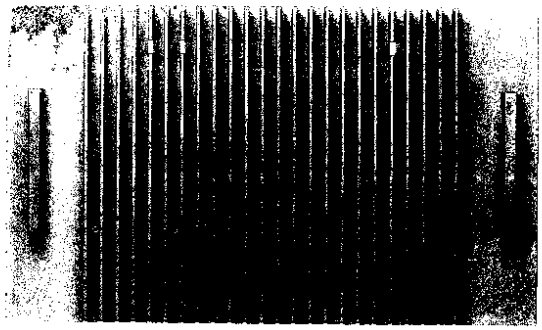
Nakamichi

Service Manual

Nakamichi 620

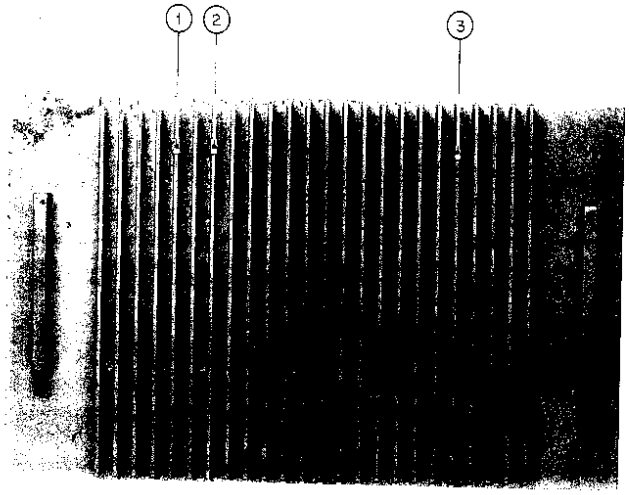
power amplifier



CONTENTS

1. GENERAL

Nakamichi 620 control functions are shown below.



1. Peak Power Indicator (L ch)
2. Peak Power Indicator (R ch)
3. AC Power Indicator
4. Power Switch
5. Power Indicator Threshold Selector Switch (High)
6. Power Indicator Threshold Selector Switch (Low)
7. Fuse
8. Voltage Selector
9. Output Terminals
10. Input Jacks

Fig. 1.1

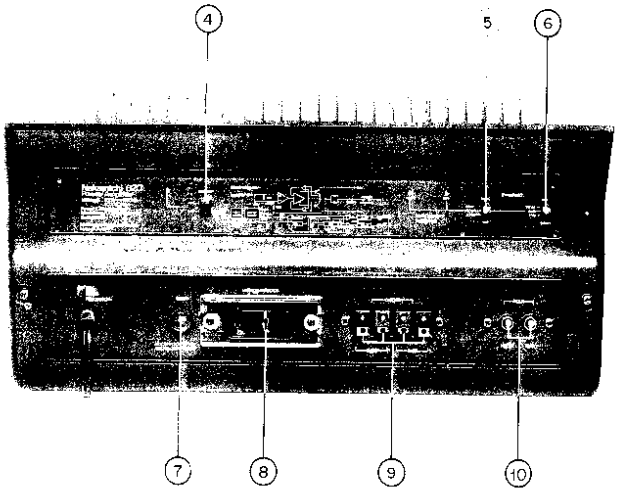


Fig. 1.2

CAUTIONS

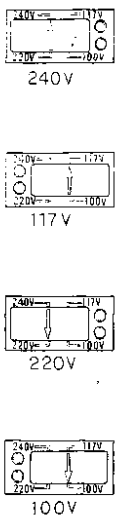
The Nakamichi 620 incorporates large capacitances. It is very dangerous to access the capacitor for a duration of about 3 minutes after the power switch has been turned off because of incomplete discharging. Use extreme care when accessing the capacitor for repair purposes.

Never short the capacitor terminals with a screwdriver or a similar tool after the power switch is turned off, with an attempt to discharging the capacitor. (Shorting the terminal in such a way can melt the shorted point leading to a hole, and will give adverse effects on the capacitor itself.)

The recommended way to discharge the capacitor as quickly as possible is to turn off the power supply with sound emitting through the loudspeaker or to discharge the capacitor with resistances of 100Ω – 300Ω, approx. 20W.

Voltage Selector

Change over to 100V, 117V, 220V or 240V.



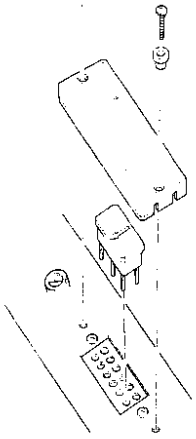


Fig. 1.3

2. PRINCIPLE OF OPERATION

2.1. Power Supply

Refer to Fig. 2.1.

The power transformer used in the 620 is of a troidal type. Generally, a troidal transformer is attacked by large rush current when the power switch is turned on. For the 620, such rush current is reduced by supplying input voltage to the primary of the transformer via a resistor (6.8Ω, 10 watts) only during the time of approx. 20 msec when the power switch is turned on, and then by shorting the resistance at a relay contact and supplying the input voltage directly to the transformer primary.

A 130°C thermal fuse is contained within the transformer and protects it from unusual heating.

If the fuse is blown, it is necessary to replace the transformer itself.

2.2. Power Block Pre-stage

Refer to Fig. 2.2.

As all the output stage consists of emitter-followers, the voltage gain is 1. Therefore, the gain required for power amplifier and NFB is obtained at the pre-stage. Generally, an increase in the number of transistor stages of an amplifier circuit increases distortion and phase shift. In large current amplification as seen with a power amplifier, a certain extent of distortion cannot be avoided and should be limited through use of NFB. However, excessive NFB is likely to cause unstable amplification as a result of phase shift in the amplifier or differences in loudspeaker impedance. This is one of the drawbacks inherent to an NFB amplifier.

The power amplifier used in the 620 employs 8 transistors, of which only two serve for voltage amplification and the remaining six are used to provide the former two with the best operating conditions. A gain of approx. 100dB is obtained through these two transistors to perform power amplification and NFB. The amplifier of this configuration assures stable NFB with low noise and low distortion and with little phase shift.

Q001 and Q007 are for voltage amplification; Q002 and Q003 form a current mirror circuit (the same current at both collectors); Q005 and Q008 provide a constant-current source; Q006 is for impedance conversion (emitter-follower); Q004 and Q001 make up a differential amplifier circuit. Thus, stable NFB is applied through a circuitry using these transistors.

C005 determines the high-band characteristic of the voltage amplifier to prevent NFB from becoming unstable because of unbalanced performance. R016 is a resistor for NFB.

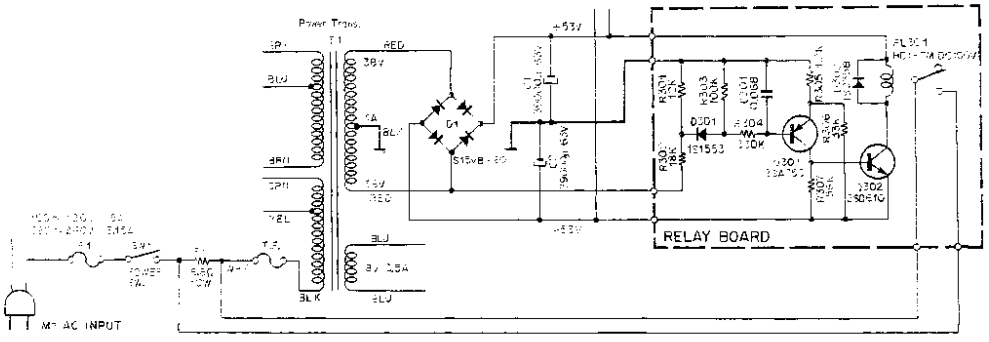


Fig. 2.1

2.3. Power Block Output Stage

In the Nakamichi 620, for making a bias voltage, varistor used in the conventional design of amplifier is replaced with transistor base-emitter so that the 620 design improves bias stability (against temperature or current changes) with lower distortion.

Especially for a class B push-pull amplifier, distortion cannot be reduced unless the positive and negative signal amplifiers are well balanced. The amplifier in the 620, however, is best balanced thanks to the vertically and horizontally symmetric configuration as shown in Fig. 2.3. This circuit allows distortion of only 0.1% at 1KHz 100 watts output even without NFB. This degree of distortion is low enough to make the amplifier used as a high-fidelity unit even if it is given no NFB.

Fig. 2.4 shows that a change in current flowing across the diode varies the terminal voltage and that E_b changes with signal current. These changes result in the generation of distortion. It is a matter of course that signal current flowing across the diode will produce distortion. See Fig. 2.3. Transistors Q009, Q011, Q010 and Q012 that generate bias voltage form an emitter-follower circuit of class A operation. Thus this circuit does not induce distorted signals.

Unless corrected perfectly against temperatures, the bias voltage of power amplifiers in the class B amplifier will increase distortion at low temperature or become unstable at high temperature. It may safely be said that temperature compensation of a transistor can be more properly and effectively carried out by the transistor of the same structure than a diode.

For an ordinary class B amplifier, crossover distortion is reduced by increasing idling current thus overlapping the operating ranges of the positive and negative transistors. The overlap portion acts as a class A amplifier. Generally, the degree of amplification decreases where a change takes place from class A to B and no linear curve is obtained as shown in Fig. 2.5 (A). However, if the circuit shown in Fig. 2.3 is current-driven, a linear curve can be obtained at the point of change from class A to B as shown in Fig. 2.5 (B).

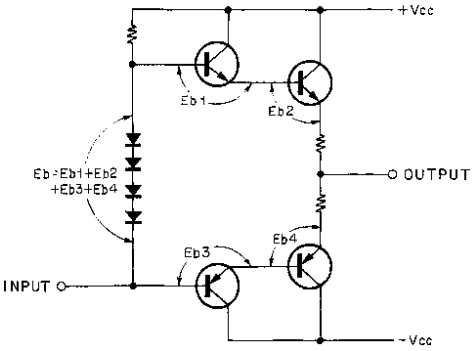


Fig. 2.4

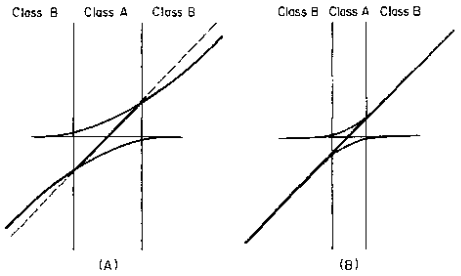


Fig. 2.5

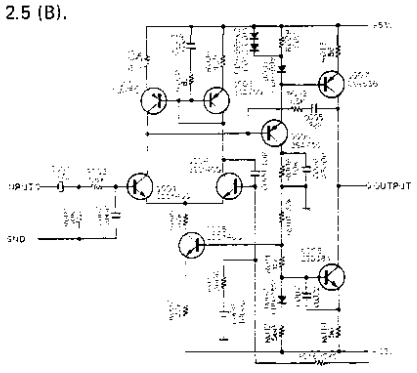


Fig. 2.2

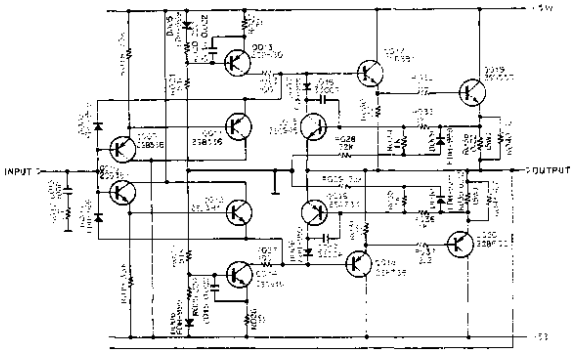


Fig. 2.3

Fig. 2.6 illustrates a simplified version of the circuit shown in Fig. 2.3.

Since the direct-coupled two-stage emitter-followers can be regarded to be one emitter-follower having greater current amplification, the Q009–Q011, Q010–Q012, Q017–Q019, and Q018–Q020 will be designated respectively to be Q1, Q2, Q3 and Q4 as shown in Fig. 2.6.

When i_d is applied with the input used as current-source, i_1 and i_2 are given as follows because of the Q1 and Q2 input impedances:

Input impedance of Q1 $\quad \beta_1 (\beta_3 r_1 + r_3)$

Input impedance of Q2 $\quad \beta_2 (\beta_4 r_2 + r_4)$

Therefore:

$$i_1 = \frac{\beta_2 (\beta_4 r_2 + r_4)}{\beta_1 (\beta_3 r_1 + r_3) + \beta_2 (\beta_4 r_2 + r_4)} id$$

$$i_2 = \frac{\beta_1 (\beta_3 r_1 + r_3)}{\beta_1 (\beta_3 r_1 + r_3) + \beta_2 (\beta_4 r_2 + r_4)} id$$

$$i_0 = i_3 + i_4 = \beta_1 \beta_3 i_1 + \beta_2 \beta_4 i_2$$

$$= \frac{\beta_1 \beta_2 \beta_3 (\beta_4 r_2 + r_4) + \beta_1 \beta_2 \beta_4 (\beta_3 r_1 + r_3)}{\beta_1 (\beta_3 r_1 + r_3) + \beta_2 (\beta_4 r_2 + r_4)} id$$

$$= \frac{\beta_1 \beta_2 \beta_3 \beta_4 \left\{ (r_2 + r_4/\beta_4) + (r_1 + r_3/\beta_3) \right\}}{\beta_1 \beta_3 (r_1 + r_3/\beta_3) + \beta_2 \beta_4 (r_2 + r_4/\beta_4)} id$$

If β of the $Q_1 - Q_3$ pair is equal to that of the $Q_2 - Q_4$ pair, then $\beta_1 \beta_3 = \beta_2 \beta_4$ (assumed as β_0).

