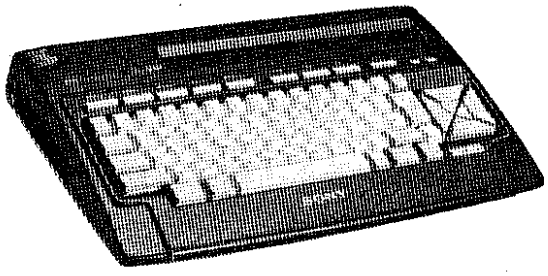
HB-10P/10B
AC-HB1P/HB1B

SERVICE MANUAL



HOME COMPUTER

SONY®

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CHAPTER 1
OPERATION

1-1. OPERATION OF HB-10P/10B

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MSX Use this computer only with peripherals and software having the MSX mark.

WARNING

To prevent fire or shock hazard, do not expose the unit to rain or moisture.

To avoid electrical shock, do not open the cabinet. Refer servicing to qualified personnel only.

NOTICE FOR THE CUSTOMERS IN THE UNITED KINGDOM

IMPORTANT

The wires in this mains lead are coloured in accordance with the following code:
  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.

FEATURES

Built-in MSX-BASIC Program
The built-in MSX-BASIC program has various commands, statements and functions which allow for easy program development. With the MSX-BASIC sprite function, you can make and move the different patterns on each of the 32 sprite planes.
The sound generator makes it possible to generate music or a wide range of sound effects by using PLAY and SOUND statement of the MSX-BASIC.

Two supplied MSX-BASIC manuals tell you not only how to use MSX-BASIC but also discuss the pleasures of programming.

Possibility of connecting two types of TVs
The HB-10P/HB10B has an RF connector and a 6-pin DIN-type VIDEO/AUDIO connector for video/audio output.

Various peripherals for the HB-10P/HB-10B
Various peripherals can be connected: the MSX-BASIC program and data can be saved on an audio cassette tape or a micro floppydisk. A color plotter printer can be used to print out data or graphics. You can use up to two joystick controllers to play a computer game.

Peripheral devices for HB-10P/HB-10B

Device name	Major features
HBD-50 Micro Floppydisk Drive	• High-density information storage • Easy-to-operate • Fast recall of data
JS-55 Joystick	• Designed for left- or right handed players • Shoot buttons on both left and right
JS-75 Wireless Joystick	• No cords to get tangled • Can be operated from up to 7 meters away
SDC-500 Bitcorder	• Easy to operate with any computer • High-speed data transfer
PRN-C41 Color Plotter Printer	• Four-color printer: black, blue, green and red • Light weight and compact • Can use any paper up to 114 mm in width

- Your dealer may not handle some of the above listed optional accessories. Please ask the dealer for detailed information about the optional accessories available in your country.

PRECAUTIONS

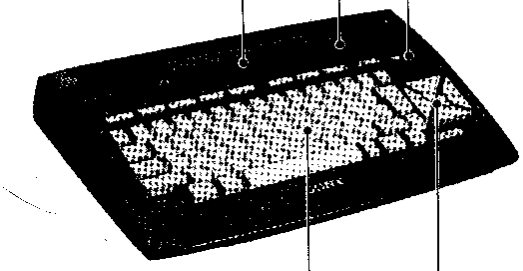
On safety
- Operate on 220 or 240 V AC by using the supplied AC power adaptor according to your local power supply. Do not use any other AC power adaptor.
- The unit is not disconnected from the AC power source (mains) as long as it is connected to the wall outlet, even if the unit itself has been turned off.
- Should any solid object or liquid fall into the cabinet, turn the power off and have the unit checked by qualified personnel before operating it any further.
- Do not place or drop heavy objects on the power cord. Use of a damaged cord is dangerous. To disconnect the cord, pull it out by the plug—never pull the cord itself.

On installation
- The computer consists of high-precision electronic parts. Do not drop it or bump it against other objects. Do not place it in a place subject to vibration or on an unstable base.
- Do not install the unit near heat sources such as a radiator or an air duct, or in a place subject to direct sunlight, excessive dust, and/or moisture.
- Do not place electronic equipment near the computer. It may malfunction if affected by an electromagnetic field.
- Provide adequate air circulation to prevent internal heat build-up. Do not place the unit on surfaces (rugs, blankets) or near materials (curtains, draperies) that may block the ventilation slots.
- Use only the specified peripheral equipment; otherwise, trouble may result. Before connecting peripheral equipment, be sure to turn the power off or the internal IC chip may be damaged.

On cleaning
- Clean the cabinet and keyboard with a soft, dry cloth, or a soft cloth lightly moistened with a mild detergent solution. Do not use any type of solvent, such as alcohol or benzine, which might damage the finish.

If trouble occurs, unplug the unit, and contact your designated Sony dealer.

LOCATION AND FUNCTION OF PARTS AND CONTROLS



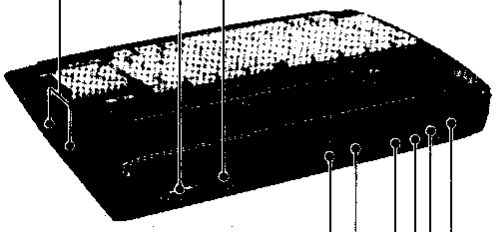
Operation indicator
Lights up while the operation switch is on.

Cartridge slot 2

Cartridge slot 1
Accepts an MSX-interface cartridge or an MSX-program cartridge here.

Keyboard ㉘
Used to enter programs and data into the computer.

Cursor move keys ㉗
Used to move the cursor to the right or left, up or down.



CONTROLLER connectors (9-pin) ⑮
Used to connect joystick controllers and I/O controllers.

PRINTER connector (14-pin) ⑲
Used to connect a printer.

TAPE connector (8-pin DIN) ⑰
Connect to a tape recorder to save a program or data.

Ground terminal

VIDEO/AUDIO output connector (6-pin DIN) ⑭⑯
Used to connect a TV set equipped with a 6-pin DIN type video/audio connector.

Channel adjustment knob ⑪⑫⑬
Select the channel on which the computer's signal will be sent to a TV set.

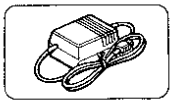
RF output connector ⑪⑫⑬
Used to connect to an ordinary TV set.

ADAPTOR IN ⑳
Accepts the AC power adaptor.

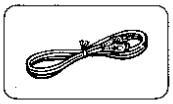
Operation switch

There are several accessories supplied with HB-10P/HB-10B.

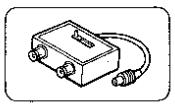
■ **AC power adaptor AC-HB1P/AC-HB1B**
Used to connect the computer to a wall outlet (mains outlet).



■ **RF cable**
Used to connect the computer to an ordinary TV set.



■ **Antenna selector**
Switch to ANTENNA to watch TV and to COMPUTER to use the computer.



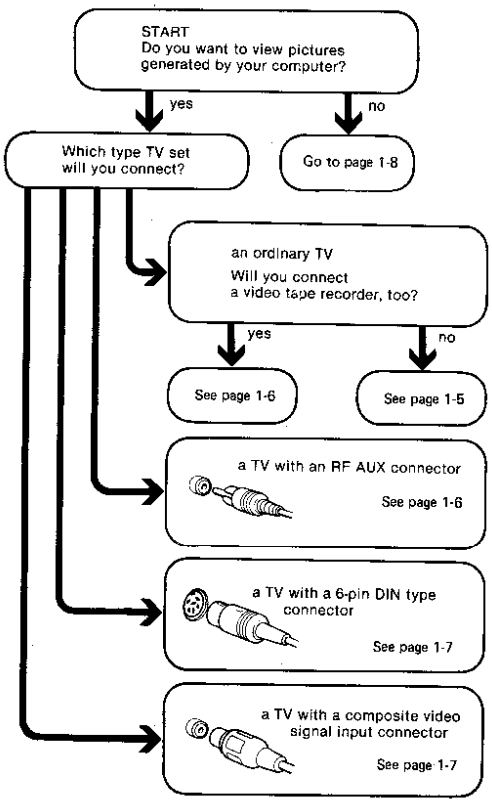
CONNECTION OF PERIPHERALS

Before making connections, make sure to turn off the computer and all the devices to be connected.

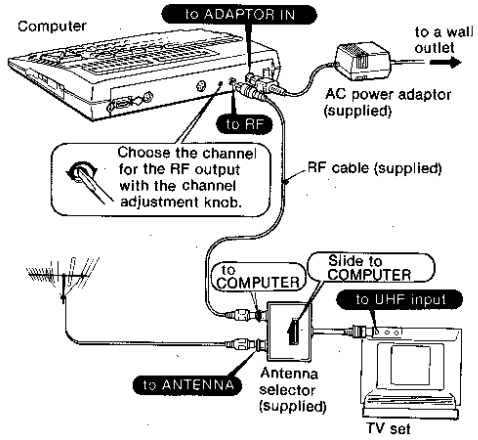
CONNECTING A TELEVISION SET

To view pictures generated by the computer, connect the computer to a TV set. There are some kinds of TV sets and they are connected differently.
Make sure which type your TV set is.

- A TV set with an RF AUX connector
  Has an RF AUX connector and an RF AUX button in front. Connect the RF AUX connector to the computer.
- A TV set with composite video-signal input connector
  Has an audio-input jack and a video-input jack. Connect the VIDEO/AUDIO connector of the computer to these jacks with an optional cable.
- A TV set with a 6-pin DIN type composite video signal input connector
  Has a 6-pin DIN type connector for composite video signal input. Connect the VIDEO/AUDIO connector of the computer to this connector with an optional cable.
- An ordinary TV set
  Does not have any of the above connectors. Connect the computer to the antenna terminal on the rear of the TV set.



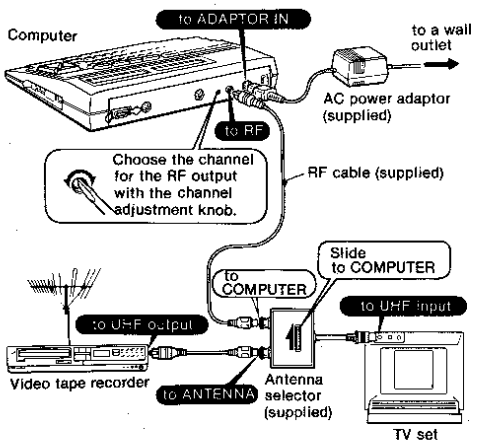
Connecting an ordinary TV set with no video tape recorder
If the TV is connected to an antenna, first disconnect the antenna cable.



The RF output of the computer is set to UHF channel 36 at the factory. If this channel is occupied, or if the picture of this channel is distorted, reset the RF output to another channel with a small screwdriver. Turn the knob clockwise for channel 35 and counterclockwise for channel 37.

After the connections have been made, see page 1-8.

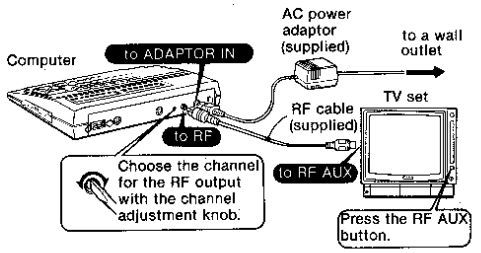
Connecting an ordinary TV set with a video tape recorder



The RF output of the computer is set to UHF channel 36 at the factory. If this channel is occupied, or if the picture of this channel is distorted, reset the RF output to another channel with a small screwdriver. Turn the knob clockwise for channel 35 and counterclockwise for channel 37.

After the connections have been made, see page 1-8.

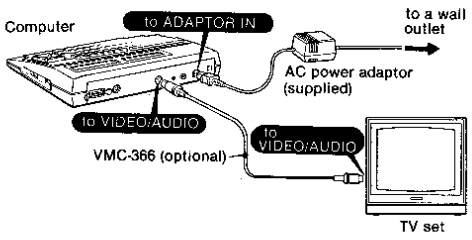
Connecting a TV set with an RF AUX connector



The RF output of the computer is set to UHF channel 36 at the factory. If this channel is occupied, or if the picture of this channel is distorted, reset the RF output to another channel with a small screwdriver. Turn the knob clockwise for channel 35 and counterclockwise for channel 37.

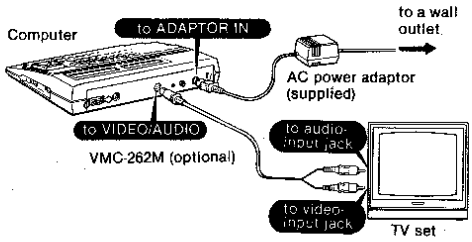
After the connections have been made, see page 1-8.

Connecting a TV set with a 6-pin DIN type composite video signal input connector



After the connections have been made, see page 1-8.

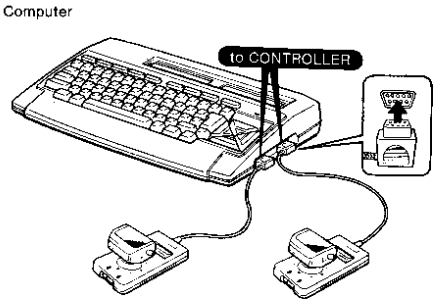
Connecting a TV set with a composite video signal input connector



If the TV set has a BNC-type composite video signal input, an RK-140 connecting cable (optional) can be used instead of the VMC-262M.

After the connections have been made, see page 1-8.

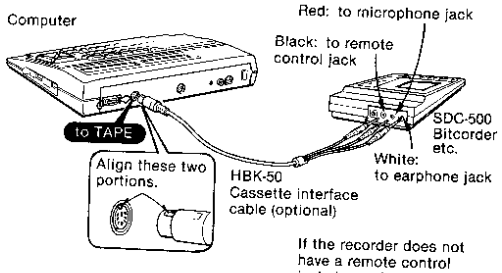
CONNECTING A JOYSTICK CONTROLLER



Joystick controller JS-55 etc.

CONNECTING A TAPE RECORDER FOR USE AS AN EXTERNAL MEMORY

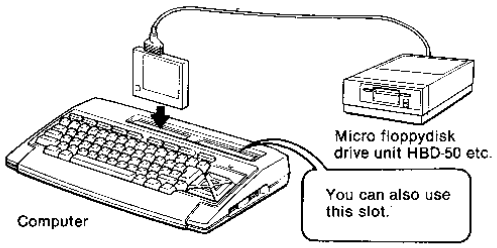
You can save programs and data by using a data corder or a cassete tape recorder.



If the recorder does not have a remote control jack, leave the black plug unconnected.

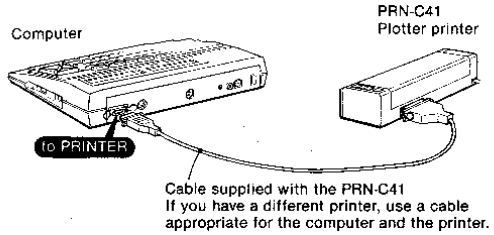
CONNECTING A FLOPPYDISK DRIVE UNIT

Use a floppydisk drive displaying an MSX mark such as the Sony HBD-50 micro floppydisk drive.



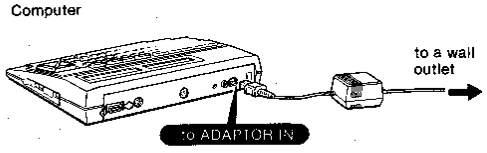
CONNECTING A PRINTER

Use a printer displaying an MSX mark such as the Sony PRN-C41 plotter printer.



PREPARATIONS

Connect the computer to a wall outlet using the AC power adaptor (supplied).



Before turning on the operation switch, check the following.

- Have all the necessary connections been made? You can find how to connect peripherals on pages 9 to 19.
- Have all devices been connected to the wall outlet?
- If the TV is connected to the RF connector of a computer, select UHF channel 35, 36 or 37 for the computer output. The channel must be the same as the channel the computer's channel adjustment knob has been set to. If the TV has a RF AUX button, depress the RF AUX button.
  Set the switch of the antenna selector to the COMPUTER position when using the computer. To watch TV, set the switch to the ANTENNA position.

HOW TO START

There are two kinds of programs and the way to start them are different.

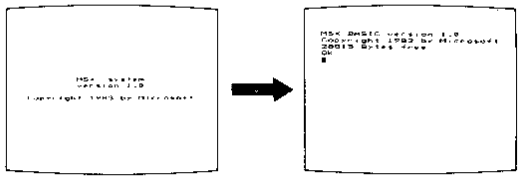
MSX-BASIC interpreter: You can make your own BASIC programs and programs in cassette tape form can be loaded.

Commercially available programs in MSX-cartridge form: Games and other useful programs are available.

Make sure which program you will start.

HOW TO ACTIVATE THE MSX-BASIC

1 Remove any program cartridges from the cartridge slots.
2 Turn on the TV set's and the computer's switch. The following display appears,



then it changes to the MSX-BASIC mode and the MSX-BASIC becomes ready.

HOW TO START A GAME OR OTHER PROGRAMS IN AN MSX-CARTRIDGE

1 Insert the cartridge into cartridge slot 1 or 2.
2 Turn on the TV and the computer.
3 The program in the cartridge will start.
For further information about the program, refer to the instruction manual that came with the cartridge.

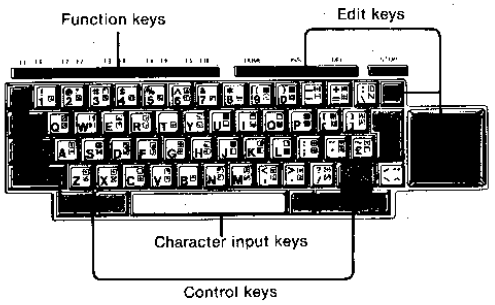
Notes: When you turn off the computer's power, wait at least four seconds before turning it on again.

Do not insert or remove a cartridge while the computer's power is on.

KEYBOARD

KEY ARRANGEMENT

Alphanumeric characters are arranged as on a standard typewriter keyboard, as shown below.



The keyboard has character input, control, edit and function keys. When a character input key is pressed, the corresponding character is entered into the computer. When a control key is pressed, the corresponding operation is performed.
A graphic pattern sheet is supplied on page 33. Use this sheet to see at a glance what keys to press to enter a desired symbol or a graphic pattern.

CHARACTER INPUT

To enter characters

When a character input key is pressed, the small letter or symbol printed on the lower part on the key top is entered.

Pressed key	Character or symbol to be entered
	t
	6

When a character input key is pressed with the ⇧ key, the capital letter or symbol printed on the upper part of the key top is entered.

Pressed key	Character or symbol to be entered
⇧ +	S
⇧ +	+

To enter only capital letters

Depress the CAPS key. When this key is pressed, it will lock; when pressed again, it will unlock. While this key locks, the indicator on the key lights up, and the 26 alphabet letters are entered in caps (just as when the ⇧ key is pressed in the normal mode), but numbers and symbols are entered in the normal mode.

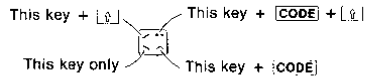
Locked key	Pressed key	Character or symbol to be entered
CAPS		K
CAPS		7

To put an accent mark on a character

Key ´ is used to put an accent mark on a character.

To put the accent mark printed on the lower-left of the key (`) on a character, first, press key ´ (in this step, no symbol is displayed on the screen). Then, press the character input key needing an accent mark. The character with an accent mark is displayed.

In the same way, to put the accent mark on the upper-left of the key ´ (´), press the key while pressing the ⇧ key. To put the accent mark on the lower-right of the key ´ (^), press the key together with the CODE key. To put the accent mark on the upper-right of the key ´ (¨), press the key while pressing the ⇧ key and the CODE key.



To enter a graphic character or symbol

The procedure to enter a character or symbol printed on the supplied graphic pattern sheet is as follows:

To enter graphic patterns

To enter the graphic pattern printed on the lower-right part of the key press the corresponding keyboard character input key while pressing the GRAPH key.

Pressed key	Graphic pattern to be entered
GRAPH +	♣
GRAPH +	▨

To enter the graphic pattern printed on the upper-right part of the key press the corresponding keyboard character input key while pressing the GRAPH key and the ⇧ key.

Pressed key	Graphic pattern to be entered
GRAPH + ⇧ +	♫
GRAPH + ⇧ +	÷

To enter special characters

To enter the character or symbol printed on the lower-left part of the key on the graphic pattern sheet, press the corresponding keyboard character input key while pressing the CODE key.

Pressed key	Character or symbol to be entered
CODE +	ó
CODE +	μ

To enter the character or symbol printed on the upper-left part of the key on the graphic pattern sheet, press the corresponding keyboard character input key while pressing the CODE key and the ⇧ key.

Pressed key	Character or symbol to be entered
CODE + ⇧ +	Σ
CODE + ⇧ +	Ñ

Note
When using the CODE key, release the CAPS key.

