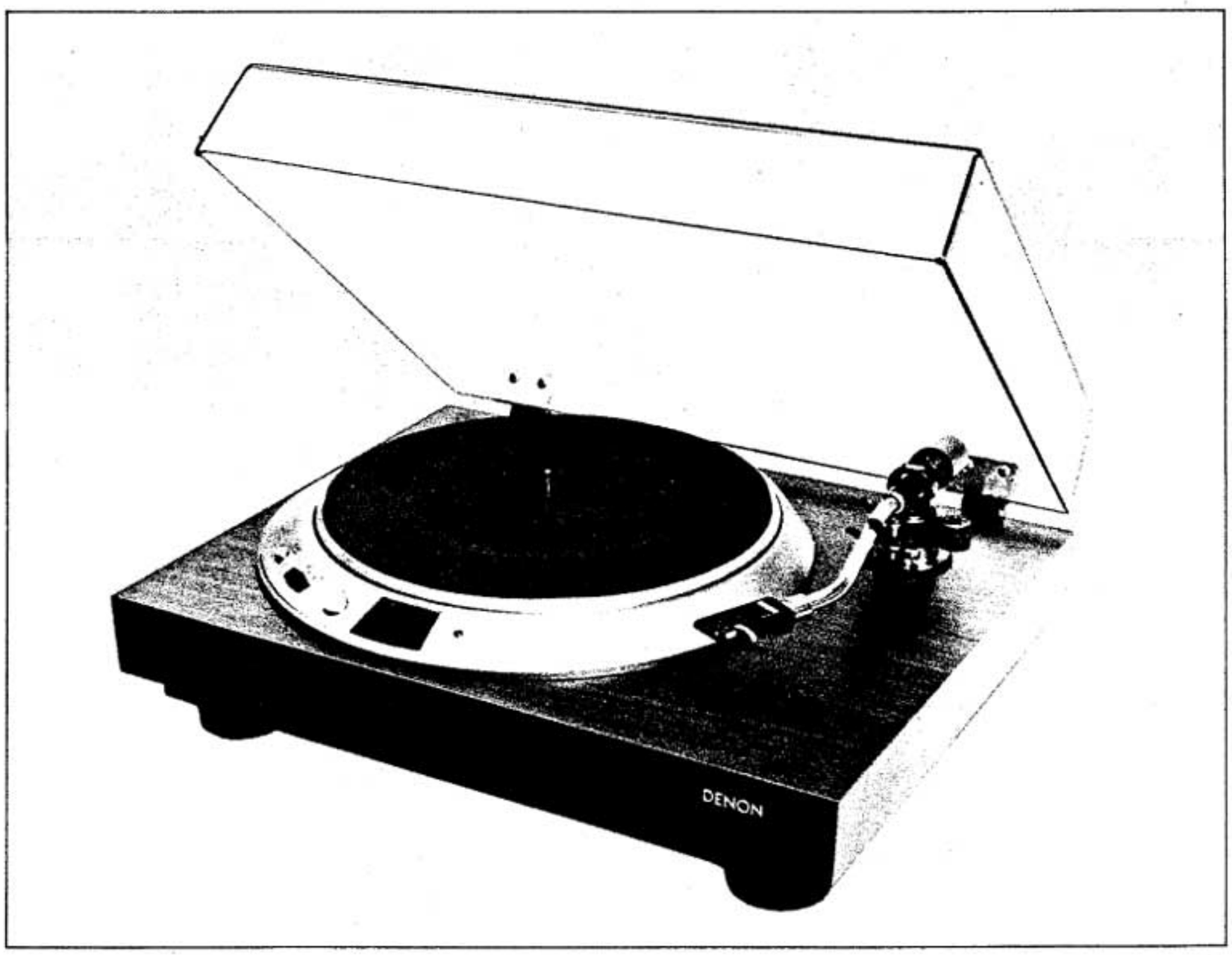
DENON

Hi Fi Component／Record Player

SERVICE MANUAL

SERVO-CONTROLLED DIRECT DRIVE TURNTABLE WITH QUARTZ CONTROL

MODEL DP-2000 SERIES



Model DP-2500

NIPPON COLUMBIA CO., LTD.

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WARNING : THOSE PARTS WITH SADING HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY

SPECIFICATIONS

PHONO MOTOR

Drive system:	Direct drive by AC servo motor
Speed control:	Frequency detection servo motor phase-locked to a quartz crystal oscillation
Speed:	33-1/3 r.p.m. & 45 r.p.m.
Speed selection:	Slide switched
Wow and flutter:	Less than 0.015% Wrms[1)]
S/N ratio:	Over 75 dB (DIN-B)
Starting time:	Less than 1.5 sec. (33-1/3 r.p.m.)
Absolute speed accuracy:	Over 99.998%
Turntable platter:	Aluminium alloy diecast, 30 cm diam, Moment of inertia of 200 kg-cm² (including turntable mat)

TONEARM (DP-2500)

Type:	Dynamically damped, static balance type
Effective length:	244 mm
Overhang:	14 mm
Tracking error:	Less than 2.5°
Acceptable weight of cartridge:	5 g to 11 g
Head shell:	Aluminium alloy (PCL-3)
Other facilities:	Oil damped cueing device Anti-skating device

GENERAL

Cabinet:	Vinyl veneered plywood (DP-2500)
Power supply:	AC 120/200/220/240 V [2)] 50/60 Hz
Power consumption:	15 W
Dimension:	485 W×175 H×405 D mm (DP-2500) 375 Diam,×146 H mm (DP-2000)
(Dust cover closed)	510 W×182 H×417 D mm (DP-2550) 485 W×176 H×408 D mm (DP-2800)
Weight:	Approx. 12 kg (DP-2500) Approx. 7 kg (DP-2000) Approx. 19 kg (DP-2800)

NOTE: 1) Measured by DENON method using a magnetie pulse wheel.
2) Rated voltage is preset to match that used in the country of original shipment. Shown on rating label on set.

*Above specifications are subject to alteration without notice,

THEORY OF OPERATION

We have already marketed turntable model DP-6000 series of quartz control type, which is widely and favourably accepted by audio fans. We are newly introducting the model DP-2000 series as the **DENON** Quartz series.

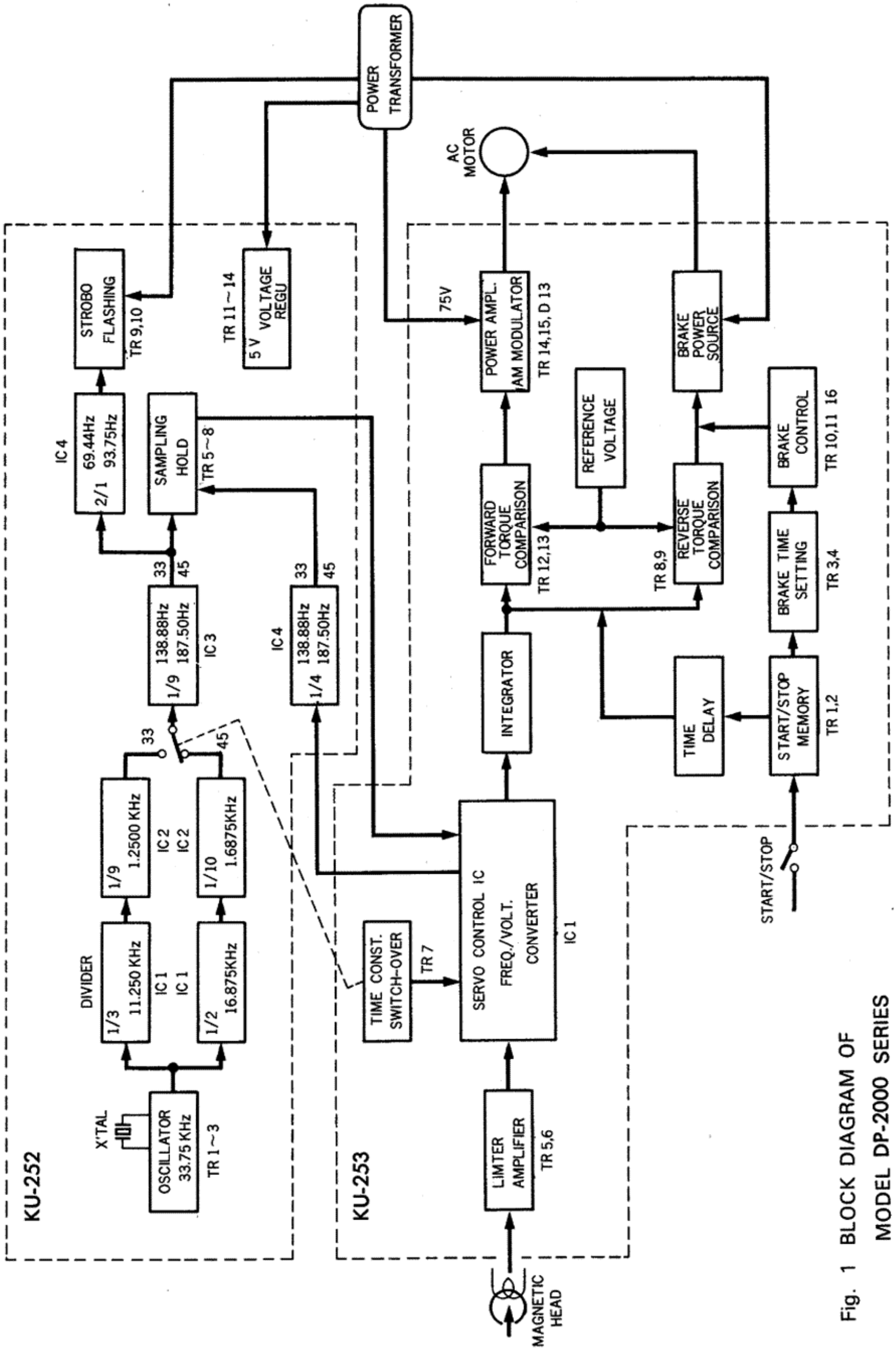


Fig. 1 BLOCK DIAGRAM OF MODEL DP-2000 SERIES

Block Diagram

The block diagram of the DP-2000 is as shown in Fig. 1.
The DP-2000 is not equipped with variable speed system but only with quartz lock system. The circuits of quartz oscillation, frequency divider, sampling hold and storobo-flash are same as that of the DP-6000. Start/Stop circuit, brake control circuit and motor driving system are noticeably different from that of the DP-6000 type. The motor driving system controls the motor by means of modulating the amplitude of commercial power source 75V (AC) in the same way as DP-3000.
This manual explains mainly the function of newly modified circuit for each block.

Frequency Dividing Circuit

Fig. 2 shows the block of the frequency dividing circuit of the DP-2000. The frequency of oscillation by quartz is 33.75 KHz, and it is divided to 1/3, 1/9 and 1/9 when the table turns at rotation speed of 33 r.p.m. The frequency, demultiplied to 138.8 Hz., is added to the sampling hold circuit. In case of the rotation speed of 45 r.p.m., the frequency is divided to 1/2, 1/10 and 1/9, and the frequency is demultiplied to 187.5 Hz—In addition, as frequency for storobo-flash, these frequencies are further divided to 1/2, and they are 69.44 Hz and 93.75 Hz for 33 r.p.m. and 45 r.p.m., respectively.

Sampling Hold

Fig. 3 illustrates a sampling hold circuit in which any difference of phases between the signal from the crystal oscillator and that from the detector head is detected and converted into voltage variation. After amplified by the head amplifier, the signal from the detector head is transmitted to Servo IC (SO275 or TCA955), while the output from this IC (PIN_4) is, after wave-from shaping by means of TR_4, transmitted to the sampling hold circuit through the divided-by-8 counter (IC_4 on KU-252). The signal transmitted to the sampling hold circuit is differentiated to create a narrow pulse in the collector of TR_5 and then a saw tooth wave is created by R_{17}, C_8 integral circuit as shown in TP_{27}.

Meanwhile, the signal from crystal oscillator is differentiated by R_{16}, C_9 differential circuit and fed to TR_7 to form a pulse as shown in TP_{28}.
The pulse and saw tooth wave are perfectly synchronous when they are in a normal cycle, and, consequently the charging voltage at C_{10} is constant, However, any variation in cycle will, as indicated in Fig. 4, lead to the fluctuation of the C_{10} charging voltage. The voltage serves as output through TR_8. The objective of the TR_8 is to form an emitter follower to lessen the load influence while increasing the C_{10} discharging constant by raising the input impedance seen from TR_6.
The performance of sampling hold circuit is illustrated as follows:
Fig. 4 illustrates the performance of sampling hold circuit where TR_6 base opens and closes the gate with accurate cycle given from the crystal oscillator. If, therefore, the saw tooth wave cycle accords with the gate cycle, C_{10} will be charged by C_8 with constant voltage. Since the discharge constant by TR_8 is large, C_{10} maintains a constant DC level.
When the revolution rate increases, the interval of saw tooth wave cycle becomes short. As indicated in the figure, the high potential charged in C_{10} will be charged back to C_8 with the result that the charged voltage of C_{10} is lowered in step. When the revolution rate decreases, vice versa, charging voltage of C_{10} will increase.

