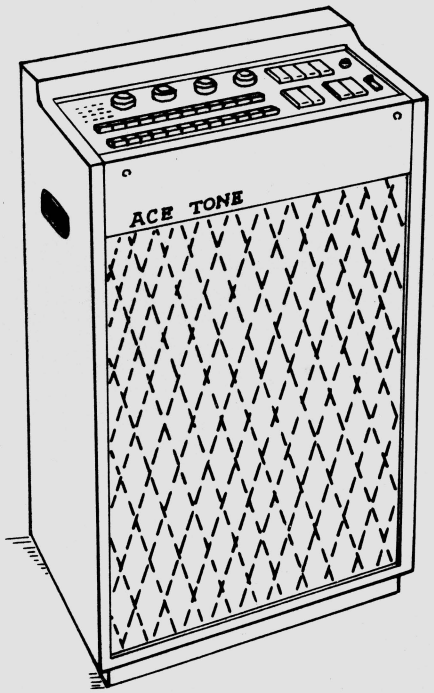
RHYTHM ACE

SERVICE NOTE

MODEL FR-70

THE SECOND EDITION



ACE ELECTRONIC IND. INC.

TOKYO HAMAMATSU OSAKA JAPAN

I N D E X

SECTION 1. SPECIFICATIONS

1. Summary

1-1. Rhythm Selector	12 Push Button Switches(CS series)		2 PCS.
	Rotary Switch		1 PCE.
1-2. Rhythm	Jazz section	Rock'n Roll 1, Rock'n Roll 2, Dodompa, Slow Rock, Ballad, Western, 6/8 March, Jazz Waltz, Waltz.	
	Ratin section	Rhumba, Beguine, Cha-Cha, Mambo 1, Mambo 2, Samba 1, Samba 2, Baion, Merengue, Bossanova, Bolero, Tango.	
	Variation 2beat	Bass drum, Bass & Snare drum, Fox trot 1, Swing 1, March, Parade.	
	Variation 4beat	Bass drum, Bass & Snare drum, Fox trot 2, Swing 2, Swing 3, Shaffle.	
1-3. Voices	Bass drum, Low conga, Low bongo, High bongo, Cow bell, Rim shot, Maracas, Claves, Snare drum, Cymbal, High hats, Tambourine, Guiro.		
1-4. Cancel Botton	Bass drum, Snare drum, Cymbal, Guiro.		
1-5. Type	Setting Type		
1-6. Semiconductors	Silicon transistors		30 PCS.
	Silicon diodes		169 PCS.
	IC		1 PCE.
	Light emitting diode		1 PCE.

2. Appearance

2-1. Dimension	Width 450 mm, Highth 740 mm, Depth 270 mm
2-2. Weight	20Kg
2-3. Finish	Walnut slice veneer
2-4. Accessory	Foot switch (FS-2)
2-5. Controler	Start-Stop, Silent-Sound, Volume control, Tempo control, Balance control.
2-6. Others	Foot switch jack(for start), Expression terminal jack, EXT. output jack, EXT. input jack, Pilot lamp(used as both Power and Tempo Pilot)

3. Electricity

3-1. Output	Max. 25W (8Ω loard)

	EXT. Output	Max. 1Vp-p
3-2. Power supply	100V, 117V, 200V, 220V, 230V, 240V.	50/60Hz
3-3. Power consumption	40VA	
3-4. Tempo of beat	Waltz	16.5 - 133beats/min.
	Rock'n Roll	12.5 - 100beats/min.

SECTION 2. THEORY OF OPERATION

Rhythm ACE FR-70 consists of six elemental sections and a power supply. The first elemental section is operation system for rhythm patterns, including a master oscillator, a reset circuit, and a tempo lamp. The second elemental one is rhythm selector system which selects pulse patterns coming out of the operation system. The third is voice generator system, and the fourth is audio-preamplifier. The fifth is the maine amplifier by IC circuit. And the last is the speaker. The following figure 1 shows the abovementioned:

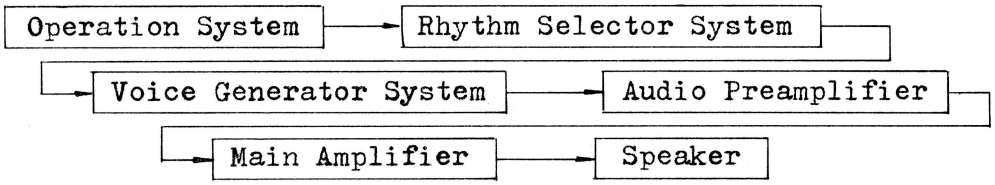


Fig. 1

1. Operation System

The Operation System may be divided into Master Oscillator, Divider, Matrix, Reset and Tempo Lamp. Master Oscillator is a multi-vibrator composed of two transistors. Tempo is controled by adjusting bias voltage of the oscillator, which consists of two semifixed resistors and a potentiometer of series connection. One semifixed resistor is the slowest tempo, and the other semifixed resistor is the fastest tempo. The another one potentiometer which is fixed on the control panel is used by a player for adjusting a very delicate tempo.

Divider is a 5-stage transistor flip-flop counter set for dividing a beat cycle into 1/32 cycle of the Master Oscillator. As a 3/4 beat rhythm must be necessary, the second and third stage divide a beat cycle as the unit of 3 instead of 4 with feedback between the output of the third and second stage of the divider. The output of the stage-four divider is supplied to the base of the transistor Q14 for lighting up the Tempo Lamp. The Tempo Lamp will light up to the first beat. But only for Slow-Rock and Ballad rhythms, light will come on the first and third beat. The control of brightness is adjusted in advance on light-up time. For the Tempo Lamp, a light emitting diode is used. Output of divider are connected to the diode matrix which is taking pulse patterns. Various pulse patterns are used as a trig-

ger of a Voice Generator.

2. Rhythm Selector

The selection of rhythm patterns is made up by a push button switch divided into two stages on the control panel and a rotary switch.

Push buttons at the two stages are separated beat buttons for the Variation section and a Jazz section and Latin section. The gate circuit provides for working on the push of " LATINS " to select the signal from a pulse pattern generator lest two trains of buttons should interfere with each other.

When this button is turned off, the output signal of the diode matrix is biassed by positive voltage and the Voice Generator will not work. Therefore, when the push button " LATIN " is not pushed, even if the button of Latin section is pushed, the rhythm of Latin will not come out. On adjusting the push button to " LATIN ", you are listning to a rhythm of Latin. While you push a Jazz section button, the push button " LATIN " is automatically returned, you will hear a Jazz section rhythm as soon as the Latin rhythm goes out. And yet Rotary Switch for variation works by pushing " 2 BEAT " or " 4 BEAT" button. The necessary pattern of the rhythm indicated by a buttons is connected with the Voice Generator. Buttons of Waltz, Jazz Waltz, Slow Rock, Ballad, 6/8 March, Bolero and Dodompa, provides for the circuit to feed back on the divider for making 3/4 beat. The diodes connected with the rhythm switch help the diode matrix and keep away from affecting Jazz and Latin rhythms to each other.

3. Voice Generator

The Rhythm ACE FR-70 has thirteen Voice Generators including Bass Drum, Low Conga, Low Bongo, High Bongo, Rim Shot, Cow Bell, Claves, Snare Drum, Cymbal, High-Hats, Maracas, Tambourine and Guiro.

Each of Bass Drum, Low Conga, Low Bongo, High Bongo, Rim Shot, Cow Bell and Claves oscillates by electrical imput pulses given to each L-C resonantly circuits of necessary frequency and index decayed oscillation. Drum sound of Snare Drum has a buffer amplifier by transistor in addition to L-C resonantly circuits, and likewise oscillates. For outputs potentiometers may be set in order to control the output level. Cow Bell is combined with binary different frequency oscillators. The outputs of these L-C resonantly circuits are coupled to Audio Preamplifier. The transistor(Q314), reversely biased, provides the basic " White Noise " which is generated in Cymbal, High-Hats, Maracas, Tambourine, Snare Drum and Guiro. The output of Noise Generator is given to the first amplifier and four semifixed resistors are parallelly connected with the collector load of the amplifier.

They are used for adjusting the output level of treble sound including Cymbal, High-Hats, Maracas, Tambourine, Snare Drum and Guiro. The signal affects a tuned amplifier after passing the required envelope circuit. This time it is compounded with " White Noise " signal. The output from the tuned amplifier, moreover, adds to the preamplifier.
Guiro is oscillated by outputs for trigger matrix, exclusively made from the diode matrix outputs, different from other outputs. The other different kind of signal comes into the base of the transistor(Q309), works the multi-vibrator composed of two transistors(Q309 and Q310), and oscillates the diode matrix outputs more closely. This multi-vibrator makes out the efficient percussion sounds of guiro itself. The frequency of the multi-vibrator comes from the bias adjustment of a semifixed resistor for providing beforehand. The output of the multi-vibrator feeds a tuned amplifier with " White Noise " signal. And this tuned amplifier is the narrow band amplifier, and the output passing this amplifier comes into the preamplifier.

4. Audio Output

Both the signal of a high frequency territory and that of a low frequency territory are added to the preamplifier. The outputs feed to the volume control fixed on the control panel. Moreover, it feeds to obtain outputs of the full auto-rhythm instrument through the buffer resistance.

5. Cancel Button

The Rhythm ACE FR-70 has four kinds of Cancel Tablets, such as Buss Drum, Snare Drum, Cymbal and Guiro. When you push the Cancel Tablet, those are cancelled. The cancel switch is inserted to make and break between Rhythm Selector and Voice Generator.

6. Reset Circuit

The reset circuit connected with the master oscillator and the divider is controled by Rocker type Start switch which is set on the control panel. When this switch Rocker tab. is " OFF "(not pushed) the master oscillator and the divider are at a stop. On the other hand, when it is set on "Start" the divider complete the preparation of working to begin with and then the master oscillator will go. Namely, differential time setting is taken for smooth operation. And without fail it starts from the first beat of rhythms. The reset circuit, moreover, shift the bias of a preamplifier to improve S/N, and is connected not to grow a noise signal.

7. Silent Sound

The Rocker Switch of silent is used for turning off audio outputs.
As this switch is set on " Silent ", the audio signal is short-circuit to the ground.

8. Rolling Snare Drum

This tablet is different from other tablets, and when letting go one's hold, it returns automatically. The circuit operates without any relations to Rhythm Selector and directs to sound circuit through the tablet switch from operation circuit.(Not cancelled by CANCEL tablet.) While pressing the tablet, it workes as Rolling Snare Drum and is a circuit synchronizing with Tempo Speed.

9. Manual Symbal

As the tablet of Rolling Snare Drum above, when letting go one's hold, it returns automatically. Cymbal sound comes out once every press. And so Cymbal sound starts in proportion to the numbers and the speed of press. This kind of Cymbal sound is not cancelled by CANCEL tablet.

10. Main Amplifier

Rhythm instrument output is connected with the main amplifier. The Level Set Volume is set to obtain regulative output.

11. EXT. AMP. Jack

EXT. AMP. Jack is an output jack in case of using an external amplifier such as guitar amplifier and stereo set. Output impedance is about 47KΩ. When connecting cord plug is inserted into this jack, the output of this main amplifier is cut-off and no sound comes out of the speaker.

12. Expression Jack

This jack is used as Expression and set to control resistance value between 0 and 10K. Expression effect can be used in case of either operating by external amplifier through EXT. AMP jack, or operating this set only.

13. Input Jack

Regulative 25W output can be obtained in input level 380-400mV.
When high level signal is connected to this jack, decay under the input level above. And also the signal to this jack cannot be controlled by Expression.

14. Start Jack

This jack is used as the input jack for Start switch with foot.

SECTION 3. GENERAL NOTICE

1. Since many delicate parts are used in " RHYTHM ACE ", avoid playing near the fluorescent light, neon light, transformers etc., as they will create undesirable noises.
2. It is absolutely free from sound distortion, but it should be played within the capacity rating of the amplifier. It is always advisable to connect to amplifiers having ample output power.

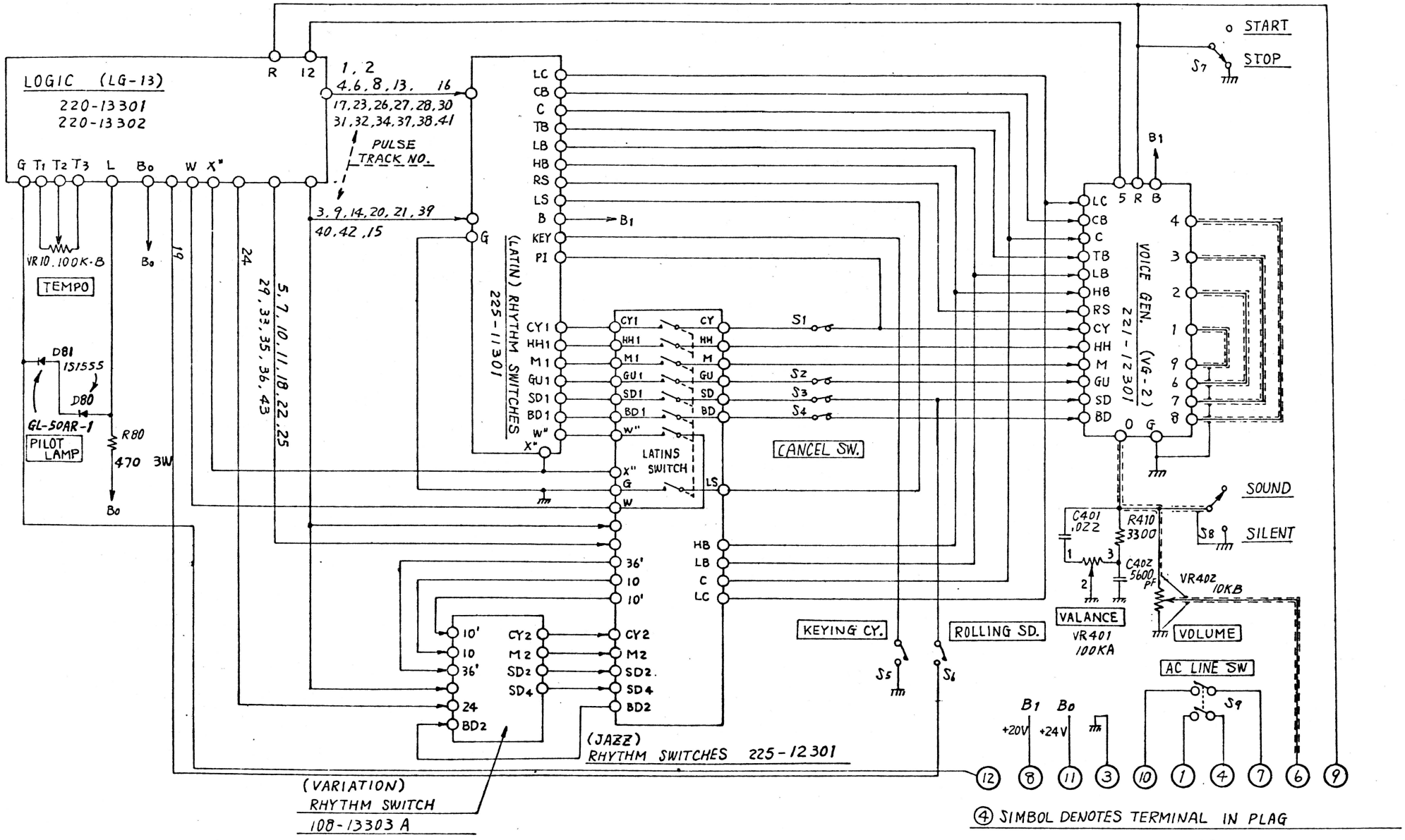
3. Since it covers a very wide range of tones, the quality of tones may very according to the types of amplifiers used. Use any amplifiers having high selective qualities.
4. Avoide using " RHYTHM ACE " in high temperature and humid places, also remember that accumulated dust will take damp.
5. Since the voltage changer used as changing AC voltage is set on the AC voltage in every country, it should not be removed.