EDIT KEY FUNCTIONS

Keys HOME, INS, DEL, ← and cursor move keys ( ) are mainly used for editing a line or screen. Each function is determined by the software used, so read the relevant Software Guide for details.
Under MSX-BASIC, the edit keys function as follows:

HOME key
When this key is pressed, the cursor moves to the upper-left corner of the display screen. The characters displayed on the screen remain.
When pressing this key together with the ⇧ key, the cursor moves to the upper-left corner of the screen, while any character displayed on the screen is erased.

INS (insert) key
Once this key is pressed, the computer is set to the insert mode. In this mode, the cursor becomes smaller and the character at the cursor position and the followings are moved one space to the right when a key is pressed, and you can insert as many characters as you want.
When pressing this key again or moving the cursor with cursor move keys, the insert mode will be released.

DEL (delete) key
The character at the cursor position is deleted. All characters after the deleted character are moved one space to the left.

← (back space) key
When this key is pressed, the cursor moves one space to the left and the character in that position is deleted.

(cursor move) keys
These keys are used to move the cursor one space in the direction of the triangle: to the right, to the left, up or down. Any character which the cursor moves over does not change.

CONTROL KEY FUNCTIONS

[⇧] key
When this key is pressed together with a character input key, the corresponding symbol in the shift position (upper-left symbol on the key) or corresponding capital letter is entered.

[CAPS] key
When this key is pressed, it will lock so that all letters are entered in capitals. Numbers and symbols will be entered normally even if this key locks. When the key is pressed again, it will unlock. While this key is locked, the indicator on the key lights up.

[CODE] key
When this key is pressed together with a character input key, the lower-left character or symbol printed on the graphic pattern sheet (supplied at the end of this manual) is entered.
When this key is pressed together with a character input key and the [⇧] key, the upper-left character or symbol on the graphic pattern sheet is entered.

[GRAPH] key
When this key is pressed together with a character input key, the lower-right graphic pattern printed on the key is entered.
When this key is pressed together with a character input key and the [⇧] key, the upper-right graphic pattern printed on the key is entered.

[CTRL] (control) key
When this key is pressed together with certain keys, a special operation is performed. The key function is determined by the software used.

[TAB] key
This key is used to move the cursor to the next tab position. In MSX-BASIC, tabs are set at every eight characters. Any characters which the cursor goes over are deleted when the cursor moves to the next tab position.

[↵] key
Press this key to indicate the end of a line of data or commands input from the keyboard. Press this key every time you finish entering a line.

[ESC] (escape) key
The function of this key is determined by the software used. Under MSX-BASIC, this key is inoperative.

[STOP] key
Press this key to interrupt program execution or listing. You can restart the program by pressing this key again.
Pressing this key together with the [CTRL] key does the same. In this case, however, you can restart program execution with the CONT command, but listing cannot be continued.

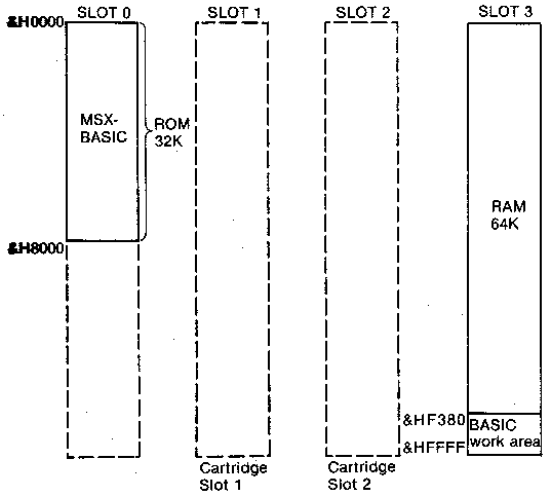
[SELECT] key
The function of this key is determined by the software used. Under MSX-BASIC, this key is not used.

FUNCTION KEYS

Keys [F1] to [F5] ([F6] to [F10]) are called function keys. The functions of these keys are determined by the software. Therefore, read the relevant software's manual for their functions.

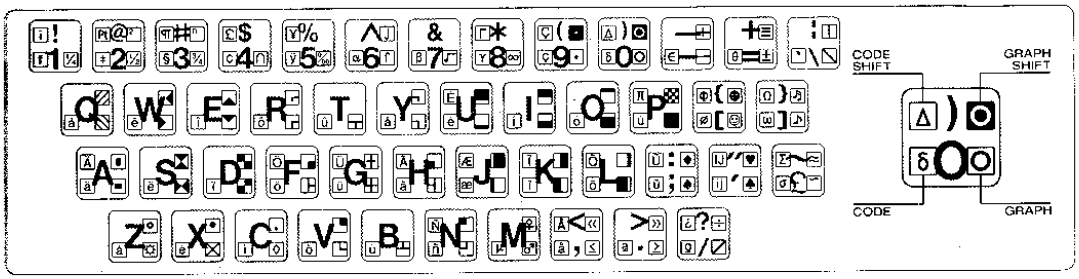
MEMORY MAP

HB-10P/HB-10B



User's program by BASIC is written from the address &H8000.
The capacity of the free area (RAM capacity excluding the system **area)** can be checked by the FRE function.

GRAPHIC PATTERN SHEET



SPECIFICATIONS

CPU

Processor used	Z-80A
Clock frequency	3.579545 MHz
WAIT	1 WAIT at CPU M1 cycle
Interrupt	Maskable interrupt Z-80A mode 0 mode 1 mode 2
Resetting	Automatic at power on (Memory contents are not maintained.)

Memory

Main memory	64K bytes RAM
Video memory	16K bytes RAM
MSX-BASIC	32K bytes ROM

CRT display

CRT controller	T6950
Display screen	Character display, graphic display and border area
Character display	8×8 dot matrix/character 37 characters×24 lines, 16 colors (max. 40×24) (The initial state in MSX-BASIC is set to this mode.)
Graphic display	16 colors Graphic I·II 256 (horizontal) ×192 (vertical) dots Multi-color 64 blocks (horizontal) ×48 blocks (vertical) Sprite function Number of sprite plane: 32
Border area	16-color display
Output interface	PAL video output: composite video signal 1 V p-p, 75 ohms, sync negative RF signal: TV UHF 36 ch adjustable within the range from 35 ch to 37 ch. Audio output: −5 dBm

I/O interface

Keyboard	Software scanning Total number of keys: 74 Control keys: 12 Function keys: 5 Edit keys: 8
Audio cassette interface	8-pin DIN jack Baud rate: 1200/2400 bauds Baud rate is selectable with the CSAVE command or the SCREEN command of MSX-BASIC. Remote control function provided
Sound generator	8-octave, 3 tones and 1 noise output
Printer interface	14-pin connector TTL level Standard 8-bit parallel transfer
General purpose interface	9-pin connector (2) For connection of joystick, etc.
MSX cartridge slot (2)	

General

Power requirement	HB-10P 220 V ac ±10% 50 Hz HB-10B 240 V ac ±10%, 50 Hz
Power consumption	7 W (main unit only) 17 W (max.)
Operating conditions	Temperature: 5°C to 35°C (41°F to 95°F) Humidity: 20 to 80%
Storage temperature	−15°C to +60°C (5°F to 140°F)
Dimensions	Approx. 384×65.5×237 mm (w/h/d) ($15^{1}/_{8}$×$2^{5}/_{8}$×$9^{3}/_{8}$ inches) main unit only, including projecting parts and controls
Weight	Approx. 1.9 kg (4 lb 3 oz) main unit only
Accessories supplied	AC power adaptor (1) RF cable (1) Antenna selector (1) Operating Instructions (1) Introduction to MSX-BASIC (1) MSX-BASIC Programming Reference Manual (1)

While the information given is true at the time of printing, small production change in the course of our company's policy of improvement through research and design might not necessarily be indicated in the specifications. We would ask you to check with your appointed Sony dealer if clarification on any point is required.

1-2. MSX-BASIC REFERENCE CHART

COLOR CODE

code	color	code	color
0	Transparent	8	Medium red
1	Black	9	Light red
2	Medium green	10	Dark yellow
3	Light green	11	Light yellow
4	Dark blue	12	Dark green
5	Light blue	13	Magenta
6	Dark red	14	Gray
7	Sky blue	15	White

OPERATORS

Arithmetic operators	^	power
	—	change signs
	*,/	multiplication, division
	\	integral division
	MOD	integral residue
	+,–	addition, subtraction
	(Priority increases from bottom to up)	
Relational operators	<>=	comparison
Logical operators	NOT	negation
	AND	logical product
	OR	logical sum
	XOR	exclusive logical sum
	EQV	negation of exclusive logical sum
	IMP	implication

COMMANDS FOR INTERRUPT

format	function	
ON KEY GOSUB line number, line number ...	Interrupt with a function key.	ON KEY GO
KEY (function key number) ON	Enable an interrupt with a function key.	KEY (1) ON
KEY (function key number) OFF	Disable an interrupt with a function key.	KEY (2) OFF
KEY (function key number) STOP	Hold an interrupt with a function key.	KEY (3) STO
ON STRIG GOSUB line number, line number ...	Interrupt with a trigger button of the joystick.	ON STRIG (
STRIG (joystick number) ON	Enable an interrupt with a joystick. Joystick number: 0 ..... space bar 1 ..... joystick 1 2 ..... joystick 2	STRIG (1) O
STRIG (joystick number) OFF	Disable an interrupt with a joystick.	STRIG (2) O
STRIG (joystick number) STOP	Hold an interrupt with a joystick.	STIRG (0) S
ON STOP GOSUB line number	Interrupt with the CTRL and STOP keys.	ON STOP G
STOP ON	Enable an interrupt with the CTRL and STOP keys.	
STOP OFF	Disable an interrupt with the CTRL and STOP keys.	
STOP STOP	Hold an interrupt with the CTRL and STOP keys.	
ON SPRITE GOSUB line number	Interrupt with an overlap of sprite patterns.	ON SPRITE
SPRITE ON	Enable an interrupt with an overlap of sprite patterns.	
SPRITE OFF	Disable an interrupt with an overlap of sprite patterns.	
SPRITE STOP	Hold an interrupt with an overlap of sprite patterns.	
ON INTERVAL=interval GOSUB line number	Interrupt after an interval. Time between interrupts is the interval × 1/50 second.	ON INTERV
INTERVAL ON	Enable intervalled interrupts.	
INTERVAL OFF	Disable intervalled interrupts.	
INTERVAL STOP	Hold intervalled interrupts.	

example
UB 1000, 2000, 3000
SUB 1000,, 2000
IP
SUB 1000
OSUB 1000
=100 GOSUB 1000

COMMANDS FOR CONNECTED DEVICE

format	function	example
LPRINT [expression] [separator expression] [separator expression] ...	Output data on the printer.	LPRINT A, B, C
LPRINT USING format symbol; expression	Output data on the printer in the specified format. (See PRINT USING.)	LPRINT USING "###"; A, B
MOTOR [{ON / OFF}]	Turn the tape recorder motor on or off.	MOTOR OFF

COMMANDS FOR ERROR PROCESSING

format	function	example
ERROR error code	Generate an error of the specified error code. Define error codes.	ERROR 3 IF A>100 THEN ERROR 250
ON ERROR GOTO line number	Transfer control to the specified line when an error occurs.	ON ERROR GOTO 1000
RESUME [{0 / NEXT / line number}]	Return control to the main program after executing an error processing routine.	RESUME 10

COMMANDS FOR MACHINE LANGUAGE SUBROUTINES

format	function	example
DEFUSR [numeric]=starting address	Define the starting address of user subroutine.	DEFUSR0=53248
POKE address, expression	Write data into memory.	POKE &HA400, &HFF

COMMANDS FOR I/O PORT AND MEMORY

format	function	example
OUT port number, expression	Output data to the I/O port.	OUT &H90, 3
WAIT port number, expression [, expression]	Hold program execution until the input data form the I/O port reaches a certain value.	WAIT &H90, 255
VPOKE address, expression	Output data to the video RAM.	VPOKE 263, 01

COMMANDS FOR EXTENDED COMMANDS

format	function	example
CALL subroutine name or _subroutine name CALL extended command [argument, argument ...] or _extended command [argument, argument ...]	Transfer control to the machine language subroutine, or transfer control to an extended command of the ROM cartridge.	CALL SUB

FUNCTI

NUMERICAL FUNC

ABS (X)
ATN (X)
CDBL (X)
CINT (X)

COS (X)
CSNG (X)
ERL
ERR
EXP (X)
FIX (X)
INT (X)

LOG (X)
RND (X)
SGN (X)
SIN (X)
SQR (X)
TAN (X)

STRING FUNCTIO

LEFT$ (X$, N)
MID$ (X$, M [, N])

RIGHT$ (X$, N)
SPACE$ (N)
STRING$ (N, J)

STRING$ (N, X$)
TAB (N)
SPC (N)

FUNCTION FOR C STRING TYPES

ASC (X$)

BIN$ (X)

CHR$ (X)

HEX$ (X)

INSTR ([N,] X$, Y$)

LEN (X$)
OCT$ (X)

STR$ (X)
VAL (X$)

OTHER FUNCTION

PLAY (N)

'IONS

INCTIONS

: Give an absolute value.
: Give arc tangent.
: Convert to the double precision type.
: Convert to the integer type.
(−32768 ≦ X ≦ 32767)
: Give cosine of X radians.
: Convert to the single precision type.
: Give the number of the line with an error.
: Give the error code.
: Give e^x.
: Give the integer part of X
: Give the maximum integer less than or equal to X
: Give natural logarithm.
: Give random number.
: Give 1 if X>0, 0 if X=0 and −1 if X<0
: Give sine of X radians.
: Give square root.
: Give tangent of X radians.

ONS

: Give N characters from the left of X$.
: Give N characters beginning with the Mth character from the left of X$.
: Give N characters from the right of X$.
: Give N spaces.
: Give N characters whose character code is J.
: Give N times the first character of X$.
: Move the cursor to the Nth position.
: Give N spaces.

CONVERSION BETWEEN NUMERICAL AND

: Give the character code of the first character of X$
: Give a binary expression of X as a string type data. (−32768 ≦ X ≦ 65535)
: Give a character whose character code is X.
: Give a hexadecimal expression of X as a string type data. (−32768 ≦ X ≦ 65535)
: Give the position of Y$ after the Nth character of X$.
: Give a number of characters of X$.
: Give an octal expression of X as a string type data. (−32768 ≦ X ≦ 65535)
: Convert to the string type.
: Convert to the numeric type.

N

: Check if music is playing.
When N=1, 2 or 3 it gives −1 when music is playing; otherwise it gives 0.
When N=0, the status (−1 or 0) of each music subcommand are ORed and the result is given.

FUNCTION FOR DATA INPUT

From the screen
CSRLIN : Give y-coordinate of the cursor.
POS (X) : Give x-coordinate of the cursor.
POINT (X, Y) : Give color code at point (X, Y).

From data file
EOF (file number) : Give −1 when last data in file is read; otherwise give 0.
INPUT$ (N, [#] file number) : Input and give N characters from the file.

From the printer
LPOS (X) : Give the position of the print head in the printer buffer.

From memory
FRE (0) : Give unused area in memory.
FRE ("") : Give unused part or string area.
PEEK (address) : Give the memory contents of the address.
VARPTR (variable) : Give the starting address of the memory area storing the variable.
VPEEK (address) : Give the video RAM contents of the address.

From the keyboard
INKEY$: Give the character corresponding to the pressed key.
INPUT$ (X) : Input X characters from the keyboard.

From I/O port
INP (port number) : Input data from the I/O port.

From machine language subroutine
USR {0 to 9} (X) : Give the value from the user subroutine.

From joystick, paddle or touch pad
STICK (N) : Give the direction of the joystick. (N=0 for cursor move keys)
(Center=0, Up=1, Right up=2, Right=3, Right down=4, Down=5, Left down=6, Left=7, Left up=8)
STRIG (N) : Give −1 when the joystick trigger button is pressed; otherwise, give 0. (N=0 for the space bar)
PDL (N) : Input data from the paddle.
PAD (N) : Give status of the touch pad.
When N=0 or 4: Give −1 if the touch pad is touched; otherwise, give 0.
When N=1 or 5: Give x-coordinate of the position touched.
When N=2 or 6: Give y-coordinate of the position touched.
When N=3 or 7: Give −1 if the switch is pressed; otherwise, give 0.

CONSTANTS AND VARIABLES

Constant	String type	Character string of 0 to 255 characters (enclosed in quotation marks)
	Integer type	−32768 to +32767
	Floating-point type	Significant digits: 6 (single precision) or 14 (double precision) Exponent part: −64 to +63
	Hexadecimal expression	Takes a prefix "&H"
	Octal expression	Takes prefix "&O" or "O"
	Binary expression	Takes a prefix "&B"

Variable	Variable name	First two characters are effective.
	Type declarator	Written after variable name % : Integer type ! : Single precision # : Double precision $: String type

SPECIAL VARIABLES

TIME : Retain a value in the timer. Can be rewritten.
SPRITE$ (sprite number) : Retain the sprite pattern.
[Example] SPRITE$(1)=CHR$(&H18)+CHR$(&H3C)+CHR$(&H7E)+CHR$(&HFF)+CHR$(&H18)+CHR$(&H18)+CHR$(&H18)+CHR$(&H18)

●Special commands and functions for VDP (Video Display Processor)

BASE (expression) : Used to read or write the base address of the VDP table.
VDP (numeric value) : Used to read or write the contents of the VDP register.

ERROR MESSAGES——

1	NEXT without FOR	: No FOR statement corresponding to NEXT statement.
2	Syntax error	: Syntax error in the statement.
3	RETURN without GOSUB	: No GOSUB statement corresponding to RETURN statement.
4	Out of DATA	: No more data to be read.
5	Illegal function call	: Illegal specification in function or command.
6	Overflow	: Too big or too small data.
7	Out of memory	: No more memory.
8	Undefined line number	: Undefined line number was specified.
9	Subscript out of range	: Array subscript outside defined range.
10	Redimensioned array	: Array in DIM statement was already specified.
11	Division by zero	: Divided by zero.
12	Illegal direct	: The command can not be used in direct command mode.
13	Type mismatch	: Data type mismatch.
14	Out of string space	: No more string variable area.
15	String too long	: String is too long.
16	String formula too complex	: String is too complex.
17	Can't CONTINUE	: Impossible to continue program execution.
18	Undefined user function	: A function which is not defined by DEF FN statement was used.
19	Device I/O error	: Error in connected equipment.
20	Verify error	: Program in cassette tape and program in memory differ.
21	No RESUME	: No RESUME statement that corresponds to ON ERROR statement.
22	RESUME without error	: No ON ERROR statement that corresponds to RESUME statement.
23	Unprintable error	: An error without an error message has occured.
24	Missing operand	: Operand is missing.
25	Line buffer overflow	: The entered program exceeds the buffer size.
51	Internal error	: Memory content or text is not normal.
52	Bad file number	: Incorrect file number.
54	File already open	: The file is already open.
55	Input past end	: Last data has been already read.
56	Bad file name	: Incorrect file specification.
57	Direct statement in file	: Command in direct command mode was entered during file loading.
59	File not OPEN	: The file needs to be opened.

SONY

MSX

MSX-BASIC
REFERENCE CHART

HIT BIT

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COMMANDS AND STATEMENTS

COMMANDS FOR PROGRAMMING

format	function	example
AUTO [starting line number] [, increment]	Generate line numbers automatically.	AUTO 100, 10
DELETE [line number] [-line number]	Delete lines in a program.	DELETE 30-60
LIST [starting line number] [-] [end line number]	Display program list.	LIST
LLIST [starting line number] [-] [end line number]	Print program list on a connected printer.	LLIST 100-200
NEW	Erase program.	
RENUM [new starting line number], [old starting line number], [increment]	Renumber lines.	RENUM 100, 10, 10
REM or '	Insert a comment.	REM--PROGRAM 1--
KEY LIST	Display the function key contents.	

