

SERVICE MANUAL & PARTS LIST

(with price)

Digital Horn

DH-500

MAY 1989



DH-500

CASIO®

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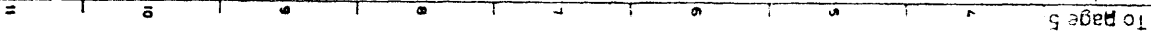
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1



7A



4,5

Pitch signal

12 MHz Oscillator

Reset Circuit

CPU

IC13

UPD78C11G-535-1B

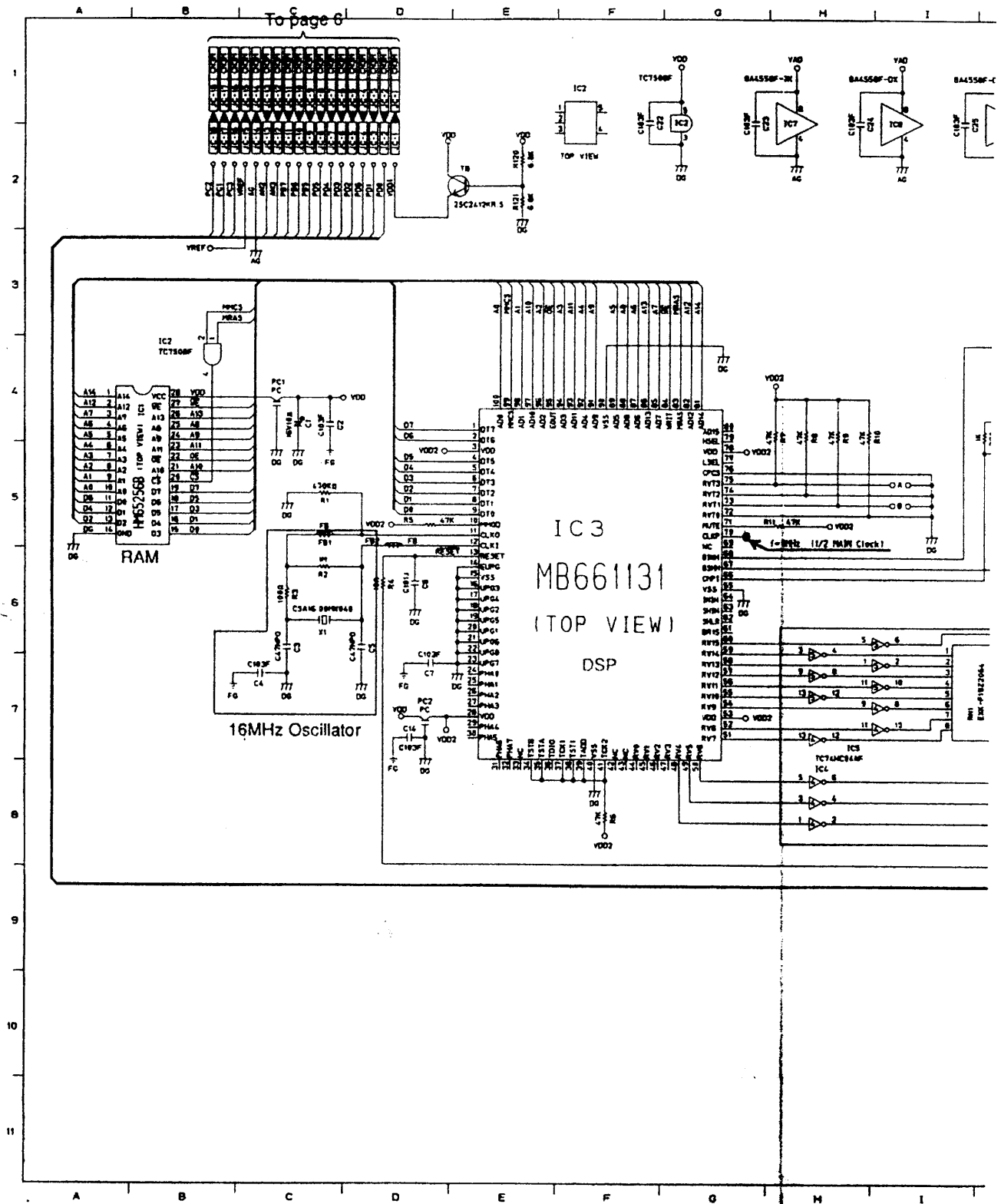
(TOP VIEW)

2000 1000

VCA

DAC1

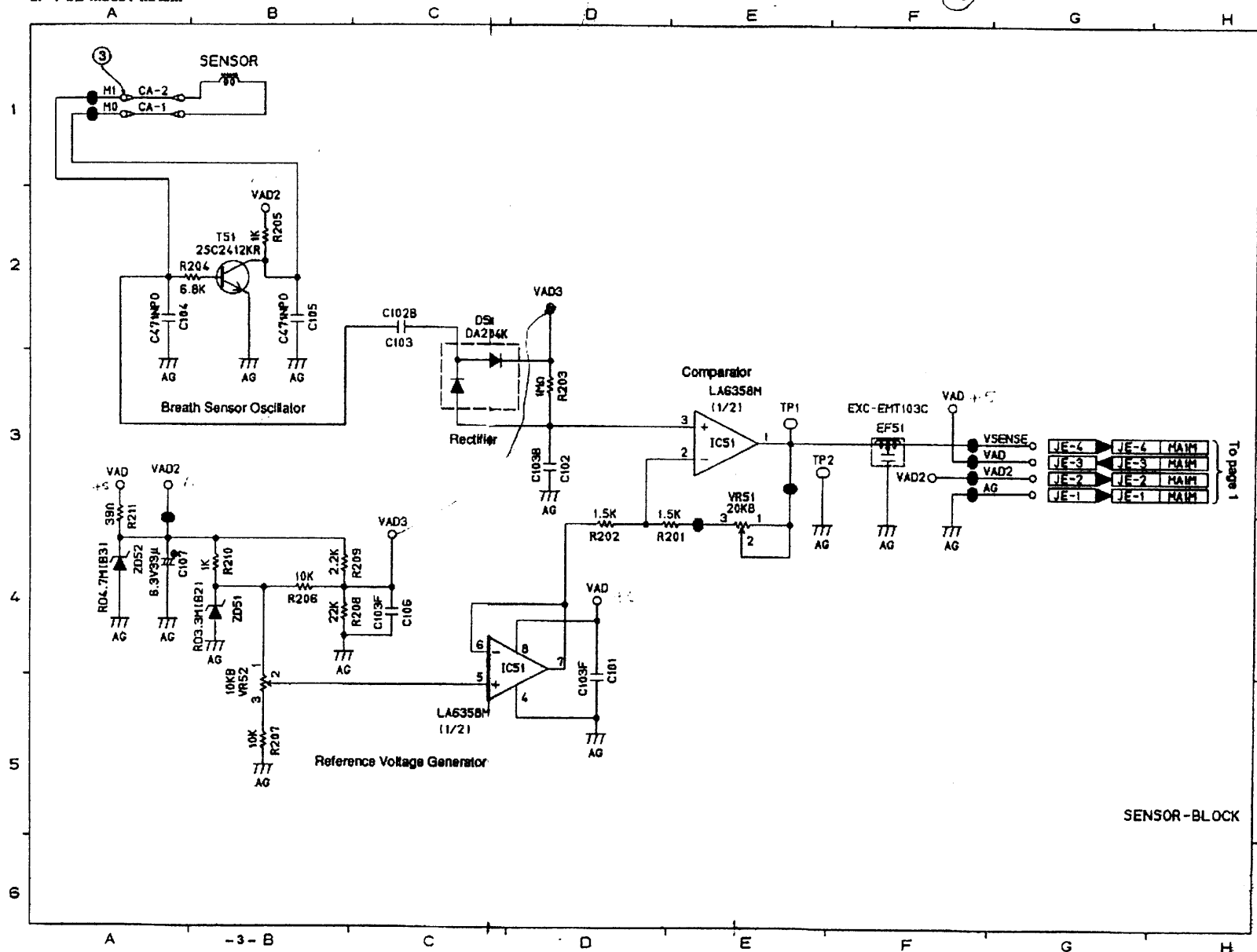
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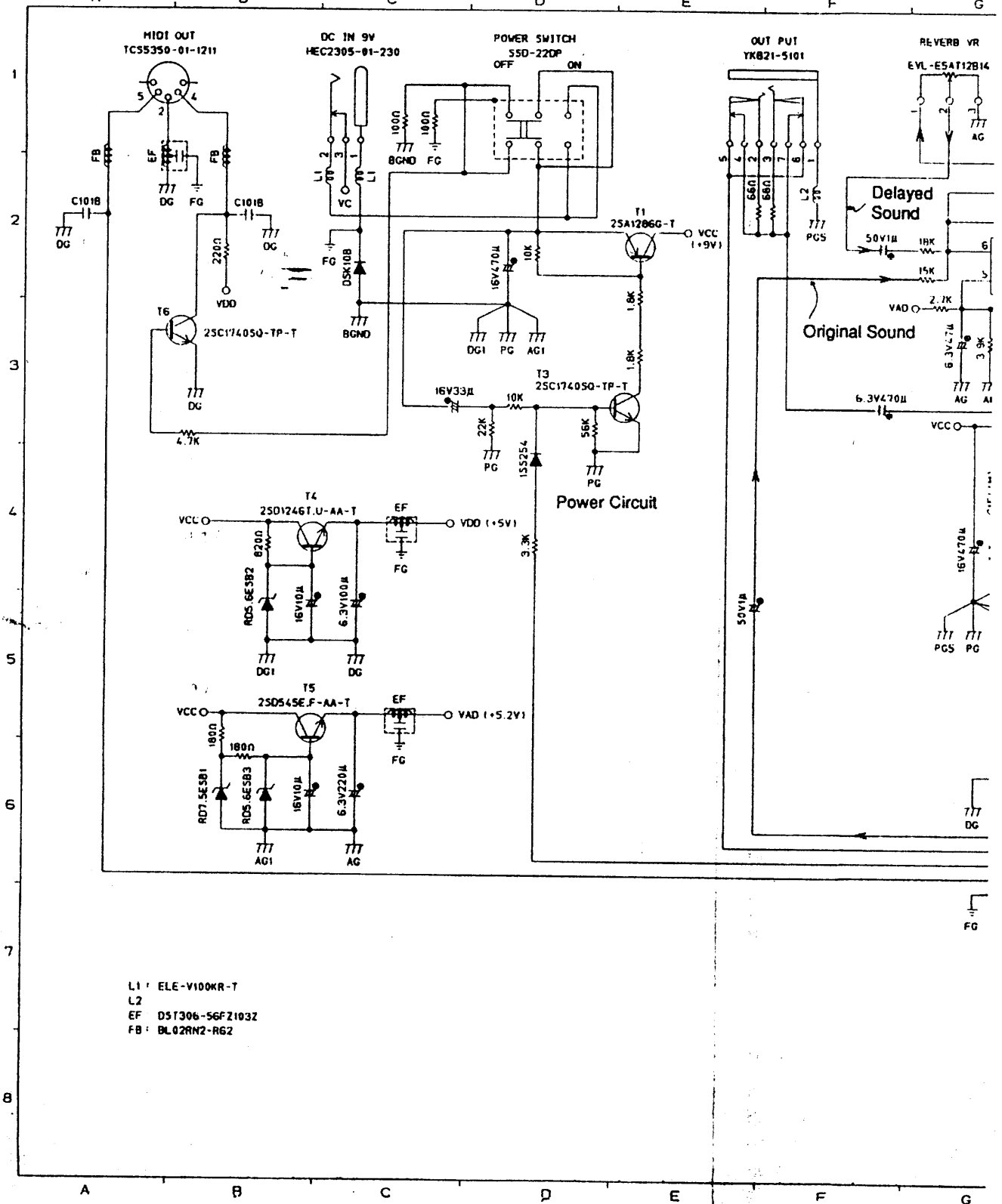
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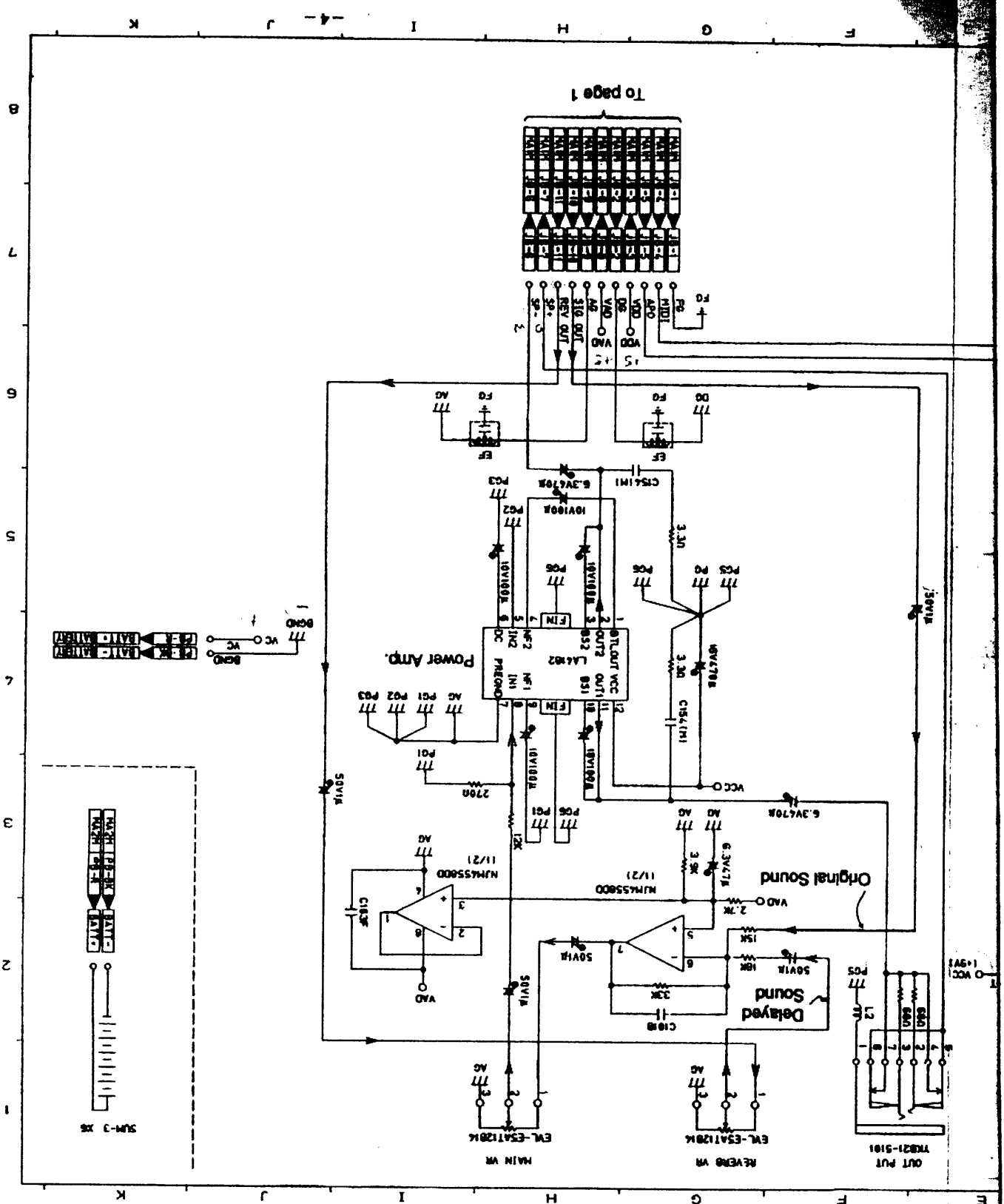
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4. PCB M5331-MA2M

