# SERVICE MANUAL
# & PARTS LIST (with price)

## Digital Horn

## DH-500

MAY 1989

DH-500

CASIO

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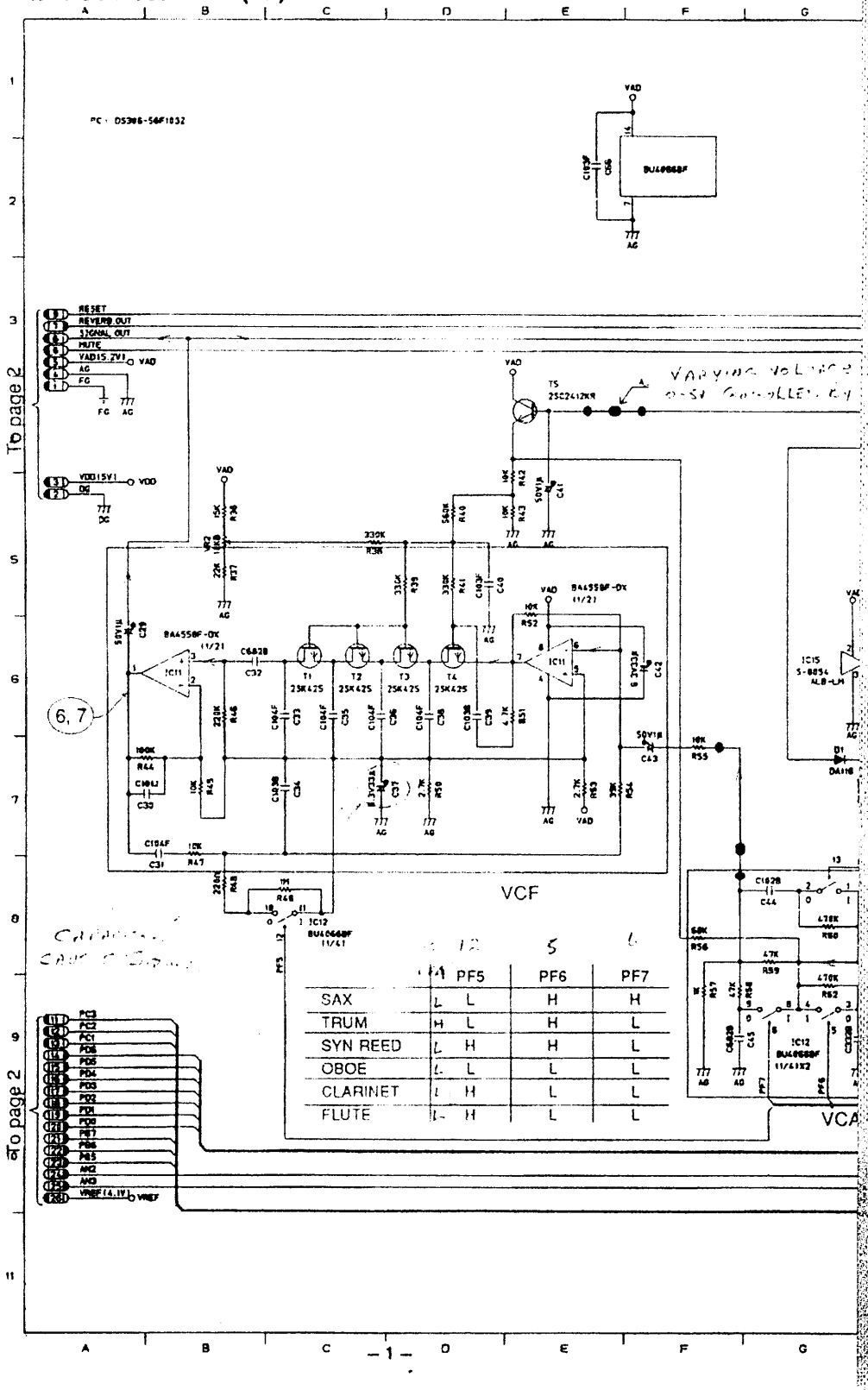
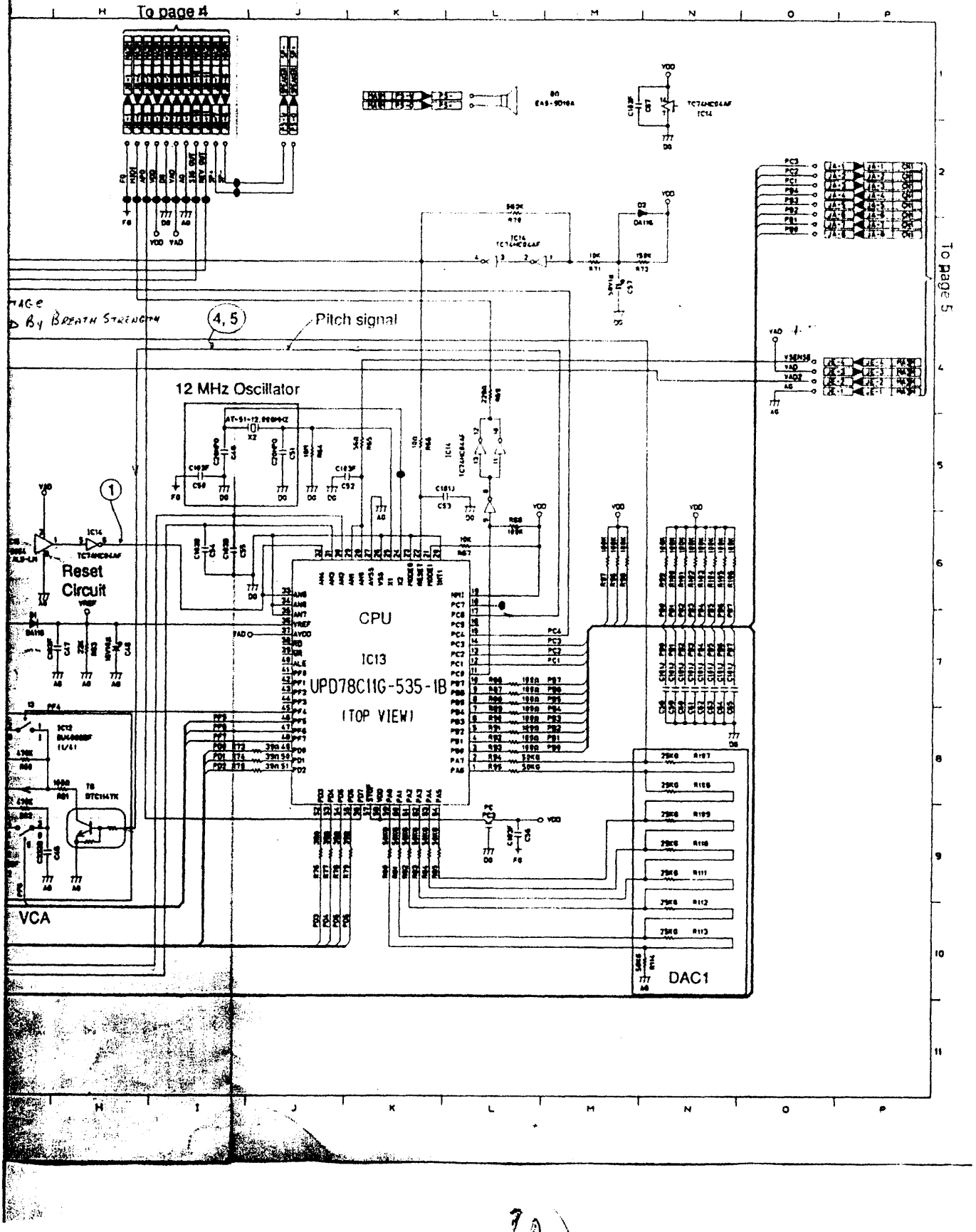
## SCHEMATIC DIAGRAM

### 1. PCB M5331-MA1 (1/2)

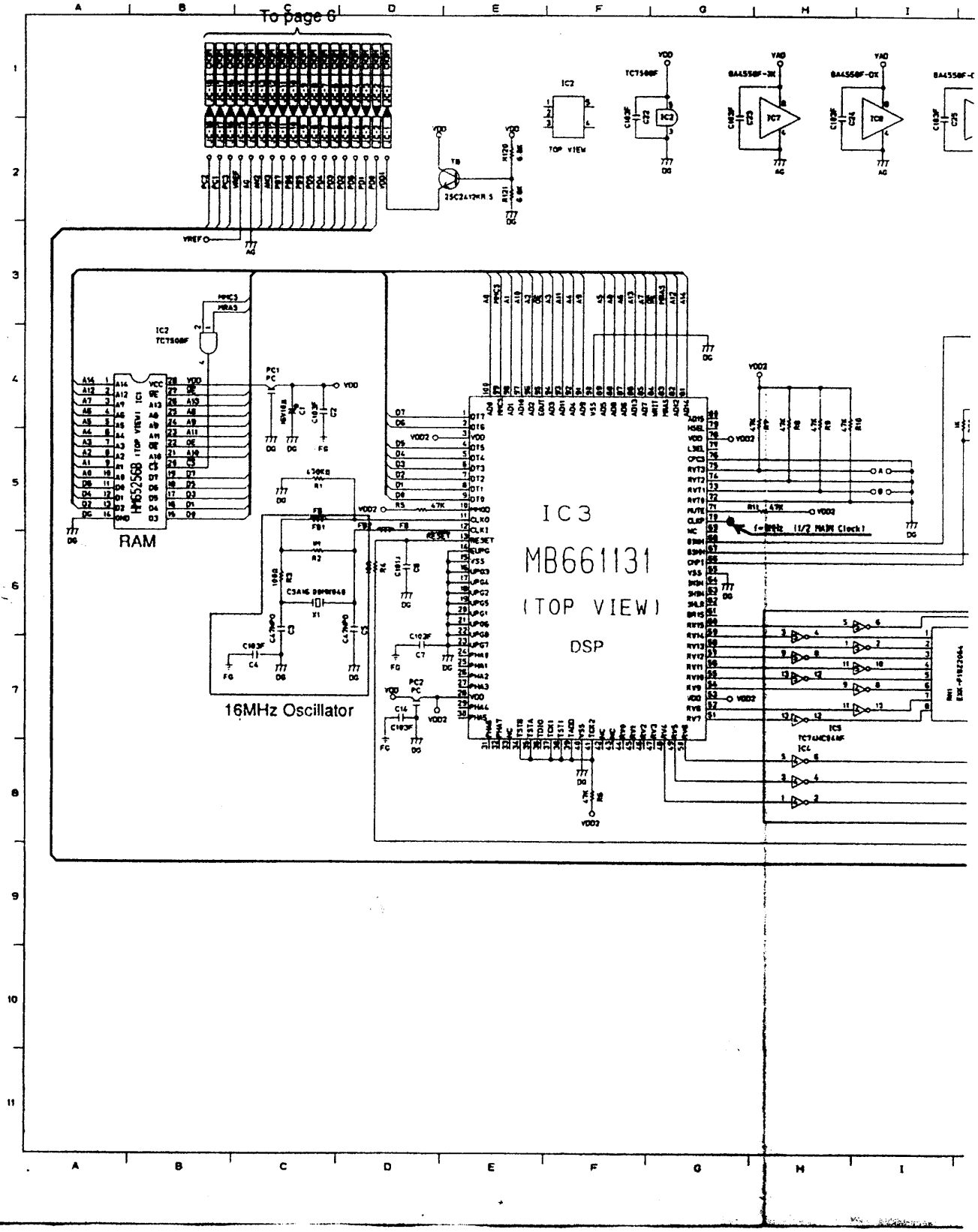


PCB M5331-MA1 1(A)

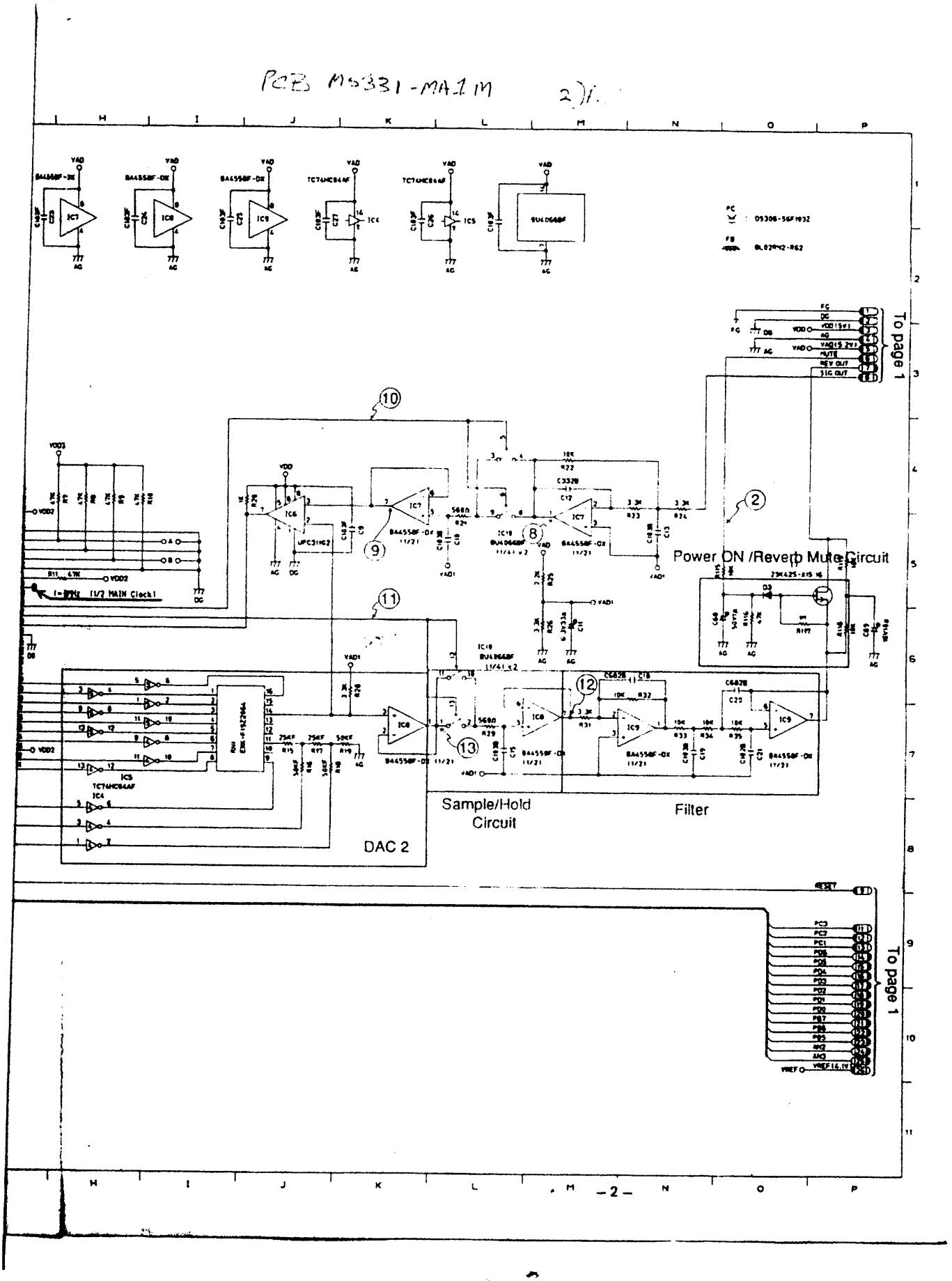



1A)