SECTION 4. DISASSEMBLING

When disassembling the cabinet, remove 4 wood screws on the rear side of cabinet by a screw driver.

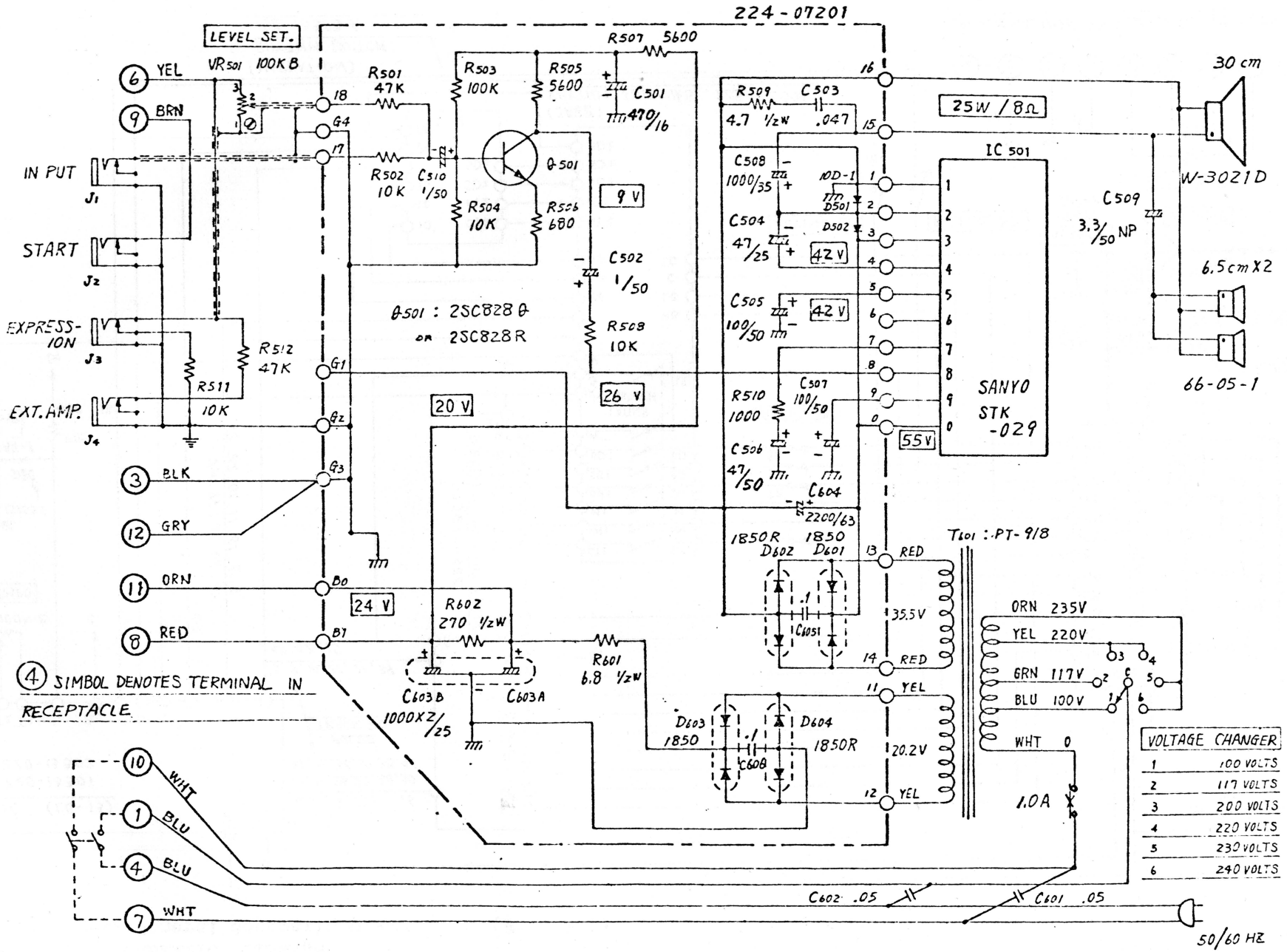
SECTION 5. SCHEMATIC DIAGRAM

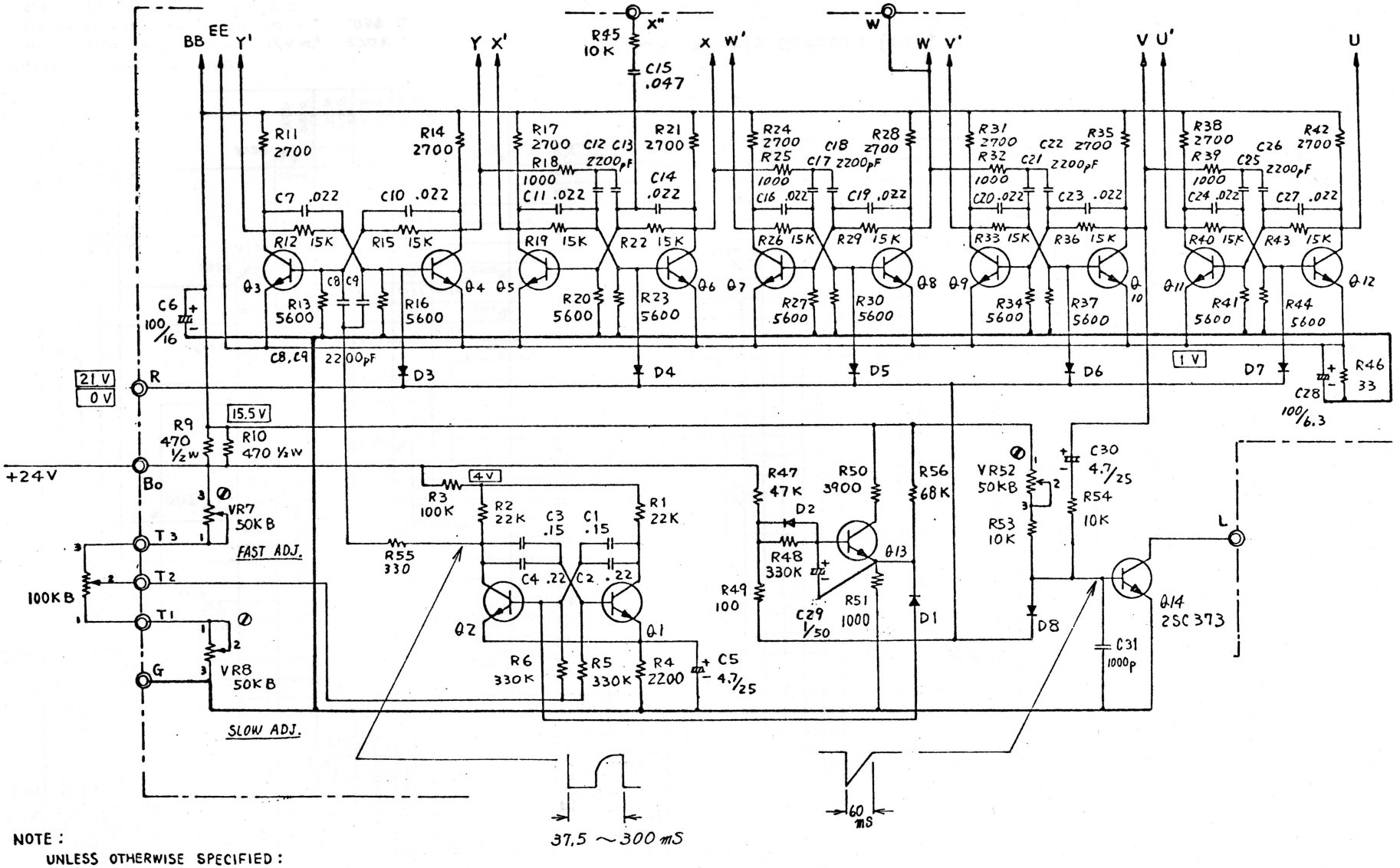
5-1. General Schematic Diagram (Fig. 2-1)



④ SIMBOL DENOTES TERMINAL IN PLAG FOR MAIN AMPLIFIRE TPA-8

(Fig. 2-2)

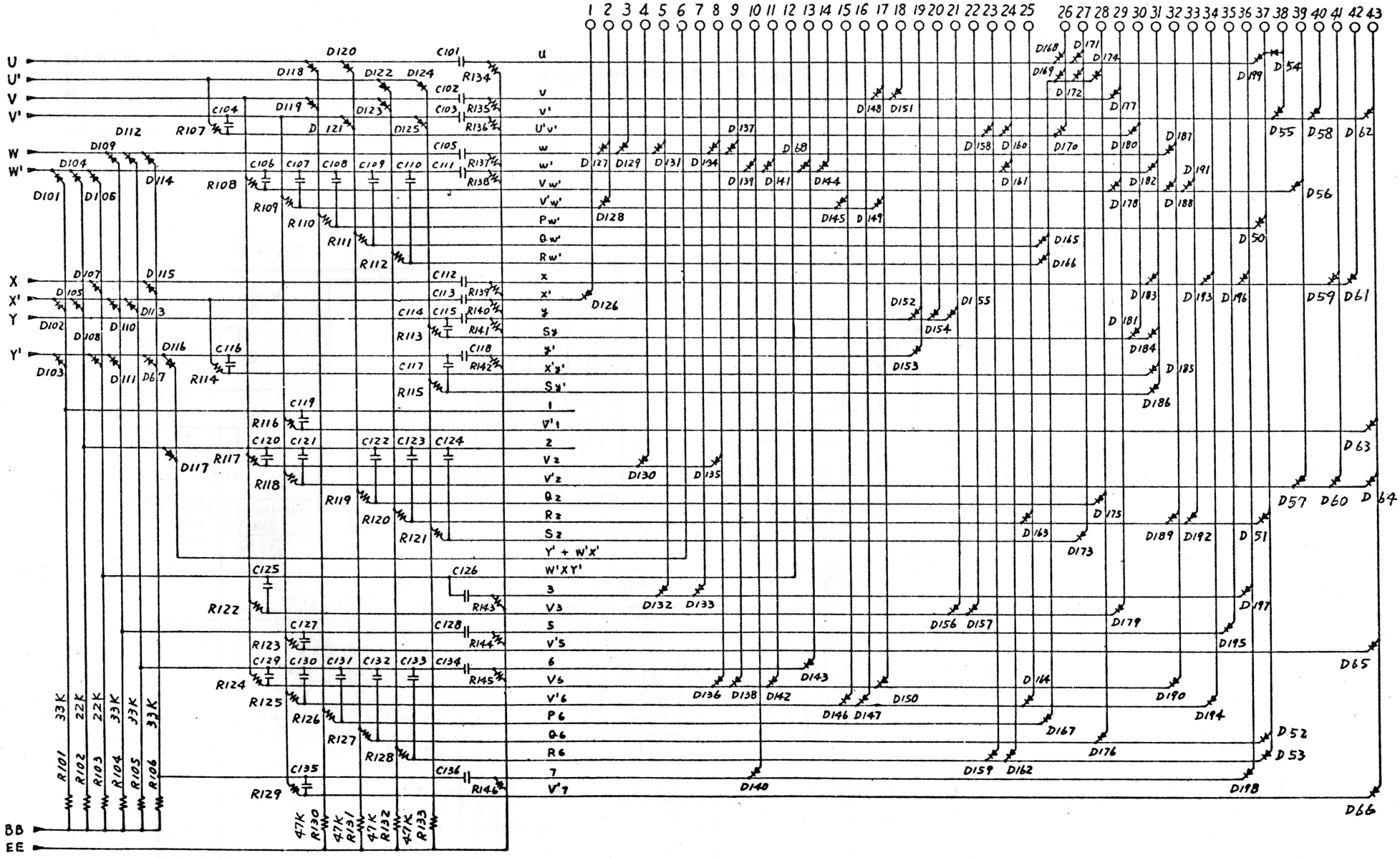

224-07201
LEVEL SET.
VR501 100K B
R501 47K
R502 10K
C510 1/50
R503 100K
R504 10K
R505 5600
R506 680
Q501
C501 470/16
R507 5600
9 V
C502 1/50
R508 10K
Q501 : 2SC828 θ
OR 2SC828R
26 V
20 V
24 V
R602 270 1/2W
C603B 1000X2/25
C603A
R601 6.8 1/2W
R509 4.7 1/2W
C503 .047
C508 1000/35
C504 47/25
C505 100/50
R510 1000
C506 47/50
C507 100/50
C604 2200/63
42 V
55 V
IC 501
SANYO STK -029
25W / 8Ω
30 cm
W-3021D
C509 3.3/50 NP
6.5cm X2
66-05-1
D501 10D-1
D502
1850R D602
1850 D601
C605 .1
35.5V
D603 1850
D604 1850R
C608 .1
20.2V
T601 : PT-9/8
ORN 235V
YEL 220V
GRN 117V
BLU 100V
WHT 0
1.0A
C602 .05
C601 .05
50/60 HZ
YEL
BRN
IN PUT
START
EXPRESS-ION
EXT.AMP.
BLK
GRY
ORN
RED
J1
J2
J3
J4
G4
G1
G2
G3
B0
B1
RED
RED
YEL
YEL
WHT
BLU
BLU
WHT
④ SIMBOL DENOTES TERMINAL IN RECEPTACLE.
VOLTAGE CHANGER
1 100 VOLTS
2 117 VOLTS
3 200 VOLTS
4 220 VOLTS
5 230 VOLTS
6 240 VOLTS



NOTE :

