ORDER NO. ED84113035C2

Service Manual

MSX

Personal Computer

CF-2700

Specifications

Microprocessor	Z-80A
Memory	ROM 32 K bytes (MSX-BASIC) Main RAM 64K bytes Video RAM 16K bytes
Video system	
Controller	TMS 9929A
Number of displayable characters	32 characters x 24 lines 8 (H) x 8 (W) dots/character mode 40 characters x 24 lines 8 (H) x 6 (W) dots/character mode
Number of displayable dots	256 (H) x 192 (V) dots
Output signals	Video output, RF output
Sound system	
Controller	AY-3-8910A
Functions	8 octave, 3 chord output
Keyboard	73 keys
Cassette tape interface	
System	FSK
Transfer rate	1200/2400 baud
I/O ports	
Slot	2 (comforms to MSX specifications)
Printer port	1, 14-pin
General port	2, 9-pin each
Sound output	1
Dimensions and Weight (Main unit)	436 (W) x 245 (D) x 90 (H) mm approx. 3.6 kg
Power requirements	
Voltage	220 V, 50 Hz (Only for UK 240 V, 50 Hz)
Power consumption	28 W

Design and Specifications are subject to change without notice.

Panasonic

Matsushita Electric Trading Co., Ltd.
P.O. Box 288, Central Osaka Japan

CONTENTS

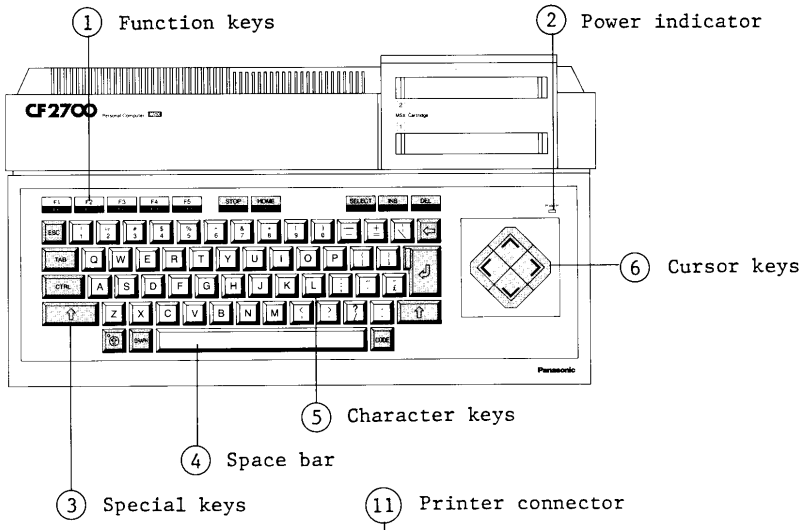
The MSX system realizes software compatibility between MSX personal computers. MSX is a trademark of Microsoft Corporation.

IMPORTANT (FOR U.K.)

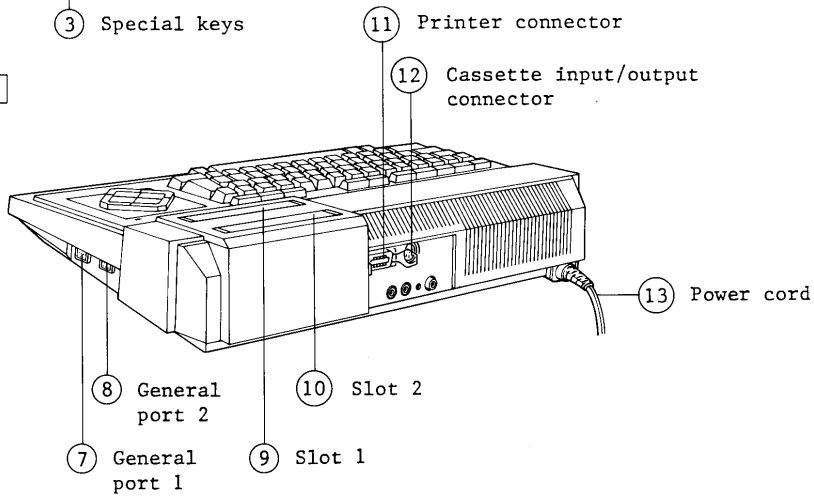
The wires in the mains lead are coloured in accordance with the following codes:
Blue: Neutral Brown: Live
As the colours of the wires in the mains lead of this apparatus may not correspond with the coloured markings identifying the terminals in your plug, proceed as follows:
•The wire which is coloured blue must be connected to the terminal which is marked with the letter N or coloured black.
•The wire which is coloured brown must be connected to the terminal which is marked with the letter L or coloured red.
Notes:
•Disconnect the mains plug from the supply socket when not in use.
•Do not remove cover. Live parts inside.

Location of Controls and Components

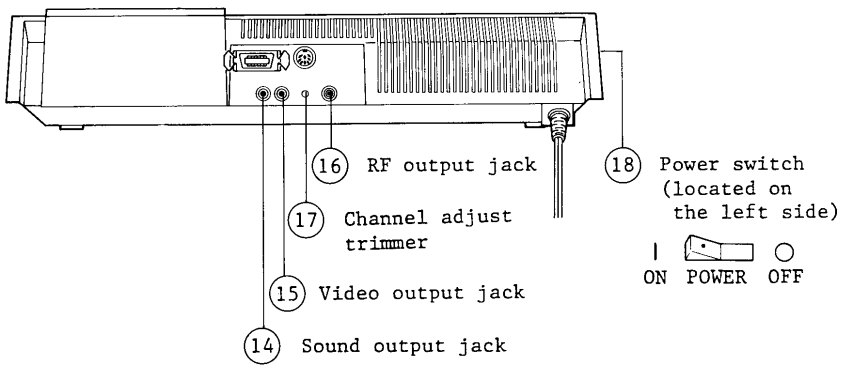
Top View



Right End Rear View



Rear View



(1) Function keys
Key used for easy inputs of pre-defined character strings.

(2) Power indicator
Lights when the power switch is turned on and goes out when the power is turned off.

(3) Special keys
Keys used to select, correct, and edit input characters, and control program execution.

(4) Space bar
Bar used to input a space between characters.

(5) Character keys
Keys used to input characters.

(6) Cursor keys
Keys used to move the cursor.

(7) (8) General port 1, General port 2
Connectors used to connect joysticks, tablets, etc.

(9) (10) Slot 1. Slot 2
Slots for MSX cartridges.

(11) Printer connector
Connector used to connect a printer, plotter, etc.

(12) Cassette Input/Output Connector
Connector used to connect a cassette tape recorder.

(13) Power cord

(14) Sound output jack
Audio (sound) signal output jack. Connects to the TV audio input terminal.

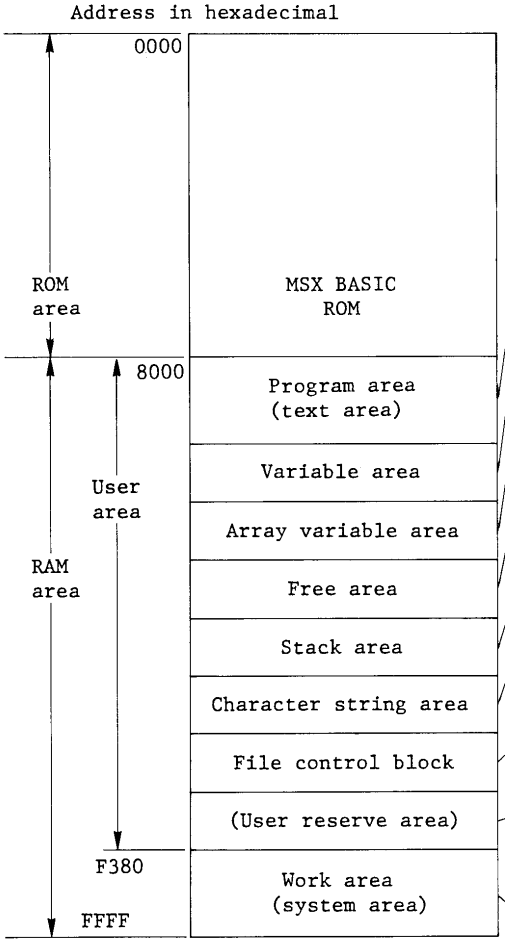
(15) Video output jack
Video signal output jack. Connects to the TV video input terminal.

(16) RF output jack
RF signal output jack. Connects to the TV antenna terminal.

(17) Channel adjust trimmer
After connecting the TV and computer, turn on the power switch. Set the TV to UHF channels 35-37. Insert the adjustment screwdriver into the channel adjust trimmer and adjust for a clear picture.

(18) Power switch
Power turns on when set to "ON" and the power indicator lights up. Power turns off when set to "OFF".

Memory Map (when using BASIC)



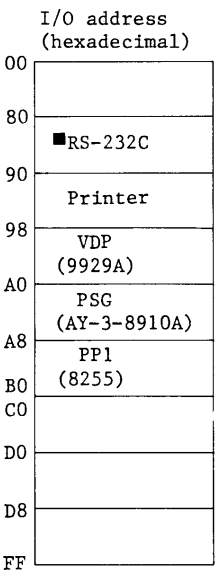
- Area storing the program to which line numbers have been added.
- Area for variables. For character variables, this area stores the pointer which points to the character string (string descriptor).
- Area for array variables. If the array variables are of the character type, this area stores the pointer which points to the string in the string area. This area is allocated when the DIM statement is executed and an array with a subscript of 10 or less is used.
- The free area is an unused area. The size of the free area is the size of the user area minus the sizes of the character area, stack area, variable area, and program area. The size of the free area can be obtained by the FRE function.
- Stack area storing the return address for BASIC when the FOR-NEXT statement or GOSUB statement is executed.
- Area storing the strings contained in the character variables and array variables. The size of the string area is as specified in the CLEAR statement. If no size is specified in the CLEAR statement, an area of 200 bytes is allocated.
- Area used during the input and output of files. This area is allocated according to the number specified in the MAXFILES statement.
- The high limit address can be set in the CLEAR statement to F380 or below so that an area (such as for machine language subroutines) can be allocated up until the work area for free use by the user.
- Work area used by BASIC.

I/O Map

PPI (8255) Bit Assignment

Port	Bit	I/O	Signal Name	Description
A	0 1	Output	CS0L CS0H	Specifies the slot number for addresses &H0-&H3FF
	2 3		CS1L CS1H	Specifies the slot number for addresses &H4000-&H7FFF
	4 5		CS2L CS2H	Specifies the slot number for addresses &H8000-&H8FFF
	6 7		CS3L CS3H	Specifies the slot number for addresses &HC000-&HFFFF
B	0 ↕ 7	Input		Keyboard return signal
C	0, 1 2, 3	Output	KB0, KB1 KB2, KB3	Keyboard scan signal
	4		CASON	Cassette control (ON when L)
	5		CASW	Cassette write signal
	6		CAPS	CAPS lamp signal (lights when L)
	7		SOUND	Software controlled sound output

I/O Address Assignment



I/O address	R/W	Contents	Remarks
&H98	W	Data write to the video RAM	
	R	Data read from the video RAM	
&H99	W	Command, address set	
	R	Status read	
&HA0	W	Address latch	
&HA1	W	Data write	
&HA2	R	Data read	
&HA8	W	Port A data write	
	R	Port A data read	
&HA9	W	Port B data write	
	R	Port B data read	
&HAA	W	Port C data write	
	R	Port C data read	
&HAB	W	Mode set	
&H90	W	Strobe output (b0)	Latch output
	R	Status input (b1)	"1" when busy
&H91	W	Print data	Latch output

- The I/O address with the ■ mark are provided to optional equipment.
- For details on the VDP, PSG, and PPI, see their respective manuals.
- Addresses &H40-&HFF represent the system reserve area.

PSG Bit Assignment

Port	Bit	I/O	Bit 6 at Port B	Connector Pin Number
A	0	Input	Low level High level	Port 1 pin 1 Port 2 pin 1
	1		Low level High level	Port 1 pin 2 Port 2 pin 2
	2		Low level High level	Port 1 pin 3 Port 2 pin 3
	3		Low level High level	Port 1 pin 4 Port 2 pin 4
	4		Low level High level	Port 1 pin 6 Port 2 pin 6
	5		Low level High level	Port 1 pin 7 Port 2 pin 7
	6		Keymatrix assignment input (low level)	
	7		CSAR (Read signal of the cassette tape)	
B	0	Output	Port 1 pin 6	Note 2
	1		Port 1 pin 7	
	2		Port 2 pin 6	
	3		Port 2 pin 7	
	4		Port 1 pin 8	
	5		Port 2 pin 8	
	6		Input select of port A	
	7		———	

Note 1: Either port 1 or 2 is selected by the output level of bit 6 at port B.
Writing a "1" to bit 6 at port B → high level output → port 2 selected.
Writing a "0" to bit 6 at port B → low level output → port 1 selected.
Note 2: Be sure to output a high level at these pins if port B is to be used for input.

General for Peripheral Circuit

CPU (Central Processing Unit) Peripheral Circuit

CPU Peripheral Circuit consists of CPU, Clock Generator Circuit and Reset Circuit.
Z80A (μPD780C-1, IC8) is used as CPU. An interruption system is maskable interrupt, not non-maskable. AND signals of VDP's $\overline{INT}$ and an external interrupt are fed to $\overline{INT}$ terminal. In M1 cycle, 1 WAIT is inserted, and external WAIT is accepted asynchronously with CLOCK signal. $\overline{BUSRQ}$ and $\overline{BUSAK}$ are not used, neither DMA function.

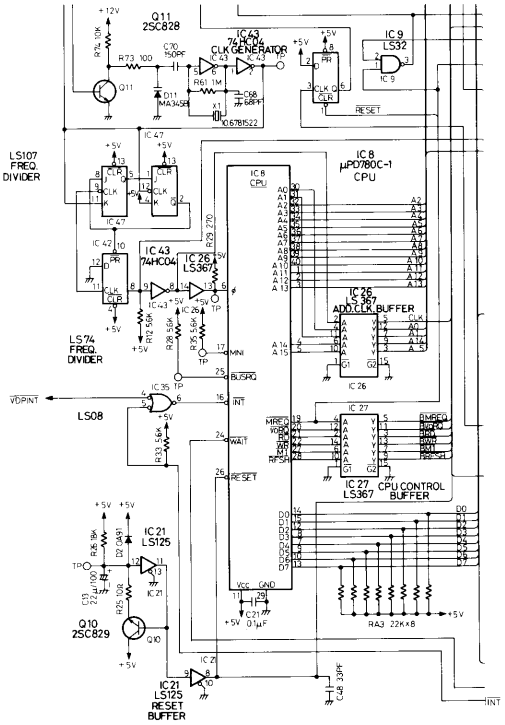


Fig. 1 CPU Peripheral Circuit

The CLOCK Generator Circuit--Serial Oscillation Circuit of 74HC04 (IC43)--oscillates 10.6781522 MHz to generate VDP CLOCK and, at the same time, generates CPU CLOCK in the circuit of 74LS74 (IC42) and 74LS107 (IC47) which divides VDP CLOCK by 3 to get 3.559384 MHz. Moreover, CLOCK Generator Circuit divides CPU CLOCK into halves to get 1.779462 MHz by 74LS74 (IC39) and generates PSG CLOCK.

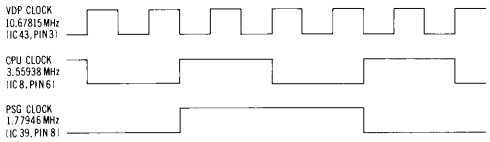


Fig. 2 CLOCK Waveform

The Reset Circuit utilizes the charge of CR Circuit (C13 and R26), but it takes too much time to raise RESET signal by only the CR. So the circuit is compulsively raised by Q10, when each end of C becomes about 1.5 V. Therefore, RESET signal changes "L" into "H" in 60 ms after power source ON.

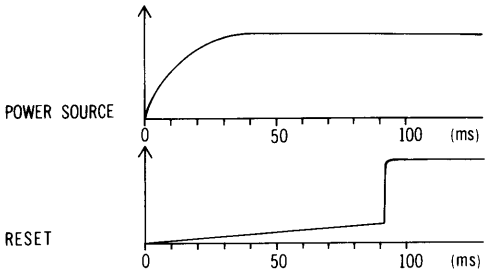


Fig. 3 RESET Signal

ROM

This system uses 32 K x 8 bits MASK ROM (IC32, MN23257) which builds in the MSX BASIC. $\overline{CS}$ is connected to SLT0, and $\overline{OE}$ to A15. Access time is available up to 325 ns.

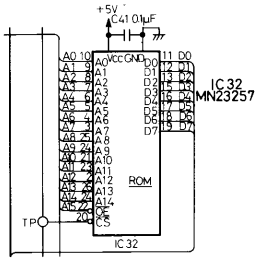


Fig. 4 ROM Periphery

Main Memory Peripheral Circuit

Main Memory Peripheral Circuit consists of Main Memory and Memory Access Circuit.
The Main Memory has a 64 KB memory space by using eight 16 K x 8-bit DRAMs. Refresh is performed by RAS-ONLY REFRESH. Because RAS pre-charge time in refreshing M1 cycle is ensured to be 100 ns by Timing Chart, the access time of RAM must be 150 ns. In the Memory Access Circuit, $\overline{RAS}$ is generated by $\overline{MERQ}$ or $\overline{RESH}$ and CLOCK. The switchover of the row address to the column address is done by the multiplexer 74LS157 and $\overline{CAS}$ is generated by being staggered the time, with the condenser C35, when the column address is outputted. C35 ensures that the $\overline{CAS}$ will be "L", considering differences of the output timing of 74LS157, after the switchover of the row address to the column address.
$\overline{WE}$ is generated by $\overline{BWR}$, and $\overline{OE}$ by $\overline{BRD}$.
$\overline{RAS}$, $\overline{CAS}$, $\overline{WE}$ and $\overline{OE}$ protect from the undershoot by being inserted a resistance for the damping.

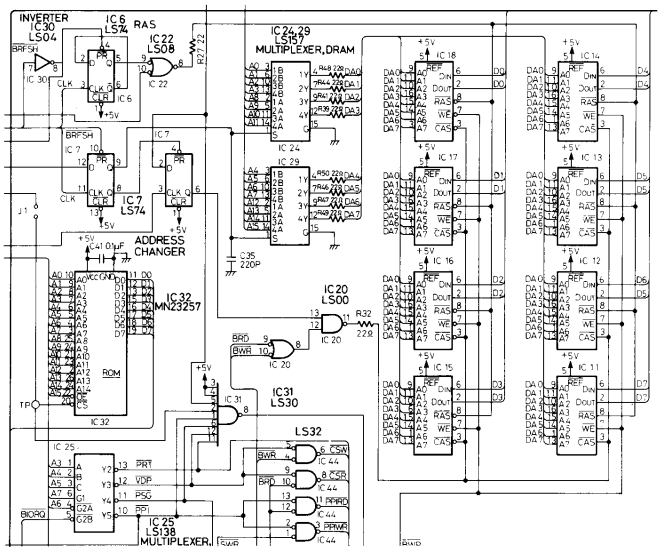


Fig. 5 I/O Select Peripheral Circuit

I/O Select Peripheral Circuit

All of Input/Output with external equipment are done through I/O ports in this system, and an access signal of each port is generated in this circuit. I/O Select Peripheral Circuit consists of I/O Select Generator Circuit, Chip Access Signal Generator Circuit and Short Write Generating Circuit.

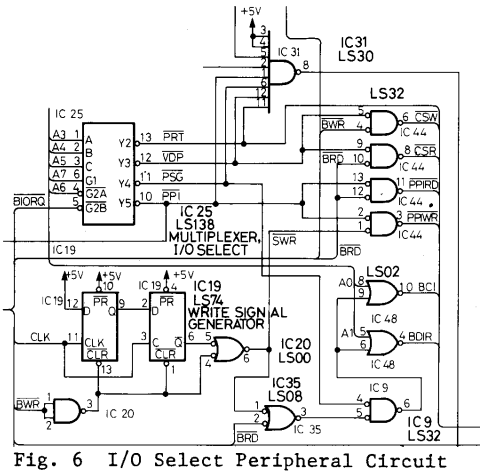


Fig. 6 I/O Select Peripheral Circuit

I/O Select Generator Circuit generates I/O Select signal according to the I/O map. This signal is generated through high-order five bits in low-order byte of Address Bus and through $\overline{BIORQ}$ and Multiplexer 74LS138 (IC25). In order to ensure data stabilizing time when PSG is engaged in WRITE, and to be considered that the output delay time is 350 ns when PPI is in WRITE, WRITE signal is raised faster by Short Write Generator Circuit.

Chip Access Generator Circuit generates $\overline{CSW}/\overline{CSR}$ (VDP Access signals), $\overline{PPIWR}/\overline{PPIRD}$ (PPI Access signals) and $\overline{BC1}/\overline{BDIR}$ (PSG Access signals) from I/O Select signal and $\overline{BWR}/\overline{BRD}/\overline{SWR}$.

VDP (Video Display Processor) Peripheral Circuit

This system uses TI's TMS9929A as CRTC. This LSI's features are as follows.

- . 256 x 192 pixels resolution
- . Used 4,8 and 16 KB as VRAM (16 KB is used in MSX.)
- . Automatic refreshing function of VRAM
- . Composite video output, in PAL system
- . Interruptible in every frame
- . Automatic processing of the sprite screen.

	Resolution	Pattern Size	Patterns	Colours	Sprite	Screen
Graphic I (SCREEN 1)	192x256 pixels	8x8 pixels	256 patterns	16 colours	usable	24rows x 32columns (768)
Graphic II (SCREEN 2)	192x256 pixels	8x8 pixels	768 patterns	16 colours	usable	24rows x 32columns (768)
Multicolour (SCREEN 3)	48x64 blocks	pixels	——	16 colours	usable	24rows x 32columns (768)
Text (SCREEN 0)	192x256 pixels	8x6 pixels	256 patterns	2 out of 16 colours	unusable	24rows x 40columns (960)

Table 1 Screen Mode of VDP.

A VDP's operation depends on values of 9 registers in VDP and a table on VRAM. VDP has three control signals which are $\overline{CSW}$, $\overline{CSR}$ and MODE. MODE signal distinguishes which should be a candidate for READ and WRITE, VDP resistor or VRAM. In "L", VRAM is the candidate. A0 is connected to MODE terminal. $\overline{CSR}$ is generated by Inverted NAND of $\overline{CSVDP}$ and $\overline{RD}$, and $\overline{CSW}$ is by OR of $\overline{CSVDP}$ and $\overline{WR}$.

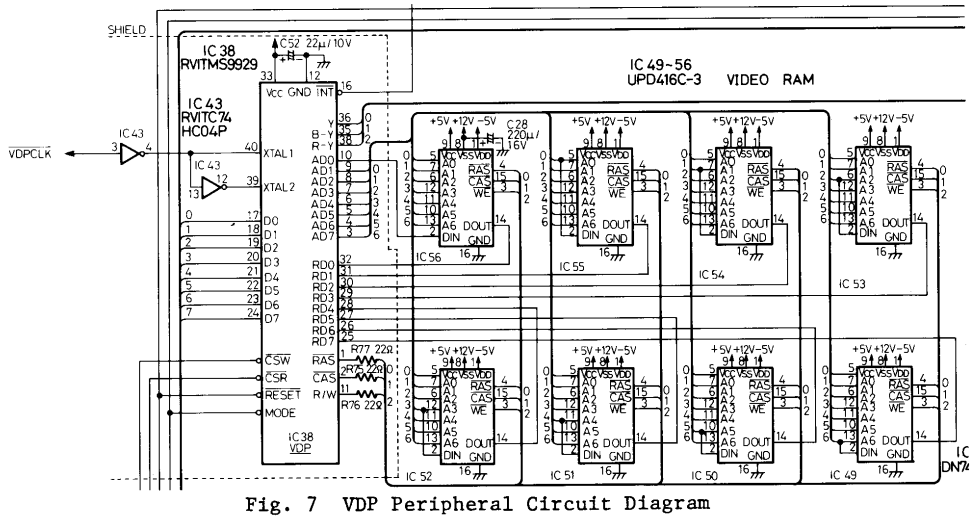


Fig. 7 VDP Peripheral Circuit Diagram

PSG (Programmable Sound Generator) Peripheral Circuit

PSG Block consists of PSG and General Port Circuit. This system uses GI's AY-3-8910A as PSG, which makes it enable to produce 8 octaves, triple chords and noise-sound effects. This LSI builds in a tone generator, a noise generator, an envelope generator and 16 registers whose each value decides the frequency and the volume of the sound by software. This LSI has also two I/O ports which are available for Input/Output with General Port, Keyboard Control and input to a cassette tape recorder. In this occasion, each bit in port A/B is assigned as the following table.

