SERVICE MANUAL

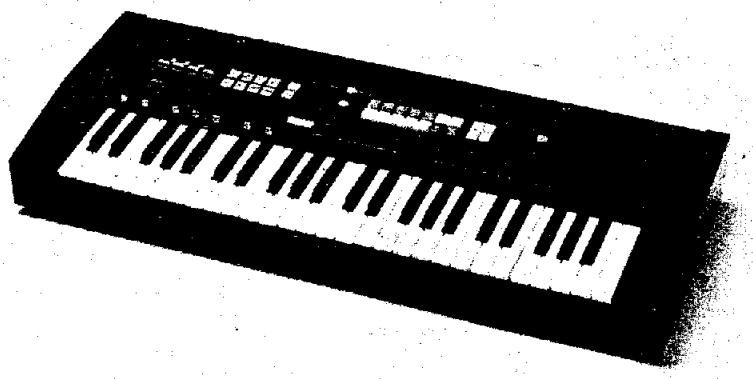
(WITHOUT PRICE)

ELECTRONIC KEYBOARD

CASIOTONE

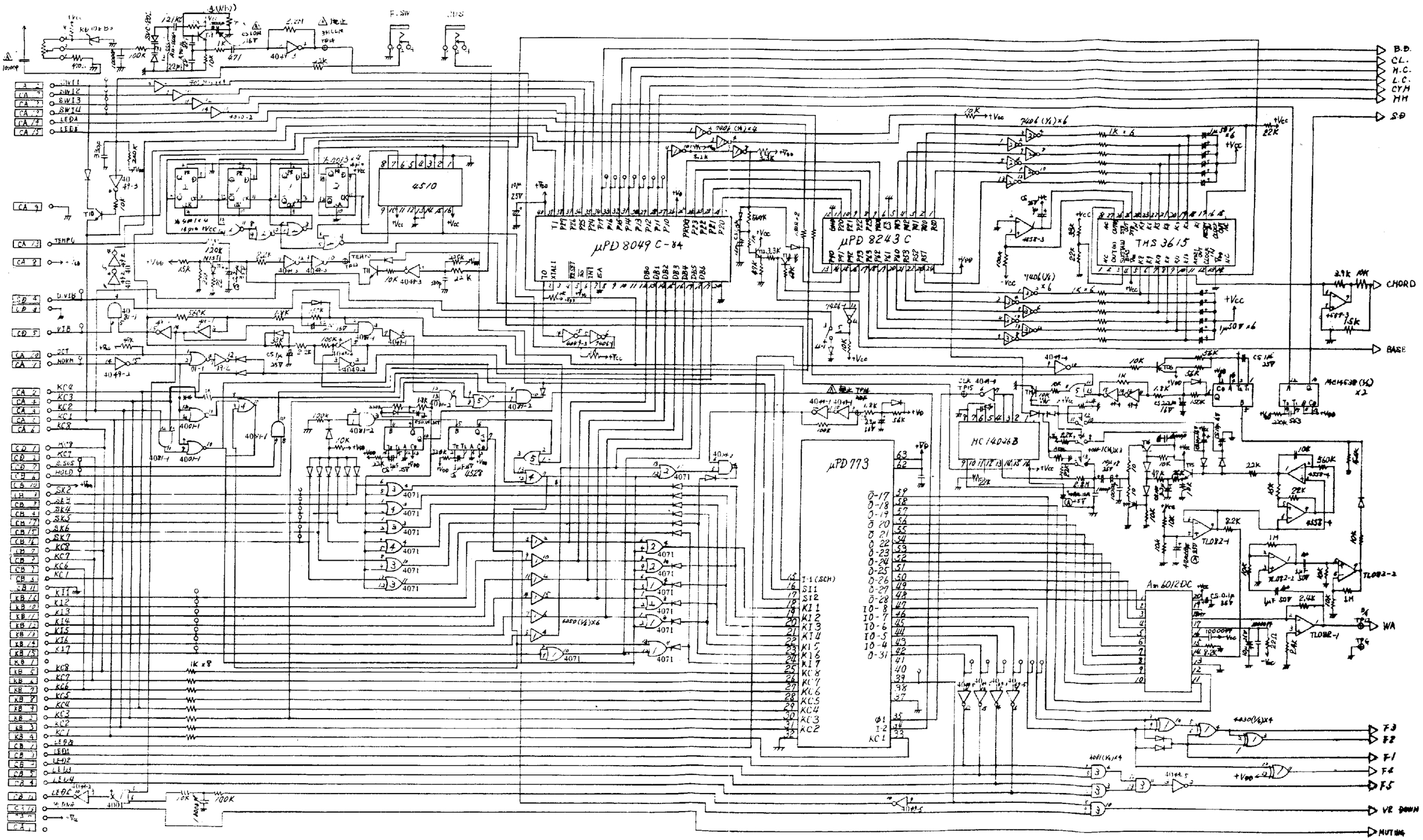
CT-401 (MX-11)

