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PS-X3

AEP Model

Cartridge is not supplied with this turntable system.

STEREO TURNTABLE SYSTEM

SPECIFICATIONS

GENERAL

Power Requirements: 110, 120, 220, 240 V ac, 50/60 Hz

Power Consumption: 12 W

Dimensions: Approx. 445 (w) × 150 (h) × 375 (d) mm
Approx. 17 1/2 (w) × 5 7/8 (h) × 14 3/4 (d) inches including projecting parts and controls

Weight: Approx. 10.2 kg, 22 lb 8 oz (net)
Approx. 11.9 kg, 26 lb 4 oz (in shipping carton)

TURNTABLE

Platter: 31.7 cm, 12 1/2 inches aluminum-alloy diecast

Motor: DC servo-controlled motor (brushless and slotless)

Drive System: Direct drive, crystal lock control system

Speed: 33 1/3 rpm, 45 rpm

Starting Characteristics: Comes to nominal speed within a third revolution (33 1/3 rpm)

Wow and Flutter: ± 0.045 % (DIN)
0.025 % (WRMS)

S/N Ratio: 73 dB (DIN-B)

Initial Drift: Within 0.0003 %

Load Characteristics: 0 % at 150 g tracking force

Speed Deviation: Within 0.003 %

TONEARM

Type: Statically balanced, universal pivot

Pivot to Stylus Length: 216.5 mm, 8 1/2 inches

Overall Arm Length: 300 mm, 11 7/8 inches

Overhang: 16.5 mm, 21/32 inches

Tracking Error: +3°, −1°

Tracking-force Adjustment Range: 0−3 g
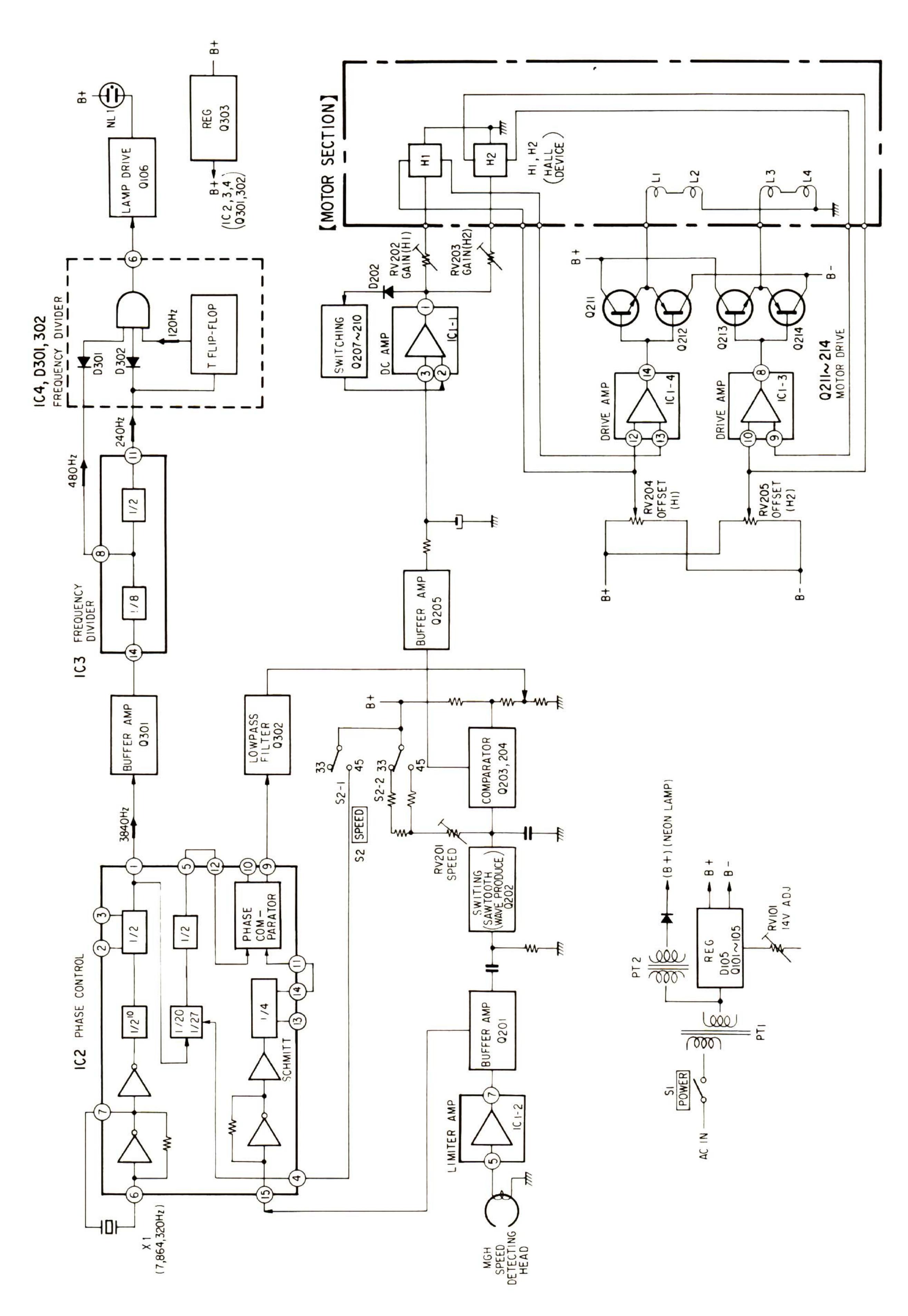
Shell Weight: 10.5 g

Cartridge Weight Range: 2.5−9.5 g
8−14.5 g (with extra weight)

SONY
SERVICE MANUAL
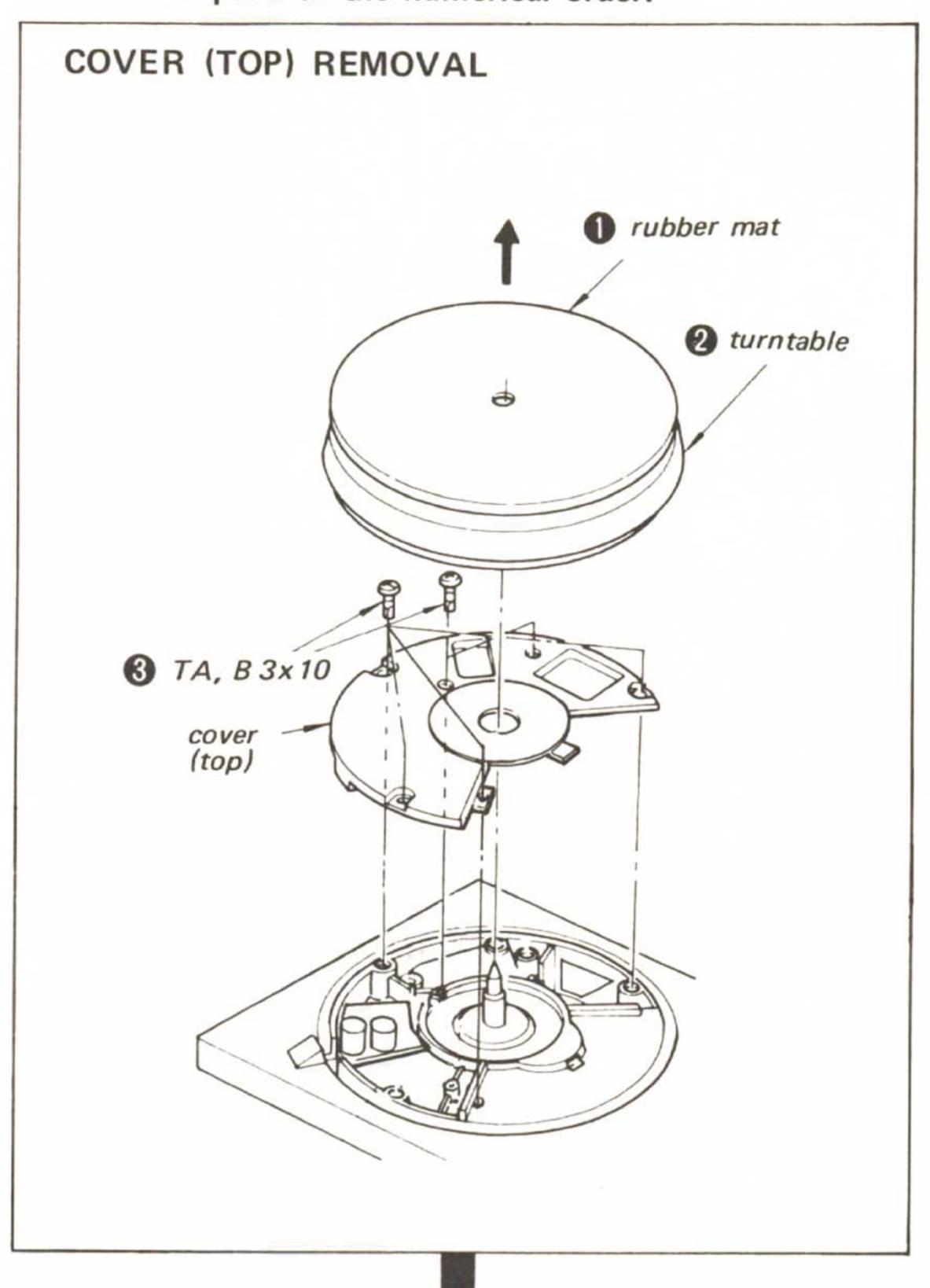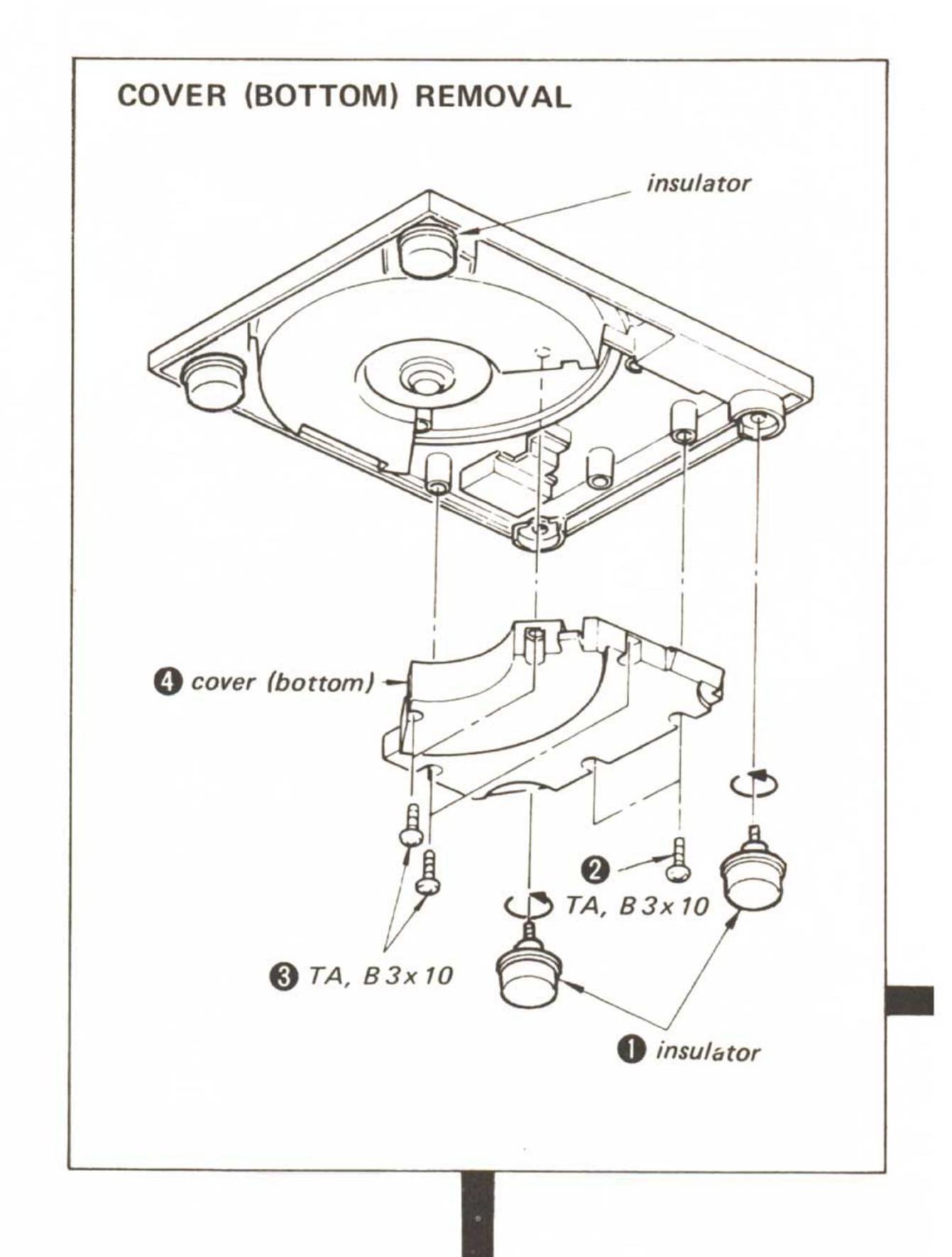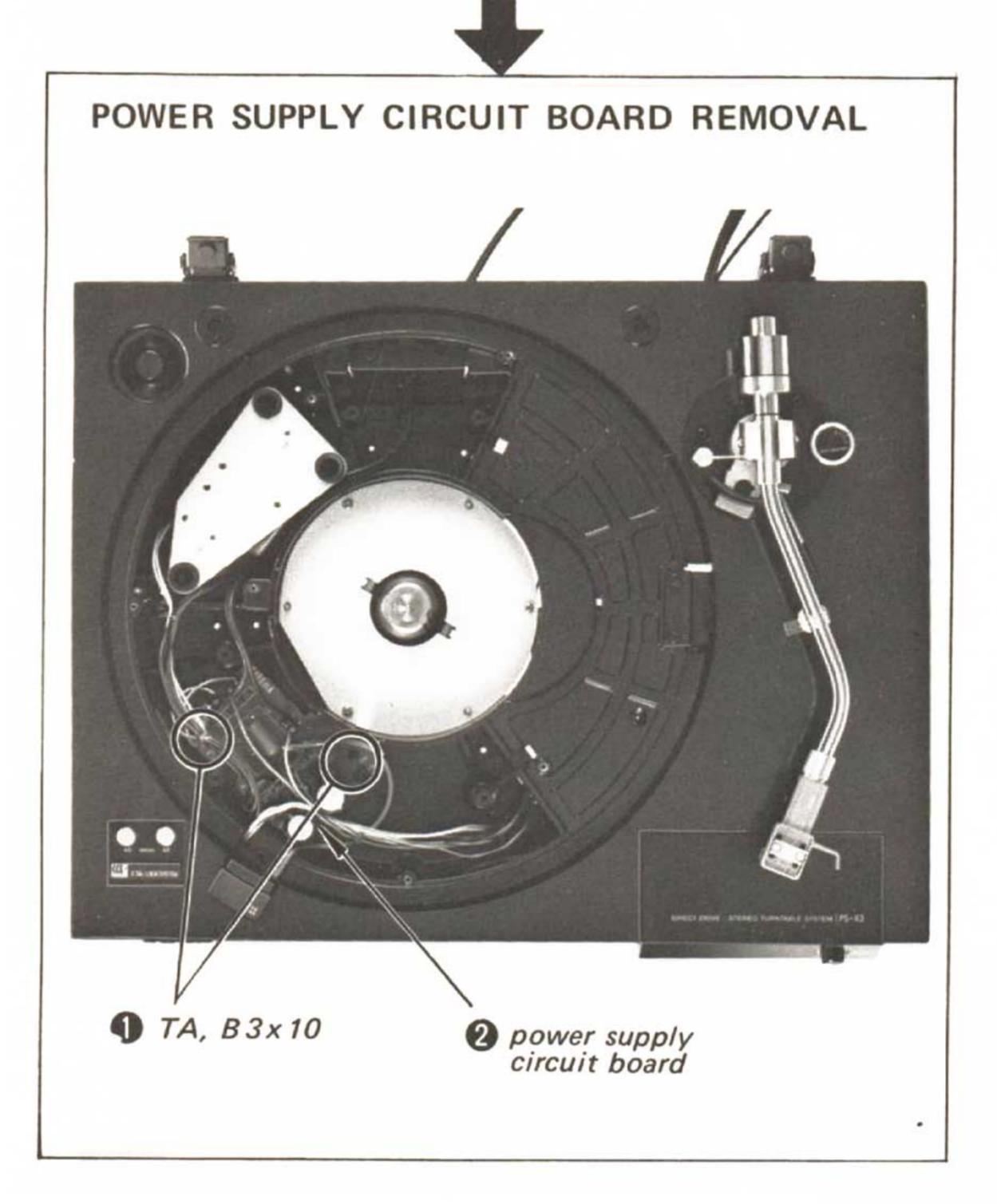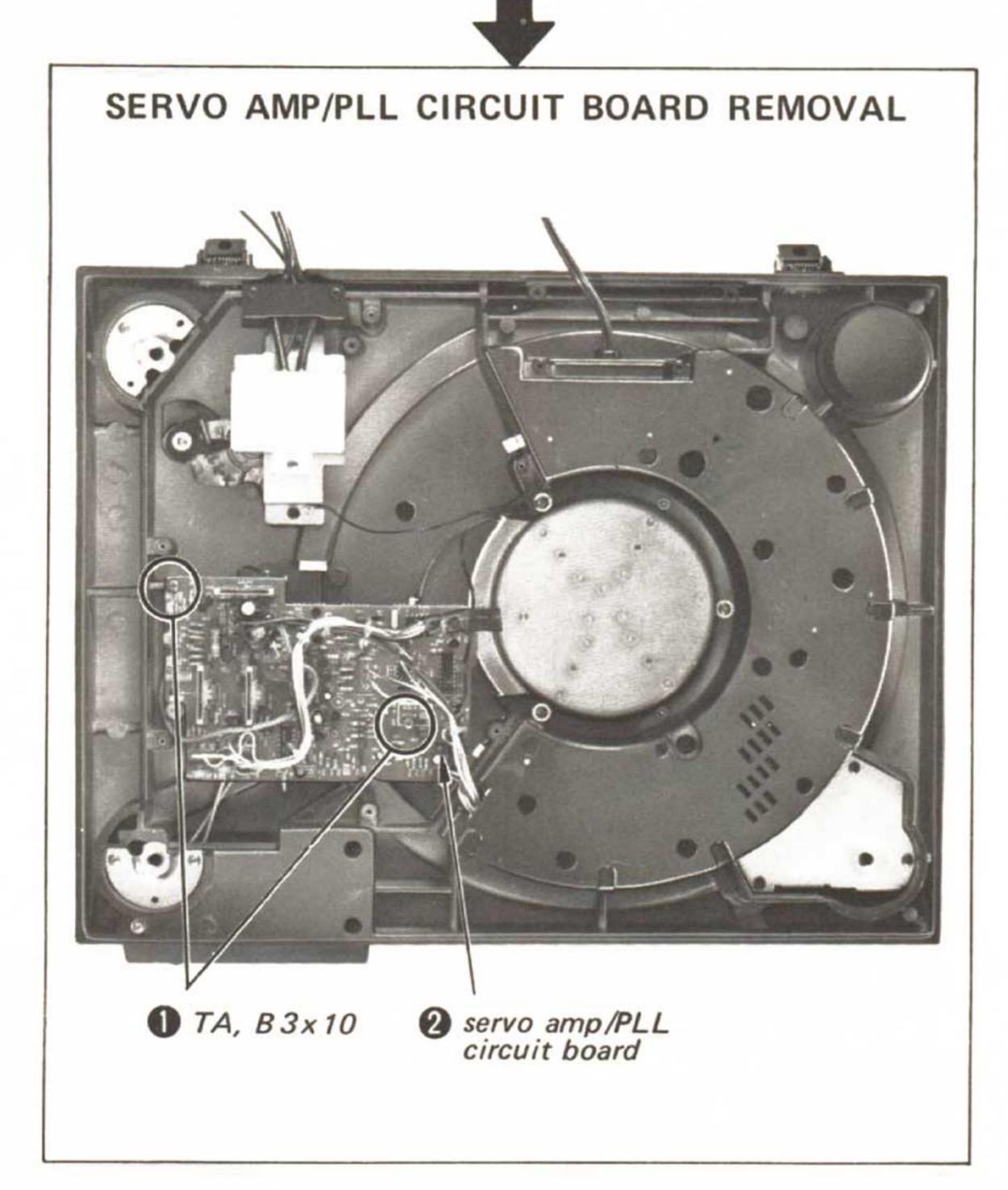
SECTION 2
DISASSEMBLY
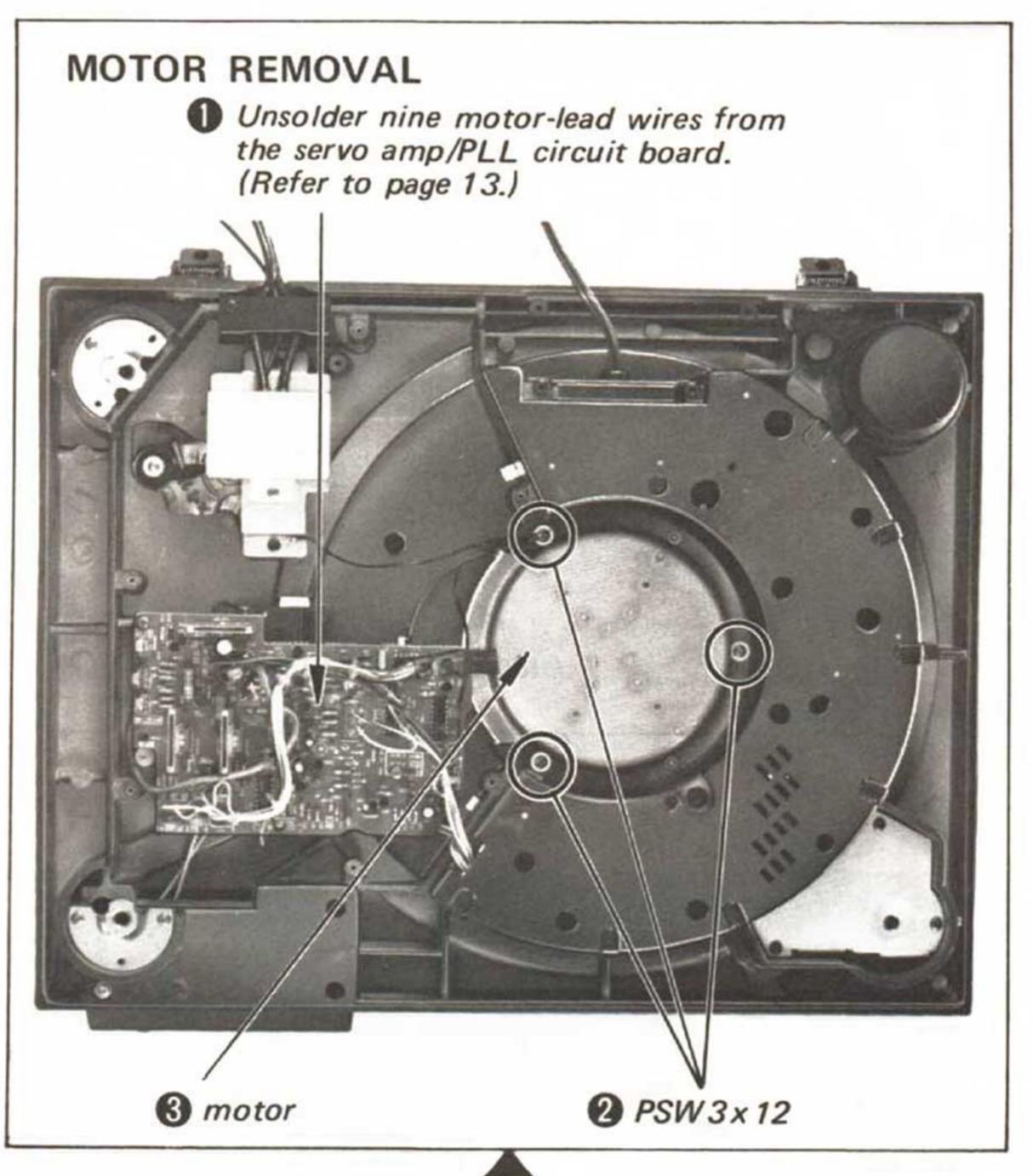
Remove the parts in the numerical order.

