Radio Shack®

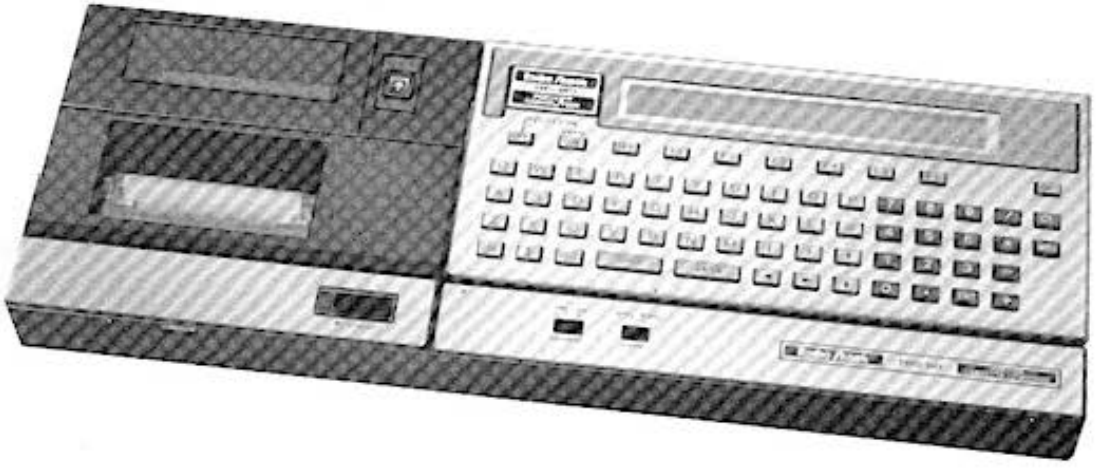
Service Manual

26-3601/3605

TRS-80®

Pocket Computer Printer and Cassette Interface

Catalog Number: 26-3601/26-3605



CUSTOM MANUFACTURED FOR RADIO SHACK, A DIVISION OF TANDY CORPORATION

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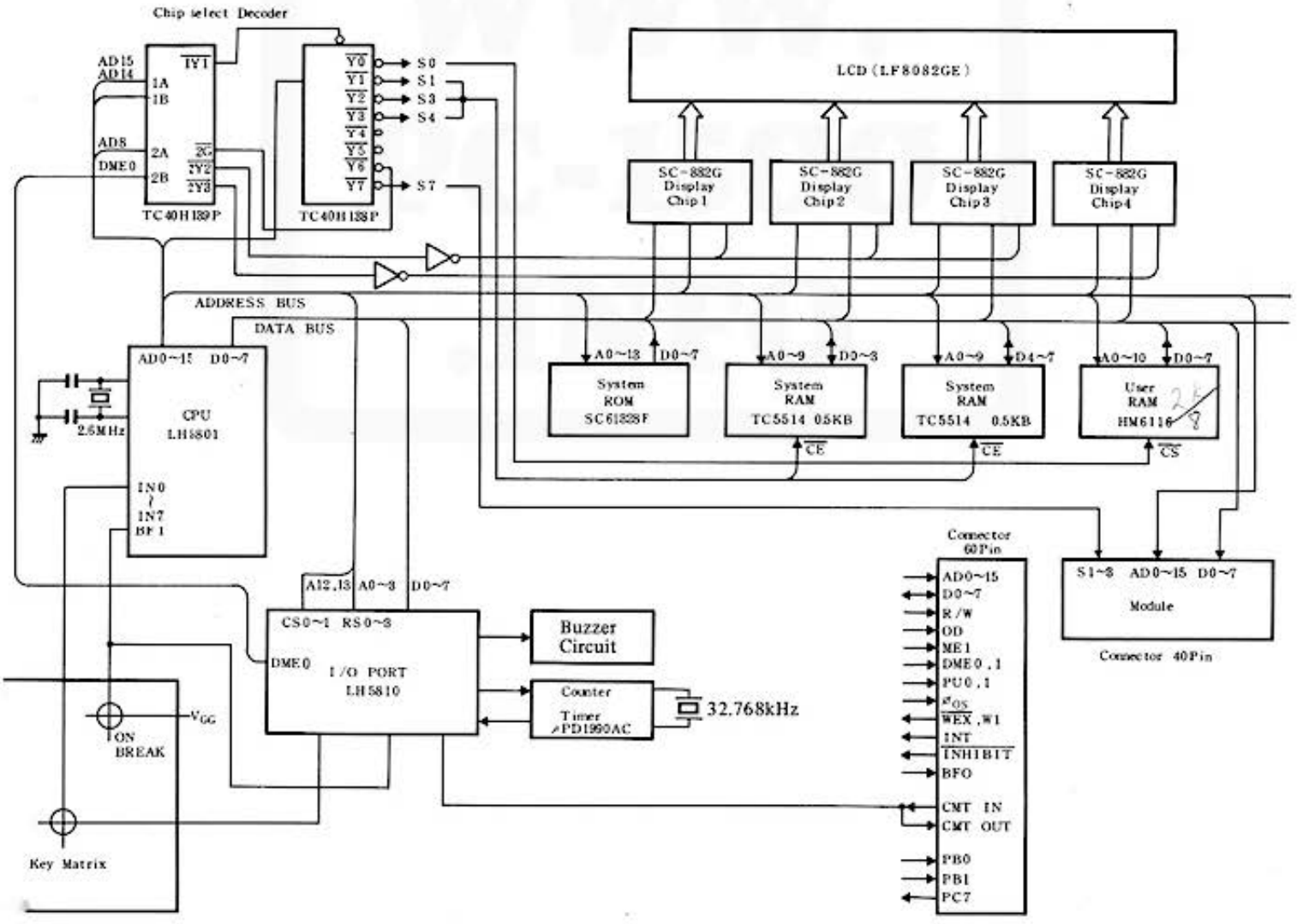
POCKET COMPUTER (26-3601)

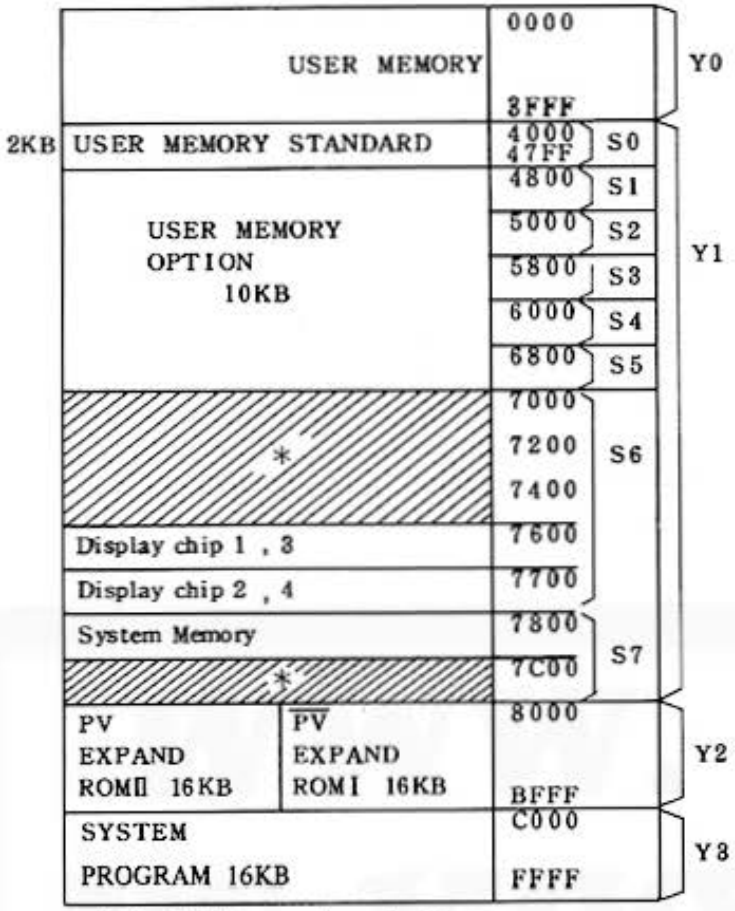
1. SPECIFICATIONS

Capacity:	10 digits (mantessa) + 2 digits (exponent)
Operating sequence:	Direct formula entry (furnished with priority determining function)
Programming language:	BASIC
Central processing unit:	CMOS 8-bit microprocessor
Memory configuration:	ROM: 16KB
	RAM: 3.5KB
	System area: 0.9KB
	Input buffer area: 80 bytes
	Stack area: 196 bytes
Power consumption:	0.13W
Physical dimensions:	195(W) x 86(D) x 25.5(H)mm (7½" x 3¼" x 1")
Weight:	375g, including batteries (13.2 oz)
Accessories:	Soft case, two templates, four batteries (type AA), instruction manual and name label.

2. BLOCK DIAGRAM



2-1. RAM MAP



* : Inhibit to use by redundancy

2-2. LSI signal description

1. LH5801 (8-bit CMOS MPU)

1) Outline

The LH5801 is the 8-bit microprocessor of the CMOS static type, featuring very low power dissipation and large data processing capability. The MPU incorporates functions such as the LCD backplate signal generator, input port, external latch clock and timer, and allows a variety of systems with ralatively few chips.

2) Features of MPU (Micro Processing Unit)

- 8-bit parallel operations
- 128KB direct accessing
- Implementation of 6-byte general purpose register besides the accumulator while allows the use of three data pointers.
- 9-bit timer function
- Three kinds of interrupts
  - Non-maskable interrupt
  - Maskable interrupt
  - Timer interrupt
- Instruction set of 80 kinds
- DMA and multiprocessor capabilities
- MPU wait function (memory access control)
- Implementation of 8-bit input port and clock Pφ for external latch
- Memory backup function
- LCD back plate control
- Clock 2.6MHz (crystal control)
  Internal machine cycle 1.3MHz
  Mininum instruction excute time 1.3μS

2-3. MPU Block diagram

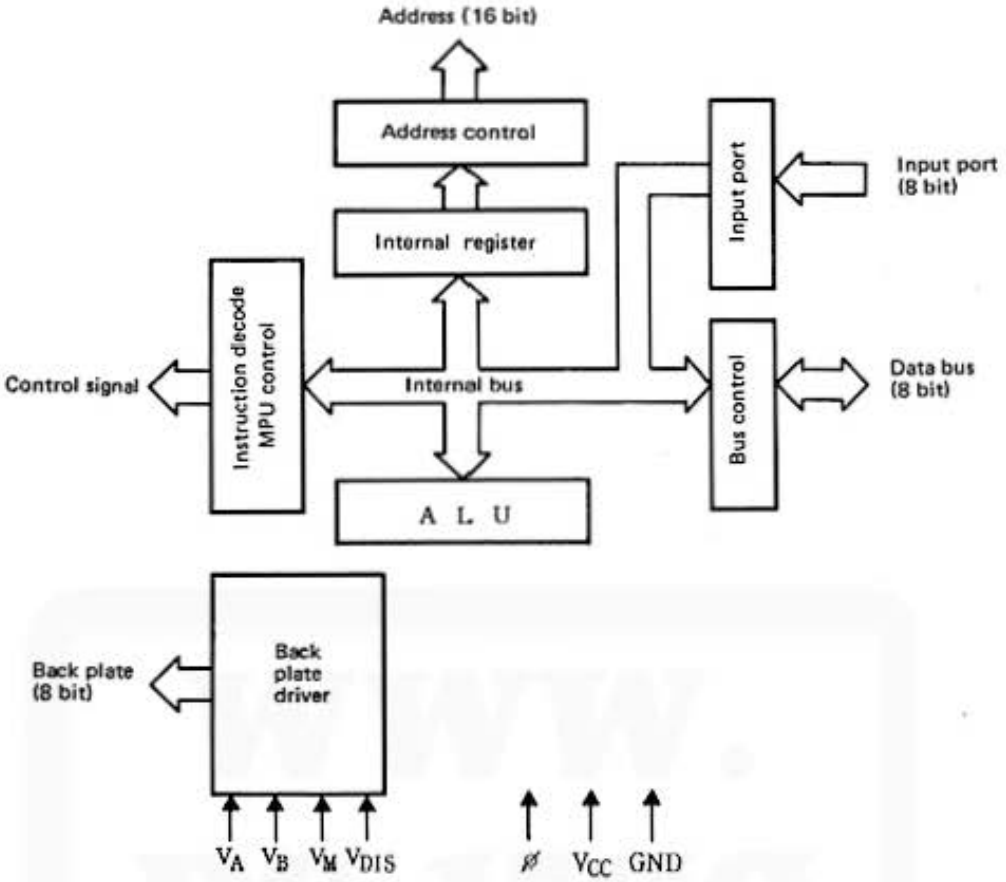


Table below shows the internal registers of the MPU that consist of 8-bit x 14 RAM storages.

P_H	P_L	..... Program counter	Exclusive registers
S_H	S_L	..... Stack pointer	
W_H	W_L	..... W register	
A	E	..... A register, E register	General purpose register
U_H	U_L	..... U register	
Y_H	Y_L	..... Y register	
X_H	X_L	..... X register	

MPU registers consist of two groups of registers; exclusive register group and general purpose register group.
Exclusive registers consist of program counter (PH, PL) [16 bits], stack pointer (SH, SL) [16 bits], and W register (WH, WL) [16 bits].
General purpose registers consist of eight 8-bit registers; U register (UH, UL), X register (XH, XL), and Y register (YH, YL) can be used in pair to comprise 16-bit registers.

2-4. Pin description

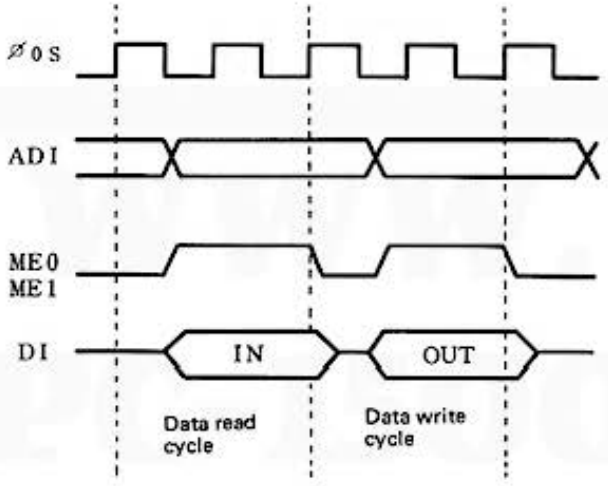
(1) XL0, XL1
Crystal oscillator external connection pins (XL0: In, XL1: Out)

(2) AD0 ~ AD15
16 bits address bus (AD0: least significant address bit, AD15: most significant address bit). Turns to high impedance by the BRQ signal.

(3) D0 ~ D7
Bidirectional data bus used to write and read data of/from the external memory (D0: least significant bit, D7: most significant bit).

(4) ME0, ME1
Memory enable signals for direct accessing to an external memory [the maximum 128KB (64KB x 2)].

(5) R/W
Read/write signal to perform reading operation when R/W=1 and write operation when R/W=0.

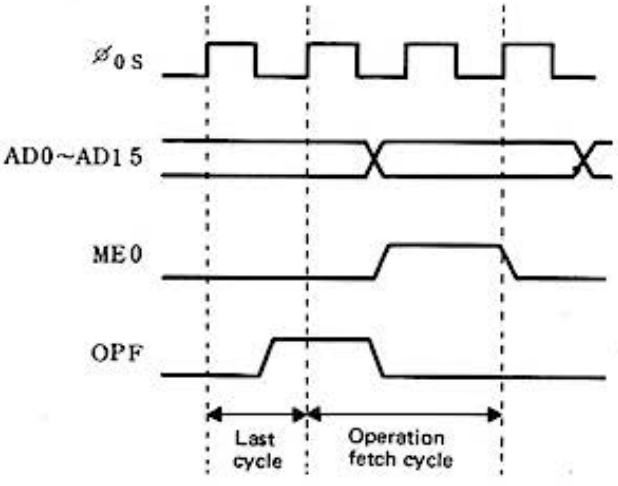


(6) RESET
The MPU returns to its initial state with a high input level to this pin.

(7) BRQ
Bus request. A high level causes the MPU to respond with the high level BAK signal after excuted pending command.

(8) BAK
Bus acknowledge appears in response with a high BRQ indicating that address bus, data bus, R/W, ME0 and ME1 are in high impedance.

(9) OPF
Operation code fetch appears when the MPU fetches an operation (instruction) code. OPF is outputted only during the fetch of an instruction code and is not outputted when address data, immediate data, or the second byte of a two step instruction is fetched.



(10) IN0 ~ IN7

Input port. The MPU takes the signal on IN0 ~ IN7 input port into the internal accumulator as 8-bit data.

(11) PU, PV, DIS

On chip flipflops output from LSI pins.

PU: Set to high with the SPU instruction and set to low with the RPU instruction.

PV: Set to high with the SPV instruction and set to low with the RPV instruction.

DIS: Set to high with the SDP instruction and set to low with the RDP instruction.

(12) Pφ

Strobe output is outputted normally during the execution of the ATP instruction, used for the external latch of the A register contents.

(13) φOS

Clock is in the same phase as the basic clock inside the chip and it is the basic clock for an entire system.
It becomes the basic clock of 1.3MHz frequency when a 2.6MHz crystal is connected between XL0 and XL1.

(14) WAIT

WAIT output that informs the MPU that addressed memory or I/O device is not ready. The MPU is in the wait state while this signal is on.

(15) H0 ~ H7

LCD backplate signal

(16) VA, VB, VM, VDIS

LCD drive source.

(17) HIN

LCD backplate signal. Counter input that generates H0 ~ H7. Normally connected to HA.

(18) HA

MPU divider output.

(19) BFO, BFI

MPU internal register BF flipflop output (BFO) and input (BFI) can be reset by the instruction from the MPU and set by the BFI input. Normally used for the memory backup system.