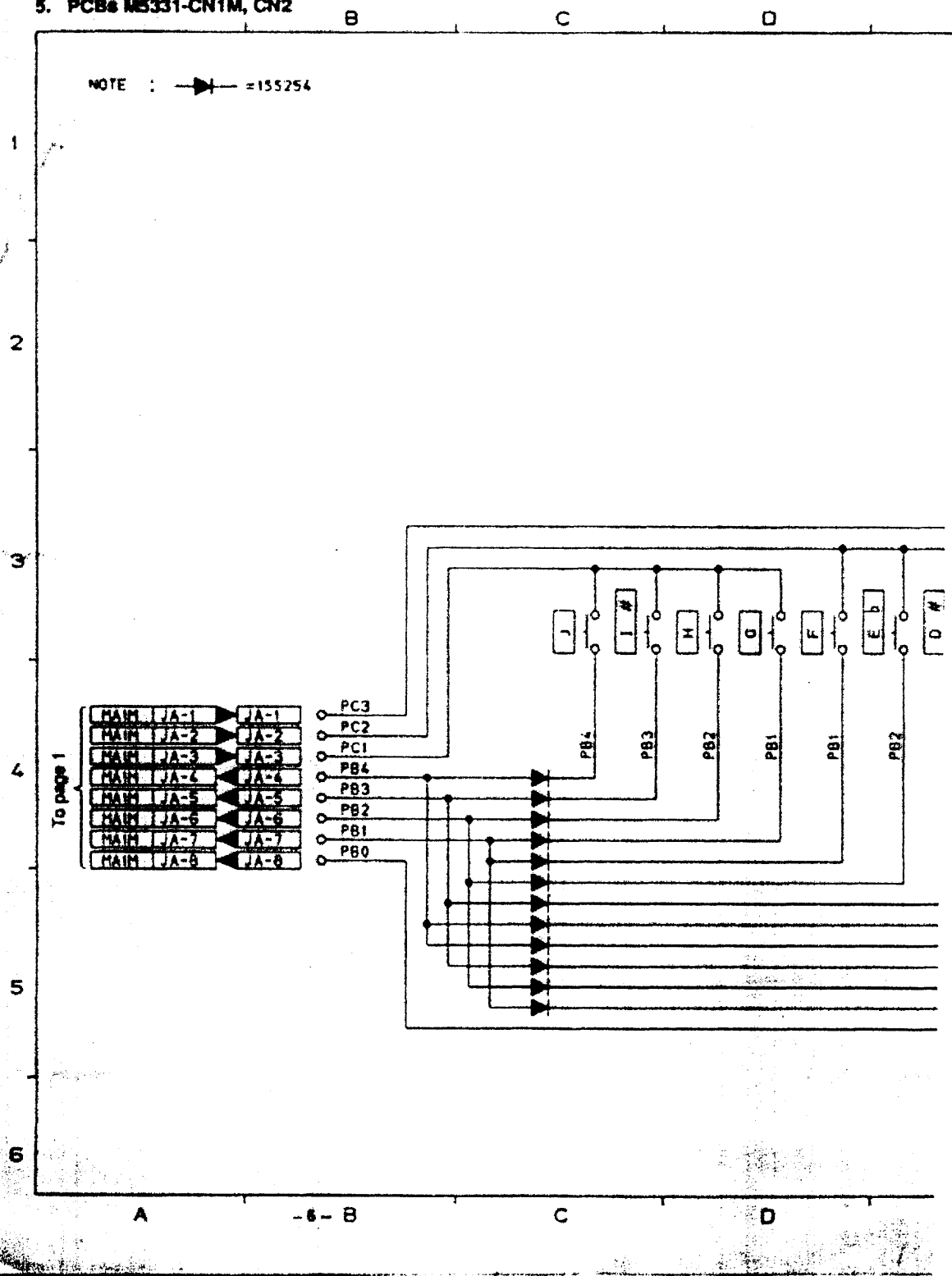


4-A
PRT: M5331-MA2M

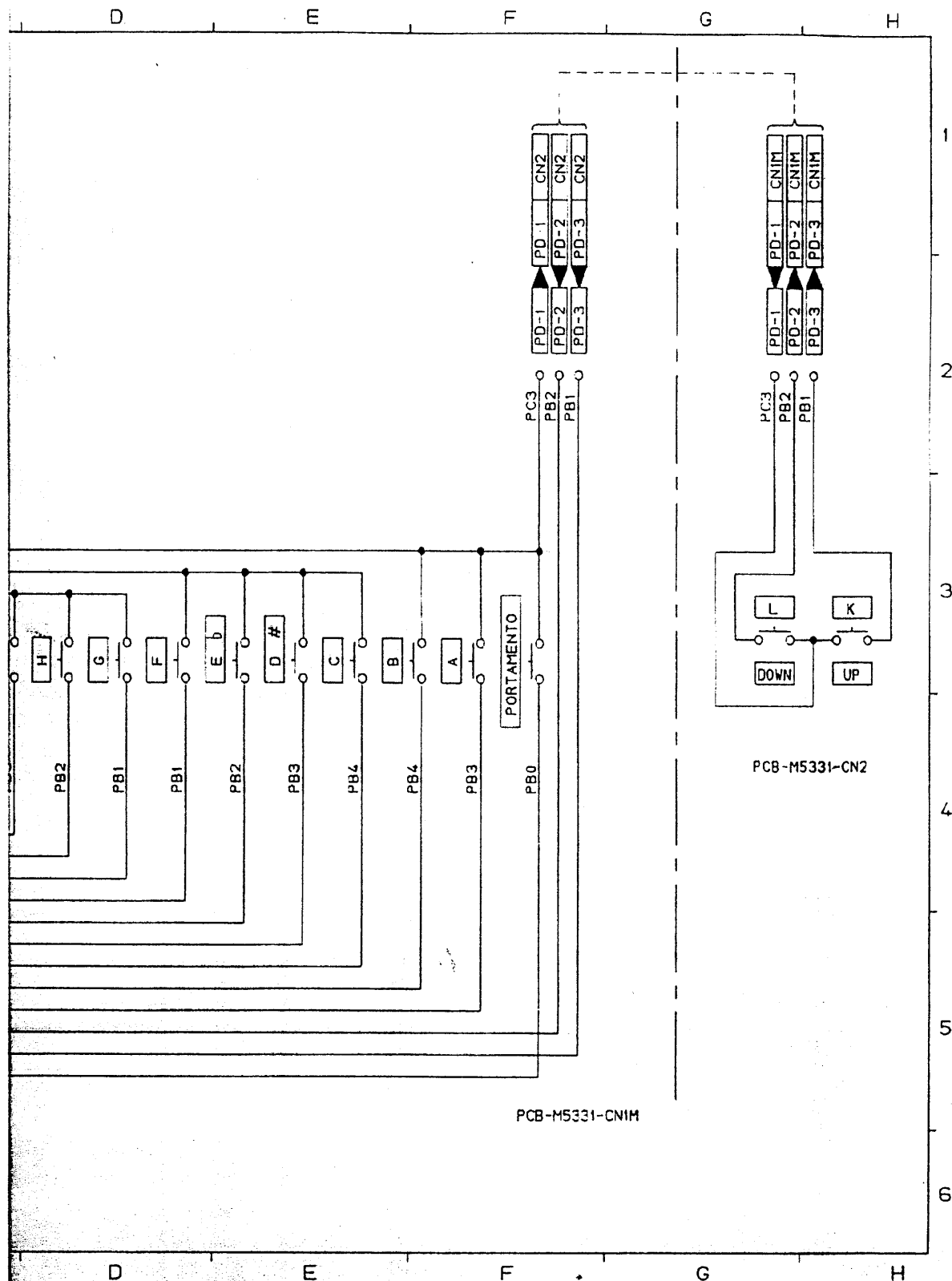


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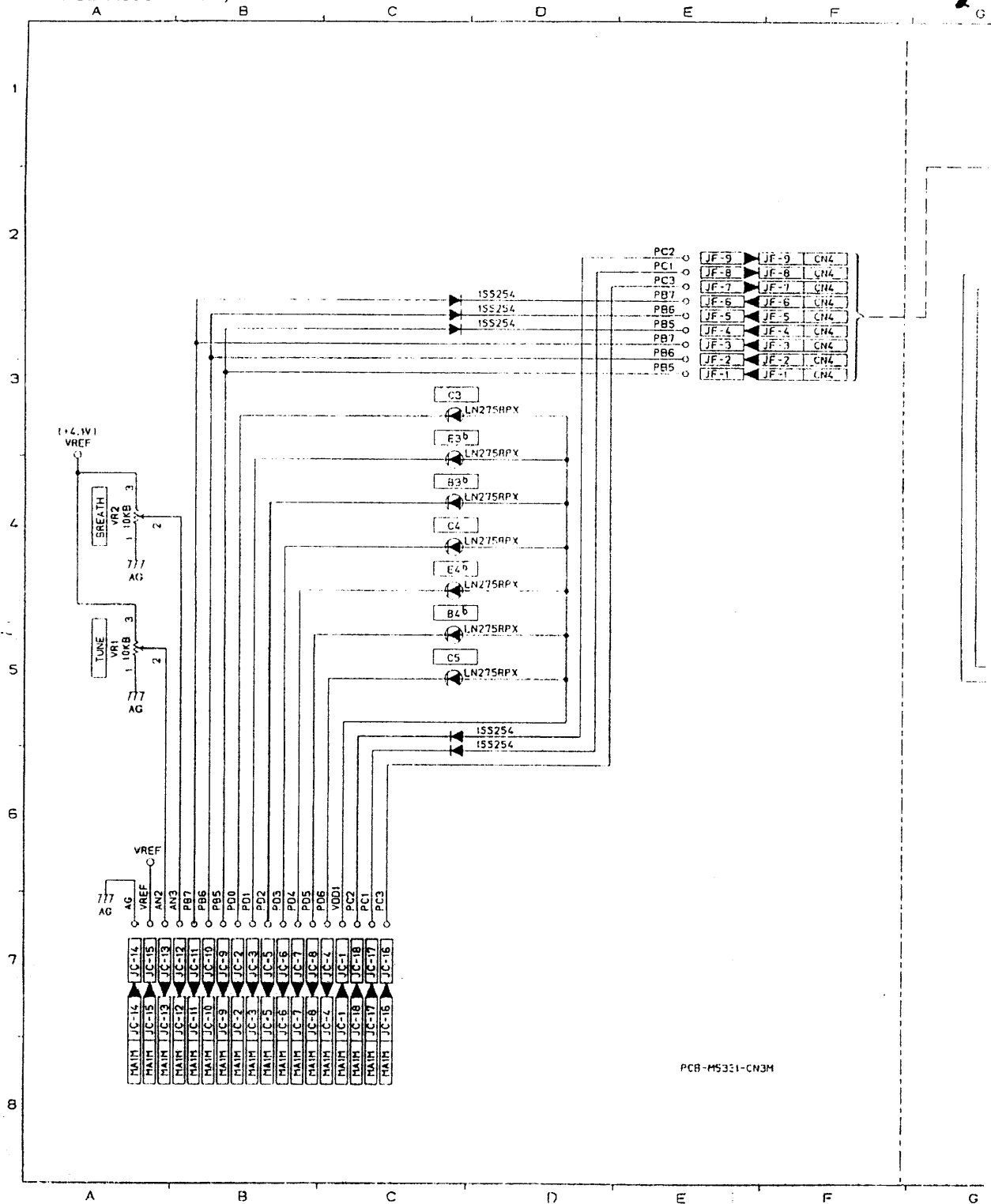
5. PCBs M5331-CN1M, CN2



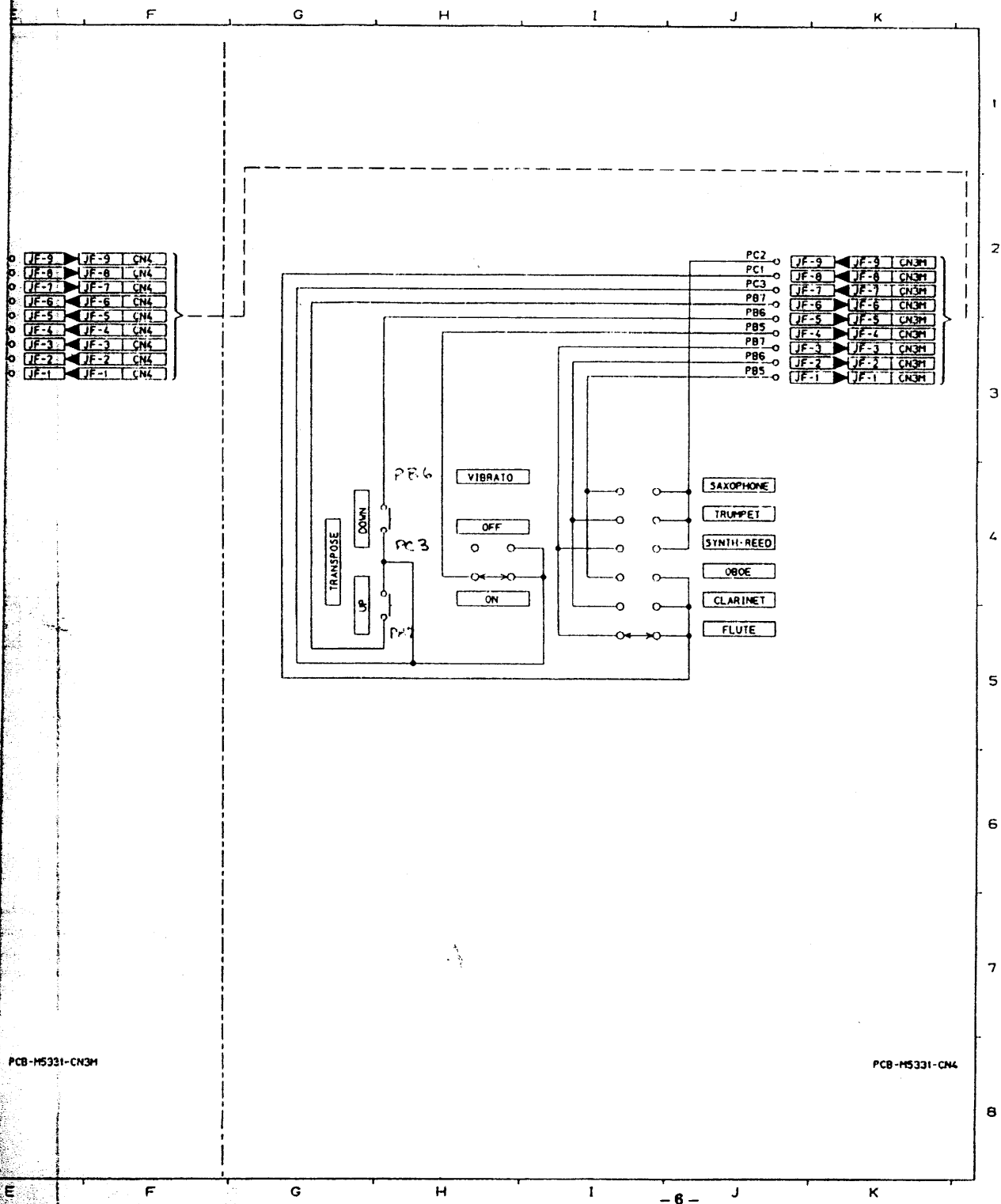
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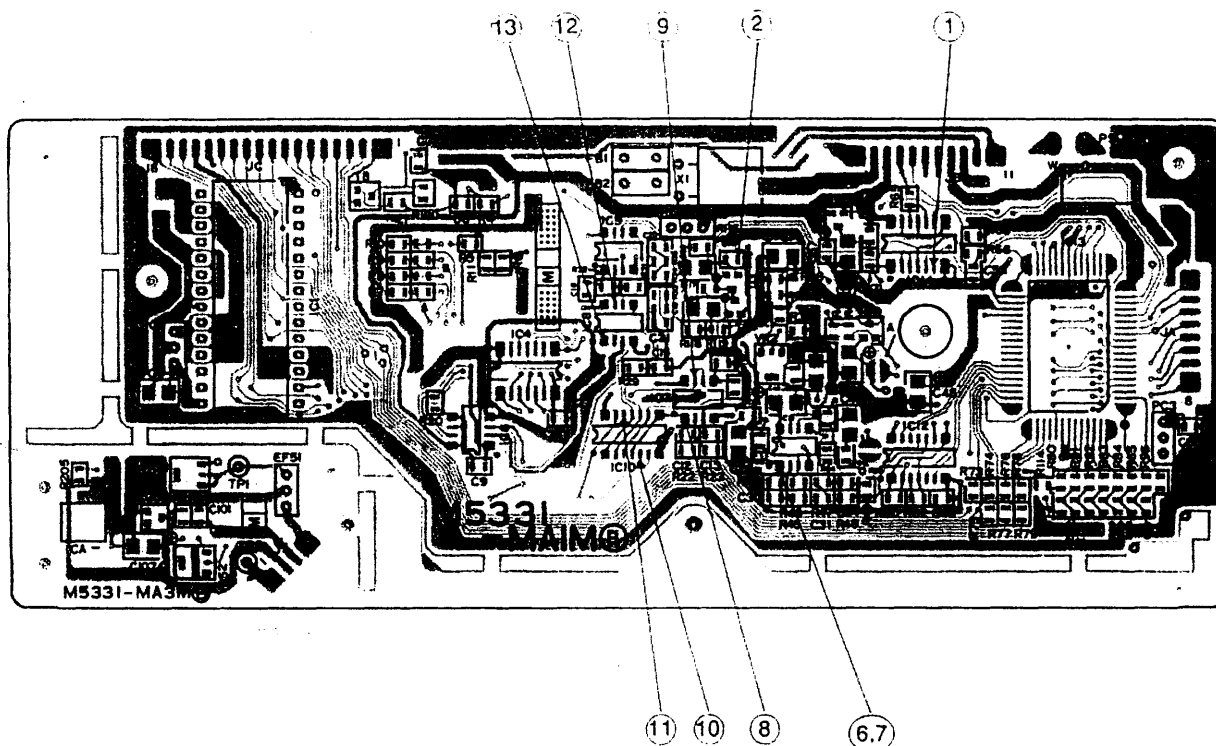
6. PCB M5331-CN3M, CN4