COVER (TOP) REMOVAL

❶ rubber mat

❷ turntable

❸ TA, B 3 x 10

cover (top)

COVER (BOTTOM) REMOVAL

insulator

❹ cover (bottom)

❷ TA, B 3 x 10

❸ TA, B 3 x 10

❶ insulator

POWER SUPPLY CIRCUIT BOARD REMOVAL

❶ TA, B 3 x 10

❷ power supply circuit board

SERVO AMP/PLL CIRCUIT BOARD REMOVAL

❶ TA, B 3 x 10

❷ servo amp/PLL circuit board

MOTOR REMOVAL

① *Unsolder nine motor-lead wires from the servo amp/PLL circuit board. (Refer to page 13.)*

③ *motor*   **②** *PSW 3 x 12*

POWER SWITCH (S1) REMOVAL

① *TA, P 3 x 30 W 4*   **②** *TA, B 3 x 10*

③ *control panel*   **④** *Power switch (S1) can be removed.*

TONEARM REMOVAL

② *shield case*

③
Unsolder five lead wires on the phono circuit board.

① *B 3 x 6*

④ *TA, B 3 x 10 (black)*

⑤ *tonearm*

SPEED SWITCH (S2) REMOVAL

① *insulator*

② *TA, B 3 x 10*

③ *speed selector base*

④ *Speed switch can be removed.*

PUSH-ROD REMOVAL

upper position
lower position (push-rod)

❹

※

❼ push-rod

❺ cueing lever

❻ ring spring

※

lift base

1.5 mm

❸ SC M 3×3, hexagon socket

❶ ornamental screw

❷ lift stopper

Note: When installing the lifter cam shaft, take care of the ring spring and lift stopper directions.

ANTI-SKATING COMPENSATOR LEVER INSTALLATION

1. Set the anti-skating force compensator knob to 0.

2. Turn the arm base fully clockwise.

3. Install the anti-skating compensator lever so that the clearance between the anti-skating compensator cam (A) and cam (B) is 1 mm.

LATERAL BALANCER WEIGHT INSTALLATION

parallel

SC M 3×3, hexagon socket

0.5 mm

1.5 mm

lateral balancer weight

❸ anti-skating compensator lever

cam (B)

cam (C)

1 mm

❹ SC M 2.6×4, hexagon socket

1.27 mm

❷

arm base

CARTRIDGE INSTALLATION

Install the cartridge into the shell with the mounting screws so that the distance between the shell end and the stylus tip is 49 mm (1 15/16 inches).

Fasten the screws lightly so that the cartridge can slide for adjustment.

49 mm
(1 15/16")

LEAD WIRE CONNECTION

blue (LE or G)

white (L)

green (RE or G)

red (R)

blue: left channel ground
white: left channel signal
green: right channel ground
red: right channel signal

3-1. MECHANICAL ADJUSTMENTS

Tonearm Height Adjustment
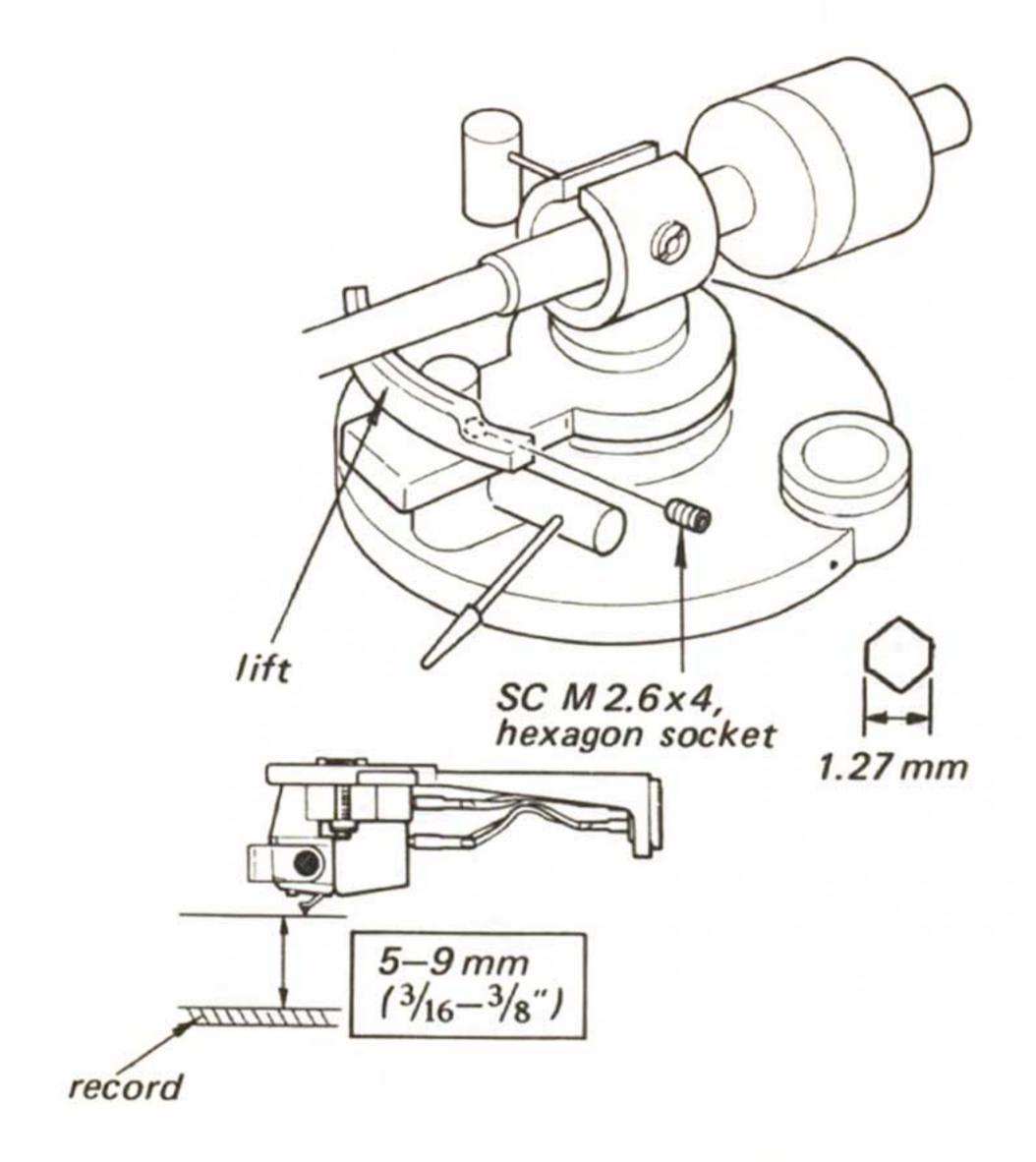
1. With the tonearm lowered on the record, make sure that the tonearm is parallel with the record.

2. If necessary, loosen the set screw and adjust the tonearm height.

SC M 4x10, hexagon socket

2 mm

Loosen. *Tighten.*

L-shaped hexagonal wrench

Stylus Height Adjustment

1. Bring the tonearm on the record.

2. Lift the cueing lever up and make sure that the clearance between the stylus tip and the record is 5–9 mm ($^3/_{16}$–$^3/_8$ inches).

3. If necessary, loosen the set screw and adjust the lift height.

2 mm

lift

SC M 2.6x4, hexagon socket

1.27 mm

5–9 mm ($^3/_{16}$–$^3/_8$")

record
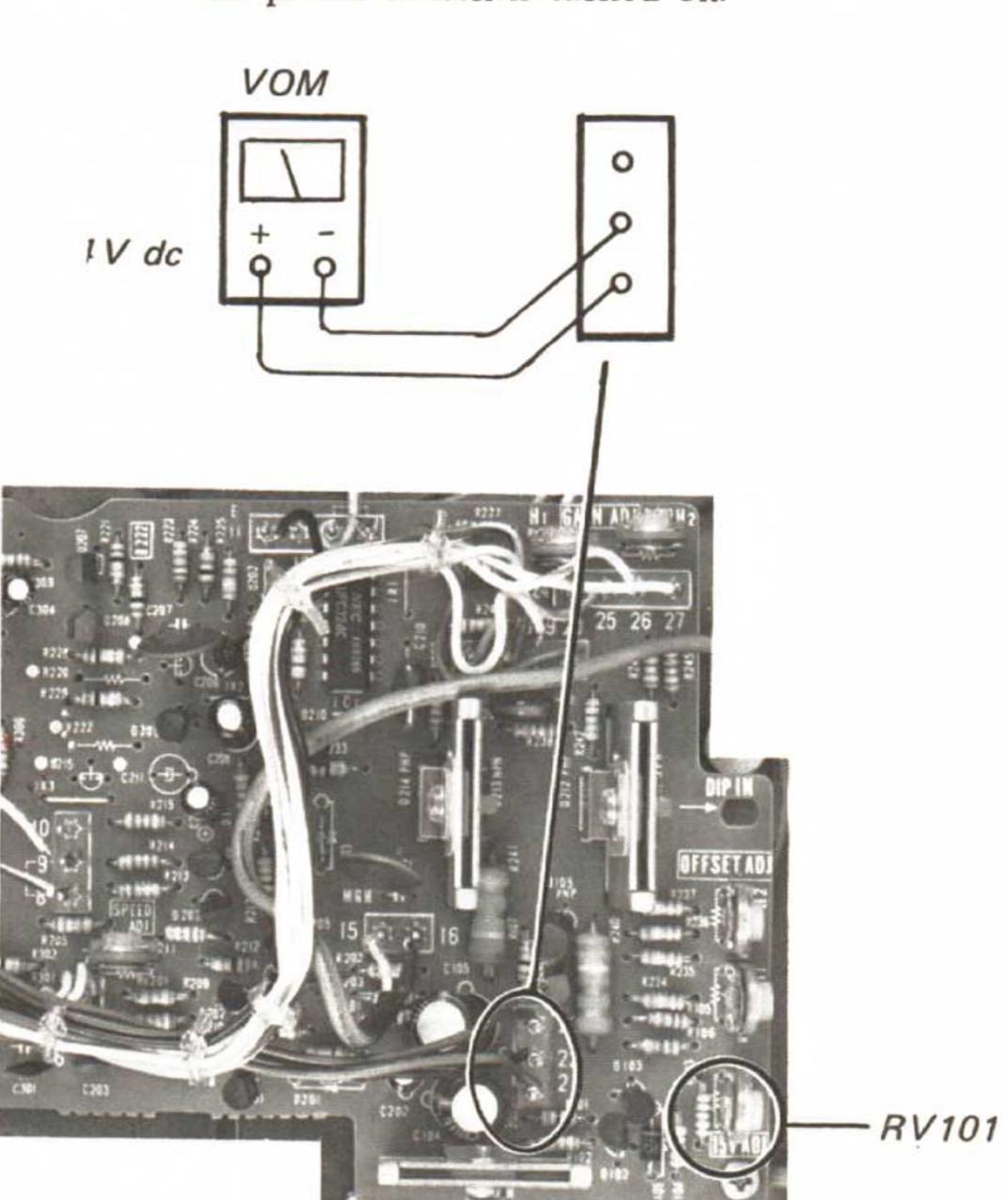
3-2. ELECTRICAL ADJUSTMENTS

B+ (14V) Adjustment
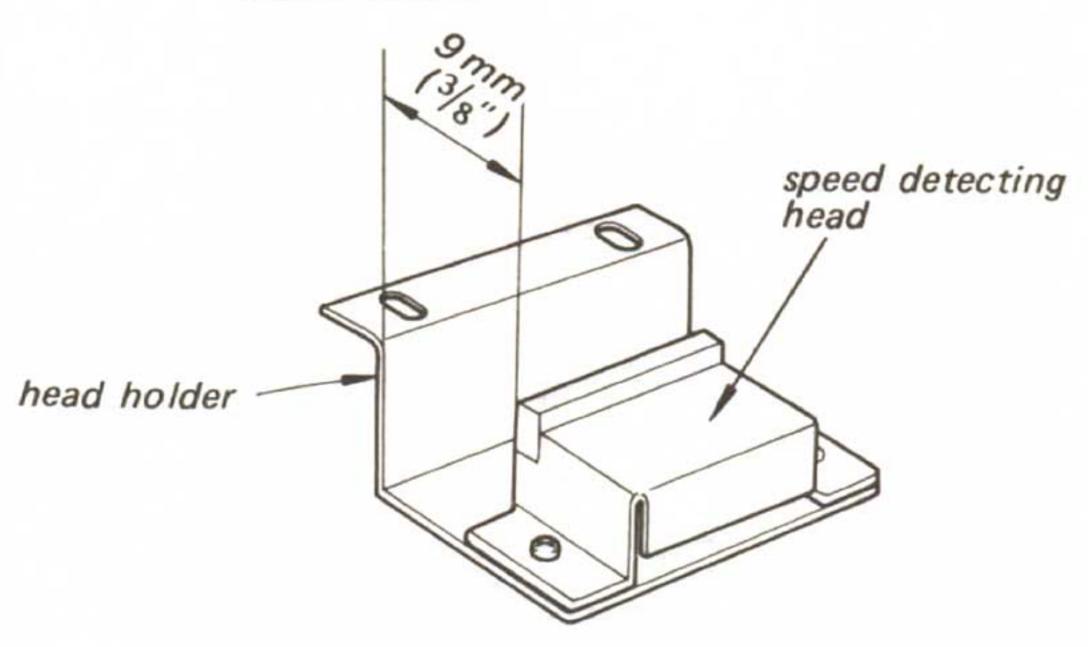
Adjust RV101 for 14V dc reading on VOM.