(20) NMI

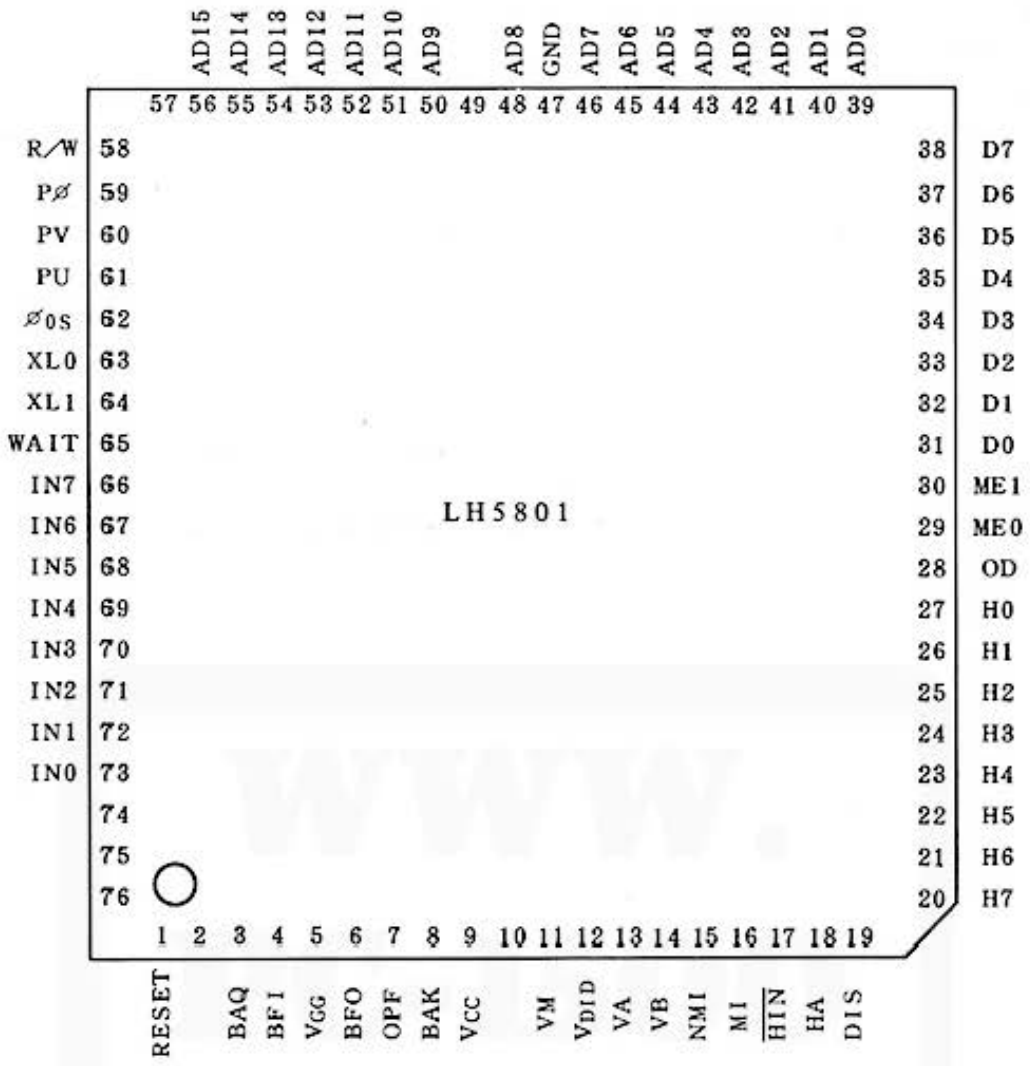
Non-maskable interrupt. A high NMI signal denotes an interrupt request, to which the MPU responds unconditionally and the control moves to start the interrupt processing routine after the contents of the memory address FFFC is moved into the high order byte of the program counter and the contents of the memory address FFFD into the low order byte of the program counter.

(21) MI

Maskable interrupt. A high on this signal makes interrupt request when interrupt enable is set. The MPU responds unconditionally to this request. Control moves to start the interrupt processing routine after the contents of the memory address FFF8 is moved into the high order byte of the program counter, the contents of the memory address FFF9 are moved into the low order byte of the program counter.

(22) OD

Output disable. When the OD signal is active the data bus is in the output mode.



3. LH5811 I/O PORT

(1) Outline

The LH5811 I/O port is the single chip LSI of CMOS static circuit that can be connected with a general purpose 8-bit CPU. It has the following functions:

(1) Two pairs of 8-bit bidirectional ports
(2) One pair of 8-bit bidirectional ports
(3) Two lines of interrupt request inputs, one of them is the input from port.
(4) One line of interrupt request output.
(5) CPU wait control
(6) Serial control

(2) Functions

(1) Ports, PA0 ~ PA7 and PB0 ~ PB7, can be programmed for I/O directions by each bit.
The CPU can access PA0 ~ PA7 and PB0 ~ PB7 as though one location of memory.

(2) PC0 ~ PC7 is the port of output type. The CPU can access it as though one location of memory.
Also, the latch clock Pϕ to the PC port can be supplied directly from an external source.

(3) LH5811 incorporates two interrupt request inputs, IRQ and PB7, when apply interrupt request of the CPU at the rising edge of the input when the corresponding bit of the internal mask register is "1". Signal PB7 represents the 8th bit of the port PB and it needs to be in the input mode when the interrupt input is applied.

(4) The LH5811 has a CPU wait control circuit which uses two output lines of memory enable signals for a memory that has slower access time. In addition, two input lines for the wait conditions are used. Six different of access times can be chosen by programming.

(5) The following functions are provided for serial control.

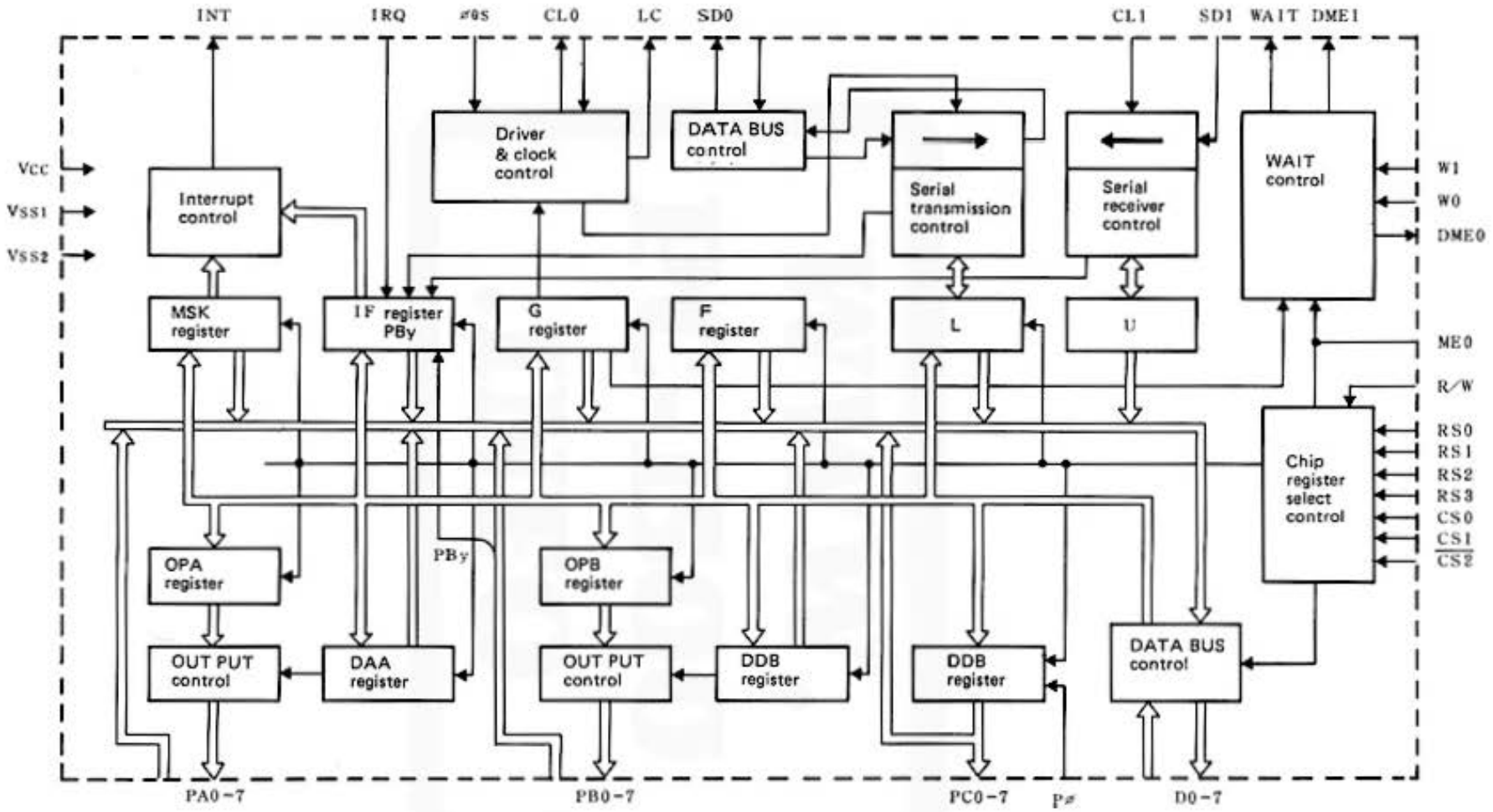
A. Serial data transmission
Serial data transmission is used in the format of start bit/8-bit data/2 stop bits.
Transmission clock is programmable by changing internal and external clocks, as well as changing the clock rate; 1/1, 1/2, 1/128, 1/256, 1/512, 1/1024, 1/2048 and 1/4096 of the basic clock.

B. Serial data reception
When a start bit is received in the idle state, 8 bits of data is received, and stored in the internal register and the interrupt request flag is set on.
Reception clock is sent from the external clock and must be synchronized with the serial data input.

C. LCD driver control
The LCD driver is connected with three signal lines of the transmission clock, a serial data bus, and a synchronous signal line to carry out data transfer for chip select, addressing, and data read/write.
For the transmission clock in this case, the clock rate can be programmed in the same manner as in the serial data transmission clock. (Transmission clock to the LCD driver is 1MHz.)

D. Pulse waveform
The pulse waveform can be sent out in continuation. Eight sorts of frequencies are programmable; 1/1, 1/2, 1/128, 1/256, 1/512, 1/1024, and 1/4096 of the basic clock.

E. Transmission to audio cassette tape recorder
The modulated signal can be sent from the SD0 output in the format of start bit/8-bit data/2 stop bits.
Modulation clocks, FX and FY, can be set separately to any of clock rate; 1/64, 1/128, 1/256, 1/512, and 1/1024 of the basic clock.



Vss1 =Vss2=GND

Vcc=4.5±0.5V

I/O PORT controller system block diagram

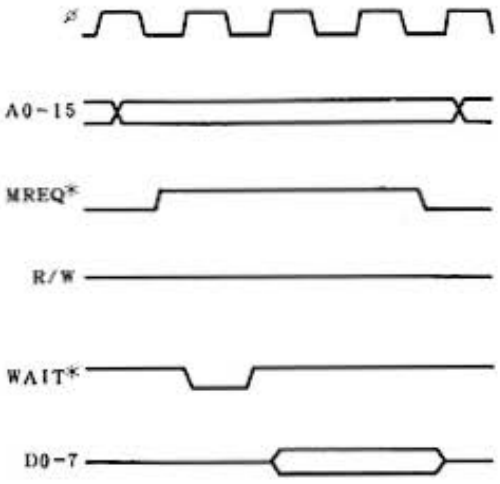
I/O port (LH5811)

Pin No.	Signal Name	In/out	Connection	Functional description
1	PA1	In/out	Key	Port A input/output. Key strobe.
⌇	⌇	⌇	⌇	⌇
7	PA7	In/out	Key	Port A input/output, Key strobe.
8	GND	In	Power	0V
9	PB0	In/out	Option	Port B input/output
10	PB1	In/out	Option	Port B input/output
11	PB2	In	CMT IN	Port B input/output. Cassette tape data input.
12	PB3	In	GND (Domestic) VCC (Export)	Domestic/export specification select pin
13	PB4	In	GND	User area determination pin
14	PB5	In	μPD1990C	Clock input from TP terminal of the timer IC
15	PB6	In	μPD1990C	Data input from the DATA OUT terminal of the timer IC
16	PB7	In	Key	BREAK key input (interrupt input)
17	Pφ	In	GND	PC port latch clock input
18	PC0	Out	μPD1990C	Data output to the DATA IN terminal to the timer IC
19	PC1	Out	μPD1990C	Strobe output to the STB terminal fo the timer IC
20	PC2	Out	μPD1990C	Clock output to the LK terminal of the timer IC
21	PC3	Out	μPD1990C	Timer IC control signal output
22	PC4	Out	μPD1990C	Timer IC control signal output
23	PC5	Out	μPD1990C	Timer IC control signal output
24	PC6	Out	Buzzer	
25	PC7			
26	CS0	In	CPU	Chip select input connected to AD12
27	CS1	In	CPU	Chip select input connected to AD13
28	$\overline{CS2}$	In	Decoder IC	Chip select input connected to Y3 of the chip select decoder IC

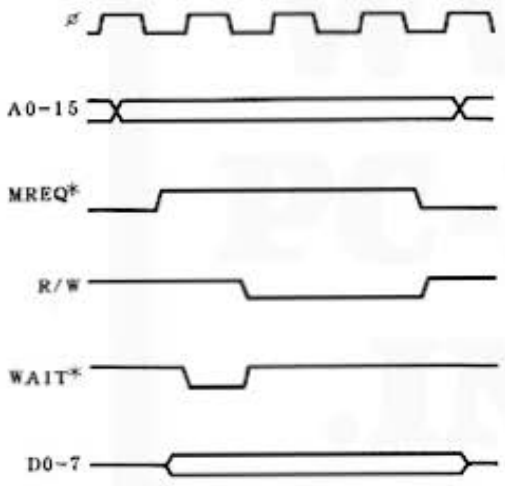
I/O port (LH5811)

Pin No.	Signal Name	In/out	Connection	Functional description
29	RS0	In	CPU	Internal register and operation select signal
32	RS3	In	CPU	Internal register and operation select signal
33	R/W	In	CPU	Read/write input
34	ME1	In	CPU	Memory enable
35	ME0	In	CPU	Memory enable and I/O port controller enable
36	W0	In	Option	Wait condition input
37	W1	In	Option	Wait condition input
38	GND	In	Power	0V
39	VCC	In	Power	+5V
40	DME1	Out	Decoder	ROM enable
41	DME0	Out	ROM, option	ROM enable
42	WAIT	Out	CPU	Wait signal to the CPU
43	INT	Out	CPU	Interrupt request to the CPU
44	RESET	In	RESET circuit	Initial reset signal
45	IRQ	In	Option	Interrupt request input
46	ϕOS	In	CPU	Basic clock input
47	CL1		CL0	Not used. Serial data reception clock input
48	SD1		(VCC)	Not used. Serial data reception input
49	LC		NC	Not used. LCD driver synchronizing signal
50	CL0	In	CL1	Serial data transmission/reception clock
51	SD0	In	CMT	Serial transmission & reception data. Use for the cassette tape data output.
52	D0	In/out	CPU	Data bus
59	D7	In/out	CPU	Data bus
60	PA0	Out	Key	Port A input/output. Used as the key strobe.

Read/write timings for I/O port



(a) Data read from I/O port

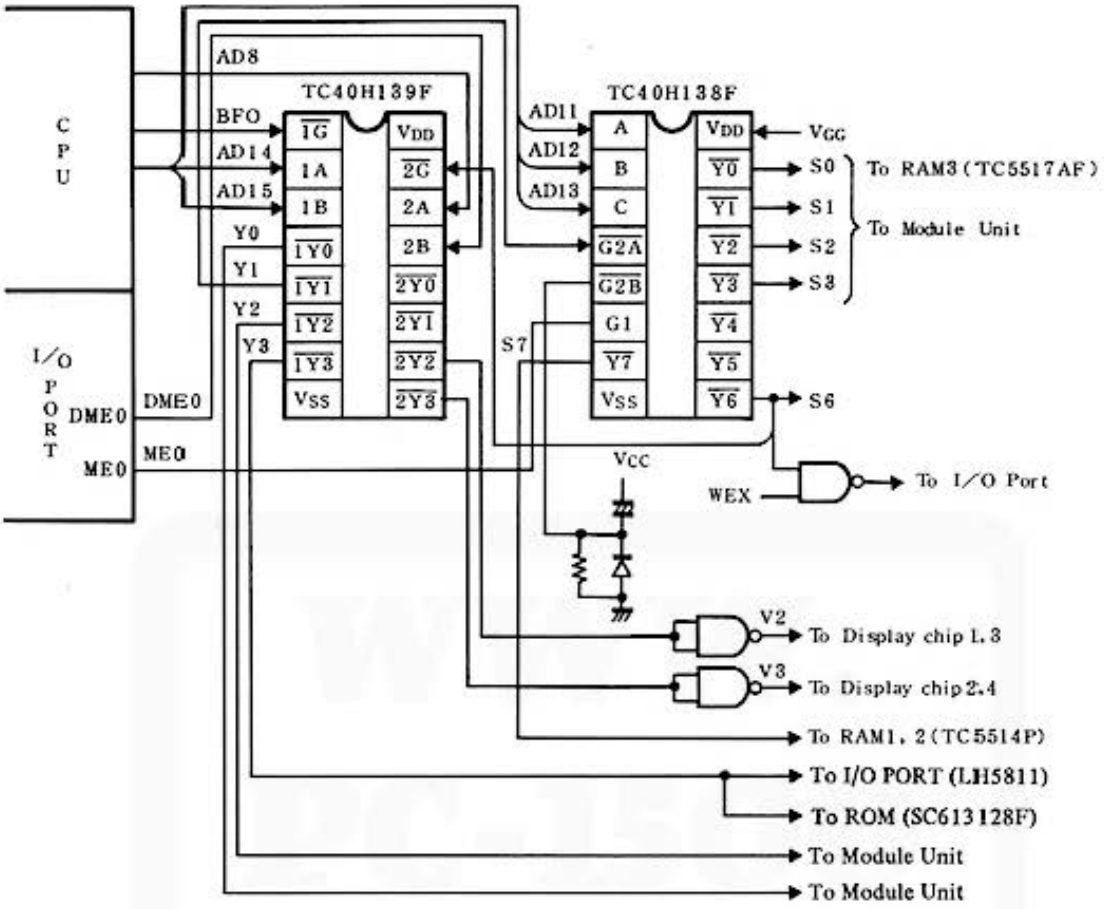


(b) Data write to I/O port

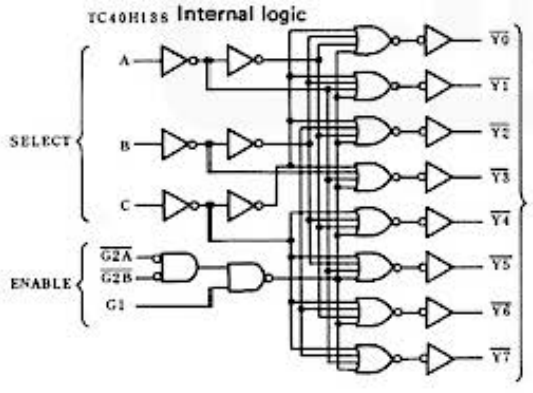
NOTE:
Clock ϕ is furnished to the ϕOS input of the I/O port. MREQ* is an inversion of $\overline{\text{MERQ}}$ of Z-80 and furnished to the ME0 of the I/O port. $\overline{\text{WAIT}}$* is an inversion of WAIT of the I/O port and furnished to the WAIT input of Z-80.

4. CIRCUIT DESCRIPTION

1. Chip Select Circuit



TC40H138 Internal logic

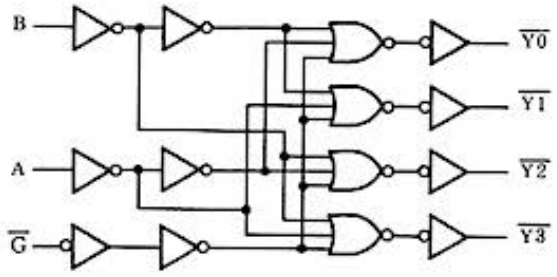


Truth Table

Input						Output							
ENABLE			SELECT										
G1	G2A	G2B	A	B	C	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
L	✣	✣	✣	✣	✣	H	H	H	H	H	H	H	H
✣	H	✣	✣	✣	✣	H	H	H	H	H	H	H	H
✣	✣	H	✣	✣	✣	H	H	H	H	H	H	H	H
H	L	L	L	L	L	L	H	H	H	H	H	H	H
H	L	L	H	L	L	H	L	H	H	H	H	H	H
H	L	L	L	H	L	H	H	L	H	H	H	H	H
H	L	L	H	H	L	H	H	H	L	H	H	H	H
H	L	L	L	L	H	H	H	H	H	L	H	H	H
H	L	L	H	L	H	H	H	H	H	H	L	H	H
H	L	L	L	H	H	H	H	H	H	H	H	L	H
H	L	L	H	H	H	H	H	H	H	H	H	H	L

✣ : Don't care

TC40H139



Truth Table

Input			Output			
ENABLE	SELECT					
$\overline{G}$	A	B	$\overline{Y0}$	$\overline{Y1}$	$\overline{Y2}$	$\overline{Y3}$
H	※	※	H	H	H	H
L	L	L	L	H	H	H
L	H	L	H	L	H	H
L	L	H	H	H	L	H
L	H	H	H	H	H	L

※= Irrelevant

- Selection of $\overline{1Y0} \sim \overline{1Y3}$ by the decoder IC (TC40H139H) is done when the gate signal ($\overline{IG}$) input BF0 is low.