Signal	I/O	Function
IO A0	Input	PORT 1-1 PORT 2-1
IO A1		PORT 1-2 PORT 2-2
IO A2		PORT 1-3 PORT 2-3
IO A3		PORT 1-4 PORT 2-4
IO A4		PORT 1-6 PORT 2-6
IO A5		PORT 1-7 PORT 2-7
IO A6		Input specifying the layout of Keyboard
IO A7		Read signal input from a cassette tape recorder
IO B0	Output	PORT1
IO B1		PORT1
IO B2		PORT2
IO B3		PORT2
IO B4		PORT1
IO B5		PORT2
IO B6		Selecting input of PORT A "L"=PORT 1 "H"=PORT 2
IO B7		————————

Table 2 Bit-Assignment in PSG Port

PSG has three control lines--BDIR, BC1 and BC2--, whose control signals in Input/Output are shown as the following table.

BDIR	BC1	BC2	State
0	0	1	Not Selected
0	1	1	Readout from PSG
1	0	1	Writing in PSG
1	1	1	Address latch

Table 3 PSG Control Signal

In General Port Circuit, there are two general ports (Input 4-bit, Output 1-bit and I/O 2-bit) using multiplexer 74LS157 (IC28, 33) and open collector gate 74LS09 (IC37, 40).

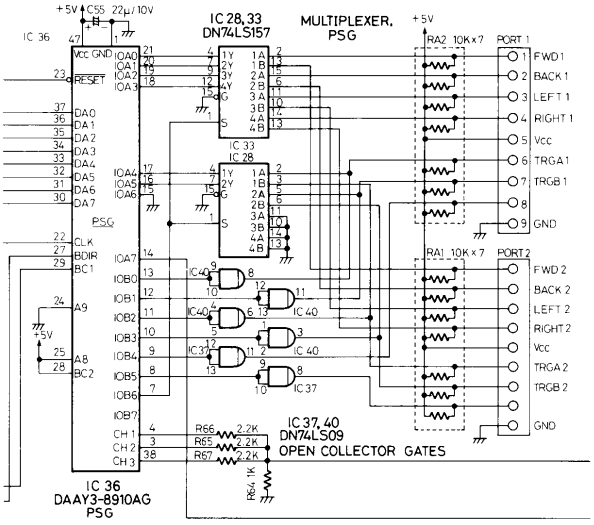


Fig. 8 PSG Peripheral Circuit

CF-2700 uses AY-3-8910A whose maximum access time is 200ns and minimum width of write data pulse is 165ns.

PPI (Programmable Peripheral Interface) Peripheral Circuit

PPI Block consists of PPI (using μPD8255AC-5), Keyboard Control Circuit and Slot Signal Generator Circuit. CF-2700 adopts MODE 0 (ports A,C for output, and port B for input). This LSI is utilized for specifying the slot number, controlling Keyboard, for output to a cassette tape recorder and its control and output of click sound. Bits of three ports are assigned as the following table.

Port	I/O	Bit	Function
A	Output	0∿7	Specifying the Slot Number
B	Input	0∿7	Keyboard Return Signal
C	Output	0∿3	Keyboard Scan Signal
		4	Controlling the motor of a cassette tape recorder 0=ON 1=OFF
		5	Signal writing in a cassette tape recorder
		6	Controlling Keyboard CAPS Lamp 0=LIGHTING
		7	Output of Click Sound

Table 4 Port function in PPI

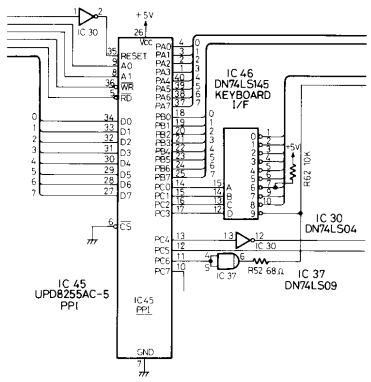


Fig. 9 PPI Peripheral Circuit

Port A is used for specifying the slot number of address bank in units of 16 KB. Port A is preset for this operation as the following table.

Bit of Port A	Contents
PA1 PA0	Slot Number of Page 0
PA3 PA2	Slot Number of Page 1
PA5 PA4	Slot Number of Page 2
PA7 PA6	Slot Number of Page 3

Table 5 Meaning of each bit in Port A

Keyboard Scan signals (0-3 bits) of Port C are decoded by 74LS145 (IC46) and inputted to Port B through Keyboard.

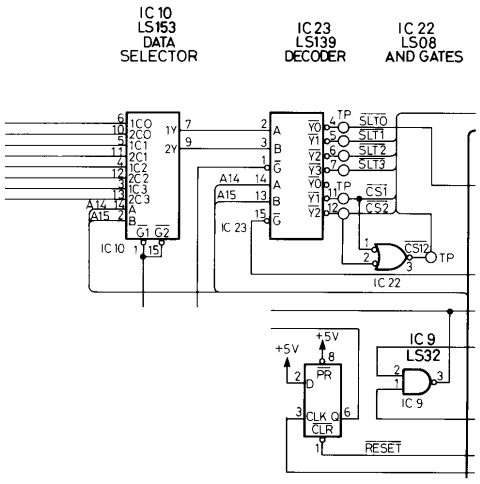


Fig 10 Slot Signal Generator Circuit

Slot signal is generated from a signal which is set up in Port A by data selector 74LS153 (IC10) and decoder 74LS139 (IC23).

Cartridge

Signals connected to Cartridge Slot are described in the table 6 and explained in the table 7.
Data bus is connected via Buffer 74LS245 (IC5). When I/O or Slot 0 is selected, the mainframe and the slot are separated and the bus is controlled to go to the mainframe in READ and INTERRUPT operations.

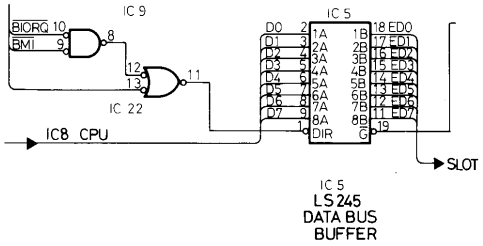


Fig. 11 Data Bus/Buffer Circuit

$\overline{CS1}$, $\overline{CS2}$ and $\overline{CS12}$ are generated from A15 and A14 by decoder 74LS139. (IC23).

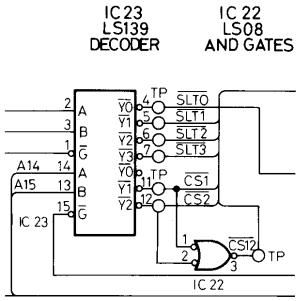


Fig. 12 Chip Select Generator Circuit

Pin Number	Name	I/O Note 1	Pin Number	Name	I/O Note 1
1	$\overline{CS1}$	0	2	$\overline{CS2}$	0
3	$\overline{CS12}$	0	4	$\overline{SLTSL}$	0
5	RESERVED	-	6	$\overline{RFSH}$	0
7	$\overline{WAIT}$	I	8	$\overline{INT}$	I
9	$\overline{MI}$	0	10	$\overline{BUSDIR}$	I
11	$\overline{IORQ}$	0	12	$\overline{MERQ}$	0
13	$\overline{WR}$	0	14	$\overline{RD}$	0
15	$\overline{RESET}$	0	16	RESERVED	-
17	A9	0	18	A15	0
19	A11	0	20	A10	0
21	A7	0	22	A6	0
23	A12	0	24	A8	0
25	A14	0	26	A13	0
27	A1	0	28	A0	0
29	A3	0	30	A2	0
31	A5	0	32	A4	0
33	D1	I/0	34	D0	I/0
35	D3	I/0	36	D2	I/0
37	D5	I/0	38	D4	I/0
39	D7	I/0	40	D6	I/0
41	GND	-	42	CLOCK	0
43	GND	-	44	SW1	-
45	+5 V	-	46	SW2	-
47	+5 V	-	48	+12 V	-
49	SUNDIN	I	50	-12 V	-

a) Note 1: The distinction of Input/Output is based on the mainframe.
b) Reserved terminals are forbidden using.

Table 6 Connected Signal Lines of Cartridge Bus

Pin No.	Name	Contents
1	CS1	ROM 4000...7FFF Address Select Signal
2	CS2	ROM 8000...BFFF Address Select Signal
3	CS12	ROM 4000...BFFF Address Select Signal (256 K for ROM)
4	SLTSL	Slot Select Signal adds Select Signal peculiar to each slot
5	RESERVED	For Future use
6	RFSH	Refresh Cycle Signal
7	WAIT	WAIT Request Signal to CPU
8	INT	INTERRUPT Request Signal to CPU
9	M1	CPU Fetch Cycle Signal
10	BUSDIR	Control Signal for direction of external Data Bus Select a cartridge and outputs L level from each cartridge except Memory at the same time when the data are outputted.
11	IORQ	I/O Request Signal
12	MERQ	Memory Request Signal
13	WR	Write Timing Signal
14	RD	Read Timing Signal
15	RESET	System Reset Signal
16	RESERVED	For furture use
17∿32	A0∿A15	Address Bus Signal
33∿40	D0∿D7	Data Bus Signal
41	GND	Ground
42	CLOCK	CPU Clock 3.559 MHz
43	GND	Ground
44,46	SW1, SW2	For protect in Connect/Disconnet
45,47	+5 V	Powr Source +5 V
48	+12 V	Power Source +12 V
49	SUNDIN	Sound Input Signal (-5 dbm)
50	-12 V	Power Source -12 V

Table 7 Explanation of Signal Lines

Cassette Interface Circuit

MSX uses FSK method for recording, whose transfer rate supports 1200 baud and 2400 baud and the transfer waveform is shown in the table 8.

	0	1
1200 baud	1200 Hz 1 Wave	2400 Hz 2 Waves
2400 baud	2400 Hz 1 Wave	4800 Hz 2 waves

Table 8 Data Waveform

Therefore, Interface Circuit must ensure 1200 Hz-4800 Hz transfer.

(i) Input Circuit

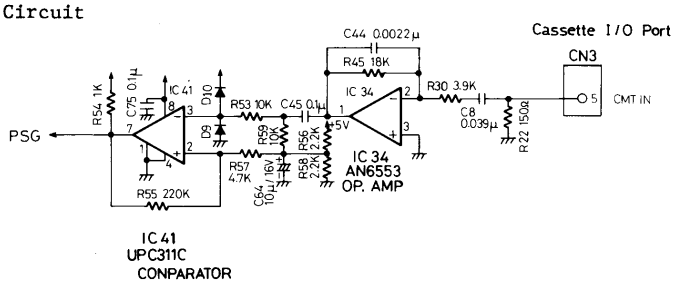


Fig. 13 Cassette Input Circuit

Input terminal is terminated by the 150 Ω resistance whose value is set for adjusting to the amplifier's characteristic on the cassette. This circuit has the gain by using OP-Amp. and also the characteristic as the filter, the waveform characteristic at this time is as follows.

This circuit uses a high-speed comparator to ensure the reproducing of 4800 Hz waveform. The standard voltage supplied to the comparator is set to about 2.5 V by resistance-division. This voltage is used in the bias voltage at the ⊖ terminal. R54 and R55 let the circuit have the hysteresis characteristic and increase the noise margin.

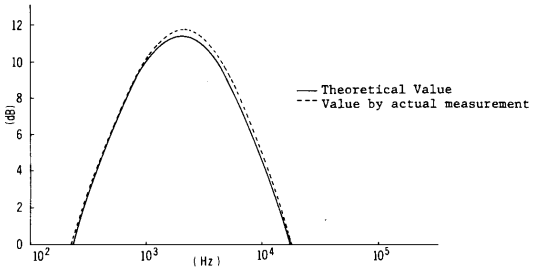


Fig. 14 Waveform Characteristic in Cassette Input Circuit

(there is no page 16 and 17 in the original, HansO)

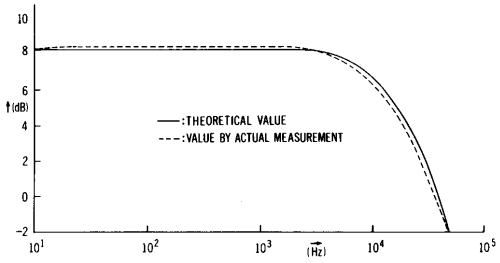


Fig. 20 Frequency Characteristic for PSG Output

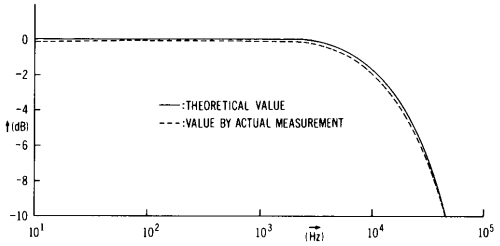


Fig. 21 Frequency Characteristic for Sound Input Signal

Power Supply Circuit

This circuit using the DROPPER system is to supply four kinds power of +5 V, -5V, +12 V and -12 V.
In a primary circuit, there is a line filter composed of condensers and coils that is to prevent a malfunction due to external noises and reduce useless radiation outward.
In a voltage-regulator circuit of a secondary circuit, +5 V circuit consists of discrete elements and +12 V, -5 V, -12 V circuits are composed of general constant-voltage regulator ICs.

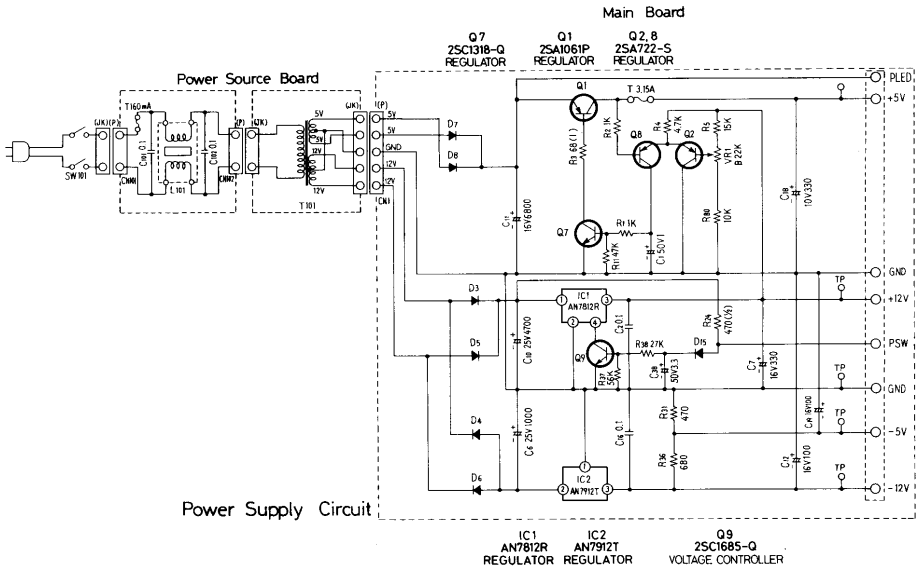
(1) Operation of +5 V Voltage-Regulator Circuit
A voltage that is rectified in full wave by diodes (D7, D8) and flattened by electrolytic capacitor (C7) is applied into a emitter (transistor Q1). The base current of the transistor Q1 is governed by a transistor Q7. The stabilization of the output voltage is achieved by varing the base current of the transistor Q1 that is to change V_{CE} of Q1.

This circuit produces a required reference voltage by dividing +12 V constant-voltage output with resistances R5, VR1 and R80, that is, enables to vary an output voltage by adjusting a value of VR1 (voltage-dividing ratio).
The detection of errors between the reference and output voltages is made in a differential amplification circuit of transistors Q8 and Q2. This control method is as the following.

① +5 V output voltage ascends.
↓
② Base current of the transistor Q8 decreases.
↓
③ Current flowing into the resistance R1 decreases.
↓
④ Base current of the transistor Q7 decreases.
↓
⑤ Base current of the transistor Q1 decreases.
↓
⑥ V_{CE} of the transistor Q1 increase.
↓
⑦ Output voltage descends.

When the output voltage descends, the contrary phenomena to the above happens--the V_{CE} of the transistor Q1 decreases and the output voltage increases.

(2) Operation of +12 V Voltage-Regulator Circuit
A voltage that is rectified in full wave by diodes (D3, D5) and flattened by an electrolytic capacitor C10 is inputted into an input terminal of a regulator IC (IC1). This IC1, which is for the constant-voltage power supply, outputs stabilized +12 V into an output terminal. Moreover, this IC can control the output with an external signal, but we will describe it in details later.



(3) Operation of -12 V Voltage-Regulator Circuit

A voltage that is rectified in full wave by diodes (D4, D6) and flattened by an electrolytic capacitor C6 is inputted into an input terminal of a regulator IC (IC2). This IC2, which is for the constant-voltage power, outputs stabilized -12 V into an output terminal.

(4) Control of Output Voltage with External Signal

The PSW terminal can control the output of +5 V and +12 V. When the PSW terminal is connected with GND, each voltage is outputted normally, and when it is open each voltage becomes about 0 V. (-12 V and -5 V are left as it is.)

This control is made by transistor Q9 and IC1. Pin No. 4 in IC1 is a terminal of which output voltage becomes about 0 V when current more than about 500 μA flows. If controlled this pin externally, it enables to control +12 V output voltage. The +5 V output is to be 0 V with +12 V being 0 V, because its reference voltage is made by dividing +12 V, as described in (1).

The output voltage control by the Pin No. 4 in IC1 is as the following.

↓

① PSW terminal is connected with GND.

↓

② Transistor Q9 is cut off.

↓

③ Current of Pin No. 4 in IC1 is near about 0 V.

↓

④ Output voltage of IC1 is +12 V.

SW terminal in open:

① PSW terminal is opened.

↓

② Transistor Q9 is on.

↓

③ Current of Pin No. 4 in IC1 flows.

↓

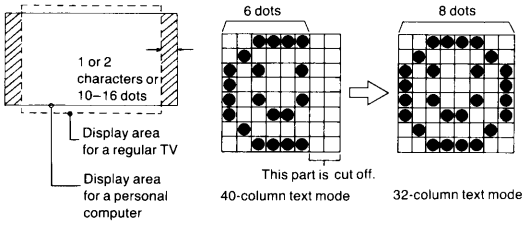
④ Output voltage of IC1 is about 0 V.

R38 and C38 compose of a time constant circuit that delays rising +5 V and +12 V. R37 is a resistance for an electric discharge of C38.

Display Screen

Note the following points for an easy to see screen.

- Depending on the type of TV, the left and right edges may not be displayed on the TV screen. This may result because the display area of the TV and that of the personal computer are different. If this is the case, do not use the shaded part shown in the illustration. In the text mode, set the displayed columns using the WIDTH command to 28-29 (see the "MSX-BASIC manual"). (It is preset to 37 columns when the power is turned on.) In the graphic mode, do not use the 10-16 dots on the left and right sides when writing a program.



- Do not adjust the screen any brighter than necessary.
- Exercise care in combining colors when programming. The screen may be hard to read due to blurred colors depending on the combination of the foreground color (color of characters, etc.) and the background color. White on blue (Color 15, 5) is a relatively easy to distinguish combination. (Color 25, 4, 4 is set when the power is turned on.)
- The color and volume settings on the TV for personal computer use are slightly different from that for TV broadcast reception. Adjust accordingly when switching from a TV broadcast to the personal computer.

Note 1: Character patterns are displayed as 8H x 6W dots/character in the 40-column text display mode (SCREEN 0). (8H x 8W dots/character in the 32-column text display mode.) For this reason, the right side of some graphic symbols may be cut off when displayed. (Letters and numbers are always displayed as full characters.)

Character Codes

High-order 4 bits (hexadecimal) / Low-order 4 bits (hexadecimal) / Graphic characters

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0				0	@	P	`	p	Ç	É	á	Ã			α	≡
1			!	1	A	Q	a	q	ü	æ	í	ã			β	±
2			"	2	B	R	b	r	é	Æ	ó	Ĩ			⌐	≥
3			#	3	C	S	c	s	â	ô	ú	ĩ			Π	≤
4			$	4	D	T	d	t	ä	ö	ñ	Õ			Σ	⌠
5			%	5	E	U	e	u	à	ò	Ñ	õ			σ	⌡
6			&	6	F	V	f	v	å	û	a	Ũ			μ	÷
7			'	7	G	W	g	w	ç	ù	o	ũ			γ	≈
8			(	8	H	X	h	x	ê	ÿ	¿	IJ			Φ	°
9			)	9	I	Y	i	y	ë	Ö	⌐	ij			θ	•
A			*	:	J	Z	j	z	è	Ü	¬	¾			ω	Ω	•
B			+	;	K	[	k	{	ï	¢	½	~			δ	√
C			,	<	L	\	l	¦	î	£	¼	◇			∞	ⁿ
D			−	=	M	]	m	}	ì	¥	¡	‰			∅	²
E			.	>	N	^	n	~	Ä	Pt	«	¶			∈	∎
F			/	?	O	_	o		Å	f	»	§			∩	

Cursor

	4	5
0	Blank (NULL)	
1	☺	
2	☻	
3	♥	
4	♦	
5	♣	
6	♠	
7	•	
8	◘	
9	○	
A	◙	
B	♂	
C	♀	
D	♪	
E	♫	
F	☼	

Reference: Correspondence between decimal and hexadecimal numbers.

Decimal	0~9	10	11	12	13	14	15	16	17	18	...	31	32	33	...	63	64	...	255
Hexadecimal	0~9	A	B	C	D	E	F	10	11	12	...	1F	20	21	...	3F	40	...	FF

Examples: The character code for A is &H41=16x4+1=65 (Decimal)

Input and output of Graphic Symbols

Graphic symbols are input and output by adding a graphic header (&H01).

For example, to input and output "○" the graphic header is used as follows.
Input from the keyboard: Two bytes, &H01 and &H4A, are input.
Output to the TV or printer: Two bytes, &H01 and &H4A, are output.
Example: To output to a TV:

```
PRINT CHR$(1);CHR$(&H4A);
```

In other words, X_2X_1 (hexadecimal) $=X_2 \times 16+X_1$ (decimal).

Examples: &H1F=1x16+15=31 (decimal)
&HFF=15x16+15=255 (decimal)

Self Test

1. Outline of Self Test

This Self Test Program is prepared for the purpose of testing hardware functions of Personal Computer CF-2700. This program is to start at the 8000H address and materials in 16 KB ROM is supplied through the slot.

2. Self Test Program

This program is made up of two main CHECK parts.

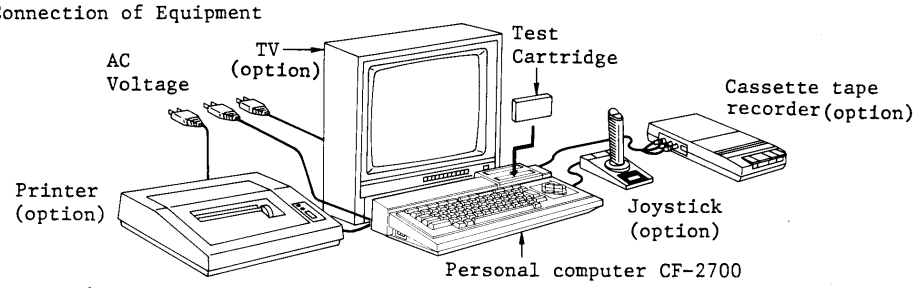
1) The first CHECK part -- for basic checks.
   (1) Check the diagnostic program on. Make sure that this program is started correctly.
   (2) VDP/VRAM basic check
   Check if the interrupt flag is correctly set or reset (between CPU - VPD), and the Read/Write of VRAM (CPU - VDP - VRAM) is done correctly.
   (3) Printer basic check
   Check if the printer is connected properly and can print out checked results.
   (4) RAM check
   Check if data are correctly written in a specified address.
   (5) PSG check
   Check if the Read/Write of PSG register (CPU - PSG) and the data input/output of I/O port (PSG - PSG) are made correctly.
   (6) Key input check
   Check if the key input works correctly.