## 2. PCB M5331-MA1M (2/2)



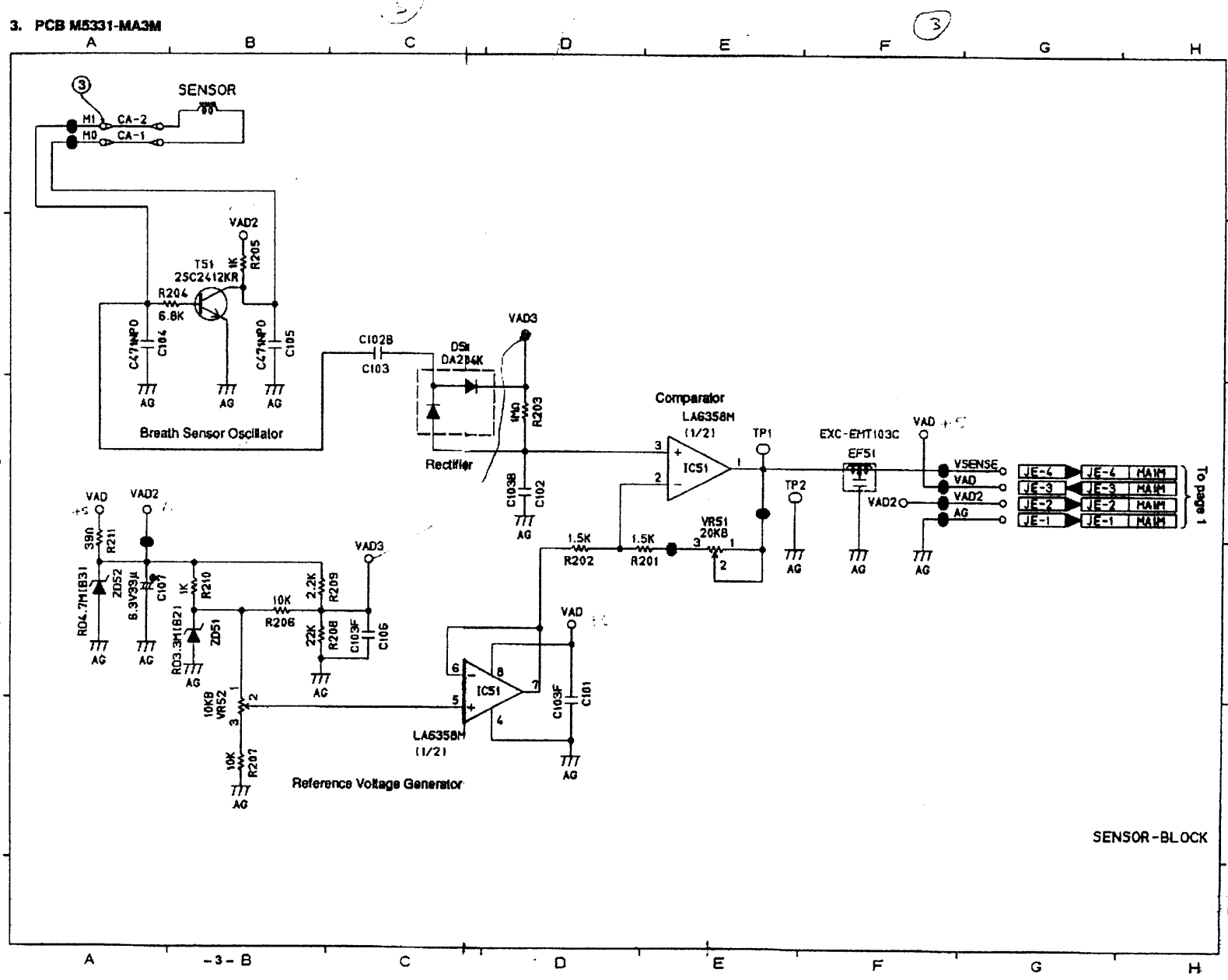
PCB MS331-MAIN 2)






12A

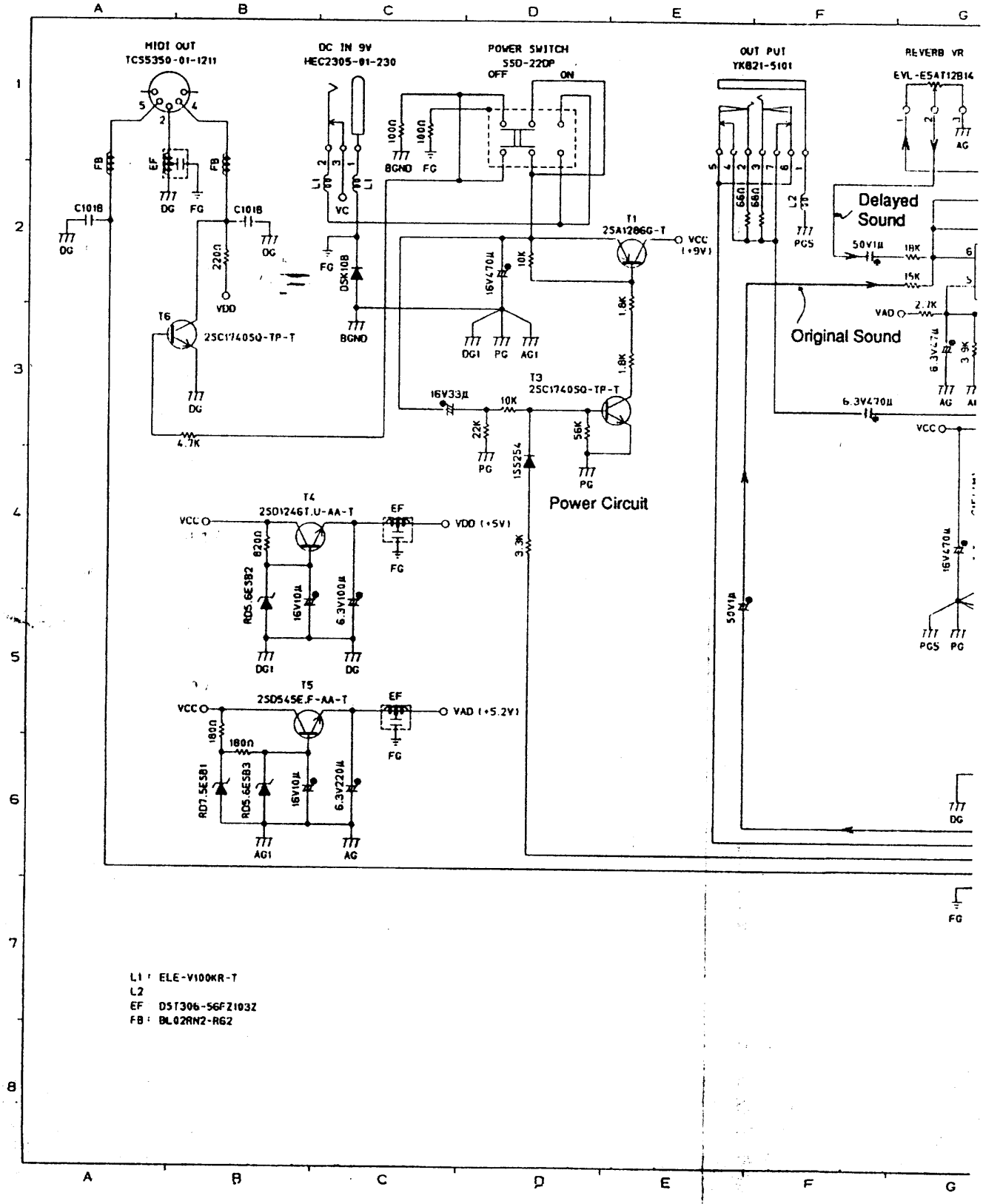
3. PCB M5331-MA3M

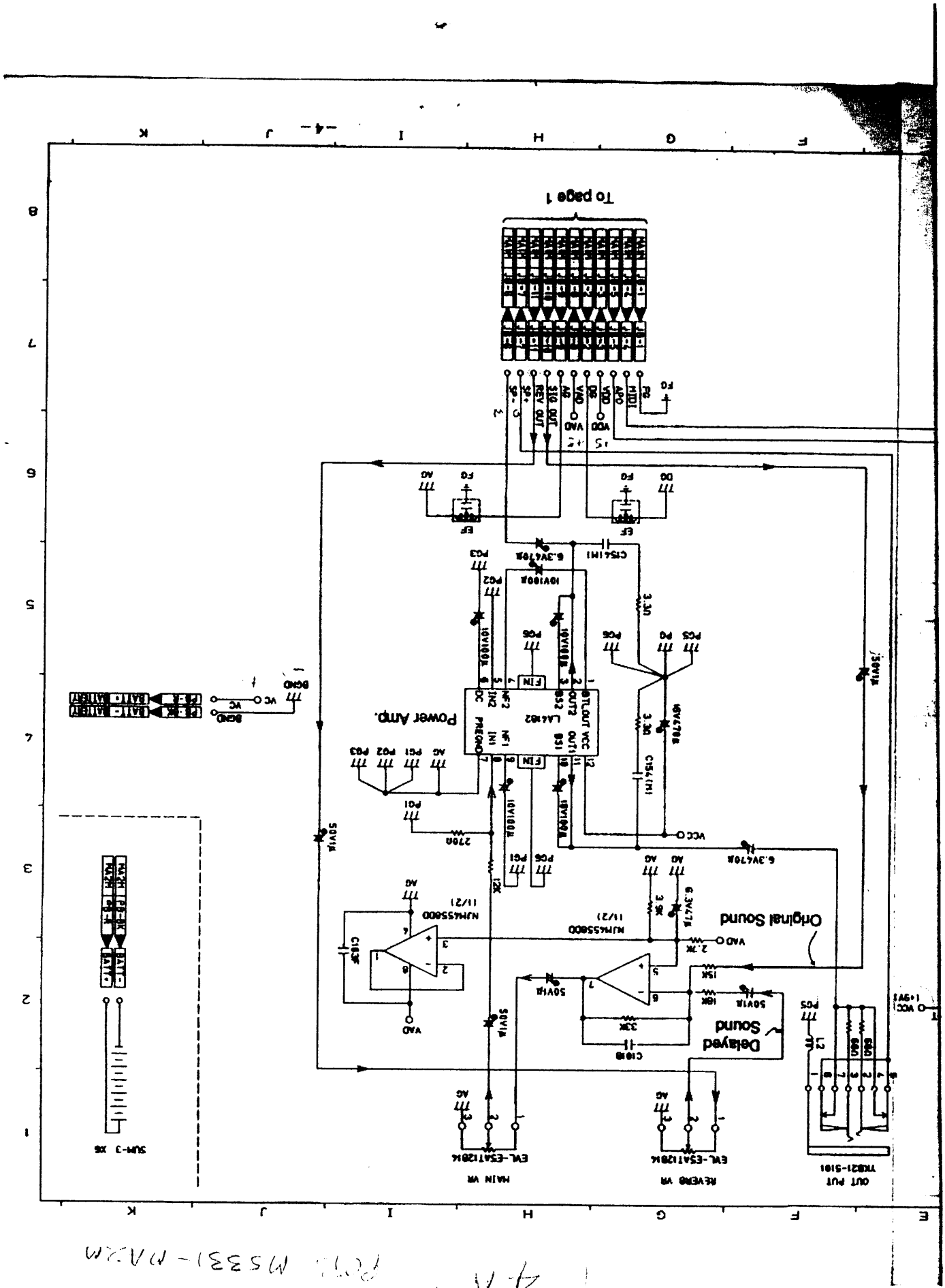


4-

(4)