The frequency from the detection head is 555Hz or 750Hz respectively for 33 r.p.m. or 45 r.p.m. This signal is divided by the 1/4 frequency divider circuit to 138.8 Hz or 187.5 Hz, corresponding perfectly to the frequency from the quartz oscillator.

In Fig. 2, IC 1 and IC 2 are shown as separate lines corresponding, respectively, to 33r.p.m. and 45r.p.m., but in practice, by use of 33/45 change-over switch, the level of the pin (2) is changed and the dividing rate is changed. IC 1 functions in order that the frequency dividing ratio is 1/2 when the level of the pin (2) is L-level, and 1/3 when H-level. IC 2 works so that the frequency dividing ratio is 1/10 when the level of the pin (2) becomes L-level, and 1/9 when H-level.

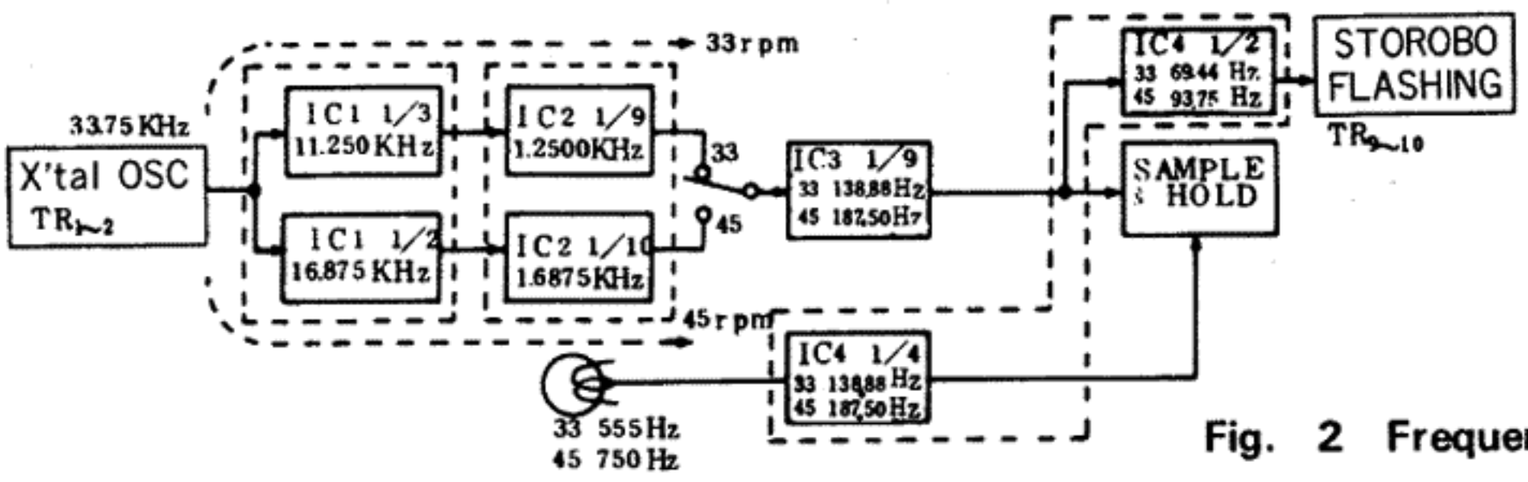


Fig. 2 Frequency dividing circuit

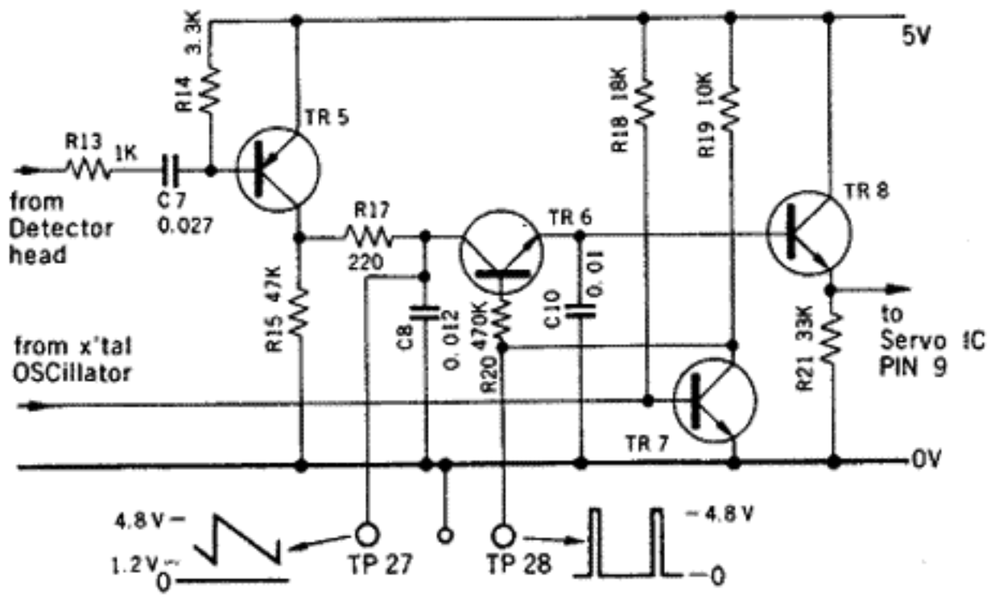


Fig. 3 Phase comparison

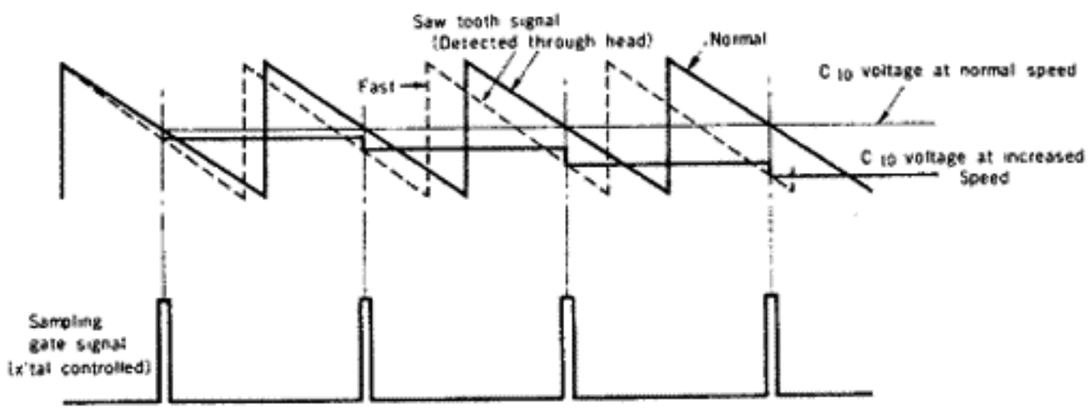


Fig. 4 Sampling hold wave form

Play/Stop Memory Circuit

Fig. 5 shows the play/stop Memory circuit equipped with bi-stable multi-vibrator. This circuit permits to control both play and stop by use of only one push button, consequently the operation is very simple. The switch is closed only when the button is being pushed.

Concerning the action of this circuit, when the power source switch is closed, at the same time the base current of TR_2 flows through R_4, D_2 and C_1, and TR_1 is preferentially switched "ON". Further, by the action of TR_2, a high voltage is added to the base of TR_1 and TR_1 is off. When the power source is switched on, also the base current of TR_1 intends to draw current through R_6 and R_9, but TR_3 is closed ahead (When the power source is switched on) by the action of C_1 connected to the base-side of TR_2. When TR_2 is closed, each circuit is under situation "STOP" ("Stand-by"). In addition, concerning the charging voltage of C_2 and C_3 under condition that TR_2 is closed, the voltage across C_3 is derived from the collector voltage of TR_2 through R_7, while the voltage across C_2 is obtained by dividing the base voltage of TR_2 by R_2, R_3 and R_4. Consequently, the charging voltage of C_3 is higher to that of C_2. When Play/Stop button is pushed under this situation, TR_1 and TR_2 are once opened (OFF) because the base voltages of TR_1 and TR_2 correspond to addition of charged voltages of C_2 or C_3 to B voltage, but C_2 side (TR_1), of which charged voltage was lower, lets the base current flow, since the charged voltage of capacitor is discharged through D_3 and D_4. Further, by the flow of base current of TR_1, its collector voltage increases the base potential of TR_2 and TR_2 is opened (OFF).

When TR_2 is opened (OFF), the charged voltage of C_2 side is higher than that of C_3 side. If Play/Stop button is pushed under this condition, TR_2 is closed (ON).

C_1 and D_2 let the base current of TR_2 flow when the power source is switched on, and they are the necessary parts to switch on TR_2 first. However, the voltage is charged on C_1 side also through R_1, the charged voltage of C_1 gets, more and more as time passes, equal to the +B voltage. Consequently, D_2 becomes reverse biased, and it is not necessary to take into account the parts depending upon D_2, D_1, R_1 and C_1, during the active time of D_2. D_1 is necessary to discharge the voltage of C_1 when the power source is switched off.

Brake Time Setting Circuit

When the "STOP" button is pushed while playing, the electric brake circuit works to stop the turn-table in a short time and smoothly, and functions so as to release the brake after stop.

The brake time setting circuit is a circuit to set the time after the "STOP" button is pushed until the brake is released. The input signal supplied to this circuit is transferred from Start/Stop Memory Circuit, the collector of TR_2. The collector voltage of TR_2 is 0.6 V at the moment of "Play" and 4.9 V at the moment of "STOP". While playing, TR_3 is opened (OFF) and TR_4 is closed (ON). Consequently, C_5 is charged by a voltage of about 5 V with the polarity shown in Fig. 6. When operating "STOP" button under this condition, the base potential of TR_3 is increased, and the charging voltage of C_5 becomes a reverse bias because TR_3 is closed (ON), and, thus, TR_4 is opened (OFF). Further, at this moment, the voltage is drawn to the collector of TR_4 through R_{14} by the action of START/STOP Memory circuit, consequently, a voltage of about 5 V is given to the collector of TR_4. In addition, this voltage is given to the base of TR_3 through R_{15}, and, as a result, TR_3 is kept switched on.

C_5 is charged through R_{13}, consequently the base potential of TR_4 increases in time and TR_4 is opend (OFF) after set time. In other words, after operating the "STOP" button, the collector of TR_4 is H level only during the set time of time constant by C_5 and R_{13}, and during this time this circuit functions as brake.

In practice, the collector voltage of TR_4 is fed to the brake circuit after being delayed by the integration circuit composed of R_{16} and R_{27}. This is for