2) The second CHECK part -- for checks including external peripheral equipment.
   (7) ROM check
   Check if the interpreter operates correctly.
   (8) Screen display check
   Check if the screen displays correctly.
   (9) Cassette I/O check
   Check if signals are inputted/outputted correctly.
   (10) Joystick input check
   Check if the joystick sends its signals correctly by operating it.
   (11) Print out check
   Check if the printer is sent the correct print out data.
   (12) Audio output check
   Check if the audio sound is outputted properly.

3. Self Test Procedure

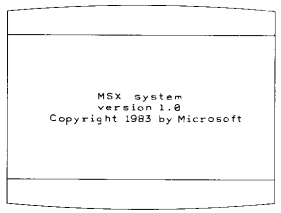
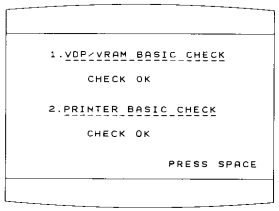
1) Equipment required
(1) Test Personal Computer,
   Model No.: CF-2700..... 1 unit
(2) Printer or Plotter
   (designed for MSX)..... 1 unit
(3) Joystick
   Model No.: CF-2201..... 1 unit
(4) TV..... 1 unit
(5) Test Cartridge
   Part No.: DFWV95C0001..... 1 pc.
(6) Cassette Tape Recorder..... 1 unit
(7) Cassette Tape..... 1 pc.

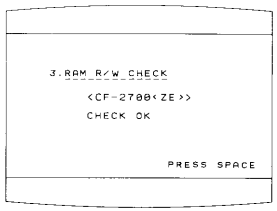
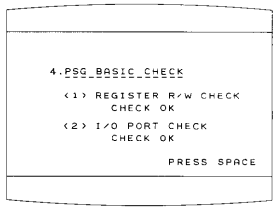
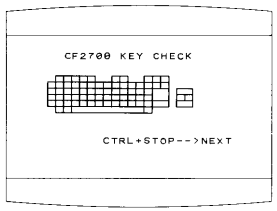
2) Connection of Equipment

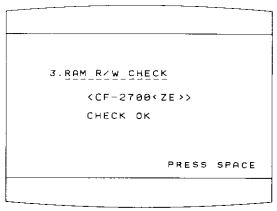
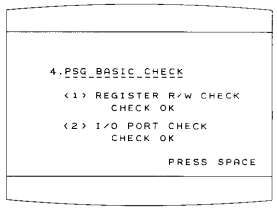
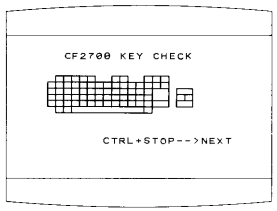


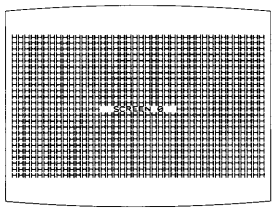
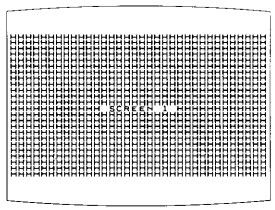
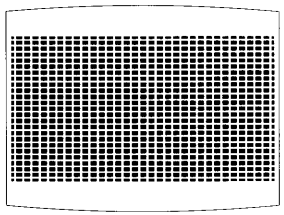
3) Preparation
(1) Connection should be made as shown above.
(2) Feed the paper into the printer.
(3) Use a printer designed for MSX. Any printers and plotters can be whichever conform to the Centronics specifications. However, printers not designed for MSX can not print the MSX characters and symbols.
(4) Insert the Test ROM cartridge (facing a label side to you) into the slot.
(5) Keep the cassette tape recorder away from the TV (at least 30 cm).
   Since regular cassette tape recorders are for audio use, some are not suitable for the Self Test due to different audio characteristics.

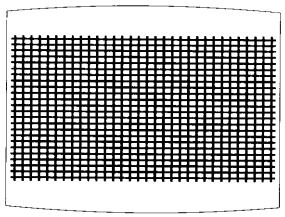
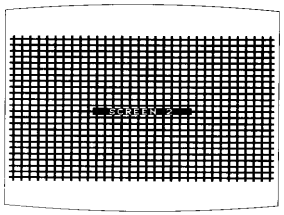
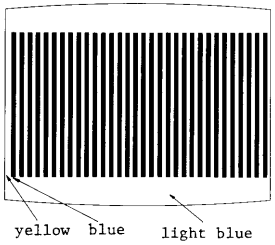
(4) Testing Procedure

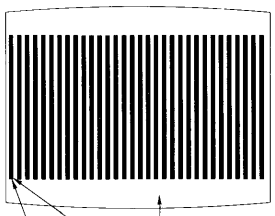
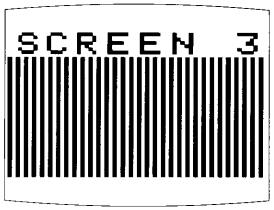
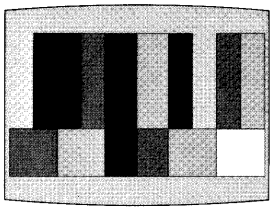
Step	Testing Procedure	CRT Screen displays or Printer prints out	Criteria	Remarks
1	Check the diagnostic program on. Turn on the Computer, TV and Printer. Note: When turning the computer on/off, perform it after turning the printer off. (If the computer is turned on/off when the printer on, the printer may operate improperly.)	CRT Screen Displays:  		Note: Pressing CTRL and ⇦ key at the same time instead of SPACE key, a testing step returns to the Step 1 displayed "Self Test", even the testing step proceeds forward.
		CRT Screen Displays:  	If the condition of the TV, Printer and Computer is the same as follows, it is OK. 1. The LED of CAPS (Ⓒ) key on the keyboard and the power indicator are lit. 2. "Self Test" is displayed in the screen. 3. "SELFTEST START" is printed out. 4. The note "1a" beeps.	<Important test points> CPU, BUS LINE, ROM, PPI, SLOT PORTION (RAM)
		Printer prints out: ********** * SELFTEST START * **********		
2	VDP/VRAM basic check Printer basic check Depress SPACE Key.	CRT Screen Displays:  	If displayed as the left, it is OK. If your printer outputs "VDP/VRAM BASIC CHECK CHECK NG", it is NG.	The beep sound and the LED go off. <Important test points> Check on Interrupt flag of VDP VDP, CPU - VDP Check on Read/Write of VRAM VRAM, BUS line CPU - VDP -VRAM Basic check on Printer Printer circuit, terminals cables, and printer

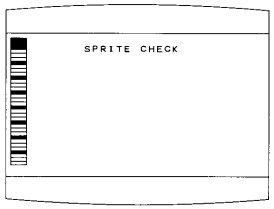
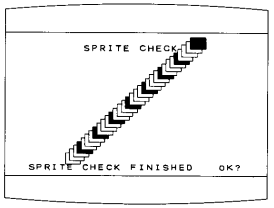
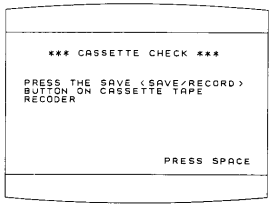
Step	Testing Procedure	CRT Screen displays or Printer prints out	Criteria	Remarks
		Printer prints out: PRINTER BASIC CHECK CHECK OK VDP/VRAM BASIC CHECK CHECK OK	If your printing output matches shown left, it is OK. If displayed "PRINTER BASIC CHECK CHECK NG", it is NG. Beeps sound according to the order of the musical scale (do, re, mi, -- do) once and the LED of CAPS (Ⓒ) key also blinks during beeping. The beep sound and the LED go off.	
3	RAM Check Depress SPACE Key.	CRT Screen Displays: 	If displayed as the left, it is OK. If "CHECK NG" is displayed, it is NG.	<Important test points> Check on Read/Write of RAM RAM, BUS line CPU - RAM
4	PSG Check Depress SPACE Key.	CRT Screen Displays: 	If displayed as the left, it is OK. If "CHECK NG" is displayed, it is NG.	<Important test points> Check on Read/Write of PSG register. PSG, BUS line CPU - PSG BUS line PSG - Port
5	Key input check Depress SPACE Key.	CRT Screen Displays: 		<Important test points> PPI, Keyboard, BUS line CPU - PPI - Keyboard

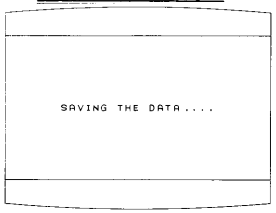
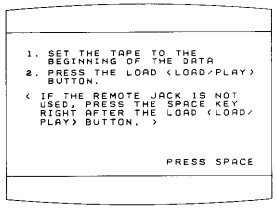
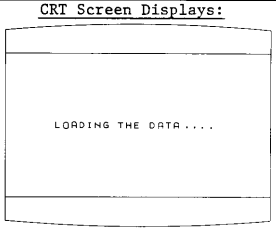
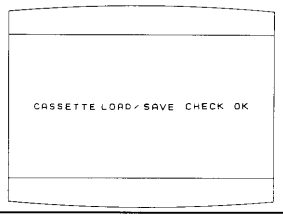
Step	Testing Procedure	CRT Screen displays or Printer prints out	Criteria	Remarks
		Printer prints out: PRINTER BASIC CHECK CHECK OK VDP/VRAM BASIC CHECK CHECK OK	If your printing output matches shown left, it is OK. If displayed "PRINTER BASIC CHECK CHECK NG", it is NG. Beeps sound according to the order of the musical scale (do, re, mi, -- do) once and the LED of CAPS (Ⓒ) key also blinks during beeping. The beep sound and the LED go off.	
3	RAM Check Depress SPACE Key.	CRT Screen Displays: 	If displayed as the left, it is OK. If "CHECK NG" is displayed, it is NG.	<Important test points> Check on Read/Write of RAM RAM, BUS line CPU - RAM
4	PSG Check Depress SPACE Key.	CRT Screen Displays: 	If displayed as the left, it is OK. If "CHECK NG" is displayed, it is NG.	<Important test points> Check on Read/Write of PSG register. PSG, BUS line CPU - PSG BUS line PSG - Port
5	Key input check Depress SPACE Key.	CRT Screen Displays: 		<Important test points> PPI, Keyboard, BUS line CPU - PPI - Keyboard

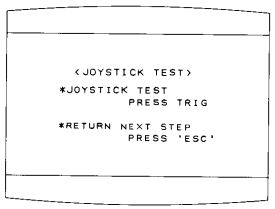
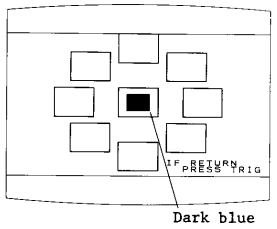
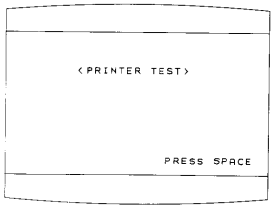
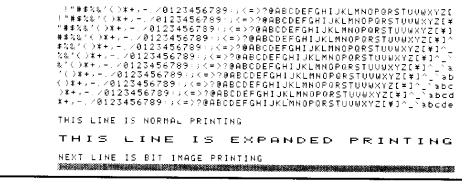
Step	Testing Procedure	CRT Screen displays or Printer prints out	Criteria	Remarks
9	Depress [SPACE] Key.	CRT Screen Displays:  (Foreground: White, Background: Blue, Periphery: Light Blue)	If displayed as the left, it is OK. ("H"s 40 by 24 appear and "SCREEN 0" in the center of the screen.) If not, it is NG.	<Important test points> [Check on TEXT mode] VDP, VRAM, VRAM - CRT, CRT
10	Depress [SPACE] Key.	CRT Screen Displays:  (Foreground: White, Background: Blue, Periphery: Light Blue)	If displayed as the left, it is OK. ("H"s 32 by 24 appear and "SCREEN 1" in the center of the screen.) If not, it is NG.	[Check on Graphic mode]
11	Depress [SPACE] Key.	CRT Screen Displays:  (Foreground: White, Background: Black, Periphery: Light Blue)	If "■■"s 32 by 24 are displayed, it is OK.	[Check on Graphic mode]

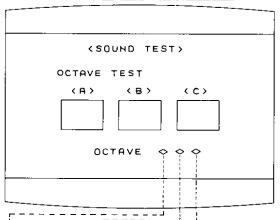
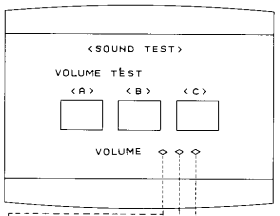
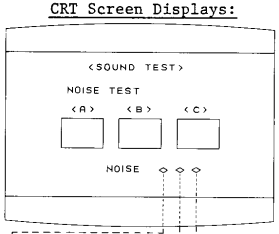
Step	Testing Procedure	CRT Screen displays or Printer prints out	Criteria	Remarks
		CRT Screen Displays:  (Foreground: Black, Background: White, Periphery: Light Blue)	It is OK if the screen display in the above turns over and "+"s 32 by 24 are displayed.	
		CRT Screen Displays:  (Foreground: Black, Background: White, Periphery: Light Blue)	Screen 2 appears in the center of the screen, it is OK. If not, it is NG.	
12	Depress [SPACE] Key.	CRT Screen Displays:  	If "■"s 32 by 24 are displayed, it is OK.	[Check on the Multi-colour mode]

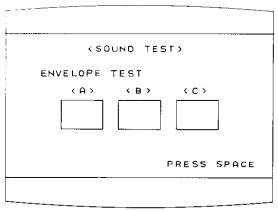
Step	Testing Procedure	CRT Screen displays or Printer prints out	Criteria	Remarks
		CRT Screen Displays:  	It is OK if the screen display in the above turns over and "■"s 32 by 24 are displayed.	
		CRT Screen Displays:  	If matched to the left, it is OK. If not, it is NG.	
13	Depress [SPACE] Key.	CRT Screen Displays: 	If matched to the left, it is OK. If not, it is NG.	[Colour check]

Step	Testing Procedure	CRT Screen displays or Printer prints out	Criteria	Remarks
14	Depress SPACE Key.	CRT Screen Displays:  a pair of black, red, white, and green light blue	The overlapped 32 sprites are displayed.	Sprite check
		CRT Screen Displays: 	If, then, each sprite is moved one by one as shown in the left, it is OK.	
15	Cassette I/O check Depress SPACE Key.	CRT Screen Displays: 	If matched to the left, it is OK. If not, it is NG.	<Important test points> PSG, BUS line CPU-PSG PPI, BUS line CPU-PPI BUS line PPI-Cassette-PSG

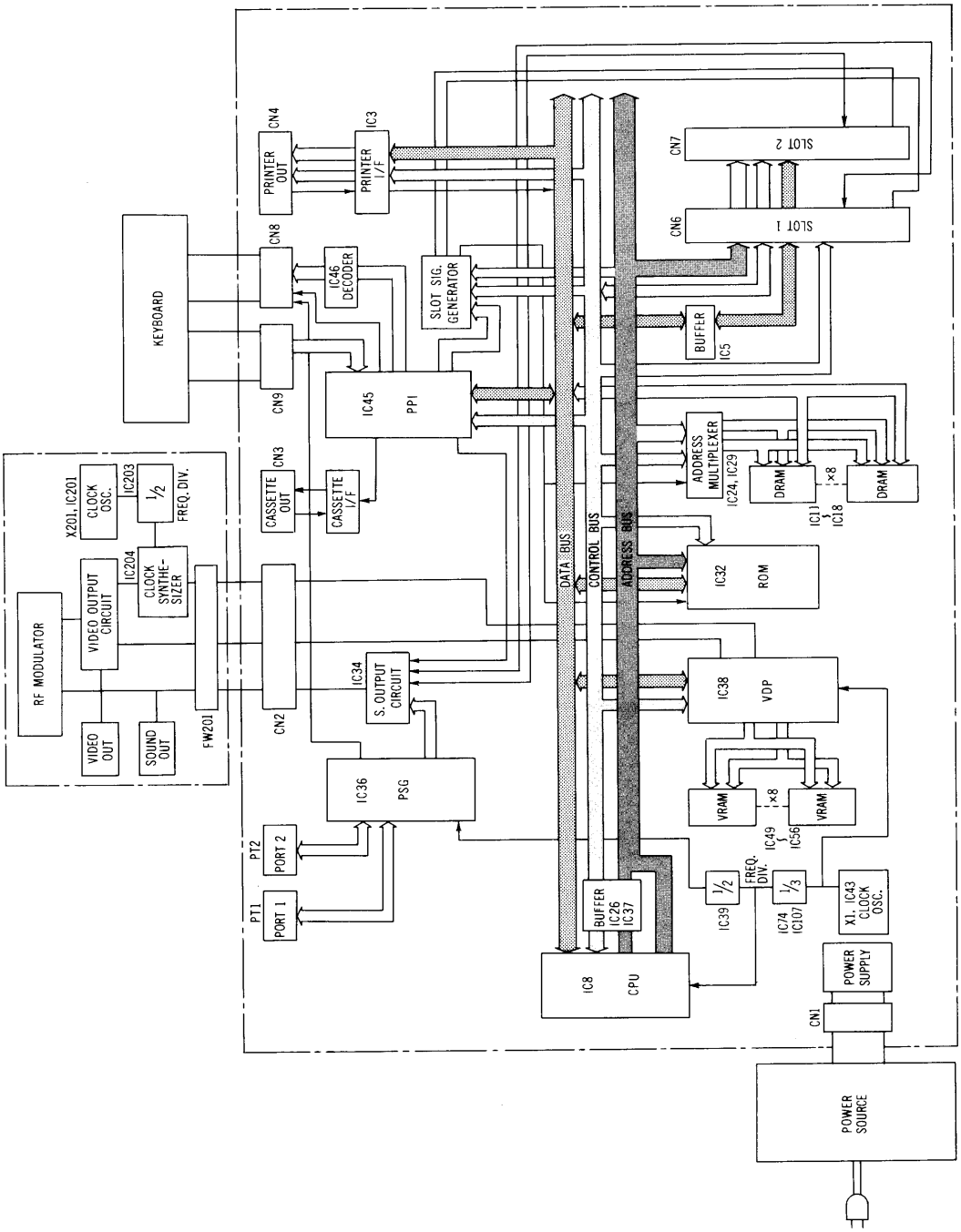
Step	Testing Procedure	CRT Screen displays or Printer prints out	Criteria	Remarks
16	After depressing the save (Save/Record) button of the cassette tape recorder, depress the SPACE Key.	CRT Screen Displays: 		
		CRT Screen Displays: 	If matched to the left, it is OK. If not, it is NG.	
17	Set the tape to the beginning of the data.			
18	After depressing the load (Load/Play) button, depress the SPACE key.	CRT Screen Displays: 		
		CRT Screen Displays: 	If displayed as the left, it is OK. If "CHECK NG" is displayed, it is NG.	

Step	Testing Procedure	CRT Screen displays or Printer prints out	Criteria	Remarks
19	Joystick input check Depress SPACE Key.	CRT Screen Displays:  		<Important test points> PSG, BUS line PSG - Port, Port 1 and 2, Joystick
20	Depress Trigger Switch of Joystick.	CRT Screen Displays:  Dark blue	If your printing output matches to the below, it is OK.	After checked Port 1, change the connection, and then, check Port 2, as step 19, 20.
21	Print out check Depress ESC Key.	CRT Screen Displays:  	If your printing output matches to the below, it is OK. If not, it is NG.	<Important test points> Printer circuit, terminal, cables, the printer
		Printer prints out:  		

Step	Testing Procedure	CRT Screen displays or Printer prints out	Criteria	Remarks
22	Audio output check Depress SPACE Key.	CRT Screen Displays:  Octave 2 Octave 4 Octave 6 When the beep sound is outputted, the corresponding indicator turns red.	If the TV is in the state as the followings, it is OK. 1) "do" in the octave 2 beeps from the channel A, "mi" in it beeps from the channel B, and "so" in it beeps from the channel C. 2) "do" in the octave 4 beeps from the channel A, "mi" in it beeps from the channel B, and "so" in it beeps from the channel C. 3) "do" in the octave 6 beeps from the channel A, "mi" in it beeps from the channel B, and "so" in it beeps from the channel C. 4) When the beep sound is outputted, the corresponding indicator turns red.	<Important test points> PSG, Sound output circuit, terminals, audio cable, CRT Octave check
		CRT Screen Displays:  Volume 5 Volume 10 Volume 15 When the beep sound is outputted, the corresponding indicator turns red.	If the TV is in the state as the followings, it is OK. 1) "do" in the volume 5 beeps from the channel A, "mi" in it beeps from the channel B, and "so" in it beeps from the channel C. 2) "do" in the volume 10 beeps from the channel A, "mi" in it beeps from the channel B, and "so" in it beeps from the channel C. 3) "do" in the volume 15 beeps from the channel A, "mi" in it beeps from the channel B, and "so" in it beeps from the channel C. 4) When the beep sound is outputted, the corresponding indicator turns red.	Volume check
		CRT Screen Displays:  NOISE 11 NOISE 21 NOISE 31 When the sound is outputted, the corresponding indicator turns red.	If the TV is in the state as the followings, it is OK. 1) "noise 11" sound is outputted from the channels A, B, and C. 2) "noise 21" sound is outputted from the channels A, B, and C. 3) "noise 31" sound is outputted from the channels A, B, and C. 4) When the sound is outputted, the corresponding indicator turns red.	"Noise" sound check

Step	Testing Procedure	CRT Screen displays or Printer prints out	Criteria	Remarks
		CRT Screen Displays:  	If the TV is in the state as the followings, it is OK. 1) When the sound is outputted, the corresponding indicator turns red. 2) The beeps sound like a crossing bell.	[Envelope check]
23	Depress [SPACE] Key.	CRT Screen Displays:  		
24	Turn off the Printer, TV and Computer. Note: When turning the computer on/off, perform it after turning the printer off.			Note: Do not turn on the power immediately after turning off the power. Wait at least 30 seconds after turning off the power before turning it back on.

Block Diagram



Disassembly Instruction

Cabinet

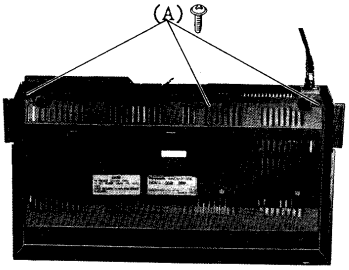


Fig. 28

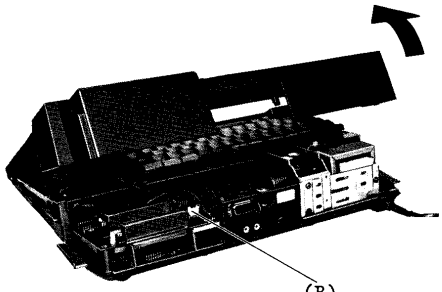
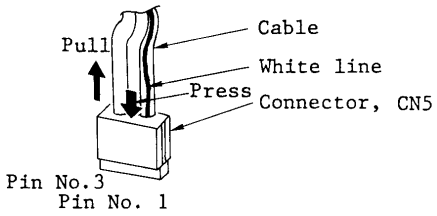


Fig. 29

Ref. No.	Procedure	Shown in Fig.-	To remove-.	Remove-.
1	1	Fig. 28	Top Cabinet	Screw (3 x 6).....(A) x 3
2	1-2	Fig. 29		• Cable for the Micro Switches (B)
3	1-3			Pull the Top Cabinet in the direction of arrow.