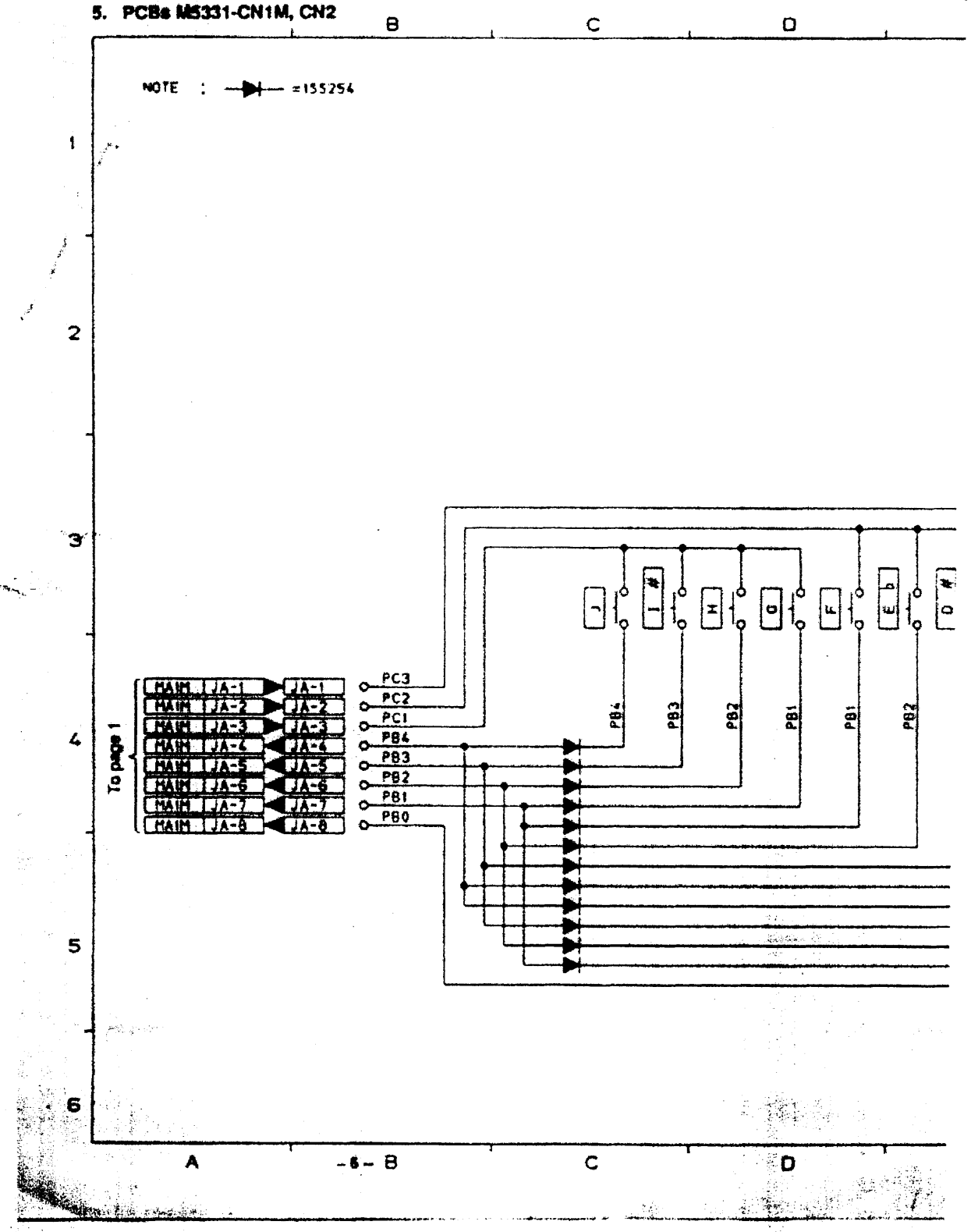
## 4. PCB M5331-MA2M



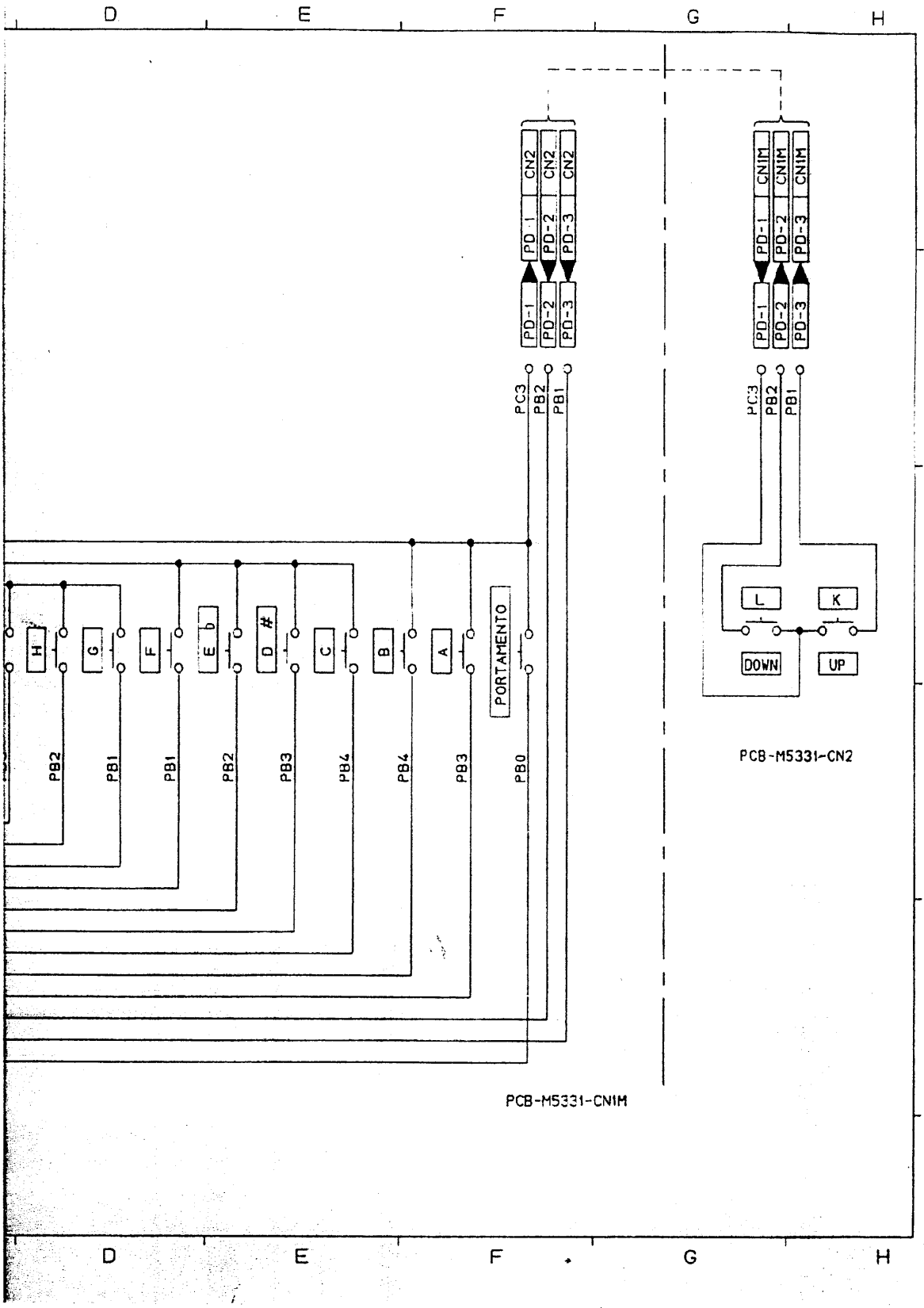

To page 1
Original Sound
Delayed Sound
Power Amp.
OUT PUT
REVERB VR
MAIN VR
SUM-3 X6

5

## 5. PCBs MS331-CN1M, CN2



(5A)


D
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PD-2
PD-3
CN2
CN1M
PC3
PB2
PB1
PB0
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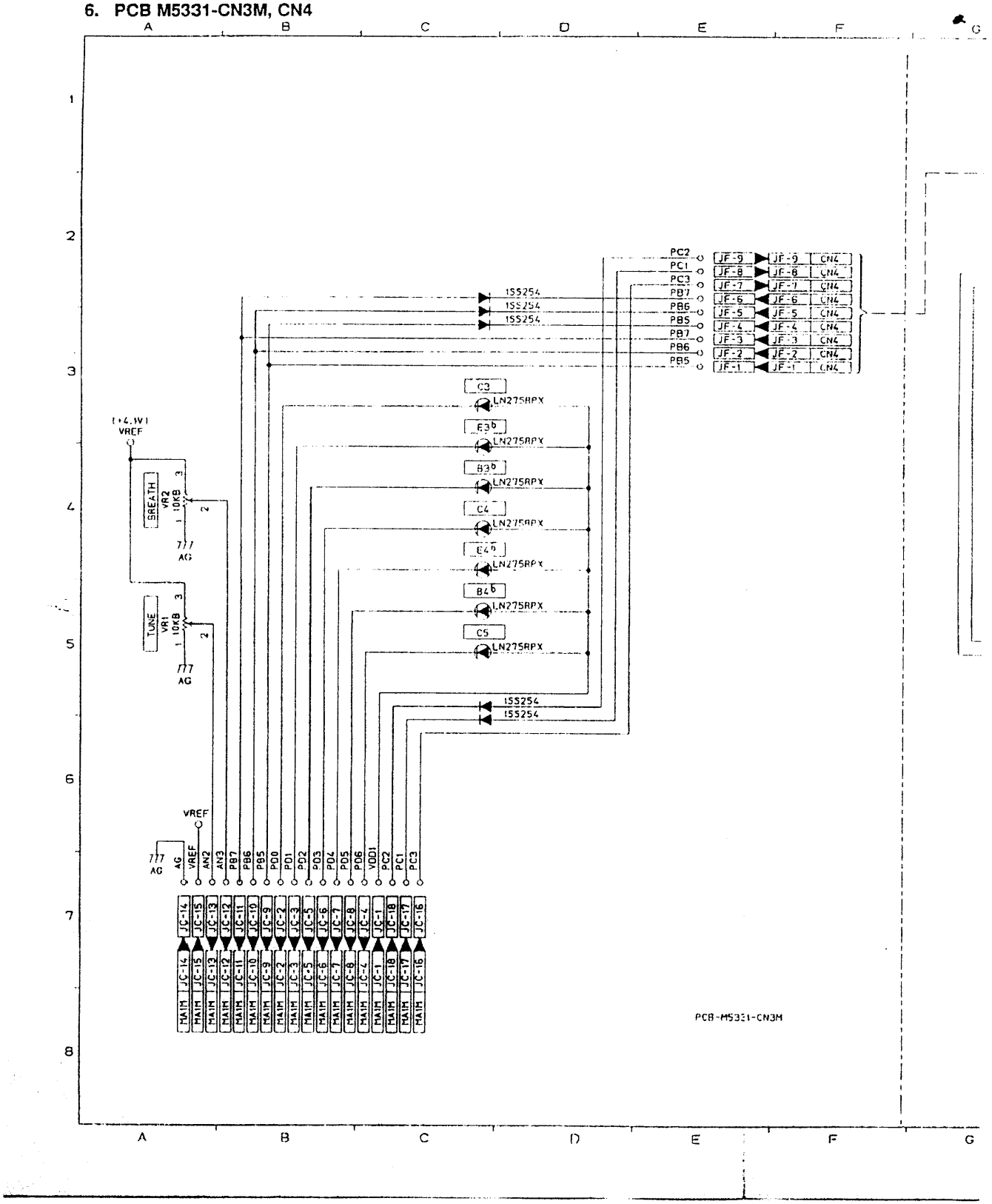
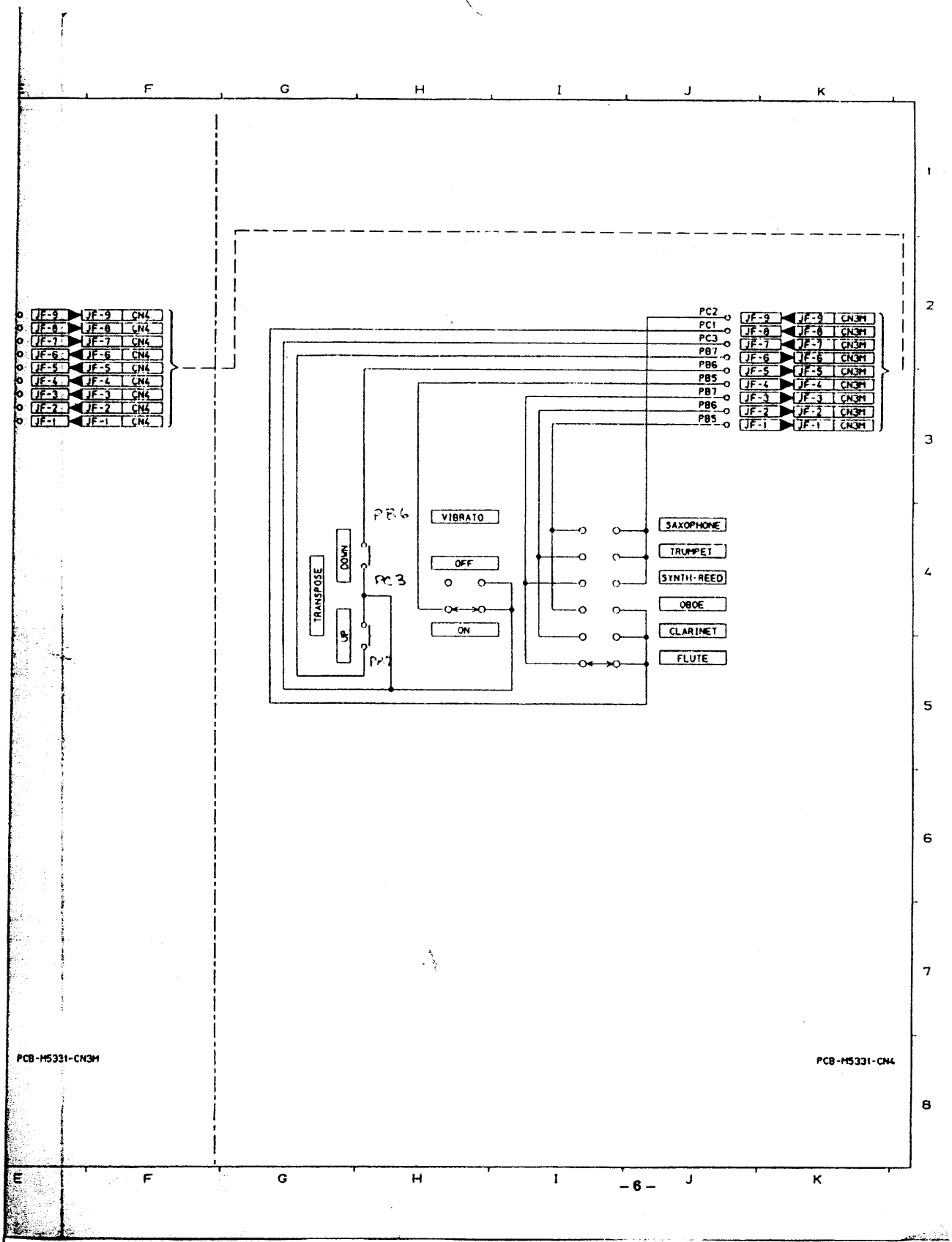
F
E b
D #
C
B
A
PORTAMENTO
L
K
DOWN
UP
PCB-M5331-CN2
PCB-M5331-CN1M

(6)

## 6. PCB M5331-CN3M, CN4



(6A)


