

# Music Computer CX-5MU

SERVICE MANUAL

**MSX**

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008040

SINCE 1887



**YAMAHA**

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## IMPORTANT NOTICE

This manual has been provided for the use of authorized Yamaha Retailers and their service personnel. It has been assumed that basic service procedures inherent to the industry, and more specifically Yamaha Products, are already known and understood by the users, and have therefore not been restated.

**WARNING:** Failure to follow appropriate service and safety procedures when servicing this product may result in personal injury, destruction of expensive components and failure of the product to perform as specified. For these reasons, we advise all Yamaha product owners that all service required should be performed by an authorized Yamaha Retailer or the appointed service representative.

**IMPORTANT:** The presentation or sale of this manual to any individual or firm does not constitute authorization, certification, recognition of any applicable technical capabilities, or establish a principle-agent relationship of any form.

The data provided is believed to be accurate and applicable to the unit(s) indicated on the cover. The research, engineering, and service departments of Yamaha are continually striving to improve Yamaha products. Modifications are, therefore, inevitable and changes in specification are subject to change without notice or obligation to retrofit. Should any discrepancy appear to exist, please contact the distributor's Service Division.

**WARNING:** Static discharges can destroy expensive components. Discharge any static electricity your body may have accumulated by grounding yourself to the ground buss in the unit (heavy gauge black wires connect to this buss).

**IMPORTANT:** Turn the unit OFF during disassembly and parts replacement. Recheck all work before you apply power to the unit.

### ■ Specifications

#### CPU

CPU:	Z80A compatible
Clock:	3.579545 MHz
Wait:	1 wait in M1 cycle
Interrupt:	INT external and VDP. NMI interrupt no used. (In MSX-BASIC interpreter 60Hz signal from VDP is used for the interrupt.) (MODE 1)
Reset:	Power on reset

#### MEMORY

Main memory:	32KB
Video RAM:	16KB
ROM:	32KB (MSX-BASIC)

#### VIDEO DISPLAY

Character set:	256 alphanumeric and graphic characters
Color:	16 colors
Text Display	
Capability:	24 lines by up to 40 columns (Software selectable)
Resolution:	256 dots X 192 lines (non-interlace)

#### INPUT AND OUTPUT

Keyboard:	Stroke type step sculpture keyboard. Special characters and Alphanumeric characters . . . . . 48 Control and special effect keys . . 16 Cursor movement keys . . . . . 4 Function keys (programmable) . . . 5 CAPS lock key with LED indication
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Audio Cassette Interface: 8 pin DIN female connector  
 Baud rate 1200/2400 BPS switchable by software, FSK format  
 With remote control (Cassette motor ON/OFF)

Printer Interface: Standard Centronics 8-bit parallel  
 TTL logic level  
 14 pin female connector

Universal I/O Interface (JOYSTICK etc.): 2 ports  
 9 pin connectors (male) X 2  
 TTL logic level

Monitor Output: 1) 5 pin DIN female connector  
 2) NTSC composite video output  
 75 ohms ..... Use video cable (VC-02)  
 3) Sound output  
 8 octaves/3 notes + noise (-5dB)  
 The SSG is YM2149  
 Beep sound (PPI:  $\mu$ PD8225C-5)  
 4) Monitor output  
 Use monitor connector (RF-02)

Upper Slot (SLOT #1): 50 pin MSX standard female connector

Rear Slot (SLOT #2): 50 pin edge-card connector

FM sound synthesizer unit  
 60 pin edge-card connector  
 Number of Preset Voices: 46

Simultaneous Notes:  
 Up to 8 notes  
 Audio L/R Outputs:  
 -9  $\pm$  2dB, 1.8k $\Omega$   
 RCA-pin jacks  
 MIDI IN/OUT:  
 5 pin DIN female connectors  
 Music keyboard:  
 For connection to an optional YK-01 or YK-10 music keyboard.  
 20 pin male connector

**POWER SUPPLY UNIT CAPACITY**

+ 5V  $\pm$  5% 1.8A  
 +12V  $\pm$  10% 0.3A  
 -12V  $\pm$  10% 0.16A

**GENERAL SPECIFICATIONS**

Line Voltage: 120V AC (Minimum 90V, Maximum 132V)

Power Consumption: 30 watts maximum

Dimensions: 16.7" wide X 2.7" high X 8.2" deep  
 (423mm wide X 68mm high X 208mm deep)

Weight: 7.7 pounds (3.5kg)

**Accessory**

Cassette interface cable  
 Computer side . . . . . 8 pin DIN male connector  
 Cassette recorder side  
 Mini-phone plug . . . . . Mini phone plug (3.5 $\phi$ )  
 Mic plug . . . . . Mini phone plug (3.5 $\phi$ )  
 Remote control plug . . . . . Mini phone plug (2.5 $\phi$ )  
 Length: 1 m

• **DISPLAY MODE**

MODE	Resolution	Size	Number	Specified Color	Sprite	Characters	
Graphic I (Screen 1)	MAX	256 X 192	8 X 8	256	16 colors	Yes	32 X 24
	NORMAL	240 X 192					29 X 24
Graphic II (Screen 2)	MAX	256 X 192	8 X 8	768	16 colors	Yes	32 X 24
	NORMAL	240 X 192					29 X 24
Multi-color (Screen 3)	MAX	64 X 40blk	4 X 4 per block	-	16 colors	No	8 X 6
	NORMAL	60 X 40blk					
Text (Screen 0)	MAX	256 X 192	6 X 8	256	2 out of 16 colors	No	40 X 29
	NORMAL	240 X 192					39 X 24

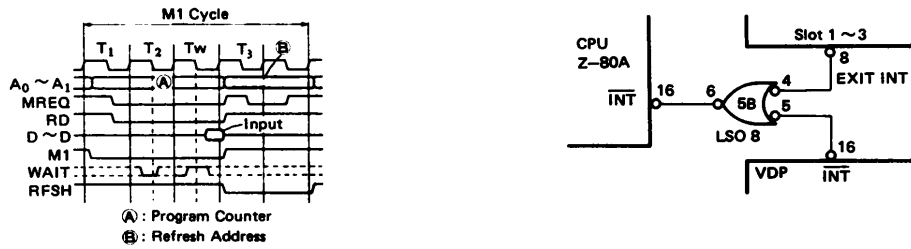
■ MSX Brief Description

CPU (Z80A)

A 10.73635 MHz clock is originated in the VDP and divided by three to produce a 3.579545 MHz system clock which is fed to the CPU. Thus one clock cycle is approximately 279nsec. Address bus (16 bits) and data bus connected to the peripheral devices and other external units.

One WAIT cycle is inserted per each M1 cycle (fetch instruction cycle). A WAIT cycle can also be inserted through slots # 1 ~ # 3.

As for the interrupt, NMI is not used, and the INT (interrupt) mode 1 is used. INT from VDP and external INT(s) from slots # 1 ~ # 3 are input to an OR gate and then fed to CPU INT line. 60 Hz interrupt signal is output from VDP to initiate each 1/60 of a second for the screen control or keyboard scan.

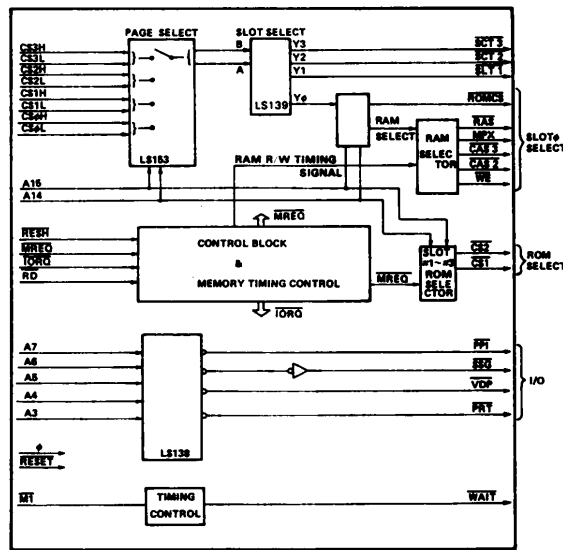


MMC (MSX Memory Controller – YM5214)

This is a dedicated LSI for MSX, and was developed by Yamaha.

Based on the MSX specifications, the memory bank select uses standard I/O M1 WAIT instruction generation.

MMC BLOCK DIAGRAM



YM5214 BLOCK DIAGRAM

**VDP (Video Display Processor – TMS9918A)**

The VDP supports 16K bytes of V-RAM (Video RAM). It produces a composite video signal for a TV display according to the CPU instructions. A 10.738635 MHz clock generated within the VDP is divided by three to be used as a system clock for various peripherals.

**SSG (Software Sound Generator – YM2149)**

The SSG is compatible to General Instrument's PSG (AY3-8910) and was enhanced, designed and developed by Yamaha. It can produce up to 3 notes and noise by software control. It also has two 8 bit universal I/O ports for joystick and other peripherals.

**PPI (Programmable Peripheral Interface – μPD6255A)**

Three 8 bit universal I/O ports A, B and C are provided.

Each port may be controlled by software, and the following functions are assigned as a specification.

Port A: Memory bank signal output.

Port B: Keyboard scan signal input.

Port C: Keyboard strobe signal output, CAPS lock LED switch, cassette data recorder control, etc.

● Memory map and slot

ROM: 32 byte MSX BASIC ROM on slot 0, address 0000H ~ 7FFFH.

RAM: DRAM (Dynamic RAM) of 16K bytes X 2 (total of 32K bytes) on slot 0, address 8000H ~ FFFFH.

	Slot 0	Slot 1	Slot 2	Slot 3
FFFFH	RAM 16Kb			
C000H	RAM 16Kb			
8000H	MSX BASIC ROM 32Kb			
4000H				
0000H				

(Memory Map)

V-RAM: 16 K bytes of V-RAM are separated from the system bus and supported by the VDP.

**SLOT SELECT SIGNAL OF PPI PORT A**

PPI PORT A			PPI-A8H-PORT	
			PORT A	
CS0	L	Specified bit to select 0000H ~ 3FFFH area from each SLOT	LSB	O
	H		bit 1	O
CS1	L	Specified bit to select 4000H ~ 7FFFH area from each SLOT	bit 2	O
	H		bit 3	O
CS2	L	Specified bit to select 8000H ~ BFFFH area from each SLOT	bit 4	O
	H		bit 5	O
CS3	L	Specified bit to select C000H ~ FFFFH area from each SLOT	bit 6	O
	H		MSB	O

MSX BASIC MODE

**SLOT SPECIFICATION BY EACH CSX L, H (X = 0, 1, 2, 3)**

L/H	0/0	1/0	0/1	1/1
Slot	ROM, RAM	Slot 1	Slot 2	Slot 3

• I/O port memory map

According to the MSX specifications, the 256 byte Z-80A I/O port area from 00H to FFH is reserved for the standard MSX system devices as follows:

FFH					
F0H					
E8H					
D8H					
D0H					
C0H					
B0H					
A8H	PPI	ABH	W	Mode set	μPD8255A
A0H	SSG	AAH	W	Port C data write	
98H	VDP		R	Port C data read	
90H	* Printer	A9H	W	Port B data write	
88H			R	Port B data read	Mode 0 set during MSX BASIC operations
80H	* RS232C	A8H	W	Port A data write	
00H			R	Port A data read	
		A2H	R	Data read	SSG YM2149
		A1H	W	Data write	
		A0H	W	Address latch	
		99H	W	Command address set	TMS 9918A
			R	Status read	
		98H	W	V-RAM data write	TMS 9918A
			R	V-RAM data read	
		91H	W	Print data	TTL LS374
		90H	W	Strobe output (bit 0)	
			R	Status input (bit 1)	

I/O address

\* Addresses reserved for optional I/O ports.

**PPI input/output port**

When MSX-BASIC is operating, the mode is set to MODE 0 (PA0 ~ PA7, PB0 ~ PB7 and PC0 ~ PC7 can be controlled as independent 8-bit ports) and each port controls the following input/output.

PA0 ~ PA7: Output port to MMC (sends out data to produce slot select signal).

PB0 ~ PB7: Input port for keyboard scanning data.

PC0 ~ PC3: Sends scanning signal to keyboard through an LS145 IC.

PC4: Motor ON/OFF control data recorder (cassette). Turns relay.

PC5: Output FSK specification data to data recorder (cassette).

PC6: LED lights at CAPS lock LED "L".

PC7: Emits beeping sound through 1 bit output.

**SSG input/output port**

This LSI can be programmed to play up to 3 notes as well as noise, and at the same time, controls the next input/output unit by means of the two input/output ports.

CHA ~ CHC : Triple chord output terminal and noise output terminal.

IOA0 ~ IOA5: Input port for general purpose. Input/output port (JOYSTICK 1, 2) data scanning.

IOA6: LED lights at CODE, locks LED "L"

IOA7: Input port for data from data recorder (cassette).

IOB0 ~ IOB6: General purpose input/output port (JOYSTICK 1, 2) select, and strobe & scanning.

IOB0 ~ IOB3: Port scanning data output

IOB4: JOYSTICK 1 strobe signal output

IOB5: JOYSTICK 2 strobe signal output

IOB6: JOYSTICK 1, 2 select signal

IOB "L" . . . . . JOYSTICK 1 select

IOB "H" . . . . . JOYSTICK 2 select

IOB7: Not used

The specified functions of the PPI and SSG input/output ports as described above are all set by the inner monitor when power ON reset and MSX-BASIC functions are in operation (without anything inserted in the slot).

● Slot pin assignment

Slot #1 (Upper Slot) and Slot #2 (Rear Slot)

Pin No.	Pin Name	I/O	Description
1	CS1	O	Select Signal for ROM 4000H-7FFFH
2	CS2	O	Select Signal for ROM 8000H-BFFFH
3	CS1,2	O	Select Signal for ROM 4000H-BFFFH
4	SLTSL	O	Slot Select Signal
5	N/C	—	No connection
6	RFSH	O	Dynamic RAM refresh signal
7	EXT WAIT	I	WAIT request, open collector signal
8	EXT INT	I	Maskable interrupt request, open collector signal
9	M1	O	M1 signal from CPU
10	BUSDIR	I	Direction Control for external Bus Buffer
11	IORQ	O	I/O request from CPU
12	MERQ	O	Internal memory request from CPU
13	WR	O	Write request from CPU
14	RD	O	Read request from CPU
15	RES	O	System Preset signal
16	N/C	—	No connection
17	A9	O	} Address Bus signal
18	A15	O	
19	A11	O	
20	A10	O	
21	A7	O	
22	A6	O	
23	A12	O	
24	A8	O	
25	A14	O	
26	A13	O	
27	A1	O	
28	A0	O	
29	A3	O	
30	A2	O	
31	A5	O	} Data Bus signal
32	A4	O	
33	D1	I/O	
34	D0	I/O	
35	D3	I/O	
36	D2	I/O	
37	D5	I/O	
38	D4	I/O	
39	D7	I/O	
40	D6	I/O	
41	GND	—	Ground
42	CLOCK	O	System Clock 3.579545MHz
43	GND	—	Ground
44	SW13	—	System protection
45	+5	—	Power Supply +5V
46	SW2	—	System protection (Note: SW1 and SW2 are connected when a cartridge is inserted.)
47	+5	—	Power Supply +5V
48	+12	—	Power Supply +12V
49	SOUND IN	I	Sound input line (–5dBm) mixed with PSG sound and output
50	–12	—	Power Supply –12V

SLOT #3 (FM Sound Synthesizer Unit)

Pin No.	Pin Name	I/O	Description
1~10			Not used
11~60			Exactly same as 50-pin assignment as above.