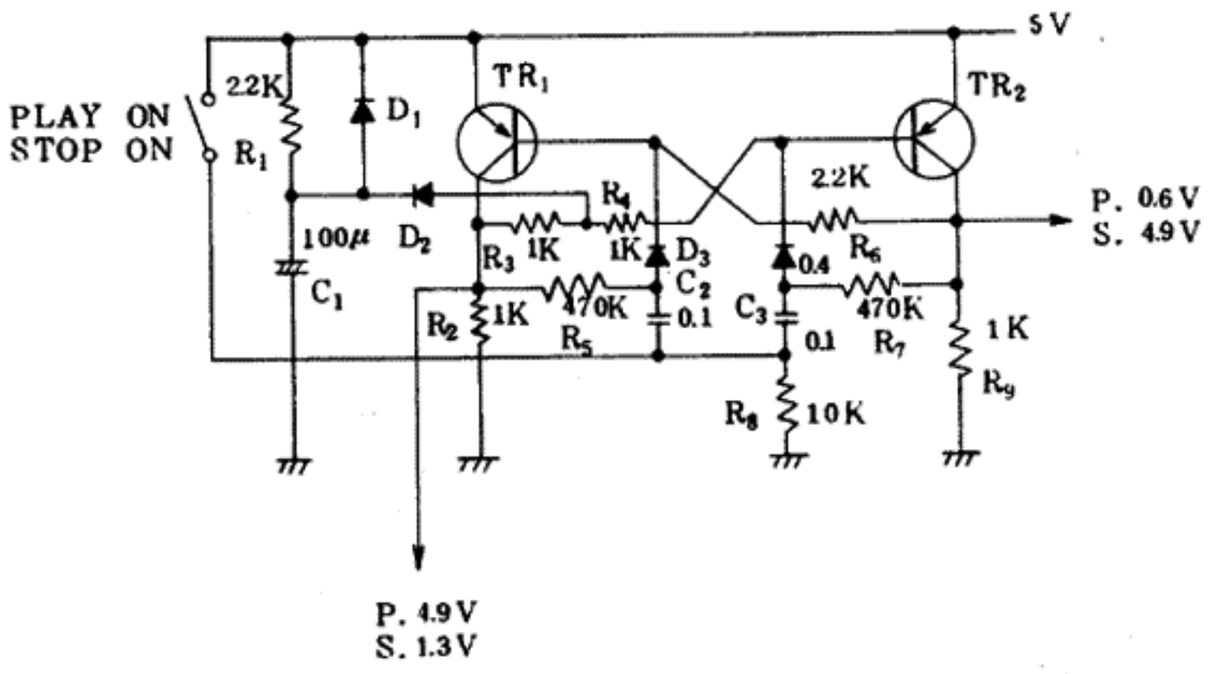


Fig. 5 PLAY · STOP Memory circuit

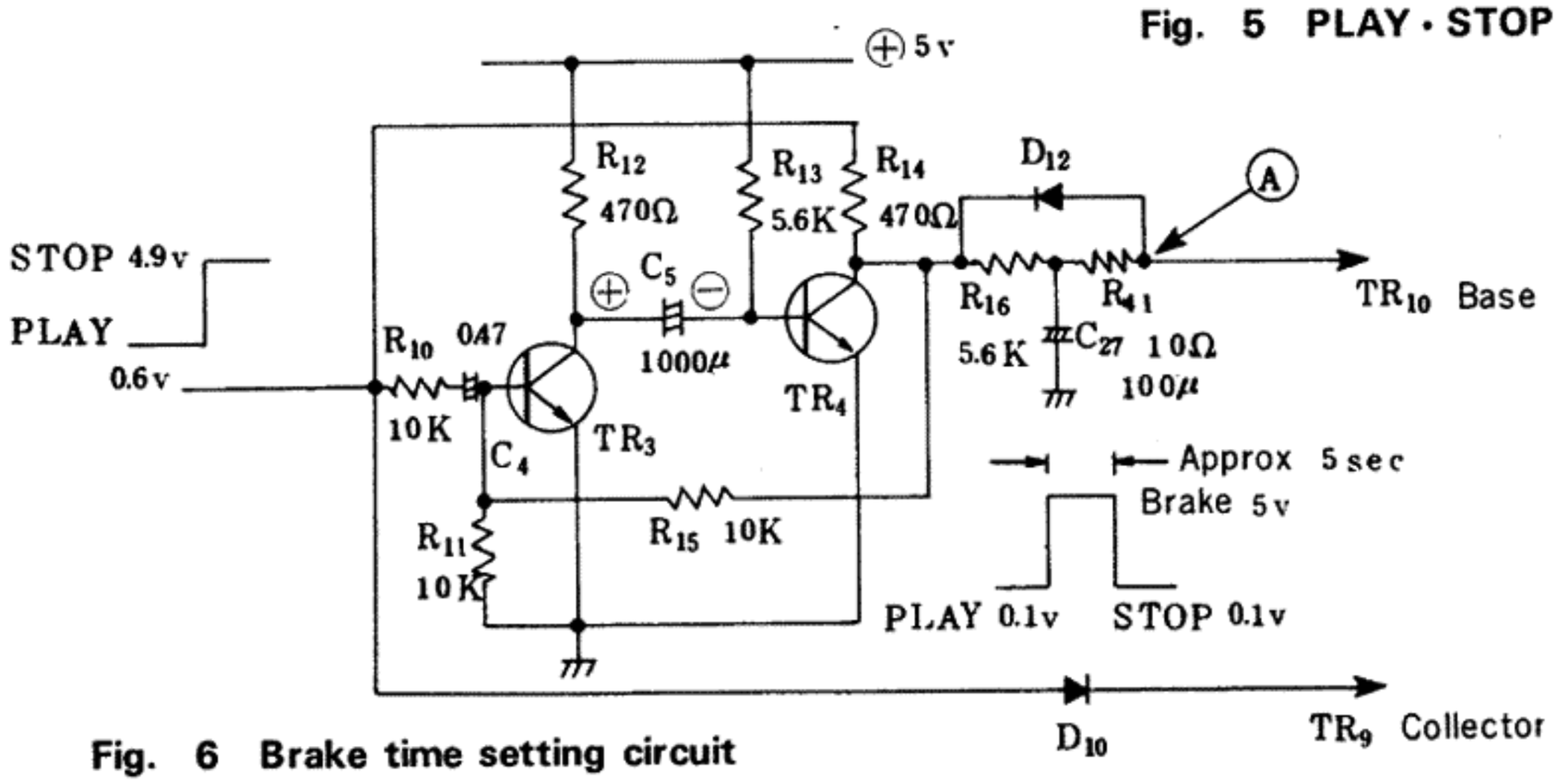


Fig. 6 Brake time setting circuit

the purpose of arranging the timing to flow the brake current after degeneration of the driving current which flows in the motor at the moment when "STOP" button is pushed.
When "Start" button is operated while the brake time setting circuit is active (while braking), the collector voltage of TR_4 is L level and the current passes through D_{12}. As result, the braking action is released in a short time.

Motor Driving System

As shown in Fig. 7, AC 75 V is used as power source for driving motor, and the regulated voltage power source via TR_{17}~$_{16}$ is supplied as power source for brake.
The driving current flows: AC-75 V→D_{13}→TR_{15}→R_{56} →D_{13}-(M)→AC-75 V. The brake current flows: Battery (TR_{17-19})→(M)→TR_{16}→D_{16}→battery.
While the driving current is applied, the brake current is cut-off, and TR_{15} must be "OFF" during brake action.
D_{14} and D_{15} exist in the route of base current of TR_{15} and TR_{16}, and are necessary to prevent the short-cut by the driving current or brake current. Therefore, it is necessary to take care enough not to short-circuit the D_{14}, D_{15} and D_{16}, when servicing.
In case the moter does not rotate, the various inspections should be performed after releasing the brake circuit.
Method for releasing the brake: Remove D_{16} and then disengage the closed loop by the Regulated voltage power source. This procedure permits a sufficient release of the brake. Confirm if the motor turns when short-cutting between (a) and (b) after this procedure. If the motor does not turn, it is necessary to check the condition or situation of motor and the wiring of the phase advance capacitor, connector, etc. If the motor rotates, make a short-circuit between emitter of TR_{15} and collector. If the motor turns under this condition, the diode D_{13} is normal, and the situation of power transistor or the situation of servo system amplifier can be considered as cause of trouble, and should be checked.
If the constant-voltage power source for brake is 27 V and the other constant-voltage circuit is not good, the stop-time will be prolonged or the noise of motor incaease during bake action. The increase of motor's noise is due to flow of ripple current in the winding of motor.

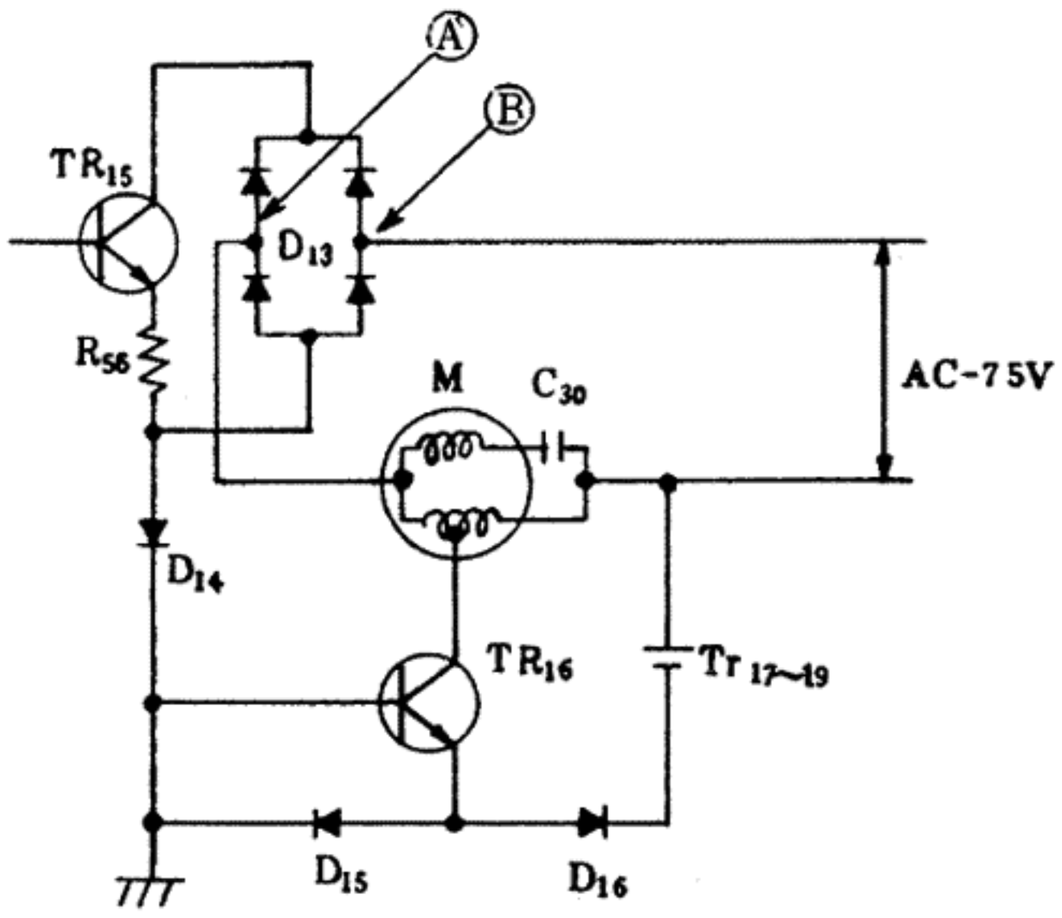


Fig. 7 Motor driving circuit

Comparison Circuit and Brake Control Circuit

Fig. 8 shows the comparison circuit and brake control circuit of the DP-2000.
As to the reference voltage, B voltage is divided by TR_{20}, D_{20}, R_{50}, R_{51} and R_{52}, and a voltage of 2.1 V and a voltage of 1.8 V are fed to the base of R_{13} and the base of TR_9, respectively.
IC output for servo system decreases its voltage in reverse proportion with the rotation speed (point (a)), and its voltage is decreased to about 2.1 V when the rotation reaches the regulated speed.
Consequently, the relationship between voltage and rotation speed, as shown in Fig. 9, is obtained.
Uuder condition shown in Fig. 9, TR_{12} and TR_{14} continue to be conductive until the rotation reaches the regulated speed after operating "START" button,