F
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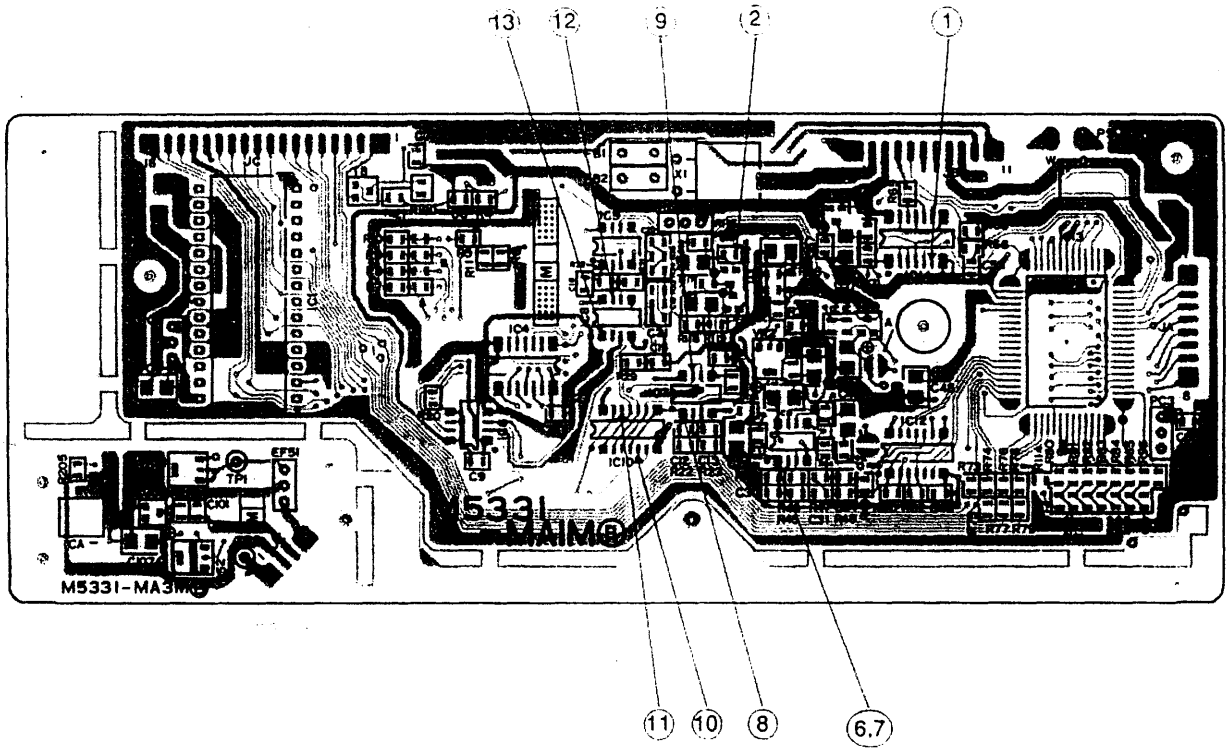
JF-9 JF-9 CN4
JF-8 JF-8 CN4
JF-7 JF-7 CN4
JF-6 JF-6 CN4
JF-5 JF-5 CN4
JF-4 JF-4 CN4
JF-3 JF-3 CN4
JF-2 JF-2 CN4
JF-1 JF-1 CN4
PC2
PC1
PC3
PB7
PB6
PB5
PB7
PB6
PB5
JF-9 JF-9 CN3M
JF-8 JF-8 CN3M
JF-7 JF-7 CN3M
JF-6 JF-6 CN3M
JF-5 JF-5 CN3M
JF-4 JF-4 CN3M
JF-3 JF-3 CN3M
JF-2 JF-2 CN3M
JF-1 JF-1 CN3M
PB6
PC3
PC2
TRANSPOSE
DOWN
UP
VIBRATO
OFF
ON
SAXOPHONE
TRUMPET
SYNTH-REED
OBOE
CLARINET
FLUTE
PCB-M5331-CN3M
PCB-M5331-CN4

## PCB VIEW & MAJOR CHECKPOINTS



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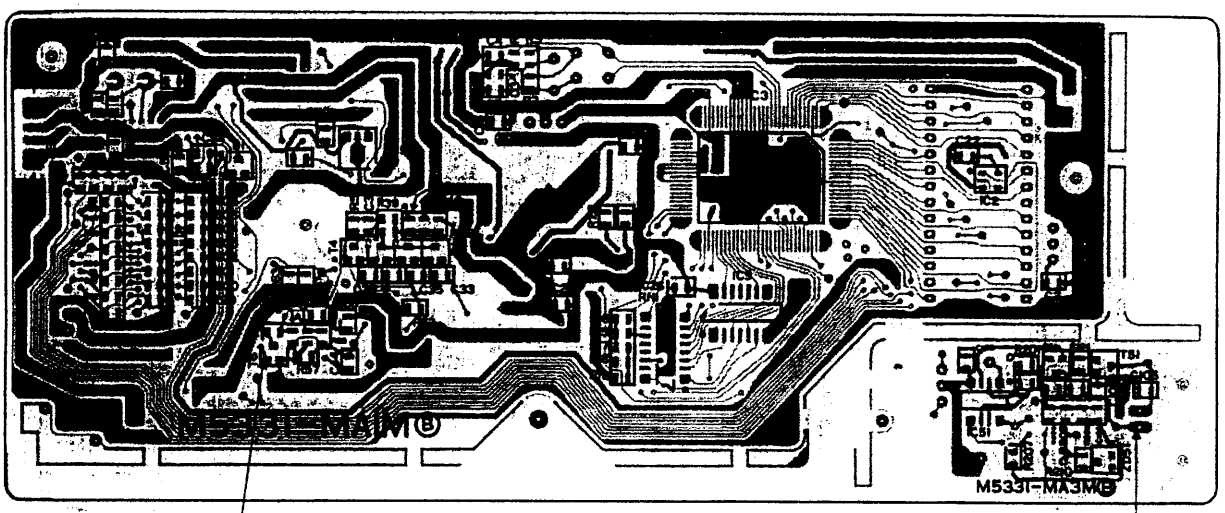
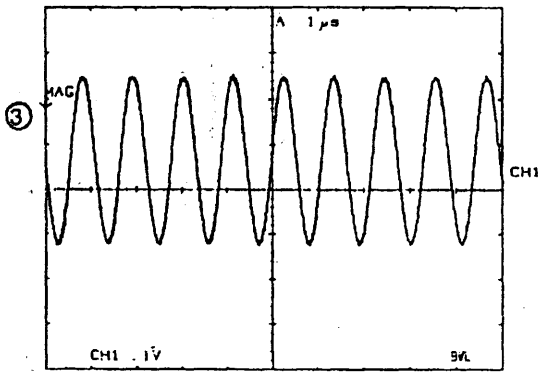
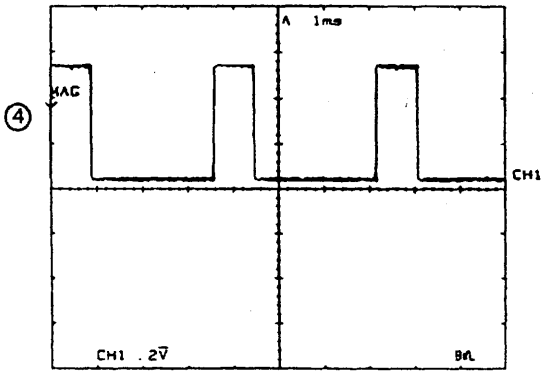
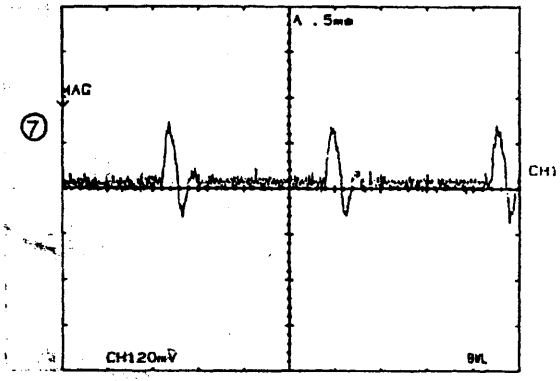

M5331-MA3MB
4,5
3



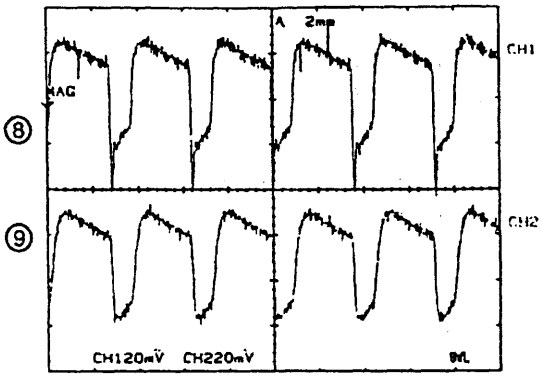

③ Breath Sensor Oscillation signal
Connector CA-2
At no breath




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

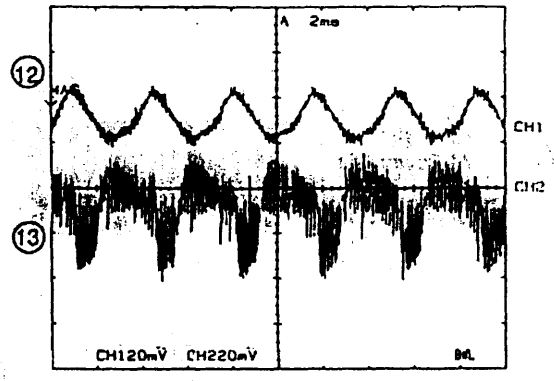



⑦ VCF output
IC11 pin 1
Tone: Oboe, No key press




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

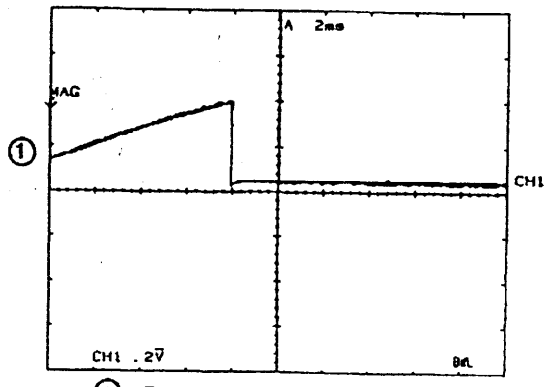
⑨ Sampling Circuit output
IC7 pin 7
Tone: Saxophone, No key press