• Note:

1) When disconnecting the cable for the Micro Switches from the Connector CN5, remove it, pressing the top of the Connector.
2) When connecting the cable to the Connector CN5, make sure proper connection.
(The lead coloured white must be connected to Pin 1 of the Connector.)



Keyboard

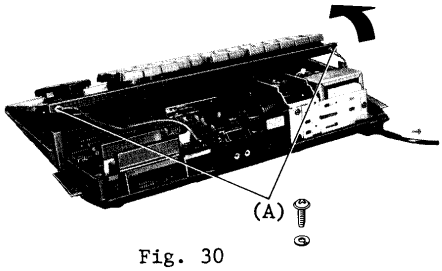


Fig. 30

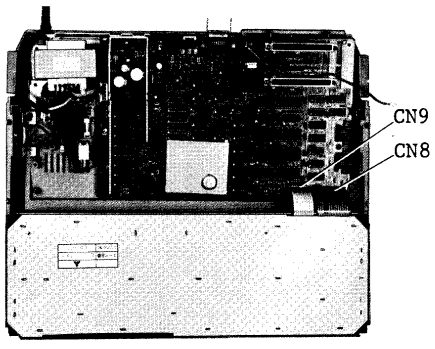
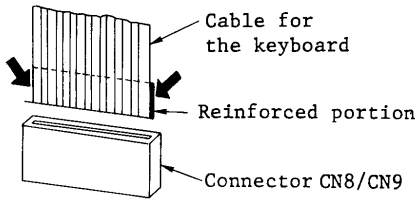


Fig. 31

Ref. No.	Procedure	Shown in Fig.-	To remove-.	Remove-.
4	1-5	Fig. 30	Keyboard	Screw (3 x 6).....(A) x 2
5				Pull the Keyboard in the direction of arrow.
6	1-6	Fig. 31		• Remove the cables of the keyboard from the Connector CN8, CN9.

• Note: Care should be taken during connection/disconnection of the cable for the Keyboard. With the both sides of the reinforced portion being held, connect/disconnect them.



Main Board

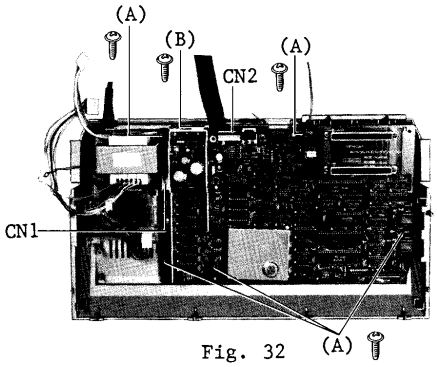


Fig. 32

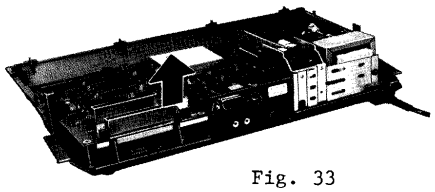
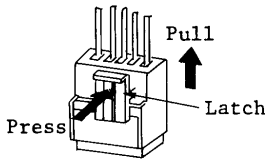


Fig. 33

Ref. No.	Procedure	Shown in Fig.-	To remove-.	Remove-.
7	1-7	Fig. 32	Main Board	Screw (3 x 10).....(A) x 5 Screw (3 x 8).....(B) x 1
8	1-3, 8			• Remove the Socket from the connector, CN1 and CN2.
9	1-9	Fig. 33		Pull the Main Board in the direction of arrow.

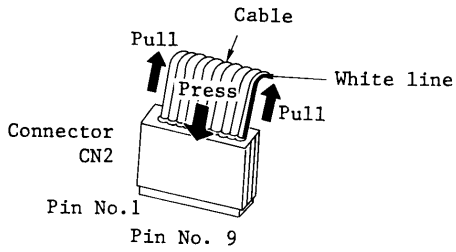
• Note: When disconnecting the Socket from the Connector CN1, remove it with the latch being pressed.



Connector, CN1

•Note:

1) When disconnecting the cable from the Connector CN2, remove it, pressing the top of the Connector CN2.
2) When connecting the cable to the Connector CN2, make sure proper connection.
   (The lead coloured white must be connected to Pin 9 of the Connector.)



Video Board

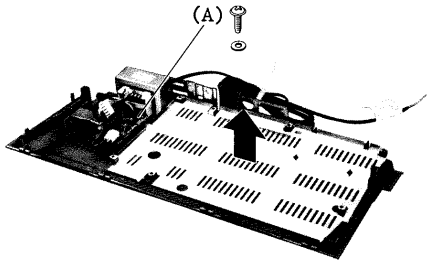


Fig. 34

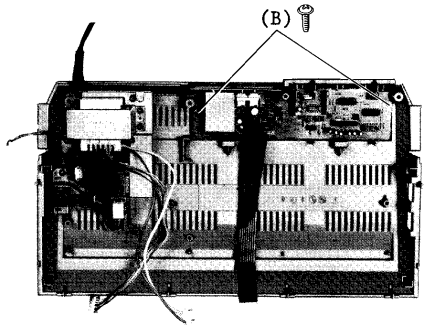


Fig. 35

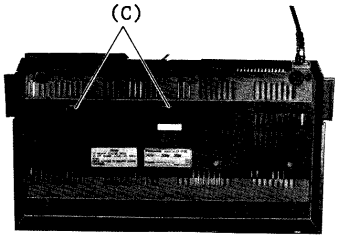


Fig. 36

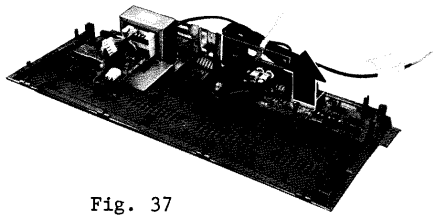
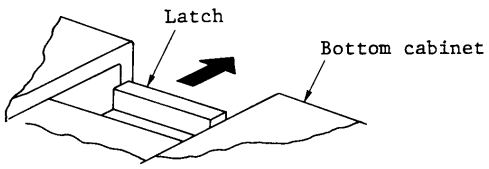


Fig. 37

Ref. No.	Procedure	Shown in Fig.-	To remove-.	Remove-.
10	1-11	Fig. 34	Shield Plate	Screw (3 x 8).....(A) x 1
11				Pull the Shield Plate in the direction of arrow.
12	1-12	Fig. 35	Video Board	Screw (3 x 10).....(B) x 2
13	1-13	Fig. 36		•Unlatch the latch of the bottom cabinet. (C) x 2
14	1-14	Fig. 37		Pull the Video Board in the direction of arrow.

• Note: When unlatching, avoid applying excessive force to the latch for the rupture.



Power Source Board

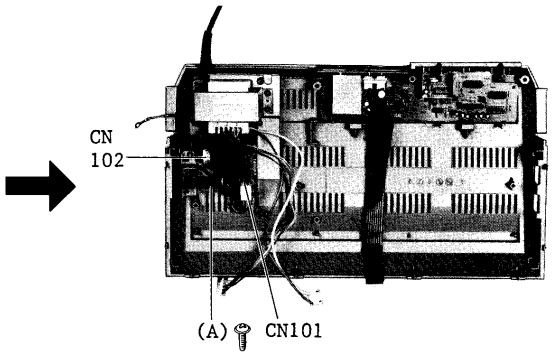
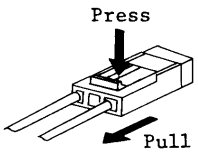


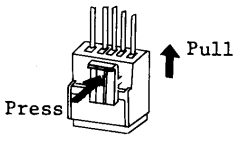
Fig. 38

Ref. No.	Procedure	Shown in Fig.-	To remove-.	Remove-.
15	7-10, 15	Fig. 38	Power Source Board	Screw (3 x 8).....(A) x 1
16	7-10, 15, 16			• Remove the Socket from the Connector, CN101 and CN102.
17	7-11, 15-17			Pull the Power Source Board in the direction of arrow.

• Note: When disconnecting the Socket from the Connector, remove it with the latch being pressed.



CN101



CN102

Slot Panel, Slot Cover

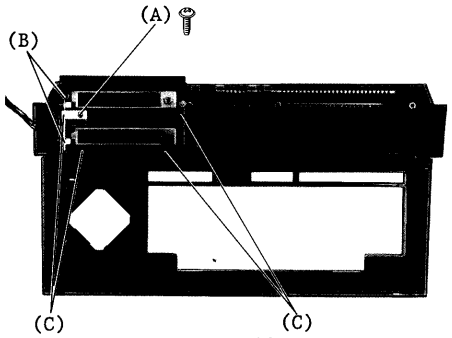


Fig. 39

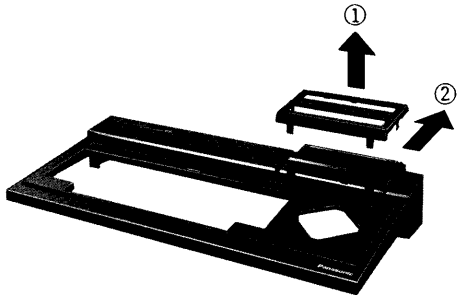
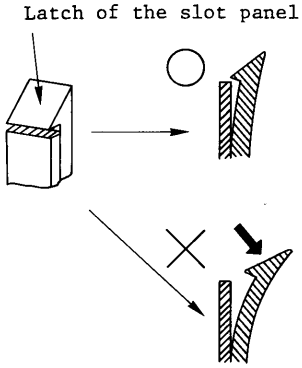


Fig. 40

Ref. No.	Procedure	Shown in Fig.-	To remove-.	Remove-.
18	1-3, 18, 19	Fig. 39	Micro Switches	Screw (3 x 10).....(A) x 1
19				Micro Switch..... (B) x 2
20	1-3, 18-20		Slot Panel	• Unlatch the latches of the Slot Panel..... (C) x 4
21	1-3, 18-21	Fig. 40		Remove the Slot Panel in the direction of arrow ①
22	1-3, 18-22		Slot Cover	Remove the Slot Cover in the direction of arrow ②

• Note: Care should be taken during disassembly, so as not to damage the slot panel.
When unlatching, avoid applying excessive force to the latch for rupture.



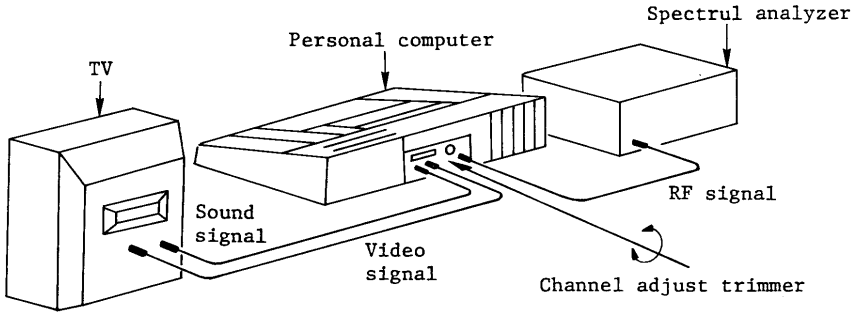
Adjustment

Channel adjust trimmer

After connecting the TV and computer, turn on the power switch.
Set the TV to UHF channels 35-37. Insert the adjustment screwdriver into the channel adjust trimmer and adjust for a clear picture.

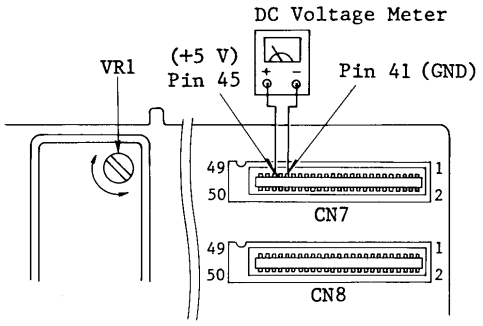
If there is a Spectrul Analyzer, adjustment can be performed precisely. Connect the Spectrul Analyzer to RF output jack of the computer. Then, adjust the channel adjust trimmer as follows.

Channel	Frequency (MHz)
35	583.25
36	591.25
37	599.25



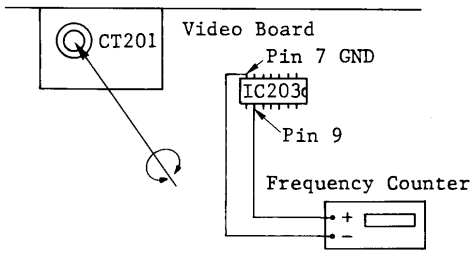
Power Source

Adjust the VR1 so that the DC voltage at Pin 45 of the connector CN7 is within 4.97-5.03 V.



Clock Frequency

Connect the clips of the Frequency counter to the Pin 9 of IC203 on Video Board.
Adjust Trimmer Capacitor, CT201, for 4.43361875 MHz ±3 Hz reading on Frequency Counter.

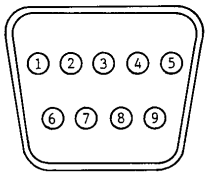


Connector Pin Connection

General Port 1 and General Port 2 (D-sub 9-pin)

Signal level TTL level
Signal Lines List

Terminal Number	Signal Name	I/O	
1	FWD	I	(Note 1)
2	BACK	I	
3	LEFT	I	
4	RIGHT	I	
5	+5 V	(Note 2)	
6	TRG 1	I/O	(Note 3)
7	TRG 2	I/O	
8	Output	0	
9	GND	-	



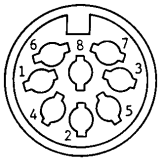
(Front view of the panel-mounted connector)

Note 1: Input or output with respect to the computer
Note 2: Load current 50 mA or less
Note 3: I/O is software controlled. To use an input, set bits 0 and 1 (for port 1) or bits 2 and 3 (for port 2) at PSG port B to high level.

Cassette I/O Port (DIN8-pin)

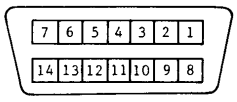
Signal Lines List

Terminal Number	Signal Name
1	GND
2	GND
3	GND
4	CMTOUT
5	CMTIN
6	REM +
7	REM -
8	GND



(Front view of the panel-mounted connector)

Printer Port (Amphenol 14-pin)



(Front view of the panel-mounted connector)

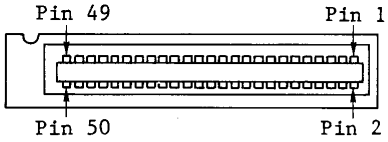
Signal level TTL level
Signal Lines List

Terminal Number	Signal Name	I/O (Note 1)	Terminal Number	Signal Name	I/O (Note 1)
1	$\overline{\text{PSTB}}$	0	8		0
2	DATA 0	0	9	DATA 7	0
3	DATA 1	0	10		
4	DATA 2	0	11	BUSY	1
5	DATA 3	0	12		
6	DATA 4	0	13		
7	DATA 5	0	14	GND	-

Note 1: Input or output with respective to the computer.

Slot 1 and Slot 2

(Card edge type, 50-pin, 2.54 mm pitch)



(Front view of the panel-mounted connector)

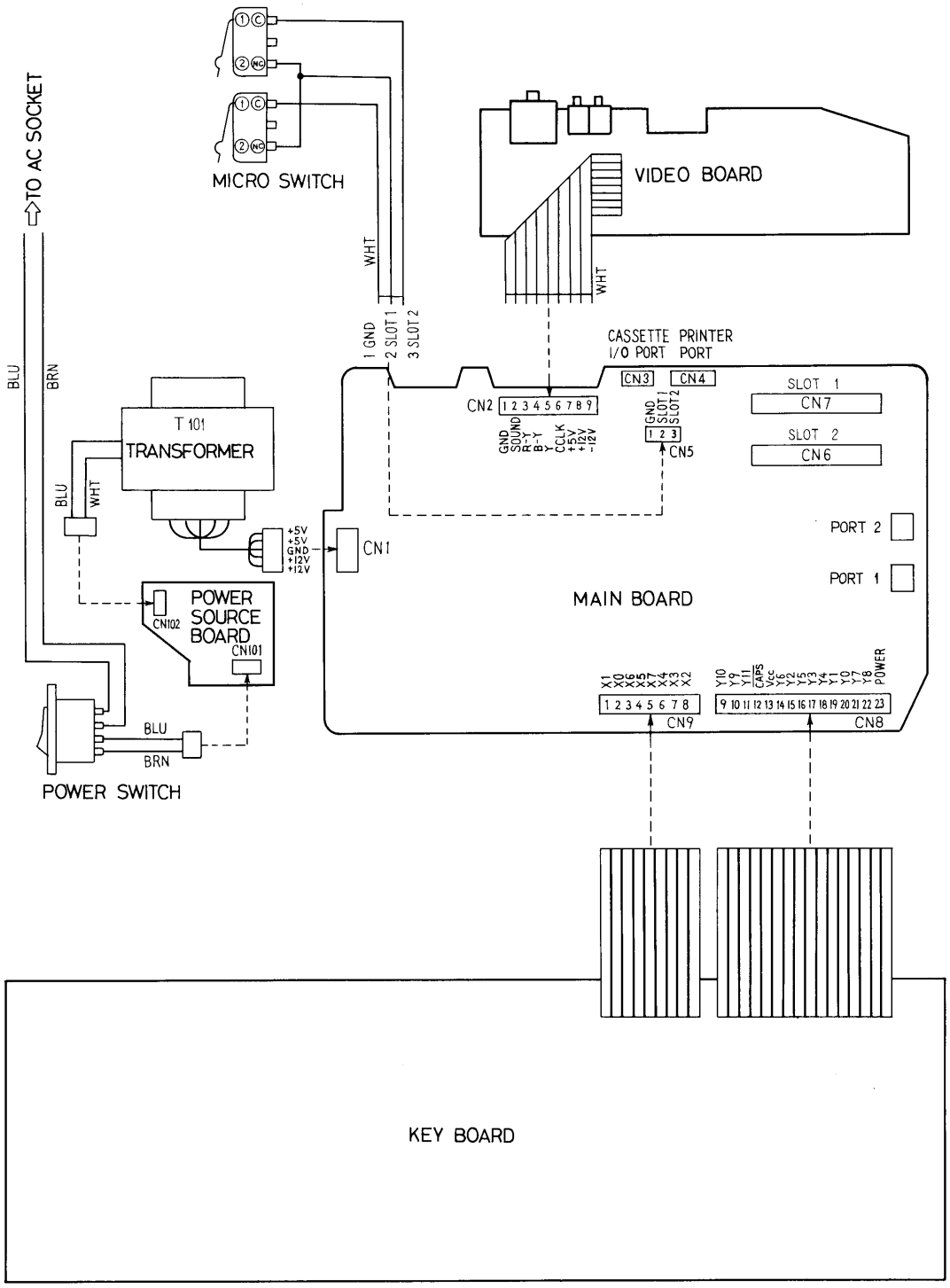
Signal level TTL level

Signal Lines List

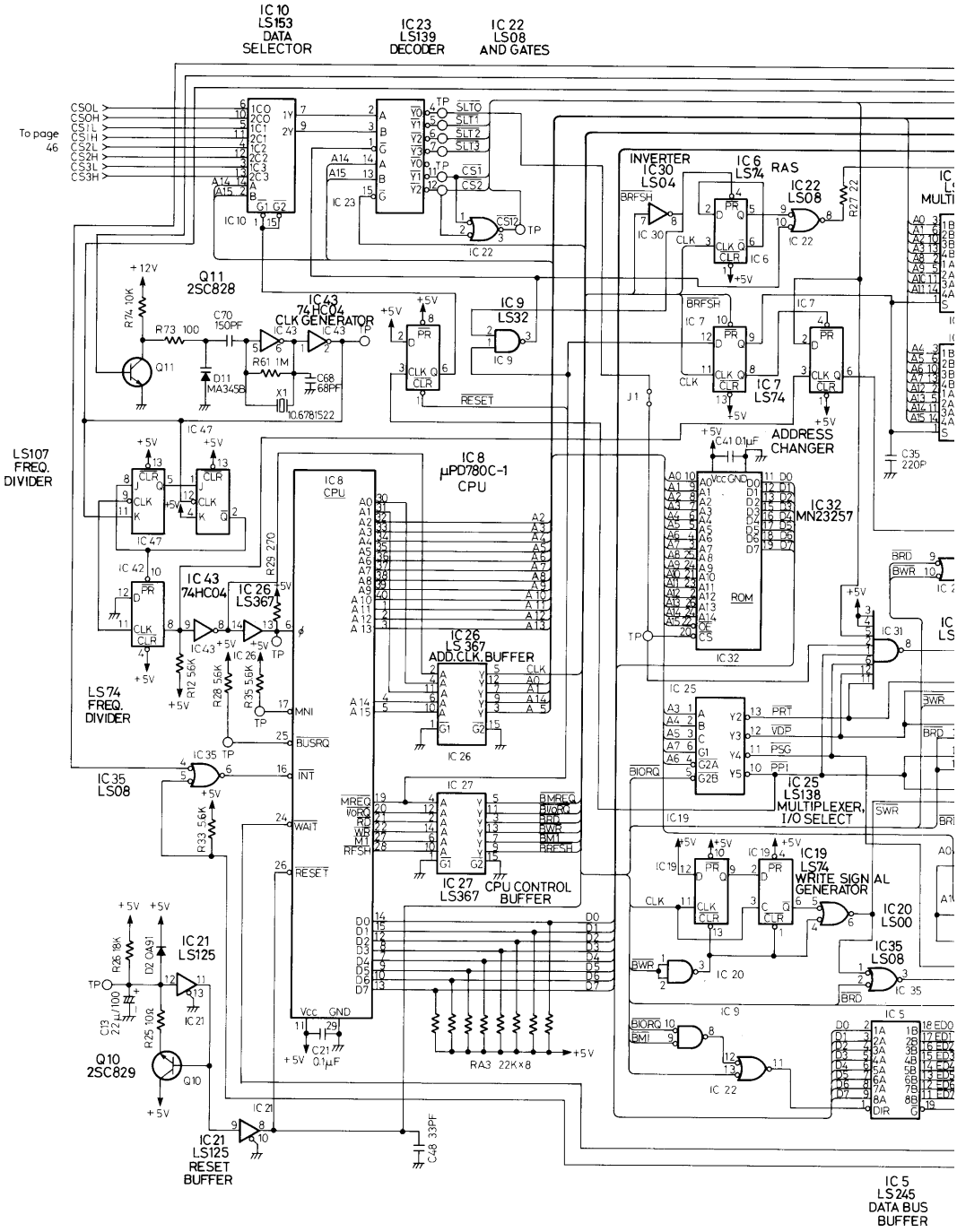
Terminal Number	Name	I/O (Note 1)	Terminal Number	Name	I/O (Note 1)
1	$\overline{CS1}$	0	2	$\overline{CS2}$	0
3	$\overline{CS12}$	0	4	$\overline{SLTSL}$	0
5	(Note 2)	-	6	$\overline{RFSH}$	0
7	$\overline{WAIT}$ (Note 3)	I	8	$\overline{INT}$ (Note 3)	I
9	$\overline{MI}$	0	10	$\overline{BUSDIR}$	I
11	$\overline{IORQ}$	0	12	$\overline{MERQ}$	0
13	$\overline{WR}$	0	14	$\overline{RD}$	0
15	$\overline{RESET}$	0	16	(Note 2)	-
17	A9	0	18	A15	0
19	A11	0	20	A10	0
21	A7	0	22	A6	0
23	A12	0	24	A8	0
25	A14	0	26	A13	0
27	A1	0	28	A0	0
29	A3	0	30	A2	0
31	A5	0	32	A4	0
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	-	42	CLOCK	0
43	GND	-	44	SW1	-
45	+5 V (Note 4)	-	46	SW2	-
47	+5 V (Note 4)	-	48	+12 V (Note 5)	-
49	SUNDIN	I	50	-12 V (Note 6)	-