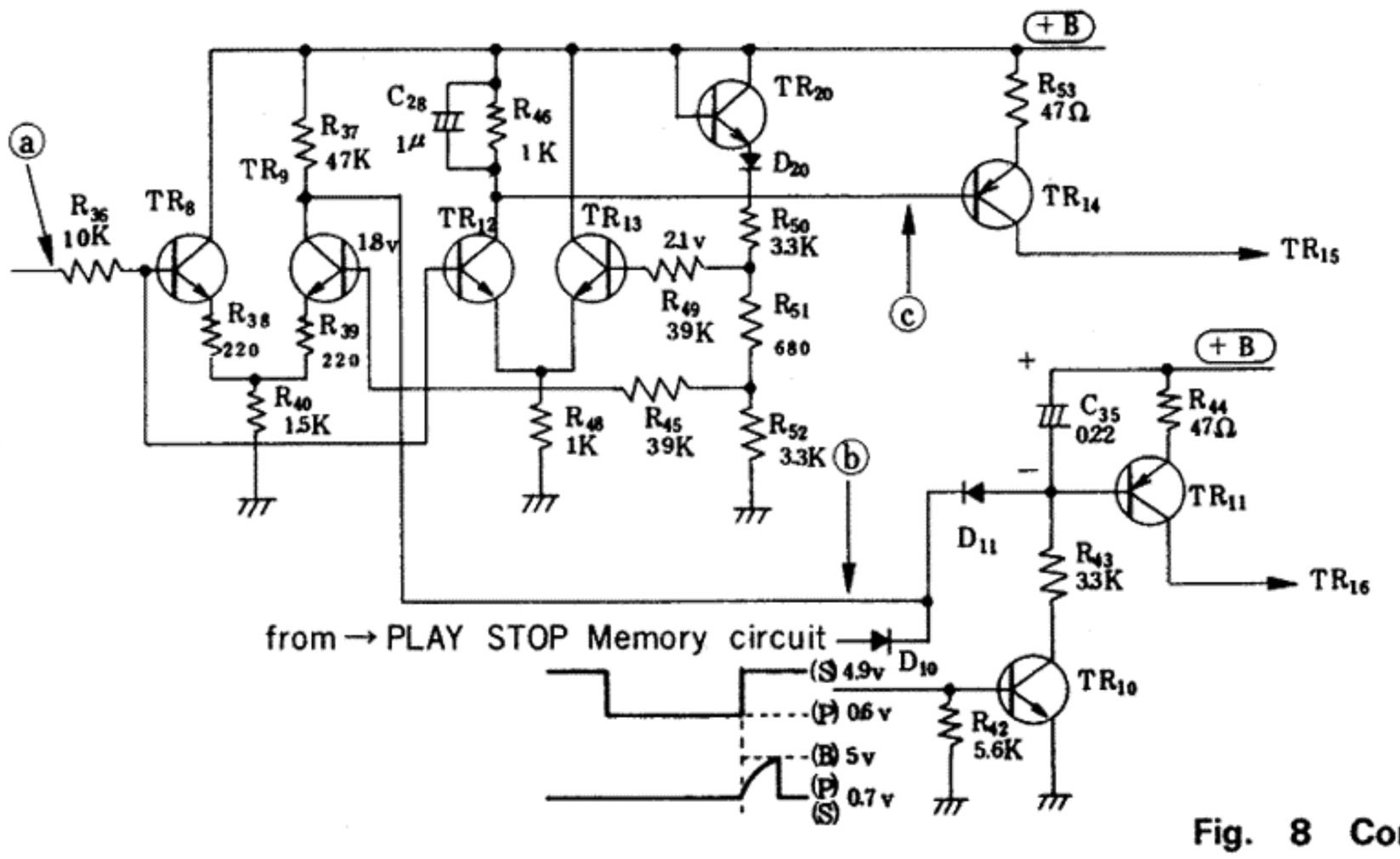


Fig. 8 Comparison circuit and brake control circuit

and the output resistances of both transistors are reduced.
Consequently, the torque for normal-direction is given to the motor. However, when the rotation speed becomes exceeding the specified speed, TR_9 and TR_{12} are opened (OFF) and the driving current is cut-off and the brake circuit does not work either (while IC output voltage is between 2.1 and 1.8 V). If the platter rotation increases or IC output voltage becomes below 1.8 V by certain causes, the collector voltage of TR_9 decreases as shown by (b) in Fig. 9, and D_{11} is closed (ON), then the brake can work.
TR_{10} and TR_{11} are the transistors for brake control. When the current can flow through TR_{11}, the brake section can be obtained. Therefore, if either D_{11} or TR_{10} is "ON", that is enough to obtain the brake function.
Because the voltage of 4.9 V for STOP or 0.6 V for PLAY is given to the anode side of D_{10} from PLAY/STOP circuit, as shown in Fig. 8, D_{10} lets the current pass and the collector voltage of TR_9 is kept at H level even when TR_9 in differential amplifier is closed (ON).
Consequently, even under condition that START/STOP memory circuit keeps the memory of "STOP", D_{11} will never be closed ("ON"). In practice, the brake action is sometimes required even when this circuit keeps the memory "STOP", i.e., when it is necessary to stop the turntable smoothly in a short time at the moment of STOP button operation. In such a case, since D_{11} is "OFF", the circuit works to make TR_{10} take the brake action.
As shown in Fig. 8, the brake time setting circuit works when the anode voltage of D_{10} rises, and this voltage is added to the base of TR_{10}. Consequently, the brake works only during astable period of brake time setting circuit.
If the current is cut-off suddenly at the moment of release of brake, the reverse pulse is generated in the motor. Therefore, the appearance of reverse pulse is prevented not by cutting off the current by TR_{10} that is "OFF", but by connecting C_{35} to the base of TR_{11} and reducing the brake current by means of discharging action of C_{35}.
Thus, in the system of the DP-2000 the appearance of reverse pulse is prevented, consequently there is no reverse pulse absorption circuit,

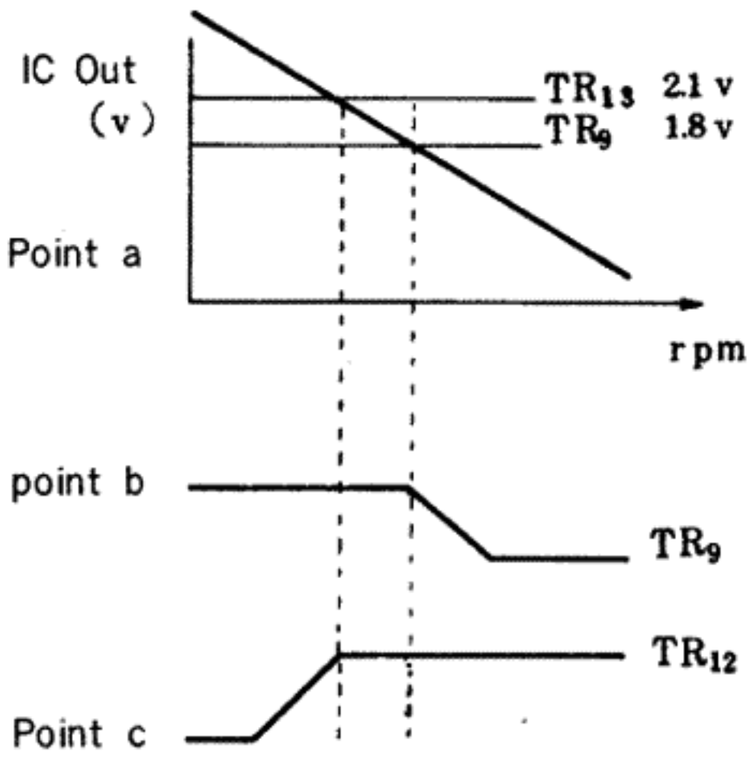


Fig. 9 Voltage reference

33/45 Time Constant Change-Over

The rotation speed of the DP-2000 is changed by changing the resistance value between the pin (11) and (5) of IC for servo with ON/OFF operation of TR_7. As shown in Fig. 10, this circuit is equipped only with a system for change-over of absolute speed but not equipped with fine-adjustment (variable) system. TR_7 is used with the reverse connection, and the base current flows as indicated by the dotted line in Fig. 10.
Method of adjustment: As same as the DP-6000, adjust first of all the rotation of 45 r.p.m., then adjust the rotation of 33 r.p.m.

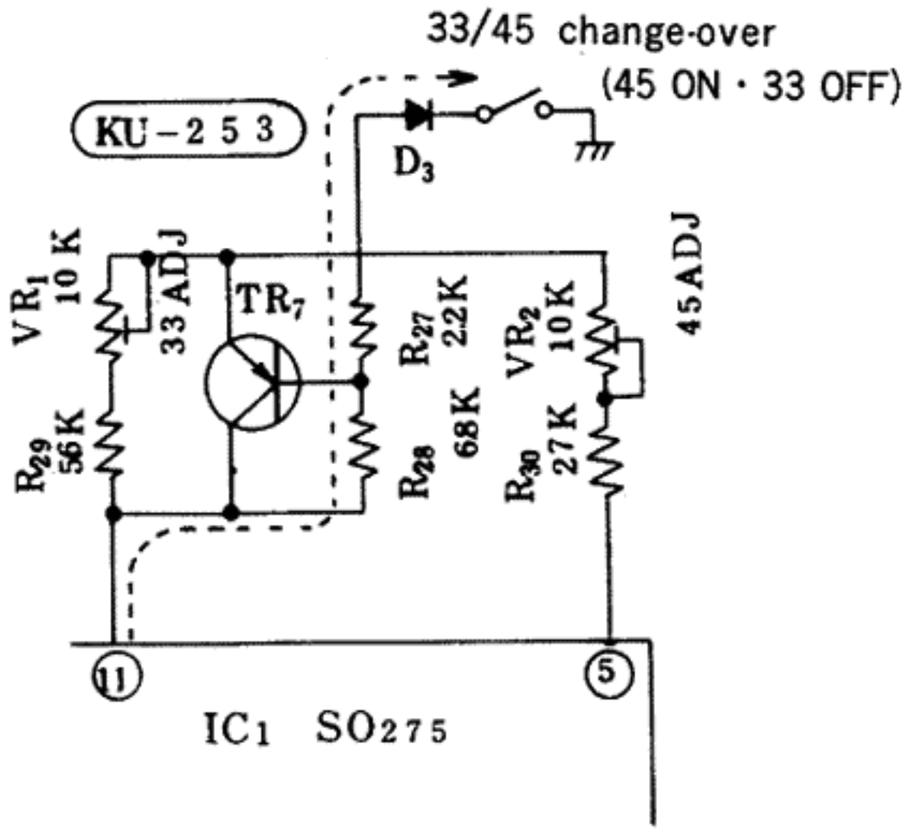


Fig. 10 Time constant change-over

When adjusting this VR, the saw-tooth wave form (TR_6, collector or TP_{27}) from the sampling hold circuit (Board KU-252) is added to the horizontal axis of oscilloscope, and the pulse from quartz oscillation circuit (TR_7 collector or TP_{28} on KU-252), to the vertical axis). As a result, the waveform shown in Fig. 11 is observed. And the VR should be adjusted so that the length A will be equal to the length B. (If the input impedance of oscilloscope is small at the moment of connecting the oscilloscope to the collector of TR_6, the measuring error is provoked. It is necessary to take care to avoid such an error).

Head Amplifier Circuit and Pulse Shaping Circuit

Fig. 12 shows the head amplifier of DP-2000, which is composed of 2 transistors.
It can be considered as same as general amplifier, but the difference is that D_5 and D_6 are used in the feedback circuit, and that when the collector voltage of TR_6 increases over a certain value, it permits the feedback voltage to pass through the diode giving change of the feedback quantity and control the gain of amplifier.
When D_5 and D_6 are "OFF", the degree of amplification is decided by the potential proportion between R_{20} and R_{21}.
Consequently, when the amplitude of input signal is small, the amplification is about 53 dB under condition that D_5 and D_6 are "OFF", but with increase of amplitude of input signal the feedback quantity

reaches 100% and the amplication degree coresponds to 1 under condition that both D_5 and D_6 are "ON". Thus, the use of diodes in feedback circuit permits to produce the limiter function and, at the same time, to amplify because it has a certain gain. Further, it is the advantage of use of diodes to obtain the well-balanced limiter effect for both positive and negative cycles.

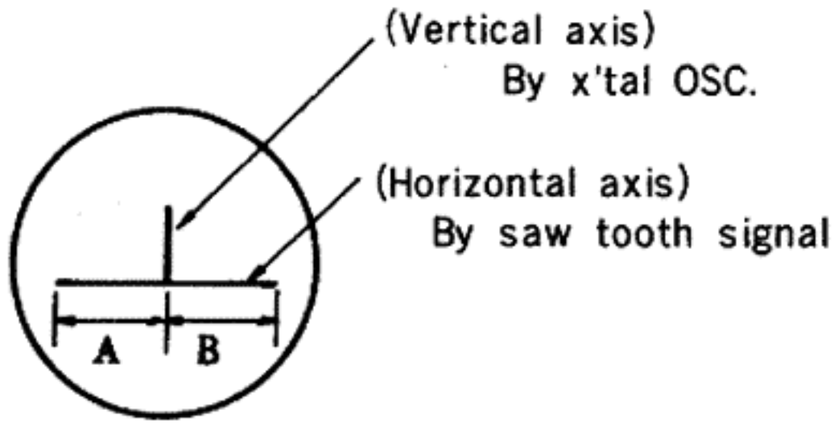


Fig. 11 Adjustment

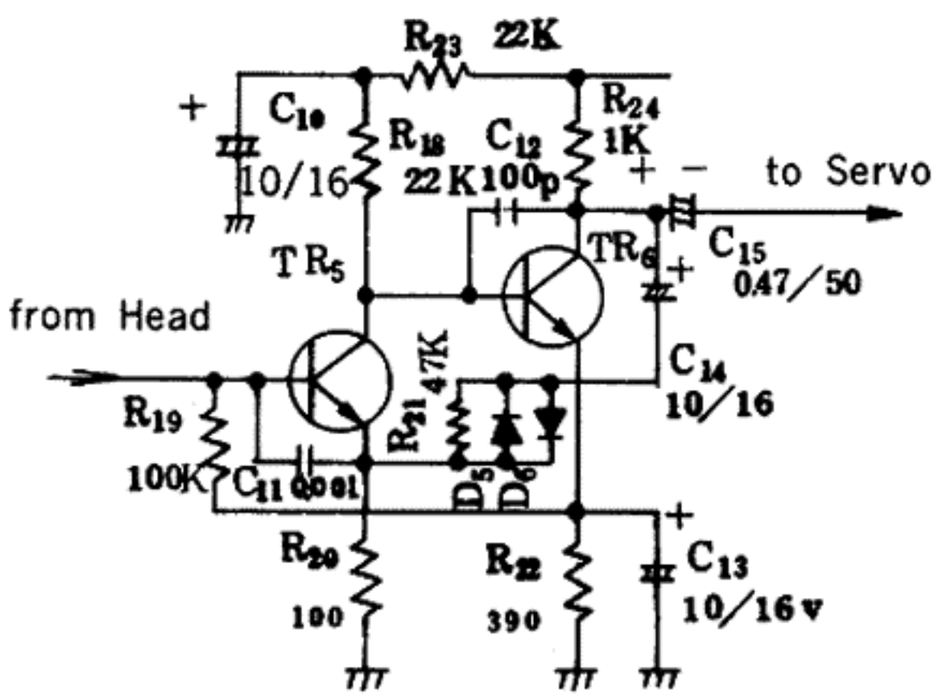


Fig. 12 Head amplifire and pulse shaping circuit

Delay Circuit

If the driving current of motor is suddenly applied or cut off at the moment of START or STOP, the abnormal noise is produced in the motor. To prevent such an abnormal noise, the sudden change of output voltage of IC at the moment of change-over must be avoided by giving the time delay to the output circuit of IC.