The following equation will be obtained:

$$i_0 = \frac{\beta_0^2 \left\{ (r_2 + r_4/\beta_4) + (r_1 + r_3/\beta_3) \right\}}{\beta_0 \left\{ (r_1 + r_3/\beta_3) + (r_2 + r_4/\beta_4) \right\}} id$$

$$= \beta_0 id$$

As a result, the same gain is obtained over the entire range as shown in Fig. 2.7.

Thus, the rate of current amplification in the idling current range (Class A) is quite the same as that in the class B amplifier. It must be noted, however, that the idling current is not included in the conditions for making the equation valid. In other words, a change in idling current will neither change the linearity of curves nor produce distortion.

Q013 and Q014 form a constant-current source; D005 and D006 are for temperature compensation; D003 and D004 prevent reverse-biased voltage from being applied in abnormal state; Q015 and Q016 form a current limiter that prevents overloading on the power transistor.

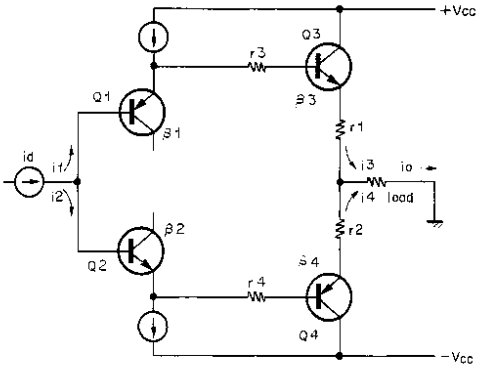


Fig. 2.6

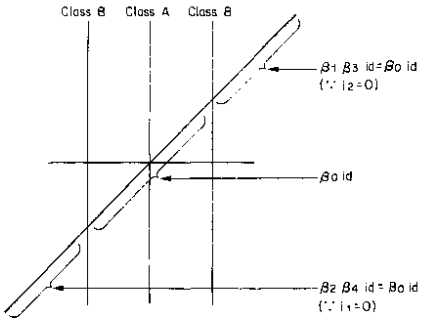


Fig. 2.7

2.4. Peak Power Indicator

Fig. 2.8 and Fig. 2.9 show, respectively, the circuit diagram and time chart of the peak power indicator. This circuit switches the peak power indicator of R-channel or L-channel to red or green depending upon the output power level.

The LOW and HIGH power indicator threshold selectors located on the rear panel of the 620 select 1/5/25 watts and 25/50/Max. watts power levels, respectively. The green lamp glows for output power levels of 1,5,25 watts (LOW) or more, while the red lamp glows for output power levels of 25, 50 or Max. watts (HIGH). (Ref. 8Ω load. If a 16Ω loudspeaker is to be used, divide the indicated power levels by two.)

The green lamp remains off while the red lamp is on. If both switches are set for 25 watts, the peak power indicator lamps will glow red only at that power point. The peak power indicating lamps are extremely fast in responding to transmit signals. A 0.1 millisecond power pulse will cause the peak indicator to light and stay "on" for 0.3 second.

AMP1 is a full-wave rectifier for input waveforms (namely output waveforms to the loudspeaker).

AMP2 is a peak detector.

Capacitor C151 and resistor R156 determine the time constant for holding the voltage of which peak has been detected.

AMP3 and AMP4 form a comparator that compares the output voltage of AMP2 with reference voltage (corresponding to power level 1, 5, 25 or Max. watts).

AMP3 and AMP4 are operational amp. ICs with open collector output. Output of these amplifiers is −5V if the AMP2 output voltage is lower than the reference voltage. In this state, transistors Q151 and Q153 are cut off and the lamps are off.

In AMP3, if the AMP2 output voltage exceeds the reference, the AMP3 output is opened and base current flows into Q151 via resistor R164. As a result, Q151 is on and the indicating lamp glows green.

In AMP4, if the AMP2 output voltage exceeds the reference, the AMP4 output is opened and base current flows into Q153 via resistor R163. As a result, Q153 is on and the indicating lamp glows red.

Then, the collector of Q153 is dropped to −5V and no current flows to Q151 via R164. Thus Q151 is cut off and the green lamp goes out.

AMP4 has hysteresis in its input/output characteristic.

Q151, Q152, and Q153, Q154 make up a sort of monostable multivibrator.

When Q151 is on and Q152 is therefore on, a positive differential pulse is applied to the Q151 base via capacitor C152. Thus Q151 is held "on" for a certain time.

Q153 and Q154 operate in the same manner as above. R157 (R165) is a resistor causing a lamp to be pre-biased.

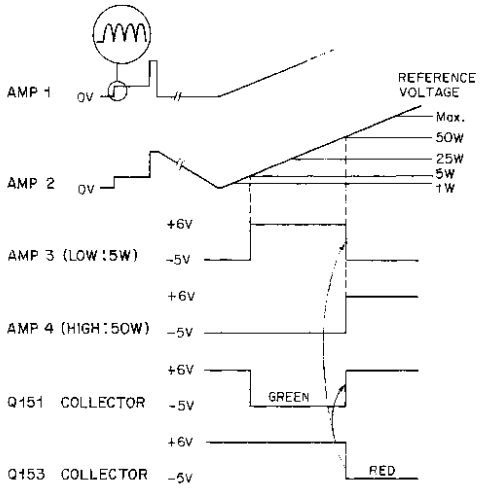


Fig. 2.9

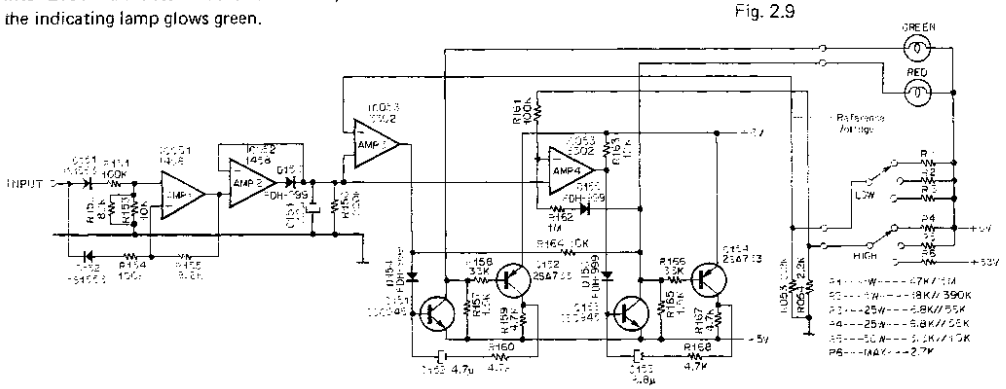


Fig. 2.8

3. REMOVAL PROCEDURES

3.1. Cabinet Ass'y
Refer to Fig. 3.1 and remove F01 and F02.

3.2. Rear Panel Ass'y
Remove cabinet ass'y (item 3.1). Refer to Fig. 3.2 and remove F01 and F02.

3.3. Lamp
Remove rear panel ass'y (3.2). Refer to Fig. 3.3 and remove F01 and F02, then remove F03, F04 and F05.

3.4. Switch
Remove rear panel ass'y (3.2). Refer to Fig. 3.4 and remove F01 and F02, then remove F03 and F04 (power sw.), and F05 and F06 (indicator sw. ass'y).

3.5. Power Block Ass'y
Remove cabinet ass'y (3.1). Refer to Fig. 3.5 and remove F01 through F04.

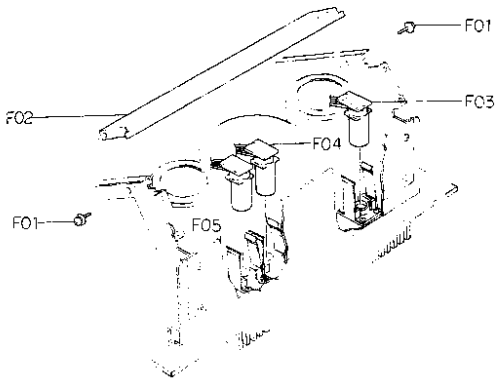


Fig. 3.3

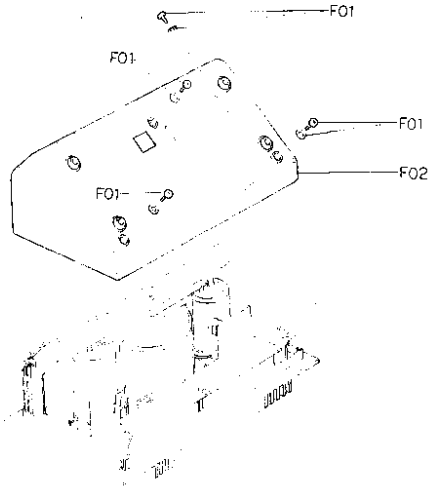


Fig. 3.1

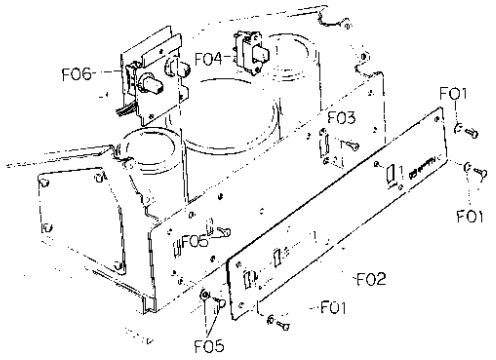


Fig. 3.4

Fig. 3.2

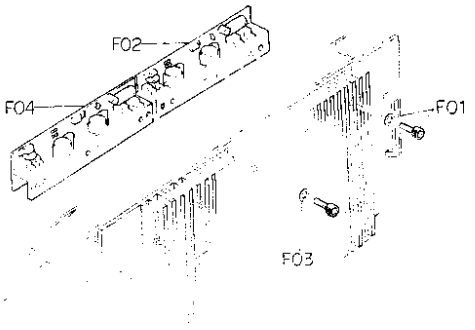


Fig. 3.5

3.6. Jack
Remove rear panel ass'y (3.2). Refer to Fig. 3.6 and remove F01 through F04 (2-pin jack) and F05 through F07 (push terminal).

3.7. Indicator P.C.B. Ass'y
Remove cabinet ass'y (3.1). Refer to Fig. 3.7 and remove F01 through F03.

3.8. Relay P.C.B. Ass'y and Cement Resistor
Remove cabinet ass'y (3.1). Refer to Fig. 3.8 and remove F01 and F02 (cement resistor), and F03 through F05 (relay P.C.B. ass'y).

3.9. Diode and Output P.C.B. Ass'y
Remove cabinet ass'y (3.1). Refer to Fig. 3.9 and remove F01 and F02 (diode), and F03 and F04 (output P.C.B. ass'y).

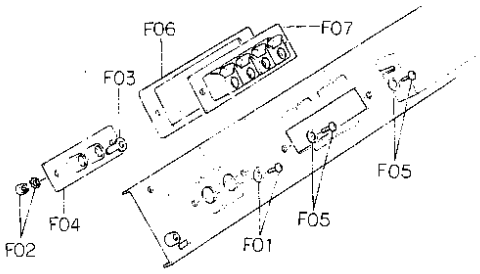


Fig. 3.6

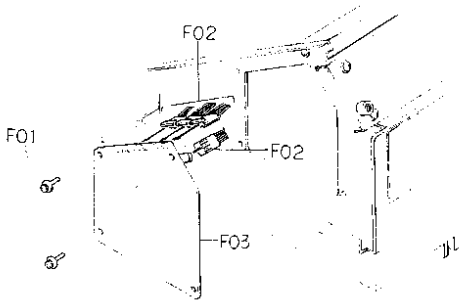


Fig. 3.7

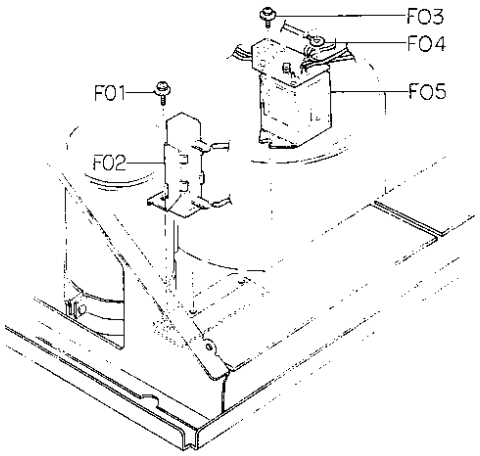


Fig. 3.8

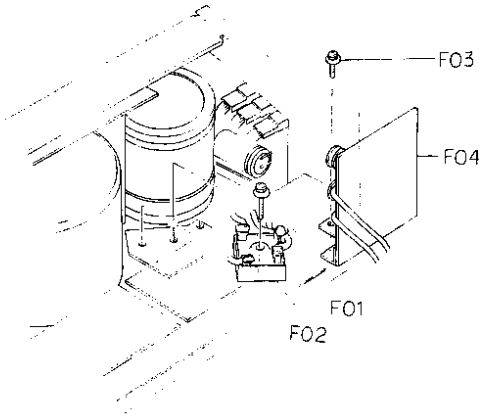


Fig. 3.9

3.10. Transformer and Capacitor

Remove cabinet ass'y(3.1). Refer to Fig. 3.10 and remove F01 through F06, F07 and F08 (transformer), F09 through F11 (capacitor) and F12 through F14 (capacitor).

