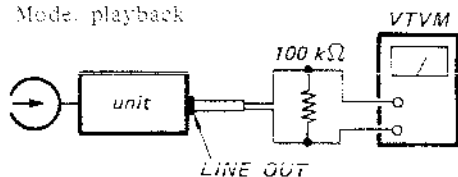
1. Mode: playback

J-19-F1  
2nd tone 400Hz



2. VTVM reading should be 0 dB (0.78V). If not, make playback output level adjustment again.
3. With no tape threaded, keep on pushing shut-off lever with finger.

Mode: playback



4. Be sure that VTVM reading is less than -48 dB (3 mV).

**Note:** S/N ratio may change by reversing the sense of motor leads.

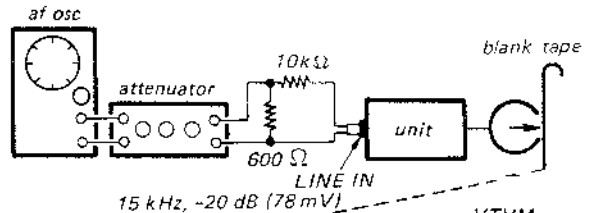
**9. Record Head Azimuth and Track Position Adjustment**

**Control/Switch Setting:**

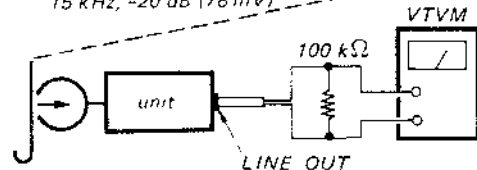
- TAPE SELECT switch: NORMAL
- TAPE SPEED selector: 7½ ips (19 cm/s)
- MONITOR switch: TAPE
- LINE RECORD
- VOLUME control: See page 16

**Procedure:**

1. Mode: record



15 kHz, -20 dB (78 mV)

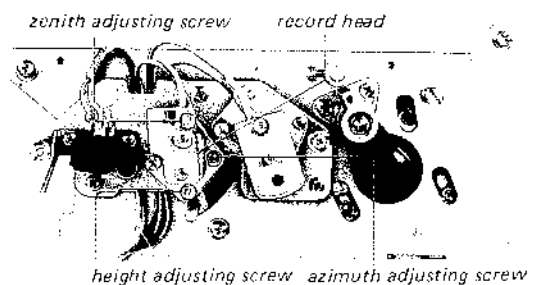


2. Adjust azimuth adjusting screw for maximum VTVM reading.

**Note:** If the maximum value of L-CH and R-CH outputs can not be obtained at the same angle, adjust the screw midway between two screw positions. (That value should not be fallen more than 1 dB from the maximum value.)

3. Supply a 1 kHz signal of -10 dB (0.24 V) into R-CH LINE IN jack and record the signal on the blank tape.
4. Adjust the height adjusting screw for maximum VTVM reading and memorize the angle of turns of the screw.
5. Turn the zenith adjusting screw by the same angle of turns obtained in preceding step 4.
6. After the adjustment, check tape path adjustment on page 17 again.

**Adjustment Location:**





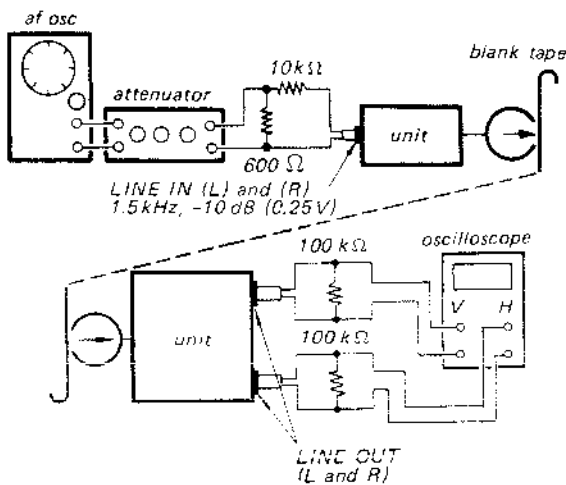
**10. Record Head Phase Check**

**Control/Switch Setting:**

- TAPE SELECT switch: NORMAL
- TAPE SPEED selector: 7½ ips (19 cm/s)
- MONITOR switch: TAPE
- LINE RECORD
- VOLUME control: See page 16

**Procedure:**

1. Make the playback head phase check on page 19 first.
2. Mode: record



3.

Adjust	On the oscilloscope
azimuth adjusting screw	

Note: If necessary, finely adjust record head azimuth adjusting screw.

**11. Trap Coil Adjustment**

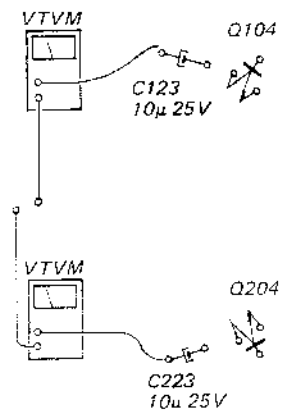
**Control/Switch Setting:**

- TAPE SELECT switch: NORMAL
- TAPE SPEED selector: 7½ ips (19 cm/s)
- MIC RECORD
- VOLUME control: MIN (fully counterclockwise)

**Procedure:**

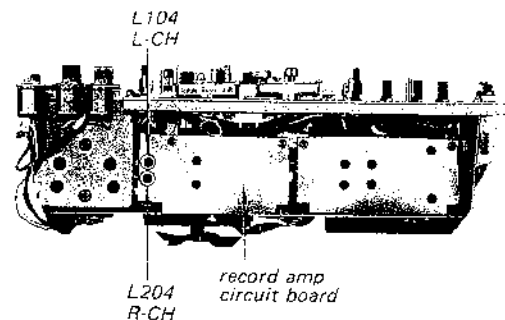
1. Connect a VTVM across the check point and ground as shown.

(RECORD AMP CIRCUIT BOARD)



2. Place unit in record mode without tape.
3. Adjust L104, L204 to obtain the minimum VTVM reading (less than -7 dB, 0.35V).

**Adjustment Location:**



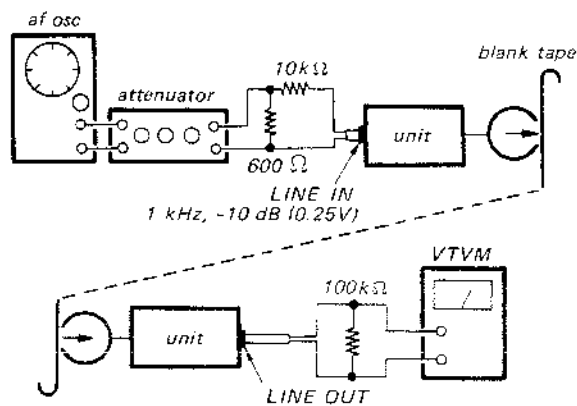
**12. Record Bias Adjustment**

**Control/Switch Setting:**

- TAPE SELECT switch: NORMAL
- TAPE SPEED selector: 7½ ips (19 cm/s)
- MONITOR switch: TAPE
- LINE RECORD
- VOLUME control: See page 16

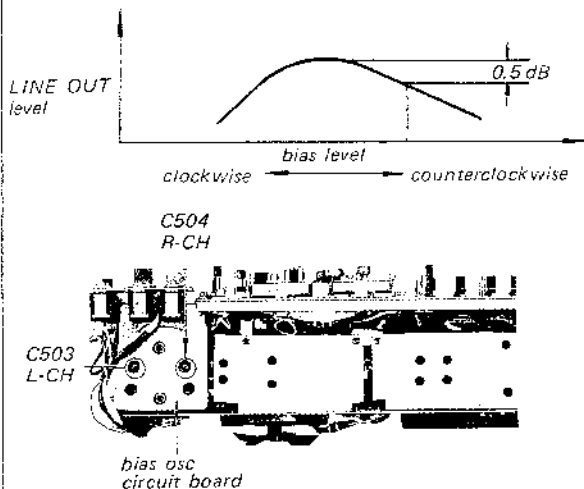
**Procedure:**

1. Be sure that trap coil adjustment has been made.
2. Mode: record



3. Turn the bias adjusting trimmer capacitors C503, C504 counterclockwise for maximum VTVM reading and then turn the capacitor counterclockwise so that VTVM reading drops 0.5 dB from the maximum value.
4. After the adjustment, be sure that voltage across record head is approximately 14V on VTVM and it decreases, as TAPE SPEED selector is changed to 3¾ ips (9.5 cm/s) and then 17/8 ips (4.8 cm/s).

**Adjustment Location:**



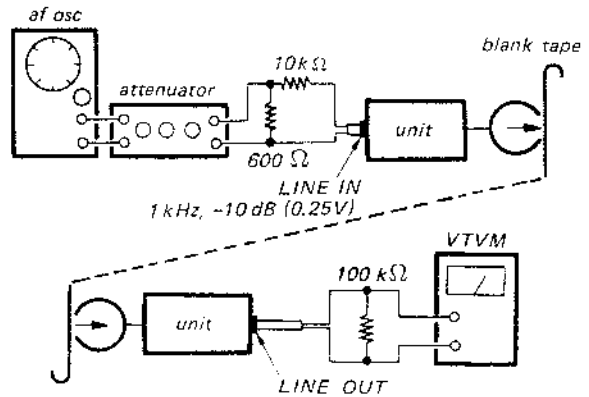
**13. Record Level Adjustment**

**Control/Switch Setting:**

- TAPE SELECT switch: NORMAL
- TAPE SPEED selector: 7½ ips (19 cm/s)
- MONITOR switch: TAPE
- LINE RECORD
- VOLUME control: See page 16

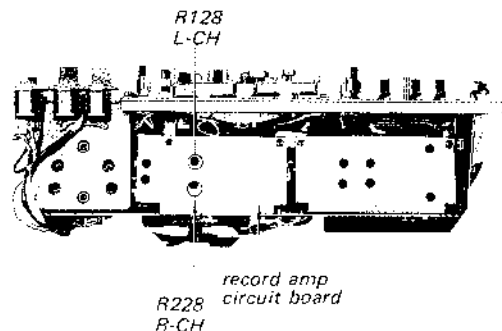
**Procedure:**

1. Mode: record



2. Adjust R128, R228 for 0 dB (0.78V) VTVM reading.
3. Be sure that VTVM reading is 0 dB (0.78V) when changing MONITOR switch from TAPE to SOURCE position and the pointer of RECORD LEVEL meter stays at "0".
4. When TAPE SELECT switch is changed to SPECIAL with MONITOR switch to SOURCE, VTVM reading should decrease approx. 1.5 dB.