•Slot management

**Memory structure of MSX**

	#0 (SLOT 0)				#1 (UPPER SLOT)				#2 (REAR SLOT)				#3 (SIDE SLOT)				
	Primary		expanded		Primary		expanded		Primary		expanded		Primary		expanded		
0FFFFH																	
0C000H																	
0BFFFH																	
8000H																	
7FFFH																	
4000H	B A S I C																
3FFFH																	
0000H																	

Total : 1024K bytes (16X64K bytes)

**Terminology:** Primary slot . . . . . Slot which is enabled by slot select register within 8255 PPI.  
 Secondary slot . . . . . Slot which is enabled by expansion slot register placed at 0FFFFH.  
 Page . . . . . Block of memory (maximum 16K) in each slot.  
 A slot is divided into 4 pages.  
 (0000H to 3FFFH, 4000H to 7FFFH, 8000H to 0BFFFH, 0C000H to 0FFFFH)

**1. Minimum configuration**

- a) Microsoft MSX BASIC interpreter at slot #0 from 0000H to 7FFFH.
- b) Minimum of 8K RAM from 0E000H to 0FFFFH in any slot (including the secondary slot).

**2. RAM search procedure**

MSX BASIC first searches for available RAM from 0BFFFH down to 8000H (including the ones in secondary slots), then enables the page containing the largest RAM. If there are more than one such pages, selects the leftmost page in the figure above. MSX BASIC next searches for available RAM from 0FFFFH down to 0C000H, and does the same thing described above. Finally, MSX BASIC searches for continuous RAM block from 0FFFFH down to 8000H and sets the system variable "BOTTOM".

**3. Program cartridge search procedure**

MSX BASIC scans all slots (including secondary slots) from 4000H to 0BFFFH for a valid ID at the beginning of each page, collects information, and passes control to each page. The scan order is from left to right in the figure above. The format of ID and others are as follows.

**Offset from top**

+0000H	
+0002H	ID
+0004H	INIT
+0006H	STATEMENT
+0008H	DEVICE
+000AH	TEXT
+0010H	reserved



**ID** is a 2 byte code used to distinguish ROM cartridges from empty pages. "AB" (41H, 42H) is used for this purpose.

**INIT** holds the address of the initialization procedure specific to the cartridge, and holds 0 when no such procedure is necessary. Programs that need to work co-operatively with BASIC interpreter should return control to it by the Z80's "RET" instruction (all registers except [stack pointer] can be destroyed). However other programs (such as game programs) may not need to use the basic interpreter.

**STATEMENT** holds an address of the expanded statement handler, if it is contained in the cartridge, and holds 0 when no such handler is inside. When BASIC encounters a 'CALL' statement, it calls this address with the statement name in the system area. The following are notes to be remembered. (In the notes below, [HL] register pair is called a 'text pointer')

- 1) The cartridge must be placed at 4000H ~ 7FFFH.
- 2) Syntax for expanded statement is,  
CALL <statement name> [ (<arg> [ , <arg> ] . . ) ]  
Key word "CALL" can be substituted with an under score character, " \_".
- 3) Statement name is strobed in the system area terminated by 0. The buffer for the statement name is of fixed length (16 bytes) so the statement name cannot be longer than 15 characters.
- 4) If the handler for that statement is not inside the cartridge, the return with carry flag is set. The text pointer must be returned unchanged.
- 5) If the handler for that statement is inside the cartridge, the cartridge should do the function, and update the text pointer to the end of the statement (usually pointing to 0 which indicates the end of line, or " : " which indicates the end of a statement), and return with the carry flag reset (registers except [stack pointer] can be destroyed). At the entry to the expanded statement handler, the text pointer is set to point to the first non-blank character after the statement name.

**DEVICE** holds an address of the expanded device handler if it is contained in the cartridge, and holds 0 when no such handler is inside. BASIC calls this address with the device name in the system area. The following are notes to be remembered.

- 1) The cartridge must be placed at 4000H ~ 7FFFH.
- 2) The device name is stored in the system area terminated by 0. The buffer for the statement name has a fixed length (16 bytes) so the device name cannot be longer than 15 characters.
- 3) A cartridge (16K) can have up to 4 logical devices.
- 4) When BASIC encounters a device name which is not known, it calls DEVICE entry with the address 0FFFH is [Acc] .  
If the handler for that device is not inside the cartridge, the carry should be returned set. If it's inside, device ID (from 0 to 3) should be returned in [Accumulator] , and the carry reset. All registers can be destroyed.
- 5) Real I/O operations take place when a DEVICE entry is entered with one of the following values in [Acc] .

- |    |                     |
|----|---------------------|
| 0  | Open                |
| 2  | Close               |
| 4  | Random I/O          |
| 6  | Sequential output   |
| 8  | Sequential input    |
| 10 | LOC function        |
| 12 | LOF function        |
| 14 | EOF function        |
| 16 | FPOS function       |
| 18 | Back up a character |

Device ID is passed in the system variable "DEVICE".

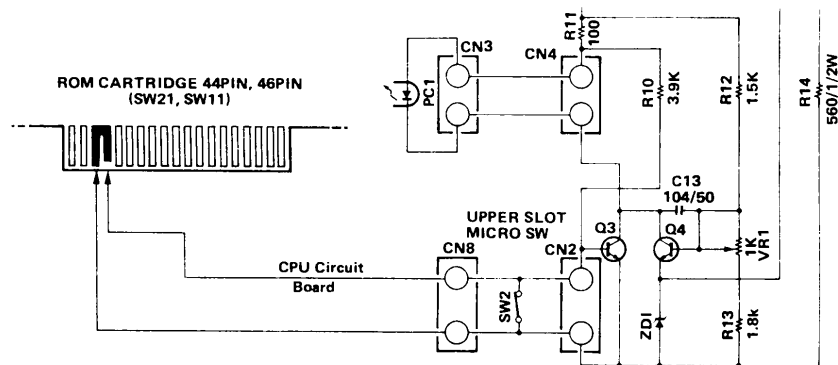
**TEXT** holds the beginning address of BASIC. Text is contained in the cartridge, but holds 0 when no such text is inside. BASIC regards this as the beginning address of BASIC text, sets pointer there, and begins execution of the program. The following are notes to be considered.

- 1) When there is more than one slot, only the leftmost one (in the figure of memory structure of MSX above) is enabled and executed.
- 2) The cartridge must be placed at 8000H ~ 0BFFFH, thus the maximum length of BASIC text cannot exceed 16 Kbytes.
- 3) Even if there is a RAM block equipped at 8000H ~ 0BFFFH, it can never be used.
- 4) The address pointed to by the TEXT entry must contain a zero.
- 5) The line numbers (for statements which reference line numbers, such as GOTO, GOSUB, etc.) must be translated to pointers in advance because they cannot be converted to pointers when executed. They can be line numbers, however the execution would become slower.

NOTE: INIT, STATEMENT, DEVICE and TEST are placed in the low order byte first.

• Operation of Cartridge Protection

The power supply circuit of this unit is a self start RC circuit type and specified secondary voltage is given by the feedback of PC-1 as shown to the figure. In the cartridge protector circuit, SW2 is shorted when the ROM cartridge is not inserted in the upper slot. For this reason, Q3 is non operating. When the cartridge is inserted, SW2 become open, Q3 is ON. In the result, the voltage supply stops. After that, when the cartridge is fully put in, Q3 turns OFF and power is supplied because pin 44 (SW21) and pin 46 (SW11) are shorted.



- Operation of Power Supply Unit

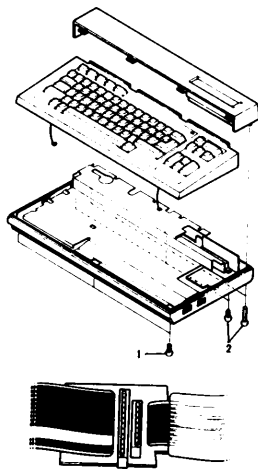
The following is the description and operation of the power supply circuit.

1. In power supply circuit, D4, C4 and R5 are the base drive circuits, and the base current of Q2 is determined by R5.
2. Q1 operates as a voltage controller and a cartridge protector.
3. The photocoupler (PC1) feeds the voltages fluctuation of +5V back to the control circuit through the error detection circuit at all times. The control circuit controls output based on the information fed back, by increasing and decreasing the base current of Q1 and changing the oscillating frequency of Q2.
4. VR1 connected to the base of Q4 in the error detection circuit adjusts the output voltage (+5V).
5. SW2 connected to Q3 in the cartridge protector circuit is ON at all times. Therefore, Q3 remains OFF normally.
6. When power is ON and if the ROM cartridge is set in the upper-slot erroneously, SW2 is turned OFF. Therefore, Q3 is turned ON, and the current flowing in the photocoupler (PC1) increases. The photocoupler (PC1) on the control circuit is turned ON to turn ON Q1. The oscillating frequency of Q2 increases, and the energy stored in L decreases, and output voltage lowers. When the ROM cartridge is properly set afterwards, pins 44 and 46 of ROM cartridge are short-circuited, and voltage increase again.
7. Overcurrent protection resistor R4:  
When excess current flows on the load side, current in proportion to it flows in Q2. At this time, R8 voltage also increases, which increases the base current of Q1 through R4. Consequently, the oscillating frequency of Q2 increases and output voltage is decreases. The oscillating frequency of Q2 is about 45 KHz.

- Disassembly Procedures

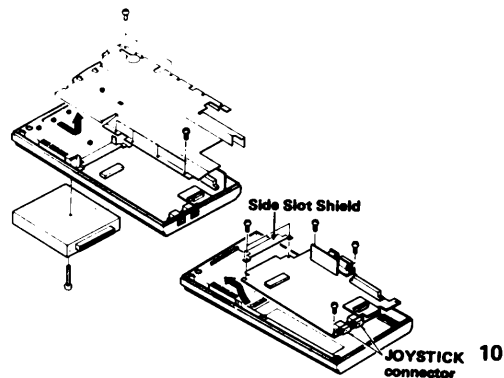
- Case removal

- 1) Remove three screws from the bottom case. Refer to reference ①.
- 2) Lift the front end of the keyboard case and remove it. Disconnect the shield wire from the shield plate of the CPU at the right front and left side. Also, disconnect the keyboard cable to the CPU board by gently pulling it up.
- 3) Remove five screws (two long ones and three short ones) from the bottom case and lift the case to disconnect the connector from the upper slot.



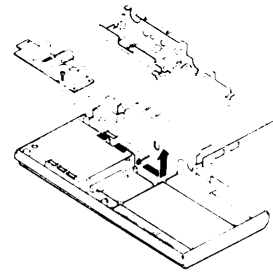
- CPU board removal

- 1) Remove the side slot screws from the bottom case and remove the FM sound synthesizer unit.
- 2) Remove seven screws securing the shield plate of the CPU board, move it to the right a little and lift it up.
- 3) Remove the side slot shield plate of the CPU board.
- 4) Remove the rear slot cover.
- 5) Remove CN2 (8 pin) from the CPU board.
- 6) Remove three screws from the CPU board and two screws from the upper slot connector.
- 7) Remove the CPU board by lifting its left side and pulling it to the left a little.



● **Power supply unit removal**

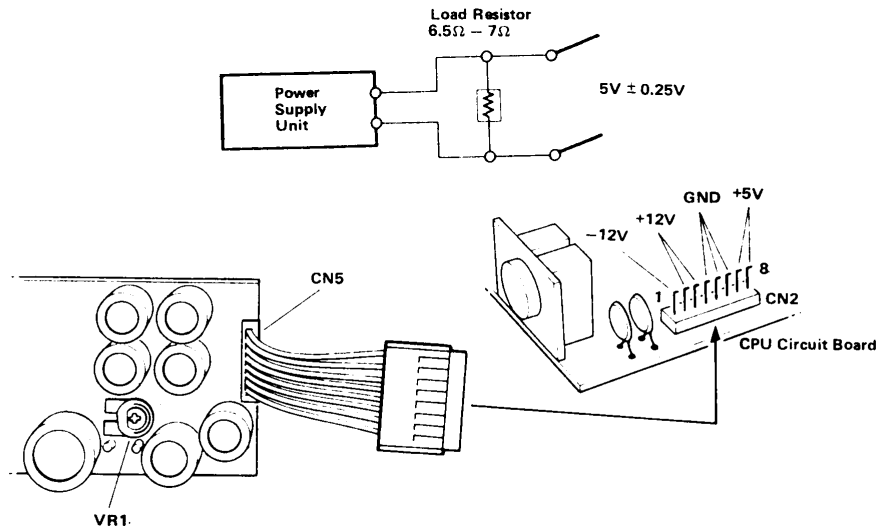
- 1) Remove two screws from the power supply unit.  
Remove the shield plate and power supply unit by lifting the right side of the shield plate and pulling it to the right a little.
- 2) Remove two screws from the cord stopper and remove the power supply unit.



■ **Adjustments**

Adjustment	Equipment Required	Measure at	Adjust	Readings
+5V supply voltage	DVM (Digital voltmeter)	Pin #4 and 7 of connector CN2, CPU board	VR1, power supply	+5V ± 0.25V
Clock Frequency	Frequency counter	Pin # 6 of Z80A CPU	TC1, u-clock card	3.579545 MHz ± 50 Hz

NOTES: Check AC line voltage to insure that it is 120V ± 10%.  
The adjustment for +5V supply voltage should be made while the circuitry of the CX-5MU is connected and the proper load resistor is terminated as shown below.  
To terminate the load resistor, remove connector CN2 from the CPU board. Then if possible, insert one lead of the load resistor into pin 7 or 8 (red wire) and the other end into pin 4, 5 or 6 (black wire).  
If the leads of the load are too big, you may need to use smaller gauge wire for the load resistor connection.  
Load resistor value: 6.5Ω ~ 7Ω, 10W or higher.



■ LSI Data Table

CPU (Z80A)

Pin No.	Pin Name	I/O	Active	Function
1 ~ 5	A11, 12, 13, 14, 15	O		Address bus
6	$\phi$	I		3.579545 MHz clock input
7 ~ 10	CD4, 3, 5, 6	I/O		Data bus
11	V <sub>DD</sub>	I		Voltage Supply +5V
12 ~ 15	CD2, 7, 0, 1	I/O		Data bus
16	INT	I	L	Maskable interrupt input pin: Mode 1 is used for interrupt which is input by taking the logic OR of the VDP interrupt output (every 1/60s.) and the cartridge interrupt input (EXT INT) (when using MSX-BASIC)
17	NMI			No connection
18	HALT			No connection
19	MREQ	O	L	Active when the effective address for memory access is on the address bus.
20	IORQ	O	L	Active when the effective address for the input/output port access is on the address bus (also active when in INT or ACK cycle)
21	RD	O	L	Active during the period when the CPU can receive data from the memory and input/output port.
22	WR	O	L	Active when the CPU sends data to be stored in the memory and input/output port to the data bus.
23	BUSAK			No connection
24	WAIT	I	L	CPU remains in the wait state as long as this signal is active "L". (No refresh signal is generated when in the WAIT state.)
25	BUSRO			No connection
26	RESET	I	L	The program counter becomes "0" at the RESET input and the CPU is initialized.
27	MT	O	L	One "L" pulse is output at each instruction fetch cycle (also active when in the INT or ACK cycle)
28	RFSH	O	L	Active when the low order 7 bit refresh address for D-RAM is on the address bus
29	V <sub>SS</sub>	I		Ground
30 ~ 40	A0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10	O		Address bus

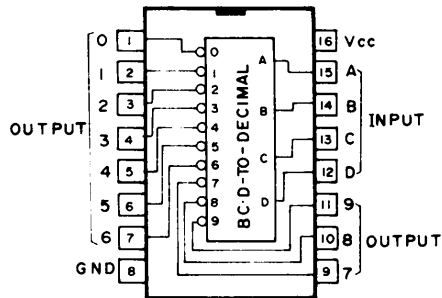
MMC (MSX Memory Controller – YM5214)