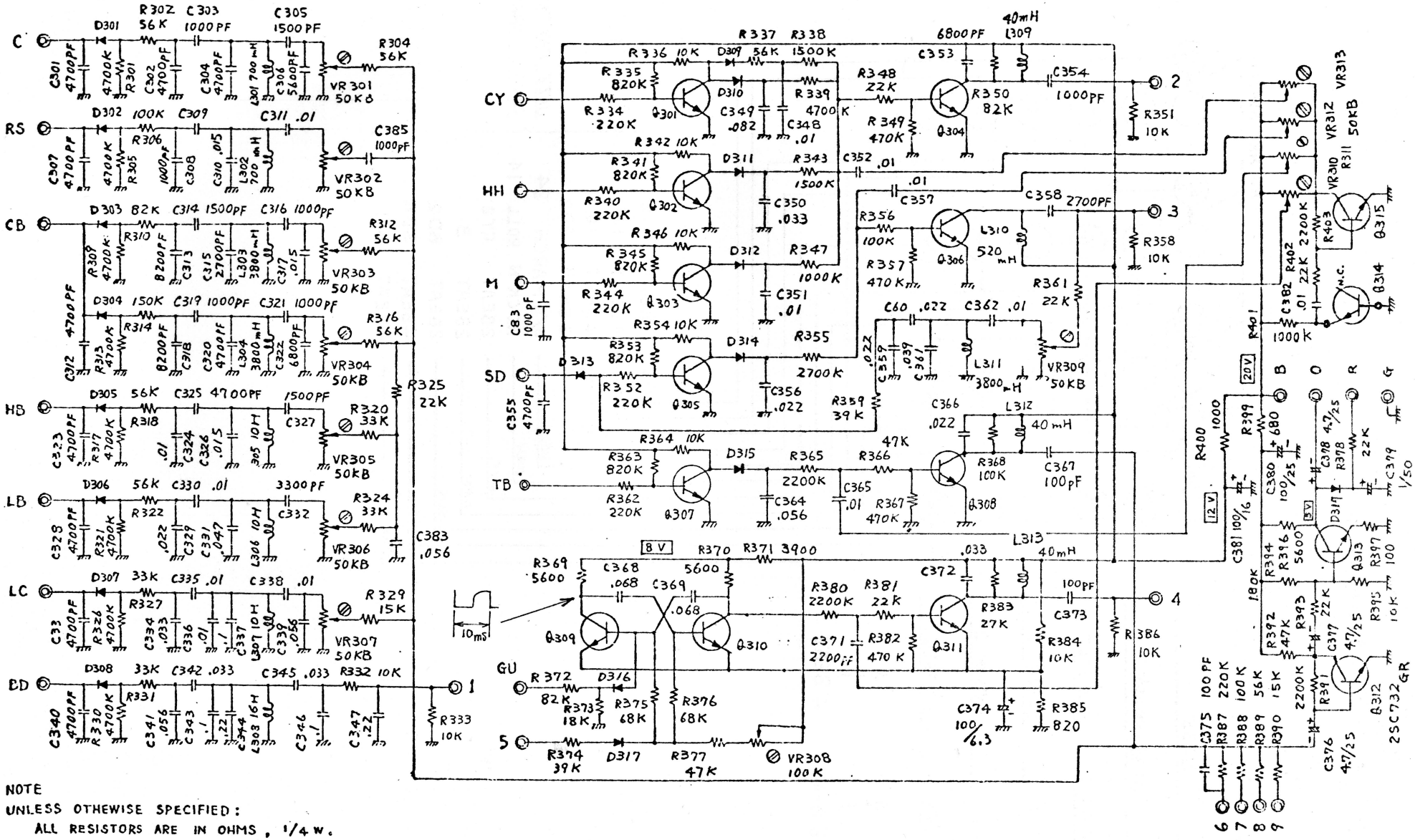
UNLESS OTHERWISE SPECIFIED :
ALL RESISTOR ARE IN OHMS, 1/4W.
ALL CAPACITOR ARE IN MFD.
ALL TRANSISTOR ARE TYPE 2SC372-Y .
ALL DIODE ARE TYPE 1S1555 .

5-2. Logic Circuit (Fig. 3)



UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR ARE IN OHMS, 1/4W, 270K.
ALL CAPACITOR ARE IN MFD, 50 V, .039.
ALL DIODE ARE TYPE 1S1555.

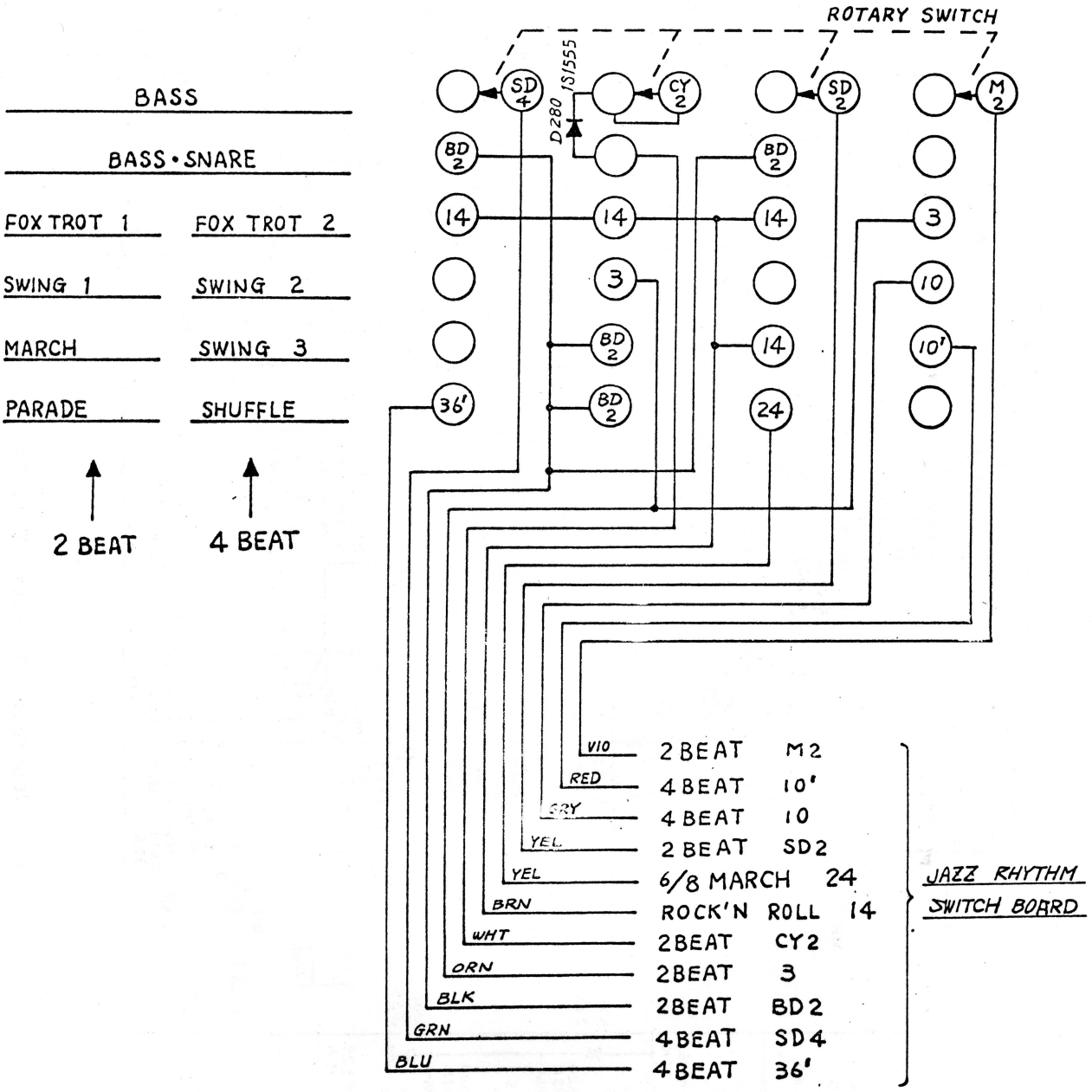
5-3. Matrix Circuit (Fig. 4)



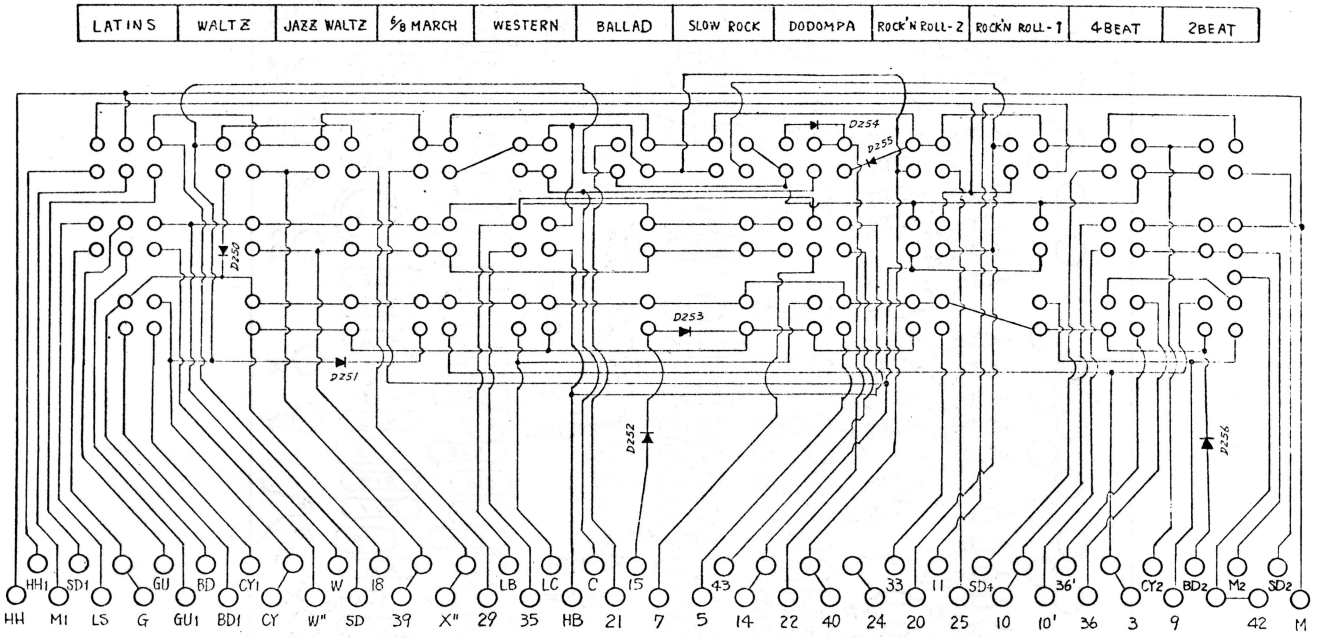
NOTE
UNLESS OTHEWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS, 1/4 W.
ALL CAPACITORS ARE IN MFD.
ALL TRANSISTORS ARE TYPE 2SC372Y.
ALL DIODES ARE TYPE 1S1555.

5-4. Voice Generator Circuit (Fig. 5)

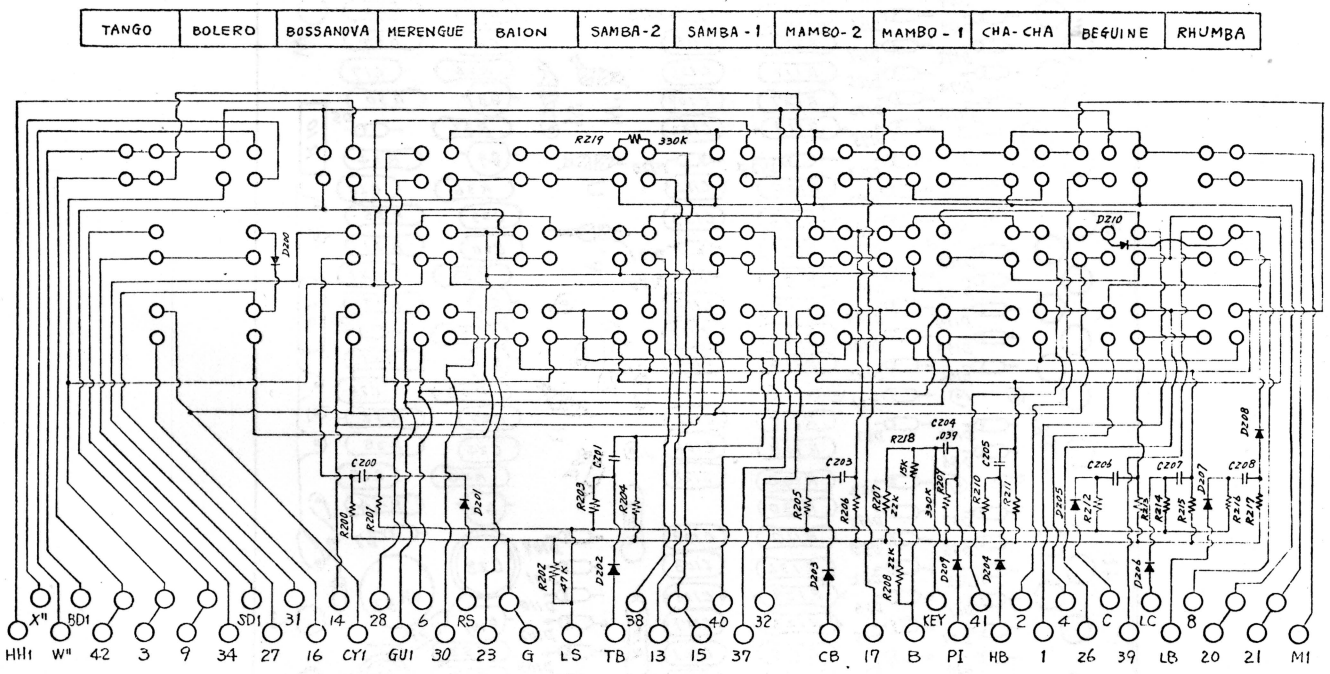
5-5. Variation Section (Fig. 6)



5-6. Rhythm Selector Circuit (Fig. 7)