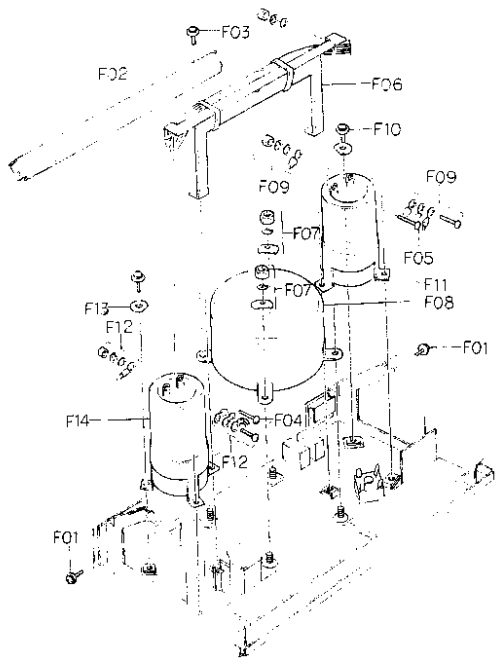


Fig. 3.10

4. READJUSTMENT OF POWER BLOCK

The 620 uses no semi-fixed parts to enhance reliability. As long as all parts meet the specification, the published characteristics can be obtained without readjustment. Generally, no readjustment is required if only defective parts are replaced at repair.
Observe the following precautions when repairing defective parts:

4.1. Relocating a wiring can cause larger distortion. Do not relocate the wiring.

4.2. Fully tighten or retighten the screws on the chassis to decrease the resistance between GND terminals.

4.3. If a new semiconductor is installed in the power block, a perfect balance should be held between it and the existing semiconductors in the block. An imperfect balance can cause larger distortion or unwanted oscillation.
To maintain a good balance, connect an 8Ω 100W load resistance to the output terminal, measure distortion and check that it meets the following requirements: (In this case, the residual distortion factor of the instrument should be lower than the specified value.)
(1) Output 1 watt, 1 and 10 KHz input signals; less than 0.005%
(2) Output 100 watts, 1 and 10 KHz input signals; less than 0.007%
Described here are the possible causes for defects and the recommended remedial steps:
(1) The characteristic of one transistor does not match that of the other transistor when they are used as a pair.
(2) Usually, the idling current of power transistors Q019 and Q020 is approx. 20mA – 30mA. If it is lower, the distortion at 1 watt will increase. In such a case, solder additional 33KΩ parallel to R018 and R019 (33KΩ), respectively, from the dip side of the printed circuit board.
(3) Improper locations of power supply wiring will increase the distortion at 100 watts.
(4) If oscillation occurs, the distortion will become large at both 1 watt and 100 watts.
Sometimes, oscillation cannot be observed even on a synchroscope if it involves frequencies as high as several MHz. Oscillation may have occurred if the distortion is large though the external operating voltage remains normal. Try the following steps to eliminate oscillation:
(a) Add ceramic capacitors of the same capacity parallel to C010 and C011 (0.047μ, 100V).
(b) Increase C013 (100pF) (by adding a 47pF in parallel) or decrease the capacitance (by replacing it with a 47p or removing it. If C013 is removed, make a short circuit by jumper wire.)
(c) Short R017 (27Ω) or increase it to 47Ω.

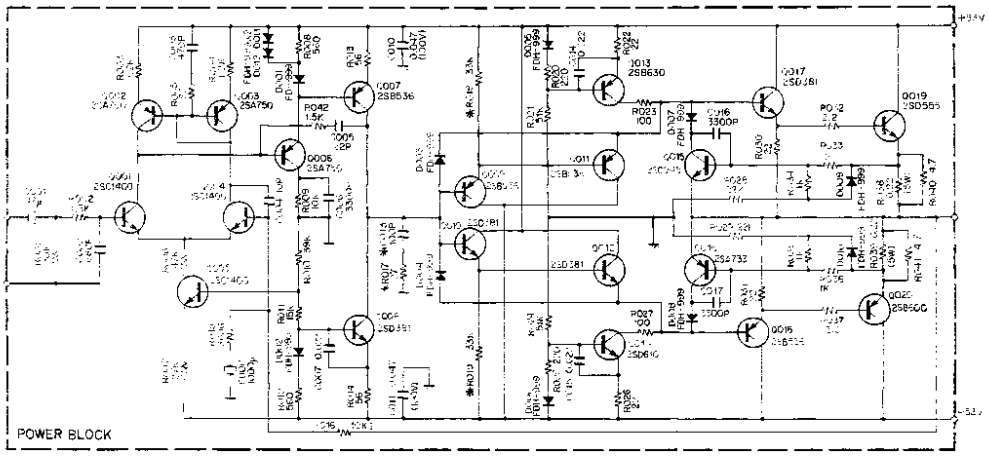


Fig. 4.

5. MOUNTING DIAGRAM AND PARTS LIST

Note: Mounting diagram shows a dip side view of the printed circuit board.

5.1. Power Block Ass'y

5.1.1. Power Block P.C.B. Ass'y

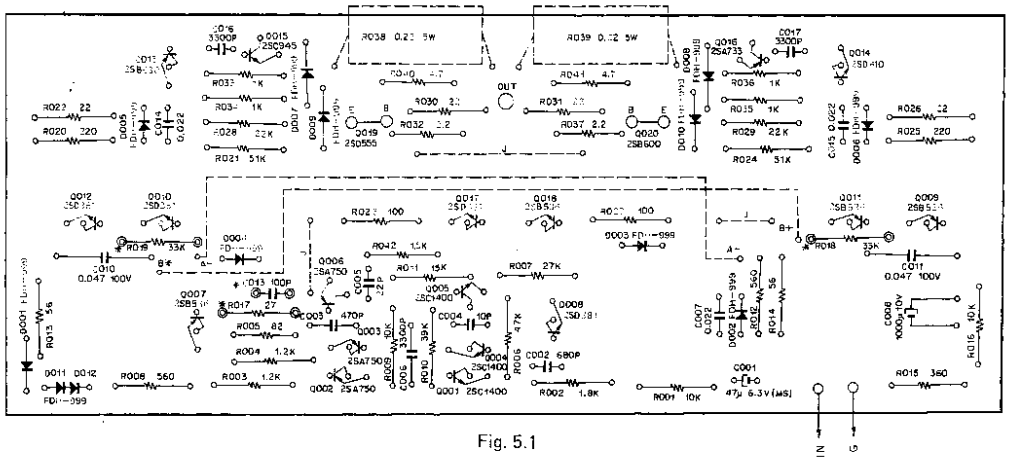


Fig. 5.1

Note: 1. Resistors R018, 019 and capacitor C013 (* marks) are the parts for adjustment, and so typical value is shown. Refer to "4. Readjustment of Power Block".

2. Diode1S1555, transistors 2SB628 and 2SD608 are the same as diode FDH-999, transistors 2SB536 and 2SD381, respectively.

5.1.2. Power Transistor P.C.B. Ass'y

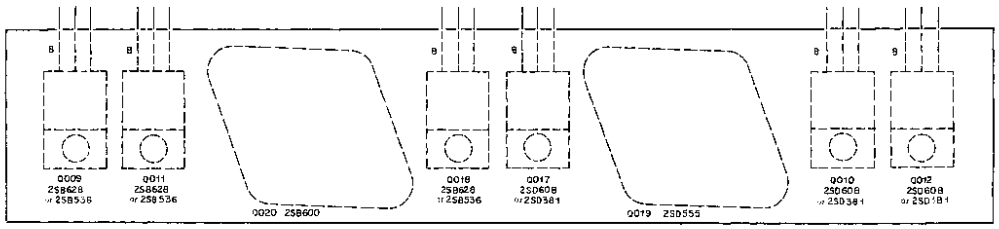


Fig. 5.2

5.2. Output P.C.B. Ass'y

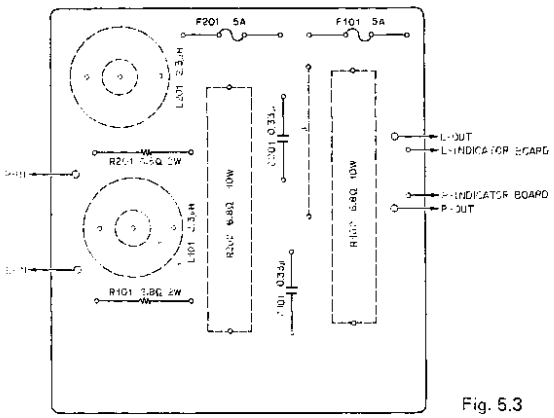


Fig. 5.3

Schematic Ref. No.	Part No.	Description
	JA03107A	**Power Block Ass'y**
	BA03781A	**Power Block P.C.B. Ass'y**
	BA03780A	**Power Transistor P.C.B. Ass'y**
	0E00231A	Screw M2.6x8 Philips Pan Head FT (4 pcs.)
	0E00026A	Washer 2.6mm Spring (4 pcs.)
	BA03781A	**Power Block P.C.B. Ass'y**
	0B07676B	Power Block P.C.B.
Q001, 004 005	0B06078A	Transistor 2SC1400
Q002, 003 006	0B06074A	Transistor 2SA750 (1)
Q007	0B06096A	Transistor 2SB536 (K, L, M)
Q008	0B06097A	Transistor 2SD381 (K, L, M)
Q013	0B06098A	Transistor 2SB630 (Q, R, S)
Q014	0B06099A	Transistor 2SD610 (Q, R, S)
Q015	0B06100A	Transistor 2SC945A (K, P, Q)
Q016	0B06013A	Transistor 2SA733
D001, 002 003, 004 005, 006 007, 008 009, 010 011, 012	0B06091A	Silicon Diode FDH-999
R001, 009	0B01888A	Carbon Resistor 10K ERD-14 TJ
R002	0B05614A	Carbon Resistor 1.8K ERD-14 TJ
R003, 004	0B05623A	Carbon Resistor 1.2K ERD-14 TJ
R005	0B05631A	Carbon Resistor 82 ERD-14 TJ
R006	0B05641A	Carbon Resistor 47K ERD-14 TJ
R007	0B05743A	Carbon Resistor 27K ERD-14 TJ
R008, 012	0B05575A	Carbon Resistor 560 ERD-14 TJ
R010	0B01854A	Carbon Resistor 39K ERD-14 TJ
R011	0B01683A	Carbon Resistor 15K ERD-14 TJ
R013, 014	0B05890A	Carbon Resistor 56 ERD-14 TJ
R015	0B05877A	Metal Film Resistor 360 ERO-25 CKG
R016	0B05878A	Metal Film Resistor 10K ERO-25 CKG
R017	0B05875A	Carbon Resistor 27 ERD-14 TJ
R018, 019	0B05509A	Carbon Resistor 33K ERD-14 TJ
R020, 025	0B01933A	Carbon Resistor 220 ERD-14 TJ
R021, 024	0B05876A	Carbon Resistor 51K ERD-14 TJ
R022, 026 030, 031	0B05579A	Carbon Resistor 22 ERD-14 TJ
R023, 027	0B01679A	Carbon Resistor 100 ERD-14 TJ
R028, 029	0B05615A	Carbon Resistor 22K ERD-14 TJ
R032, 037	0B05580A	Carbon Resistor 2.2 ERD-14 TJ
R033, 034 035, 036	0B01857A	Carbon Resistor 1K ERD-14 TJ
R038, 039	0B05871A	Cement Resistor 0.22 5W
R040, 041	0B05891A	Carbon Resistor 4.7 ERD-14 TJ
R042	0B05698A	Carbon Resistor 1.5K ERD-14 TJ
C001	0B05864A	Electrolytic Capacitor 47μ 16V M (MS)
C002	0B05893A	Ceramic Capacitor 680P 50V K
C003	0B05880A	Ceramic Capacitor 470P 50V K
C004	0B05798A	Ceramic Capacitor 10P 50V K
C005	0B05806A	Ceramic Capacitor 22P 50V K
C006, 016 017	0B05881A	Ceramic Capacitor 3300P 50V M