**Adjustment Location:**



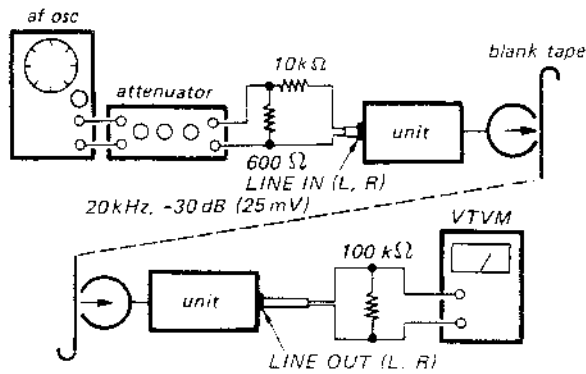
**14. Dummy Coil Adjustment**

**Control/Switch Setting:**

- TAPE SELECT switch: NORMAL
- TAPE SPEED selector: 7½ ips (19 cm/s)
- MONITOR switch: TAPE
- LINE RECORD
- VOLUME control: See page 16

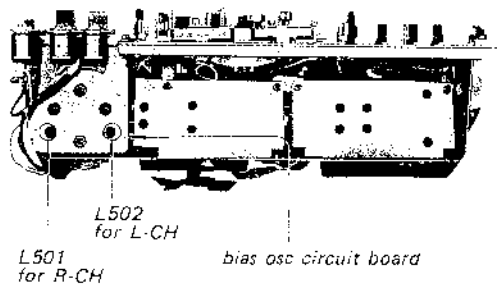
**Procedure:**

1. Mode: stereo record



2. Memorize VTVM readings.
3. Set L-channel (R-channel) only in record mode.
4. Adjust L502 (L501) with non-magnetic screwdriver, taking care not to break the core, so that VTVM reading is the same as that obtained in step 2.

**Adjustment Location:**



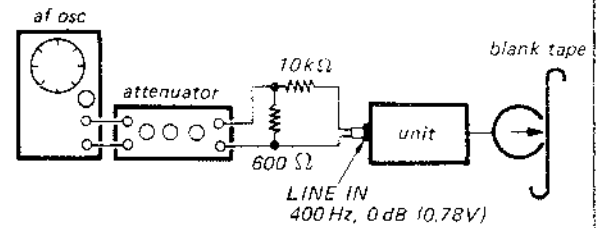
**15. Erase Ratio Measurement**

**Control/Switch Setting:**

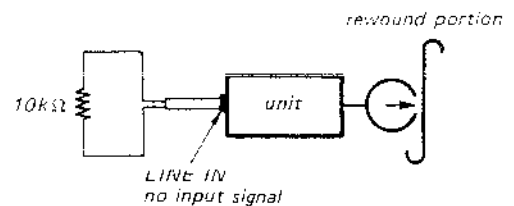
- TAPE SELECT switch: NORMAL
- TAPE SPEED selector: 7½ ips (19 cm/s)
- MONITOR switch: TAPE
- LINE RECORD
- VOLUME control: See page 16

**Procedure:**

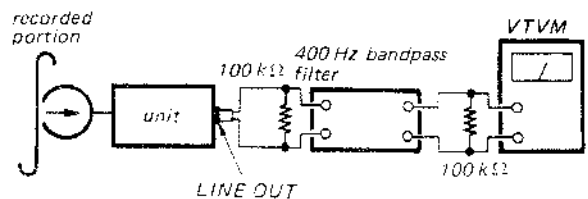
1. Mode: stereo record



2. Rewind half of the recorded part.
3. Mode: stereo record (erase)



4. Mode: playback



**Specification:**

Recorded Signal	VTVM Reading
1 kHz	level difference: greater than 65 dB
erased portion	

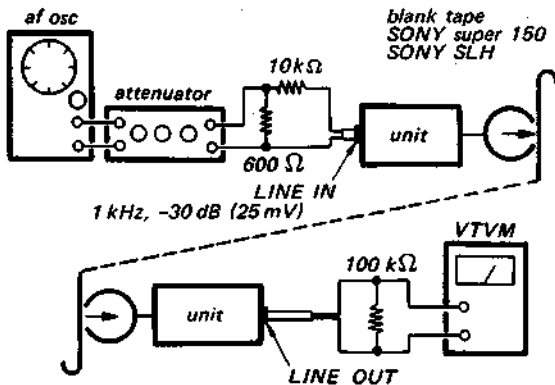
**16. Overall Frequency Response Measurement**

**Control/Switch Setting:**

- TAPE SELECT switch: NORMAL and SPECIAL  
 TAPE SPEED selector: 7½ ips (19 cm/s)  
 3¾ ips (9.5 cm/s)  
 and 1⅞ ips (4.8 cm/s)  
 MONITOR switch: TAPE  
 LINE RECORD  
 VOLUME control: See page 16

**Procedure:**

1. Mode: record



2. Level Deviation from 1 kHz signal.  
 (for both SPECIAL and NORMAL)

Frequency Tape speed	50Hz	100Hz	5kHz	7kHz	12.5kHz	20kHz
19 cm/s	±3 dB	±3	±3	±3	±3	+3 -4
9.5 cm/s	+3 -6	±3	±3	±3	+3 -4	
4.8 cm/s	+4 -5	+5 -1	+1 -6			

**Note:** When recording signal on SONY tape "super 150", set TAPE SELECT switch to NORMAL and on SONY SLH tape, to SPECIAL.

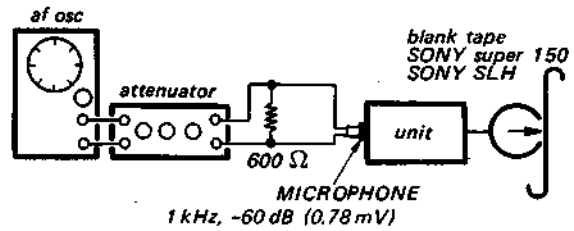
**17. Overall S/N Ratio Measurement**

**Control/Switch Setting:**

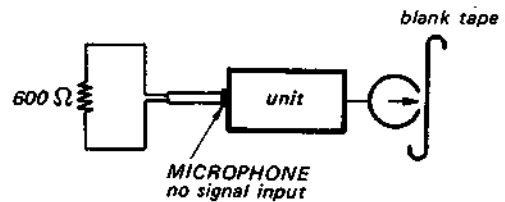
- TAPE SELECT switch: NORMAL and SPECIAL  
 TAPE SPEED selector: 7½ ips (19 cm/s)  
 MONITOR switch: TAPE  
 MIC RECORD  
 VOLUME control: See page 16

**Procedure:**

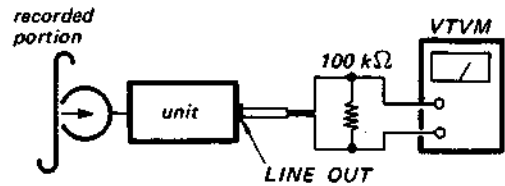
1. Mode: record



2. Mode: record



3. Mode: playback



**Specification:**

Recorded Signal	VTVM Reading	
	NORMAL	SPECIAL
1 kHz	level difference: greater than 45 dB	level difference: greater than 47 dB
no signal		

**Note:** When recording signal on SONY tape "super 150", set TAPE SELECT switch to NORMAL and on SONY SLH tape, to SPECIAL.

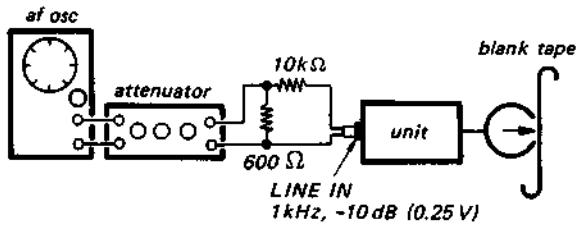
**18. Overall Distortion Measurement**

**Control/Switch Setting:**

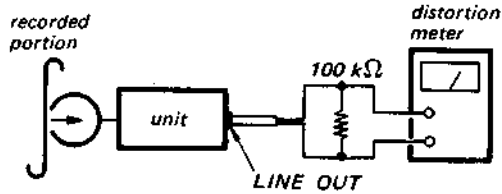
- TAPE SELECT switch: NORMAL
- TAPE SPEED selector: 7 1/2 ips (19 cm/s)
- MONITOR switch: TAPE
- LINE RECORD
- VOLUME control: See page 16

**Procedure:**

1. Mode: record



2. Mode: playback



Specification: less than 1.5%

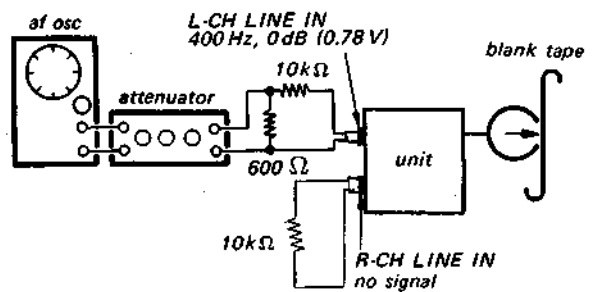
**19. Cross-talk Measurement (between channels)**

**Control/Switch Setting:**

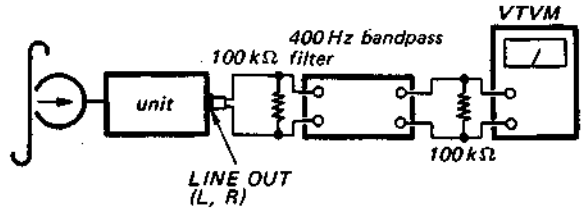
- TAPE SELECT switch: NORMAL
- TAPE SPEED selector: 7 1/2 ips (19 cm/s)
- MONITOR switch: TAPE
- LINE RECORD
- VOLUME control: See page 16

**Procedure:**

1. Mode: stereo record



2. Mode: playback



Specification:

Playback	VTVM Reading
L-CH (400 Hz)	level difference: greater than 48 dB
R-CH (no signal)	

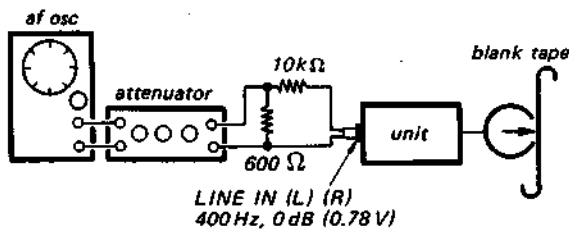
**20. Cross-Talk Measurement  
(between tracks)**

**Control/Switch Setting:**

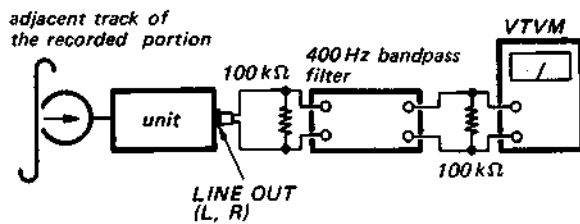
- TAPE SELECT switch: NORMAL
- TAPE SPEED selector: 7 1/2 ips (19 cm/s)
- MONITOR switch: TAPE
- LINE RECORD VOLUME control: See page 16