Note: Wait a few seconds for warm-up after the power switch is turned on.
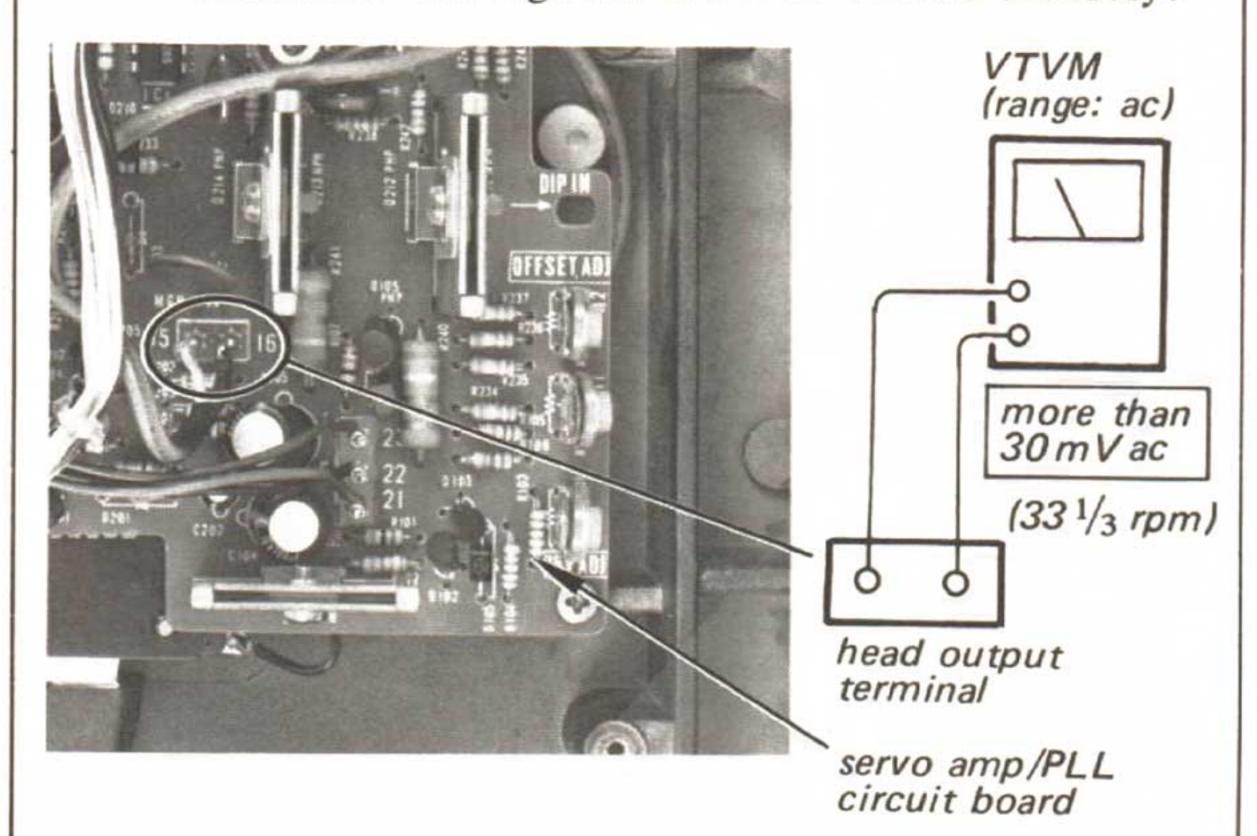
Speed Detecting Head Output Adjustment
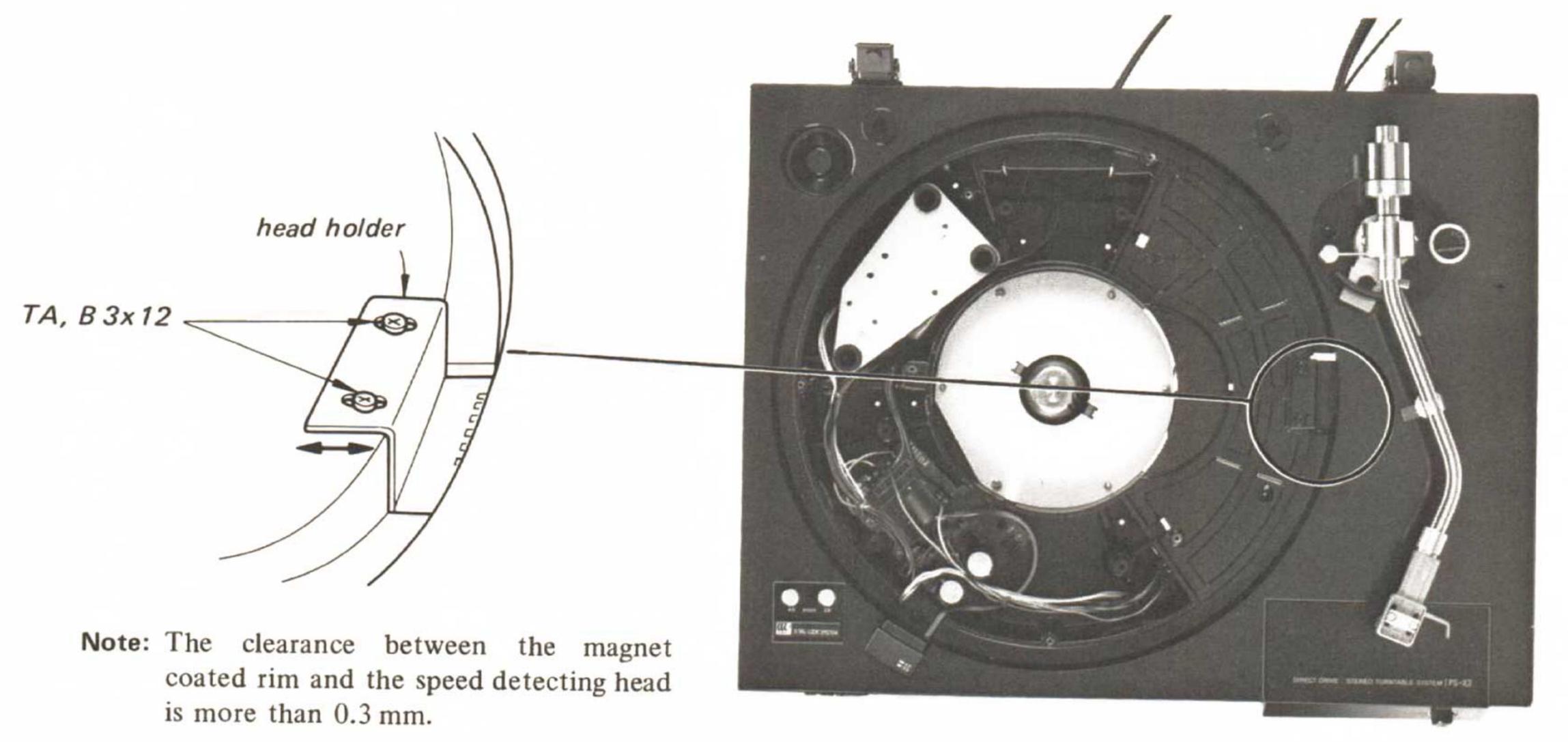
Note: Before this adjustment, set the speed detecting head on the head holder as shown below.
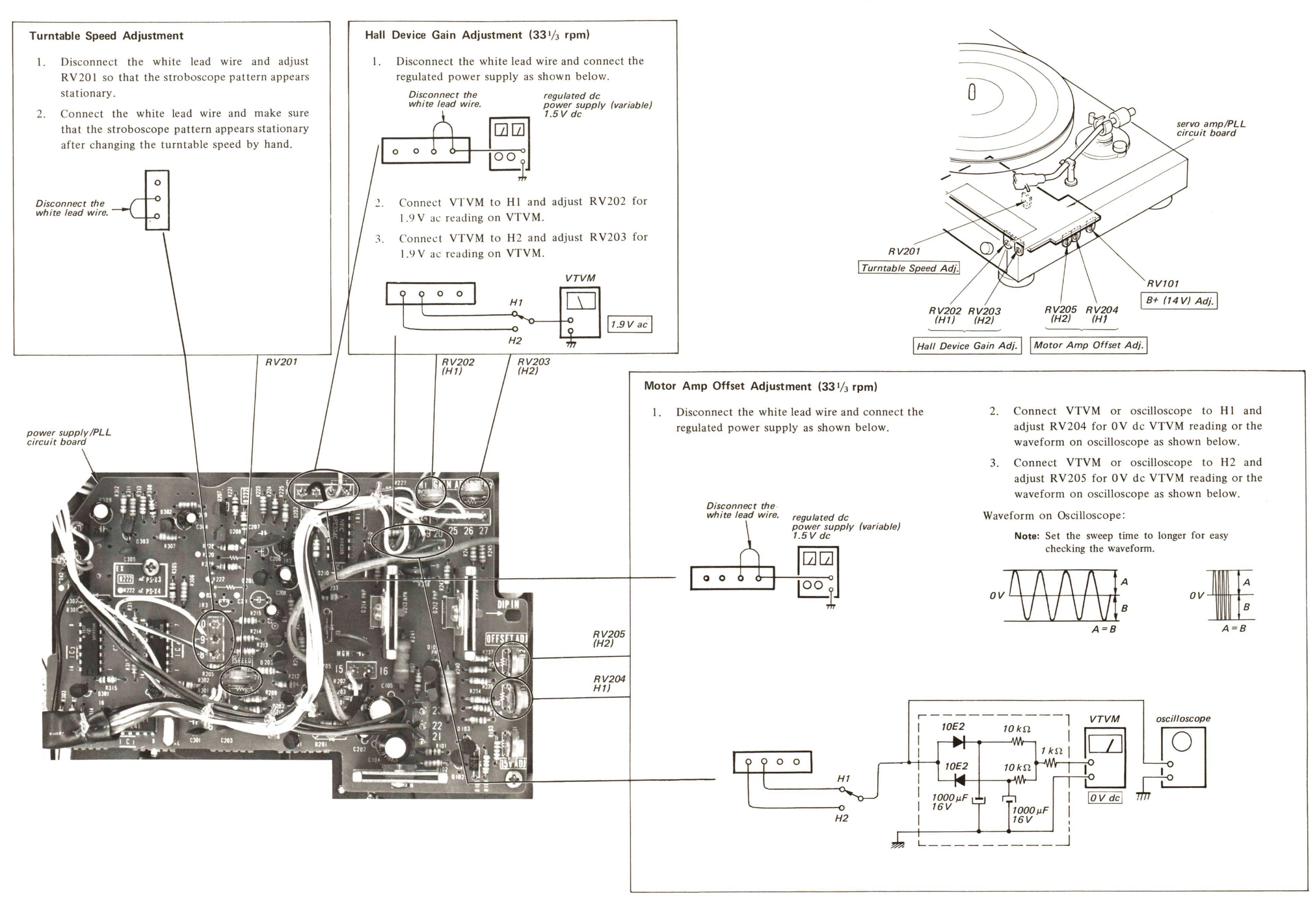
1. Adjust the position of the head holder by loosening B 3 × 12 screws so that the VTVM reads more than 30 mV ac (33 rpm) as shown below.

2. Make sure that the head does not touch the turntable and tighten B 3 × 12 screws securely.

Adjustment Location:

Note: The clearance between the magnet coated rim and the speed detecting head is more than 0.3 mm.

Turntable Speed Adjustment

1. Disconnect the white lead wire and adjust RV201 so that the stroboscope pattern appears stationary.

2. Connect the white lead wire and make sure that the stroboscope pattern appears stationary after changing the turntable speed by hand.

Disconnect the white lead wire. →

RV201

Hall Device Gain Adjustment (33⅓ rpm)

1. Disconnect the white lead wire and connect the regulated power supply as shown below.

Disconnect the white lead wire.

regulated dc power supply (variable) 1.5 V dc

2. Connect VTVM to H1 and adjust RV202 for 1.9 V ac reading on VTVM.

3. Connect VTVM to H2 and adjust RV203 for 1.9 V ac reading on VTVM.

VTVM

H1

H2

1.9 V ac

RV202 (H1)   RV203 (H2)

servo amp/PLL circuit board

RV201
Turntable Speed Adj.

RV101
B+ (14 V) Adj.

RV202 (H1)   RV203 (H2)   RV205 (H2)   RV204 (H1)

Hall Device Gain Adj.   Motor Amp Offset Adj.

power supply/PLL circuit board

RV205 (H2)

RV204 H1)

Motor Amp Offset Adjustment (33⅓ rpm)

1. Disconnect the white lead wire and connect the regulated power supply as shown below.

Disconnect the white lead wire.

regulated dc power supply (variable) 1.5 V dc

2. Connect VTVM or oscilloscope to H1 and adjust RV204 for 0V dc VTVM reading or the waveform on oscilloscope as shown below.

3. Connect VTVM or oscilloscope to H2 and adjust RV205 for 0V dc VTVM reading or the waveform on oscilloscope as shown below.

Waveform on Oscilloscope:

Note: Set the sweep time to longer for easy checking the waveform.

0V   A
            B
      A = B

0V   A
            B
      A = B

H1

H2

10E2   10 kΩ
              1 kΩ
10E2   10 kΩ

1000 μF 16 V   1000 μF 16 V

VTVM   oscilloscope

0 V dc

SECTION 4
DIAGRAMS

4-1. MOUNTING DIAGRAM — Power Supply Board —

— Conductor Side —

Replacement Semiconductors

For replacement, use semiconductors except in ( ).

Q106: 2SC926A

D101–106: 10E2 (GP08-D)

D106: 10D6 (SIB01-06)

Note:

- ○——: parts extracted from the component side.
- ▬▬ : B+ pattern.
- Readings are taken under 33 rpm conditions with a VOM (20 kΩ/V).
- Color code of sleeving over the end of the jacket.

CAUTION ON NEON LAMP

Apply higher dc voltage to the terminal marked by ●. (●side is equivalent to + side shown in diagram.)

4-2. MOUNTING DIAGRAM

Replacement Semiconductors

For replacement, use semiconductors except in ( ).