  Y0 ($\overline{1Y0}$) With low state of AD14 and AD15, the Y0 output becomes low to select the system ROM area of the module unit. (0000 ~ 3FFF address setup)

  Y1 ($\overline{1Y1}$) With high state of AD14 and low state of AD15, the Y1 output becomes low to select the gate ($\overline{G2A}$) of the IC (TC40H138F). (4000 ~ 7FFF address setup)

  Y2 ($\overline{1Y2}$) With low state of AD14 and high state of AD15, the Y2 output becomes low to select the expansion ROM area of the module unit. (8000 ~ BFFF address setup)

  Y3 ($\overline{1Y3}$) With high state of AD14 and AD15, the Y3 output becomes low to select the system program ROM (SC-613128F) and the I/O port (LH5811). (C000 ~ FFFF address setup)

- Selection of S0 ~ S7 by the decoder IC (TC40H138F) is done when the gate signal input ME0 (G1) is high, Y1 ($\overline{G2A}$) low, and $\overline{G2B}$ is low (which is normally low).

  S0 ($\overline{Y0}$) With all of AD11, AD12 and AD13 in low state, S0 goes to the low state and selects the RAM3 (TC5517AF). (4000 ~ 47FF address setup)

  S1 ($\overline{Y1}$) With high state of AD11 and low state of AD12 and AD13, S1 goes to the low state to select the option user RAM area. (4800 ~ 4FFF address setup)

  S2 ($\overline{Y2}$) With low state of AD11 and high state of AD12 and low state of AD13, S2 goes to the low state to select the option RAM area. (5000 ~ 57FF address setup)

  S3 ($\overline{Y3}$) With high state of AD11 and AD12 and low state of AD13, S3 goes to the low state to select the option user RAM area. (5800 ~ 5FFF address setup)

  S6 ($\overline{Y6}$) With low state of AD11 and high state of AD12 and AD13, S6 goes to the low state to receive the interrupt input from an option into the I/O port. (7000 ~ 77FF address setup)

  S7 ($\overline{Y7}$) With all of AD11, AD12, and AD13 in high state, S7 goes to the low state to select the system memory RAM1 and 2 (TC5514P). (7800 ~ 7FFF addres setup) RAM1 and RAM2 are 4-bit RAMs, independently used to assume low order and high order bits to comprise one byte with a pair of 4 bits each.

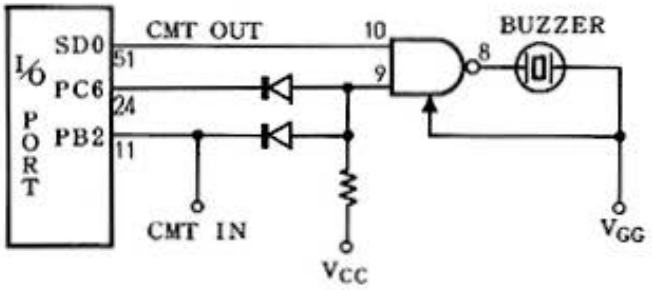
- Selection of $\overline{2Y2}$ and $\overline{2Y3}$ by the decoder IC (TC40H139) is done when the gate of $\overline{2G}$ becomes active with the selection of the TC40H138F output, S6 ($\overline{Y6}$).

  $\overline{2Y2}$ (V2) With low state of AD8 and high state of DME0, the $\overline{2Y2}$ output goes to the low state so that the NAND gate output V2 is turned high to select the display chip 1 and 3. (7600 ~ 76FF address setup)

  $\overline{2Y3}$ (V3) With high state of AD8 and DME0, the $\overline{2Y3}$ output goes to the low state so that the NAND gate out V3 is turned high to select the display chip 2 and 4. (7700 ~ 7FFF address setup)

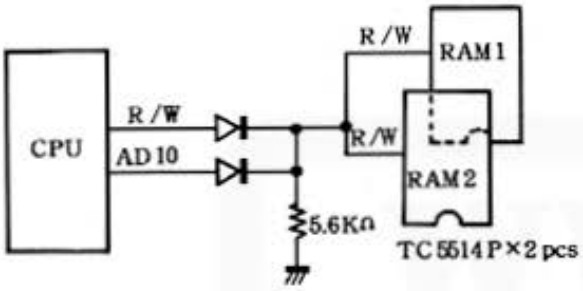
- Display chip (SC882G) is a 4-bit RAM, comprised of one byte of data with 4 low order bits and 4 high order bits of data, so that even the chip select signals are used in pair of chip 1 with chip 3 and chip 2 with chip 4.

2) Buzzer circuit



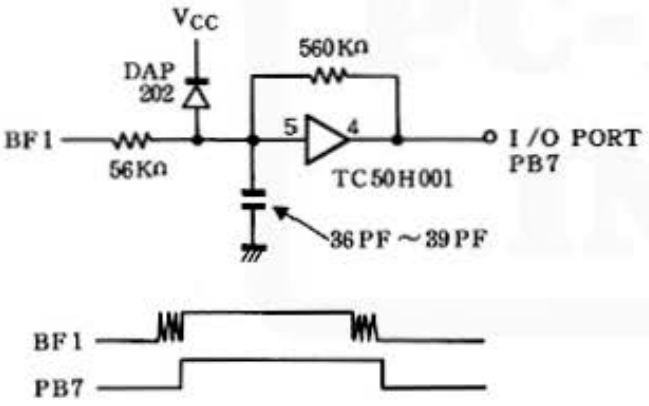
The control signal CMT OUT is sent out from the pin SD0 of the I/O port which sounds the buzzer in combination with the low state of either the programmed output from the I/O port or CMT IN sent from the cassette tape deck.

3) RAM R/W signal circuit



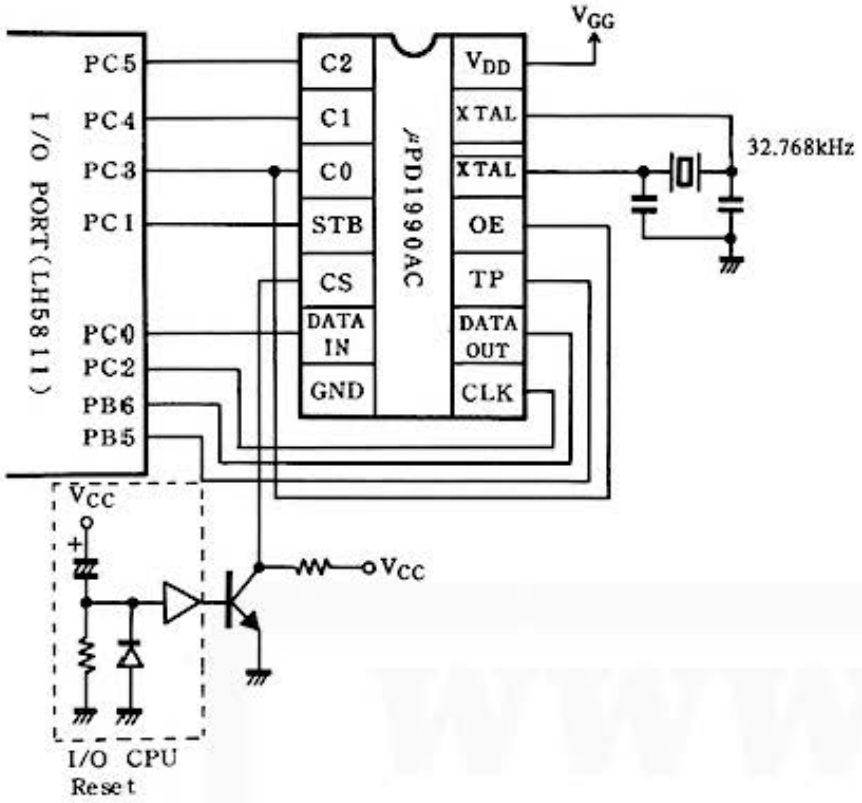
This circuit prevents writing if AD10 is in high state during the write mode (when R/W is low). This is to prevent wrong operation when a specific key, ↓ or ↑ is pushed without performing "NEW 0 ENTER" after battery replacement.

4) ON key double action preventive circuit



This circuit consists of the Schmitt circuit that prevents the possibility of setting the input flag of the LH5811 I/O port which depends on how the ON key is pushed.

5) Timer/counter circuit

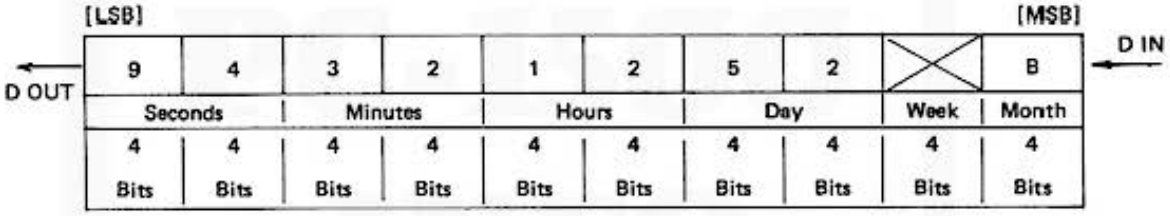


1. Outline

As shown in the left, the μPD1990AC is used for the time keeping IC to count hour/minute/second/month/day.

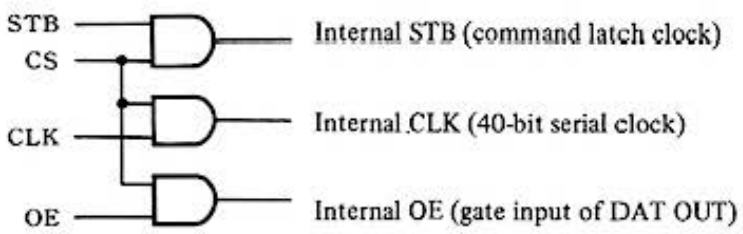
2. Main function of μPD1990AC

Time data is in the BCD form and is judged by means of comparison. However, day of week is not used with this chip and hour is represented by 24-hour system.



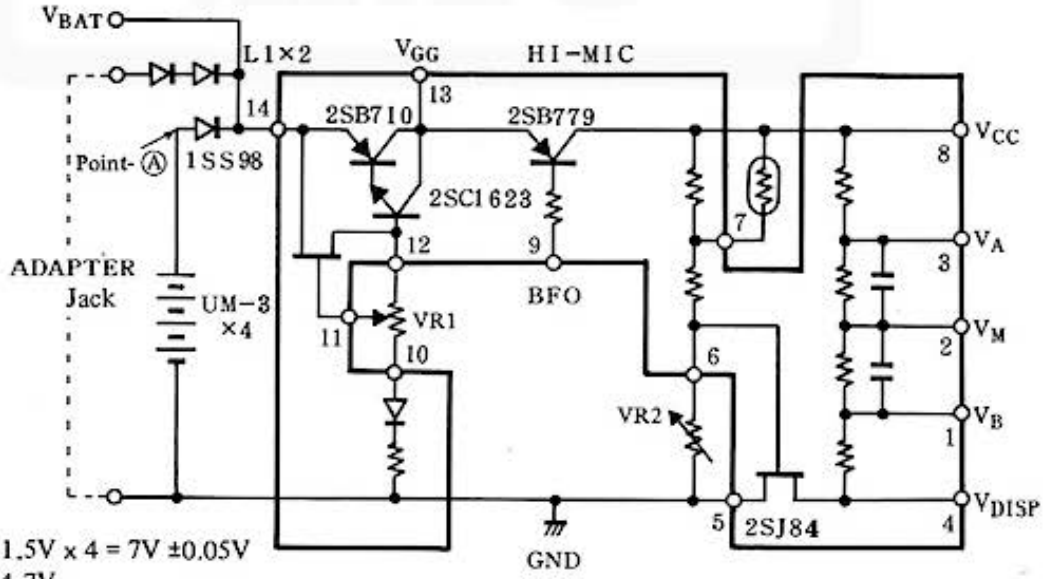
Pin No.	Signal Name	In/out	Description
1	C2	In	Mode select signal
2	C1	In	Mode select signal
3	C0	In	Mode select signal
4	STB	In	Strobe. Command is latched by the strobe STB.

		C2=0	
C1	C0	Mode	Data In/out mode
0	0	0	Register hold
0	1	1	Register shift
1	0	2	Time set
1	1	3	Time read

5	CS	In	Chip select: disable CLK and STB input and DATA OUT output by the CS input. All input/output are invalid unless CS is high. 
6	DATA IN	In	Data input signal (40-bit serial data)
7	GND	In	0V
8	CLK	In	40-bit shift register clock (Data input/output is carried out in synchronization with CLK.)
9	DATA OUT	Out	Data output signal (40-bit serial data)
10	TP	Out	Timer pulse output: to C0, C1, C2 during command assignment.
11	OUT ENABLE	In	Output enable: input to control the output of DATA OUT.
12	$\overline{\text{XTAL}}$	In	Basic clock, 32.768kHz
13	XTAL	In	Same the above
14	VDD	In	Source power input, connected to VGG (4.7V).

6) Power supply circuit

The power supply is incorporated in a single resin molded IC that consists of the stabilizer circuit, temperature compensation circuit, and bleeder circuit.



Supply voltage: 1.5V x 4 = 7V ±0.05V
VGG: 4.7V
VCC: 4.7V ±0.02V
VDISP: 3.7V ±0.01V
(In the case of 25°C)

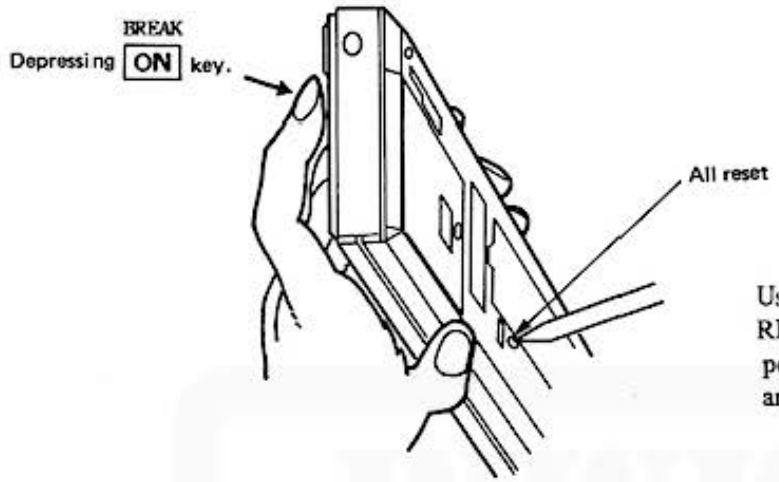
Adjusting method

1. Apply 7.0 ± 0.2V DC. at point-Ⓐ.
2. Turn VR1 to read at VCC 4.7 ± 0.02 V DC from GND.
3. Turn VR2 to read at VDISP 3.7 ± 0.01V DC from GND.
4. Adjusting condition is 25°C.

5. SERVICING

1) Measures against irregular condition

In a rare case, all keys on the keyboard might become inoperative, including the [BREAK ON] key, when a strong external noise interference is met or when a strong impact is given to the machine body.
When such a condition is encountered, keep the ALL RESET key pushed for a period of about 15 seconds while depressing the [BREAK ON] key.



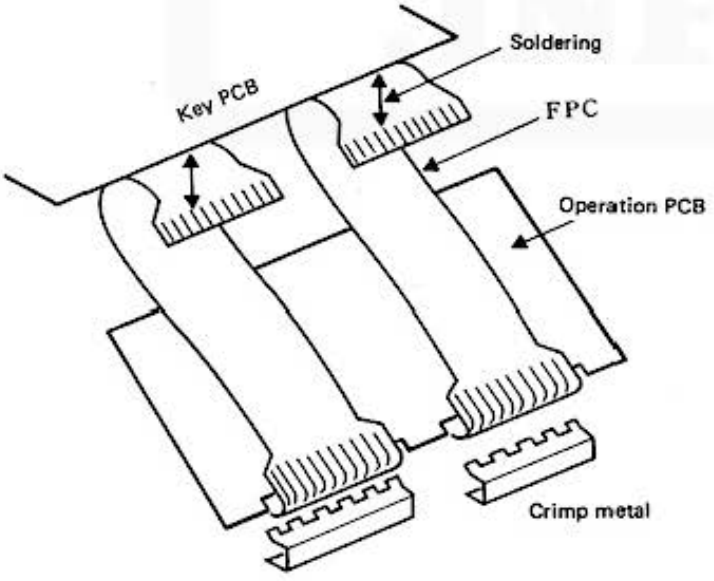
Use the tip of a ball point pen to push the ALL RESET SW. Do not use the tip of something such as a pencil of which the tip might break. Also, do not use anything with a sharp edge such as a needle.

Wait for the prompt "NEW 0?: CHECK" to appear on the display, then push [CL] NEW 0 [ENTER].
If the prompt "NEW0?: CHECK" does not appear, try the above entry again.
DO not use the ALL RESET switch except for the above operation, or destruction of the program, data, and reserve contents will occur.

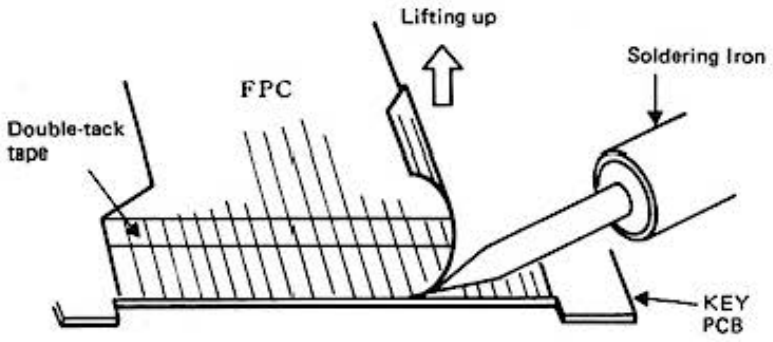
2) How to replace FPC (Flexible Printed Cable)

To replace the FPC that connect the Key PCB with the Operation PCB, the following procedure should be used.

2-1. Removal

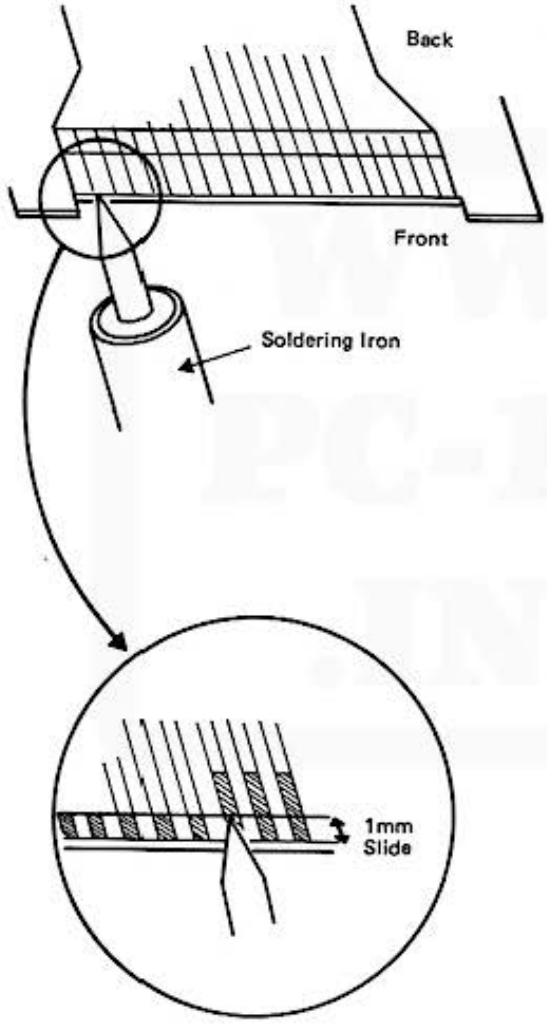


Since the Operation PCB is connected with the FPC by means of the crimp metal, the Key PCB is disconnected from the Operation PCB after removing the crimp metal.



