

# PSG6&9Voices Card for HITACHI BASIC MASTER LEVEL3

Designed by Sasaji 2021 Rev. 0.2

This is an extension card for HITACHI BASIC MASTER LEVEL3, markII and mark5. This is equipped with 3 PSGs and you can play with up to 9 voices.



## Implementation



## Installation

This card has two modes to control PSG via PIA and to do it via VIA.

<b>PIA mode</b>	<p>This control two PSGs. You can play up to 6 voices.</p> <p>Supported games:</p> <p>Destroy Alien, The Cockpit</p>
<b>VIA mode</b>	<p>This control three PSGs. You can play up to 9 voices.</p> <p>Supported games:</p> <p>Skipper</p>

You can toggle these modes using a I/O port by software, or buttons on the back side.

When specify from BASIC:

PIA: POKE &HFF34, 0

VIA: POKE &HFF34, &H81

## I/O Ports

### PIA Register

Address	D7	D6	D5	D4	D3	D2	D1	D0	R/W	
\$FF30	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0	R/W	PIA Data Register A Write to PSG
\$FF31									R/W	PIA Control Register A
\$FF32	x	x	x	x	x	SEL	BDIR	BC1	R/W	PIA Data Register B PSG Bus Control
\$FF33									R/W	PIA Control Register B

When BDIR = 1 and BC1 = 1, latch register number on PSG.

When BDIR = 1 and BC1 = 0, write data to PSG.

When BDIR = 0 and BC1 = 1, read data from PSG.

SEL : Select PSG1 = 0, Select PSG2 = 1

### PIA/VIA Select

Address	D7	D6	D5	D4	D3	D2	D1	D0	R/W	
\$FF34 (\$FF35)	CLK	x	x	x	x	x	x	V/P	R/W	

V/P ... "0":Select PIA, "1":Select VIA

CLK ... Select clock on PSG "0": 1MHz "1":2MHz

## VIA Register

Address	D7	D6	D5	D4	D3	D2	D1	D0	R/W	
\$FF70	x	x	x	PSG3	PSG2	PSG1	BC1	BDIR	R/W	ORB PSG Bus Control
\$FF71	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0	R/W	ORA Write to PSG
\$FF72 ~ \$FF7F										VIA Register See datasheet of VIA for details.

When BDIR = 1 and BC1 = 1, latch register number on PSG.

When BDIR = 1 and BC1 = 0, write data to PSG.

When BDIR = 0 and BC1 = 1, read data from PSG.

PSG1:Select PSG1=1

PSG2:Select PSG2=1

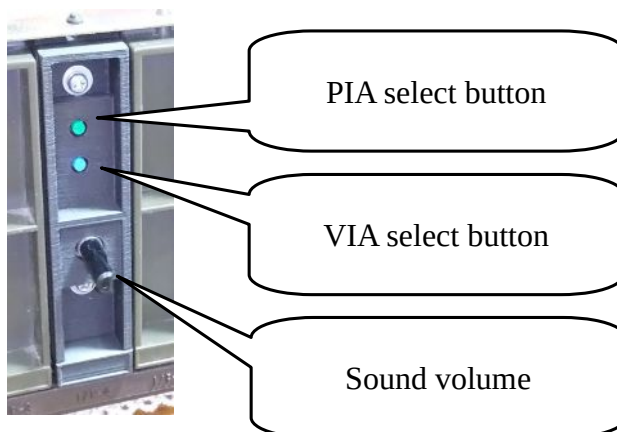
PSG3:Select PSG3=1

## Jumper Pin

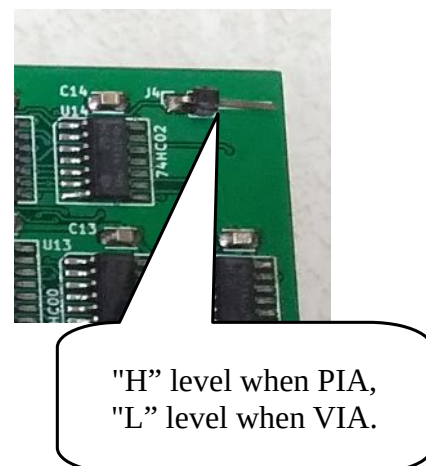
This connect the interrupt signals from PIA and VIA to the CPU side.  
Normally, short the IRQ side (1-2).