COMMANDS FOR DEFINITION AND SETTING

format	function	example
CLEAR [size of character area] [, highest address]	Initialize all variables and set the size of the character area and the high memory.	CLEAR 400, 55296
DIM variable name (maximum value of subscript [,maxmum value of subscript] ...)	Declare the name, type, size and dimension of array.	DIM A$ (100)
DEF {INT / SNG / DBL / STR} character [-character]	Define matching between the first character of a variable name and the type of variable. (INT: integer, SNG: single precision, DBL: double precision, STR: string)	DEFINT I-N
DEF FN function name [(parameter)]=expression	Define user functions.	DEF FNA (X)=A * X^2+B * X+C
ERASE [name of array variable] [, name of array variable] ...	Erase arrays	ERASE A, B, C
KEY function key number, character string	Define strings for function keys.	KEY 1, "LLIST"+CHR$ (13)

COMMANDS FOR DATA INPUT/OUTPUT

format	function	example
DATA constant [, constant] [, constant] ...	Give data to be read with a READ statement.	DATA 3, 4, 5, 6, ABC, "C, D"
INPUT ["prompt statement";] variable [, variable] [, variable] ...	Give value of variable from the keyboard.	INPUT "A$=";A$
LINE INPUT ["prompt statement";] string type variable	Give string of up to 254 characters from the keyboard to the string type variable	LINE INPUT "C$=";C$
[LET] variable=expression	Assign data to the variable.	LET A=A+5
MID$ (X$, M[, N])=Y$	Replace characters beginning with the Mth character of the string X$ with characters from the beginning to Nth character of Y$.	MID$ (A$, 2, 5)=B$
PRINT [expression] [separator] [expression] [separator] ... or ? [expression] [separator] [expression] [separator] ...	Output data onto display screen. A separator is a semi-colon (;), a comma (,) or a space.	PRINT A;B;C
PRINT USING format symbol; expres		
READ variable [, variable] [, variable]		
RESTORE [line number]		
SWAP variable, variable		

COMMANDS FOR CONTRO

format
RUN [line number]
STOP
CONT
END
TRON
TROFF
FOR variable=initial value TO end va [STEP increm
NEXT [variable] [, variable] ...
GOSUB line number
RETURN [line number]
GOTO line number
IF expression {THEN {statement / line number} / GOTO line number} [ELSE {statement / line nuber}]
ON expression GOTO line number [, line number] ...
ON expression GOSUB line number [, line number] ...

Output data onto display screen in the specified format. Format symbols: "!" Output the first character. "\n spaces \" Outputs n+2 characters. "&" Output the entire string. "#" Specify the number of display digits of the numeric data. "+" Add + or - before (after) numeric data. "-" Add - after negative numeric data. "**" Fill space befor numeric data with *. "$$" Put $ in front of numeric data. "**$" Put $ in front of numeric data and fill space in front of it with *. "," Put, after every third digit to the left of the decimal point. "^^^^" Output with floating decimal points.	10 A$="ABCDEFG" 20 PRINT USING "!";A$ 30 PRINT USING "\ \";A$ 40 PRINT USING "SSS&TTT";A$ PRINT USING "##.##";123.45,10.5 PRING USING "+###";100, -200 PRINT USING "###-";100, -200 PRING USING "**###";100, -200 PRINT USING "$$###";100, 200 PRING USING "**$##";10, 20 PRINT USING "####,.##";1234.56 PRINT USING "#.###^^^^";123.98
Read data in DATA statement.	READ A%
Specify the DATA statement to be read with a READ statement executed next.	RESTORE100
Exchange values of two variables.	SWAP A,B

G PROGRAM EXECUTION AND FLOW

function	example
Start program execution.	RUN 100
Interrupt program execution.	
Restart program execution.	
Terminate program execution.	
Display line number that was executed.	
Cancel TRON.	
Repeat the program execution between FOR and NEXT.	FOR I=1 TO 10 STEP 2 : NEXT I
Transfer control to the specified subroutine. Return to the main routine with RUTURN.	100 GOSUB 1000 : 1000 : 1100 RETURN
Transfer control to the specified line.	GOTO 100
Branch control according to the expression value.	IF X=0 THEN 100 ELSE 200
Branch control according to the expression value.	ON A GOTO 100, 200, 300
Branch control according to the expression value.	ON SGN (A)+2 GOSUB 1000, 2000, 3000

COMMANDS FOR DISPLAY SCREEN

format	function	
SCREEN [mode], [sprite size], [key click switch], [baud rate], [printer type]	Specify the screen display mode. Mode 0: 40×24 character text mode 1: 32×24 character text mode 2: high resolution graphic mode 3: multi-color mode Sprite size 0: 8×8 dot unmagnified 1: 8×8 dot magnified 2: 16×16 dot unmagnified 3: 16×16 dot magnified Key click switch 0: Supress key click sounds. 1: Produce key click sounds. Baud rate 0: 1200 baud 1: 2400 baud Printer type 0: MSX printer 1: Non-MSX printer	SCREEN 2, 0
WIDTH number of display characters per line	Specify the number of characters per line in the text mode.	WIDTH 28
CLS	Erase all displays on the screen.	
LOCATE [x-coordinate], [y-coordinate], [cursor switch]	Move the cursor. Cursor switch 0: Not display the cursor. 1: Display the cursor.	LOCATE 10,
COLOR [foreground color], [background color], [border color]	Specify colors of the foreground, background and the border.	COLOR 8, 1
PUT SPRITE sprite plane number [, [STEP] (x-coordinate, y-coordinate)], [color code], [sprite number]	Display the specified sprite pattern at the specified position on the specified sprite plane.	PUT SPRITE
CIRCLE [STEP] (x-coordinate, y-coordinate), radius, [color code], [start angle], [end angle], [aspect ratio]	Draw a circle.	CIRCLE (80
DRAW "graphic subcommands"	Draw an arbitrary graphic.	DRAW "S4
LINE [[STEP] (x-coordinate, y-coordinate)]-[STEP] (x-coordinate, y-coordinate), [color code] {, [B] / , [BF]}	Draw a line or a square.	LINE -STEP
PAINT [STEP] (x-coordinate, y-coordinate), [color code], [border line color code]	Color the area inside the border line.	PAINT (120
PSET [STEP] (x-coordinate, y-coordinate) [, color code]	Mark a dot.	PSET STEP
PRESET [STEP] (x-coordinate, y-coordinate) [, color code]	Mark or erase a dot.	PRESET (1
KEY {ON / OFF}	Display or erase the contents of function keys.	KEY OFF

tion	example
isplay mode. r text mode r text mode graphic mode e nified ied gnified nified k sounds. k sounds.	SCREEN 2, 0,0
of characters per the screen.	WIDTH 28
cursor. or.	LOCATE 10, 12, 1
foreground, border.	COLOR 8, 15, 2
f sprite pattern at n on the specified	PUT SPRITE 0, (100, 50), 7, 2
	CIRCLE (80, 60), 15, 8
aphic.	DRAW "S40U5R5D5L5"
are.	LINE -STEP (20, 50),, B
the border line.	PAINT (120, 100)
	PSET STEP (10, 10), 14
	PRESET (100, 100)
contents of function	KEY OFF

Graphic subcommands (When B is added, a subcommand changes the starting point only without drawing lines. If N is added, it draws lines but does not move starting point.)

subcommand	function	initial value	subcommand	function	initial value
Mx, y	To an absolute position (x, y)		Fn	Move down to the right.	n=1
M±x, ±y	Move by ±x, ±y from current position.		Gn	Move down to the left.	n=1
Un	Move up.	n=1	Hn	Move up to the left.	n=1
Dn	Move down.	n=1	An	Rotate the coordinate system.	
Rn	Move to the right.	n=1	Cn	Specify a color.	n=15
Ln	Move to the left.	n=1	Sn	Specify the unit number of dots.	n=4
En	Move up to the right.	n=1	X string type variable;	Execute the subcommand assigned to the string type variable.	

COMMANDS FOR MUSIC PERFORMANCE

format	function	example
BEEP	Generate a beep sound.	BEEP: BEEP: BEEP
SOUND PSG register number, expression	Write data into PSG register.	SOUND 7, 7
PLAY "music subcommands" [, "music subcommands"] [, "music subcommands"]	Play music.	PLAY "O4L4CEGEL1C"

Music subcommands

subcommand	function and range	initial value	subcommand	function and range	initial value
A [#/+/−] -G [#/+/−]	Music notes		Tn	Tempo 32≦n≦255	n=120
On	Octave 1≦n≦8	n=4	Vn	Volume 0≦n≦15	n=8
Nn	Pitch 0≦n≦96		Mn	Envelope frequency 1≦n≦65535	n=255
Ln	Length 1≦n≦64	n=4	Sn	Envelope pattern 1≦n≦15	n=1
Rn	Rest 1≦n≦64	n=4		Dot	
X string type variable;	Execute the subcommand assigned to the string type variable.				

COMMANDS FOR PROGRAM AND DATA FILES

format	function	example
MAXFILES=expression	Set the number of files that can be opened in a program.	MAXFILES=3
OPEN "device name [file name]" [FOR mode] AS [#] file number	Open a file and specify a mode. Modes: OUTPUT..... Write INPUT..... Read	OPEN "CRT:TEST" FOR OUTPUT AS#1
PRINT # file number, expression	Write data into file in sequence.	PRINT #1, "ABC"
PRINT # file number, USING format symbol; expression	Write data into file in sequence in the specified format. (See PRINT USING.)	PRINT #1, USING "\ \";A$
INPUT # file number, variable [, variable] ...	Read data from file in sequence and assign them to variables.	INPUT #1, A, B, C
LINE INPUT # file number, string type variable	Read string up to 254 characters from file and assign them to variable.	LINE INPUT #1, A$
CLOSE [#] [file number] [, file number] ...	Close files.	CLOSE #1, 2
SAVE "device name [file name]"	Save the program.	SAVE "CAS:PROGRAM"
LOAD "device name [file name]"	Load the program.	LOAD "CAS:PROGRAM"
MERGE "device name [file name]"	Load ASCII codes program and merge it with the program in memory.	MERGE "CAS:PROG2"
BSAVE "device name [file name]", starting address, end address [, execution starting address]	Save the contents of memory within the specified range.	BSAVE "CAS:GAME", &H3000, &H3FFF
BLOAD "device name [file name]" [, R] [, offset]	Load machine language program. Load and execute program when, R is added. The offset is one for the memory address at the time of loading.	BLOAD "CAS:GAME", R
CSAVE "file name" [, baud rate]	Save the program into cassette tape. Baud rate: 1..... 1,200 baud 2..... 2,400 baud	CSAVE "STAR"
CLOAD ["file name"]	Load program from cassette tape.	CLOAD "STAR"
CLOAD? ["file name"]	Compare program saved on cassette tape and program in memory.	CLOAD? "STAR"

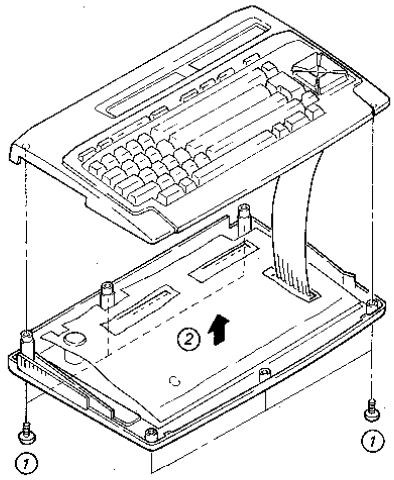
Device name
CAS:..... cassette tape
CRT:..... text mode screen
GRP:..... graphic mode screen
LPT:..... printer
CAT:..... data cartridge

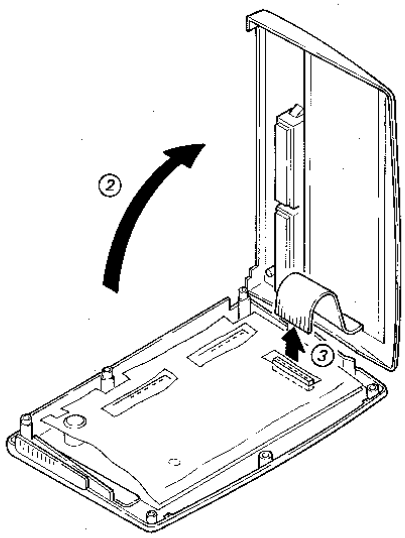
CHAPTER 2
SERVICE INFORMATION

2-1. DISASSEMBLY

2-1-1. Disassembly of Case

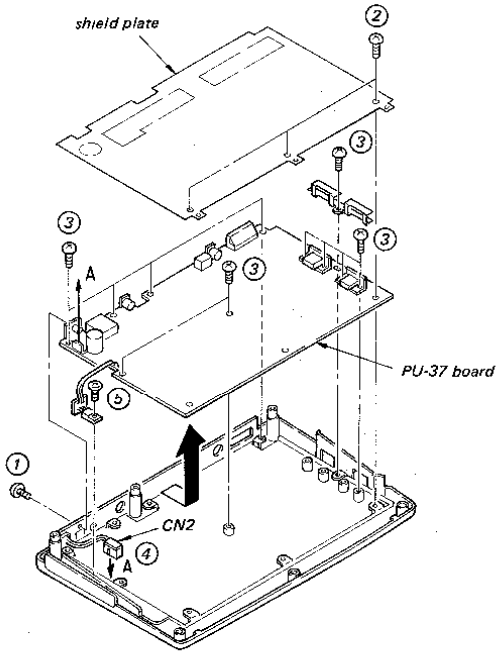
① Remove the five screw of the case.
② Remove the upper case to the direction shown by the arrow.
③ Pull out tape cord of keyboard.





2-1-2. Removal of PU-37 Board

① Remove a screw of bottom cabinet.
② Remove three screws on shield board.
③ Remove nine screws on PU-37 board.
④ Disconnect a CN2 of PU-37 board.
⑤ Remove a screw of IC1.
⑥ Remove PU-37 board in the direction of arrow.

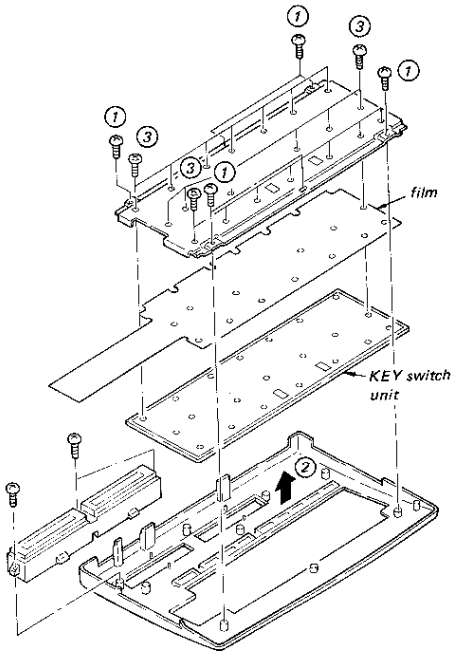


2-1-3. Removal of Keyboard

(1) Remove six keyboard unit fixing screws.

(2) Pull up the keyboard unit in the direction indicated by the arrow.

(3) Remove 21 keyboard fixing screws.



2-1-4. Replace of PU-37 Board

PU-37 mount equipment MODULATOR, RF unit (MDG-UE3622, AE type). If HB-1B model ordering the PU-37 mount please include the MODULATOR, RF unit (MOG-UB3622).

2-2. SERVICE PAR

1. Safety Related Components Warning.
   Components identified by shading marked with ⚠ on the schematic diagrams, exploded views and electrical spare parts list are critical to safe operation. Replace these components with Sony parts whose part numbers appear in this manual or in service bulletins and service manual supplements published by Sony.

2. Replacement Parts supplied from Sony Parts Center will sometimes have a different shape from the original parts. This is due to "accommodating the improved parts and/or engineering changes" or "standardization of genuine parts".
   This manual's exploded views and electrical spare parts list indicate the parts numbers of "the standardized genuine parts at present".
   Regarding engineering parts changes in our engineering department, refer to Sony service bulletins and service manual supplements.

3. Printed Components in Bold-Face type on the exploded views and electrical spare parts list are normally stocked for replacement purposes. The remaining parts are not normally required for routine service work. Orders for parts not shown in Bold-Face type will be processed, but allow for additional delivery time.

4. Abbreviations

Ref. No.	Description
C□□, CV□□	CAPACITOR
CN□□	CONNECTOR
CP□□	COMBINATION PARTS
D□□	DIODE
DL□□	DELAY LINE
F□□	FUSE
FL□□	FILTER
IC□□	IC
L□□, LV□□	INDUCTOR
M□□	MOTOR
ME□□	METER
PL□□	LAMP
Q□□	TRANSISTOR
R□□, RV□□	RESISTOR
RY□□	RELAY
S□□	SWITCH
T□□	TRANSFORMER
TH□□	THERMISTOR
X□□	CRYSTAL

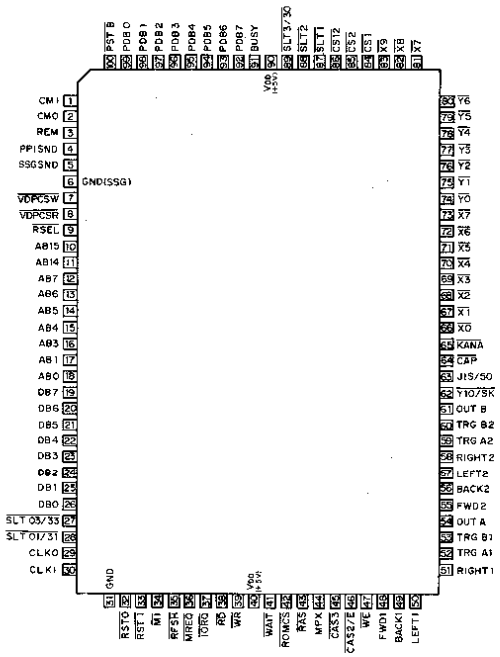
5. Units for Capacitors, Inductors and Resistors
   The following units are assumed in schematic diagrams, electrical parts list and exploded views unless otherwise specified:
   Capacitors: μF
   Inductors: μH
   Resistors: ohm

CHAPTER 3
THEORY OF OPERATION

3-1. S-3527 (MSX SYSTEM)

This LSI used with a Z80A (CPU) controls peripheral equipment. The SSG incorporated into the S-3527 enables sound signal generation. Moreover, the S-3527 is provided with 100 terminals configured as shown in the figure below.

External terminal block diagram of S-3527



3-2. TERMINAL FUNCTIONS

① AB0, AB1, AB3 – AB7 (Address bus)
These bus lines input addresses during memory read/write or input/output operations.

② DB0 to DB7 (Data bus)
These bus lines read or output data.

③ $\overline{MREQ}$, $\overline{IORQ}$
These are signals from the Z80A. The $\overline{MREQ}$ signal is a memory access input. The $\overline{IORQ}$ signal is an I/O port access input. The I/O port is an address to control a printer or programmable sound generator (PSG).

④ $\overline{RFSH}$
This signal from the Z80A is a timing pulse input to refresh the dynamic RAM.

⑤ $\overline{RD}$, $\overline{WR}$
These are signals from the Z80A. The $\overline{WR}$ signal is input when Z80A writes data to the memory or I/O device; the RD signal is input when the Z80A reads data from them.

⑥ $\overline{WAIT}$
This signal instructs the CPU to wait until peripheral equipment which cannot follw CPU operation completes its operation. It is output to the Z80A.

⑦ $\overline{ROMCS}$
This is an MSX BASIC ROM (IC12) select signal.

⑧ $\overline{MPX}$
This is a dynamic RAM address select signal.

⑨ $\overline{RAS}$
A dynamic RAM can memorize no data without periodic refreshing. This is a timing pulse to refresh the dynamic RAM.

⑩ $\overline{CAS2/E}$, $\overline{CAS3}$
These are dynamic RAM $\overline{CAS}$ signals.

⑪ $\overline{WE}$
This is a dynamic RAM write signal.

⑫ $\overline{CS1}$, $\overline{CS2}$, $\overline{CS3}$
These are ROM (Insert the SLOT) read chip select signals. ($\overline{CS1}$, 4000-7FFF; $\overline{CS2}$, 8000-BFFF; $\overline{CS12}$, 4000-BFF)

⑬ $\overline{SLT1}$, $\overline{SLT2}$, $\overline{SLT3/30}$
These are slot select signals. ($\overline{SLT1}$, SLOT #1; $\overline{SLT2}$, SLOT #2; $\overline{SLT3/30}$ #3 or SLOT #30)

⑭ $\overline{SLT01/31}$
This is an extended slot #01 or #31 select signal.

⑮ $\overline{SLT03/33}$
This is an extended slot #03 or #33 select signal.

⑯ $\overline{RSEL}$
This is an extended slot select register control signal.

⑰ $\overline{VDPCR}$
This is a VDP (IC5) read timing signal output.

⑱ $\overline{VDPCW}$
This is a VDP (IC5) write timing signal output.

⑲ PDB0 to PDB7
These are data output signals to the printer.

⑳ $\overline{P\ STB}$
A printer starts printing when it receives this signal.

㉑ BUSY
This is a signal input from the printer; it is sent during printer operations. Therefore, data transmission is determined by the presence of the BUSY signal.

㉒ $\overline{X0}$ to $\overline{X7}$
These are keyboard return signals.

㉓ $\overline{Y0}$ to $\overline{Y9}$ ($\overline{Y10/SK}$)
These are keyboard scan signal output. ($\overline{Y10/SK}$ is used as a serial input terminal depending on the function selected during reset operations.)

㉔ FWD1, FWD2
These are joystick FWD signals or general port inputs.

㉕ BACK1, BACK2
These are joystick BACK signals or general port inputs.

㉖ LEFT1, LEFT2
These are joystick LEFT signals or general port inputs.

㉗ RIGHT1, RIGHT2
These are joystick RIGHT signals or general port inputs.