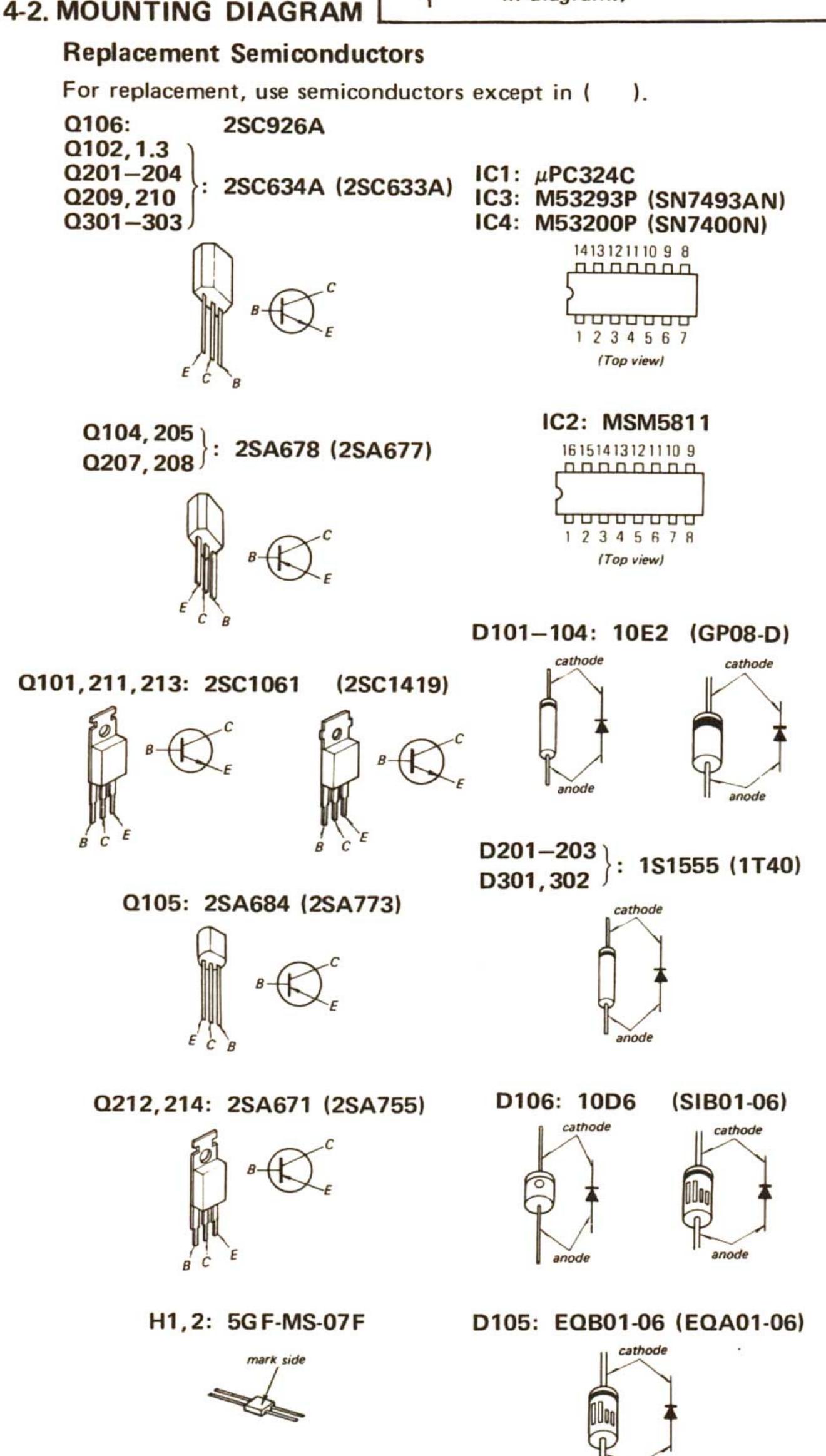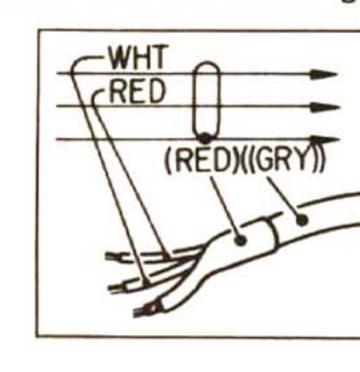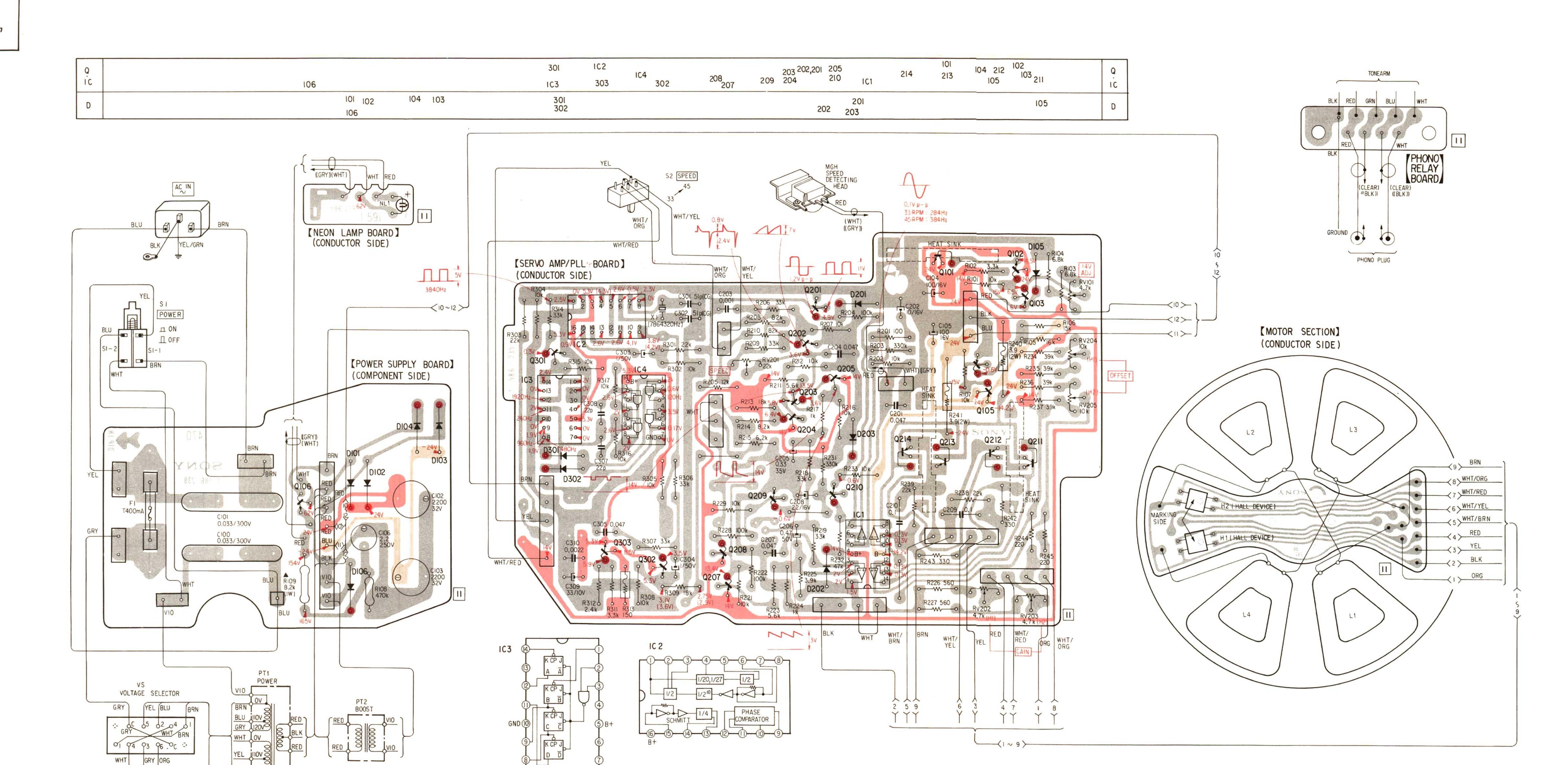|	
Q106:	2SC926A
Q102, 1,3	
Q201−204	2SC634A (2SC633A)
Q209, 210	
Q301−303	

IC1: μPC324C
IC3: M53293P (SN7493AN)
IC4: M53200P (SN7400N)

1413121110 9 8
1 2 3 4 5 6 7
(Top view)

IC2: MSM5811

1615141312 11 10 9
1 2 3 4 5 6 7 8
(Top view)

Q104, 205
Q207, 208 : 2SA678 (2SA677)

Q101, 211, 213: 2SC1061 (2SC1419)

D101−104: 10E2 (GP08-D)
cathode / anode

D201−203
D301, 302 : 1S1555 (1T40)
cathode / anode

Q105: 2SA684 (2SA773)

Q212, 214: 2SA671 (2SA755)

D106: 10D6 (SIB01-06)
cathode / anode

H1, 2: 5GF-MS-07F
mark side

D105: EQB01-06 (EQA01-06)
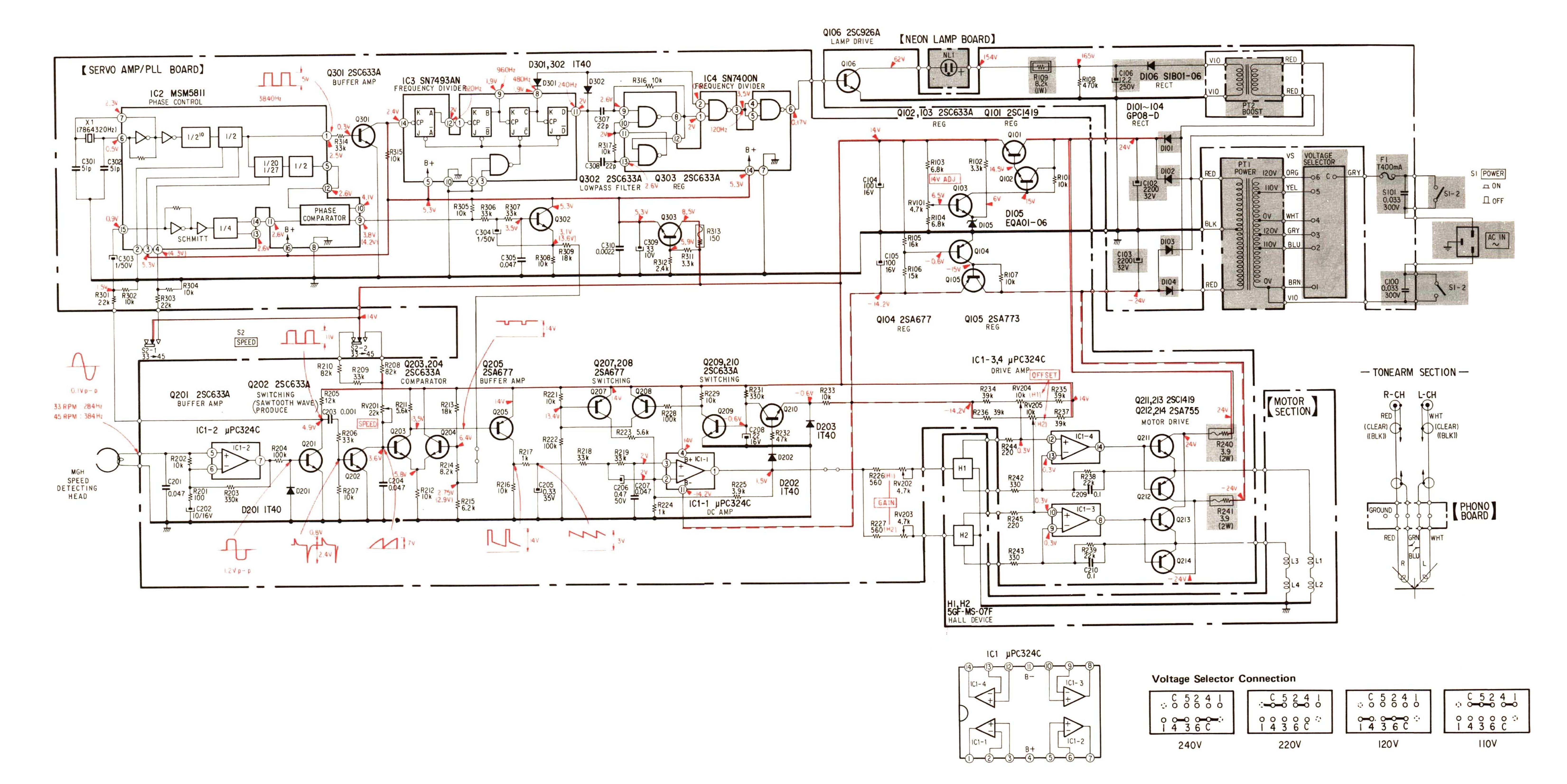cathode / anode

Note:

● ○ : parts extracted from the component side.
● ● : parts extracted from the conductor side.
● : B+ pattern.

● ▲ : nonflammable resistor.
● Ⓕ : fusible resistor.
● Readings are taken under 33 rpm condition with a VOM (20 kΩ/V).
( ) : 45 rpm
● Color code of sleeving over the end of the jacket.

WHT
RED
(RED)(GRY)

Boards / Sections (labels)

【NEON LAMP BOARD】 (CONDUCTOR SIDE)

【SERVO AMP/PLL BOARD】 (CONDUCTOR SIDE)

【POWER SUPPLY BOARD】 (COMPONENT SIDE)

【MOTOR SECTION】 (CONDUCTOR SIDE)

PHONO RELAY BOARD

TONEARM

PHONO PLUG

AC IN

S1 POWER

VS VOLTAGE SELECTOR

PT1 POWER

PT2 BOOST

IC3

IC2

240V 220V 120V 110V

4-3. SCHEMATIC DIAGRAM

Note:
- All capacitors are in μF unless otherwise noted. pF = μμF 50WV or less are not indicated except for electrolytics.
- All resistors are in ohms, ¼W unless otherwise noted. kΩ = 1000Ω, MΩ = 1000 kΩ
- All adjustable resistors have characteristic curve B, unless otherwise noted.

- ▬ⱲⱲ▬ : nonflammable resistor.
- ▬ⱲⱲ▬ : fusible resistor.
- ▬▬▬ : B+ bus.
- ▭ : panel designation.
- ⏚ : direct connection to points marked ⏚ on the chassis.
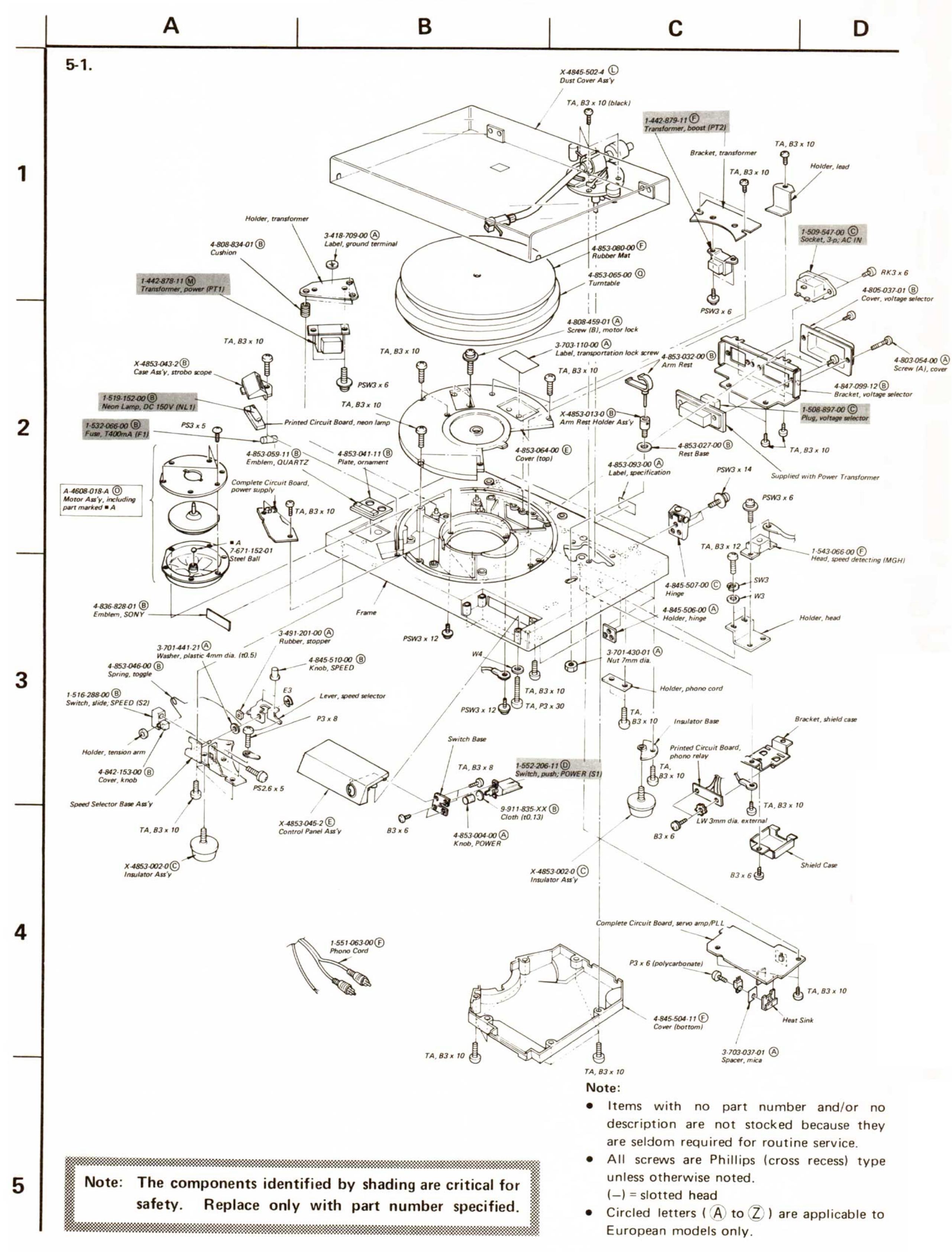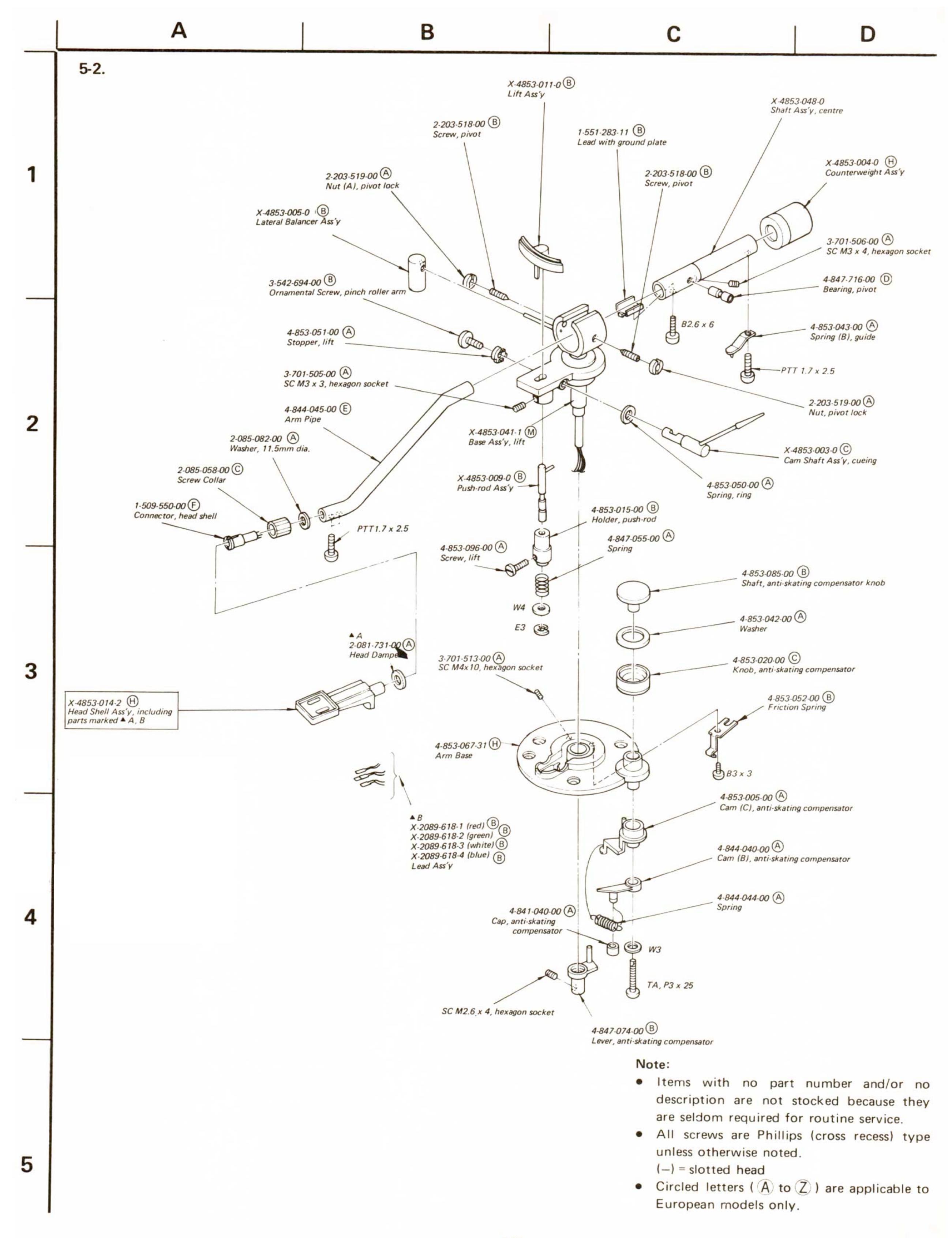
- ▭ : adjustment for repair.
- ▰▰▰ : B− bus.
- Readings are taken under 33 rpm condition with a VOM (20 kΩ/V).
- ( ) : 45 rpm
- Voltage variations may be noted due to normal production tolerances.