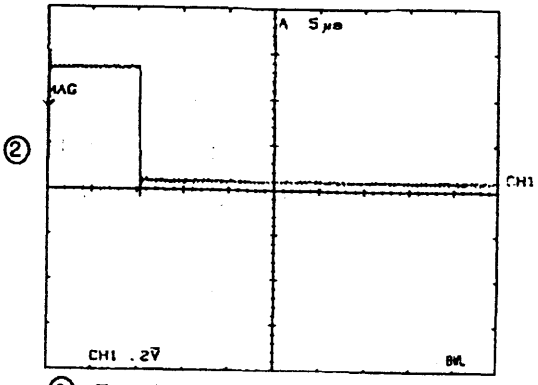

⑫ Sample/Hold circuit output
IC9 pin 1

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

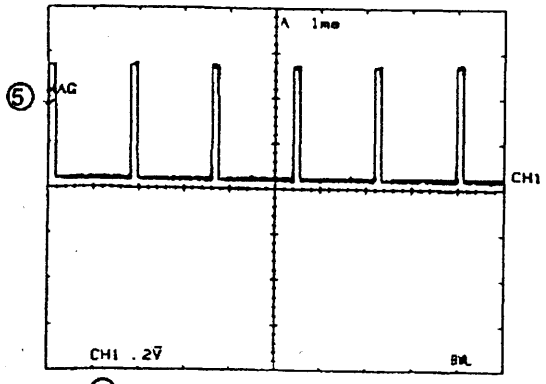
## MAJOR WAVEFORM



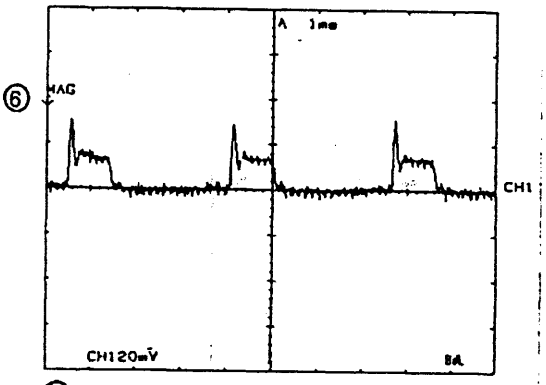

① Reset signal
IC14 pin 6
At Power ON



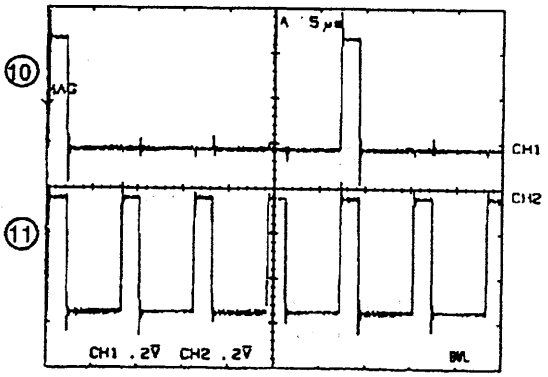

② Reverb Mute signal
IC 13 pin 15
AT Power ON




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



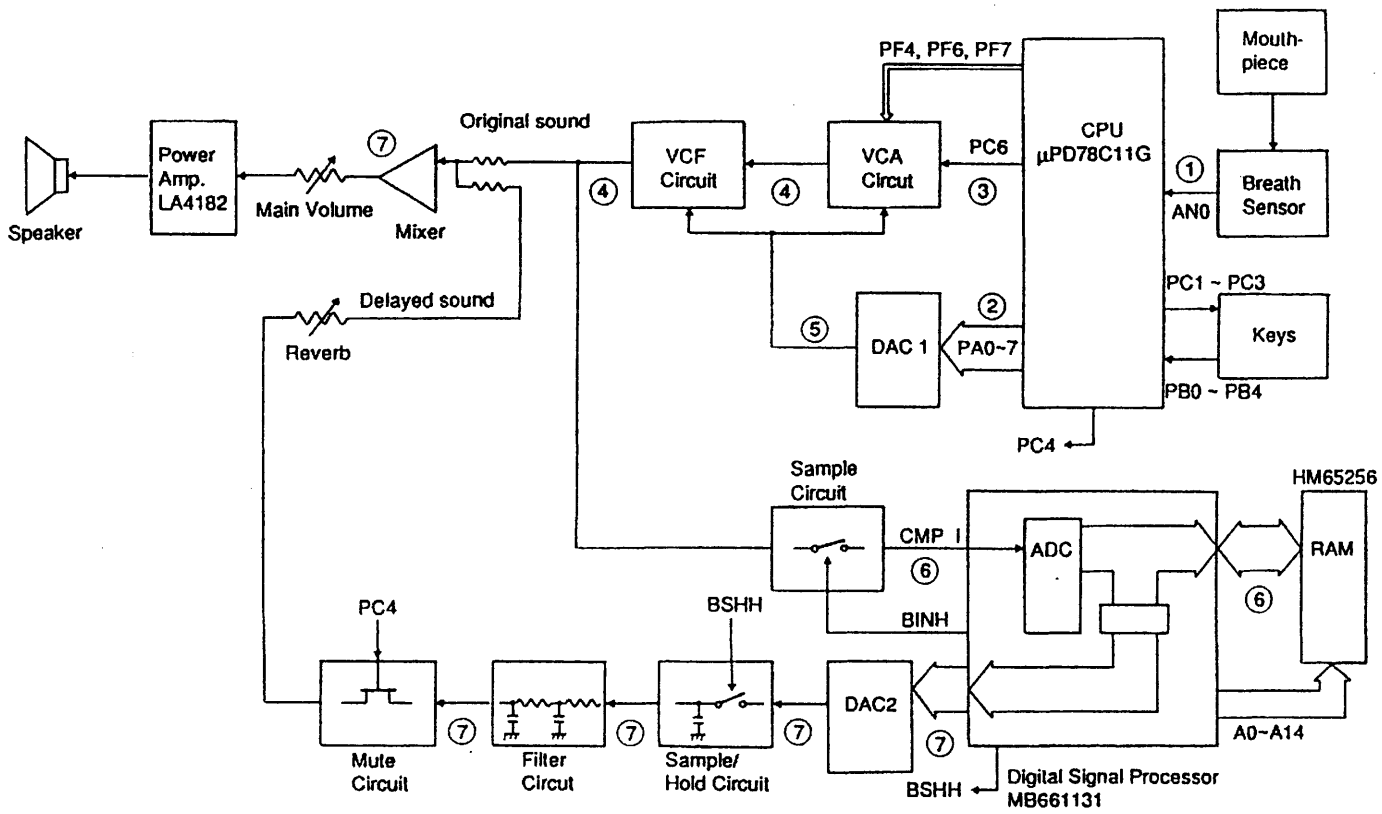

⑥ VCF output
IC11 pin 1
Tone: Saxophone, No key press




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.

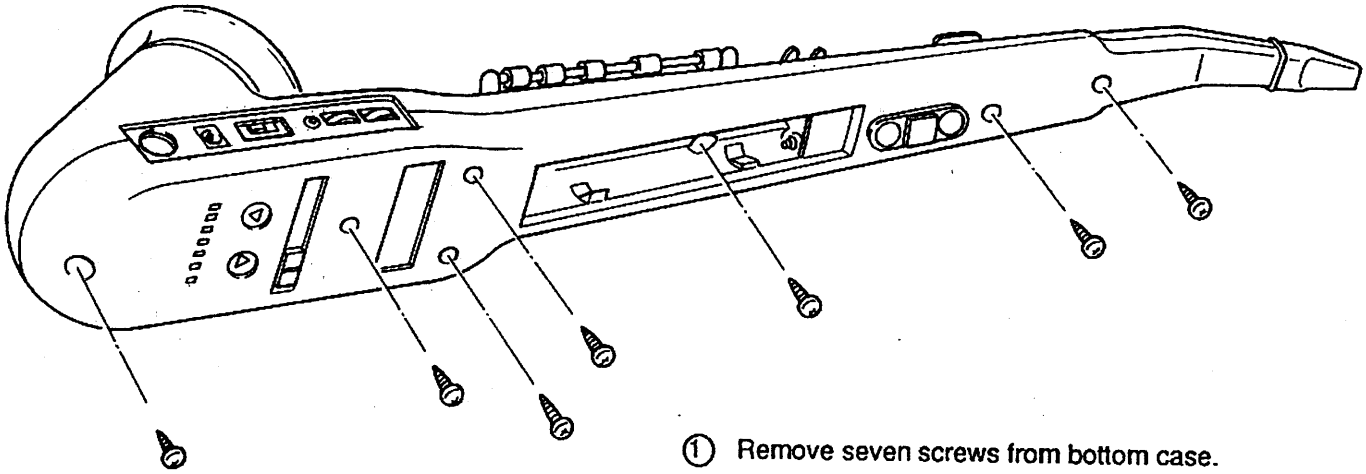
④ The sound signal is amplified and filtered in VCA (Voltage Controlled Amplifier) and VCF (Voltage Controlled Filter) whose amplitude and cutoff frequency depend upon control voltage from DAC1.

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.

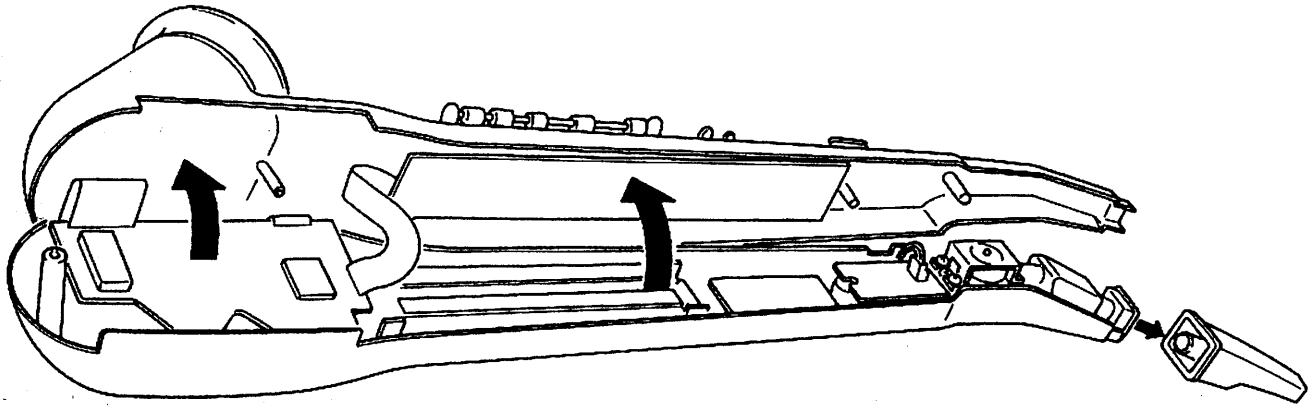
⑦ Changing the reading speed of RAM data, the sound data is delayed, DAC'd, filtered, and mixed with the original sound in Mixer.

## DISASSEMBLY & CHECKING METHOD



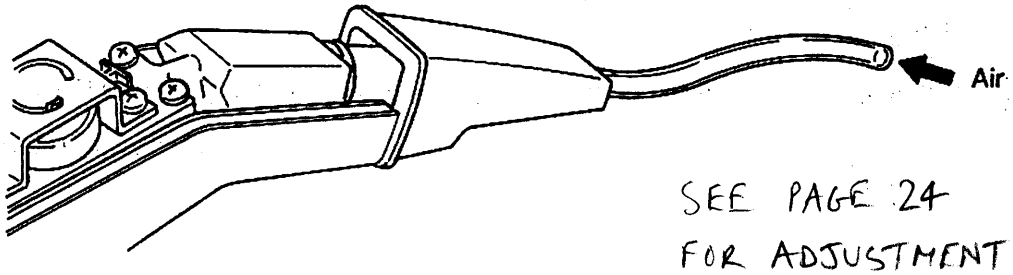
① Remove seven screws from bottom case.

② Remove the mouthpieth and open the top case

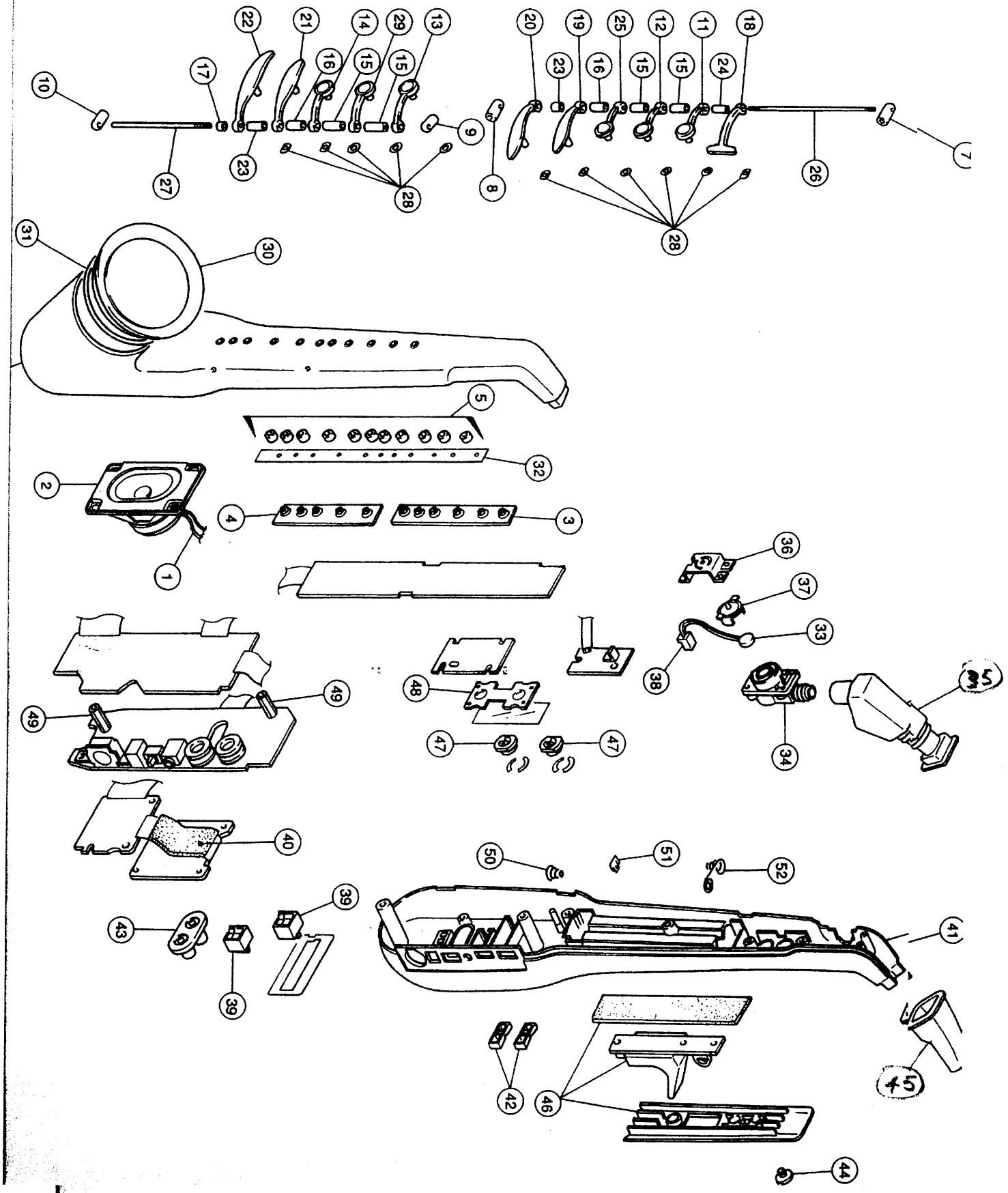


③ Insert a silicon rubber tube (code No. 6914 7972) in mouthpiece and set the mouthpiece on bottom cover.

④ Waveforms can be observed with oscilloscope by blowing the tube.




SEE PAGE 24
FOR ADJUSTMENT POT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## CPU (μPD78C11G)

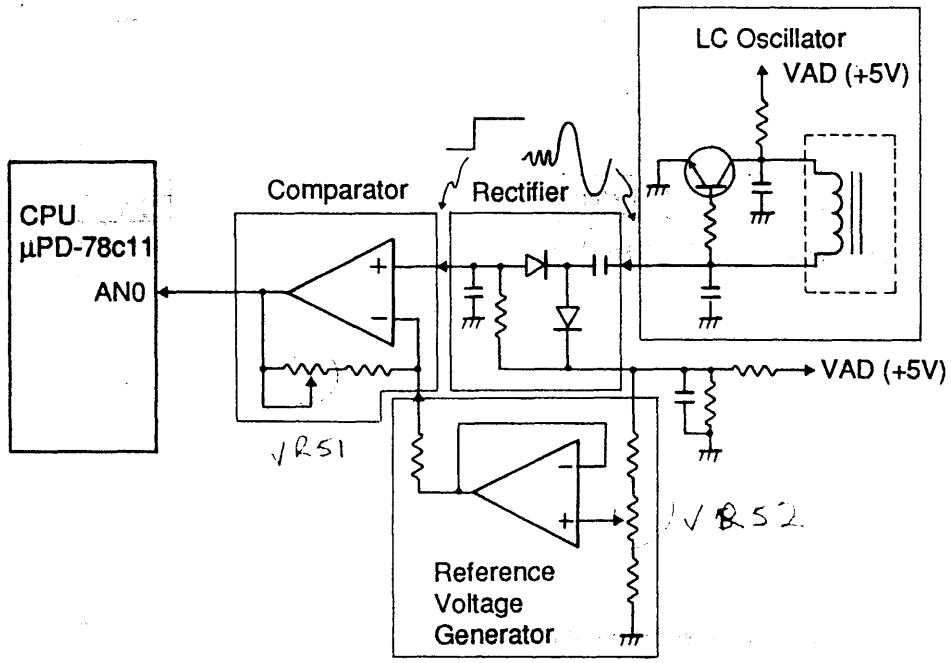
CPU detects the pressed keys and breath strength. The following is pin function of the LSI.

| 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.<br>AN0, AN1 — Input from Breath Sensor block<br>AN2 — Input from Tuning pot<br>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 |