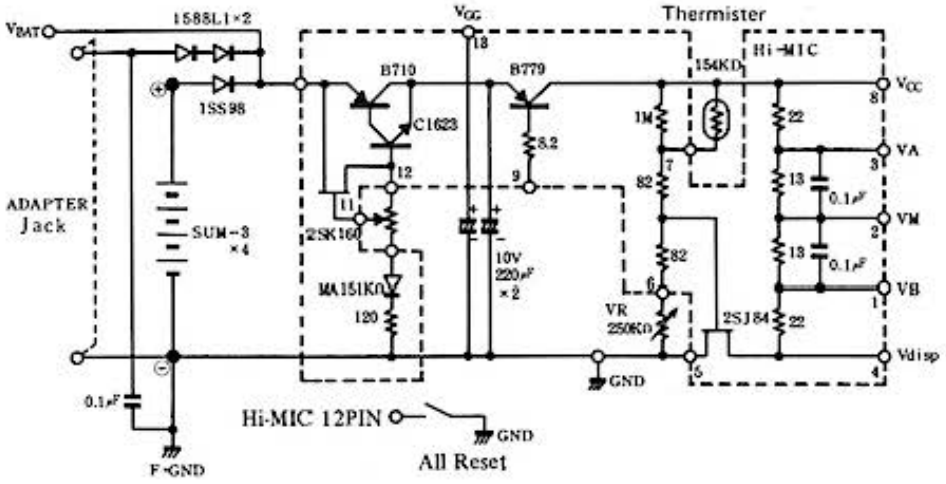
The Key PCB is connected with the FPC by soldering. Peel away the double-tack tape that fastened the FPC with the PCB, then apply the tip of the soldering pencil on the side of the soldered surface to remove the FPC, while lifting up the end of the FPC lightly.

2-2. Replacing

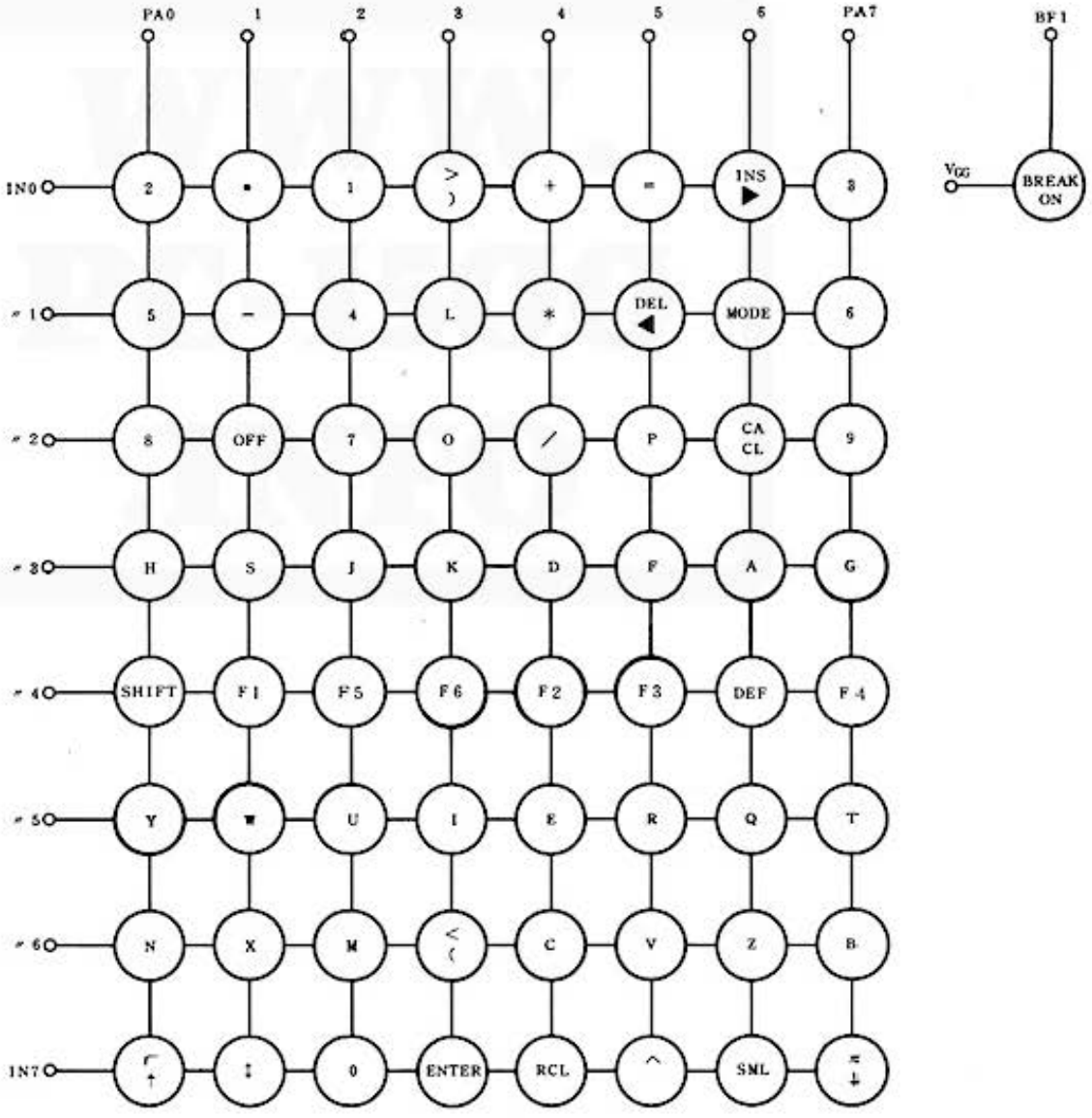


(1) Coat the FPC and PCB with solder with care not to make it uneven.
(2) Temporarily secure the FPC using the double-tack tape.
(3) Match the printed circuit pattern of the PCB with FPC and secure them temporarily. Slide the FPC about 1mm backward in this case.

6. KEY & POWER SUPPLY CIRCUIT



KEY MATRIX



10. PARTS LIST (26-3601)

Ref. No.	Description	RS Location	Manufacturer Part Number
	Transistor (2SC2412) Tiny Chip Type	AA2SC2412	V32SC2412-/-1
1	Buzzer	AB-7073	RALMB1006CCZZ
	Coil, Ceramic Osc. (2.6 MHz)	ACA-8240	RCRSZ1038CCZZ
	Capacitor Electrolytic 1μF, +80/−20% 50V	ACF-7340	RC-EZ105ACC1H
	Capacitor Electrolytic 220μF +80%/−20% 10V	ACC227ZCAP	RC-EZ227ACC1A
	Capacitor Tiny Chip Type 100pF	ACF-7328	RC-CZ1023CCZZ
	Capacitor Tiny Chip Type 15pF	ACF-7329	RC-CZ1041CCN1
	Capacitor Tiny Chip Type 30pF	ACF-7330	RC-CZ1042CCN1
	Capacitor Tiny Chip Type 0.1uF	ACF-7331	RC-CZ1021CCZZ
2	Cover, Connector	ADA-0383	GFTAA1273CCZZ
3	Cover, Module	ADA-0384	GFTAU1274CCZZ
4	Cover, Battery	ADB-0453	GFTAB1272CCZZ
	Diode (1S1588L2)	ADX-1717	VHDDS1588L2-1
	Diode (1SS98)	ADX-1718	VHD1SS98///-1
	Diode (DAP202) Tiny Chip Type	ADX-1719	RH-DZ1005CCN1
	Diode (DAN202) Tiny Chip Type	ADX-1720	RH-DZ1008CCN1
5	Tape for LCD	AHB-9953	PTPE H1033CCZZ
	Label, Name	AHB-9960	TLABZ1295CCZZ
6	Angle, Connector	AHC-1421	GWAKP1041CCZZ
7	Badge, Model	AHC-1422	HBDGE1353CCZZ
8	Plate, Connector	AHC-1423	LANGK1221CCZZ
9	Angle A	AHC-1424	LANGT1438CCZZ
10	Angle B	AHC-1425	LANGT1439CCZZ
11	Presser, Angle	AHC-1426	LFiX-1116CCZZ
12	Plate	AHC-1427	LFiX-1126CCZZ
	Template	AHC-1428	LPLTP1094CCZZ
13	Filter for LCD	AHC-1429	PFiLW1354CCZZ
14	Filter, Display	AHC-1430	PFiLW1391CCZZ
15	Rubber, key	AHC-1431	PGUMM1396CCZZ
16	Plate, Shield	AHC-1432	PSLDC1321CCZZ
17	Mask Display	AHC-1433	PSLDP1322CCZZ
18	Mask	AHC-1434	PSLDP1334CCZZ
19	Sheet Insulator	AHC-1435	PZETL1439CCZZ
20	Spacer, Connector	AHC-1436	PSPAP1207CCZZ
21	Angle , LCD	AHC-1437	LANGK1437CCZZ
22	Socket, Adaptor	AJ-7020	QJAKC1003CCZZ

Ref. No.	Description	RS Location	Manufacturer Part Number
23	Connector (60P) Female	AJ-7155	QCNCW1293CCZZ
24	Connector (40P) Female	AJ-7156	QCNCW1294CCZZ
25-1	Key Top (Sec. 1)	AK-4895	JKNBZ1748CC01
25-2	Key Top (Sec. 2)	AK-4896	JKNBZ1748CC02
25-3	Key Top (Sec. 3)	AK-4897	JKNBZ1749CC01
25-4	Key Top (SPACE) 10pcs/set	AK-4898	JKNBZ1750CC01
25-5	Key Top (ENTER) 10pcs/set	AK-4899	JKNBZ1732CC01
25-6	Key Top (CL) 20pcs/set	AK-4222	JKNBZ1622CC01
25-7	Key Top (OFF) 20pcs/set	AK-4900	JKNBZ1515CC12
25-8	Key Top (ON) 20pcs/set	AK-4901	JKNBZ1515CC11
25-9	Key Top (DEF) 20pcs/set	AK-4902	JKNBZ1515CC10
25-10	Key Top (F1) 20pcs/set	AK-4903	JKNBZ1751CC01
25-11	Key Top (F2) 20pcs/set	AK-4904	JKNBZ1751CC02
25-12	Key Top (F3) 20pcs/set	AK-4905	JKNBZ1751CC03
25-13	Key Top (F4) 20pcs/set	AK-4906	JKNBZ1751CC04
25-14	Key Top (F5) 20pcs/set	AK-4907	JKNBZ1751CC05
25-15	Key Top (F6) 20pcs/set	AK-4908	JKNBZ1751CC06
25-16	Key Top (SHIFT) 20pcs/set	AK-4909	JKNBZ1751CC07
26	LCD	AL-1394	VVLLF8082GE-1
	Crystal (37.768 kHz)	AMX-2983	RCRSP1036CCZZ
	IC (MA1066)	AMX-5063	VHiMA1066//-1
	IC (TC40H000FN)	AMX-5064	VHiTC40H000FN
	IC (TC40H138FN)	AMX-5065	VHiTC40H138FN
	IC (TC40H139FN)	AMX-5066	VHiTC40H139FN
	IC (TC50H001FN)	AMX-5067	VHiTC50H001FN
	IC (UPD1990AC)	AMX-5068	VHiUPD1990ACC
	LSI (LH5801)	AMX-5069	VHiLH5801//-1
	LSI (LH5811) *1	AMX-5070	VHiLH5811//-1
	LSI (HM6116) *2	AMX-5071	VHiHM6116//-C
	LSI (SC613128FN)	AMX-5072	VHiSC613128FN
	LSI (SC882G)	AMX-5073	VHiSC882G//-1
	LSI (TC5514P) *3	AMX-5074	VHiTC5514P/-C
	Resistor Variable (250K)	AP-7105	RVR-MB510QCZZ
	Resistor Variable (220K)	AP-7252	RVR-M13SB50QC
27	Rubber, Conductive	ART-2985	PGUMS1190CCZZ
	Resistor, 10 ohm, Tiny Chip Type	ARX-0278	VRS-TP2BD100J
	Resistor, 1K ohm, Tiny Chip Type	ARX-0279	VRS-TP2BD102J
	Resistor, 10K ohm, Tiny Chip Type	ARX-0280	VRS-TP2BD103J
	Resistor, 100K ohm, Tiny Chip Type	ARX-0281	VRS-TP2BD104J
	Resistor, 33K ohm, Tiny Chip Type	ARX-0282	VRS-TP2BD333J

Ref. No.	Description	RS Location	Manufacturer Part Number
	Resistor, 47K ohm, Tiny Chip Type	ARX-0283	VRS-TP2BD473J
	Resistor, 5.6K ohm, Tiny Chip Type	ARX-0284	VRS-TP2BD562J
	Reistor, 56K ohm, Tiny Chip Type	ARX-0285	VRS-TP2BD563J
	Resistor, 560K ohm, Tiny Chip Type	ARX-0286	VRS-TP2BD564J
	Switch, Reset	AS-2747	QCNTM1051CCZZ
	Thermister	AT-1218	VHH154KD-5/-1
	Wire, Lead	AW-2813	QCNW-1209CCZZ
28	Wire, Flexible	AW-2814	QPWBM2066CCZZ
29	PCB unit, Main	AX-9133	DUNTK6658CCZZ
30	PCB unit, Key	AX-9114	DUNTK6586CCZZ
31	Cabinet Ass'y, Buttom	AZ-6518	CCABA2618CC01
32	Cabinet unit, Top	AZ-6519	DUNTG6585CCZZ
	Case soft	AZ-6520	UBAGC1302CCZZ
	Manual, Instruction	MU2603601	TiNSE3503CCZZ
	Card, Reference	MU260360IJ	TCADZ1579CCZZ
33	Screw, Coin		LX-BZ1124CCZZ
34	Screw (M2 x 5)		LX-BZ1060CCZZ
35	Screw (M2 x 7)		LX-BZ1114CCZZ
36	Screw (M2 x 11)		LX-BZ1115CCZZ
37	Screw (M2 x 4)		LX-BZ1123CCZZ
38	Screw (M2 x 6)		XBBSD20P06000
39, 43	Screw (M2 x 5)		XUBSD20P5000
40	Screw (M2 x 4)		LX-BZ1113CCZZ
41	Screw (M2 x 8)		XBBSD20P08000
42	Nut		XNESD20-16000

*1 Manufacturer may use either LH5811 or LH5810, as interchangeable.
*2 Manufacturer may use either HM6116 or TC5517AF, as interchangeable.
*3 Manufacturer may use either TC5514P or HM4334P-4, as interchangeable.

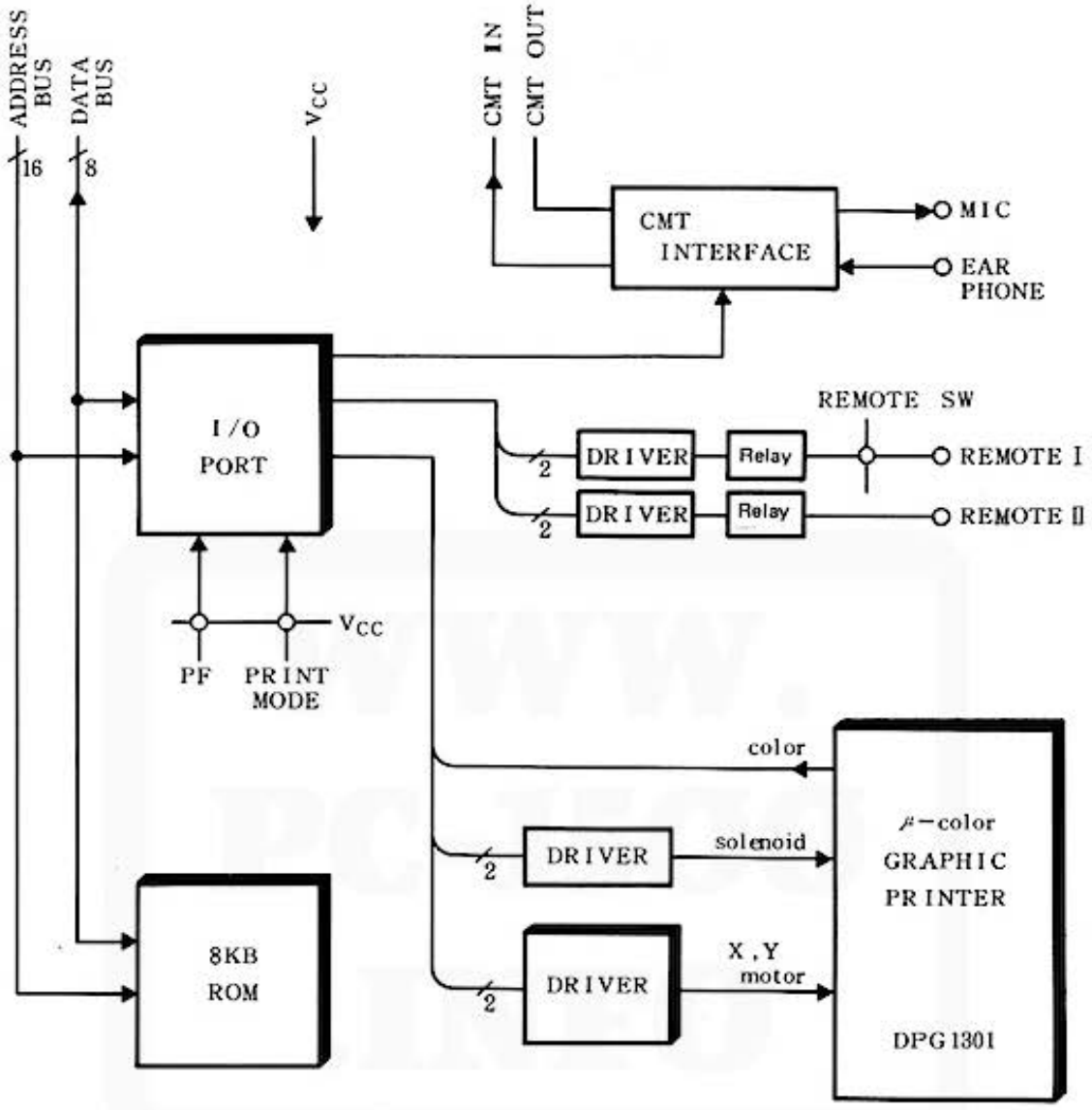
OPTIONAL PRINTER & CASSETTE INTERFACE (26-3605)

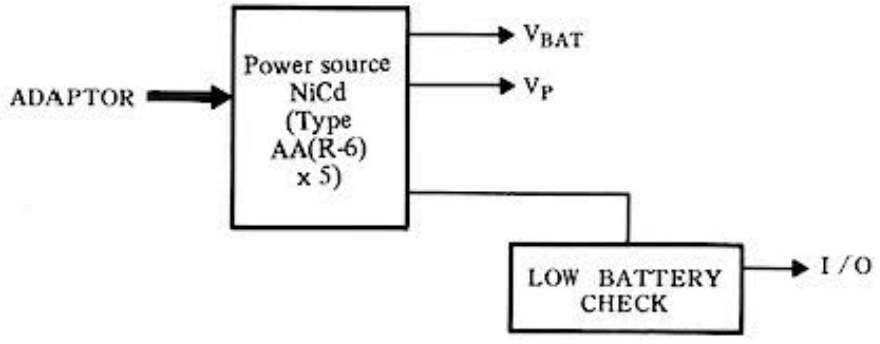
A) ELECTRICAL SECTION

1. SPECIFICATIONS

Printing method:	X-Y plotter method
Print capacity:	18 digits, nominal. (Possible to select 36, 18, 12, 9, 7, 6, 5, and 4 digits operations)
Character size:	Nine variable sizes, 1.2mm x 0.8mm thru 10.8mm x 7.2mm.
Ball point pen:	26-1481 (blue, green, red) 26-1480 (black only)
Printing directions:	Four directions (up, down, right, left)
Minimum pen moving distance:	0.2mm
Print speed:	11 characters/sec, max. (Print speed may vary according to character printed.)
Print paper:	Roll paper with maximum outer diameter 30mm and width of 58mm. Supplies as 26-3606
Power source:	Rechargeable battery. AC Adapter
Line print power capacity:	About 1,100 lines (continuous printing of 555555555 of the character size 2 under 20°C, with a slight variation depending on operating condition).
Power consumption:	5.2W
Operating temperature:	5 to 40°C
Physical dimensions:	330(W) x 115(D) x 50(H)mm (13″ x 4½″ x 2″)
Weight:	900g, except accessories (2 lbs.)
Accessories:	Carrying case, tape recorder connection cable (one each of three-line and one-line wires), AC Adapter, 3 rolls of paper, one each of black, blue, green, and red pen, name lebel, instruction manual.