Voltage Selector Connection

240V 220V 120V 110V

Switch

Ref. No.	Switch	Position
S1	POWER	OFF
S2	SPEED	33

A	B	C	D

5-1.

X-4845-502-4 ⓛ
Dust Cover Ass'y

TA, B3 x 10 (black)

1-442-879-11 ⓕ
Transformer, boost (PT2)

Bracket, transformer

TA, B3 x 10

TA, B3 x 10

Holder, lead

Holder, transformer

3-418-709-00 ⓐ
Label, ground terminal

4-808-834-01 ⓑ
Cushion

1-442-878-11 ⓜ
Transformer, power (PT1)

4-853-080-00 ⓕ
Rubber Mat

4-853-065-00 ⓠ
Turntable

1-509-547-00 ⓒ
Socket, 3-p; AC IN

RK3 x 6

4-805-037-01 ⓑ
Cover, voltage selector

TA, B3 x 10

X-4853-043-2 ⓑ
Case Ass'y, strobo scope

1-519-152-00 ⓑ
Neon Lamp, DC 150V (NL1)

1-532-066-00 ⓑ
Fuse, T400mA (F1)

PS3 x 5

Printed Circuit Board, neon lamp

PSW3 x 6

TA, B3 x 10

4-808-459-01 ⓐ
Screw (B), motor lock

3-703-110-00 ⓐ
Label, transportation lock screw

TA, B3 x 10

4-853-032-00 ⓐ
Arm Rest

X-4853-013-0 ⓑ
Arm Rest Holder Ass'y

4-847-099-12 ⓑ
Bracket, voltage selector

4-803-054-00 ⓐ
Screw (A), cover

1-508-897-00 ⓒ
Plug, voltage selector

TA, B3 x 10

A-4608-018-A ⓞ
Motor Ass'y, including part marked ■ A

4-853-059-11 ⓑ
Emblem, QUARTZ

Complete Circuit Board, power supply

4-853-041-11 ⓑ
Plate, ornament

TA, B3 x 10

■ A
7-671-152-01
Steel Ball

4-853-064-00 ⓔ
Cover (top)

4-853-093-00 ⓐ
Label, specification

4-853-027-00 ⓑ
Rest Base

PSW3 x 14

Supplied with Power Transformer

PSW3 x 6

TA, B3 x 12

1-543-066-00 ⓕ
Head, speed detecting (MGH)

4-845-507-00 ⓒ
Hinge

SW3

W3

4-845-506-00 ⓑ
Holder, hinge

Holder, head

4-836-828-01 ⓑ
Emblem, SONY

Frame

3-491-201-00 ⓐ
Rubber, stopper

PSW3 x 12

W4

3-701-430-01 ⓐ
Nut 7mm dia.

Holder, phono cord

3-701-441-21 ⓐ
Washer, plastic 4mm dia. (t0.5)

4-845-510-00 ⓑ
Knob, SPEED

Lever, speed selector

E3

P3 x 8

4-853-046-00 ⓑ
Spring, toggle

1-516-288-00 ⓑ
Switch, slide; SPEED (S2)

Holder, tension arm

4-842-153-00 ⓑ
Cover, knob

Speed Selector Base Ass'y

PS2.6 x 5

TA, B3 x 10

X-4853-002-0 ⓒ
Insulator Ass'y

X-4853-045-2 ⓔ
Control Panel Ass'y

Switch Base

TA, B3 x 8

1-552-206-11 ⓓ
Switch, push; POWER (S1)

B3 x 6

9-911-835-XX ⓑ
Cloth (t0.13)

4-853-004-00 ⓐ
Knob, POWER

Printed Circuit Board, phono relay

TA, B3 x 10

Insulator Base

Bracket, shield case

TA, B3 x 10

LW 3mm dia. external

B3 x 6

Shield Case

B3 x 6

X-4853-002-0 ⓒ
Insulator Ass'y

PSW3 x 12

TA, B3 x 10

TA, P3 x 30

TA, B3 x 10

TA, B3 x 10

Complete Circuit Board, servo amp/PLL

1-551-063-00 ⓕ
Phono Cord

P3 x 6 (polycarbonate)

TA, B3 x 10

4-845-504-11 ⓕ
Cover (bottom)

Heat Sink

3-703-037-01 ⓐ
Spacer, mica

TA, B3 x 10

TA, B3 x 10

Note:
- Items with no part number and/or no description are not stocked because they are seldom required for routine service.
- All screws are Phillips (cross recess) type unless otherwise noted.
  (−) = slotted head
- Circled letters (Ⓐ to Ⓩ) are applicable to European models only.

Note: The components identified by shading are critical for safety. Replace only with part number specified.

X-4853-011-0 (B)
Lift Ass'y

2-203-518-00 (B)
Screw, pivot

1-551-283-11 (B)
Lead with ground plate

X-4853-048-0
Shaft Ass'y, centre

2-203-519-00 (A)
Nut (A), pivot lock

2-203-518-00 (B)
Screw, pivot

X-4853-004-0 (H)
Counterweight Ass'y

X-4853-005-0 (B)
Lateral Balancer Ass'y

3-701-506-00 (A)
SC M3 x 4, hexagon socket

3-542-694-00 (B)
Ornamental Screw, pinch roller arm

4-847-716-00 (D)
Bearing, pivot

4-853-051-00 (A)
Stopper, lift

B2.6 x 6

4-853-043-00 (A)
Spring (B), guide

3-701-505-00 (A)
SC M3 x 3, hexagon socket

PTT 1.7 x 2.5

4-844-045-00 (E)
Arm Pipe

X-4853-041-1 (M)
Base Ass'y, lift

2-203-519-00 (A)
Nut, pivot lock

2-085-082-00 (A)
Washer, 11.5mm dia.

2-085-058-00 (C)
Screw Collar

X-4853-009-0 (B)
Push-rod Ass'y

X-4853-003-0 (C)
Cam Shaft Ass'y, cueing

1-509-550-00 (F)
Connector, head shell

4-853-050-00 (A)
Spring, ring

4-853-015-00 (B)
Holder, push-rod

PTT1.7 x 2.5

4-853-096-00 (A)
Screw, lift

4-847-055-00 (A)
Spring

4-853-085-00 (B)
Shaft, anti-skating compensator knob

W4

4-853-042-00 (A)
Washer

E3

▲ A
2-081-731-00 (A)
Head Damper

3-701-513-00 (A)
SC M4x10, hexagon socket

4-853-020-00 (C)
Knob, anti-skating compensator

X-4853-014-2 (H)
Head Shell Ass'y, including
parts marked ▲ A, B

4-853-052-00 (B)
Friction Spring

4-853-067-31 (H)
Arm Base

B3 x 3

4-853-005-00 (A)
Cam (C), anti-skating compensator

▲ B
X-2089-618-1 (red) (B)
X-2089-618-2 (green) (B)
X-2089-618-3 (white) (B)
X-2089-618-4 (blue) (B)
Lead Ass'y

4-844-040-00 (A)
Cam (B), anti-skating compensator

4-844-044-00 (A)
Spring

4-841-040-00 (A)
Cap, anti-skating
compensator

W3

TA, P3 x 25

SC M2.6 x 4, hexagon socket

4-847-074-00 (B)
Lever, anti-skating compensator

Note:
- Items with no part number and/or no description are not stocked because they are seldom required for routine service.
- All screws are Phillips (cross recess) type unless otherwise noted.
  (−) = slotted head
- Circled letters ((A) to (Z)) are applicable to European models only.

SECTION 6
ELECTRICAL PARTS LIST

Note: Circled letters (Ⓐ to Ⓩ) are applicable to European models only.

Ref. No.	Part No.	Description

SEMICONDUCTORS

Transistors

Ref. No.		Part No.
⇒ Q101	Ⓓ	2SC1061
⇒ Q102, 103	Ⓑ	2SC634A
⇒ Q104	Ⓒ	2SA678
⇒ Q105	Ⓒ	2SA684
Q106	Ⓒ	2SC926A
⇒ Q201−204	Ⓑ	2SC634A
⇒ Q205, 207, 208	Ⓒ	2SA678
⇒ Q209, 210	Ⓑ	2SC634A
⇒ Q211	Ⓓ	2SC1061
⇒ Q212	Ⓔ	2SA671
⇒ Q213	Ⓓ	2SC1061
⇒ Q214	Ⓔ	2SA671
⇒ Q301−303	Ⓑ	2SC634A

ICs

IC1	Ⓖ	μPC324C
IC2	Ⓛ	MSM5811
⇒ IC3	Ⓚ	M53293P
⇒ IC4	Ⓔ	M53200P

Diodes

⇒ D101−104	Ⓑ	10E2
⇒ D105	Ⓑ	EQB01-06
⇒ D106	Ⓑ	10D6
⇒ D201−203	Ⓑ	1S1555
⇒ D301, 302	Ⓑ	1S1555
H1, H2	Ⓓ	5GF-MS-07F

TRANSFORMERS

PT1	1-442-878-11	Ⓜ	Power
PT2	1-442-879-11	Ⓕ	Boost

CAPACITORS

All capacitors are in μF and ceramic unless otherwise noted. 50WV or less are not indicated except for electrolytics.
pF = μμF, elect = electrolytic

Ref. No.	Part No.		Description		
C100, 101	1-108-750-12	Ⓑ	0.033	300V	mylar
C102, 103	1-123-047-11	Ⓒ	2200	32V	elect
C104, 105	1-123-193-11	Ⓑ	100	16V	elect
C106	1-123-027-11	Ⓑ	2.2	250V	elect
C201	1-101-925-11	Ⓐ	0.047		
C202	1-121-651-11	Ⓐ	10	16V	elect
C203	1-102-074-11	Ⓐ	0.001		
C204	1-108-246-12	Ⓐ	0.047		mylar
C205	1-131-212-11	Ⓑ	0.33	35V	tantalum
C206	1-121-951-11	Ⓐ	0.47	50V	elect
C207	1-101-925-11	Ⓐ	0.047		
C208	1-123-191-11	Ⓐ	22	16V	elect
C209, 210	1-108-251-12	Ⓑ	0.1		mylar
C301, 302	1-102-491-11	Ⓐ	51p		
C303	1-121-391-11	Ⓐ	1	50V	elect
C304	1-121-952-11	Ⓐ	1	50V	elect
C305	1-101-925-11	Ⓐ	0.047		
C307, 308	1-102-959-11	Ⓐ	22p		
C309	1-123-194-11	Ⓐ	33	10V	elect
C310	1-101-919-11	Ⓐ	0.0022		

RESISTORS

All resistors are in ohms. Common ¼W carbon resistors are omitted. Check schematic diagram for values.

Ref. No.	Part No.		Description		
R109	1-213-154-11	Ⓐ	8.2k	1W	metal oxide (nonflammable)
R240, 241	1-217-429-11	Ⓑ	3.9	2W	fusible
R313	1-217-401-11	Ⓑ	150	¼W	fusible
RV101	1-224-644-XX	Ⓑ	4.7k, adjustable		
RV201	1-224-635-00	Ⓑ	22k, adjustable		
RV202,203	1-224-644-XX	Ⓑ	4.7k, adjustable		
RV204,205	1-224-645-XX	Ⓑ	10k, adjustable		

⇒: Due to standardization, interchangeable replacements may be substituted for parts specified in the diagrams.

Note: The components identified by shading are critical for safety. Replace only with part number specified.

Ref. No.	Part No.		Description

SWITCHES

| S1 | 1-552-206-11 | Ⓓ | Pushbutton, POWER |
| S2 | 1-516-288-00 | Ⓑ | Slide, SPEED |

MISCELLANEOUS

F1	1-532-066-11	Ⓑ	Fuse, T400mA
NL1	1-519-152-00	Ⓑ	Neon Lamp, DC150V 10mA
MGH	1-543-066-00	Ⓕ	Head, speed detecting
X1	1-527-304-00	Ⓕ	Crystal 7.864320MHz
	A-4608-018-A	Ⓞ	Motor Ass'y
	X-2089-618-1	Ⓑ	Lead Ass'y, cartridge (red)
	X-2089-618-2	Ⓑ	Lead Ass'y, cartridge (green)
	X-2089-618-3	Ⓑ	Lead Ass'y, cartridge (white)
	X-2089-618-4	Ⓑ	Lead Ass'y, cartridge (blue)
	1-508-897-00	Ⓒ	Plug, voltage selector
	1-509-547-11	Ⓒ	Socket, 3-p; AC IN
	1-509-550-00	Ⓕ	Connector, head shell
	1-551-063-00	Ⓕ	Phono Cord
	1-551-283-11	Ⓑ	Lead, with ground plate

ACCESSORIES & PACKING MATERIALS

Part No.		Description
X-4853-006-2	Ⓔ	Screw Ass'y, carridge
including;		
2-054-625-00	Ⓐ	Screw (C), cartridge
2-056-532-00	Ⓑ	Screw (A), cartridge
2-224-081-01	Ⓑ	Screw (E), cartridge
2-224-018-11	Ⓑ	Screw (E), cartridge
3-701-614-00	Ⓐ	Bag, plastic
4-815-655-01	Ⓐ	Nut (A), cartridge
4-853-038-01	Ⓒ	Holder, screw
X-4853-018-0	Ⓒ	Sub-weight Ass'y
3-701-613-00	Ⓐ	Bag, plastic; sub-weight, wrench
3-701-616-00	Ⓐ	Bag, plastic; shell
3-701-623-00	Ⓐ	Bag, plastic
3-701-630-00	Ⓐ	Bag, plastic; printed matters
3-701-806-01	Ⓐ	Adaptor, 45 rpm
3-770-313-11	Ⓔ	Manual, instruction
3-793-395-11	Ⓑ	Gauge, tracking-error check
3-849-790-00	Ⓑ	Bag, protection
4-844-060-00	Ⓒ	Bag, protection; set
4-848-005-00	Ⓒ	Box, accessory
4-848-006-00	Ⓑ	Bag, accessory
4-848-012-00	Ⓐ	Board, protection
4-853-086-00	Ⓐ	Wrench, hexagonal
4-853-836-00	Ⓒ	Cushion
4-853-837-00	Ⓕ	Carton
4-853-839-00	Ⓕ	Frame

Note: The components identified by shading are critical for
safety. Replace only with part number specified.

Sony Corporation

1977

STEREO TURNTABLE SYSTEM

PS-X3

AEP Model

No. 2
May, 1978

SUPPLEMENT

File this supplement with the service manual.

CIRCUIT DESCRIPTION

TABLE OF CONTENTS

Title

SONY®
SERVICE MANUAL

1. Operation of Servo Amplifier Circuit (See Fig. 1-1)

During Motor Start

1. When the power switch is turned on, Q202 is still turned off since an output signal from the MG head is not applied to IC1-2. C204 will thus charge up through R210, R209 and RV201 (or R208 and RV201 for 45 rpm).

2. Once the emitter voltage of Q203 (charging voltage applied to the base of Q203) exceeds $+V_{BE}$, this transistor turns on.

3. Q205 is thus turned on, thereby applying a voltage to IC1-1.

Limiter Circuit

1. Once the turntable starts to rotate, an output signal is produced by the MG head.

2. Although the MG head output signal is a sine wave, there is some fluctuation in amplitude. Therefore, above a certain level, this sine wave is changed into a constant-amplitude square wave.

Waveform Rectification

1. The IC1-2 output signal is amplified by Q201 to obtain a complete square wave signal. The D201 is employed to maintain the base voltage of Q201 at ±0.6Vp-p.

2. This limiter circuit (IC1-2, Q201) serves to prevent incorrect detection of amplitude fluctuations as frequency changes.

3. The square wave signal on the collector of Q201 is then applied to the phase control circuit.

Differential Circuit

The square wave signal on the collector of Q201 is changed to a triangular wave by C203, R206 and R207. The differentiated (triangular) pulse triggers the sawtooth wave generator transistor (Q202).

Sawtooth Wave Generator Circuit

1. While Q202 is turned off, C204 is charged up through R210, R209 and RV201 (or R208 and RV201 for 45 rpm). But when the positive part of the differentiated wave turns Q202 on, C204 discharges immediately, resulting in the collector voltage of Q202 dropping to 0V.

2. After the ⊕ portion of this differentiated wave has passed on, Q202 is again turned off, and C204 is charged up, resulting in the Q203 base voltage forming a sawtooth wave signal.