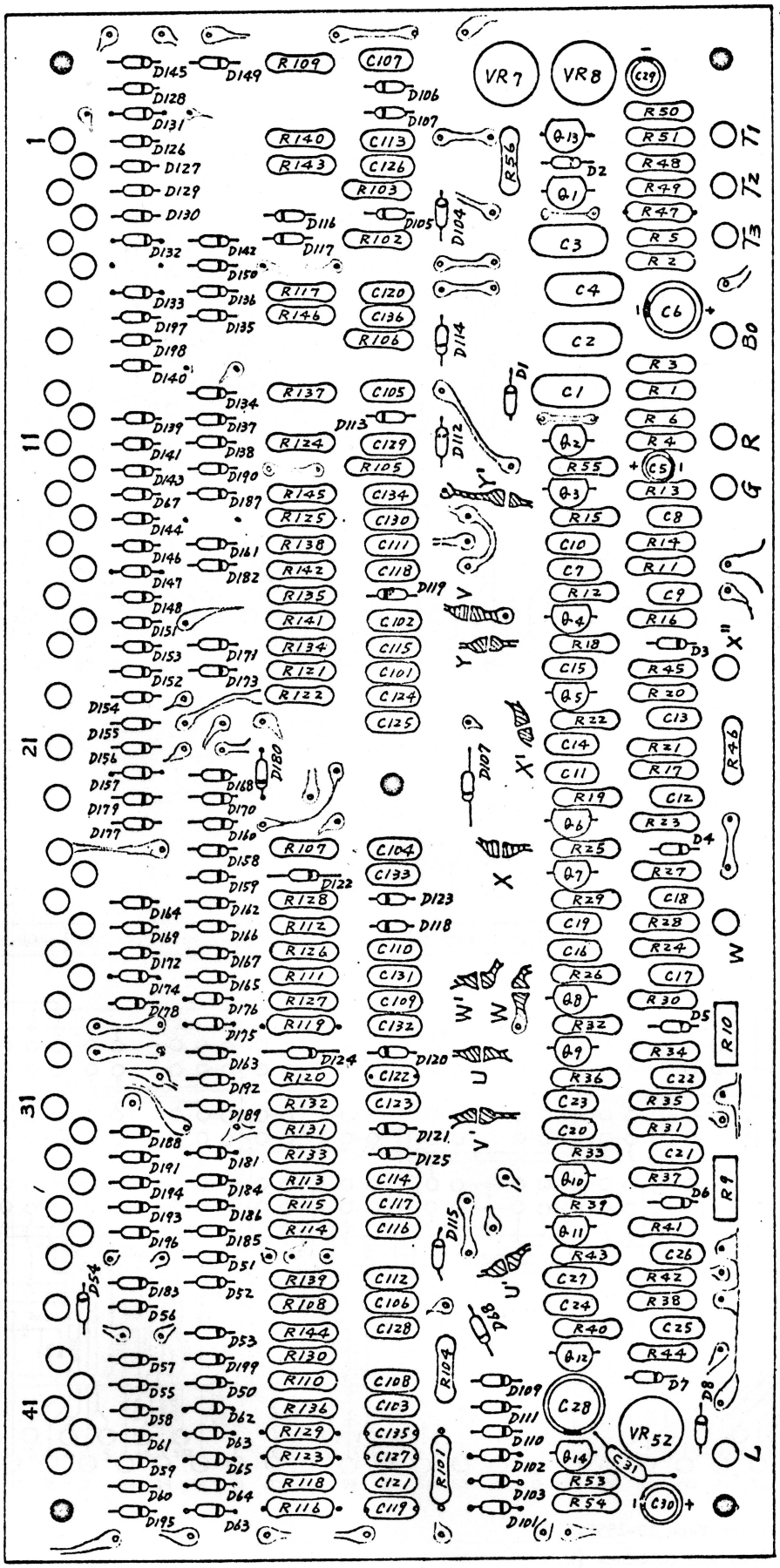
Diodes unmarked are Type 1S-1555.



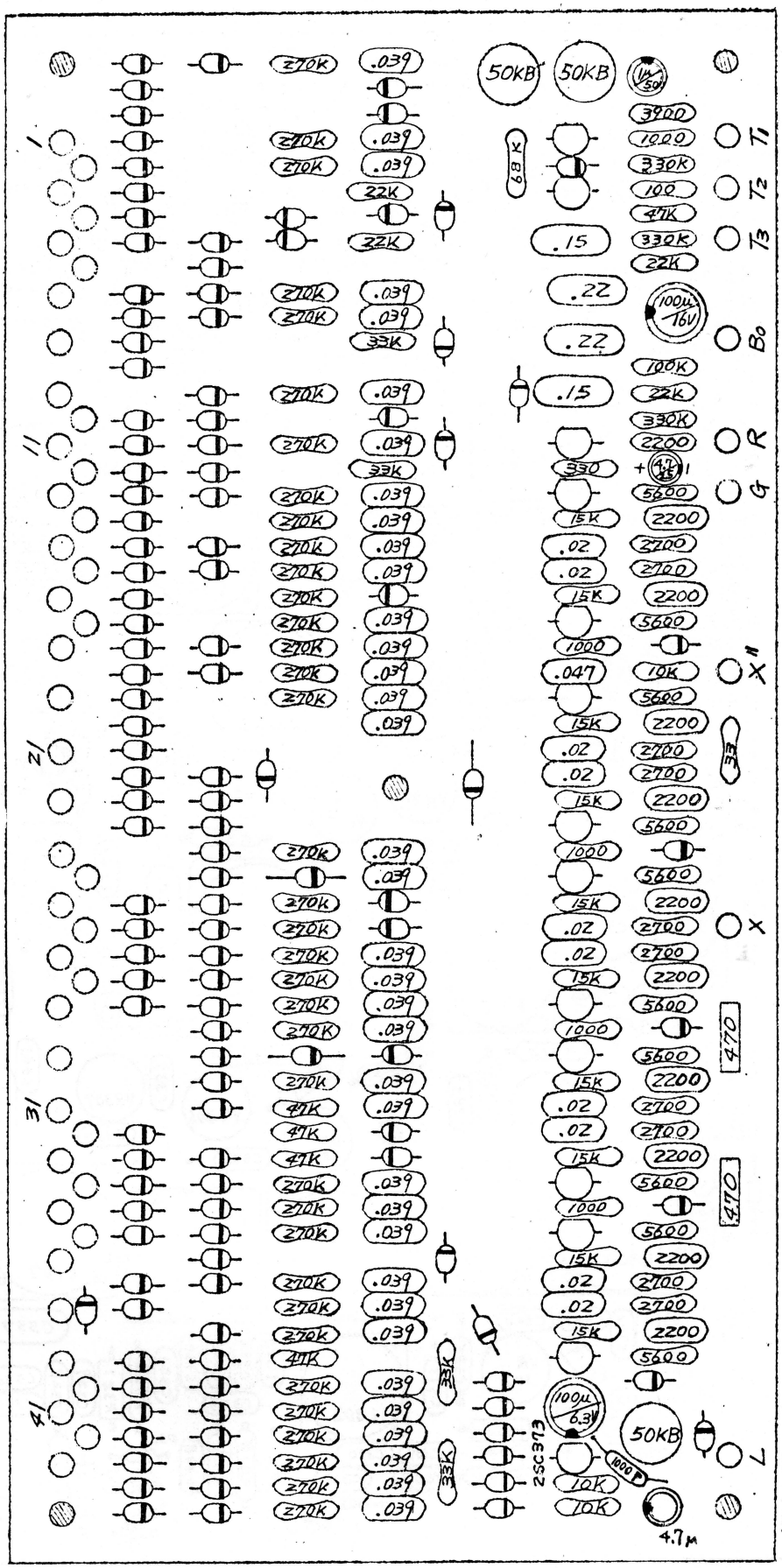
Diodes unmarked are Type 1S-1555.
Resistors unmarked are 1000Kohm $\frac{1}{4}$W.
Capacitors unmarked are 0.1mfd/50V.

SECTION 6. PARTS LAYOUT

6-1. Logic Matrix Board (LG-13) (Fig. 8-1)

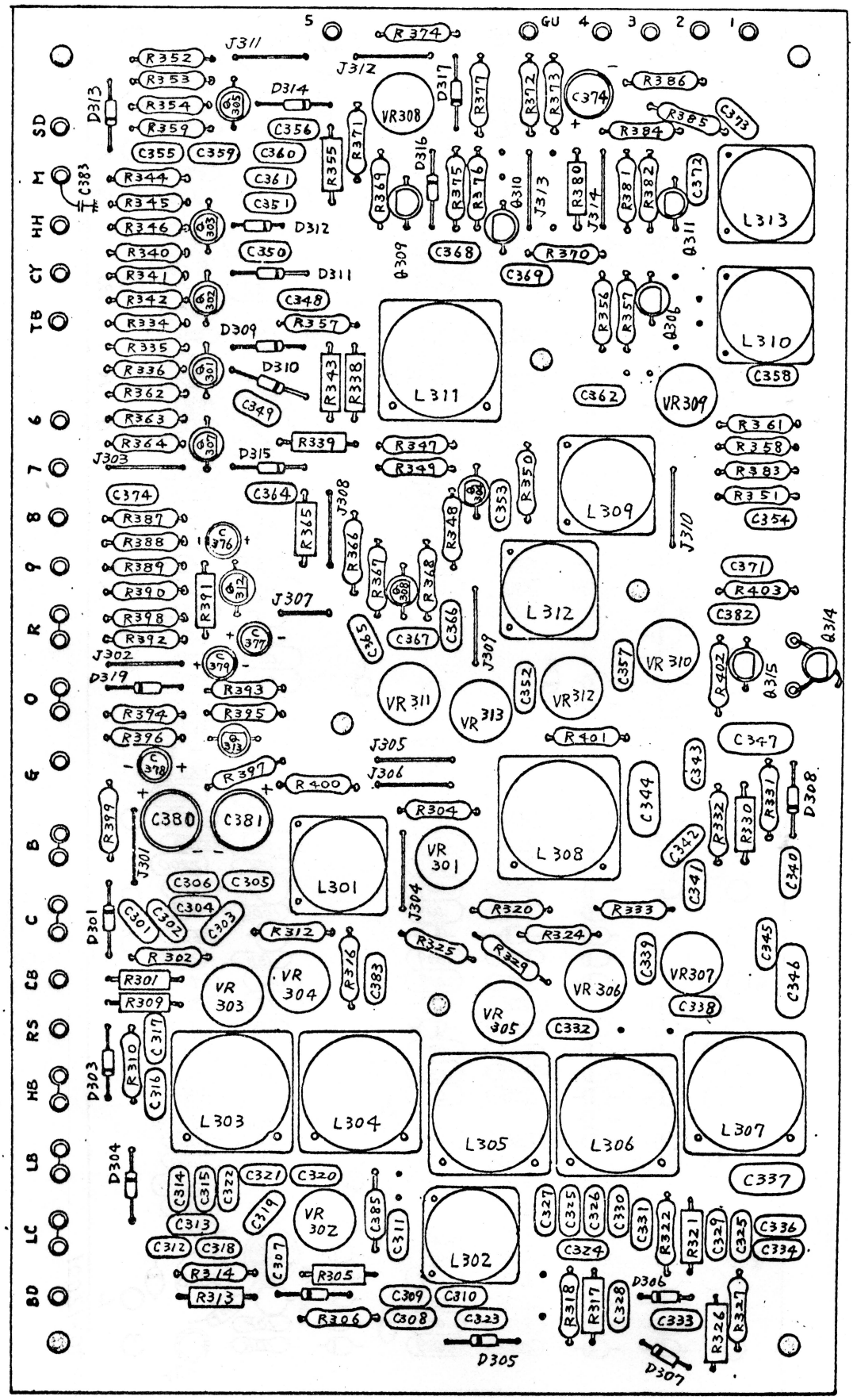


(Fig. 8-2)

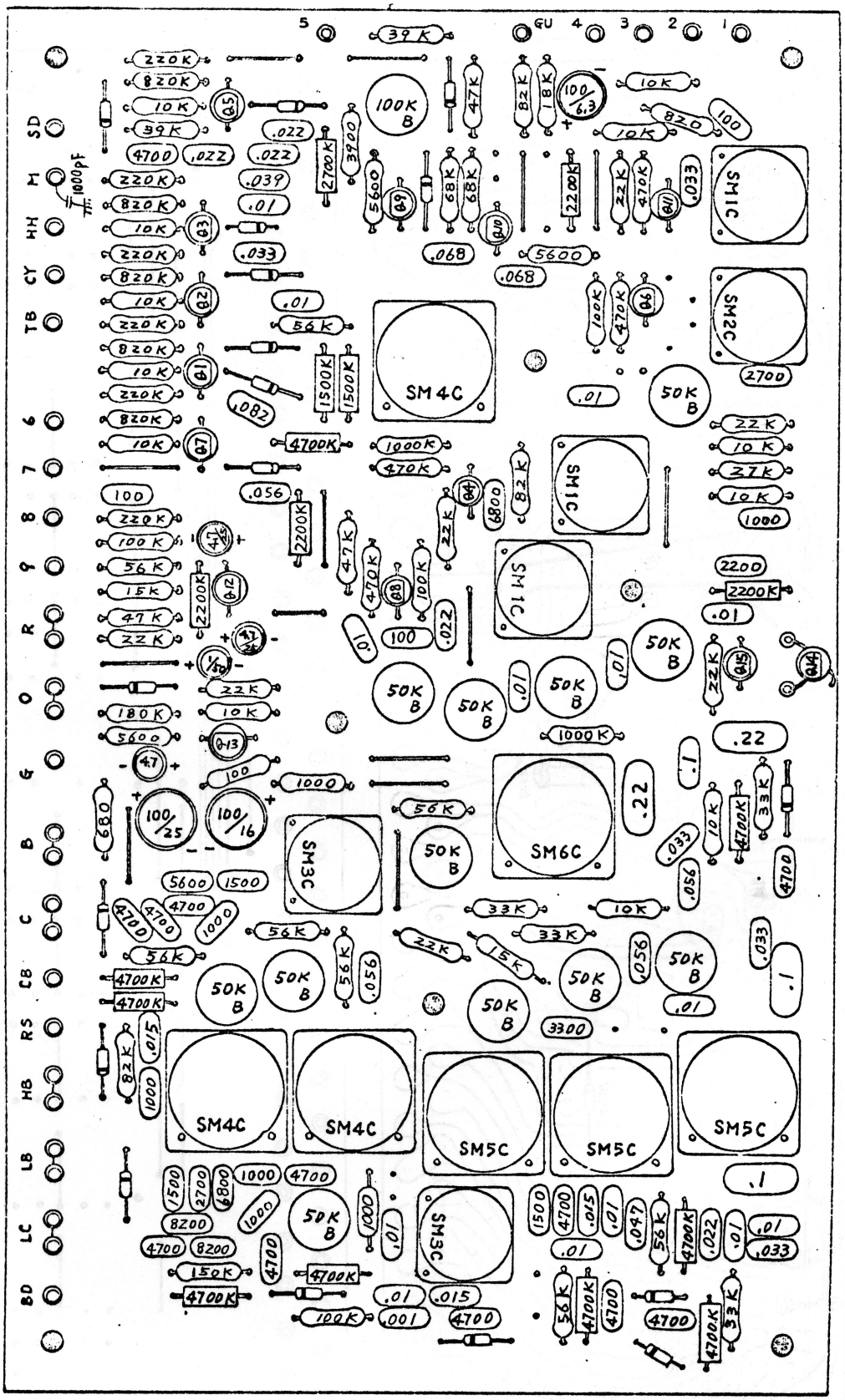


Transistors unmarked are Type 2SC-372Y.
Diodes unmarked are Type 1S1555.