**Procedure:**

1. Mode: stereo record

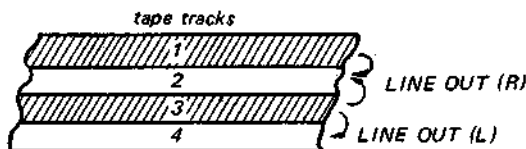


2. Turn the reels over.
3. Mode: playback



**Specification:**

Playback	VTVM reading
400 Hz	level difference: greater than 65 dB
adjacent track of the recorded portion	



**21. Minimum Input Level Check**

**Control/Switch Setting:**

- MONITOR switch: SOURCE

**Procedure:**

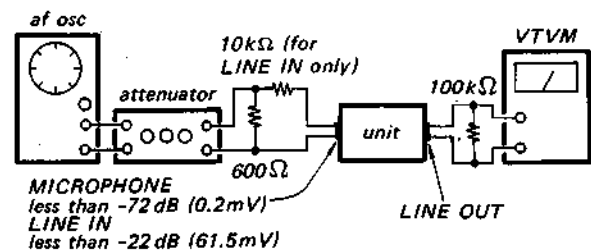
**A. MICROPHONE Jack Level Check**

1. Set LINE RECORD VOLUME to MIN and MIC RECORD VOLUME to MAX position.
2. Supply 1 kHz signal into MICROPHONE jack and adjust attenuator to obtain 0 dB (0.78 V) VTVM reading.
3. Be sure that MICROPHONE jack level is less than -72 dB (0.2 mV).

**B. LINE IN Jack Level Check**

1. Set MIC RECORD VOLUME to MIN and LINE RECORD VOLUME to MAX position.
2. Supply 1 kHz signal into LINE IN jack and adjust attenuator to obtain 0 dB (0.78 V) VTVM reading.
3. Be sure that LINE IN jack level is less than -22 dB (61.5 mV).

**Mode: record**



**3.3. POWER FREQUENCY ADAPTATION**

The motor pulley and tapping of the motor capacitor terminals must be changed, if the line frequency differs from what the recorder is set for.

**To change connection of the motor capacitor terminals**

The motor capacitor is located at the upper side of the drive mechanism. Change the connection of the motor capacitor terminals by soldering as illustrated.

**To change motor pulley**

Remove the top panel as described in DISASSEMBLY on page 6.

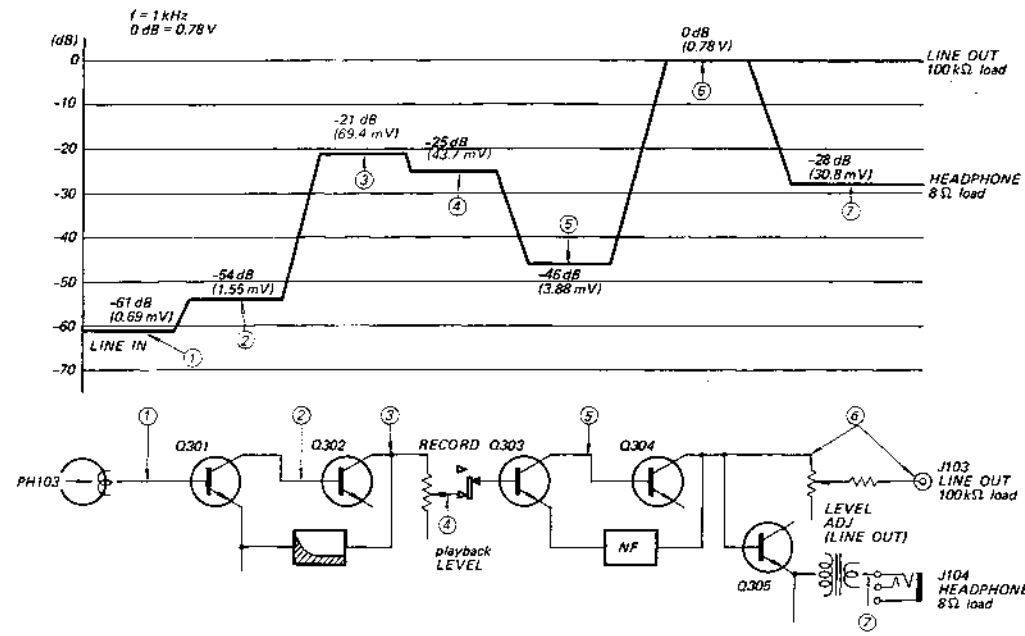
1. Remove PAUSE adjusting plate by loosening the screw (A) . Withdraw PAUSE pull rod.
2. Remove rubber belt from the motor pulley and idler wheel.
3. Remove motor pulley by loosening two screws (B) and (C) which hold motor pulley.
4. Use the supplied motor pulley with same mark and tighten the screws.

Motor Pulley Part No.			
for 50 Hz		for 60 Hz	
Mark on Motor Pulley	Part No.	Mark on Motor Pulley	Part No.
+ 2	3-518-067-61	+ 2	3-518-068-61
+ 1	3-518-067-51	+ 1	3-518-068-51
+ 0.5	3-518-067-41	+ 0.5	3-518-068-41
0	3-518-067-01	0	3-518-068-01
- 0.5	3-518-067-11	- 0.5	3-518-068-11
- 1	3-518-067-21	- 1	3-518-068-21
- 2	3-518-067-31	- 2	3-518-068-31

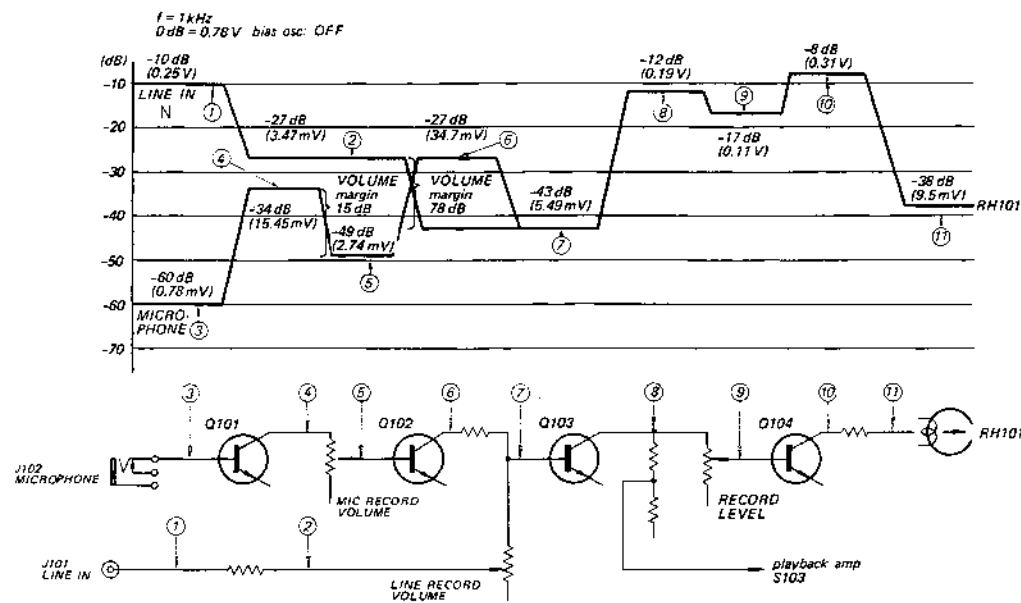
SECTION 4  
DIAGRAMS

4-1. LEVEL DIAGRAMS

Playback



Record



MEMO

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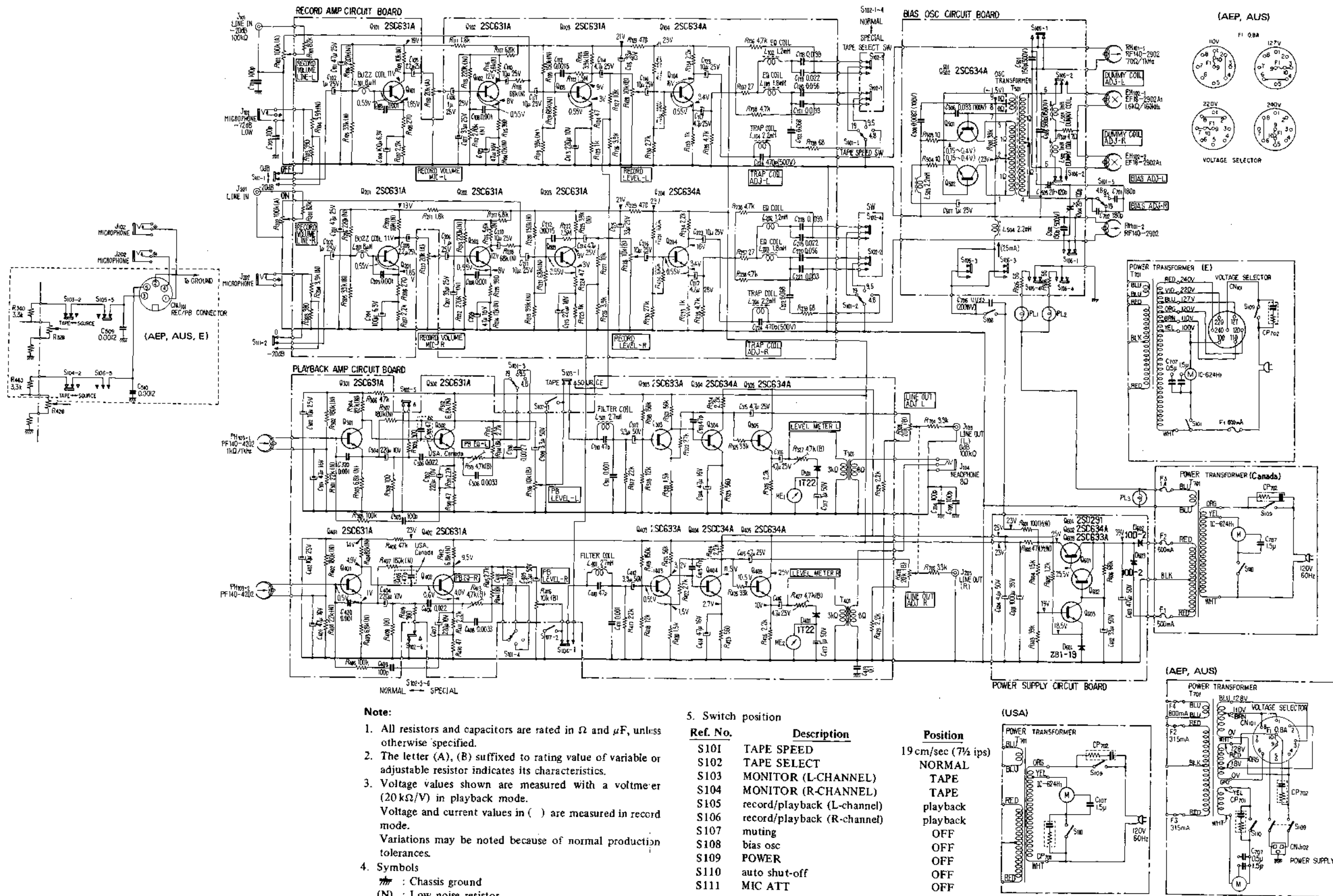
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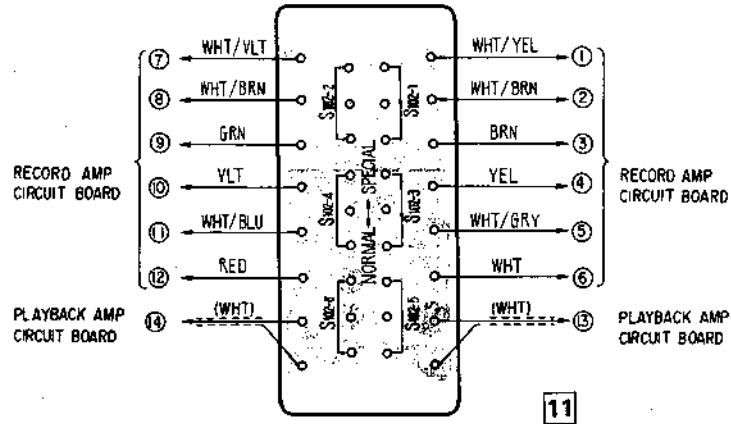


