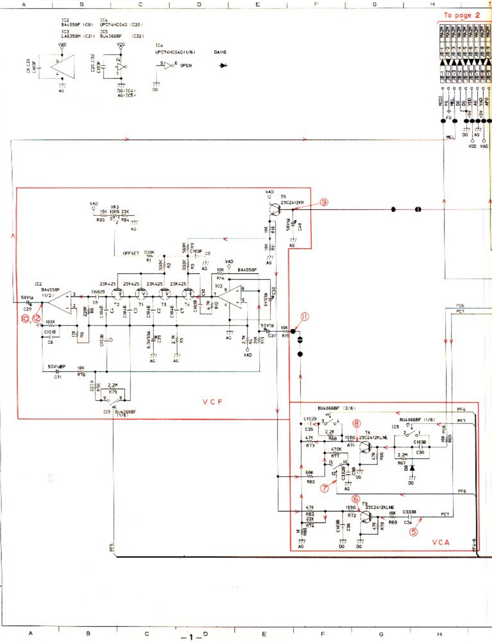
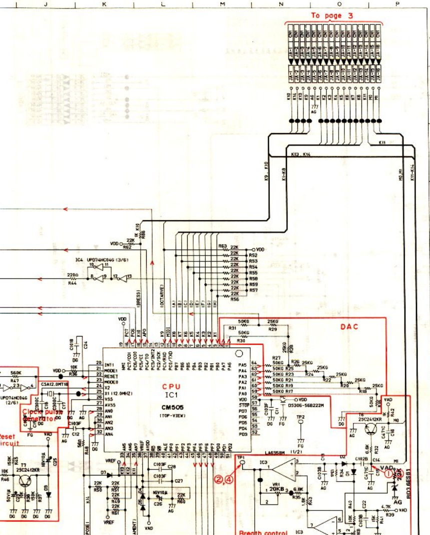
1. SCHEMATIC DIAGRAM

1-1. Main PCB M263-MA1M

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CM505
(TOP-VIEW)
DAC
Breath control circuit
Clock pulse generator
Reset circuit
IC3 LA6358M (1/2)
IC4 UPD74HC04G (3/6)
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T6 2SC2412KR
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D5306-568222M
RD3.6ESB1
VR1 20KB
TP1
TP2
TP6
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(TONE)
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(BRESS)
K11-K14
K13, K14
K11
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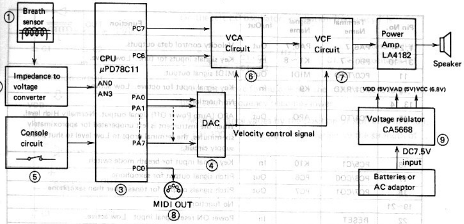
3. BLOCK DIAGARM



① Breath sensor changes the impedance value in accordance with strength of blowing from mouthpiece.

② Impedance to voltage converter converts the impedance value (velocity) into voltage.

③ CPU converts the voltage into digital signals and outputs from terminals PA0 ~ PA7.

④ DAC (Digital to Analog Converter) transforms the digital signals into an analog waveform and outputs the signal to VCA and VCF circuits as velocity control signal.

⑤ In accordance with pressed buttons, CPU outputs appropriate pitch signals from terminal PC6 or PC7.

⑥ VCA (Voltage Controlled Amplifier) amplifies the pitch signals in accordance with the velocity control signal.

⑦ VCF (Voltage Controlled Filter) changes the cutoff frequency of the signals in accordance with the velocity control signal.

⑧ MIDI (Musical Instruments Digital Interface) signal is provided from terminal PC0 to the CPU.

⑨ Voltage regulator IC LA5668 provides the necessary voltages.

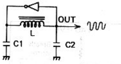
4. CPU (μPD78C11G-CM505)

CPU has internal ROM, RAM and eight ADCs.