Schematic Ref. No.	Part No.	Description
C007, 014 015	0B05882A	Ceramic Capacitor 0.022μ 50V M
C008	0B05852A	Electrolytic Capacitor 1000μ 10V
C010, 011	0B05883A	Ceramic Capacitor 0.047μ 100V M
C013	0B05892A	Ceramic Capacitor 100P 50V K
	0E00566A	Screw M3x6 Philips Pan Head (4 pcs.)
	0E00718A	Nut Hex. M3 (4 pcs.)
	0J03505A	Washer 3mm (Fiber) (2 pcs.)
	BA03780A	**Power Transistor P.C.B. Ass'y**
	0B07677A	Power Transistor P.C.B.
Q009	0B06094A	Transistor 2SB536 (L)
Q010	0B06095A	Transistor 2SD381 (L)
Q011, 018	0B06096A	Transistor 2SB536 (K, L, M)
Q012, 017	0B06097A	Transistor 2SD381 (K, L, M)
Q019	0B06083A	Transistor 2SD555
Q020	0B06081A	Transistor 2SB600
	0J03488C	Power Transistor Heat Sink (1 pce.)
	0J03493A	Power Transistor Bush (4 pcs.)
	0J03494A	Transistor Bush (6 pcs.)
	0J03560A	Spring Pin (4 pcs.)
	0E00719A	Screw M4x15 Philips Pan Head (4 pcs.)
	0E00720A	Washer 4mm Spring (4 pcs.)
	0E00721A	Nut Hex. M4 (4 pcs.)
	0E00723A	Washer 3mm Spring (6 pcs.)
	0E00718A	Nut Hex. M3 (6 pcs.)
	0E00741A	Screw M3x12 Philips Binding Head (6 pcs.)
	0E00731A	Washer 4mm (4 pcs.)
	0E00732A	Washer 3mm (12 pcs.)
	BA03777A	**Output P.C.B. Ass'y**
	0B07674B	Output P.C.B.
L101, 201	BA03784A	Output Coil Ass'y 2.3μH
R101, 201	0B05872A	Metal Oxide Resistor 6.8 2W
R102, 202	0B05870A	Cement Resistor 6.8 10W
C101, 201	0B01602A	Mylar Capacitor 0.33μ 50V K
F101, 201	0B08239U	Fuse 5A (2 pcs.)
	0J03510A	Output P.C.B. Holder (1 pce.)
	0E00166A	Screw M2x4 Cylinder Head (2 pcs.)
	0E00606A	Screw M3x6 Philips Pan Head (3A) (3 pcs.)

5.3. Indicator P.C.B. Ass'y

Note: Diode 1S1555 is the same as FDH-999.

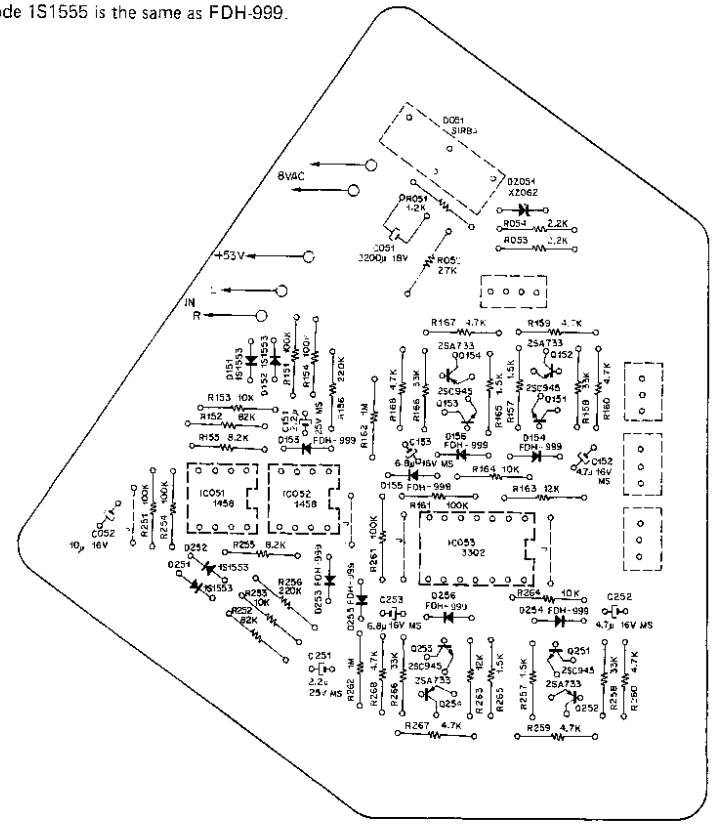


Fig. 5.4

5.4. Indicator Sw. P.C.B. Ass'y

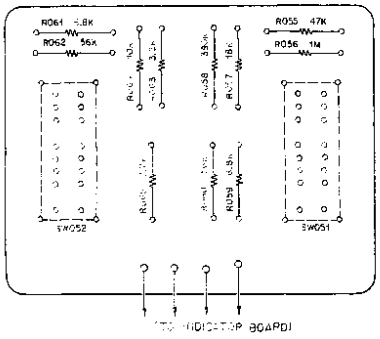


Fig. 5.5

5.5. Indicator Lamp P.C.B. Ass'y

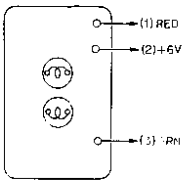


Fig. 5.6

5.6. Power Lamp P.C.B. Ass'y

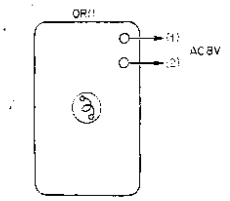


Fig. 5.7

5.7. Relay P.C.B. Ass'y

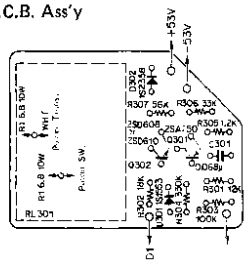


Fig. 5.8

Schematic Ref. No.	Part No.	Description
	BA03776A	**Indicator P.C.B. Ass'y**
	0B07678C	Indicator P.C.B.
IC051, 052	0B06086A	IC 1458
IC053	0B06087A	IC 3302
Q151, 153 251, 253	0B06100A	Transistor 2SC945A (K, P, Q)
Q152, 154 252, 254	0B06013A	Transistor 2SA733
DZ051	0B06089A	Silicon Diode XZ062
D051	0B06088A	Silicon Diode SIRBA
D151, 152 251, 252	0B06076A	Silicon Diode 1S1553
D153, 154 155, 156 253, 254 255, 256	0B06091A	Silicon Diode FDH-999
R051	0B05623A	Carbon Resistor 1.2K ERD-14 TJ
R052	0B06743A	Carbon Resistor 27K ERD-14 TJ
R053, 054	0B05622A	Carbon Resistor 2.2K ERD-14 TJ
R151, 154 161, 251 254, 261	0B01889A	Carbon Resistor 100K ERD-14 TJ
R152, 252	0B05668A	Carbon Resistor 82K ERD-14 TJ
R153, 164 253, 264	0B01888A	Carbon Resistor 10K ERD-14 TJ
R155, 255	0B01856A	Carbon Resistor 8.2K ERD-14 TJ
R156, 256	0B05625A	Carbon Resistor 220K ERD-14 TJ
R157, 165 257, 265	0B05698A	Carbon Resistor 1.5K ERD-14 TJ
R158, 166 258, 266	0B05509A	Carbon Resistor 33K ERD-14 TJ
R159, 160 167, 168 259, 260 267, 268	0B01846A	Carbon Resistor 4.7K ERD-14 TJ
R162, 262	0B05776A	Carbon Resistor 1M ERD-14 TJ
R163, 263	0B05771A	Carbon Resistor 12K ERD-14 TJ
C051	0B01835A	Electrolytic Capacitor 2200μ 18V
C052	0B01412A	Electrolytic Capacitor 10μ 16V
C151, 251	0B05598A	Tantalum Capacitor 2.2μ 25VM
C152, 252	0B05819A	Electrolytic Capacitor 4.7μ 16V M (MS)
C153, 253	0B05861A	Electrolytic Capacitor 6.8μ 16V M (MS)
	0B08185A	3P-T Post (3 pcs.)
	0B08236A	4P-T Post (1 pce.)

Schematic Ref. No.	Part No.	Description
	BA03779A	**Indicator Sw. P.C.B. Ass'y**
	0B07679B	Indicator SW. P.C.B.
R055	0B05641A	Carbon Resistor 47K ERD-14 TJ
R056	0B05776A	Carbon Resistor 1M ERD-14 TJ
R057	0B05560A	Carbon Resistor 18K ERD-14 TJ
R058	0B05676A	Carbon Resistor 390K ERD-14 TJ
R059, 061	0B01682A	Carbon Resistor 6.8K ERD-14 TJ
R060, 062	0B05508A	Carbon Resistor 56K ERD-14 TJ
R063	0B01681A	Carbon Resistor 3.3K ERD-14 TJ
R064	0B01888A	Carbon Resistor 10K ERD-14 TJ
R065	0B05629A	Carbon Resistor 2.7K ERD-14 TJ
SW051, 052	0B07105A	Slide SW.
	0B08237A	4P-H Connector Ass'y (1 pce.)
	0J03501A	Indicator SW. P.C.B. Holder (1 pce.)
	0E00166A	Screw M2x4 Cylinder Head (4 pcs.)
	BA03783A	**Indicator Lamp P.C.B. Ass'y**
	0B07675A	Lamp P.C.B.
	0B08234U	Lamp 12V 60mA (2 pcs.)
	0B08235A	3P-H Connector Ass'y C (1 pce.)
	BA03782A	**Power Lamp P.C.B. Ass'y**
	0B07675A	Lamp P.C.B'
	0B08234U	Lamp 12V 60mA (1 pce.)
	0B08238A	3P-H Connector Ass'y D (1 pce.)
	BA03778A	**Relay P.C.B. Ass'y**
	0B07673B	Relay P.C.B.
Q301	0B06074A	Transistor 2SA750
Q302	0B06099A	Transistor 2SD610
D301	0B06076A	Silicon Diode 1S1553
D302	0B06077A	Silicon Diode 1S2358
R301	0B05650A	Carbon Resistor 12K ERD-14 VJ
R302	0B05561A	Carbon Resistor 18K ERD-14 VJ
R303	0B01920A	Carbon Resistor 100K ERD-14 VJ
R304	0B01921A	Carbon Resistor 330K ERD-14 VJ
R305	0B05565A	Carbon Resistor 1.2K ERD-14 VJ
R306	0B01879A	Carbon Resistor 33K ERD-14 VJ
R307	0B05563A	Carbon Resistor 56K ERD-14 VJ
C301	0B05586A	Mylar Capacitor 0.068μ 50V K
RL301	0B08228A	Relay HCI-TMCD 100VDC

6. MECHANISM ASS'Y AND PARTS LIST

6.1. Synthesis (A01)

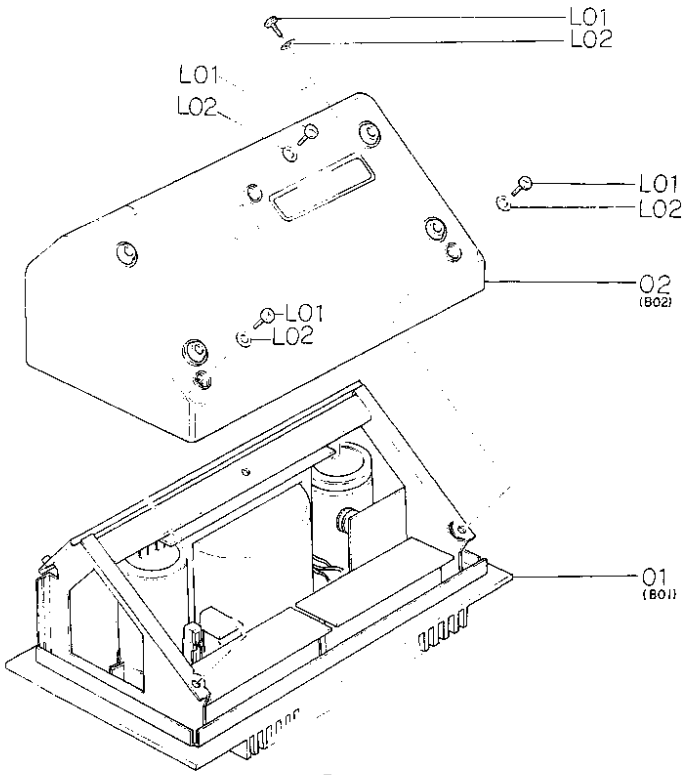


Fig. 6.1

Schematic Ref. No.	Part No.	Description	Q'ty	Schematic Ref. No.	Part No.	Description	Q'ty
A01		Synthesis			0805122A	Cord with Terminal B	1
					0805123A	Cord with Terminal C	1
01	JA03103A	Mechanism Ass'y	1		0805124A	Cord with Terminal D	1
02	HA03634A	Cabinet Ass'y	1		0805125A	Cord with Terminal E	1
L01	0E00594A	Screw M3x8 Philips Binding head (Bronze)	5		0805126A	Cord with Terminal F	1
					0805127A	Cord with Terminal G	1
L02	0E00197A	Washer 3mm (Bronze)	5	L01	0E00733A	M4x12Bolt (Hex.Socket Head)	6
				L02	0J03556A	Washer 4mm (Black)	6
B01	JA03103A	Mechanism Ass'y	1	L03	0E00657A	Screw M3x5 Philips Pan Head	8
				L04	0E00677A	Washer 3mm (Black)	8
01	0H03454A	Handle (B)	2	L05	0E00606A	Screw M3x6 Philips Pan Head (3A)	6
02	HA03658A	Front Panel Ass'y	1				
03	0H03456B	Light-intersepting Shade	2	L06	0E00718A	Nut Hex. M3	5
04	0M03683B	Rear Name Plate	1	L07	0E00723A	Washer 3mm Spring	5
05	BA03776A	Indicator P.C.B. Ass'y	1	L08	0E00732A	Washer 3mm	5
06	JA03104A	Main Chassis Ass'y	1	L09	0E00659A	Screw M3x10 Philips Pan Head	5
07	JA03106A	Indicator Lamp Ass'y	2	L10	0E00700A	Screw M5x16 Philips Pan Head (2A)	4
08	JA03105A	Power Lamp Ass'y	1				
09	JA03108A	Rear Panel Ass'y	1	L11	0E00593A	Screw M3x6 Philips Binding Head	4
10	JA03107A	Power Block Ass'y	2				
11	0J03506A	Rear Angle	1	L12	0E00197A	Washer 3mm (Bronze)	4
	0805121A	Cord with Terminal A	1	L13	0E00037A	Earth Lug B-5	2