Fig. 13. shows the circuit used for this purpose. In case of STOP, the level at point (a) is low and D_9 and D_8 let the current pass, and, as a result, IC output is divided by R_{34}, R_{35} and R_{33}. So, even when the IC output is maximum while the turntable is stopped, the voltage at point (c) remains low.

Consequently, the comparison circuit functions to cut off the driving current.

When the START button is operated, the voltage of point (a) rises soon, but the voltage of point (c) rises as C_{23} is charged. Consequently, the driving current of motor is never impressed suddenly and it rises smoothly. At the regulated rotation, the charged voltage at point (a) is higher than the voltage at point (c), so D_9 works as reverse bias.

By operation of STOP button, the voltage at point (a) drops soon, but the voltage at point (c) decreases with discharge from C_{23}. Consequently, the driving current is never cut off suddenly, and this circuit permits the performance of the following brake action.

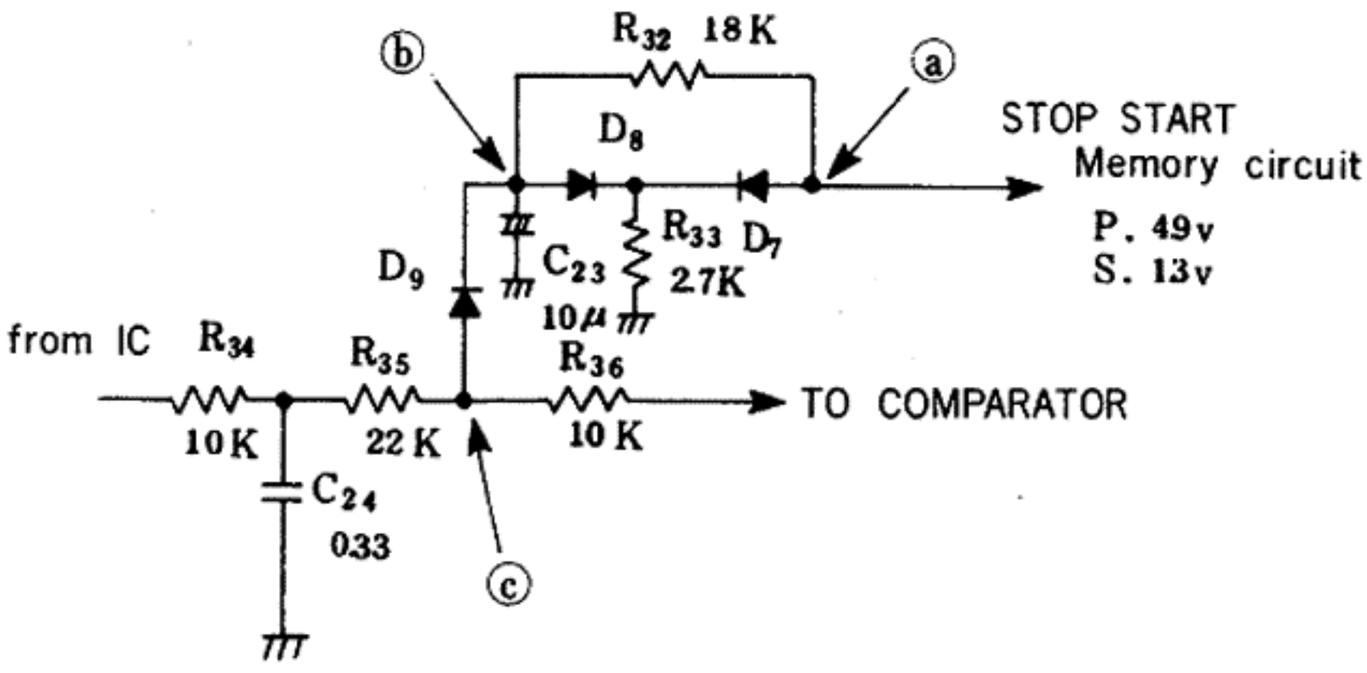


Fig. 13 Delay circuit

PARTS LIST FOR MODEL DP-2000 SERIES

D-2500, D-2500A

Part No.	Part Name	Remark
1018050300	CABINET ASS. (DP-2500)	Europian Model
1018073002	CABINET ASS. (DP-2500)	American Model, Walnut grain
1018073015	CABINET ASS. (DP-2500A)	American Model, Ash grain
1468022412	DUST COVER	
1048006104	INSULATOR LEG ASS.	
FPU-900	TONE ARM UNIT	
3158033007	ARM LIFTER ASS.	
FPU-0376N	HEAD SHELL ASS.	
FPU0431H	SHELL ACCESSORY ASS.	
FMD0469J	STAND SHEET	} TONE ARM CUSHION
FMD070H	RUBBER WASHER	
2039601106	OUTPUT CORD	
FMD0541H	45 ADAPTER	
4218079007	RUBBER SHEET	Europian Model
4218093009	RUBBER MAT	UL recognized (USA, CANADA)

DP-2550, DP-2550A (American Model)

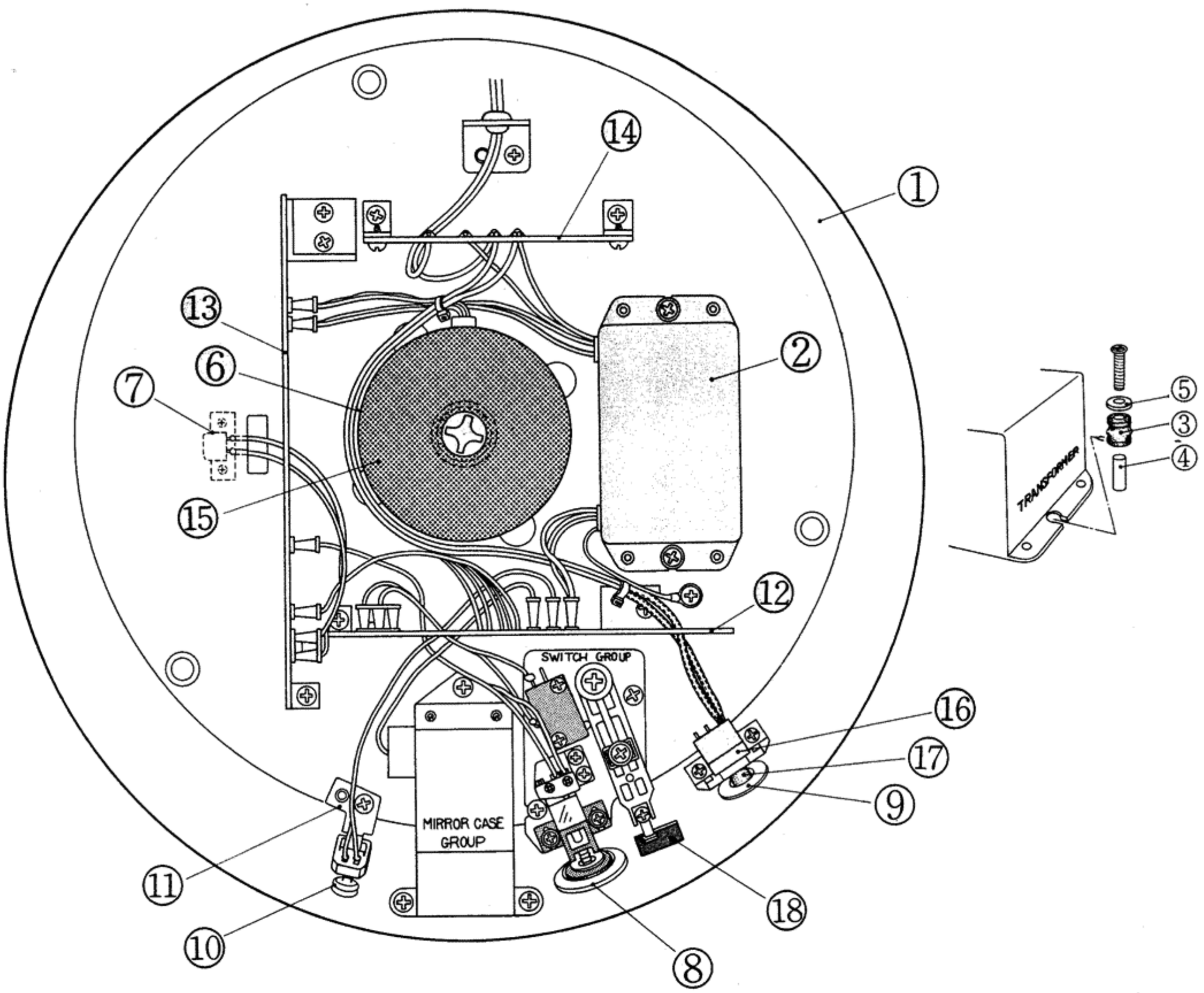
Part No.	Part Name	Remark
1018079006	CABINET ASS.	Walnut grain
1018079019	CABINET ASS.	Ash grain
1018077008	ARM BOARD	Walnut grain
1018077011	ARM BOARD	Ash grain
FWA0061	WASHER	Arm board fixing
FMD0526J	DUST COVER ASS.	
1048006104	INSULATOR LEG. ASS.	
FMD0541H	45 ADAPTER	
4218093009	RUBBER MAT	UL recognized (USA, CANADA)

DP-2800 (American Model)

Part No.	Part Name	Remark
1018066200	CABINET ASS.	
1018068004	MARBLE PLATE	
1468022425	DUST COVER	
1048006104	INUSLATOR LEG.	

Note: Europian Model includes Australian and Asian Models as well.
Amerian Model includes USA and Canadian Models only.