Comparator

1. The sawtooth wave signal is applied to the comparator circuit formed by Q203 and Q204. The base of Q204 is biased by the reference voltage produced by voltage division of B+ by the output from R213, R214, R215 and the phase control circuit.
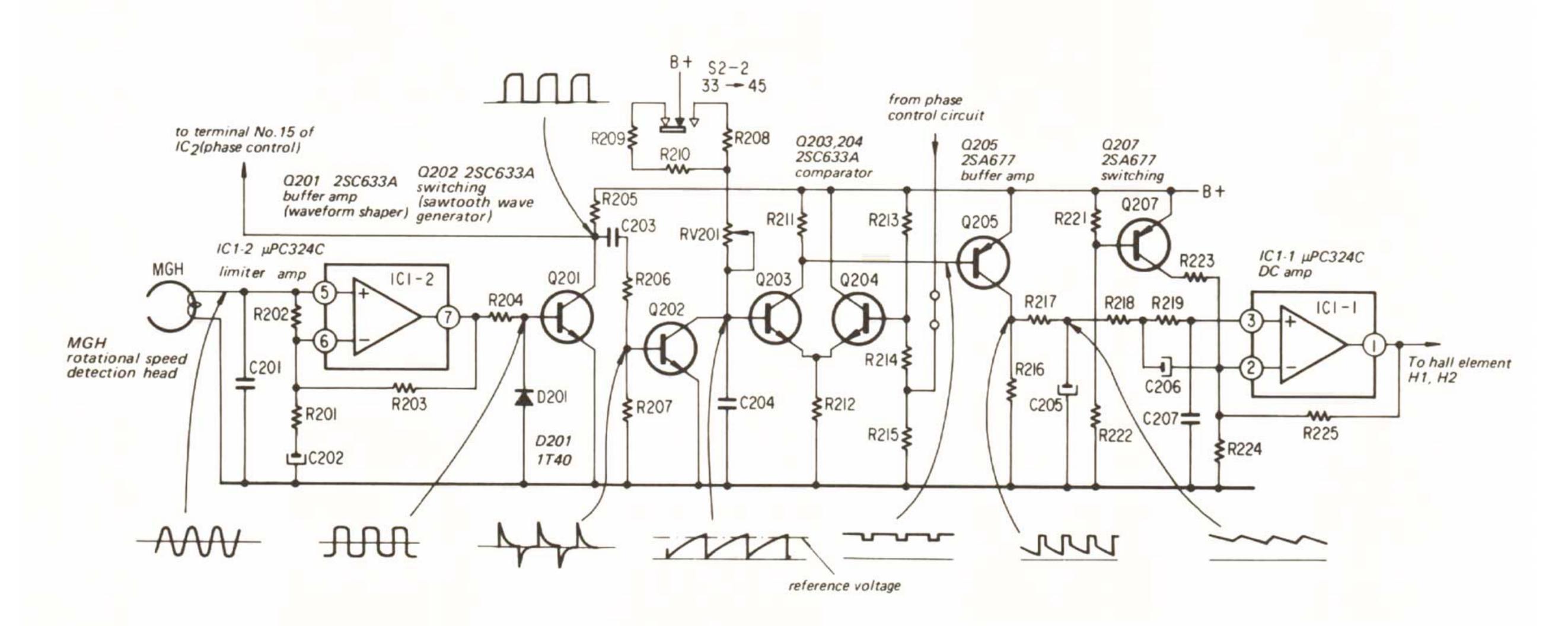
Fig. 1-1.

Since the emitter voltage of Q203 is determined at this time by the reference voltage, Q203 turns on when its base voltage (sawtooth wave) exceeds the total voltage (emitter voltage plus $+V_{BE}$). So a negative pulse will appear on the collector of Q203.

2. If the rotational speed slows down, the frequency of the sawtooth wave will be low. Also, the output pulse width increases, because the on-time of Q203 becomes long.
    On the other hand, if the rotational speed increases, the frequency of the sawtooth wave will be high. Also, the output pulse width becomes narrow, because the on-period of Q203 becomes short.
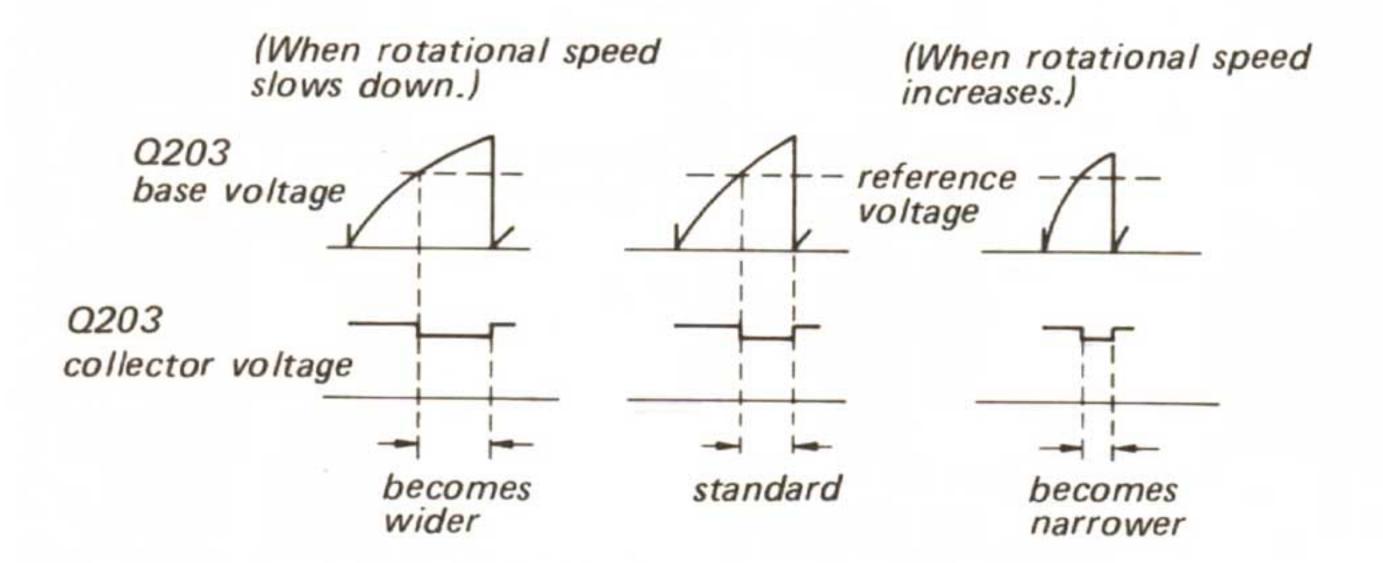
Fig. 1-2.

Pulse Signal Amplifier

Besides amplifying pulse signals, Q205 also serves as a phase inverter which feeds positive pulse signals to the next stage.

Smoothing Circuit (low-pass filter)

This smoothing circuit has two filters (one is made up of R217 and C205, and the other is IC1-1, R218, R219, C206 and C207). These filters operate as an integrating circuit which converts the pulse signals into dc signals (the voltage level being in proportion to pulse width).

DC Amplifier Circuit

The dc amplifier (that also serves as a low-pass filter), uses IC1-1, and amplifies the dc output signals from the previous stage.

Speed Selector Switch (S2)

1. The circuit time constant is changed by simply changing the resistance connected to the base of Q203.

2. The time constant for 45 rpm is designed to be faster than that for 33 rpm.

3. Consequently, when switching the speed selector switch from 33 to 45 rpm, the collector output pulse width of Q205 is widened, thereby increasing the level of the low-pass filter DC output signal. Motor speed is thus increased, followed by re-application of the servo control mechanism.

4. When switching back to 33 rpm, the reverse sequence of events takes place.
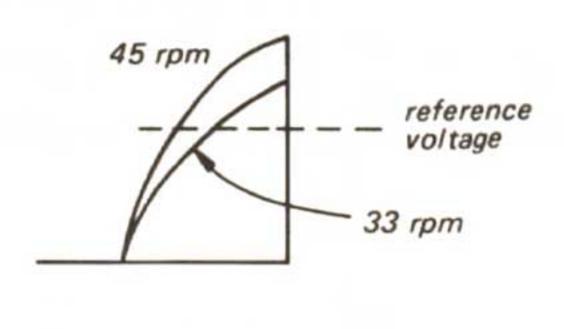
Fig. 1-3.

Servo Control

If for any reason, motor speed decreases or increases, even by the slightest degree, the servo control mechanism is activated to correct for the deviation, and returns the speed to the reference standard value.

1. If the motor speed is decreased slightly, the frequency of the MG head output signal decreases. This signal is applied to the phase control circuit (IC2) for phase comparison. The resultant output, of decreased voltage level, is then sent to the servo control. And since the base voltage of Q204 is reduced, the emitter voltage (reference voltage) of Q203 also decreases, resulting in the width of the Q203 collector output pulse being widened.

2. The dc output voltage from the low-pass filter consequently decreases, thereby increasing motor speed back to the original standard value.

3. If, on the other hand, motor speed is increased by some external influence, the servo control mechanism reduces speed in the reverse manner of that described above.
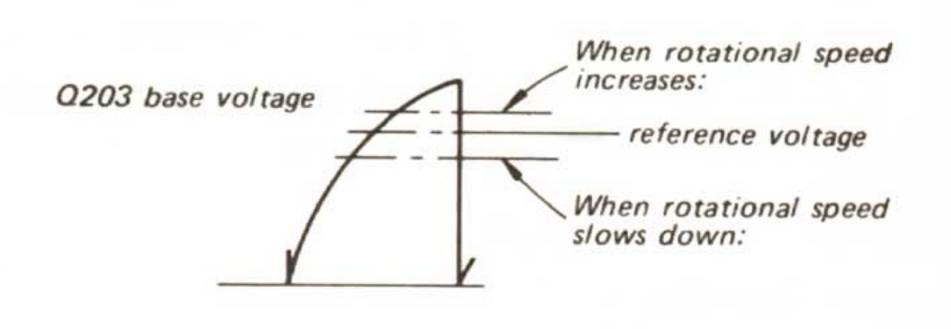
Fig. 1-4.
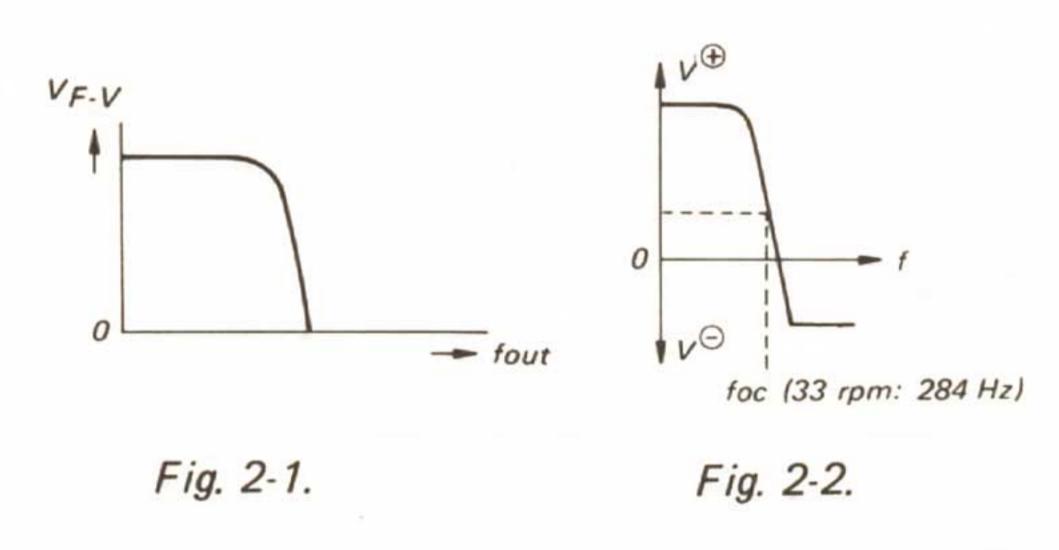
2. Maintaining Forward Rotation (See Fig. 2-3)

1. When a ⊕ signal is applied to the input terminal of the Hall elements, the motor is turned in the forward direction, but when a ⊖ signal is applied, the motor is turned in the reverse direction. Therefore, the reverse rotation that is caused by applying ⊖ input serves as a brake for rapid stopping of the turntable.
(Conventional speed reduction systems use the phenomenon of hysteresis loss or mechanical loss.)

2. F-V converter circuit
This circuit converts the frequency of the MG head output signal into a voltage signal in accordance with the curve as shown in Fig. 2-1.

Fig. 2-1.　　Fig. 2-2.

This curve shows "frequency against output voltage" for both forward and reverse rotations.

3. DC amplifier (IC1-1) operation
The output level of IC1-1 is determined by the relationship:
$$V_{OUT} = (V^{\oplus}_{IN} - V^{\ominus}_{IN}) \times Gain,$$
or $V_{OUT} = V^{\oplus}_{IN} \times Gain$ when $V^{\ominus}_{IN}$ is 0 V.
In this equipment, output levels of approx. $-1.5V$ to $+13V$ are possible by applying ⊕ voltage to $V^{\ominus}_{IN}$ through Q207 and R223. When the speed selector is instantly switched from 45 rpm to 33 rpm, $V^{\oplus}_{IN}$ becomes 0V, $V^{\ominus}_{IN}$ becomes positive, and V_{OUT} minus, thereby activating the brake operation.

4. If the frequency of the MG head exceeds foc during forward rotation, V_{OUT} becomes 0 or minus, thereby slowing down rotational speed. But during reverse rotation, the result is an acceleration of the reverse rotational action.

5. In order to prevent such "run-away" acceleration, a switching circuit consisting of Q210, Q209, and Q208 is employed, thus maintaining forward rotation.

Normal Operation

1. For normal operation, the emitter of Q210 is fixed to a level of −0.5 V by D203.

2. Since the base potential of Q210 is normally kept at about 1.5 V, Q210 turns on.

3. Since the base of Q209 is −0.5 V, Q209 turns off. Q208 also turns off, and then Q207 turns on.

4. A ⊕ signal is thereby applied to the ⊖ input terminal of IC1-1 through R223.

Conditions in brackets ( ) refer to reverse rotation case.
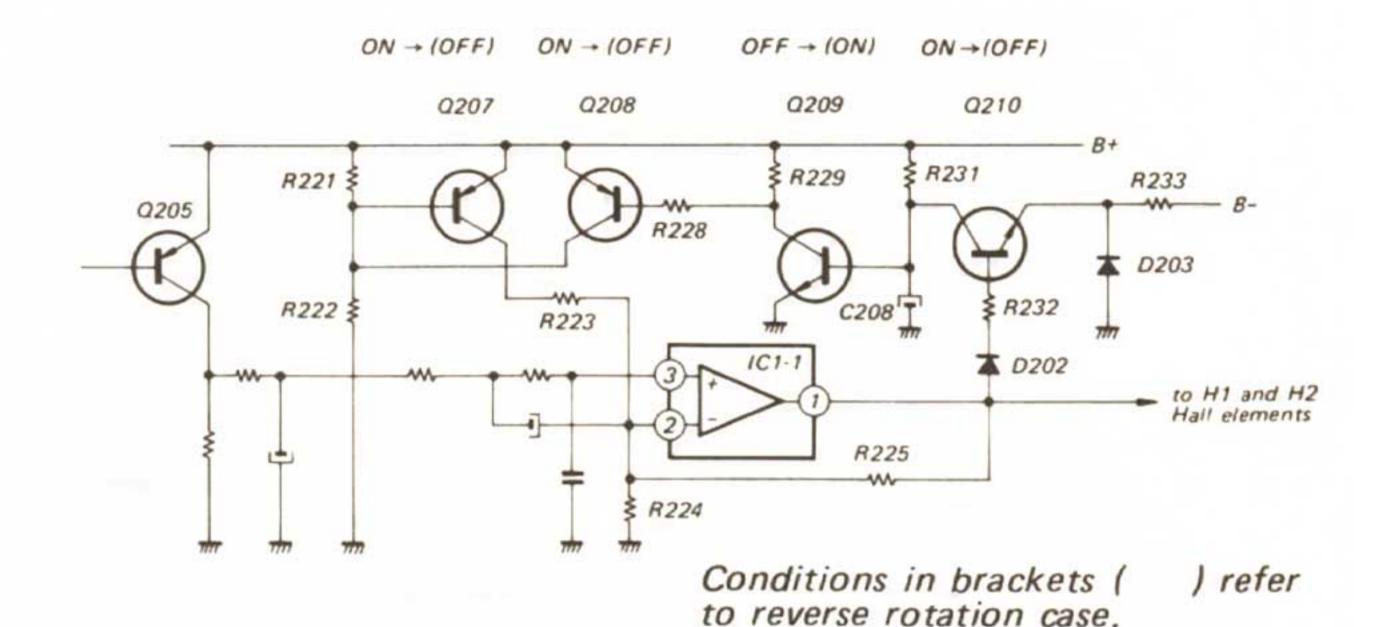
Fig. 2-3.

Reverse Rotation

1. When operating too fast during reverse rotation (when the frequency of the MG head output signal exceeds f_{oc}), Q205 is turned off and no signal is obtained on the ⊕ input terminal of IC1-1. The output level of IC1-1 then drops from the normal 1.5V (relative to ground) to less than +0.5V, resulting in Q210 being turned off.

2. Consequently, the base voltage of Q209 rises in accordance with the R231/C208 time constant, finally turning Q209 on once the base potential exceeds +0.5V.

3. Q208 then turns on, and Q207 turns off.

4. Consequently, no voltage is applied to the ⊖ input terminal of IC1-1.

5. That is, the operation of IC1-1 will be stopped, resulting in the output level reducing to 0V, and the slowing down of rotational speed.

6. The MG head output frequency consequently drops below f_{oc}, resulting in a positive output signal from the F-V converter, and forward motor rotation. Once the IC1-1 output level exceeds +0.5V, the reverse-rotation prevention circuit is put into standby status.

7. This reverse rotation prevention circuit can be switched off again extremely rapidly. When Q210 is turned on, C208 discharges through R233 to the B− bus.

Stroboscope

The stroboscope system employed in this equipment consists of stroboscope stripes marked on the outer rim of the turntable platter, plus a neon lamp directed onto the outer rim stripes. The number of stroboscope stripes for 33⅓ rpm and 45 rpm are determined by the following equation:

$$n = \frac{60\ (m + 2f)}{N}$$

where n = number of stripes,
     m = the number of stripes to pass any one point during 1 second,
      f = power supply frequency (Hz),
and N = turntable speed (rpm).

Table 1

RPM	Number of stroboscope stripes	
	50 Hz	60 Hz
33⅓	180	216
45	133⅓	160

As can be seen from this table, the above equation does not give an integral number of stripes for the 45 rpm speed at 50 Hz.

Therefore, the strips of the stroboscope are difficult to judge at 50 Hz, 45 rpm. However, this speed error can be ignored while a record is being played. To eliminate this error, a 120 Hz signal corresponding to a 60 Hz power line is generated to light the neon lamp.

Stroboscope Operation (See Fig. 2-5 and Fig. 2-6)

1. A signal of approximately 7.9 MHz is generated by IC2 and the crystal oscillator, and then divided within IC2. The output signal appearing at terminal No. 1 of IC2 has a frequency of 3840 Hz.

2. This frequency is then fed into IC3 where it is further divided. A 480 Hz signal appears at terminal No. 8, and a 240 Hz signal at terminal No. 11.