2. SYSTEM BLOCK DIAGRAM





Refering to the block diagram, the 26-3605 is the printer (DGP1301) and the CMT (cassette tape recorder interface) which consists of three blocks, the CMT interface, printer interface and power supply circuit.

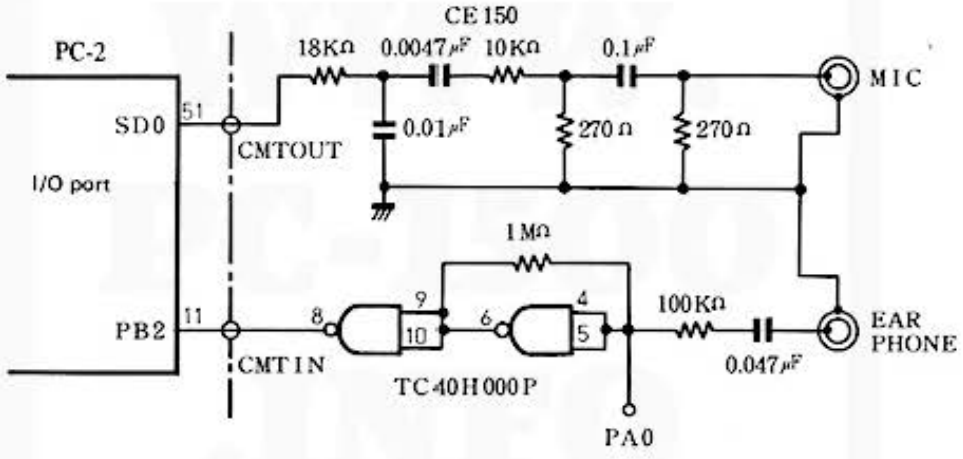
- **CMT interface**
  The CMT interface is the circuit that handles data transfer between the PC-2 and the CMT and consists of a simple driver circuit (voltage level conversion circuit).
  In addition, there is the CMT on/off remote controlling circuit which is under the program control of the PC-2 and performs switching operation via the I/O port using the relay circuit.

- **Printer interface**
  The printer interface consists of character generator ROM (LH5367-02), I/O port (LH5801), motor drive circuit, print solenoid drive circuit, and the pen color detect input signal circuit.

- **Power supply block**
  A simple power stabilization circuit is provided to take care of recharging to the built-in NiCd batteries from the AC adaptor. (Refer the section of circuit diagram for adjusting)

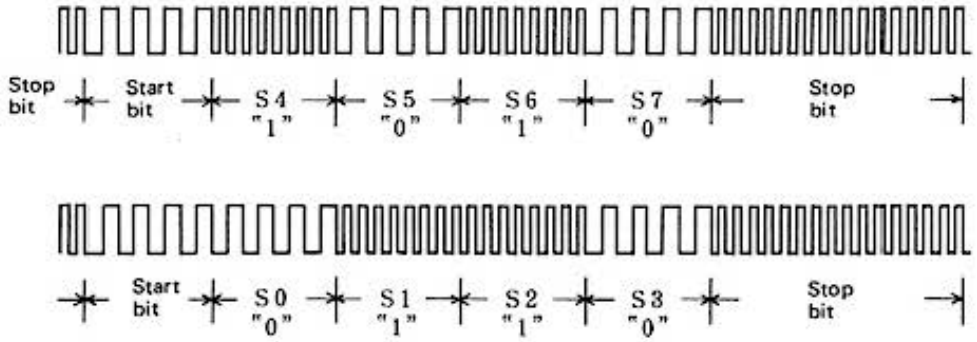
3. CIRCUIT DESCRIPTION

3-1. CMT Interface circuit diagram

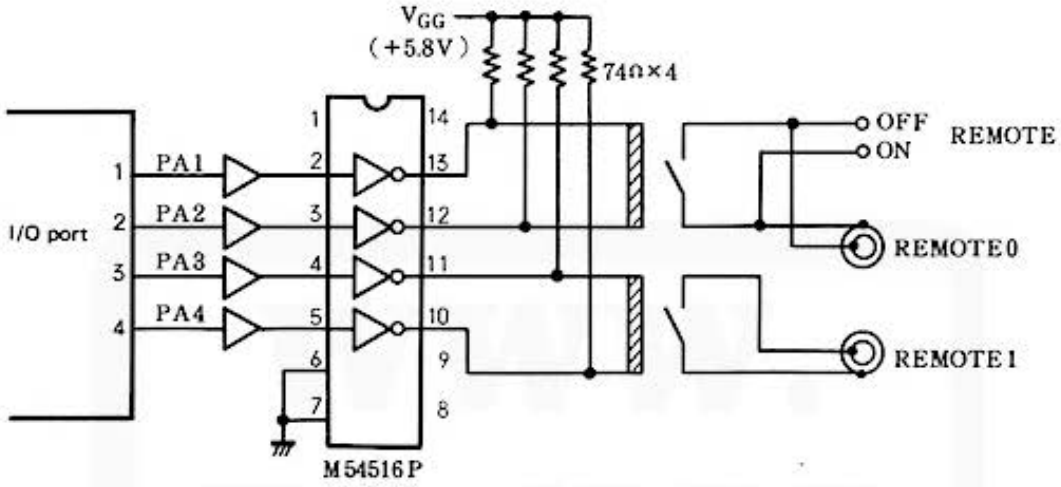


The signal CMT OUT is sent from the PC-2 to write data on the cassette tape and the capacitor coupled interface circuit is provided to shift the voltage level before supplying the MIC jack. The read signal is the input from the EARPHONE jack and passed through the capacitor and two stages of gates to perform voltage level shift and waveform shaping and delivered to the PC-2 as the CMT IN signal.
With respect to the CMT IN signal, the gate input to the first stage of the gate is forced to a low level by means of the PA0 signal as there is a possibility of supplying noise to the EARPHONE jack as input data to the PC-2, except during the data read mode.

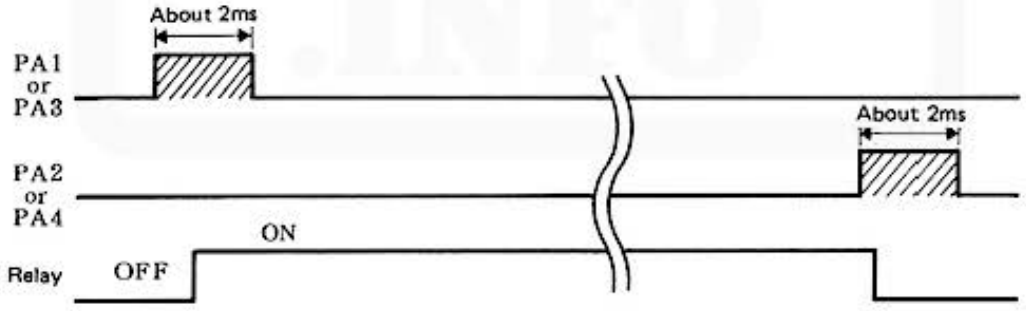
- **Recording signal**
  When the contents of the start bit or data bit is "0", four pulses of 1.27kHz are recorded in a time of 3.15ms. When the contents of the data bit is "1", eight pulses of 2.54kHz are recorded in the tape in a time of 3.15ms.
  Shown below is an example of the contents of S (one byte) is "0 1 0 1 0 1 1 0".
  (5) (6)



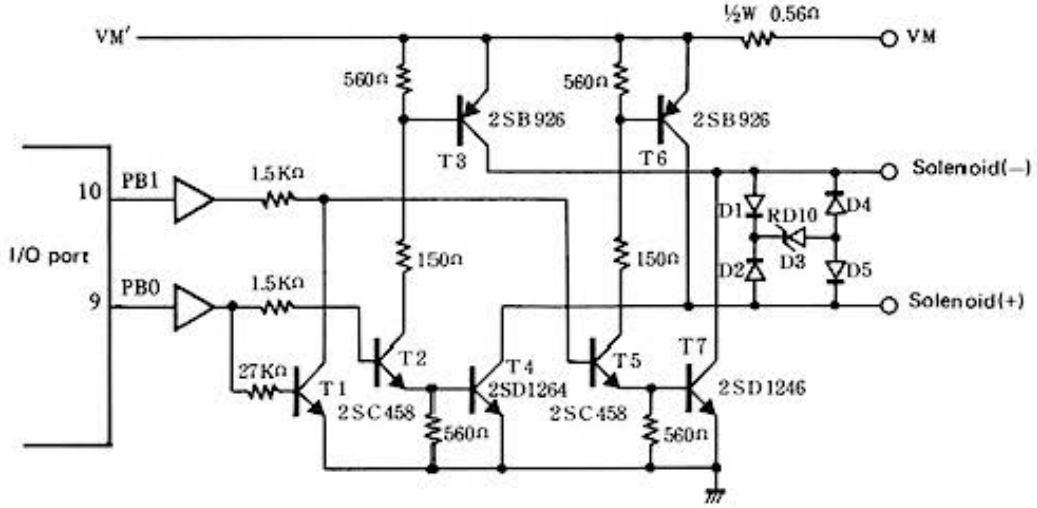
3-2. Remote circuit



This circuit is provided to perform automatic control of CMT on/off action. Signal from the PC-2 is used to actuate the relay via the I/O port (LH5810 or LH5811).
When the REMOTE ON/OFF switch is in the OFF position, the REMOTE 0 circuit shuts off and disables control from the PC-2. Normally, connection is made to the REMOTE 0 jack when one unit of CMT is used and both REMOTE 0 and REMOTE 1 jacks are connected to use two units of CMT.



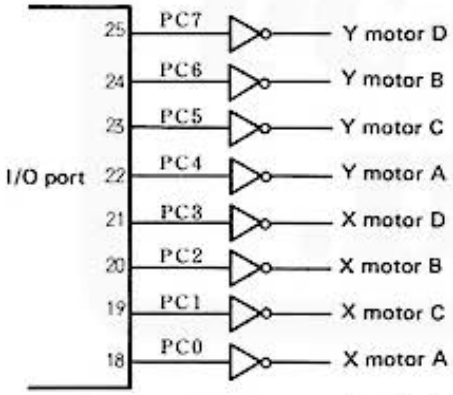
- **Solenoid drive circuit**



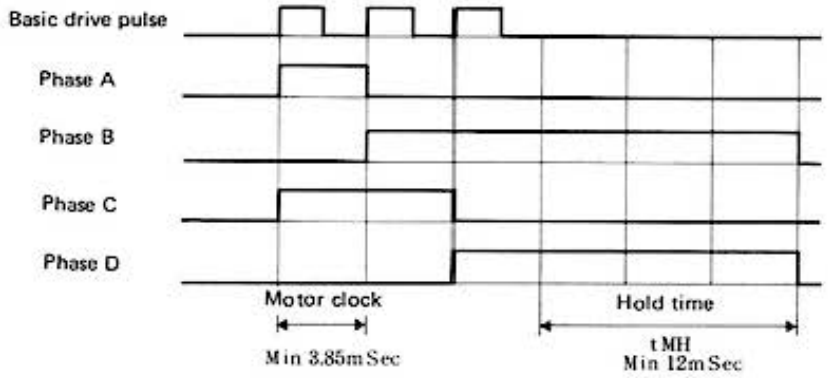
The solenoid is driven by the PEN UP signal PB0 and the PEN DOWN signal PB1 that is sent to the drive circuit via the I/O port.

1) With high state of the PB1 signal, T5 and T7 actuate to turn the solenoid(−) terminal GND level. Actuation of the T5 causes T6 to actuate to turn the solenoid(+) terminal VM level (about +6V) and drive the solenoid to lower the pen to start printing.
2) With high state of the PB0 signal, T2 and T4 actuate to turn the solenoid (+) terminal GND level. Actuation of the T2 causes T3 to actuate to turn the solenoid(−) terminal VM level (about +6V) and drive the solenoid to lift up the pen to stop printing.
3) D1 thru D5 are the arc suppressor diodes for the solenoid.

- **Motor drive circuit**



X motor A thru X motor D are the signals that drive the step motor that moves the carriage on the carriage rail. And, Y motor A thru Y motor D are the paper feed step motor drive signals.
As the PC-2 fetches character data from the ROM of the Printer, the motor drive action is controlled via the I/O port of the Printer.



6. PARTS LIST (26-3605)

Ref. No.	Description	RS Location	Manufacturer Part Number
	Transistor (2SC926)	AA2SB926	VS2SB926-S/TC
	Transistor (2SC458KS)	AA2SC458KS	VS2SC458KS/-1
	Transistor (2SC2021)	AA2SC2021	VS2SC2021-RSC
	Transistor (2SD1246)	AA2SD1246	VS2SD1246-STC
1	Holder, Battery	AB-0613	LFIX-1127CCZZ
	Capacitor, Ceramic Semiconductor 0.01μF 20% 25V	ACC103MFTP	VCTYPU1EX103M
	Capacitor, Ceramic Semiconductor 0.1μF 20% 12V	ACC104MDTP	VCTYPU1NX104M
	Capacitor, Electrolytic 1μF +80/−20% 50V	ACC105ZJAP	VCEAAU1HW105Q
	Capacitor, Electrolytic 100μF +80/−20%	ACC107ZCAP	RC-EZ107ACC1A
	Capacitor, Ceramic Semiconductor 4700pF 20% 25V	ACC472MFCP	VCTYPU1EX472M
	Capacitor, Ceramic Semiconductor 0.047μF 20% 25V	ACC473MFCP	VCTYPU1EX473M
2	Battery pack, Ni-Cad	ACS-0093	UBATN2135CC01
3	Cover, connector	ADA-0385	GFTAA1273CC01
	Diode (10D1)	ADX-1547	VHD10D1////-1
	Diode (IS1588L2)	ADX-1717	VHDDS1588L2-1
	Diode, Zenor (HZ4CLL)	ADX-1721	VHEHZ4CLL//-1
	Diode, zenor (RD10E9)	ADX-1722	VHERD10E9//-1
4	Leg, rubber	AF-0351	GLEGP1009CCZZ
	Label, name	AHB-9960	TLABZ1295CCZZ
5	Shaft, paper	AHC-1454	DSFTZ0480CSZZ
6	Cover, Jack	AHC-1455	GCOVH1343CCZZ
7	Angle	AHC-1456	LANGT1448CCZZ
	Cover (Inside of Top CAB.)	AHC-1457	PCOVM1027CCZZ
8	Shield connector	AHC-1458	PSLDC1344CCZZ
9	Sheet, Insulator	AHC-1460	PZETL1429CCZZ
10	Plate, shield	AHC-1461	QTANS1365CCZZ
11	Label, caution	AHC-1462	TCAUH1180CCZZ
12	Socket, JACK (φ3.5)	AJ-7019	QJAKC1013CCZZ
13	Socket, JACK (Adaptor)	AJ-7020	QJAKC1003CCZZ
14	Socket, JACK (φ2.5)	AJ-7021	QJAKC1016CCZZ
15	Connector (60P) Female	AJ-7155	QCNCW1293CCZZ
16	Connector (60P) Male	AJ-7160	QCNCM1295CC6J
	Plug with wire (3pcs together)	AJ-7161	QPLGJ1014CCZZ
	Plug with wire (1pc)	AJ-7162	QPLGJ1013CCZZ
17	Button, Lock	AK-4920	JBTN-1009CCZZ
18	Key top (PF) 20pcs/set	AK-4921	JKNBZ1737CC01

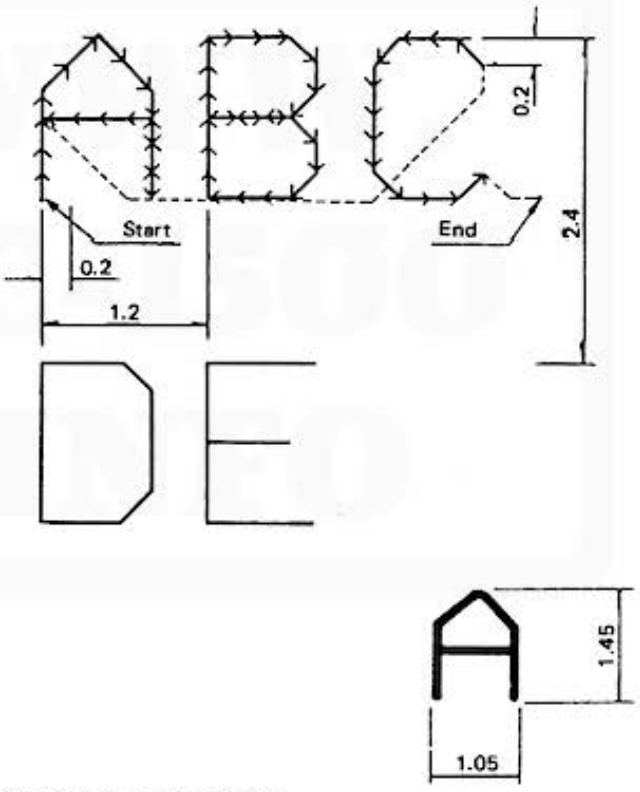
Ref. No.	Description	RS Location	Manufacturer Part Number
	IC (TC 50H001FN)	AMX-5067	VHiTC50H001FN
	LSI (LH5811)	AMX-5070	VHiLH5811//-1
	LSI (LH536702)	AMX-5089	VHiLH536702-1
	IC (LB1257)	AMX-5090	VHiLB1257//-1
	IC (M54516P)	AMX-5091	VHiM54516P/-1
	IC (TC40H000P)	AMX-5092	VHiTC40H00P1
	Resistor, Carbon 27ohm 5% 1/2W	AN0082EFB	VRD-ST2HY270J
	Resistor, Variable 22K ohm	AP-7257	RVR-MB410QCZZ
19	Spring, Lock	ARB-7485	MSPRP1189CCZZ
20	Cover Unit, Printer	ART-4127	DUNTG6588CCZZ
	Resistor, Block 1/6W 100K x 6	ARX-0287	RMPTC6104QCKJ
	Relay	AR-8151	RRLYZ9999QCNI
21	Switch PF	AS-2753	QSW-K1295CCZZ
22	Switch Select	AS-2754	QSW-S1074CCZZ
	Adaptor (USA, Canada)	AW-2815	DUNT-6452CC02
	Adaptor (Belgium)		DUNT-6455CC02
	Adaptor (England)		DUNT-6454CC02
	Adaptor (Australia)		DUNT-6453CC02
23	Wire, Flexible	AW-2817	QPWBM2029CCZZ
24	PCB Unit, Main	AX-9124	DUNTK5169CSZZ
25	Printer Unit	AX-9125	Ki-OB0066CCZZ
26	Cabinet Unit, Top	AZ-6539	DUNTG6590CCZZ
27	Cabinet, Bottom	AZ-6540	GCABA2629CCZZ
28	Nut		XNESD20-16000
29	Terminal		QTANS1372CCZZ
30	Screw		LX-BZ1038CCZZ
31	Screw (M2 x 4.5)		LX-BZ1116CCN1
32	Screw (M3 x 3)		LX-BZ1122CCZZ
33	Screw (M2 x 4)		XBBSD20P04000
34	Screw (M2 x 6)		XBBSF20P06000
35	Screw (M2 x 4)		XUPSD20P04000
36	Screw (M2.6 x 4)		XUPSD26P04000
37	Screw (M3 x 6)		XUPSD30P06000
38	Screw (M2.6 x 8)		XUPSF26P08000
39	Screw (M2 x 10)		XBBSD20P10000
40	Connector with wire		QCNCW1296CC01
	Resistor, Carbon 10K ohm 5% 1/4W		VRD-ST2EY103J
	Resistor, Carbon 100K ohm 5% 1/4W		VRD-ST2EY104J
	Resistor, Carbon 1M ohm 5% 1/4W		VRD-ST2EY105J
	Resistor, Carbon 150 ohm 5% 1/4W		VRD-ST2EY151J