4-2. SCHEMATIC DIAGRAM



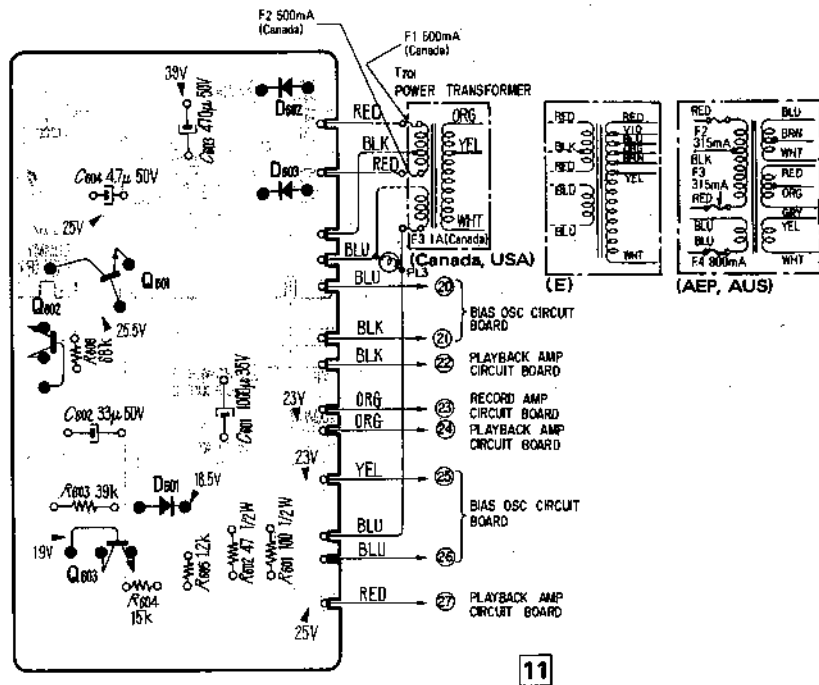
4.3. MOUNTING DIAGRAMS

4-3-1. Tape Select Switch Circuit Board

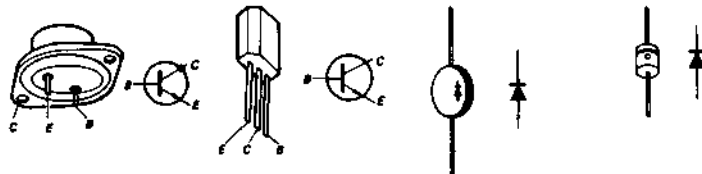


4-3-2. Power Supply Circuit Board

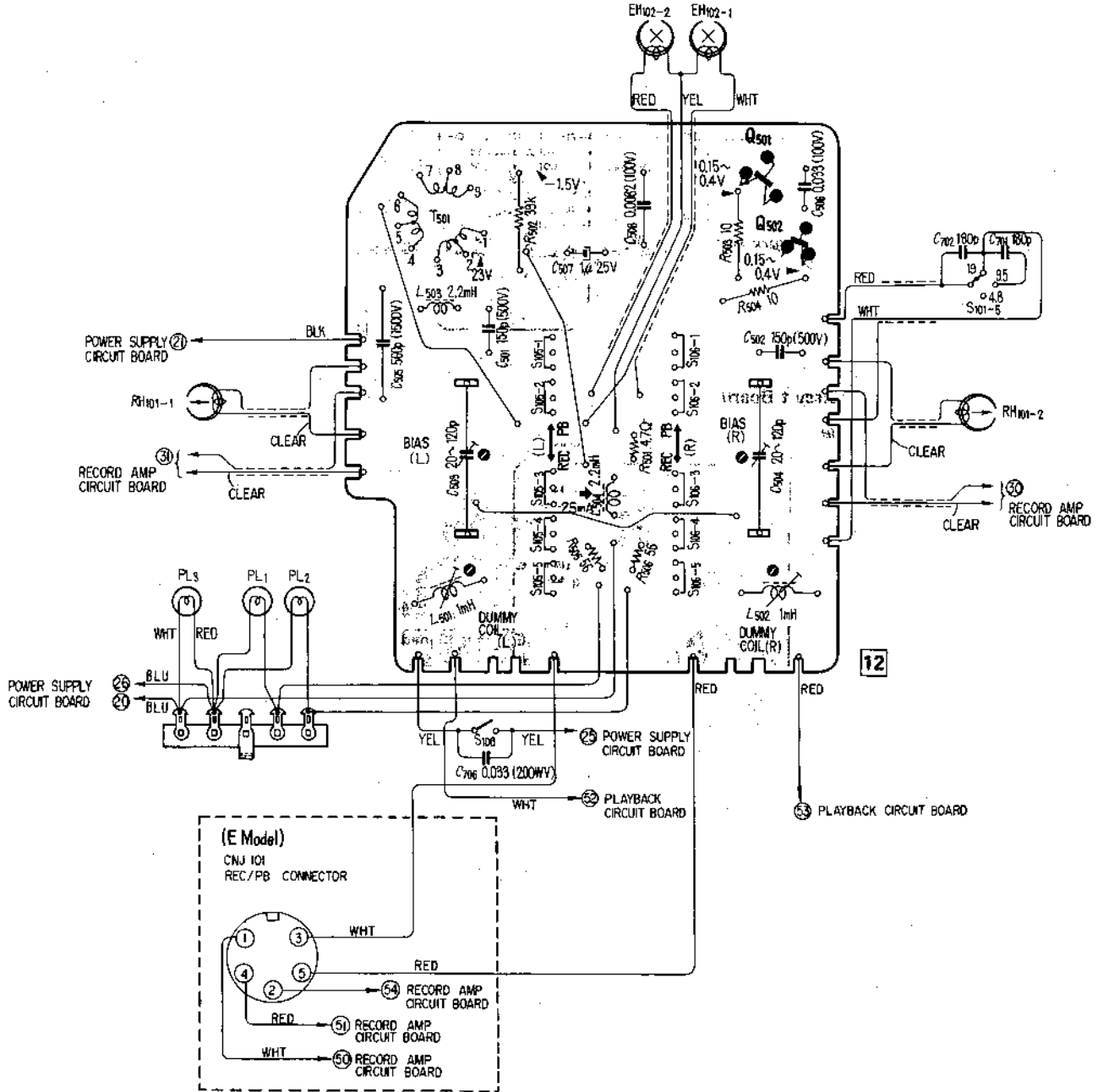
Conductor Side



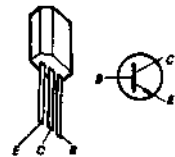
- O601: 2SD291
- O602: 2SC634A
- O603: 2SC633A
- D601: ZB1-19
- D602, 603: 10D-2