3. The 240 Hz signal is divided again into a 120 Hz signal by the flip-flop of IC4.

4. Although stroboscope stripes designed with smaller t/T ratios appear to be sharper to the eye, they do require stronger illumination than is normally available. The stripes marked on the turntable platter of this equipment have a t/T ratio corresponding to 13%.
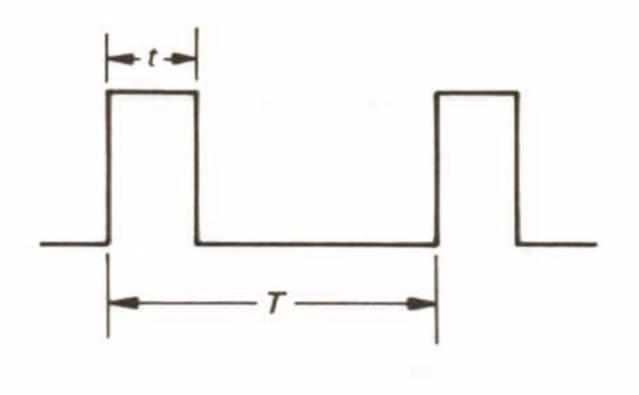
Fig. 2-4.
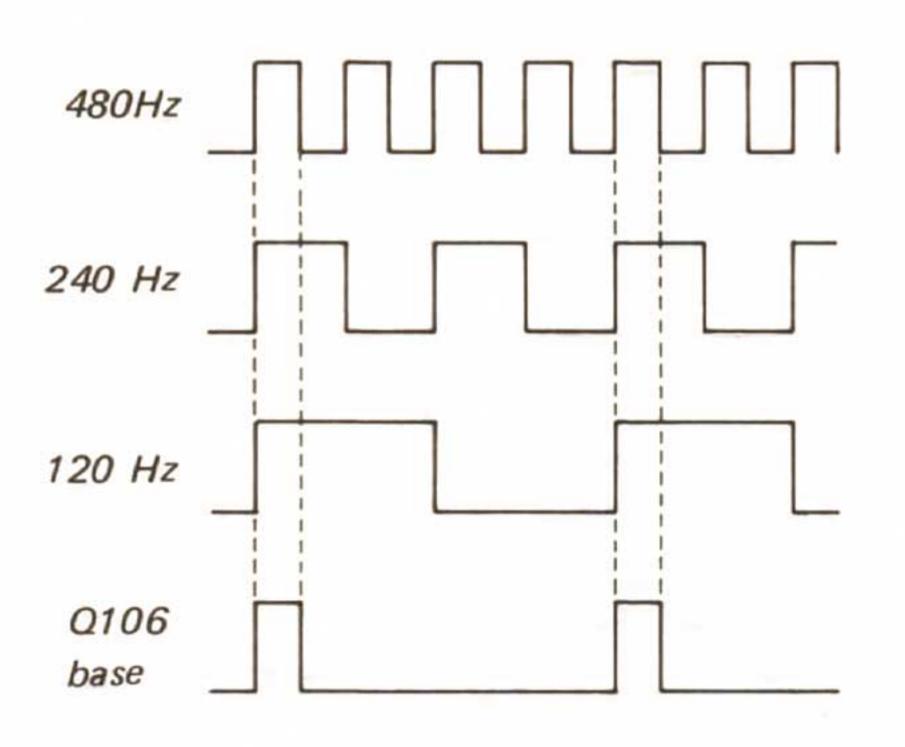
Fig. 2-5.
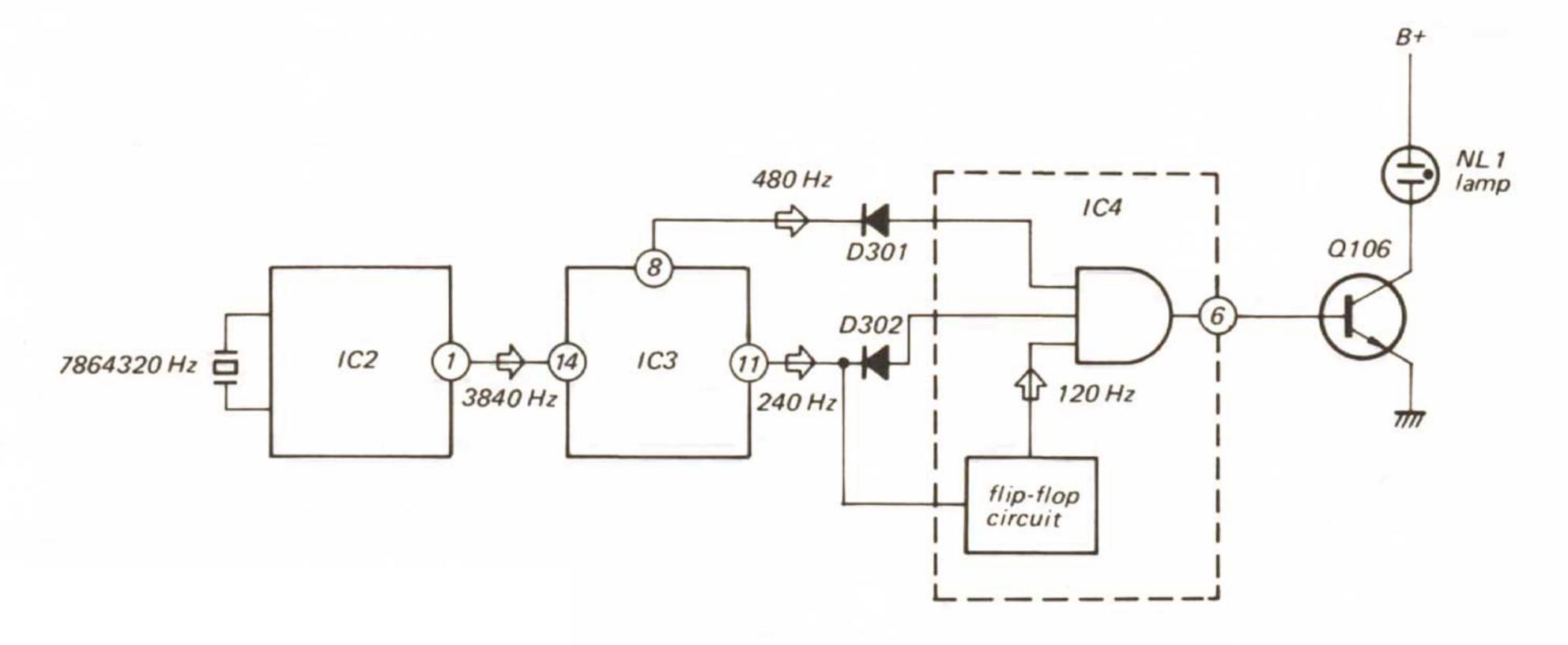
Fig. 2-6.

3-4. Hall Motor
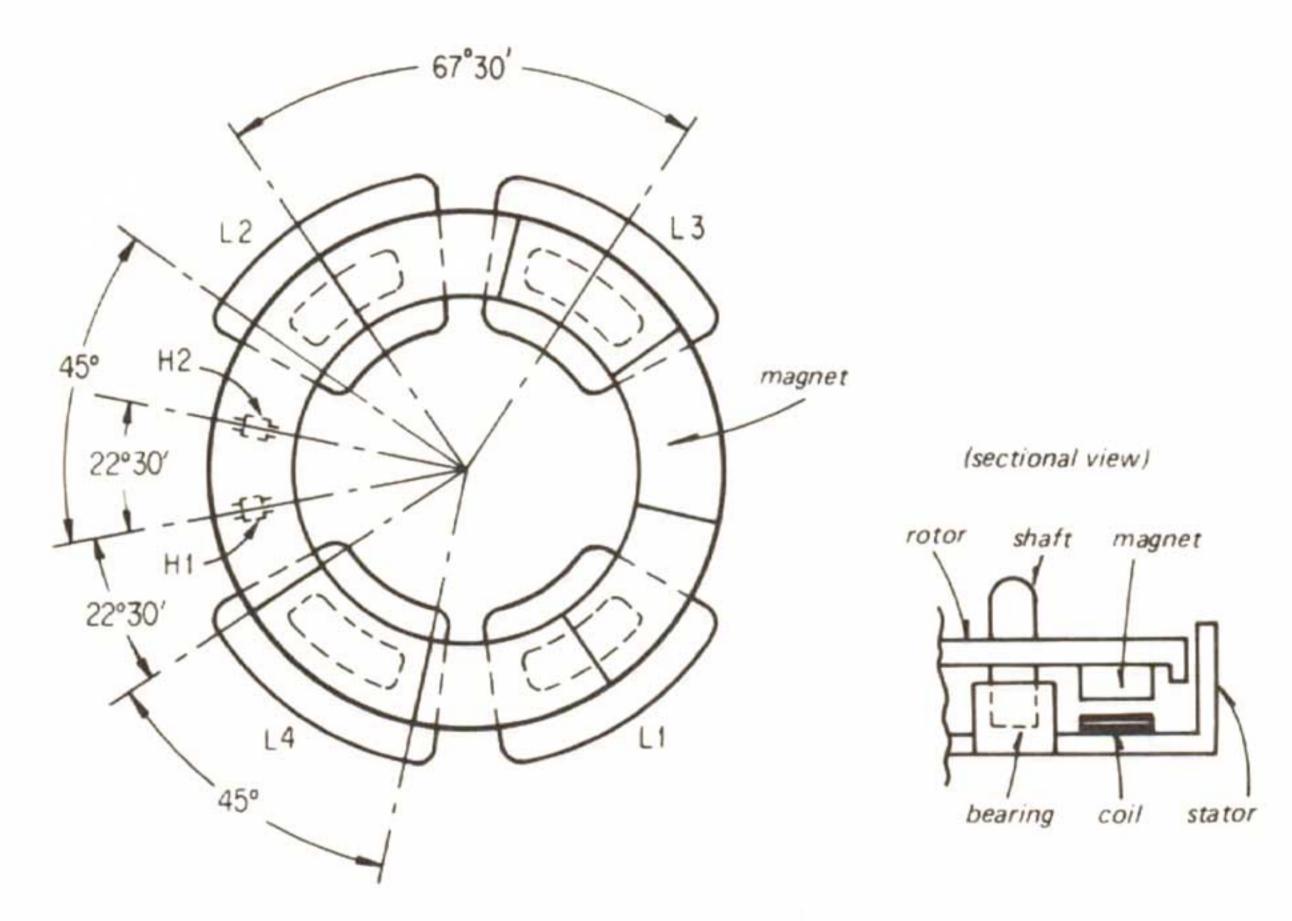
The PS-X3 is equipped with the newly developed BSL (brush and slotless) dc servo motor, which has the following major advantages.

1. Extremely uniform torque.

2. All-electronic switching (no mechanical contacts used at all), resulting in very little noise.

3. Extremely stable performance, and long operational life.

Magnetic Pole Arrangement (See Fig. 3-1)

- The motor coils L1 and L2 (plus L3 and L4) form a pair, connected in series.

- The reason for positioning two Hall elements H1 and H2 at an angle of $22°30'$ from each other is to displace the electrical phase angle by $90°$, thereby rotating the rotor in a 2-phase action.

- For the same reason, the positions of the coil pairs are set at an angle of $67°30'$.

- The coil windings are wound in a partial cone shape to match the similarly shaped magnets, 8 of which are arranged in a circle underneath the rotor.

Motor Internal View (top view)
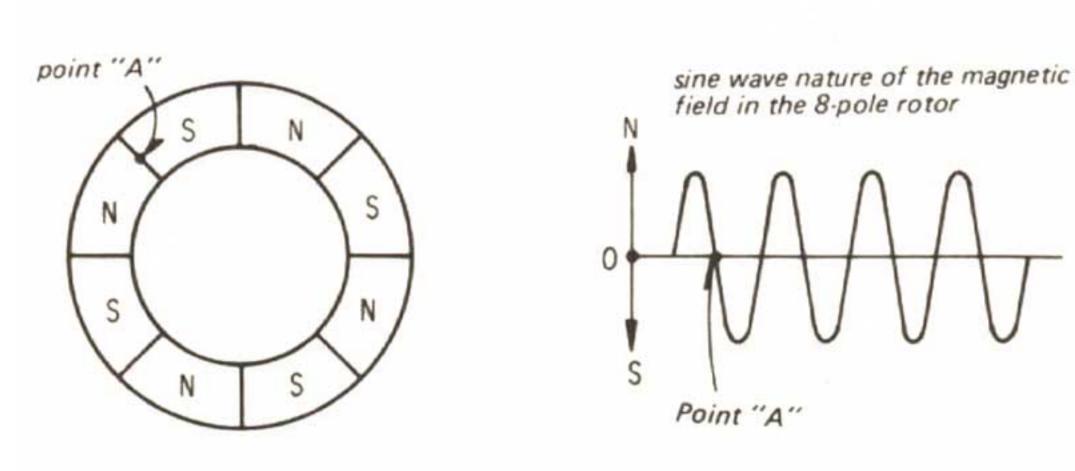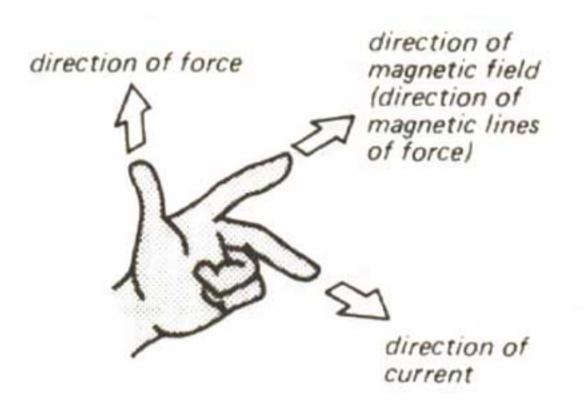
Fig. 3-1.
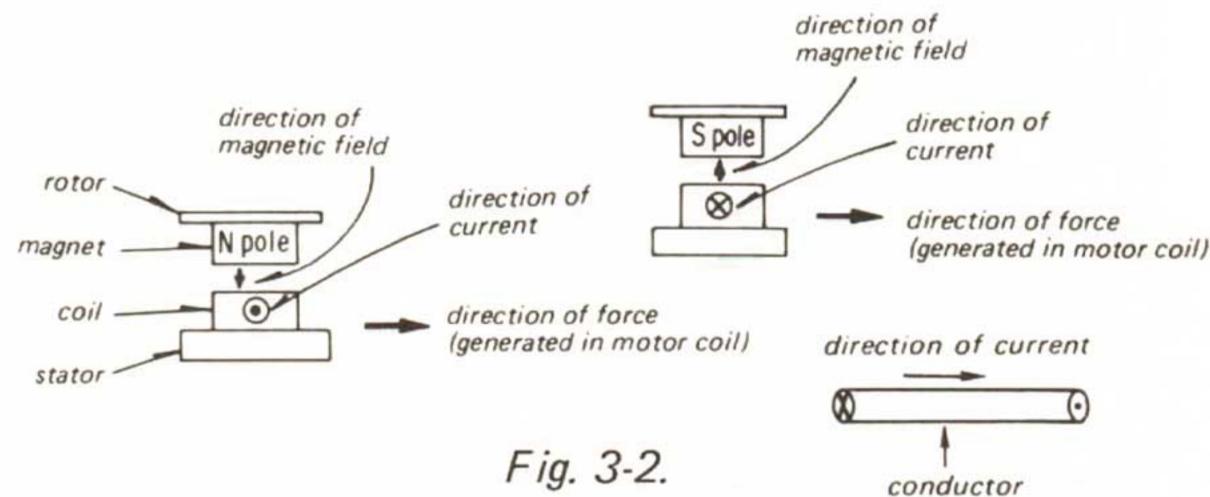
- Hall elements and motor coils have been set apart at an angle of $22°30'$ so that the peak of an N or S pole magnetic field will cut across the center of a motor coil at the same time that the magnetic field peak of the preceeding or following S or N pole cuts across a Hall element.

Generation of Rotational Force (See Fig. 3-2)

According to Fleming's left hand rule, the force generated in the motor coils will be in the counter-clockwise direction, but since the coils are fixed, the magnets (attached to the rotor) will rotate in the clockwise direction. (Refer to Fig. 3-3 and Fig. 3-4.)

Fleming's left hand rule

Fig. 3-2.

When an N pole corresponds to the Hall element H1 (shown in the diagram below), a positive voltage is generated in H1. This voltage is then amplified by IC1-4, and applied to Q211.

When Q211 is turned on, B+ voltage is applied to L1 and L2. The current flowing through L1 and L2, and the magnetic field produce an electro-magnetic force which spins the rotor in the direction of the arrow as shown in Fig. 3-3.

When an N pole corresponds to the Hall element H2 as shown in Fig. 3-3, current flows through L3 and L4, thereby generating the same electro-magnetic force to continue spinning the rotor.

When an S pole corresponds to the Hall element H1 (shown in Fig. 3-4), a negative voltage is generated in H1. This voltage is then amplified by IC1-4, and applied to Q212.