Pin No.	Pin Name	I/O	Active	Function
1	Vss	I		Ground
2	$\overline{RD}$	I	L	CPU (Z80A) $\overline{RD}$ signal input
3	$\overline{IORQ}$	I	L	CPU (Z80A) $\overline{IORQ}$ signal input
4	$\overline{M1}$	I	L	CPU (Z80A) $\overline{M1}$ signal input
5 ~ 9	AD7, 6, 5, 4, 3	I		CPU (Z80A) address 7 ~ 3 signal input
10	VDD			Voltage Supply +5V
11	$\overline{PRT}$	O	L	Printer interface port select
12	$\overline{VDP}$	O	L	VDP port select
13	SSG	O	H	SSG port select
14	$\overline{PPI}$	O	L	PPI port select
15	$\overline{WAIT}$	O	L	WAIT signal
16	$\overline{WE}$	O	L	D-RAM $\overline{WE}$ signal
17	$\overline{RAS}$	O	L	D-RAM $\overline{RAS}$ signal
18	MPX	O	H	D-RAM address multiplex signal
19	$\overline{CAS2}$	O	L	D-RAM (SLOT # 0,8000H-BFFFH) $\overline{CAS}$ signal
20	$\overline{CAS3}$	O	L	D-RAM (SLOT # 0,C000H-FFFFH) $\overline{CAS}$ signal
21	$\overline{ROMCS}$	O	L	MSX-BASIC ROM select signal
22	$\overline{CS1}$	O	L	ROM 4000H-7FFFH select signal
23	$\overline{CS2}$	O	L	ROM 8000H-BFFFH select signal
24	$\overline{RESET}$	I	L	SYSTEM RESET signal input
25	$\overline{SLT3}$	O	L	SLOT #3 select signal
26	$\overline{SLT2}$	O	L	SLOT #2 select signal
27	$\overline{SLT1}$	O	L	SLOT #1 select signal
28	CS3H	I		Slot select register (PPI PORT-A) signal
29	CS3L	I		Slot select register (PPI PORT-A) signal
30	CS2H	I		Slot select register (PPI PORT-A) signal
31	CS2L	I		Slot select register (PPI PORT-A) signal
32	CS1H	I		Slot select register (PPI PORT-A) signal
33	CS1L	I		Slot select register (PPI PORT-A) signal
34	CS0H	I		Slot select register (PPI PORT-A) signal
35	CS0L	I		Slot select register (PPI PORT-A) signal
36, 37	A15, A14	I		CPU (Z80A) ADDRESS 15, 14 signal input
38	$\overline{MREQ}$	I	L	CPU (Z80A) $\overline{MREQ}$ signal input
39	$\overline{RFSH}$	I	L	CPU (Z80A) $\overline{RFSH}$ signal input
40	$\phi$	I		CPU (Z80A) CLOCK signal input

VDP (Video Display Processor – TMS9918A)

Pin No.	Pin Name	I/O	Active	Function
1	$\overline{\text{RAS}}$	O	L	Row address strobe
2	$\overline{\text{CAS}}$	O	L	VRAM column address strobe
3 ~ 10	AD7, 6, 5, 4, 3, 2, 1, 0 (MSB)	O		VRAM address and data bus (VRAM row and columns address, multiplexed data and output) (AD0 is the most significant bit)
11	$\overline{\text{R/W}}$	O	H=read	VRAM write strobe
12	V <sub>SS</sub>	I		Ground
13	MODE	I		CPU interface mode select
14	$\overline{\text{CSW}}$	I	L	Write strobe
15	$\overline{\text{CSR}}$	I	L	Read strobe
16	$\overline{\text{INT}}$	O	L	Interrupt signal to CPU
17 ~ 24	CD7, 6, 5, 4, 3, 2, 1, 0 (MSB)	I/O		CPU data bus (CDO is the most significant bit) CPU data bus (CDO is the most significant bit)
25 ~ 32	RD7, 6, 5, 4, 3, 2, 1, 0 (MSB)	I		VRAM read data bus (RDO is the most significant bit)
33	V <sub>DD</sub>	I		Voltage Supply +5V
34	$\overline{\text{RESET/SYNC}}$	I		3-level input pin (less than 0.6V: $\overline{\text{RESET}}$ active → VDP initialized, over 10V: SYNC active → VDP synchronized externally)
35	B-Y/EXTVID	O		B-Y color signal out/external video signal input
36	Y/COMVID	O		Y signal out (brightness and synchronous composite video signal)
37	GROMCLK	O		Output of quartz oscillator (or external clock) signal frequency divided by 24 (ordinarily not used)
38	R-Y/CLOCK	O		R-Y color signal out/clock $\phi$ output
39	XTAL2	I		Quartz oscillator connecting terminal
40	XTAL1	I		(10.73864MHz) (When driving external clock, drive both inputs)

● 74LS145 (iG12410)  
0, C, BCD to DECIMAL  
Decoder/Driver



Truth: Table

No.	INPUTS				OUTPUTS										
	D	C	B	A	0	1	2	3	4	5	6	7	8	9	
0	L	L	L	L	L	H	H	H	H	H	H	H	H	H	H
1	L	L	L	H	L	H	H	H	H	H	H	H	H	H	H
2	L	L	H	L	H	H	H	H	H	H	H	H	H	H	H
3	L	L	H	H	H	H	H	H	H	H	H	H	H	H	H
4	L	H	L	L	H	H	H	H	H	L	H	H	H	H	
5	L	H	L	H	H	H	H	H	H	L	H	H	H	H	
6	L	H	H	L	H	H	H	H	H	H	L	H	H	H	
7	L	H	H	H	H	H	H	H	H	H	L	H	H	H	
8	H	L	L	L	H	H	H	H	H	H	H	L	H	H	
9	H	L	L	H	H	H	H	H	H	H	H	H	L	H	
INVALID	H	L	L	H	H	H	H	H	H	H	H	H	H	H	
	H	L	H	L	H	H	H	H	H	H	H	H	H	H	
	H	L	H	H	L	H	H	H	H	H	H	H	H	H	
	H	L	H	H	H	L	H	H	H	H	H	H	H	H	

SSG (Software Sound Generator – YM-2149)

Pin No.	Pin Names	I/O	Active	Function
1	V <sub>SS</sub>			Ground
2	NC			No connection
3, 4	ANALOG CHANNEL B, A	O		Output of D/A converter
5	NC			No connection
6 ~ 13	IOB7, 6, 5, 4, 3, 2, 1, 0	I/O		Parallel data 8 bit port input/output
14 ~ 21	IOA7, 6, 5, 4, 3, 2, 1, 0	I/O		Parallel data 8 bit port input/output
22	CLOCK	I		Supplies reference time for tone, noise and envelope generator
23	$\overline{\text{RESET}}$	I	L	$\overline{\text{RESET}}$ input
24	A9	I		Fixed to "L"
25	A8	I		Fixed to "H"
26	$\overline{\text{SEL}}$		L	Selection of CLOCK frequency
27	BDIR	I		
28, 29	BC2, BC1	I		
30 ~ 37	DA7, 6, 5, 4, 3, 2, 1, 0	I/O		Data input/output
38	ANALOG CHANNEL C	O		Output of D/A converter
39	TEST1			Test pin
40	V <sub>DD</sub>			Voltage Supply +5V

PPI (Programmable Peripheral Interface –  $\mu$ PD8255A)

Pin No.	Pin Name	I/O	Active	Function
1 ~ 4	PA3, 2, 1, 0			Port A (BIT)
5	$\overline{\text{RD}}$	I	L	Read input
6	$\overline{\text{CS}}$		L	Chip select
7	GND			Ground
8, 9	A1, A0	I		Internal register select signal input
10 ~ 17	PC7, 6, 5, 4, 0, 1, 2, 3			Port C (BIT)
18 ~ 25	PB0, 1, 2, 3, 4, 5, 6, 7			Port B (BIT)
26	V <sub>DD</sub>			Power Supply +5V
27 ~ 34	D7, 6, 5, 4, 3, 2, 1, 0			Data bus
35	$\overline{\text{RESET}}$			$\overline{\text{RESET}}$ input
36	$\overline{\text{WR}}$		L	Write input
37 ~ 40	PA7, 6, 5, 4			Port A (BIT)



**RAM (MB81416-12)**

Pin No.	Pin Name	I/O	Active	Function
1	$\overline{OE}$	I	L	Output enable
2, 3	DQ1, DQ2	I/O		Data input/output
4	$\overline{WE}$	I	L	Write enable
5	$\overline{RAS}$	I	L	Lower address strobe
6~8	A6, 5, 4	I		Address input
9	V <sub>DD</sub>			Voltage Supply +5V
10~14	A7, 3, 2, 1, 0	I		Address input
15	DQ3	I/O		Data input/output
16	$\overline{CAS}$	I	L	Column address strobe
17	DQ4	I/O		Data input/output
18	V <sub>SS</sub>			Ground

Note) MB81416 is an N channel MOS RAM consisting of 16384 word x 4 bit.  $\overline{RAS}$  only refresh type, write cycle (early write) type.;

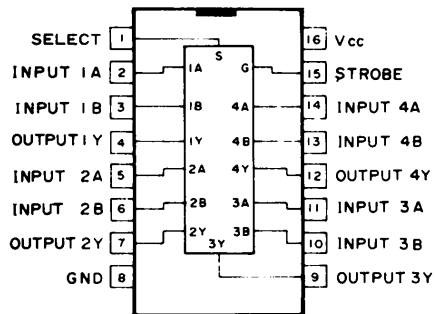
**V-RAM (MB8116) ( $\mu$ PD416C)**

Pin No.	Pin Name	I/O	Active	Function
1	VBB			-5V
2	DIN	I		Data input
3	$\overline{WE}$	I	L	Write enable, write mode to D-RAM at active "L"
4	RAS	I	L	Lower address strobe
5~7	A0, 2, 1	I		Address bus
8	V <sub>DD</sub>			+12V
9	V <sub>CC</sub>			+5V
10~13	A5, 4, 3, 6	I		Address bus
14	DOUT	O		Data output
15	$\overline{CAS}$	I	L	Column address strobe
16	V <sub>SS</sub>			Ground

Note) MB8116 is an N channel MOS RAM consisting of 16384 word x 1bit Output is three state.  $\overline{RAS}$  only refresh type, write cycle (early write) type. VDD: +12V, V<sub>CC</sub>: +5V, VBB: -5V

**●74LS157 (iG059650)**

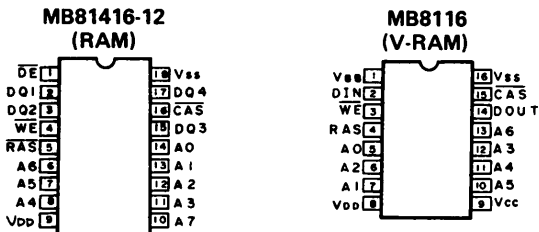
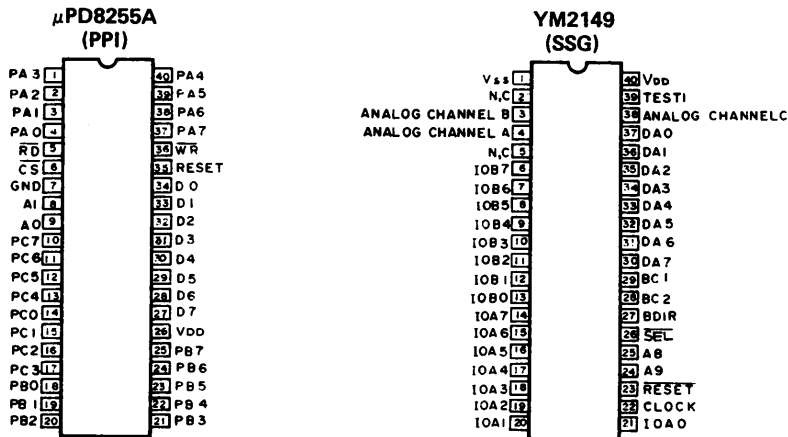
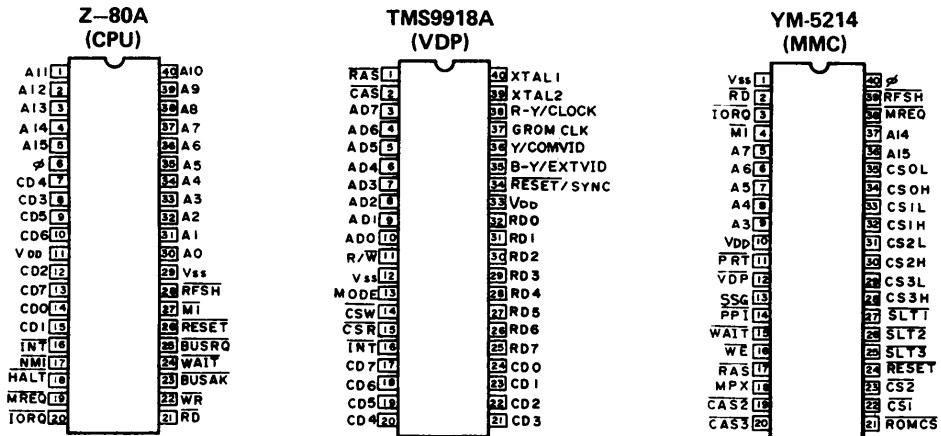
2 to 1 Data Selectors



Truth Table

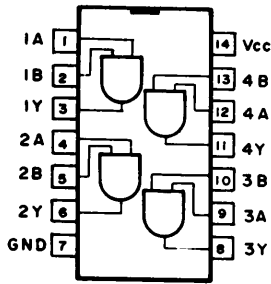
INPUTS		OUTPUT	
Select	Strobe	Y	
	G	A	B
X	H	L	L
L	L	A	A
H	L	L	B

LSI Pin Configuration

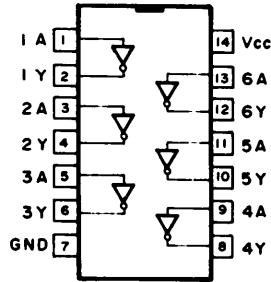


■ IC Diagrams

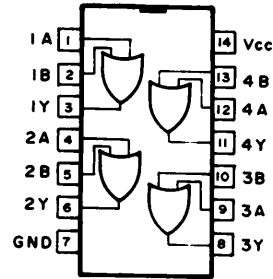
● 74LS08 (iG043750)  
Quad 2Input AND



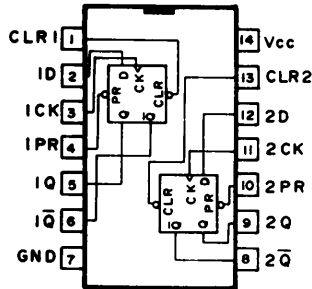
● 74LS14 (iG049650)  
Hex Schmitt  
Trigger Inverters



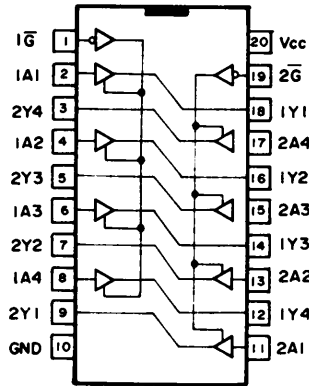
● 74LS32 (iG049850)  
Quad 2 Input  
O.C. NOR Buffer



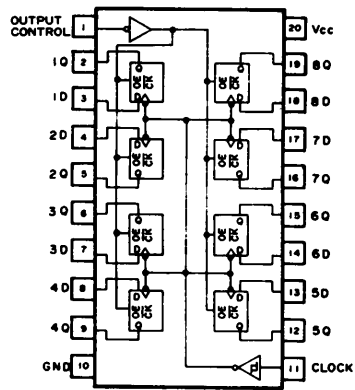
● 74LS74 (iG044050)  
Dual D-FFs  
with preset and clear



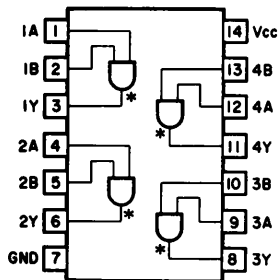
● 74LS244 (iG060050)  
Octal 3 State Bus Buffers