6-2. Voice Generator Board (VG-12) (Fig. 9-1)



(Fig. 9-2)

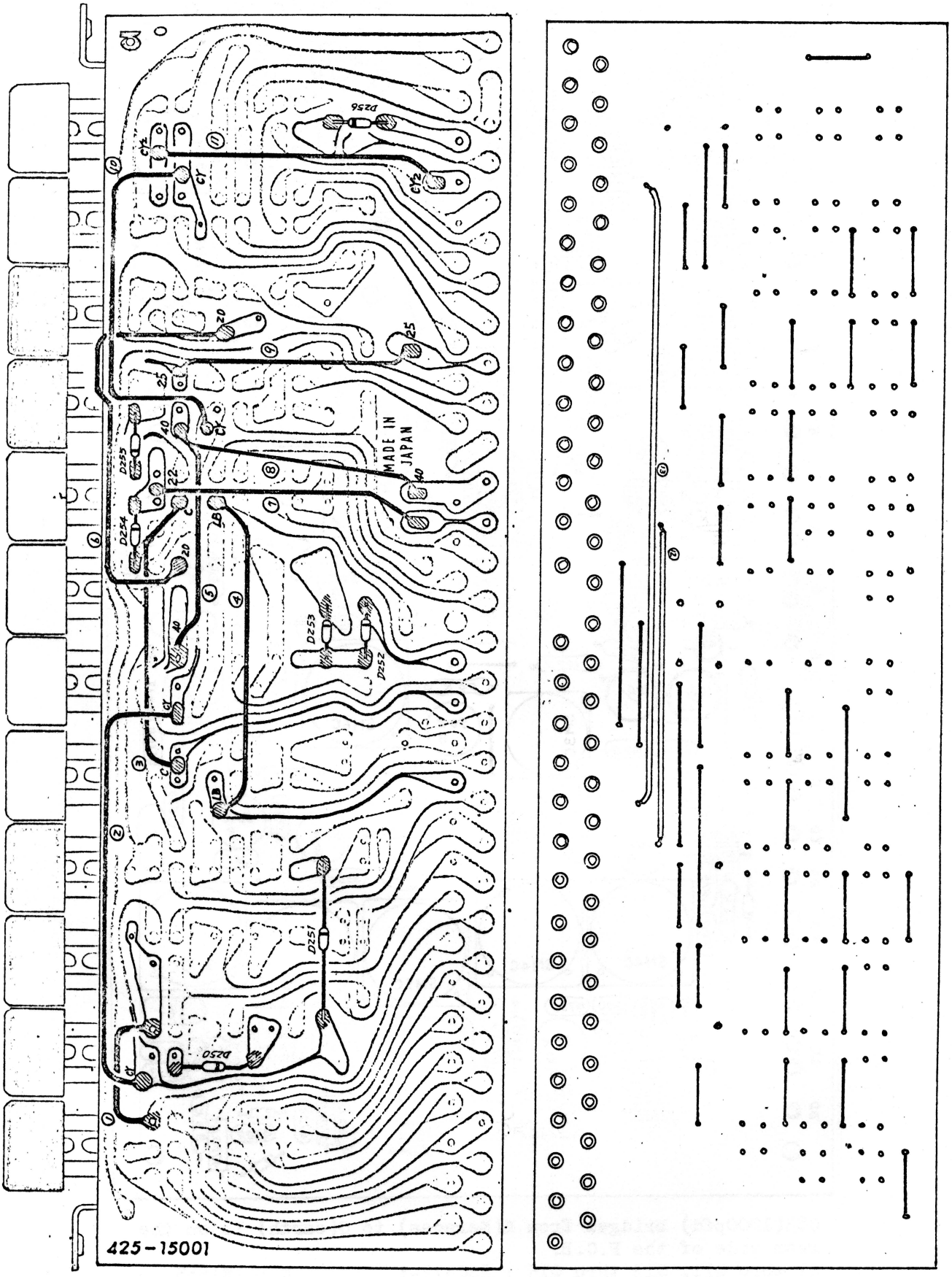


C83(1000pfd) bridged from M(Maracas) to G(earth) is on the rear side of the P.C.B.

Q1 thru Q11, Q13 thru Q15 : 2SC372-Y D : 1S1555

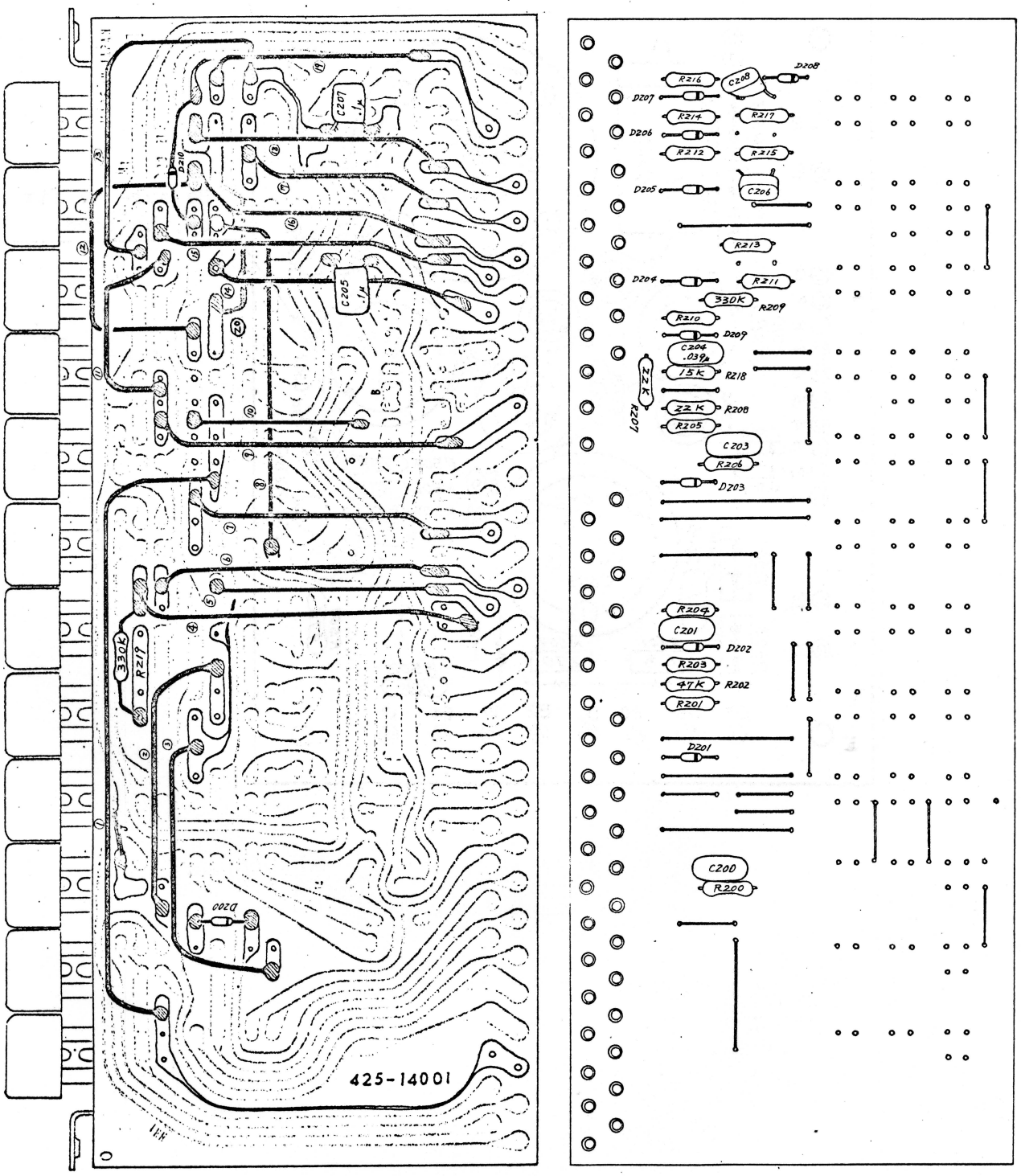
Q12 : 2SC732-GR

6-3. Jazz Section Switch Assembly SW-12 (Fig. 10)



Diodes are Type 1S1555.

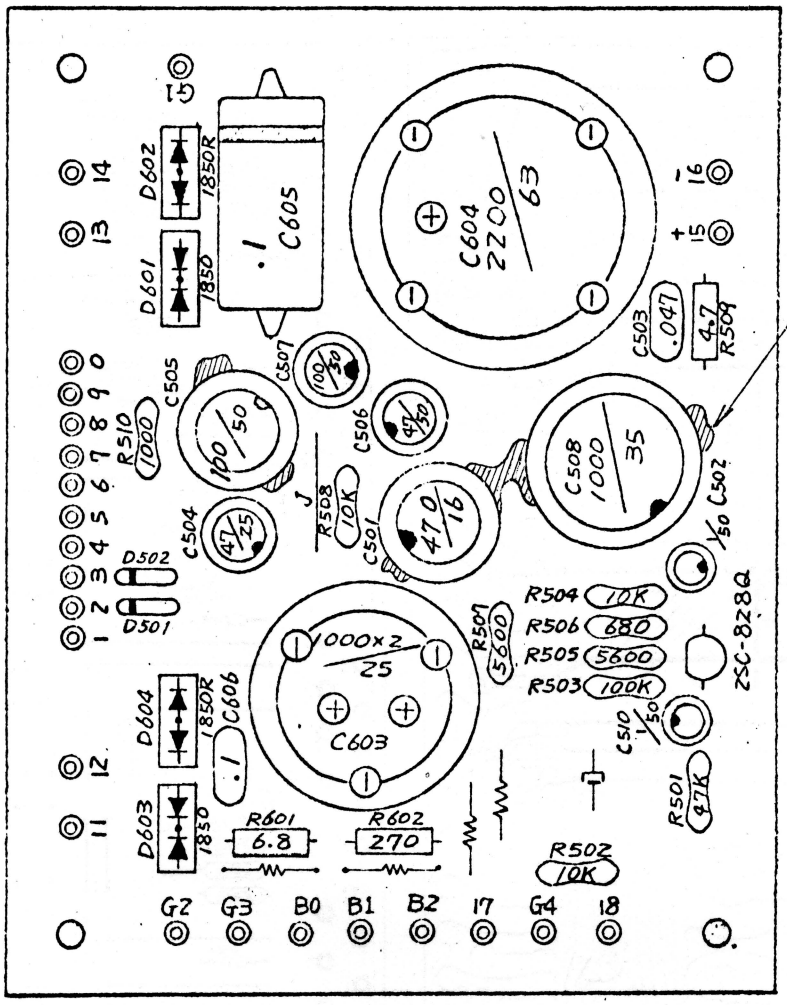
6-4. Latin Section Switch Assembly SW-11 (Fig. 11)



Diodes are Type 1S1555.

Resistors unmarked are 1000Kohm $\frac{1}{4}$R.
Plastic Film Capacitors unmarked are 0.1mfd/50V.
Diodes unmarked are Type 1S1555.

6-5. Power Supply Board Assembly (PS-7) (Fig. 12-0)



SECTION 7. ALIGNMENT PROSEDURE

1. Adjustment of Tempo Speed

* Rating

For oscillation period of Master Oscillator(Q1, Q2)

37.5mS(FAST) - 300mS(SLOW) ± 10%

In case of measuring wave form of logic output terminal "19"(pulse track No.19) by the oscilloscope.

a) Clockwise turning to the end of tempo volume (fast), adjust semifixed resistor VR7 so as to make the period of measured negative pulse as 37.5mS.

b) Counterclockwise turning to the end of tempo volume (slow), adjust semifixed resistor VR8 to make the period of negative pulse as 300mS.

c) Repeat above-mentioned procedures and adjust satisfactorily semifixed resistor VR7 and VR8.

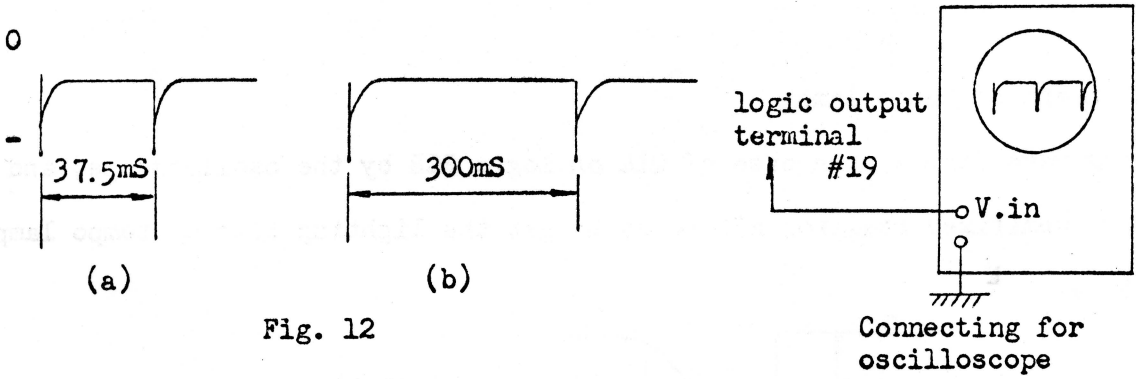


Fig. 12

Connecting for oscilloscope

1-1. Checking the wave form of Master oscillator

Seeing the wave form on the collectors of Q1 and Q2, and check the wave forms whether they are as Fig. B undesirable wave form including unsaturated territory. The wave form like Fig. C including wide unsaturated territory is to be wrong. It becomes the wave form like Fig.C when hfe of a transistor is small, or a Time constant of R5·C3//C4 or R6·C1//C2 is small.

Note : Be sure to use a Probe(10:1) to seeing the wave form on the terminal TP.

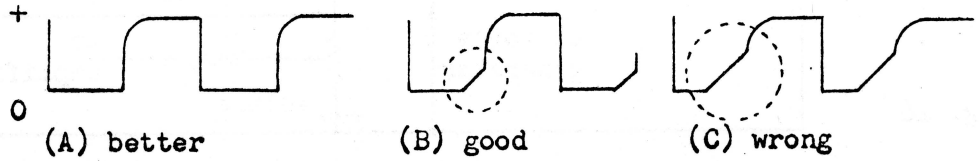


Fig. 13

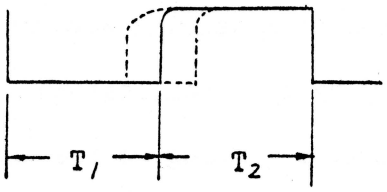
1-2. For symmetrical the wave form of output of the Master oscillator

The wave form on the collector becomes not to be symmetrical, because of instability of the circuit constant of the Master oscillator.