MOTOR BOARD GROUP

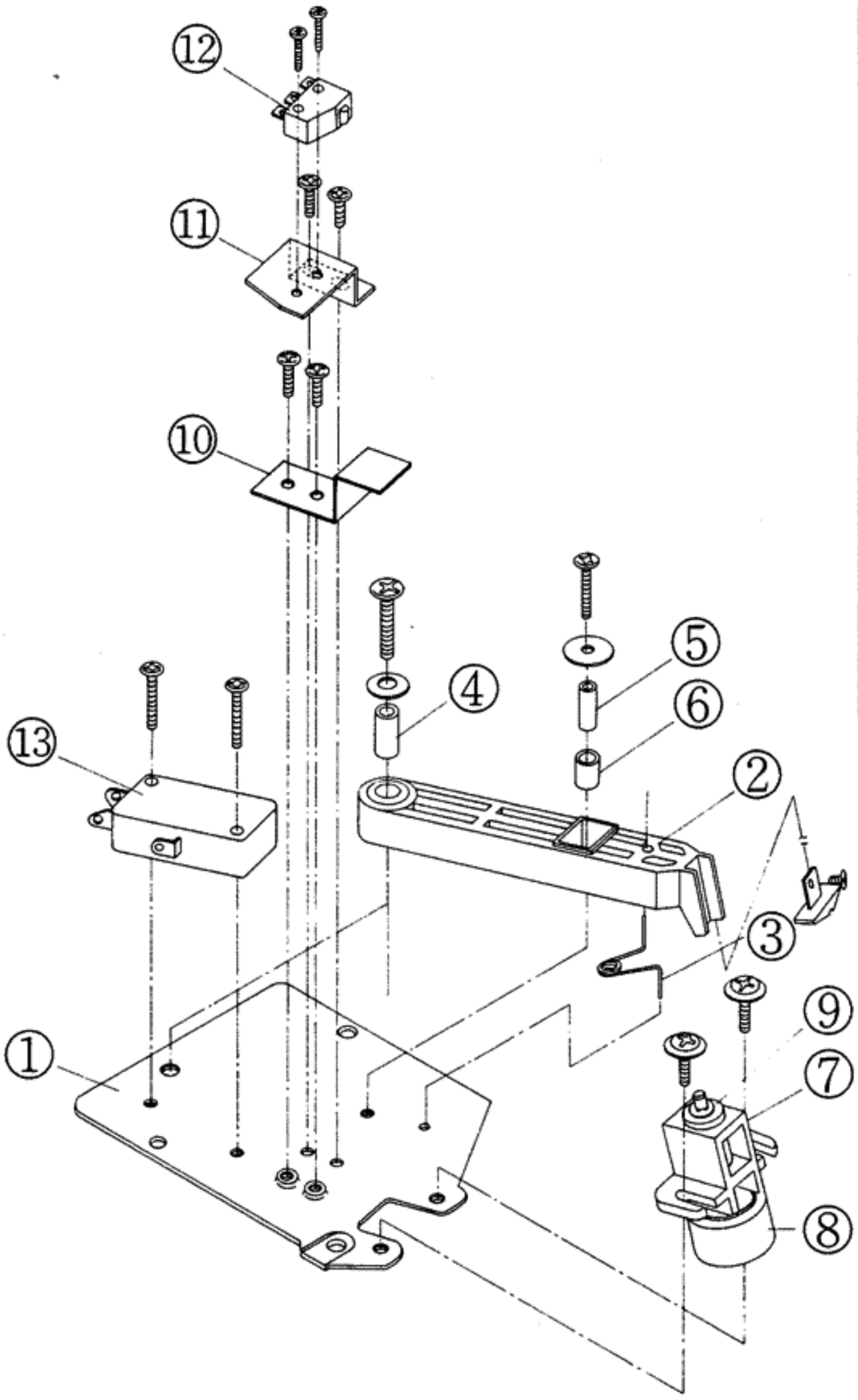


Ref. No.	Part No.	Part Name	Remark
1	4468013101	MOTOR BOARD	
	4148014404	BOARD COVER	
2	2339008001	POWER TRANSFORMER	120V
2	2339009000	POWER TRANSFORMER	200—240V
3	1298004008	CUSHION RUBBER	for TRANSFORMER
4	4438057100	SPACER	
5	FWA0078	WASHER	
6	2178014201	SERVO MOTOR	
7	3918423006	MAGNETIC HEAD ASS.	
8	1148004103	KNOB PROTECTOR (A)	START/STOP
9	1148005005	KNOB PROTECTOR (B)	POWER
10	3998008001	LED ASS.	
11	4418121409	SOCKET HOLDER	
12	KU-252	PHASE LOCK AMP UNIT	
13	KU-253	SERVO AMP UNIT	

Ref. No.	Part No.	Part Name	Remark
14	PS-136	POWER SUPPLY UNIT	120V
14	PS-137	POWER SUPPLY UNIT	200—240V
15	4618042003	PAD	UL recognized
15	4618031001	PAD	
16	2129039002	PUSH SWITCH	120V POWER
16	2124049055	PUSH SWITCH	240V POWER
17	1138033207	KNOB	POWER
18	4418122000	POWER SW SUPPORT	
19	1138032208	KNOB	45—33
	4218074109	RECORDED TURNTABLE	PLATTER
	1468033100	STROBO WINDOW	
	4148013007	BLIND	
	4148019001	SHIELD PLATE	

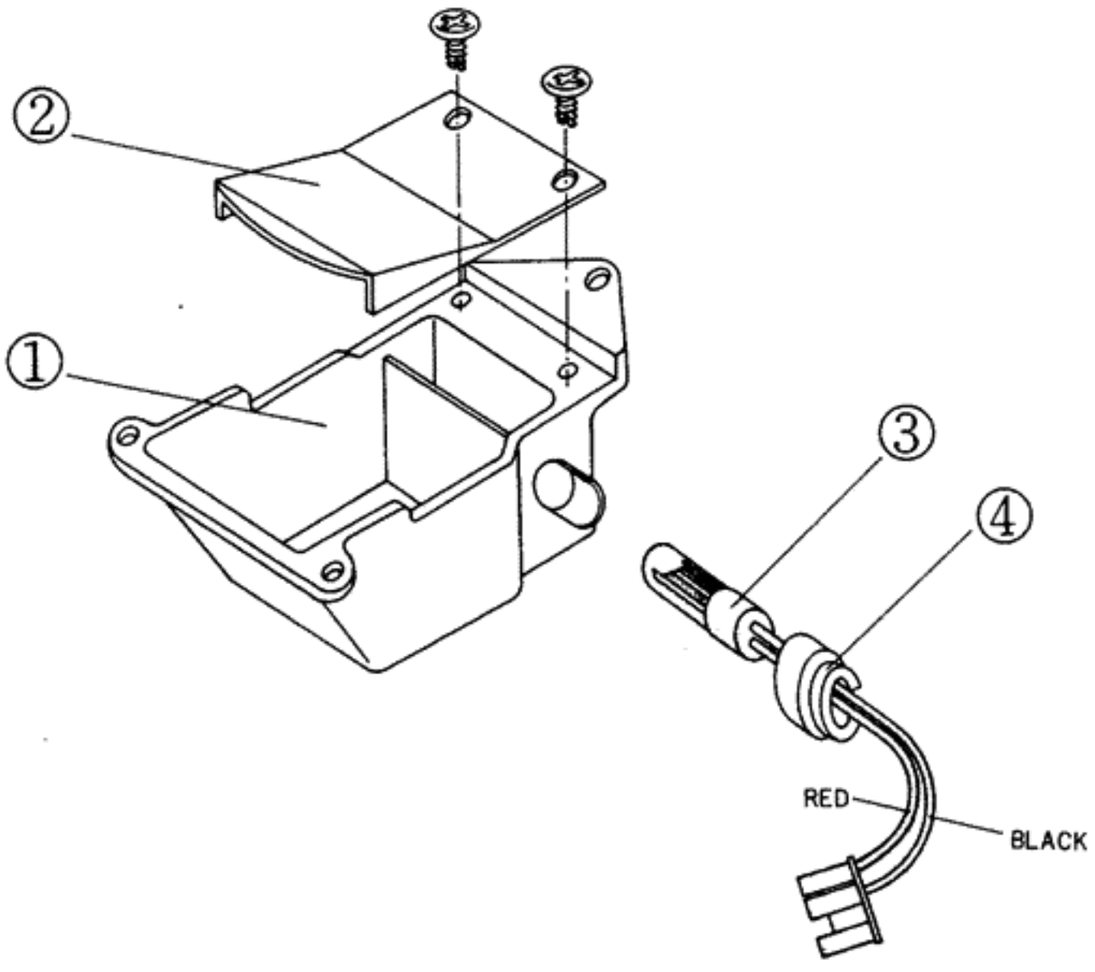
WARNING: THOSE PARTS WITH SHADING HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY.

SWITCH GROUP



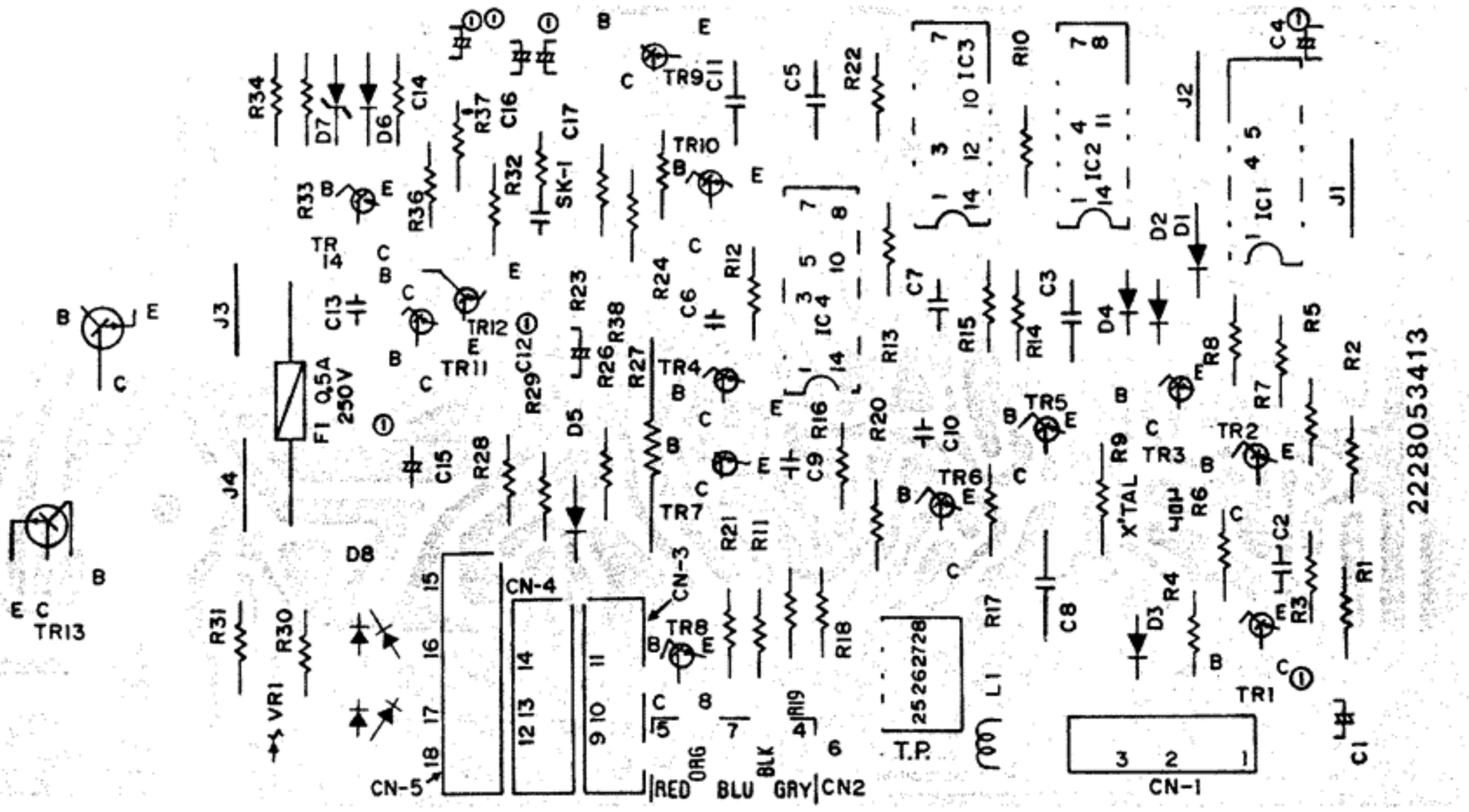
Ref. No.	Part No.	Part Name	Remark
1	4498013003	SWITCH PLATE	
2	4338065001	SWITCH LEVER	
3	4638058103	TWIST SPRING	
4	FTS0690H	COLLAR (A)	
5	4438101001	COLLAR	
6	4628007009	RUBBER TUBE	
7	4318021007	COLLAR/KNOB SUPPORT	
8	1138034400	KNOB	START/STOP
9	4618030001	RUBBER WASHER	
10	4638067000	ACTUTOR	
11	4418143005	SWITCH SUPPORT	
12	2129036102	MICRO SWITCH	START/STOP
13	2129037101	MICRO SWITCH	45—33

MIRROR CASE GROUP



Ref. No.	Part No.	Part Name	Remark
1	1468035205	MIRROR CASE ASS.	
2	1468037009	ACRYL COVER	
3	3933008011	NEON LAMP WITH CONNE	
4	FMD0439	STROBO CAP	