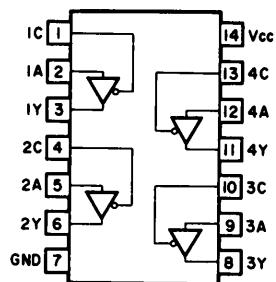
● 74LS374  
Octal 3 State D FFs



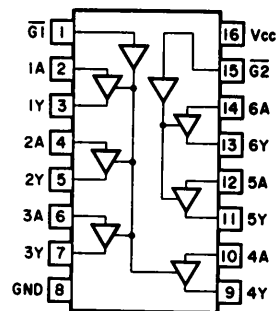
● 74LS09 (iG122500)  
Quad 2 Input O.C. AND



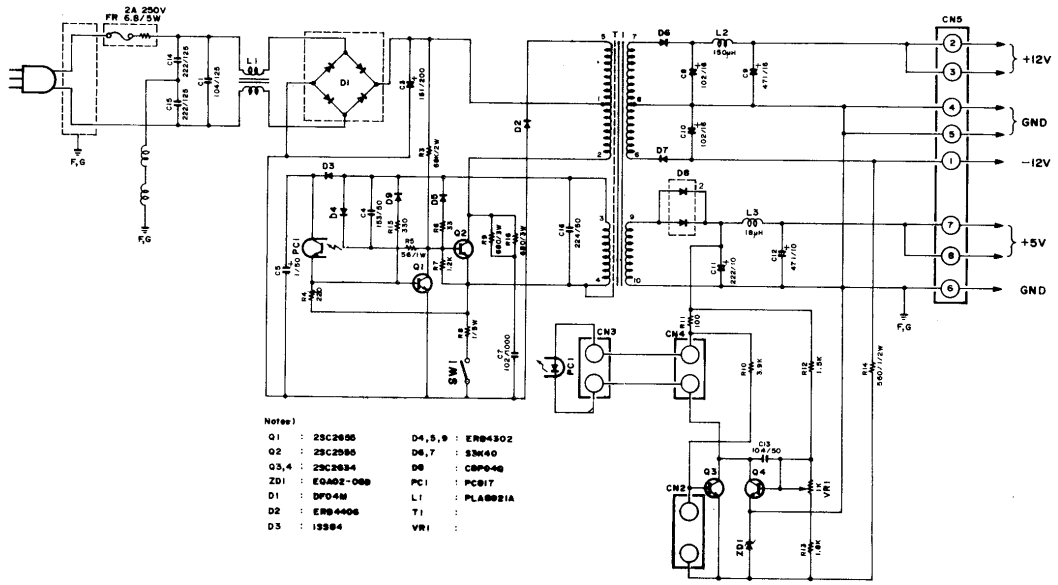
● 74LS125 (iG059550)  
Quad 3 State Bus Buffers