## The back cover



## Extended terminal



## Attention

- You cannot adjust the sound using the volume on the main board. Please use it on the back cover.
- The Kanji ROM card and VIA address are duplicated. When select the VIA side, don't read from Kanji ROM or VIA port.
- This board is a prototype. No consideration is given to noise generated during use and deterioration over time.

---

## Parts List

### The main board

Parts Number	Parts Name	Qty.	Description
C1~C16	Ceramic Capacitor	16	0.1uF (Bypass)
C19	Electrolytic Capacitor	1	1uF, 10V~
C100	Electrolytic Capacitor	1	100uF, 16V~ (Bypass)
C101~C103	Electrolytic Capacitor	3	22uF, 10V~ (Coupling)
C104	Electrolytic Capacitor	1	100uF, 10V~ (Coupling)
R1	Carbon Resistor	1	4.7K $\Omega$ , 1/4W~ (Pullup)
R3~R5	Carbon Resistor	3	4.7K $\Omega$ , 1/4W~ (Pulldown)
R6~R10	Carbon Resistor	5	3.3K $\Omega$ , 1/4W~ (Pulldown)
R11~R19	Carbon Resistor	9	470 $\Omega$ , 1/4W~ (Analog sound)
R21~R24	Carbon Resistor	4	1K $\Omega$ , 1/4W~ (Analog sound)
R31~R32	Carbon Resistor	2	10K $\Omega$ , 1/4W~ (Pullup)
U1~U3	PSG (or compatible IC)	3	AY-3-8910, AY-3-8913 or YM2149 DIP40pin or 24pin 600mil * Use the same type IC on U1~U3.
U4	PIA	1	HD6821P or MC6821, DIP40pin 600mil
U5	VIA	1	MCS6522 or R6522, DIP40pin 600mil
U6~U7	CMOS Logic IC	2	74CBT3257C, SOIC16pin
U8	CMOS Logic IC	1	74HC244, SOIC20pin
U9	CMOS Logic IC	1	74HC74, SOIC14pin
U10	CMOS Logic IC	1	74HC139, SOIC16pin
U11	CMOS Logic IC	1	74HC04, SOIC14pin
U12,U14	CMOS Logic IC	2	74HC02, SOIC14pin
U13	CMOS Logic IC	1	74HC00, SOIC14pin
U15,U16	CMOS Logic IC	2	74HC125, SOIC14pin
J1	Jumper	1	Pin header 3pin x1 2.54mm pitch straight
	Jumper Pin	1	To short the J1
J2	Wire cable	3	Connect to button on the sub board (J1)
J3	Wire cable	3	Connect to volume on the sub board (J2)

Optional parts			
J4	Connector	1	Pin header 1pin x1 L angled (PIA/VIA select output)
	IC Socket	5	Use on U1~U5

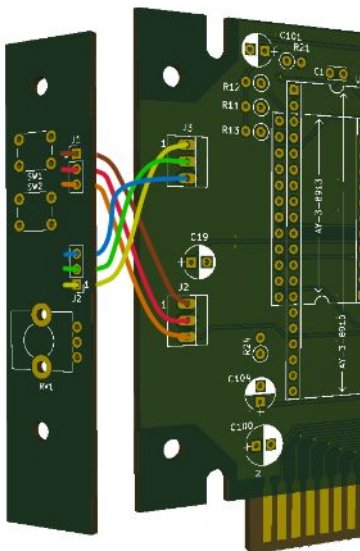
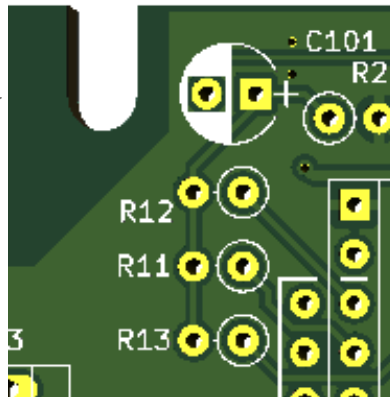
## The sub board

Parts Number	Parts Name	Qty.	Description
SW1,SW2	Push button	2	Tact switch (momentary) Phi is ~3.5mm, and the height of the key top is 4mm or more.
RV1	Volume	1	10K $\Omega$ Alpus RK09 Series
J1	Wire cable	3	Connect to J2 on the main board
J2	Wire cable	3	Connect to J3 on the main board

## Attention to build the board

### The capacitor near screw hole

When attaching the C101, R11, R12, and R13 to the board, bend them slightly to avoid interference with the tapping screw and the adjacent expansion card.