6.2. Mechanism Ass'y (B01)

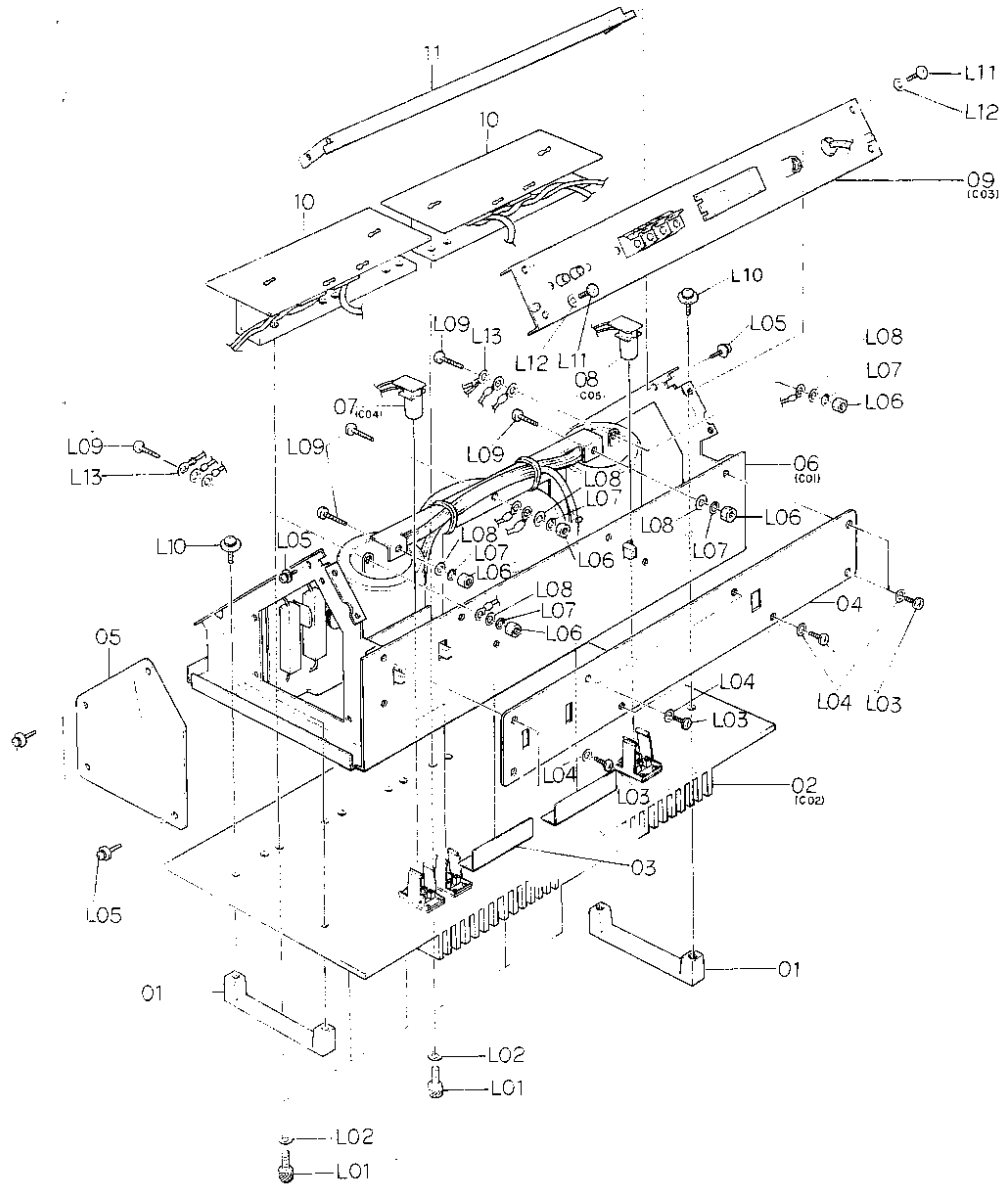


Fig. 6.2

6.3. Cabinet Ass'y (B02)

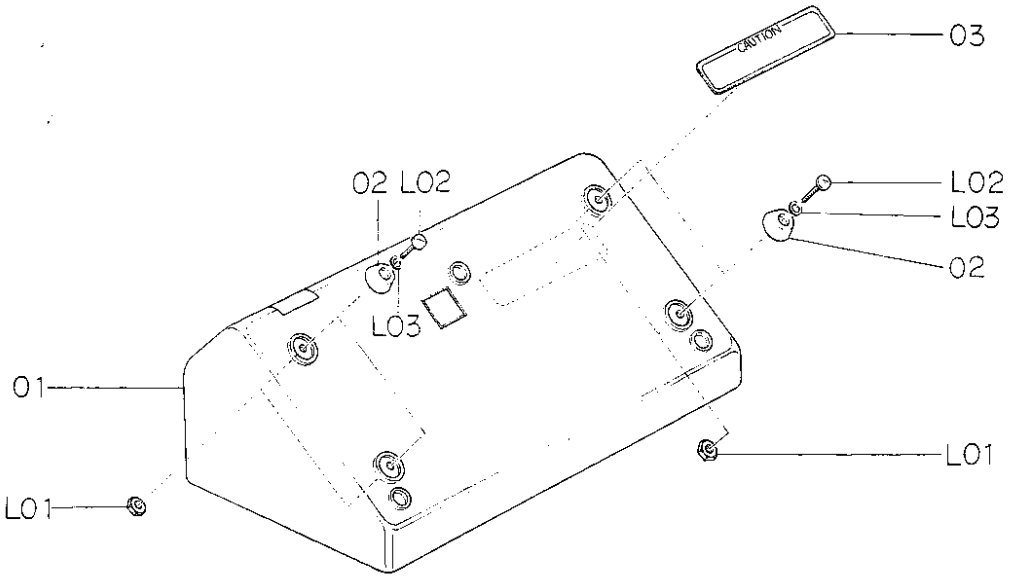


Fig. 6.3

Schematic Ref. No.	Part No.	Description	Q'ty	Schematic Ref. No.	Part No.	Description	Q'ty
B02	**HA03634A**	**Cabinet Ass'y**	**1**	10	0B06554U	Power Transformer	1
01	0A03254A	Cabinet	1	11	0J03508B	Earth Angle	1
02	0A00518C	Gum Foot	4	L01	0E00533A	Screw M3x5 Philips Countersunk	2
03	0M03339A	Caution Label	1	L02	0E00007A	Screw M2.6x5 Philips Countersunk	1
	0M03674A	Shield Foil 610	1	L03	0E00219A	Screw M2.6x5 Philips Pan Head	2
L01	0E00552A	Nut Hex. M3	4	L04	0E00606A	Screw M3x6 Philips Pan Head (3A)	5
L02	0E00701A	Screw M3x10 Philips Binding Head (Bronze)	4	L05	0E00037A	Earth Lug 8-5	1
L03	0E00253A	Washer 3.3mm	4	L06	0J03512A	Capacitor Holder Washer	4
	0M03619A	Gate Bind Plate	1	L07	0E00667A	Screw M4x6 Philips Pan Head (2A)	4
C01	**JA03104A**	**Main Chassis Ass'y**	**1**	L08	0J03511A	Transformer Holder Washer	4
01	JA03109A	Main Chassis Sub Ass'y	1	L09	0E00709A	Washer 5mm Spring	4
02	0B07092U	Power SW.	1	L10	0E00513A	Nut Hex. M5	4
03	BA03779A	Indicator SW. P.C.B. Ass'y	1	L11	0E00727A	Screw M4x8 Philips Pan Head (2A)	2
04	0J03469A	SW. Shade	2	L12	0E00726A	Screw M4x15 Philips Pan Head (3A)	1
05	BA03777A	Output P.C.B. Ass'y	1	L13	0E00142A	Washer 2.6mm	2
06	0B06085A	Silicon Diode S15VB-20	1				
07	0B05874A	Cement Resistor 6.8Ω 10W	1				
08	BA03778A	Relay P.C.B. Ass'y	1				
09	0B05873B	Electrolytic Capacitor 39,000μF 63V	2				