4-3-3. Bias Osc Circuit Board  
Conductor Side

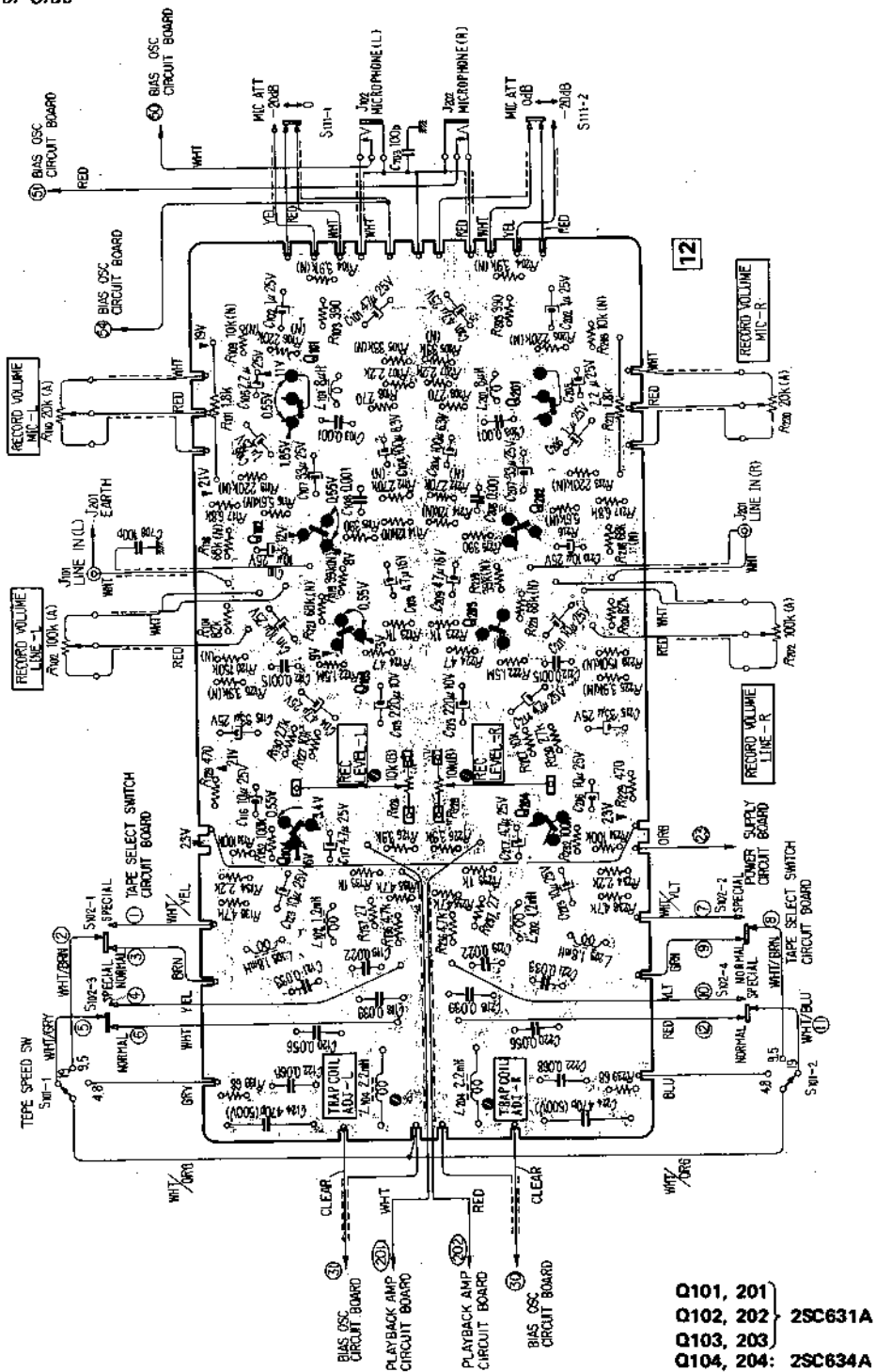


Q501, 502: 2SC634A

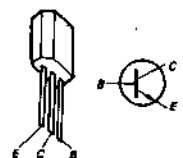


### 4-3.4. Record Amp Circuit Board

Conductor Side

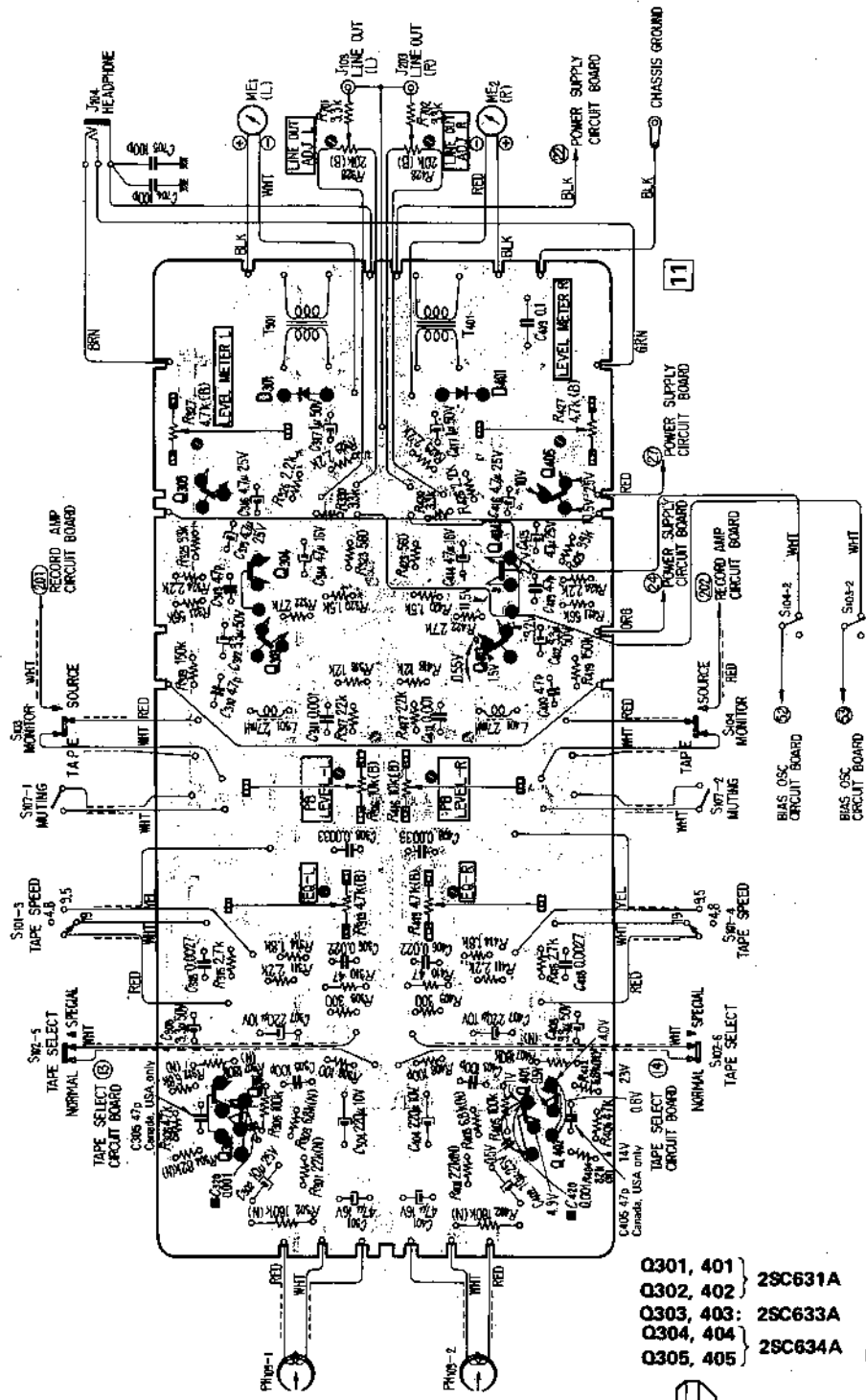


- Q101, 201
- Q102, 202 } 25C631A
- Q103, 203
- Q104, 204: 25C634A



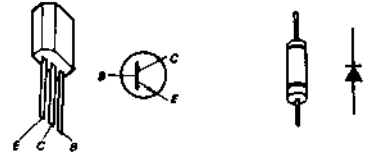
**4-3-5. Playback Amp Circuit Board**

*Conductor Side*



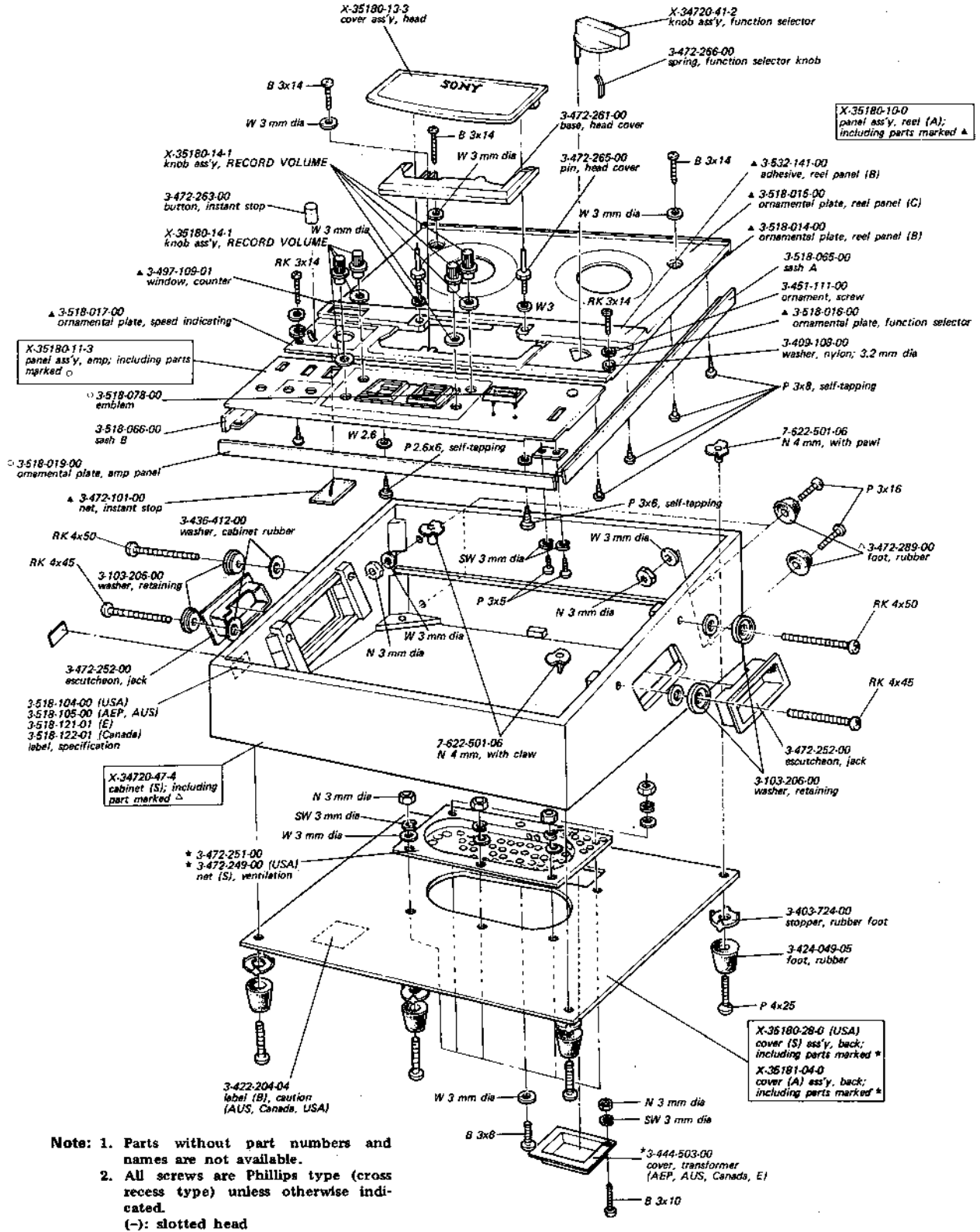
■ : Mounted on the Conductor Side of Playback Amp Circuit Board.