This circuit constant is set as following mention, and adjust it by changing the capacitors C1 and C3.

$$T_1 = \frac{T_1 + T_2}{2} \pm 20\ (\%)$$

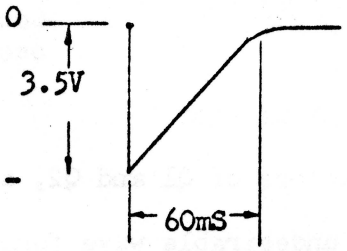
Fig. 14



The adjustment of tempo speed can be adjusted by in addition to logic output terminal "19". It is necessary to convert the period on adjustment into rating of the oscillation period at the Master Oscillator and also to measure wave form at the Master Oscillator.

2. Adjustment of tempo lamp

Seeing wave form at the base of Q14 on logic PCB by the oscilloscope, and adjust semifixed resistor R52 so as to get the lighting time of tempo lamp as 60mS.



(±20mS)

Fig. 15

3. Voice Generator

3-1. Adjustment by measuring wave form on the oscilloscope

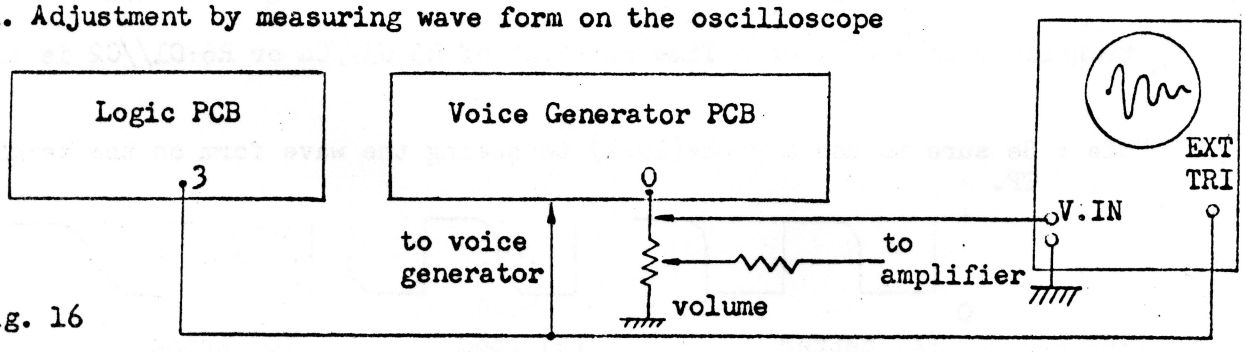


Fig. 16

Logic output terminal "3" (pulse track No.3, negative pulse) is a standard trigger pulse. The period of a standard trigger pulse is generally 0.6sec. Measure voltage of output terminal "O" on the Voice Generator PCB, and connect jack output (low out) with an amplifier. In case of listening to sound at the same time, connecting an amplifier, take down the volume position not to be due to output terminal. The position of Balance control knob is to be in center.

3-2. Adjustment of the noise section (Cy, M, Sd, Tb, Gu)

Set the Balance control knob to maximum of clockwise turn. Tb and Gu however, are otherwise free.

3-2-1. Adjustment of Maracas

Connect a trigger pulse with terminal "M" on Voice Generator PCB, and adjust semifixed resistor VR313 so that the level of output voltage may reach 2.0V. Check decay time within regular value.

3-2-2. Adjustment of Cymbal

Connect a trigger pulse with terminal "Cy" on the PCB, and check decay time and output voltage within regular value.

(output adjustment of Cymbal is same Maracas)

3-2-3. Adjustment of High Hat

Connect a trigger pulse with terminal "HH", and see output voltage within regular value. (The High Hat adjuster for output is to do the same semifixed resistor as Maracas's and Cymbal's) And check decay time within regular value.

3-2-4. Adjustment of Snare Drum

Connect a trigger pulse with terminal "SD" on PCB, turn semifixed resistor VR312 and get "Noise" as O. Measure voltage of output at terminal "O" on PCB. Adjust semifixed resistor VR309 so that the level of Drum voltage may reach 1.0V. Turn semifixed resistor VR312 so that the level of "Noise" may reach 2.0V. And also check decay time within regular time.

3-2-5. Adjustment of Tambourine

Connect a trigger pulse with terminal " TB " on PCB, and adjust semi-fixed resistor VR311 so that the level of output voltage may reach 1.2 V. And also check decay time within regular value.

3-2-6. Adjustment of Guiro

Change output No.6 on the Logic PCB, only for a trigger pulse of Guiro. Connect trigger No.6 with Guiro and see output wave form of collectors Q309 and Q310. Adjust semifixed resistor VR308 so that the period may get 10mS.

a) The wave form on the collector of transistor Q310 is shown on Fig.17. But concerning backward 1/3 of the wave form of a prolonged sound, its period is made short owing to pulse track No.12.

b) The wave form of output of the Noise section (excluding BD & GU) (cf. Fig. 18)

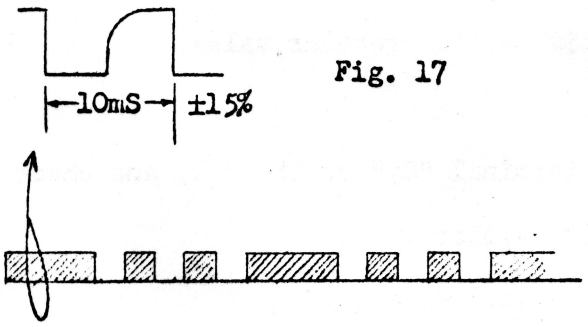


Fig. 17

T_D : decay time
E : output voltage

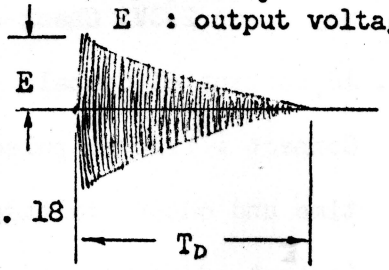


Fig. 18

c) In case that each the decay time of M, CY, HH, TB and SD is over or under the regular value, after checking the circuit constant, adjust each capacitor C351(for M), C349(for CY), C350(for HH), C364(for TB) and C356(for SD) so as to make each the decay time within regular value.

3-3. Adjustment of the Drum section (BD, LC, LB, HB, RS, CB, C)

Set the balance control knob to maximum of counterclockwise, only for BD.

3-3-1. Adjustment of Bass Drum

Connect a trigger pulse with terminal " BD " on PCB, and check the level of output voltage within regular value. Check frequency and the decay time within regular value.

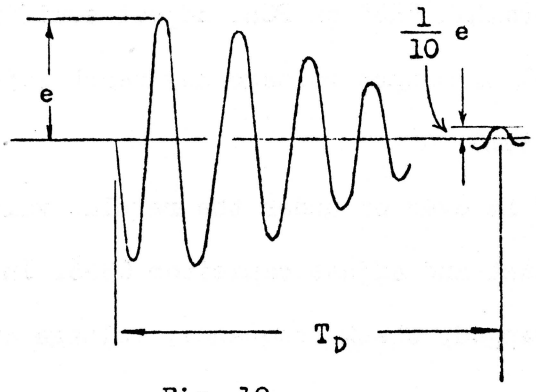


Fig. 19

Concerning measurement of Frequency, firstly measure time of a period at wave form of vibration decay time, and its reciprocal number is shown as a unit of Hz.

65Hz is nearly 15.4mS.

e : voltage

T_D : decay time

In case that the frequency of BD is out of the regular value, after checking the circuit constant, adjust C343 or C344.

When a capacitor or value is changed, check frequency, voltage and decay time again.

3-3-2. Adjustment of Low Conga

Connect a trigger pulse with terminal "LC" on PCB, adjust semifixed resistor VR 307 so that the level of output voltage may reach 4.0 V.

Check frequency and decay time within regular value.

Frequency 139Hz is nearly 7.19mS.

When frequency of terminal "LC" is over or under the regular value or in trouble, check circuit constant and adjust capacitor C336 or C337.

In case that a capacitor or value is changed, check frequency, voltage and decay time again.

3-3-3. Adjustment of Low Bongo

Connect a trigger pulse with terminal "LB" on PCB, adjust semifixed resistor VR306 so that the level of output voltage may reach 1.5V.

Check frequency and decay time within regular value.

Frequency 208Hz is nearly 4.81mS

When frequency of terminal "LB" is over or under the regular value or in trouble, check circuit constant and adjust capacitor C331.

In case that a capacitor or value is changed, check frequency, voltage and decay time again.

3-3-4. Adjustment of High Bongo

Connect a trigger pulse with terminal "HB" on PCB, adjust semifixed resistor VR320 so that the level of output voltage may reach 1.5V.

Frequency 346Hz is nearly 2.89mS

When frequency of terminal "HB" is over or under the regular value or in trouble, check circuit constant and adjust capacitor C326. In case that a capacitor or value is changed, check frequency, voltage and decay time again.

3-3-5. Adjustment of Cow Bell

Check of frequency

Connect a trigger pulse with terminal "CB" on PCB, turn semifixed resistor VR303, release the higher sound CB-H, and check frequency of the lower sound CB-L. On the other hand, turn semifixed resistor VR316, release the lower sound CB-L. Turn semifixed resistor VR303, and check frequency of the higher sound CB-H.

Check decay time at the same time as the above-mentioned procedures.

When frequency of the lower sound CB-L or the higher sound CB-H is over or under the regular value, or in trouble, check circuit constant, and for the higher sound CB-H, adjust capacitor C315. For the lower sound CB-L, adjust capacitor C320.

In case that a capacitor or value is changed, check frequency and decay time again.

Adjustment of voltage

Turn semifixed resistor VR303, release the higher sound CB-H. Adjust semifixed resistor VR316 so that the CB-L voltage may reach 0.6V.

Adjust semifixed resistor VR303 so that the combined voltage of the higher sound CB-H and the lower sound CB-L may reach 1.3V.

Frequency of the higher sound CB-H : 1,176Hz is nearly 0.85mS

Frequency of the lower sound CB-L : 984Hz is nearly 1.02mS

3-3-6. Adjustment of Claves

Connect a trigger pulse with terminal "C" on PCB, adjust semifixed resistor VR304 so that the voltage level may reach 2.0V. Check frequency and decay time within regular value.

Frequency 2,350Hz is nearly 0.42mS

When frequency of terminal "C" is over or under the regular value or in trouble, check circuit constant and adjust capacitor C304. In case that a capacitor or value is changed, check frequency, voltage and decay time again.

3-3-7. Adjustment of Rim Shot

Connect a trigger pulse with terminal "RS" on PCB, adjust semifixed resistor VR302 so as to get the level of output voltage as 4.0V. Check frequency and decay time within regular value.

Frequency 1,480Hz is nearly 0.68mS

When frequency of terminal "RS" is over or under the regular value or in trouble, check circuit constant and adjust capacitor C310. In case that a capacitor or value is changed, check frequency, voltage and decay time again.

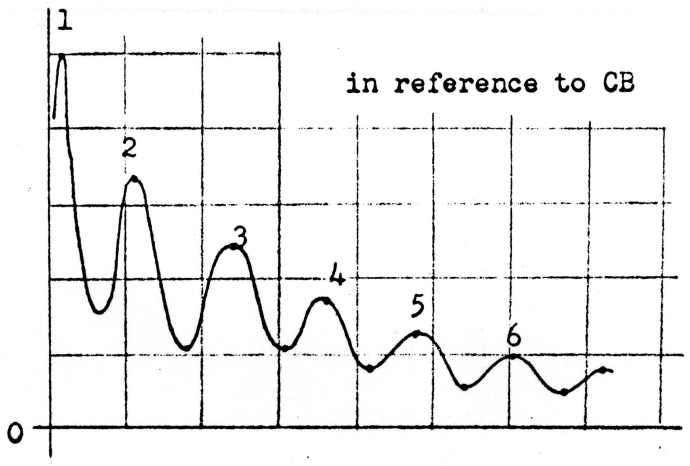


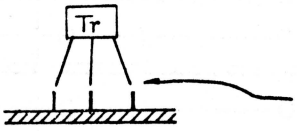
Fig. 20

* Standards of outputs

VOICE	AMPLITUDE (V)			FREQUENCY (Hz)			DURATION (mSec.)		
	MIN.	AVE.	MAX.	MIN.	AVE.	MAX.	MIN.	AVE.	MAX.
BD	2.3	3.0	3.6	60	65	70	90	130	160
LC	3.4	4.0	4.6	126	139	154	80	120	150
LB	1.2	1.5	1.8	187	208	229	55	85	120
HB	1.2	1.5	1.8	312	346	378	50	70	95
CB (L)	1.0	0.6	1.6	883	984	1080	25	40	60
CB (H)		1.0 1.3		1060	1176	1290	30	45	65
RS	3.4	4.0	4.6	1340	1480	1650	2	4	6
C	1.7	2.0	2.3	2100	2350	2600	9	14	18
SD	1.7	2.0	2.3				65	90	110
(Drum)		1.0		280	330	380			
M	1.7	2.0	2.3		—		25	30	38
HH	1.7	2.0	2.3		—		75	100	120
CY	1.7	2.0	2.3		—		200	300	400
TB	0.8	1.2	1.6				170	220	290
GU	0.2	0.3	0.45		—			—	

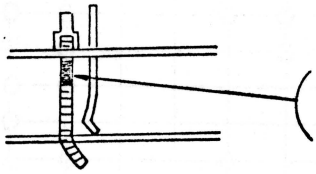
SERVICE NOTES

1. Replace parts of Sulfur Plate portion on LG-13 Logic panel so that leads may remain some on the panel after cutting and solder a new part on the lead as in the following. So with diode, resistance and so on.



Soldering on the lead

2. When repairing distributing wires, do not hold a soldering iron to the terminal for a long while, because a coil spring of the switch contact may fall down, or solder may flow in, and in addition external repairment will be impossible.