### Connect the main and sub board

Connect the main J2 <-> sub J1 and the main J3 <-> sub J2 with electric wires.

Match the main and sub pin numbers. When connected, the wires will cross each other.

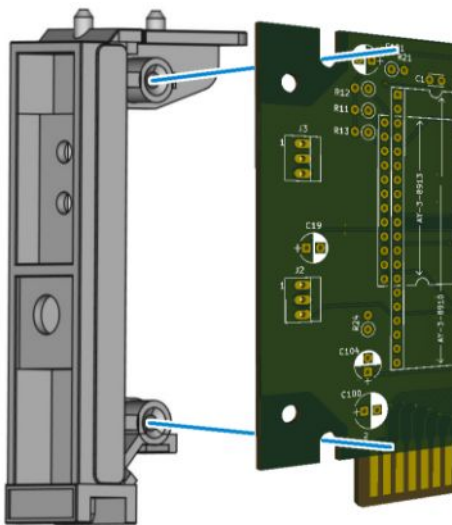
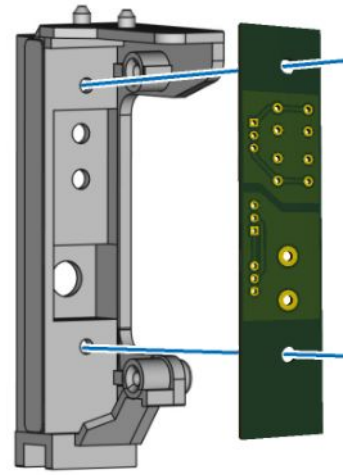


## Attach the sub board to the back cover

Before soldering electronic components, temporarily fix the components to the sub-board and check if they can be attached to the back cover in that state.

If the board does not fit all the way into the cover, cut the lower part of the sub board by about 5 mm.

After confirming the mounting of the board, solder it and fix it to the cover with M3 screws.



## Attach the main board to the back cover

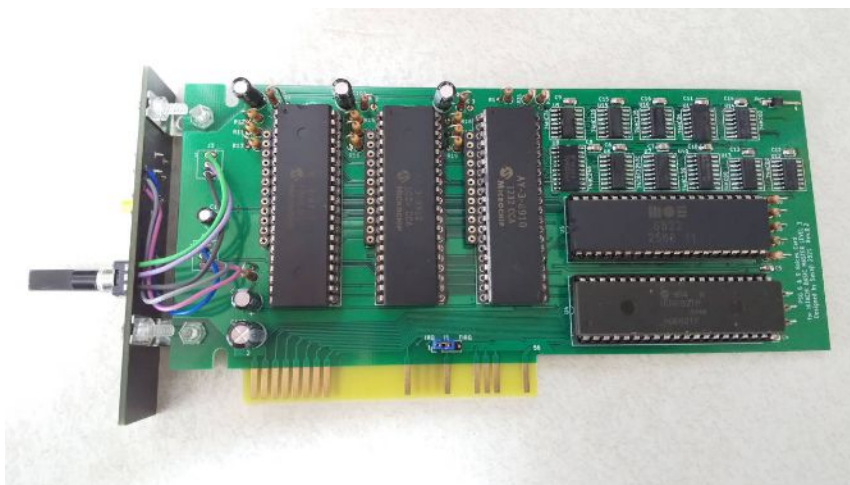
Attach the main board and cover to the positions shown in the figure with tapping screws.

The back cover is fragile, so be careful and do not use too much force when tightening a screw.

## [Extra way] Use the black board as a back cover

The black board is used when you want to use it as a back cover as it is.

Connect to the main board using L-angled brackets and screws.



## No warranty

We are not responsible for any damage caused by this card.

You use this card at your own risk.

## Web

This document and CAD data are opened on the web.

<http://s-sasaji.ddo.jp/bml3mk5/l3psg6n9.htm#board>

Sasaji ([sasaji@s-sasaji.ddo.jp](mailto:sasaji@s-sasaji.ddo.jp))

<http://s-sasaji.ddo.jp/bml3mk5/>

(Twitter: <https://twitter.com/bml3mk5>)