● 74LS367 (iG071600)  
Hex 3 State Bus Buffers

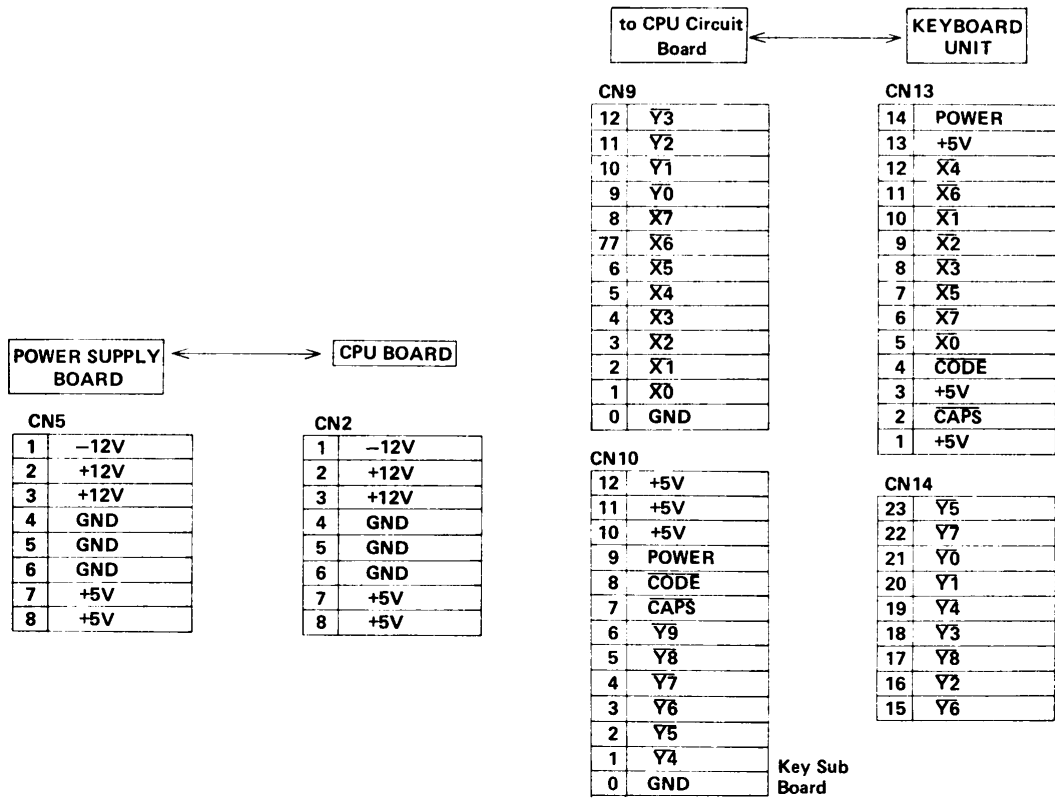


■ Power Supply Unit Schematic Diagram

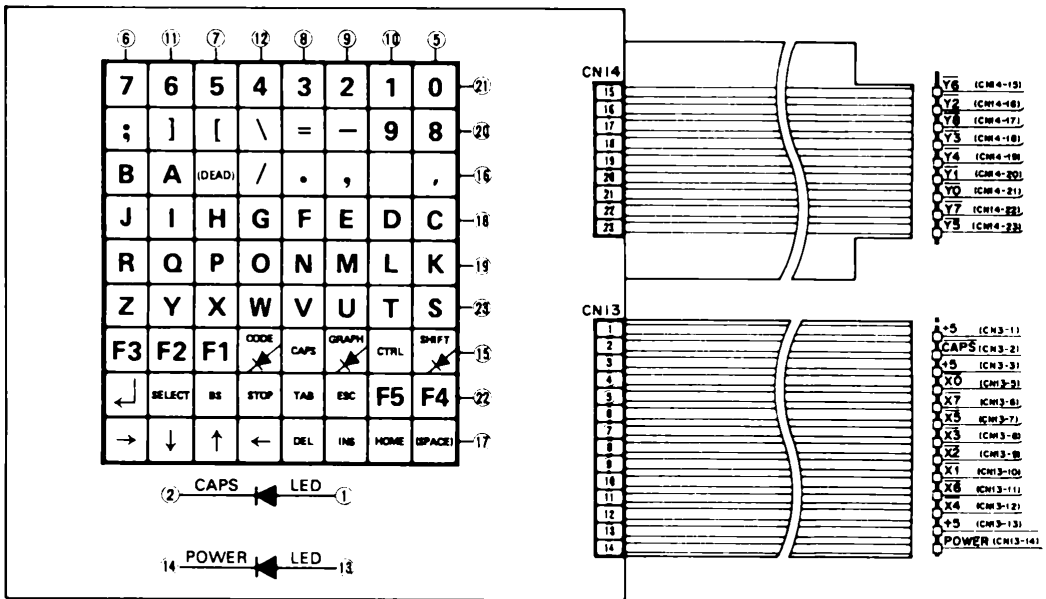


■ Power Supply Circuit Board

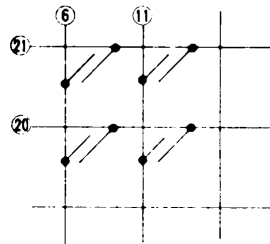
■ Wiring Diagram



■ Keyboard Matrix



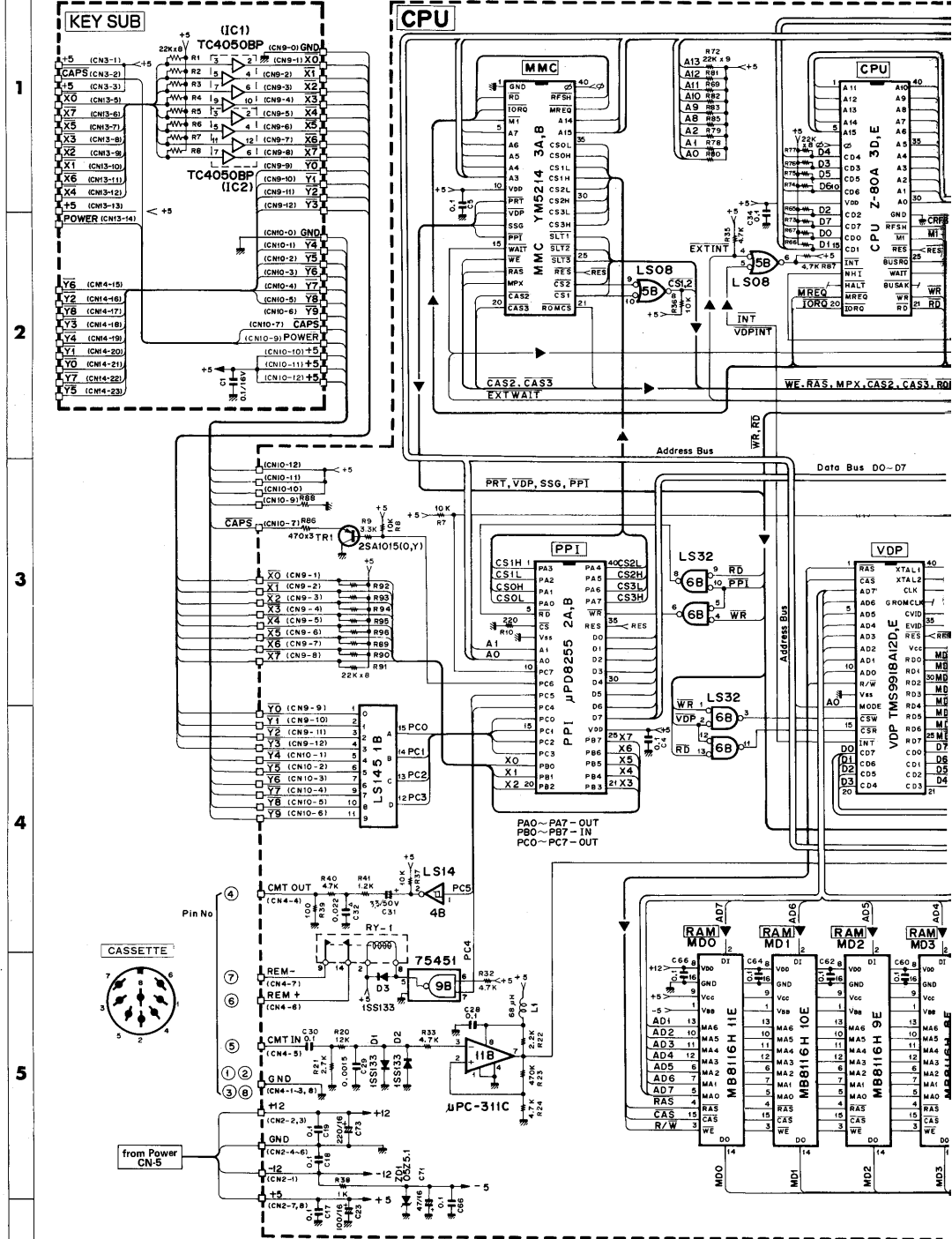
● Keyboard Matrix Schematic Diagram

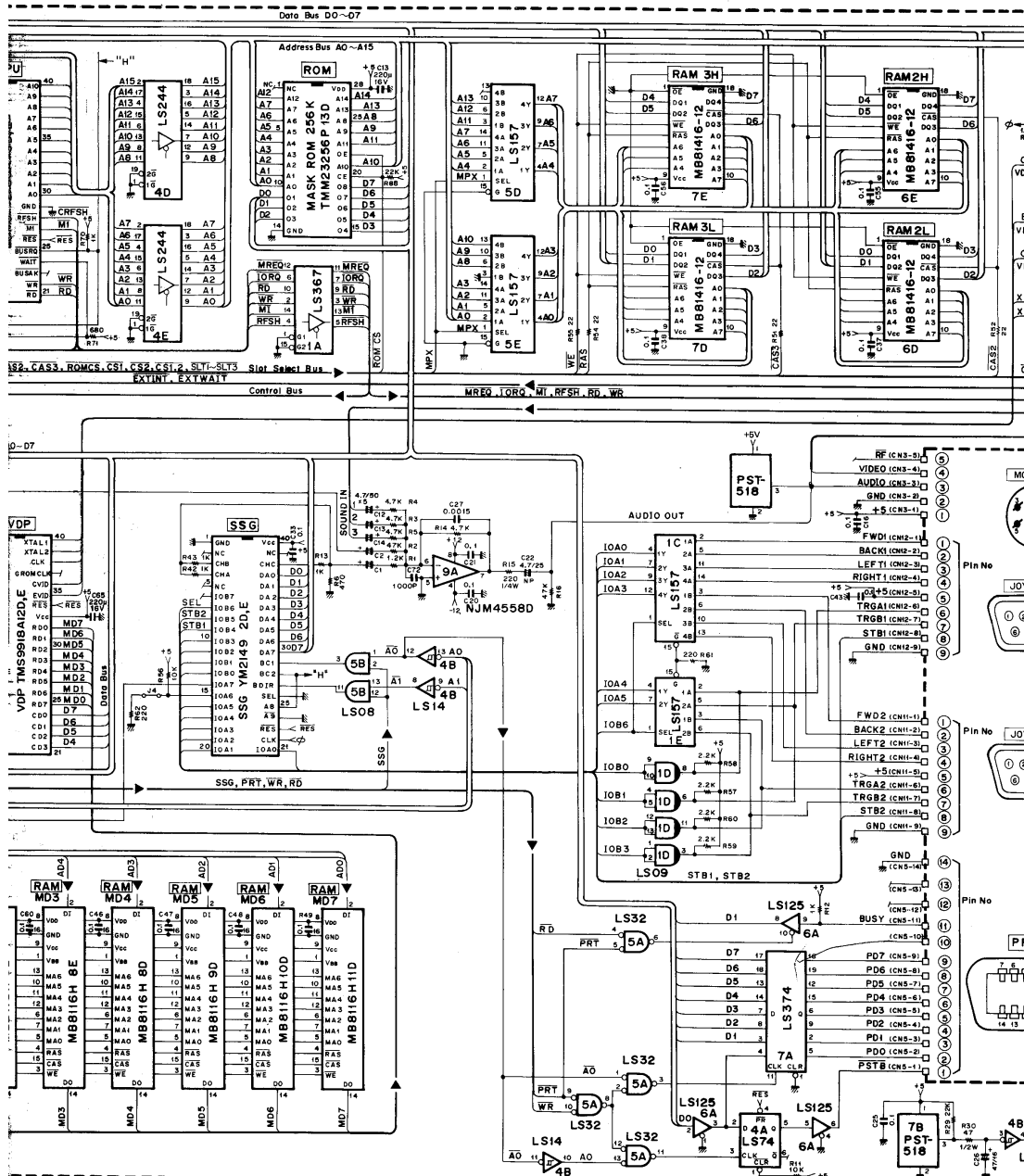


■ Key Sub Circuit Board

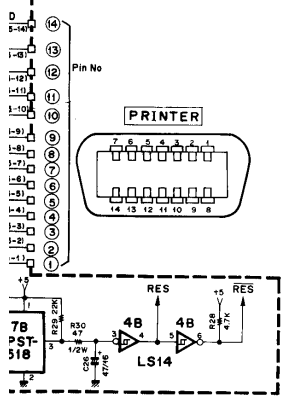
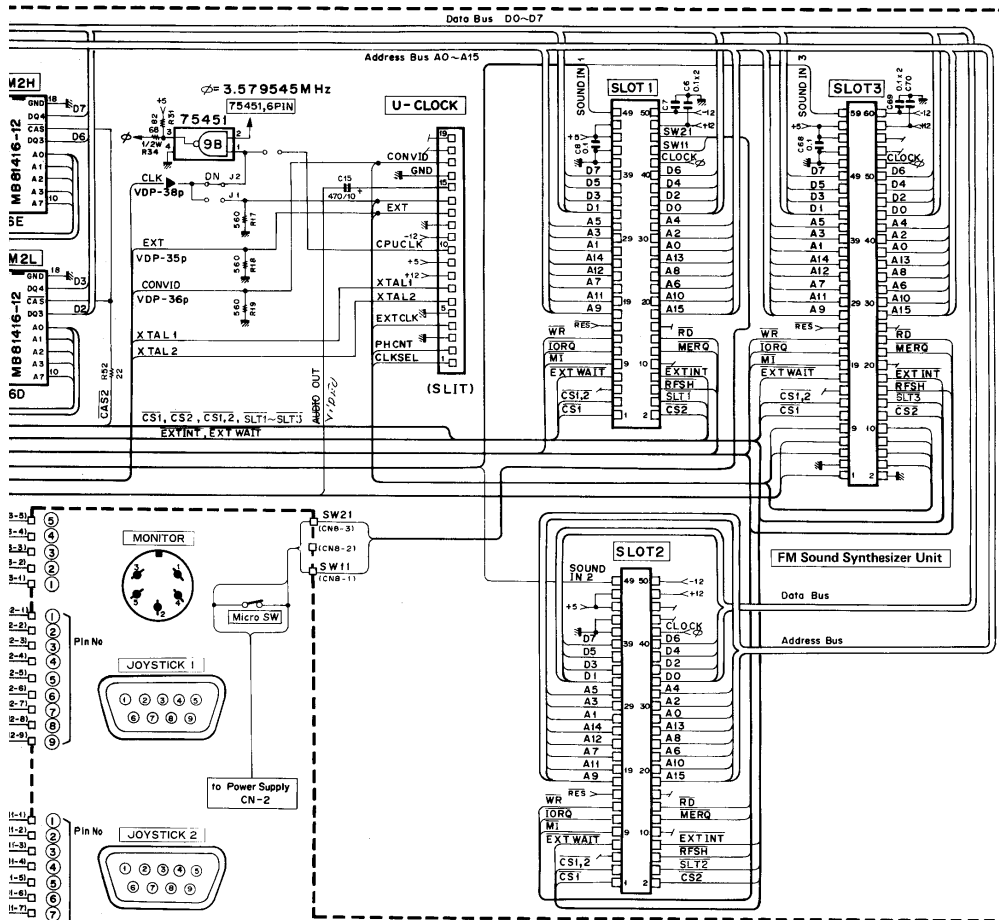
■ U-Clock Card Circuit Board

# CX-5MU Schematic Circuit Diagram



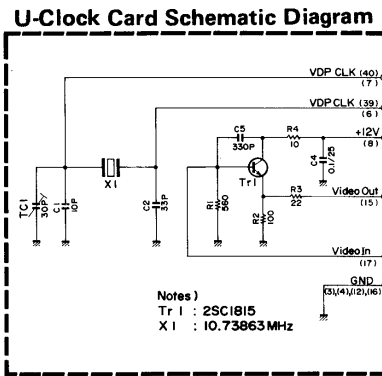






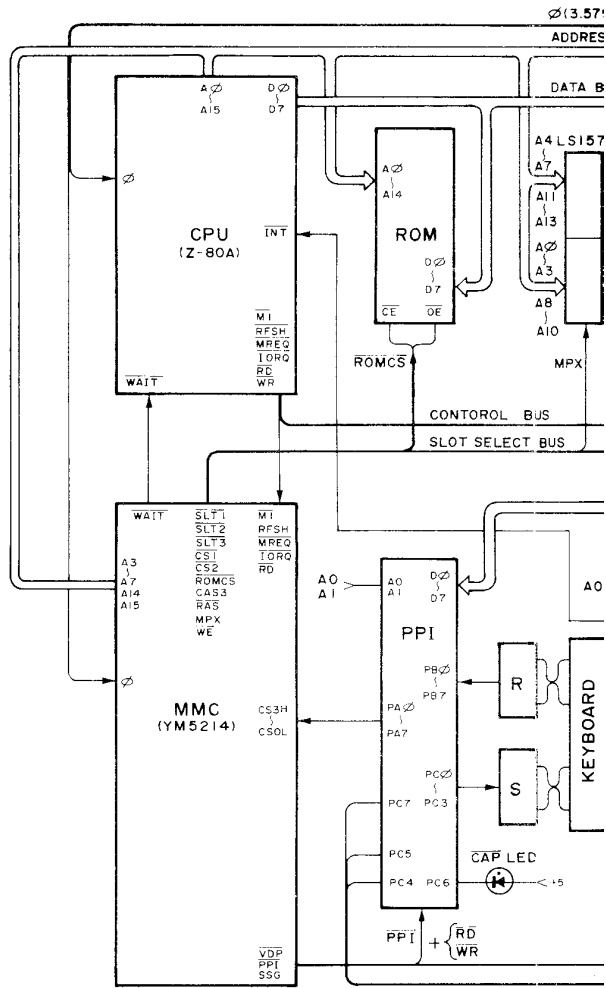
**U - CLOCK CARD**

19	NC
18	NC
17	VIDEO IN
16	GND
15	VIDEO OUT
14	NC
13	NC
12	GND
11	NC
10	NC
9	NC
8	+12V
7	XTAL1 (40)
6	XTAL2 (39)
5	NC
4	GND
3	GND
2	NC
1	NC

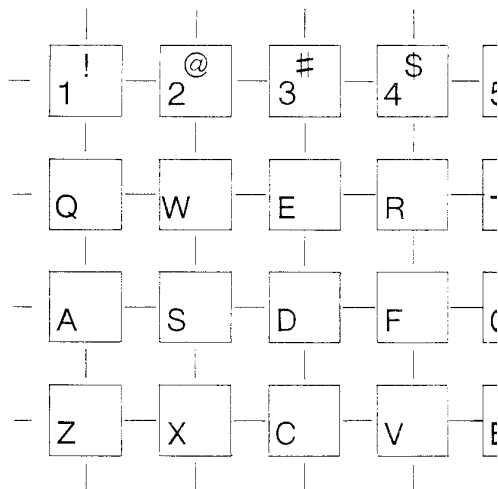


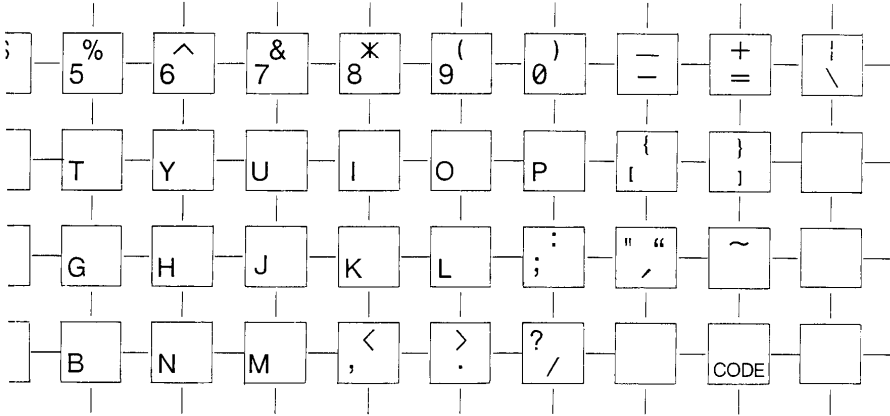
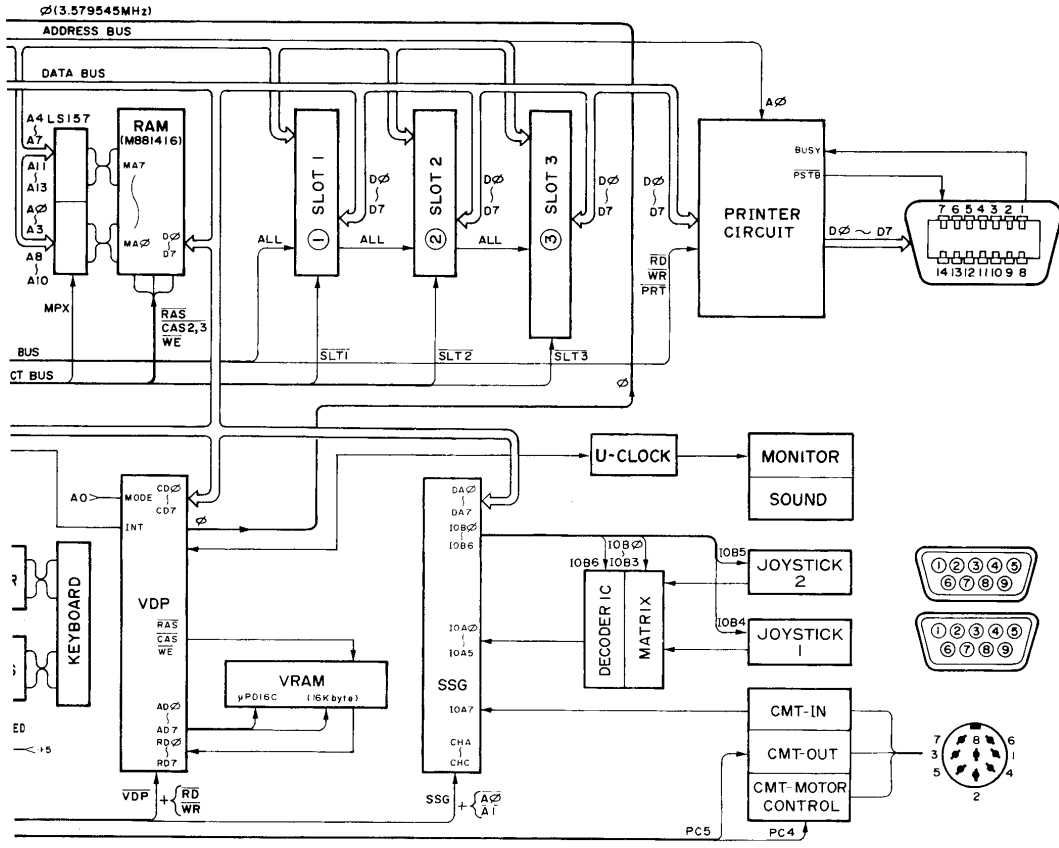
- CPU Circuit Board