(6A)

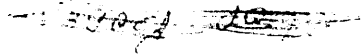


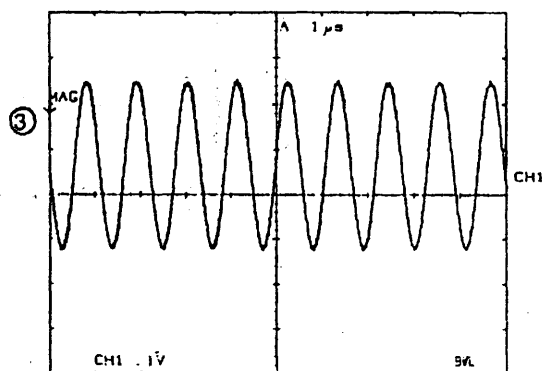
PCB VIEW & MAJOR CHECKPOINTS



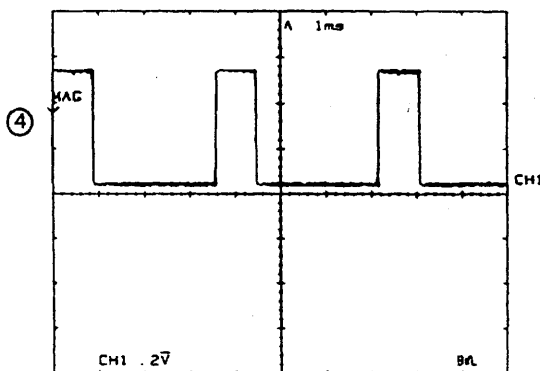
7

7A

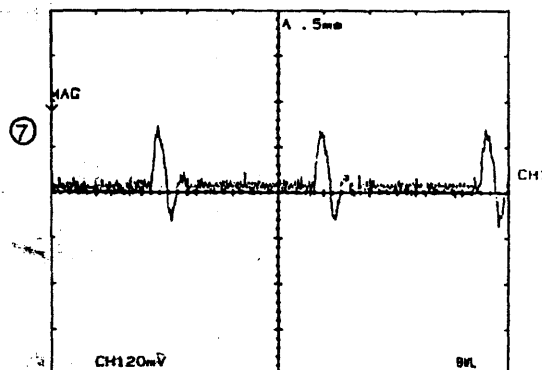




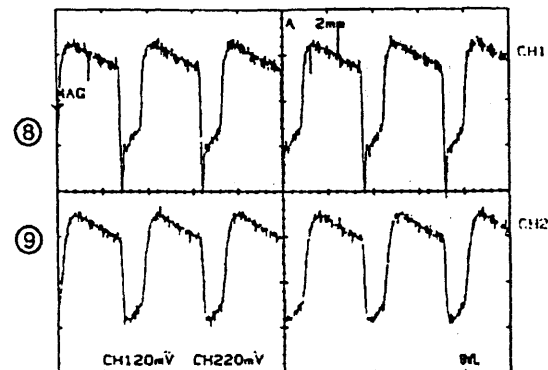
③ Breath Sensor Oscillation signal
Connector CA-2
At no breath



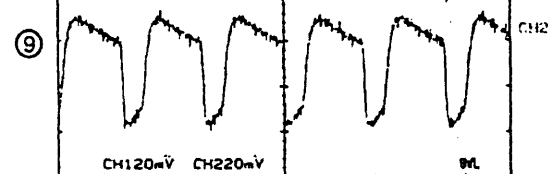
④ Pitch signal PC6
IC13 pin 17
Tone: Saxophone, No key press



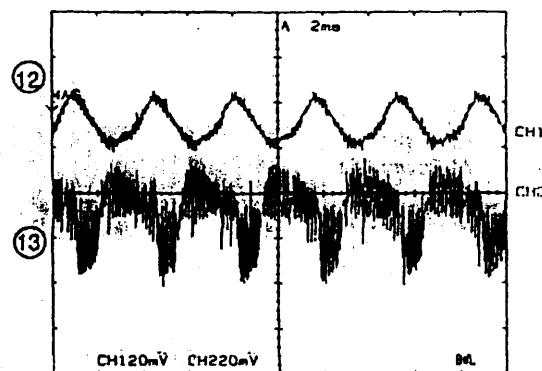
⑦ VCF output
IC11 pin 1
Tone: Oboe, No key press



⑧ Sampling Circuit input
IC7 pin 1
Tone: Saxophone, No key press



⑨ Sampling Circuit output
IC7 pin 7
Tone: Saxophone, No key press

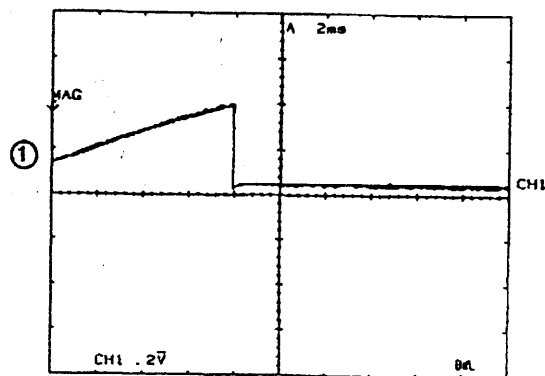


⑫ Sample/Hold circuit output
IC9 pin 1

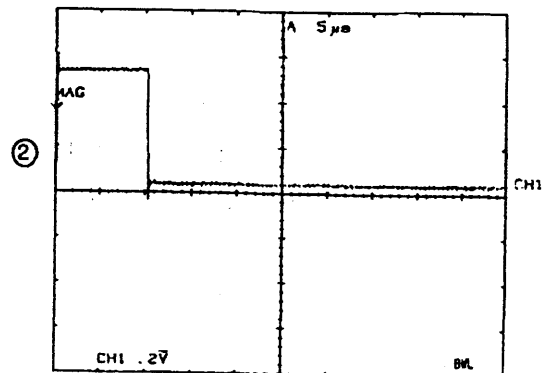


⑬ DAC2 output
IC8 pin 1
Tone: Saxophone, No key press

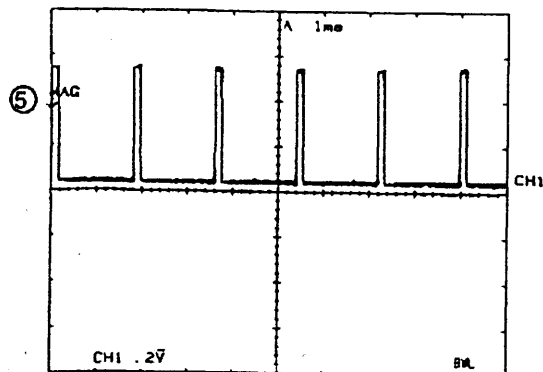
MAJOR WAVEFORM



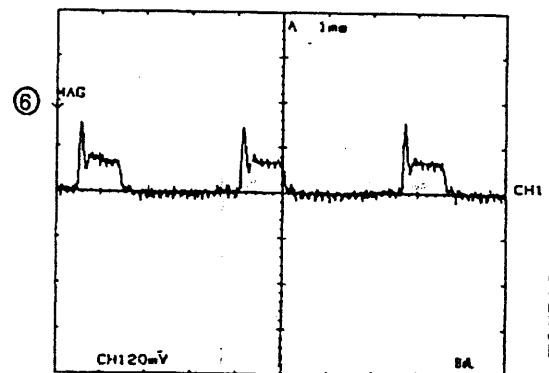
① Reset signal
IC14 pin 6
At Power ON



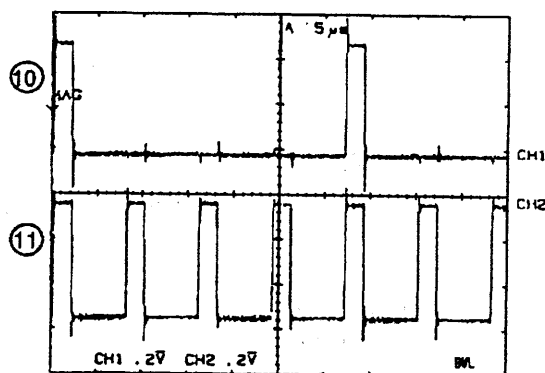
② Reverb Mute signal
IC13 pin 15
At Power ON



⑤ Pitch signal PC6
IC13, pin 17
Tone: Oboe, No key press



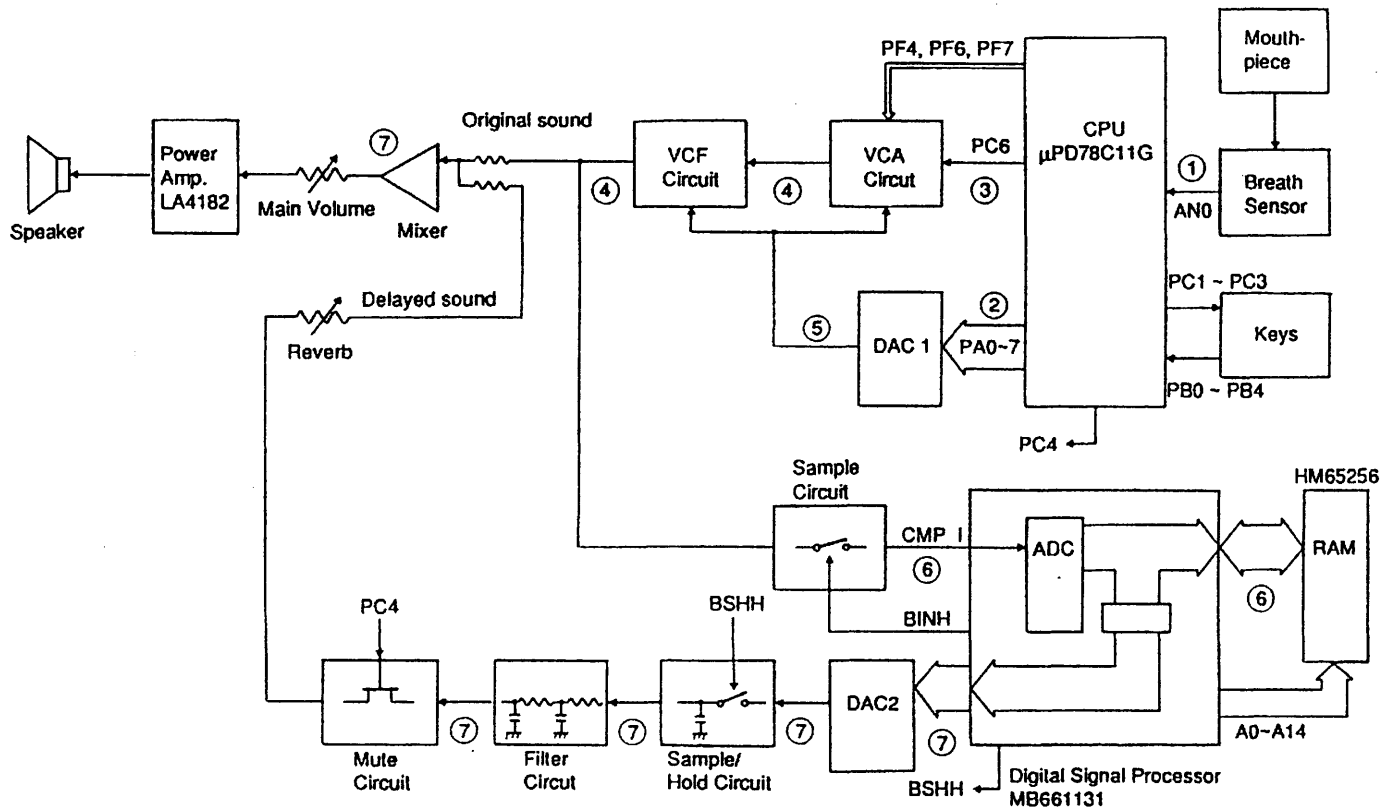
⑥ VCF output
IC11 pin 1
Tone: Saxophone, No key press