B) MECHANICAL SECTION

1. SPECIFICATIONS

1. Printing functions

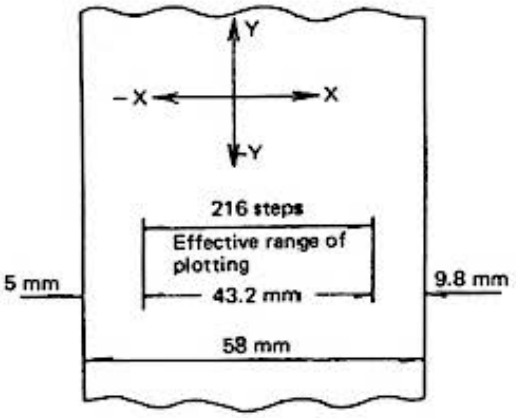
Print method:	Ball point pen recording with four color rotary select system
Drive system:	Drum type X-Y plotter
Printing speed:	12 characters/second for specified characters (Reference)
Printing columns:	36 columns/line for specified characters 36, 18, 12, 9 columns selective
Stepping speed:	260 steps/second
Stepping distance:	0.2mm for X-axis and 0.2mm for Y-axis
Line drawing speed:	52mm/second (X and Y axis) 73mm/second for 45° direction
Character size:	One example of printed character



1) Character size: 1.05 x 1.45, for line width of 0.25
2) Character-to-character spacing: 1.2 ±10%
3) Line spacing: 2.4 ± 10%

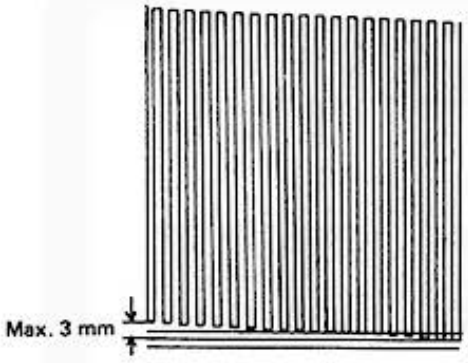
2. Effective range of plotting

1) Plotting direction
In reference with the carriage moving direction, the rightward direction is determined to be X-axis(+) and the leftward direction is determined to be X-axis(−).
2) Effective range of plotting
X-axis: 43.2mm, 216 steps
Y-axis: Any range as determined by software.



3) Accumulative error in Y-axis

As the paper is fed by means of friction with rubber for the Y-axis, there may arise a slight deviation, which should be within a range of ±3mm as measured in the following manner, provided that specific paper guide is in use.



Example – Program

```
10:GRAPH :
   GLCURSOR (8,0)
20:FOR A=1TO 20
30:RLINE -(0,-200
   )-(5,0)-(0,200
   )-(5,0)
40:NEXT A
50:RLINE -(0,-185
   )-(-205,0)-(0,
   -15)
60:RLINE -(210,0)
   -(0,-15)-(-215
   ,0)
70:END
```

3. Recording paper and ball point pens

[Recording paper] (26-3606)

Kind: Ordinary paper

Dimensions:

Paper width: 58^{+0}_{-1}mm (2-1/4")

Core size: 70mm (2-3/4"), max.

Paper length: About 55m (for the core size of 70mm)

Recommend paper:

High quality paper of about 45Kg with thickness of 65 to 80 micron. (1,000 sheets of 788 x 1,091mm paper equals to 45Kg.) (Weight: equivalent to 52.3g/m^2) Approximately equivalent to 14 lbs. bond paper.

[Ball point pen] (26-1481 [blue, red, green], 26-1480 (black only])

Color: Black, blue, red, green

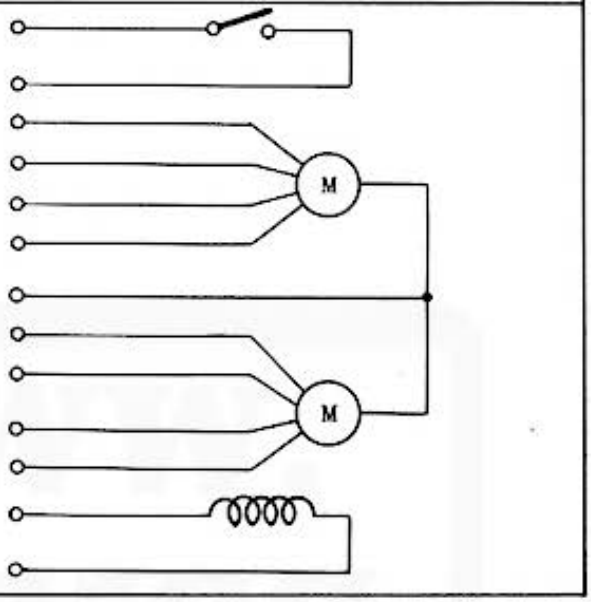
Size: 5ϕ x 23.3

Kind of ink: Water color

Life: 250m or more

4. Electrical characteristics

4-1. Input/output terminals

Name		No.	Circuit diagram
Color position sensor	B	1	
	A	2	
X motor	D	3	
	C	4	
	B	5	
	A	6	
Motor common		7	
Y motor	D	8	
	C	9	
	B	10	
	A	11	
Magnet (+)	B	12	
Magnet (−)	A	13	

Pen moves down when current of the above polarity is suppied to the magnet.

4-2. Magnet

1. Voltage: 4.85±0.65V
2. Type: Self-holding magnet
3. DC resistance: 5Ω±10% (20°C)
4. Peak current: About 1.1A (20°C, 4.85V)
   About 1.4A (0°C, 5.5V, worst case)

4-3. Motor (260 steps/second)

	Item	X-axis	Y-axis	Condition
1	Voltage	4.85V±.65V		0–50°C
2	Type	4-phase stepping motor (2 phase excitation)		
3	DC resistance	(A1) 30Ω±10%	25Ω±10%	20°C (resistance per phase)
4	Peak current	(A2) Abt. 0.16A	Abt. 0.19A	20°C, 4.85V
	(per phase)	(A3) Abt. 0.23A	Abt. 0.27A	0°C, 5.5V, (worst case)
5	Average Current	(A4) Abt. 0.12A	Abt. 0.13A	20°C, 4.85V
	(per phase)	(A5) Abt. 0.16A	Abt. 0.18A	0°C, 5.5V (worst case)

4-4. Power consumption

Print pattern	Scale	Supply voltage	Current consumption (mA)	Power consumption (W)
ASCII 64 character set	S=0	4.8V	500~550	2.4~2.6
ASCII 64 character set (excluding CR)	S=1	4.8V	400~450	1.9~2.2
ASCII 64 character set	S=1	4.2V	340~370	1.4~1.6
ASCII 64 character set	S=1	5.8V	500~580	2.9~3.4
"5" printed in 5 columns	S=1	4.8V	385	1.8
Paper feed action	—	4.8V	260	1.2
X-axis forward and backward	—	4.8V	180	0.9
45° line drawing	(L=0)	4.8V	490	2.4
45° dot drawing	(L=1)	4.8V	790	3.8

S = 0; Small character
S = 1; Standard charactor

4-5. Color position sensing switch

1. Operating voltage: DC 24V, max.
2. Operating current: 100mA, max.
3. Contact resistance: 150mΩ, max.

5. Durability

No.	Item and test method	Test item	Specification
1	Life 6.5 million characters ASCII 64 character set are continuously printed in the minimum scale (S=0). At any time during the test (ie. 1, 2, 4, and 6.5 million characters), appearance, operating conditions, and print quality are tested.	1. Appearance 2. Print quality	Life: 6.5 million characters Must be good.
2	Pen life Continuous operational test is carried out with the new pen in use.	1. Ink life	Must be able to drawn 250 meters.

2. MECHANISM AND OPERATION

The printer roughly consists of six blocks – a frame, X-direction drive, Y-direction drive, pen drive mechanism, color change mechanism, and pen take-out mechanism sections. An explanation is made per each block.

1. Frame section

The frame section has a side plate (right), side plate (left), holding plate, and paper guide. The lower edge of the frame, bent in the shape of the letter L, acts as a mounting leg.

2. X Drive Mechanism Section

The principal elements of the X-direction drive mechanism are the X stepping motor, idle gear, bobbin gear, pulley support base (left), pulley support base (right), slider unit and wire.

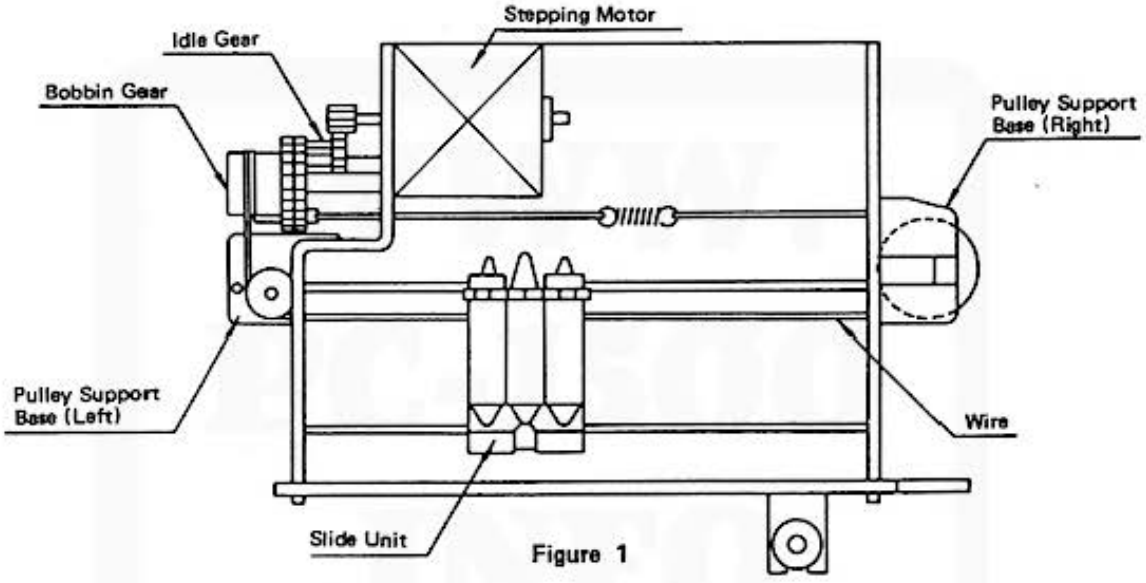


Figure 1

- Step Angle and Minimum Movement Pitch
  The reduction ratio between the stepping motor and bobbin gear is 1:9.01, and for each stepping motor pulse (18/360°), the slider unit, that is, X direction movement of pen is 0.2mm. The motive power is transmitted to the bobbin gear via idle gear and to the slider unit by a wire. The wire tension is maintained by a coil spring.

3. Y Drive Machanism (Paper Feed Mechanism) Section

The Y-direction drive mechanism consists of the Y stepping motor, idle gear, rubber roller unit, paper holding roller (right) and paper holding roller (left). The reduction ratio between the Y stepping motor (called as the Y motor hereafter) and rubber roller gear is 1:7.86. As the casa with the X direction, the rubber roller movement per each pulse of the Y motor, that is, the Y direction movement of the paper, is 0.2 mm.

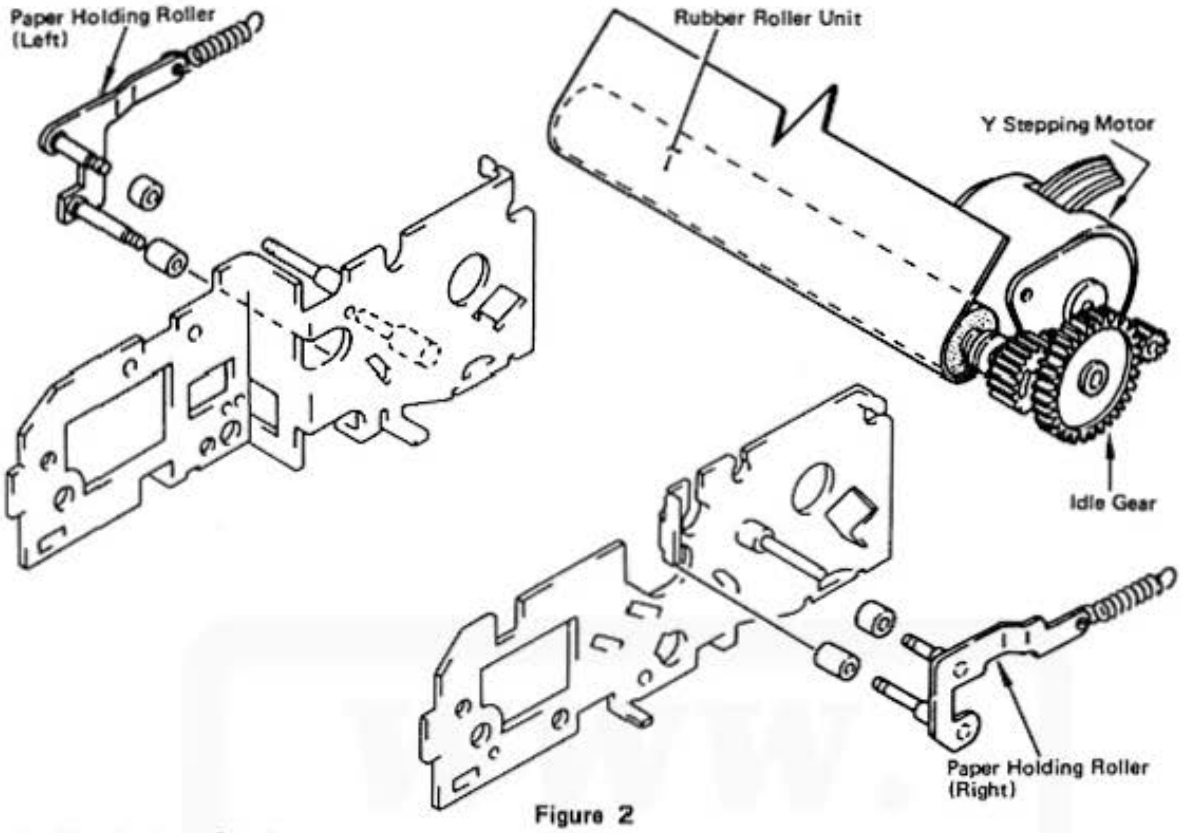


Figure 2

4. Pen Drive Machanism Section

The pen drive mechanism, that is, the pen up-down mechanism comprises a self-holding type electromagnet, ejection lever, roller lever, and ball-point pens. Pen up and down directions are as shown below.

- Pen-up State

  The pen retracts when the suction iron core is pulled by a current for 5 ms against the actuator spring of the electromagnet, and suction is maintained by a permanent magnet even after the current is cut off after the initial 5 ms.

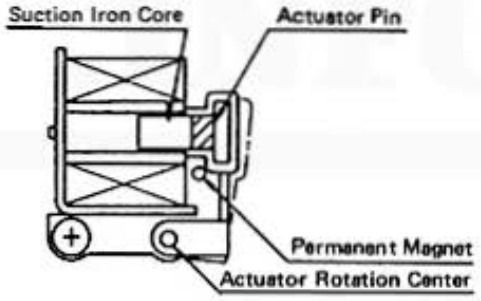


Figure 3

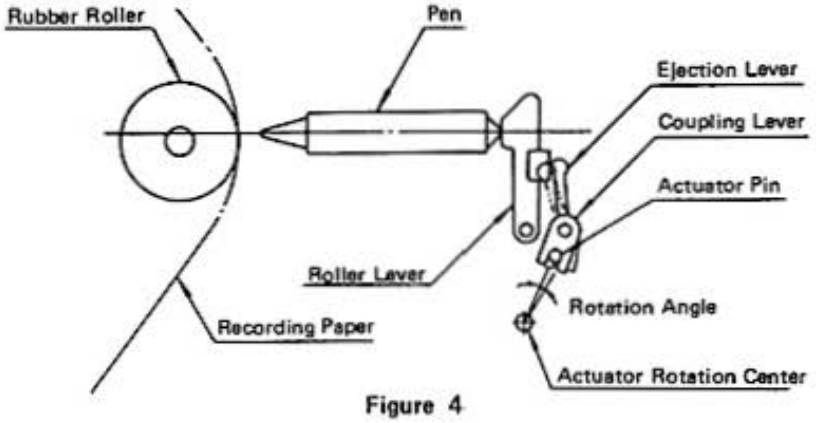


Figure 4

- Pen down State
  The pen descends when a current flows through the electromagnet for 5 ms in a direction opposite that which is impressed during suction against the suction force of the permanent magnet. After 5ms, the pen-down state will be maintained by the actuator spring force.

5. Color Change Mechanism Section

The color change mechanism section consists of the X-direction drive mechanism, a pen holder and holder stopper, both in the slider unit, and projections inside the holding plates. The operating principles are explained below.

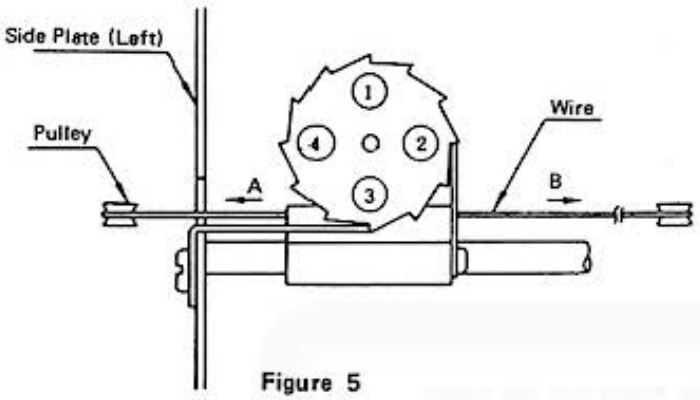


Figure 5

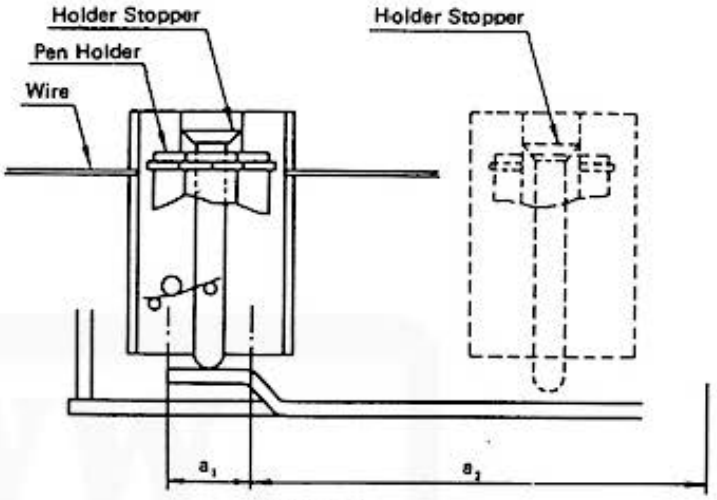


Figure 6

First, the slider moves to the area a-1 in Figure 6 (45 pulses to the left from the origin). Then, the holder stopper in the slider contacts the projection on the holding plate, and the wedge section of the holder stopper slips out of the pen holder, and releases holder to rotate. Next, by repeating the movement of the X motor for 30 pulses each in direction A and to the left, the pen ① in Figure 5 changes to pen ②. The spring moves the pen holder to the right until it returns to the origin. The pen holder then enters its groove, and printer is ready to print.