㉘ TRGA1, TRGA2
These are joystick TRGA signals or general port outputs.

㉙ TRGB1, TRGB2
These are joystick TRGB signals or general port outputs.

㉚ STB1, STB2
These are general port outputs.

㉛ CMI
This is a cassette tape data input.

㉜ CMO
This is a cassette tape recording data output.

㉝ REM
This is a cassette control signal.

㉞ $\overline{CAPS}$
This is a CAPS LAMP signal output to the keyboard (LED driving).

㉟ $\overline{KANA}$
This is a KANA LAMP signal output to the keyboard (LED driving).

㊱ JIS/50
This is a keyboard array control input.

㊲ $\overline{RSTI}$
This is an initializing signal input (Schmitt input).

㊳ RSTO
This initializing signal output initializes the Z80A.

㊴ PPISND
This is a sound signal output using a software program.

㊵ SSGSND
This is an analog sound signal output using an SSG.

㊶ ϕ IN
This is a Z80A clock input. (Clocks for other CPUs are input through a buffer.)

㊷ ϕ OUT
This is a Z80A clock output.

3-3. FUNCTION DESCRIPTION

When the Z80A enters the M1 cycle, "L" is output to the Z80A M1 terminal during T1 state and is input to the S-3527 M1 terminal. At this time, both the Z80A and S-3527 enter the M1 mode.

① S-3527 enters the M1 cycle.

② While the second clock signal appears during T1 state, the $\overline{RAS}$ terminal is set to "L" and the MPX terminal to "L". At this time, the dynamic memory address bus is selected to access a low address.

③ During T1 state, the $\overline{MREQ}$ and $\overline{RD}$ signals from Z80A go low and are input to S-3527. The $\overline{MREQ}$, $\overline{RD}$, and the S-3527 equipment during slot register $\overline{CAS2}$, $\overline{CS}$, and $\overline{ROMCS}$ signals, make an access to the memory, instruct the CPU operation code, and fetch data to the register.

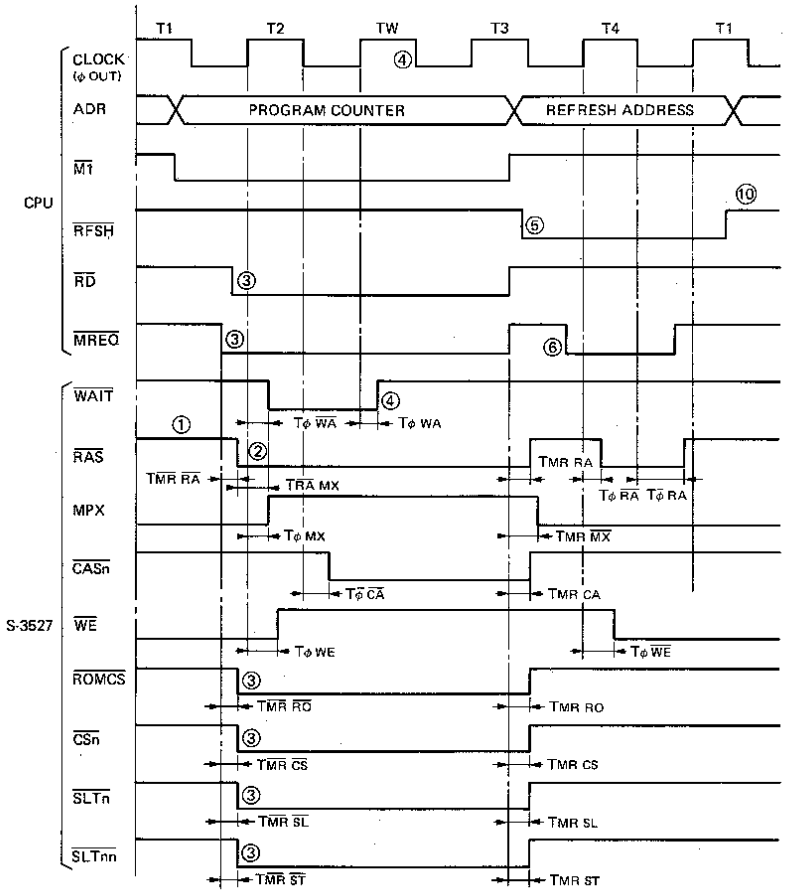
④ When the S-3527 output to the Z80 $\overline{WAIT}$ pin goes high during T2 state, Z80 enters the T3 state. When the output goes low, Z80 enters the wait state (TW) and waits to enter the T3 state until the output of S-3527 goes high.

⑤ Z80A outputs the contents of a refresh register to the address bus during T3 state. As a result, an $\overline{RFSH}$ signal is input to S-3527 as a low signal.

⑥ The $\overline{MREQ}$ signal from the Z80A returns from low to high during T4 state. A dynamic memory can be refreshed using the $\overline{MREQ}$, $\overline{RFSH}$, and address bus.

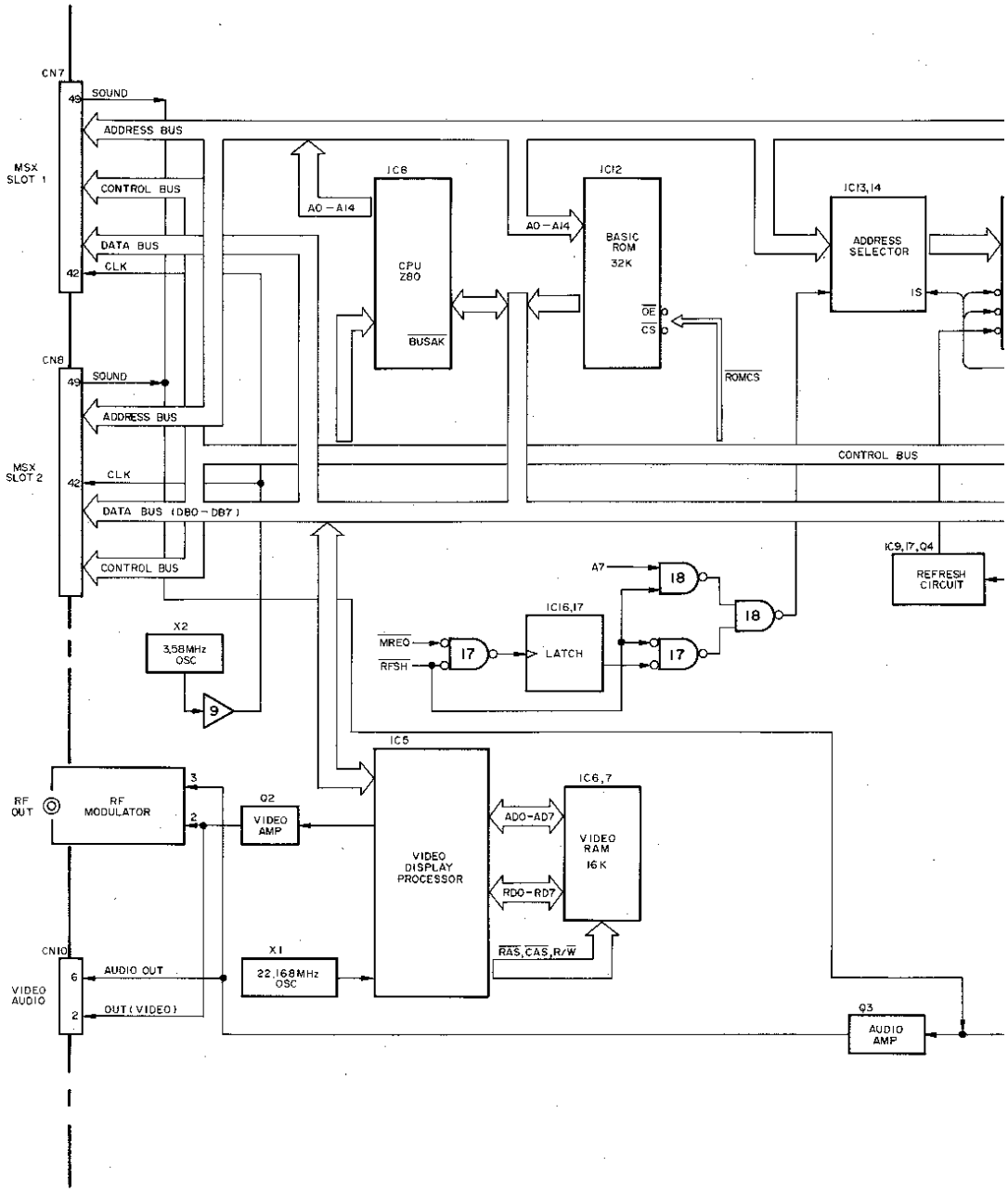
As shown in the figure below, the operation code fetch cycle is located between T1 and T4 states. Point ⑩ indicates the T1 state in the next cycle.
When a refresh address is output on the address during T4 state, the $\overline{RFSH}$ signal goes low. When the refresh address disappears on the address, the $\overline{RFSH}$ signal goes high.

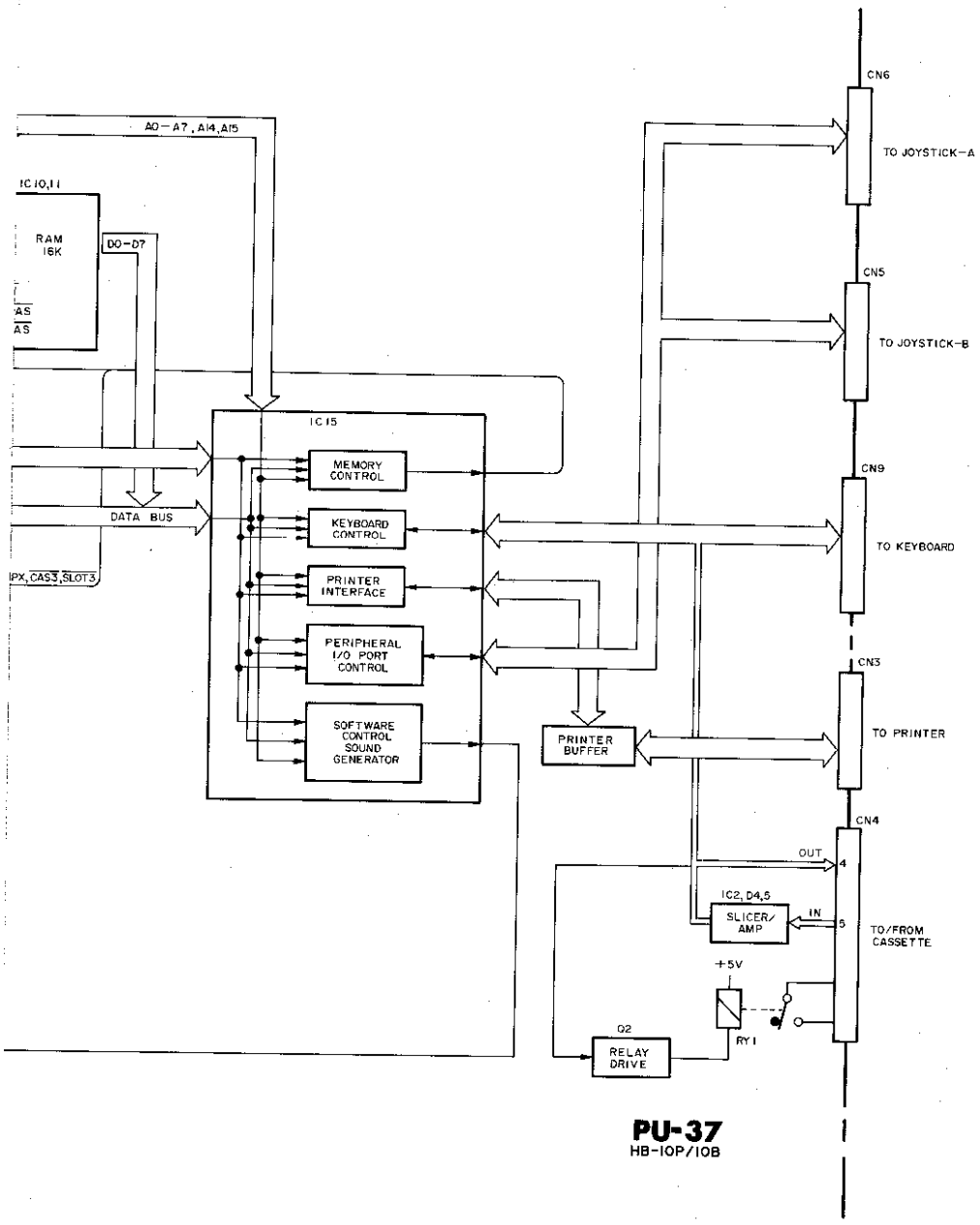
M1 Cycle timing



CHAPTER 4
BLOCK DIAGRAM

4-1. PU-37 BOARD





PU-37
HB-10P/10B

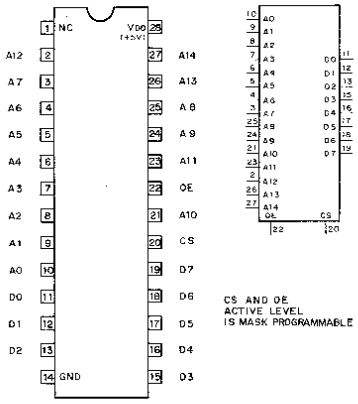
CHAPTER 5
SCHEMATIC DIAGRAM AND PRINTED CIRCUIT BOARD

5-1. SEMICONDUCTOR PIN ASSIGNMENTS

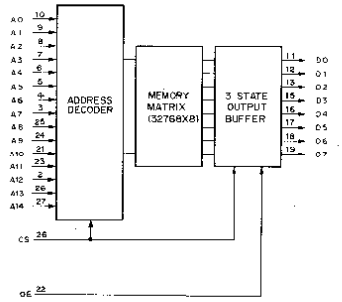
TYPE	PAGE
10E-2	5-7
11DQ04	5-7
1S1555	5-7
1SS119	5-7
1SS133	5-7
1SS148	5-7
2SA1048	5-7
2SA1115	5-7
2SA1175	5-7
2SA733	5-7
2SA933S	5-7
2SC1740S	5-7
2SC2458	5-7
2SC2603	5-7
2SC2785	5-7
2SC945	5-7
HN613256P	5-2
LH0080A	5-2
MB74LS00	5-4
MB74LS08	5-4
MB74LS157	5-4
MB74LS32	5-4
MB74LS367A	5-4
MB74LS74A	5-4
MB81416-12P	5-3
MB81416-15P	5-3
MB81464-12	5-3
MSM38256RS	5-7
NJM79L12A	5-3
S-3527	5-5
SN74LS00N	5-4
SN74LS08N	5-4
SN74LS157N	5-4
SN74LS32N	5-4
SN74LS367AN	5-4
SN74LS74AN	5-4

TYPE	PAGE
T6950	5-6
TMS4416-15NL	5-3
TMS9118NL	5-6
uPC311C	5-6
uPC7805H	5-6
uPC78L12	5-6
uPD780C	5-2
Z80A	5-2

HN613256P (HITACHI)
C-MOS MASK PROGRAMMABLE ROM 256K-BIT (32768x8)
— TOP VIEW —

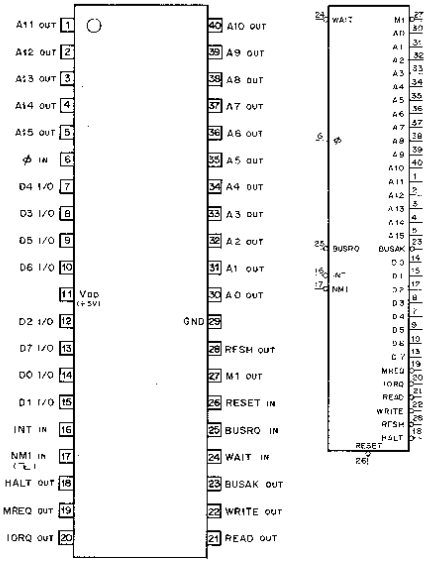


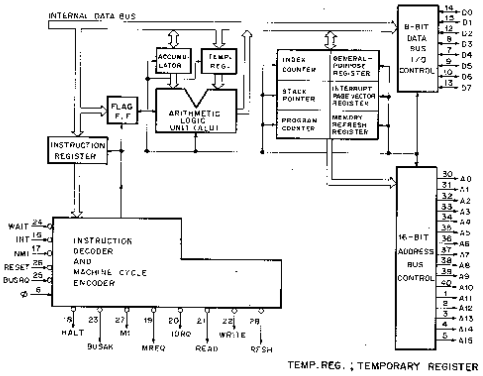
CS AND OE
ACTIVE LEVEL
IS MASK PROGRAMMABLE



A0~A14 ; ADDRESS INPUT
CS ; CHIP SELECT
D0~D7 ; DATA
OE ; OUTPUT ENABLE

LH0080A (SHARP)
μPD780C (NEC)
Z80A (ZILOG)
N-MOS 8-BIT MICROPROCESSOR
— TOP VIEW —

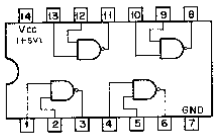


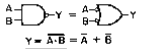


TEMP. REG. ; TEMPORARY REGISTER

φ ; CLOCK
A0-A15 ; 3-STATE ADDRESS OUTPUT
BUSAK ; BUS ACKNOWLEDGE
BUSRQ ; BUS REQUEST
D0-D7 ; 3-STATE DATA INPUT/OUTPUT
HALT ; HALT STATE
INT ; INTERRUPT REQUEST
IORQ ; 3-STATE I/O REQUEST
M1 ; MACHINE CYCLE 1
MREQ ; 3-STATE MEMORY REQUEST
NMI ; NON-MASKABLE INTERRUPT (DOWN EDGE TRIGGER)
READ ; 3-STATE MEMORY READ
RFSH ; REFRESH
WRITE ; 3-STATE MEMORY WRITE

MB74LS00 (FUJITSU)
SN74LS00N (TI)
TTL 2-INPUT POSITIVE-NAND GATE
— TOP VIEW —



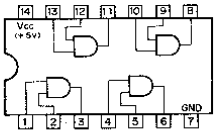


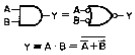
$Y = \overline{A \cdot B} = \overline{A} + \overline{B}$

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

0; LOW LEVEL
1; HIGH LEVEL

MB74LS08 (FUJITSU)
SN74LS08N (TI)
TTL 2-INPUT POSITIVE-AND GATE
— TOP VIEW —



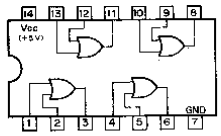


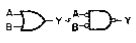
$Y = A \cdot B = \overline{\overline{A} + \overline{B}}$

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

0; LOW LEVEL
1; HIGH LEVEL

MB74LS32 (FUJITSU)
SN74LS32N (TI)
TTL 2-INPUT POSITIVE-OR GATE
— TOP VIEW —



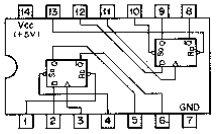


$Y = A + B = \overline{\overline{A} \cdot \overline{B}}$

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

0; LOW LEVEL
1; HIGH LEVEL

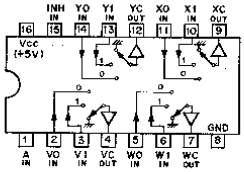
MB74LS74A (FUJITSU)
SN74LS74AN (TI)
TTL D-TYPE FLIP FLOP WITH DIRECT SET/RESET
— TOP VIEW —

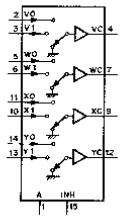


INPUTS			OUTPUTS	
$\overline{S_D}$	$\overline{R_D}$	D	Q_{n+1}	$\overline{Q_{n+1}}$
0	1	X	1	0
1	0	X	0	1
0	0	X	1*	1*
1	1	↑	1	0
1	1	↓	0	1
1	1	0	Q_n	$\overline{Q_n}$

0; LOW LEVEL
1; HIGH LEVEL
X; DON'T CARE
1*; NONSTABLE

MB74LS157 (FUJITSU)
SN74LS157N (TI)
TTL 2-LINE-TO-1-LINE DATA SELECTOR/MULTIPLEXER
— TOP VIEW —

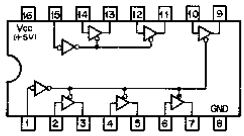




CONT. IN		ON CHANNEL
INH	A	
0	0	0
0	1	1
1	X	GND

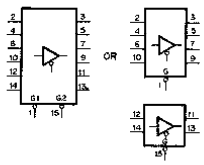
0; LOW LEVEL
1; HIGH LEVEL
X; DON'T CARE