6.4. Main Chassis Ass'y (C01)

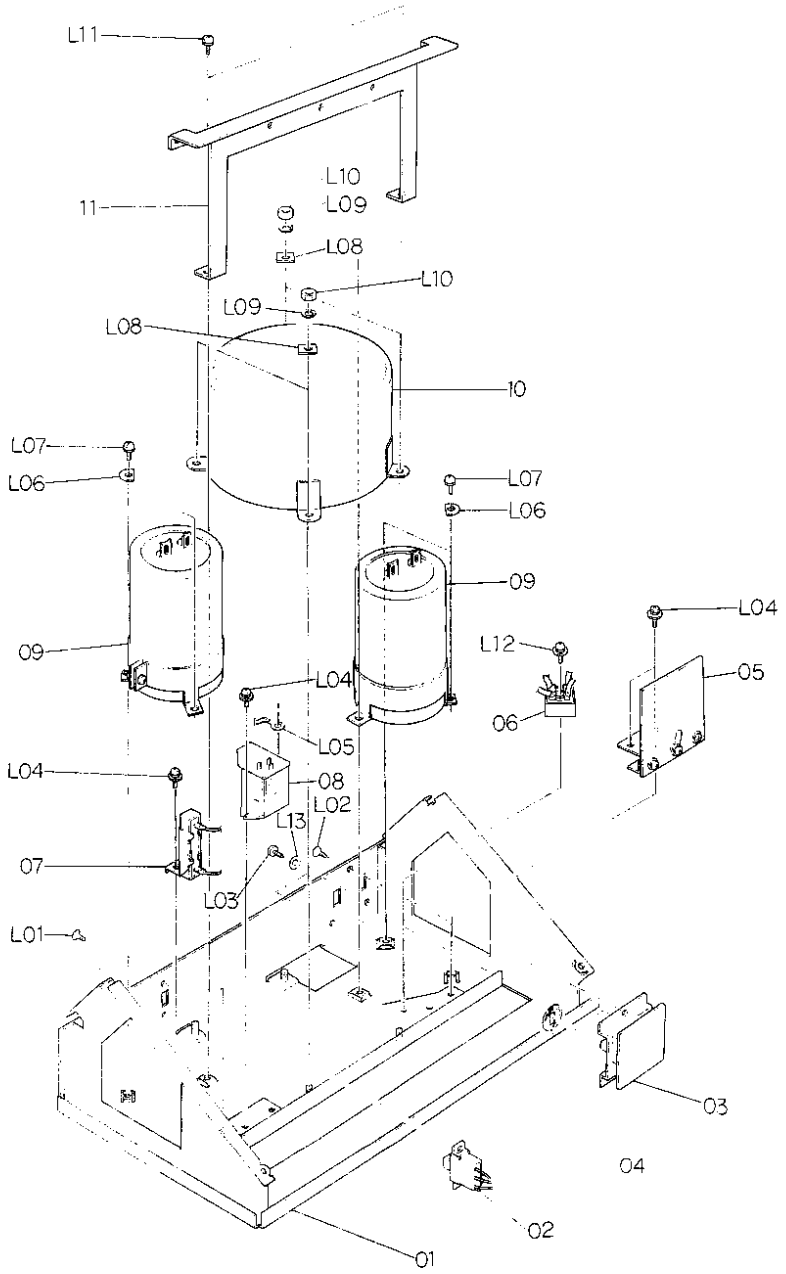


Fig. 6.4

6.5. Front Panel Ass'y (C02)

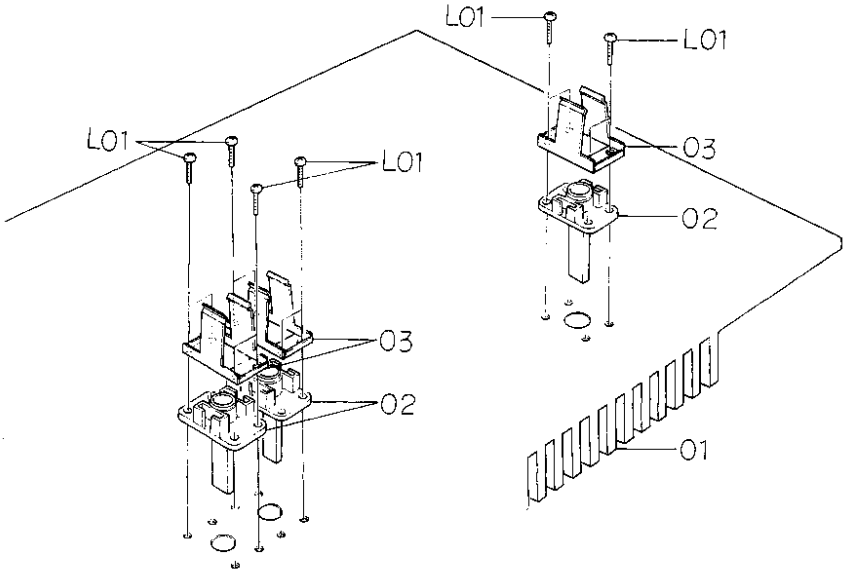


Fig. 6.5

6.6. Rear Panel Ass'y (C03)

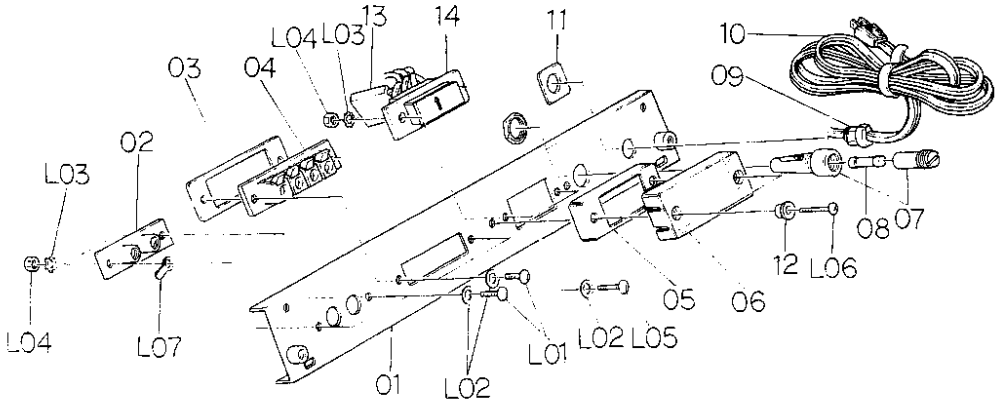


Fig. 6.6

6.7. Indicator Lamp Ass'y (C04)

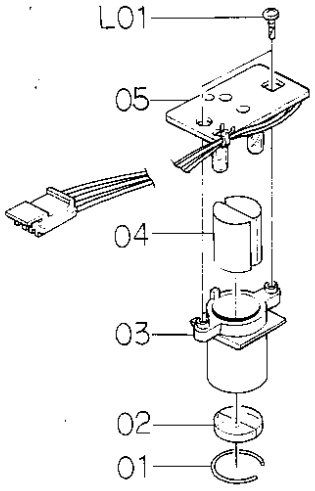


Fig. 6.7

6.8. Power Lamp Ass'y (C05)

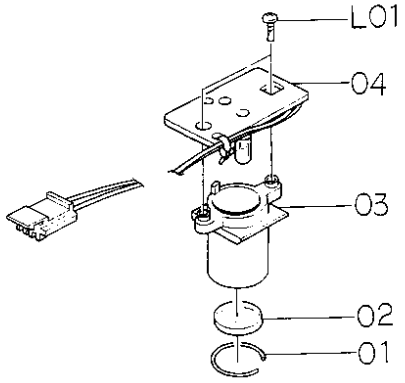


Fig. 6.8

Schematic Ref. No.	Part No.	Description	Q'ty
C02	**HA03658A**	**Front Panel Ass'y**	**1**
01	0H03452B	Front Panel	1
02	0H03453C	Indicator Base	3
03	0J03559B	Lamp House Holder Spring (B)	3
L01	0E00740A	Screw M2x8 Cylinder Head	12
C03	**JA03108A**	**Rear Panel Ass'y**	**1**
01	JA03110A	Rear Panel Sub Ass'y	1
02	0B03072A	2P Pin Jack	1
03	0J03502A	Push Terminal Holder	1
04	0B08233U	Push Terminal	1
05	0H03335A	Voltage Selector Cover S0	1
06	0H03334B	Acrylic Cover	1
07	0B08231U	Fuse Socket	1
08	0B08230U	Fuse 3.15A (220, 240V)	1
08	0B08232U	Fuse 5A (100, 117V)	1
09	0B08037U	Cord Bush (C)	1
10	0B03900U	Power Cord	1
11	0A03154B	Cord Spacer	1
12	0H03366A	Washer for/Voltage Selector Cover	2
13	0B08240U	Spark Killer	1
14	0B03877U	Voltage Selector Socket	1
L01	0E00594A	Screw M3x8 Philips Pan Head (Bronze)	4
L02	0E00157A	Washer 3mm (Black)	6
L03	0E00172A	Washer 3mm Toothed Lock	4
L04	0E00507A	Nut Hex. M3	4
L05	0E00590A	Screw M3x12 Philips Pan Head (Bronze)	2
L06	0E00591A	Screw M3x20 Philips Pan Head (Bronze)	2
L07	0E00037A	Earth Lug B-5	1

Schematic Ref. No.	Part No.	Description	Q'ty
C04	**JA03106A**	**Indicator Lamp Ass'y**	**2**
01	0J03509A	Filter Stopper	1
02	JA03111A	Filter Ass'y	1
03	0J03489A	Lamp House	1
04	0J03507C	Light-Intercepting Plate	1
05	BA03783A	Indicator Lamp P.C.B. Ass'y	1
L01	0E00724A	Screw M2.6x5 Philips Pan Head (Tapping)	2
C05	**JA03105A**	**Power Lamp Ass'y**	**1**
01	0J03509A	Filter Stopper	1
02	0J03490A	Orange Filter	1
03	0J03489A	Lamp House	1
04	BA03782A	Power Lamp P.C.B. Ass'y	1
L01	0E00724A	Screw M2.6x5 Philips Pan Head (Tapping)	2

7. WIRING DIAGRAM

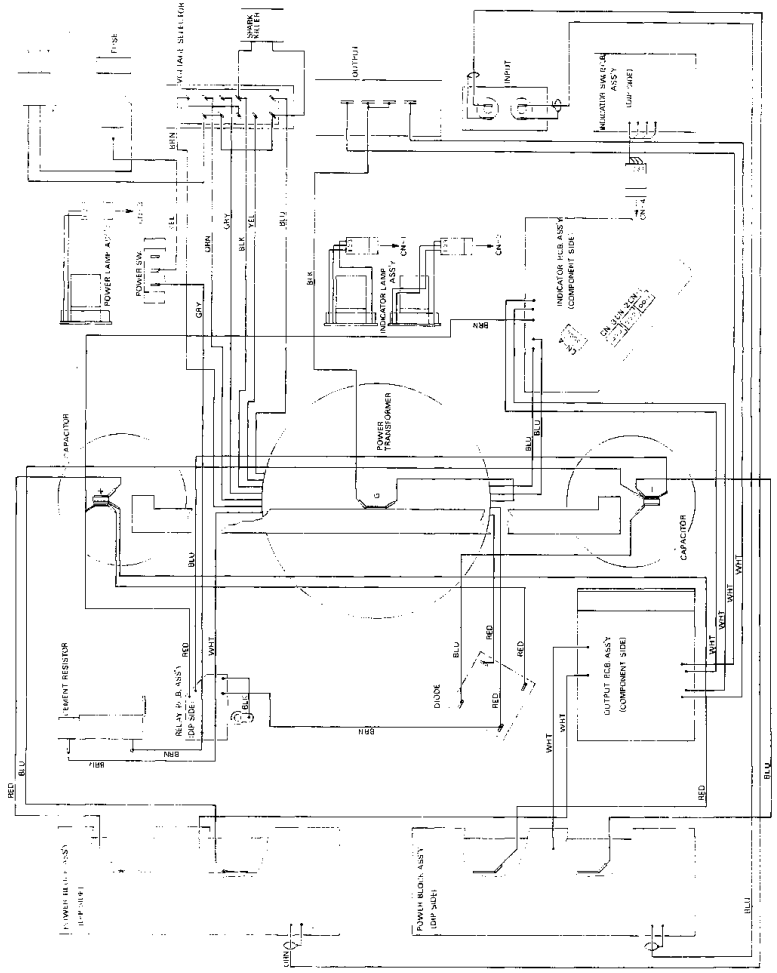


Fig. 7

8. PERFORMANCE DATA

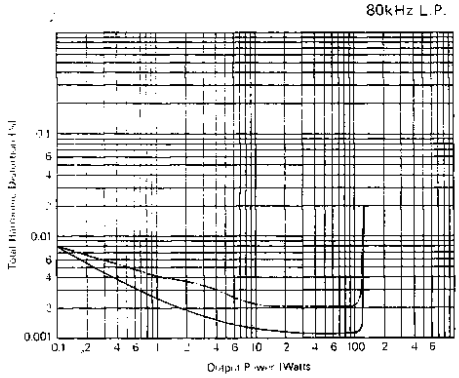
Output vs Total Harmonic Distortion

——— : 1kHz

— - — - — : 10kHz

Load Imp: 8 ohms

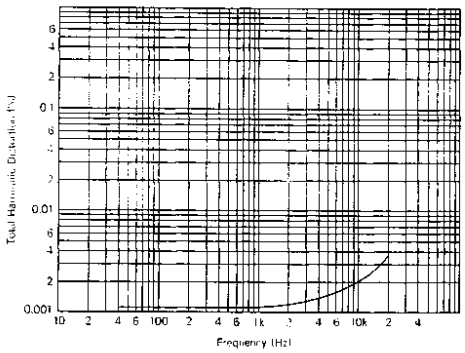
Filter: 400Hz H.P.
80kHz L.P.



Frequency vs Total Harmonic Distortion

Output: 100 Watts Constant

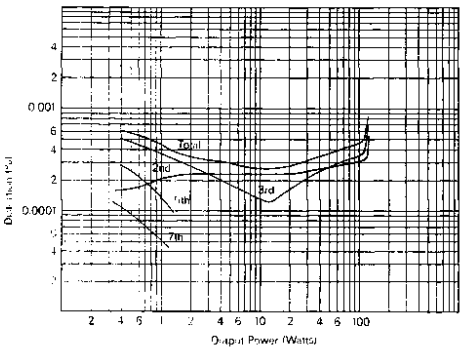
Load Imp: 8 ohms



Output vs Harmonic Distortion

Frequency: 1kHz

Load Imp: 8 ohms



The distortion data immediately above was obtained with the aid of a Brüel & Kjær 2348 Real Time Analyzer. These measurements cannot be made with conventional distortion analyzers because of noise factors.