FEB. 1981

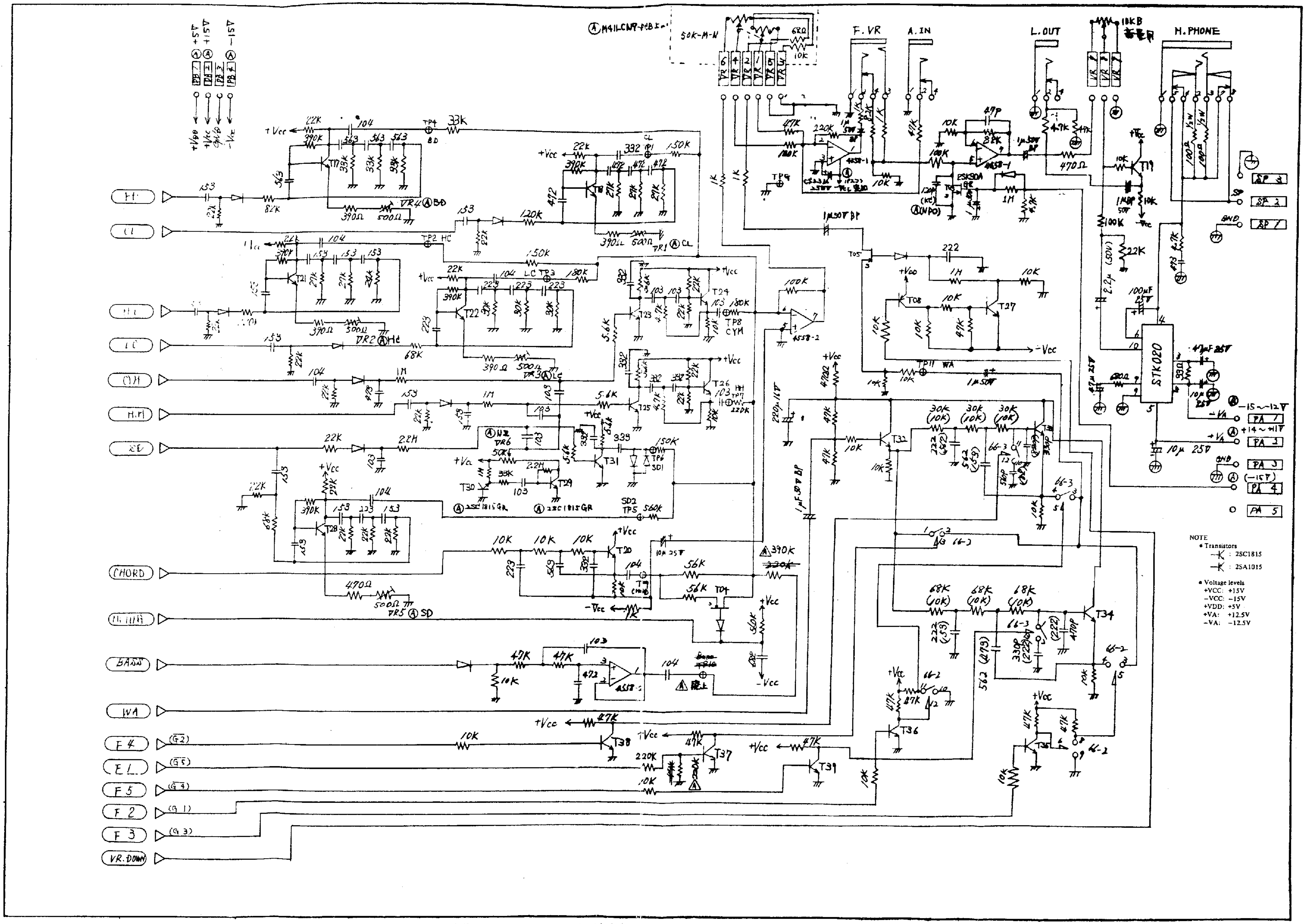


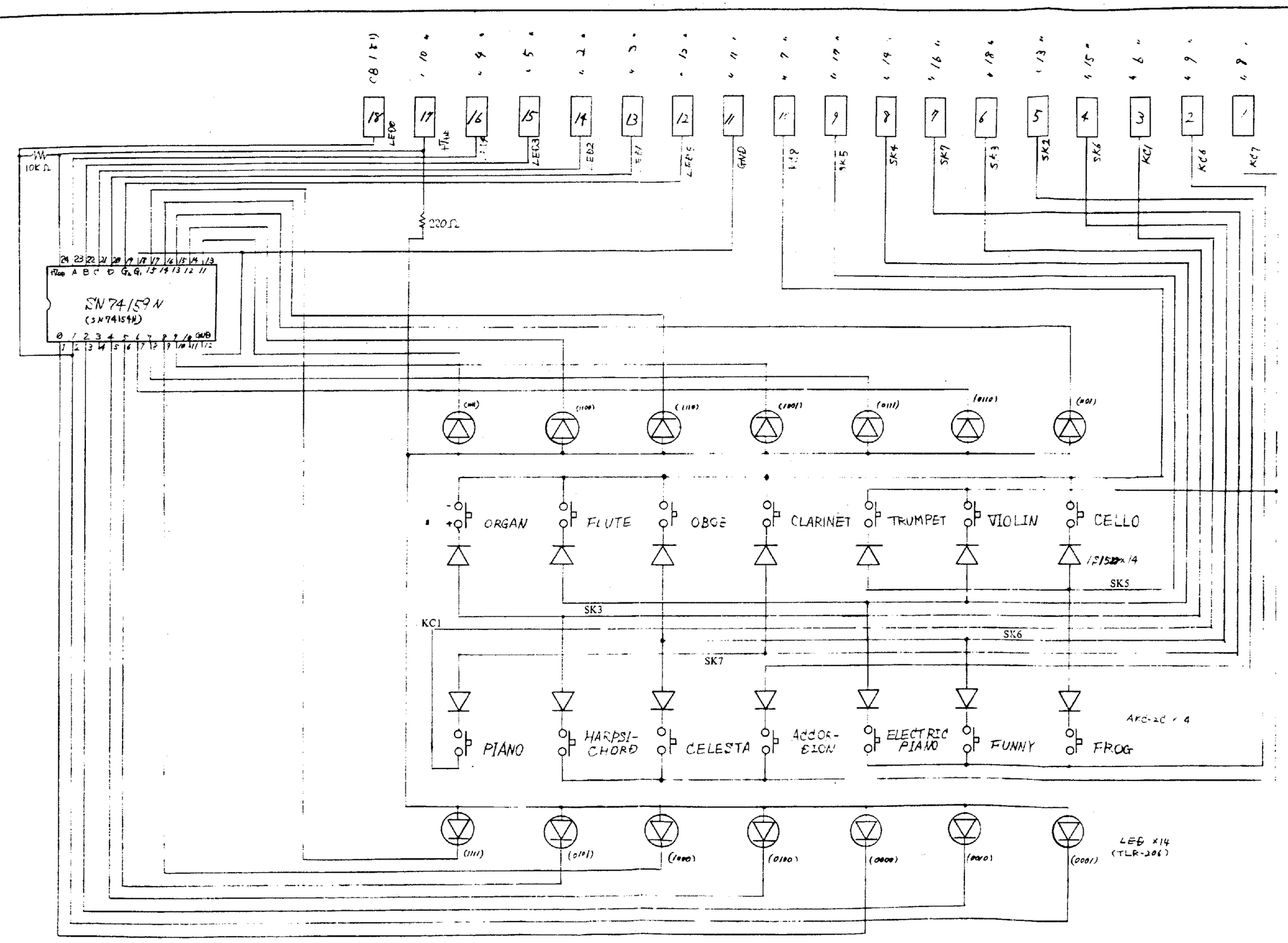
CASIO

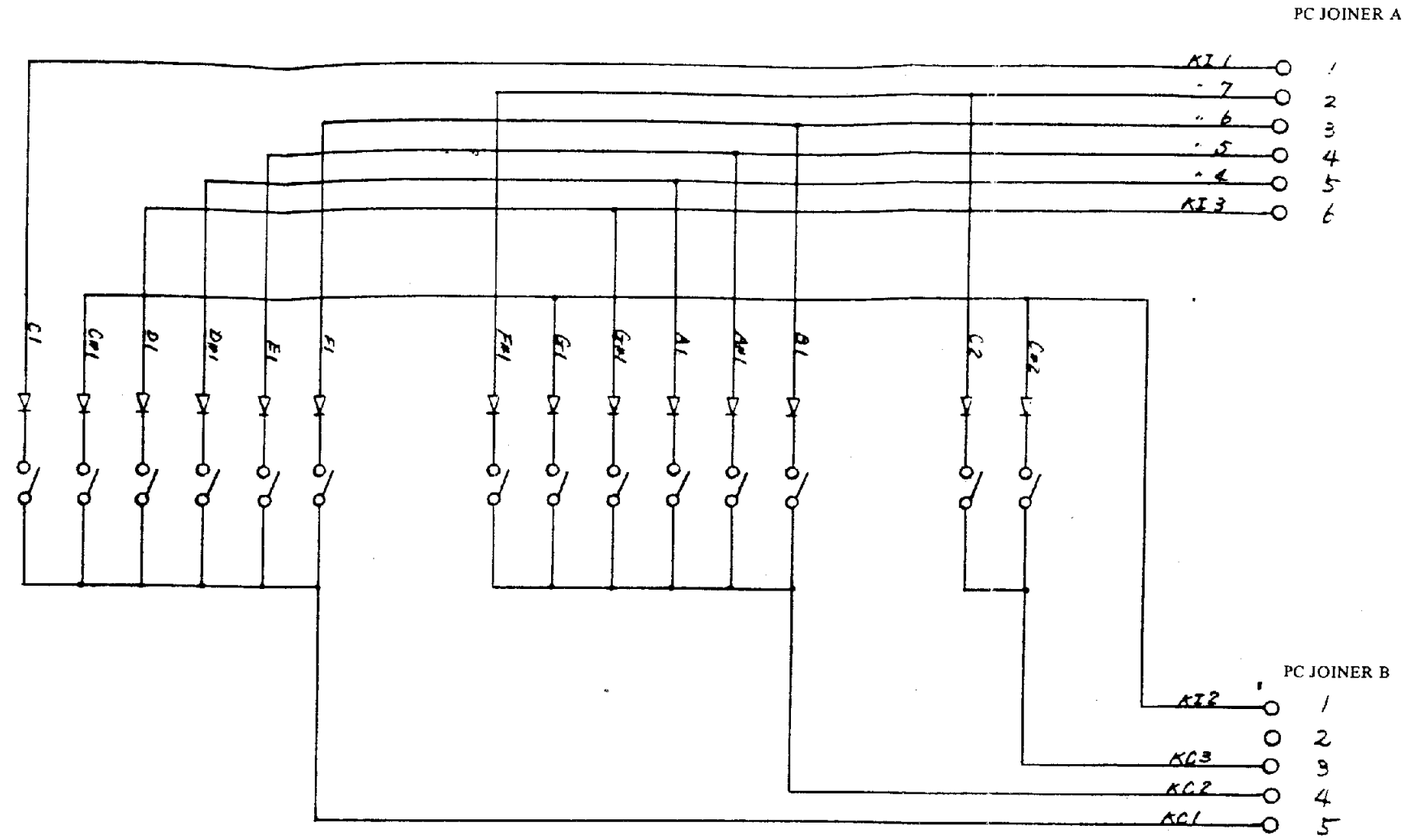
1. CIRCUIT DIAGRAM



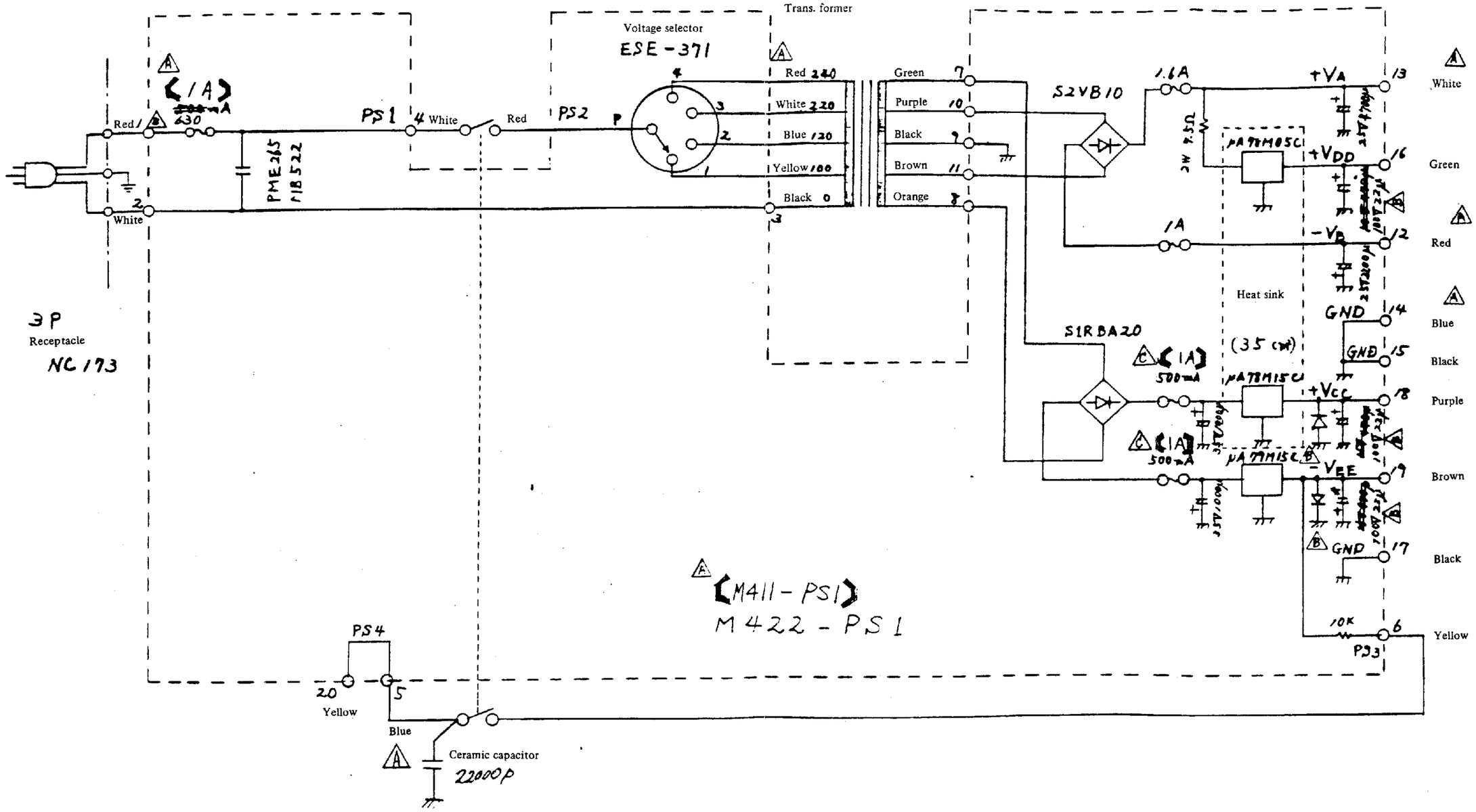
	ORGAN	FLUTE	OBOE	CLARI.	TRUMP.	VIOLIN	CELLO	PIANO	HARPSI	CELEST	ACCORD	E.PIAN	FUNNY	FROG
O-31	L	L	L	L	H	H	L	L	H	L	H	H	H	H
IO-4	H	L	L	H	L	L	L	L		H	L	H	H	H
IO-5	L	H	L	H	L	L	H	L		H	H	H	L	H
IO-6	L	H	H	L	L	H	L	L		H	H	H	H	L
IO-7	H	H	H	H	L	L	H	H		L	L	H	L	L
IO-8	H	H	L	L	H	H	H	H		H	L	L	L	L
I-1	H	H	H	H	H	H	L	H		H	L	H	L	L
I-2	L	L	H	H	H	H	L	L		H	L	H	L	L
I-3	H	H	L	L	L	L	H	H		L	L	L	L	L
F4	L	L	L	L	H	H	L	L	H	H	H	L	H	H
F5	H	H	H	H	H	H	H	H	L	H	H	H	H	H

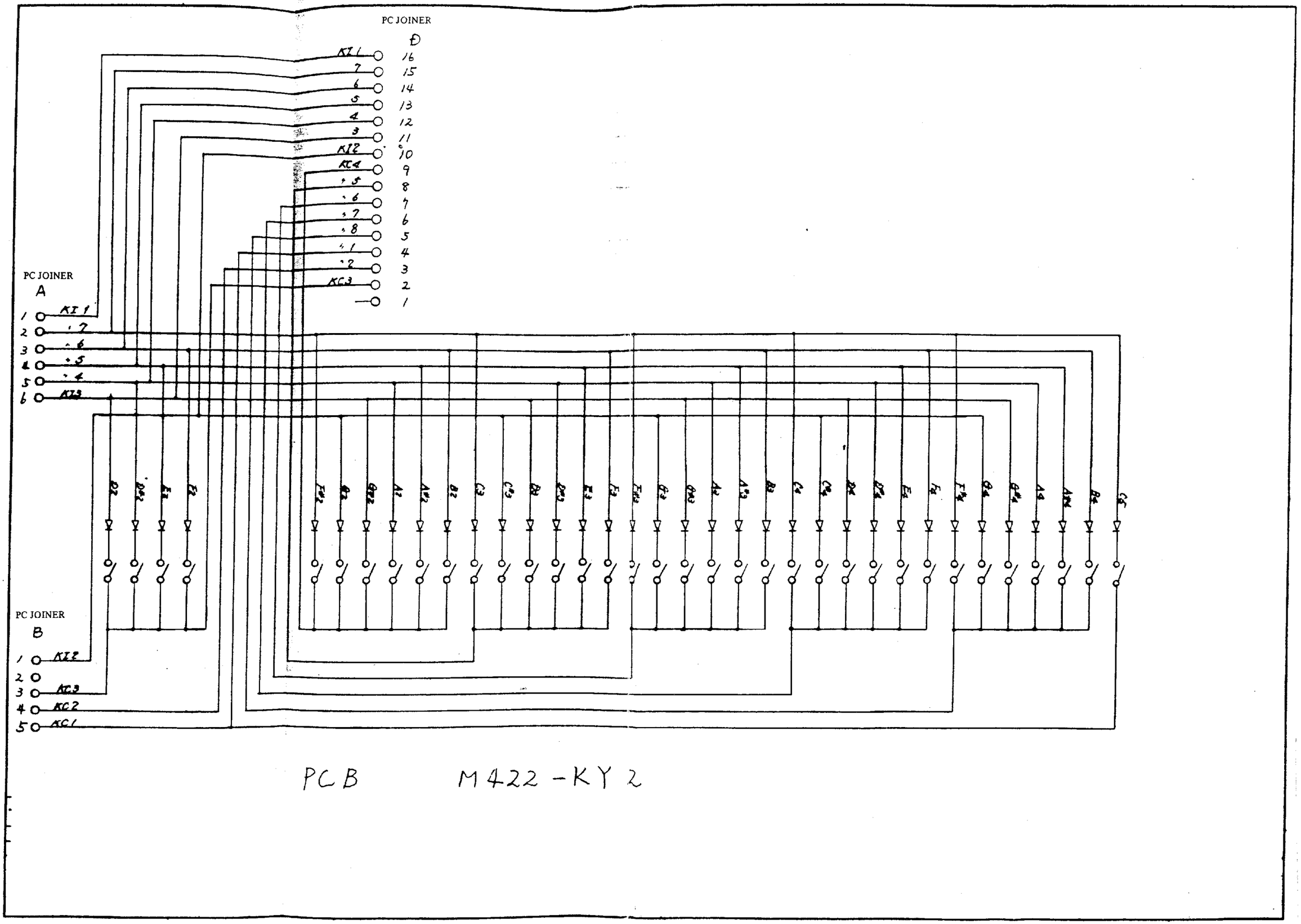

F.VR
A.IN
L.OUT
H.PHONE
STK020
4558-1
4558-2
SP 1
SP 2
SP 3
PA 1
PA 2
PA 3
PA 4
PA 5
CHORD
BASS
WA
F 4
E L
F 5
F 2
F 3
VR.DOWN
NOTE
• Transistors
: 2SC1815
: 2SA1015
• Voltage levels
+VCC: +15V
−VCC: −15V
+VDD: +5V
+VA: +12.5V
−VA: −12.5V


10KΩ
220Ω
SN74159N
(SN74154N)
+Vcc
GND
LED8
LED3
LED2
LED1
LED5
GND
SK4
SK7
SK3
SK2
SK6
KC1
KC4
KC7
ORGAN
FLUTE
OBOE
CLARINET
TRUMPET
VIOLIN
CELLO
SK5
SK3
KC1
SK6
SK7
PIANO
HARPSI-CHORD
CELESTA
ACCOR-DION
ELECTRIC PIANO
FUNNY
FROG
LED ×14
(TLR-206)

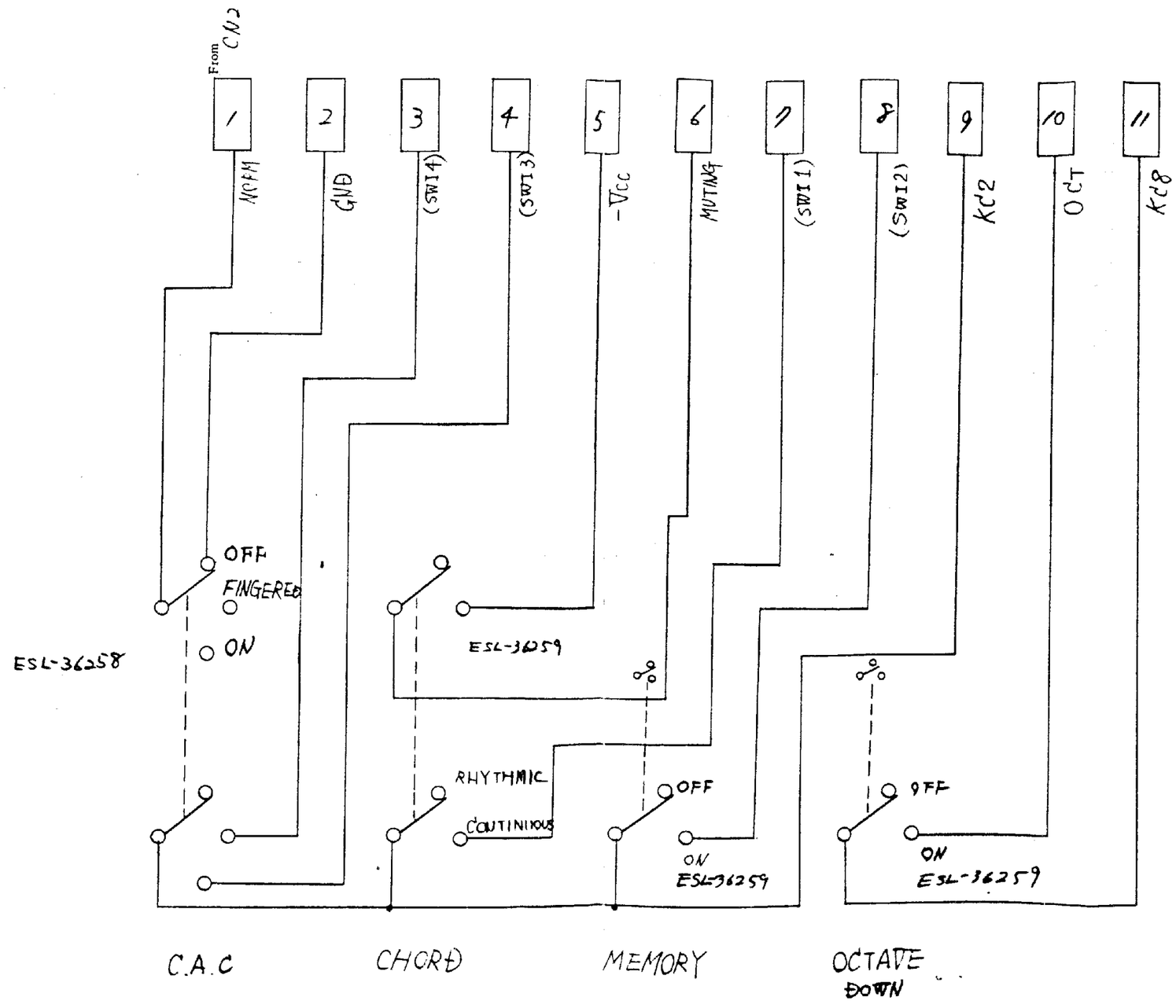

PC JOINER A
KI1
7
6
5
4
KI3
1
2
3
4
5
6
C1
C#1
D1
D#1
E1
F1
F#1
G1
G#1
A1
A#1
B1
C2
C#2
PC JOINER B
KI2
KC3
KC2
KC1
1
2
3
4
5

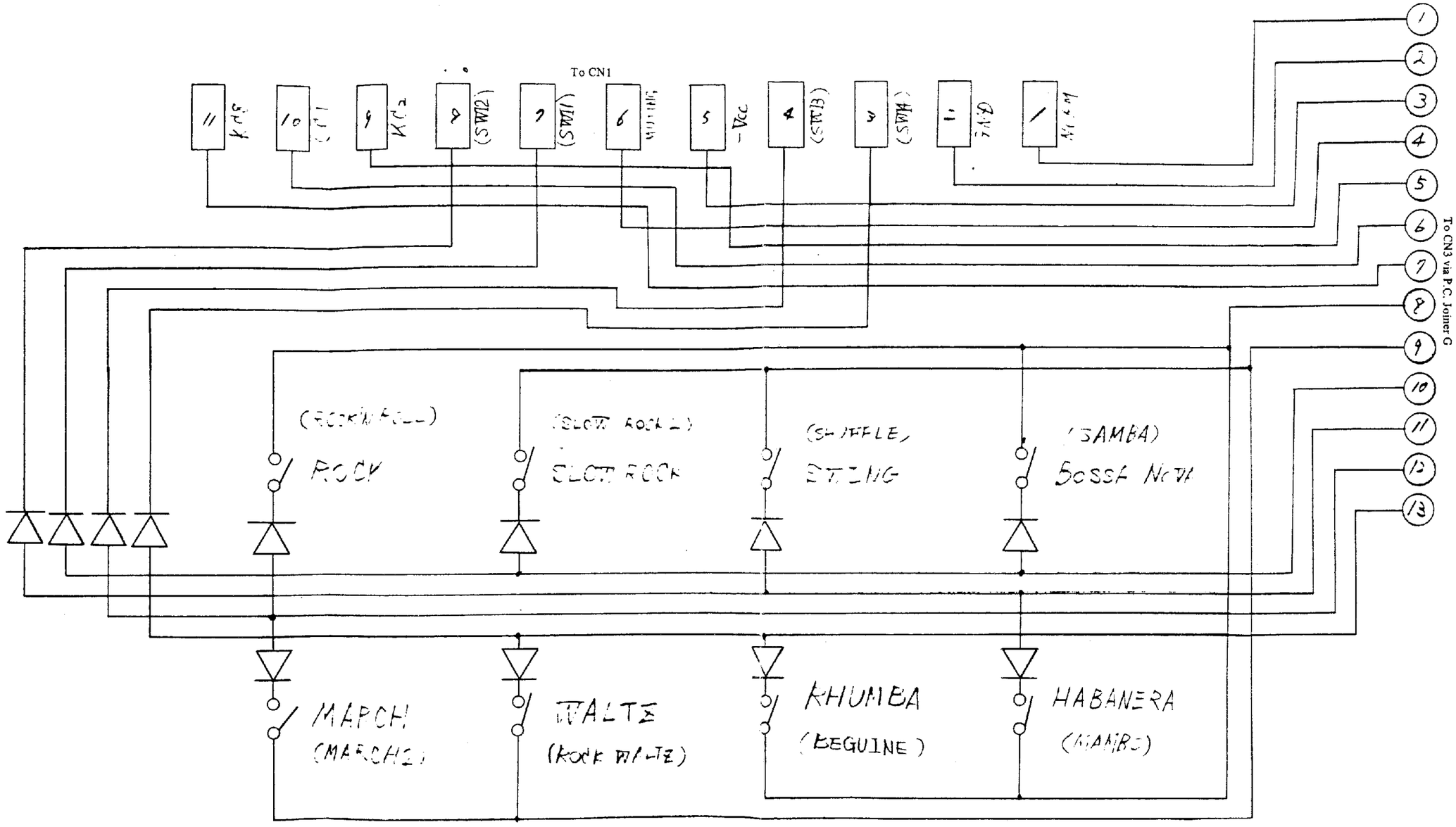
PCB M422-KY 1

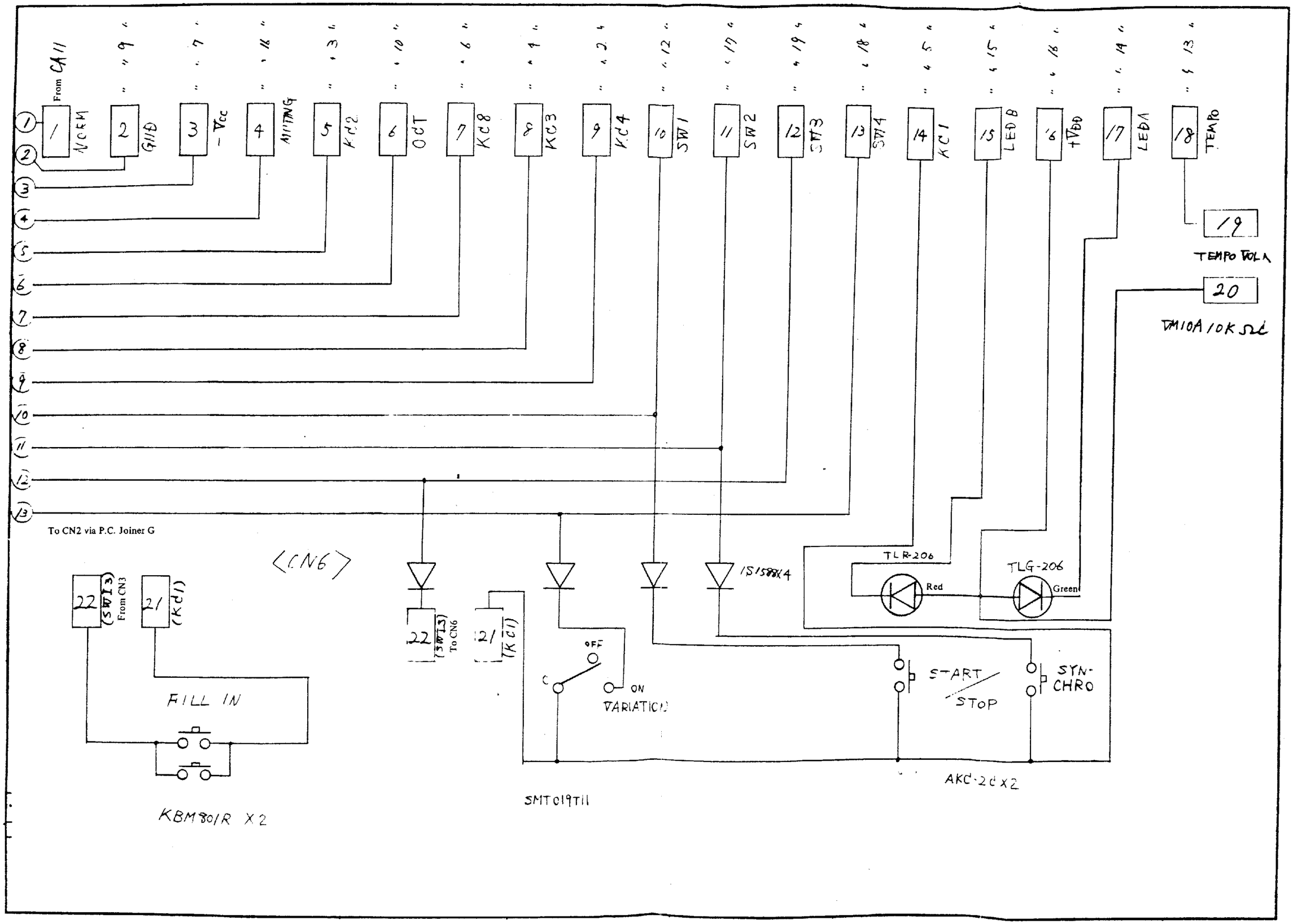

Trans. former
Voltage selector
ESE-371
Red 240
White 220
Blue 120
Yellow 100
Black 0
Green
Purple
Black
Brown
Orange
PS1
PS2
PS4
Red
White
PME265
1IB522
3P
Receptacle
NC173
S2VB10
1.6A
+VA
+VDD
-VB
GND
GND
+VCC
-VEE
GND
μA78M05C
μA78M15C
μA79M15C
Heat sink
(35 cm²)
S1RBA20
1A
500mA
10K
PS3
PS4
20
5
6
Yellow
Blue
Ceramic capacitor
22000P
M411-PS1
M422-PS1
White
Green
Red
Blue
Black
Purple
Brown
Black
Yellow