MB74LS367A (FUJITSU)
SN74LS367AN (TI)
TTL BUS DRIVER WITH 3-STATE OUTPUTS
— TOP VIEW —

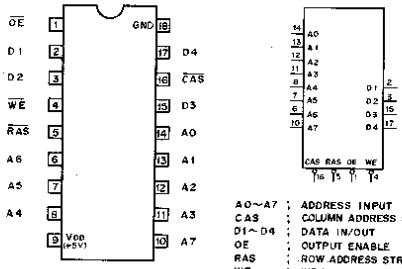


G	A	Y
0	0	0
0	1	1
1	X	HI-Z

0; LOW LEVEL
1; HIGH LEVEL
X; DON'T CARE
HI-Z; HIGH IMPEDANCE



MB81416-12P (FUJITSU) (ACCESS TIME = 120nS)
MB81416-15P (FUJITSU) (ACCESS TIME = 150nS)
TMS4416-15NL (TI) (ACCESS TIME = 150nS)
N-MOS 16384-WORD BY 4-BIT DYNAMIC RAM
— TOP VIEW —

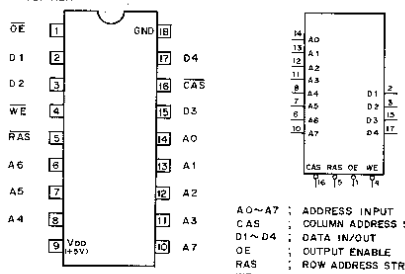


A0~A7	; ADDRESS INPUT
CAS	; COLUMN ADDRESS STROBE
D1~D4	; DATA IN/OUT
OE	; OUTPUT ENABLE
RAS	; ROW ADDRESS STROBE
WE	; WRITE ENABLE

MODE	CONTROL		DATA
	WE	OE	D1~D4
—	0	0	X
WRITE	0	1	DATA IN
READ	1	0	DATA OUT
—	1	1	HI-Z

0 ; LOW LEVEL
1 ; HIGH LEVEL
X ; DON'T CARE
HI-Z ; HIGH IMPEDANCE

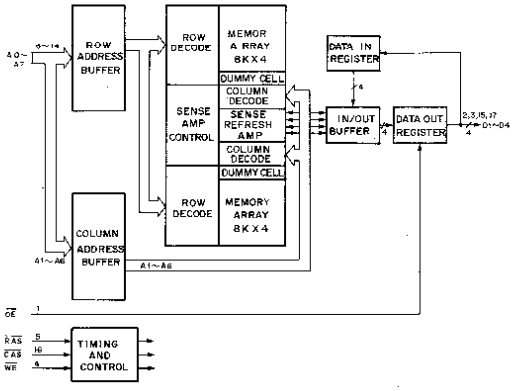
MB81464-12 (FUJITSU) (ACCESS TIME = 120nS)
N-MOS 65536-WORD BY 4-BIT DYNAMIC RAM
— TOP VIEW —

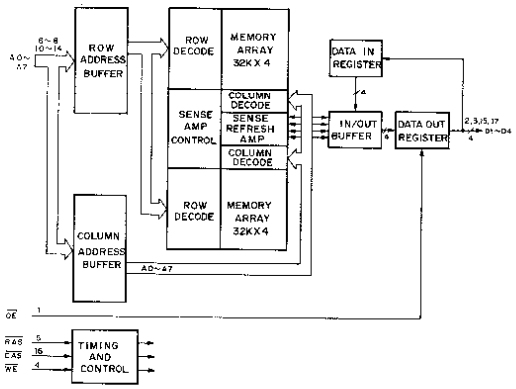


A0~A7	; ADDRESS INPUT
CAS	; COLUMN ADDRESS STROBE
D1~D4	; DATA IN/OUT
OE	; OUTPUT ENABLE
RAS	; ROW ADDRESS STROBE
WE	; WRITE ENABLE

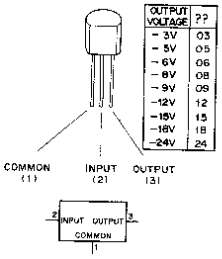
MODE	CONTROL		DATA
	WE	OE	D1~D4
—	0	0	X
WRITE	0	1	DATA IN
READ	1	0	DATA OUT
—	1	1	HI-Z

0 ; LOW LEVEL
1 ; HIGH LEVEL
X ; DON'T CARE
HI-Z ; HIGH IMPEDANCE



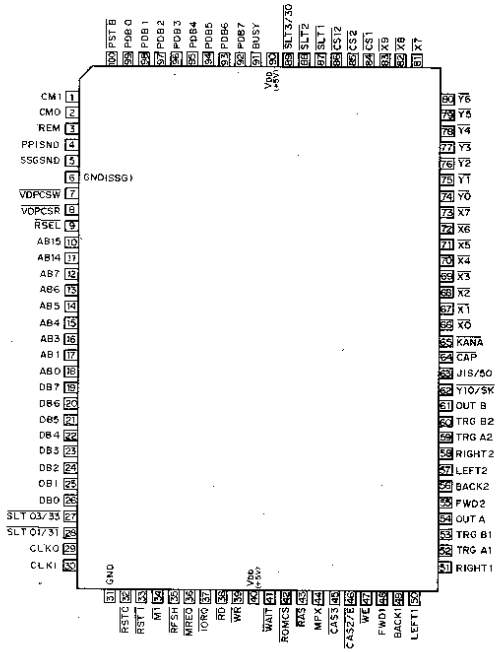


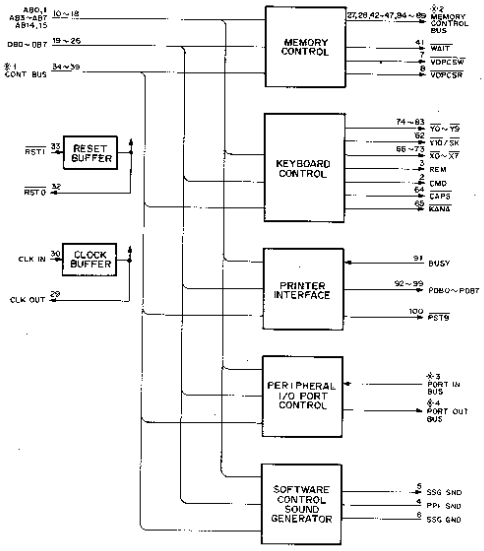
NJM79L ? ?A (JRC)
NEGATIVE VOLTAGE REGULATOR (100mA)
— FRONT VIEW —



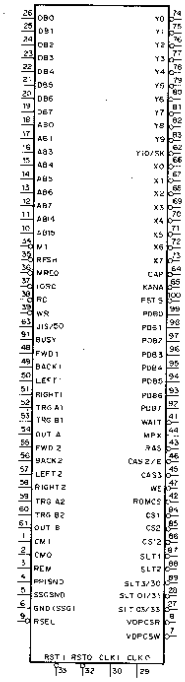
OUTPUT VOLTAGE	??
− 3V	03
− 5V	05
− 6V	06
− 8V	08
− 9V	09
−12V	12
−15V	15
−18V	18
−24V	24

S-3527 (YAMAHA)
C MOS MSX PORT CONTROLLER AND SOFTWARE CONTROLLED SOUND GENERATOR
— TOP VIEW —



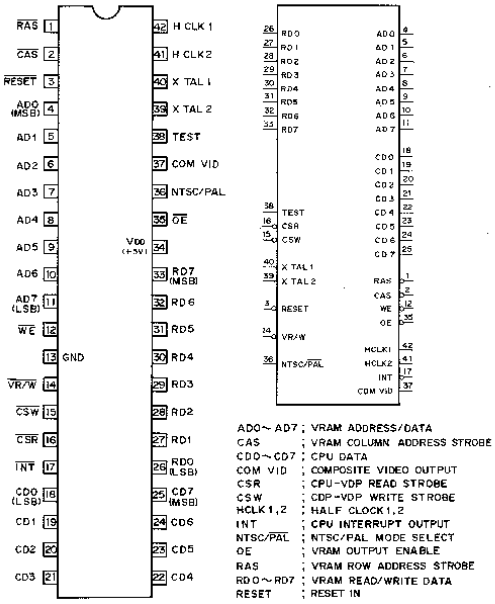


※1 CONT BUS $\overline{IORQ}$, M1, MREQ, $\overline{RD}$, $\overline{RFSH}$, $\overline{WR}$
※2 MEMORY CONTROL BUS $\overline{CAS2/E}$, $\overline{CAS3}$, $\overline{CS1}$, $\overline{CS2}$, $\overline{CS12}$, MPX, $\overline{RAS}$, $\overline{ROMCS}$
$\overline{SLT1}$, $\overline{SLT2}$, $\overline{SLT01/31}$, $\overline{SLOT03/33}$, $\overline{SLT3/30}$
※3 PORT IN BUS BACK1, BACK2, FWD1, FWD2, LEFT1, LEFT2, RIGHT1, RIGHT2, (TRGA1, TRGA2, TRGB1, TRGB2)
※4 PORT OUT BUS OUTA, OUTB, (TRGA1, TRGA2, TRGB1, TRGB2)



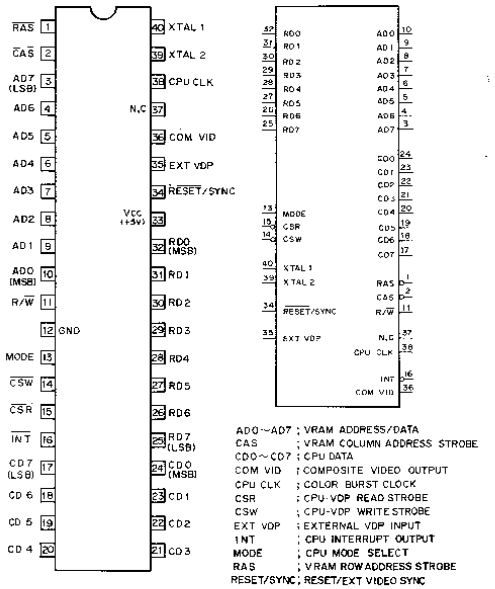
AB0,1,3~7,14,15	;	ADDRESS BUS
BACK 1,2	;	BACK SIGNAL 1,2
BUSY	;	PRINTER BUSY SIGNAL
CAP	;	CAP LED SIGNAL
CAS2/E	;	RAM COLUMN ADDRESS STROBE
CAS3	;	RAM COLUMN ADDRESS STROBE
CLK 1,0	;	CLOCK INPUT, OUTPUT
CM 1,0	;	CASSETTE SIGNAL IN, OUT
CS1,2,12	;	ROM CHIP SELECT 1,2,12
DB0~DB7	;	DATA BUS
FWD 1,2	;	FWD SIGNAL 1,2
IORQ	;	I/O REQUEST
JIS/50	;	KEYBOARD ASSIGNMENT CONTROL JIS/50
KANA	;	KANA LED SIGNAL
LEFT 1,2	;	LEFT SIGNAL 1,2
M1	;	MACHINE CYCLE 1
MPX	;	D-RAM MULTIPLEX SIGNAL
MREQ	;	MEMORY REQUEST
OUT A,B	;	OUT SIGNAL A,B
PDB0~7	;	PRINTER DATA BUS
PPISND	;	PPI SOUND
PSTB	;	PRINTER STROBE SIGNAL
RAS	;	DRAM ROW ADDRESS STROBE
RD	;	READ SIGNAL
REM	;	CASSETTE REMOTE SIGNAL
RFSH	;	REFRESH
RIGHT 1,2	;	RIGHT SIGNAL 1,2
RSEL	;	EXPANSION SELECT REGISTOR CONTROL SIGNAL
RST 1,0	;	RESET IN, OUT
SLT 1	;	SLOT SELECT 1
SLT 2	;	SLOT SELECT 2
SLT 3/30	;	SLOT SELECT 3/30
SSG SND	;	ANALOG SOUND
GND (SSG)	;	GROUND (SSG)
TRG A 1, 2	;	TRIGGER A1,2
TRG B 1, 2	;	TRIGGER B1,2
VDP CSR	;	VDP READ STROBE
VDP CSW	;	VDP WRITE STROBE
WAIT	;	WAIT REQUEST SIGNAL
WE	;	DRAM WRITE SIGNAL
WR	;	WR SIGNAL
X0~X7	;	KEYBOARD RETURN SIGNAL
Y0~Y9	;	KEYBOARD SCAN SIGNAL
Y10/SK	;	KEYBOARD SCAN SIGNAL/SERIAL KEY IN

T6950 (TOSHIBA)
C-MOS VIDEO DISPLAY PROCESSOR (NTSC/PAL)
— TOP VIEW —



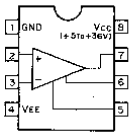
AD0～AD7	; VRAM ADDRESS/DATA
CAS	; VRAM COLUMN ADDRESS STROBE
CD0～CD7	; CPU DATA
COM VID	; COMPOSITE VIDEO OUTPUT
CSR	; CPU-VDP READ STROBE
CSW	; CDP-VDP WRITE STROBE
HCLK1,2	; HALF CLOCK1,2
INT	; CPU INTERRUPT OUTPUT
NTSC/PAL	; NTSC/PAL MODE SELECT
OE	; VRAM OUTPUT ENABLE
RAS	; VRAM ROW ADDRESS STROBE
RD0～RD7	; VRAM READ/WRITE DATA
RESET	; RESET IN
TEST	; TEST
VR/W	; VRAM READ/WRITE
WE	; VRAM WRITE ENABLE
XTAL1,2	; CRYSTAL INPUT

TMS9118NL (TI)
N-MOS VIDEO DISPLAY PROCESSOR
— TOP VIEW —

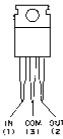


AD0～AD7	; VRAM ADDRESS/DATA
CAS	; VRAM COLUMN ADDRESS STROBE
CD0～CD7	; CPU DATA
COM VID	; COMPOSITE VIDEO OUTPUT
CPU CLK	; COLOR BURST CLOCK
CSR	; CPU-VDP READ STROBE
CSW	; CPU-VDP WRITE STROBE
EXT VDP	; EXTERNAL VDP INPUT
INT	; CPU INTERRUPT OUTPUT
MODE	; CPU MODE SELECT
RAS	; VRAM ROW ADDRESS STROBE
RESET/SYNC	; RESET/EXT VIDEO SYNC
RD0～RD7	; VRAM READ/WRITE DATA
R/W	; VRAM READ/WRITE
XTAL1,2	; CRYSTAL INPUT

μPC311C (NEC)
VOLTAGE COMPARATOR
— TOP VIEW —



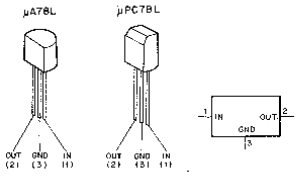
μPC78？?H (NEC)
POSITIVE VOLTAGE REGULATOR (1A)



5V	μA7805UC	FS7805	μPC14305H	μPC7805H	HA17805P
6V	μA7806UC				HA17806P
7V					HA17807P
8V	μA7808UC			μPC7808H	HA17808P
8.5V	μA7885UC				
9V					
12V	μA7812UC	FS7812	μPC14312H	μPC7812H	HA17812P
15V	μA7815UC	FS7815	μPC14315H	μPC7815H	HA17815P
18V	μA7818UC		μPC14318H	μPC7818H	HA17818P
24V	μA7824UC	FS7824	μPC14324H	μPC7824H	HA17824P

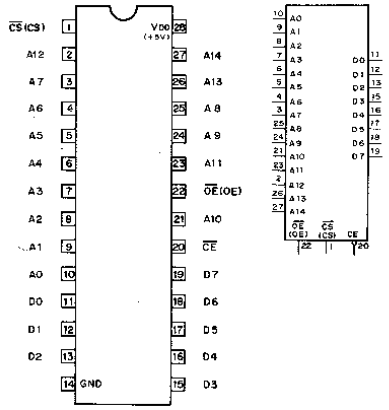
5V
6V
7V
8V
8.5V
9V
12V NJM78128
15V
18V
24V

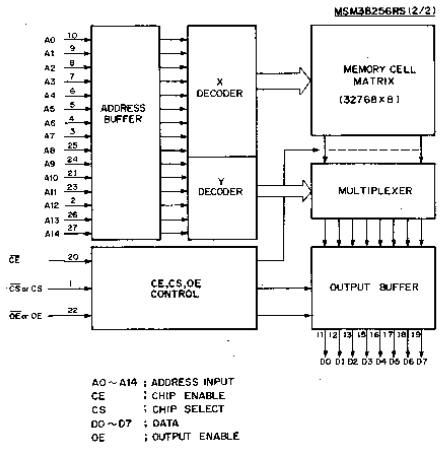
μPC78L？？(NEC)
POSITIVE VOLTAGE REGULATOR (100mA)

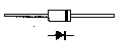


2.6V	μA78L26AWV	μA78L02ACL	
5V	μA78L05AWV	μA78L05ACL	μPC78L05(A)
6.2V	μA78L62AWV	μA78L06ACL	
8V		μA78L08ACL	μPC78L08
8.2V	μA78L82AWV		
9V	μA78L09AWV	μA78L09ACL	
10V		μA78L10ACL	
12V	μA78L12AWV	μA78L12ACL	μPC78L12
15V	μA78L15AWV	μA78L15ACL	μPC78L15
18V	μA78L18AWV		
24V	μA78L24AWV		

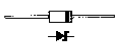
MSM38256RS (OKI)
N-MOS MASK PROGRAMMABLE ROM 256K-BIT (32768x8)
— TOP VIEW —