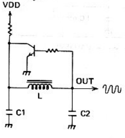
Pin No.	Terminal Name	Signal Name	In/Out	Function
1, 2	PA6, 7	PA6, 7	Out	Velocity control data outputs.
3 ~ 10	PB0 ~ 7	K1 ~ 8	In	Key signals inputs for tune. Low active.
11	PC0/TXD	MIDI	Out	MIDI signal output.
12	PC1/RXD	K9	In	Key signal input for octave. Low active.
13, 14				No function
15	PC4/TO	APO	Out	APO (Auto Power Off) signal output. Normally High level. When the instrument is left unoperated for approximately six minutes, the terminal drops to Low level to shut power supply circuit.
16	PC5/C1	K10	In	Key signal input for breath mode switch.
17	PC6/CO0	PC6	Out	Pitch signal output for saxophone.
18	PC7/CO1	PC7	Out	Pitch signals output for tones other than saxophone
19~21				No function
22	RESET		In	Power ON reset signal input. Low active.
23				No function
24, 25	X2, X1		Out/In	Clock pulse (12MHz) signal output/input.
26	VSS			Digital ground (0V) source.
27	AVSS			Analog ground (0V) source for internal ADCs.
28	AN0	SENCE	In	Breath sensor voltage input. Voltage level from breath sensor is converted into digital data by internal ADC.
29, 30				No function
31	AN3	SENCE	In	Same as terminal AN0.
32	AN4	K14	In	Key signal input for transpose switch. Low active.
33	AN5	K13	In	Key signal input for tone select switch. Low active.
34				No function
35	AN7	K11	In	Key signal input for portament switch. Low active.
36	VREF			Reference voltage (+5V) for internal ADCs.
37	AVDD			+5V source for internal ADCs.
38~44				No function
45	PF4	PF4	Out	Gain control signal for VCA circuit.
46	PF5	PF5	Out	Resonance effect control signal.
47	PF6	PF6	Out	LPF control signal for VCA circuit.
48	PF7	PF7	Out	Gain control signal for VCA circuit.
49~56				No function
57, 58	$\overline{STOP}$, VDD			+5V source for digital logic circuits.
59~64	PA0~5		Out	Velocity control data outputs.

5. BREATH CONTROL CIRCUIT

5-1. Breath Sensor



LC oscillation circuit



DH-100 circuit

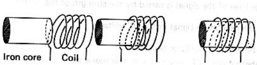
On the left LC oscillator, oscillation frequency f is:

$$f = \frac{1}{2\pi\sqrt{L \cdot \frac{C1 \cdot C2}{C1 + C2}}} \; [\mathrm{Hz}]$$

L: Inductance (H)
C1, C2: Capacitance (F)

From the above formula, when the inductance is large, the oscillation frequency becomes lower.

The inductance varies by the position of iron core in a coil. In DH-100, the core position is varied by the strength of breath.

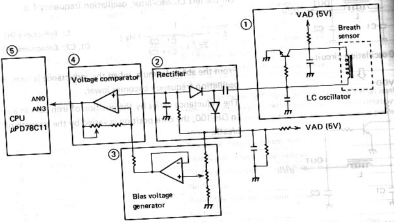


Inductance value :	Min.	<	Medium	<	Max.
Breath :	Strong		Weak		No

Thus, in proportion to the strength of breath, output voltage becomes larger. Also, the oscillation frequency is out of proportion to the breath strength, namely, stronger the breath, lower the frequency.

5-2. **Impedance to Voltage Converter**

The circuit converts impedance (inductance) of breath sensor into voltage level.

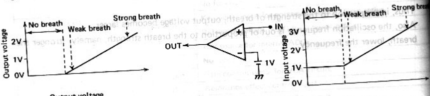


① LC oscillator generates oscillation signal corresponding to inductance value of breath sensor. The output voltage level of the signal is varied by the strength of the breath.

② Rectifier rectifies the oscillation signal into a DC voltage.

③ Even no breath is blown, the oscillator oscillates. To discriminate whether breath is blown or not, this block provides the same voltage as rectifier output at no breath.

④ Voltage comparator outputs DC voltage in accordance with the breath strength as shown below.