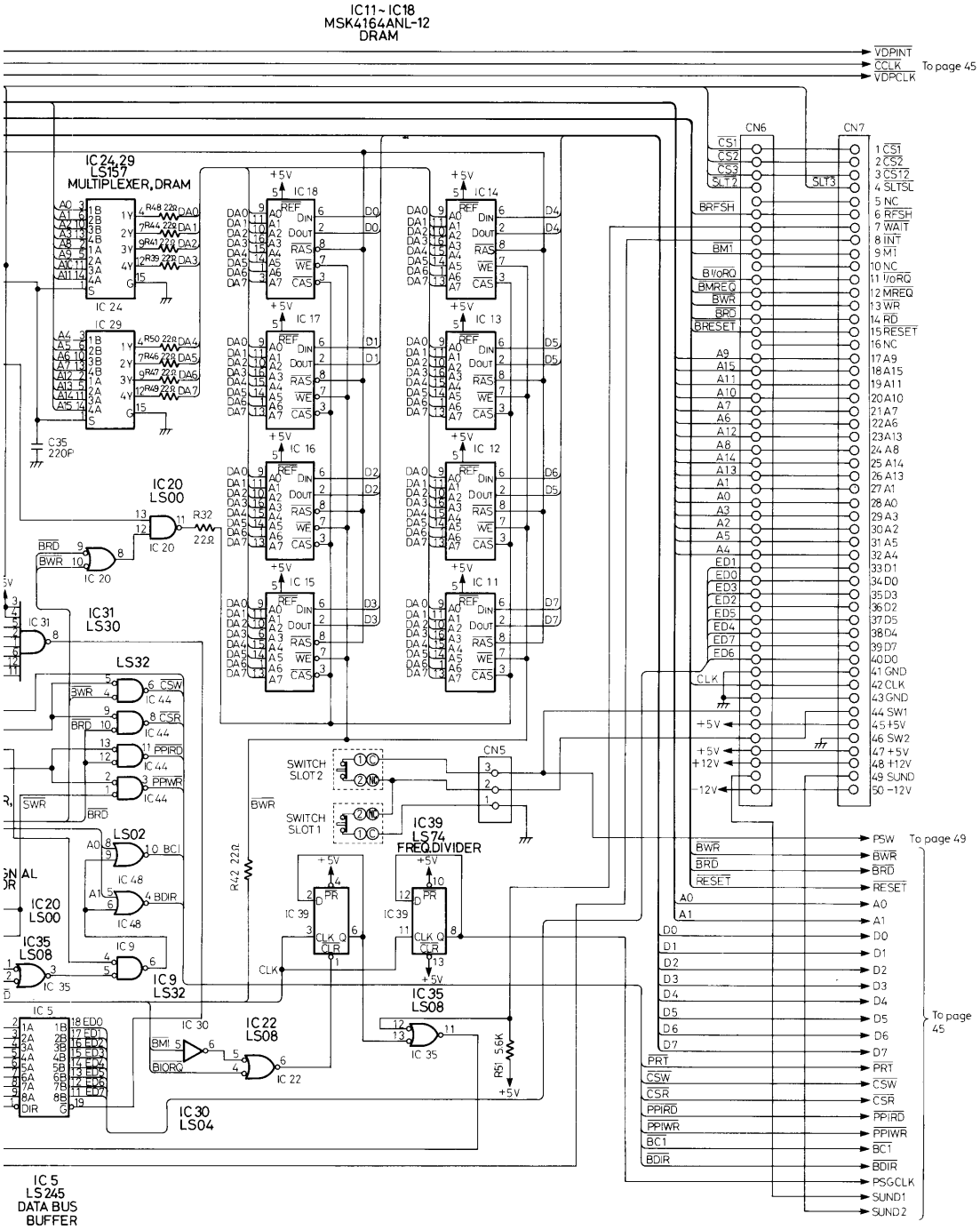
Note 1: Input or output with respect to the computer
Note 2: System reserve terminal
Note 3: Be sure to input using an open collector output
Note 4: Load current 300 mA or less
Note 5: Load current 50 mA or less
Note 6: Load current 50 mA or less
Note 7: Be sure to fully understand the signals before actual designing a slot connected interface.

Wiring Connection Diagram

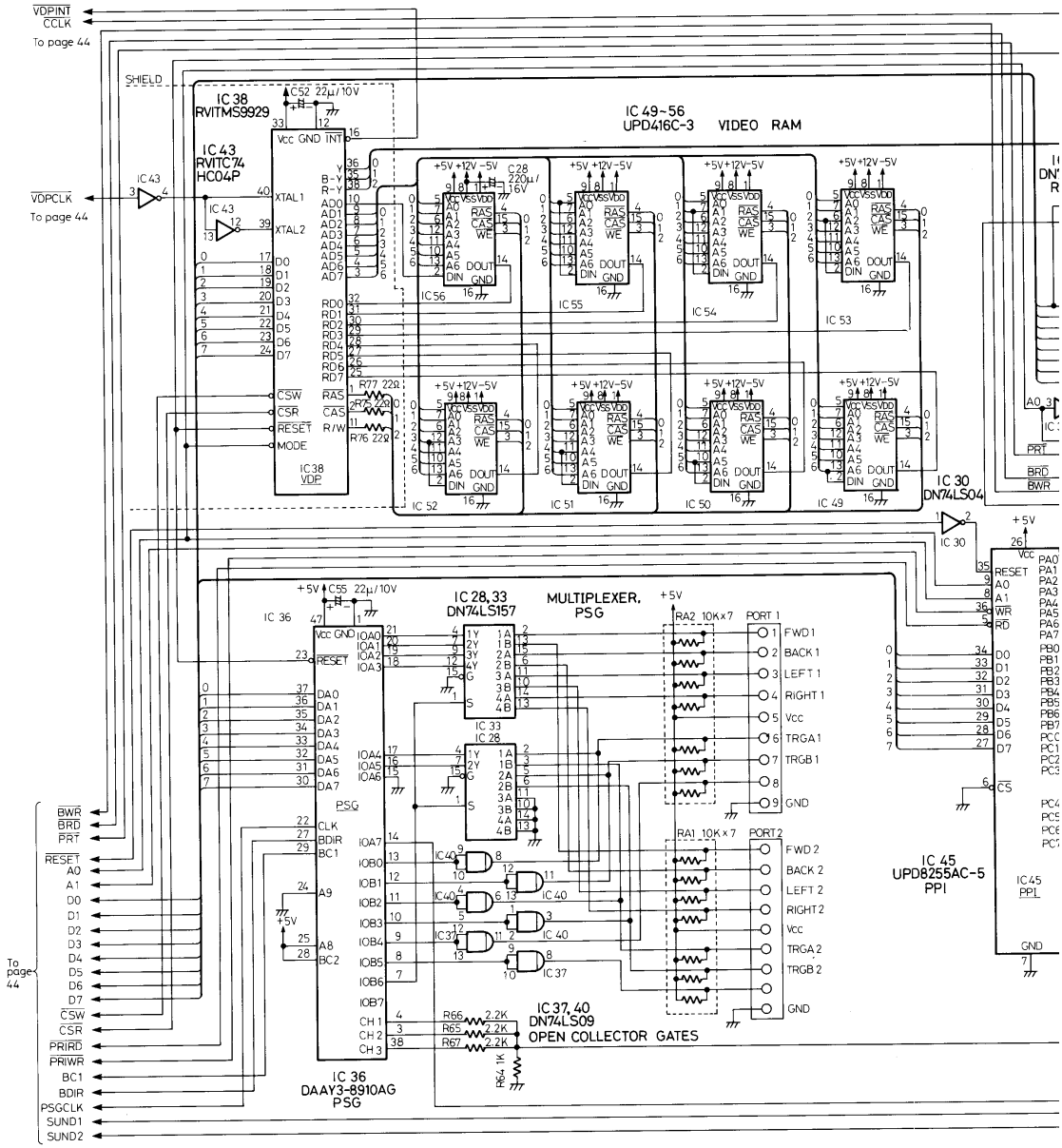


Schematic Diagram (Main Board)

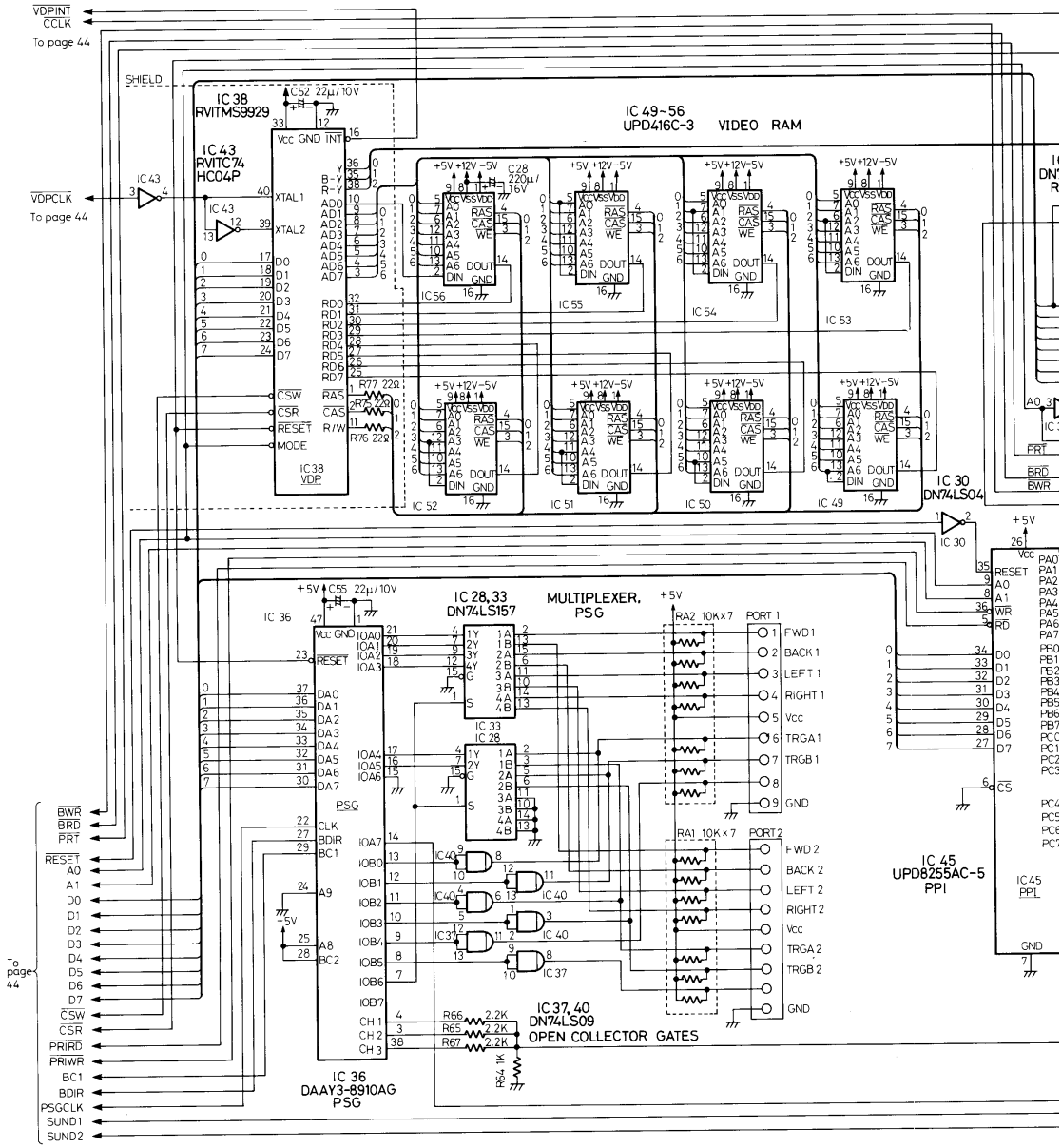



IC11~IC18
MSK4164ANL-12
DRAM
VDPINT
CCLK
VDPCLK
To page 45
CN6
CN7
IC24 29
LS157
MULTIPLEXER, DRAM
IC 24
IC 29
IC 18
IC 17
IC 16
IC 15
IC 14
IC 13
IC 12
IC 11
C35
220P
IC20
LS00
IC 20
R32
22Ω
IC31
LS30
IC 31
LS32
IC 44
IC 48
IC 9
IC35
LS08
IC 35
IC 5
LS245
DATA BUS
BUFFER
IC 30
LS04
IC22
LS08
IC 22
SWITCH
SLOT2
SWITCH
SLOT1
CN5
IC39
LS74
FREQ.DIVIDER
R42 22Ω
R51 5.6K
+5V
BWR
BRD
BRFSH
BM1
BIORQ
BMREQ
BRESET
CLK
PSW
To page 49
To page
45
PRT
CSW
CSR
PPIRD
PPIWR
BC1
BDIR
PSGCLK
SUND1
SUND2

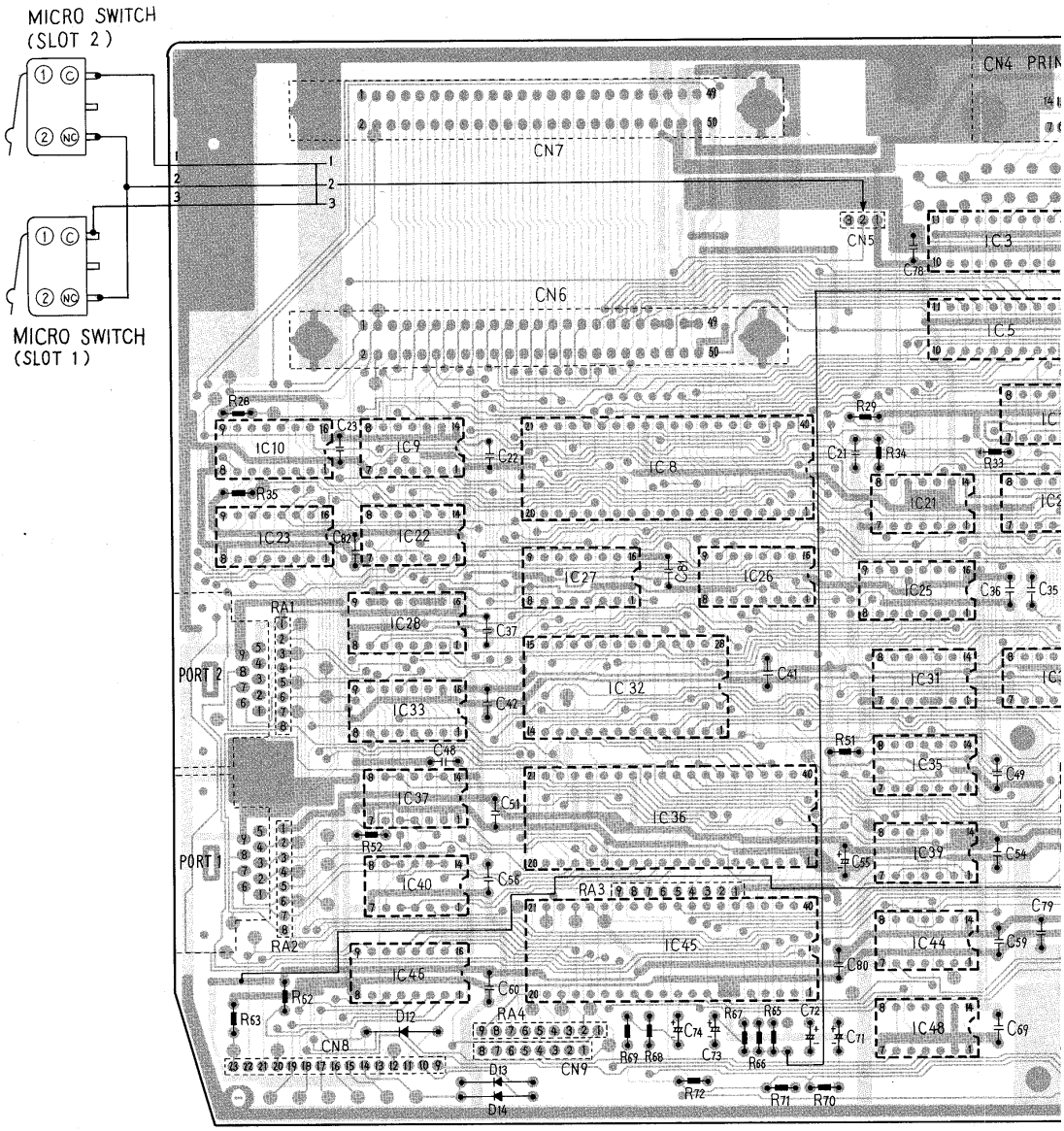
Schematic Diagram (Main Board)

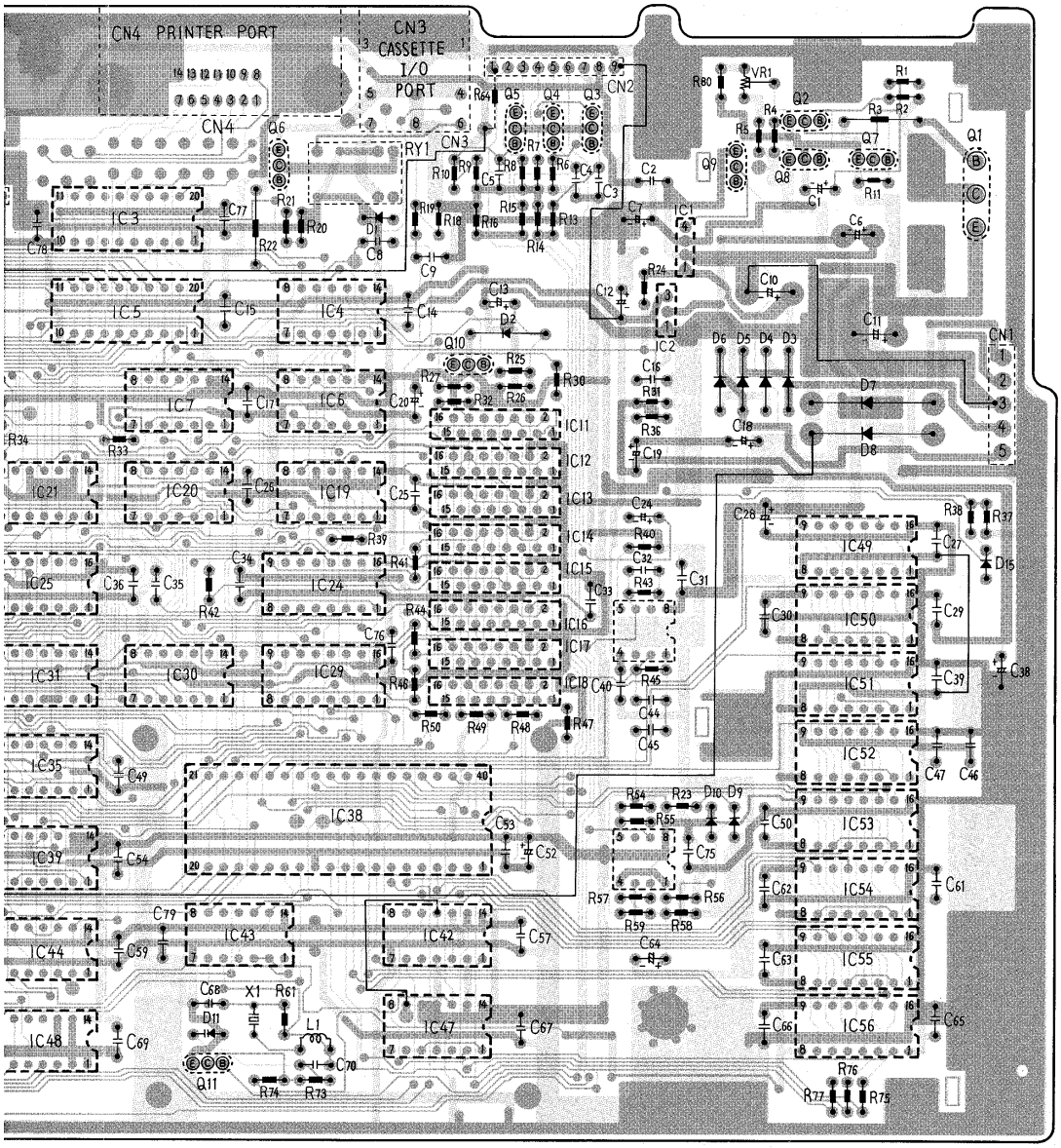


Schematic Diagram (Main Board)

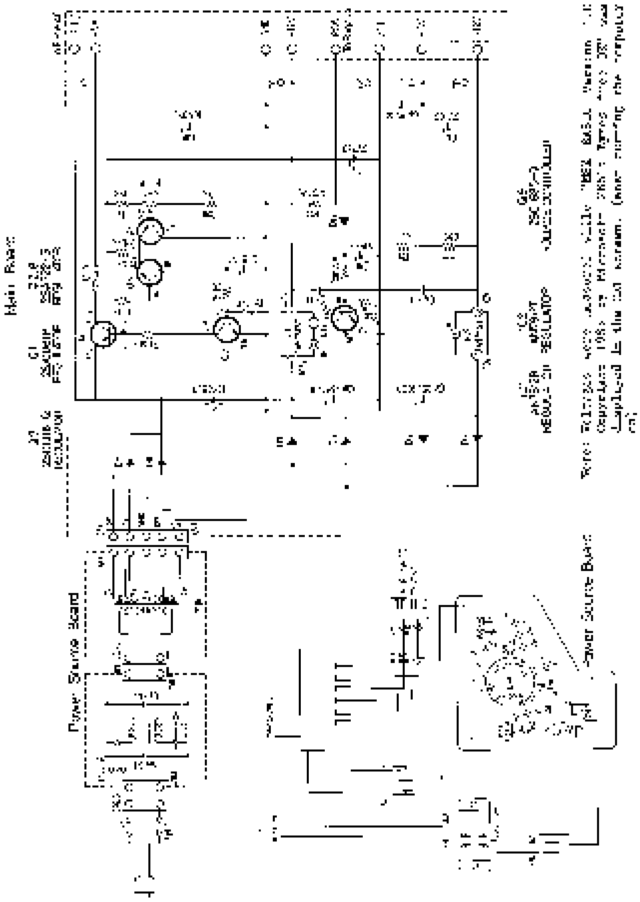


Printed Circuit Board (Main Board)