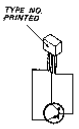


10E-2
1S1555
1SS119
1SS133
1SS148

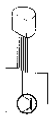


11DQ04

2SA1048
2SA1116

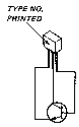


2SA1175

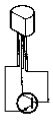


2SA733
2SA933

2SC1740S
2SC2458
2SC2603

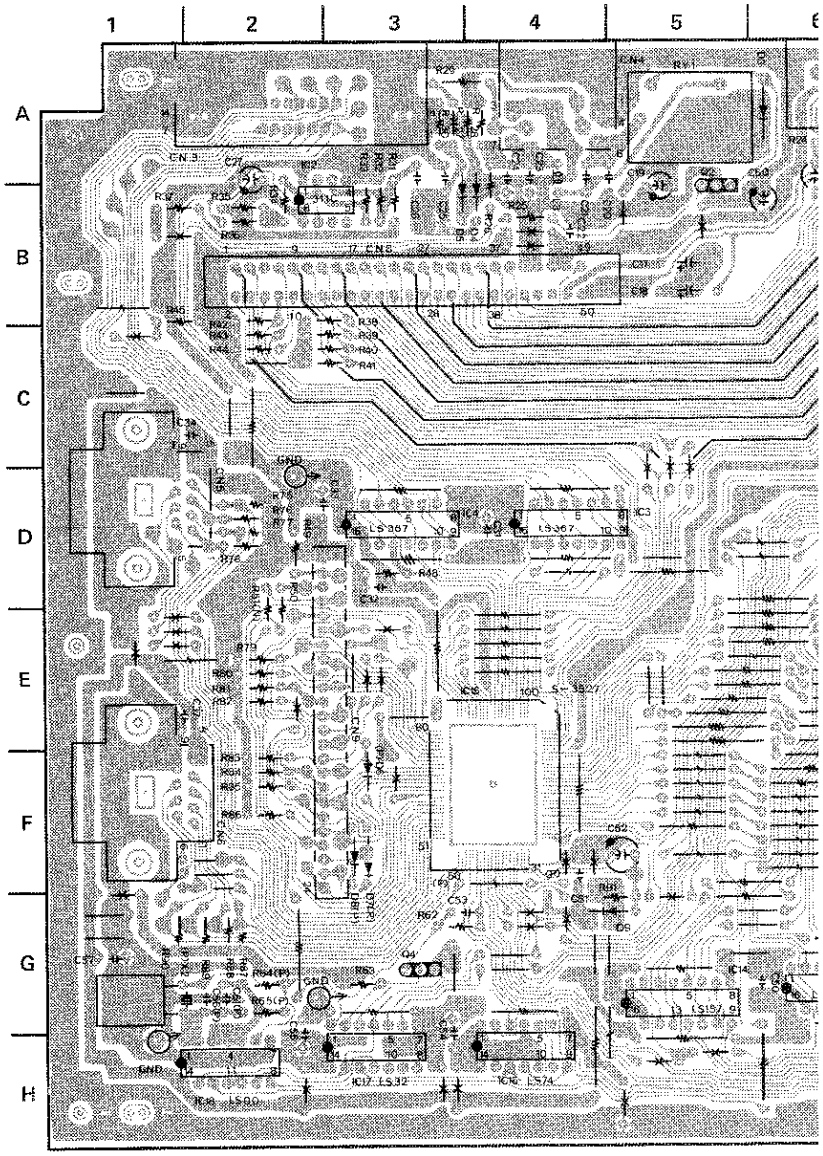


2SC2785

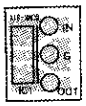


2SC945

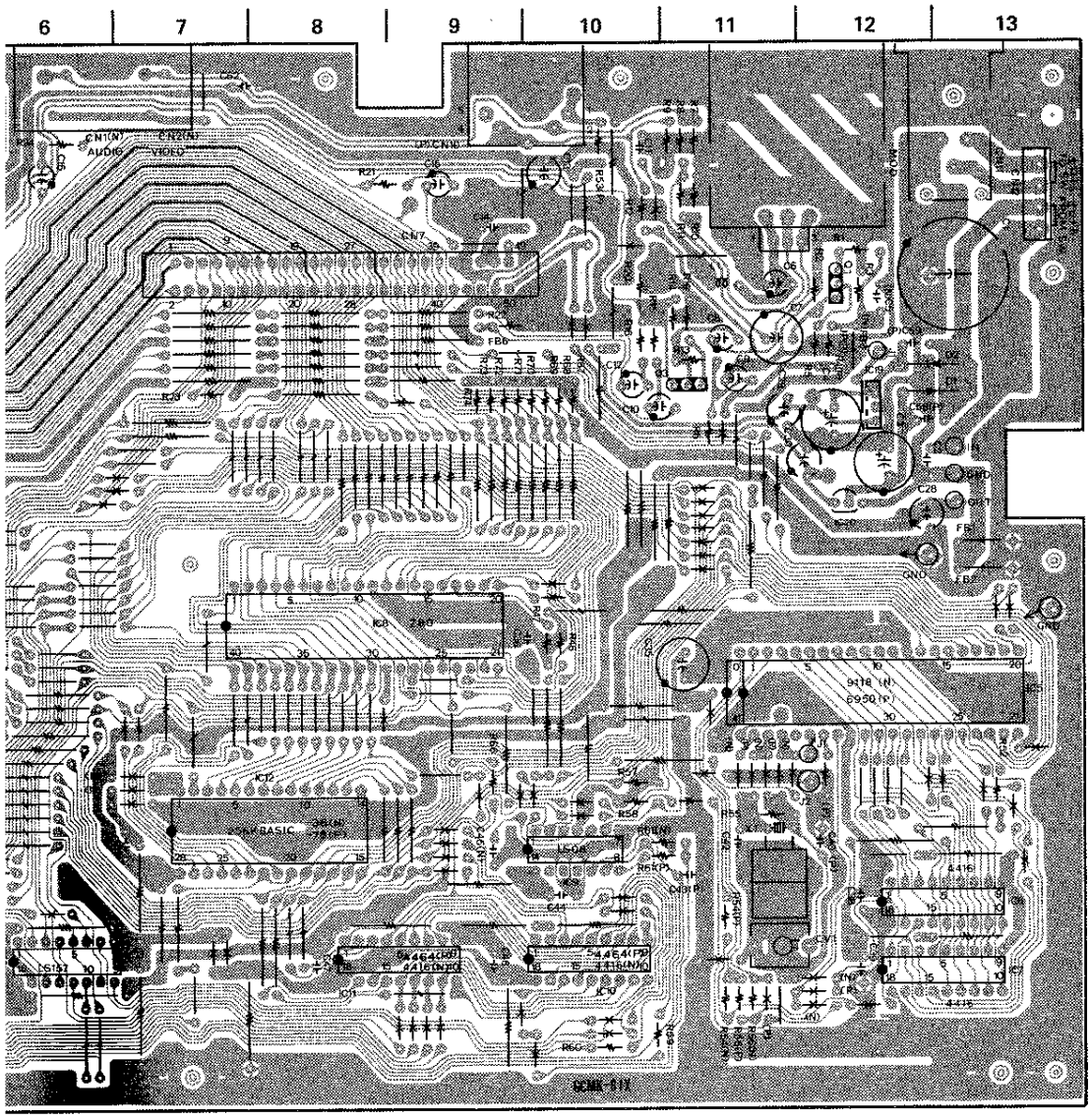
5-2. PU-37 BOARD



A
SOLDERING SIDE
A-8050-173-A
HB-10P/10B (AE/UK)



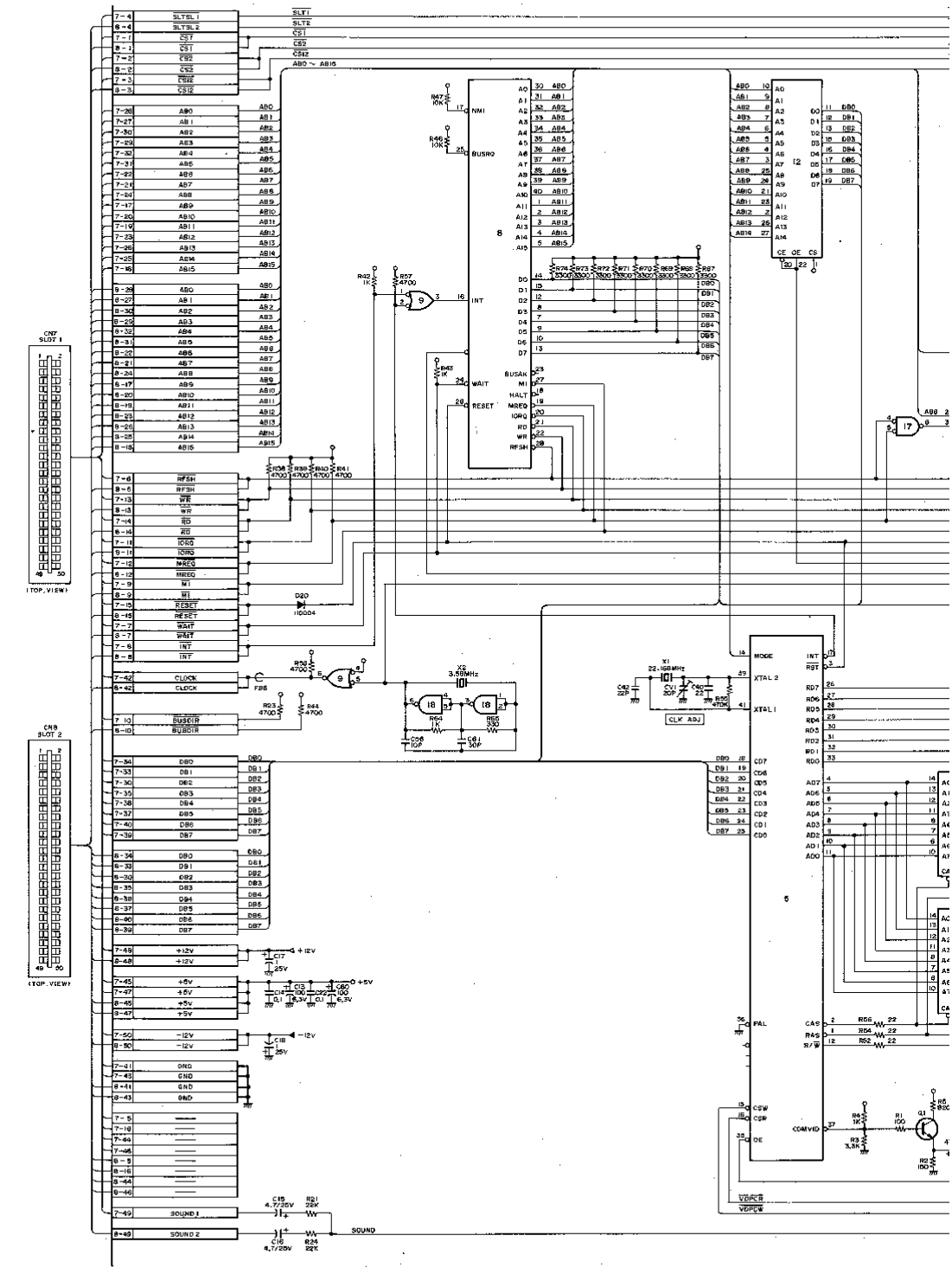
PU-37
SOLDERING SIDE
A-8050-173-A
HB-10P/10B (AE/UK)



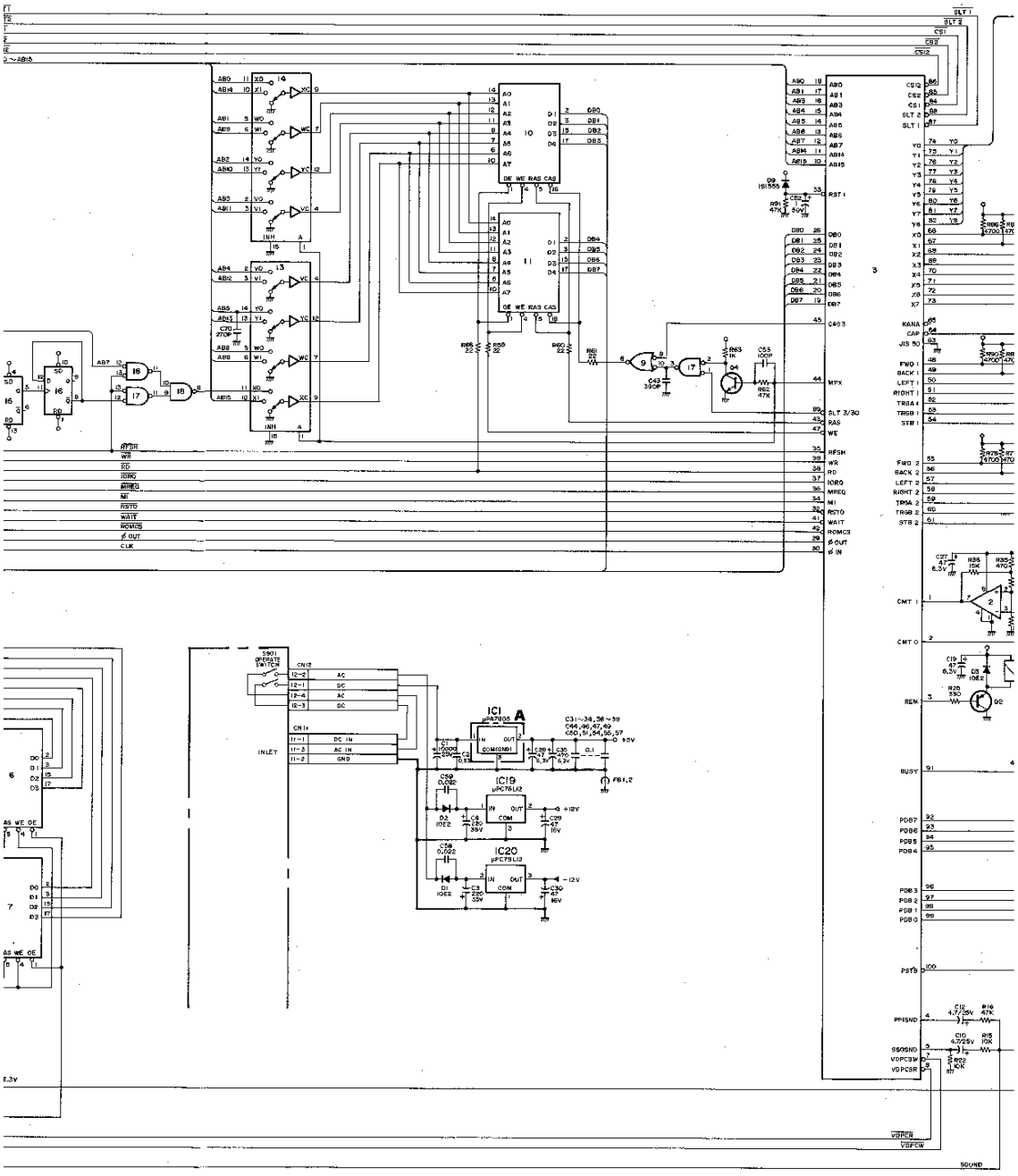
NOTE: —— ; jumper wire.

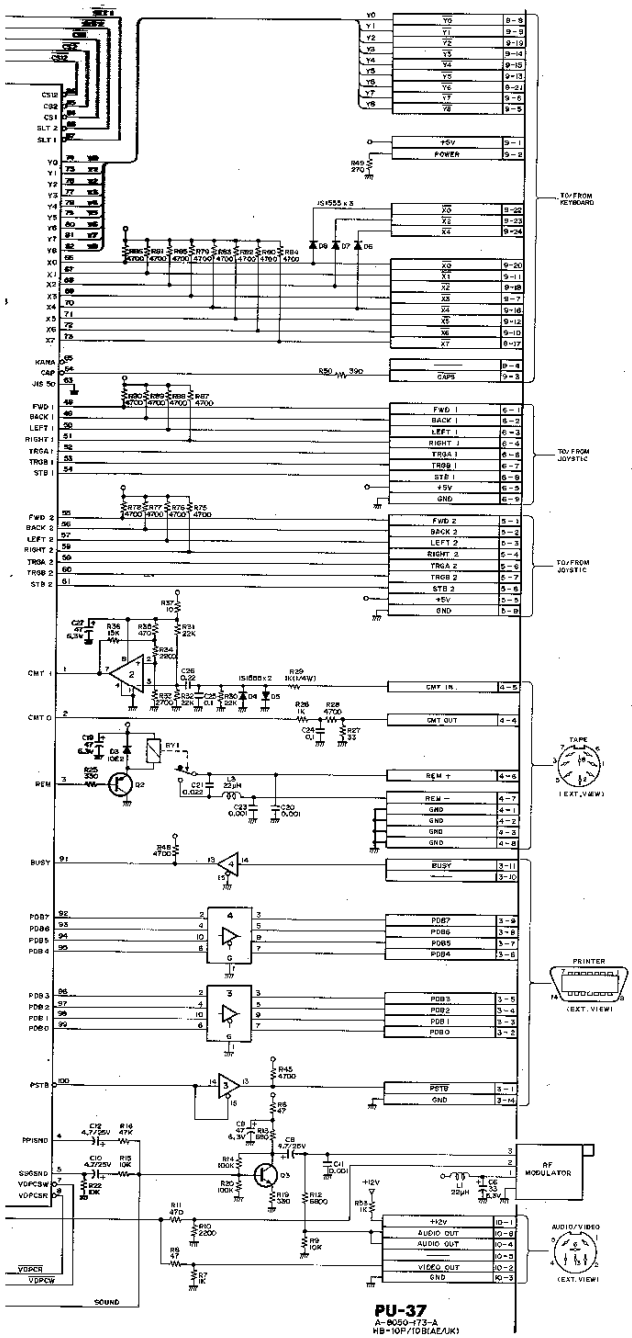
C1	B-13	C32	D-3	CN3	A-2	IC6	G-13	R6	C-11	R38	B-3	R69	C-10
C2	D-13	C33	D-3	CN4	A-4	IC7	G-13	R7	A-11	R39	C-3	R70	C-10
C3	D-12	C34	C-2	CN5	D-1	IC8	E-8	R8	A-11	R40	C-3	R71	C-9
C4	C-12	C35	E-11	CN6	F-1	IC9	F-10	R9	A-11	R41	C-3	R72	C-9
C6	B-11	C36	E-10	CN7	B-9	IC10	G-10	R10	B-11	R42	B-2	R73	C-9
C7	C-11	C37	E-1	CN8	B-3	IC11	G-8	R11	B-11	R43	C-2	R74	C-9
C8	C-11	C38	G-12	CN9	E-3	IC12	F-8	R12	B-10	R44	C-2	R75	D-2
C9	C-11	C39	G-12	CN10	A-9	IC13	G-6	R13	B-11	R45	B-1	R76	D-2
C10	C-10	C40	F-12	CN11	A-13	IC14	G-5	R14	B-11	R46	E-10	R77	D-2
C11	A-10	C42	F-11	CN12	B-13	IC15	F-4	R15	C-10	R47	E-10	R78	D-2
C12	C-10	C43	G-11	CV1	G-12	IC16	H-4	R16	C-10	R48	D-3	R79	E-2
C13	A-10	C44	G-10			IC17	H-3	R19	B-11	R49	D-2	R80	E-2
C14	B-9	C46	G-9	D1	C-13	IC18	H-2	R20	B-10	R50	D-2	R81	E-2
C15	A-9	C47	G-8	D2	C-13	IC19	C-12	R21	A-8	R52	F-13	R82	E-2
C16	A-6	C49	F-7	D3	A-6	IC20	D-12	R22	C-9	R53	A-10	R83	F-2
				D4	B-4								
C17	B-5	C50	G-6	D5	B-3	L1	B-11	R23	C-7	R54	G-11	R84	F-2
C18	B-5	C51	F-4			L3	A-4	R24	A-6	R55	F-11	R85	F-2
C19	A-5	C52	F-5	D6	F-3			R25	B-4	R56	H-11	R86	F-2
C20	A-5	C53	G-3	D7	F-3	Q1	B-12	R26	B-4	R57	F-10	R87	G-2
C21	A-4	C54	H-3	D8	F-3	Q2	A-5	R27	A-4	R58	F-10	R88	G-2
				D9	G-5	Q3	C-11						
C22	B-4	C55	H-2	D20		Q4	G-3	R28	A-4	R59	H-11	R89	G-2
C23	A-4	C56	G-2					R29	A-3	R60	H-10	R90	G-1
C24	A-4	C57	G-1	FB1	D-13	R1	B-12	R30	A-3	R61	G-11	R91	G-5
C25	A-3	C58	C-13	FB2	D-13	R2	B-12	R31	B-3	R62	G-3		
C26	A-3	C59	D-12	FB6	C-9	R3	B-12	R32	B-3	R63	G-3	RY1	A-5
						R4	C-12						
C27	A-2	C60	B-6	IC2	B-2	R5	C-12	R33	B-3	R64	G-2	X1	F-11
C28	D-13	C61	G-2	IC3	D-4			R34	B-2	R65	G-2	X2	G-1
C29	C-11	C62	A-7	IC4	D-3			R35	B-2	R66	F-9		
C30	D-12	C70		IC5	E-12			R36	B-2	R67	C-10		
C31	D-4							R37	B-1	R68	C-10		

REF.NO.	TYPE	PIN NO.			
		+12V	+5V	GND	-5V
IC 1	UPC7805		3	3	
IC 2	UPC311C		8	1	
IC 3	MB74LS367A		16	8	
IC 4	MB74LS367A		16	8	
IC 5	T6950		34	13	
IC 6	MB81416-15P,MB81416-12P		9	18	
IC 7	MB81416-12P,MB81416-15P		9	18	
IC 8	Z80A,LH0080A,UPD780C-1		11	29	
IC 9	MB74LS08		14	7	
IC 10	MB81464-12		9	18	
IC 11	MB81464-12		9	18	
IC 12	MSM38256-78RS		28	14	
IC 13	MB74LS157		16	8	
IC 14	MB74LS157		16	8	
IC 15	S-3527		90,40	6,31	
IC 16	MB74LS74A		14	7	
IC 17	MB74LS32		14	7	
IC 18	MB74LS00		14	7	
IC 19	UPC78L12	2		3	
IC 20	NJM79L12A			1	2



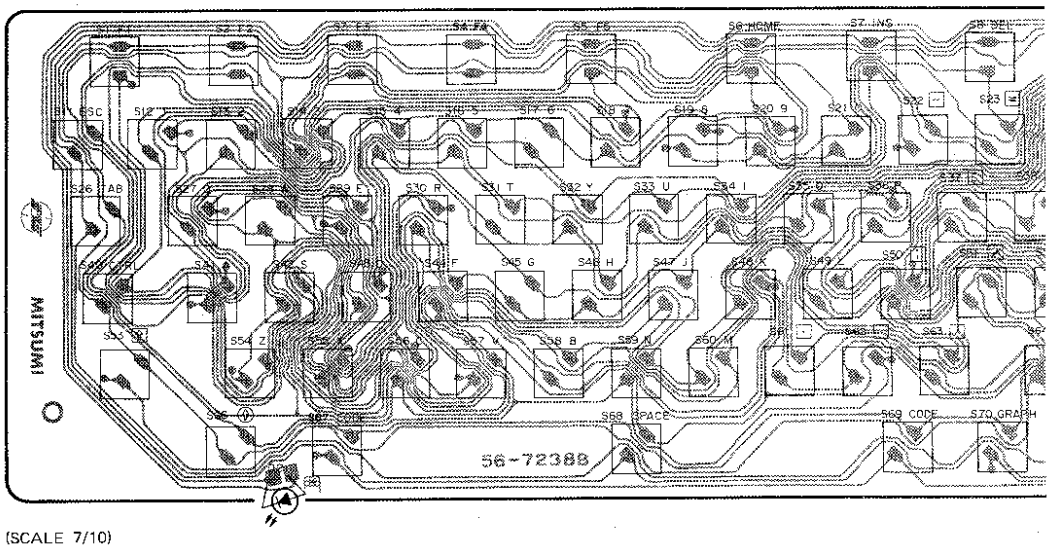
PU-37



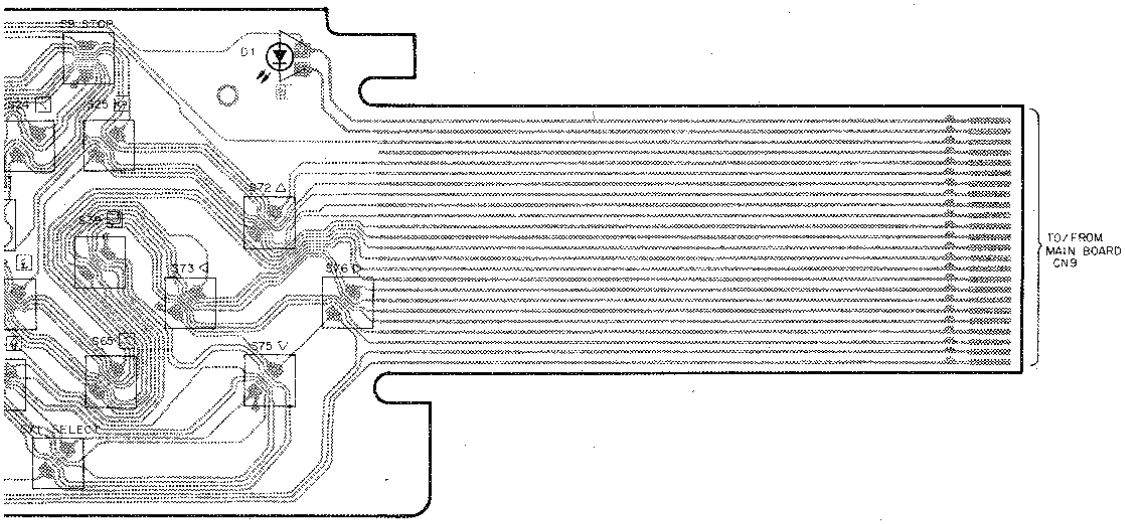


PU-37
A-8050-173-A
HB-10P/10B(AE/UK)