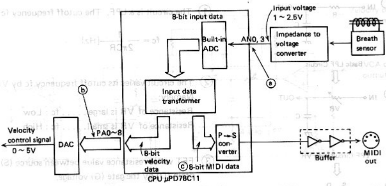
Output voltage

Voltage comparator

Input voltage

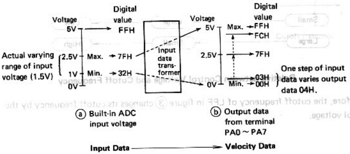
⑤ CPU converts the DC voltage of the comparator into digital signals in the internal ADC (Analog to Digital Converter).

6. VELOCITY CONTROL CIRCUIT



① CPU converts voltage level of breath sensor into 8-bit digital data in the built-in ADC.

② Since the actual varying range of Impedance to Voltage Converter is only from 1.0V to 2.5V (1.5V) input data transformer varies the input data into appropriate output data for velocity and MIDI.



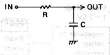
	ⓐ Input Data	ⓒ MIDI Out Data
Ex.	FFH = 1111 1111	0111 1111 = 7FH
	7FH = 1001 0110	0100 1011 = 4BH

(All of input data are shifted 1 bit to the right.)

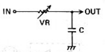
Input Data ——→ MIDI Out Data

7. VCF CIRCUIT

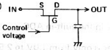
7-1. Principle

① 

Basic LPF Circuit

② 

LPF Circuit with VR

③ 

LPF Circuit with FET

① The circuit is a LPF. The cutoff frequency fc is;

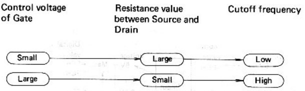
$$fc = \frac{1}{2\pi CR} [Hz]$$

② The circuit varies its cutoff frequency fc by VR. Namely;

Resistance of VR is large . . . . . fc : Low

Resistance of VR is small. . . . . fc : High

③ FET varies resistance value between source (S) and drain (D) by the gate (G) voltage.

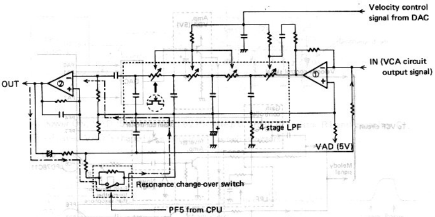


Relative between Control Voltage and Cutoff Frequency

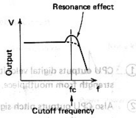
Therefore, the cutoff frequency of LPF in figure ③ changes its cutoff frequency by the control voltage.

7-2. Circuit

The circuit is a low-pass filter whose cutoff frequency is varied by velocity control signal.

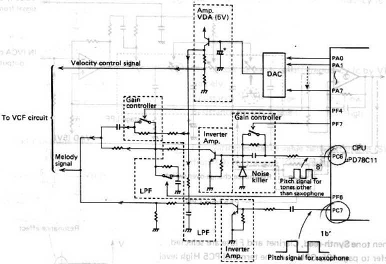


When tone Synth-reed, Clarinet and Flute are selected, (refer to page 12), CPU rises the terminal PC5 High level causing output signal of opamp 2 is fed-back as shown in the figure in order to give sounds the resonance effect.



8. VCA CIRCUIT

The block varies the sound volume in accordance with the voltage level of velocity control signal.



① CPU outputs digital velocity data from terminal PA0 ~ PA7 corresponding to breath strength from mouthpiece.

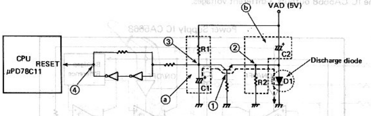
② Also CPU outputs pitch signal from terminal PC6 or PC7 in accordance with selected tones or the notes.

③ DAC converts these digital data into analog signal after amplified by one transistor, the voltage level of DAC output is added to the pitch signal for varying the sound volume in accordance with breath strength.