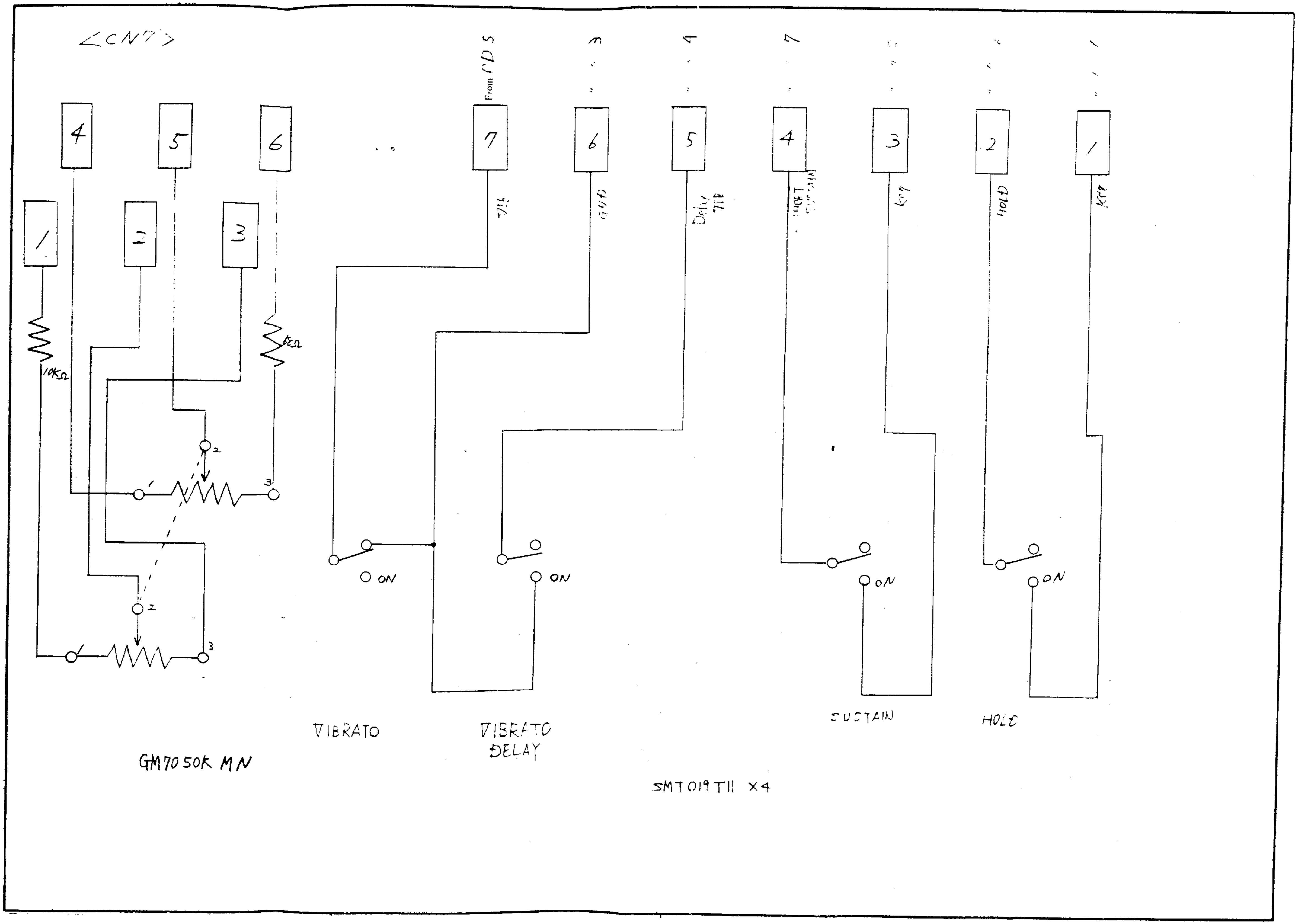

PC JOINER
D
KI 1
7
6
5
4
3
KI 2
KC 4
KC 3
PC JOINER
A
KI 1
KI 2
KI 3
PC JOINER
B
KI 2
KC 3
KC 2
KC 1

PCB M422-KY2

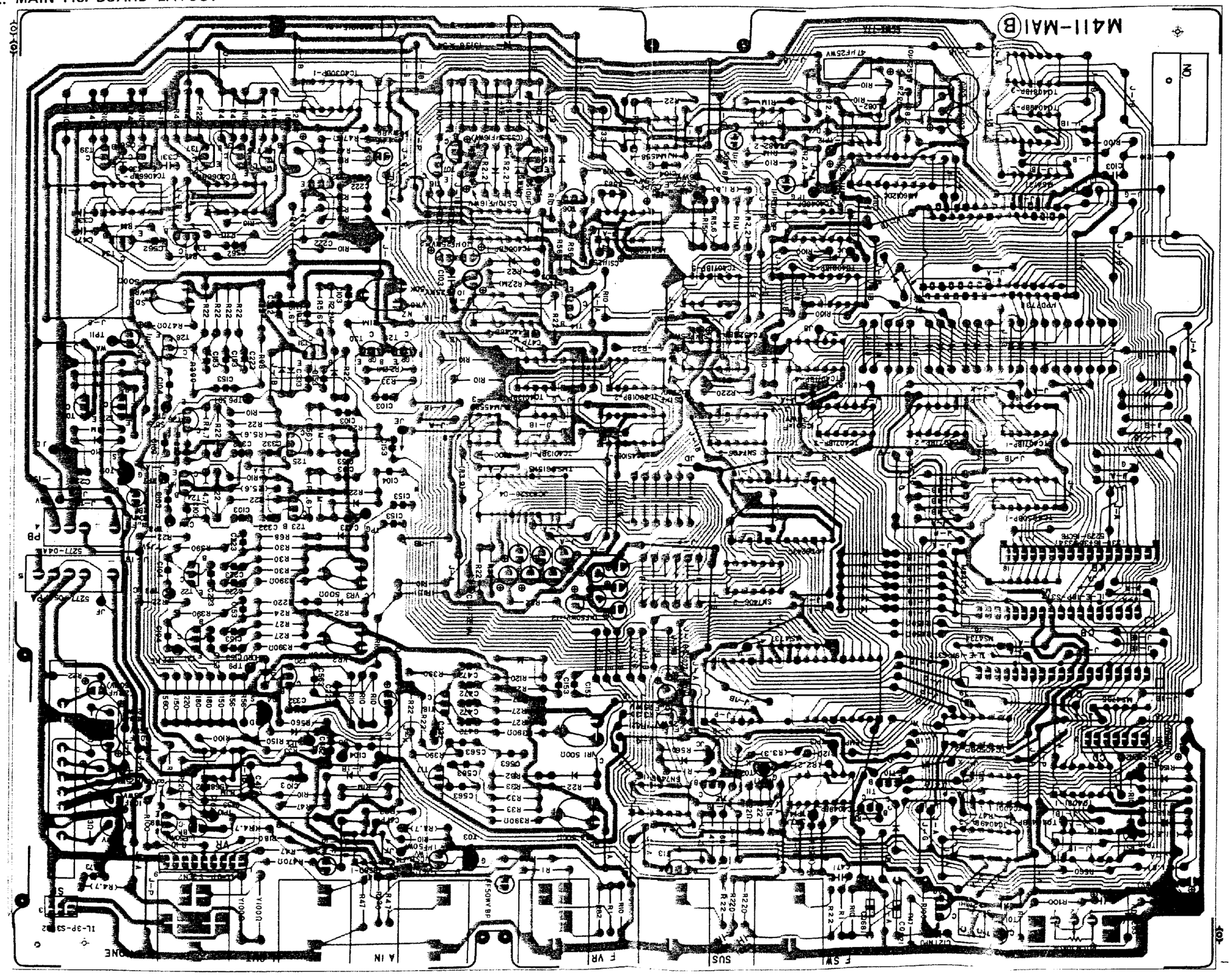

From CN2
1
2
3
4
5
6
7
8
9
10
11
MOM
GND
(SW14)
(SW13)
-Vcc
MUTING
(SW11)
(SW12)
KC'2
OCT
KC'8
OFF
FINGERED
ON
ESL-36258
ESL-36259
RHYTHMIC
CONTINUOUS
OFF
ON
ESL-36259
OFF
ON
ESL-36259
C.A.C
CHORD
MEMORY
OCTAVE
DOWN


To CN1
To CN3 via P.C. Joiner G
(ROCK'N ROLL)
ROCK
(SLOW ROCK)
SLOW ROCK
(SHUFFLE)
STING
(SAMBA)
BOSSA NOVA
MARCH
(MARCH)
WALTZ
(ROCK WALTZ)
RHUMBA
(BEGUINE)
HABANERA
(HABANERA)

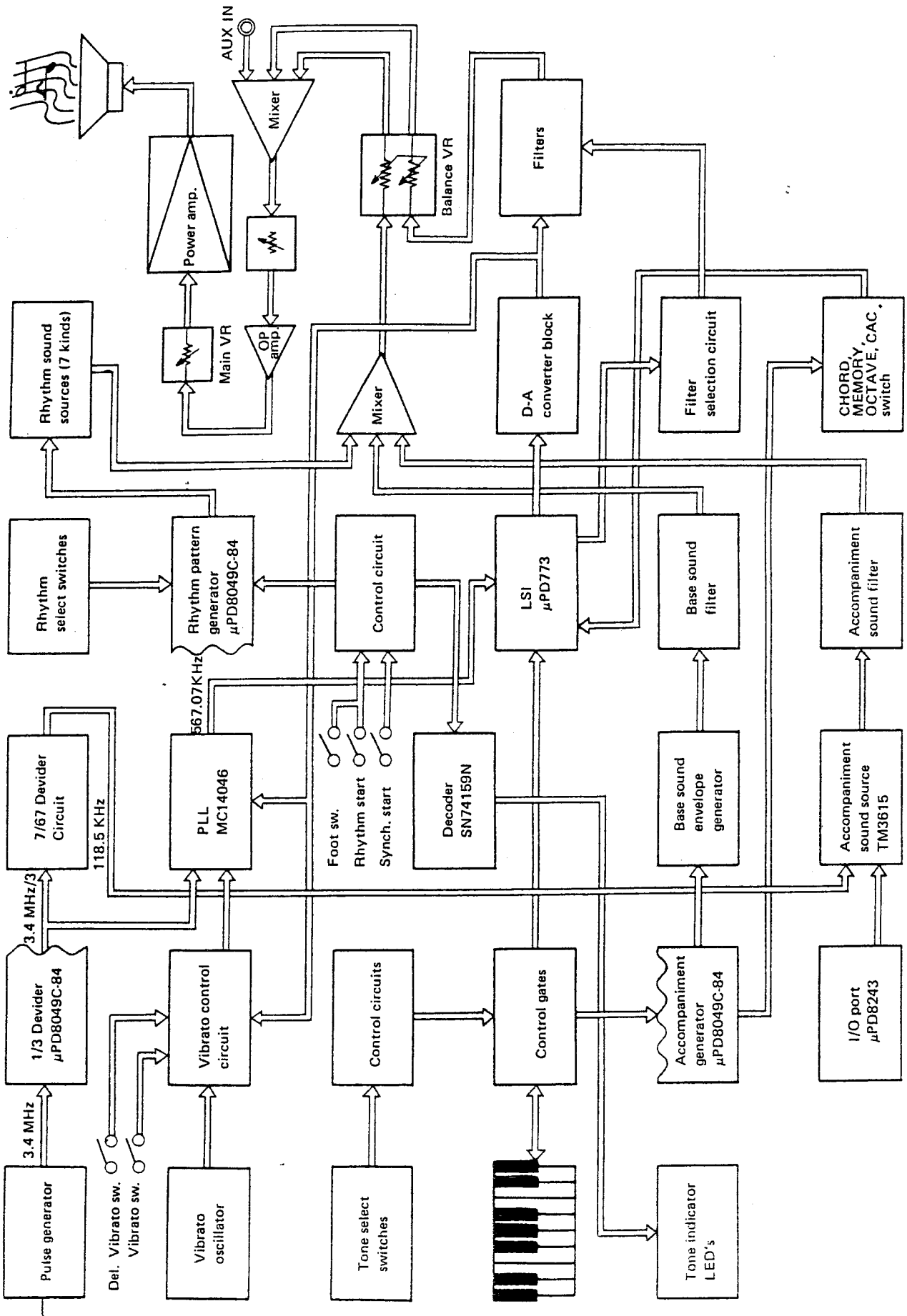

From CA11
1 NCKM
2 GND
3 -Vcc
4 MUTING
5 KC2
6 OCT
7 KC8
8 KC3
9 KC4
10 SW1
11 SW2
12 SW3
13 SW4
14 KC1
15 LED B
16 +VDD
17 LEDA
18 TEMPO
19
TEMPO VOL
20
DM10A 10K Ω
To CN2 via P.C. Joiner G
<CN6>
22 (SW13) From CN3
21 (KC1)
FILL IN
KBM801R X2
22 (SW13) To CN6
21 (KC1)
SMT019T11
OFF
ON
VARIATION
1S1588X4
TLR-206
Red
TLG-206
Green
START
STOP
SYN-
CHRO
AKC-2d X2


<CN7>
From CD5
4
5
6
1
2
3
7
6
5
4
3
2
1
10kΩ
ON
VIBRATO
VIBRATO
DELAY
SUSTAIN
HOLD
GM7050K MN
SMT019TII x4

2. MAIN P.C. BOARD LAYOUT



3. BLOCK DIAGRAM



4. KEYBOARD AND SWITCHES

4-1. Keyboard Matrix

A key entry is done by sending key common signals to the key input terminals of the LSI μPD773. Key common signals KC1 - KC8 are generated in the LSI μPD773 and are always applied to the keyboard. For example, signal KC8 is applied to keys G4, G#4, A4, A#4, B4 and F#4. If the key A4 is hit, common signal KC8 enters the key input terminal KI4 of the LSI.
By receiving KC8 signal from the KI4 terminal, LSI generates 12-bit digital sound signal for A4 sound.
The following lists the keyboard matrix table of CT-401.

	KI1	KI2	KI3	KI4	KI5	KI6	KI7
KC1	C1	C#1	D1	D#1	E1	F1	C5
KC2		G1	G#1	A1	A#1	B1	F#1
KC3		C#2	D2	D#2	E2	F2	C2
KC4		G2	G#2	A2	A#2	B2	F#2
KC5		C#3	D3	D#3	E3	F3	C3
KC6		G3	G#3	A3	A#3	B3	F#3
KC7		C#4	D4	D#4	E4	F4	C4
KC8		G4	G#4	A4	A#4	B4	F#4

Table 4-1 Keyboard matrix.