KU-252 PHASE LOCK AMP UNIT

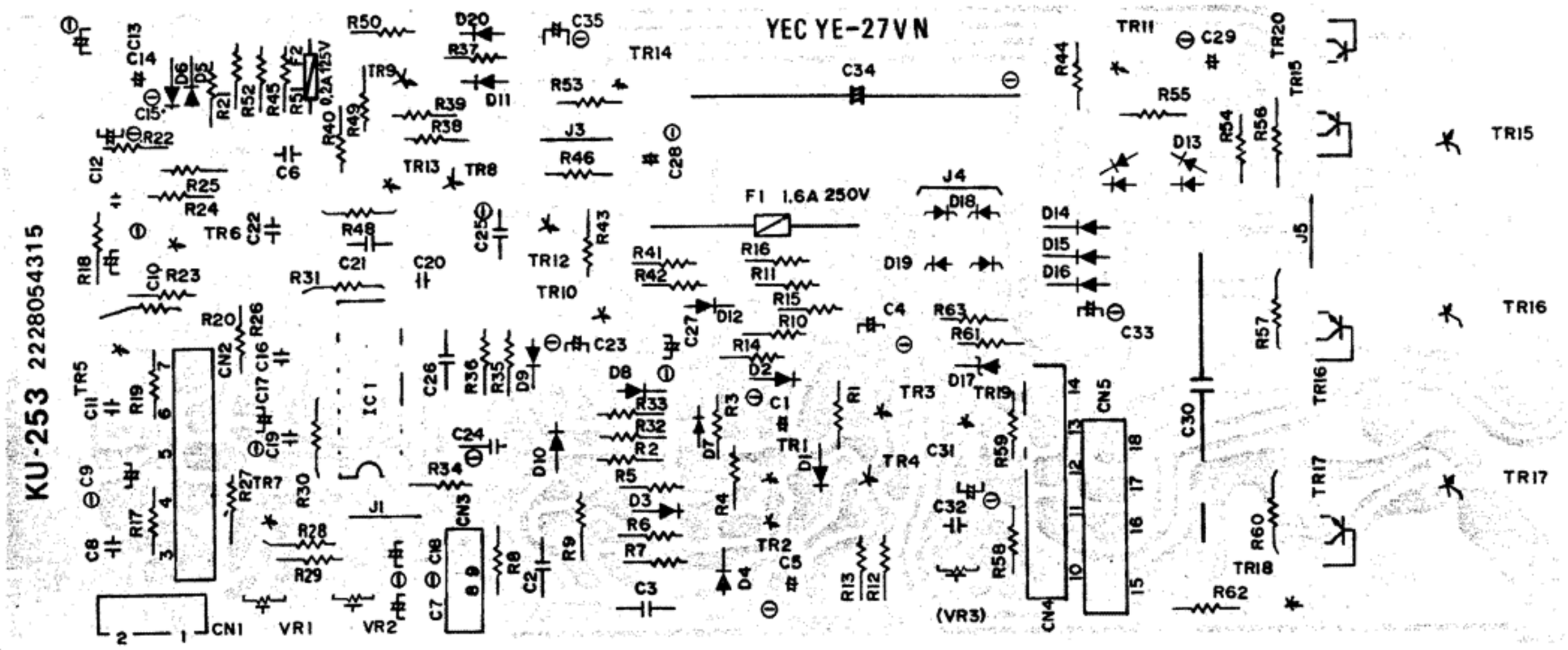


Ref. No.	Part No.	Part Name	Remark
	2228053413	P. CIRCUIT BOARD	
	4418119107	C. B. STAY	
	4178013307	HEAT SINK	
	2618003206	CRYSTAL (33, 75kHz)	
L_1	2328008106	INDUCTOR	
SK_1	FEP0429K	SPARK KILLER	
F_1	EP-7266	FUSE (0.5A)	
SEMICONDUCTORS			
$TR_{1,2}$	2710089021	2SA844(D)	or 2SA836(D)
$TR_{3,4,7,9,11,12}$	2730021043	2SC458(D)	
$TR_{5,14}$	2710040028	2SA673(C)	
$TR_{6,8}$	2730064068	2SC711(G)	
TR_{10}	2740053001	2SD669A(C)	
TR_{13}	2730083007	2SC830H(C)	
$D_{1,2,4}$	2760002003	1N60	or 1S34
$D_{3,6}$	2760049011	1S2076A	
D_5	2760057029	V06E	
D_7	2760185001	HZ4B	or RD3.9E(C) or MZ204(B) Zener
D_8	2760194005	1S2371A	Rectifier
IC_1	2620057004	HD7473P	or SN7473N
$IC_{2,3}$	2620058003	HD7490AP	or SN7490N
IC_4	2620059002	HD7493AP	or SN7593N
RESISTERS			
$R_{1,2,6}$	2410364004	RD14B2E124J	120kΩJ 1/4W
$R_{3,4,5,7}$	2410330009	RD14B2E472J	4.7kΩJ 1/4W
$R_{8,10,12,23,35,37}$	2410346006	RD14B2E223J	22kΩJ 1/4W
$R_{11,15}$	2410354001	RD14B2E473J	47kΩJ 1/4W
$R_{13,16,22,23}$	2410314009	RD14B2E102J	1kΩJ 1/4W
R_{17}	2410298002	RD14B2E221J	220ΩJ 1/4W
R_{18}	2410344008	RD14B2E183J	18kΩJ 1/4W
$R_{19,36}$	2410338001	RD14B2E103J	10kΩJ 1/4W
R_{20}	2410378003	RD14B2E474J	470kΩJ 1/4W
$R_{21,26}$	2410350005	RD14B2E333J	33kΩJ 1/4W
R_{28}	2410374007	RD14B2E334J	330kΩJ 1/4W
R_{29}	2410294006	RD14B2E151J	150ΩJ 1/4W
R_{30}	2410306004	RD14B2E471J	470ΩJ 1/4W
$R_{14,31}$	2410326000	RD14B2E332J	3.3kΩJ 1/4W
$R_{33,34}$	2410290000	RD14B2E101J	100ΩJ 1/4W
$R_{24,28}$	2410322004	RD14B2E222J	2.2kΩJ 1/4W
R_9	2410282005	RD14B2E470J	47ΩJ 1/4W
R_{27}	2440103002	RS14B3D272JNB	2.7kΩJ 1/4W Metal film
VR_1	2116003067	V10QB102	1kΩVR Preset VR
CAPACITORS			
C_1	2544044009	CE04W1H010	1μF 50V Electrolitic
$C_{4,16}$	2544009002	CE04W1A470	47μF 10V Electrolitic
C_{12}	2544073009	CE04W2E4R7=	4.7μF 250V Electrolitic
C_{14}	2544015009	CE04W1C100	10μF 16V Electrolitic
C_{15}	2544022005	CE04W1C102	1000μF 16V Electrolitic
C_{17}	2444003008	CE04W0J101	100μF 6.3V Electrolitic
C_2	2533662007	CC45SL1H271K	270μFK 50V Ceramic
$C_{3,5,11}$	2551084007	CQ93M1H104K	0.1μFK 50V Film
C_6	2551066009	CQ93M1H332K	0.0033μFK 50V Film
C_7	2551077001	CQ93M1H273K	0.027μF 50V Film
C_8	2551085006	CQ93M1H124K	0.12μFK 50V Film
C_9	2551074004	CQ93M1H153K	0.015μF 50V Film
$C_{10,13}$	2551072006	CQ93M1H103K	0.01μF 50V Film

Note : All resister are carbon film resistors unless otherswise notified.
G : ±2% J : ±5% K : ±10% M : ±20%

WARNING : THOSE PARTS WITH SHADING HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY.

KU-253 SERVO AMP UNIT



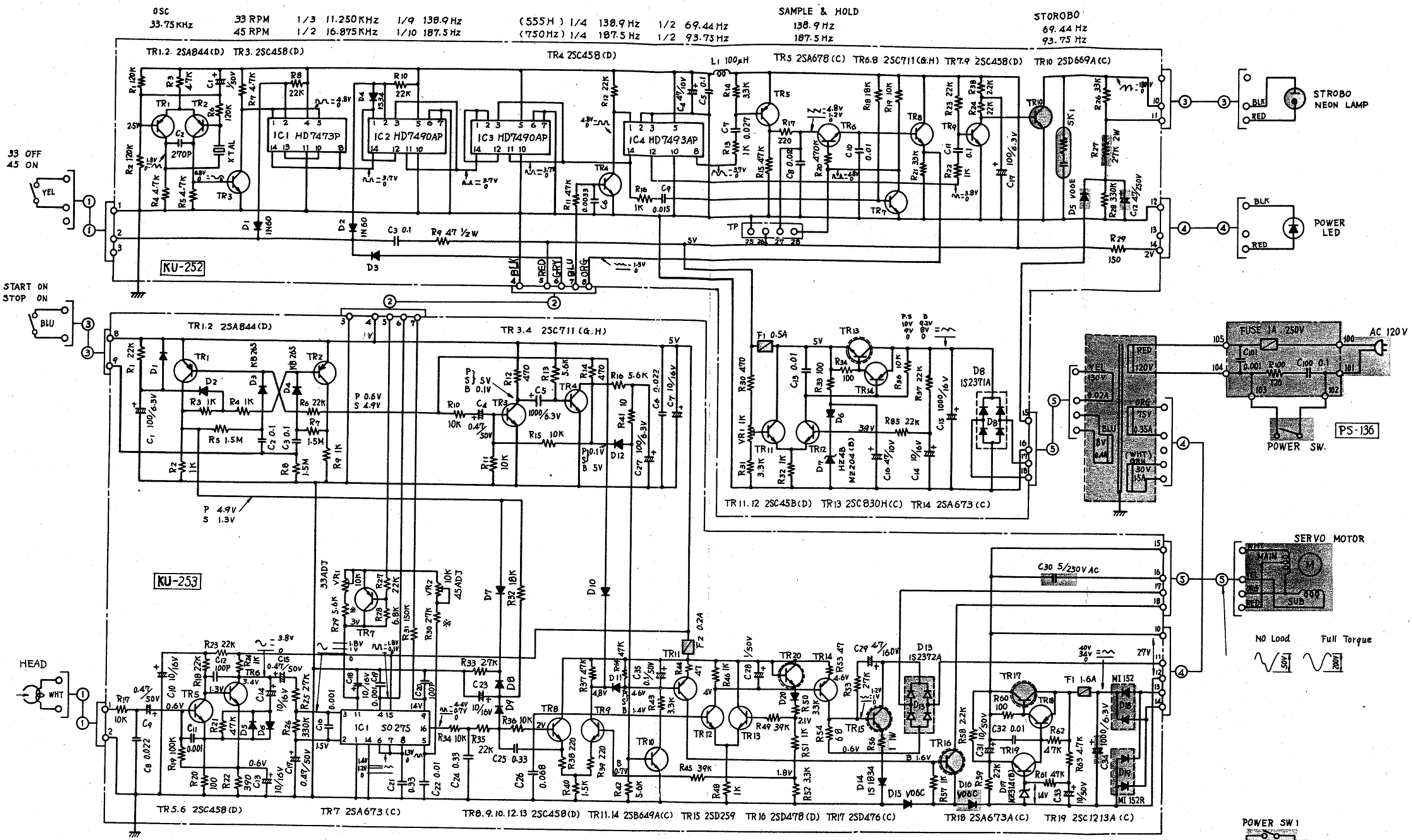
Ref. No.	Part No.	Part Name	Remark
	2228054315	P. CIRCUIT BOARD	
	4418119107	C. B. STAY	
	4178012405	HEAT SINK	
F_1	2061006012	FUSE (1, 6A)	
F_2	2061030004	LEAD FUSE (0.2A)	
SEMICONDUCTORS			
$TR_{1,2}$	2710089021	2SA844(D)	or 2SA836(D)
$TR_{3,4}$	2730064068	2SD711(G)	
$TR_{5,6,8,9,10,12,13}$	2730021043	2SC458(D)	
TR_7	2710040028	2SA673(C)	
$TR_{11,14}$	2720037005	2SB649A(C)	or 2SB568(C)
TR_{15}	2740026009	2SD259	
TR_{16}	2740044007	2SD478(D)	
TR_{17}	2740043008	2SD476(C)	
TR_{18}	2710040057	2SA673A(C)	
TR_{19}	2730111050	2SC1213A(C)	
*TR_{20}	2730110006	2SC1212(C)	
$D_{1,2,5,6,7,8,9,10,11,12,20}$	2760049011	1S2076A	
D_{13}	2760213009	S 2372A	
D_{15}	2760166017	RA-1Z	or VO6C
D_{16}	2760166017	RA-1Z	or VO6C
D_{17}	2760174012	MZ314B	Rectifier
D_{18}	2760215007	MI 152	Rectifier
D_{19}	2760215010	MI 152R	Rectifier
D_{14}	2760184002	1S183A	
$D_{3,4}$	2760216019	KB265	Varistor
IC_1	2680008006	SO275	or TCA955
RESISTORS			
$R_{1,6,27}$	2410322004	RD14B2E222J	2.2kΩJ 1/4W
$R_{2,3,4,9,24,46,48,51,57}$	2410314009	RD14B2E102J	1kΩJ 1/4W
$R_{5,7,8}$	2410769007	RD14B2E155J	1.5MΩJ 1/4W
$R_{10,11,15,17,34,36}$	2410338001	RD14B2E103J	10kΩJ 1/4W
$R_{61,63}$	2410330009	RD14B2E472J	4.7kΩJ 1/4W
$R_{13,16,42}$	2410332007	RD14B2E562J	5.6kΩJ 1/4W
$R_{18,23,35}$	2410346006	RD14B2E223J	22kΩJ 1/4W
R_{19}	2410362006	RD14B2E104J	100kΩJ 1/4W
$R_{21,37,62,64}$	2410354001	RD14B2E473J	47kΩJ 1/4W
$R_{20,60}$	2410209000	RD14B2E101J	100ΩJ 1/4W
R_{22}	2410304006	RD14B2E391J	390kΩJ 1/4W
$R_{25,55}$	2410348004	RD14B2E273J	27kΩJ 1/4W
R_{26}	2410374007	RD14B2E334J	330kΩJ 1/4W
R_{28}	2410334005	RD14B2E682J	6.8kΩJ 1/4W
R_{31}	2410366002	RD14B2E154J	150ΩJ 1/4W
R_{32}	2410344008	RD14B2E183J	18kΩJ 1/4W
R_{33}	2410324002	RD14B2E272J	2.7ΩJ 1/4W
$R_{38,39}$	2410298002	RD14B2E221J	220ΩJ 1/4W
R_{40}	2410318005	RD14B2E152J	1.5kΩJ 1/4W
R_{41}	2410266005	RD14B2E100J	10ΩJ 1/4W
$R_{43,50,52}$	2410326000	RD14B2E332J	3.3kΩJ 1/4W
$R_{45,49}$	2410352003	RD14B2E393J	39kΩJ 1/4W
R_{54}	2419286001	RD14B2E680J	68ΩJ 1/4W
$R_{12,14}$	2410306004	RD14B2E471J	470ΩJ 1/4W
$R_{44,53}$	2410282005	RD14B2E470J	47ΩJ 1/4W
R_{56}	2440005003	RD14B3A010JNB	1ΩJ1W Metal oxide
$R_{58,59}$	2412012095	RD14B2E222G	2.2kΩG 1/4W
*R_{29}	FEP101120	RN1/4PS5,6kΩG	5.6kΩ 1/4W Metal film
*R_{30}	FEP101125	RN1/4PS27kΩG	27kΩ 1/4W Metal film
$VR_{1,2}$	2116001027	V10QB103	10kΩ Preset VR