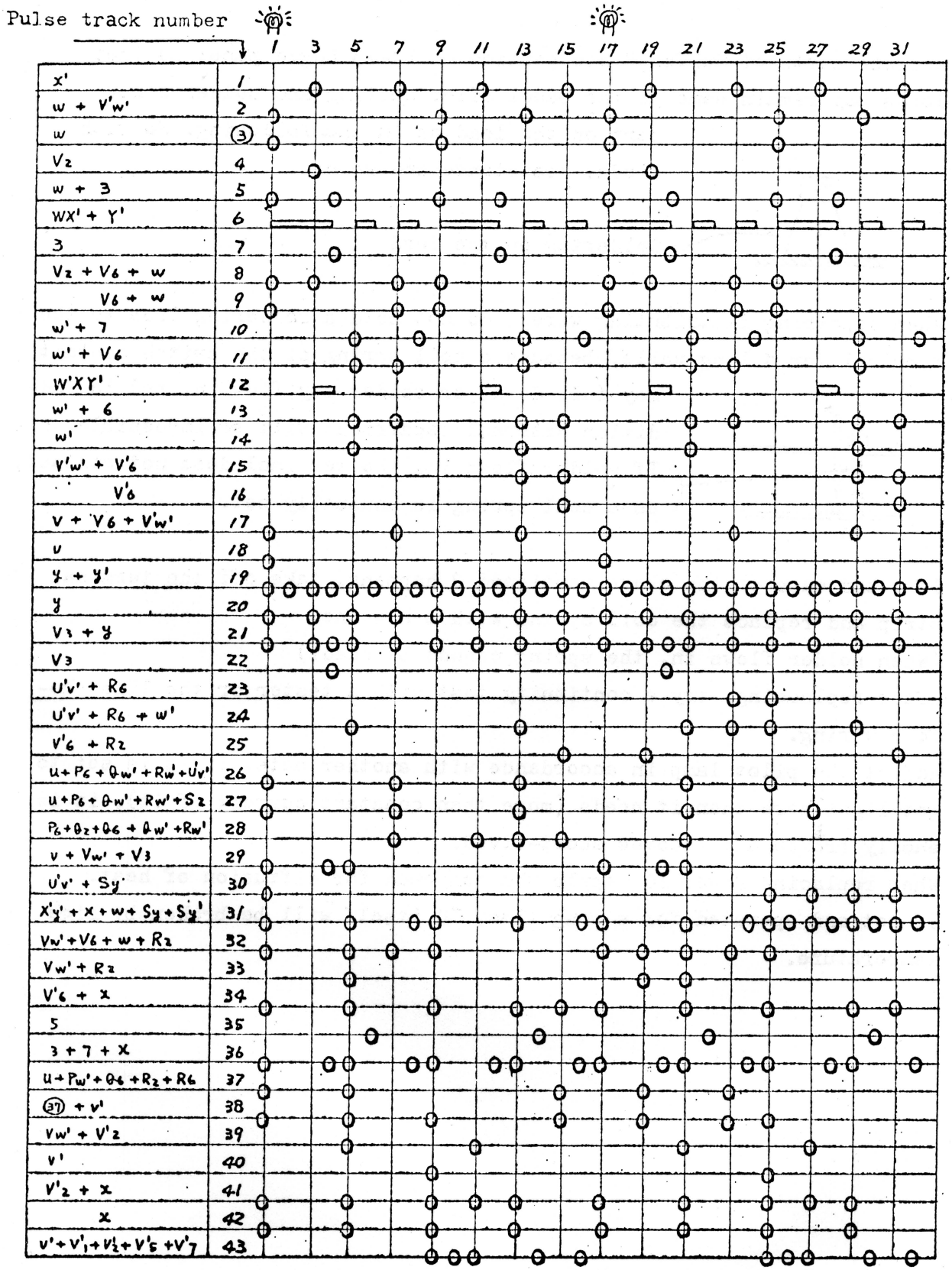


If solder flows in, the terminal does not contact, as a coil spring is unusually set.

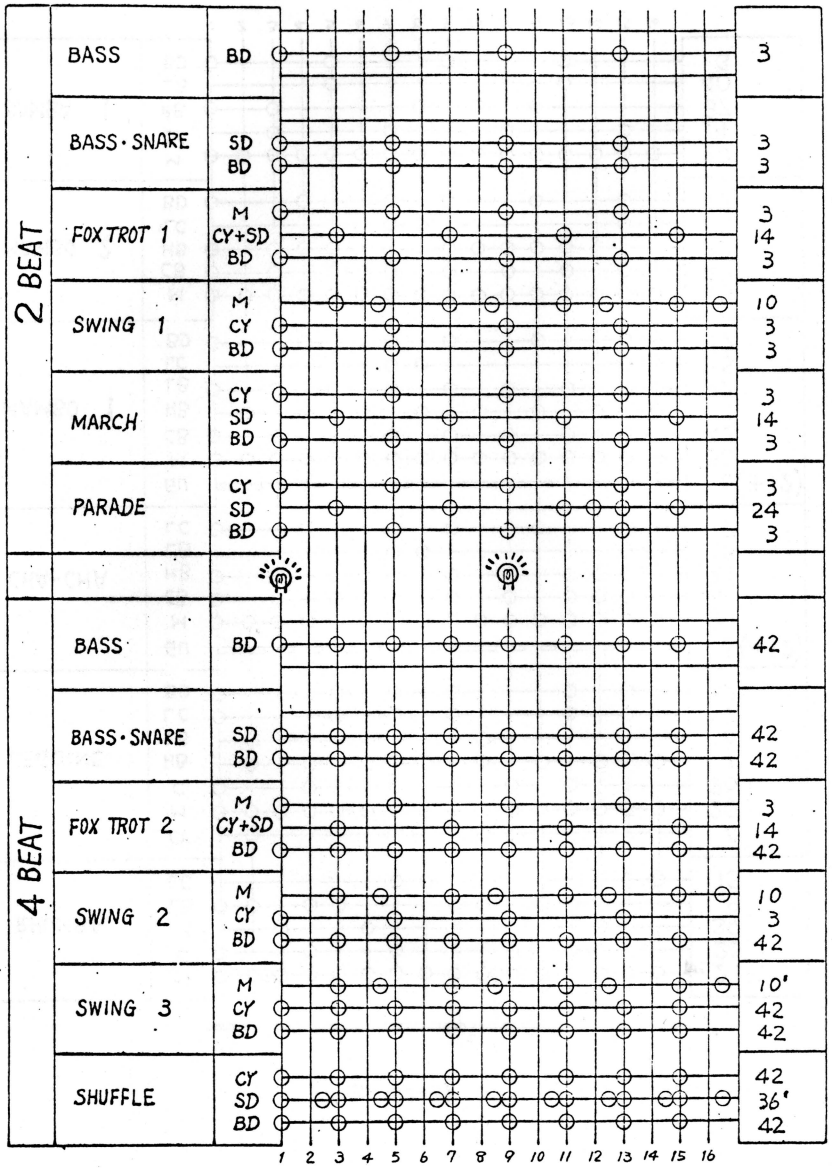
3. If a bad case of the above-mentioned 2 happens, take off the terminal strip and replace the coil spring with a new one.
   (When solder flows in, the spring cannot be used.)
   After replaceing, try a continuity test with a tester or the like before wiring.
4. Adjust the pilot lamp in accordance with another note. If it is set to get light more than it needs (more than constant current of it), it is easily broken and becomes short-lived.
5. When replacing Power IC, apply the compound for diffusion of heat. If not and operated for a long time, IC itself will be broken by high temperature.

SECTION 8. RHYTHM PATTERN

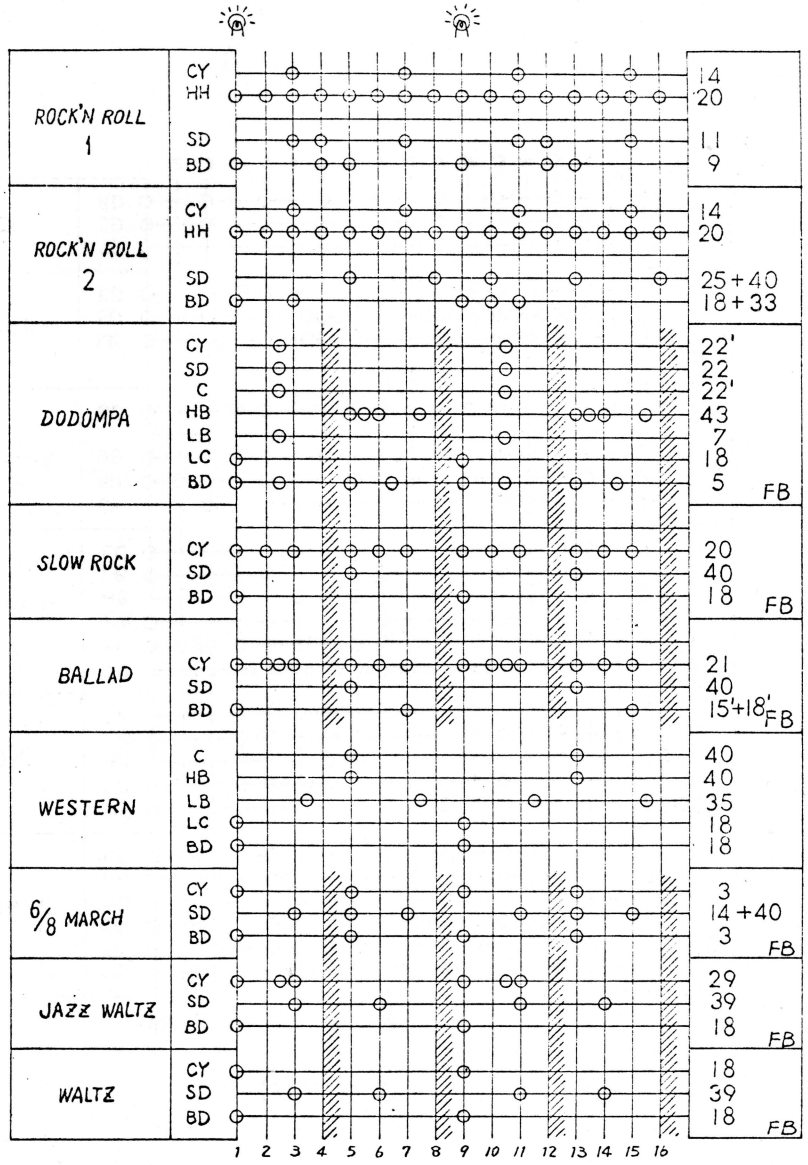
8-1. Logic output timing chart (Fig. 21)



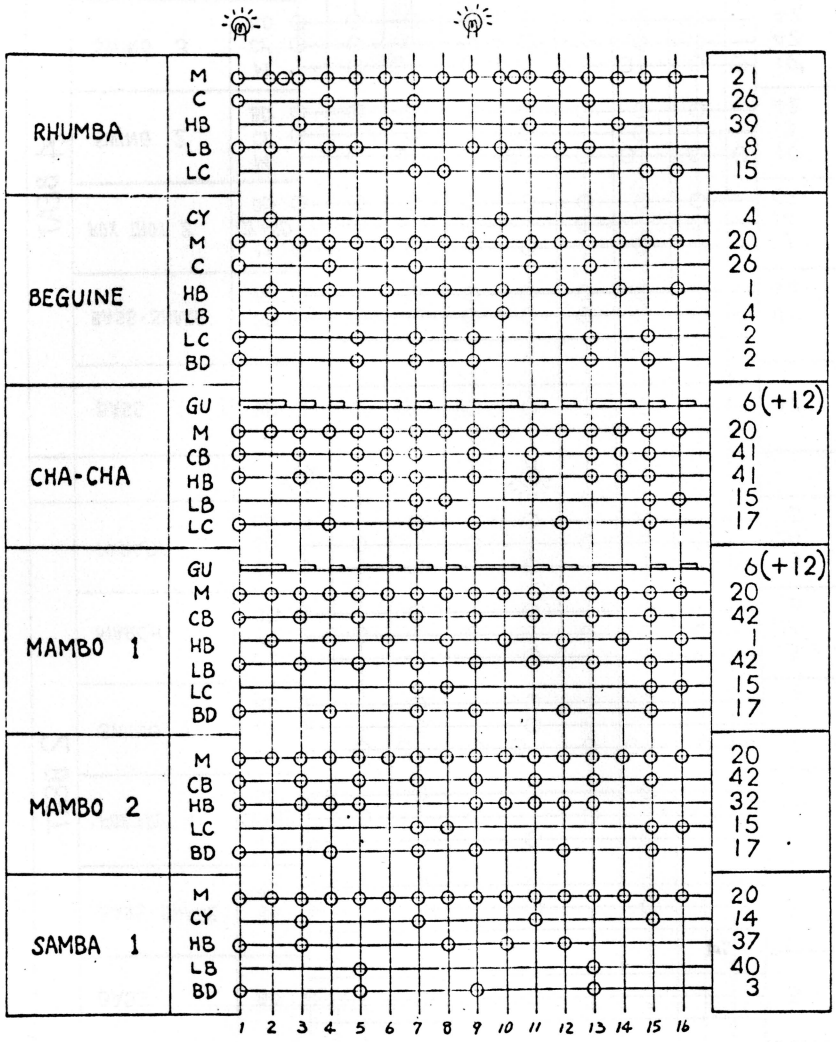
8-2. Rhythm ensemble pattern (Fig. 22-1)



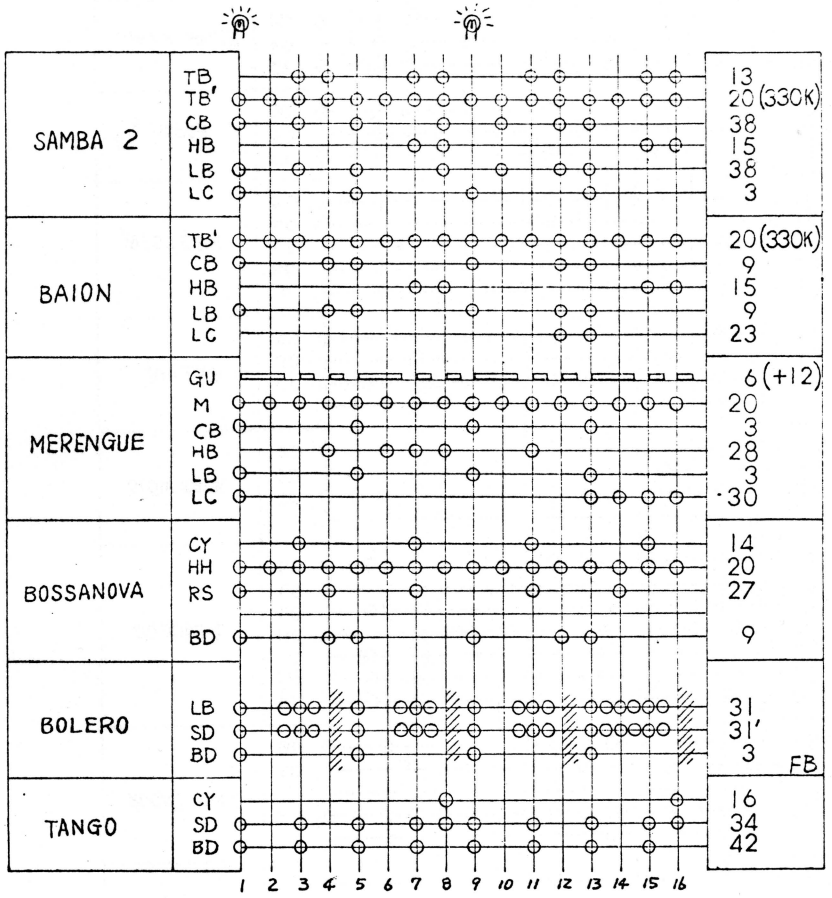
(Fig. 22-2)



(Fig. 22-3)



(Fig. 22-4)