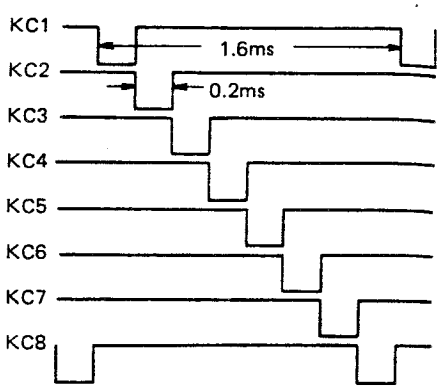


Fig. 4-1 Time chart of key common signals

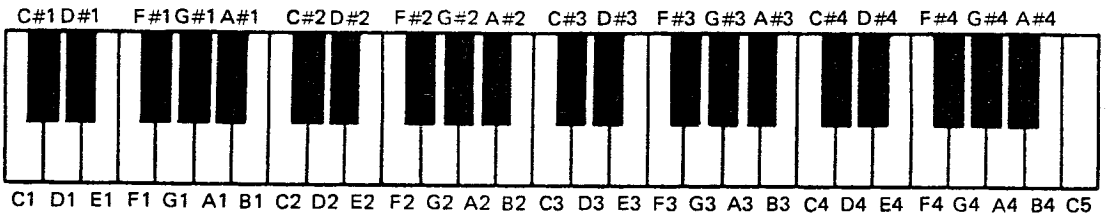


Fig. 4-2 Nomenclature of the keys

4-2. CAC (Casio Auto Chord) Control Circuit

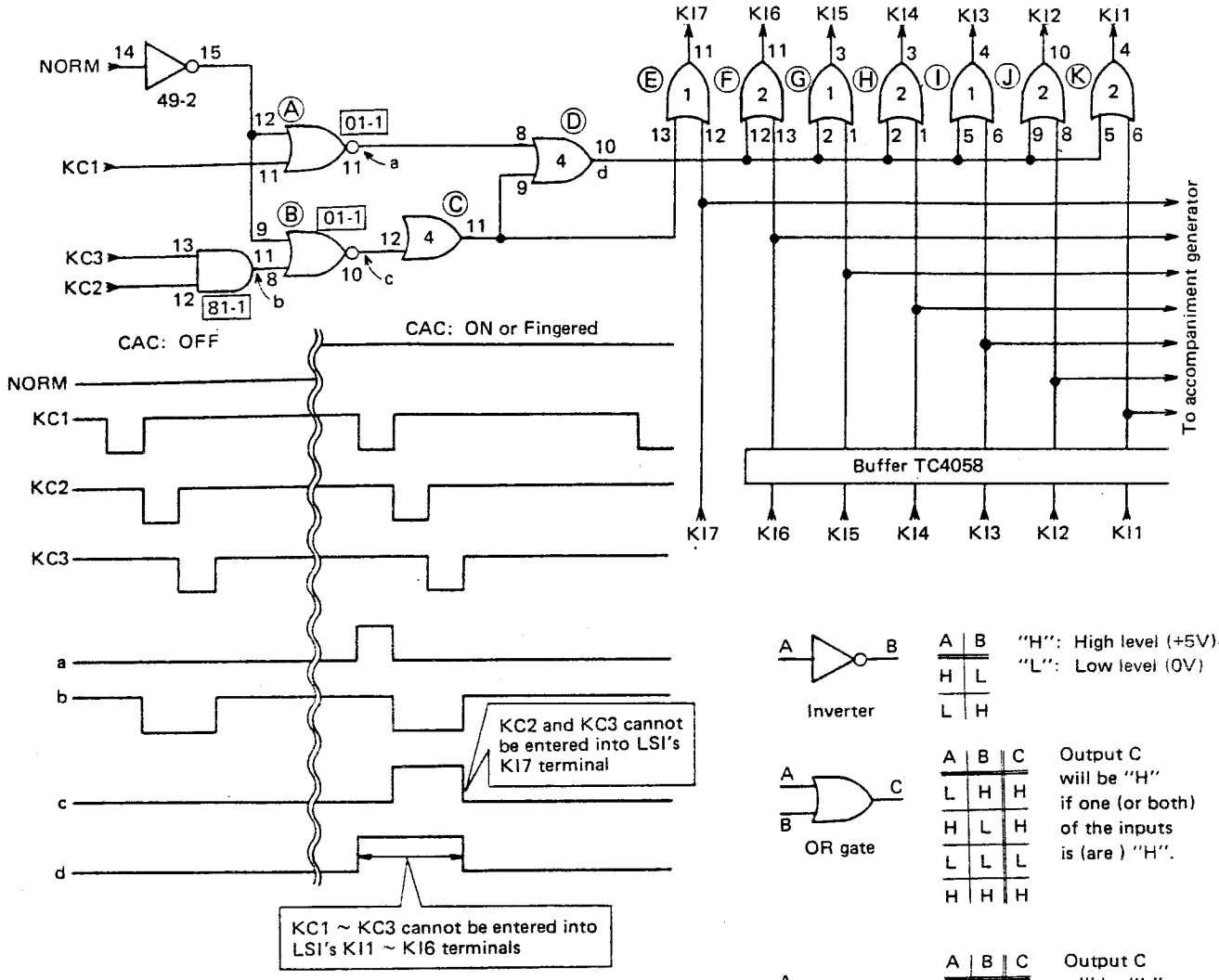
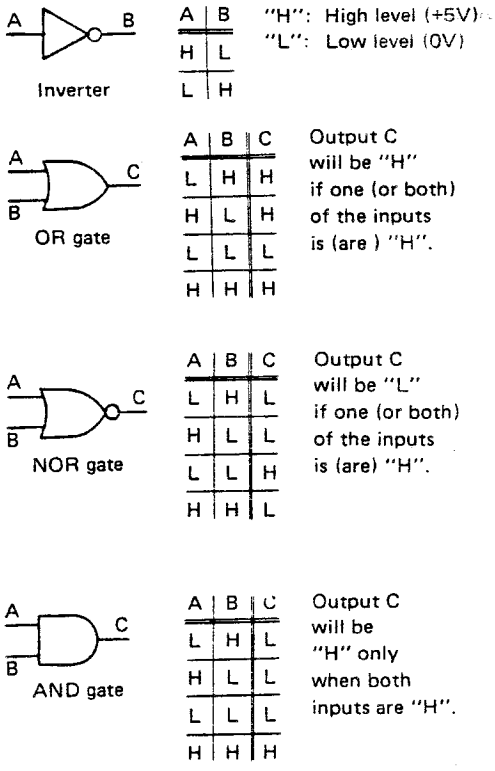


Fig. 4-3 CAC control circuit



While CAC switch is at "ON" or "Fingered" position, key entry signals of keys C1 to F2 should not be entered into the LSI μPD773 (as μPD773 generates only melody signals) but into the accompaniment generator μPD8049.

Figure 4-3 shows the CAC control circuit.

When CAC switch is at "ON" or "FINGERED" position, terminal NORM stays at "H" voltage level (+5V) gates Ⓐ and Ⓑ open causing gate Ⓒ open.

The gates Ⓕ to Ⓚ are closed during KC1 - KC3 timings therefore key common signals KC1, KC2 and KC3 cannot be entered into the LSI μPD773 through KI6 - KI1 terminals but enter to the accompaniment generator μPD8049.

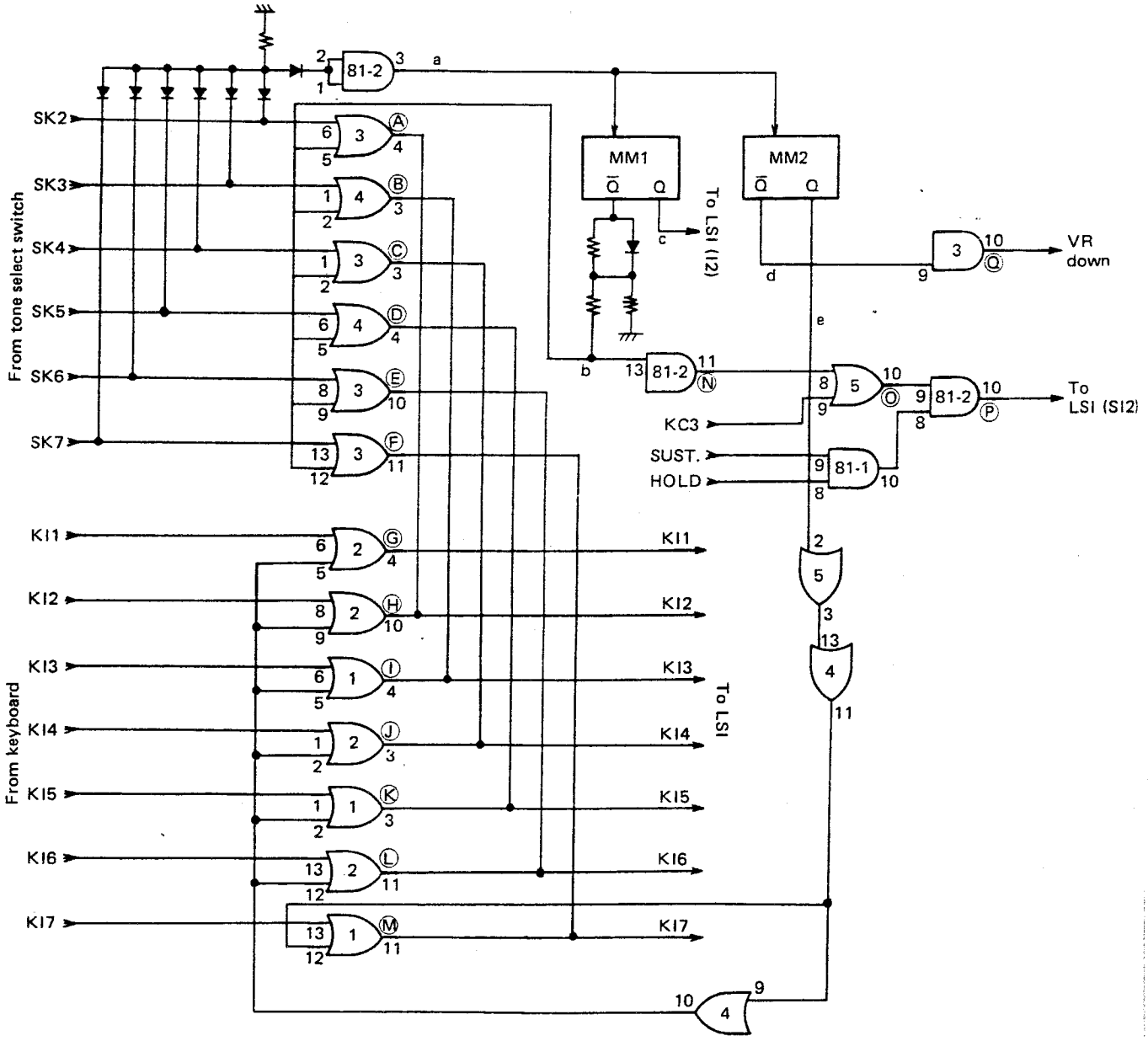
Also by opening gate Ⓒ, gate Ⓔ is closed only at time of KC2 and KC3 as the key C5's entering matrix is KC1/KI7 (refer table 4-1).

4-3. Tone Select Circuit

The LSI μPD773 descriminates the selected tone by receiving one of KC signals from KI terminals while terminal I2 (pin No. 34) of the LSI is at "H" level.
The following shows the matrix table of tone selection.

	SK2 (KI2)	SK3 (KI3)	SK4 (KI4)	SK5 (KI5)	SK6 (KI6)	SK7 (KI7)
KC1						Piano
KC6			Elec. Piano	Frog	Funny	
KC7	Accordion	Harpsichord	Violin	Trumpet	Celesta	
KC8		Organ	Flute	Cello	Oboe	Clarinet

(Table 4-2; Tone selection matrix)



(Fig. 4-4; Tone select control circuit)

Figure 4-4 shows the tone selection control circuit.
This circuit performs;

1. To enable the tone selection signals to enter into the LSI.
2. To cut sustain or hold.
3. Send "H" level to terminal I2 of the LSI in order to descriminates tone selection from key entry.
4. To cut a shock noise which may be generated when a tone is changed to another..
5. Cut the key entry circuit in order to protect from wrong tone selection as tone selection is done by the same method as key entry.

In figure 4-4, while one of the tone select switch is pressed,

a; appears one of KC signals causing to set the monostable multivibrator MM1 and MM2 (output Q: "H" $\overline{Q}$: "L")

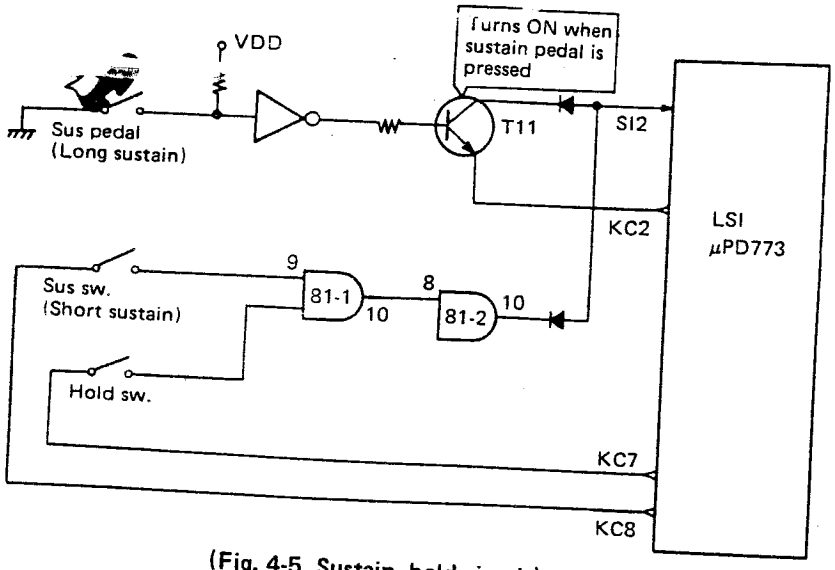
b; Stays at "L" level causing to open the gates Ⓐ ~ Ⓕ so that the signal from tone select switch can be entered into the LSI.
Also close the gates Ⓝ, Ⓞ and Ⓟ to cut sustain or hold. (Refer 4-5)

c; Send "H" level to terminal I2 of the LSI in order to descriminates a tone selection from a key entry.

d; Stays "L" level causing to close gate Ⓠ in order to cut a shock noise which may be generated when a tone is switched to another. (Refer Chapter 8)

e; Stays at "H" level causing to close the gates Ⓖ ~ Ⓜ so that the signals KI1 ~ KI7 from the keyboard cannot be entered into the LSI.

4-4. Sustain, Hold Circuit



(Fig. 4-5 Sustain, hold circuit)

The LSI μPD773 descriminates long sustain, short sustain or hold by receiving common signal KC2, KC7 or KC8 respectively into the SI-2 terminal (pin No. 17).
The order of the priority of those three switches are;

1. Sustain pedal
2. Hold switch
3. Sustain switch

4-5. Vibrato, Vibrato-Delay Circuit

Vibrato effect is made by modulating the frequency of the clock pulse (fundamental pulse for all the signals). Clock pulse modulation is done by the PLL (Phase-Locked Loop).

A. Fundamentals of the PLL

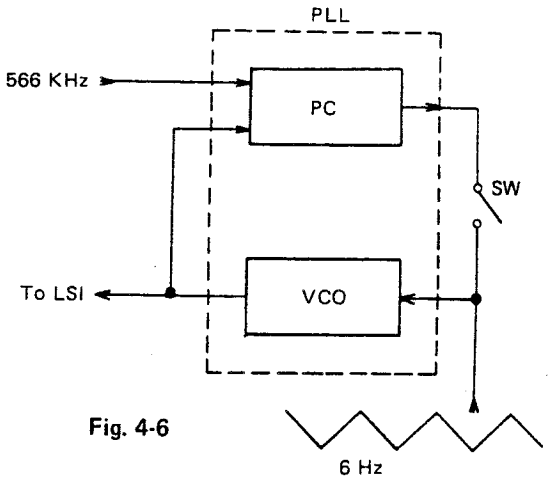


Fig. 4-6

PLL is basically composed of PC (Phase Comparator) and VCO (Voltage Controlled Oscillator). The PC compares the two input frequency and generates the difference of the frequency as voltage level.
VCO oscillates pulse according to the input voltage.
Now if the switch is closed, the PLL is locked and functions as frequency stabilizer.
If the switch is turned off, the PLL is unlocked 6 Hz triangle wave enters into the VCO and output pulse of the VCO is expanded and contracted in the period of 6 Hz.

B. Vibrato

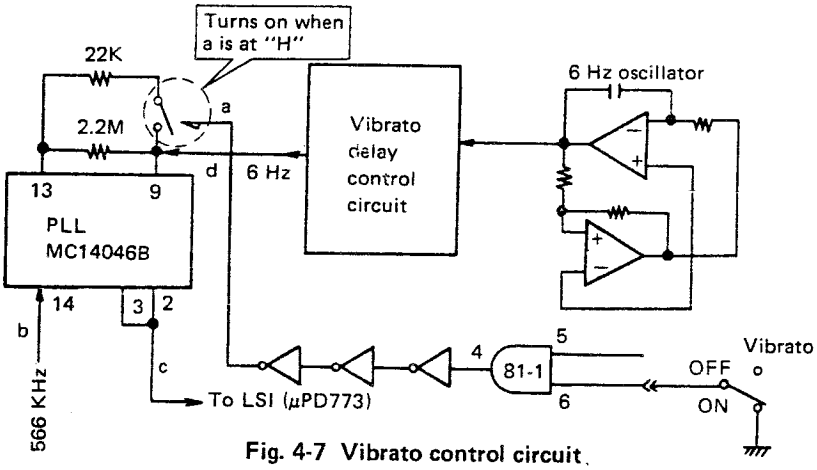


Fig. 4-7 Vibrato control circuit

When the vibrato switch is turned off, the electronic switch SW1 is on, the PLL is locked. 566 KHz pulse is stabilized and supplied to the LSI μPD773.
If vibrato switch is turned on, SW1 is turned off causing the PLL unlocked. The 566 KHz pulse expanded and contracted in the period of 6 Hz.