Note: All resister are carbon film resisters unless specified.

CAPACITORS			
$C_{1,27}$	2544003008	CE04W0J101	100μF 6.3V EC
$C_{4,9,15,17}$	2544043000	CE04W1HR47	0.47μF 50V EC
C_5	2544007004	CE04W0J102	1,000μF 6.3V EC
$C_{7,10,13,14,18,23}$	2544015009	CE04W1C100	10μF 16V EC
C_{29}	2544070002	CE04W2C4R7	4.7μF 16V EC
$C_{31,33}$	2544047006	CE04W1H100	10μF 50V EC
C_{28}	2544044009	CE04W1H010	1μF 50V EC
C_{35}	2549014005	CE04W1HR10M	0.1μFM 50V EC
C_{34}	2542063008	CE02W1J102	1,000μF 63V EC
$C_{12,20}$	2533657009	CC45SL1H101K	100pFK 50V Ceramic
$C_{2,3}$	2551084007	CQ93M1H104K	0.1μFK 50V Film
$C_{6,8}$	2551076002	CQ93M1H223K	0.022μFK 50V Film
$C_{11,16,19}$	2551060005	CQ93M1H102K	0.001μFK 50V Film
C_{22}	2551121025	CQ93M1H103J	0.01μFJ 50V Film
C_{32}	2551072006	CQ93M1H103K	0.01μFK 50V Film
C_{26}	2551082009	CQ93M1H683K	0.068μFK 50V Film
$C_{21,24,25}$	2561007003	CF99B2A334K	0.33μFK 50V Metalized
C_{30}	2568007077	CF99-2EAC505J	5.0μFJ 250VAC Metalized

Note: EC is electrolitic capacitor
G: ±2% J: ±5% K: ±10% M: ±20%
*Parts with asteriscs are temperature compensating devices.

WARNING: THOSE PARTS WITH SHADING HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY.

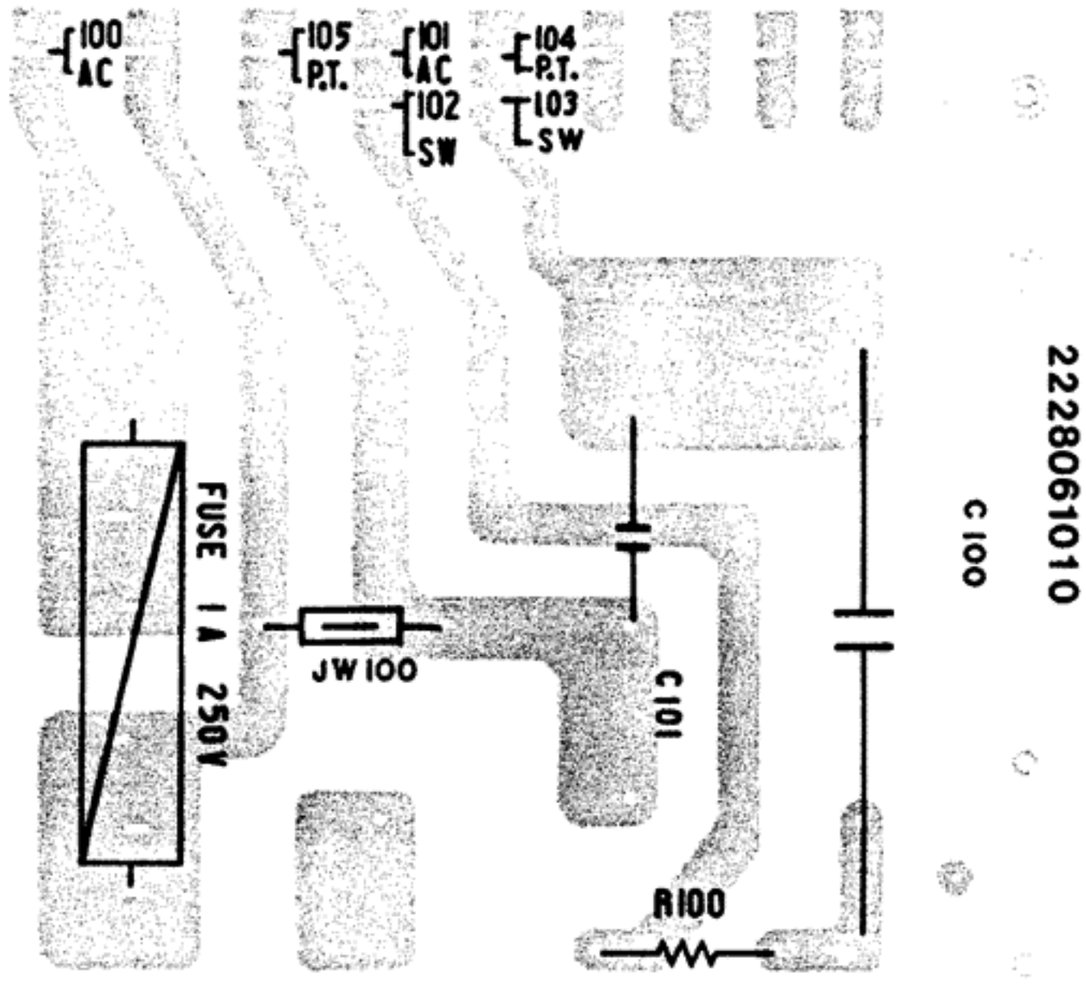


WARNING: **SHADED PARTS AND COMPONENTS HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY.**

(NOTE)

1. ALL THE DIODES WITHOUT REMARKS ARE IS 2076A.
2. MARK "※" ARE TEMPERATURE COMPENSATING DEVICE
3. RESISTORS ARE IN Ω, CAPACITORS ARE IN μF.
4. ALL THE RESISTORS WITHOUT REMARKS ARE 1/4 W ATT ±5%
5. VOLTAGES SHOWN ARE MEASURED WITH REFERENCE TO GROUND AT 33 rpm.
   - P (OR NOT SPECIFIED) ····· 33 rpm
   - B ····· BRAKE ENGAGED
   - S ····· STOP

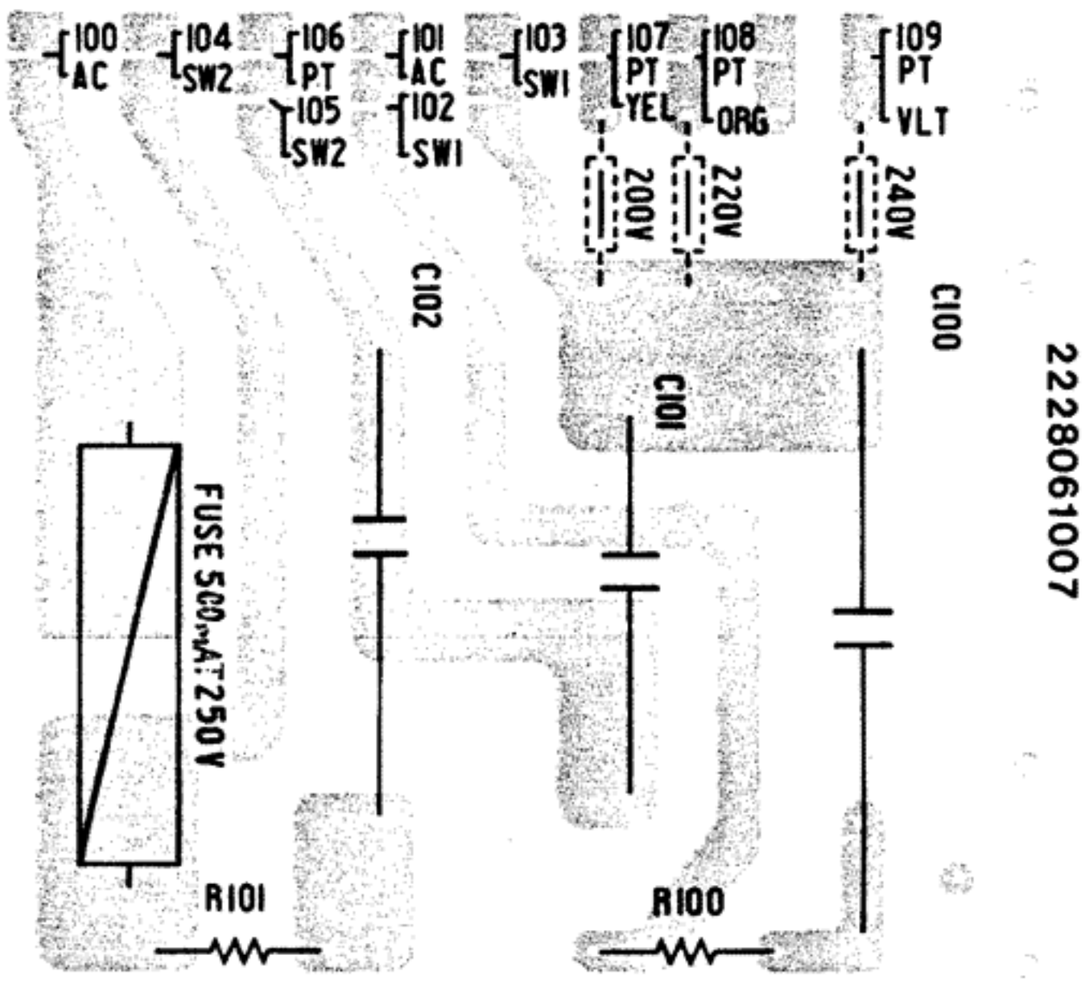
PS-136 POWER SUPPLY UNIT (120 V)



PS–136 POWER SUPPLY UNIT

Ref. No.	Part No.	Part Name	Remark	
R_{100}	2410292008	RD14B2E121J	120ΩJ 1/4W	Carbon film Resistor
C_{101}	2568017009	CF99B2BAC102MW	0.001μFM 125VAC	Metalized Capacitor
C_{100}	2568017012	CF99B2BAC104MW	0.1μFM 125VAC	Metalized Capacitor
	2228061010	P. CIRCUIT BOARD		
	4418119107	C. B. STAY		
	EP-72663	FUSE (1A)		
	FEP1258H2	FUSE CAP		
	J: ±5% M: ±20%			

PS-137 POWER SUPPLY UNIT (200~240 V)



PS–137 POWER SUPPLY UNIT

Ref. No.	Part No.	Part Name	Remark	
$R_{100, 101}$	2410163001	RD14B2H121J	120ΩJ 1/2W	Metal oxide Retistor
$C_{100, 102}$	2518001036	CP05C= =AC104M	0.1μFM 450VAC	Oil Capacitor
C_{101}	2518001049	CP05C= =AC102M	0.001μFM 450VAC	Oil Capacitor
	2228061023	P. CIRCUIT BOARD		
	4418119107	C. B. STAY		
	FEP1287	FUSE HOLDER		
	2061015003	FUSE (0.5 A)		
	J: ±5% M: ±20%			

DENON

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