When Q212 is turned on, B− voltage is applied to L1 and L2. The current flowing through L1 and L2, and the magnetic field produce an electro-magnetic force which spins the rotor in the direction of the arrow as shown in Fig. 3-4.
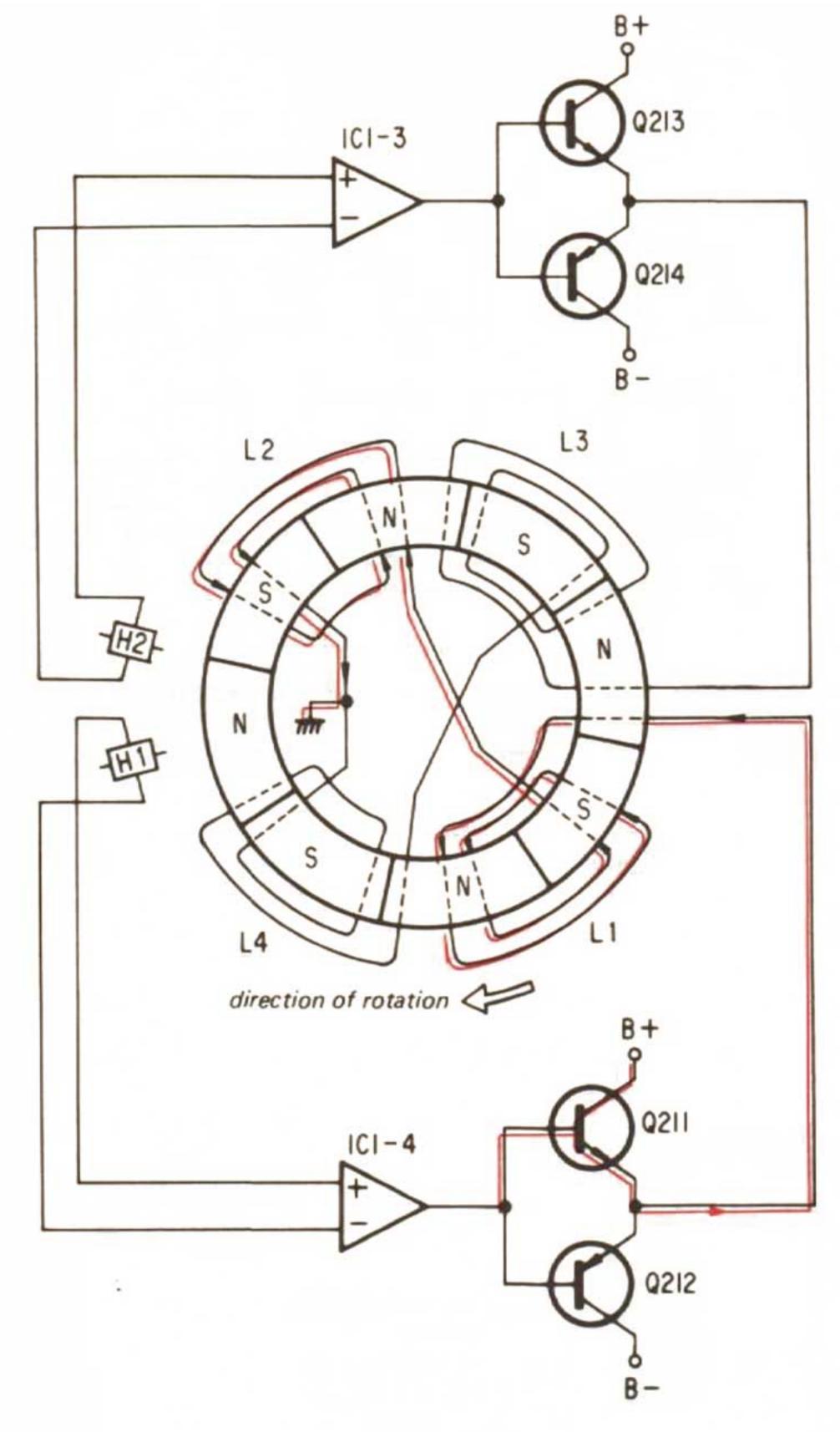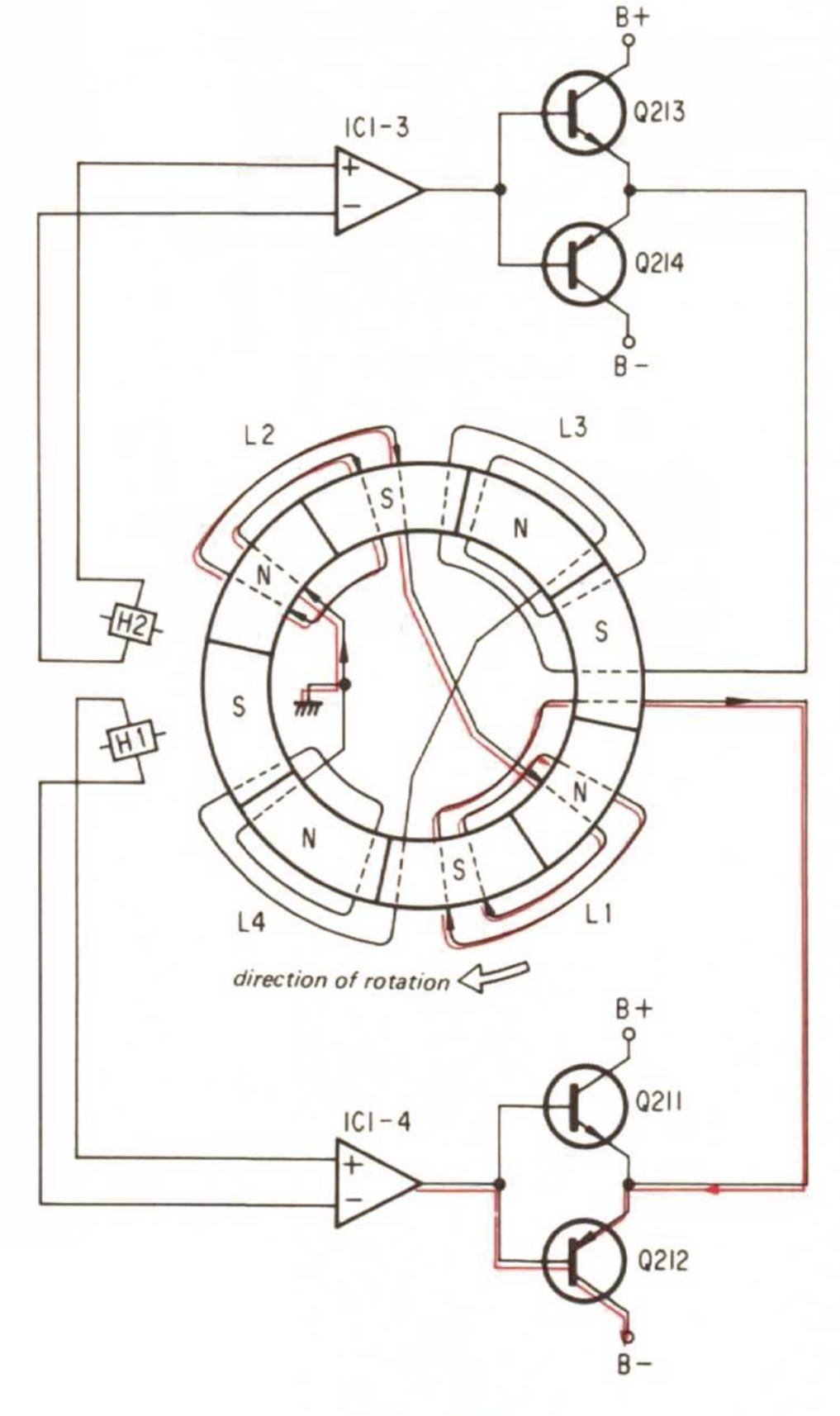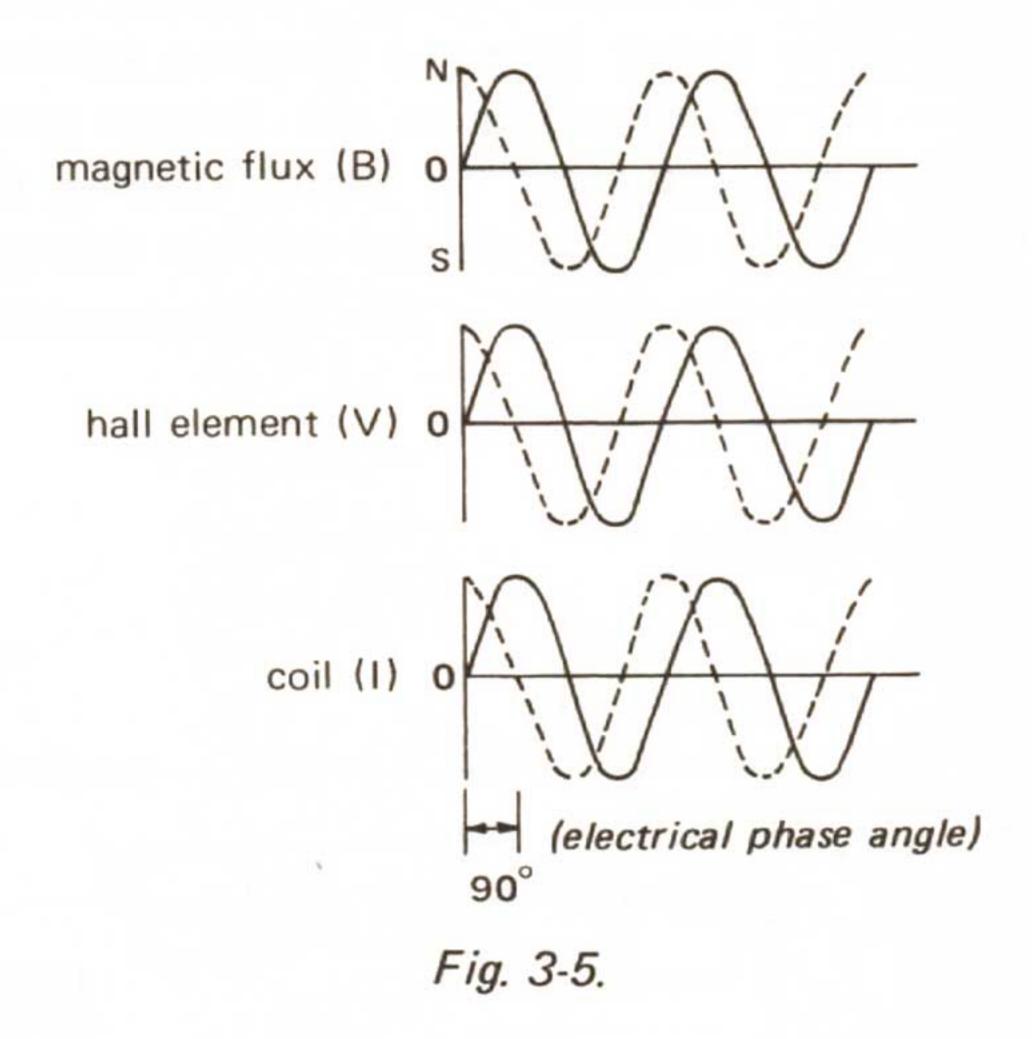
Fig. 3-3

Fig. 3-4.

When an S pole corresponds to the Hall element H2, current flows through L3 and L4, thereby generating the same electro-magnetic force to continue spinning the rotor.

Hence, N and S poles are repeatedly positioned oppositely to the Hall elements H1 and H2 every 22°30′ of a rotation thereby generating the voltages in these elements, resulting in the production of a current in the motor coils, and subsequent rotation of the motor.

Fig. 3-5.

Rotational Force

The rotational force (torque F) varies directly with the strength of the magnetic field (B) cutting across the coils, and the amount of current (I) flowing through the coils.

That is, $F = B \cdot I$

But since the magnetic field produced by the magnets of the rotor varies in accordance with a sine wave relation with the angle of rotation, and the pairs of motor coils are arranged 90° out of phase each other, the combined torque will be constant.

Constant Speed Rotation (See Figs. 3-6 and 3-7)

In order to maintain constant turntable speed, this model features a magnetic-disc detection system in the speed-detector stage, and a crystal oscillator in the phase control stage of a crystal-locked servo system.

Changes in rotational speed of the turntable are detected by the speed-detection head fixed on the frame. (S and N magnets are mounted around the outer rim of the turntable platter with a very high degree of precision.) The reference standard frequencies detected by this head are 284 Hz at 33 rpm, and 384 Hz at 45 rpm. Any changes in frequency detected by this head are converted into voltage signals, and fed to the servo amplifier.

In addition, the phase of the frequency signal from the speed detection head is compared with the reference phase of the crystal oscillator frequency. Any difference in phase is also converted into a voltage signal, and fed to the servo amplifier, thereby ensuring accurate turntable rotational speed.

Since motor speed is determined by the amount of current flowing through the motor (that is, through the motor coils), motor speed may be conveniently changed by simply changing the flow of current through the Hall elements. In other words, if motor speed tends to deviate from the reference standard value due to external influences, the constant speed value may be maintained by simply varying the amount of current flowing through the Hall elements in proportion to the amount of deviation in turntable speed.
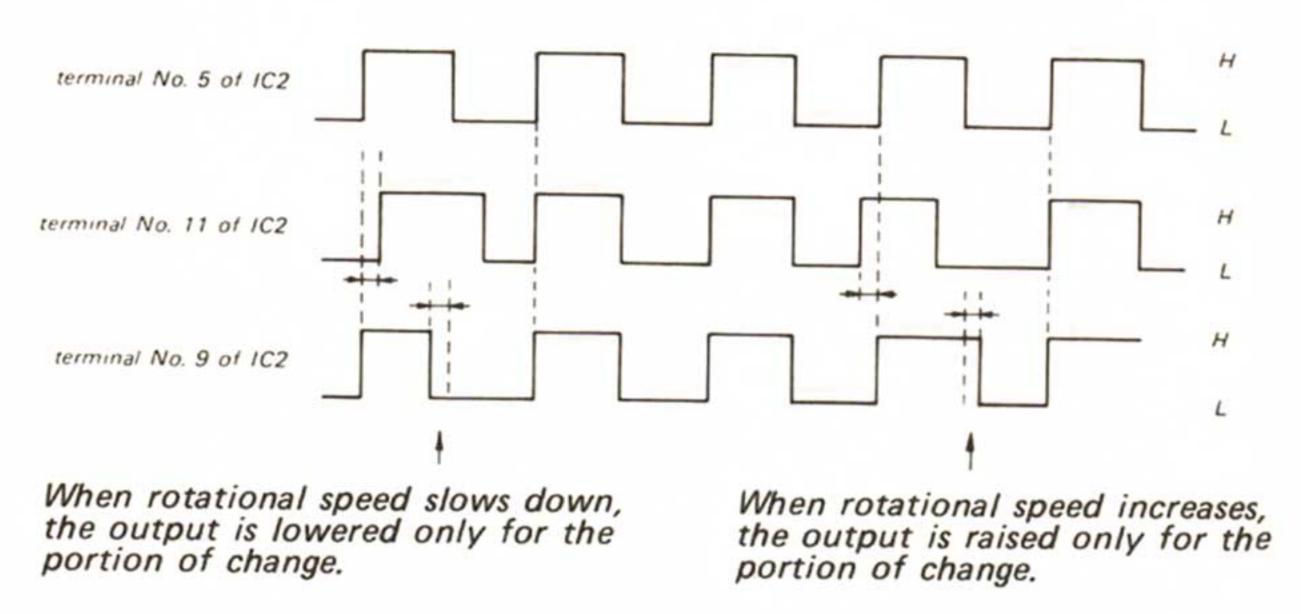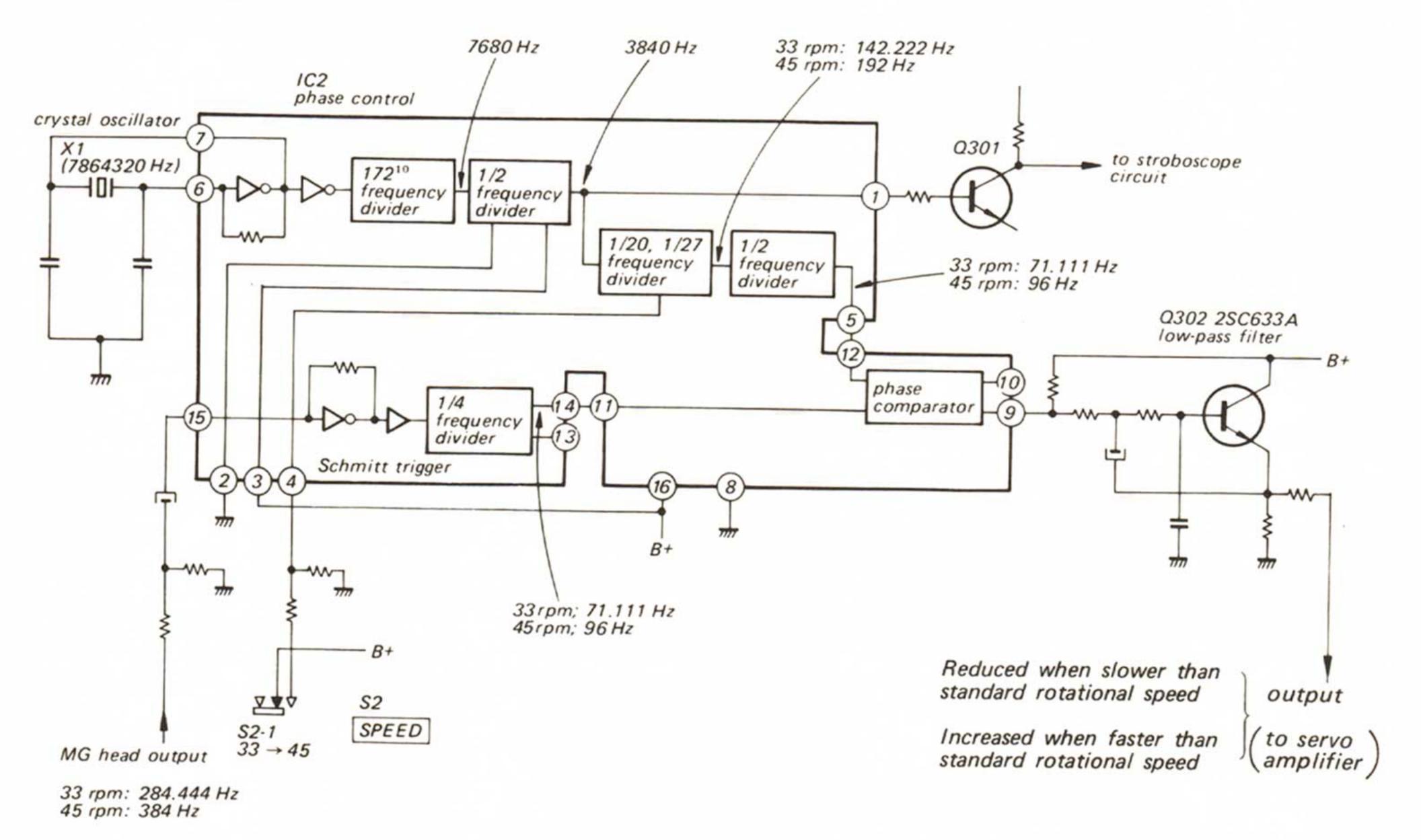

When rotational speed slows down, the output is lowered only for the portion of change.

When rotational speed increases, the output is raised only for the portion of change.

Fig. 3-7.

Phase Control

Fig. 3-6.