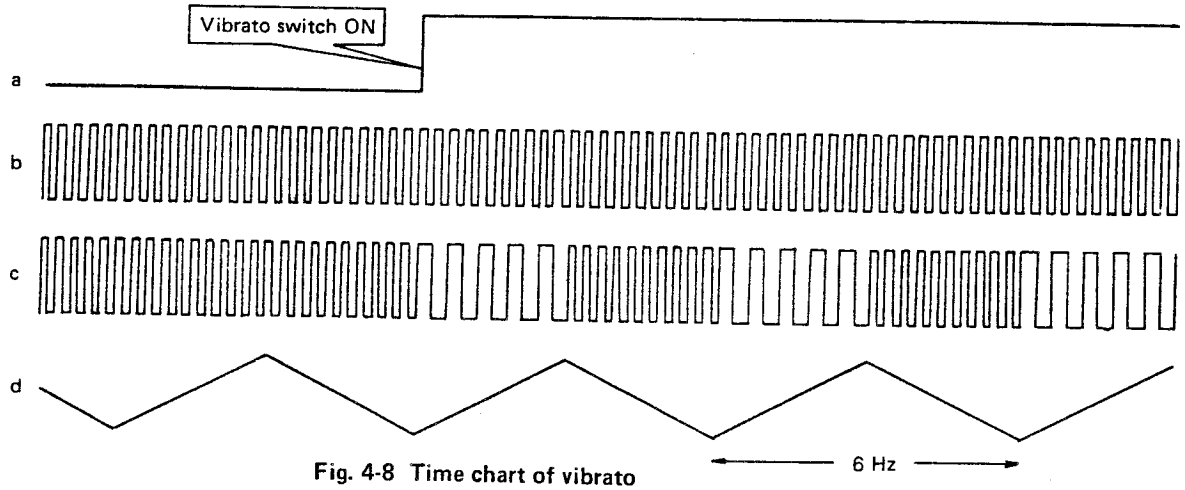


Fig. 4-8 Time chart of vibrato

C. Vibrato-delay control circuit

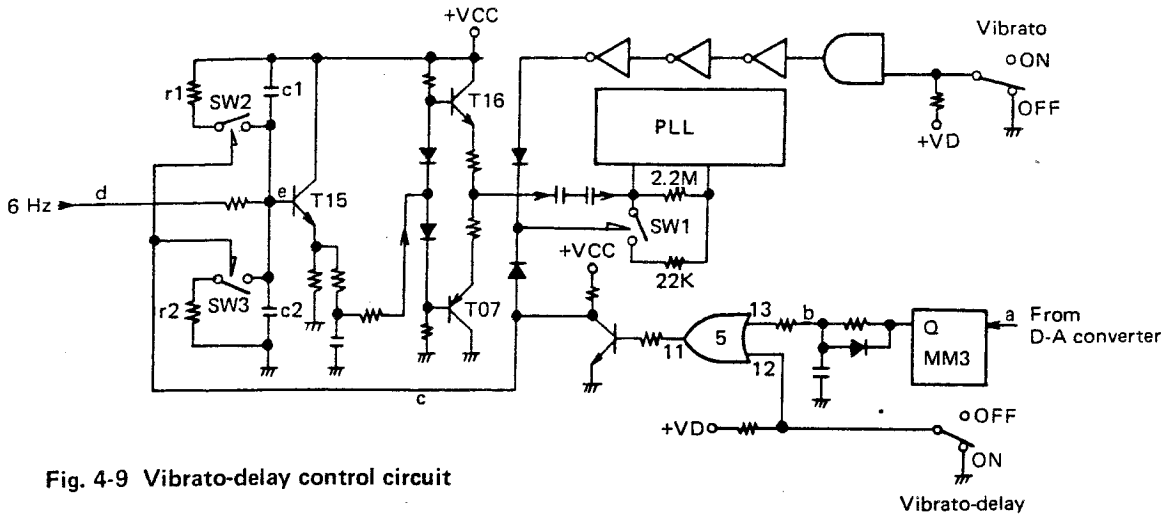


Fig. 4-9 Vibrato-delay control circuit

1) While no key is hit, output signal is not generated from the D-A converter block, monostable multivibrator MM3 is not set.
2) Transistor T-14 is turned off causing the electronic switches SW2 and SW3 turned on.
3) Capacitor c1 and c2 are discharged through the resistors r1 and r2.
4) If a key is hit, output from D-A converter set MM3 and the OR gate is closed.
5) Transistor T-14 turns on causing the switches SW2 and SW3 turned off.
6) GND and +VCC are not applied to the base of transistor T-15 and causing the 6 Hz triangle signal cannot pass through the transistor.
7) Each peak of the 6 Hz triangle signal charge the capacitors c1 and c2.
8) The 6 Hz signal gradually appear from transistor T-9 and supplied to the PLL through the push-pull circuit.
9) Thus clock pulse is modulated gradually after hitting of a key.

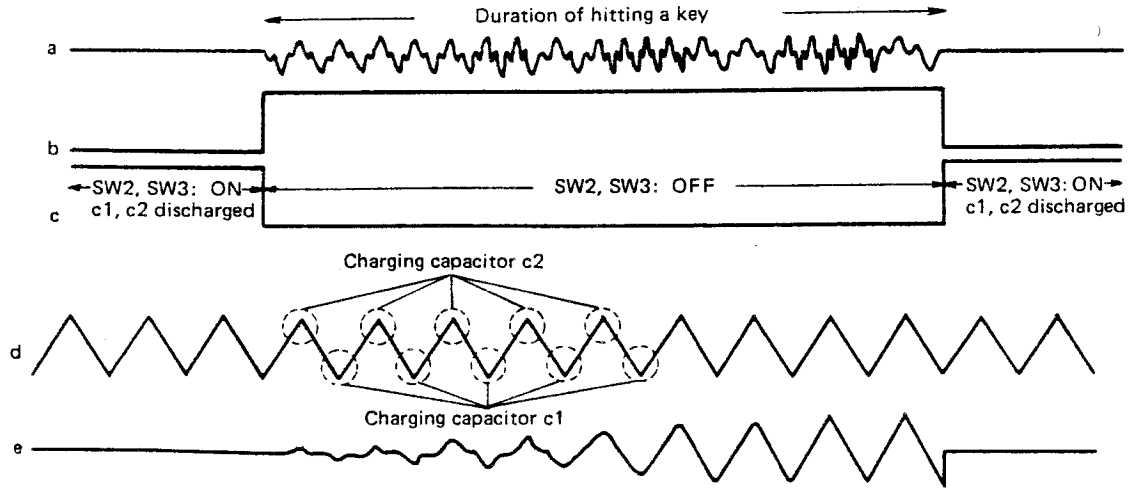


Fig. 4-10 Time chart of vibrato-delay control circuit

4-6. Octave Down Circuit

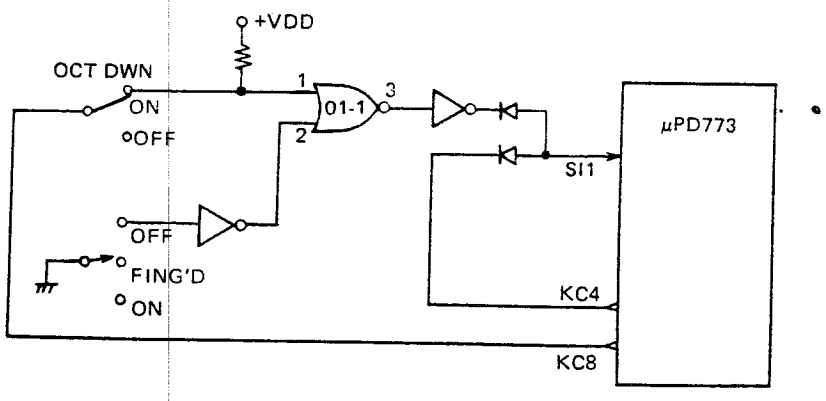


Fig. 4-11 Octave down circuit

Normally, SI1 terminal of the LSI μPD773 receives key comm signal KC4.
When the octave down switch is turned on, KC8 is also supplied to the LSI and by receiving KC8 from SI1 terminal, the LSI makes the output signals one octave lower.
The octave down switch is not effective when the C.A.C. switch is at off as the OR gate 01-1 is closed.

5. LSI (μPD773)

By receiving key input signal, the LSI generates 12-bit digital signal.
The LSI also selects filters in accordance with selected tone.
The following lists purpose of each terminal of the LSI.

Pin No.	Name	IN/OUT	Function
15	I1	IN	Receives schmitt trigger pulse which sets the internal circuit of the LSI at initial position when power switch is turned on.
16	SI1	IN	Octave control terminal. Normally KC4 is applied to this terminal and when Octave Down switch is turned on, KC8 is also supplied.
17	SI2	IN	Sustain control terminal. If this terminal receives KC2, the output signal is sustained.
18~24	KI1~KI7	IN	Key and tone selector input terminals.
25~33	KC8~KC1	OUT	Common signals for keys and tone selector.
34	I2	IN	Stays "H" level during depression of one of the tone selector switch.
35	ϕ	IN	Receives clock pulse which is basic pulse for all the signals from PLL.
39	IO-1	OUT	This terminal is used to prevent generation of shock noises which might be generated as a filter is switched to another to change tone.
42~47	O-31~IO-8	OUT	Filter selection signals.
48~59	O-28~O-17	OUT	12-bit digital output terminals.

6. D/A (CONVERTER (AM6012DC)

As the output of the LSI μPD773 is 12-bit digital signal, D/A (Digital to Analog) converter changes digital input data to corresponding analog signal values (amount of current).

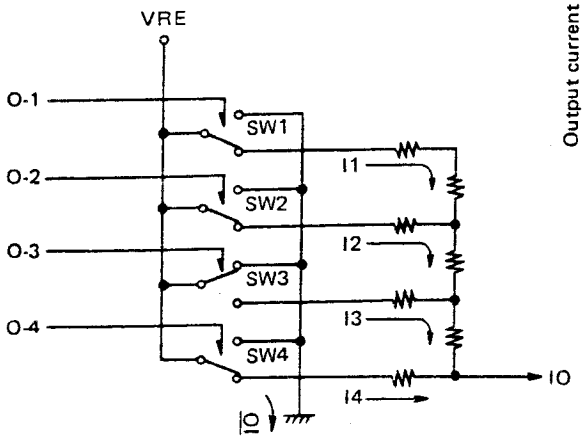


Fig. 6-1 4-bit D/A converter

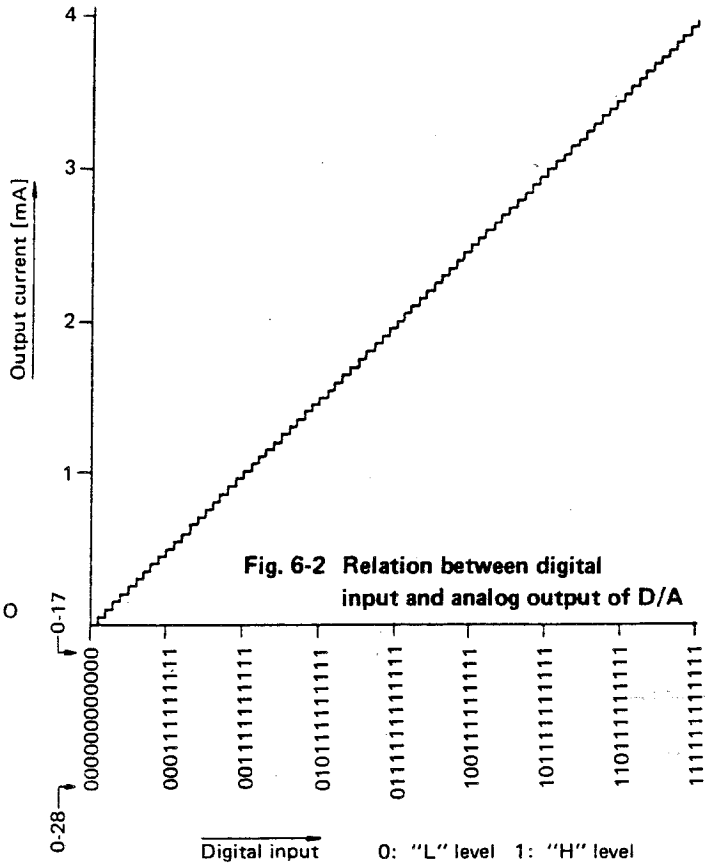


Fig. 6-2 Relation between digital input and analog output of D/A

Fig. 6-1 shows the fundamental of 4-bit D/A converter.
Current I1 ~ I4 flow if the switches SW1 ~ SW4 are ON.
The electronic switches SW1 ~ SW4 turn on or off by the voltage levels of digital signals O-1 ~ O-4. If all the switches are turned on, the output current I0 will be;

$$I0 = I1 + I2 + I3 + I4$$

Thus, digital signal is converted to analog amount of current.

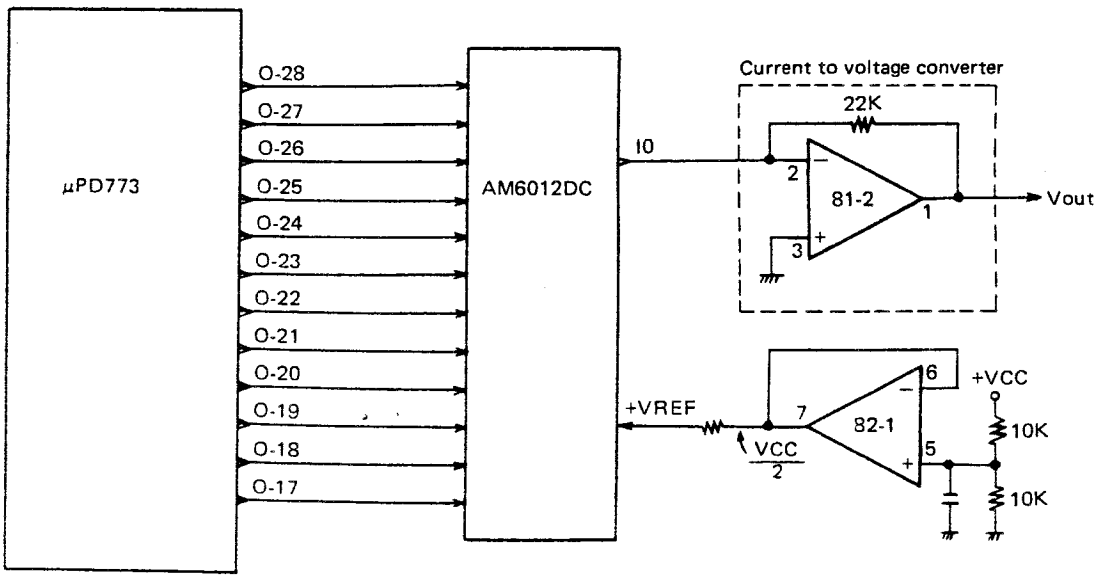


Fig. 6-3 D/A converter block

7. LOW PASS FILTER BLOCK

Functions of the filter block are as follows.

1. Waveform shaping (as output of the D-A converter is stepped waveform, it should be smoothed)
2. Removing noises
3. To cut unnecessary frequency

Four cutoff frequencies (which are 0.83 KHz, 1.12 KHz, 1.8 KHz and 3.13 KHz) are selected by the voltage levels of signals IO-8 ~ O-31 from the LSI μPD773 in accordance with the selected tone.

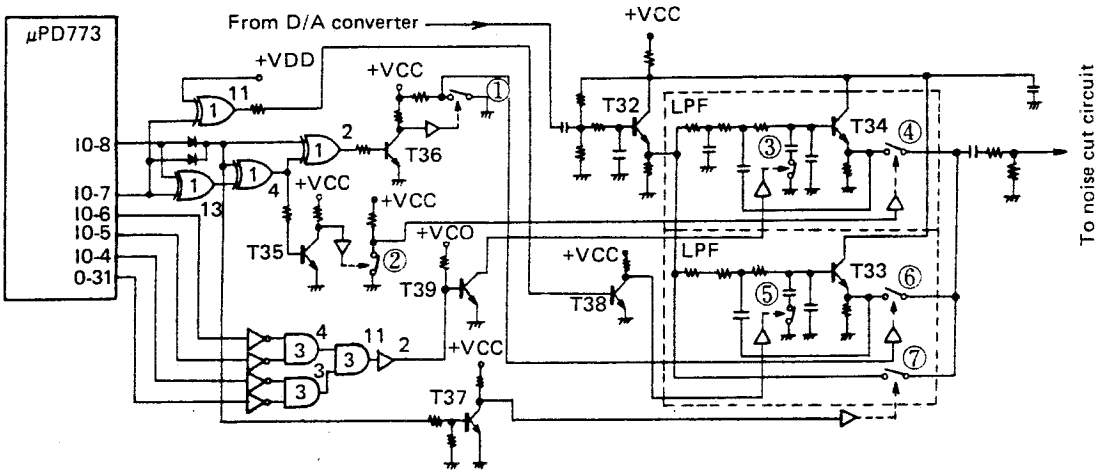
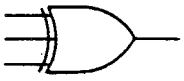


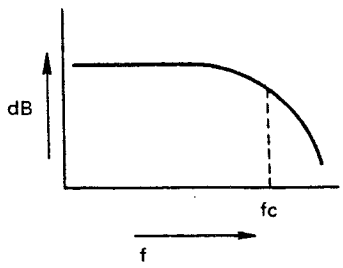
Fig. 7-1 Filter block

EXCLUSIVE-OR gate; A logic gate whose output is "H" if any one but not more than one of its inputs is "H". The output is "L" if more than one input is "H" or all inputs are "L" also called XOR gate.



Cutoff freq.	SW1	SW2	SW3	SW4	SW5	SW6	SW7	TONE
Plain*	ON	ON	OFF	OFF	OFF	OFF	ON	Accord. Frog, Funny Harpsi
0.83 KHz	ON	OFF	ON	ON	ON	OFF	OFF	Piano
1.12 KHz	ON	OFF	OFF	ON	ON	OFF	OFF	Organ, Flute, Cello
1.8 KHz	OFF	ON	OFF	OFF	ON	ON	OFF	Oboe, Clari., Elec. Piano
3.1 KHz	OFF	ON	OFF	OFF	OFF	ON	OFF	Trump., Viol., Celesta

*Plain; signal does not pass through any filter.



8. NOISE CUT CIRCUIT

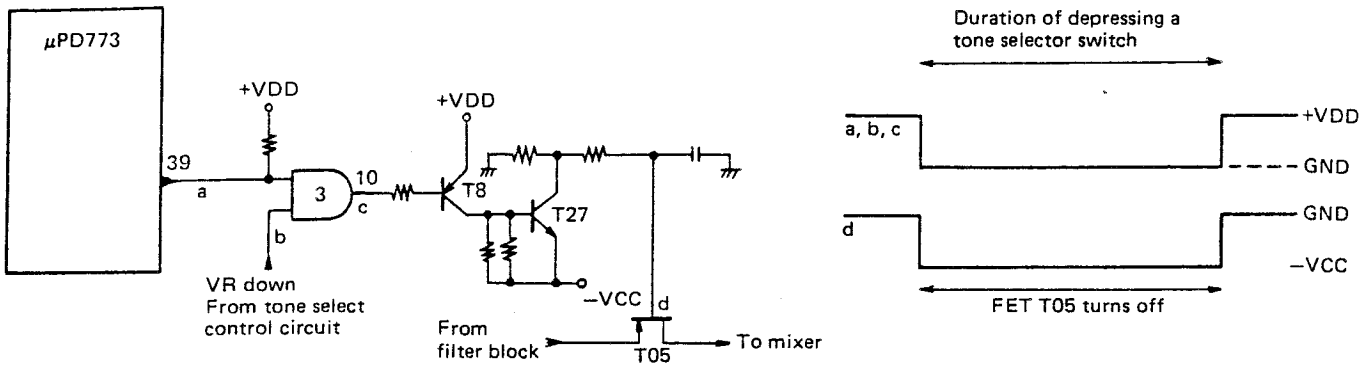


Fig. 8-1 Noise cut circuit

As a shock noise may be generated when a filter is switched to another, the FET T05 cut the output signal of the filter block.
While a tone selector switch is depressed, both inputs of the AND gate 3 becomes "L" voltage level (GND; 0 volt) the transistors T8 and T27 turn on causing the FET to turn OFF.