SECTION 9. PARTS LIST

MODEL FR-70 PARTS LIST

Cabinet Assembly (complete)			
Cabinet			402-07031A
Rear Board			402-04028
Plastic Handle			402-01059
Speaker 30cm	W-3021D		315-05022
Speaker 6.5cm	66-05-1 16Ω		315-01002
Rhythm Unit Assembly			
Logic Board Assembly	LG-13		220-13201
Voice Generator Board Assembly	VG-12		221-12201
Jazz Section Switch Assembly	SW-12		225-12201
Latin Section Switch Assembly	SW-11		225-11201
CS Bracket			401-03166A
Chassis			401-01054B
Knob	TK-825		304-01018
Panel			401-02105B
Potentio Meter 10Kohm(B)	EVC-B0AS15B14	VR402	309-17002
Potentio Meter 100Kohm(A)	EVC-B0AS15A15	VR401	309-16005
Potentio Meter 100Kohm(B)	EVC-B0AS15B15	VR10	309-17005
Rotary Switch (TS-1)	ESR-E246R15B		301-05006
Rocker Switch "	GUIRO		202-06011
Rocker Switch "	BASS DRUM		202-06012
Rocker Switch "	CYMBAL		202-06013
Rocker Switch "	SNARE DRUM		202-06014
Rocker Switch "	SILENT-SOUND		202-10021
Rocker Switch "	START		202-10022
Rocker Switch (TS-2)	ROLLING SNARE DRUM		235-08001
Rocker Switch "	CYMBAL		235-05001
Seesaw Switch	SQ-142		301-08005
Light Emitting Diode	GL-50AR-1	D81	321-03001
Lamp Lens			401-03191
Lamp Holder No.2			402-01070
Speed Nut	type M8P Fe		332-01001
Nylon Connector	No.1360P		317-01004
Pin Terminal	No.1381-TL		314-07002
Terminal Strip	2L4P		314-03003
Plastic Film Capacitor	5600pfd 50V	C402	311-03012
Plastic Film Capacitor	0.022mfd "	C401	311-03020
Carbon Film Resistor	3300ohm ¼R	R410	320-06332
Long Nut			401-05004
Silicon Diode	1S1555	D80 D280	306-01005
Metallic Oxide Film Resistor	470ohm 3W	R80	320-86471
Logic Board Assembly	LG-13		220-13201
Printed Wiring Board			420-12001
Silicon Transistor	2SC-372 Y EES	Q1 thru Q13	305-03003
Silicon Transistor	2SC-373	Q14	305-03014
Silicon Diode	1S-1555	126PCS.	306-01005
Semifixed Resistor	50 Kohm(B)	VR7, VR8, VR52	336-01009
Carbon Film Resistor	33 ohm ¼R	R46	320-06330
Carbon Film Resistor	100 ohm "	R49	320-06101
Carbon Film Resistor	330 ohm "	R55	320-06331
Carbon Film Resistor	1000ohm "	R18 R25 R32 R39 R51	320-06102
Carbon Film Resistor	2200ohm "	R4	320-06222
Carbon Film Resistor	2700ohm "	R11 R14 R17 R21 R24 R28 R31 R35 R38 R42	320-06272

Carbon Film Resistor	3900ohm ¼R	R50	320-06392
Carbon Film Resistor	5600ohm "	R13 R16 R20 R23 R27 R30 R34 R37 R41 R44	320-06562
Carbon Film Resistor	10 Kohm "	R45 R53 R54	320-06103
Carbon Film Resistor	15 Kohm "	R12 R15 R19 R22 R26 R29 R33 R36 R40 R43	320-06153
Carbon Film Resistor	22 Kohm "	R1 R2 R102 R103	320-06223
Carbon Film Resistor	33 Kohm "	R101 R104 105 106	320-06333
Carbon Film Resistor	47 Kohm "	R47 R130 thru R133	320-06473
Carbon Film Resistor	68 Kohm "	R56	320-06683
Carbon Film Resistor	100Kohm "	R3	320-06104
Carbon Film Resistor	270Kohm "	36PCS.	320-06274
Carbon Film Resistor	330Kohm "	R5 R6 R48	320-06334
Carbon Solid Resistor	470 ohm ½GF	R9 R10	320-48471
Electrolytic Capacitor	1 mfd 50V	C29	311-08058
Electrolytic Capacitor	4.7 mfd 25V	C5 C30	311-08047
Electrolytic Capacitor	100 mfd 6.3V	C28	311-08010
Electrolytic Capacitor	100 mfd 16V	C6	311-08038
Plastic Film Capacitor	**1000pfd 50V**	**C31**	**311-03001**
Plastic Film Capacitor	2200pfd 50V	C8 C9 C12 C13 C17 C18 C21 C22 C25 C26	311-03006
Plastic Film Capacitor	0.022mfd "	C7 C10 C11 C14 C16 C19 C20 C23 C24 C27	311-03020
Plastic Film Capacitor	0.039mfd "	C101 thru C136	311-03023
Plastic Film Capacitor	0.047mfd "	C15	311-03024
Plastic Film Capacitor	0.15 mfd "	C1 C3	311-03030
Plastic Film Capacitor	0.22 mfd "	C2 C4	311-03031
Voice Generator Board Assembly	VG-12		221-12201
Printed Wiring Board			421-08001
Silicon Transistor	2SC-372 Y EES	Q301 thru Q311 Q313 thru Q315	305-03003
Silicon Transistor	2SC-732 GR	Q312	305-03024
Silicon Diode	1S-1555	18PCS.	306-01005
Semifixed Resistor	50 Kohm(B)	VR301 thru VR307 VR309 VR310 thru VR313	336-01009
Semifixed Resistor	100Kohm(B)	VR308	336-01010
Coil	SM-1C 40mH	L309 L312 L313	312-01019
Coil	SM-2C 520mH	L310	312-01018
Coil	SM-3C 700mH	L301 L302	312-01017
Coil	SM-4C 3800mH	L303 L304 L311	312-01016
Coil	SM-5C 10 H	L305 thru L307	312-01015
Coil	SM-6C 16 H	L303	312-01014
Carbon Film Resistor	100 ohm ¼R	R397	320-06101
Carbon Film Resistor	680 ohm "	R399	320-06681
Carbon Film Resistor	820 ohm "	R385	320-06821
Carbon Film Resistor	1000ohm "	R400	320-06102
Carbon Film Resistor	3900ohm "	R371	320-06392
Carbon Film Resistor	5600ohm "	R369 R370 R396	320-06562
Carbon Film Resistor	10 Kohm "	R332 R333 R336 R342 R346 R351 R354 R358 R364 R384 R386 R395	320-06103
Carbon Film Resistor	15 Kohm "	R329 R390	320-06153
Carbon Film Resistor	18 Kohm "	R373	320-06183
Carbon Film Resistor	22 Kohm "	R325 R348 R361 R378 R381 R393 R402	320-06223
Carbon Film Resistor	27 Kohm "	R383	320-06273
Carbon Film Resistor	33 Kohm "	R320 R324 R327 R331	320-06333
Carbon Film Resistor	47 Kohm "	R366 R377 R392	320-06473
Carbon Film Resistor	56 Kohm "	R302 R304 R312 R316 R318 R322 R337 R389	320-06563

Carbon Film Resistor	68 Kohm ¼R	R375 R376	320-06683
Carbon Film Resistor	82 Kohm "	R310 R350 R372	320-06823
Carbon Film Resistor	100Kohm "	R306 R356 R368 R388	320-06104
Carbon Film Resistor	150Kohm "	R314	320-06154
Carbon Film Resistor	180Kohm "	R394	320-06184
Carbon Film Resistor	220Kohm "	R334 R340 R344 R352 R362 R387	320-06224
Carbon Film Resistor	470Kohm "	R349 R357 R367 R382	320-06474
Carbon Film Resistor	1000Kohm "	R347 R401	320-06105
Carbon Solid Resistor	1500Kohm ½GF	R338 R343	320-48155
Carbon Solid Resistor	2200Kohm "	R365 R380 R391 R403	320-48225
Carbon Solid Resistor	2700Kohm "	R355	320-48275
Carbon Solid Resistor	4700Kohm "	R301 R305 R309 R313 R317 R321 R326 R330 R339	320-48475
Carbon Film Resistor	39 Kohm ¼R	R359 R374	320-06393
Carbon Film Resistor	820Kohm "	R335 R341 R345 R353 R363	320-06824
Electrolytic Capacitor	1 mfd 50V	C379	311-08058
Electrolytic Capacitor	4.7 mfd 25V	C376 thru C378	311-08047
Electrolytic Capacitor	100 mfd 6.3V	C374	311-08010
Electrolytic Capacitor	100 mfd 16V	C381	311-08038
Electrolytic Capacitor	100 mfd 25V	C380	311-08052
Ceramic Capacitor	100 pfd 50V	C367 C373 C375	311-01010
Plastic Film Capacitor	1000pfd "	C83 C303 C308 C316 C319 C321 C354 C385	311-03001
Plastic Film Capacitor	1500pfd "	C305 C314 C327	311-03003
Plastic Film Capacitor	2200pfd "	C371	311-03006
Plastic Film Capacitor	2700pfd "	C315 C358	311-03007
Plastic Film Capacitor	3300pfd "	C332	311-03009
Plastic Film Capacitor	4700pfd "	C33 C301 C302 C304 C307 C312 C320 C323 C325 C328 C340 C355	311-03011
Plastic Film Capacitor	5600pfd "	C306	311-03012
Plastic Film Capacitor	6800pfd "	C322 C353	311-03013
Plastic Film Capacitor	8200pfd "	C313 C318	311-03014
Plastic Film Capacitor	0.01mfd "	C309 C311 C324 C330 C335 C336 C338 C348 C351 C352 C357 C362 C365 C382	311-03015
Plastic Film Capacitor	0.015mfd "	C310 C317 C326	311-03017
Plastic Film Capacitor	0.022mfd "	C60 C329 C356 C359 C366	311-03020
Plastic Film Capacitor	0.033mfd 50V	C334 C342 C345 C350 C372	311-03022
Plastic Film Capacitor	0.039mfd "	C361	311-03023
Plastic Film Capacitor	0.047mfd "	C331	311-03024
Plastic Film Capacitor	0.068mfd "	C368 C369	311-03027
Plastic Film Capacitor	0.082mfd "	C349	311-03028
Plastic Film Capacitor	0.1 mfd "	C337 C343 C346	311-03029
Plastic Film Capacitor	0.22 mfd "	C344 C347	311-03031
Plastic Film Capacitor	0.056mfd "	C339 C341 C364 C383	311-03026
Jazz Section Switch Assembly	SW-12		225-12201
Printed Wiring Board			425-15001
CS Switch	CS-6		201-06201
Silicon Diode	1S-1555	D250 thru D256	306-01005

Latin Section Switch Assembly	SW-11		225-11201
Printed Wiring Board			425-14001
CS Switch	CS-5		201-05201
Silicon Diode	1S-1555	D200 thru D210	306-01005
Carbon Film Resistor	15 Kohm ¼R	R218	320-06153
Carbon Film Resistor	22 Kohm "	R207 R208	320-06223
Carbon Film Resistor	47 Kohm "	R202	320-06473
Carbon Film Resistor	330Kohm "	R209 R219	320-06334
Carbon Film Resistor	1000Kohm "	R200 R201 R203 thru R206 R210 thru R217	320-06105
Plastic Film Capacitor	0.039mfd 50V	C204	311-03023
Plastic Film Capacitor	0.1 mfd "	C200 C201 C203 C205 C206 C207 C208	311-03029

Main Amplifier Assembly	TPA-8		208-08201
Printed Wiring Board	PS-7		224-07201
Main Chassis			401-01053A
Power Amplifier I.C.	STK-029		319-21003
Power Trans Hormer	PT-918		307-01038A
AC Cord 4m	SJT-AWG18 Brown		438-02002
Cord Binder	No.11		340-06001
Cord Bush	No.4801 Black		340-04005
Circuit Breaker	NW-1 1.0A		302-02011
Nylo Clip	HP-5N		340-02003
Nylon Connector	No.1360R		312-01005
Pin Terminal	No.1380TL		314-07001
Semifixed Resistor	100Kohm(B)	VR501	309-17005
Terminal Strip	2L-5P		314-03004
Sub-Panel			401-02100
Jack	SG-7615 No.5		318-04001
Jack Washer	OP-0116		401-05002
Carbon Film Resistor	10 Kohm ¼R	R511	320-06103
Carbon Film Resistor	47 Kohm "	R512	320-06473
Oil Capacitor	0.05mfd 600WV	C601 C602	311-02011
Voltage Changer	PSW-1E		303-02001
CB Bracket			401-03108A
Heat Sinker No.8	for STK-029 1.2t Al		401-04009

Power Supply Board Assembly	PS-7		224-07201
Printed Wiring Board			424-08001A
Electrolytic Capacitor	2200mfd	C604	311-12023
Electrolytic Capacitor	1000mfd X 2	C603A,B	311-12047
Electrolytic Capacitor	1000mfd	C508	311-13012
Electrolytic Capacitor	470 mfd 16V V	C501	311-08041
Electrolytic Capacitor	47 mfd 50V V	C506	311-08065
Electrolytic Capacitor	100 mfd " "	C507	311-08066
Electrolytic Capacitor	47 mfd 25V V	C504	311-08051
Electrolytic Capacitor	1 mfd 50V V	C502	311-08058
Plastic Film Capacitor	0.047mfd " "	C503	311-03024
Plastic Film Capacitor	0.1 mfd " "	C606	311-03029
Oil Capacitor	0.1 mfd 600WV	C605	311-02013
Carbon Solid Resistor	4.7 ohm ½GF	R509	320-48478
Carbon Solid Resistor	6.8 ohm "	R601	320-48688
Carbon Solid Resistor	270 ohm "	R602	320-48271
Carbon Film Resistor	680 ohm ¼R	R506	320-06681
Carbon Film Resistor	1000ohm "	R510	320-06102
Carbon Film Resistor	5600ohm "	R505 R507	320-06562
Carbon Film Resistor	10 Kohm "	R502 R504 R508	320-06103
Carbon Film Resistor	47 Kohm "	R501	320-06473
Carbon Film Resistor	100Kohm "	R503	320-06104

Silicon Transistor	2SC-828Q or 2SC-828R	Q501	305-03002 305-03016
Diode	10D-1	D501 D502	306-01004
Diode	1850	D601 D603	306-01011
Diode	1850R	D602 D604	306-01012

Miscellaneous

Foot Switch	FS-2 Red or Black		234-11201 234-11202
Electrolytic Capacitor	3.3 mfd 50V NP(H)	C509	311-08239
Terminal Strip	2P No.606		314-04001
Interior Packing Case			402-08154
Pad (A)			402-08155
Pad (B)			402-08164
Exterior Packing Case			402-08156