⑩ Signal BINH
IC10 pin 5
At Power ON

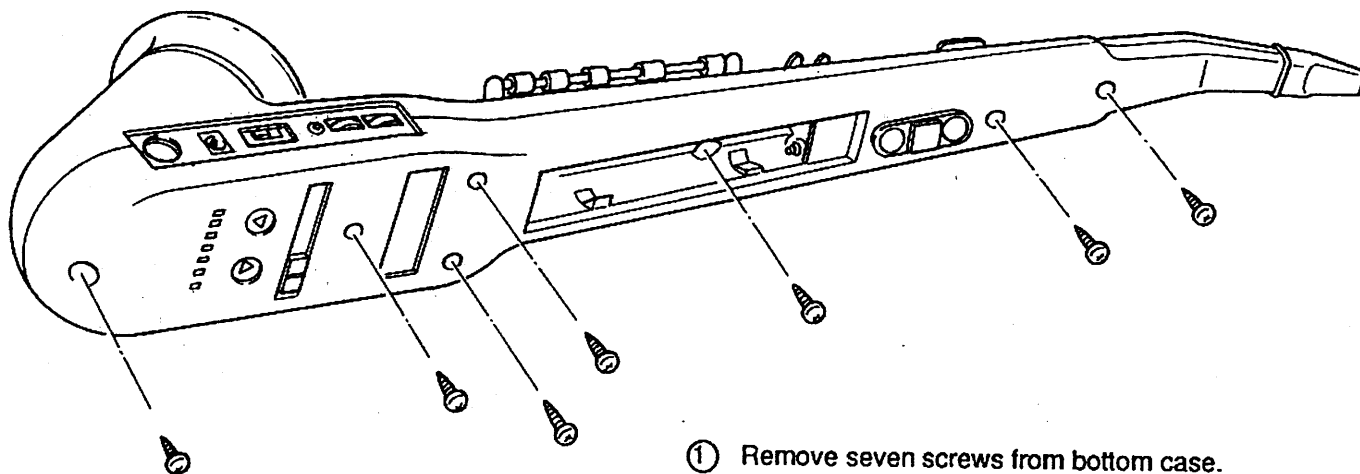
⑪ Signal BSHH
IC10 pin 12
At power ON

BLOCK DIAGRAM

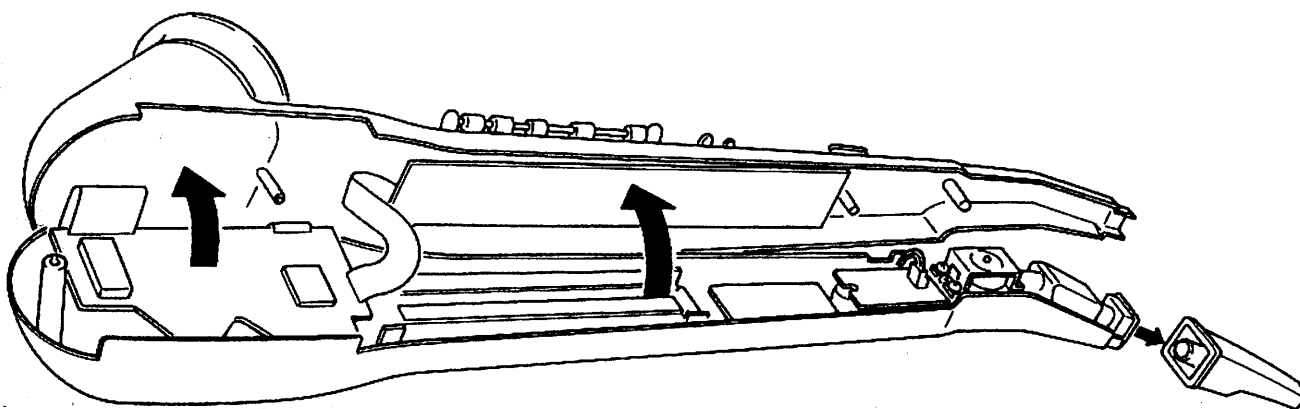


- ① Breath Sensor block outputs voltage which corresponds to the strength of breath.
- ② Using a built-in ADC (Analog to Digital Converter), the CPU digitizes the voltage level from Breath Sensor and outputs the digitized data P0~P7 to DAC (Digital to Analog Converter) 1.
- ③ On the other hand, CPU detects pressed keys and provides corresponding sound signal PC6.
- ④ The sound signal is amplified and filtered in VCA (Voltage Controlled Amplifier) and VCF (Voltage Controlled Filter) whose amplitude and cutoff frequency depend upon control voltage from DAC1.
- ⑤ DAC1 converts the digitized data P0~P7 into a voltage level which becomes control voltage of VCA and VCF. Thus, the sound output PC6's volume and cutoff frequency are varied in accordance with the strength of the breath.
- ⑥ VCF output is digitized in DSP (Digital Signal Processor) and stored in the RAM.
- ⑦ Changing the reading speed of RAM data, the sound data is delayed, DAC'd, filtered, and mixed with the original sound in Mixer.

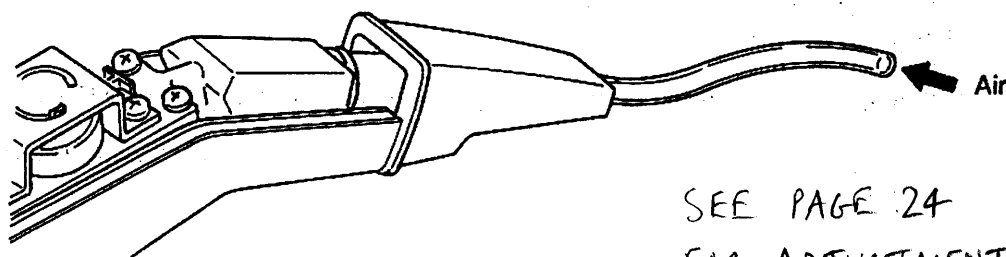
DISASSEMBLY & CHECKING METHOD



- ① Remove seven screws from bottom case.
- ② Remove the mouthpiece and open the top case

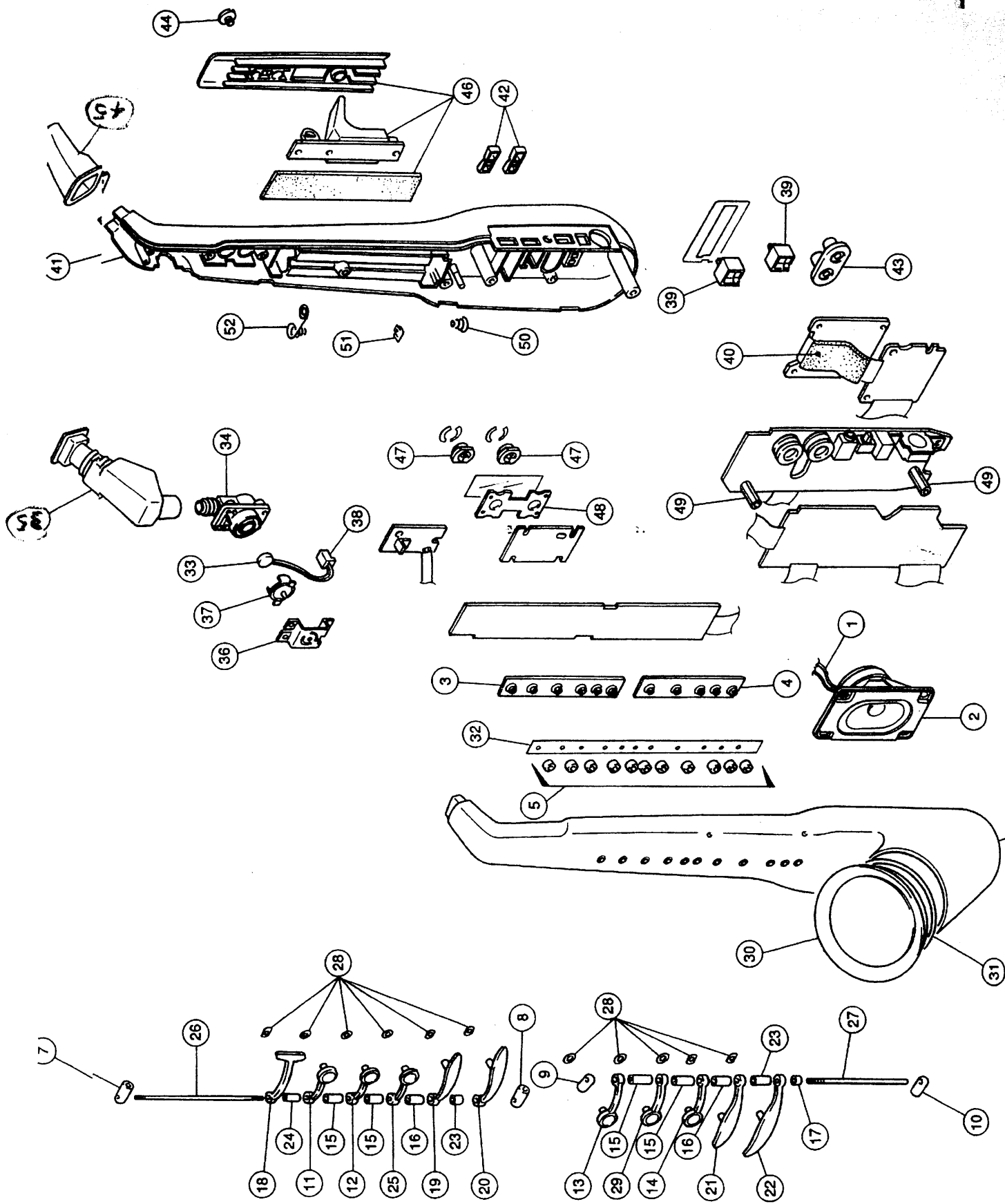


- ③ Insert a silicon rubber tube (code No. 6914 7972) in mouthpiece and set the mouthpiece on bottom cover.
- ④ Waveforms can be observed with oscilloscope by blowing the tube.



SEE PAGE 24
FOR ADJUSTMENT POT

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CPU (μ PD78C11G)

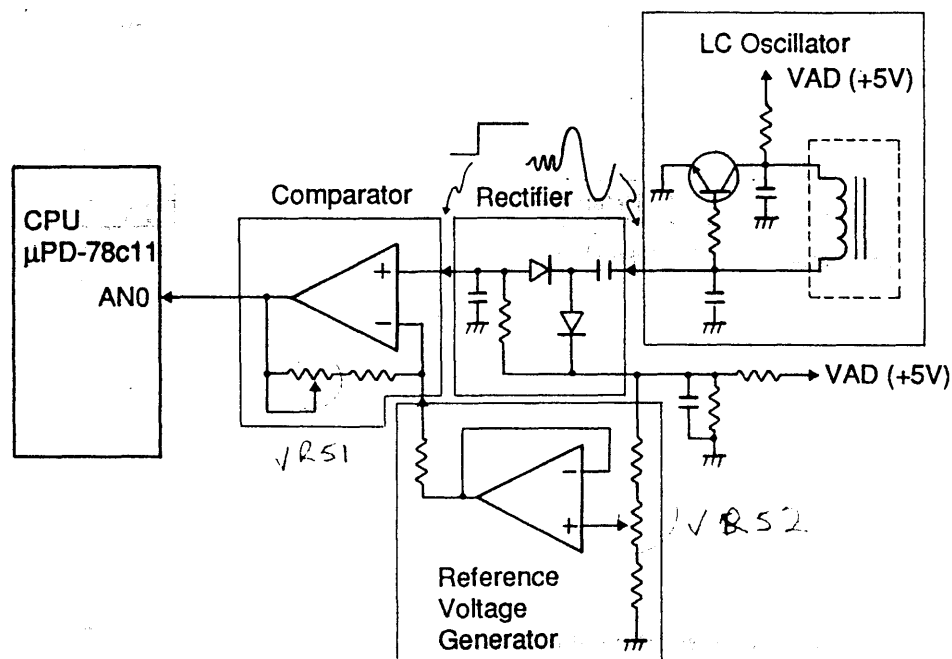
CPU detects the pressed keys and breath strength. The following is pin function of the LSI.

Pin No.	Terminal	In/Out	Pin Function	
3 ~ 10	PB0 ~ PB7	In	Inputs from keys and switches	
11	PC0	Out	MIDI signal output	
12 ~ 14	PC1 ~ PC3	Out	Scan signals for keys and switches	
15	PC4	Out	The terminal outputs a High level pulse at Power ON to prevent reverb noise.	
16	PC5	—	Not used	
17	PC6	Out	Sound pitch signal output	
18 ~ 21	PC7 ~ MODE1	—	Not used	
22	RESET	In	Power on reset terminal. When power switch is turned on, the terminal receives a High level signal for approximately 8 milli-seconds in which the internal circuits of the LSI are initialized.	
23	MODE0	—	Not used	
24, 25	X2, X1	In/Out	12 MHz clock pulse input and output	
26	VSS	In	Ground source for internal digital circuits	
27	AVSS	In	Ground source for built-in ADC's (Analog to Digital Converters)	
28 ~ 35	AN0 ~ AN7	In	Input terminals of eight built-in ADC's which convert the voltage inputs from Breath Sensor Tuning pot, and Breath pot into digital data.	
			AN0, AN1	Input from Breath Sensor block
			AN2	Input from Tuning pot
			AN3	Input from Breath pot
36	VREF	In	Reference voltage for built-in ADC	
37	AVDD	In	+5 V source for built-in ADC	
38 ~ 44	$\overline{RD}$ ~ PF3	—	Not used	

45 ~ 48	PF4 ~ PF7	Out	PF4, PF6, PF7 — Tone control signal in VCA (Voltage Controlled Amplifier) filter. *In accordance with set tone, the voltage level of these terminals change the cutoff frequency of the sound. PF5 — Resonance control signal in VCF (Voltage Controlled Filter). When the terminal is Low, resonance effect is given to the sound. <table><tr><td>Tone</td><td>PF4</td><td>PF5</td><td>PF6</td><td>PF7</td></tr><tr><td>Saxophone</td><td>Low</td><td>Low</td><td>High</td><td>High</td></tr><tr><td>Trumpet</td><td>High</td><td>Low</td><td>High</td><td>Low</td></tr><tr><td>Synth. Reed</td><td>Low</td><td>High</td><td>High</td><td>Low</td></tr><tr><td>Oboe</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td></tr><tr><td>Clarinet</td><td>Low</td><td>High</td><td>Low</td><td>Low</td></tr><tr><td>Flute</td><td>Low</td><td>High</td><td>Low</td><td>Low</td></tr></table>	Tone	PF4	PF5	PF6	PF7	Saxophone	Low	Low	High	High	Trumpet	High	Low	High	Low	Synth. Reed	Low	High	High	Low	Oboe	Low	Low	Low	Low	Clarinet	Low	High	Low	Low	Flute	Low	High	Low	Low
Tone	PF4	PF5	PF6	PF7																																		
Saxophone	Low	Low	High	High																																		
Trumpet	High	Low	High	Low																																		
Synth. Reed	Low	High	High	Low																																		
Oboe	Low	Low	Low	Low																																		
Clarinet	Low	High	Low	Low																																		
Flute	Low	High	Low	Low																																		
49 ~ 55	PD0 ~ PD6	Out	LED drive signals																																			
56	PD7	Out	APO (Auto Power Off) signal. When the horn is not played for six minutes, the voltage of the terminal drops to Low level causing the voltage VCC (+9 V) to shut off.																																			
57	<u>STOP</u>	—	Not used. Connected to VDD																																			
58	VDD	In	+5 V source																																			
59 ~ 2	PA0 ~ PA7	Out	Digitized breath strength data																																			

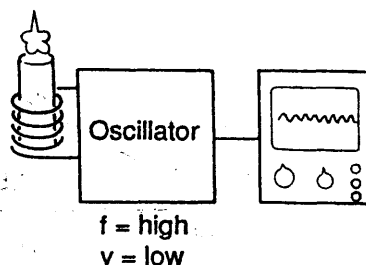
A2504256

BREATH SENSOR BLOCK

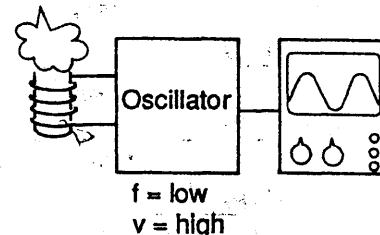


- ① LC Oscillator An oscillator which is composed of a coil and capacitors. As the core in the coil moves by the breath, inductance of the coil varies by the blowing strength. Variation of the inductance changes the frequency and peak to peak voltage of the oscillation signal. Namely, when the breath is weak, oscillation frequency is high and peak to peak voltage is low. On the contrary, strong blow lowers the frequency and heighten the voltage.