6. Pen Ejection Mechanism

The pen ejection mechanism consists only of the pen ejection lever that is mounted on the side plate (right). The slider unit is moved fully to the side plate (right) and stops. Push the pen ejection lever towards you, and the pen will eject.

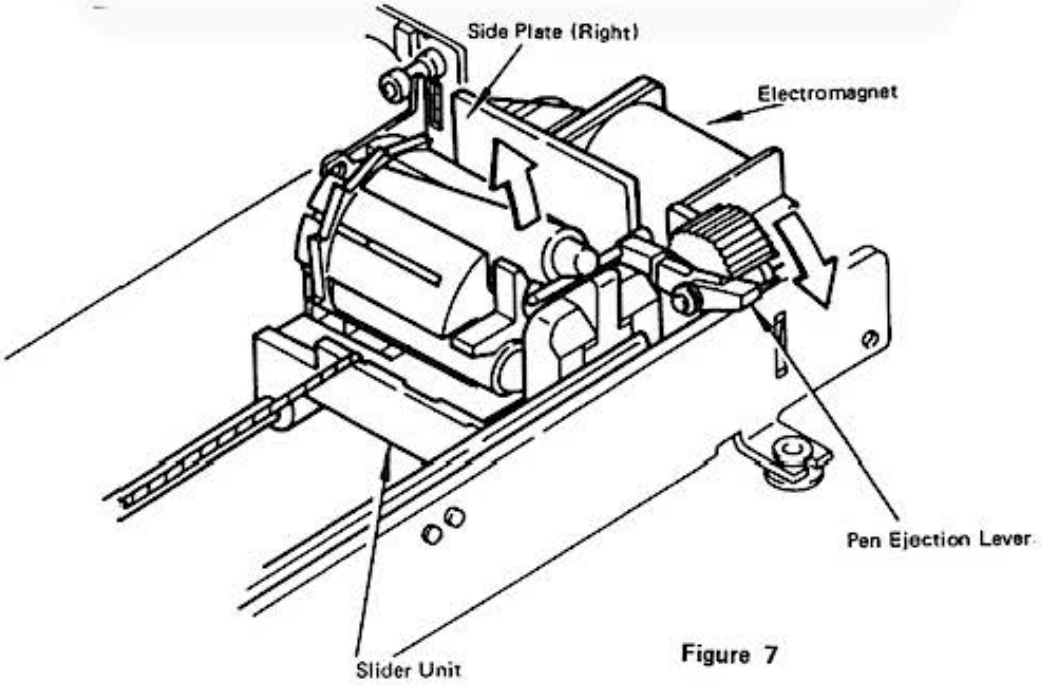
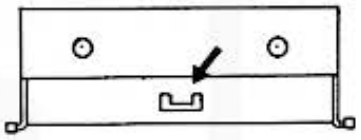


Figure 7

3. DISASSEMBLY AND REASSEMBLY

1. Disassembly

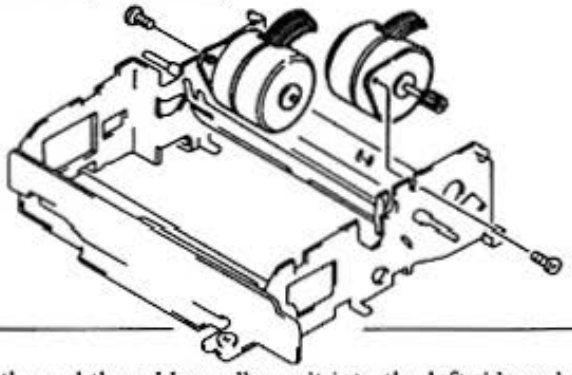
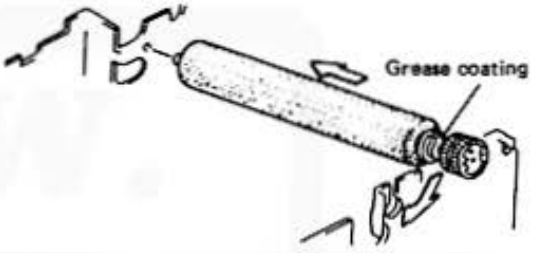
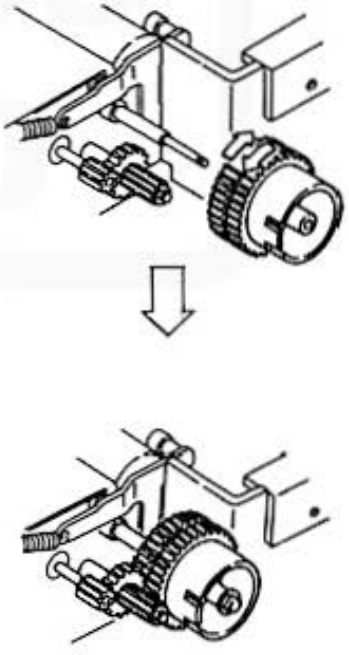
Remove the following parts from the frame in the sequence shown below.

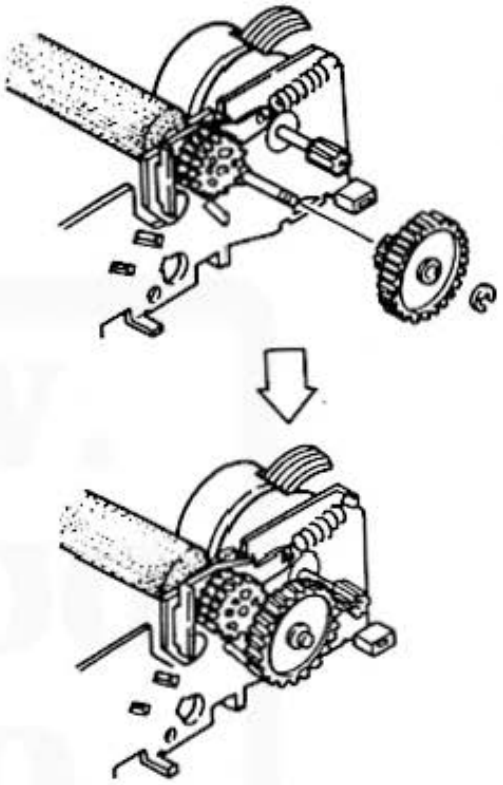
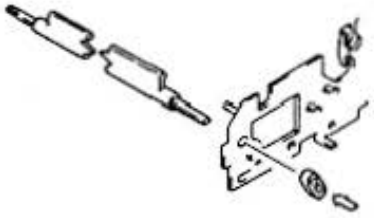
Disassembly Sequence	Part Ref. No.	Parts to be Removed	Point for Disassembly
1	4-1	Electromagnet Unit	• Disassemble after removing cross-recessed pan head machine screws (SP2 x 3) and (SP2.3 x 3), and sleeves (2-5).
	2-4	Wire Unit	
	6-1	Pen Take-out Bar Unit	
	2-7	Pulley Support Base (Right) Unit	
	3-2	Y Idle Gear	
	3-5	Paper Holding Roller Support Plate (Right) Unit	
2	7-1	Motor Cover	• Lift up the motor cover (7-1) covering the cross-recessed pan head machine screws (SP 2.3 x 3) holding the motor. • Remove the entire motor cover (7-1) by inserting a flat-blade screwdriver in the paper guide as shown. 
3	3-3	Rubber Roller Unit	• Push the rubber roller unit bearing to the left and remove from the right side of the rubber roller unit (3-3) as it comes off the frame unit (1-1).
4	3-1	Y Motor Unit	• Suction solder in the juction section of the two printed circuit boards
	7-4	Flat Wafer Assembly	
	2-3	Bobbin Unit	
	2-2	X Idle Unit	
	3-4	Paper Holding Roller Support Plate (Left) Unit	

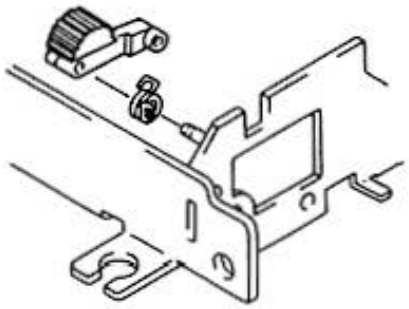
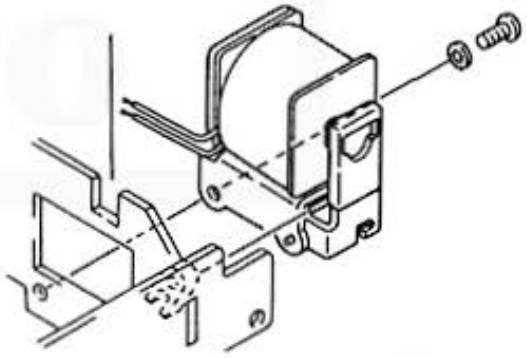
Disassembly Sequence	Part Ref. No.	Parts to be Removed	Point for Disassembly
5	2-1	X Motor Unit	
	2-7	Pulley Support Base (Left) Unit	
	2-8	Slider Shaft (A)	
	2-9	Slider Shaft (B)	
	4-5	Slider Unit	
	4-2	Ejection Lever Shaft Unit	
	4-3	Ejection Lever	
	4-7	Color Change Click	
	4-6	Reed Switch Unit	
	7-2	Rubber Bushing	
	7-3	Rubber Pad	

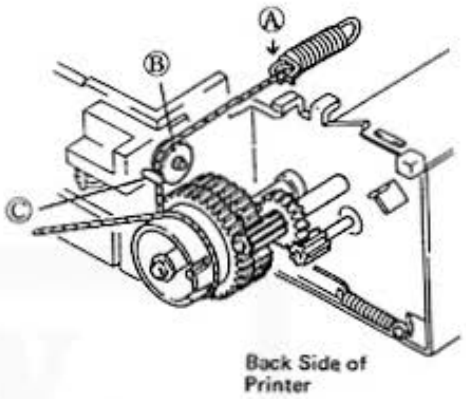
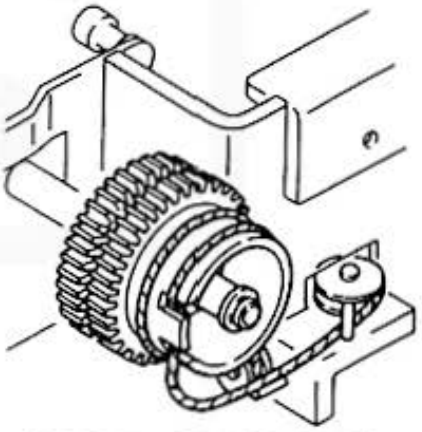
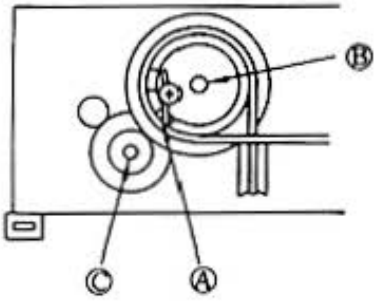
2. Reassembly

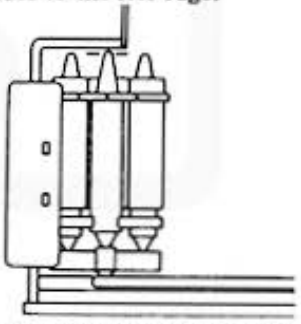
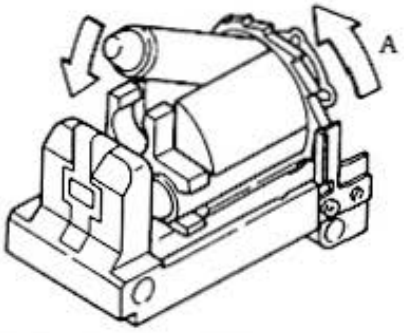
Reassembly can be completed most efficiently by referring to the reassembly sequence and precautions shown below.

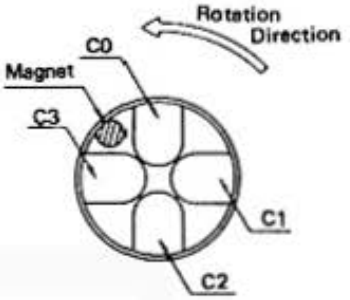
Reassembly Sequence	Part Symbol	Parts to be Reassembled	Precautions for Reassembly
1	2-1 SP2.5 x 3 3-1 SP2.5 x 3	X Motor Unit Cross-recessed Pan Head Machine Screws Y Motor Unit Cross-recessed Pan Head Machine Screws	Screw lock paint coating 
2	7-3 7-2 2-6 3-3 WF1.7 3-5	Rubber Pad Rubber Bushing Paper Holding Roller Support Plate (Left) Unit Rubber Roller Unit Plain Washer Paper Holding Roller Plate (Right) Unit	Fit the end the rubber roller unit into the left side and push the bearing to the left side to fit the other end into the right side. 
3	2-2 RE1.5 2-3	X idle Gear Type E Stopper Ring Bobbin Gear Unit	Move the bobbin gear by one tooth and insert the X idle gear.  Recommended to engage after marking the tooth tip and moving the gear by one tooth.

Reassembly Sequence	Part Symbol	Parts to be Reassembled	Precautions for Reassembly
4	3-2 RE1.5	Y Idle Gear Type E Stopper Ring	Insert the Y idle gear after moving the paper feed gear by one tooth.  Recommended to engage after marking the tooth tip and moving the gear by one tooth.
5	7-1	Motor Cover	Hang the motor cover by its square hole on the hook on the paper guide B on the rear of the frame unit.
6	4-2 4-3 RE2	Ejection Lever Shaft Unit Ejection Lever Type E Stopper Ring	Insert the ejection lever shaft unit into the frame through a bearing hole and press in the coupling lever from outside the frame. 

Reassembly Sequence	Part Symbol	Parts to be Reassembled	Precautions for Reassembly
7	6-1 6-2 RE1.2	Pen Take-out Lever Unit Pen Take-out Lever Spring Type E Stopper Ring	
8	4-7 SP1.4 x 1.6	Color Change Click Cross-recessed Pan Head Machine Screws	Screw lock paint coating
9	4-5 2-8 2-9 RE-2	Slider Unit Slider Shaft (A) Slider Shaft (B) Type E Stop Ring	Never bring another magnet close to the slider unit magnet. (The magnet inside the slider unit demagnetizes causing the color detection switch to operate incorrectly).
10	2-6	Pulley Support Base (Left) Unit	
11	4-1 SP2.5 x 3 WT2.5 7-4	Electromagnet Unit Cross-recessed Pan Head Machine Screws Shake-proof Washer Flat Wafer Assembly	Hang the electromagnet unit actuator on the coupling lever on the ejection lever unit.  Mount so that open strokes are 0.6mm. Clamping torque, 3.5 kg-cm. Screw lock paint coating.
12	4-6 SP2 x 3	Reed Switch Unit Cross-recessed Pan Head Machine Screws	Screw lock paint coating Rotate the bobbin gear. The reed switch must actuate when the magnet at the left edge of the slider approaches the closest reed switch.

Reassembly Sequence	Part Symbol	Parts to be Reassembled	Precautions for Reassembly
13	2-7	Pulley Support Base (Right) Unit	
14	2-4 2-5	Wire Unit Sleeve	Stretch wire on the pulley support plate (left) unit and bobbin gear  Back Side of Printer Wind wire once on the bobbin gear.   Pass wire through the bobbin gear notch

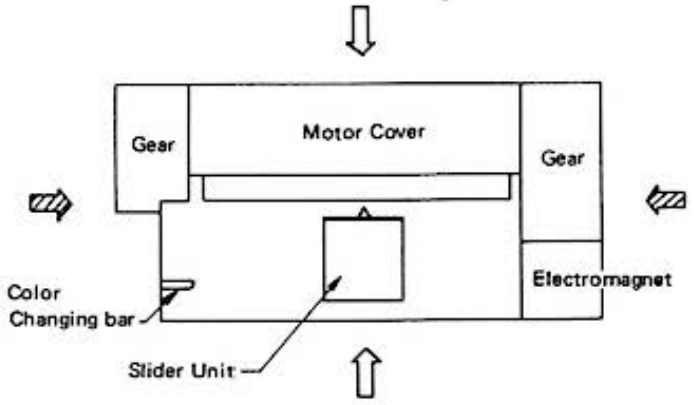
Reassembly Sequence	Part Symbol	Parts to be Reassembled	Precautions for Reassembly
			Reassemble when the notch A of the bobbin gear is aligned with the straight line extending between the bobbin gear shaft B and idle gear shaft C . Insert the wire through the pulley and slider of the pulley support plate (left) unit, and then through the sleeve and spring of the pulley support plate (right) unit.  Pull wire end D to produce tension (Wire Tension 160 gr).
	SP2 x 3	Cross-recessed Pan Head Machine Screw	Fix the bobbin gear and wire.
	SP2.3 x 3	Cross-recessed Pan Head Machine Screw	Adjust the relative positions of the wire and slider so that the drawing line in the direction will be at the center of the paper guide. Screw lock paint coating
	5-1 5-2 5-3 5-4	Ball-point Pen (Black) Ball-point Pen (Blue) Ball-point Pen (Green) Ball-point Pen (Red)	Move the slider to the left edge.  Insert the pen tip at the top of the pen return spring and push the rear section. 

Reassembly Sequence	Part Symbol	Parts to be Reassembled	Precautions for Reassembly
			Rotate the rotary holder in the direction of arrow A and insert the pen. Mount the pen color position making the magent for the reed switch as the reference. 

4. REPAIR AND MAINTENANCE

1. Handling Precautions

1) Carrying Printer



1 Carry the printer by holding it in the directions shown by ⇧. Carrying the printer in the ⇧ direction will cause various troubles.
2 The printer may be carried by holding on to the upper face of the motor cover and paper guide. However, do not apply strong pressure to it.

2) Sections Where Pressure Should Not be Applied:

1 Do not touch the slider unit except when taking a pen out. Particularly, never apply pressure in the direction of rotation.
2 Do not touch the wire. The pulley may come off.
3 Do not touch the color changing click. When bent, color changing cannot be accomplished.

3) Sections not to be Touched

1 No shaft should be touched with bare hands.
2 Do not touch the pen return spring.
3 Do not touch the rotary holder except when the slider is positioned at the right edge of the frame and a pen is mounted.
4 Do not touch the slider

4) Sections where Magnetic Substances Should be Kept Away

1 Do not place a magnetic substance or powder, a permanent magnet, or an electromagnet close to the permanent magnet of the color position detector.
2 A strong rare earth magnet is used in the electromagnet unit.