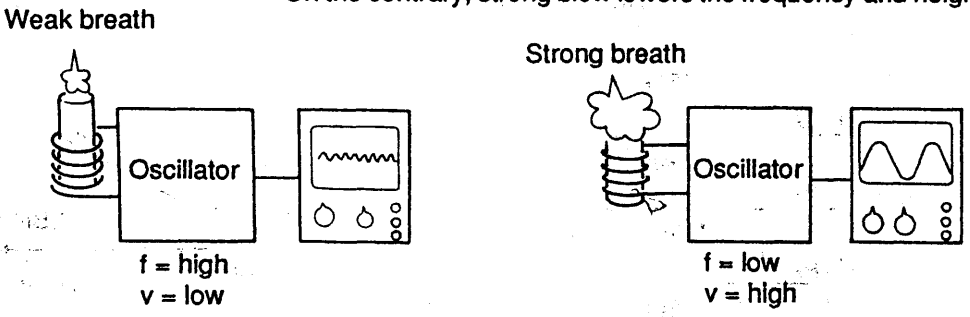
<table>
<tr><td>45 ~ 48</td><td>PF4 ~ PF7</td><td>Out</td><td>PF4, PF6, PF7 — Tone control signal in VCA (Voltage Controlled Amplifier) filter. In accordance with set tone, the voltage level of these terminals change the cutoff frequency of the sound.<br><br>PF5 — Resonance control signal in VCF (Voltage Controlled Filter). When the terminal is Low, resonance effect is given to the sound.<br><br><table><tr><th>Tone</th><th>PF4</th><th>PF5</th><th>PF6</th><th>PF7</th></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></td></tr>
<tr><td>49 ~ 55</td><td>PD0 ~ PD6</td><td>Out</td><td>LED drive signals</td></tr>
<tr><td>56</td><td>PD7</td><td>Out</td><td>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.</td></tr>
<tr><td>57</td><td>$\overline{\text{STOP}}$</td><td>—</td><td>Not used. Connected to VDD</td></tr>
<tr><td>58</td><td>VDD</td><td>In</td><td>+5 V source</td></tr>
<tr><td>59 ~ 2</td><td>PA0 ~ PA7</td><td>Out</td><td>Digitized breath strength data</td></tr>
</table>

A2504256

## BREATH SENSOR BLOCK



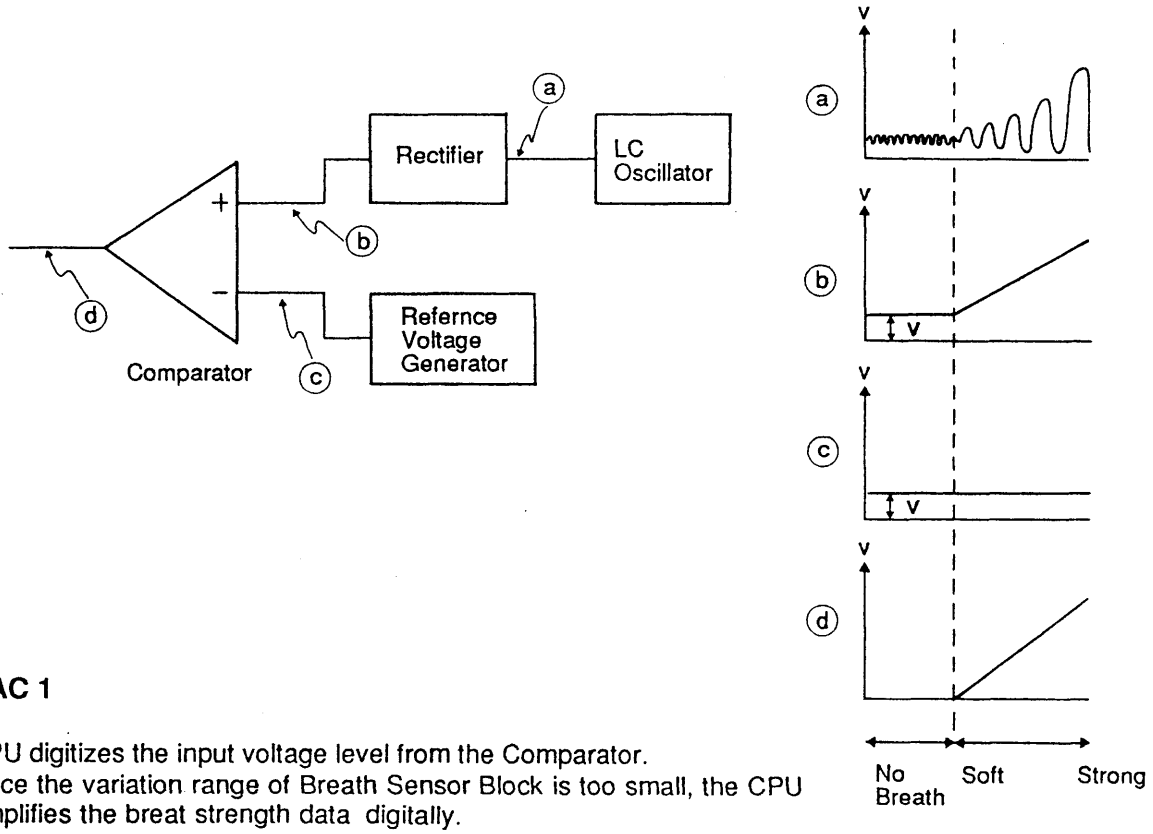

① LC Oscillator . . . . . An oscillator which is composed of a coil and capacitors.
As the core in the coil moves by the breath, inductance of the coil varies by the blowing strength.
Variation of the inductance changes the frequency and peak to peak voltage of the oscillation signal.
Namely, when the 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.




② Rectifier . . . . . Alter the oscillation signal into a DC voltage. Stronger the breath, higher the output voltage.

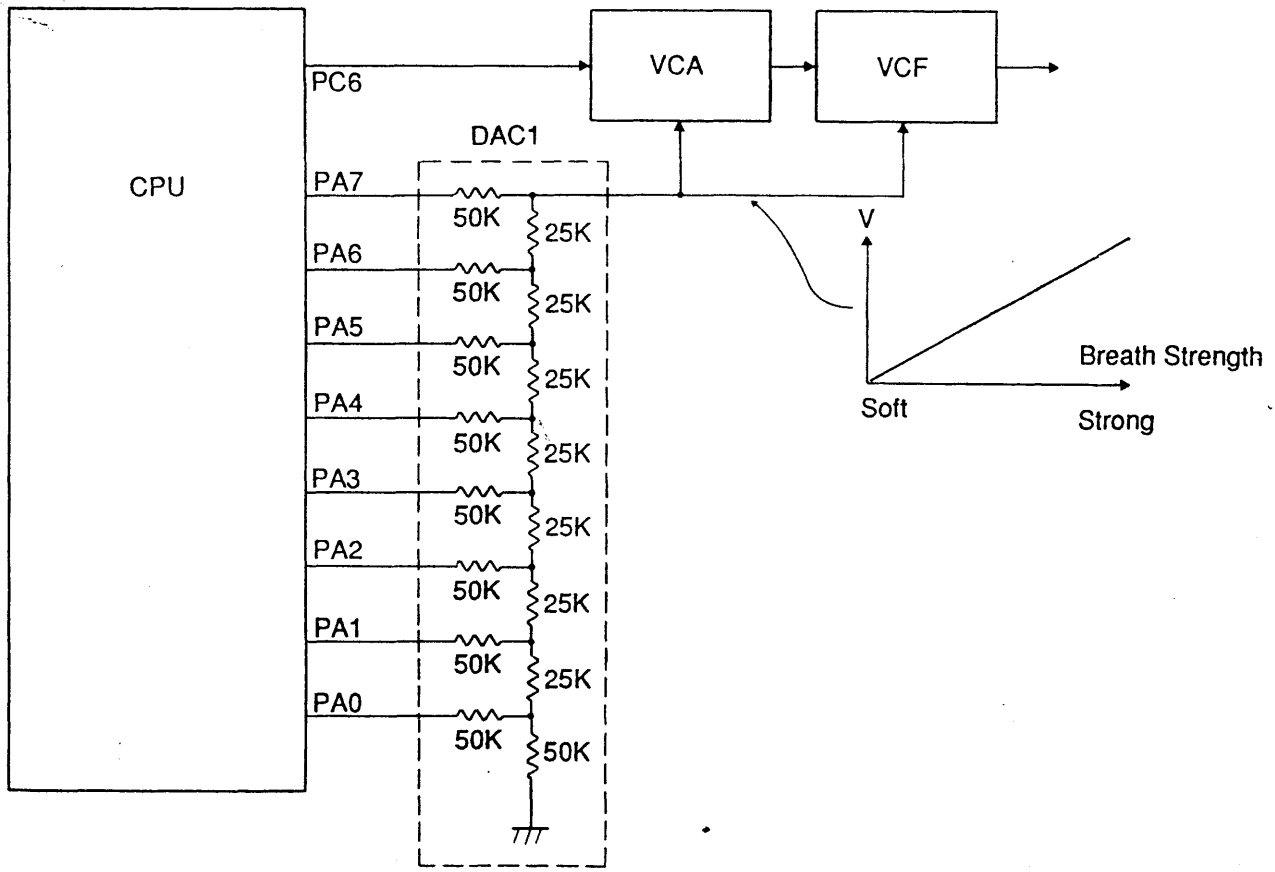
③ Reference Voltage Generator . . . . . Since the LC Oscillator is always oscillating, the Rectifier outputs voltage even when no breath is blown. Reference Voltage Generator provides a voltage which is equivalent to the Rectifier output at no blowing in order to descriminates whether breath is blown 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.



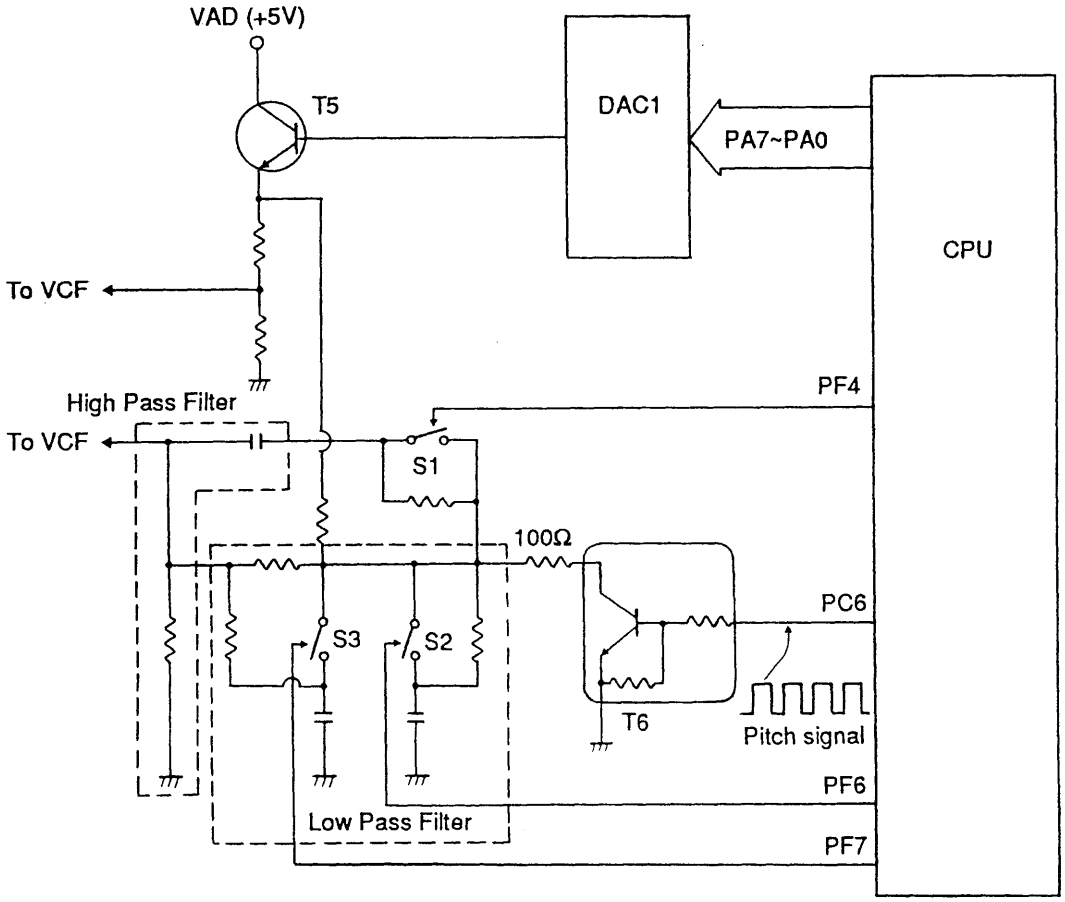

## DAC 1

CPU digitizes the input voltage level from the Comparator.
Since the variation range of Breath Sensor Block is too small, the CPU amplifies the breat 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.



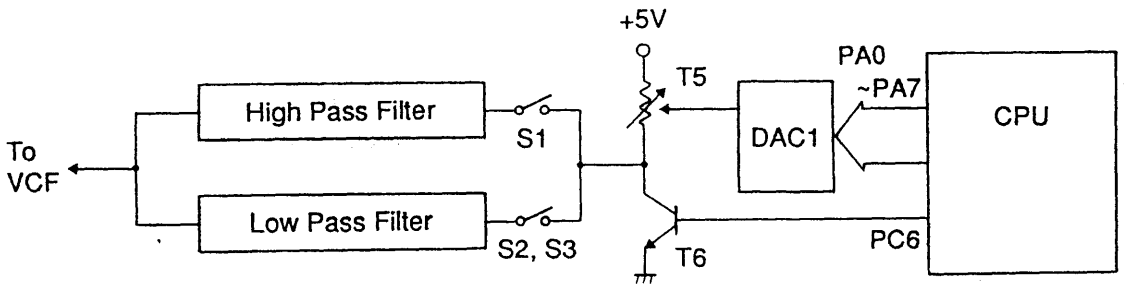
## VCA (Voltage Controlled Amplifier)

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)

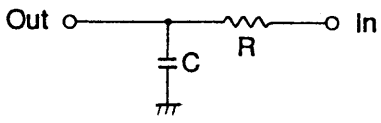
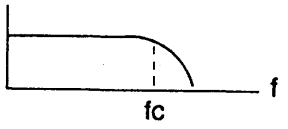



Fig. A

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

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



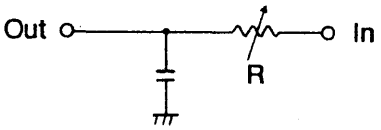




Fig. B

Using a variable resistor changes the cutoff frequency fc randomely.