9. ACCOMPANIMENT

Accompaniment which are percussion, chord and base sounds are generated by the CPU (μPD8049-84), I/O PORT (μPD8243C) and Chord Generator (TMS3615).
The following lists the functions of each LSI's terminal.
CPU (Central Processing Unit μPD8049C-84)
This LSI is 8-bit micro computer consisting programs for chords, base sounds and percussion sounds.

Pin No.	Name	IN/OUT	Function
1	TO	OUT	1 MHz pulse output
2	X/TAL	IN	3 MHz pulse input
3	–	–	Not used
4	RESET	IN	Set the internal circuit of this LSI at the initial position when power is turned on
5	+VDD	IN	Receives +VDD (+5 volt) from power supply unit
6	TEMPO CLK	IN	Receives clock pulse for the tempo
7	EA	IN	GND (0 volt) terminal
8~11	–	–	Not used
12~18	DB0~DB6	IN	Key input terminals
19		IN	CAC ON/OFF terminal. While the CAC lever is at "ON" or "FINGERED", the terminal stays at "L" level (0 volt)
20		IN	GND terminal
21~25	P20~PROG	OUT	Chord output
26	+VDD	IN	+VDD terminal
27	P10	OUT	Output of envelope waveform for base sound
28	P11	OUT	Hi-hat output
29	P12	OUT	Cymbal output
30	P13	OUT	Low conga output
31	P14	OUT	High conga output
32	P15	OUT	Claves output
33	P16	OUT	Snare drum output
34	P17	OUT	Bass drum output
35~38	SW1~SW4	IN	Switch input terminals. By receiving common signals KC1 ~ KC4 from these terminals, the LSI descriminates the statuses of the switches and levers.
39	T1	IN	Receives KC1 signal in order to be synchronized with the LSI μPD773
40	+VDD	IN	Receives +VDD (+5 volt)

	KC1	KC2	KC3	KC4
SW1	START /STOP	CHORD CONTINUE	BOSSA-NOVA	SLOW ROCK 1
SW2	SYNCH. START	MEMORY ON	HABA-NERA	SWING
SW3	FILL IN	C.A.C. ON	ROCK	MARCH
SW4	VARI-ATION	C.A.C. FINGERED	RHUMBA	WALTZ

I/O Port (μPD8243C)

By receiving signals from the CPU, I/O port generates chord and pitch (frequency) of base sound.

Pin No.	Name	IN/OUT	Function
1	P50	OUT	E output
2	P40	OUT	C output
3	P41	OUT	C# output
4	P42	OUT	D output
5	P43	OUT	D# output
6	GND	IN	Connected to GND (0 volt)
7~11	PROG~P20	IN	Receive input signal from CPU. By variations of voltage levels of these terminals, the LSI generates corresponding output.
12	GND	IN	GND (0 volt) terminal
13	P70	OUT	L.E.D. (Green) drive signal
14	P71	OUT	L.E.D. (Red) drive signal
15	P72	OUT	Accompaniment start signal. When accompaniment starts, this terminal generates "L" level pulse.
16	P73	OUT	Base pitch output
17	P63	OUT	B output
18	P62	OUT	A# output
19	P61	OUT	A output
20	P60	OUT	G# output
21	P53	OUT	G output
22	P52	OUT	F# output
23	P51	OUT	F output
24	+VDD	IN	+VDD (+5 volt terminal)

Chord generator (TMS3615)

The LSI generates one octave tones in accordance with input K2 ~ K13 from the I/O port.

Pin No.	Name	IN/OUT	Function
3	SUS BIAS	IN	By the voltage level of this terminal, sustain length is selected
4	+VCC	IN	+VCC (+15 volt) terminal
5	K8	IN	F# input
6	K9	IN	G input
7	K10	IN	G# input
8	K11	IN	A input
9	K12	IN	A# input
10	K13	IN	B input
12	CLOCK	IN	Clock pulse (118.5 KHz) input
17	RESET IN	IN	Receives schmitt pulse which sets the internal circuit of the LSI when power switch is turned on
19	K2	IN	C input
20	K3	IN	C# input

Pin No.	Name	IN/OUT	Function
21	K4	IN	D input
22	K5	IN	D# input
23	K6	IN	E input
24	K7	IN	F input
25	STB IN	IN	Internal stabilizer control terminal
26	STB OUT	OUT	Internal stabilizer control terminal
27	OUT	OUT	Sound signal output terminal. Output signal is appeared as electric current.

9-1. Percussion

(A) Bass drum, Snare drum, Claves, Low conga, High conga

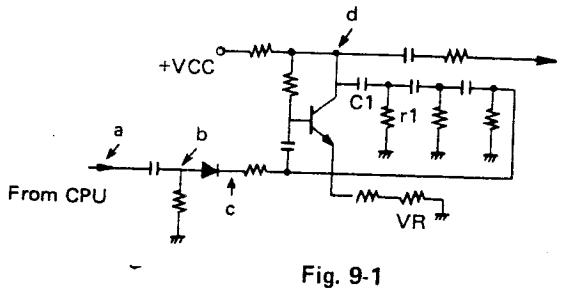


Fig. 9-1

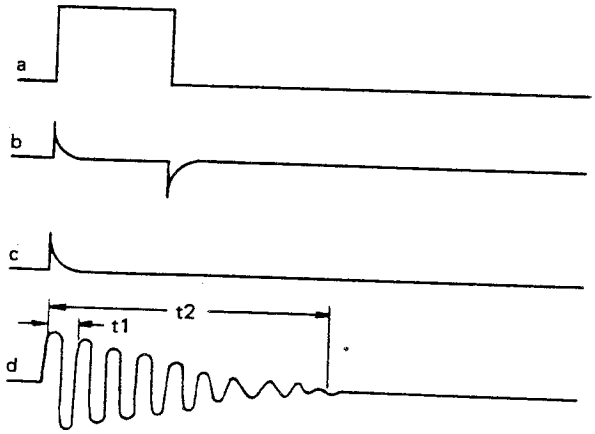


Fig. 9-2

As percussion output P11 ~ P17 from the CPU are single pulses, they should be changed to sound waveforms.
The frequency t1 is varied by the capacitor c1's and resistor r1's which are fixed in accordance with the percussion instruments.
The decreasing time t2 is varied by the variable resistor VR's.
The following shows the method of t2 adjustment.

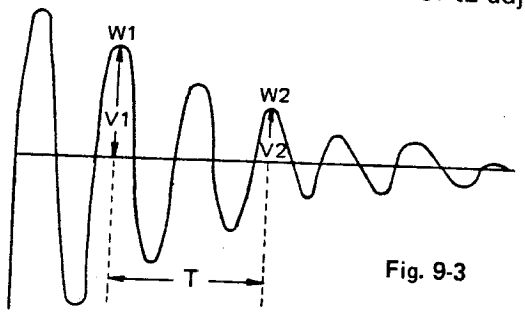


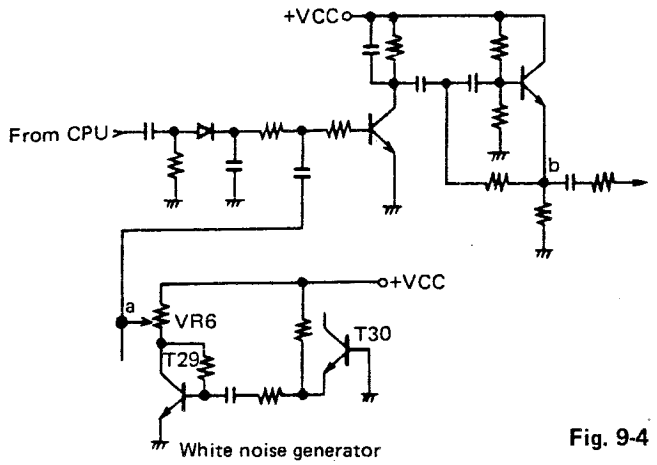
Fig. 9-3

1. Pick up any wave w1 and check it's voltage v1.
2. Find a wave w2 whose voltage v2 is about half of v1.
3. Set the length T between w1 and w2 as mentioned below by turning the variable resistor VR.

	Bass Drum	Snare Drum	Low Conga	High Conga	Claves
T	15 m sec.	7 m sec.	27 m sec.	16 m sec.	3.9 m sec.
VR to adjust	VR4	VR5	VR3	VR2	VR1
Check point	TP4	TP5	TP3	TP2	TP1

(B) Cymbal, Hi-hat, Snare drum

As those percussions have hissing sound, those sounds are created from a noise so called "white noise".



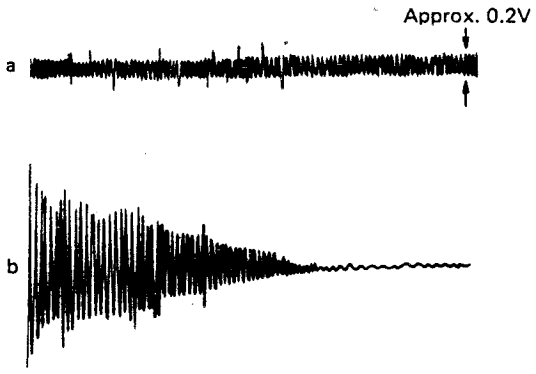


Fig. 9-4

9-2. Base Sound

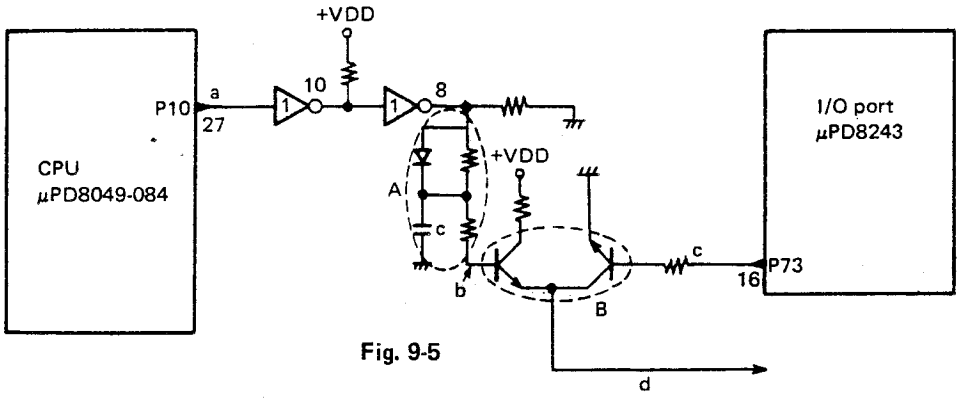
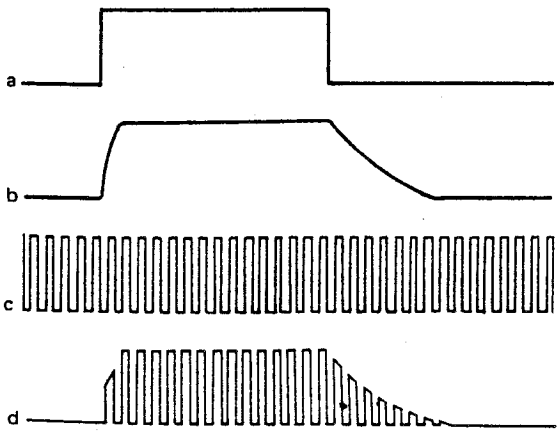


Fig. 9-5



B: Transistor AND gate
mix the signals P10 and P73

a: P10 from CPU
By the length of this signal, length of base sound is choosen.

A: Envelope generator
By charging and discharging of the capacitor c, signal P10 from the CPU is enveloped for making natural sound of base.

c: P73 from I/O Port
Appears frequency (pitch) of base sound.

9-3. Chord

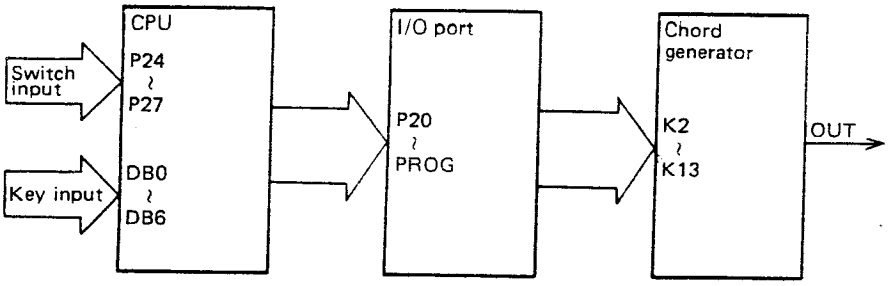


Fig. 9-6

CPU μPD8649-84 is a micro computer consisting of programs for chords and rhythms. In accordance with key input and selected switches, the CPU send 5-bit signals PROG ~ P20, I/O port generates 12-bit output for chord C ~ B.

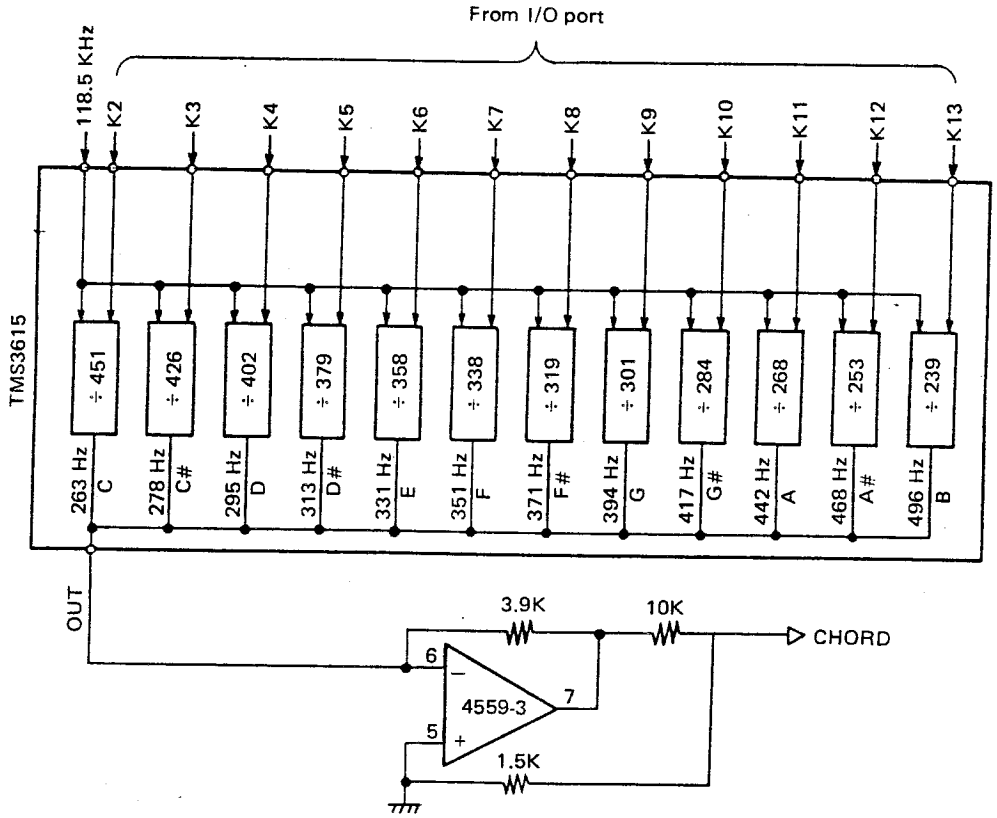


Fig. 9-7

The Chord generator TMS3615 consists 12 dividers which divide the fundamental frequency 118.5 KHz signal into each frequency of chord tone. The output of the chord generator appears a electric current, the OP amp converts the output signal to voltage level.

9-4. Accompaniment Start Control Circuit

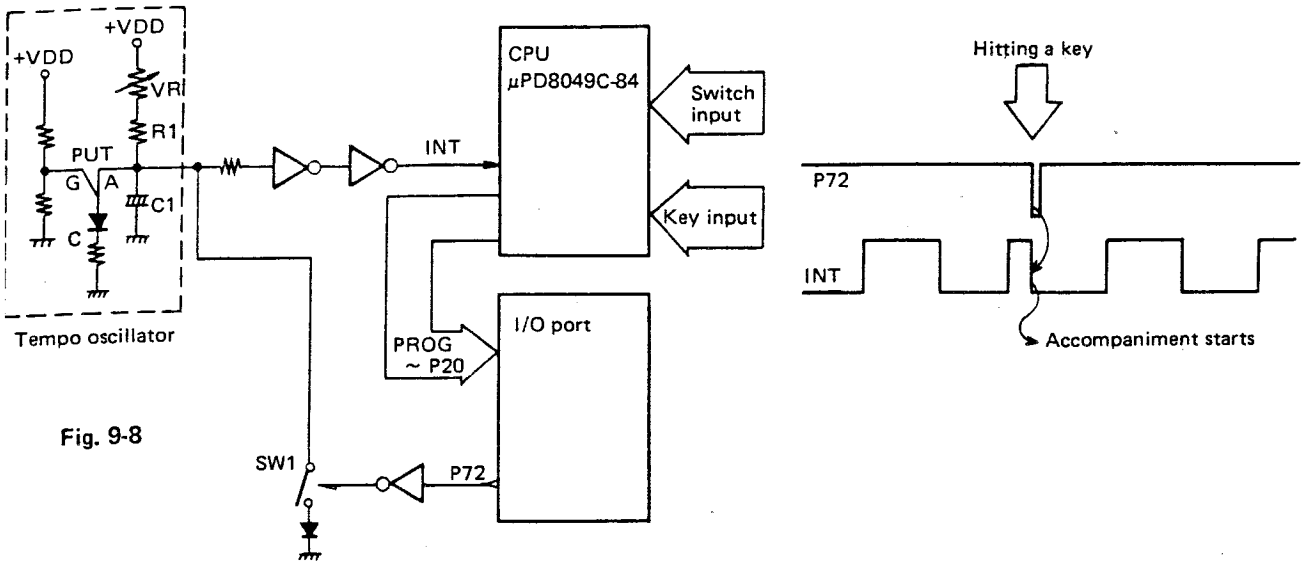


Fig. 9-8

Tempo oscillation is done by the PUT*. The capacitor C1 is charged through resistor R1 and VR and if charged voltage (equal to voltage level of PUT's anode) become higher than the gate, the PUT turns ON.
By turning ON of the PUT, the capacitor C1 is discharged and the PUT turns OFF again.
Thus tempo oscillation for accompaniment is done by turning ON and OFF of the PUT.
When a key (for accompaniment) is hit, signal P72 (pin No. 15) of the I/O port drops to "L" level for approx. 3 msec causing the electronic switch SW1 to turn ON, the PUT is turned off compulsorily.
The selected rhythm starts at the edge of INT signal.
The tempo speed is changed by the variable resistor VR.