Output Power vs IM Distortion

60Hz : 7kHz (4 : 1)

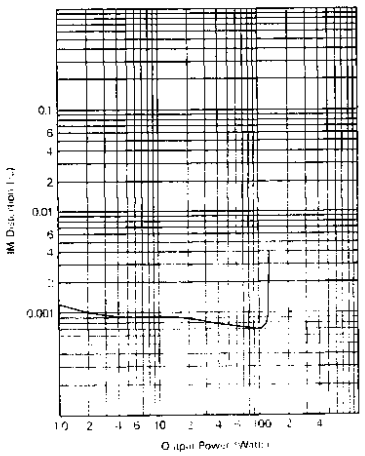


Fig. 8

9. BLOCK DIAGRAM

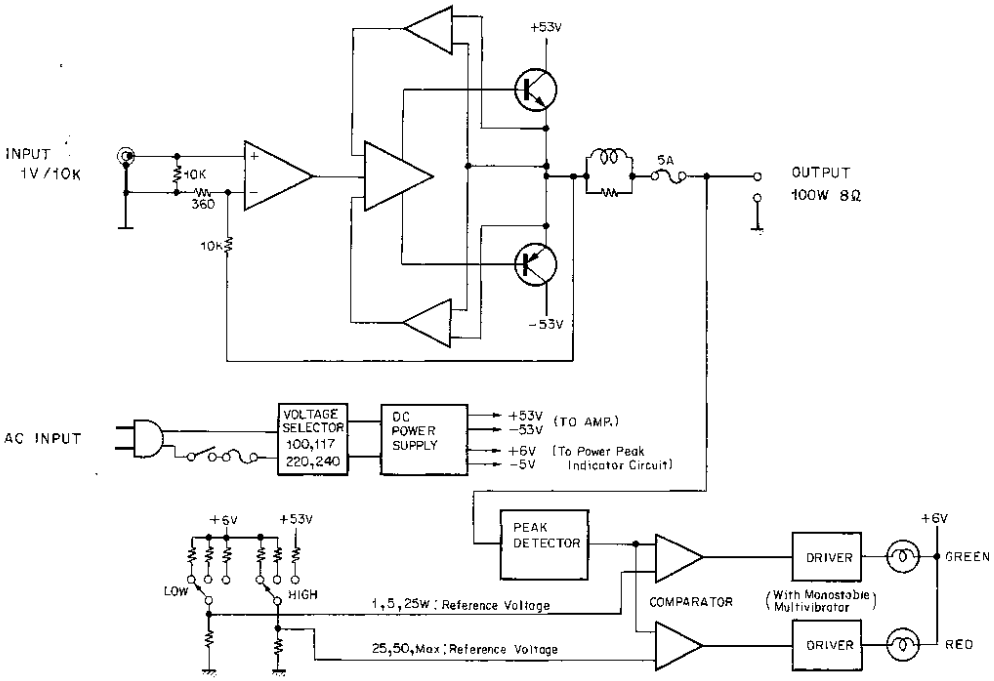
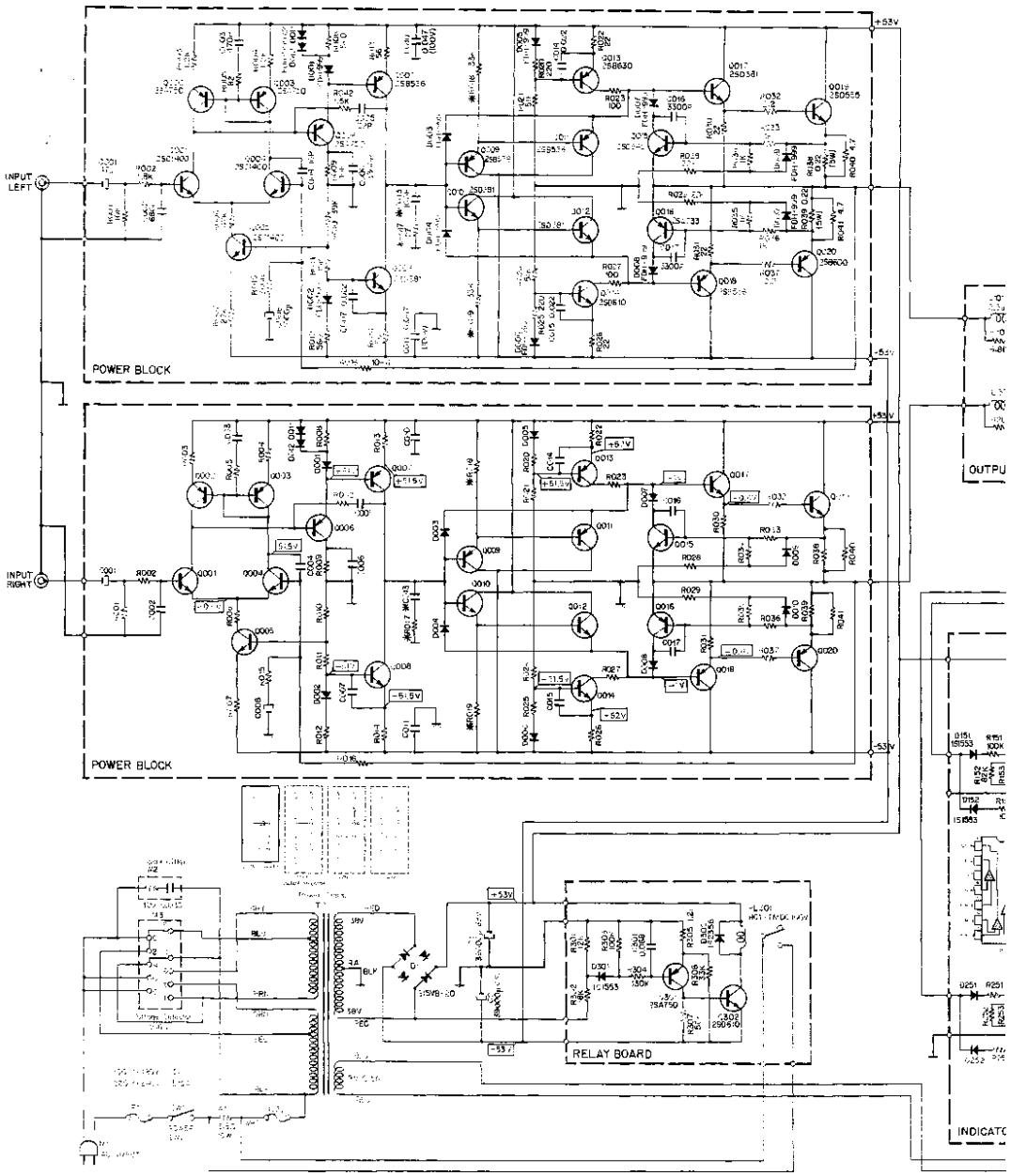


Fig. 9

10. SCHEMATIC DIAGRAM



Note: 1. [ ] shows the reference circuit voltage at approx. 30 watts output.

2. In the power block circuit, resistor R018,019 and capacitor C013 (* marks) are the parts for adjustment, and so typical value is shown.

11. SPECIFICATIONS

Power Source	100/117/220/240 V AC, 50/60 Hz
Power Consumption	50 VA at idling
	700 VA with both channels driven to clipping into 8 ohm loads
Power Output	100 Watts per channel minimum continuous sine wave ("RMS") at 8 ohms, 5–20,000 Hz with less than 0.01%THD
	50 Watts per channel at 16 ohms
IHF Power Bandwidth (both channels driven)	5 – 50,000 Hz for less than 0.1%THD
	5 – 20,000 Hz for less than 0.01%THD
	5 – 10,000 Hz for less than 0.005%THD
Damping Factor	Greater than 100 (1 KHz, 8 ohms)
Total Harmonic Distortion	Less than 0.002% @ 1 KHz or below
	Less than 0.005% @ 10 KHz or below
Intermodulation Distortion	Less than 0.002% (60 Hz: 7 KHz, 4:1, 8 ohm load, 100 W output)
Frequency Response	5 – 100,000 Hz +0, -1 dB
Input Impedance	10 K ohms
Residual Noise Level	Less than 0.05 mV (IHF A Network)
	Less than 0.1 mV (linear)
Signal-to-Noise Ratio	Better than 120 dB at rated output (IHF A, input shorted)
Crosstalk	Better than -70 dB @ 1 KHz
Peak Power Indicators	Green at 1 W, 5 W, 25 W, selectable
	Red at 25 W, 50 W, Maximum (110–130 W) selectable
	(Response time: responds to 0.1 ms pulse – off after 0.3 sec)
Dimensions	15.75"(W) x 7.44"(H) x 9.76"(D)
	400mm (W) x 189mm (H) x 248mm (D)
Weight	27.6 lbs. (12.5 kg)

- Specifications and appearance design are subject to change for further improvement without notice.

Service Manual

Nakamichi 620

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0-709108 Printed in Japan

Service Information

NAKAMICHI

Model Nakamichi 620 (Power Amplifier)
Serial No. from 4104902

No. OOD-M-0044 (1/5)
Date 1 September, 1977

Subject Addition of Protector Circuit

I. General:

A. Purpose:

A protector circuit has been added to prevent speakers from breakage, as the breakage of transistors in 620 would induce possible breakage of the speaker.

Note: When the protector circuit is activated (speaker terminals shorted with relay contacts), the power supply for 620 is required to be once switched off so as to release the protecting function. The power should again be supplied for at least 5 minutes after switching off.

B. Modification:

Additional Parts:

Part No. BA03865A Protector P.C.B. Ass'y .... 1 pce.
0J03687A E.P. Stud A .... 2 pcs.
0E00030A Washer 3mm .... 1 pce.

Modified Parts:

Main Chassis Ass'y .... Part No. has been changed from JA03104A to JA03104B (including Protector P.C.B. Ass'y).

Mechanism Ass'y ..... Part No. has been changed from JA03103A to JA03103B (including Protector P.C.B. Ass'y).

C. Principle of Operation:

The protector circuit aims at protecting the speaker with a shortcut from the speaker terminals to GND by operating the relay in Protector P.C.B. Ass'y when D.C. voltage is impressed between speaker terminals against any possible accident.

The time length required for protector to operate are specified as below according to D.C. voltages (either plus or minus) impressed between the speaker terminals:

D.C. Voltage between Speaker Terminals	Time required till Protector operates
50V DC	approx. 0.5 sec or less
20V DC	approx. 1.2 sec ± 30%

D.C. Voltage between Speaker Terminals	Time required till Protector operates
10V DC	approx. 2.5 sec ± 30%
5V DC	approx. 4 ∿ 10 sec

Once the protector circuit is activated, the protecting state is retained until the power supply to 620 is disconnected to release it.
The power should be supplied after power capacitors are fully discharged (for approximately 5 minutes or more).

Note: The protector circuit in 620 may occasionally be activated if a high transient D.C. voltage is delivered from the preamplifier connected with 620 at the time when the power supply for the preamplifier is turned on.
The cause is not from any trouble in 620.
For its countermeasure, the power for 620 is recommended to be supplied last of all.

II. Parts List:

Part No. BA03865A Protector P.C.B. Ass'y .... 1 pce.
0J03687A E.P. Stud A .... 2 pcs.
0E00030A Washer 3mm .... 1 pce.

Schematic Ref. No.	Part No.	Description
	BA03865A	Protector P.C.B. Ass'y
	0B07727A	Protector P.C.B.
Q401,402 403	0B06078A	Transistor 2SC1400
Q404	0B06074A	Transistor 2SA750
D401,402	0B01909A	Silicon Diode 1S1555
D403	0B06109A	Silicon Diode GP08B
ZD401	0B06073A	Zener Diode 10S
ZD402	0B06002A	Zener Diode 15R
R401,402	0B01921A	Carbon Resistor 330K ERD-25V J
R403,404 407	0B05650A	Carbon Resistor 12K ERD-25V J
R405,406	0B01781A	Carbon Resistor 1K ERD-25V J
R408	0B05593A	Carbon Resistor 150K ERD-25V J
R409,410	0B01920A	Carbon Resistor 100K ERD-25V J
R411,414	0B05607A	Carbon Resistor 180 ERD-25V J
R412	0B01795A	Carbon Resistor 4.7K ERD-25V J
R413,415	0B01833A	Carbon Resistor 10K ERD-25V J
C401,402	0B05885A	Electrolytic Capacitor 100μF 10V
C403	0B01290A	Ceramic Capacitor 0.01μF 50V
RY401	0B07171A	Relay HB-2T

Ⅲ. Mounting Diagram and Schematic Diagram:

Refer to Figs. 2 and 3.

Ⅳ. Modification Procedures for the Current Models:

Following shows the way how to assemble the Protector P.C.B. Ass'y in the current Models.

A. Parts to be required:

Part No. BA03865A	Protector P.C.B. Ass'y	.... 1 pce.
0J03687A	E.P. Stud A	.... 2 pcs.
0E00030A	Washer 3mm	.... 1 pce.

B. Modification Procedures:

Refer to Fig. 1.

1. Disassemble the Cabinet by removing five screws.
2. Remove two screws from the Relay P.C.B. Ass'y and replace with E.P. Studs. Note to add a washer as shown in the figure.
3. Loosen the screw which fixes the cement resistor 6.8Ω 10W to the chassis, then move the cement resistor to prevent contacting the Protector P.C.B. Ass'y.
4. Assemble the Protector P.C.B. Ass'y.
5. Disassemble the Rear Angle by removing two screws.
6. Solder the signal wires (WHT,WHT) of the Protector P.C.B. Ass'y to the speaker terminal (output terminal) plus side of both channels.
7. Solder the RED wire of the Protector P.C.B. Ass'y to the plus terminal (RED wires are already soldered) of the capacitor C1 39,000μF 63V.
8. Solder the BLU wire of the Protector P.C.B. Ass'y to the minus terminal (BLU wires are already soldered) of the capacitor C2 39,000μF 63V.
9. Bind these wires at an appropriate point.
10. Assemble the Rear Angle.
11. Assemble the Cabinet.