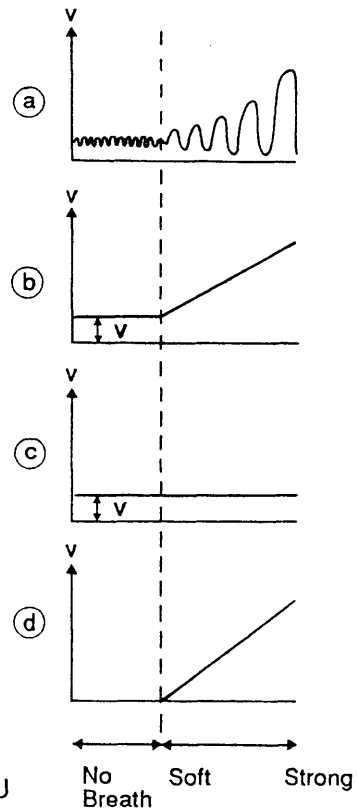
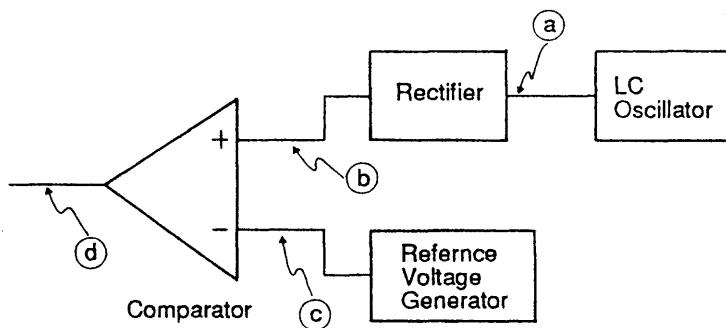
Weak breath



Strong breath



- ② Rectifier Alter the oscillation signal into a DC voltage. Stronger the breath, higher the output voltage.
- ③ Reference Voltage Generator Since the LC Oscillator is always oscillating, the Rectifier outputs voltage even when no breath is blown. Reference Voltage Generator provides a voltage which is equivalent to the Rectifier output at no blowing in order to discriminates whether breath is blown or not.
- ④ Comparator Compares the Rectifier and Reference Voltage Generator outputs. When the instrument is not blown, the output voltage of Comparator is zero volt. The output voltage rises in accordance with the breath strength.



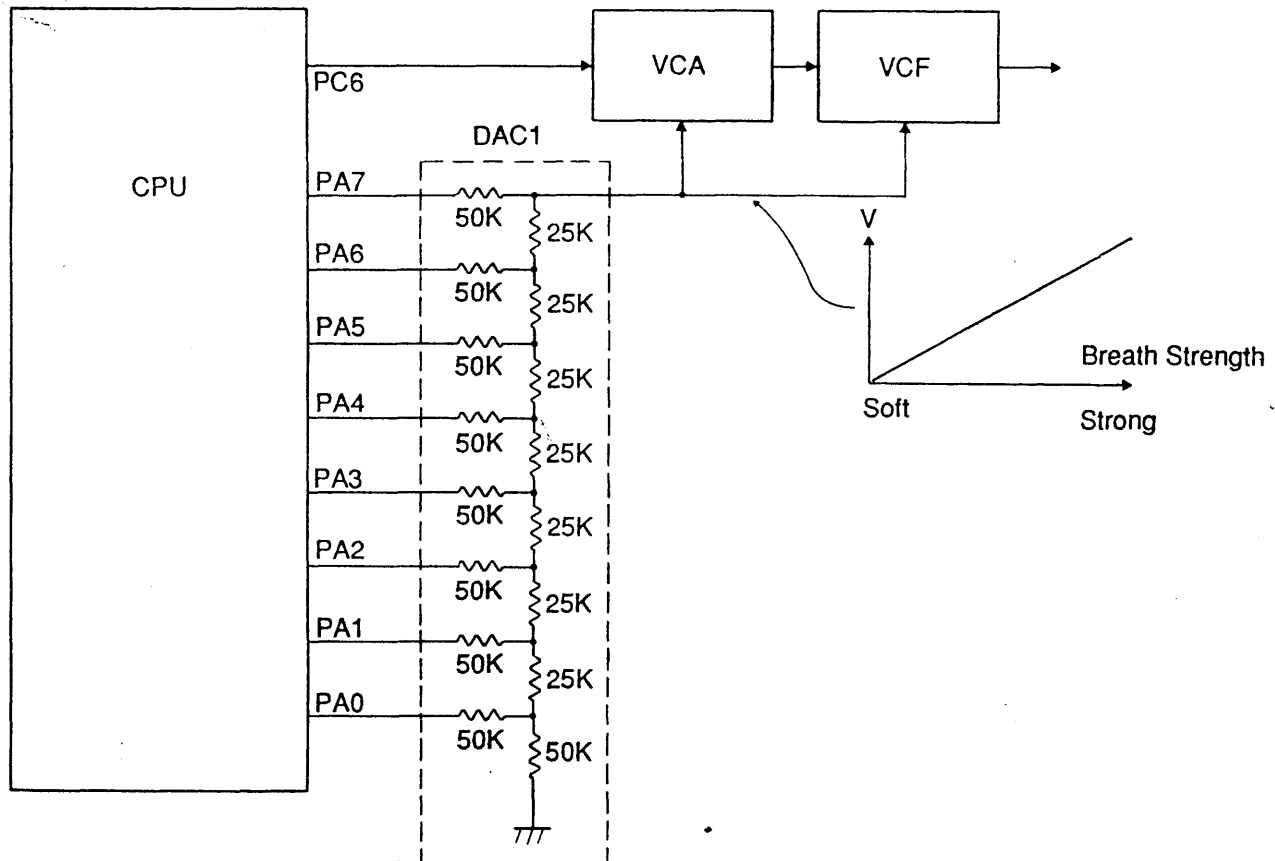
DAC 1

CPU digitizes the input voltage level from the Comparator.

Since the variation range of Breath Sensor Block is too small, the CPU amplifies the breath strength data digitally.

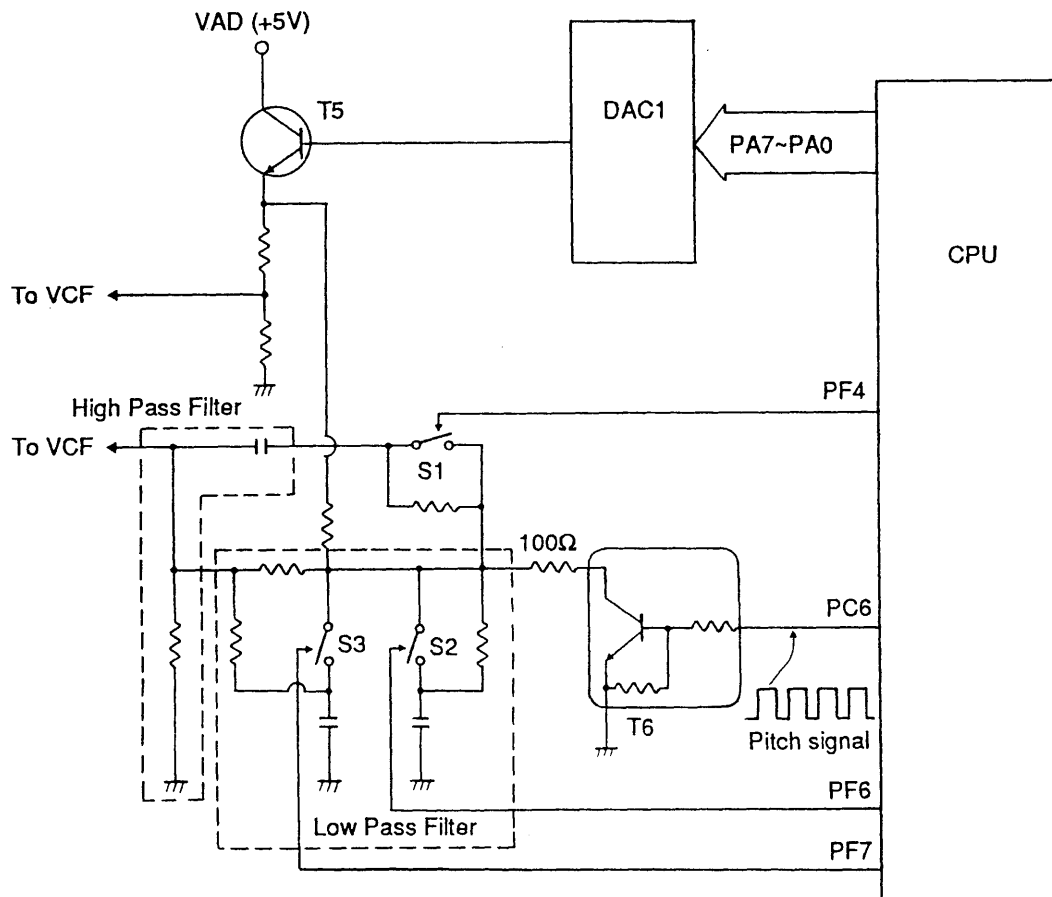
Digital breath strength data PA0 ~ PA7 is converted in a voltage level by DAC1 which is made up by resistive ladder network.

The output voltage of DAC1 is provided to VCA and VCF.



VCA (Voltage Controlled Amplifier)

In accordance with breath strength, the VCA changes the sound volume.

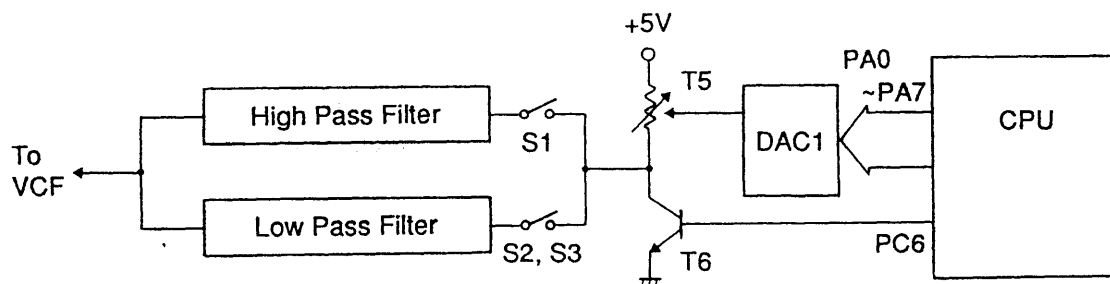


In accordance with pressed keys, CPU generates pitch signal PC6 which enters transistor T6. As the collector of T6 is connected to T5 emitter, amplitude of T6 depends on T5 base voltage. Thus, DAC1 output voltage (i.e. breath strength) determines the volume of pitch signal.

VCA also consists of high pass and low pass filters. According to the set tone, CPU provides signal PF4, PF6, or PF7 which select the filters' cutoff frequency.

The following shows an equivalent block diagram of VCA Circuit.

Equivalent Circuit



VCF (Voltage Controlled Filter)

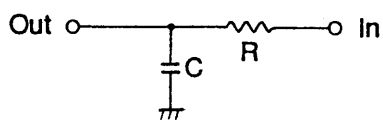


Fig. A

The left figure is one-stage low pass filter whose cutoff frequency f_c depends on the capacitance C and the resistance R .

$$f_c = \frac{1}{2\pi CR}$$

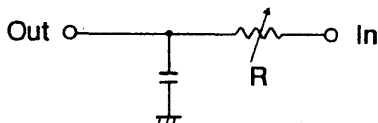
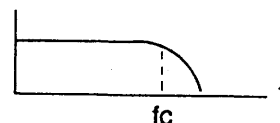


Fig. B

Using a variable resistor changes the cutoff frequency f_c randomly.

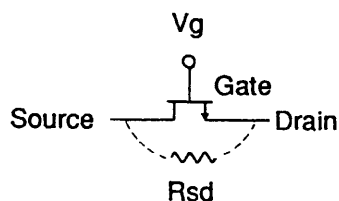


Fig. C

FETs (Field Effect Transistor) have a characteristics that the resistance between source and drain varies in accordance with gate voltage.

$V_g = \text{high} \dots R_{sd} = \text{small}$

$V_g = \text{low} \dots R_{sd} = \text{large}$

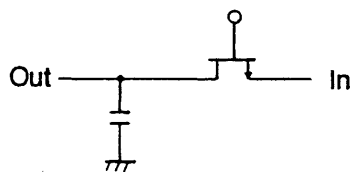
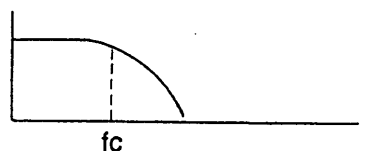
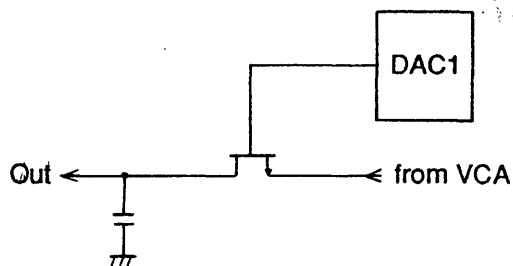


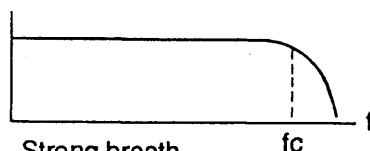
Fig. D

Therefore, putting a FET instead of a variable resistor makes the same circuit as figure B.

Since the FET's gate voltage is provided from DAC1, the cutoff frequency varies by the strength of breath. Namely, stronger the breath, higher the cutoff frequency.