*PUT [abbreviation for Programmable Unijunction Transistor]
A PNPN device (thyristor) with an anode gate.
For a constant gate voltage, the device remains off or nonconducting until the anode voltage exceeds the gate voltage by a predetermined amount, at which point it turns on. The action is much like that of a silicon controlled switch.

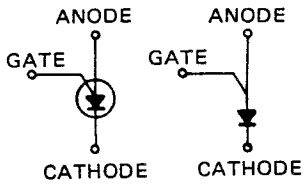
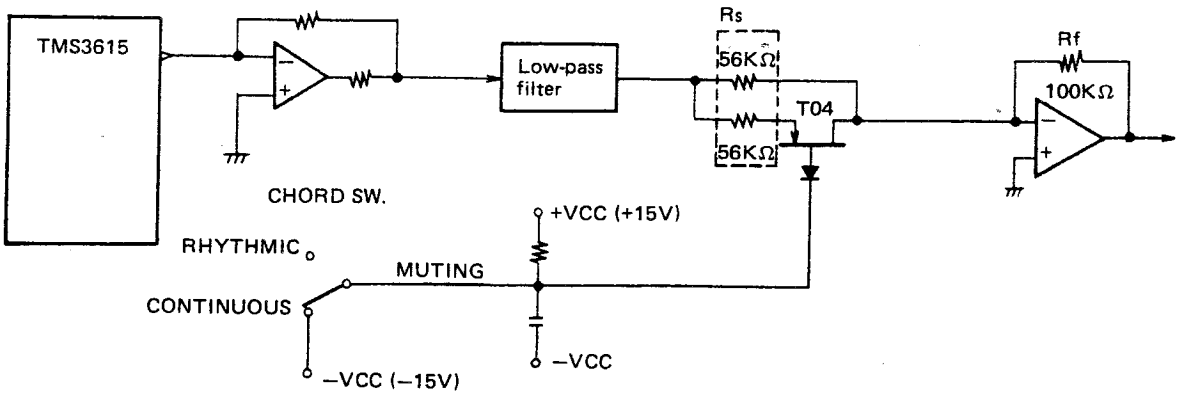


Fig. 9-9 Symbol of PUT

9-5. Muting Circuit

As continuous chord sound is felt louder than rhythmic chord, sound level for chord is lowered while CHORD switch is set at "CONTINUOUS".



When CHORD switch is set at "RHYTHMIC", gate of the FET T04 is at +VCC (+15 volt) and the FET turns on. The resistance Rs is;

$$Rs = \frac{56}{2} \text{ K Ohms} = 28 \text{ K Ohms}$$

Amplitude A of the OP amp will be;

$$A = -\frac{Rf}{Rs} = -\frac{100}{28} = -3.57$$

By setting CHORD switch at "CONTINUOUS", the FET T04 is turned off.
The resistance Rs become 56 K Ohms. Amplitude A will be;

$$A = -\frac{100}{56} = -1.79$$

Thus continuous chord level is lowered in half.

10. MIXING CIRCUIT

All the accompaniment sound and main melody are mixed in the following circuit.

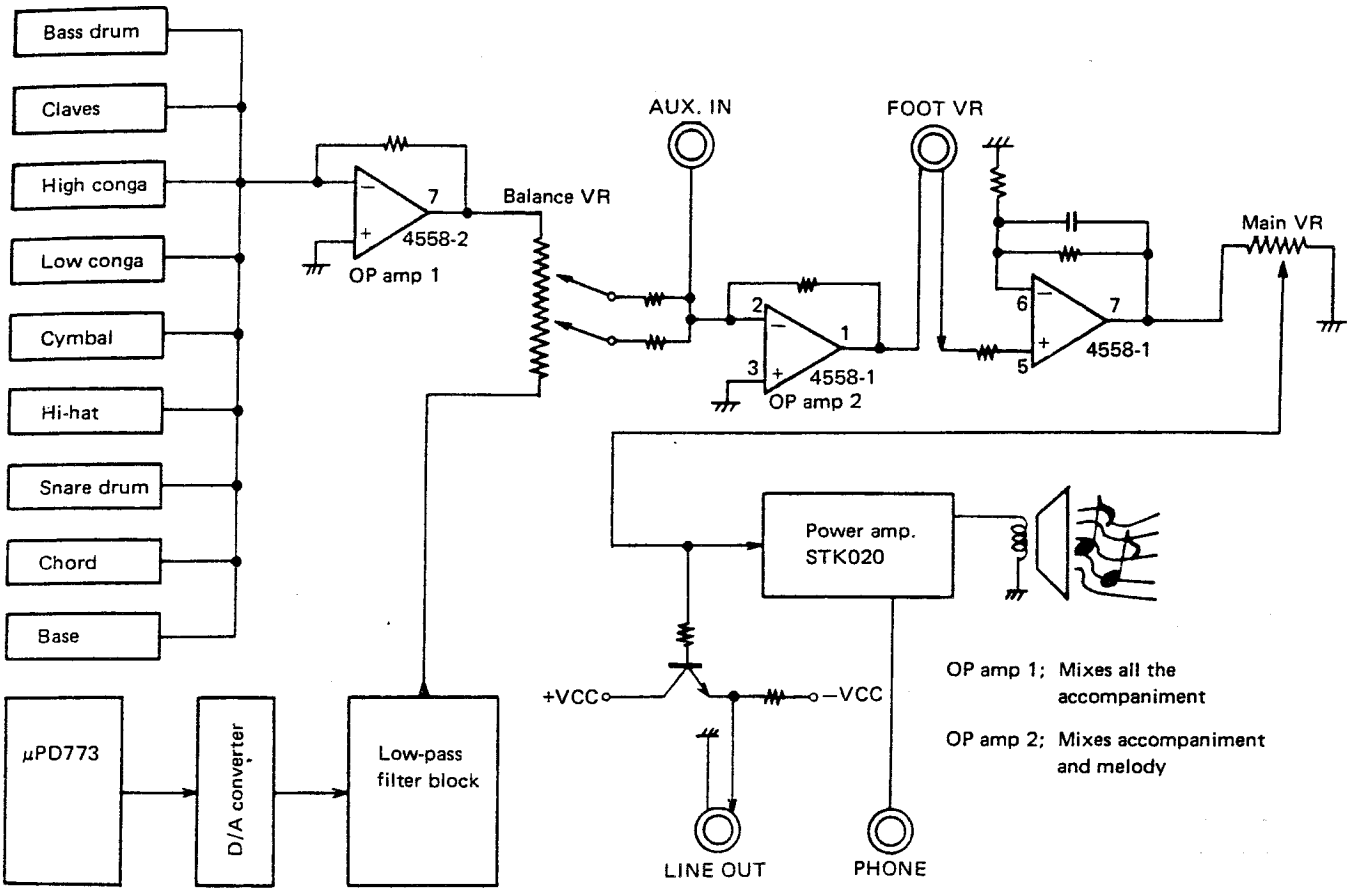


Fig. 10-1

11. POWER AMPLIFIER

The power amp STK-020 has 10 watt min. output power.
The following is the equivalent circuit of STK-020.

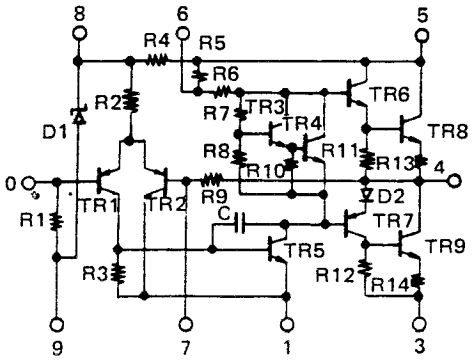


Fig. 11-1

12. PARTS LIST

CODE NO.	PARTS NAME	SPECIFICATION	UNIT PRICE (¥)	NEWLY EMPLOYED
	MAIN PC BOARD			
2001 1351	LSI	μPD773G		
2001 1378	LSI	μPD8049C-84		○
2001 1386	LSI	μPD8243C		○
2005 0888	LSI	TMS3615		○
2100 3247	MOS IC	TC4050BP		
2100 3255	MOS IC	TC4049BP		
2100 3271	MOS IC	TC4001BP		
2100 3310	MOS IC	TC4013BP		
2100 3352	MOS IC	TC4030BP		
2100 3361	MOS IC	TC4071BP		
2100 3379	MOS IC	TC4081BP		
2100 3450	MOS IC	TC4528BP		
2100 3549	MOS IC	TC4066BP		
2100 3859	C-MOS IC	TC4510BP		○
2101 2122	C-MOS IC	MC14538B		
2101 2131	C-MOS IC	MC14046B		
2111 5754	Bipolar IC	SN7406		○
2120 8469	Hybrid IC	STK020		○
2120 9244	Monolithic IC	TL082CP		
2121 0013	OP amp	NJM4558DD		
2122 0019	D/A converter	AM6012DC		
2200 3551	Transistor	2SA1015		
2240 5110	FET	2SA30A-TM-GR		
2240 6019	PUT	N13T1		○
2280 0016	Transistor	2SC1815Y		
2280 0017	Transistor	2SC1815GR		○
2300 3031	Diode	1S1588		
2310 3389	Zenor diode	RD10EB		
2340 0014	Vari-Cap	SVC202		
2760 1324	Semi-fixed resistor	H0811A-001-500B		○
2760 1332	Semi-fixed resistor	H0811A-001-50KB		○
2770 6436	Variable resistor	VM60-10KK		
2890 1038	Tantalum capacitor	CS15E1V0R1M1S		

CODE NO.	PARTS NAME	SPECIFICATION	UNIT PRICE (¥)	NEWLY EMPLOYED
2890 1054	Tantalum capacitor	CS15E1C100M1S		
2890 4029	Tantalum capacitor	CS15E1E010M1S		
2890 4070	Tantalum capacitor	CS15E1C2R2M1S		
2890 4355	Tantalum capacitor	CS15E1D3R3M1S		
2890 4363	Tantalum capacitor	CS15E1VR22M1S		○
3500 2626	PCB connector	IL-3P-S3EN2		
3500 3037	PCB connector	IL-9P-S3EN2		
3500 3045	PCB connector	IL-E-18P-S3T2		
3500 3134	PCB connector	IL-E-19P-S3T2		○
3500 3142	PCB connector	IL-7P-S3EN2		○
3500 7016	PCB connector	5229-16CPB		
3510 2566	PCB connector	5277-04A		
3511 0712	PCB connector	5277-05A		○
3610 5208	IC socket	JC83S28-04		○
3841 0024	Coil	R12-5606X		○
	PCB M422-PS1			
2120 9210	Monolithick IC	UA78M05CKC		
2120 9228	Monolithick IC	UA78M15CKC		
2120 9236	Monolithick IC	UA79M15CKC		
2330 1091	Bridge diode	SIRBA20		
2330 1105	Bridge diode	S2VB10		
2710 2760	Wire wound resistor	ERF-2AJ7R5		
3600 1186	Voltage selector	ESE-371		
3630 2399	Fuse	ST4-1A		
3631 0049	Time lag fuse	UL-TSC-1A		
3631 0073	Time lag fuse	UL-TSC-0.5A		
3631 0081	Time lag fuse	US-TSC-1.6A		
	PCB M411-CN6			
3470 1164	Keyboard switch	R569123		○
	PCB M411-CN4			
2184 0055	Bipolar IC	SN74195N		
2300 3031	Diode	1S1588		
	PCB M411-CNA			
2300 3031	Diode	1S1588		
6900 4260	PC joiner G	M4323-1		○

No.	CODE No.	PARTS NAME	SPECIFICATION	UNIT PRICE (¥)	NEWLY EMPLOYED
		Fig. 1			
1	6900 4121	Lower case	M2253A*1		○
2	6900 2702	Keyboard spacer (R)	M3306B*1		
3	6900 2692	Keyboard spacer (L)	M3307B*1		
4	5161 3066	Screw with washers	4x8		
5	6900 3441	Tuning label	M4283A-1		○
6	5041 2318	Screw	2.3x6 B		
7	6900 5441	Rating plate	M4284A-1		○
		Fig. 2			
8	6900 1361	Key contact rubber A	M300043A-1		
9	6900 1371	Key contact rubber B	M300045A-1		
		Fig. 3			
10	6900 3070	Speaker box	M3305*1		
11	3830 3015	Speaker	C100K0370011		
12	6900 3102	Speaker connector	M4295B*1		○
13	6900 3110	Speaker felt	M4298-1		○
		Fig. 4			
14	6900 4171	Upper case	M2255A*1		○
15	6900 2912	Dial B	M3304B-1		
16					
17	6900 2922	Dial A	M3303B-1		
18	6900 4191	Lever knob	M3344A-1		○
19	6900 4200	Keytop (FILL IN)	M3328-1		○
		Fig. 5			
20	3440 5239	Power switch	SDA-3SDAU		
21	3670 5019	Receptacle	NC-173		
22	6900 4950	Power connector	M4346*1		○
23	6900 4960	Power connector	M4345*1		○
24	3000 5023	Power transformer	TE-11-2M1		○
		Fig. 6			
25	6900 2781	Keyboard chassis	M1225A-1		
26	6900 1562	Stopper felt	M300042B-1		
27	6900 4850	Stopper felt (Black)	M3360-1		
		Fig. 7			
28	6900 4270	Jack panel	M3333-1		○
29	3612 0037	Jack	HLJ-0315-01-100		
30	3612 0029	Jack	HLJ-0315-01-090		
31	3612 0011	Jack	HLJ-0315-01-040		

No.	CODE No.	PARTS NAME	SPECIFICATION	UNIT PRICE (¥)	NEWLY EMPLOYED
		Fig. 8			
32	6900 4220	Switch fixing board	M2251-1		○
33	3440 5115	Push switch	SUH83W4		
34	3450 1084	Seesaw switch	SMT019T11		
35	3470 1130	Keyboard switch	AKC-2C		
36	2770 6495	Variable resistor	K16110007E-10KB		○
37	2770 6479	Variable resistor	GM70A-50KMN		○
38	2770 6487	Variable resistor	VM10A-1MC		○
39	3400 1103	Lever switch	ESL-36258		○
40	3400 1111	Lever switch	ESL-36259		○
41					
42					
43	2320 3111	LED (Red)	TLR-206		
44	2320 3138	LED (Green)	TLG-206		○
45	2320 3111	LED (RED)	TLR-206		
46	5041 2091	Screw (Pan +)	3x5 B		
47					
48	6900 3292	Rhythm button (ROCK)	M3296B-1		
49	6900 5362	R button (SLOW ROCK 1)	M3296B-9		○
50	6900 3312	R button (SWING)	M3296B-3		
51	6900 3322	R button (BOSSA-NOVA)	M3296B-4		
52	6900 5372	R button (MARCH)	M3296B-10		○
53	6900 3342	R button (WALTZ)	M3296B-6		
54	6900 5382	R button (RHUMBA)	M3296B-11		○
55	6900 5392	R button (HABANERA)	M3296B-12		○
56	6900 5401	Start button (Black)	M3308A-15		○
57					
58	6900 3151	Tone button (ORGAN)	M3308A-1		
59	6900 3161	Tone button (FLUTE)	M3308A-2		
60	6900 3171	Tone button (OBOE)	M3308A-3		
61	6900 3181	Tone button (CLARINET)	M3308A-4		
62	6900 3191	Tone button (TRUMPET)	M3308A-5		
63	6900 3201	Tone button (VIOLIN)	M3308A-6		
64	6900 3211	Tone button (CELLO)	M3308A-7		
65	6900 3221	Tone button (PIANO)	M3308A-8		

No.	CODE No.	PARTS NAME	SPECIFICATION	UNIT PRICE (¥)	NEWLY EMPLOYED
66	6900 3231	Tone button (HARPSICHORD)	M3308A-9		
67	6900 3241	Tone button (CELESTA)	M3308A-10		
68	6900 3251	Tone button (ACCORDION)	M3308A-11		
69	6900 3261	Tone button (ELEC. PIANO)	M3308A-12		
70	6900 3271	Tone button (FUNNY)	M3308A-13		
71	6900 3281	Tone button (FROG)	M3308A-14		
72	6900 3391	Keytop (VARIATION)	M3298A-3		
73	6900 3371	Keytop (VIBRATO)	M3298A-1		
74	6900 3381	Keytop (VIB. DELAY)	M3298A-2		
75	6900 5411	Keytop (SUSTAIN)	M3298A-6		○
76	6900 5421	Keytop (HOLD)	M3298A-7		○
77	6900 5310	VR connector	M4348*1		○
78	6900 5330	Connector A	M3365*1		○
79	6900 5320	Connector B	M3364*1		○
80	6900 5340	Connector D	M4347*1		○
		Fig. 9			
81	6900 1613	Key A	M300002C-1		
82	6900 1623	Key B	M300003C-1		
83	6900 1633	Key C	M300004C-1		
84	6900 1643	Key D	M300005C-1		
85	6900 1653	Key E	M300006C-1		
86	6900 1663	Key F	M300007C-1		
87	6900 1673	Key G	M300008C-1		
88	6900 1683	Key S	M300009C-1		
89	6900 1690	Spring A	M400010-1		
90	6900 0270	Rubber silencer	M400016-1		
		Fig. 10			
91	6900 1713	Black key	M300013C-1		
92	6900 1720	Spring B	M400014-1		
93	6900 0270	Rubber silencer	M400016-1		
		Fig. 11			
94	6900 1580	Guide plate A	M300036-C		
		Fig. 12			
95	6900 1600	Guide plate B	M300039-1		
96	6900 1590	Guide rubber	M400037-1		