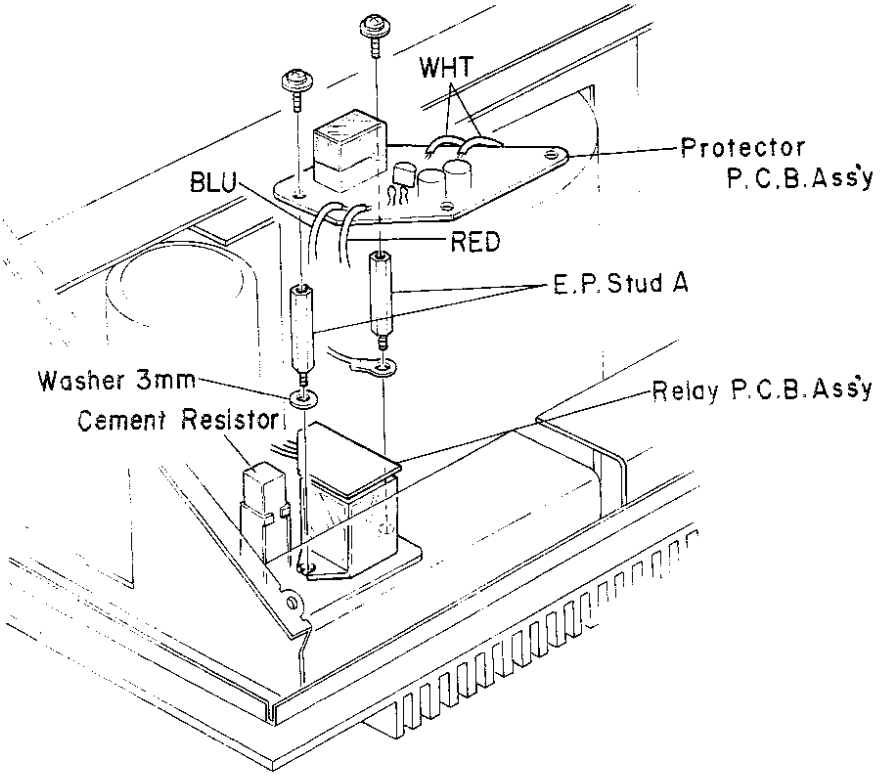


Fig. 1

Protector P.C.B. Ass'y Mounting Diagram

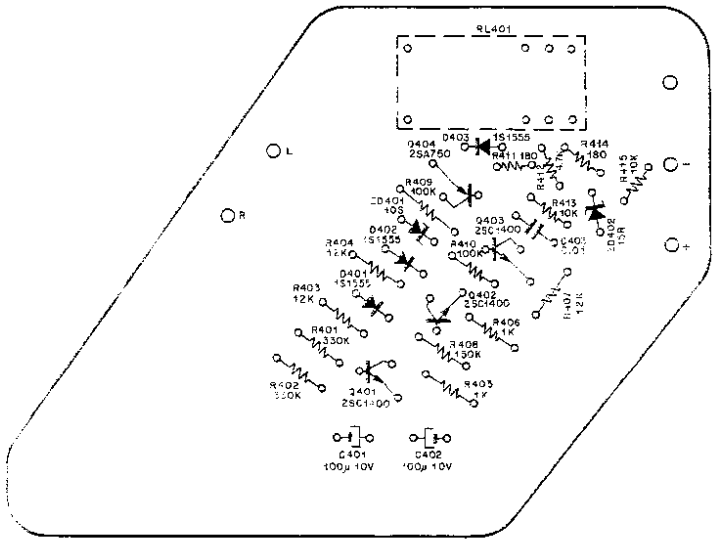


Fig. 2

Schematic Diagram

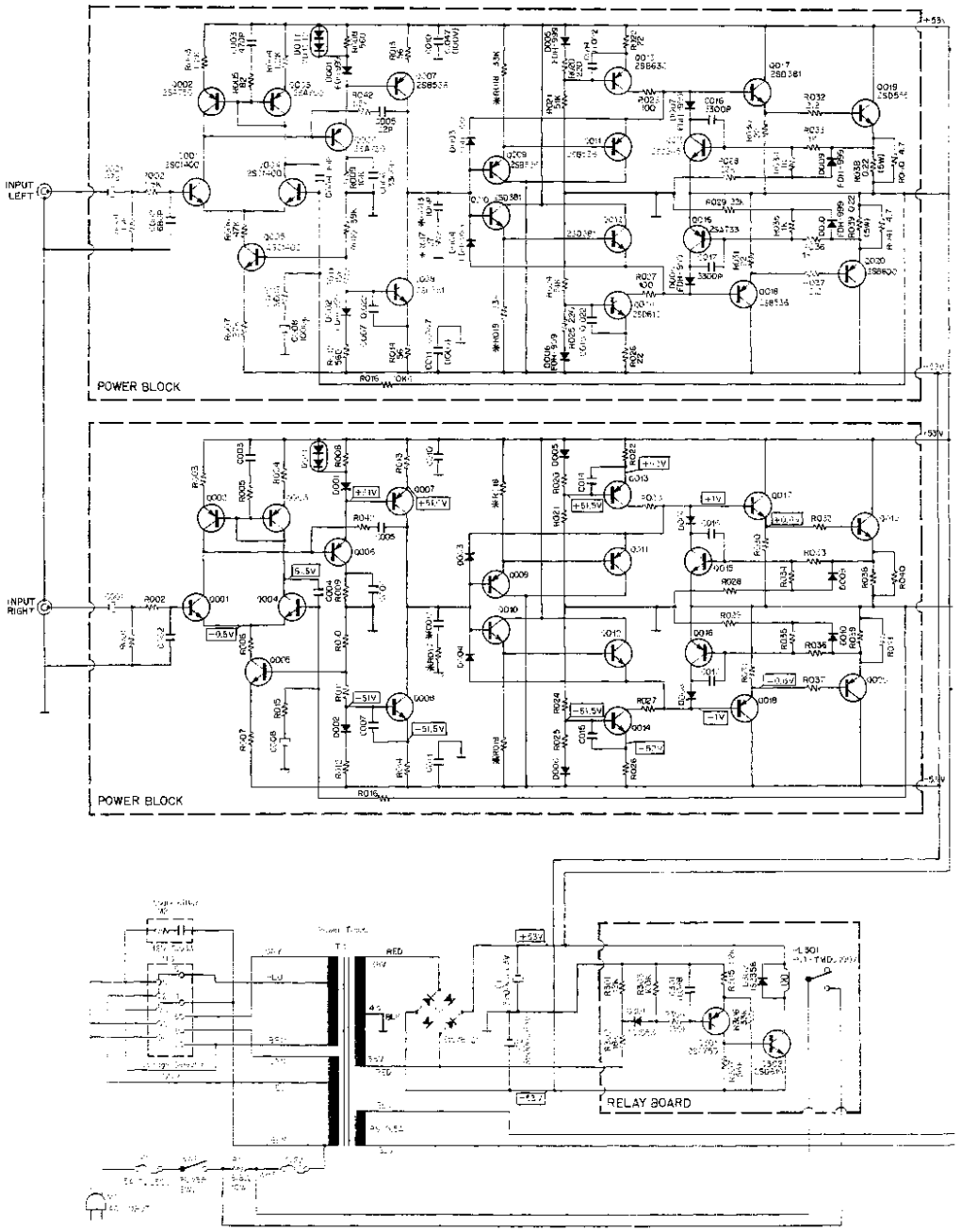
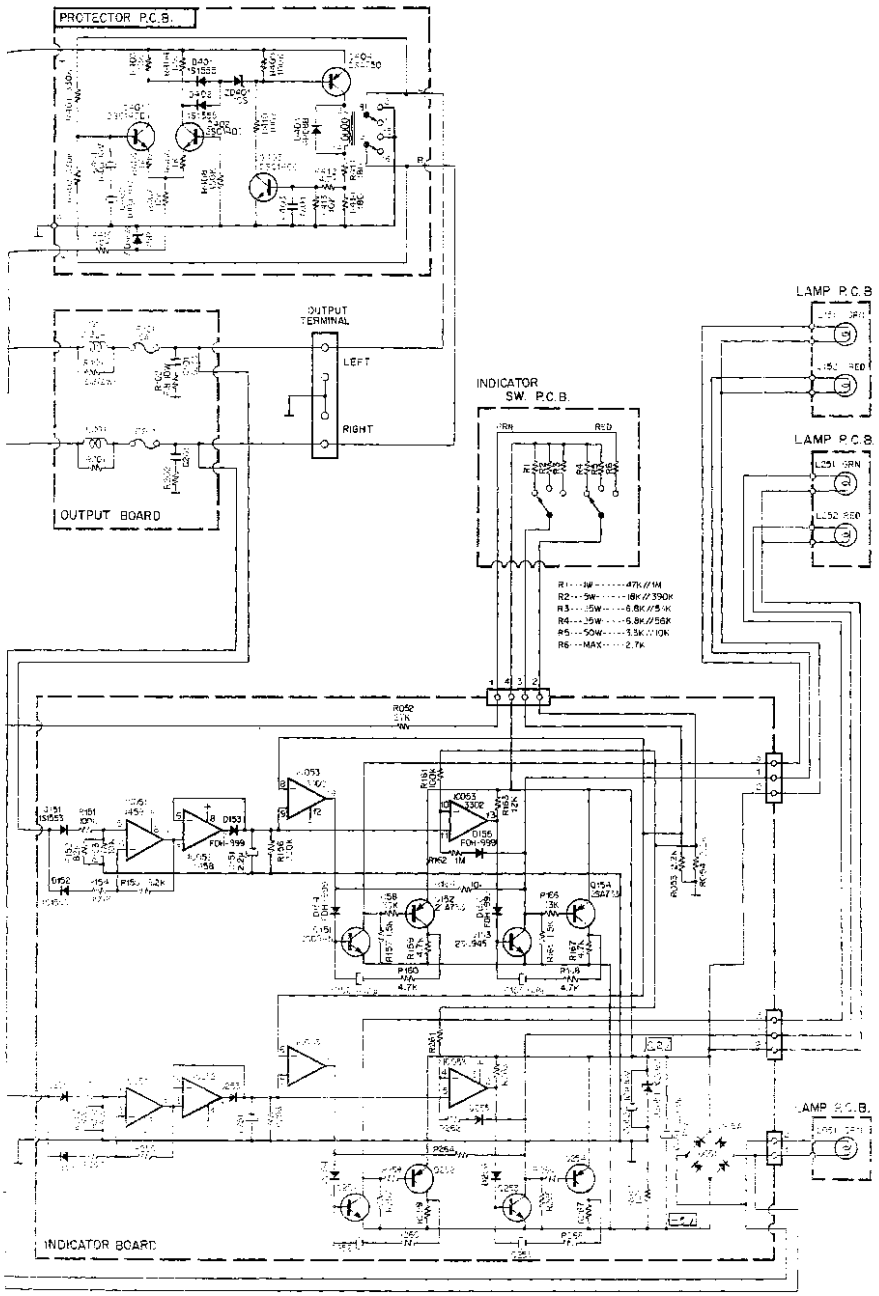


Fig. 3


PROTECTOR P.C.B.
OUTPUT TERMINAL
LEFT
RIGHT
OUTPUT BOARD
INDICATOR SW. P.C.B.
GRN
RED
LAMP P.C.B
LAMP P.C.B
LAMP P.C.B.
INDICATOR BOARD

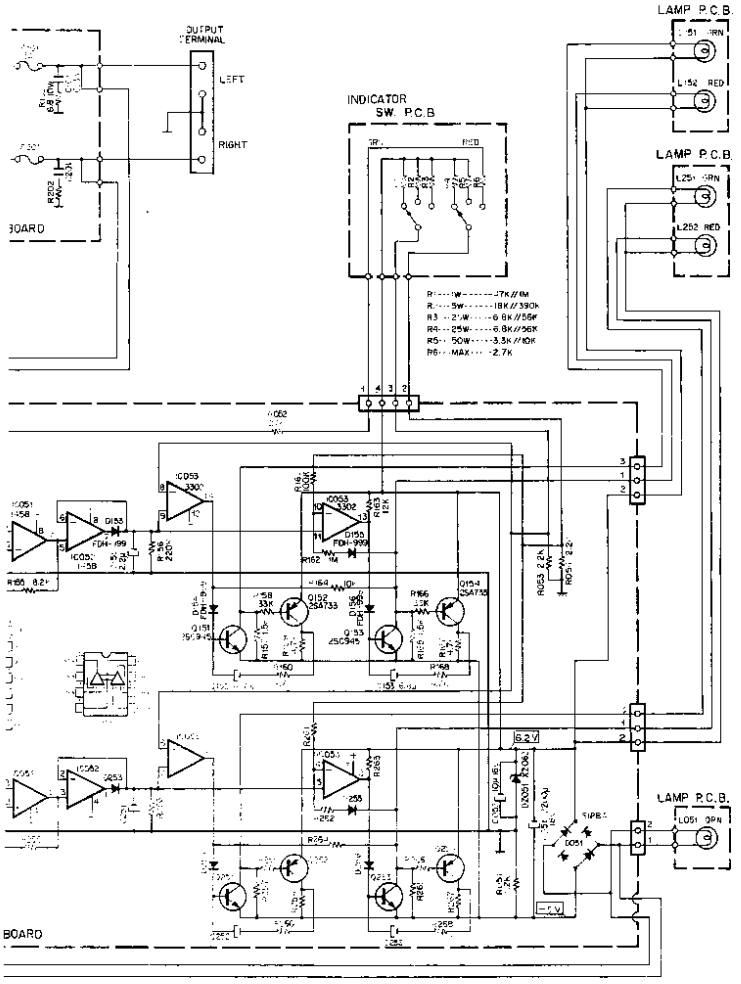

OUTPUT TERMINAL
LEFT
RIGHT
INDICATOR SW. P.C.B
LAMP P.C.B.
LAMP P.C.B.
LAMP P.C.B.
BOARD
BOARD

Fig. 10