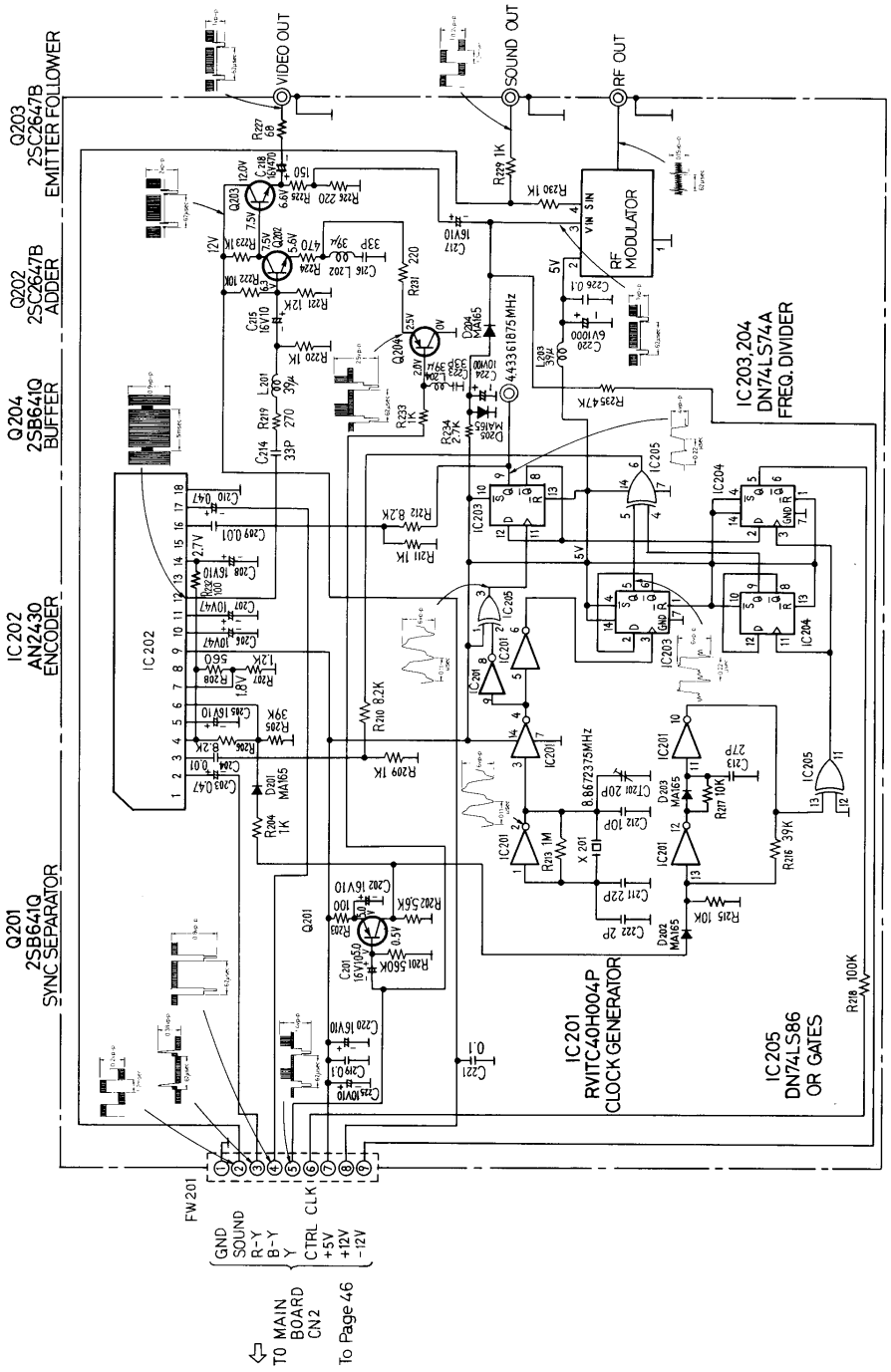



CN4 PRINTER PORT
CN3 CASSETTE I/O PORT
CN4
CN3
CN2
CN1
RY1
VR1
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC11
IC12
IC13
IC14
IC15
IC16
IC17
IC18
IC19
IC20
IC21
IC24
IC25
IC29
IC30
IC31
IC35
IC37
IC38
IC42
IC43
IC44
IC47
IC48
IC49
IC50
IC51
IC52
IC53
IC54
IC55
IC56
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D15
X1
L1

Schematic Diagram & Printed Circuit Board (Power Source) & Main Board



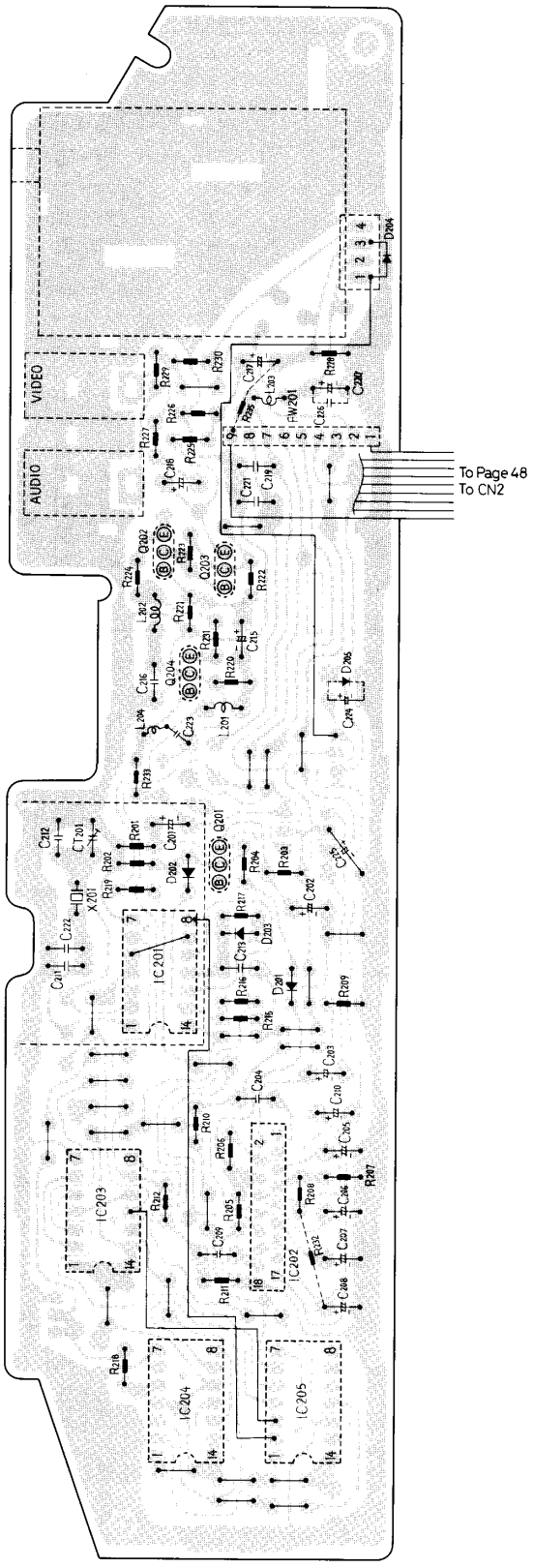
Schematic Diagram (Video Board)



Note: Waveforms and Voltages were measured while "MSX BASIC Version 1.0
Copyright 1983 by Microsoft 28815 Bytes free OK" was displayed in the
CRT screen. (When turning the computer on)
For waveform of sound, the sound "A" was beeped by following programming.

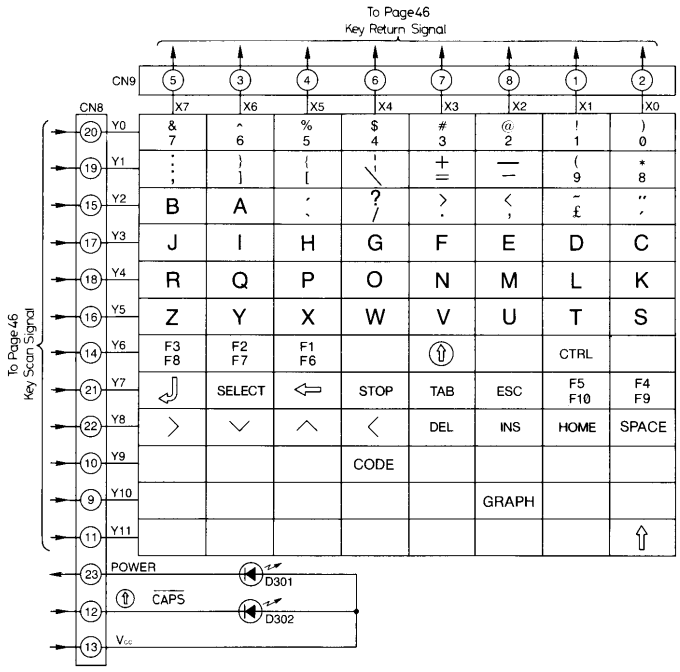
```
10: PLAY "AAAAAAAAAA"
20: GOTO 10
```

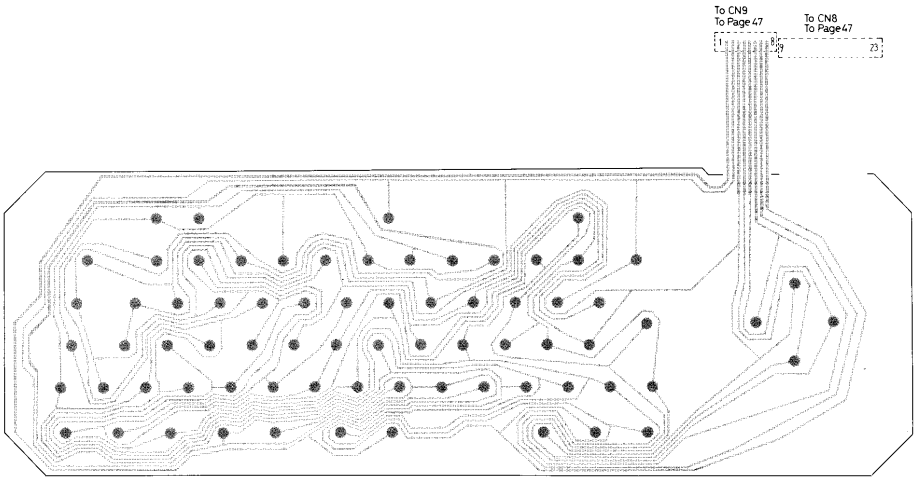
Printed Circuit Board (Video Board)



Printed Circuit Board (Keyboard)

Keyboard Matrix





Note: When the Keytop is depressed, contacts of both flexible patterns (,) contact each other.

IC Block Diagram

——74 Families of TTL Circuits——

(1) DN74LS00
(2) DN74LS02
(3) DN74LS04/RVITC74HC04P
(4) DN74LS08
(5) DN74LS09
(6) DN74LS30
(7) DN74LS32
(8) DN74LS74A
(9) DN74LS86
(10) DN74LS107
(11) DN74LS125A
(12) DN74LS138
(13) DN74LS139
(14) DN74LS145
(15) DN74LS153
(16) DN74LS157
(17) DN74LS245
(18) DN74LS273
(19) DN74LS367A

——Others IC——

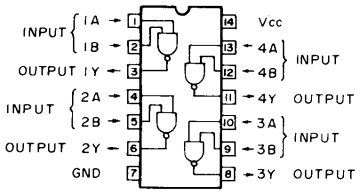
(20) AN2430
(21) AN6553
(22) AN7812R
(23) AN7912T
(24) DA4164ANL12M
(25) DAAY3-8910AG
(26) MN23257CFH
(27) RVITC40H004P
(28) RVITMS9929AJ
(29) UPC311C
(30) UPD416C-3
(31) UPD780C-1
(32) UPD8255AC-5

EXPLANATION OF TRUTH TABLES

The following symbols are now being used in truth tables.

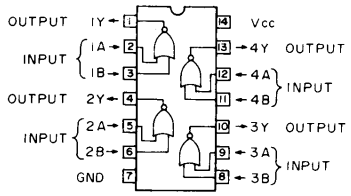
H = high level (steady state)
L = low level (steady state)
↑ = transition from low to high level
↓ = transition from high to low level
X = irrelevant (any input, including transitions)
Z = off (high-impedance) state of a 3-state output
a..h = the level of steady-state inputs at inputs A through H respectively
Q_0 = level of Q before the indicated steady-state input conditions were established
$\overline{Q}_0$ = complement of Q_0 or level of $\overline{Q}$ before the indicated steady-state input conditions were established
Q_n = level of Q before the most recent active transition indicated by ↓ or ↑
⎍ = one high-level pulse
⎏ = one low-level pulse

(1) DN74LS00



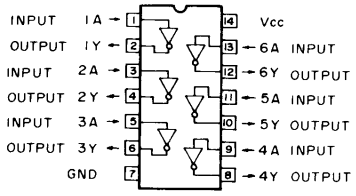
Positive logic : $Y = \overline{AB}$

(2) DN74LS02



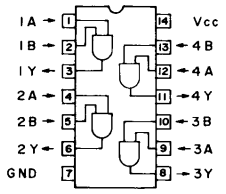
Positive logic : $Y = \overline{A + B}$

(3) DN74LS04/RVITC74HC04P



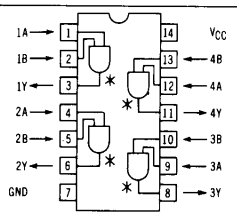
Positive logic : $Y = \overline{A}$

(4) DN74LS08



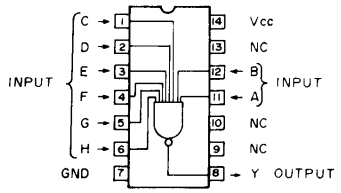
Positive logic : Y = AB

(5) DN74LS09



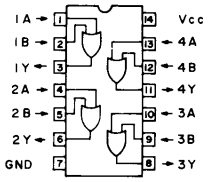
* OPEN-COLLECTOR OUTPUTS
Positive logic:Y=AB

(6) DN74LS30



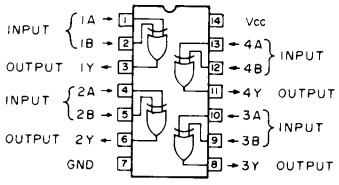
Positive logic : $Y = \overline{ABCDEFGH}$

(7) DN74LS32



Positive logic : Y = A + B

(9) DN74LS86



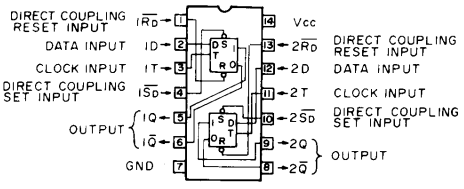
TRUTH TABLE

INPUTS		OUTPUT
A	B	Y
L	L	L
L	H	H
H	L	H
H	H	L

H=high level, L=low level

$Y = A \oplus B = \overline{A}B + A\overline{B}$

(8) DN74LS74A

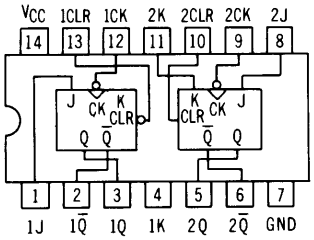


TRUTH TABLE

INPUTS				OUTPUTS	
$\overline{S}_D$	$\overline{R}_D$	T	D	Q	$\overline{Q}$
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H*	H*
H	H	L	X	Q^0	$\overline{Q}^0$
H	H	↑	H	H	L
H	H	↑	L	L	H

* This configuration is nonstable.

(10) DN74LS107

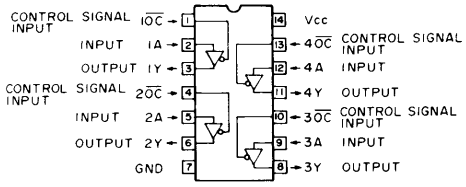


TRUTH TABLE

INPUTS				OUTPUTS	
CLR	CLK	J	K	Q	$\bar{Q}$
L	X	X	X	L	H
H	⎍	L	L	Q_0	$\bar{Q}_0$
H	⎍	H	L	H	L
H	⎍	L	H	L	H
H	⎍	H	H	TOGGLE	

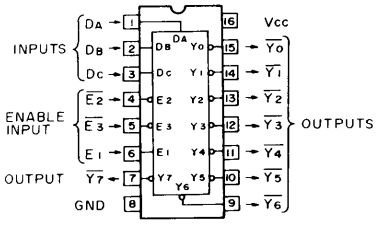
X = irrelevant

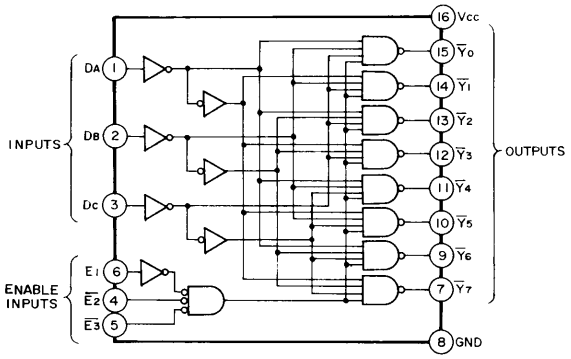
(11) DN74LS125A



Positive logic : Y = A Output is off (disabled) when $\overline{OC}$ is high

(12) DN74LS138



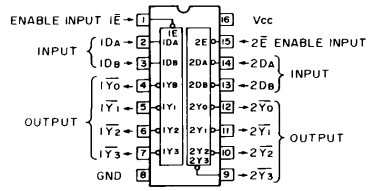


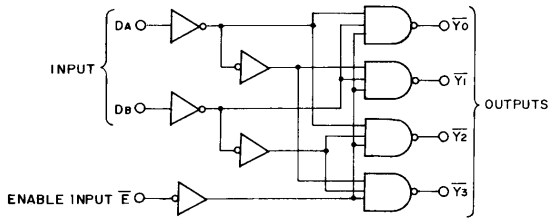
TRUTH TABLE

INPUTS					OUTPUTS							
ENABLE		SELECT										
E_1	$\bar{E}_X$	D_C	D_B	D_A	$\bar{Y}_0$	$\bar{Y}_1$	$\bar{Y}_2$	$\bar{Y}_3$	$\bar{Y}_4$	$\bar{Y}_5$	$\bar{Y}_6$	$\bar{Y}_7$
X	H	X	X	X	H	H	H	H	H	H	H	H
L	X	X	X	X	H	H	H	H	H	H	H	H
H	L	L	L	L	L	H	H	H	H	H	H	H
H	L	L	L	H	H	L	H	H	H	H	H	H
H	L	L	H	L	H	H	L	H	H	H	H	H
H	L	L	H	H	H	H	H	L	H	H	H	H
H	L	H	L	L	H	H	H	H	L	H	H	H
H	L	H	L	H	H	H	H	H	H	L	H	H
H	L	H	H	L	H	H	H	H	H	H	L	H
H	L	H	H	H	H	H	H	H	H	H	H	L

$\bar{E}_X = \bar{E}_2 + \bar{E}_3$ X=irrelevant

(13) DN74LS139





TRUTH TABLE

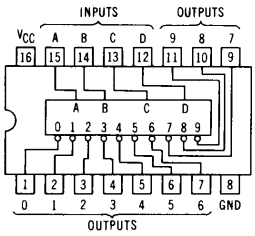
INPUTS			OUTPUTS			
$\overline{E}$	DB	DA	$\overline{Y_0}$	$\overline{Y_1}$	$\overline{Y_2}$	$\overline{Y_3}$
H	X	X	H	H	H	H
L	L	L	L	H	H	H
L	L	H	H	L	H	H
L	H	L	H	H	L	H
L	H	H	H	H	H	L

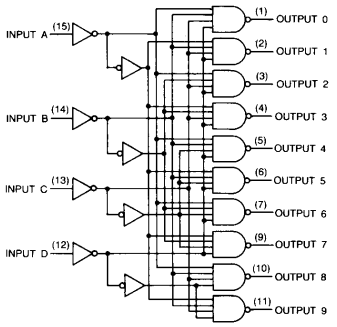
X=irrelevant

(14) DN74LS145

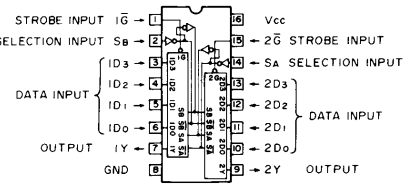
TRUTH TABLE

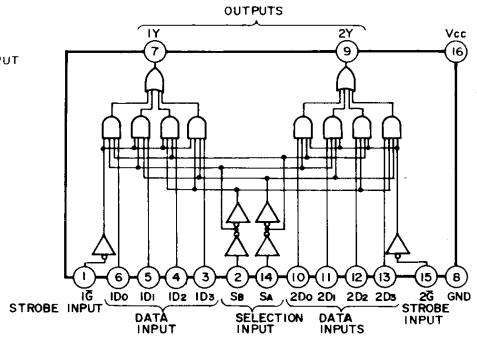
NO.	INPUTS				OUTPUTS									
	D	C	B	A	0	1	2	3	4	5	6	7	8	9
0	L	L	L	L	L	H	H	H	H	H	H	H	H	H
1	L	L	L	H	H	L	H	H	H	H	H	H	H	H
2	L	L	H	L	H	H	L	H	H	H	H	H	H	H
3	L	L	H	H	H	H	H	L	H	H	H	H	H	H
4	L	H	L	L	H	H	H	H	L	H	H	H	H	H
5	L	H	L	H	H	H	H	H	H	L	H	H	H	H
6	L	H	H	L	H	H	H	H	H	H	L	H	H	H
7	L	H	H	H	H	H	H	H	H	H	H	L	H	H
8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





(15) DN74LS153



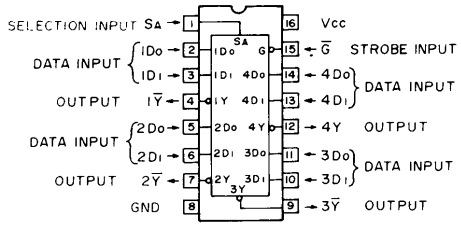


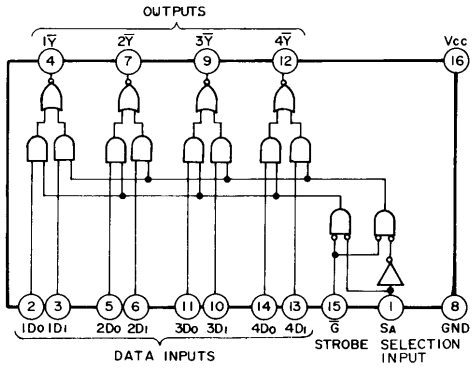
TRUTH TABLE

INPUTS							OUTPUTS
SB	SA	D0	D1	D2	D3	$\overline{G}$	Y
X	X	X	X	X	X	H	L
L	L	L	X	X	X	L	L
L	L	H	X	X	X	L	H
L	H	X	L	X	X	L	L
L	H	X	H	X	X	L	H
H	L	X	X	L	X	L	L
H	L	X	X	H	X	L	H
H	H	X	X	X	L	L	L
H	H	X	X	X	H	L	H

X=irrelevant

(16) DN74LS157



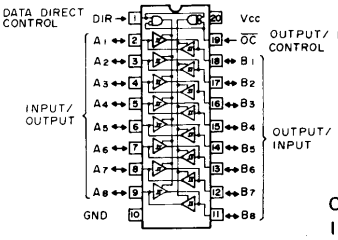


TRUTH TABLE

INPUTS				OUTPUTS
$\overline{G}$	SA	D0	D1	$\overline{Y}$
H	X	X	X	H
L	L	L	X	H
L	L	H	X	L
L	H	X	L	H
L	H	X	H	L