- Q301, 401 } 2SC631A
- Q302, 402 } 2SC631A
- Q303, 403: 2SC633A
- Q304, 404 } 2SC634A
- Q305, 405 } 2SC634A
- D301, 401: 1T22

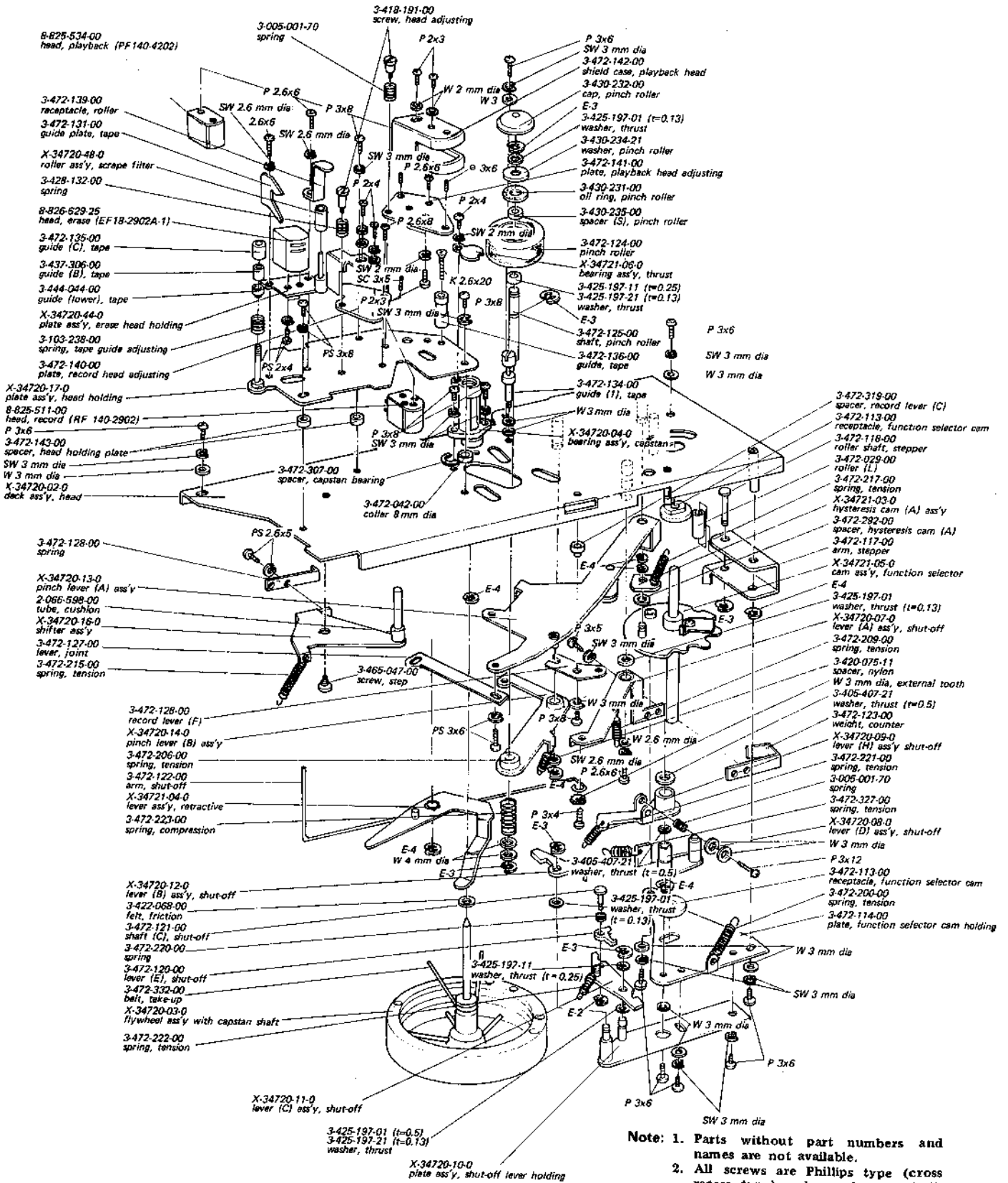


## SECTION 5 EXPLODED VIEWS

### 5-1. CABINET – Top View –

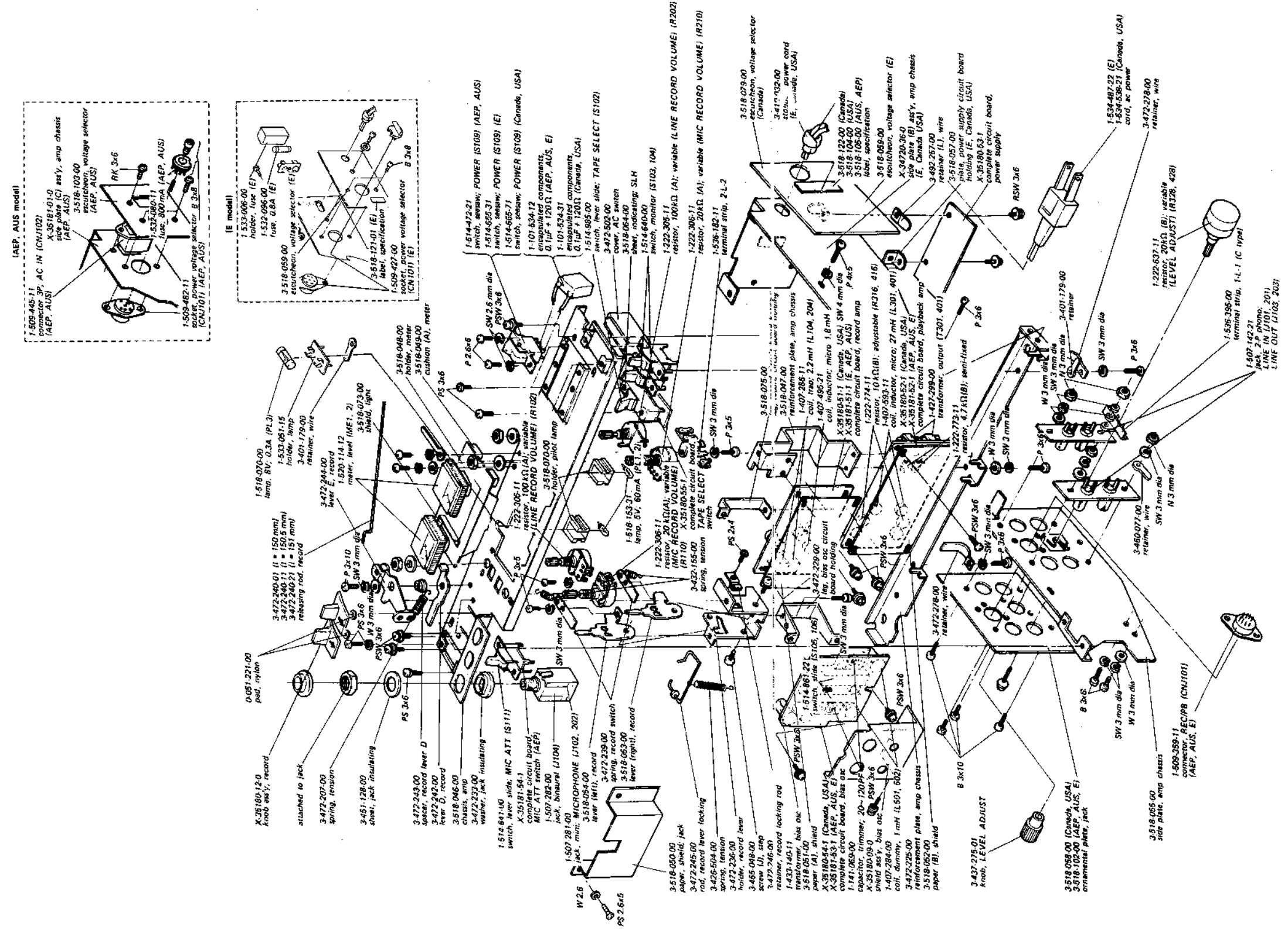


## 5-2. HEAD DECK - Top View -



**Note: 1.** Parts without part numbers and names are not available.  
**2.** All screws are Phillips type (cross recess type) unless otherwise indicated.  
 (-): slotted head

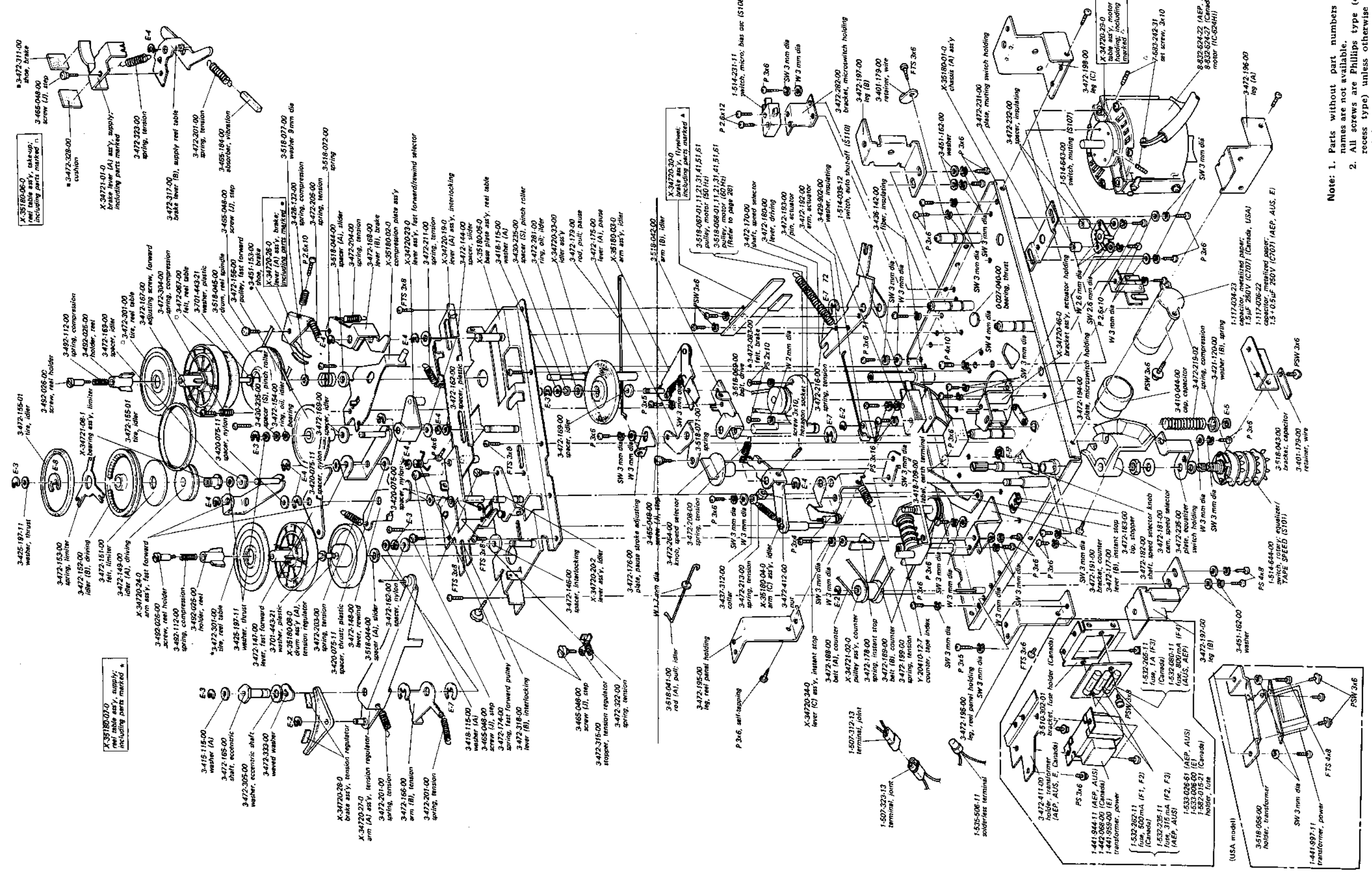
5-3. AMPLIFIER CHASSIS – Top View –



Note: 1. Parts without part numbers and names are not available.  
 2. All screws are Phillips type (cross recess type) unless otherwise indicated.  
 (-): slotted head