5) Other

Be very careful not to drop the pen or in any way joint it. When the ink is exhausted, hold by the tail plug section and shake it.

2. Maintenance

Cleaning

Clean the printer and remove paper dust, dist, etc. periodically (after using or mostly every three months.)

Points for Cleaning

1 Paper dust, dirt, dust, etc. should be vaccumed up. (Use an electric vacuum cleaner).
2 Use alcohol or benzene when removing stains. Thinner, trichloroethylene and ketone solvent may damage the plastic parts, so do not use.
3 Grease any places where there is no grease or where it is not sufficient. Do not use a lubricant except the one specified. (Refer to Oiling Standard section)

3. Repairs

(1) Repair Procedure

When a fault occurs, carefully observe and check the type of the trouble. Find out the cause and make repairs after checking the location of the fault, referring to the "Repair Guide."

1 "Phenomenon": Determine the trouble phenomenon from this column.
2 "Condition": Compare the trouble with this column and verify whether it coincides.
3 "Cause": Causes based on the condition of the trouble are listed. Verify the cause.

4 "Locations and Methods of Checking":
The column lists where to check for trouble and by what method. Check according to the instructions in this column and locate the trouble.

5 "Repair Method": Repair the trouble according to the instructions described in this column. If the same phenomenon or conditions exist after making repairs, check the other items in the cause of this column and make necessary repairs.

(2) Repair Tools

- Screwdrivers (Precision Screwdrivers)
  Phillips Type 4.
  Phillips Type 5.
  Flat-blade Type 5.
- ET Holders
  ET 2
  ET 1.5
  ET 1.2
- Radio pliers, or reed pliers
- Tweezers
- Soldering iron

Phenomen	Condition	Cause	Location and Method of Checking	Repair Method
–1– Does not draw lines	X-motor (2-1), Y-motor (3-1), and pen drive electromagnet (4-1) operate normally, but no printing is done.	Pen (5-1 to 4) have come off, or the ink is exhausted.	Are the pens mounted properly? Do the pens have enough ink?	Mount properly. Replace the pens.
–2– Lateral lines cannot be drawn.	1 X-motor (2-1) does not rotate.	1 X-motor lead wire is cut	Check that a normal current is impressed to each phase of the motor.	Replace X-motor.
		2 Idle gear (2-2) is deformed.	Check if the X idle gear is normal.	Replace the X idle gear.
		3 Deformation of bobbin gear unit (2-3), misalignment of two-piece teeth.	Dismount wire unit (2-4), rotate bobbin gear by hand, and check rotation state.	Replace bobbin gear unit.
		4 Foreign matter has accumulated between gears	Rotate bobbin and unit by hand and check for foreign matter	Remove foreign matter.
		5 Low battery voltage	Check if battery voltage is below 4.5V.	Recharge to regular voltage.
		6 Slider unit (4-5) does not slide properly on the shaft.	Dismount wire and move slider unit to the right and left by hand.	• Replace slide unit • Remove foreign matter if it is obstructing movement.
	2 X-motor rotates, but slider unit does not move to the right or left.	1 Wire has come off	Check if wire has come off bobbin gear.	Restretch wire properly.
		2 Wire is cut.	Check that wire has not been cut.	Replace wire unit.
		3 Bobbin gear and wire slip.	Confirm that wire is properly screwed on to bobbin gear.	• Tighten the screws. • Replace the bobbin gear unit.
		4 Gear is damaged	Check that X idle gear and bobbin gear are operating properly.	• Replace damaged gear.
–3– Insufficient Lateral Movement	1 Operates in pen-down mode only, and not normal.	1 Rubber roller unit (3-3) is scratched.	Slowly rotate the rubber roller by hand and check for scratches and foreign matter.	• Replace rubber roller unit if scatches are found. • Remove foreign matter.
		2 Print paper has steps.	Check the surface of the print paper	Use normal print paper.

Note: Figure in ( ) is reference number of part.

Phenomen	Condition	Cause	Location and Method of Checking	Repair Method
		3 Deformation of ejection lever shaft unit (4-2).	Check the contact between the ejection lever and ejection roller (4-4).	• Replace ejection lever shaft unit
		4 Low battery voltage	Check that battery voltage is not below 4.5V.	Recharge to normal voltage
	2 Abnormality is noticed regardless of whether the pen is moving up or down.	1 Foreign matter has accumulated in the moving section of the slider unit.	Check that slider unit moves smoothly on the effective printing area and check for an abnormal load by slowly rotating the bobbin gear by hand.	Remove any foreign matter
		2 Contact between pen tape-out lever unit (6-1) and pen.	Check contact between pen take-out lever and slider unit.	Replace pen take-out lever.
		3 Wire fastening position on bobbin has moved.	Rotate bobbin gear unit (2-3) by hand and check that slider unit moves smoothly from left edge to right edge.	Restretch wire if its fastening position is wrong.
		4 Improper pulley rotation of pulley support base unit (right).	Dismount wire from pulley and check for smooth rotation.	Replace pulley support base unit.
		5 Sleeve (2-5) and frame make contact.	Check for deformation between frame unit and sleeve, as well as for other phenomena.	Replace sleeve.
		6 X-motor unit (2-1) is operating improperly.	Dismount X idle gear (2-2), slowly rotate motor gear, and check for abnormal load.	Replace motor.
		7 Contact between set-screw of return spring and small roller.	Move slider and confirm contact	• Repalce rotary holder • Replace paper holding roller support plate unit.
—4— Drawing is done segment by segment	1 Actuator of the electro-magnet unit (4-1) is detached from the electromagnet coil.	1 Current is not being supplied to the electro-magnet properly.	Check if current is going to the electromagnet.	Replace electromagnet and repair drive circuit.

Phenomen	Condition	Cause	Location and Method of Checking	Repair Method
		2 Abnormally large electromagnet suction stroke	Check if gap between rubber roller and pen tip is 0.6mm in the pen-up mode	• Replace with a pen having the standard length ($23.3^{+0}_{-0.1}$mm). • Adjust the gap by turning the mounting screw on the electromagnet unit (4-1).
		3 Low battery voltage	Check if battery voltage is below 4.5V.	Recharge to normal voltage.
		4 Electromagnet unit is faulty.	Check operation of the actuator for the electromagnet unit, spring fatigue, deformation, etc.	Replace electromagnet unit.
		5 Rotary holder on slider unit has moved.	Check that rotary holder pen is directly above the specified position (print position).	Manually maintain electromagnet actuator in the adsorption state, rotate rotary holder in a counterclockwise direction, and fix it in its proper position.
		6 Ejection lever does not operate smoothly.	Check for a bend in the ejection lever and inspect the bearing section.	• Exchange ejection lever and ejection lever shaft unit.
	2 Electromagnet operate normally	1 Pen movement is slow	Check the shape of the pen. Also check for rotary holder deformation and the presence of foreign matter.	• Pen exchange • Rotary holder exchange • Removal of foreign matter
		2 Deformation and fatigue of pen return spring	Inspect the pen return spring.	Replace slider head unit (4-5)
		3 Paper is not winding on rubber roller properly	Remove paper and check for paper guide deformation, etc.	• Return it to its normal shape using tweezers, etc if it is only slightly deformed. • Remount properly if small roller which holds the paper has come off.
		4 Pen is too long	Measure the pen length.	• Mount a proper pen (length 23.3^{+0}_{-1}mm)

Phenomen	Condition	Cause	Location and Method of Checking	Repair Method
–5– Color does not Change	1 Pen moves to color change area without moving up.	1 Electromagnet induced pen up function is abnormal.	Check transmission system from electromagnet to pen drive.	See Phenomenon 4
	2 Carriage does not move until it reaches the left edge.	1 Foreign matter has accumulated in slider section.	Check for foreign matter. Check if slider moves smoothly by rotating the bobbin gear by hand.	Remove foreign matter and exchange slider unit.
		2 Contact between slide shaft support plate and frame	Check for contact.	Replace slider unit.
	3 Rotary holder does not rotate at all.	1 Fatigue and deformation of color change click (4-7).	Check color change click	• Gently lift color change click using tweezers. • Replace color change click.
		2 Pen tip has come off the return spring.	Check all four pens to see if they have come off.	• Repair using tweezers. • Replace rotary holder if return spring is deformed.
		3 Pen return spring is deformed.	Check the shape of the pen return spring	• Replace rotary holder.
		4 Holder stopper inside slider unit does not operate well.	Check holder stop operation.	Replace slider unit.
	4 Rotary holder rotates not only counterclockwise, but also clockwise.	1 Deformation of hooking click	Check if hooking click and rotary holder ratchet are making proper contact.	Replace slider unit.
	5 Rotary holder makes excessive rotations	1 Deformation of paper guide.	Check for contact between paper guide and pen tip.	• Adjust pen stroke. • Replace printer.
		2 Presence of foreign matter.	Check for foreign matter.	Remove foreign matter.
	6 Rotary holder rotation is bad only for the first movement after resetting.	1 Slider unit is misaligned	Check stop sections of slider and wire.	Adjust relative postions of slider and wire

Phenomen	Condition	Cause	Location and Method of Checking	Repair Method
–6– Does not select proper color	1 It is reproduced no matter how many times power supply is turned on.	1 Pen mounting position is different.	Check that the proper colored pen is mounted using as reference the position when the color position detection magnet is located at the left side.	Refit pen in its proper position.
	2 A different color is selected when the power supply is turned on again and reset.	1 Insufficient magnetic force.	Check the magnetic flux on the magnet surface with a Gauss meter.	Replace rotary holder.
		2 Reed switch is faulty	Check if reed switch actuates when magnetic flux is normal.	Replace reed switch unit (4-6).
	3 Rotary holder rotations are short by one reciprocation when the power is turned on.	1 Discrepancy in mounting of the reed switch unit.	Check position of reed switch unit.	Replace reed switch unit.
		2 Excessive rotation of rotary holder.	Check if rotary holder rotates excessively due to foreign matter, etc.	Remove foreign matter, etc.
–7– Paper is not fed.	1 Y motor (3-1) does not rotate.	1 Y Motor lead wire is cut.	Check if normal current is impressed to each phase of the motor.	Replace X-motor.
		2 Deformation of Y-gear idle (3-2).	Check if Y-gear idel is normal or not.	Replace Y-gear idle.
		3 Rubber roller unit (3-3) does not rotate well.	Dismount Y-gear idle and check rubber roller rotations. Caution rotations are heavy due to friction between rubber roller and paper guide when paper is not inserted.	Replace rubber roller unit.
		4 Foreign matter between gears.	Slowly rotate Y-gear idle by hand and check for foreign matter.	Remove foreign matter.
		5 Low battery voltage.	Check if battery voltage is below 4.5V.	Recharge to normal voltage.

Phenomen	Condition	Cause	Location and Method of Checking	Repair Method
		6 Paper holding roller support plate unit (left) (3-4) does not operate smoothly.	Hook tweezer tips in hole of spring hook on paper holding roller support plate unit and move it up and down.	Replace paper holding roller support plate unit (left).
		7 Paper holding roller support plate unit (right) (3-5) does not operate smoothly.	Hook tweezer tips in hole of spring hook on paper holding roller support plate unit and move it up and down.	Replace paper holding roller support plate unit (right).
	2 Paper and rubber roller slip.	1 Damage to paper holding roller (large) (3-6) and paper holding roller (small) (3-7).	Check if paper holding roller is there.	Mount damaged roller.
		2 Deformation of paper guide.	Check for paper quide deformation.	Replace printer.
		3 Foreign matter in paper guide.	Check for foreign matter in paper guide and for insertion of paper.	Remove foreign matter.
–8– Y-direction movement is insufficient.	1 Character alignment on one line is bad, and the line rises at the right end.	1 Roll paper load is too heavy.	Check that roll paper is guided smoothly in to the printer.	Repair roll paper guide.
	2 Stepping error in Y-direction.	1 Y drive mechanism gear is damaged.	Check Y-gear idle (3-2), rubber roller unit (3-3) gear, and Y-motor unit (3-1) gear.	Replace gears.
		2 Sliding paper feed gear, by one tooth, gearing of rubber roller unit is not enough.	Check that the two-piece tooth gear on rubber roller unit is engaging after being slid by one tooth.	Mount after setting it properly.
		3 Rubber roller unit bearing is worn.	Move rubber roller unit gear up and down by hand and check for play.	• Replace rubber roller unit if wear is noticed. • Fix by using a cyanoacrylate adhesive when there is play between the bearing and frame. • Replace printer.

Phenomen	Condition	Cause	Location and Method of Checking	Repair Method
		4 Low battery voltage.	Check if battery voltage is below 4.5V.	Recharge to regular voltage.
	3 Origin position differs after making many reciprocal movement in Y-direction. Origin position changes after printing a large number of characters.	1 Rubber roller and paper slip.	Check for stained rubber roller.	Wipe off rubber rollers stain.
		2 Deformation of paper guide.	Check paper guide.	• Repair paper guide if there is any deformation. • Repair roll paper guide.
		3 Roll paper is guided improperly.	Check roll paper rotation and ensure that the center of the paper and the center of the printer are aligned.	Repair roll paper guide.
		4 Paper type does not match printer.	Check that the specified paper is used.	Use the specified paper.
–9– Character misalignment	1 "F" is drawn as shown below. 	1 Improper engagement of robbin gear unit (2-3) after sliding by one tooth.	Check gear engagement.	Mount properly.
		2 Rotary holder and slider do not lock sufficiently.	Check rotary holder play by rotating it slowly by hand.	Exchange slider unit.
		3 Play between pen return spring and pen tips.	Check by rotating X-bobbin gear back and forth for several seconds by hand in the pen-down mode.	Replace rotary holder.
		4 Wire spring fatigue in wire unit (2-4), elongation of wire.	Check for slack in wire spring.	Replace wire unit.

Phenomen	Condition	Cause	Location and Method of Checking	Repair Method
	2 "F" is printed as shown below  OK NG	1 Pen and return spring.	Check by rotating Y-gear idle back and forth for several seconds by hand in the pen-down mode.	Replace rotary holder.
		2 Play in entire slider	Check slider and X-drive system	Exchange slider.
	3 "P" is short as shown below.  OK NG	1 Faulty engagement of paper feed gear inside rubber roller unit after sliding by one tooth.	Check gear engagement.	Mount properly.
		2 Substantial play in roller bearing.	Check for play by moving the gear vertically.	Replace rubber roller unit.

5. OILING STANDARD

Two types (G488 and CRC5-56) of oil are used in this printer. When oiling during disassembly and reassembly, thoroughly chean the parts and oil in accordance with the table below.

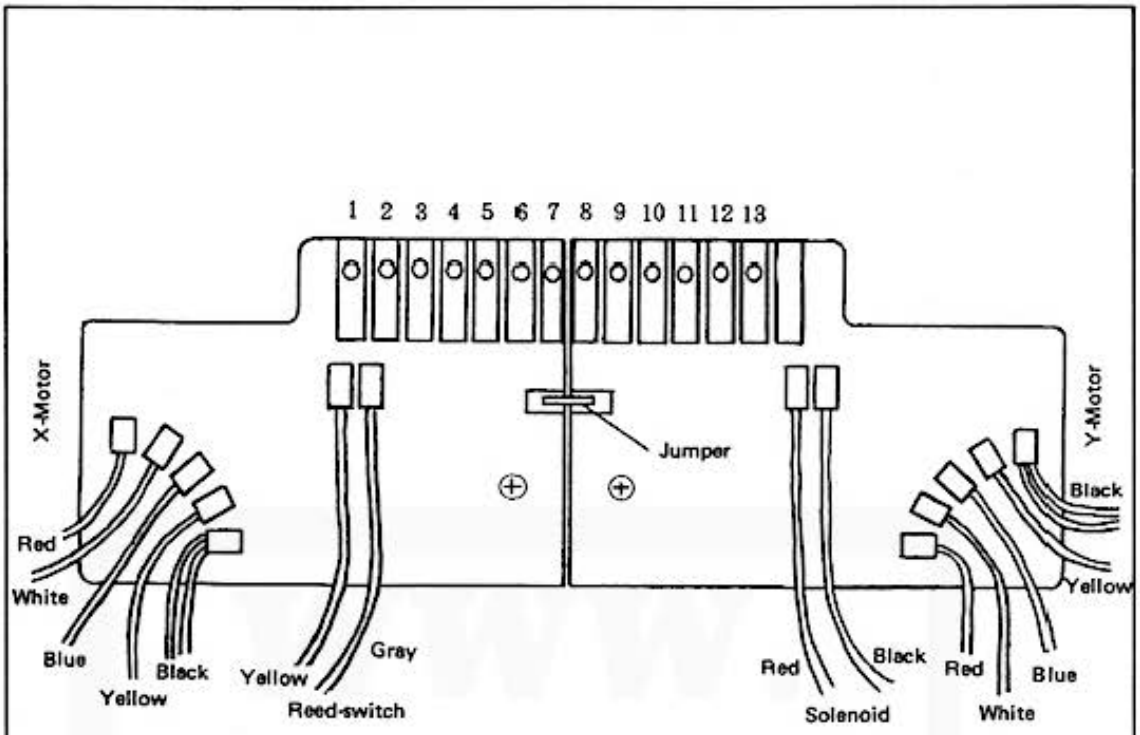
No.	Oiling Location	Oil Type	Remarks
1	Area of contact between paper holding roller support plate (left) and side plate.	G-488	UKOG-0108CSZZ
2	Contact section between paper holding roller support plate (right) and side place.	G-488	
3	Sliding section (4 locations) between paper holding roller and roller shaft	G-488	
4	Sliding section between rubber roller unit shaft and plain washer	G-488	
5	Contact section between plain washer and side plate	G-488	
6	Sliding section between ejection lever shaft unit and slide plate.	G-488	
7	Sliding section between ejection roller and slider set.	G-488	
8	Tooth section of X idle gear	G-488	
9	Tooth section of Y idle gear	G-488	
10	Sliding section between holder stopper and holding plate	G-488	
11	Electromagnet unit actuator shaft	G-488	
12	Slider shaft (A)	CRC5-56	
13	Slider shaft (B)	CRC5-56	

6. ADHENSION STANDARD

The table below shows points on the clamps where adhesion is to be applied to lock the screws as well as adhesion points on the printer bearings. Make sure that more than 1/4 of the screw heads are glued, but that no adhesive is present in the screw head recessions.

No.	Adhesion Point	Adhesive	Remarks
1	X-motor unit set-screws in 2 places Phillips type pan head machine screws (SP2.3 x 3) Phillips type pan head machine screws (SP2 x 3)	Screw lock	
2	Bobbin gear unit wire set-screws (1 place) Phillips type pan head machine screws (SP2 x 3)	Screw lock	
3	Slider unit wire set-screws (1 place) Phillips type pan head machine screws (SP2 x 3)	Screw lock	
4	Y-motor unit set-screws 2 places Phillips type pan head machine screws (SP2.3 x 3) Phillips type pan head machine screws (SP2 x 3)	Screw lock	
5	Electromagnet unit set-screws in one place Phillips type pan head machine screws (SP2.5 x 3)	Screw lock	
6	Reed switch unit set-screws in one place Phillips type pan head machine screws (SP2 x 3)	Screw lock	
7	Color change click set-screws Phillips type pan head machine screws (SP1.4 x 1.6)	Screw lock	
8	Rubber roller unit bearing and side plate	Cyanoacrylate adhesive	VISCA NS-10 (Matsumoto Trading)

7. CIRCUIT DIAGRAM & WIRING



Name		No.	Circuit diagram
Color positon detector	B	1	
	A	2	
X-Motor	D	3	
	C	4	
	B	5	
	A	6	
Motor common		7	
Y-Motor	D	8	
	C	9	
	B	10	
	A	11	
Solenoid (+)	B	12	
Solenoid (−)	A	13	

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