X=irrelevant

(17) DN74LS245

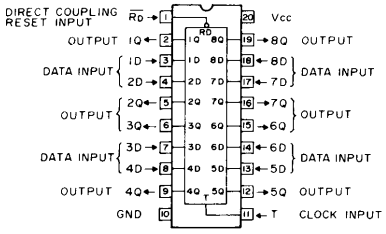


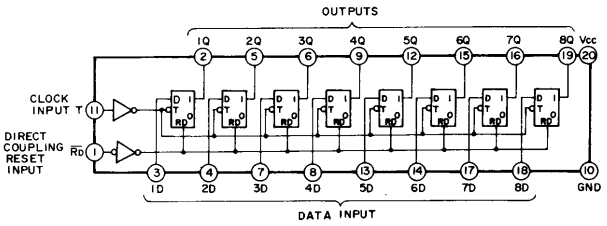
TRUTH TABLE

$\overline{OC}$	DIR	A	B
L	L	O	I
L	H	I	O
H	X	Z	Z

O=Output terminal
I =Input terminal

(18) DN74LS273

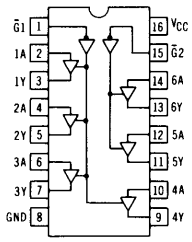




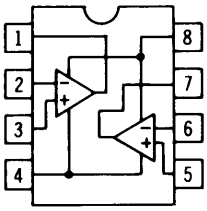
TRUTH TABLE

INPUTS			OUTPUT
$\overline{R_D}$	T	D	Q
L	X	X	L
H	↑	H	H
H	↑	L	L
H	L	X	Q^0

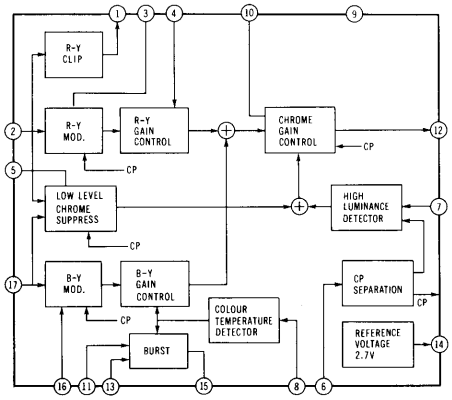
(19) DN74LS367A



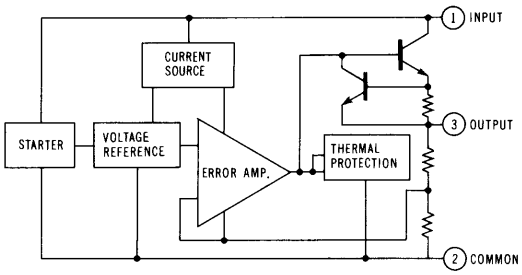
(21) AN6553



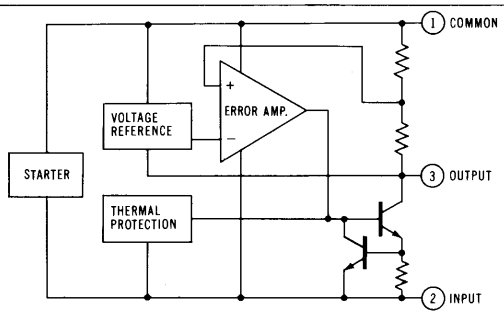
(20) AN2430



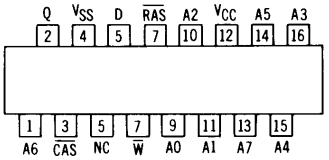
(22) AN7812R

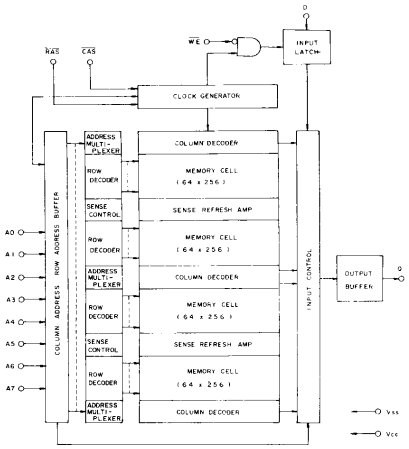


(23) AN7912T

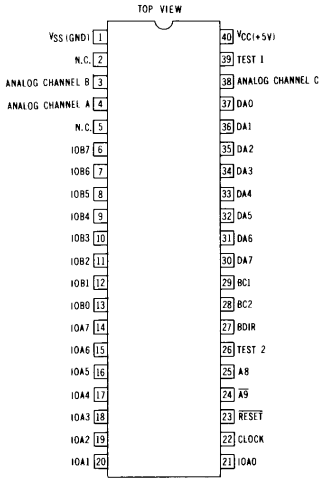


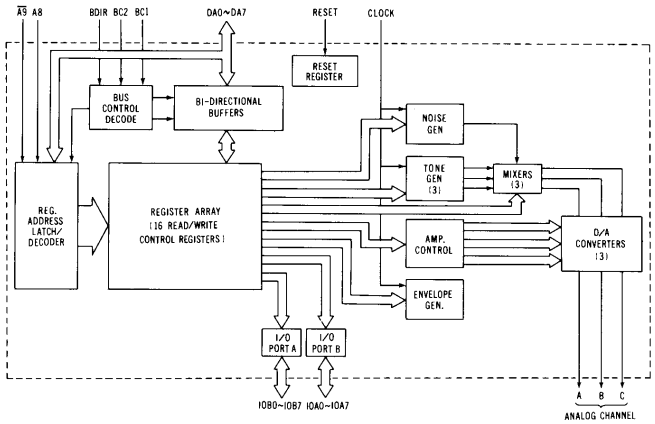
(24) DA4164ANL12M



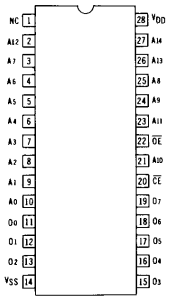


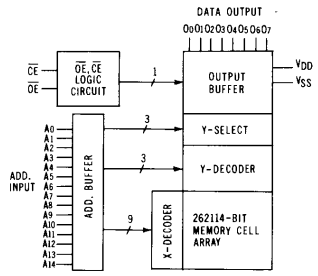
(25) DAAY3-8910AG



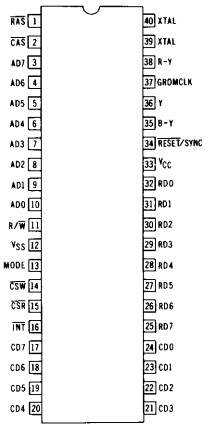


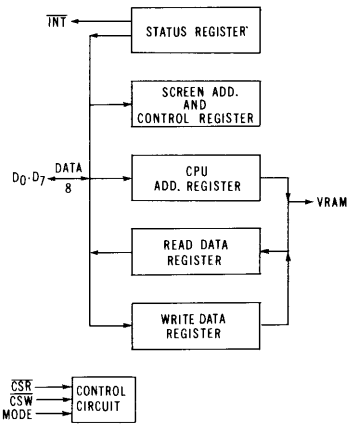
(26) MN23257CFH



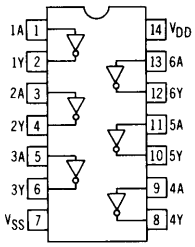


(28) RVITMS9929AJ

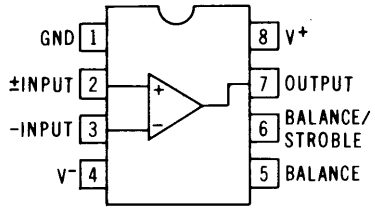




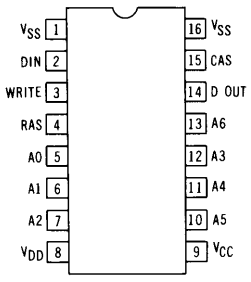
(27) RVITC40H004P

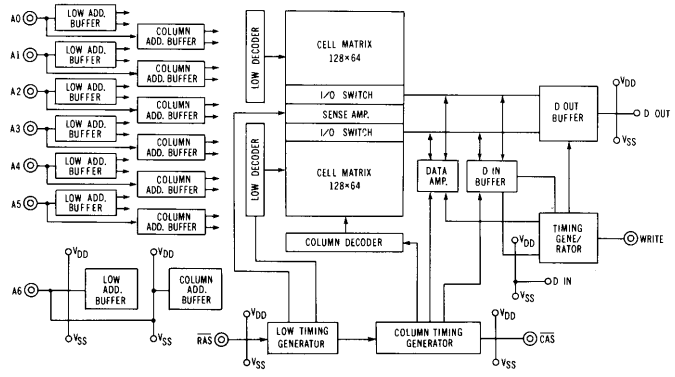


(29) UPC311C

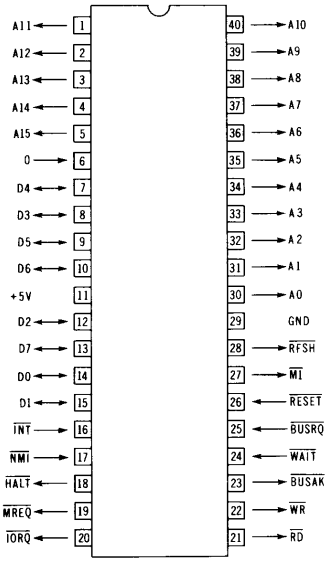


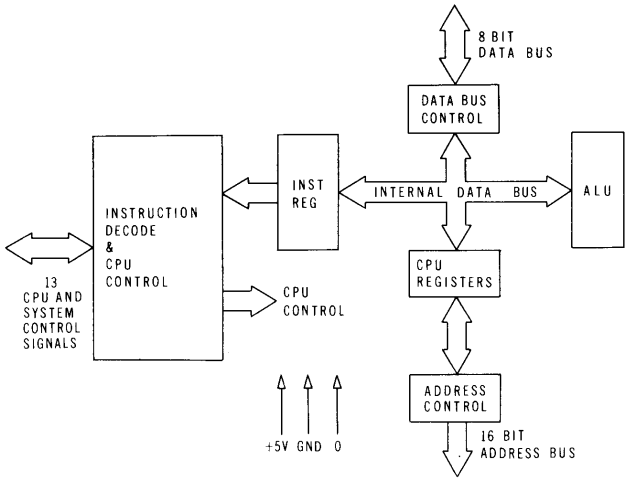
(30) UPD416C-3



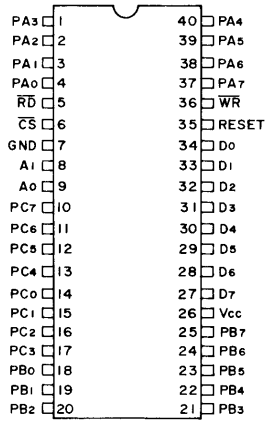


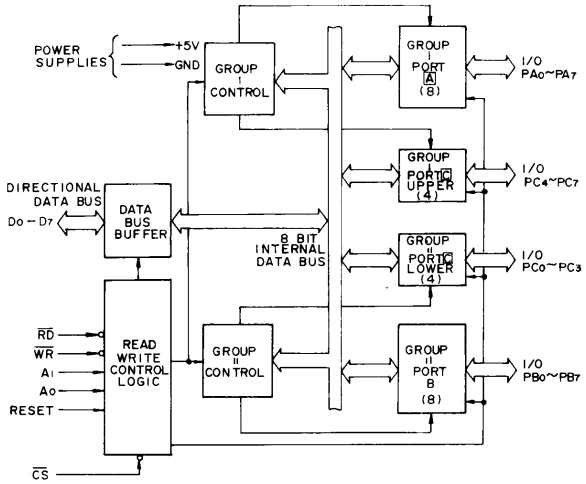
(31) UPD780C-1



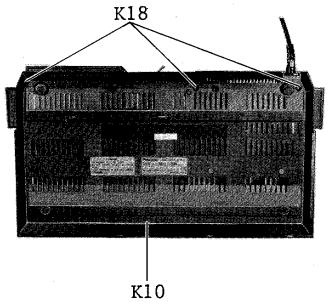


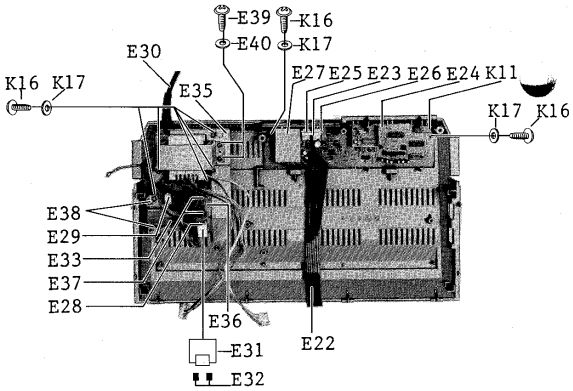
(32) UPD8255AC-5

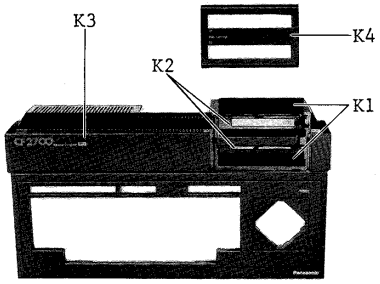


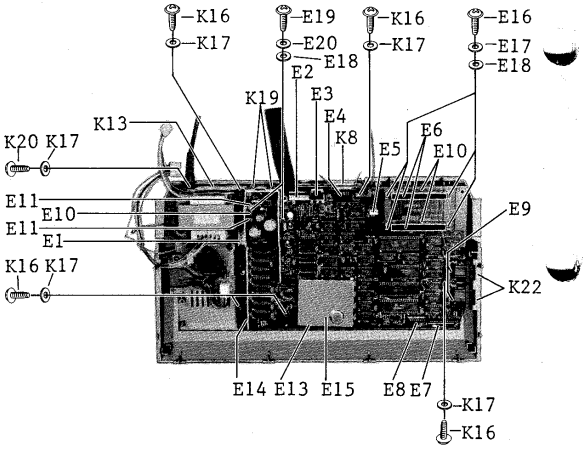


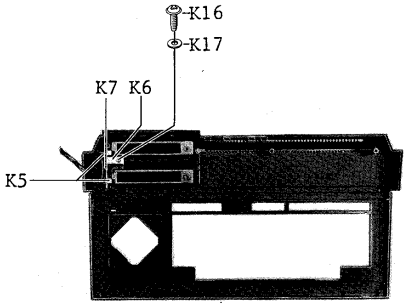
Parts Location

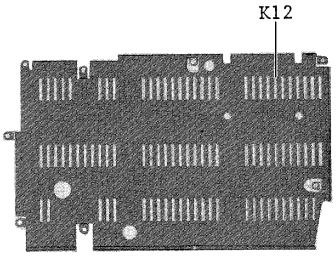




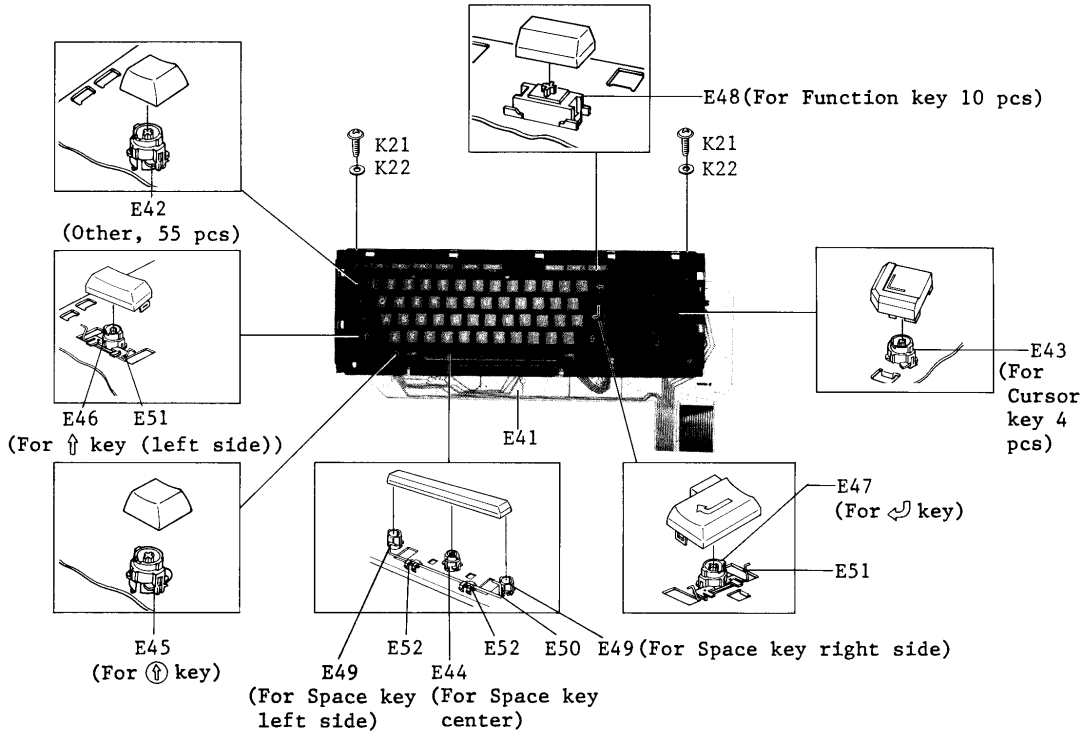


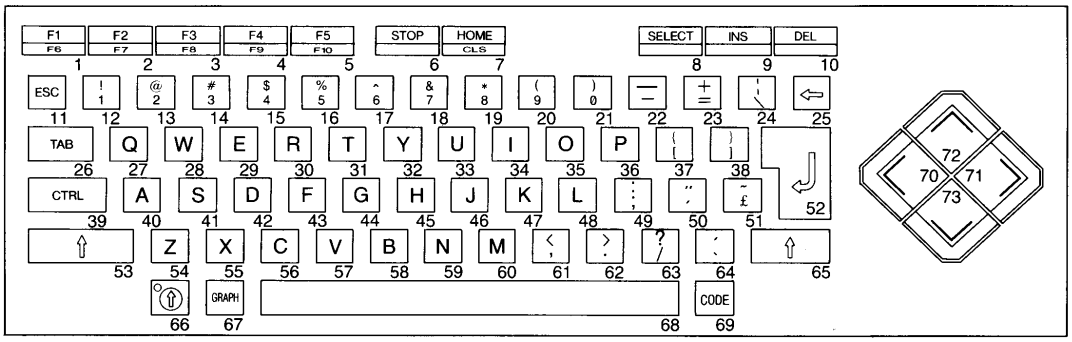




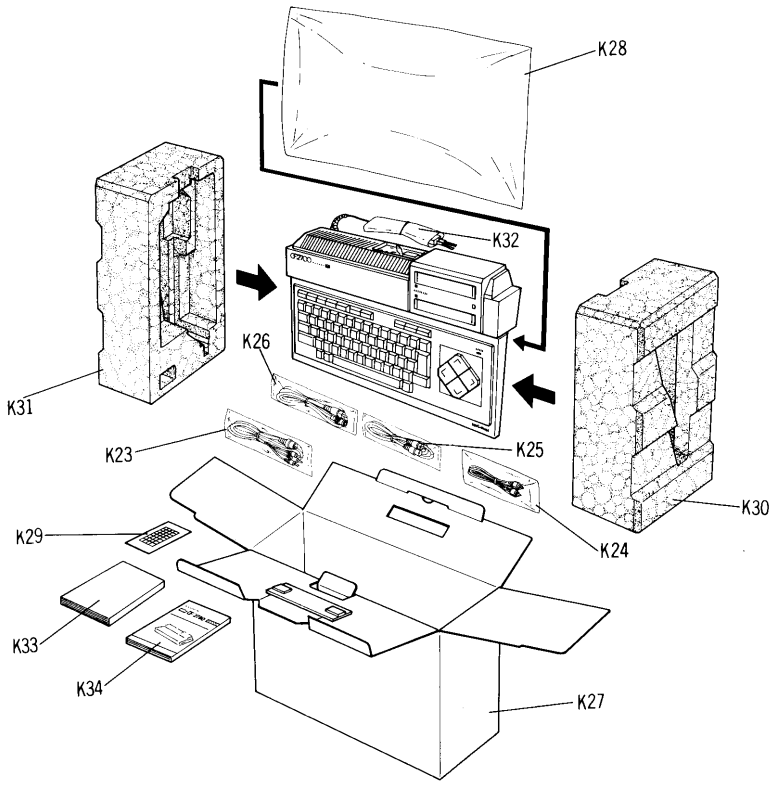


Parts Location (Keyboard)





Packing Instruction



Replacement Parts List CF-2700

Notes: 1. Parts Name and Location.
Components identified by ⚠ mark have special characteristics important for safety. When replacing any of these components, use only manufacturer's specified parts.
2. The S mark indicates service standard parts and may differ from production parts.

Ref. No.	Part No.	Part Name & Description	Per Set
		MAIN P.C. BOARD BLOCK	
IC1	AN7812R	IC, REGULATOR	1
IC2	AN7912T	IC, REGULATOR	1
IC3	DN74LS273	IC, DATA LATCH	1
IC4	DN74LS32	IC, QUADRUPLE OR GATES	1
IC5	DN74LS245	IC, DATA BUS BUFFER	1
IC6	DN74LS74A	IC, RAS	1
IC7	DN74LS74A	IC, ADRESS CHANGER	1
IC8	UPD780C-1	IC, CPU	1
IC9	DN74LS32	IC, QUADRUPLE OR GATES	1
IC10	DN74LS153	IC, DATA SELECTOR, SLOT	1
IC11	DA4164ANL12M	IC, DYNAMIC RAM	1
IC12	DA4164ANL12M	IC, DYNAMIC RAM	1
IC13	DA4164ANL12M	IC, DYNAMIC RAM	1
IC14	DA4164ANL12M	IC, DYNAMIC RAM	1
IC15	DA4164ANL12M	IC, DYNAMIC RAM	1
IC16	DA4164ANL12M	IC, DYNAMIC RAM	1
IC17	DA4164ANL12M	IC, DYNAMIC RAM	1
IC18	DA4164ANL12M	IC, DYNAMIC RAM	1
IC19	DN74LS74A	IC, WRITE SIGNAL GENERATOR	1

Ref. No.	Part No.	Part Name & Description	Per Set
IC20	DN74LS00	IC, QUADRUPLE NAND GATES	1
IC21	DN74LS125A	IC, RESET BUFFER	1
IC22	DN74LS08	IC, QUADRUPLE AND GATES	1
IC23	DN74LS139	IC, DECODER, SLOT	1
IC24	DN74LS157	IC, MULTIPLEXER, DRAM	1
IC25	DN74LS138	IC, MULTIPLEXER, I/O SELECT	1
IC26	DN74LS367A	IC, ADDRESS CLOCK BUFFER	1
IC27	DN74LS367A	IC, CPU CONTROL BUFFER	1
IC28	DN74LS157	IC, MULTIPLEXER, PSG	1
IC29	DN74LS157	IC, MULTIPLEXER, DRAM	1
IC30	DN74LS04	IC, INVERTERS	1
IC31	DN74LS30	IC, POSITIVE NAND GATES	1
IC32	MN23257CFH	IC, MASK ROM	1
IC33	DN74LS157	IC, MULTIPLEXER, PSG	1
IC34	AN6553	IC, OP AMP	1
IC35	DN74LS08	IC, QUADRUPLE AND GATES	1
IC36	DAAY3-8910A	IC, PSG (PROGRAMMABLE SOUND GENERATOR)	1
IC37	DN74LS09	IC, OPEN COLLECTOR GATES	1
IC38	RVITMS9929AJ	IC, VDP (VIDEO DISPLAY PROCESSOR)	1
IC39	DN74LS74A	IC, FREQUENCY DIVIDER	1

Ref. No.	Part No.	Part Name & Description	Per Set
IC40	DN74LS09	IC, OPEN COLLECTOR GATES	1
IC41	UPC311C	IC, CONPARATOR	1
IC42	DN74LS74A	IC, FREQUENCY DIVIDER	1
IC43	RVITC74HC04P	IC, OSCILLATOR	1
IC44	DN74LS32	IC, QUADRUPLE OR GATES	1
IC45	UPD8255AC-5	IC, PPI (PROGRAMMABLE PERIPHERAL INTERFACE)	1
IC46	DN74LS145	IC, KEYBOARD INTERFACE	1
IC47	DN74LS107	IC, FREQUENCY DIVIDER	1
IC48	DN74LS02	IC, QUADRUPLE NOR GATES	1
IC49	UPD416C-3	IC, VIDEO RAM	1
IC50	UPD416C-3	IC, VIDEO RAM	1
IC51	UPD416C-3	IC, VIDEO RAM	1
IC52	UPD416C-3	IC, VIDEO RAM	1
IC53	UPD416C-3	IC, VIDEO RAM	1
IC54	UPD416C-3	IC, VIDEO RAM	1
IC55	UPD416C-3	IC, VIDEO RAM	1
IC56	UPD416C-3	IC, VIDEO RAM	1
Q1	2SA1061P	Transistor	1
Q2	2SA722-S	Transistor	1
Q3	2SC829-B	Transistor	1
Q4	2SC829-B	Transistor	1
Q5	2SC829-B	Transistor	1
Q6	2SC1685-Q	Transistor	1
Q7	2SC1318-Q	Transistor	1
Q8	2SA722-S	Transistor	1
Q9	2SC1685-Q	Transistor	1
Q10	2SC829-B	Transistor	1
Q11	2SC1685-Q	Transistor	1
D1	MA165	Diode	1
D2	0A91LF	Diode	1
D3	FBM-032-009	Diode	1
D4	FBM-032-009	Diode	1
D5	FBM-032-009	Diode	1
D6	FBM-032-009	Diode	1
D7	DEDS3V20F4	Diode	1
D8	DEDS3V20F4	Diode	1
D9	MA165	Diode	1
D10	MA165	Diode	1
D11	MA345B	Diode	1
D12	0A95	Diode	1
D13	0A95	Diode	1
D14	0A95	Diode	1
D15	MA165	Diode	1
X1	DECA10678K1M	Crystal	1
RY1	FBM-450-004	Relay	1
RA1	EXBP87103J	Component Combination	1
RA2	EXBP87103J	Component Combination	1
RA3	EXBP88103J	Component Combination	1
RA4	EXBP88223J	Component Combination	1
VR1	DENC1B222	Variable Registor volume	1
R1	ERDS2TJ102	Registor 1K ohms	1
R2	ERDS2TJ102	Registor 1K ohms	1
R3	ERG1SJ680P	Registor 68 ohms	1
R4	ERDS2TJ472	Registor 4.7K ohms	1
R5	ERDS2TJ153	Registor 15K ohms	1
R6	ERDS2TJ122	Registor 1.2K ohms	1
R7	ERDS2TJ122	Registor 1.2K ohms	1
R8	ERDS2TJ122	Registor 1.2K ohms	1
R9	ERDS2TJ561	Registor 560 ohms	1
R10	ERDS2TJ471	Registor 470 ohms	1
R11	ERDS2TJ472	Registor 4.7K ohms	1
R12	ERDS2TJ562	Registor 5.6K ohms	1
R13	ERDS2TJ471	Registor 470 ohms	1
R14	ERDS2TJ561	Registor 560 ohms	1
R15	ERDS2TJ471	Registor 470 ohms	1
R16	ERDS2TJ561	Registor 560 ohms	1
R18	ERDS2TJ101	Registor 100 ohms	1
R19	ERDS2TJ472	Registor 4.7K ohms	1
R20	ERDS2TJ222	Registor 2.2K ohms	1
R21	ERDS2TJ222	Registor 2.2K ohms	1
R22	ERD50TJ151	Registor 150 ohms	1
R24	ERG1AN471U	Registor 470 ohms	1
R25	ERDS2TJ100	Registor 10 ohms	1
R26	ERDS2TJ183	Registor 18K ohms	1
R27	ERDS2TJ220	Registor 22 ohms	1
R28	ERDS2TJ562	Registor 5.6K ohms	1