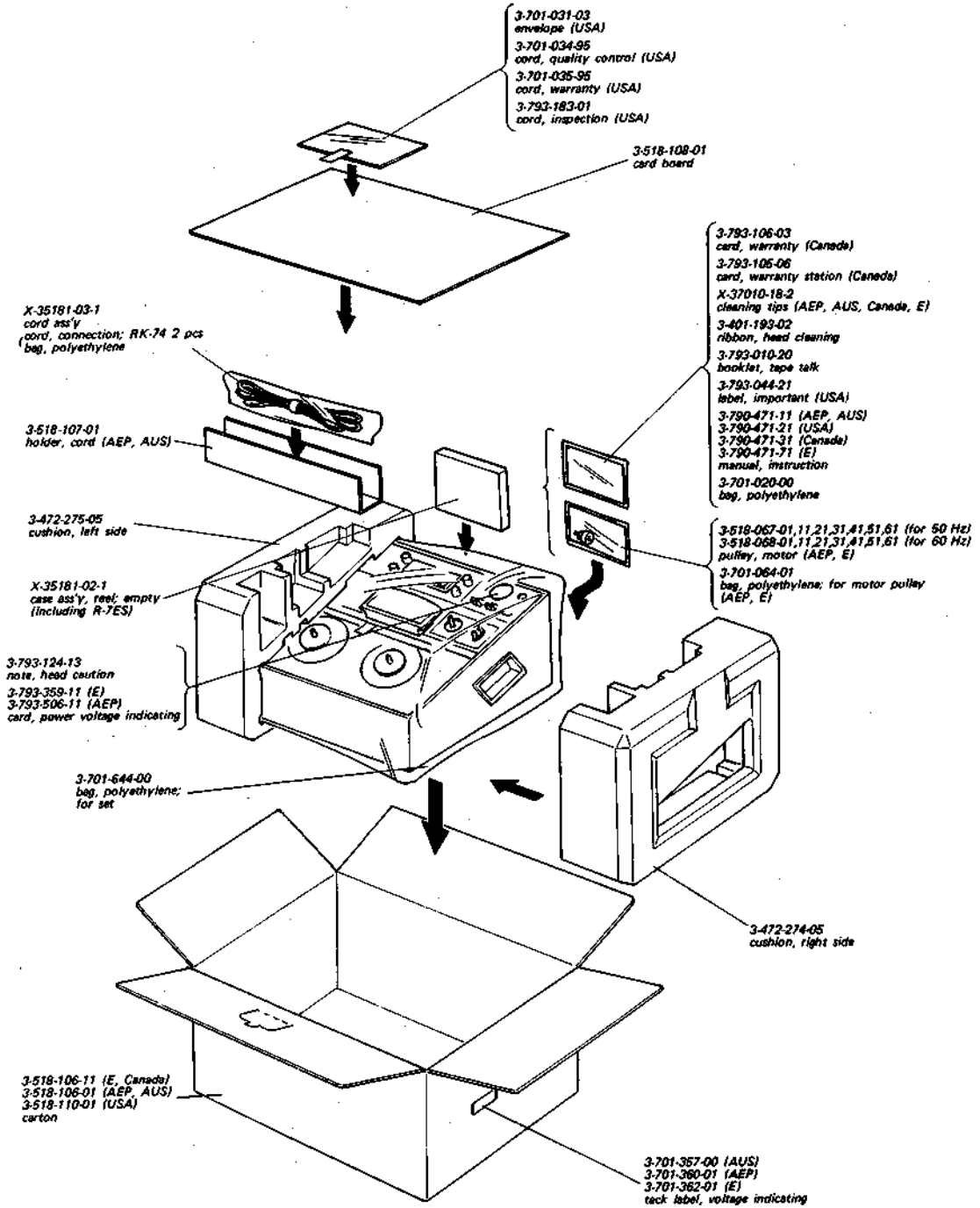


54. CHASSIS - Top View -



Note: 1. Parts without part numbers and names are not available.  
 2. All screws are Phillips type (cross recess type) unless otherwise indicated.  
 (-): slotted head

**5.5. PACKING**



**Notes:** 1. Parts without part numbers and names are not available.  
 2. All screws are Phillips type (cross recess type) unless otherwise indicated.  
 (-): slotted head

**SECTION 6  
ELECTRICAL PARTS LIST**

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
<b>COMPLETE CIRCUIT BOARDS</b>		
X-35180-51-1		record amp (Canada, USA)
X-35180-52-1		playback amp (Canada, USA)
X-35180-53-1		power supply
X-35180-54-1		bias osc (Canada, USA)
X-35180-55-1		TAPE SELECT switch
X-35181-51-1		record amp (AEP, AUS, E)
X-35181-52-1		playback amp (AEP, AUS, E)
X-35181-53-1		bias osc (AEP, AUS, E)

**SEMICONDUCTORS**

Q101, 201	transistor	2SC631A
Q102, 202	transistor	2SC631A
Q103, 203	transistor	2SC631A
Q104, 204	transistor	2SC634A
Q301, 401	transistor	2SC631A
Q302, 402	transistor	2SC631A
Q303, 403	transistor	2SC633A
Q304, 404	transistor	2SC634A
Q305, 405	transistor	2SC634A
Q501	transistor	2SC634A
Q502	transistor	2SC634A
Q601	transistor	2SD291
Q602	transistor	2SC634A
Q603	transistor	2SC633A
D301, 401	diode	1T-22
D601	diode	ZB1-19
D602	diode	10D-2
D603	diode	10D-2

**COILS**

L101, 201	1-407-519-11	inductor, micro 8 $\mu$ H
L102, 202	1-407-493-21	inductor, micro 1.2 mH
L103, 203	1-407-495-21	inductor, micro 1.8 mH
L104, 204	1-407-286-11	coil, trap 2.2 mH
L301, 401	1-407-593-11	inductor, micro 27 mH
L501	1-407-284-00	coil, dummy 1 mH
L502	1-407-284-00	coil, dummy 1 mH

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
L503	1-407-198-21	inductor, micro 2.2 mH
L504	1-407-198-21	inductor, micro 2.2 mH

**TRANSFORMERS**

T301, 401	1-427-299-00	output
T501	1-433-140-11	bias osc
T701	1-441-997-11	power (USA)
	1-441-944-11	power (AEP, AUS)
	1-441-959-00	power (E)
	1-442-068-00	power (Canada)

**CAPACITORS**

All capacitors are microfarads unless otherwise noted. (p =  $\mu$ F, elect = electrolytic)

C101, 201	1-121-410-11	47	25V	elect
C102, 202	1-127-094-11	1	25V	solid aluminum elect
C103, 203	1-105-821-12	0.001	50V	mylar
C104, 204	1-121-413-11	100	6.3V	elect
C105, 205	1-127-095-11	2.2	25V	solid aluminum elect
C106, 206	1-127-094-11	1	25V	solid aluminum elect
C107, 207	1-121-404-11	33	25V	elect
C108, 208	1-105-821-12	0.001	50V	mylar
C109, 209	1-121-409-11	47	16V	elect
C110, 210	1-121-398-11	10	25V	elect
C111, 211	1-121-398-11	10	25V	elect
C112, 212	1-105-663-12	0.0015	50V	mylar
C113, 213	1-121-420-11	220	10V	elect
C114, 214	1-121-395-11	4.7	25V	elect
C115, 215	1-121-404-11	33	25V	elect
C116, 216	1-121-398-11	10	25V	elect
C117, 217	1-121-395-11	4.7	25V	elect
C118, 218	1-105-520-12	0.039	50V	mylar
C119, 219	1-105-517-12	0.022	50V	mylar
C120, 220	1-105-522-12	0.056	50V	mylar
C121, 221	1-105-519-12	0.033	50V	mylar
C122, 222	1-105-523-12	0.068	50V	mylar
C123, 223	1-121-398-11	10	25V	elect
C124, 224	1-107-016-11	470	50V	silvered mica
C301, 401	1-121-409-11	47	16V	elect
C302, 402	1-121-398-11	10	25V	elect
C303, 403	1-107-131-11	100p	50V	silvered mica