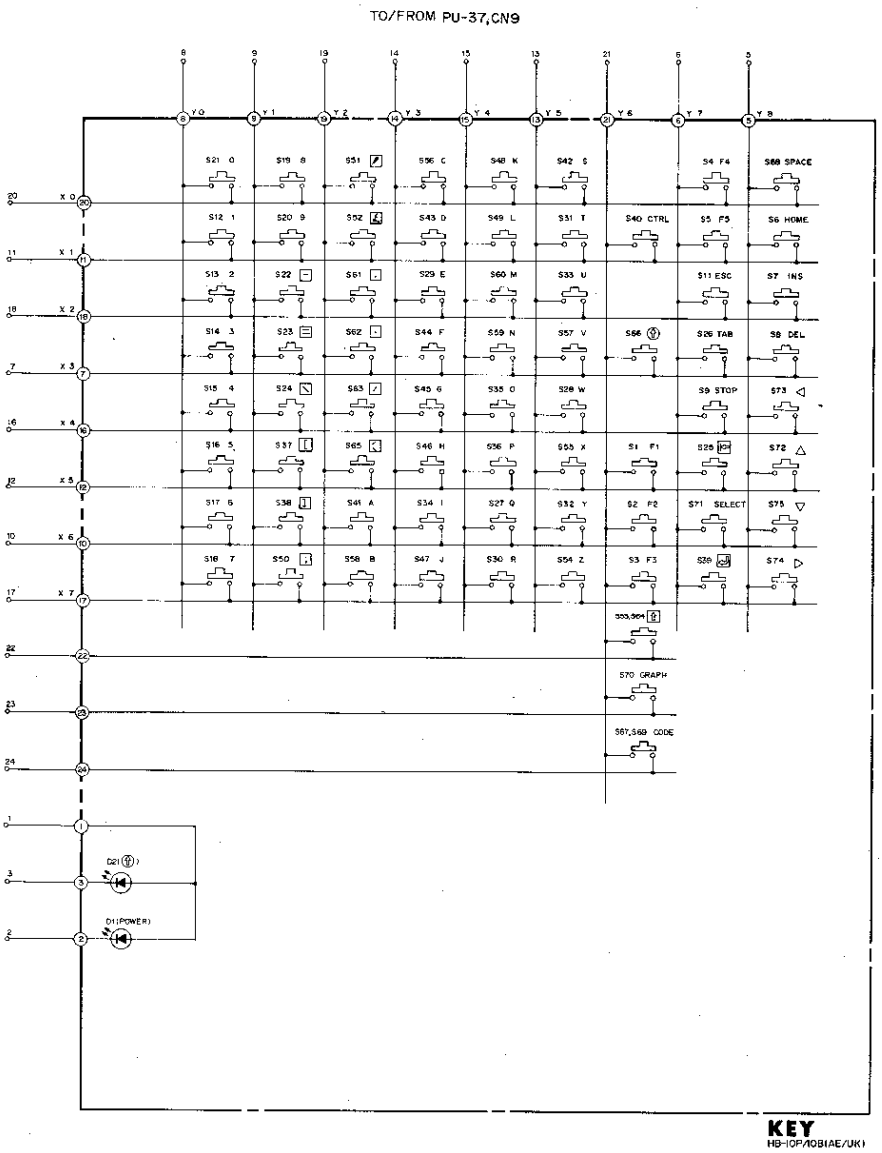
5-3. KEY BOARD



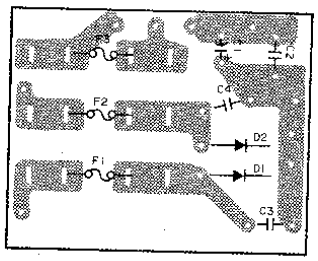
(SCALE 7/10)



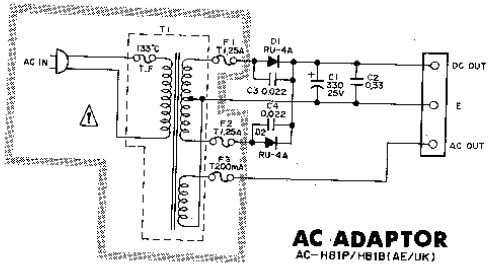
KEY
HB-10P/10B (AE/UK)


TO/FROM PU-37,CN9
TO/FROM PU-37,CN9
KEY
HB-10P/10BIAE/UK)

5-4. AC ADAPTOR (AC-HB1P/HB1B)



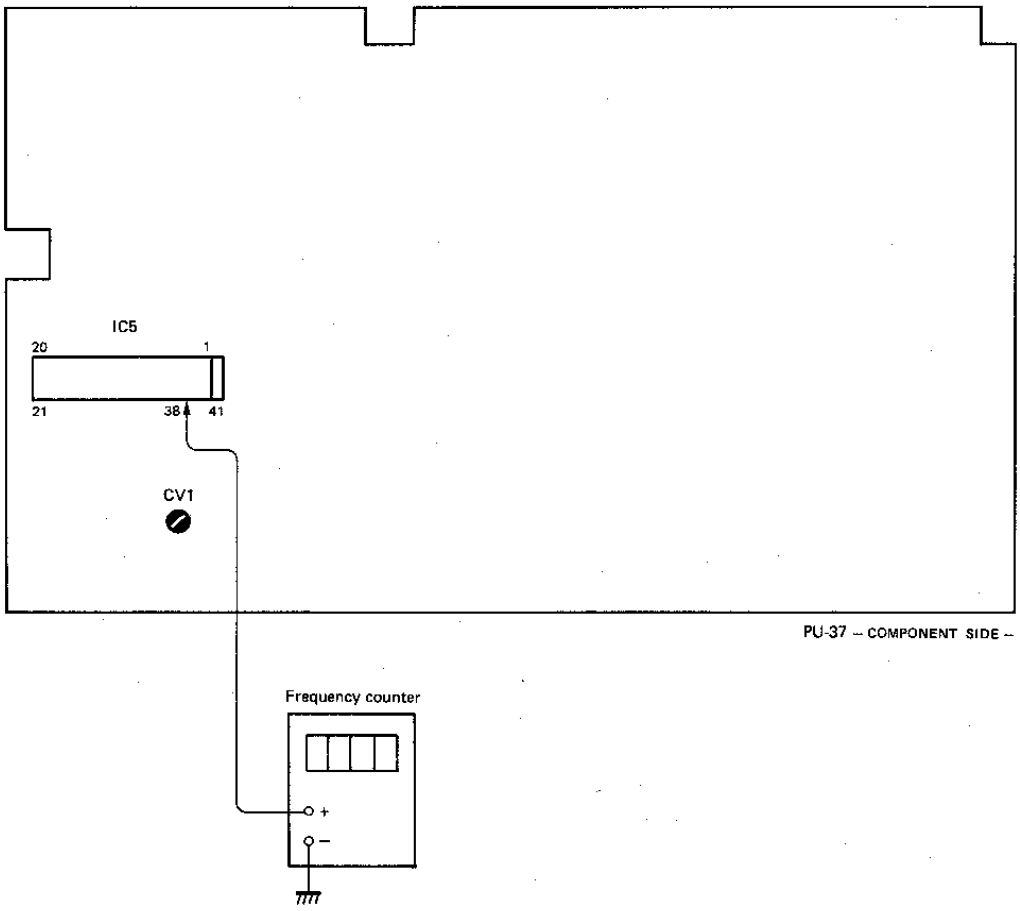
AC ADAPTOR
SOLDERING SIDE
AC-HB1P/HB1B (AE/UK)



CHAPTER 6
ALIGNMENT

6-1. CLOCK FREQUENCY ADJUSTMENT

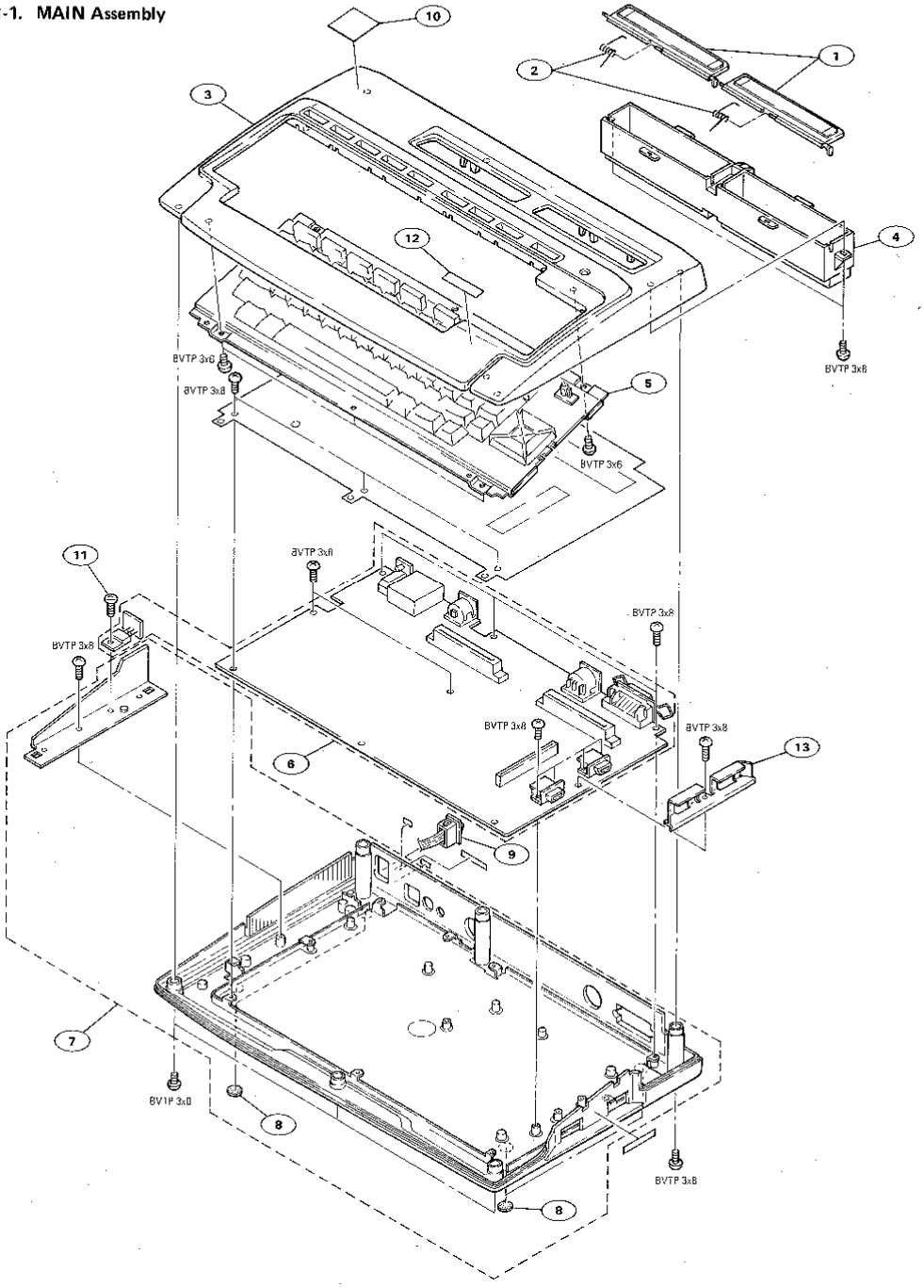
1. Power switch to ON.
2. Connect the frequency counter to pin 38 of IC5.
3. Adjust CV1 so that frequency counter to 22.168 MHz ±10 Hz.



CHAPTER 7
REPAIR PARTS AND FIXTURE

7-1. EXPLODED VIEWS

7-1-1. MAIN Assembly



MAIN

No.	Parts No.	Description
1	**4-605-410-61**	**LID, CARTRIDGE (GRAY)**
	4-605-410-41	**LID, CARTRIDGE (RED)**
	4-605-410-51	**LID, CARTRIDGE (BLACK)**
2	**4-605-615-01**	**SPRING**
3	**4-608-405-81**	**CABINET, UPPER (GRAY)**
	4-608-405-71	**CABINET, UPPER (RED)**
	4-608-405-61	**CABINET, UPPER (BLACK)**
4	4-608-407-01	HOLDER, CARTRIDGE
5	1-464-565-11	BOARD, KEY (I.N)
6	A-8050-173-A	MOUNTED PCB, PU-37
7	**X-4608-403-1**	**CABINET ASSY (BLACK), LOWER**
	X-4608-404-1	**CABINET ASSY (RED), LOWER**
	X-4608-405-1	**CABINET ASSY (GRAY), LOWER**
8	**4-860-711-00**	**FELT**
9	**1-570-412-11**	**SWITCH, OPERATE SEESAW**
10	3-703-710-21	STICKER, SONY SYMBOL (12) (WHITE)
	3-703-710-01	STICKER, SONY SYMBOL (12) (RED)
11	3-706-165-00	SCREW
12	**4-608-401-01**	**SEAL, HIT BIT (RED, BLACK)**
	4-608-401-11	**SEAL, HIT BIT (GLAY)**
13	**4-608-402-01**	**PALTE, SHIELD**

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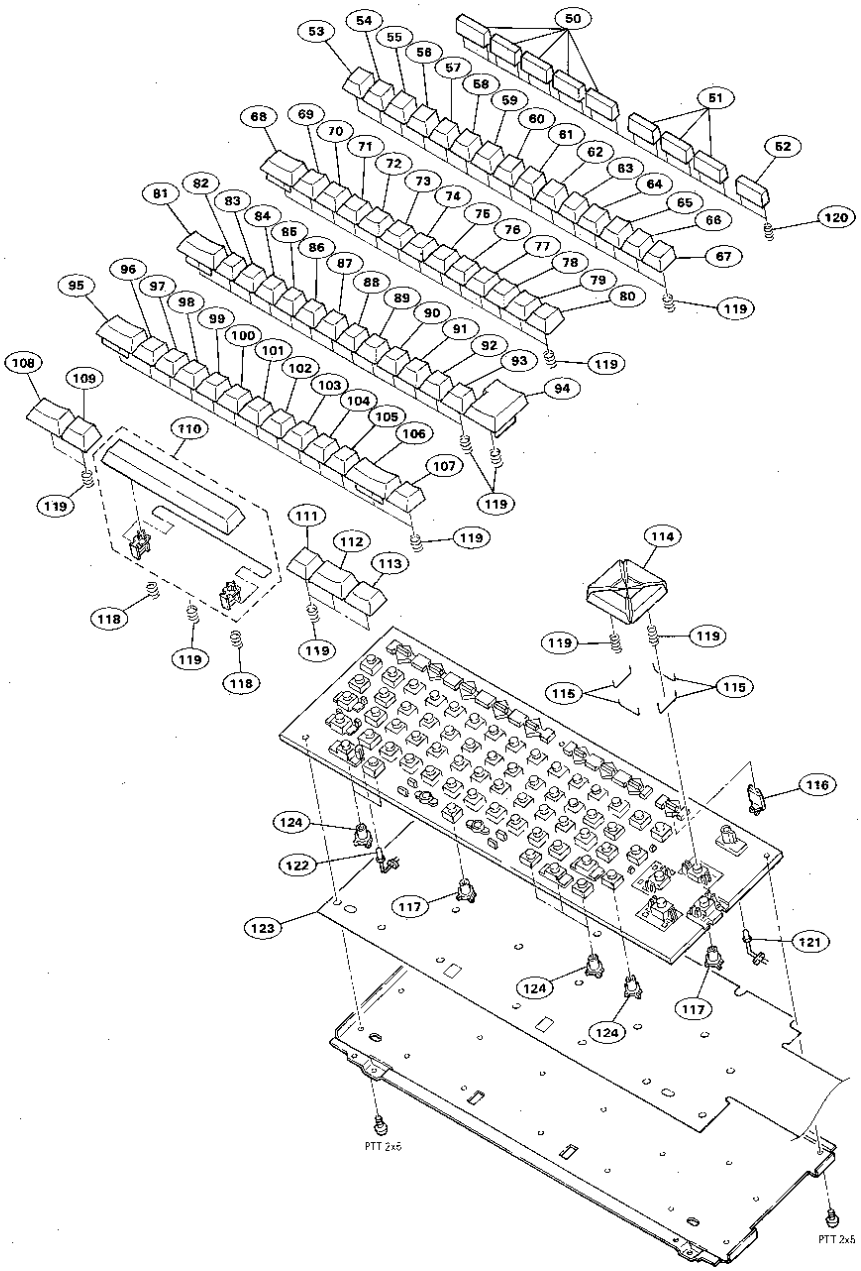
7-1-2. Keyboard Unit



KEYBOARD

No.	Parts No.	Description
50	**9-988-624-01**	**KEYTOP F1–F5**
51	**9-988-623-01**	**KEYTOP HOME, INS, DEL**
52	**9-988-622-01**	**KEYTOP STOP**
53	**9-988-598-01**	**KEYTOP ESC**
54	**9-988-673-01**	**KEYTOP 1**
55	**9-988-672-01**	**KEYTOP 2**
56	**9-988-671-01**	**KEYTOP 3**
57	**9-988-670-01**	**KEYTOP 4**
58	**9-988-669-01**	**KEYTOP 5**
59	**9-988-668-01**	**KEYTOP 6**
60	**9-988-667-01**	**KEYTOP 7**
61	**9-988-666-01**	**KEYTOP 8**
62	**9-988-665-01**	**KEYTOP 9**
63	**9-988-664-01**	**KEYTOP 0**
64	**9-988-663-01**	**KEYTOP -**
65	**9-988-662-01**	**KEYTOP =**
66	**9-988-661-01**	**KEYTOP **
67	**9-988-660-01**	**KEYTOP ←**
68	**9-988-583-01**	**KEYTOP TAB**
69	**9-988-659-01**	**KEYTOP Q**
70	**9-988-658-01**	**KEYTOP W**
71	**9-988-657-01**	**KEYTOP E**
72	**9-988-656-01**	**KEYTOP R**
73	**9-988-655-01**	**KEYTOP T**
74	**9-988-654-01**	**KEYTOP Y**
75	**9-988-653-01**	**KEYTOP U**
76	**9-988-652-01**	**KEYTOP I**
77	**9-988-651-01**	**KEYTOP O**
78	**9-988-650-01**	**KEYTOP P**
79	**9-988-706-01**	**KEYTOP [**
80	**9-988-705-01**	**KEYTOP]**
81	**9-988-605-01**	**KEYTOP CTRL**
82	**9-988-704-01**	**KEYTOP A**
83	**9-988-703-01**	**KEYTOP S**
84	**9-988-702-01**	**KEYTOP D**
85	**9-988-701-01**	**KEYTOP F**
86	**9-988-700-01**	**KEYTOP G**
87	**9-988-699-01**	**KEYTOP H**
88	**9-988-698-01**	**KEYTOP J**
89	**9-988-697-01**	**KEYTOP K**
90	**9-988-696-01**	**KEYTOP L**
91	**9-988-695-01**	**KEYTOP :**
92	**9-988-694-01**	**KEYTOP "**
93	**9-988-693-01**	**KEYTOP ~**
94	**9-988-680-01**	**KEYTOP ↵**
95	**9-988-679-01**	**KEYTOP ⇧**
96	**9-988-692-01**	**KEYTOP Z**
97	**9-988-691-01**	**KEYTOP X**
98	**9-988-690-01**	**KEYTOP C**
99	**9-988-689-01**	**KEYTOP V**
100	**9-988-688-01**	**KEYTOP B**
101	**9-988-687-01**	**KEYTOP N**
102	**9-988-686-01**	**KEYTOP M**
103	**9-988-685-01**	**KEYTOP <**
104	**9-988-684-01**	**KEYTOP >**
105	**9-988-683-01**	**KEYTOP ?**
106	**9-988-677-01**	**KEYTOP ⇧**
107	**9-988-682-01**	**KEYTOP `**
108	**9-988-678-01**	**KEYTOP ⓕ**
109	**9-988-676-01**	**KEYTOP CODE (LEFT SIDE)**
110	**9-988-681-01**	**KEYTOP SPACE**
111	**9-988-675-01**	**KEYTOP CODE (RIGHT SIDE)**
112	**9-988-674-01**	**KEYTOP GRAPH**
113	**9-988-599-01**	**KEYTOP SELECT**
114	**9-988-621-01**	**KEYTOP CURSOR**
115	9-988-607-01	SHAFT
116	**9-988-618-01**	**CONTACT ASSY**
117	**9-988-619-01**	**CONTACT ASSY (SPACE, CURSOR)**
118	**9-988-609-01**	**SPRING**
119	**9-988-610-01**	**SPRING**
120	**9-988-608-01**	**SPRING**
121	**9-988-611-01**	**LED (GREEN)**
122	**9-988-612-01**	**LED (RED)**
123	9-988-613-01	PC BOARD
124	**9-988-620-01**	**CONTACT ASSY**