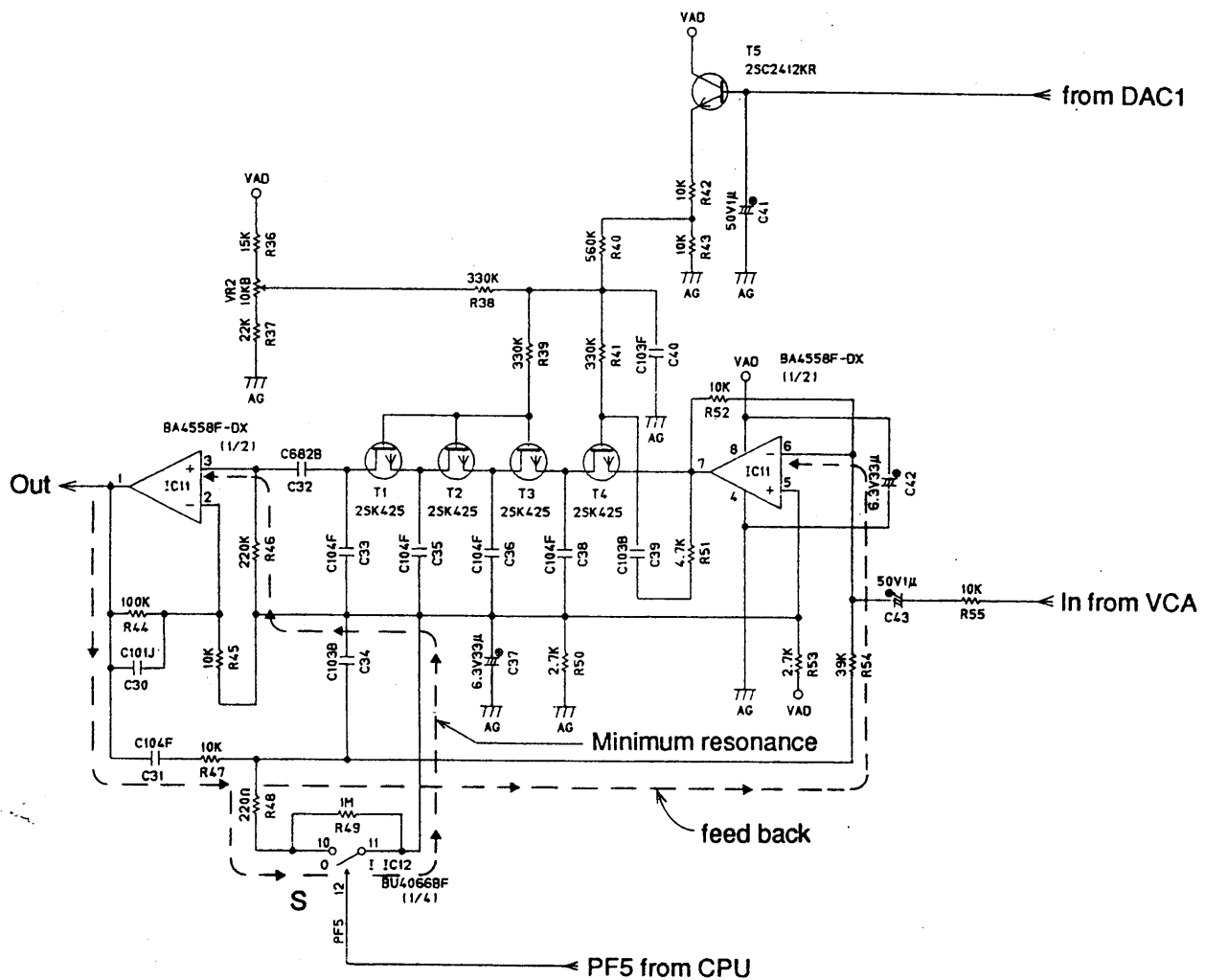


Weak breath

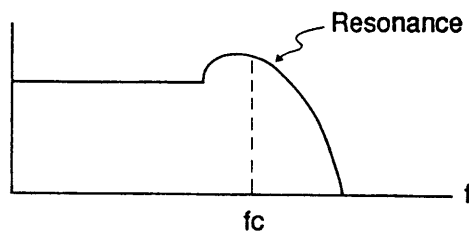


Strong breath

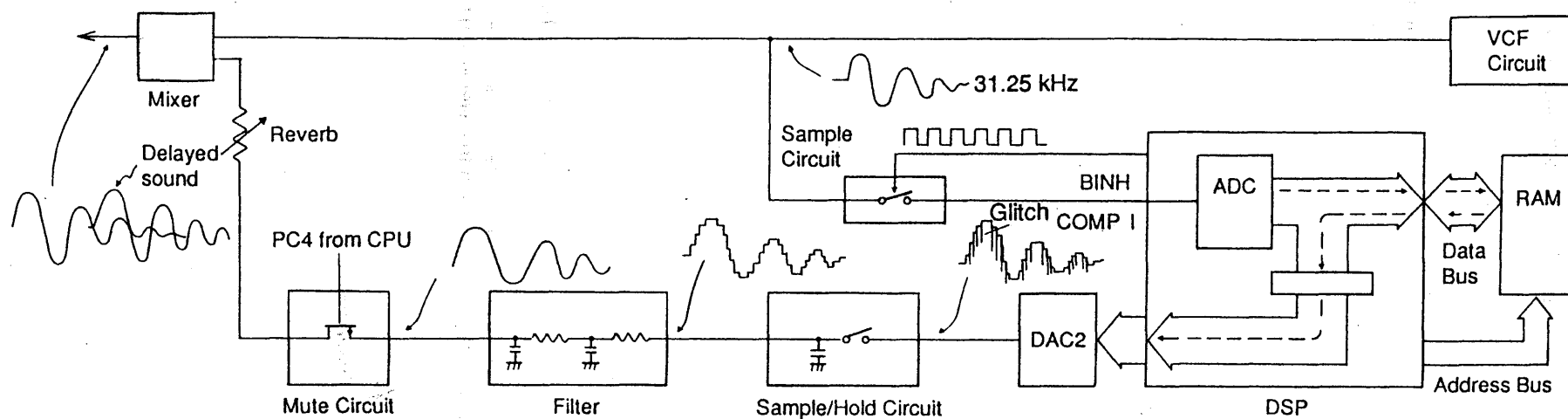
The actual VCF Circuit is a four-stage low pass filter which makes sharp drop of cutoff frequency response.



The switch S turns on or off by signal PF5 from CPU and controls the resonance effect which is given by feeding the output sound signal of VCF back to the input. When signal PF5 from CPU is Low, the switch S turns off causing the VCF output fed-back to the input. If PF5 is High, the switch turns on sending the VCF output sound to the last stage of the filter which minimize the resonance effect.



REVERB EFFECT CIRCUIT



VCF output sound signal is digitized in built-in ADC in the DSP with sampling frequency of 31.25 KHz.

The digital sound data from built-in ADC is temporary stored in the RAM.

The stored data in RAM is read by DSP (Digital Signal Processor) and re-formed in a waveform in DAC2. At this time, DSP changes the reading speed by varying address signals' frequency in order to delay the sound signal.

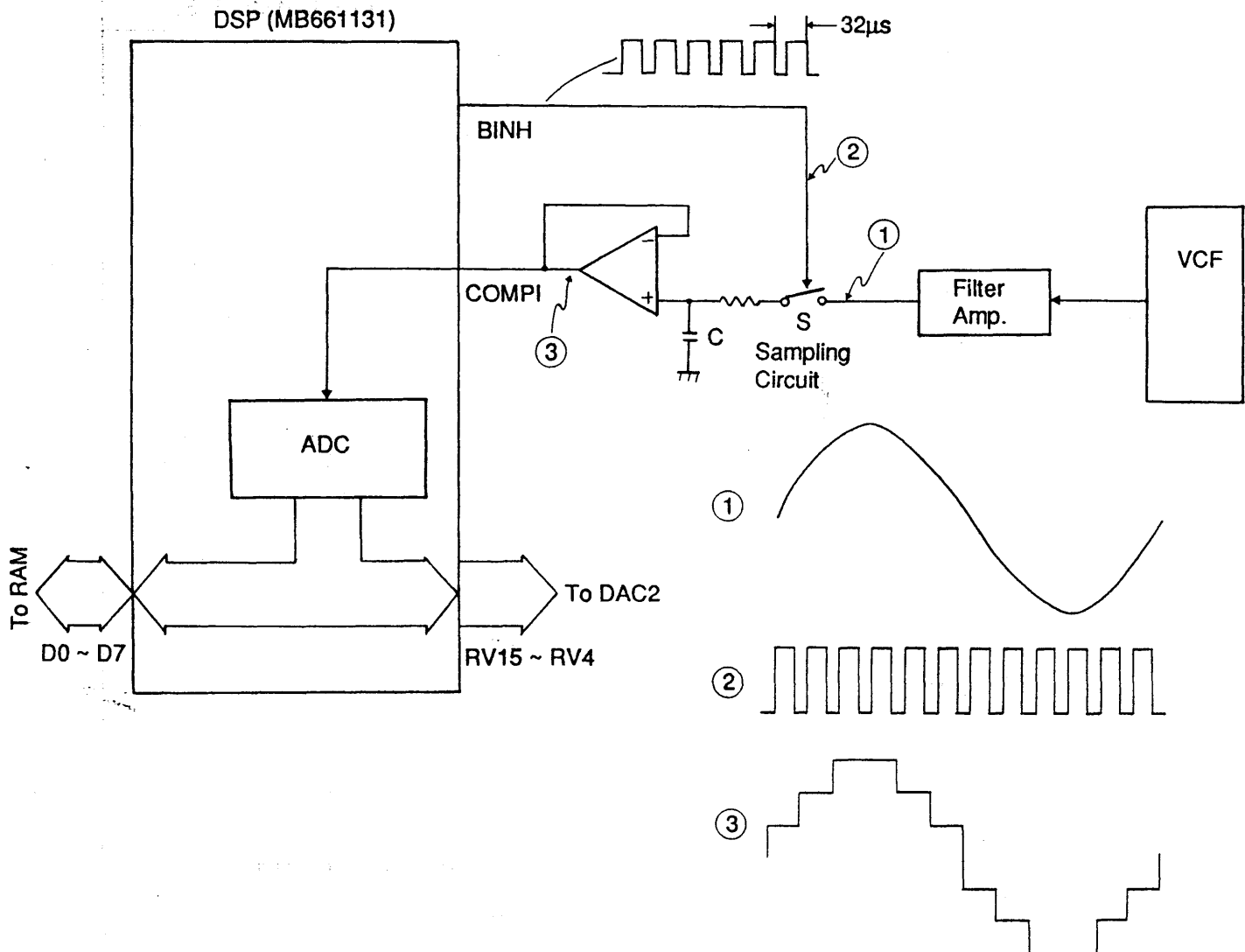
Since DAC2 output is stepped waveform containing glitch noise, Sample/Hold Circuit removes the glitch and Filter smoothes the stepped waveform.

When the horn is not blown, CPU turns the FET off by signal PC4 to cut the sound off.

Reverb effect is given by adding VCF output and delayed sound.

DIGITIZATION SAMPLING CIRCUIT

Sound waveform from VCF enters the DSP with 31.25 KHz sampling frequency.



Sound waveform from VCF is filtered and amplified in the Filter Amp block in order to sample the waveform effectively.

DSP provides 31.25 KHz pulse from BINH terminal. The switch S turns on or off when BINH is High or Low respectively.

While the switch is ON, the voltage level of the waveform enters DSP. At the same time, the voltage level charges the capacitor C.

Even the switch is OFF, DSP receives the same voltage level as capacitor C discharges.

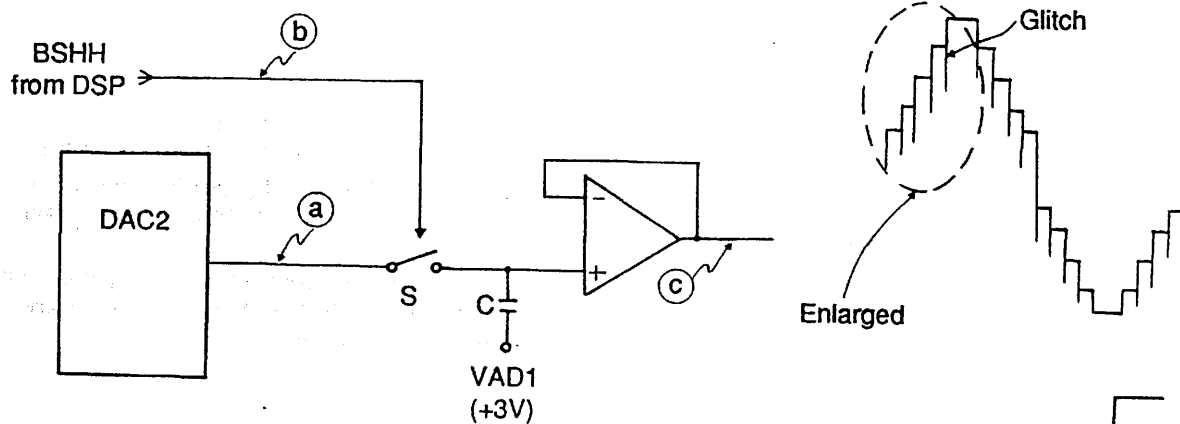
The voltage level is digitized in built-in ADC of DSP and sent to the RAM.

DSP (Digital Signal Processor: MB661131) PIN FUNCTION

Pin No.	Terminal	In/Out	Function
1, 2, 4~9	DT7 ~ DT0	In/Out	Data bus between external RAM MB65256
3	VDD	In	+5V source
10	MM0D	In	External RAM selection terminal. High Static RAM Low Dynamic RAM Connected to High level
11, 12	CLK0, CLK1	In/Out	16 MHz clock pulse input/output
13	RESET	In	Power ON reset signal input. Low action
28	VDD	In	+5V source
40	VSS	In	Ground (0V) source
48 ~ 52 54 ~ 60	RV4 ~ RV8 RV9 ~ RV15	Out	Digital sound data output. Sound waveform from pin 66 is digitized in the built-in ADC and output from these terminals.
65	VSS	In	Ground (0V) source
66	CMP I	In	Sound waveform input
67	BSHH	Out	KHz pulse for Sample/Hold Circuit
68	BINH	Out	KHz sampling pulse for built-in ADC
70	CLKP	Out	8 MHz (16 MHz/2) clock pulse output. As direct touch of oscilloscope probe on oscillator may stop the oscillation, this terminal is used for clock pulse checking.
72 ~ 75	RVT0 ~ RVT3	In	Reverb time determination terminals. Reverb time is determined by the voltage levels of these terminals.
78	VDD2	In	+5V source
81, 82 85 ~ 89 91 ~ 94 96 ~ 98 100	AD14, AD12 AD7 ~ AD5 AD9 ~ AD3 AD2 ~ AD1 AD0	Out	Address bus for the external RAM. Stored data in RAM are read in various delay time by varying address signals' frequency.
83, 89	MRAS, MMCS	Out	External RAM chip select signals. The RAM is selected when both of these signals are Low level.
84	WRIT	Out	Write enable signal. When Low, digitized sound data are written in RAM.
90	VSS	In	Ground (0V source)
95	EOUT	Out	Output enable signal. When Low, the RAM outputs stored data.

SAMPLE/HOLD CIRCUIT

DAC output waveform is a stepped waveform and contains a thin noise called "glitch" in each step. The Sample/Hold circuit eliminates the glitch noise.

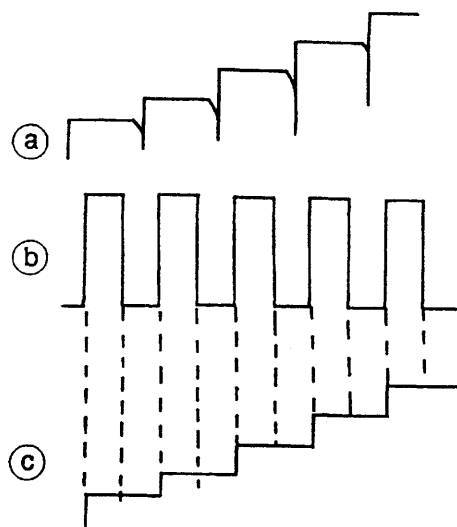


DSP outputs a sampling signal BSHH in each step of the DAC2 output.

While signal BSHH is High level, the switch S turns on causing the signal to pass through. At the same time, voltage of the signal is charged in the capacitor C.

At the end of one step where the glitch appears, signal BSHH falls to Low level. The switch S turns off shutting the glitch out. While switch turns off, capacitor C discharges so that the output of the switch keeps the same voltage level.

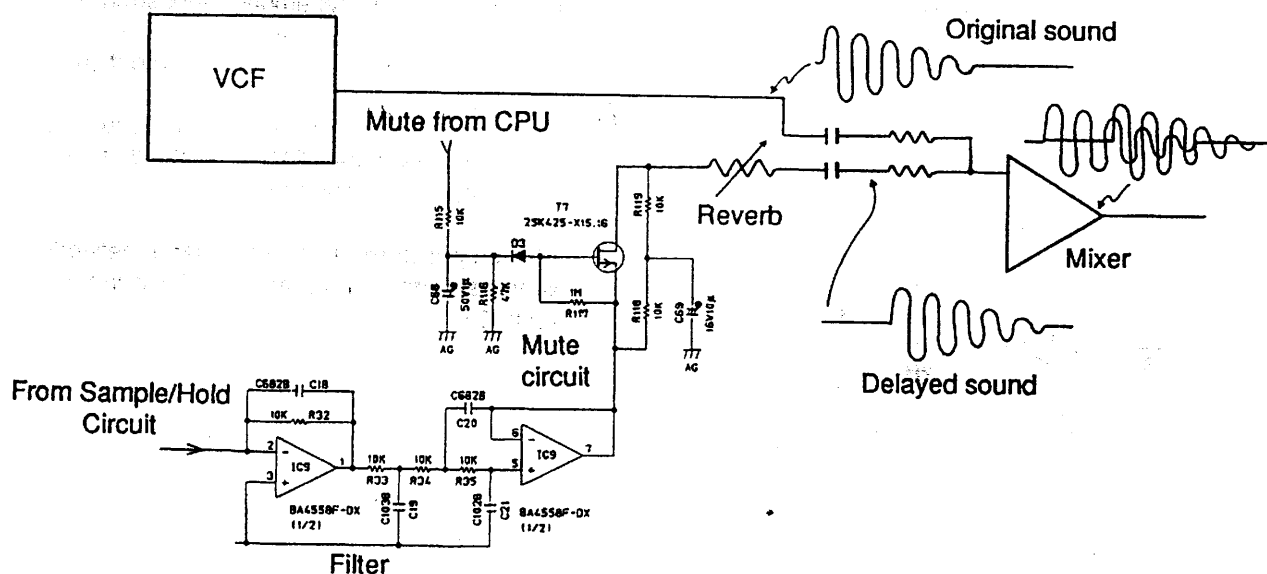
Thus, the glitch noise is eliminated from the DAC2 output.