■ Block Diagram



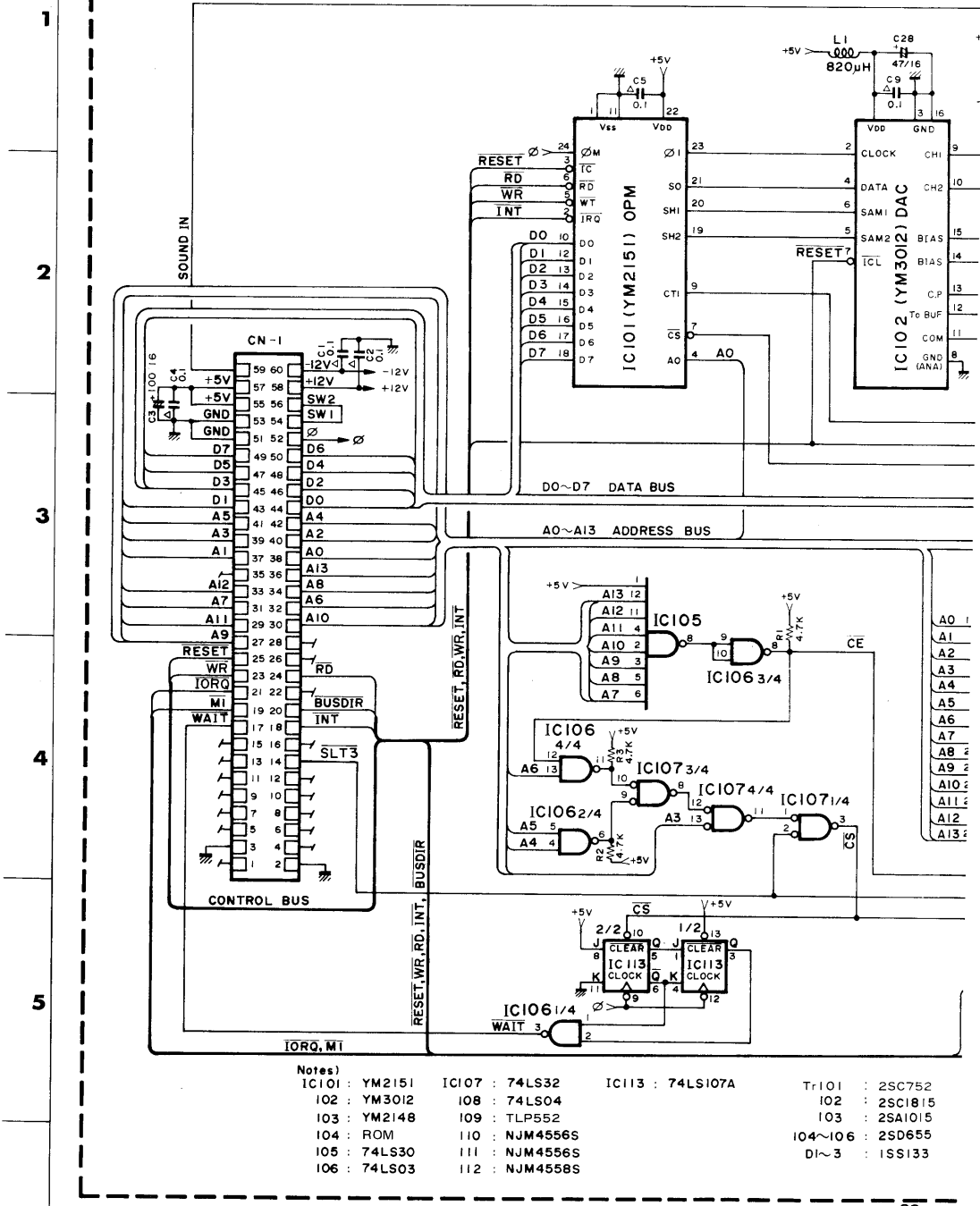
■ Keyboard Layout



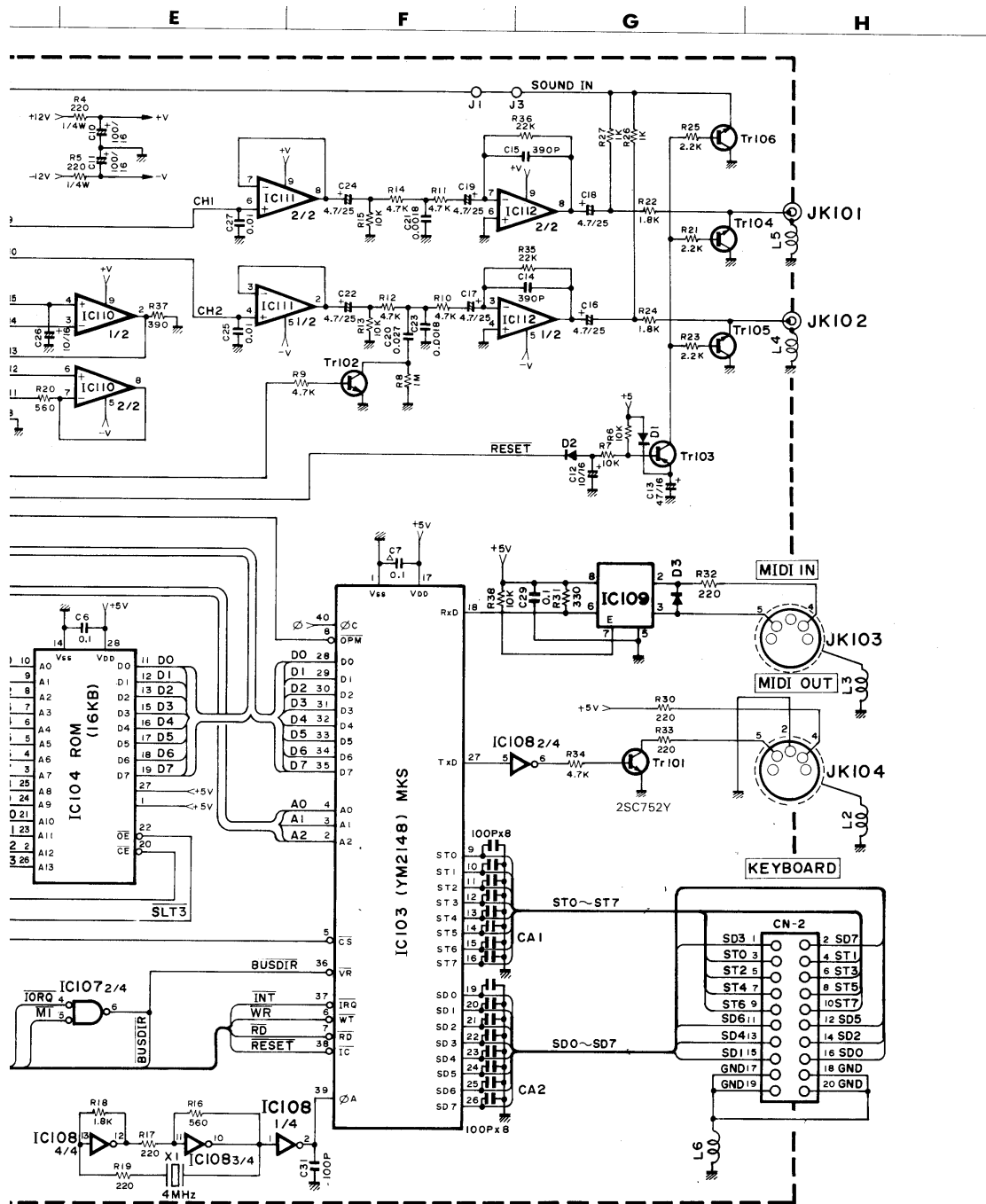


**A**                      **B**                      **C**                      **D**

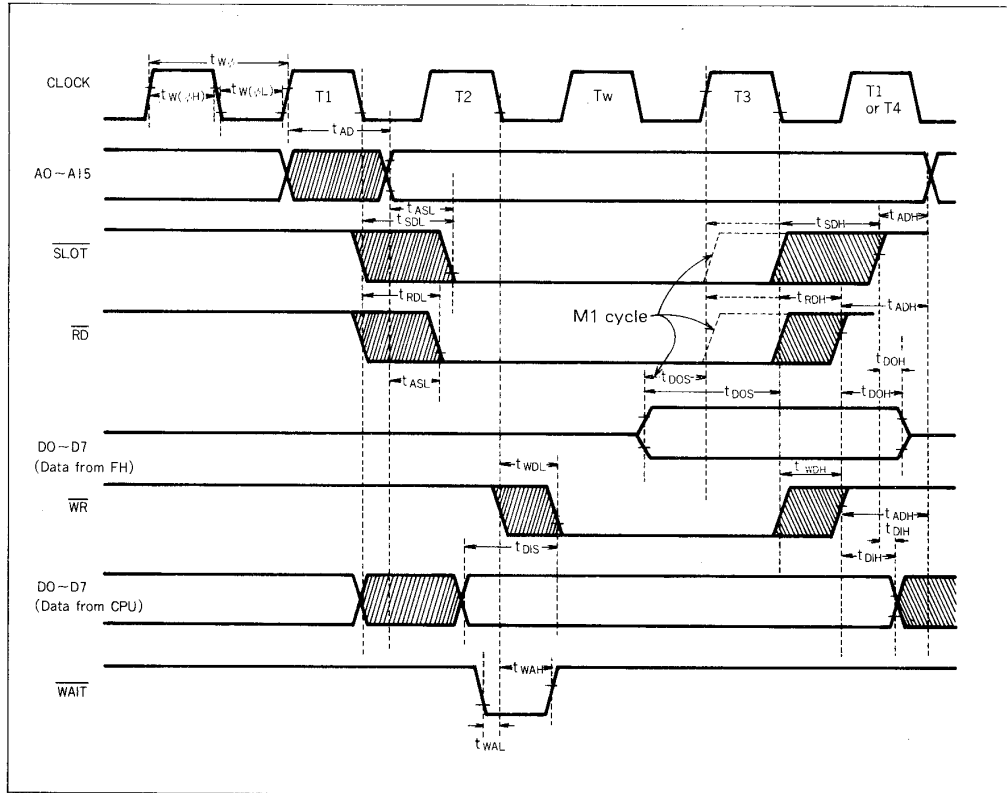
■ **FM Sound Synthesizer Unit Schematic Diagram**



- Notes)
- |                |                  |                  |                      |
|----------------|------------------|------------------|----------------------|
| IC101 : YM2151 | IC107 : 74LS32   | IC113 : 74LS107A | Tr101 : 2SC752       |
| IC102 : YM3012 | IC108 : 74LS04   |                  | IC102 : 2SC1815      |
| IC103 : YM2148 | IC109 : TLP552   |                  | IC103 : 2SA1015      |
| IC104 : ROM    | IC110 : NJM4556S |                  | IC104~IC106 : 2SD655 |
| IC105 : 74LS30 | IC111 : NJM4556S |                  | DI~D3 : 1SS133       |
| IC106 : 74LS03 | IC112 : NJM4558S |                  |                      |



■ Timing Chart



■ FM Circuit Board

■ LSI Function

1) OPM (YM2151)

FM sound generator of the FM sound synthesizer unit. When used with a D/A converter (DAC), 8 audio tone signals can be obtained at the R and L channels.

The YM2151 has 8 note capability and it is also equipped with a noise generator, vibrato oscillator, amplitude modulation circuit, tonal effect generator and timer circuitry. 2 sets of times are used and when a timer overflows an interrupt request takes place.

2) DAC (YM3012)

As related in OPM section, this is a D/A converter to produce 2 channel (left and right) audio signal.

3) ROM (YM2270-2)

Program is written to control MKS and OPM and located in SLOT # 3 000H ~ 3F7FH.

4) MKS (YM2148)

MKS has a MIDI function, keyboard scan function and supports MODE 2 IRQ for CPU.

MIDI is a synchronous serial data transfer of 31.25 K baud transfer rate. Keyboard scan is a function to handle keyboard ON/OFF data of the connected music keyboard.

When MODE 2 IRQ takes place, due to demand by CPU, VECTOR ADDRESS goes out to DATA BUS.

■ FM Sound Synthesizer Unit Address Map

AD- DRESS	INPUT						OUTPUT OPM	INTERNAL REGISTERS
	CS0	RD	WT	A 2	A 1	A 0		
	1	/	/	/	/	/	1	/
	/	1	1	/	/	/		/
3FF0H	0	0	1	0	0	0	0	OPM STATUS REGISTER * YM2195(OPM)
	0	1	0	0	0	0		OPM ADDRESS REGISTER "
3FF1H	0	0	1	0	0	1		OPM DATA REGISTER "
	0	1	0	0	0	1		OPM DATA REGISTER "
3FF2H	0	1	0	0	1	0	1	ST0 ~ ST7 OUTPUT DATA REGISTER
	0	0	1	0	1	0		SD0 ~ SD7 INPUT DATA REGISTER
3FF3H	0	1	0	0	1	1		MIDI IRQ VECTOR ADDRESS REGISTER
	/	0	1	0	1	1		/
3FF4H	0	1	0	1	0	0		EXTERNAL IRQ VECTOR ADDRESS REGISTER
	/	0	1	1	0	0		/
3FF5H	0	0	1	1	0	1		MIDI UART DATA READ BUFFER
	0	1	0	1	0	1		MIDI UART DATA WRITE BUFFER
3FF6H	0	0	1	1	1	0		MIDI UART STATUS REGISTER
	0	1	0	1	1	0		MIDI UART COMMAND REGISTER
3FF7H	/	/	/	1	1	1		/



■ LSI Data Table  
YM2148 MKS

Pin No.	Pin Name	I/O	Function
1	VSS	—	Ground
2	A <sub>0</sub>	I	} Selection data for internal registers
3	A <sub>1</sub>	I	
4	A <sub>2</sub>	I	
5	$\overline{\text{CS}}$	I	Chip select
6	$\overline{\text{WT}}$	I	Write request signal
7	$\overline{\text{RD}}$	I	Read request signal
8	$\overline{\text{OPM}}$	O	Address decode out to OPM
9	ST <sub>0</sub>	O	} (Latch port in 2nd address) Use as strobe output to musical keyboard
∧	∧	∧	
16	ST <sub>7</sub>	O	
17	VDD	—	Power Supply + 5V DC
18	RXD	I	MIDI serial data
19	SD <sub>0</sub>	I	} Input port from musical keyboard
∧	∧	∧	
26	SD <sub>7</sub>	I	
27	TXD	O	MIDI serial data
28	D <sub>0</sub>	I/O	} I/O port for 3-state data bus
∧	∧	∧	
35	D <sub>7</sub>	I/O	
36	$\overline{\text{VR}}$	I	VECTOR ADDRESS REQUEST / for Z80 MODE 2 IRQ
37	$\overline{\text{IRQ}}$	O	Interrupted request data when MIDI data transmission
38	$\overline{\text{IC}}$	I	"L" reset data IRQ → "H", $\overline{\text{OPM}}$ → "H"
39	φA	I	Baud-rate setting clock for MIDI transmission
40	φ	I	Master clock

YM2151 OPM

Pin No.	Pin Name	I/O	Function
1	V <sub>SS</sub>	—	Ground
2	$\overline{\text{IRQ}}$		IRQ output port
3	$\overline{\text{IC}}$	I	"L" reset
4	A <sub>0</sub>	I	Selection data for internal registers
5	$\overline{\text{WT}}$	I	Write request signal
6	$\overline{\text{RD}}$	I	Read request signal
7	$\overline{\text{CS}}$	I	Chip select
8	GND		Analog ground
9	$\overline{\text{CT}}_1$	O	Filter selector data (CUTOFF FREQUENCY 2 KHz)
10	D <sub>0</sub>	I/O	I/O port for 3-state data bus
11	V <sub>SS</sub>	—	Ground
12	D <sub>1</sub>	I/O	I/O port for 3-state data
17	?	I	
18	D <sub>7</sub>	I/O	
19	SH1	O	Data for separation L with R
20	SH2	O	
21	S <sub>0</sub>	O	Serial data for sound source
22	V <sub>DD</sub>	—	Power supply + 5V
23	$\phi$ 1	O	Clock for DAC
24	$\phi$	I	Master clock

YM3012 DAC

Pin No.	Pin Name	I/O	Function
1	V <sub>DD</sub>	—	+ 5V
2	CLOCK	I	Timing clock for OPM
3	GND	—	Ground
4	DATA	I	Serial data for sound source
5	SAM2	I	Sampling data 1 (for separation L with R)
6	SAM1	I	Sampling data 2 (for separation L with R)
7	$\overline{\text{ICL}}$	I	Initial clear
8	GND	—	Analog ground
9	CH1	O	Analog data on 1ch (Lch)
10	CH2	O	Analog data on 2ch (Rch)
11	COM	O	Off-set control
12	T <sub>0</sub> BUF	O	
13	C,P	I	Center point
14	BIAS	O	BIAS compensation
15	BIAS	O	BIAS OUT
16	GND	—	Ground

# Parts List

## Electronic Components

Ref. No.	Part No.	Description	品名	Remarks	ランク
*	NA 55 16 70	CPU Circuit Board Assembly	C P U ボ ー ドAss'y	(CX5MU)	
*	iG 12 19 00	IC	LH0080A	I C	CPU
*	iG 12 21 00	"	THS9918ANC	"	VDP (CX5MU)
*	iG 10 56 00	"	D8255AC-5	"	PPI
*	iT 52 14 00	"	YM5214	"	MMC
*	iT 21 49 00	"	YM2149	"	SSG
*	iT 23 90 70	"	YM23907	"	USA-BASIC-ROM
*	iG 12 23 00	"	MB81416-12	"	D RAM
*	iG 10 43 00	"	μPD416C-3(MB8116H)	"	V RAM
*	iG 04 37 50	" (P.C.B Address:5B)	SN74LS08	"	Quad 2 Input AND
*	iG 12 25 00	" (P.C.B Address:1D)	SN74LS09	"	Quad 2 Input O.C.AND
*	iG 04 96 50	" (P.C.B Address:4B)	SN74LS14	"	Hex Schmitt Tigger Inv.
*	iG 04 98 50	" (P.C.B Address:6B,5A)	SN74LS32	"	Quad 2 Input OR
*	iG 04 40 50	" (P.C.B Address:4A)	SN74LS74	"	Dual D-FFs
*	iG 05 95 00	" (P.C.B Address:6A)	SN74LS125	"	Quad 3 State Bus Buffers
*	iG 12 41 00	" (P.C.B Address:1B)	SN74LS145	"	O.C.BCD to DECIMAL D/D
*	iG 05 96 50	" (P.C.B Address:1C,1E,5D,5E)	SN74LS157	"	2 to 1 Data Selectors
*	iG 06 00 50	" (P.C.B Address:4D,4E)	SN74LS244	"	Octal 3 State Bus Buffers
*	iG 05 07 00	" (P.C.B Address:7A)	SN74LS374	"	Octal 3 State D-FFs
*	iG 07 16 00	" (P.C.B Address:1A)	SN74LS367	"	Hex 3 State Bus Buffers
*	iG 07 76 00	" (P.C.B Address:9B)	SN75451	"	Dual Peripheral AND
*	iG 00 13 90	"	NJM4558D	"	OP Amp.
*	iG 03 34 00	" (P.C.B Address:11B)	μPC-311C	"	
*	iG 12 43 00	" (P.C.B Address:7B)	PST518	"	RESET IC
	iA 10 15 10	Transistor	2SA1015(O,Y)	ト ラ ン ジ ス タ	TR1,2
	iF 00 34 50	Diode	1S5133	ダ イ オ ー ド	D1,2,3
	iF 00 40 80	Zener Diode	05Z5,1	ツ ェ ナ ー ダ イ オ ー ド	ZD1
	HF 85 42 20	Resistor	22 1/6W	抵 抗	R51,52,54,55
	HF 85 52 20	"	220 "	"	R10,61,62,63,64,84,86
	HF 85 54 70	"	470 "	"	R06,84,86,88
	HF 85 56 80	"	680 "	"	R71
	HF 85 61 00	"	1K "	"	R12,13,42,43,70
	HF 85 61 20	"	1.2K "	"	R41
	HF 85 62 20	"	2.2K "	"	R22,57,58,59,60
	HF 85 62 70	"	2.7K "	"	R21
	HF 85 63 30	"	3.3K "	"	R09,53
	HF 85 64 70	"	4.7K "	"	R01,02,03,04,05,14,24,28,32,33 35,40,87
	HF 85 71 00	"	10K "	"	R07,08,11,36,37,56,68
	HF 85 71 20	"	12K "	"	R20
	HF 85 72 20	"	22K "	"	R29,44,45,46,47,48,65,66 67,69,72,73,74,75,76,77 78,79,80,81,82,83,85,90 91,92,93,94,95,96
	HF 85 74 70	"	47K "	"	R16