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>		<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>	
C304, 404	1-121-420-11	220	10V elect	R102, 202	1-222-305-11	100 k (A)	variable (LINE RECORD VOLUME)
C305, 405	1-107-123-11	47p	50V silvered mica (Canada, USA)	R103, 203	1-242-663-11	390	
C306, 406	1-105-517-12	0.022	50V mylar	R104, 204	1-242-687-09	3.9 k	low noise
C307, 407	1-121-420-11	220	10V elect	R105, 205	1-242-709-09	33 k	low noise
C308, 408	1-106-667-12	0.0033	50V mylar	R106, 206	1-242-729-09	220 k	low noise
C309, 409	1-121-393-11	3.3	50V elect	R107, 207	1-242-681-11	2.2 k	
C310, 410	1-107-123-11	47p	50V silvered mica	R108, 208	1-242-659-11	270	
C311, 411	1-105-661-12	0.001	50V mylar	R109, 209	1-242-697-09	10 k	low noise
C312, 412	1-121-393-11	3.3	50V elect	R110, 210	1-222-306-11	20 k (A)	variable (MIC RECORD VOLUME)
C313, 413	1-107-123-11	47p	50V silvered mica	R111, 211	1-244-679-11	1.8 k	
C314, 414	1-121-409-11	47	16V elect	R112, 212	1-242-731-09	270 k	low noise
C315, 415	1-121-395-11	4.7	25V elect	R113, 213	1-242-729-09	220 k	low noise
C316, 416	1-121-395-11	4.7	25V elect	R114, 214	1-242-699-09	12 k	low noise
C317, 417	1-121-391-11	1	50V elect	R115, 215	1-242-663-11	390	
C318, 418	1-105-666-12	0.0027	50V mylar	R116, 216	1-242-691-09	5.6 k	low noise
C419	1-105-845-12	0.1	50V mylar	R117, 217	1-242-693-11	6.8 k	
C320, 420	1-105-661-12	0.001	50V mylar	R118, 218	1-242-717-09	68 k	low noise
C501	1-107-008-11	150p	500V silvered mica	R119, 219	1-242-711-09	39 k	low noise
C502	1-107-008-11	150p	500V silvered mica	R120, 220	1-242-725-09	150 k	low noise
C503	1-141-069-11	20 ~ 120p	trimmer	R121, 221	1-242-717-09	68 k	low noise
C504	1-141-069-11	20 ~ 120p	trimmer	R122, 222	1-242-749-11	1.5M	
C505	1-107-221-11	560p	1,500V silvered mica	R123, 223	1-242-673-11	1 k	
C506	1-105-719-12	0.033	100V mylar	R124, 224	1-242-641-11	47	
C507	1-127-094-11	1	25V solid aluminum elect	R125, 225	1-242-687-09	3.9 k	low noise
C508	1-105-712-12	0.0082	100V mylar	R126, 226	1-242-687-11	3.9 k	
C509	1-106-060-12	0.0012	100V mylar (AEP, AUS, E)	R127, 227	1-242-697-11	10 k	
C510	1-106-060-12	0.0012	100V mylar (AEP, AUS, E)	R128, 228	1-222-774-11	10 k (B)	adjustable (record level adj)
C601	1-121-388-11	1,000	35V elect	R129, 229	1-242-665-11	470	
C602	1-121-405-11	33	50V elect	R130, 230	1-242-707-11	27 k	
C603	1-121-810-11	470	50V elect	R131, 231	1-242-721-11	100 k	
C604	1-121-396-11	4.7	50V elect	R132, 232	1-242-721-11	100 k	
C701	1-107-175-11	180p	50V silvered mica	R133, 233	1-242-673-11	1 k	
C702	1-107-175-11	180p	50V silvered mica	R134, 234	1-242-681-11	2.2 k	
C703	1-107-131-11	100p	50V silvered mica	R135, 235	1-242-689-11	4.7 k	
C704	1-107-131-11	100p	50V silvered mica	R136, 236	1-242-689-11	4.7 k	
C705	1-107-131-11	100p	50V silvered mica	R137, 237	1-242-635-11	27	
C706	1-105-759-12	0.033	200V mylar	R138, 238	1-242-689-11	4.7 k	
C707	1-117-034-23	1.5	250V metalized paper (Canada, USA)	R139, 239	1-242-645-11	68	
C707	1-117-036-22	1.5+0.5	250V metalized paper (AEP, AUS, E)	R301, 401	1-242-705-09	22 k	low noise
C708	1-107-131-11	100p	silvered mica	R302, 402	1-242-727-09	180 k	low noise
				R303, 403	1-242-693-09	68 k	low noise
				R304, 404	1-242-719-09	82 k	low noise
				R305, 405	1-242-721-11	100 k	
				R306, 406	1-242-713-11	47 k	
				R307, 407	1-242-727-09	180 k	low noise
				R308, 408	1-242-649-11	100	
				R309, 409	1-242-660-11	300	
				R310, 410	1-242-641-11	47	
				R311, 411	1-242-681-11	2.2 k	
				R312, 412	1-242-693-09	6.8 k	low noise

## RESISTORS

All resistors are 1/4W, carbon type and in  $\Omega$  unless otherwise noted.

R101, 201 1-244-719-11 82 k

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
R313, 413	1-222-773-11	4.7 k (B) adjustable (PB EQ adj)
R314, 414	1-242-679-11	1.8 k
R315, 415	1-242-683-11	2.7 k
R316, 416	1-222-774-11	10k (B) adjustable (PB EQ adj)
R317, 417	1-242-705-11	22k
R318, 418	1-242-699-11	12k
R319, 419	1-242-725-11	150k
R320, 420	1-242-677-11	1.5k
R321, 421	1-242-715-11	56k
R322, 422	1-242-707-11	27k
R323, 423	1-242-667-11	560
R324, 424	1-242-681-11	2.2k
R325, 425	1-242-709-11	33k
R326, 426	1-242-681-11	2.2k
R327, 427	1-222-773-11	4.7k (B) adjustable (level meter adj)
R328, 428	1-222-637-11	20k (B) variable (LEVEL ADJUST)
R329, 429	1-242-681-11	2.2k
R340, 440	1-242-685-11	3.3k (AEP, AUS, E)
R501	1-242-617-11	4.7
R502	1-244-711-11	39k
R503	1-244-625-11	10
R504	1-244-625-11	10
R505	1-242-643-11	56
R506	1-242-643-11	56
R601	1-202-549-31	100 (½) composition
R602	1-202-541-31	47 (½) composition
R603	1-242-711-11	39k
R604	1-242-701-11	15k
R605	1-242-675-11	1.2k
R606	1-242-717-11	68k
R701	1-244-685-11	3.3k
R702	1-244-685-11	3.3k

**SWITCHES**

S101	1-514-644-00	rotary, equalizer; TAPE SPEED
S102	1-514-985-00	lever slide, TAPE SELECT
S103	1-514-640-00	lever slide, MONITOR(L-CHANNEL)
S104	1-514-640-00	lever slide, MONITOR(R-CHANNEL)
S105	1-514-861-22	slide, record/playback (L-CH)
S106	1-514-861-22	slide, record/playback (R-CH)
S107	1-514-643-00	rotary, muting

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
S108	1-514-231-11	micro, bias osc
S109	1-514-655-31	seesaw, POWER (E)
	1-514-472-21	seesaw, POWER (AEP, AUS)
	1-514-655-71	seesaw, POWER (Canada, USA)
S110	1-514-039-12	micro, auto shut-off
S111	1-514-641-00	lever slide, MIC ATT

**JACKS**

J101, 201	1-507-142-21	2-P phono, LINE IN
J102, 202	1-507-281-00	mini, MICROPHONE
J103, 203	1-507-142-21	2-P phono, LINE OUT
J104	1-507-282-00	binaural, HEADPHONE
CNJ101	1-509-359-11	connector, REC/PB (AEP, AUS, E)
CNJ102	1-509-445-11	connector 3-P, AC IN (AEP, AUS)
CN101	1-509-427-11	socket, power voltage selector (E)
	1-509-482-11	socket, power voltage selector (AEP, AUS)

**MISCELLANEOUS**

M	8-832-624-22	motor, IC-624H1 (AEP, AUS, E, USA)
	8-832-624-27	motor, IC-624H1 (Canada)
CP701, CP702	1-101-534-12	encapsulated components, 0.1µF + 120Ω (AEP, AUS, E)
	1-101-534-31	encapsulated components, 0.1µF + 120Ω (Canada, USA)
RH101	8-825-511-00	head, record (RF140-2902)
PH103	8-825-534-00	head, playback (PF140-4202)
EH102	8-826-629-25	head, erase (EF18-2902A1)
PL1, 2	1-518-153-31	lamp, 5V/60 mA
PL3	1-518-070-00	lamp, 8V/0.3 A
	1-533-051-15	holder, lamp
ME1, 2	1-520-114-12	meter, level
F1	1-532-096-00	fuse, 800mA (E)
	1-532-080-11	fuse, 800mA (AEP, AUS)
F1, 2	1-532-262-11	fuse, 500mA (Canada)
F2	1-532-235-11	fuse, 315mA (AEP, AUS)
F3	1-532-235-11	fuse, 315mA (AEP, AUS)
	1-532-265-11	fuse, 1A (Canada)
F4	1-532-080-11	fuse, 800mA (AEP, AUS)
	1-533-006-00	holder, fuse (E)
	1-533-026-61	holder, fuse (AEP, AUS)
	1-582-015-21	holder, fuse (Canada)
	1-534-487-22	cord, ac power (E)
	1-534-538-21	cord, ac power (Canada, USA)
	1-535-506-11	solderless terminal
	1-536-395-11	terminal strip, 1-L-1 (C type)
	1-536-398-11	terminal strip, 2-L-2 (C type)
	1-506-312-13	terminal, joint
	1-507-323-13	terminal, joint

**SECTION 7  
HARDWARE**

<u>Part No.</u>	<u>Description</u>
<b>SCREWS</b>	
7-621-259-42	P 2.6 x 6
7-621-259-52	P 2.6 x 8
7-621-259-62	P 2.6 x 10
7-621-259-72	P 2.6 x 12
7-621-560-52	K 2.6 x 22
7-621-711-35	B 2.6 x 6
7-621-771-38	B 2.6 x 8
7-628-145-01	P 3 x 4
7-628-147-01	P 3 x 6
7-628-148-01	P 3 x 8
7-628-149-01	P 3 x 10
7-628-150-01	P 3 x 12
7-628-160-01	P 3 x 6
7-628-161-01	P 4 x 8
7-628-547-13	B 3 x 6
7-628-548-13	B 3 x 8
7-682-549-13	B 3 x 10
7-682-550-14	B 3 x 12
7-682-551-15	B 3 x 4
7-682-562-13	B 4 x 10
7-682-571-14	B 4 x 45
7-682-624-00	PS 2 x 4
7-682-627-00	PS 2 x 8
7-682-633-00	PS 2.6 x 4
7-682-635-00	PS 2.6 x 6
7-682-637-00	PS 2.6 x 10
7-682-646-00	PS 3 x 5
7-682-647-00	PS 3 x 6
7-682-648-00	PS 3 x 8
7-682-652-00	PS 3 x 16
7-682-660-00	PS 4 x 6
7-682-661-00	PS 4 x 8
7-683-140-01	⊕ SC 3 x 6, flat point
7-683-242-31	SC 3 x 10

<u>Part No.</u>	<u>Description</u>
7-685-145-21	P 3 x 6, self-tapping
7-685-146-21	P 3 x 8, self-tapping
7-685-549-01	P 3 x 16

**WASHERS**

7-623-105-12	2 mm dia
7-623-107-02	2.6 mm dia (small)
7-623-107-22	2.6 mm dia
7-623-108-02	3 mm dia (small)
7-623-108-12	3 mm dia (nickel plated)
7-623-108-18	3 mm dia (chrome plated)
7-623-108-20	3 mm dia
7-623-110-02	4 mm dia (small)
7-623-110-12	4 mm dia
7-623-113-12	6 mm dia
7-623-208-22	3 mm dia, spring
7-623-408-05	3 mm dia, external tooth

**NUTS**

7-622-108-02	3 mm dia
7-622-501-06	4 mm dia

**RETAINING RINGS**

7-624-104-01	E-2
7-624-106-01	E-3
7-624-108-01	E-4
7-624-109-01	E-5
7-624-110-01	E-6
7-624-111-01	E-7
7-624-112-01	E-8

**Note:** All screws are Phillips type (cross recess type) unless otherwise indicated.  
(-): slotted head

**- Hardware Nomenclature -**