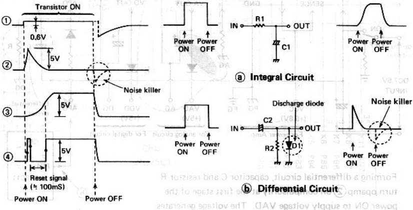
④ Each analog switches for gain controller or LPF are controlled by CPU.
The following table shows the conditions of each terminal in each tone.

CPU terminal	Control function	Tone					
		SAXOPHONE	TRUMPET	SYNTH-REED	OBOE	CLARINET	FLUTE
PF4	Gain	Low	High	Low	Low	Low	Low
PF5	Resonance	Low	Low	High	Low	High	Hgih
PF6	LPF	Low	High	High	Low	Low	Low
PF7	Gain	Low	Low	Low	Low	High	Low

9. RESET CIRCUIT



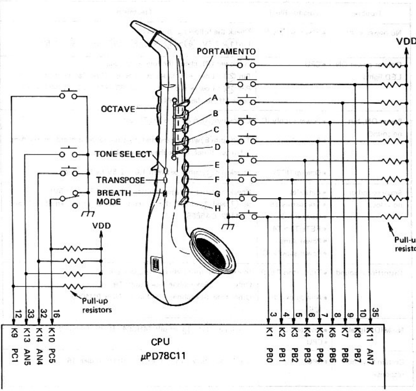
At power ON, VAD (5V) is delayed by the integral circuit of resistor R1 and capacitor C1.
The delayed VAD is shaped in square wave by two inverters.



Time Chart for Reset Circuit

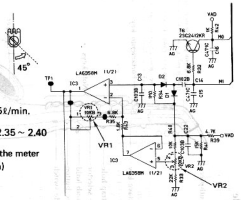
When the power switch is turned off, capacitor C1 should be discharged immediately for next power ON.
While C1 is fully charged, the transistor turns on discharging C1.

11. KEY SCANNING



13. ADJUSTMENTS

13-1. Sensor Sensitivity



① Set VR1 as shown in the right figure.

② Turn power switch ON.

③ Connect a voltmeter to TP1.

④ Blow the instrument with flow rate 15ℓ/min. (When strongest breath)

⑤ Adjust VR2 so that the meter shows 2.35 ~ 2.40

⑥ Stop blowing and adjust VR1 so that the meter shows 0.55 ~ 0.60V (When no breath)

⑦ Reperform the procedure ④ and ⑤.

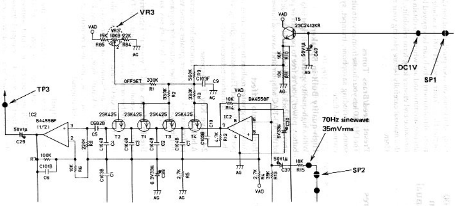
13-2. VCF Offset Voltage

① Open the short-pads SP1 and SP2.

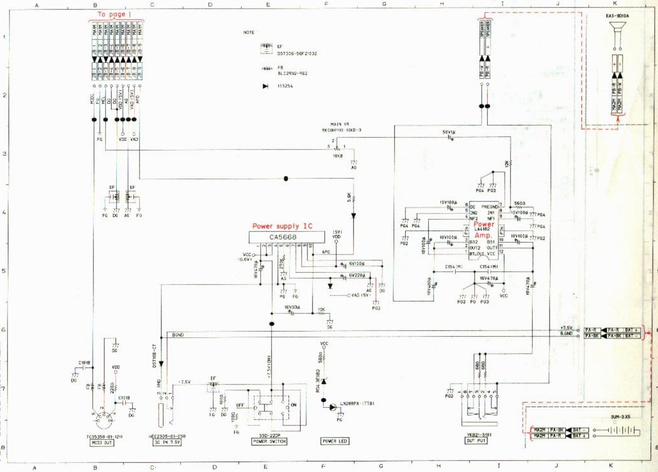
② Set tone Saxophone and supply the following signals to checkpoints.

③ Connect an AC voltmeter to TP3.

④ Adjust VR3 so that the meter shows **50mVrms ±5mV**.



1-2. Sub PCB M263-MA2M



1-3. Console PCBs M263-CN1, 2, 3, 4