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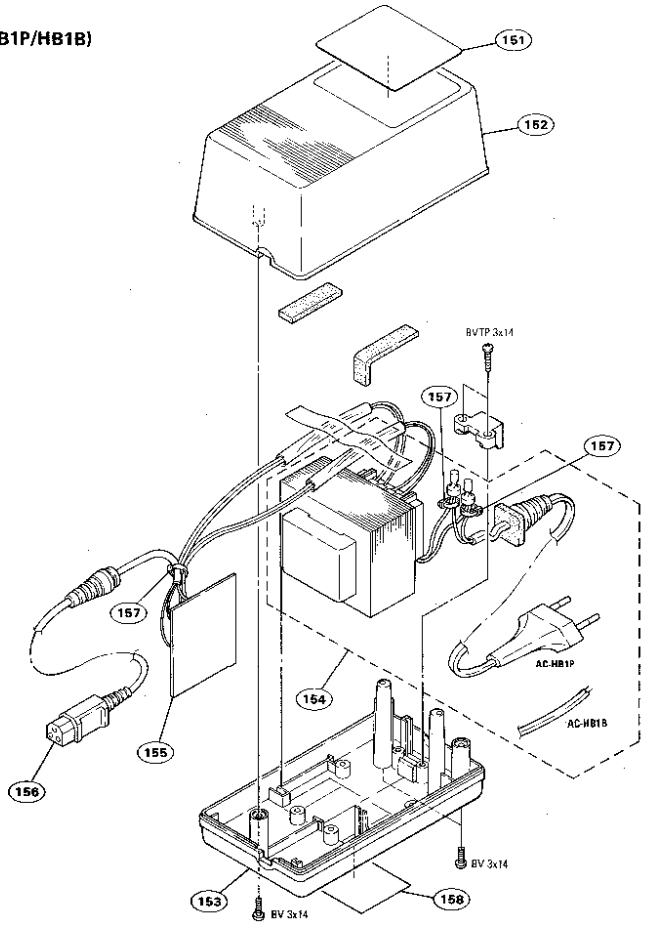
7-1-3. AC Adaptor (AC-HB1P/HB1B)



No.	Parts No.	Description
151	9-988-551-01	LABEL, MODEL NUMBER (AC-HB1P)
	9-988-565-01	LABEL, MODEL NUMBER (AC-HB1B)
152	9-988-558-01	CASE, UPPER (GRAY)
	9-988-557-01	CASE, UPPER (RED)
	9-988-556-01	CASE, UPPER (BLACK)
153	9-988-555-01	CASE, LOWER (GRAY)
	9-988-554-01	CASE, LOWER (RED)
	9-988-553-01	CASE, LOWER (BLACK)
⚠154	9-988-550-01	TRANSFORMER WITH POWER CORD (AC-HB1P)
	9-988-564-01	TRANSFORMER WITH POWER CORD (AC-HB1B)
155	**9-988-561-01**	**PRINTED CIRCUIT BOARD**
⚠156	**9-988-560-01**	**CORD WITH PLUG**
157	3-701-748-01	BAND, BINDING
158	9-988-549-01	LABEL, CAUTION

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7-2. ELECTRICAL PARTS LIST

7-2-1. PU-37 Board

Ref. No.	Parts No.	Description
	A-8050-173-A	MOUNTED PCB, PU-37
	4-843-416-00	PLATE, DIXED, CAP
	1-464-560-21	**MODULATOR, RF (MDG-UB3622) (HB-10B)**
	1-464-560-31	**MODULATOR, RF (MDG-UE3622) (HB-10P)**
C1	**1-124-772-11**	**ELECT 10000 20% 25V**
C2	**1-136-171-00**	**FILM 0.33 5% 50V**
C3	**1-123-346-00**	**ELECT 220 20% 35V**
C4	**1-123-346-00**	**ELECT 220 20% 35V**
C6	**1-123-318-00**	**ELECT 33 20% 6.3V**
C7	**1-123-298-00**	**ELECT 470 20% 6.3V**
C8	**1-123-369-00**	**ELECT 4.7 20% 25V**
C9	**1-123-306-00**	**ELECT 47 20% 6.3V**
C10	**1-123-369-00**	**ELECT 4.7 20% 25V**
C11	**1-101-001-00**	**CERAMIC 0.001 50V**
C12	**1-123-369-00**	**ELECT 4.7 20% 25V**
C13	**1-123-661-00**	**ELECT 100 20% 6.3V**
C14	**1-162-561-11**	**CERAMIC 0.1 16V**
C15	**1-123-369-00**	**ELECT 4.7 20% 25V**
C16	**1-123-369-00**	**ELECT 4.7 20% 25V**
C17	**1-119-501-00**	**ELECT 1 20% 25V**
C18	**1-119-501-00**	**ELECT 1 20% 25V**
C19	**1-123-306-00**	**ELECT 47 20% 6.3V**
C20	**1-101-001-00**	**CERAMIC 0.001 50V**
C21	**1-101-005-00**	**CERAMIC 0.022 50V**
C22	**1-162-561-11**	**CERAMIC 0.1 16V**
C23	**1-101-001-00**	**CERAMIC 0.001 50V**
C24	**1-162-561-11**	**CERAMIC 0.1 16V**
C25	**1-162-561-11**	**CERAMIC 0.1 16V**
C26	**1-162-562-26**	**CERAMIC 0.22 16V**
C27	**1-123-306-00**	**ELECT 47 20% 6.3V**
C28	**1-123-306-00**	**ELECT 47 20% 6.3V**
C29	**1-123-332-00**	**ELECT 47 20% 16V**
C30	**1-123-332-00**	**ELECT 47 20% 16V**
C31	**1-162-561-11**	**CERAMIC 0.1 16V**
C32	**1-162-561-11**	**CERAMIC 0.1 16V**
C33	**1-162-561-11**	**CERAMIC 0.1 16V**
C34	**1-162-561-11**	**CERAMIC 0.1 16V**
C35	**1-123-298-00**	**ELECT 470 20% 6.3V**
C36	**1-162-561-11**	**CERAMIC 0.1 16V**
C37	**1-162-561-11**	**CERAMIC 0.1 16V**
C38	**1-162-561-11**	**CERAMIC 0.1 16V**
C39	**1-162-561-11**	**CERAMIC 0.1 16V**
C40	**1-102-514-00**	**CERAMIC 22PF 5% 50V**
C42	**1-102-514-00**	**CERAMIC 22PF 5% 50V**
C43	**1-102-822-00**	**CERAMIC 390PF 5% 50V**
C44	**1-162-561-11**	**CERAMIC 0.1 16V**
C46	**1-162-561-11**	**CERAMIC 0.1 16V**
C47	**1-162-561-11**	**CERAMIC 0.1 16V**
C49	**1-162-561-11**	**CERAMIC 0.1 16V**
C50	**1-162-561-11**	**CERAMIC 0.1 16V**
C51	**1-162-561-11**	**CERAMIC 0.1 16V**
C52	**1-123-380-00**	**ELECT 1 20% 50V**
C53	**1-102-529-00**	**CERAMIC 100PF 5% 50V**
C54	**1-162-561-11**	**CERAMIC 0.1 16V**
C55	**1-162-561-11**	**CERAMIC 0.1 16V**
C56	**1-102-508-00**	**CERAMIC 10PF 0.5PF 50V**
C57	**1-162-561-11**	**CERAMIC 0.1 16V**
C58	**1-101-005-00**	**CERAMIC 0.022 50V**
C59	**1-101-005-00**	**CERAMIC 0.022 50V**
C60	**1-123-661-00**	**ELECT 100 20% 6.3V**
C61	**1-102-517-00**	**CERAMIC 30PF 5% 50V**
C62	**1-101-001-00**	**CERAMIC 0.001 50V**
C70	**1-102-980-00**	**CERAMIC 270PF 5% 50V**
CN3	**1-563-005-21**	**CONNECTOR 14P**
CN4	**1-563-002-11**	**SOCKET, CONNECTOR (DIN) 8P**
CN5	**1-506-542-11**	**PIN, CONNECTOR (D SUB) 9P**
CN6	**1-506-542-11**	**PIN, CONNECTOR (D SUB) 9P**
CN7	**1-562-383-00**	**SOCKET, CONNECTOR**
CN8	**1-562-383-00**	**SOCKET, CONNECTOR**
CN9	1-562-678-11	CONNECTOR, FPC 24P
CN10	**1-563-001-11**	**SOCKET, CONNECTOR (DIN) 6P**
CN11	**1-563-031-11**	**PIN, ADAPTOR CONNECTOR**
CN12	1-564-241-00	PIN, CONNECTOR 4P
CV1	**1-141-171-00**	**CAP, TRIMMER 20P**
D1	**8-719-200-02**	**10E-2**
D2	**8-719-200-02**	**10E-2**
D3	**8-719-200-02**	**10E-2**
D4	**8-719-815-55**	**1S1555**
D5	**8-719-815-55**	**1S1555**

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D6	8-719-815-55	1S1555
D7	8-719-815-55	1S1555
D8	8-719-815-55	1S1555
D9	8-719-815-55	1S1555
D20	8-719-200-29	11DQ04
FB1	1-543-274-21	BEAD, FERRITE
FB2	1-543-274-21	BEAD, FERRITE
FB6	1-543-274-21	BEAD, FERRITE
IC1	8-759-171-05	μPC7805H
IC2	8-759-131-11	μPC311C
IC3	8-759-966-67	MB74LS367A
IC4	8-759-966-67	MB74LS367A
IC5	8-759-206-22	T5950
IC6	8-759-909-04	TMS4416-15NL
IC7	8-759-909-04	TMS4416-15NL
IC8	8-759-916-80	LH0080A
IC9	8-759-900-08	SN74LS08
IC10	8-759-922-42	MB81464-12
IC11	8-759-922-42	MB81464-12
IC12	8-759-922-70	MSM38256-78RS
IC13	8-759-901-57	SN74LS157
IC14	8-759-901-57	SN74LS157
IC15	8-759-922-52	S-3527
IC16	8-759-900-74	SN74LS74A
IC17	8-759-900-32	SN74LS32
IC18	8-759-900-00	SN74LS00
IC19	8-759-178-12	μPC78L12
IC20	8-759-700-69	NJM79L12A
L1	1-408-413-00	MICRO INDUCTOR 22UH
L3	1-408-413-00	MICRO INDUCTOR 22UH
Q1	8-729-606-33	2SC2603F
Q2	8-729-901-52	2SA933S-R
Q3	8-729-606-33	2SC2603F
Q4	8-729-606-33	2SC2603F

Ref. No.	Parts No.	Description
R1	1-247-807-00	CARBON 100 5% 1/6W
R2	1-247-811-00	CARBON 150 5% 1/6W
R3	1-247-843-00	CARBON 3.3K 5% 1/6W
R4	1-247-831-00	CARBON 1K 5% 1/6W
R5	1-247-781-00	CARBON 8.2 5% 1/6W
R6	1-247-799-00	CARBON 47 5% 1/6W
R7	1-247-831-00	CARBON 1K 5% 1/6W
R8	1-247-799-00	CARBON 47 5% 1/6W
R9	1-249-429-11	CARBON 10K 5% 1/6W
R10	1-249-421-11	CARBON 2.2K 5% 1/6W
R11	1-247-823-00	CARBON 470 5% 1/6W
R12	1-247-851-00	CARBON 6.8K 5% 1/6W
R13	1-247-827-00	CARBON 680 5% 1/6W
R14	1-247-879-00	CARBON 100K 5% 1/6W
R15	1-249-429-11	CARBON 10K 5% 1/6W
R16	1-249-437-11	CARBON 47K 5% 1/6W
R19	1-247-819-00	CARBON 330 5% 1/6W
R20	1-247-879-00	CARBON 100K 5% 1/6W
R21	1-247-863-00	CARBON 22K 5% 1/6W
R22	1-249-429-11	CARBON 10K 5% 1/6W
R23	1-247-847-00	CARBON 4.7K 5% 1/6W
R24	1-247-863-00	CARBON 22K 5% 1/6W
R25	1-247-819-00	CARBON 330 5% 1/6W
R26	1-247-831-00	CARBON 1K 5% 1/6W
R27	1-247-795-00	CARBON 33 5% 1/6W
R28	1-247-847-00	CARBON 4.7K 5% 1/6W
R29	1-247-713-11	CARBON 1K 5% 1/4W
R30	1-247-863-00	CARBON 22K 5% 1/6W
R31	1-247-863-00	CARBON 22K 5% 1/6W
R32	1-247-863-00	CARBON 22K 5% 1/6W
R33	1-247-841-00	CARBON 2.7K 5% 1/6W
R34	1-249-421-11	CARBON 2.2K 5% 1/6W
R35	1-247-823-00	CARBON 470 5% 1/6W
R36	1-247-859-00	CARBON 15K 5% 1/6W
R37	1-247-783-00	CARBON 10 5% 1/6W
R38	1-247-847-00	CARBON 4.7K 5% 1/6W
R39	1-247-847-00	CARBON 4.7K 5% 1/6W
R40	1-247-847-00	CARBON 4.7K 5% 1/6W
R41	1-247-847-00	CARBON 4.7K 5% 1/6W
R42	1-247-831-00	CARBON 1K 5% 1/6W
R43	1-247-831-00	CARBON 1K 5% 1/6W
R44	1-247-847-00	CARBON 4.7K 5% 1/6W
R45	1-247-847-00	CARBON 4.7K 5% 1/6W
R46	1-249-429-11	CARBON 10K 5% 1/6W
R47	1-249-429-11	CARBON 10K 5% 1/6W

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Ref. No.	Parts No.	Description
R48	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R49	**1-247-817-00**	**CARBON 270 5% 1/6W**
R50	**1-247-821-00**	**CARBON 390 5% 1/6W**
R52	**1-247-791-00**	**CARBON 22 5% 1/6W**
R53	**1-247-831-00**	**CARBON 1K 5% 1/6W**
R54	**1-247-791-00**	**CARBON 22 5% 1/6W**
R55	**1-247-895-00**	**CARBON 470K 5% 1/6W**
R56	**1-247-791-00**	**CARBON 22 5% 1/6W**
R57	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R58	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R59	**1-247-791-00**	**CARBON 22 5% 1/6W**
R60	**1-247-791-00**	**CARBON 22 5% 1/6W**
R61	**1-247-791-00**	**CARBON 22 5% 1/6W**
R62	**1-249-437-11**	**CARBON 47K 5% 1/6W**
R63	**1-247-831-00**	**CARBON 1K 5% 1/6W**
R64	**1-247-831-00**	**CARBON 1K 5% 1/6W**
R65	**1-247-819-00**	**CARBON 330 5% 1/6W**
R66	**1-247-791-00**	**CARBON 22 5% 1/6W**
R67	**1-247-843-00**	**CARBON 3.3K 5% 1/6W**
R68	**1-247-843-00**	**CARBON 3.3K 5% 1/6W**
R69	**1-247-843-00**	**CARBON 3.3K 5% 1/6W**
R70	**1-247-843-00**	**CARBON 3.3K 5% 1/6W**
R71	**1-247-843-00**	**CARBON 3.3K 5% 1/6W**
R72	**1-247-843-00**	**CARBON 3.3K 5% 1/6W**
R73	**1-247-843-00**	**CARBON 3.3K 5% 1/6W**
R74	**1-247-843-00**	**CARBON 3.3K 5% 1/6W**
R75	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R76	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R77	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R78	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R79	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R80	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R81	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R82	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R83	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R84	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R85	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R86	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R87	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R88	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R89	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R90	**1-247-847-00**	**CARBON 4.7K 5% 1/6W**
R91	**1-249-437-11**	**CARBON 47K 5% 1/6W**

Ref. No.	Parts No.	Description
RY1	**1-515-520-00**	**RELAY**
X1	**1-567-518-11**	**VIBRATOR, CRYSTAL**
X2	**1-527-396-00**	**CRYSTAL, OSC**

7-2-2. KEY Board

	1-464-565-11	KEYBOARD UNIT
	9-988-613-01	PC BOARD
D1	**9-988-611-01**	**POWER (WITH RUBBER)**
D2	**9-988-612-01**	**CAP (WITH RUBBER)**

7-2-3. FRAME

S901	**1-570-412-11**	**SWITCH, OPERATE SEESAW**

NOTE:

1. **The shaded and ⚠-marked components are critical to safety.**
   Replace only with same components as specified.

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7-2-4. AC Adaptor (AC-HB1P/HB1B)

Ref. No.	Parts No.	Description
	9-988-561-01	PC BOARD
	⚠ 9-988-560-01	**CORD WITH PLUG**
C1	**1-123-335-00**	**ELECT 330 25V**
C2	**1-136-171-00**	**FILM 0.33 50V**
C3	**1-101-005-91**	**CERAMIC 0.022 50V**
C4	**1-101-005-91**	**CERAMIC 0.022 50V**
D1	**9-988-559-01**	**RU-4A**
D2	**9-988-559-01**	**RU-4A**
⚠ F1	1-532-502-31	T1.25A 250V
⚠ F2	1-532-502-31	T1.25A 250V
⚠ F3	1-532-387-31	T200mA 250V
⚠ T1	9-988-564-01	TRANSFORMER WITH POWER CORD (AC-HB1B)
	9-988-550-01	TRANSFORMER WITH POWER CORD (AC-HB1P)

7-3. PACKING MATERIAL AND ACCESSORY

Ref. No.	Parts No.	Description
	1-417-134-11	**ELECTOR, ANT**
	1-463-663-11	**ADAPTOR, AC (AC-HB1P) (for HB-10P)**
	1-463-665-11	**ADAPTOR, AC (AC-HB1B) (for HB-10B)**
	1-558-201-11	**CORD, RF CONNECTION**
	3-760-821-11	MANUAL, INSTRUCTION (ENGLISH)
	3-760-821-41	MANUAL, INSTRUCTION (FRENCH, GERMAN, SPANISH) (10P AE)
	3-760-821-51	MANUAL, INSTRUCTION (DUTCH, SWEDISH, ITALIAN) (10P AE)
	3-795-898-12	MANUAL, MSX-BASIC (ENGLISH) (10P AE)
	3-795-898-33	MANUAL, MSX-BASIC (FRENCH) (10P AE)
	3-795-898-52	MANUAL, MSX-BASIC (GERMAN) (10P AE)
	3-795-898-82	MANUAL, MSX-BASIC (SWEDISH) (10P AE)
	3-795-899-12	MANUAL, MSX-BASIC (ENGLISH)
	3-795-899-33	MANUAL, MSX-BASIC (FRENCH) (10P AE)
	3-795-899-52	MANUAL, MSX-BASIC (GERMAN) (10P AE)
	3-795-899-81	MANUAL, MSX-BASIC (SWEDISH) (10P AE)
	4-608-413-01	BOX, ACCESSORY
	4-608-420-01	CUSHION (UPPER)
	4-608-421-01	CUSHION (LOWER)
	4-605-140-01	**SHEET, PROTECTION**
	4-608-418-01	INDIVIDUAL CARTON (for HB-10P)
	4-608-419-01	INDIVIDUAL CARTON (for HB-10B)

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HB-10P/10B (AE/UK)
9-975-599-01

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