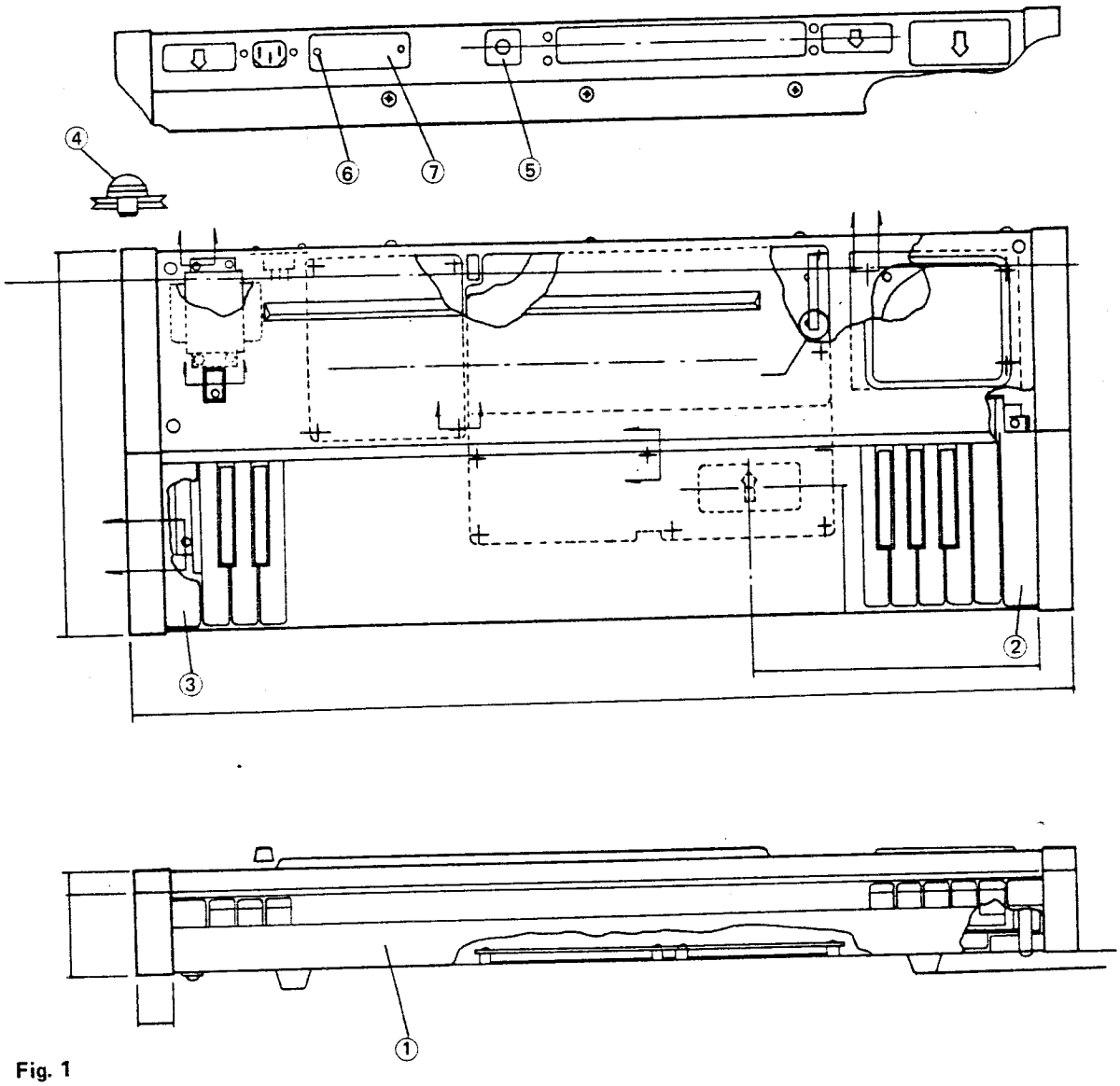


Fig. 1

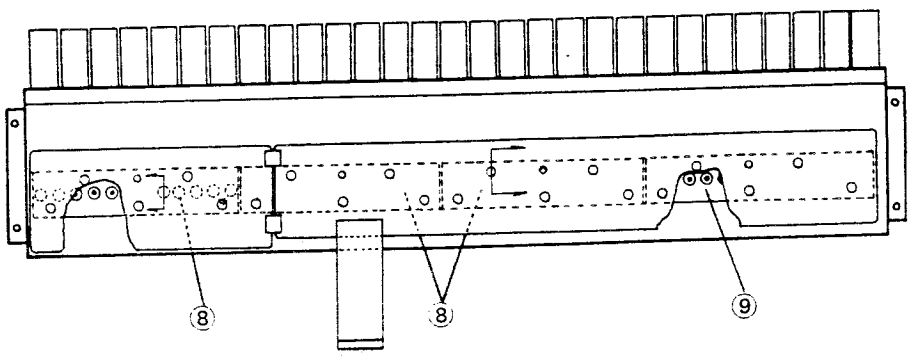


Fig. 2

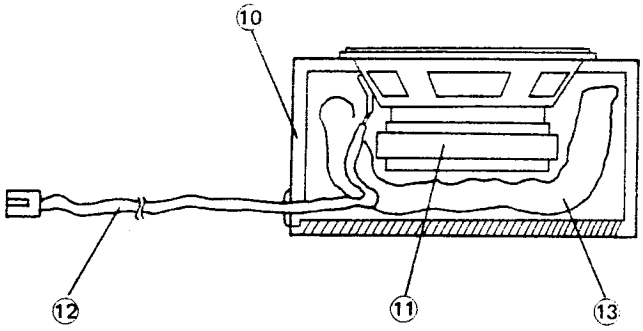


Fig. 3

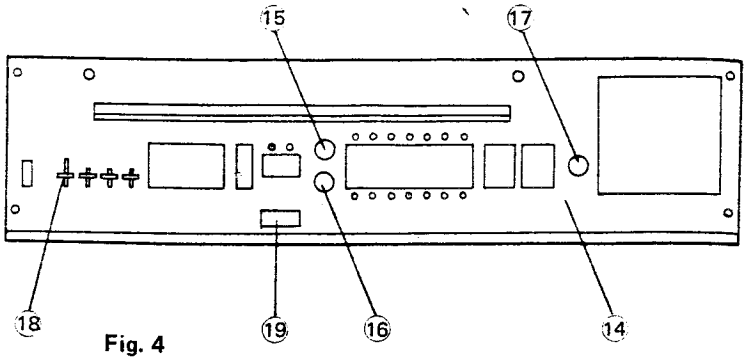


Fig. 4

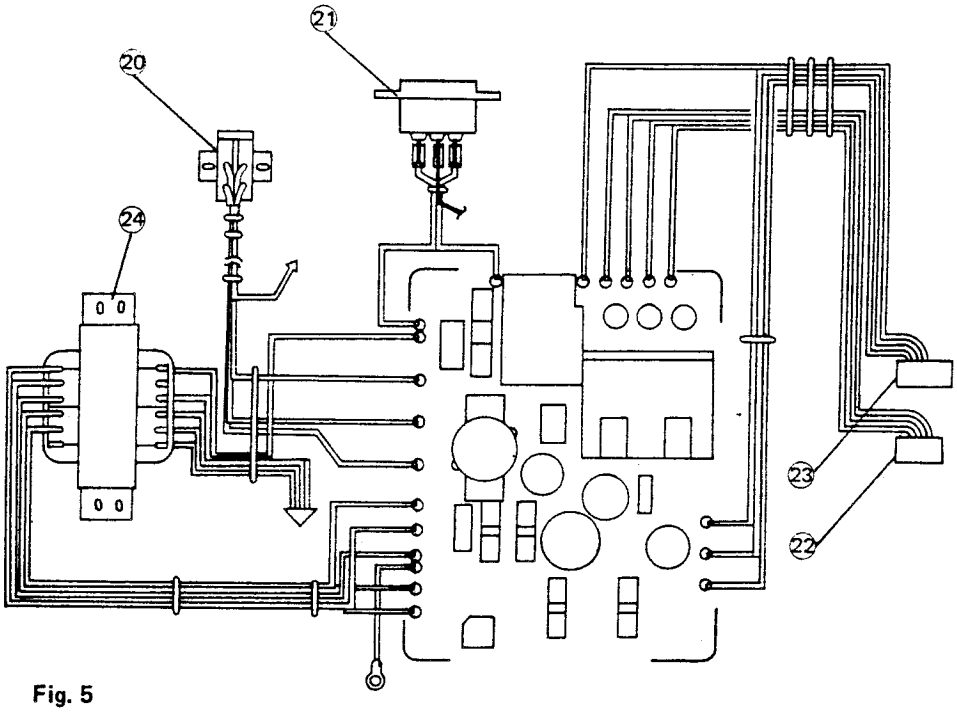


Fig. 5

Fig. 6

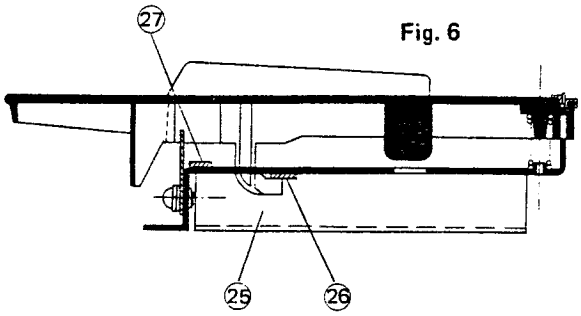
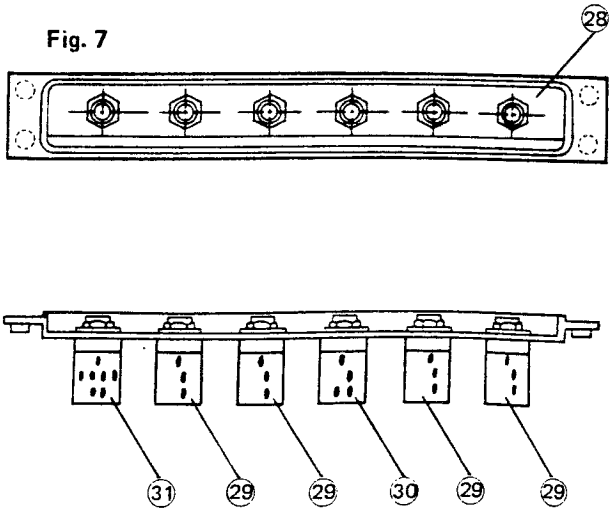


Fig. 7



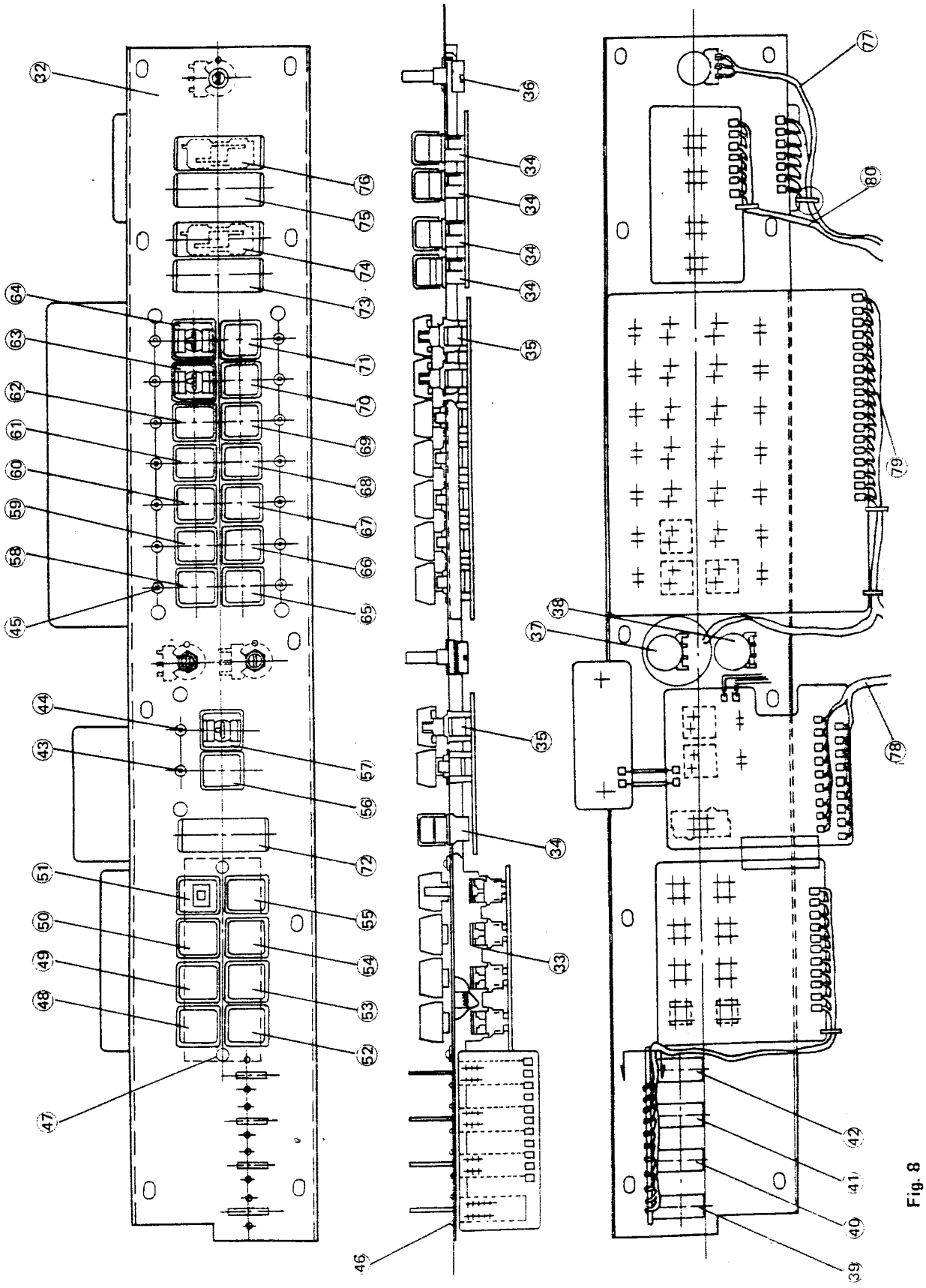

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Fig. 8

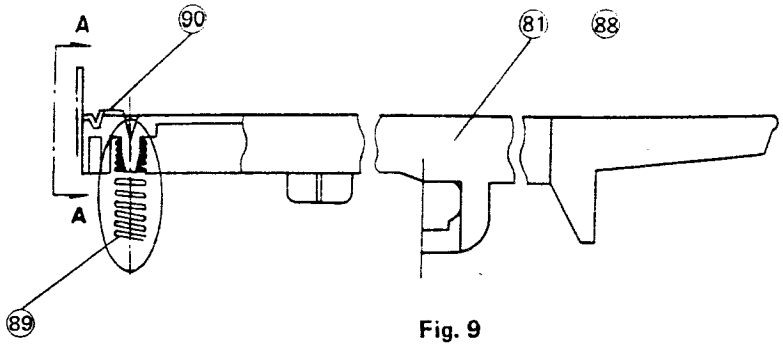

Fig. 9

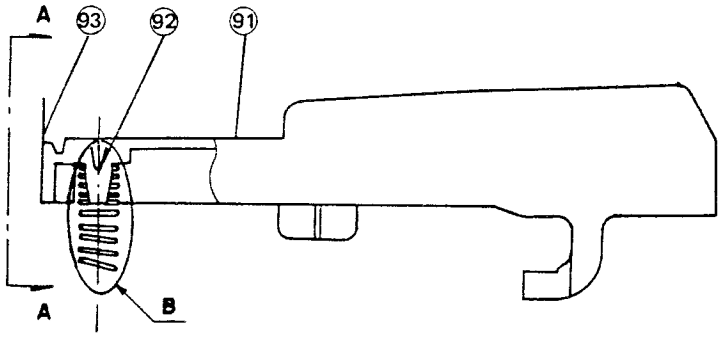

Fig. 10

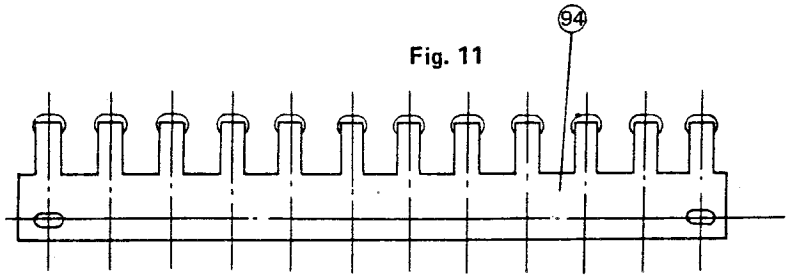

Fig. 11

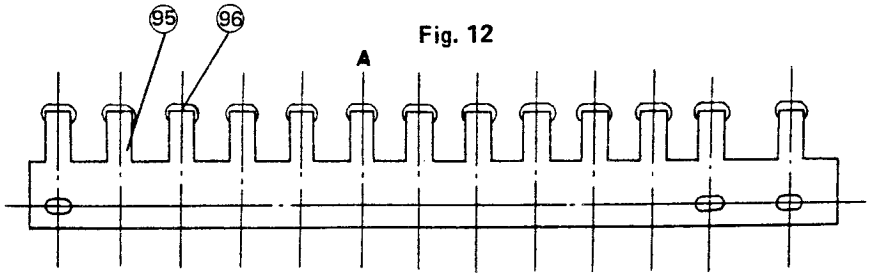

Fig. 12