\* : New Parts

ランク: Japan only 34

● Electronic Components

Ref. No.	Part No.	Description	品名	Remarks	ランク	
	HF 85 84 70	Resistor	470K 1/6W	抵抗	抗	R23
	HJ 35 51 00	"	100 1/4W	"	"	R39
	HJ 35 52 20	"	220 1/4W	"	"	R15
	HJ 35 61 00	"	1K 1/4W	"	"	R38
	HL 50 44 70	"	47 1/2W	"	"	R30
	HL 50 46 80	"	68 1/2W	"	"	R34
	HL 50 48 20	"	82 1/2W	"	"	R31
	UJ 16 64 70	Electrolytic Cap	4.7/50	ケミコン		C01,02,12,13,14
	UJ 13 74 70	"	47/16	"		C26,71
	UJ 46 63 30	"	3.3/50	"		C31
	UJ 13 81 00	"	100/16	"		C23
	UJ 12 84 70	"	470/10	"		C15
	UK 14 64 70	NP Cap.	4.7/25	NPコンデンサ		C22
※	FA 15 31 50	Mylar Cap.	0.0015(K)	マイラーコン		C29
	FA 15 31 50	"	0.0015(J)	"		C27
	FA 15 42 20	"	0.022 50V	"		C32
	FS 68 51 00	Ceramic Cap.	0.1 25V	半導体セラコン		C03,04,05,06,07,08,09, 16,17,18,19,20,21,25,28, 33,34,35,36,37,38,39,40, 41,42,43,46,47,48,49, 50,51,52,53,54,55,56, 57,58,59,60,61,62,63,64, 66,68,69,70
	FG 71 31 00	Ceramic Cap.	1000P 25V	セラコン		C72
	UJ 13 82 20	Ultra Miniature Electrolytic Cap.	220 $\mu$ 16V	超小型ケミコン		C65,67
	GE 30 03 50	Coil	68 $\mu$ H	チョークコイル		L01
	KC 00 13 50	Relay	AW-6219	リレー		RY1
	CB 55 28 10	Spacer		ジュラコンスペーサ		
※	LB 50 06 20	Connector	5P TCS5034-15-1111	D I N		VIDEO
※	LB 60 68 40	"	50P M475-25-30-142	コネクタ		SLOT1
※	LB 60 76 80	"	8P TCS5034-18-1111	D I N		CASSETTE
※	LB 60 76 90	"	9P CA-M59	D - S U B		JOYSTICK 1/2
※	LB 60 68 70	"	14P 57EL40140-7708D12	アンフェノール		PRINTER
※	LB 60 68 80	"	HBR12S1J	ジャンパコネクタ		CN9,10
※	LB 60 24 90	"	B8P-SHF-1AA	N H コネクタ		CN2
※	LB 30 07 30	"	B3P-SHF-1AA	N H コネクタ		CN8
	FZ 00 60 90	EMI Filter	DS310-55B-271M	EMIフィルター		
	BD 06 18 00	Filter	B-20L-25	ビーズ		

※ : New Parts

ランク: Japan only

Ref. No.	Part No.	Description	品 名	Remarks	ランク
	<b>NA 55 17 10</b>	<b>Key Sub Circuit Board</b>			
			キーサブシート		
	iG 00 17 40	IC	TC4050BP	I C	IC1,2
	HJ 35 62 20	Carbon Resistor	2.2K 1/4W	カーボン抵抗	R1~8
	FS 68 51 00	Ceramic Cap	0.1 25V	セラコン	C1,2
	LB 60 77 00	Connector	9P	コネクタ	
	LB 60 77 10	"	14P	"	
	LB 60 77 20	"		"	

\* : New Parts

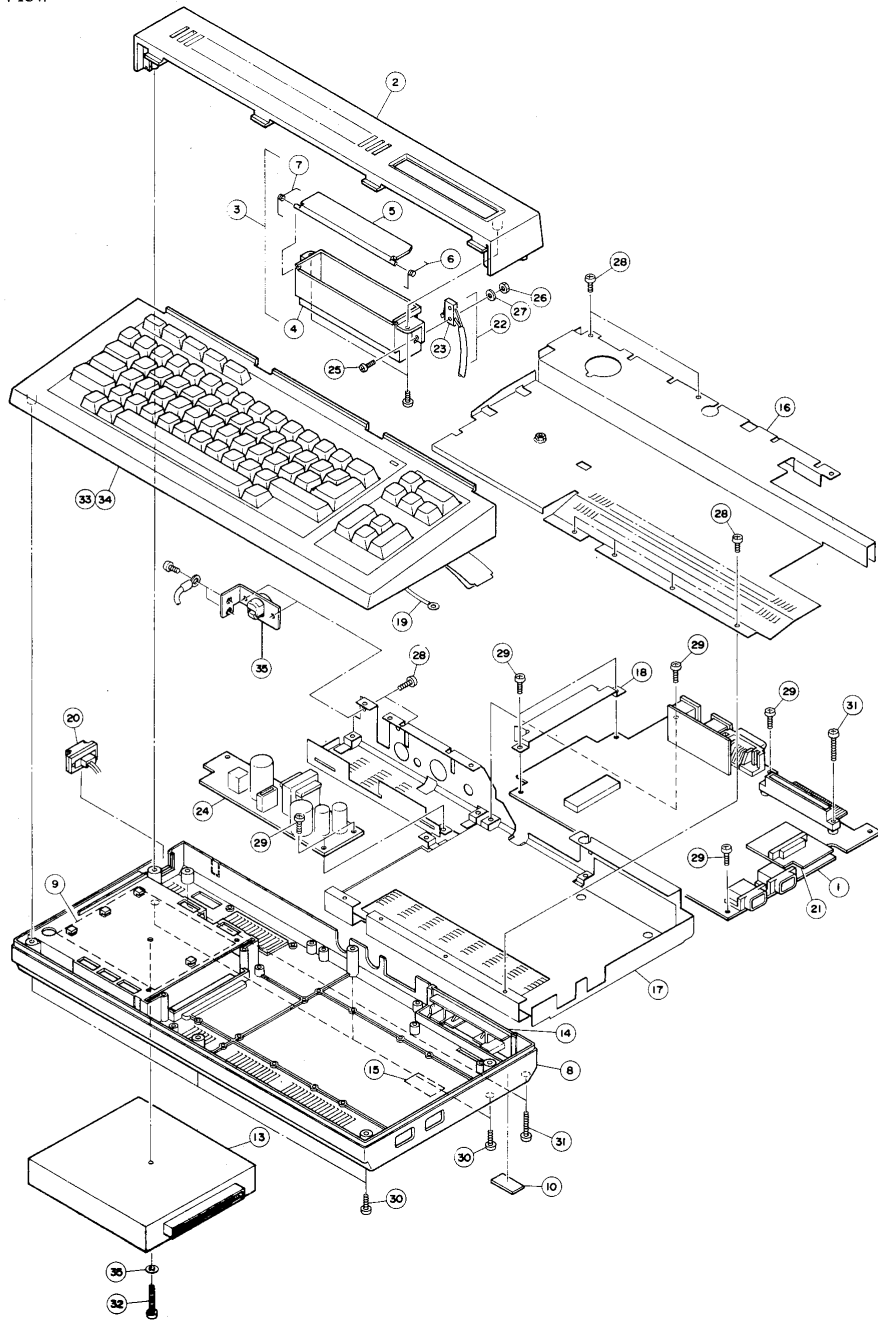
ランク: Japan only

Ref. No.	Part No.	Description	品 名	Remarks	ランク
	<b>NA 55 17 30</b>	<b>U-Clock Card</b>			
			Uクロックカード		
	iC 18 15 10	Transistor	2 SC 1815	トランジスタ	TR1
	FG 41 11 00	Ceramic Cap	10P 50V	セラコン	C1
	FG 41 13 00	"	33P 50V	"	C2
	FG 41 23 30	"	330P 50V	"	C5
	FY 00 02 70	Trim	TZ03R300FR		TC1
	FS 68 51 00	Ceramic Cap	0.1 25V	セラコン	C4
	QU 00 62 00	Quartz Crystal Unit	10.73863MHz	水晶発振ユニット	X1

\* : New Parts

ランク: Japan only

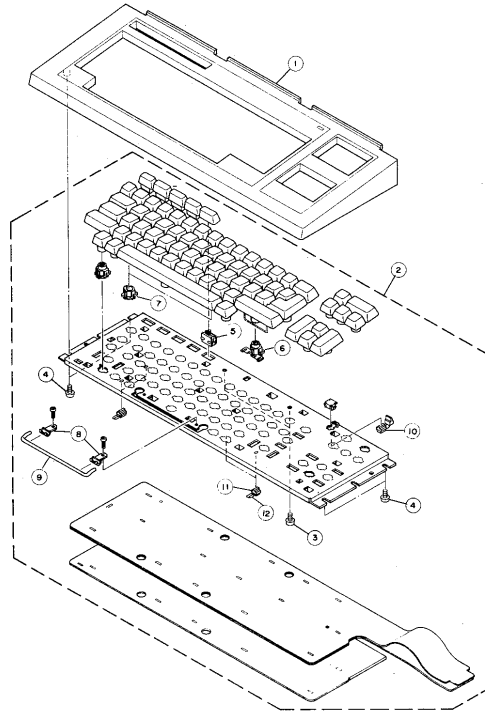
● Exploded View



Ref. No.	Part No.	Description	品 名	Remarks	ランク
* 1	NA 55 16 70	CPU Circuit Board	ROM 32KB #9918	M S X C P U シート	
* 2	CB 55 36 50	Rear Case		リ ア ケ ー ス	
* 3	NB 55 18 70	Upper Slot Assembly		ア ッ パ ー ス ロ ッ ト Ass'y	
* 4	CB 55 38 10	Upper Slot		ア ッ パ ー ス ロ ッ ト	
* 5	CB 55 38 20	Upper Slot Door		ア ッ パ ー ス ロ ッ ト ドア	
* 6	AA 55 32 40	Upper Slot Door Spring	Right	ア ッ パ ー ス ロ ッ ト ドア ばね (右)	
* 7	AA 55 32 50	"	Left	" (左)	
* 8	NB 55 18 80	Bottom Case		下 ケ ー ス	
* 9	CB 55 39 50	Side Slot Shield	PET12 $\mu$	サイドスロットシールド板	
* 10	CC 03 61 30	Foot		脚	
* 11	CA 55 16 10	Spacer		ス ペ ー サ	
* 13	NB 55 19 50	FM Sound Synthesizer Unit		FM サ ウ ン ド ユ ニ ッ ト	See page 44
* 14	CB 55 37 30	Rear Slot Cover		リアスロットカバー	
* 15	CB 55 36 30	Name Plate	0.05t POLYFILM	銘 板	
* 16	NB 55 16 90	Top Shield Cover		シールドケーストップ Ass'y	
* 17	AA 55 36 40	Bottom Shield Cover		シールドケースボトム	
* 18	AA 55 36 60	Grounding Bracket		サイドスロットアース	
* 19	MZ 55 12 80	Grounding Terminal Ass'y		キーボードアース Ass'y	
* 20	KA 10 12 20	Switch	SDJ1A-A	パ ワ ー ス イ ッ チ	
* 21	NA 55 17 10	Key Sub Board Assembly		キ ー サ ブ シ ー ト	
* 22	NB 55 27 20	Micro Switch Assembly		マ イ ク ロ S W Ass'y	
* 23	KA 60 06 80	Micro Switch	D2MSL13-C	マ イ ク ロ S W	
* 24	NP 55 12 00	Power Supply Unit		電 源 ユ ニ ッ ト	See page 42
	LB 30 07 30	Connector Housing	H3P-SHF-AA	コネクタハウジング	
	BB 00 44 30	"	SHF-0.01T-0.8CS	"	
* 25	ED 02 01 26	Bind Head Screw	2 $\times$ 12	バ イ ン ド 小 ネ ジ	
* 26	EV 10 00 26	Hexagonal Nut	M2	六 角 ナ ッ ト	
* 27	EV 20 02 06	Flat Washer	M2	ワ ッ シ ャ ー	
* 28	Ei 03 00 66	Bind Head Tapping Screw	3 $\times$ 6	バ イ ン ド タ ッ ピ ン ネ ジ	
* 29	Ei 03 00 86	"	3 $\times$ 8	"	
* 30	Ei 13 01 06	"	3 $\times$ 10	"	
* 31	EJ 03 01 80	Pan Head Tapping Screw	3 $\times$ 18	ナ ベ タ ッ ピ ン ネ ジ	
* 32	EX 55 00 10	Screw	3 $\times$ 30 (Black)	小 ネ ジ	
* 33	Ei 04 00 60	Bind Head Tapping Screw	4 $\times$ 6	バ イ ン ド タ ッ ピ ン ネ ジ	
* 34	Ei 41 00 30	"	4 $\times$ 8	"	
* 35	AA 55 37 40	Power Cord Stopper Holder		ス ト ッ パ ー ホ ル ダ ー	
	Mi 55 11 60	CMT Cable		C M T ケ ー ブ ル	

\* : New Parts

● Keyboard



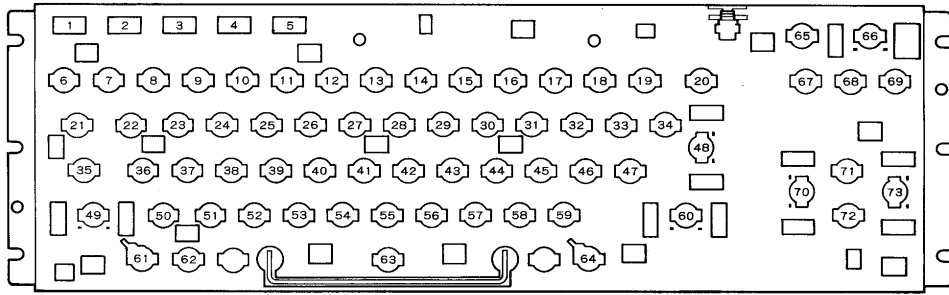
Ref. No.	Part No.	Description	品名	Remarks	ランク
1	CB 55 37 20	Upper Case	上 ケ ー ス		
2	PB 55 07 30	Keyboard	キ ー ボ ー ド		
3	Ei 04 00 60	Bind Head Tapping Screw	バインドタッピンネジ		
4	Ei 04 00 80	"	"		
* 5	KX 55 03 40	Key Switch Assembly	F1~F5 Keys	キ ー ス イ ッ チ Ass'y	
* 6	KX 55 03 50	"	SHIFT, RETURN	"	
* 7	KX 55 03 60	"	CURSOR(L,R)	"	
* 8	KX 55 03 70	"	STOP	"	
* 9	KX 55 03 80	Switch Guide	SHIFT(R),SPACE	ス イ ッ チ ガ イ ド	
10	CX 55 16 40	Space Bar Plate		ス ペ ー ス バ ー プ レ ー ト	
11	AX 55 00 40	Space Bar Arm		ス ペ ー ス バ ー ア ー ム	
12	iX 55 16 40	LED	Power	L E D	
	iF 00 17 20	"	CAPS	"	
13	CX 55 60 00	Rubber		ゴ ム (ダイオード用)	
14	iF 00 34 50	Diode	ISS133	ダ イ オ ー ド	

\* : New Parts

ランク: Japan only



● Keytops



Ref. No.	Part No.	Description	品名	Remarks	ランク
	<b>CX5MU</b>				
1	CX 55 37 50	Keytop	F1/F6		
2	CX 55 37 60	"	F2/F7		
3	CX 55 37 70	"	F3/F8		
4	CX 55 37 80	"	F4/F9		
5	CX 55 37 90	"	F5/F10		
6	CX 55 38 00	"	ESC		
7	CX 55 38 10	"	1		
8	CX 55 38 20	"	2		
9	CX 55 38 30	"	3		
10	CX 55 38 40	"	4		
11	CX 55 38 50	"	5		
12	CX 55 38 60	"	6		
13	CX 55 38 70	"	7		
14	CX 55 38 80	"	8		
15	CX 55 38 90	"	9		
16	CX 55 39 00	"	0		
17	CX 55 39 10	"	-		
18	CX 55 39 20	"	= +		
19	CX 55 39 30	"	\ :		
20	CX 55 39 40	"	BS		
21	CX 55 39 50	"	TAB		
22	CX 55 39 60	"	Q		
23	CX 55 39 70	"	W		
24	CX 55 39 80	"	F		
25	CX 55 39 90	"	R		
26	CX 55 40 00	"	T		
27	CX 55 40 10	"	Y		
28	CX 55 40 20	"	U		
29	CX 55 40 30	"	I		
30	CX 55 40 40	"	O		
31	CX 55 40 50	"	P		
32	CX 55 40 60	"	[		
33	CX 55 40 70	"	]		
34	CX 55 40 80	"	(DEAD)		
35	CX 55 40 90	"	CTRL		