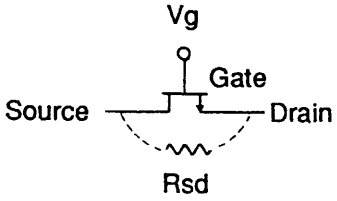



Fig. C

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

Vg = high . . . . Rsd = small
Vg = low . . . . . Rsd = large

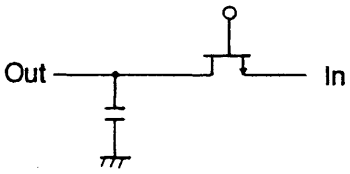
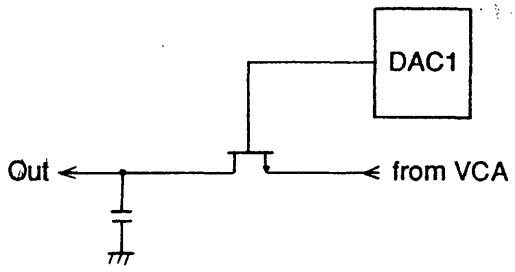
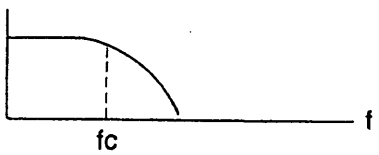



Fig. D

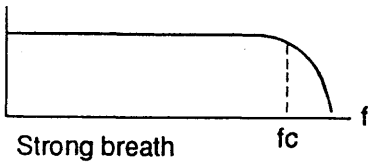
Therefore, putting a FET instead of a variable resistor makes the same circuit as figure B.

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.



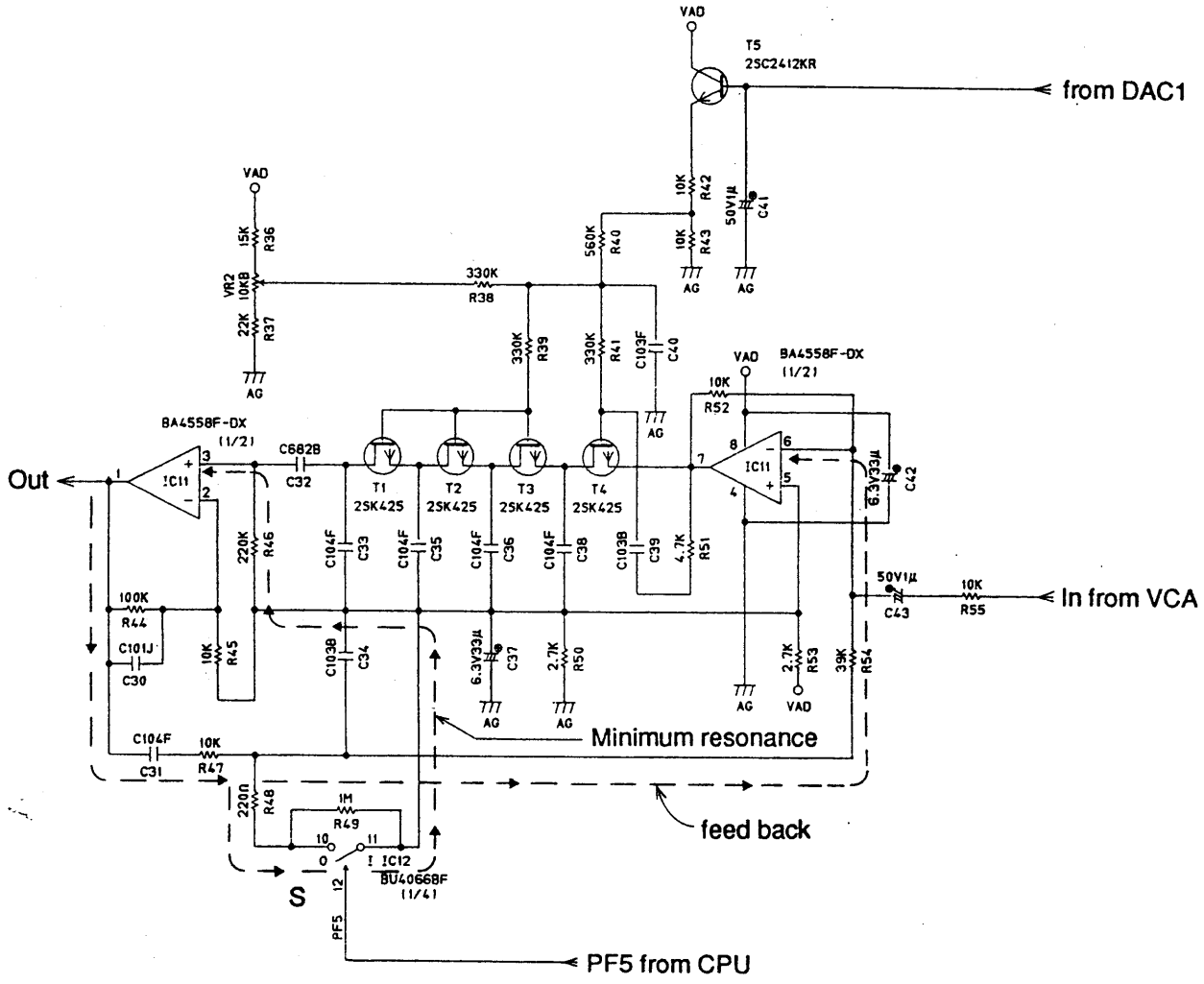




Weak breath

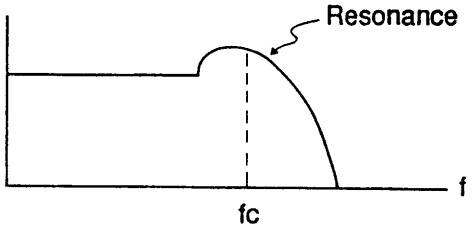



Strong breath

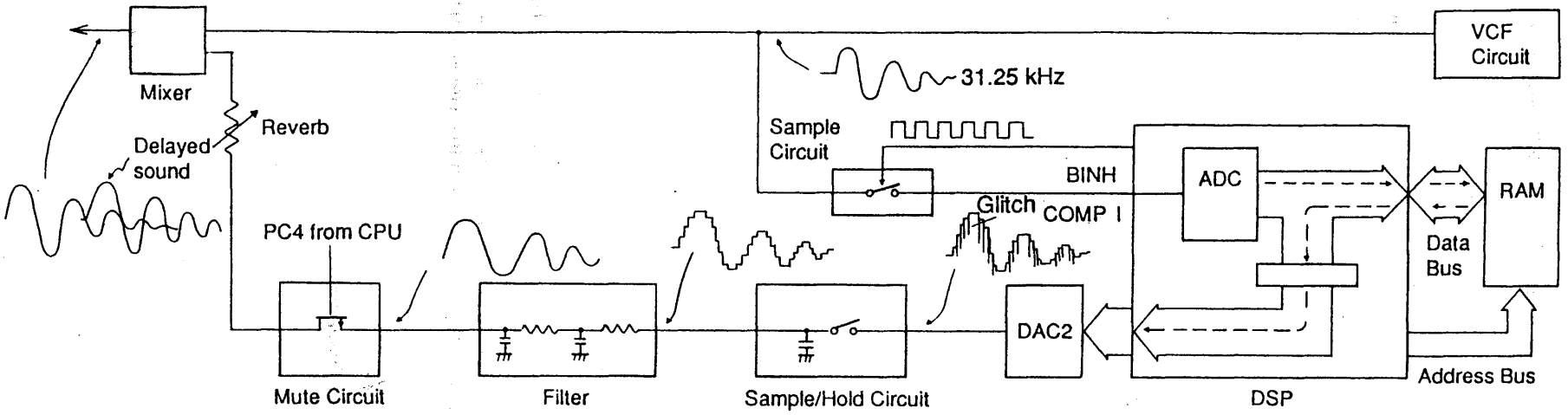
The actual VCF Circuit is a four-stage low pass filter which makes sharp drop of cutoff frequency response.




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 varing address signals' frequency in order to delay the sound signal.

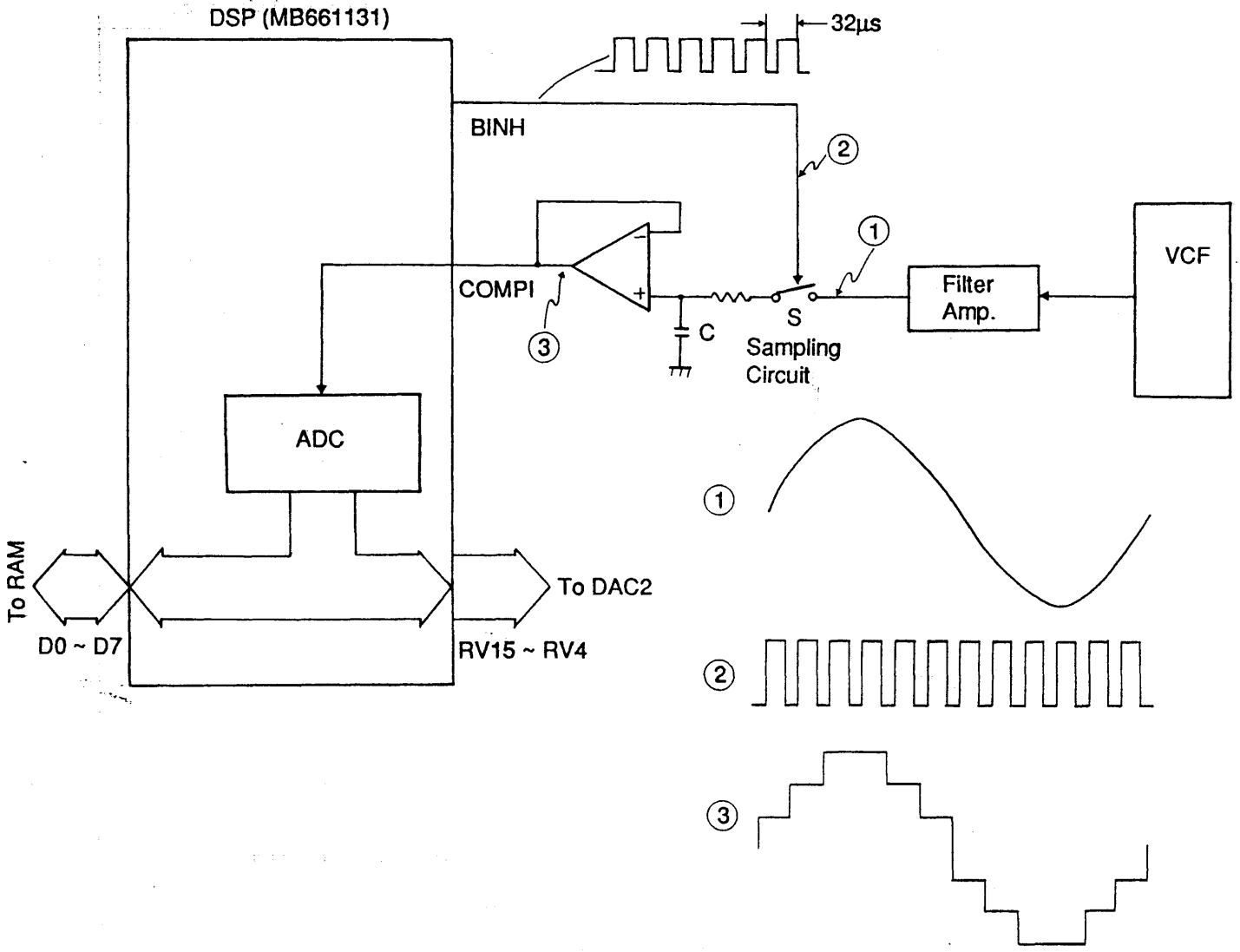
Since DAC2 output is stepped waveform containing glitch noise, Sample/Hold Circuit removes the glitch and Filter smoothes the stepped waveform.

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.



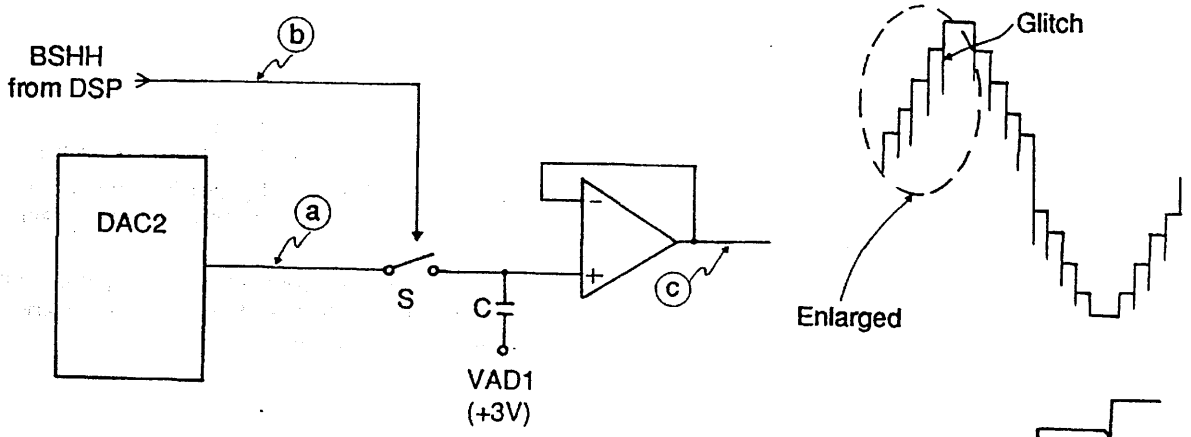

Sound waveform from VCF is filtered and amplified in the Filter Amp block in order to sample the waveform effectively.
DSP provides 31.25 KHz pulse from BINH terminal. The switch S turns on or off when BINH is High or Low respectively.
While the switch is ON, the voltage level of the waveform enters 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.<br>High . . . . Static RAM<br>Low . . . . . Dynamic RAM<br>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<br>54 ~ 60 | RV4 ~ RV8<br>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.<br>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.<br>Reverb time is determined by the voltage levels of these terminals. |
| 78 | VDD2 | In | +5V source |
| 81, 82<br>85 ~ 89<br>91 ~ 94<br>96 ~ 98<br>100 | AD14, AD12<br>AD7 ~ AD5<br>AD9 ~ AD3<br>AD2 ~ AD1<br>AD0 | Out | Address bus for the external RAM.<br>Stored data in RAM are read in various delay time by varing address signals' frequency. |
| 83, 89 | MRAS, MMCS | Out | External RAM chip select signals.<br>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.