FILTER, POWER ON MUTE, MIXER CIRCUITS

The stepped waveform is smoothed by the Filter.

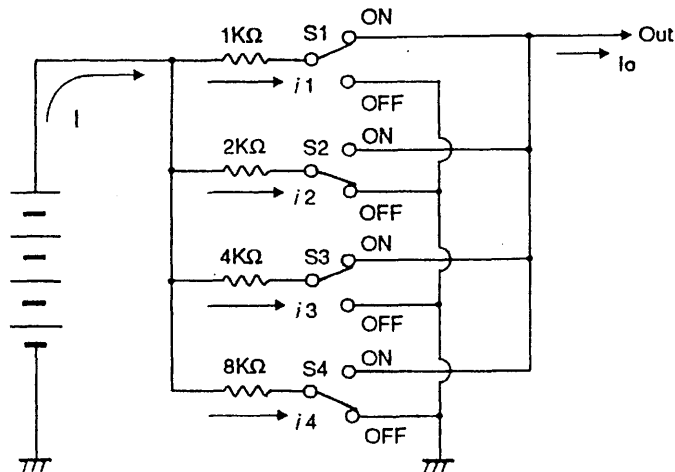
At Power ON, CPU rises the signal MUTE turning FET T7 off. The power on reverb noise is eliminated. Delayed sound signal from DAC2 is then mixed with the VCF output by Mixer.



DAC2

DAC2 consists of inverters and resistive ladder network and reforms the digitized data from DSP in sound waveform.

The followings explain the digital to analog conversion method.



In the left figure, if the current I from the battery is 1.5 [A], $i_1 = 0.8$ [A], $i_2 = 0.4$ [A], $i_3 = 0.2$ [A], and $i_4 = 0.1$ [A] as they pass through 1K, 2K, 4K, and 8K ohm resistors respectively.

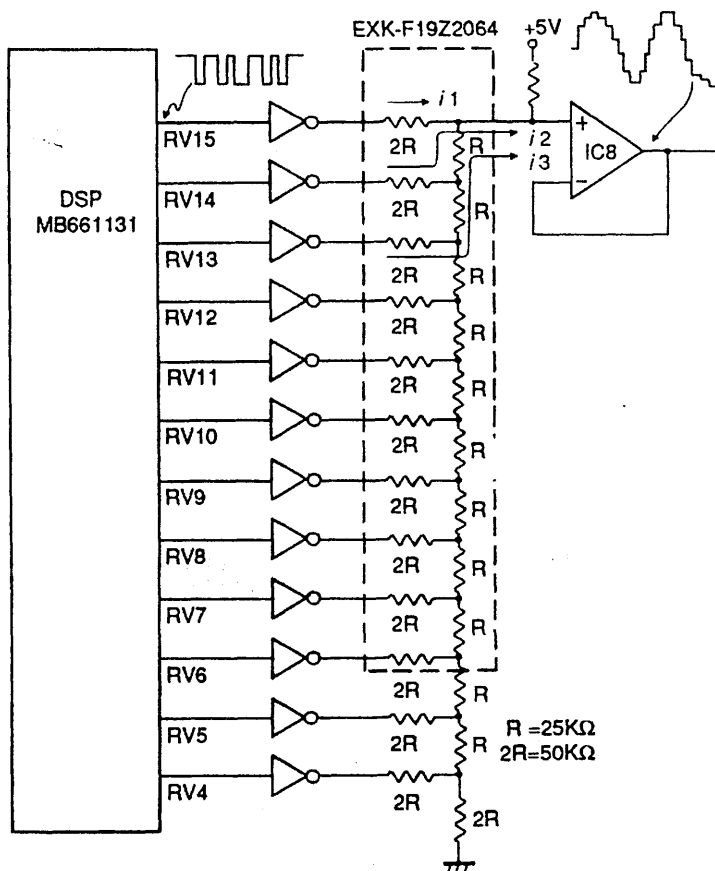
When all the switches are OFF, the output current I_o is 0 [A] but, if switches S1 and S3 are ON, the output current will be;

$$I_o = i_1 + i_3 = 1 \text{ [A]}$$

If all the switches are ON;

$$I_o = i_1 + i_2 + i_3 + i_4 = 0.1 + 0.2 + 0.4 + 0.8 = 1.5 \text{ [A]}$$

Thus, digital action of switch ON/OFF is converted into analog amount of the current.



Actually, the DAC in DH-500 is made up by inverters and R-2R ladder network.

Instead of switches, being High or Low of DSP's digital sound signal determines current flow. For instance, when signal RV15 is Low, the inverter output becomes High causing the current i_1 to be flowed. If RV15 is High, the current does not flow.

Since the DSP output current is too small to drive the DAC, the inverters amplify the current.

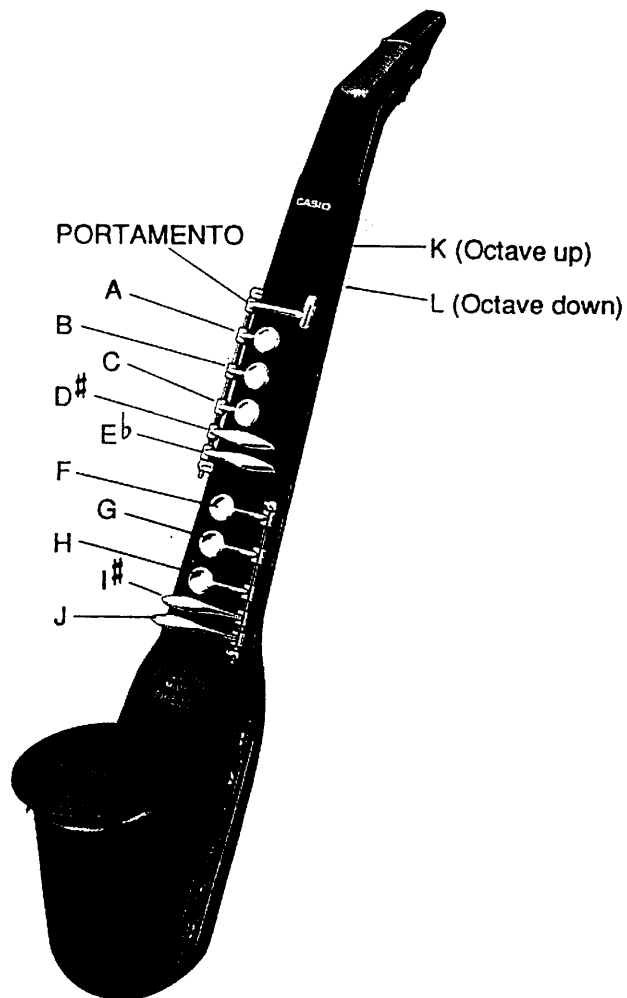
R-2R networked resistors halve the current in each junction. For example, suppose current i_1 is 10 [mA], i_2 is 5 [mA], i_3 is 2.5 [mA]. Therefore, each bit of DSP output has significance.

Namely since the circuit is 12 bit DAC, current flow from terminal RV15 is 2048 times larger than the current from RV4.

The output current I_o from ladder network is transformed in voltage level by the op amp IC8.

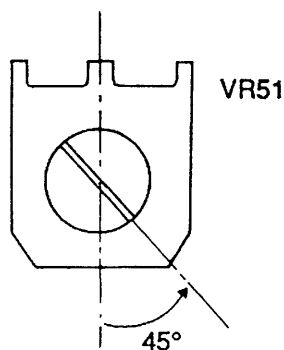
KEY AND SWITCH MATRIX

	PB0	PB1	PB2	PB3	PB4	PB5	PB6	PB7
PC1		G	H	1#	J	OBOE	CLARINET	FLUTE
PC2		F	E ^b	D#	C	SAXO- PHONE	TRUMPET	SYNTH. REED
PC3	PORTA- MENT	OCTAVE UP	OCTAVE DOWN	A	B	VIBRAT ON	TRAMS. UP	TRAMS. DOWN



ADJUSTMENTS

1. Insert a silicon rubber tube (code No. 6914 7972) into the mouthpiece as shown on page 10.
2. Turn VR51 on PCB MA3M as shown on the figure below.



3. Connect a digital voltmeter between testpins TP1 and TP2.
4. Blowing air strongly from the tube, adjust VR52 so that meter reading is $2.6V \pm 0.05V$.
5. While it is not blown, adjust VR-51 for the meter reading; $1.00V \pm 0.05V$.
6. Repeat the above procedures 4 and 5.

TROUBLESHOOTING TABLE

Trouble	Faulty Block	Checkpoint
No Powr ON (TUNING lamp does not light at all)	Power Circuit	T1 collector voltage (+9V) T4 emitter voltage (+5V) T5 emitter voltage (+5V)
	Power switch	Switch contact
	Power jack	
	CPU (μ PD78C11G-1B)	Pin 56 (Should be High)
No sound at all	Reset Circuit	Refer to waveform ①
	12 MHz Oscillator	
	CPU (IC13)	Pins 59~2 should output pulses when the horn is blown.
		Pin 17 should output pulses when it is blown (Refer to waveforms ④ and ⑤).
	VCA Circuit	
	VCF Circuit	Waveforms ⑥ and ⑦.
	DAC1	T5 emitter voltage should rise when the horn is blown.
	Power Amp (LA4182)	Pins 2 and 11 should output waveforms when the horn is blown.
	Speaker	
No reverb effect	Sampling Circuit	Waveform ⑨
	DSP (IC3)	Data bus, Address bus
		Pins 48 ~ 60 should output pulses when played.
		Sampling signals BINH and BSHH (refer to waveforms ⑩ and ⑪)
	Sample/Hold Circuit	Waveform ⑫
	Filter Block	
	Power ON Mute Circuit	
	CPU (IC13)	Pin 15 should output waveform ② at Power ON.
	RAM (IC1)	
	REVERB VR	
Certain key(s) do(es) not work	Key contact	
	Open circuit on PB0 ~ PB4 or PC1 ~ PC3 lines	

(PAGE 26 MISSING)

Item	Code No.	Parts Name	Spec. No.	Q	*	FOB Japan N. R. Yen Unit Price	R N K
PCB M5331-MA1M/MA3M ASS'Y							
O*	2010 2534	LSI	HM65256BLP-10,12	1		800	A
	2010 7840	LSI	UPD78C11G-535-1B	1		880	A
	2010 7847	LSI	MB661131	1		1,320	A
	2590 0203	Ceramic oscillator	CSA16.00MX040	1		100	B
O*	2590 0693	Crystal oscillator	AT-51-12.000MHZ	1		110	B
	2845 0098	Three polarity capacitor	DS306-56F103Z	3	10	22	C
	3020 2147	Ferrite beads	BL02RN2-R62	2	10	15	C
	3060 6043	Resistive ladder network	EXK-F19Z2064	1		50	A
O*	3719 2191	Ribbon cable	DF0H04290-30003000	1	20	27	X
	2105 0952	C-MOS IC	BU4066BF-T1	2	10	42	A
	2105 1113	C-MOS IC	TC74HC04AF-T1	2		30	A
	2114 0511	Monolithic IC	BA4558F-DX-T1	4		40	A
	2114 0686	Monolithic IC	NJM311M-T1	1		95	A
	2252 0595	Chip transistor	2SC2412KT-146R,S	1	20	9	A
	2254 0154	Chip FET	2SK425-T1B-X15,16	1	10	32	A
	2390 0749	Chip diode	DA116T-146	2	20	11	C
	2730 0530	Chip resistor	MCR10EZHJ272	1	20	3	C
	2792 0209	Chip resistor	MCR10EZHJ104	2	20	3	C
	2792 0462	Chip resistor	MCR10EZHJ473	8	20	3	C
	2792 0470	Chip resistor	MCR10EZHJ102	1	20	3	C
	2792 0815	Chip resistor	MCR10EZHJ221	2	20	3	C
	2792 0831	Chip resistor	MCR10EZHJ103	15	20	3	C
	2792 0845	Chip resistor	MCR10EZHJ153	1	20	3	C
	2792 0861	Chip resistor	MCR10EZHJ474	2	10	4	C
	2792 0926	Chip resistor	MCR10EZHJ100	2	20	3	C
	2792 0942	Chip resistor	MCR10EZHJ332	4	20	3	C
	2792 0977	Chip resistor	MCR10EZHJ154	1	10	9	C
	2792 1043	Chip resistor	MCR10EZHJ223	1	20	3	C
	2792 1051	Chip resistor	MCR10EZHJ222	1	20	3	C
	2792 1116	Chip resistor	MCR10EZHJ224	1	10	9	C
	2792 1140	Chip resistor	MCR10EZHJ682	1	20	3	C
	2795 0266	Chip resistor	MCR10EZHJ181	7	10	9	C
	2795 0532	Chip resistor	MCR10EZHJ105	2	20	3	C
	2795 0861	Chip resistor	MCR10EZHJ393	1	20	3	C
	2795 0973	Chip resistor	MCR10EZHJ561	2	10	9	C
O*	2795 2261	Chip resistor	MCR10EZHJ253	7	20	21	C
O*	2795 2268	Chip resistor	MCR10EZHJ503	9	20	3	C
O*	2797 0406	Chip semi-fixed resistor	EVM-6PSW00B14	1	10	34	B
	2807 6238	Chip electrolytic capacitor	50RVJ1-T	5	20	28	C
	2807 6252	Chip electrolytic capacitor	16VJ10-T	3	20	28	C
	2807 6259	Chip electrolytic capacitor	6.3RVJ33S-T	3	20	28	C
	2845 0308	Chip capacitor	T1-21N1EF103Z-T	5	20	6	C
	2845 0763	Chip capacitor	T1-21N1ER103K-T	5	20	8	C
	2845 0812	Chip capacitor	T1-21N1ER682K-T	3	20	7	C
	2845 0966	Chip capacitor	T1-21N1ER332K-T	2	20	6	C
	2845 1050	Chip capacitor	T1-21N1HSL101J-T	3	20	6	C
O*	2845 1057	Chip capacitor	T1-21N1EF104Z-T	1	20	7	C
	2845 1246	Chip capacitor	T1-21N1ER102K-T	1	20	5	C
O*	2360 1225	Chip zener diode	RD4.7M-T1B(B3)	1	20	18	B
O*	2775 0350	Chip semi-fixed resistor	EVM-6PSW00B24	1	10	26	B
O*	2792 0250	Chip resistor	MCR10EZHJ390	1	20	4	C
	2792 0470	Chip resistor	MCR10EZHJ102	1	20	3	C
O*	2797 0406	Chip semi-fixed resistor	EVM-6PSW00B14	1	10	34	B

Notes: O* - New parts
Q'ty - Quantity used per unit
* - Minimum order and supply quantity