Ref. No.	Part No.	Part Name & Description	Per Set
R29	ERDS2TJ271	Registor 270 ohms	1
R30	ERDS2TJ392	Registor 3.9K ohms	1
R31	ERDS2TJ471	Registor 470 ohms	1
R32	ERDS2TJ220	Registor 22 ohms	1
R33	ERDS2TJ562	Registor 5.6K ohms	1
R34	ERDS2TJ103	Registor 10K ohms	1
R35	ERDS2TJ562	Registor 5.6K ohms	1
R36	ERDS2TJ681	Registor 680 ohms	1
R37	ERDS2TJ563	Registor 56K ohms	1
R38	ERDS2TJ273	Registor 27K ohms	1
R39	ERDS2TJ220	Registor 22 ohms	1
R40	ERDS2TJ102	Registor 1K ohms	1
R41	ERDS2TJ220	Registor 22 ohms	1
R42	ERDS2TJ220	Registor 22 ohms	1
R43	ERDS2TJ472	Registor 4.7K ohms	1
R44	ERDS2TJ220	Registor 22 ohms	1
R45	ERDS2TJ183	Registor 18K ohms	1
R46	ERDS2TJ220	Registor 22 ohms	1
R47	ERDS2TJ220	Registor 22 ohms	1
R48	ERDS2TJ220	Registor 22 ohms	1
R49	ERDS2TJ220	Registor 22 ohms	1
R50	ERDS2TJ220	Registor 22 ohms	1
R51	ERDS2TJ562	Registor 5.6K ohms	1
R52	ERDS2TJ680	Registor 68 ohms	1
R53	ERDS2TJ103	Registor 10K ohms	1
R54	ERDS2TJ102	Registor 1K ohms	1
R55	ERDS2TJ224	Registor 220K ohms	1
R56	ERDS2TJ222	Registor 2.2K ohms	1
R57	ERDS2TJ472	Registor 4.7K ohms	1
R58	ERDS2TJ222	Registor 2.2K ohms	1
R59	ERDS2TJ103	Registor 10K ohms	1
R61	ERDS2TJ105	Registor 1M ohms	1
R62	ERDS2TJ103	Registor 10K ohms	1
R63	ERDS2TJ680	Registor 68 ohms	1
R64	ERD25TJ102	Registor 1K ohms	1
R65	ERDS2TJ222	Registor 2.2K ohms	1
R66	ERDS2TJ222	Registor 2.2K ohms	1
R67	ERDS2TJ222	Registor 2.2K ohms	1
R68	ERDS2TJ472	Registor 4.7K ohms	1
R69	ERDS2TJ223	Registor 22K ohms	1
R70	ERDS2TJ472	Registor 4.7K ohms	1
R71	ERDS2TJ472	Registor 4.7K ohms	1
R72	ERDS2TJ182	Registor 1.8K ohms	1
R73	ERDS2TJ104	Registor 100K ohms	1
R74	ERDS2TJ103	Registor 10K ohms	1
R75	ERDS2TJ220	Registor 22 ohms	1
R76	ERDS2TJ220	Registor 22 ohms	1
R77	ERDS2TJ220	Registor 22 ohms	1
R80	ERDS2TJ103	Registor 10K ohms	1
C1	ECEA1HV010	Capacitor 1 μF	1
C2	ECFF1E104ZF	Capacitor 0.1 μF	1
C3	ECCF1H680JC	Capacitor 68 pF	1
C4	ECCF1H680JC	Capacitor 68 pF	1
C5	ECCF1H680JC	Capacitor 68 pF	1
C6	ECEA1EU102	Capacitor 1000 μF	1
C7	ECEA1CU331	Capacitor 330 μF	1
C8	ECQV1H393JZ	Capacitor 0.039 μF	1
C9	ECQV1H103JZ	Capacitor 0.01 μF	1
C10	ECEA1EU472	Capacitor 4700 μF	1
C11	ECEA1CU682	Capacitor 6800 μF	1
C12	ECEA1CU101	Capacitor 100 μF	1
C13	ECEA1AU220	Capacitor 22 μF	1
C14	ECFF1E104ZF	Capacitor 0.1 μF	1
C15	ECFF1E104ZF	Capacitor 0.1 μF	1
C16	ECFF1E104ZF	Capacitor 0.1 μF	1
C17	ECFF1E104ZF	Capacitor 0.1 μF	1
C18	ECEA1AU331	Capacitor 330 μF	1
C19	ECEA1AU101	Capacitor 100 μF	1
C20	ECSF1AE225	Capacitor 22 μF	1
C21	ECFF1E104ZF	Capacitor 0.1 μF	1
C22	ECFF1E104ZF	Capacitor 0.1 μF	1
C23	ECFF1E104ZF	Capacitor 0.1 μF	1
C24	ECEA1AU101	Capacitor 100 μF	1
C25	ECFF1E104ZF	Capacitor 0.1 μF	1
C26	ECFF1E104ZF	Capacitor 0.1 μF	1
C27	ECFF1E104ZF	Capacitor 0.1 μF	1
C28	ECSF1EE226	Capacitor 220 μF	1
C29	ECFF1E104ZF	Capacitor 0.1 μF	1
C30	ECFF1E104ZF	Capacitor 0.1 μF	1
C31	ECFF1E104ZF	Capacitor 0.1 μF	1
C32	ECKD1H222KB	Capacitor 2200 pF	1

Ref. No.	Part No.	Part Name & Description	Per Set
C33	ECFF1E104ZF	Capacitor 0.1 µF	1
C34	ECFF1E104ZF	Capacitor 0.1 µF	1
C35	ECKD1H221KB	Capacitor 220 pF	1
C36	ECFF1E104ZF	Capacitor 0.1 µF	1
C37	ECFF1E104ZF	Capacitor 0.1 µF	1
C38	ECEA1HU3R3	Capacitor 3.3 µF	1
C39	ECFF1E104ZF	Capacitor 0.1 µF	1
C40	ECFF1E104ZF	Capacitor 0.1 µF	1
C41	ECFF1E104ZF	Capacitor 0.1 µF	1
C42	ECFF1E104ZF	Capacitor 0.1 µF	1
C44	ECQV1H222JZ	Capacitor 0.0022 µF	1
C45	ECQV1H104JZ	Capacitor 0.1 µF	1
C46	ECFF1E104ZF	Capacitor 0.1 µF	1
C47	ECFF1E104ZF	Capacitor 0.1 µF	1
C48	ECCD1H330KC	Capacitor 33 pF	1
C49	ECFF1E104ZF	Capacitor 0.1 µF	1
C50	ECFF1E104ZF	Capacitor 0.1 µF	1
C51	ECFF1E104ZF	Capacitor 0.1 µF	1
C52	ECSF1AE225	Capacitor 22 µF	1
C53	ECFF1E104ZF	Capacitor 0.1 µF	1
C54	ECFF1E104ZF	Capacitor 0.1 µF	1
C55	ECSF1AE225	Capacitor 22 µF	1
C56	ECFF1E104ZF	Capacitor 0.1 µF	1
C57	ECFF1E104ZF	Capacitor 0.1 µF	1
C58	ECFF1E104ZF	Capacitor 0.1 µF	1
C59	ECFF1E104ZF	Capacitor 0.1 µF	1
C60	ECFF1E104ZF	Capacitor 0.1 µF	1
C61	ECFF1E104ZF	Capacitor 0.1 µF	1
C62	ECFF1E104ZF	Capacitor 0.1 µF	1
C63	ECFF1E104ZF	Capacitor 0.1 µF	1
C64	ECEA1CU100	Capacitor 10 µF	1
C65	ECFF1E104ZF	Capacitor 0.1 µF	1
C66	ECFF1E104ZF	Capacitor 0.1 µF	1
C67	ECFF1E104ZF	Capacitor 0.1 µF	1
C68	ECCF1H680JC	Capacitor 68 pF	1
C69	ECFF1E104ZF	Capacitor 0.1 µF	1
C70	ECCF1H151JC	Capacitor 150 pF	1
C71	ECEA1AU101	Capacitor 100 µF	1
C72	ECEA1AU101	Capacitor 100 µF	1
C73	ECEA1AU101	Capacitor 100 µF	1
C74	ECEA1AU101	Capacitor 100 µF	1
C75	ECFF1E104ZF	Capacitor 0.1 µF	1
C76	ECFF1E104ZF	Capacitor 0.1 µF	1
C77	ECFF1E104ZF	Capacitor 0.1 µF	1
C78	ECFF1E104ZF	Capacitor 0.1 µF	1
C79	ECFF1E104ZF	Capacitor 0.1 µF	1
C80	ECFF1E104ZF	Capacitor 0.1 µF	1
C81	ECFF1E104ZF	Capacitor 0.1 µF	1
C82	ECFF1E104ZF	Capacitor 0.1 µF	1
C83	ECEA1CU472	Capacitor 4700 µF	1
E1	DFJP5G1Z	Connector, CN1	1
E2	DFJS9H1Z	Connector, CN2	1
E3	DFJS08J01Z	Connector, CN3	1
E4	FBM-403-075	Connector, CN4	1
E5	DFJS3H1Z	Connector, CN5	1
E6	EMCAD05001A1	Connector, CN6, CN7	2
E7	DFJS15H1Z	Connector, CN8	1
E8	DFJS8H1Z	Connector, CN9	1
E9	FBM-403-052	Connector, PT1, PT2	2
E10	DFUS0001Z	Spring	1
E11	FBM-415-010	Fuse Holder	2
E12	XBAD31501	Fuse	1
E13	DFMC0005Z	Shield Case, VDP	1
E14	DFMY005Z	Heat Sink	1
E15	DFMC0009Z	Cover, Shield Case	1
E16	XSN3+12S	Screw	4
E17	XWA3B	Washer	6
E18	XNG3ES	Nut	4
E19	XSN3+10S	Screw	2
E20	XWG3	Washer	2
E21	DDB6M001L-F	Ferrite bead	9
		VIDEO P.C.Board Block	
IC201	RVITC40H004P	IC, OSCILLATOR	1
IC202	AN2430	IC, ENCODER	1
IC203	DN74LS74A	IC, FREQUENCY DIVIDER	1
IC204	DN74LS74A	IC, FREQUENCY DIVIDER	1
IC205	DN74LS86	IC, QUADRUPLE OR GATES	1
Q201	2SB641Q	Transistor	1
Q202	2SC2647B	Transistor	1

Ref. No.	Part No.	Part Name & Description	Per Set
Q203	2SC2647B	Transistor	1
Q204	2SB641Q	Transistor	1
D201	MA165	Diode	1
D202	MA165	Diode	1
D203	MA165	Diode	1
D204	MA165	Diode	1
D205	MA165	Diode	1
X201	DECA08867H1M	Crystal	1
L201	ELEMY390KA	Coil	1
L202	ELEMY390KA	Coil	1
L203	ELEMY390KA	Coil	1
L204	ELEMY390KA	Coil	1
R201	ERDS2TJ564	Resistor 560K ohms	1
R202	ERDS2TJ562	Resistor 5.6K ohms	1
R203	ERDS2TJ101	Resistor 100 ohms	1
R204	ERDS2TJ102	Resistor 1K ohms	1
R205	ERDS2TJ393	Resistor 39K ohms	1
R206	ERDS2TJ822	Resistor 8.2K ohms	1
R207	ERDS2TJ122	Resistor 1.2K ohms	1
R208	ERDS2TJ561	Resistor 560 ohms	1
R209	ERDS2TJ102	Resistor 1K ohms	1
R210	ERDS2TJ822	Resistor 8.2K ohms	1
R211	ERDS2TJ102	Resistor 1K ohms	1
R212	ERDS2TJ822	Resistor 8.2K ohms	1
R213	ERDS2TJ105	Resistor 1M ohms	1
R215	ERDS2TJ103	Resistor 10K ohms	1
R216	ERDS2TJ393	Resistor 39K ohms	1
R217	ERDS2TJ103	Resistor 10K ohms	1
R218	ERDS2TJ104	Resistor 100K ohms	1
R219	ERD25TJ271	Resistor 270 ohms	1
R220	ERDS2TJ102	Resistor 1K ohms	1
R221	ERDS2TJ123	Resistor 12K ohms	1
R222	ERDS2TJ103	Resistor 10K ohms	1
R223	ERDS2TJ102	Resistor 1K ohms	1
R224	ERDS2TJ471	Resistor 47 ohms	1
R225	ERDS2TJ151	Resistor 150 ohms	1
R226	ERD25TJ221	Resistor 220 ohms	1
R227	ERDS2TJ680	Resistor 68 ohms	1
R229	ERDS2TJ102	Resistor 1K ohms	1
R230	ERDS2TJ102	Resistor 1K ohms	1
R231	ERDS2TJ221	Resistor 220 ohms	1
R232	ERD25TJ101	Resistor 100 ohms	1
R233	ERD25TJ102	Resistor 1K ohms	1
R234	ERD25TJ272	Resistor 2.7K ohms	1
R235	ERD25TJ473	Resistor 47K ohms	1
CT201	ECRH020D11	Trimmer	1
C201	ECEA1CU100	Capacitor 10 µF	1
C202	ECEA1CU100	Capacitor 10 µF	1
C203	ECEA1HUR47	Capacitor 0.47 µF	1
C204	ECQV1H103JZ	Capacitor 0.01 µF	1
C205	ECEA1CU100	Capacitor 10 µF	1
C206	ECEA1AU470	Capacitor 47 µF	1
C207	ECEA1AU470	Capacitor 47 µF	1
C208	ECEA1CU100	Capacitor 10 µF	1
C209	ECQV1H103JZ	Capacitor 0.01 µF	1
C210	ECEA1HUR47	Capacitor 0.47 µF	1
C211	ECCD1H220KC	Capacitor 22 pF	1
C212	ECCD1H100KC	Capacitor 10 pF	1
C213	ECCD1H270KC	Capacitor 27 pF	1
C214	ECCD1H330KC	Capacitor 33 pF	1
C215	ECEA1CU100	Capacitor 10 µF	1
C216	ECCF1H330KC	Capacitor 33 pF	1
C217	ECEA1CU100	Capacitor 10 µF	1
C218	ECEA1CU471	Capacitor 470 µF	1
C219	ECFF1E104ZF	Capacitor 0.1 µF	1
C220	ECEA0JU102	Capacitor 1000 µF	1
C221	ECFF1E104ZF	Capacitor 0.1 µF	1
C222	ECCD1H020KC	Capacitor 2 pF	1
C223	ECCF1H330KC	Capacitor 33 pF	1
C224	ECEA1AU101	Capacitor 100 µF	1
C225	ECEA1CU100	Capacitor 10 µF	1
C226	ECFF1E104ZF	Capacitor 0.1 µF	1
E22	DFJE002Z	Flat Cable	1
E23	DFUL0005Z	Reinforcement Board	1
E24	DFMC0006Z	Shield Plate	1

Ref. No.	Part No.	Part Name & Description	Per Set
E25	DFJF1A001Z	Pin Jack, VIDEO	1
E26	DFJF1A002Z	Pin Jack, SOUND	1
E27	DFSD002Z	RF Modulater	1
		Power Source Block	
T101	DDT5M7E01Z	Transformer	1
L101	DDASC0210V	Coil	1
SW101	EST15802B	Power Switch	1
C101	ECQE2A104M	Capacitor 0.1 µF	1
C102	ECQE2A104M	Capacitor 0.1 µF	1
E28	DFJP02G1Z	Connector, CN101	1
E29	DFJP02G2Z	Connector, CN102	1
E30	DFJA03Z	AC Cord	1
E31	DFJS2G1Z	Connector	1
E32	DFJT401Z	Contact	2
E33	DFUV0003Z	Switch Cap	1
E34	RHR993Z	Band	1
E35	DFMD003Z	Attachment stand	1
E36	DFJP02G2Z	Fuse Holder	2
E37	XBAD01601	Fuse	1
E38	XTV3+8BFN	Screw	2
E39	XTN3+8B	Screw	4
E40	XWG3	Washer	4
		Keyboard Block	
D301	LN220RP	LED, Power	1
D302	LN88RCPP	LED, ⏎	1
1	DFWV70C0001	Key Button F1 F6	1
2	DFWV70C0002	Key Button F2 F7	1
3	DFWV70C0003	Key Button F3 F8	1
4	DFWV70C0004	Key Button F4 F9	1
5	DFWV70C0005	Key Button F5 F10	1
6	DFWV70C0006	Key Button STOP	1
7	DFWV70C0007	Key Button HOME	1
8	DFWV70C0008	Key Button CLS	1
9	DFWV70C0009	Key Button SELECT	1
10	DFWV70C0010	Key Button INS	1
11	DFWV70C0011	Key Button DEL	1
12	DFWV70C0012	Key Button ESC	1
13	DFWV70C0013	Key Button ! 1	1
14	DFWV70C0014	Key Button @ 2	1
15	DFWV70C0015	Key Button # 3	1
16	DFWV70C0016	Key Button $ 4	1
17	DFWV70C0017	Key Button % 5	1
18	DFWV70C0018	Key Button ^ 6	1
19	DFWV70C0019	Key Button & 7	1
20	DFWV70C0020	Key Button * 8	1
21	DFWV70C0021	Key Button (9	1
22	DFWV70C0022	Key Button) 0	1
23	DFWV70C0023	Key Button _ -	1
24	DFWV70C0024	Key Button + =	1
25	DFWV70C0025	Key Button :/	1
26	DFWV70C0026	Key Button ⇦	1
27	DFWV70C0027	Key Button TAB	1
28	DFWV70C0028	Key Button Q	1
29	DFWV70C0029	Key Button W	1
30	DFWV70C0030	Key Button E	1
31	DFWV70C0031	Key Button R	1
32	DFWV70C0032	Key Button T	1
33	DFWV70C0033	Key Button Y	1
34	DFWV70C0034	Key Button U	1
35	DFWV70C0035	Key Button I	1
36	DFWV70C0036	Key Button O	1
37	DFWV70C0037	Key Button P	1
38	DFWV70C0038	Key Button [{	1
39	DFWV70C0039	Key Button] }	1
40	DFWV70C0040	Key Button CTRL	1
41	DFWV70C0041	Key Button A	1
42	DFWV70C0042	Key Button S	1
43	DFWV70C0043	Key Button D	1
44	DFWV70C0044	Key Button F	1
45	DFWV70C0045	Key Button G	1
46	DFWV70C0046	Key Button H	1
47	DFWV70C0047	Key Button J	1
48	DFWV70C0048	Key Button K	1

Ref. No.	Part No.	Part Name & Description	Per Set
49	DFWV70C0049	Key Button ; +	1
50	DFWV70C0050	Key Button " *	1
51	DFWV70C0051	Key Button ` £	1
52	DFWV70C0052	Key Button ⏎	1
53	DFWV70C0053	Key Button ⇧	1
54	DFWV70C0054	Key Button Z	1
55	DFWV70C0055	Key Button X	1
56	DFWV70C0056	Key Button C	1
57	DFWV70C0057	Key Button V	1
58	DFWV70C0058	Key Button B	1
59	DFWV70C0059	Key Button N	1
60	DFWV70C0060	Key Button M	1
61	DFWV70C0060	Key Button < ,	1
62	DFWV70C0062	Key Button > .	1
63	DFWV70C0063	Key Button ? /	1
64	DFWV70C0064	Key Button ~ '	1
65	DFWV70C0065	Key Button ⇧	1
66	DFWV70C0066	Key Button ⓒ	1
67	DFWV70C0067	Key Button GRAPH	1
68	DFWV70C0068	Key Button SPACE	1
69	DFWV70C0069	Key Button CODE	1
70	DFWV70C0070	Key Button ←	1
71	DFWV70C0071	Key Button →	1
72	DFWV70C0072	Key Button ↑	1
73	DFWV70C0073	Key Button ↓	1
E41	DFWV48A0008	Flexible Pattern Ass'y	1
E42	FBM-652-K20	Switch Unit A, B, C etc.	55
E43	FBM-652-K21	Switch Unit CURSOR	4
E44	FBM-652-K23	Switch Unit SPACE	1
E45	FBM-652-K24	Switch Unit ⓒ	1
E46	FBM-652-K26	Switch Unit ⇧(left side)	1
E47	FBM-652-K25	Switch Unit ⏎	1
E48	FBM-652-K22	Switch Unit FUNCTION	10
E49	FBM-652-K22	Switch Unit SPACE (both ends)	2
E50	FBM-717-023	Arm, SPACE	1
E51	FBM-717-022	Arm, ⇧ ⏎	2
E52	FBM-652-146	Installation Board, SPACE	2
E53	FBM-653-034	LED Contact	2
E54	DFWV65C0005	LED Holder	2
		Cabinet Block	
K1	DFKE0002Z	Slot Cover	2
K2	FBM-728-011	Slot Spring	2
K3	DFKM0004Z	Upper Cabinet	1
K4	DFGP0002Z	Slot Pannel	1
K5	FBM-438-008	Micro Switch	2
K6	DFMD0001Z	Pressure Board	1
K7	DFDF3001Z	Support Shaft	1
K8	FBM-845-033	Connector Cover, CN4	1
K9	DFUV0004Z	Connector Cover, PT1, PT2	1
K10	DFWV80C0006	Bottom Cabinet Ass'y	1
K11	DFMC0004Z	RF Shield Plate	1
K12	DFMC0003Z	Bottom Shield Plate	1
K13	DFMY003Z	Heat Sink	1
K16	XTN3+10B	Screw	14
K17	XWG3	Washer	15
K18	XTV3+16BFZ	Screw	3
K19	XTN3+8BFN	Screw	2
K20	XTN3+6B	Screw	1
K21	XTN3+6S	Screw	2
K22	XWA3B	Spring Washer	2
		Accessories	
K23	DFJP00Z01Z	Cable, CASSETTE	1
K24	FBM-497-022	Cable, SOUND	1
K25	DFJP0E01Z	Cable, RF	1
K26	DFJP0E02Z	Cable, VIDEO	1
K27	DFPK0021Z	Packing Case	1
K28	DFPP0001Z	Wrap, Set	1
K29	DFQA1702Z	Graphic Labels	1
K30	DFPN0001Z	Insulation Material, Right Side	1
K31	DFPN0002Z	Insulation Material, Left Side	1
K32	QPC0072	AC Cord Cover	1
K33	DFQX2004Z	BASIC Manual	1
K34	DFQX5003Z	Instruction Manual	1