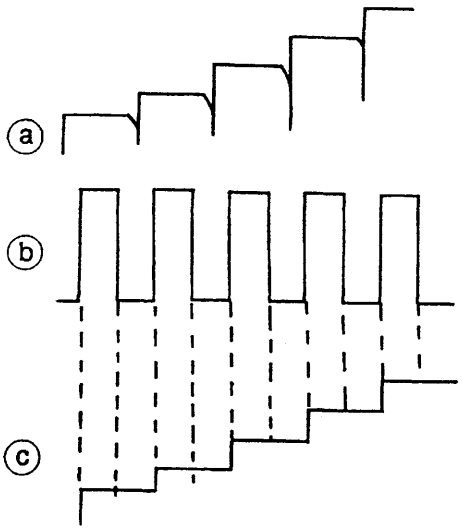



DSP outputs a sampling signal BSHH in each step of the DAC2 output.

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.

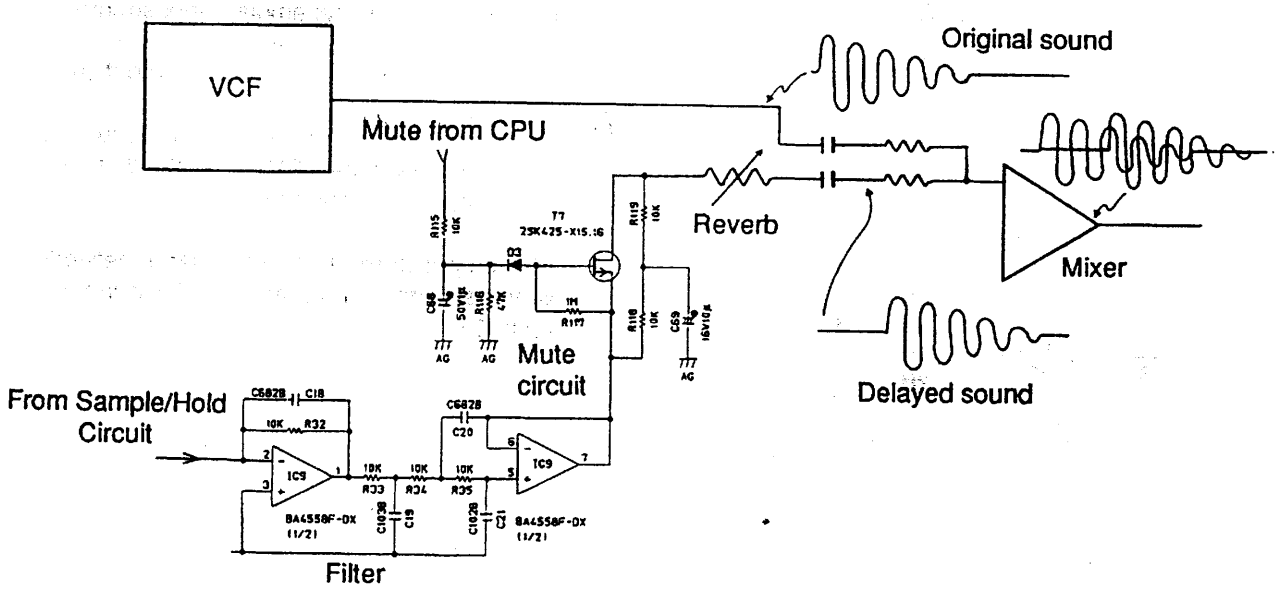
At the end of one step where the glitch appears, signal BSHH falls to Low level. The switch S turns off shutting the glitch out. While switch turns off, capacitor C discharges so that the output of the switch keeps the same voltage level.

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




## FILTER, POWER ON MUTE, MIXER CIRCUITS

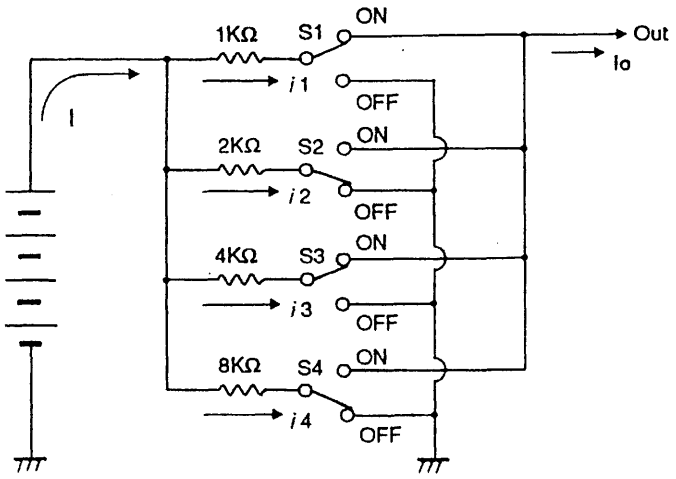
The stepped waveform is smoothed by the Filter.
At Power ON, CPU rises the signal MUTE turning FET T7 off. The power on reverb noise is eliminated.
Delayed sound signal from DAC2 is then mixed with the VCF output by Mixer.



## 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.

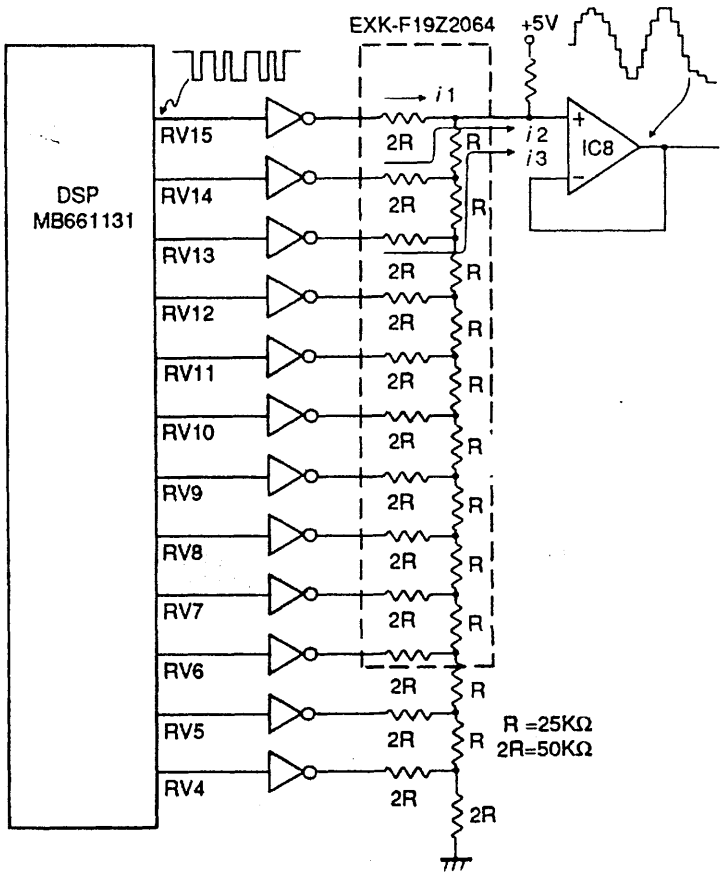



In the left figure, if the current *I* from the battery is 1.5 [A], *i1* =0.8 [A], *i2* =0.4 [A], *i3* =0.2 [A], and *i4* =0.1 [A] as they pass through 1K, 2K, 4K, and 8K ohm resistors respectively.
When all the switches are OFF, the output current *Io* is 0 [A] but, if switches S1 and S3 are ON, the output current will be;

$$Io = i1 + i3 = 1 \text{ [A]}$$

If all the switches are ON;
$Io = i1 + i2 + i3 + i4 = 0.1 + 0.2 + 0.4 + 0.8 = 1.5$ [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 *i1* to be flowed. If RV15 is High, the current does not flow.

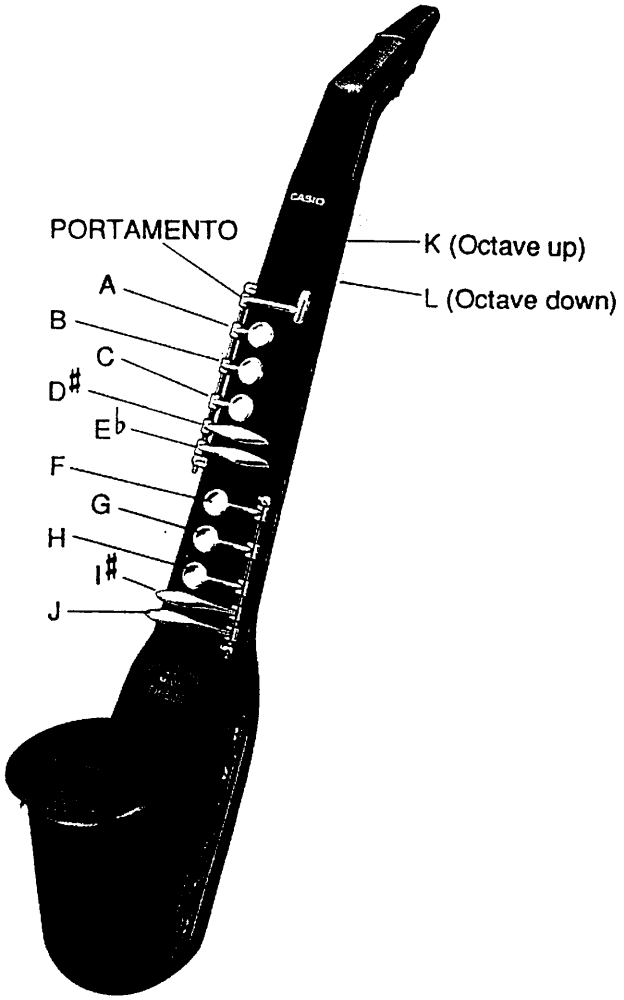
Since the DSP output current is too small to drive the DAC, the inverters amplify the current.

R-2R networked resistors halve the current in each junction. For example, suppose current *il* is 10 [mA], *i2* is 5 [mA], *i3* 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 *Io* from ladder network is transformed in voltage level by the op amp IC8.

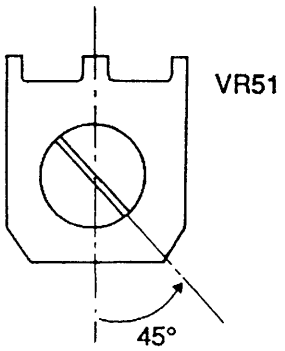
## KEY AND SWITCH MATRIX

| | PB0 | PB1 | PB2 | PB3 | PB4 | PB5 | PB6 | PB7 |
|---|---|---|---|---|---|---|---|---|
| PC1 | | G | H | 1# | J | OBOE | CLARINET | FLUTE |
| PC2 | | F | Eb | 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 ± 0.05V.
5. While it is not blown, adjust VR-51 for the meter reading; 1.00V ± 0.05V.
6. Repeat the above procedures 4 and 5.

## TROUBLESHOOTING TABLE

| Trouble | Faulty Block | Checkpoint |
|---|---|---|
| No Powr ON<br>(TUNING lamp does not light at all) | Power Circuit | T1 collector voltage (+9V)<br>T4 emitter voltage (+5V)<br>T5 emitter voltage (+5V) |
| | Power switch | Switch contact |
| | Power jack | |
| | CPU (μPD78C11G-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 | RNK | |
|---|---|---|---|---|---|---|---|---|
| | 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 | MCR10EZHG253 | 7 | 20 | 21 | C | |
| O* | 2795 2268 | Chip resistor | MCR10EZHG503 | 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 | RNK | |
|---|---|---|---|---|---|---|---|---|
| | 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 | |
| O* | 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 | MCR10EZHJ272 | 1 | 20 | 3 | C | |
| | 2792 0209 | Chip resistor | MCR10EZHJ104 | 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 | |
| O* | 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 | |
| O* | 2360 1232 | Zener diode | RD7.5ESB1-T1-T | 1 | 20 | 9 | B | |
| | 2390 0378 | Diode | 1SR139-100T-32-T | 1 | 20 | 11 | B | |
| | 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 | |
| | 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 | |
| | 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 | |
| | 2818 0446 | Ceramic capacitor | RT-HE40TKYB101K-T | 3 | 20 | 3 | C | |
| O* | 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
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C: Others
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| 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 | |
| | 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** | | | | | | | |
| | 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 | MCR10EZHJ101 | 10 | 20 | 3 | C | |
| | 2792 0462 | Chip resistor | MCR10EZHJ473 | 2 | 20 | 3 | C | |
| | 2792 0470 | Chip resistor | MCR10EZHJ102 | 1 | 20 | 3 | C | |
| | 2792 0799 | Chip resistor | MCR10EZHJ472 | 1 | 20 | 3 | C | |
| | 2792 0831 | Chip resistor | MCR10EZHJ103 | 1 | 20 | 3 | C | |
| | 2792 0861 | Chip resistor | MCR10EZHJ474 | 1 | 20 | 4 | C | |
| | 2792 0888 | Chip resistor | MCR10EZHJ334 | 3 | 20 | 3 | C | |
| | 2792 0942 | Chip resistor | MCR10EZHJ332 | 1 | 20 | 3 | C | |
| | 2792 1019 | Chip resistor | MCR10EZHJ564 | 2 | 10 | 9 | C | |
| | 2792 1043 | Chip resistor | MCR10EZHJ223 | 1 | 20 | 3 | C | |
| | 2795 0273 | Chip resistor | MCR10EZHJ823 | 1 | 20 | 3 | C | |
| | 2795 0532 | Chip resistor | MCR10EZHJ105 | 1 | 20 | 3 | C | |
| | 2795 0728 | Chip resistor | MCR10EZHJ560 | 1 | 20 | 3 | C | |
| | 2795 0742 | Chip resistor | MCR10EZHJ683 | 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 | MCR10EZHJ272 | 1 | 20 | 3 | C | |
| | 2792 0470 | Chip resistor | MCR10EZHJ102 | 1 | 20 | 3 | C | |
| | 2792 0831 | Chip resistor | MCR10EZHJ103 | 2 | 20 | 3 | C | |
| | 2792 1043 | Chip resistor | MCR10EZHJ223 | 1 | 20 | 3 | C | |
| | 2792 1051 | Chip resistor | MCR10EZHJ222 | 1 | 20 | 3 | C | |
| | 2792 1140 | Chip resistor | MCR10EZHJ682 | 2 | 20 | 3 | C | |
| | 2795 0532 | Chip resistor | MCR10EZHJ105 | 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
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| 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 | |

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| 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 | |

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