\* : New Parts

ランク : Japan only

Ref. No.	Part No.	Description	品名	Remarks	ランク
	<b>CX-5M</b>				
36	CX 55 41 00	Keytop	A		
37	CX 55 41 10	"	S		
38	CX 55 41 20	"	D		
39	CX 55 41 30	"	F		
40	CX 55 41 40	"	G		
41	CX 55 41 50	"	H		
42	CX 55 41 60	"	J		
43	CX 55 41 70	"	K		
44	CX 55 41 80	"	L		
45	CX 55 41 90	"	:		
46	CX 55 42 00	"	<		
47	CX 55 42 10	"	~ \		
48	CX 55 42 30	"	(RETURN)		
49	CX 55 42 40	"	SHIFT		
50	CX 55 42 50	"	Z		
51	CX 55 42 60	"	X		
52	CX 55 42 70	"	C		
53	CX 55 42 80	"	V		
54	CX 55 42 90	"	B		
55	CX 55 43 00	"	N		
56	CX 55 43 10	"	M		
57	CX 55 43 20	"	,		
58	CX 55 43 30	"	.		
59	CX 55 43 40	"	/		
60	CX 55 43 50	"	SHIFT (Long)		
61	CX 55 43 60	"	CAPS		
62	CX 55 43 70	"	GRAPH		
63	CX 55 43 80	"	(SPACE)		
64	CX 55 43 90	"	CODE		
65	CX 55 44 00	"	SELECT		
66	CX 55 44 10	"	STOP		
67	CX 55 44 20	"	CLS HOME		
68	CX 55 44 30	"	INS		
69	CX 55 44 40	"	DEL		
70,73	CX 55 44 50	"	← → (Large)		
71,72	CX 55 44 60	"	↑ ↓ (short)		

Power Supply Unit

Ref. No.	Part No.	Description	品 名		Remarks	ランク
	NP 55 12 00	Power Supply Unit		電 源 ユ ニ ッ ト		
※	HX 55 13 00	Fuse Resistor L53D-6R8JF	6.8	2A/125V 5W	フューズ抵抗	R01
	HL 32 46 80	Metal Oxide Resistor	68	2W	金属皮膜抵抗	R03
	HJ 35 52 20	Carbon Resistor	220	1/4W	カーボン抵抗	R04
	HL 31 45 60	Metal Oxide Resistor	56	1W	金属皮膜抵抗	R05
	HJ 35 43 30	Carbon Resistor	33	1/4W	カーボン抵抗	R06
	HJ 35 61 20	"	1.2K	1/4W	"	R07
	HM 55 31 00	Cement Molded Resistor	1	5W	セメント抵抗	R08
	HL 35 56 80	Metal Oxide Resistor	680	3W	金属皮膜抵抗	R09,16
	HJ 35 63 90	Carbon Resistor	3.9K	1/4W	カーボン抵抗	R10
	HJ 35 51 00	"	100	1/4W	"	R11
	HJ 35 61 50	"	1.5K	1/4W	"	R12
	HJ 35 61 80	"	1.8K	1/4W	"	R13
	HL 30 55 60	"	560	1/2W	"	R14
	HJ 35 53 30	"	330	1/4W	"	R15
	FZ 00 43 30	Metalized Cap. ECQ-U1A104MH	0.01 $\mu$ F	125V	金属皮膜コンデンサ	C01
	FX 55 11 30	Electrolytic Cap. UHU2D151MRAAMP	150 $\mu$ F	200V	ケミカルコンデンサ	C03
	UA 15 41 50	Mylar Cap. ECQ-V1H153JZ	0.015 $\mu$ F	50V	マイラーコンデンサ	C04
	UJ 16 61 00	Electrolytic Cap. UPC1H010MAH	1 $\mu$ F	50V	ケミカルコンデンサ	C05
※	FX 55 11 40	Ceramic Cap. DE0705B102K	1000pF	DC1kV	セラミックコンデンサ	C07
	UJ 13 91 00	Electrolytic Cap. UPC1C102MRH	1000 $\mu$ F	16V	ケミカルコンデンサ	C08,10
	UJ 13 84 70	" UPC1C471MRH	470 $\mu$ F	16V	"	C09,12
	UJ 12 92 20	" UPX1A222MRH	2200 $\mu$ F	10V	"	C11
	FG 24 51 00	Ceramic Cap. ECQ-V1H104JZ	0.1 $\mu$ F	50V	セラミックコンデンサ	C13
	FG 71 32 20	" DE7100F222MVA1K	0.22 $\mu$ F	50V	"	C14,15
	FA 15 52 20	Mylar Cap. ECQ-V1H224JZ	0.22 $\mu$ F	50V	マイラーコンデンサ	C16
※	iX 55 29 40	Transistor	2SC2655		トランジスタ	Q01
※	iX 55 29 50	"	2SC2555		"	Q02
	iC 99 02 00	"	2SC2634		"	Q03
※	iX 55 29 20	Diode	DF04M		ダイオード	D01
	iX 55 15 80	"	ERB4406		"	D02
	iF 00 13 80	"	1SS84		"	D03
	iX 55 16 00	"	ERB4302		"	D04,05,09
※	iX 55 17 20	"	30DF2		"	D06,07
※	iX 55 29 30	"	C8PO4Q		"	D08
	iF 00 14 70	Zener Diode	RD6.2EB2		ツェナーダイオード	ZD01
※	GX 55 03 70	Coil	PLA8021A	8MH 0.5A	コイル	L01
	GX 55 00 90	"	FL9H151K-30	150 $\mu$ H 0.5A	"	L02
	GX 55 01 00	"	FL11Z180K-60	18 $\mu$ H 2.8A	"	L03
※	HX 55 13 10	Variable Resistor	RVF8P-B	1K	可変抵抗	VR01
※	GX 55 03 80	Transformer	HC-J1(TM135)		トランス	T01
	iX 55 16 30	Photocoupler	PC817		フォトカプラー	PC01
	KB 00 03 40	Fuse			フューズ	F01
	KA 10 12 20	Power Switch	SDJ1S-A	1.5A 125V	パワースイッチ	SW01
	KA 60 06 80	Micro Switch	D2MSL13C		マイクロスイッチ	SW02

※ : New Parts

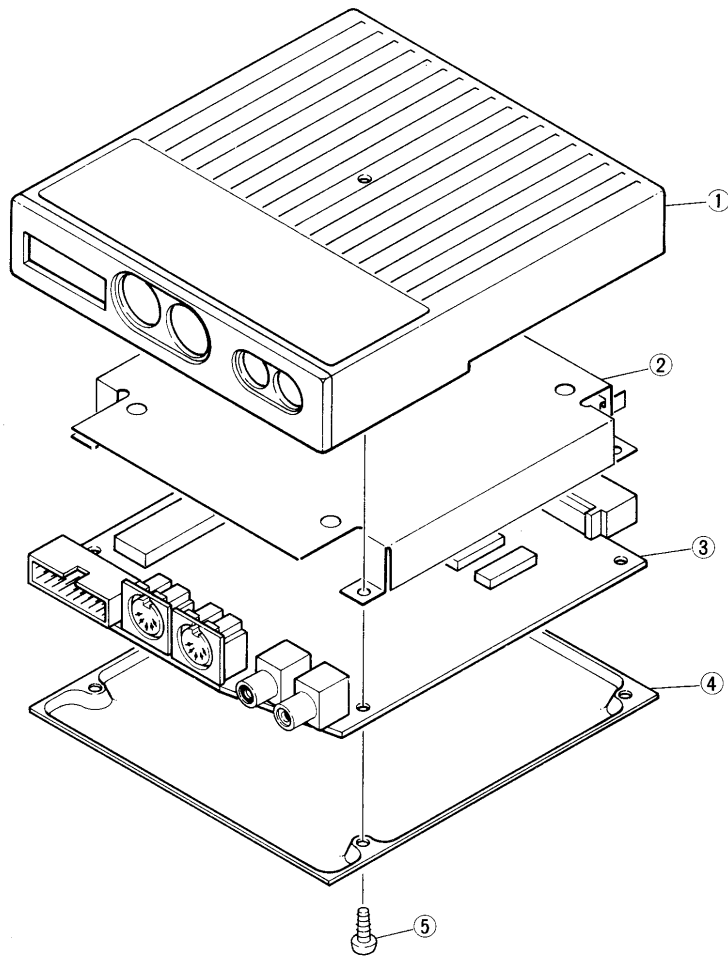
ランク : Japan only

Ref. No.	Part No.	Description	品名	Remarks	ランク
*	MX 55 01 30	Power Cord Assembly	YG-4012-007	A C ケーブル Ass'y	
*	CB 81 12 30	Power Cord Stopper		A C ケーブル ストッパー	
*	AX 55 00 70	Power Cord Stopper Holder	YG-4012-005	ストッパーホルダー	
*	MX 55 01 40	DC Flat Cable	YG-4012-013	D C ケーブル	8Lines
*	BX 55 00 40	Heat Sink MTO-15	DPS-15 A-30	放 熱 板	for D08
*	BX 55 00 60	"	YG-4012-021	"	for Q02
*	KA 60 06 80	Micro Switch	D2MSL13-C	マイクロスイッチ	
*	KA 10 12 20	Power Switch		パワースイッチ	
*	BX 55 00 70	Ferrite Bead	B-20L-48B	フェライトビーズ	
*	CX 55 00 10	Insulator		サ - コ ン	for Q02
	CX 55 00 10	"		"	for D08
	BB 00 44 30	Contact Pin	SHF-001T-08P	コンタクトピン	CN1,6
	LB 30 07 20	Connector Housing	H3P-SHF-AA	コネクタハウジング	CN1
*	LA 00 49 80	Pin (Board in Type)	SCN-001T-10	ピ ン	CN2
	LA 00 50 00	Connector	2P-SCN	コ ネ ク タ	CN2,3,4
	LA 00 50 60	"	8P-SCN	"	CN5
	LB 60 24 80	Connector Housing	H8P-SHF-AA	コネクタハウジング	CN6
	EA 04 00 46	Pan Head Screw	M4x4	ナベ小ネジ	
	ED 03 00 86	Bind Head Screw	M3x8	バインド小ネジ	
	ED 03 01 06	"	M3x10	"	
	EV 10 00 36	Hexagonal Nut	M3	六角ナット	
	EV 20 00 46	Washer	4M	平座金	

43 \* : New Parts

ランク : Japan only

● FM Sound Synthesizer Unit



Ref. No.	Part No.	Description	品名	Remarks
* 1	CB 55 39 10	Upper Case	Metallic	上 ケ ー ス
* 2	AA 55 32 30	Shield		シ ー ル ド 板
* 3	NA 55 16 30	FM Circuit Board		FM-EX シ ー ト
4	AA 55 32 20	Lower Case		下 ケ ー ス
5	EJ 33 00 86	Pan Head Tapping Screw	3×12	ナ ベ タ ッ ピ ン ネ ジ
	CB 55 30 80	MKC Cover		M K C カ バ ー
*	CB 55 39 80	CAUTION Label		注 意 書
*	CB 55 40 00	Label		ラ ベ ル

\* : New Parts

Electronic Components

Ref. No.	Part No.	Description	品 名	Remarks
*	NA 55 16 30	FM Circuit Board	F M 音 源 シ ー ト	
*	IT 21 51 00	IC	YM2151	I C IC101 (OPM)
*	IT 30 12 00	"	YM3012	" IC102 (DAC)
*	IT 21 48 00	"	YM2148	" IC103 (MKS)
*	IT 22 70 20	"	YM22702	" IC104 (128KROM)
*	IG 04 97 50	"	SN74LS30	" IC105
*	IG 09 06 00	"	SN74LS03	" IC106
*	IG 04 98 50	"	SN74LS32	" IC107
*	IG 02 70 20	"	SN74LS04	" IC108
*	IK 00 04 70	"	TLP552	" IC109
*	IG 07 74 00	"	NJM4556S	" IC110,111
*	IG 07 68 00	"	NJM4558S	" IC112
*	IG 07 13 00	"	SN74LS107A	" IC113
*	IC 07 52 20	Transistor	2SC752Y	ト ラ ン ジ ス タ Tr101
*	IC 18 15 50	"	2SC1815Y,GR	" Tr102
*	IA 10 15 80	"	2SA10150,Y	" Tr103
*	ID 06 55 00	"	2SD655D,E,F	" Tr104~106
*	IF 00 34 50	Diode	1SS133	ダ イ オ ー ド D1-3
*	HJ 35 52 20	Carbon Resistor R28FSL 1/4W	220Ω	カ ー ボ ン 抵 抗 R4,5
*	HF 85 64 70	" RD16ST52 1/6W	4.7KΩ	" R1-3,9-12,14,34
*	HF 85 71 00	" " 1/6W	10KΩ	" R6,7,13,15
*	HF 85 91 00	" " 1/6W	1MΩ	" R8
*	HF 85 55 60	" " 1/6W	560Ω	" R16,20
*	HF 85 52 20	" " 1/6W	220Ω	" R17,19,30,32,33
*	HF 85 61 80	" " 1/6W	1.8KΩ	" R18,22,24
*	HF 85 62 20	" " 1/6W	2.2KΩ	" R21,23,25
*	HF 85 61 00	" " 1/6W	1KΩ	" R26,27
*	HF 85 52 70	" " 1/6W	270Ω	" R31
*	HF 85 72 20	" " 1/6W	22KΩ	" R35,36
*	HF 85 53 90	" " 1/6W	390Ω	" R37
*	HF 85 53 30	" " 1/6W	330Ω	"
*	FS 68 51 00	Ceramic Cap.	0.1 25V	半 導 体 セ ラ コ ン C1,2,4~7,9
*	UJ 13 74 70	Electrolytic Cap.	47/16	小 型 ケ ミ コ ン C3,13,28
*	UJ 13 81 00	"	100/16	" C10,11
*	UJ 13 71 00	"	10/16	" C12,26
*	FG 21 23 90	Ceramic Cap.	390P	セ ラ コ ン C14,15
*	UJ 14 64 70	Electrolytic Cap.	4.7/25	小 型 ケ ミ コ ン C16~19,22,24
*	FA 15 42 70	Mylar Cap.	0.027	マ イ ラ ー コ ン C20
*	FA 15 31 80	"	0.0018	" C21,23
*	FA 15 31 00	"	0.001	" C25,27
*	FZ 00 66 80	C-ARY	100p×8	CA1,CA2
*	GE 90 09 60	Coil	820μH	固 定 コ イ ル L1
*	QU 00 05 00	Quartz Oscillator	4MHz	水 晶 発 振 子 X1
*	GE 30 06 70	Ferrite Bead	BL02RN2-R62-T2	フェ ラ イ ト ビ ー ズ L2,3,4,5,6
*	LB 20 27 20	Jack, Pin(with Switch)	(White)	ス イ ッ チ 付 ピ ン ジャ ッ ク (白) JK101
*	LB 20 27 30	" , Pin(with Switch)	(Red)	" (赤) JK102
*	LB 50 06 50	" , DIN-5P		5P. DIN ジャ ッ ク JK103,104
*	LB 60 68 30	Connector	60P	コ ネ ク タ CN1
*	LB 60 54 30	"	20P	コ ネ ク タ CN2

\* : New Parts