Rank A: Essential
B: Stock recommended
C: Others
X: No stock recommended

Item	Code No.	Parts Name	Spec. No.	Q	*	FOB Japan N. R. Yen Unit Price	R N K
O*	2807 6259	Chip electrolytic capacitor	6.3RVJ33S-T	1	20	28	C
	2845 0308	Chip capacitor	T1-21N1EF103Z-T	1	20	6	C
	2105 1113	C-MOS IC	TC74HC04AF-T1	1		30	A
	2105 1120	L-MOS IC	TC7S08F-TE85R	1	10	27	A
	2254 0154	Chip FET	2SK425-T1B-X15,16	4	10	32	A
	2259 0959	Chip digital transistor	DTC114YKT-146	1	20	12	A
	2390 0749	Chip diode	DA116T-146	1	20	11	C
	2730 0530	Chip resistor	MCR10EZJH272	1	20	3	C
	2792 0209	Chip resistor	MCR10EZJH104	11	20	3	C
	2250 0140	Transistor	2SA1286-T	1	10	35	A
	2252 0567	Transistor	2SC4266QR-T	2	20	9	A
	2253 0217	Transistor	2SD1246T,U-AA-T	1	10	29	A
	2253 0364	Transistor	2SD545E,F-AA-T	1	20	25	A
	2301 0275	Diode	1SS176-TPA7-T	1	20	5	C
	2310 7732	Zener diode	RD5.6ESB2-T1-T	1		12	B
	2310 7775	Zener diode	RD5.6ESB3-T1-T	1	20	12	B
	2310 7970	Zener diode	RD5.6JSB2-T1-T	1	10	12	B
	2360 1232	Zener diode	RD7.5ESB1-T1-T	1	20	9	B
	2390 0378	Diode	1SR139-100T-32-T	1	20	11	B
O*	2606 0007	Carbon film resistor	R-20-180-J-T24-T	2	20	3	C
	2606 0315	Carbon film resistor	R-20-3.3-J-T24-T	2	20	3	C
	2617 0028	Carbon film resistor	R-20-100-J-T24-T	2	20	3	C
	2617 0036	Carbon film resistor	R-20-220-J-T24-T	1	20	3	C
	2617 0079	Carbon film resistor	R-20-3.3K-J-T24-T	1	20	3	C
	2617 0079	Carbon film resistor	R-20-3.3K-J-T24-T	2	20	3	C
	2617 0087	Carbon film resistor	R-20-4.7K-J-T24-T	1	20	3	C
	2617 0095	Carbon film resistor	R-20-10K-J-T24-T	2	20	3	C
	2617 0109	Carbon film resistor	R-20-33K-J-T24-T	1	20	3	C
	2617 0192	Carbon film resistor	R-20-1.8K-J-T24-T	2	20	3	C
	2617 0214	Carbon film resistor	R-20-2.7K-J-T24-T	1	20	3	C
	2617 0222	Carbon film resistor	R-20-820-J-T24-T	1	20	3	C
	2617 0231	Carbon film resistor	R-20-270-J-T24-T	1	20	3	C
	2617 0246	Carbon film resistor	R-20-12K-J-T24-T	1	20	3	C
	2617 0289	Carbon film resistor	R-20-15K-J-T24-T	1	20	3	C
	2617 0297	Carbon film resistor	R-20-22K-J-T24-T	1	20	3	C
	2617 0301	Carbon film resistor	R-20-56K-J-T24-T	1	20	3	C
	2617 0378	Carbon film resistor	R-20-3.9K-J-T24-T	1	20	3	C
	2617 0416	Carbon film resistor	R-20-18K-J-T24-T	1	20	3	C
	2617 0467	Carbon film resistor	R-20-68-J-T24-T	2	20	3	C
O*	2801 7546	Electrolytic capacitor	10RC2-100-T2-T	5	20	19	C
O*	2801 7994	Electrolytic capacitor	16RE3-470-T14-T	2	20	27	C
O*	2801 9604	Electrolytic capacitor	16RC2-33-T2-T	1	20	17	C
O*	2801 9611	Electrolytic capacitor	6.3RC2-100-T2-T	1	20	17	C
O*	2801 9618	Electrolytic capacitor	6.3RC2-220-T2-T	1	20	20	C
O*	2804 6002	Electrolytic capacitor	6.3RE2-470-T14-T	2	10	27	C
O*	2805 3029	Electrolytic capacitor	50RC2-1-T2-T	5	20	18	C
O*	2805 3037	Electrolytic capacitor	16RC2-10-T2-T	2	20	18	C
O*	2805 3045	Electrolytic capacitor	6.3RC2-47-T2-T	1	20	20	C
O*	2818 0446	Ceramic capacitor	RT-HE40TKYB101K-T	3	20	3	C
	2818 2082	Ceramic capacitor	RT-HE70TKYF103Z-T	1	20	6	C
	2830 6211	Mylar capacitor	AMZV-154K50-T	2	10	3	C
	3841 0539	Fixed inductor	ELE-V100KR-T	3	20	26	C
PCB M5331-CN1/CN2 ASS'Y							
	2301 0275	Diode	1SS176-TPA7-T	12	20	5	C

Notes: O* - New parts

Qty - Quantity used per unit

* - Minimum order and supply quantity

Rank A: Essential

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C: Others

X: No stock recommended

Item	Code No.	Parts Name	Spec. No.	Q	*	FOB Japan N. R. Yen Unit Price	R N K
O*	3719 2184	Ribbon cable	DF5H03120-80008000	1	20	15	C
O*	3725 1246	PC joiner M124F	JSF00-8-130M	1		58	C
O*	4317 0840	PCB-M5331-CN1M	M210650-2	1		100	X
O*	4317 0850	PCB-M5331-CN2	M210650-2	1	20	27	X
PCB M5331-CN3 ASS'Y							
O*	2301 0275	Diode	1SS176-TPA7-T	5	20	5	C
O*	2370 0462	LED	LN275RPX-(TA3)	7	21	20	B
O*	2775 0574	Semi fixed resistor	EVN-D4AA00B14	2	20	16	B
O*	3725 1988	PCB joiner M331C	JSF00-18-85M	1	10	40	C
O*	4317 0880	PCB-M5331-CN3M	M210651-1	1	10	37	X
PCB M5331-CN4 ASS'Y							
O*	3725 1995	PC joiner M331F	JSF00-9-90	1	20	28	C
O*	4317 0860	PCB-M5331-CN4	M310850-1	1		220	X
	2792 0217	Chip resistor	MCR10EZJH101	10	20	3	C
	2792 0462	Chip resistor	MCR10EZJH473	2	20	3	C
	2792 0470	Chip resistor	MCR10EZJH102	1	20	3	C
	2792 0799	Chip resistor	MCR10EZJH472	1	20	3	C
	2792 0831	Chip resistor	MCR10EZJH103	1	20	3	C
	2792 0861	Chip resistor	MCR10EZJH474	1	20	4	C
	2792 0888	Chip resistor	MCR10EZJH334	3	20	3	C
	2792 0942	Chip resistor	MCR10EZJH332	1	20	3	C
	2792 1019	Chip resistor	MCR10EZJH564	2	10	9	C
	2792 1043	Chip resistor	MCR10EZJH223	1	20	3	C
	2795 0273	Chip resistor	MCR10EZJH823	1	20	3	C
	2795 0532	Chip resistor	MCR10EZJH105	1	20	3	C
	2795 0728	Chip resistor	MCR10EZJH560	1	20	3	C
	2795 0742	Chip resistor	MCR10EZJH683	1	20	3	C
O*	2795 2478	Chip resistor	MCR10EZHK106	1	20	2	C
O*	2795 2905	Chip resistor	MCR10EZHF5002	3	20	5	C
O*	2795 2912	Chip resistor	MCR10EZHF2502	2	20	5	C
	2845 0308	Chip capacitor	T1-21N1EF103Z-T	14	20	6	C
	2845 0763	Chip capacitor	T1-21N1ER103K-T	3	20	8	C
	2845 0812	Chip capacitor	T1-21N1ER682K-T	1	20	7	C
O*	2845 0896	Chip capacitor	T1-21N1HCG470J-T	2	20	4	C
	2845 1050	Chip capacitor	T1-21N1HSL101J-T	8	20	6	C
O*	2845 1057	Chip capacitor	T1-21N1EF104Z-T	4	20	7	C
	2845 1246	Chip capacitor	T1-21N1ER102K-T	1	20	5	C
O*	2845 1729	Chip capacitor	T1-21N1HCG200J-T	2	20	4	C
O*	4317 0890	PCB-M5531-MA1M	M110560-1	1		590	X
	2114 1274	Monolithic IC	LA6358M-TP-T1	1	10	43	A
O*	2252 0595	Chip transistor	2SC2412KT-146R;S	1	20	9	A
	2360 1036	Chip zener diode	RD3.3M-T1B(B2)	1	20	18	B
O*	2390 0994	Chip diode	DA204K-T146	1	20	14	C
	2730 0530	Chip resistor	MCR10EZJH272	1	20	3	C
	2792 0470	Chip resistor	MCR10EZJH102	1	20	3	C
	2792 0831	Chip resistor	MCR10EZJH103	2	20	3	C
	2792 1043	Chip resistor	MCR10EZJH223	1	20	3	C
	2792 1051	Chip resistor	MCR10EZJH222	1	20	3	C
	2792 1140	Chip resistor	MCR10EZJH682	2	20	3	C
	2795 0532	Chip resistor	MCR10EZJH105	1	20	3	C
	2845 0308	Chip capacitor	T1-21N1EF103Z-T	1	20	6	C
	2845 0763	Chip capacitor	T1-21N1ER103K-T	1	20	8	C
	2845 1071	Chip capacitor	T1-21N1HCGH471J-T	2	20	9	C
	2845 1246	Chip capacitor	T1-21N1ER102K-T	1	20	5	C

Notes: O* - New parts
Q'ty - Quantity used per unit
* - Minimum order and supply quantity

Rank A: Essential
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C: Others
X: No stock recommended

Item	Code No.	Parts Name	Spec. No.	Q	*	FOB Japan N. R. Yen Unit Price	R N K
O*	4317 0900	PCB-M5331-MA3M	M110560-2	1		100	X
	3025 0217	EMI filter	EXC-EMT103DC	1	10	23	C
	3500 3371	Connector 2P	IL-G-2P-S3T2-E	1		5	X
	3665 0070	Test pin	IPS-1136	2	20	3	X
PCB M5331-MA2M ASS'Y							
	2114 1253	Monolithic IC	LA4182	1		130	A
	2121 0013	OP amp	NJM4558DD	1		78	A
	2765 0812	Volume	EVL-E5A-T12B14	2		100	B
	3020 2147	Ferrite beads	BL02RN2-R62	2	10	15	C
	3025 0063	EMI filter	DST306-56FZ103Z	3	10	28	C
	3412 0238	Slide switch	SSD-22DP	1		68	B
	3501 0196	DIN jack	TCS5350-01-1211	1	5	79	B
	3501 3717	DC jack	HEC2305 01-230	1		28	B
	3612 0711	Miniature jack	YKB21-5101	1	5	90	B
O*	4317 0870	PCB-M5331-MA2M	M110561-1	1		130	X
O*	6915 5181	VR knob 264	M310558A-1	2	20	24	C
O*	6916 0360	Screw 264	M410817-1	2	20	5	X
UPPER CASE BLOCK							
1 O*	3719 1911	Ribbon cable M250BS	DF5H02100-35353535	1	20	15	X
2	3831 0252	Speaker	EAS-9D10A	1		310	B
3 O*	6917 0381	Contact rubber 331A	M31087A-1	1	10	42	B
4 O*	6917 0391	Contact rubber 331B	M31087A-1	1	10	34	B
5 O*	6915 1918	Key ring	M410568A-1	11	20	13	C
6 O*	6917 0420	Upper case sub assy	M210679*1	1		1,170	C
7	6914 8141	Key support A	M410397A-1	1		12	X
8	6914 8151	Key support B	M410398A-1	1		12	X
9	6914 8161	Key support C	M410399A-1	1		12	X
10	6914 8171	Key support D	M410400A-1	1		12	X
11	6915 6282	Key top 263PB	M410698B-1	1		10	C
12	6915 6292	Key top 263PC	M410699B-1	1		10	C
13	6915 6322	Key top 263PF	M410702B-1	1		10	C
14	6915 6342	Key top 263PH	M410704B-1	1		10	C
15 O*	6916 1260	Key spacer D	M410837-1	4	10	43	X
16 O*	6916 1280	Key spacer D	M410837-3	2	10	43	X
17 O*	6916 1290	Key spacer D	M410837-4	1	10	43	X
18 O*	6917 0550	Key top 331A	M410989-1	1	5	79	C
19 O*	6917 0560	Key top 331B	M410990-1	1	5	79	C
20 O*	6917 0570	Key top 331C	M410991-1	1	5	79	C
21 O*	6917 0580	Key top 331D	M410992-1	1	5	79	C
22 O*	6917 0590	Key top 331E	M410993-1	1	5	79	C
23 O*	6917 0620	Key spacer D	M410837-5	2	10	43	X
24 O*	6917 0630	Key spacer D	M410837-6	1	10	43	X
25 O*	6917 0680	Key top 263PD	M410670-1	1	5	77	C
26 O*	6917 2221	Key shaft 331C	M411032-1	1		120	X
27 O*	6917 2231	Key shaft 331D	M411033-1	1		120	X
28 O*	6917 2320	Felt (lower)	M411020-1	10	20	7	X
29 O*	6915 6332	Key top 263PG	M410703B-1	1	20	10	C
30 O*	6912 7246	Speaker grill	M310477F*3	1		290	C
31 O*	6914 8000	Speaker ring	M410357-1	1		220	C
32 O*	6917 0540	Stopper(upper)	M411012-1	1	20	24	X
SENSOR BLOCK							
33 O*	6917 0430	Sensor sub assy 331	M411019*1	1	1	270	A
34 O*	6917 0440	Sensor house sub assy	M411018*1	1	1	100	C
35 O*	6917 0470	Tube 331	M310877-1	1	1	84	C

Notes: O* - New parts
Q1 - Quantity used per unit
* - Minimum order and supply quantity

Rank A: Essential
B: Stock recommended
C: Others
X: No stock recommended

Item	Code No.	Parts Name	Spec. No.	Q	*	FOB Japan N. R. Yen Unit Price	R N K
36 O*	6917 0480	Sensor cover 331	M411000-1	1	1	63	X
37 O*	6917 0490	Sensor ring 331	M411025-1	1	20	17	X
38 O*	3501 4396	2P connector M331	IL-2P-9-M331	1	10	36	
LOWER CASE BLOCK							
39	6909 5880	SL contact 12S	CSB-12S	2	10	35	B
40	6911 5530	Sponge	M42106-1	1		9	X
41 O*	6917 0500	Lower case sub assy	M210682*1	1		860	C
42 O*	6917 0510	Slide knob 331	M310868-1	2	20	14	C
43 O*	6917 0521	Rubber button	M310870A-1	1	10	38	C
50 O*	6907 3200	Battery spring 93B	M42629-1	1	20	7	X
51 O*	6912 8881	Battery spring 331	M411021A-1	1	20	15	X
52 O*	6914 7920	Battery spring 263	M410375-1	1	10	21	X
OTHERS							
O*	6917 3630	Strap	STR-2	1		210	C
44	6914 7781	Decorating screw 263	M410405A-1	1	50	2	C
45	6915 8720	Mouth piece A	M310667-1	1		45	A
46 O*	6917 0220	Battery cover sub assy	M411017*1	1		370	C
47 O*	6917 0360	Button 331	M310869-1	2	5	75	C
48 O*	6917 0371	Contact rubber 331C	M410994A-1	1	20	27	B
O*	3725 2002	PC joiner M331B	JSF00-11-100	1	10	27	C
49 O*	6905 3840	Spacer 5.5	M4948-9	2	20	15	X

Notes: O* - New parts
Q'ty - Quantity used per unit
* - Minimum order and supply quantity

Rank A: Essential
B: Stock recommended
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